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Golder Associates

**REPORT ON**

# 2001 OPERATIONS MONITORING AND 2001 HYDROGEOLOGICAL INVESTIGATION AND GROUNDWATER AND SURFACE WATER MONITORING PROGRAM CALEDONIA LANDFILL SITE CORPORATION OF THE NATION MUNICIPALITY ONTARIO

File 2249

Submitted to:

Corporation of the Nation Municipality
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## TABLE OF CONTENTS

# PART A

## 2001 OPERATIONS MONITORING

Stantec Consulting Ltd.

Stantec

# Nation Municipality
# Caledonia Landfill Site
# 2001 Annual Report


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**March 31, 2002**

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# EXECUTIVE SUMMARY

The Nation Municipality through the process of amalgamation assumed ownership of the Caledonia landfill located on the east half of Lot 23, Concession 6 (Figure 1) of the former Township of Caledonia, United Counties of Prescott and Russell.

The landfill is operated under the Certificate of Approval No. A 471003 and has a total site area of 14.57 hectares and an approved footprint of 4.0 hectares. A legal survey was prepared for the site during 1999 by David Shultz and has been registered at the registry office as plan 46R-6108.

The 1999 Certificate of Approval identifies the theoretical capacity of the landfill to be 122,386 $m^3$. This capacity includes the volume consumed by the former trench (31,230 $m^3$) method and 91,150 $m^3$ that can be developed by the area method, as shown in the design contours provided in Figure 3. During 2001, a waste volume of 235 $m^3$ was deposited at the site. This brought the waste volume deposited to date to 10,489 $m^3$ and the remaining capacity to 80,665 $m^3$. All waste was deposited within the approved footprint and design contours.

The landfill provides disposal services to the former Township of Caledonia residents only and accepts municipal and non-hazardous solid industrial waste, white goods, tires and wood waste. The remaining capacity is estimated to service the former Township of Caledonia residents till 2045.

This 2001 annual report was prepared to satisfy Condition 35 of the provisional Certificate of Approval (COA) for a waste disposal site No. A471003, dated October 1st 1999. Condition 35 specifies the information that must be presented in the annual report and requires the report to be submitted to the Ministry of the Environment (MOE) District Manager by March 31 of each year for the previous year's operation.

The Township's segregation of products at the landfill, its blue box recycling program and its hazardous waste day collection events form an important part of the Township's diversion strategy and should be continued in 2002.

Given that the Township started diverting its curbside residential and commercial waste to Lafleche Environment landfill in 2001, we would anticipate that the future impact to groundwater and surface water resources, as well as to the service life of the landfill, is expected to be minimal. Some minor work is required at the landfill during 2002, this is the erection of a new entrance sign and the control of a 30 metre wide strip of land along the east side (for buffer and attenuation) to bring the site into compliance with the Ministry's Guideline B-7.

## TABLE OF CONTENTS

**PART A - OPERATIONS MONITORING**

**EXECUTIVE SUMMARY**

## 1.0 INTRODUCTION

The Nation Municipality was formed through the amalgamation of four surrounding municipalities (Figure 1) in January 1998. As part of that process, the Nation Municipality assumed ownership of the Caledonia landfill located on the east half of Lot 23, Concession 6 of the former Township of Caledonia, United Counties of Prescott and Russell.

The landfill is operated under the Certificate of Approval No. A 471003 and has a total site area of 14.57 hectares and an approved footprint of 4.0 hectares. It provides disposal services to the former Township of Caledonia residents only and accepts municipal and non-hazardous solid industrial waste, white goods, tires and wood waste. The site is approximately 192 metres wide (E-W) and 760 metres (N-S). The site is located in rural area and is surrounded by bush on the west and north sides, by agricultural land on the east side and the Concession 7 road on the South side. The Municipality's zoning map identifies the property as being zoned Solid Waste Disposal Site (SRD) within a General Rural zone (RU1).

Most of the landfill is situated on flat land with less than 1 metre difference in elevation throughout most of the site, except for the north end which is transected by a 7-8 metres escarpment. The site is underlain by the deposit of silty sand which overlies glacial till and bedrock. Generally, groundwater flow direction is towards the north with a gradient about 0.01. As shown in Figure 2, there exists three main discharge points within the landfill; 1) a 300 metre long ditch that parallels the west side of the access road and discharges to the north; 2 ), a 60 metre long ditch along the east side of the landfill that also discharges to the north; and 3) a 7-8 metre high escarpment that transects the north end of the landfill. A natural drainage course, some 2-3 metres wide and up to 1 metre deep, flows westward at the base of the escarpment and discharges to a larger surface water course, Paxton Creek, towards the north west corner of the landfill. Paxton Creek appears to be the main receptor for all groundwater and surface water generated at the landfill.

A legal survey was prepared for the site during 1999 by David Shultz and has been registered at the registry office as plan 46R-6108.

## 2.0 PURPOSE OF ANNUAL REPORT

This 2001 annual report was prepared to satisfy Condition 35 of the provisional Certificate of Approval (COA) for a waste disposal site No. A471003, dated October 1st 1999. Condition 35 specifies the information that must be presented in the annual report and requires the report to be submitted to the Ministry of the Environment (MOE) District Manager by March 31 of each year for the previous year's operation.

## 3.0 SUMMARY OF SITE OPERATIONS

### 3.1 Guidelines for Operations (COA)

The Provisional Certificate of Approval No. A471003 dated October 1, 1999 for the Caledonia landfill site allows for the use and operation of a 14.57 hectares landfill with an approved waste footprint of 4.0 hectares. The Certificate of Approval contains a total of 37 conditions and is reproduced in Appendix A.

There have been no Notices issued since October 1, 1999 to amend the Certificate of Approval.

The conditions that can have an impact on the physical operations at the site are reviewed below to ensure that the site operates in compliance with the Certificate of Approval. All other conditions which are considered administrative in nature were not reviewed (Conditions 1-8, 12,14 and 32) but are provided in Appendix A for reference purposes.

**Condition 9** requires that all communications and correspondence made pursuant to this Certificate make reference to the Certificate of Approval No. A 471003.

Discussion:

Correspondence regarding the Caledonia landfill site references the Certificate of Approval No A471003.

**Condition 10** requires that applicant notify the Director in writing if there is a change within 30 days in the name, address, or change of partners of the Corporation.

Discussion:

The Certificate of Approval reflects the current owner and operator of the site (Corporation of the Nation Municipality) and lists its current address (958 Highway 500 West, Casselman, ON)

**Condition 11** requires that the applicant notify in writing any succeeding owner of the site of the existence of this Certificate and provide proof of this to the Director.

Discussion:

There has been no change in ownership of the site.

**Condition 13** requires that all records and monitoring data required by the conditions of the certificate be maintained on the owners premises for a period of two years from the date of their creation.

Discussion:

This report shall be filed with Corporation on the Nation Municipality and will be maintained on its premises for a period of two years.

**Condition 15** requires that the Certificate of Approval be registered on title to the property using a completed certificate of prohibition. Upon receiving the signed certificate of prohibition from the Ministry, the applicant shall register the certificate in the appropriate land Registry office.

Discussion:

The Municipality forwarded a Certificate of Prohibition for the Ministry of the Environment's signature (Toronto) in January 2000. The Municipality registered the Certificate of Prohibition on March 2, 2000 under instrument number 104043.

**Condition 16** specifies that only municipal non hazardous solid industrial waste and wood waste be accepted at this site. No hazardous or liquid industrial waste shall be accepted. The total amount of tires received and stored on the site shall not exceed 3000 tires and any one time. The site is approved to accept white goods and white goods containing refrigerant.

Discussion:

The Municipality only accepts municipal non hazardous solid industrial waste. As stated in section 5 of this report, the total number of tires has not exceeded 3000. In this same section, the diversion of white goods and white goods containing refrigerant is specified.

**Condition 17** specifies that the waste received at this site may be only from the boundaries of the former geographic Township of Caledonia.

Discussion:

During the reporting period, all waste deposited at the landfill site has been generated from the former geographic Township of Caledonia.

**Condition 18** requires that within six months of the issuance of the Certificate, the applicant shall submit a revised Development Operation and Closure addendum report which provides details of final design and operational plans for the site.

Discussion:

The Nation Municipality received correspondence dated August 23, 2001 from the Ministry of the Environment (Toronto), stating that condition 18, of the Certificate of Approval No. A471003 dated October 1st 1999, had been satisfied.

**Condition 19** requires that the Municipality operate the landfill according to item Nos. 3 and 11 of Schedule A, provided that all requirements of Condition 18 have been addressed in the report.

Discussion:

The Municipality operates the site following the site development, operation and closure report listed in Schedule A of the Certificate of Approval.

**Condition 20** requires that the Municipality submit to the Director for approval a detailed monitoring program for surface water, groundwater, and leachate.

Discussion:

The Municipality has included a monitoring program for surface water and groundwater as part of the annual monitoring reports which it must submit according to condition 35 prior to the end of March 31st, 2000, and annually thereafter.

**Condition 21** requires that an impact assessment report be submitted with the annual monitoring report to describe surface water and groundwater quality and quantity, and establish trigger values for remedial and corrective actions.

Discussion:

The Municipality has provided an assessment of the impact of landfilling on groundwater and surface water resources within the annual monitoring report required by condition 35. Trigger levels would be established once an adequate monitoring database has been gathered.

**Condition 22** requires that the Municipality submit a contingency plan and schedule dealing with remedial measures that are to be undertaken if Reasonable Use Guidelines and Provincial Water Quality Objectives are exceeded.

Discussion:

The Municipality shall prepare a contingency plan to respond to any exceedance to the trigger level (yet to be established), PWQO or RUPO as a part of its annual monitoring report.

**Condition 23** requires that all monitoring wells which are no longer required for monitoring or which need to be closed due to operational changes shall be abandoned according to Ontario Regulation 903.

Discussion:

Monitoring wells are addressed in the groundwater and surface water monitoring report contained in Part B of this report.

**Condition 24** states that approvals are required for any storm water management and landfill gas management programs that are to be implemented at this site.

Discussion:

The design drawings submitted with the operational report do not contain any storm water management or landfill gas management programs. Due to the rural setting of the landfill, these programs are not considered necessary at this time.

**Condition 25** contains many subsections a) through r) which specify operational issues regarding landfilling. The most significant issues are summarized as follows;

- the burning of wood waste shall cease on October 1st 2000
- the custodian must maintain a detailed log for all white goods containing refrigerant that enters the site, ensure that white goods are stored within a security fence and are removed within six months from the time of receipt at the site,
- site custodian shall conduct weekly inspections of the site and maintain records of such inspections. The site custodian must be aware of the types of waste to be disposed at this site, be knowledgeable about the requirements of this Certificate and the site operational plans,
- the site custodian must ensure that waste that is deposited at the working face is properly compacted before cover material is applied, and that the waste is covered on a weekly basis

Discussion:

The Township no longer burns wood at the site. The site custodian maintains a log of the number of users at the site. A Ministry of the Environment Inspection report dated February 20, 2001 indicated that the active slope was too steep (greater than 4:1) and had inadequate cover. The site custodian must ensure that the waste is adequately covered and that the slope is not too steep.

**Condition 26** requires that the Municipality delimit the landfill site boundaries with permanent markers.

Discussion:

During the year 2000, the Municipality demarked the 2.1 hectare footprint with four permanent markers. Only the waste to be placed by the area method (2.1 ha) will be delineated since the remaining area of the approved 4 ha. footprint has buried waste from the previous trench method.

**Condition 27** restricts the service area to the former Township of Caledonia

Discussion:

Only waste from the former Township of Caledonia was accepted at this landfill.

**Condition 28** specifies that all waste shall be deposited within the four hectare landfill footprint defined in the Operation and Development plan, that the total capacity shall not exceed 122,386 cubic metres and the contours described in Condition 28 c).

Discussion:

As shown in the plan and cross section provided in the figures to this report, the waste deposited during the period of this monitoring report has been placed within the footprint and approved contours. The Municipality is currently negotiating with the neighbouring property owners to acquire the ground water easement to satisfy condition 28 (f) and have requested an extension to the deadline from the Ministry of the Environment in correspondence dated November 20, 2001.

**Condition 29** specifies that the operating hours for the site shall be posted on the entrance sign and include other information such as waste types, service area, Certificate of Approval No., name and telephone number for emergencies.

Discussion:

The existing sign at the entrance to the landfill is in poor condition and does not contain all of the required information. During 2002, the Municipality should replace the sign and ensure that it contains all the required information listed in condition 29.

**Condition 30** requires that a litter fence be installed, on an as need basis, to minimize litter.

Discussion:

A litter fence shall be installed as required.

**Condition 31** requires that the Municipality inspect all lands and roads in the vicinity of this site and remove any litter found on those lands and roads.

Discussion:

The site custodian duties shall include this activity.

**Condition 33** specifies that the Municipality maintain a complaint procedure by recording each complaint in a log book and action taken to respond to it.

Discussion:

The Municipality has established a complaint procedure that has been followed by the site custodian.

**Condition 34** requires that the Municipality call the Ministry of the Environment Spills Action Center in the event of an emergency.

Discussion:

All emergencies such as fires or spills are reported to the Ministry of the Environment office in Cornwall. Fortunately, no such events were recorded during this monitoring period.

**Condition 35** specifies the information that shall be provided in the annual monitoring report that is to be submitted to be Ministry of the Environment prior to March 31st of each year, for the previous year's monitoring.

Discussion:

Part A of the annual monitoring report contains a summary of the information requested in Condition 35. A copy of Condition 35 can be found in the Certificate of Approval reproduced in Appendix A.

**Condition 36** requires that the annual report be available in the municipal office for viewing by the general public.

Discussion:

The Municipality shall keep a copy of the annual monitoring report at their municipal office for a period of two years following the adoption of the report by Municipal Council.

**Condition 37** specifies that the Municipality shall submit a detailed site closure plan to the Ministry for approval two years prior to the closing of the site.

Discussion:

Given that there is approximately 45 years remaining capacity at this location, no immediate action is required at this time.

## 3.2 Waste Deposited During 2001 and Waste Contours

Figure 4 shows the waste contours, as measured in December 2001, in relation to the design contours approved in the Certificate of Approval. We observed that only 235 c.m. of waste has been deposited at the site during 2001 and has been deposited within the approved footprint within Lifts 1A and 2A. The cross-section shown in Figure 5 identifies the existing waste in relation to the approved design cross-section.

## 3.3 Site Capacity and Remaining Lifts

The 1999 Certificate of Approval identifies the theoretical capacity of the landfill to be 122,386 cubic metres. This capacity includes the volume consumed by the former trench (31,230 c.m.) method, by 10,489 c.m. deposited by the area method up to December 2001 and 80,665 c.m. airspace remaining for future use. The design contours shown in Figure 3 and cross-section reflect the total capacity of 91,150 c.m. that can be developed by the area method. This capacity will be developed in 4 Lifts (as shown in Figure 5 and Table 1) and provide for the disposal needs of the community for many more years. Table 2 presents the capacity of each lift and the estimated time to fill each lift.

**TABLE 1 - LIFT CAPACITY**

| Lift | Volume c.m. | Cumulative capacity remaining c.m. | Anticipated Years | Life Ending |
|---|---|---|---|---|
| Lift 1 | 34,688 | 26,688 Note 1 | 17 | 2013 |
| Lift 2 | 26,176 | 52,864 | 15 | 2028 |
| Lift 3 | 18,688 | 71,552 | 11 | 2039 |
| Lift 4 | 11,598 | 83,150 | 6 | 2045 |

Note 1 – Remaining capacity is counted starting December 1996 and for this reason the 8,000 c.m. already placed above ground is substracted from the volume in column 2.

Remaining Capacity

The previous survey completed for the period December 1996 to December 1999 measured an increase of 2,080 c.m. in the size of the waste pile. The November 2000 survey measured an increase of 174 c.m and the December 2001 survey measured an increase of 235 c.m. This brings the total volume of waste deposited by the area method to 10,489 c.m. and the remaining capacity to 80,665 c.m.

Remaining Service Life

Table 2 (reproduced from Table 2 of the 1997 Operation and Development Report) presents the population and waste generation projections for the former Township of Caledonia for the period 1996-2045 and compares the waste projections to the actual measurements to date.

In comparing the 2000 to 2001 annual measured volume of 174 and 235 cubic metres, respectively, to the estimates presented in Table 2, we observe that the actual generation rates are approximately 85 percent less than the projected rates. This is because, as of July 1st, 2001, the residential waste from the service area (Township of Caledonia) is diverted to the Laflèche Environmental site in Moose Creek.

**TABLE 2 - POPULATION & WASTE PROJECTIONS**

| Year | Design Population | Design Waste c.m./yr | Design total cum. c.m. | Actual c.m./yr | Actual Cum.total |
|---|---|---|---|---|---|
| 1994 | 1441 | | 0 | | |
| 1995 | 1448 | 0 | 0 | | |
| 1996 | 1456 | 1456 | 8000 | | 8000 |
| 1997 | 1464 | 1464 | 9464 | 700 | 8,700 |
| 1998 | 1471 | 1471 | 10935 | 700 | 9,400 |
| 1999 | 1479 | 1479 | 12414 | 700 | 10,080 |
| 2000 | 1487 | 1487 | 13901 | 174 | 10,254 |
| 2001 | 1494 | 1494 | 15395 | 235 | 10,489 |
| 2002 | 1502 | 1502 | 16897 | | |
| 2003 | 1510 | 1510 | 18407 | | |
| 2004 | 1518 | 1518 | 19925 | | |
| 2005 | 1526 | 1526 | 21451 | | |
| 2006 | 1534 | 1534 | 22985 | | |
| 2007 | 1542 | 1542 | 24527 | | |
| 2008 | 1550 | 1550 | 26077 | | |
| 2009 | 1558 | 1558 | 27635 | | |
| 2010 | 1566 | 1566 | 29201 | | |
| 2011 | 1574 | 1574 | 30775 | | |
| 2012 | 1582 | 1582 | 32357 | | |
| 2013 | 1590 | 1590 | 33947 | | |
| 2014 | 1599 | 1599 | 35546 | | |
| 2015 | 1607 | 1607 | 37153 | | |
| 2016 | 1615 | 1615 | 38768 | | |
| 2045 | 1927 | 85951 | 83150 | | |

## 3.4 Summary of Landfill Operations During 2001

During 2001, the Municipality continued with its previous practice of dumping waste over the top or south edge of the waste mound (Section A) and advancing the face of the waste in a southerly direction within Lifts 1A and 2A. This method does not produce a high compaction of the waste but given the small volume of waste produced annually, it does not have a large impact on the remaining service life.

During 2001, the Municipality signed a ten year agreement with a private landfill contractor, Laflèche Environmental Ltd., for the disposal of all the Nation Municipality's residential and commercial waste at the Laflèche Environmental Ltd. landfill near Moose Creek (Figure 1).

The Municipality imports the silty sand material for daily cover uses. The compaction of the waste and the spreading of cover material is done by Municipality staff and equipment (Case 580 Super L backhoe). The waste is covered on a monthly basis during the summer and as required during the winter period. Given that the Municipality accepts only dry waste at this location (construction waste, old furniture, scrap metal, white goods, tires, wood products), this compaction frequency does not create undesirable impacts such as odours and wind blown litter.

The landfill is open every second and fourth Saturday of the month between the hours of 9 a.m. and 1 p.m. and while open, is under the supervision of the custodian The site custodian records indicate that there are on average 5 users going to the landfill every second week or 10 users per month. Throughout the year, there has been only one occurrence when waste was refused at the landfill. At the date of survey, the segregated material stockpiles were as follows; tires – 38 c.m., metal – 65 c.m..

Table 3 provides an assessment of the condition of the facilities located at the landfill site and identifies the work required in 2002 to upgrade deficient items.

## TABLE 3 - Condition of Facilities

| Description of item | Condition 2001 | Work to be done in 2002 |
|---|---|---|
| Gate & signs | The sign is in poor condition | The sign should be replaced and include the information in condition 29 of C of A No. A471003 |
| Access road & traffic | Good | None |
| Screening | Good | Maintain trees on south side |
| Drainage ditches | Good | None |
| Security & fences | Good | Inspect and maintain fence along the east side. |
| Trafficability on cover | Good except during spring. | Provide additional cover to maintain trafficability as required. |
| Soil cover thickness and frequency of application | Frequency monthly. | None. |
| Waste side slopes | Ministry of the Environment inspection report (February, 2001) stated that the slope of the active face was greater than 4:1 | The Municipality should not increase the height of the waste any further and should ensure that the slope does not exceed 4:1 |
| Grading on cover | Good | Sufficient grade to promote runoff. |
| Grade/survey control | Permanent markers were installed at the four corners of the 2.1 ha. Footprint during 2000. | Maintain corner posts so that they are not destroyed. |
| Custodian shelter | Small tin clad wooden shelter | Shelter adequate for this location. |
| Recycling | Blue box program started during 1995. | Continue with program. |
| Burn area | Certificate of Approval prohibits the burning of wood. | Burning no longer permitted after October 1, 2000. |
| Tire stockpile | The survey found that the tire stockpile was approximately 38 c.m. | Number of tires to be restricted to less than 3000 to prevent impact from fires. |
| Metal stockpile | Scrap metal collected by local scrap metal dealer as required. The survey found that the metal stockpile was 65 c.m. | Continue with existing program. |
| Visual appearance and litter | Good | Conduct monthly inspections and provide cleanup as necessary. |
| Vegetation | Good | None |
| Scavenging | Not allowed | None |
| Waste types | Residential & commercial. | Custodian to maintain a record of the number of users. |
| Record keeping | COA requires weekly records to be kept. | Custodian to maintain records on days when site is open. |
| CFC handling | Only accept tagged appliances. | Continue with program. |

The total cost for waste management services for 2001 compared to 2000 is as follows:

**Table 4 - Costs**

| DESCRIPTION | Year 2001 | Year 2000 |
|---|---|---|
| **COSTS**: | | |
| - Waste Collection | | |
| - Waste Disposal | 4,753 | 3,827 |
| - Engineering & Monitoring | 25,522 | 18,125 |
| - Blue Box Recycling (Note 1) | 21,217 | 20,031 |
| - Other waste diversion (Note 1) | | |
| - Other (legal) | | 2,797 |
| **TOTAL COSTS** | $51,492 | $44,780 |
| **REVENUES:** Tipping fees | $1, 175 | $524 |
| **NET COSTS** | $50,317 | $44,256 |

Note 1 - Cost prorated based on population of Caledonia (1450) vs entire Nation Municipality (10,460) or 14 %.

Based on the above table, during 2001 the cost to dispose of waste at the landfill was approximately $ 124 per c.m. (($50,317-$21,217) /235). This is a significant increase compared to 2000 when the cost was approximately $40 per c.m. ($ 44,256-20,031) ÷ 563 (2,245 c.m. ÷ 4 years).

## 3.5 Proposed Changes to Landfill Operations for 2002

During the year 2002, the height of the waste pile should not increase as the active face of the waste proceeds southerly within Lifts 1A and 2A. The active face can be advanced approximately 30 metres before reaching the south boundary of the approved footprint.

As shown in Table 3, the improvements to be made to operations during 2002 include:

- replace the entrance sign;
- ensure that the slope of the active face is less than 4:1;
- the Municipality should finalize the purchase of the 30 metres wide buffer along the east side and amend their Certificate of Approval to incorporate the buffer.

## 4.0 HYDROGEOLOGICAL MONITORING - IMPACT ON OPERATIONS

A hydrogeological and surface water monitoring report for the Caledonia Landfill was completed by Golder Associates Ltd. for 2001 and is presented in Part B of this report. The results of the hydrogeological and surface water monitoring for 2001 is consistent with the previous findings and does not necessitate changes to the method of operation for the year 2002. As noted earlier, the Municipality needs to purchase needs to purchase a 30 metre wide strip of land along the east side to make the site comply with the Ministry of the Environment's Guideline B-7 (Reasonable Use).

## 5.0 WASTE DIVERSION INITIATIVES

The MOEE established waste reduction targets of 25 % by 1992 and 50 % by the year 2000. Municipalities throughout Ontario should attempt to meet these same targets by establishing procedures that will promote waste reduction, reuse and recycling. The former Township of Caledonia, now Nation Municipality, implemented the following programs towards achieving the year 2000 waste reduction target;

- promotes backyard composting to divert organic material such as kitchen waste and yard waste.
- segregates scrap metal, CFC, natural wood products and tires at the landfill.
- operates a curbside multi material blue box program that was started during 1995.
- participates in household hazardous waste day events (not held every year).

During 1997, the Municipality established a procedure for the handling of metal goods containing CFC's that enter the landfill. Metal goods containing CFC's such as refrigerators, coolers, air conditioners, freezers, heat pumps and other similar objects must be tagged by an authorized technician before it is accepted at the landfill.

The Municipality blue box recycling program that was started during 1995 successfully diverted 88.9 tonnes of material from disposal during 2001. This is a reduction of 6.9 tonnes compared to 95.8 tonnes of material diverted in 2000. Table 5 identifies the type and total quantity of recyclable material collected by the blue box program within Caledonia. We would estimate that the blue box recycling program provides a diversion of 12-15% of the waste stream. The Municipality now contracts its recycling to Ontario Disposal Services of Vars, Ontario.

**TABLE 5 - Blue Box Recycling Program**

| Material | Tonnage 2001 | Tonnage 2000 |
|---|---|---|
| Newspaper & mixed | 33 | 34.5 |
| OCC & boxboard | 26.5 | 27.7 |
| Clear glass | 5.6 | 6.4 |
| Coloured glass | 5.3 | 6.1 |
| Steel & Al. Cans | 10.7 | 12.2 |
| Plastics | 7.7 | 8.8 |
| **TOTAL (Note 1)** | 88.9 Tonnes | 95.8 tonnes |

Note 1 – entire municipality prorated at 14% for Caledonia, based on population.

## 6.0 OTHER ISSUES

### 6.1 Long term planning for waste disposal

Given that there is a significant remaining capacity within the Caledonia landfill, the Nation Municipality does not need to undertake any long term planning to find additional waste disposal capacity to service the former Township of Caledonia residents.

### 6.2 Review of complaints, inspections and correspondence

The MOE conducted a compliance inspection of the landfill on February 20, 2001.
The Nation Municipality confirmed that there were no complaints listed during 2001.
The Municipality received correspondence from the Ministry of the Environment; this included the review of the 2000 annual monitoring report, which is addressed in Part B, the Golder Associates monitoring report. In correspondence dated August 23, 2001, the Ministry of the Environment notified the Municipality that they had satisfied condition number 18 and 35 of C of A No. A471003 dated October 1999.

## 7.0 RECOMMENDATIONS

The following recommendations are made to improve operations during 2001. These recommendations are additional to the Golder Associates comments made elsewhere in this report.

1. The municipality should finalize the purchase of the 30 metres wide buffer along the east side and amend the total site area of the Certificate of Approval.
2. The municipality should plant trees between the edge of waste and the east fence line, as shown in Figure 3.
3. The municipality should continue with the existing waste reduction initiatives (blue box, hazardous waste day, segregation of CFC, white goods, tires, metal, natural wood products).
4. All wood products are to be chipped using the municipality's chipper or other equipment rented for this task. The frequency of chipping shall depend on the volume of wood stored.
5. Provide training to site operator on conditions contained within the Certificate of Approval.
6. The Township should install a new sign at the entrance, which contains the information specified in Condition 29.
7. The municipality should not increase the height of the waste any further as the active face advances southward. The municipality can only advance the face another 30 metres southerly before reaching the south limit of the footprint.

## 8.0 LIMITATIONS AND USE OF REPORT

In the preparation of this report, Stantec provides the benefit of its professional judgement based on its experience and in accordance with generally accepted professional standards for this type of project.

This report has been prepared for the exclusive use of the Nation Municipality for the purpose of annual operations monitoring and reporting at the subject property. Any use that a third party makes of this report, or any reliance on or decisions to be made on it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

All of which is respectfully submitted,

**STANTEC CONSULTING LTD.**

Gerry Lalonde P.Eng.

# APPENDIX A

## CERTIFICATE OF APPROVAL
## And
## CORRESPONDENCE

**Ministry of the Environment**

**Ministère de l'Environnement**

Ontario

**Environmental Assessment and Approvals Branch**
2 St. Clair Ave West, 12A Floor
Toronto ON M4V 1L5

**Direction des évaluations environnementales et des autorisations**
2, avenue St. Clair Ouest, 12A étage
Toronto ON M4V 1L5

Tel/Tél (416) 314-7967
Fax/Téléc (416) 314-8452

Municipalité de la Nation
Received
OCT 12 1999
Reçu
The Nation Municipality

1 October 1999

Ms. Mary McCuaig, Clerk
The Corporation of the Nation Municipality
958 Highway 500 West
R.R. #3
Casselman, Ontario
K0A 1M0

Dear Ms. McCuaig:

Attached is a new Provisional Certificate of Approval No. A 471003 for the Caledonia Landfill Site is to accommodate the request by the former Township of Caledonia in their application and letter, both dated June 26, 1997, to incorporate the Operation, Development and Closure Report and a Hydrogeological Report, dated March 1997 into the Certificate and legal plan prepared by Schultz dated October 11, 1996, and to increase the total site area from 12 to 14.58 hectares and recognize a change from a trench to an area method of fill to develop the remaining approved capacity, and to recognize a change in name from the Town of Caledonia to Corporation of the Nation Municipality.

In addition, please note that we have also taken this opportunity to upgrade the Certificate so that eventually the landfill Site will meet the Ministry's current standards and procedures for operation. It is recommended that you review this Certificate in detail, so that the terms and conditions by which this Site may be operated are fully understood.

Reasons for the Conditions in this Certificate and procedures to be followed should you wish to appeal, are provided as part of the Certificate.

If you have any questions, please do not hesitate to contact Ms. Ellen R. Reed at (416) 314-8320.

Yours truly,

A. Dominski P. Eng., Supervisor
Waste Approvals

ER/lf
Encl.
c: District Manager, Kingston

Ontario

Ministry of the Environment

Ministère de l'Environnement

*PROVISIONAL CERTIFICATE OF APPROVAL FOR A WASTE DISPOSAL SITE*
*NO. A 471003*


Municipalité de la Nation
Received
OCT 19 1999
Reçu
The Nation Municipality

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

Corporation of the Nation Municipality
958 West Route 500
R.R. #3
Casselman, Ontario
K0A 1M0

*for the use and operation* of a 4.0 hectare landfill within a 14.57 hectare total Site area;

*all in accordance with the following plans and specifications:*

The application and supporting information as listed in Schedule "A", which is attached to this Provisional Certificate of Approval and forms part of this Certificate;

*Located:* Lot 23, Concession 6
within the former Township of Caledonia, now the Corporation of the Nation Municipality

*which includes the use of the Site only for the* receiving and 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)* municipal and non-hazardous solid industrial waste including white goods, tires and woodwaste.

*and subject to the following conditions:*

## A. DEFINITIONS

For the purpose of this Provisional Certificate of Approval:

(a) "Act" and "EPA" mean the Environmental Protection Act, R.S.O. 1990, C. E-19 as amended;

(b) "Applicant", "Owner" and "Operator" mean the Corporation of the Nation Municipality, including its officers, employees, agents or contractors;

(c) "buffer area" means that part of a landfilling site that is not used as a waste fill area;

(d) "Certificate" means this entire Provisional Certificate of Approval including its schedules, if any, issued in accordance with Section 27, Part V of the Environmental Protection Act;

(e) "Director" means a Director, Environmental Assessment and Approvals Branch of the Ministry of the Environment;

(f) "District Manager" means the District Manager of the Kingston District Office, Eastern Region of the Ministry;

(g) "Ministry" means the Ontario Ministry of the Environment (MOE);

(h) "O. Reg 347" means Ontario Regulation 347, R.R.O. 1990, as amended;

(i) "PWQO's" means Provincial Water Quality Objectives;

(j) "Reasonable Use Guideline" means the Ministry Guideline No. B-7 entitled, "Incorporation of the Reasonable Use Concept into MOE Groundwater Management Activities", dated April 1994, or as amended;

(k) "Site" means the landfill site as described in this Certificate;

(l) "waste fill area" means the area on the surface of the landfilling site beneath which or above which waste is disposed by landfilling; and

(m) "woodwaste" is as defined in Ontario Regulation 347, R.R.O., 1990, as amended.

## B. GENERAL

1. (a) The Provisional Certificate of Approval No. A 471003, dated April 16, 1980 is hereby revoked and replaced by this Certificate; and

   (b) Notwithstanding Condition 8, nothing in Condition 1(a) revokes any ongoing obligations and requirements imposed and initiated as the result of the issuance or existence of the previous Certificate for this Site unless specifically stated in this Certificate.

2. Except as otherwise provided by these Conditions, the Site shall be operated, in accordance with the Applications for a Certificate of Approval for a Waste Disposal Site, dated July 17, 1972 and June 26, 1997, and its supporting documents as listed in Schedule "A".

3. The requirements specified in this Certificate are the requirements under the Environmental Protection Act, R.S.O. 1990. The issuance of this Certificate in no way abrogates the Applicant's legal obligations to take all reasonable steps to avoid violating other applicable provisions of this legislation and other legislation and regulations.

4. The requirements of the Certificate are severable. If any requirement of this Provisional Certificate of Approval, or the application of any requirement of the Provisional Certificate of Approval to any circumstance, is held invalid, the application of such requirement to other circumstances and the remainder of the Provisional Certificate of Approval shall not be affected in any way.

5. The Applicant shall ensure compliance with all the terms and conditions of this Certificate. Any non-compliance constitutes a violation of the Environmental Protection Act, R.S.O. 1990 and its grounds for enforcement.

6. (a) The Applicant shall, forthwith upon request of the Director, District Manager, or Provincial Officer (as defined in the Act), furnish any information requested by such persons with respect to compliance with this Certificate, including but not limited to, any records required to be kept under this Certificate; and

(b) In the event, the Applicant provides the Ministry with information, records, documentation or notification in accordance with this Certificate (for the purposes of this condition referred to as "Information"),

i. the receipt of Information by the Ministry;
ii. the acceptance by the Ministry of the Information's completeness or accuracy; or
iii. the failure of the Ministry to prosecute the Applicant, or to require the Applicant to take any action, under this Certificate or any statute or regulation in relation to the Information;

shall not be construed as an approval, excuse or justification by the Ministry of any act or omission of the Applicant relating to the Information, amounting to non-compliance with this Certificate or any statute or regulation.

7. The Applicant shall allow Ministry personnel, or a Ministry authorized representative(s), upon presentation of credentials, to:

(a) carry out any and all inspections authorized by Section 156, 157 or 158 of the Environmental Protection Act, R.S.O. 1990, Section 15, 16 or 17 of the Ontario Water Resources Act, R.S.O. 1990, or Section 19 or 20 of the Pesticides Act, R.S.O. 1990, as amended from time to time, of any place to which this Certificate relates; and

without restricting the generality of the foregoing, to:

(b) i. enter upon the premises where the records required by the conditions of this Certificate are kept;

ii. have access to and copy, at reasonable times, any records required by the conditions of this Certificate;

iii. inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations required by the conditions of this Certificate; and

iv. sample and monitor at reasonable times for the purposes of assuring compliance with the conditions of this Certificate.

8. (a) Where there is a conflict between a provision of any document referred to in Schedule "A" and the conditions of this Certificate, the conditions in this Certificate shall take precedence; and

(b) Where there is a conflict between documents listed in Schedule "A", the document bearing the most recent date shall prevail.

9. The Applicant shall ensure that all communications/correspondence made pursuant to this Certificate includes reference to the Certificate approval number A 471003.

10. The Applicant shall notify the Director in writing of any of the following changes within thirty (30) days of the change occurring:

(a) change of Applicant or Operator of the Site or both;

(b) change of address or address of the new Applicant;

(c) change of partners where the Applicant or Operator is or at any time becomes a partnership, and a copy of the most recent declaration filed under the Business Names Act, 1991 shall be included in the notification to the Director; and

(d) any change of name of the corporation where the Applicant or Operator is or at any time becomes a corporation, and a copy of the most current "Initial Notice or Notice of Change" (form 1 or 2 of O. Reg. 182, Chapter C-39, R.R.O. 1990 as amended from time to time), filed under the Corporations Information Act shall be included in the notification to the Director.

11. In the event of any change in ownership of the Site, the Applicant shall notify, in writing, the succeeding owner of the existence of this Certificate, and a copy of such notice shall be forwarded to the Director.

12. Any information relating to this Certificate and contained in Ministry files may be made available to the public in accordance with the provisions of the Freedom of Information and Protection of Privacy Act, R.S.O. 1990, C. F-31.

13. All records and monitoring data required by the conditions of this Certificate shall be kept on the Owners's premises for a minimum period of two (2) years from the date of their creation.

14. The obligations imposed by the terms and conditions of this Certificate are obligations of due diligence.

## C. PROHIBITION AND REGISTRATION ON TITLE

15. (a) Pursuant to Section 197 of the EPA, neither the Applicant nor any person having an interest in

the Site shall deal with the Site in any way without first giving a copy of the Provisional Certificate of Approval to each person acquiring an interest in the Site as a result of the dealing;

(b) Within sixty (60) calendar days of the date of this Certificate of Approval, submit to the Director for the Director's signature two (2) copies of a completed Certificate of Prohibition containing a registerable description of the Site, in accordance with Form 1 of O. Reg. 14/92; and

(c) Within ten (10) calendar days of receiving the Certificate of Prohibition, the Applicant shall register the Certificate of Prohibition in the appropriate Land Registry Office on title and immediately following registration, submit to the Director the duplicate registered copy.

## D. WASTE TYPE

16. (a) Except as noted under Condition 16(c) and (d), only municipal, non-hazardous solid industrial waste and woodwastes as define under O. Reg 347, pursuant to the EPA, shall be accepted at this Site;

(b) No hazardous waste or liquid industrial waste, as defined in O. Reg 347, pursuant to the Environmental Protection Act, or any other waste not listed under Condition 16(a) shall be accepted or deposited at this Site;

(c) The total amount of tires received and stored on the Site shall not exceed 3000 tire units at any one time; and

(d) The Site is approved to accept white goods and white goods containing Refrigerant.

## E. SERVICE AREA

17. Waste approved for disposal or use at this Site may only be received from, and as generated within, the boundaries of the former geographic Township of Caledonia.

## F. DESIGN AND OPERATIONS REPORT

18. Within six (6) months of the issuance of this Certificate, the Applicant shall prepare and submit to the Director, for approval, a Development, Operation and Closure addendum report which details the final design and operational plans for the Site which will include, a surveyed plan, final design drawings and specifications for the Site for his/her approval. The report shall be prepared to reflect the conceptual design and operation of this Site as modified by the Conditions in the Certificate. The report shall include the following information:

(a) geographical area served, waste types and quantities received on daily/yearly basis including anticipated future types and quantities and waste diverted through on-site recycling programs initiated under Ontario Regulation 101, R.R.O. 1990 or in a similar manner;

(b) Site capacity (cubic metres), remaining capacity, historical volume, updated drawings showing the waste fill area (footprint), closed fill areas, buffer areas, and special usage areas (e.g. recycling facilities, burning areas, etc.);

(c) detailed operational and management plans for all special usage areas;

(d) a supplemental hydrogeological investigation to address the effect of landfilling with respect to compliance with the Reasonable Use Guideline;

(e) method of landfill operation;

(f) Site development stages and sequence;

(g) dimensions of working face, cells and lifts;

(h) cover material type, quantities required and quantities available for interim and final use, location and dimensions of stockpiles;

(i) daily and/or intermediate cover procedures;

(j) final cover and final contour design;

(k) buffer zones and landscaping details including buffer zones for existing fill areas;

(l) equipment and staffing requirements;

(m) Site fencing, gates, signs, security, and supervision;

(n) Site buildings, weigh scales, access roads and on-site roads;

(o) procedures for mitigation of environmental impacts from dust, litter, odour, noise, vector and vermin, and for the handling of complaints related to this Site;

(p) if applicable, design details of the leachate collection system (underdrains, toe drains, manholes, collector sewers, holding ponds, pumping station), leachate management and disposal;

(q) if applicable, details of a program for the inspection, maintenance, repair and replacement of all components of the leachate collection system, including estimates of service life of the system components, frequency and number of replacements, and procedures to ensure that the service life exceeds the contaminating life span of the landfill;

(r) if applicable, surface water control and management plans, specifications and descriptions of the design features, control facilities such as berms, drainage ditches, control ponds and operational

procedures to isolate, contain, convey, control and/or treat the surface water on and off site prior to its discharge to the receiving water course(s);

(s) where applicable, contingency plans for groundwater, surface water, leachate, and landfill (methane) gas management, including trigger mechanisms to determine if the contingency plan is to be implemented;

(t) inclement weather operations;

(u) annual reporting on Site operations and required monitoring;

(v) Site closure activities;

(w) post-closure maintenance, monitoring and reporting; and

(x) the addition, revision or deletion of other information agreed to, or as instructed, in writing, by the Director or the District Manager, prior to and after the issuance of this Certificate.

19. Notwithstanding Condition 18, the Site may be operated under the Site development and operating report in item #3 and #11 of Schedule "A" of this Certificate, except as otherwise noted in this Certificate, provided all the provisions in Condition 18 have been addressed in the report or the District Manager has agreed, in writing, to any omissions and revisions noted in those provisions.

## G. MONITORING PROGRAMS

20. In conjunction with Condition 18, the Applicant shall submit, to the Director, for approval, detailed monitoring programs for surface water, groundwater, leachate. If warranted, at some later date or at the request of the District Manager, the Applicant shall submit, to the Director, for approval, detailed monitoring programs for landfill gas, and noise, as well as dust, odour and traffic. A sufficient number of monitoring wells shall be placed in such a manner to provide pertinent information with respect to the horizontal and vertical extent of the leachate contamination plume and compliance at the property boundary.

21. As part of the annual report, described in Condition 35, the Applicant shall provide the District Manager with an impact assessment report. The report shall, with respect to surface water and groundwater quality and quantity, include trigger values for remedial or corrective action due to surface and/or groundwater impacts associated with landfilling.

22. Dependant upon the results of the report referred to in Condition 21, the Applicant shall submit, along with the annual report, to the District Manager, for the approval of the Director, a contingency plan and schedule detailing the remedial measures which will be initiated for controlling and/or treating any water quality impacts above the Reasonable Use Guidelines (Policy B-7) and/or the PWQO's which are detected

or predicted to occur at or beyond the present property boundary. Implementation of the contingency plan shall be initiated no later than 60 days of approval by the Director.

## H. EXISTING WELLS

23. Any wells or monitoring wells on the Site, which are no longer required for monitoring or which need to be closed due to operational changes on the Site, shall only be abandoned according to Ontario Regulation 903, R.R.O. 1990. Wells shall be sealed following the procedures outlined in the Ministry Information Sheet entitled, "Water Wells and Groundwater Supplies: Recommended Methods for Plugging Abandoned Water Wells", dated June 1994, or as revised.

## L. STORMWATER MANAGEMENT AND LANDFILL GAS MANAGEMENT

24. (a) The Applicant must comply with the approval requirements of Section 53 of the Ontario Water Resources Act prior to the construction or modification of any element of a stormwater management system at this Site; and

(b) Any landfill gas release equipment shall not be installed unless a Certificate of Approval (Air) has been issued under the Environmental Protection Act.

## J. LANDFILL OPERATIONS

25. Notwithstanding the requirements under other Conditions of this Certificate, the Applicant shall be responsible for the following:

(a) the burning of woodwaste on the Site for one year from the time of issuance of this Provisional Certificate of Approval provided that:

i. the burning of woodwaste is continuously supervised; carried out in compliance with the Ministry of the Environment "Guidelines for Burning at Landfill Sites in Ontario"; and adheres to any other burning regulations and restrictions in effect for the area, (example: burning restrictions by the MNR); that no other wastes are burned on the Site; and, that the location for burning is segregated from the areas used for landfilling and recycling and that the burning does not impede or cause risk to the landfilling operation or any recycling facilities on the Site; and

ii. at any time that the Ministry receives a complaint, and upon notice of the District Manager, the Applicant shall cease all burning activities at this Site;

(b) maintaining a detailed log for all white goods containing refrigerant received at this Site; as a minimum, the log shall include the date of the record, types, quantities and source of white goods received, details on removal of refrigerants as required by Ontario Regulation 189/94, and the quantities and destination of the white goods and/or refrigerant materials transferred from the Site;

(c) ensuring that the Refrigerant associated with white goods are removed within six (6) months from the time of receipt at the Site and by a licensed technician in accordance with Ontario Regulation 189/94; and transported and disposed in accordance with Ontario Regulation 347, R.R.O. 1990, as amended;

(d) ensuring that all white goods accepted at the Site, which have not been tagged by a licensed technician to verify that the refrigeration equipment no longer contains any refrigerant, are stored in an upright position, in an area with a security fence, so that the white goods containing refrigerant is segregated from all other waste, recycling and public access areas, and in such a manner to allow for the safe handling and removal of refrigerant;

(e) conducting a weekly inspections of the Site to ensure that there are no environmental or operational problems which may impact on the quality of the environment or cause an "adverse effect", as defined under the EPA;

(f) ensuring that each weekly inspection, as described in Condition 25(e), shall be recorded in an inspection book to be maintained by the Applicant and any deficiencies detected during these inspections, that might negatively impact the environment, are promptly corrected and recorded;

(g) ensuring that all necessary measures are taken to contain and minimize any air emissions (example: noise, odour, gas, dust, smoke, etc.) which may result from the operation of this Site; and, that the Site is operated in compliance with all applicable legislation governing these emissions;

(h) ensuring that personnel supervising the landfilling operation are aware of the types of waste which may be disposed at this Site; and that they are knowledgeable about the requirements of this Certificate and the Site operation;

(i) maintaining the fencing around the Site and ensuring that the Site gate is securely locked when the Site is not operational;

(j) ensuring that on-site roads are treated with water and/or dust suppression materials when necessary to minimize dust generation;

(k) ensuring that, if applicable, leachate collection systems are constructed, operated and maintained in a manner that minimizes the effects of leachate accumulation;

(l) ensuring that, if applicable, the leachate collection system is inspected and maintained regularly throughout the contaminating life span of the landfill;

(m) ensuring that waste is deposited in a manner that minimizes the size of the working face and that the waste is properly compacted before cover material is applied;

(n) ensuring that active fill area is covered on a regular weekly basis;

(o) ensuring that a final cover material layer of at least 750mm in depth is applied and vegetation initiated in any part of the landfill area that has reached its approved contour, unless otherwise approved by the Director;

(p) ensuring that cracked or eroded cover material is immediately repaired and re-vegetated;

(q) ensuring that surface ponding of water is kept to a minimum; and

(r) ensuring that erosion and sedimentation is kept to a minimum and that litter is cleaned up, as required.

26. Within 90 days of issuance of this Certificate, the Applicant shall mark the landfill site boundaries with permanent markers, that shall be erected so as to be visible throughout the year for the life of the landfill Site.

## K. WASTE DELIVERY/REMOVAL

27. (a) Waste managed at this Site shall only be generated and received from residents within the approved service area for this Site; or under an approved Waste Management System, as defined under Ontario Regulation 347, R.R.O. 1990, hauling only waste which has been generated within the approved service area for this Site; and

(b) Unless otherwise exempted by legislation, waste recyclables, collected and sorted on the Site, shall be removed from the Site under an approved Waste Management System.

28. (a) Notwithstanding Condition 18(b), all waste received at this landfill Site under the authority of this Certificate shall be deposited within the 4 hectare landfill footprint shown on Figure No. 6B, dated March, 1997, defined in Schedule "A";

(b) Notwithstanding Condition 18(b), the total capacity or final volume of waste that can be deposited in this Site shall not exceed 122, 386 cubic metres:

(c) Notwithstanding Condition 18(b), once the final contour elevations identified on Figure No. 7, dated March, 1997, and subsequently revised in a letter dated June 17, 1999, defined in Schedule "A", have been attained no further waste shall be deposited on this landfill Site;

(d) The maximum elevation of waste, including final cover, shall not exceed the final contours, as described under Condition 28(c);

(e) Waste shall only be landfilled within the limits of the waste fill area and the boundary corners of the waste fill area shall be securely staked and the Operator shall ensure wastes are only placed within the boundaries of that area; and

(f) Conditions 28 (a) through (d) are contingent on the Applicant obtaining the acquired minimum 30 metre buffer zone around the perimeter of the waste fill area. The Applicant shall bring the Site into compliance with the required minimum 30 metre buffer zone within 2 years of the issuance of this Provisional Certificate of Approval.

## M. ENTRANCE SIGN AND OPERATING HOURS

29. (a) The operating hours of this Site shall be posted on a permanent readable sign at the entrance to the Site. The sign shall include as a minimum, information on waste types which may be accepted at the Site, the area serviced by this Site, Waste Management System requirements for commercial haulers, the license number of the Site and the name of the Applicant's contact telephone number(s) for emergencies (e.g. fire), complaints and enquires; and

(b) Notwithstanding Condition 29(a), the operating hours and routing restrictions shall be in accordance with municipal by-laws.

## N. LITTER CONTROL

30. Litter fencing shall be installed, on an as need basis, in order to minimize litter.

31. The Applicant shall inspect all lands and roads in the vicinity of the Site as necessary and shall take responsibility for the removal and disposal of any litter found on those lands and roads as soon as possible thereafter, which includes the cleanup of illegal dumping of waste outside the landfill gate.

## O. NOISE CONTROL

32. Noise from or related to the Site shall be kept to a minimum.

## P. COMPLAINT PROCEDURES

33. In the event the Applicant receives complaints regarding the Site operations, the Applicant shall respond to these complaints according to the following procedure:

(a) The Applicant shall record each complaint in a log book. The information recorded must include the nature of the complaint, the name, address and the telephone number of the complainant and the time and date of the complaint; and

(b) The Applicant, upon notification of the complaint, must determine the cause(s) of the complaint and , if appropriate, take action to remove the cause(s).

## Q. EMERGENCIES

34. In case of a emergency (example: fire) at this Site, the Applicant shall forthwith call the Ministry of the Environment Spills Action Centre **(1-800-268-6060)**. All emergencies shall be recorded in the annual report described in Condition 35.

## R. REPORT SUBMISSIONS

35. Notwithstanding the requirements under other Conditions of this Certificate, the Applicant shall submit an annual report on the operation, development and monitoring of the Site to the District Manager, for his information, by March 31st of each year. The report shall cover the calendar year ending the preceding December 31st and shall include the following information as a minimum, where applicable:

    (a) an updated site contour plan(s) showing the fill area, buffer zones, access and on-site roads, berms, buildings, cover material stockpiles, monitoring locations, leachate holding pond(s), leachate collection system, surface water control works, areas that have been filled with waste, and areas to be filled with waste during the next reporting period;

    (b) a summary of weekly quantities of waste received, waste landfilled, and cover materials used;

    (c) the results of any other inspections initiated under Conditions 18;

    (d) an estimate of the remaining Site capacity and Site life;

    (e) an assessment of the operation and performance of all leachate collection facilities;

    (f) any operational or environmental problems, that might negatively impact the environment, encountered and any mitigative actions taken;

    (g) the data and interpretive analyses of the data from all monitoring programs;

    (h) an assessment of the need for any remedial measures;

    (i) the status of compliance with all Conditions of this Certificate, including inspection and reporting requirements;

    (j) any recommendations for changes to the operation, development and monitoring of the Site; and

    (k) any other information required under this Certificate or which the Director or the District Manager may require from time to time.

36. The annual report described in Condition 35 shall be available in the municipal office of the Corporation of the Nation Municipality for viewing by the general public.

## S. CLOSURE PLAN

37. Notwithstanding Condition 18, two (2) years prior to the time when the applicant expects the Site to be at capacity, the Applicant shall submit to the Director, for approval, a detailed Site closure plan pertaining to the termination of landfilling operations at this Site, post-closure inspection, maintenance and monitoring, and end use, or the Applicant shall submit a application for the expansion of the Site.

## *SCHEDULE "A"*

*This Schedule "A" forms part of Provisional Certificate of Approval No. A 451003:*

1. Application from the Township of Caledonia, dated July 17, 1972.

2. Provisional Certificate of Approval A 471003, dated April 16, 1980.

3. Letter from Joanne Bougie-Normand, the Township of Caledonia to the Ministry of the Environment (MOE) enclosing an Application for an amendment for a Waste Disposal Site, dated June 26, 1997, and two reports titled "Landfill Development, Operation and Closure Report for Waste Disposal Site" and "Hydrogeological Assessment", both dated March, 1997.

4. Memo from V. Castro, MOE to J. Mulder, MOE, dated October 22, 1997 providing comments on the proposed application for an amendment dated June 26, 1997.

5. Memo from F. Crossley MOE to J. Mulder, MOE, dated December 22, 1997 providing comments on the proposed application for an amendment dated June 26, 1997.

6. Facsimile from Jim Mulder, MOE to Gerry Lalonde, Stanley Consulting Group Ltd., dated April 29, 1998, requesting additional information.

7. Letter from H. Francois, Corporation of the Nation Municipality, to M. Robert, MOE, dated July 16, 1998 confirming that site is zoned appropriately.

8. Letter from Gerry Lalonde, Stanley Consulting Group Ltd., to Marc Robert, MOE, dated July 24, 1998 responding to the request for additional information in item #6 of Schedule "A".

9. Letter from Gerry Lalonde, Stantec Consulting Ltd., to A. Dominski, MOE, dated April 19, 1999, providing an update with respect to pursuing the purchase of additional lands and implementation of a revised groundwater and surface water monitoring program.

10. Letter from Gerry Lalonde, Stantec Consulting Ltd., to M. Robert, MOE, dated May 28, 1999, providing copies of correspondence per the Ministry's request.

11. Letter from Gerry Lalonde, Stantec Consulting Ltd., to E. Reed, MOE, dated June 17, 1999, revising the calculation for the theoretical capacity of the landfill.

12. Letter from M. McCuaig, Corporation of the Nation Municipality to A. Dominski, MOE, dated June 17, 1999, requesting that the owner's name be changed from the Township of Caledonia to the Nation Municipality.

13. Facsimile from M. McCuaig, The Nation Municipality to E. Reed, MOE, dated June 23, 1999, confirming that the legal name is Corporation of the Nation Municipality.

*The reason for the imposition of these changes is:*

To bring the Site into compliance with current operating procedures for landfill Sites and to accommodate the request by the Township of Caledonia in their application and letter, both dated June 26, 1997, to incorporate the Operation, Development and Closure Report and a Hydrogeological Report, dated March 1997 into the Certificate and legal plan prepared by Schultz dated October 11, 1996, and to increase the total site area from 12 to 14.58 hectares and recognize a change from a trench to an area method of fill to develop the remaining approved capacity, and to recognize a change in name from the Town of Caledonia to Corporation of the Nation Municipality.

*Specific reasons for the conditions are as follows:*

1. Conditions 1, 3, 4, 5, 8, 9, 10, 11, 12, 13 and 15 are to clarify the legal rights and obligations of this Certificate.

2. Condition 7 is to ensure that the appropriate Ministry staff have ready access to the waste Site to inspect the operations that are approved under this Certificate. The condition is supplementary to the powers of entry afforded a Provincial Officer pursuant to the Environmental Protection Act, as amended.

3. Conditions 2 and 6 are to ensure that the waste disposal Site is operated in accordance with the application for this Certificate and supporting information and not in any way or under any name which the Director has not been asked to consider; and to ensure the property is cleaned up and restored to the satisfaction of the Ministry.

4. Condition 14 is required to clarify that the terms and conditions of this Certificate impose a standard of due diligence and not absolute liability.

5. Conditions 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, and 34 are to ensure that the Site is used only for the wastes and quantities specified; that the Site is properly supervised, monitored, operated and closed in an organized and secure manner by trained persons in order to prevent environmental detriment and to ensure the safety of the general public and site personnel; that the collection, handling, and transportation of all waste materials are conducted in an environmentally acceptable manner in accordance with Provincial regulations; and that emergencies are properly recorded.

6. Conditions 35, 36 and 37 are to provide the Operator and the Ministry of the Environment with an assessment of waste landfill Site operation.

*In accordance with Section 139 of the Environmental Protection Act, R.S.O. 1990 c. E-19, 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. Section 142 of the Environmental Protection Act, as amended provides that the Notice requiring a hearing shall state:*

1. The portions of the approval or each term or condition in the approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

*In addition to these legal requirements, the Notice should also include:*

3. The name of the appellant;
4. The address of the appellant;
5. The Certificate of Approval number;
6. The date of the Certificate of Approval;
7. The name of the Director;
8. The municipality within which the waste disposal site is located;

*And the Notice should be signed and dated by the appellant.*

*This Notice must be served upon:*

The Secretary,
Environmental Appeal Board,
2300 Yonge St., 12th Floor,
P.O. Box 2382
Toronto, Ontario.
M4P 1E4

AND

The Director,
Section 39, Environmental Protection Act,
Ministry of the Environment,
2 St. Clair Avenue, 12A Floor,
Toronto, Ontario.
M4V 1L5

*DATED AT TORONTO this* 1st *day of* October, 1999.

A. Dominski, P. Eng.,
Director,
Section 39,
Environmental Protection Act

ER/lf
c: District Manager, Kingston

**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

MAR 19 2001
Reçu
The Nation Municipality

March 14, 2001

Réunion Conseil
Council Mtg. - 26/03/01
D / M / YR
Action reports
Clerk.
Greffier

Mary McGuaig, Clerk
Corporation of the Nation Municipality
958 Road 500 West, R.R. #3
Casselman, ON K0A 1M0

Dear Madam:

**Re: Compliance Inspection Report - Caledonia Disposal Site**

The above-mentioned facility was inspected by Marc Robert, of this office, on February 20, 2001.

A copy of the report is provided. Your attention is directed to sections 4.1, 5.0 and 5.1 of the report. Please provide a response by April 16, 2001.

Should you have any questions pertaining to the report, please do not hesitate to contact Marc Robert at extension 229.

Yours truly,

James D. Mahoney
Area Manager (Acting)
Cornwall Area Office
Kingston District

JDM:sp
Enclosure

S:\GROUPS\WORDPRO\2001\Inspections\Waste\Caledonia.wpd

0761 CGB (08/95) 50% Recycled Chlorine Free. Made in Canada

COMPLIANCE INSPECTION REPORT

# CALEDONIA

## SOLID NON-HAZARDOUS WASTE DISPOSAL SITE

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

Inspected by: Marc Robert
Inspection: February 20, 2001

## TABLE OF CONTENTS

**Item No.** **Page No.**

Ontario

# MINISTRY OF THE ENVIRONMENT

# SOLID NON-HAZARDOUS WASTE DISPOSAL SITE INSPECTION REPORT

**COMPANY/MUNICIPALITY:** The Corporation of the Nation Municipality

**ADDRESS:** R.R. #3, 958 Route 500 West, Casselman ON K0A 1M0

**CONTACT NAME:** Mary McCuaig **TITLE:** Clerk

**CONTACT TELEPHONE:** (613) 764-5444 **FAX:** (613) 764-3310

**SITE LOCATION:** South Part of East half of Lot 23, Concession 6 (former Caledonia Township), Nation Municipality

**SITE NAME:** Caledonia Waste Disposal Site

**INSPECTION DATE:** February 20, 2001

**DATE OF LAST INSPECTION:** May 26, 1998

## 1.0 CERTIFICATES OF APPROVAL

| CERTIFICATES OF APPROVAL | DATE |
|---|---|
| 471003 | 29 September 1972 (1) |
| same | 16 May 1974 (2) |
| same | 16 May 1975 (3) |
| A 471003 | 16 April 1980 (4) |
| A 471003 | 1 October 1999 |

1. Expired on 15 May 1973
2. Expired on 15 May 1975
3. Expired on 15 May 1976
4. Revoked on 1 October 1999

- **Are there any emission requirements, limits or pertinent conditions in the C of A which are required to directly protect human health or the environment?**

  Provisional Certificate of Approval No. A471003 dated October 1, 1999, lists several conditions designed to protect the environment and to a lesser extent human health.

  For example:

  Section D of the C of A states that only municipal, non-hazardous solid industrial waste and woodwastes can be accepted at the landfill site;

  Section F of the C of A requires the Nation Municipality to prepare and submit to the MOE for approval a Development, Operation and Closure addendum report for the landfill site;

  Section G of the C of A requires the Nation Municipality to prepare a detailed hydrogeological monitoring program for the landfill site;

  Section J of the C of A lists several conditions as to the daily operations of the waste disposal site.

  For more detailed information, see the C of A in Appendix "A" of this report.

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

  There is no record of financial assurance on file with the MOE.

- **What is the approved total area of the site?**

  Provisional C of A No. A 471003 was issued for the use and operation of a waste disposal site with a total area of 14.57 hectares.

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

  Provisional C of A No. A 471003 was issued for the use and operation of a landfill area of 4.0 hectares within the total site area.

- **Does the site have an approved capacity?**

  Yes. Condition 28(b) of Provisional C of A No. A 471003 states that the total capacity or final volume of waste that can be deposited in the landfill site shall not exceed 122,386 $m^3$.

Also, Condition 28(c) of the C of A provides for final contours at the landfill site at which time no further waste may be deposited at the site.

## 2.0 INSPECTION OBSERVATIONS

Photos taken during the inspection of the Caledonia waste disposal site are found in Appendix "B" of this report.

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

Condition 28(e) of the C of A requires the Nation Municipality to mark the boundary corners of the footprint with stakes and Condition 26 of the C of A requires the Municipality to mark the landfill site boundaries with permanent markers, visible throughout the year. The latter was a recommendation of the MOE's previous compliance inspection report. The February 2000 addendum report to the March 1997 Landfill Development, Operation and Closure Report for the landfill site states that the Municipality will delineate the footprint with permanent markers prior to April 30, 2000. This was also a recommendation of the 1999 Annual report for the Caledonia landfill site dated March 2000.

At the time of my inspection, markers delineating the extent of the footprint did not appear to have been installed. Nor did the waste disposal site boundaries appear to be marked.

- **Are wastes being deposited outside of the footprint?**

Condition 28(a) of the C of A requires all waste received at the landfill site to be deposited within the 4.0 hectare footprint.

At the time of my inspection, waste did not appear to have been deposited outside of the footprint. However, this was difficult to judge because of snow cover and because markers delineating the extent of the footprint were not evident.

- **Is access to the site controlled?**

Access to the waste disposal site is controlled by bush on the west and north sides and by a fence on the east side that separates the landfill site from agricultural land. Access to the road leading into the south side of the site is controlled by a metal gate.

Condition 25(i) requires the gate to the landfill site to be securely locked when the site is not operational.

At the time of my inspection, the site was closed to waste disposal operations and the gate to the site was securely locked.

- **Are wastes being adequately covered?**

Condition 25(n) of the C of A requires that the active fill area be covered on a regular weekly basis.

At the time of my inspection, it was difficult to judge whether or not waste was being adequately covered due to the existing snow cover. A few small piles of uncovered waste was visible.

- **Is there evidence of burning?**

Condition 25(a) of the C of A permits the supervised burning of woodwaste at the landfill site for a period of one year following the date of issuance of the C of A or until October 1, 2000.

At the time of my inspection, the was no evidence that waste or woodwaste was being burned. Woodwaste did appear to be stockpiled for reasons unknown.

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

The 1999 Hydrogeological Investigation for the landfill site, dated March 2000, demonstrated that the site is not in a state of compliance with the MOE's Guideline B-7 (Reasonable Use Concept) along the eastern property boundary. Also, the report concluded that off-property surface water in a creek that intersects the landfill site appears to be unaffected by leachate originating from the site.

The MOE reviewed the report and agreed with this finding. However, the review recommended a larger monitoring well network to precisely determine the vertical and horizontal extent of the landfill site's leachate plume. A more comprehensive surface water monitoring program was also recommended.

At the time of my inspection no leachate springs or leachate ponding was noted. Nor were there trenches constructed below the water table or waste deposited in water. These observations were limited by the extent of snow cover at the time of my inspection.

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

There is no leachate control system at the landfill site.

The 1999 Hydrogeological Investigation for the landfill site recommended that a 30 metre buffer be established along the eastern property boundary to address the issue of non-compliance with the MOE's Guideline B-7 (Reasonable Use Concept).

At the time of my inspection, the 30 metre buffer to be established along the eastern property boundary had not yet been acquired.

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

A methane gas control system is not required for the landfill site at the present time.

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

At the time of my inspection, there was no evidence that wastes other than solid non-hazardous wastes were being deposited at the landfill site. This observation was very limited due to snow cover at the site.

Condition 16(d) of the C of A states that the landfill site is approved to accept white goods containing refrigerant. Conditions 25(b) and (d) of the C of A require that white goods containing refrigerant and refrigerant from white goods be properly managed. According to the 1999 Annual Report for the Caledonia Landfill Site, white goods that contain ozone depleting substances must be tagged by an authorized technician indicating that refrigerants have been properly removed from the white goods before they are accepted at the landfill site.

At the time of my inspection, there was no evidence of white goods at the landfill site.

## 3.0 REVIEW OF OUTSTANDING ISSUES

A review of the MOE's Occurrence Report Information System, from the date of the previous MOE compliance inspection (May 26, 1998) 96/01/01 to date revealed one occurrence on the Caledonia landfill site pertaining to impacts to groundwater and surface water from the landfill site.

There are presently no voluntary nor mandatory abatement requirements imposed upon the Nation Township for the Caledonia waste disposal site.

On October 1, 1999, the Corporation of the Nation Municipality received a new Provisional C of A for the Caledonia waste disposal site. Condition 18 of the C of A required the municipality to prepare and submit to the MOE for approval a Development, Operation and Closure addendum report that detailed the final

design and operational plans for the landfill site. The report dated February 2000 was submitted to the MOE and is presently under review by the MOE's Environmental Assessment and Approvals Branch.

## 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**

  **Specifics:**

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

  **Yes** No

  **Specifics:** The waste disposal site continues to be in non compliance with the MOE's Guideline B-7 (Reasonable Use Concept) along the site's eastern property boundary. This issue was also raised in the previous MOE compliance inspection report.

- 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:**

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

  Yes **No**

  **Specifics:**

## 4.1 ACTION(S) REQUIRED

The municipality must take steps to bring the Caledonia Waste Disposal Site into compliance with the MOE's Guideline B-7 (Reasonable Use Concept). The Development, Operation and Closure addendum report for the landfill site dated February 2000 recommends the purchase of a 30 metre wide buffer along the east side of the total site area. The MOE's Eastern Region Technical Assessment Unit - Groundwater Unit is in agreement with this recommendation.

Condition 22 of the C of A requires the Corporation of the Nation Municipality to submit a contingency plan and schedule detailing the remedial measures which will be initiated for controlling and/or treating any water quality impacts above the MOE's Guideline B-7 (Reasonable Use Concept).

Although a contingency plan and schedule appear not to have been submitted to the MOE, the 1999 Annual Report for the Caledonia landfill Site stated that the municipality would purchase the 30 metres wide buffer during 2000. This was not done.

Before the end of 2001, the Nation Municipality must finalize the purchase of the 30 metres wide buffer along the east side of the landfill site and amend its C of A to incorporate the buffer.

## 5.0 OTHER INSPECTION FINDINGS

- Condition 15(c) of C of A No. A471003 requires the Corporation of the Nation Municipality to provide the MOE with a copy of the landfill site's Certificate of Prohibition (Appendix "C") that has been registered on title in the appropriate Land Registry Office.

  At the time of my inspection, there were no records at the Cornwall MOE Office indicating that this had been done.

- Condition 25(a) forbids the burning of woodwaste at the landfill site.

  There was no evidence at the time of my inspection that woodwaste was being burned. It was being stockpiled.

- Condition 25(f) requires the owner of the waste disposal site to record weekly inspections of the waste disposal site in a log book.

  At the time of my inspection, records of inspections of the landfill site by municipal staff were being kept on more or less a weekly basis as demonstrated by the information found in Appendix "D" of this report.

– Condition 25(m) requires the owner of the waste disposal site deposit waste at the site in a manner that minimizes the size of the working face and that the waste is properly compacted before cover material is applied.

At the time of my inspection, the active face of the waste placement area was snow covered. However waste was visible through the snow which indicates inadequate covering of the waste. Also, the active face was quite steep (greater than a 4:1 slope) which does not facilitate the application of earth cover nor it remaining in place.

## 5.1 OTHER ACTION(S) REQUIRED

The Nation Municipality must take steps to correct the above noted outstanding issues.

**OCCURRENCE REPORT #:** 9940006920

**PREPARED BY:**

**ENVIRONMENTAL OFFICER:** Marc Robert
(Print)

(Signature)

Kingston /Cornwall Area Office
(District/Area Office)

March 13, 2001
(Date)

**REVIEWED BY:**

**DISTRICT SUPERVISOR:** James D. Mahoney
(Print)

(Signature)

March 14, 2001
(Date)

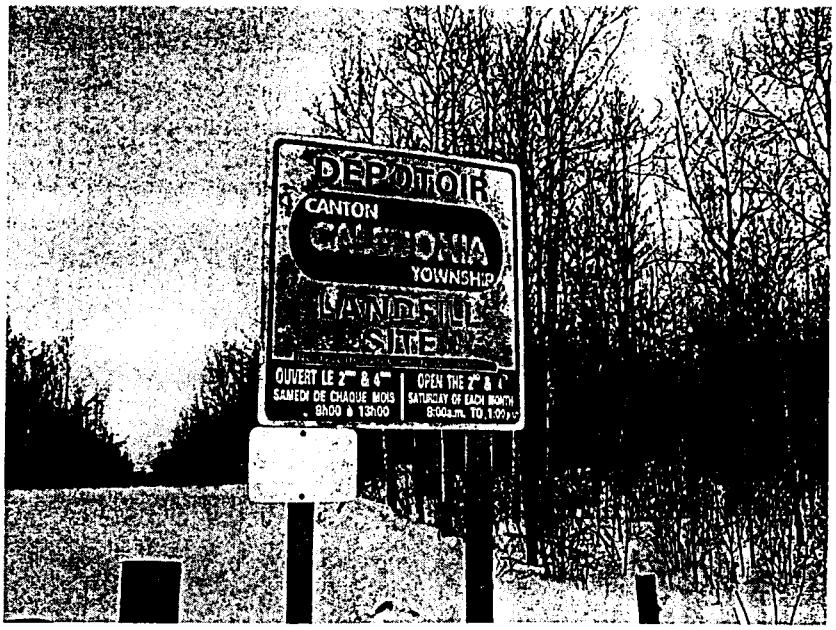
**REPORT MAILED OUT ON:** March 14, 2001
(Date)

**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."**

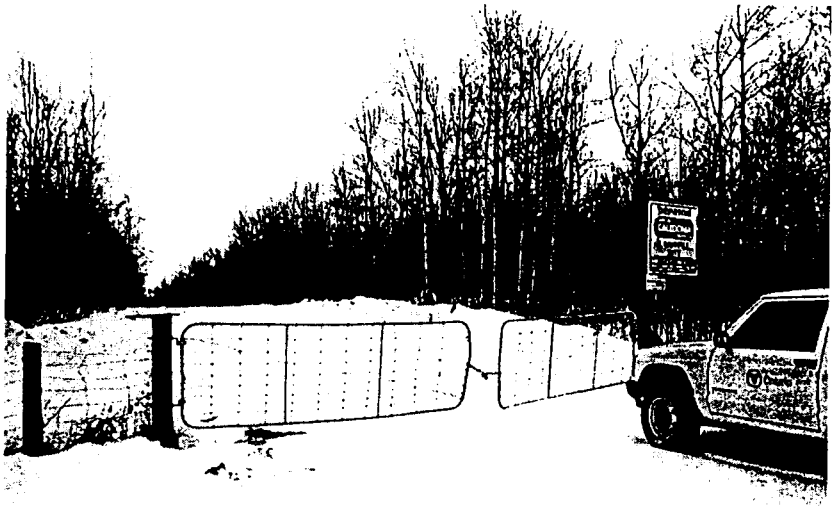
## APPENDICES

# APPENDIX "B"

## The Nation Municipality (Caledonia) Waste Disposal Site
## Photos




Sign at entrance to the Caledonia waste disposal site.

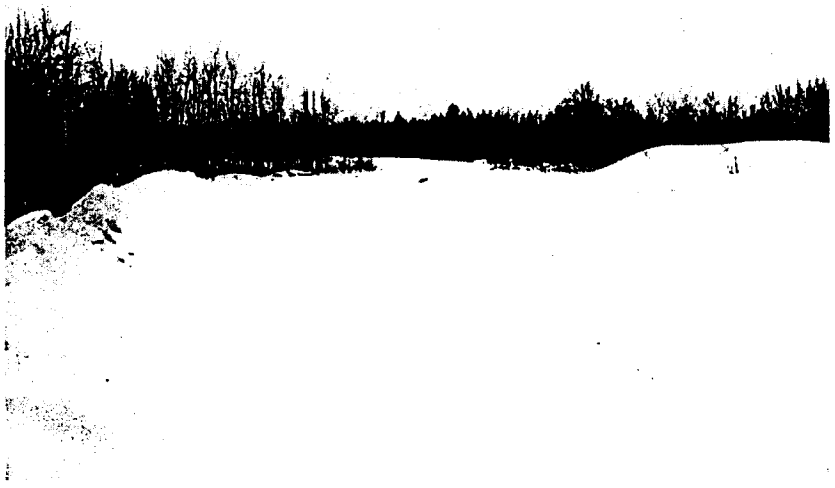


Locked gate at entrance to the Caledonia waste disposal site.

View of access road to the Caledonia landfill site waste disposal area.

View of access road (right) and waste footprint (left).

View of waste footprint from the bottom of lift, facing south.



View of waste footprint from top of lift, facing north.

Unburied waste located in the footprint of the waste disposal site.

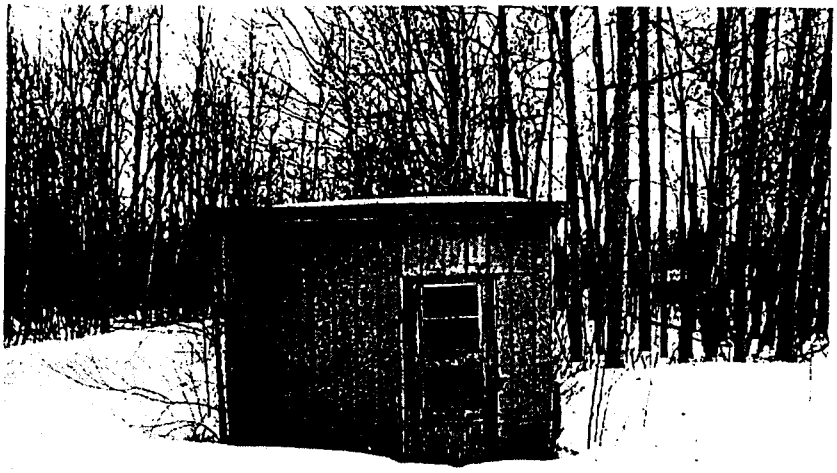
Unburied waste located in the footprint of the waste disposal site.

South slope of waste footprint (active face).

South slope of waste footprint (active face).

Stockpiled waste tires at the landfill site.

Stockpiled woodwaste at the landfill site.



Waste disposal site attendant's shelter.

Groundwater piezometre along west boundary of the landfill site.

## APPENDIX "C"

## The Nation Municipality (Caledonia) Waste Disposal Site
## Certificate of Prohibition

Province of Ontario

# Document General

Form 4 — Land Registration Reform Act

D

FOR OFFICE USE ONLY

(1) Registry [X] Land Titles [ ]

(2) Page 1 of 2 pages

(3) Property Identifier(s) Block Property Additional: See Schedule [ ]

(4) Nature of Document
CERTIFICATE OF PROHIBITION

(5) Consideration
Dollars $

(6) Description
Part of Lot 23, Concession 6, formerly in the geographic Township of Caledonia, now in The Nation Municipality, in the County of Prescott, designated as Part 1 on Plan 46R-6108.

New Property Identifiers Additional: See Schedule [ ]

Executions Additional: See Schedule [ ]

(7) This Document Contains: (a) Redescription New Easement Plan/Sketch [ ] (b) Schedule for: Description [ ] Additional Parties [ ] Other [X]

(8) This Document provides as follows:

See Schedule attached

Continued on Schedule [ ]

(9) This Document relates to Instrument number(s)

(10) Party(ies) (Set out Status or Interest)
Name(s) Signature(s) Date of Signature Y M D

MINISTRY OF THE ENVIRONMENT ~~AND ENERGY~~ AD
OF ONTARIO
A. DOMINSKI, P.ENG.SUPERVISOR
WASTE APPROVALS

AD ~~1999~~ AD ~~11~~ 2000 02 03

(11) Address for Service 2 St. Clair Avenue West, 122th Floor, Toronto, Ontario, M4V 1L5.

(12) Party(ies) (Set out Status or Interest)
Name(s) Signature(s) Date of Signature Y M D

THE CORPORATION OF THE NATION MUNICIPALITY
PER: CLAUDE GRAVEL, REEVE 1999 11
PER: MARY J. McCUAIG, CLERK 1999 11
we have authority to bind the Corporation

(13) Address for Service 958 Route 500 West, R.R.#3, Casselman, Ontario, K0A 1M0

(14) Municipal Address of Property
not assigned

(15) Document Prepared by:
DAVID R. SHELLY
SHELLY & Gauthier
86 High Street
P.O. Box 190
Vankleek Hill, Ontario K0B 1R0

FOR OFFICE USE ONLY

| Fees and Tax | |
|---|---|
| Registration Fee | |
| | |
| | |
| | |

Additional Property Identifier(s) and/or Other Information

(6) This document contains be schedule for other:

***CERTIFICATE OF PROHIBITION***

s. 197 (2) Environmental Protection Act

This is to certify that pursuant to a Provisional Certificate of Approval Number 471003 dated the 1st day of October, 1999 relating to the waste disposal site, the Corporation of The Nation Municipality is prohibited from dealing with the property being Part of Lot 23, Concession 6, formerly in the Township of Caledonia, now in The Nation Municipality, in the County of Prescott, designated as Part 1 on Plan 46R-6108 without first giving a copy of the Provisional Certificate of Approval to each person acquiring an interest in the property as a result of the dealing.

Under subsection 197 (3) of the Environmental Protection Act, the prohibition applies to each person who, subsequent to the registration of this certificate, acquires an interest in the property.

OFFICE USE ONLY

# APPENDIX "D"

## The Nation Municipality (Caledonia) Waste Disposal Site
## Municipal Landfill Site Inspection Forms

# MUNICIPALITÉ de LA NATION
# THE NATION MUNICIPALITY

## Weekly landfill site inspection

**Landfill site operator shall verify and perform on a weekly basis the following report .**

**Date** 13-01-2001 **Temperature** .....**celsius** **wind** .....**KM**
Direction:.....

| | Good or No | Poor or Yes |
|---|---|---|
| 1) On site road condition | Good | ..... |
| 2) Any waste placed at gate | NO | ..... |
| 3) Any repairs required to gate , signs, chain , fence or lock | NO | ..... |
| ( if yes specify.....) | | |
| 4) tires , scrap metal , brush deposited at designated areas during the day | Yes | ..... |
| 5) Any problems with controlling users at gate | NO | ..... |
| 6) Any waste refused during this day | NO | ..... |
| 7) #no. of white goods accepted (fridge etc..) | | |
| - with red tag | ..... | ..... |
| - no tag | ..... | ..... |
| 8) Fridge or freezer doors removed | ..... | ..... |
| 9) Has waste been covered with soil during the week | Yes | ..... |
| 10) Any signs of erosion on cover or on site ditches | NO | ..... |
| 11) Any odours from the wastes | NO | ..... |
| 12) Visual evidence of rats and or other vermins | NO | ..... |
| 13) Visual evidence of excessive birds ( crows , seagulls) | NO | ..... |
| 14) Pick up wind blown litter | ..... | ..... |
| 15) Evidence of vandalism and / or trespassing | ..... | ..... |
| 16) Any brush burnt – size of pile | NO | ..... |
| 17) Any material removed from the site (tires ,scrap metal) | NO | ..... |
| 18) Number of tipping fee slips issued to- day | ..... 3 | ..... |

See over.....

Col

# MUNICIPALITÉ de LA NATION
# THE NATION MUNICIPALITY

## Weekly landfill site inspection

**Landfill site operator shall verify and perform on a weekly basis the following report .**

**Date** 24 Janv 2001 **Temperature** .....**celsius** **wind** .....**KM**
Direction:.....

| | Good or No | Poor or Yes |
|---|---|---|
| 1) On site road condition | Good | ..... |
| 2) Any waste placed at gate | NO | ..... |
| 3) Any repairs required to gate , signs, chain , fence or lock | NO | ..... |
| ( If yes specify.....) | | |
| 4) tires , scrap metal , brush deposited at designated areas during the day | ..... | Yes |
| 5) Any problems with controlling users at gate | NO | ..... |
| 6) Any waste refused during this day | NO | ..... |
| 7) #no. of white goods accepted (fridge etc..) | | |
| - with red tag | ..... | ..... |
| - no tag | ..... | ..... |
| 8) Fridge or freezer doors removed | ..... | ..... |
| 9) Has waste been covered with soil during the week | ..... | Yes |
| 10) Any signs of erosion on cover or on site ditches | NO | ..... |
| 11) Any odours from the wastes | NO | ..... |
| 12) Visual evidence of rats and or other vermins | NO | ..... |
| 13) Visual evidence of excessive birds ( crows , seagulls) | NO | ..... |
| 14) Pick up wind blown litter | ..... | ..... |
| 15) Evidence of vandalism and / or trespassing | ..... | ..... |
| 16) Any brush burnt – size of pile | NO | ..... |
| 17) Any material removed from the site (tires ,scrap metal) | NO | ..... |
| 18) Number of tipping fee slips issued to- day | ..... Ø | ..... |

See over.....

# MUNICIPALITÉ de LA NATION
# THE NATION MUNICIPALITY

## Weekly landfill site inspection

**Landfill site operator shall verify and perform on a weekly basis the following report .**

**Date** 27-01-2001 **Temperature** .....**celsius** **wind** .....**KM**
Direction:.....

| | Good or No | Poor or Yes | |
|---|---|---|---|
| 1) On site road condition | Good | | |
| 2) Any waste placed at gate | | yes | empty paint cans |
| 3) Any repairs required to gate , signs, chain , fence or lock | no | | |
| ( if yes specify.....) | | | |
| 4) tires , scrap metal , brush deposited at designated areas during the day | yes | | |
| 5) Any problems with controlling users at gate | no | | |
| 6) Any waste refused during this day | no | | |
| 7) #no. of white goods accepted (fridge etc..) | | | |
| - with red tag | | | |
| - no tag | | | |
| 8) Fridge or freezer doors removed | | | |
| 9) Has waste been covered with soil during the week | yes | | |
| 10) Any signs of erosion on cover or on site ditches | no | | |
| 11) Any odours from the wastes | no | | |
| 12) Visual evidence of rats and or other vermins | no | | |
| 13) Visual evidence of excessive birds ( crows , seagulls) | no | | |
| 14) Pick up wind blown litter | | | |
| 15) Evidence of vandalism and / or trespassing | | | |
| 16) Any brush burnt – size of pile | no | | |
| 17) Any material removed from the site (tires ,scrap metal) | no | | |
| 18) Number of tipping fee slips issued to- day | 2 | | |

See over.....

# MUNICIPALITÉ de LA NATION
# THE NATION MUNICIPALITY

## Weekly landfill site inspection

**Laudfill site operator shall verify and perform on a weekly basis the following report .**

**Date** 10 fév 2001 **Temperature** .....**celsius** **wind** .....**KM**
Direction:.....

| | Good or No | Poor or Yes |
|---|---|---|
| 1) On site road condition | ..... | ICY |
| 2) Any waste placed at gate | NO | ..... |
| 3) Any repairs required to gate , signs, chain , fence or lock | NO | ..... |
| ( if yes specify.....) | | |
| 4) tires , scrap metal , brush deposited at designated areas during the day | ..... | ..... |
| 5) Any problems with controlling users at gate | NO | ..... |
| 6) Any waste refused during this day | NO | ..... |
| 7) #no. of white goods accepted (fridge etc..) | | |
| - with red tag | ..... | ..... |
| - no tag | ..... | ..... |
| 8) Fridge or freezer doors removed | ..... | ..... |
| 9) Has waste been covered with soil during the week | ..... | Yes |
| 10) Any signs of erosion on cover or on site ditches | NO | ..... |
| 11) Any odours from the wastes | NO | ..... |
| 12) Visual evidence of rats and or other vermins | NO | ..... |
| 13) Visual evidence of excessive birds ( crows , seagulls) | NO | ..... |
| 14) Pick up wind blown litter | ..... | ..... |
| 15) Evidence of vandalism and / or trespassing | NO | ..... |
| 16) Any brush burnt – size of pile | ..... | ..... |
| 17) Any material removed from the site (tires ,scrap metal) | NO | ..... |
| 18) Number of tipping fee slips issued to- day | ..... 3 | ..... |

See over.....

**Ministry of the Environment**

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

**Ministère de l'Environnement**

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Téléphone: (613)933-7402
Télécopieur: (613)933-6402

Ontario

Municipalité de la Nation
Received
Aug Août 3 1 2001
Reçu
The Nation Municipality

August 28, 2001

Mrs. Mary McCuaig, Clerk
The Nation Municipality
958 Road 500 West, R.R. #3
Casselman ON
K0A 1M0

Dear Mrs. McCuaig:

**RE: The Nation Municipality**
**2000 Annual Report**
**Caledonia Waste Disposal Site - Certificate of Approval No. A471003**

Attached for your information and follow-up are copies of the reviews of the above-mentioned document performed by the Ministry of the Environment's Eastern Region Technical Support Section - Surface and Groundwater Units.

In general, the Surface Water Unit reviewer agrees with the consultant's finding that the 2000 data did not indicate an impact from the Caledonia landfill site on local surface waters. The same cannot be said for the groundwater as it was demonstrated that the site is not in compliance with the MOE's Guideline B-7 (Reasonable Use Concept) along its eastern boundary.

Both reviewers recommend the continuation and the expansion of surface water and groundwater monitoring programs for the year 2001.

If you have any questions please contact me at this office at extension 229.

Yours truly,

Marc Robert
Senior Environmental Officer

MR:sp
Enclosures

Réunion Conseil / Council Mtg 17 | 9 | 01 (D | M | YR)
Action reports
Clerk Greffier

S:\GROUPS\WORDPRO\Marc Robert (Mr)\LETTERS\2001\Caledonia0828.wpd

SI PC CA C6250

Ministry of the Environment
133 Dalton Avenue
P O Box 820
Kingston ON K7L 4X6

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133 avenue Dalton
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Kingston ON K7L 4X6

Ontario

1-613/549-4000 1-800/267-0974 Fax: 613/548-6908

MEMORANDUM

August 23, 2001

TO: M. Robert
Sr. Environmental Officer
Cornwall Area Office
Eastern Region

FROM: F. Crossley
Hydrogeologist
Technical Support Section
Eastern Region

RE: 2000 Operation and Development
Groundwater and Surface Water Monitoring Program
Caledonia Landfill Site, Lot 23, Concession VI
Nation Municipality
A471003

Having reviewed the above noted report dated March, 2001 (received May, 2001) by Golder Associates Limited (GAL) and Stantec Consultants Limited, I offer the following comments. The report is subdivided into Part A "Operation and Development" by Stantec and Part B "Groundwater and Surface Water Monitoring Program" by GAL.

The site is licensed under Certificate of Approval, A471003. The site is licensed for the use and operation of a 4.0 hectare landfill within a total site area of 14.57 hectares. The site is licensed to receive municipal and non-hazardous solid industrial waste including white goods, tires and wood waste. Formerly this site was a trench and fill operation, however it has been changed to an area fill operation. The landfill operates as a naturally attenuating site.

GAL determined the geology to be:

- silty sand
- sand
- bedrock was not encountered at a maximum depth of borehole investigation (6.1 metres). Based on the water well record information bedrock consists of shale and limestone and is encountered approximately 30 metres below ground surface.

Previously GAL determined the hydrogeological characteristics to be:

- The horizontal hydraulic gradient ranges from 0.012 to 0.015.
- The estimated hydraulic conductivity (rising head) ranges from $2.8 \times 10^{-4}$ to $1.3 \times 10^{-3}$ cm/sec. with a geometric mean of $6.0 \times 10^{-4}$ cm/sec.
- The shallow groundwater flow is to the north which is towards the wetland and Paxton Creek (Figure 2).

Monitoring Well BH-96-4 is located upgradient, with respect to groundwater flow, of the waste. The water quality in this monitoring well is representative of background water quality.

Monitoring Well BH-99-6 is located directly downgradient of the active landfilling area. The water quality in this monitoring well shows elevated concentrations of numerous typical leachate indicator parameters. The water quality in this monitoring well is representative of leachate. Leachate impacts are evident in monitoring wells: 96-1; 96-2 (slight); 96-3; 99-5; and 99-6.

Guideline B-7, Reasonable Use Concept, applies to this waste disposal site operation. GAL determined the Reasonable Use Limits. Exceedances of the guideline occur along the eastern property boundary (BH-96-1) and at BH-96-2 and BH-99-5 which are the furtherest downgradient (north) monitoring wells.

Table 5 outlines the proposed groundwater and surface water monitoring program. The proposed 2001 groundwater monitoring is to remain similar to the 2000 Groundwater Monitoring Program with the elimination of volatile organic compound scans.

I offer the following conclusions and recommendations:

- This site is not in compliance with Guideline B-7 along the eastern property boundary. Stantec state that the Township is in the process of acquiring an additional 30 metre wide strip of land along the eastern boundary for the purpose of buffer and contaminant attenuation zone. This additional land will likely bring the site into compliance along the eastern property boundary. The Certificate of Approval should be amended to recognize these lands as buffer and contaminant attenuation zone.

- The horizontal extent of the leachate plume has not been determined as leachate impacts occur at the furtherest downgradient monitoring wells. An additional multi-level monitoring well should be placed between the existing monitoring wells and the suspected discharge point (Paxton Creek).

- The vertical extent of the leachate plume cannot be determined as all the monitoring wells are completed as single level. A deeper monitoring well is required to better define the groundwater flow regime. This can be done at the recommended new monitoring well location. This additional information could be used to support the consultants hypothesis that the creek is acting as a groundwater interceptor.

- The potential exists for impacts to the surface water as a result of leachate impacted groundwater discharging to the surface water course (drainage ditches/wetland and/or Paxton Creek).

- I concur with the consultants recommended groundwater monitoring program.

Frank Crossley
/gl

c: R. Robertson
D. Cruickshank
File SI PC CA C VI / GW-07-04 Caledonia Township (A471003)
FC/STAR 12896

Ministry of the Environment
133 Dalton Avenue
P O Box 820
Kingston ON K7L 4X6

Ministère de l'Environnement
133 avenue Dalton
C P 820
Kingston ON K7L 4X6

Ontario

1-613/549-4000 1-800/267-0974 Fax: 613/548-6908

MEMORANDUM

17 August 2001

TO: Marc Robert
Sr. Environmental Officer
Cornwall District Office
Eastern Region

MINISTRY OF THE ENVIRONMENT
AUG 21 2001
CORNWALL

FROM: Dana Cruikshank
Surface Water Specialist
Technical Support Section
Eastern Region

RE: Caledonia Waste Disposal Site
2000 Annual Report
Certificate of Approval A471003
Corporation of the Nation Municipality
Lot 23, Concession 6, former Township of Caledonia

I have reviewed the above report with respect to surface water concerns. Groundwater comments will be sent under separate cover.

**WDS Summary**

The Caledonia Waste Disposal Site provides disposal services to the former Township of Caledonia. It accepts municipal and non-hazardous solid industrial waste, white goods, tires and wood waste. The landfill is situated on flat land with less than a 1 metre difference in elevation and is transected in the north end by a 7-8 metre escarpment. The site is underlain by silty sand over glacial till and bedrock. Surface water on the west side of the property flows north into an ephemeral stream that drains through a swampy area which discharges to Paxton Creek. The east side of the property flows north into a stream which empties into Paxton Creek. Paxton Creek is a tributary of the South Nation River which is located about 4 kilometres from the waste disposal site. Groundwater flows are interpreted to flow towards the swamp and to the creek north of the waste disposal site.

Three surface water sampling periods were conducted in 2000 (August 08, November 29 and December 23). All stations were frozen in December and no data was collected. Seven surface water stations have been established to monitor flows off the site to assess impact on Paxton Creek.

**Report Conclusions:**

Based on the 2000 surface water quality data the consultant concludes that leachate originating from the WDS is not adversely impacting water quality in Paxton Creek. Golder Associates is proposing to sample the site in spring, summer, fall and winter at all seven (7) stations. Parameters are listed in Table 5 of the report.

**Reviewer's Comments:**

Golder Associates has selected good surface water station locations that should alert the South Nation Municipality should any impacts occur from the Caledonia WDS.

*East Side Drainage*

SW7 is the background station on the stream and is located upgradient of the WDS. The data collected to date from this station show background water quality that has exceedances of PWQO's. Exceedances are seen in aluminum, cadmium, cobalt, copper, iron, phenols, total phosphorus, thallium and vanadium. Some of these exceedances are likely natural water quality conditions and others are agricultural impacts.

SW3 and SW5 are located downgradient of the WDS prior to the stream's entrance into Paxton Creek. Results from both stations are very similar and tracked almost identically with the background station SW7. Some increases in concentrations were observed at SW3 in boron, calcium, alkalinity, TDS, and strontium over the background data.

From the data collected to date it does not appear that the WDS east drainage area is having an impact on the tributary stream to Paxton Creek.

*West Side Drainage*

The west side drainage is characterized by SW2 located in the ephemeral stream downgradient of the WDS and SW4 in the swamp area downgradient of the WDS.

Data shows exceedances in the same parameters and concentrations similar to those found in the East Side Drainage area. One interesting difference was a higher than average concentration including a PWQO exceedance for boron at SW4. Boron has been used at other waste disposal sites as a tracer of groundwater leachate. There is currently not enough data to make any conclusions regarding contamination of surface water at SW4 from either surface water or groundwater flows.

*Paxton Creek*

Paxton Creek has two surface water stations. SW6 is located upstream of the WDS and is considered the background station and SW8 is located at the edge of the property line downgradient from the WDS and the two inflows off the WDS. 2000 data indicates that there is little difference in water quality between the two stations. Exceedances of PWQO's in iron, aluminum, total phosphorus and possibly thallium and vanadium are in the same range as other stations.

I am therefore in agreement with Golder Associates in stating that the 2000 data does not indicate an impact from the Caledonia WDS on local surface water.

**Recommendations:**

1. The sampling frequency is adequate for this site at this time. I would recommend a sampling session done in summer or early fall within 24 hours after a significant precipitation event (>10 mm). The samples in 2000 were collected during periods of low flow and likely little runoff from the WDS. Samples after a rainfall event would provide some data on flushing from the site. Since the 2000 data shows the site is relatively benign in impacts I would be willing to drop the winter sampling period in 2001 for precipitation event in late summer or early fall. For 2002 I would similarly be willing to trade off the winter sampling period for a precipitation sampling event in summer.

2. The suggested list of parameters is acceptable. In addition to field measurements of DO, pH and temperature I would like to see discharge estimates of the east drainage stream and Paxton Creek made during each sampling visit. This will provide data to better evaluate impacts should they occur in the future.

3. Observations of aquatic invertebrates, algae growth, aquatic plants, litter, debris, etc. should be made at each station.

4. It would be appreciated if the water chemistry spreadsheet summaries provided in Appendix C could be provided on disk or sent electronically upon request.

If you have any questions regarding the above comments or recommendations I would be pleased to discuss them with you. I can be reached at (613) 549-4000, extension 2619.

Dana Cruikshank
DRC/sh

c: Dana Cruikshank
Frank Crossley
File SW-05-04 (Caledonia Waste Disposal Site)
File SW-13-06-02 (Paxton Creek)

Ontario

Ministry of the Environment | Ministère de l'Environnement

*AMENDMENT TO PROVISIONAL CERTIFICATE OF APPROVAL*
*WASTE DISPOSAL SITE*
*NUMBER A471003*
*Notice No. 1*

Corporation of the Nation Municipality
958 Highway 500 West
Casselman, Ontario
K0A 1M0

Site Location: Lot 23, Concession 6
The Nation Municipality, United Counties Of Prescott & Russell

*You are hereby notified that I have amended Provisional Certificate of Approval No. A471003 issued on October 1, 1999 for the use and operation of 4.0 hectares landfill within a 14.57 hectare total Site area, as follows:*

The Caledonia Landfill Site shall be designed and operated as per the following documents prepared by Stantec Consulting Ltd. and Golder Associates which have been added to Schedule "A":

14. 1997 Landfill Development, Operation and Closure Report for Waste Disposal Site
15. Addendum to March 1997 report described in item 1 above, dated February, 2000.
16. 1999 Operations and Development and 1999 Hydrogeological Investigation and Groundwater and Surface Water Monitoring Program, Caledonia Landfill Site, Corporation of the Nation Municipality, Ontario, dated March 2000.

**This Notice shall constitute part of the approval issued under Provisional Certificate of Approval No. A471003 dated October 1, 1999.**

*In accordance with Section 139 of the Environmental Protection Act, R.S.O. 1990, Chapter E-19, as amended, 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. Section 142 of the Environmental Protection Act, provides that the Notice requiring the hearing shall state:*

1. The portions of the approval or each term or condition in the approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

*The Notice should also include:*

3. The name of the appellant;

4. The address of the appellant;
5. The Certificate of Approval number;
6. The date of the Certificate of Approval;
7. The name of the Director;
8. The municipality within which the waste disposal site is located;

*And the Notice should be signed and dated by the appellant.*

*This Notice must be served upon:*

The Secretary*
Environmental Appeal Board
2300 Yonge St., 12th Floor
P.O. Box 2382
Toronto, Ontario
M4P 1E4

AND

The Director
Section 39, *Environmental Protection Act*
Ministry of the Environment
2 St. Clair Avenue West, Floor 12A
Toronto, Ontario
M4V 1L5

*** Further information on the Environmental Appeal Board's requirements for an appeal can be obtained directly from the Board at: Tel: (416) 314-4600, Fax: (416) 314-4506 or www.ert.gov.on.ca**

*The above noted waste disposal site is approved under Section 39 of the Environmental Protection Act.*

DATED AT TORONTO this 22nd day of August, 2001

Ian Parrott, P.Eng.
Director
Section 39, *Environmental Protection Act*

TG/

c: District Manager, MOE Cornwall
Gerry Lalonde, McNeely Engineering Consultants Ltd.

RECEIVED NOV 2 2001 6345730

Corporation de la Municipalité de La Nation
Corporation of The Nation Municipality

November 20, 2001

Ministry of the Environment,
Director,
Environmental Assessment and Approvals Branch,
2 St. Clair Avenue W., Floor 12A,
Toronto, Ont.
M4V 1L5

Dear Sirs,

Re: Application for Amendment for Certificate of Approval No. A471003
Caledonia Waste Disposal Site

Please find enclosed an application for an amendment to the above mentioned C of A. We have been negotiating in good faith with the property owners to acquire the groundwater easement as per Condition 28(f) of said C of A but as yet have not struck a deal. We feel that in continuing the negotiations we will arrive at a solution to the concerns raised by the property owners. We also do not wish to be forced into commencing expropriation procedures because of a time restriction imposed by the C of A. We respectfully request an approval of a twelve month extension for Condition 28(f).

Yours truly,

Mary J. McCuaig,
Clerk.

COPY

Cc: Marc Robert, Senior Environmental Officer, MOE Cornwall
Gerry Lalonde, P. Eng., Stantec Consulting
Dave Shelly, Municipal Solicitor

APPROVED FOR PAYMENT
☐ PAY PROMPTLY
☐ PAY WHEN COLLECTED FROM CLIENT
PC PROJ. NO. PHASE PRE-GST AMT.
GST/HST 24000 $
DATE
FIRST APPROVAL DATE
2ND APPROVAL

958 route 500 ouest, Road 500 West, R.R.3, Casselman Ontario K0A 1M0 • Tél.: (613) 764-5444 • Fax: (613) 764-3310

# MANIFEST - MANIFESTE

This Manifest conforms to all Federal and Provincial transport and environmental legislation requiring manifesting.
Ce manifeste est conforme aux législations fédérale et provinciale sur l'environnement et le transport, requérant un manifeste.

Manifest Reference No. / N° de référence du manifeste: [illegible]

## A Consignor (Generator) / Expéditeur (Producteur)

Provincial ID No. / N° d'id. provincial: 03247200

Company name / Nom de l'entreprise: The Nation Municipality

Mailing address / Adresse postale: 958 Route 500, Casselman — City / Ville — Province — Postal code / Code postal

Shipping site address / Origine de l'expédition: 3245 County Road #9

City / Ville: Town of St Isidore — Province: ON — Postal code / Code postal:

Intended consignee / Destinataire prévu: Drain All Ltd

Provincial ID No. / No d'id. provincial: A1460722

Address / Adresse: 2705 Stevenage Dr — City / Ville — Province — Postal code / Code postal

Receiving site address / Destination de l'expédition: Same

City / Ville: Ottawa — Province: ON — Postal code / Code postal: K1G 3N2

## B Carrier / Transporteur

Provincial ID No. / N° d'id. provincial: A6650502

Company name / Nom de l'entreprise: Drain All Ltd

Address / Adresse: 2705 Stevenage Dr

City / Ville: Ottawa — Prov.: ON — Postal code / Code postal: K1G 3N2

| | Registration No. / N° d'immatriculation | Prov. |
|---|---|---|
| Vehicle / Véhicule | R87-695 | ON |
| Trailer/Rail Car No. 1 / 1er remorque – wagon | | |
| Trailer/Rail Car No. 2 / 2e remorque – wagon | | |

Point of entry / Point d'entrée — Point of exit / Point de sortie

*Carrier Certification: I declare that I have received waste as offered by the consignor in Part A for delivery to the intended consignee and that the information contained in Part B is complete and correct. / Déclaration du transporteur : J'atteste avoir reçu les déchets offerts par l'expéditeur dans la partie A en vue de leur livraison au destinataire choisi et que les renseignements inscrits à la partie B sont exacts et complets.*

Year / Année: 01 — Month / Mois: 10 — Day / Jour: 20 — Name of authorized person (print) / Nom de l'agent autorisé (caractères d'imprimerie): Pat Lemire

Signature: [signature] — Tel. No. / N° de tél.: 613 739-1070

Reference nos. of other Manifest(s) used / N°'s de références des autres manifestes utilisés

## C Consignee (Receiver) / Destinataire (Réceptionnaire)

Provincial ID No. / N° d'id. provincial:

Consignee information same as Intended Consignee in Part A / L'information à fournir par le destinataire est la même qu'en A — ☐ Yes / Oui ☐ No, complete the boxed area below

Company name / Nom de l'entreprise:

Address / Adresse:

City / Ville — Province — Postal code / Code postal

Receiving site address / Destination de l'expédition:

City / Ville — Province — Postal code / Code postal

Date received / Date de reception — Year / Année — Month / Mois — Day / Jour — Time / Heure — ☐ A.M. ☐ P.M.

| Physical state / État physique | Shipping name of waste / Appellation réglementaire du déchet | Waste identification / Identification du déchet: Provincial No. / N° (Quebec-Ontario only) (Quebec-Ontario seul) | Waste identification: TDGA/PIN LTMD/NIP | Quantity shipped / Quantité expédiée | Units L or kg / unités | Classification | Packaging Contenants: Packing group / Groupe d'emballage | Packaging Contenants: No. / Nbre | Packaging Contenants: Codes int.-ext. | Quantity received / Quantité reçu | Units L or kg / unités | Identify any shipment discrepancy problems. Attach addendum if necessary. / Indiquer toute différence relative à l'expédition. Annexer une feuille au besoin. | Handling code / Code de manutention | Decontamination / Décontamination: Packaging Contenants Yes / Oui | Packaging Contenants No / Non | Vehicle / Véhicule Yes / Oui | Vehicle / Véhicule No / Non |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | Waste Paint Related Material | 145B | UN1263 | 4800 | L | 3 | II | 03 | 07 | | | | | | | | |
| L | Waste Oil | 2527 | NA | 525 | L | NA | NA | 07 | 01 | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |

Special handling/Emergency instructions / Manutention spéciale/instructions d'urgence — ☐ Attached / Ci-jointes ☒ Below / Ci-dessous

07 = cage

Drain All Ltd - 1-800-265-3868

Circulation no. – Quebec only / N° de circulation – Réservée au Québec

If handling code "Other" (specify) / Si code de manutention "divers", spécifier

If waste to be transferred, specify intended company name / Si les déchets doivent être transférés, préciser le nom du destinataire — Provincial ID No. / N° d'id. provinci

Address / Adresse — City / Ville — Prov.

Date shipped / Date d'expédition — Year / Année: 01 — Month / Mois: 10 — Day / Jour: 20

Time / Heure: 4:15 ☐ A.M. ☒ P.M.

Scheduled arrival date / Date d'arrivée prévue — Year / Année: 01 — Month / Mois: 10 — Day / Jour: 20

***Consignor Certification:*** *I declare that the information contained in Part A is correct and complete.*
***Déclaration de l'expéditeur :*** *Je déclare que tous les renseignements à la partie A sont véridiques et complets.*

Name of authorized person (print) / Nom de l'agent autorisé (caractères d'imprimerie): Jeanne Beugé Normand

Signature: Jeanne Beugé Normand — Tel. no. / N° de tél.: 613-524-2932

*Consignee Certification: I declare that the information contained in Part C is correct and complete. / Déclaration du l'expéditeur : Je déclare que tous les renseignements à la partie C sont véridiques complets.*

Name of authorized person (print) / Nom de l'agent autorisé (caractères d'imprimerie):

Signature — Tel. no. / N° de tél.: ( )

# MANIFEST - MANIFESTE

This Manifest conforms to all Federal and Provincial transport and environmental legislation requiring manifesting.
Ce manifeste est conforme aux législations fédérale et provinciale sur l'environnement et le transport, requérant un manifeste.

Manifest Reference No. / N° de référence du manifeste: MM-[illegible]3 SN 2

## A Consignor (Generator) / Expéditeur (Producteur)

Provincial ID No. / N° d'id. provincial: ON[illegible]4200

Company name / Nom de l'entreprise: The Nation Municipality

Mailing address / Adresse postale | City / Ville | Province | Postal code / Code postal: 958 Route 500 | Casselman

Shipping site address / Origine de l'expédition: 3745 County Road 49

City / Ville | Province | Postal code / Code postal: Fournier | ON

Intended consignee / Destinataire prévu: Dion All Ltd

Provincial ID No. / No d'id. provincial: A460722

Address / Adresse | City / Ville | Province | Postal code / Code postal: 2705 Stevage Dr

Receiving site address / Destination de l'expédition: Same

City / Ville | Province | Postal code / Code postal: Ottawa | ON | K1G 3N2

## B Carrier / Transporteur

Provincial ID No. / N° d'id. provincial: A[illegible]200

Company name / Nom de l'entreprise: Dion All Ltd

Address / Adresse: 2705 Stevage Dr

City / Ville | Prov. | Postal code / Code postal: Ottawa | ON | K1G 3N2

| | Registration No. / N° d'immatriculation | Prov. |
|---|---|---|
| Vehicle / Véhicule | P119-075 | ONT |
| Trailer/Rail Car No. 1 / 1er remorque – wagon | | |
| Trailer/Rail Car No. 2 / 2e remorque – wagon | | |

Point of entry / Point d'entrée:

Point of exit / Point de sortie:

*Carrier Certification: I declare that I have received waste as offered by the consignor in Part A for delivery to the intended consignee and that the information contained in Part B is complete and correct. / Déclaration du transporteur : J'atteste avoir reçu les déchets offerts par l'expéditeur dans la partie A en vue de leur livraison au destinataire choisi et que les renseignements inscrits à la partie B sont exacts et complets.*

Year / Année | Month / Mois | Day / Jour: 01 | 10 | 20

Name of authorized person (print) / Nom de l'agent autorisé (caractères d'imprimerie): [illegible]

Signature:

Tel. No. / N° de tél.: (613) 759-1070

## C Consignee (Receiver) / Destinataire (Réceptionnaire)

Reference nos. of other Manifest(s) used / N°s de références des autres manifestes utilisés: MM8935-7 + MM8934-0

Provincial ID No. / N° d'id. provincial:

Consignee information same as Intended Consignee in Part A / L'information à fournir par le destinataire est la même qu'en A: ☐ Yes / Oui ☐ No, complete the boxed area below

Company name / Nom de l'entreprise:

Address / Adresse:

City / Ville | Province | Postal code / Code postal:

Receiving site address / Destination de l'expédition:

City / Ville | Province | Postal code / Code postal:

Date received / Date de reception — Year / Année | Month / Mois | Day / Jour:

Time / Heure: ☐ A.M. ☐ P.M.

| Physical state / État physique | Shipping name of waste / Appellation réglementaire du déchet | Waste Identification / Identification du déchet: Provincial No. / N° (Quebec-Ontario only) (Quebec-Ontario seul) | TDGA/PIN /LTMD/NIP | Quantity shipped / Quantité expédiée | Units L or ou kg unites | Classification | Packing group / Groupe d'emballage | Packaging Contenants: No. Nbre | Codes int.-ext. | Quantity received / Quantité reçu | Units L or ou kg unites | Identify any shipment discrepancy problems. Attach addendum if necessary. / Indiquer toute différence relative à l'expédition. Annexer une feuille au besoin. | Handling code / Code de manutention | Decontamination / Décontamination: Packaging Contenants Yes / Oui | Packaging Contenants No / Non | Vehicle / Véhicule Yes / Oui | Vehicle / Véhicule N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | Waste Flammable Liquids, NOS (Adhesives) | 263A | UN1133 | 1700 | L | 3 | II | 17 | 01 | | | | | | | | |
| L | Waste Aerosols | 331I | UN1950 | 100 | L | 2.1 | II | 01 | 01 | | | | | | | | |
| L | Waste Corrosive Liquids, NOS (Sodium Hydroxide) | 148C | UN1760 | 100 | L | 8 | II | 01 | 01 | | | | | | | | |
| L | Waste Corrosive Liquids, NOS (Sulfuric Acid) | 148C | UN1760 | 100 | L | 8 | II | 01 | 01 | | | | | | | | |

Special handling/Emergency instructions / Manutention spéciale/instructions d'urgence: ☐ Attached / Ci-jointes ☒ Below / Ci-dessous

Dion All Ltd 1-800-265-3868

Circulation no. – Quebec only / N° de circulation – Réservée au Québec

If handling code "Other" (specify) / Si code de manutention "divers", spécifier

Date shipped / Date d'expédition — Year / Année | Month / Mois | Day / Jour: 01 | 10 | 20

Time / Heure: 4:15 ☐ A.M. ☒ P.M.

Scheduled arrival date / Date d'arrivée prévue — Year / Année | Month / Mois | Day / Jour: 01 | 10 | 20

If waste to be transferred, specify intended company name / Si les déchets doivent être transférés, préciser le nom du destinataire

Provincial ID No. / N° d'id. provincial:

Address / Adresse | City / Ville | Prov.:

***Consignor Certification:** I declare that the information contained in Part A is correct and complete.*
***Déclaration de l'expéditeur :** Je déclare que tous les renseignements à la partie A sont véridiques et complets.*

Name of authorized person (print) / Nom de l'agent autorisé (caractères d'imprimerie): Joanne Bourgie Normand

Signature: Joanne Bourgie Normand

Tel. no. / N° de tél.: (613) 524 2932

*Consignee Certification: I declare that the information contained in Part C is correct and complete. / Déclaration du l'expéditeur : Je déclare que tous les renseignements à la partie C sont véridiques et complets.*

Name of authorized person (print) / Nom de l'agent autorisé (caractères d'imprimerie):

Signature | Tel. no / N° de tél.: ( )

MOE 04-1917 (01/99)

# MANIFEST - MANIFESTE

This Manifest conforms to all Federal and Provincial transport and environmental legislation requiring manifesting.
Ce manifeste est conforme aux législations fédérale et provinciale sur l'environnement et le transport, requérant un manifeste.

Manifest Reference No. / N° de référence du manifeste: MM18937

**A Consignor (Generator) / Expéditeur (Producteur)**

Provincial ID No. / N° d'id. provincial: ON 1442 0

Company name / Nom de l'entreprise: The Nation Municipality

Mailing address / Adresse postale: 958 Route 500 W. | City / Ville: Casselman | Province: | Postal code / Code postal:

Shipping site address / Origine de l'expédition: 2240 County Road 9

City / Ville: Fournier | Province: ON | Postal code / Code postal:

Intended consignee / Destinataire prévu: Drain All Ltd | Provincial ID No. / No d'id. provincial: A1K0722

Address / Adresse: 2705 Stevenage Dr | City / Ville: | Province: | Postal code / Code postal:

Receiving site address / Destination de l'expédition: Same

City / Ville: Ottawa | Province: ON | Postal code / Code postal: K1G3N2

**B Carrier / Transporteur**

Provincial ID No. / N° d'id. provincial: A1366302

Company name / Nom de l'entreprise: Drain All Ltd

Address / Adresse: 2705 Stevenage Dr

City / Ville: Ottawa | Prov.: ON | Postal code / Code postal: K1G3J2

| | Registration No. / N° d'immatriculation | Prov. |
|---|---|---|
| Vehicle / Véhicule | DG 025 | ONT |
| Trailer/Rail Car No. 1 / 1er remorque – wagon | | |
| Trailer/Rail Car No. 2 / 2e remorque – wagon | | |

Point of entry / Point d'entrée: | Point of exit / Point de sortie:

*Carrier Certification: I declare that I have received waste as offered by the consignor in Part A for delivery to the intended consignee and that the information contained in Part B is complete and correct. / Déclaration du transporteur : J'atteste avoir reçu les déchets offerts par l'expéditeur dans la partie A en vue de leur livraison au destinataire choisi et que les renseignements inscrits à la partie B sont exacts et complets.*

Year / Année: 01 | Month / Mois: 10 | Day / Jour: 20 | Name of authorized person (print) / Nom de l'agent autorisé (caractères d'imprimerie):

Signature: | Tel. No. / N° de tél.: (613) 759-1070

Reference nos. of other Manifest(s) used / N°'s de références des autres manifestes utilisés: MM18933-2 + MM18934-0

**C Consignee (Receiver) / Destinataire (Réceptionnaire)**

Provincial ID No. / N° d'id. provincial:

Consignee information same as Intended Consignee in Part A / L'information à fournir par le destinataire est la même qu'en A
☐ Yes / Oui ☐ No, complete the boxed area below

Company name / Nom de l'entreprise:

Address / Adresse:

City / Ville: | Province: | Postal code / Code postal:

Receiving site address / Destination de l'expédition:

City / Ville: | Province: | Postal code / Code postal:

Date received / Date de réception — Year / Année: | Month / Mois: | Day / Jour: | Time / Heure: ☐ A.M. ☐ P.M.

| Physical state / État physique | Shipping name of waste / Appellation réglementaire du déchet | Waste Identification / Identification du déchet: Provincial No. / N° (Quebec-Ontario only) (Quebec-Ontario seul) | TDGA/PIN LTMD/NIP | Quantity shipped / Quantité expédiée | Units L or kg / unités | Classification | Packing group / Groupe d'emballage | Packaging Contenants: No. / Nbre | Codes Int. – ext. |
|---|---|---|---|---|---|---|---|---|---|
| L | Waste Oil | 252T | N/A | 2460 | L | NA | NA | 12 | 01 |
| L | Waste Flammable Liquids, NOS (Gasoline) | 221I | UN1993 | 75 | L | 3 | II | 01 | 01 |
| L | Waste Antifreeze (Glycol) | 212L | NA | 150 | L | NA | NA | 01 | 01 |
| | | | | | | | | | |

| Quantity received / Quantité reçu | Units L or kg / unités | Identify any shipment discrepancy problems. Attach addendum if necessary. / Indiquer toute différence relative à l'expédition. Annexer une feuille au besoin. | Handling code / Code de manutention | Decontamination / Décontamination: Packaging Contenants Yes / Oui | Packaging Contenants No / Non | Vehicle / Véhicule Yes / Oui | Vehicle / Véhicule N |
|---|---|---|---|---|---|---|---|
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| | | | | | | | |

Special handling/Emergency instructions / Manutention spéciale/instructions d'urgence: ☐ Attached / Ci-jointes ☒ Below / Ci-dessous

Drain All Ltd 1-800-265-3868

Circulation no. – Quebec only / N° de circulation – Réservée au Québec

If handling code "Other" (specify) / Si code de manutention "divers", spécifier

If waste to be transferred, specify intended company name / Si les déchets doivent être transférés, préciser le nom du destinataire | Provincial ID No. / N° d'id. provincial

Address / Adresse | City / Ville | Prov.

Date shipped / Date d'expédition — Year / Année: 01 | Month / Mois: 10 | Day / Jour: 20 | Time / Heure: 4:15 ☐ A.M. ☒ P.M. | Scheduled arrival date / Date d'arrivée prévue — Year / Année: 01 | Month / Mois: 10 | Day / Jour: 20

***Consignor Certification:** I declare that the information contained in Part A is correct and complete.*
***Déclaration de l'expéditeur :** Je déclare que tous les renseignements à la partie A sont véridiques et complets.*

Name of authorized person (print) / Nom de l'agent autorisé (caractères d'imprimerie): Joanne Bougie-Normand | Signature: Joanne Bougie-Normand | Tel. no. / N° de tél.: (613) 524-2932

*Consignee Certification: I declare that the information contained in Part C is correct and complete. / Déclaration du l'expéditeur : Je déclare que tous les renseignements à la partie C sont véridiques et complets.*

Name of authorized person (print) / Nom de l'agent autorisé (caractères d'imprimerie):

Signature: | Tel. no. / N° de tél.: ( )

# MANIFEST - MANIFESTE

This Manifest conforms to all Federal and Provincial transport and environmental legislation requiring manifesting.
Ce manifeste est conforme aux législations fédérale et provinciale sur l'environnement et le transport, requérant un manifeste.

Manifest Reference No. / N° de référence du manifeste: MM [illegible] 4-0

**A Consignor (Generator) / Expéditeur (Producteur)**

Provincial ID No. / N° d'id. provincial: ON 7414200

Company name / Nom de l'entreprise: The Nature Conservancy

Mailing address / Adresse postale: 258 Lodo Rd W Kingston

City / Ville: | Province: | Postal code / Code postal:

Shipping site address / Origine de l'expédition: 3246 County Road 9

City / Ville: Fournier | Province: ON | Postal code / Code postal:

Intended consignee / Destinataire prévu: Drain All Ltd

Provincial ID No. / No d'id. provincial: AH60722

Address / Adresse: 2705 Steverage Dr | City / Ville: | Province: | Postal code / Code postal:

Receiving site address / Destination de l'expédition: Same

City / Ville: Ottawa | Province: ON | Postal code / Code postal: K1G 2N2

**B Carrier / Transporteur**

Provincial ID No. / N° d'id. provincial: AB-0202

Company name / Nom de l'entreprise: Drain All Ltd

Address / Adresse: 2705 Steverage Dr

City / Ville: Ottawa | Prov.: ON | Postal code / Code postal:

| | Registration No. / N° d'immatriculation | Prov. |
|---|---|---|
| Vehicle / Véhicule | [illegible] | ONT |
| Trailer/Rail Car No. 1 / 1er remorque – wagon | | |
| Trailer/Rail Car No. 2 / 2e remorque – wagon | | |

Point of entry / Point d'entrée:

Point of exit / Point de sortie:

*Carrier Certification: I declare that I have received waste as offered by the consignor in Part A for delivery to the intended consignee and that the information contained in Part B is complete and correct. / Déclaration du transporteur : J'atteste avoir reçu les déchets offerts par l'expéditeur dans la partie A en vue de leur livraison au destinataire choisi et que les renseignements inscrits à la partie B sont exacts et complets.*

Year / Année: 0,1 | Month / Mois: 1,0 | Day / Jour: 2,0

Name of authorized person (print) / Nom de l'agent autorisé (caractères d'imprimerie): [illegible]

Signature:

Tel. No. / N° de tél.: (613) 739-1070

**C Consignee (Receiver) / Destinataire (Réceptionnaire)**

Reference nos. of other Manifest(s) used / N°'s de références des autres manifestes utilisés: MM 01933-2 + MM 01955-5

Provincial ID No. / N° d'id. provincial:

Consignee information same as Intended Consignee in Part A / L'information à fournir par le destinataire est la même qu'en A

☐ Yes / Oui ☐ No, complete the boxed area below

Company name / Nom de l'entreprise:

Address / Adresse:

City / Ville: | Province: | Postal code / Code postal:

Receiving site address / Destination de l'expédition:

City / Ville: | Province: | Postal code / Code postal:

Date received / Date de reception: Year / Année | Month / Mois | Day / Jour

Time / Heure: ☐ A.M. ☐ P.M.

| Physical state / État physique | Shipping name of waste / Appellation réglementaire du déchet | Waste identification / Identification du déchet: Provincial No. / N° (Quebec-Ontario only) (Quebec-Ontario seul) | TDGA/PIN LTMD/NIP | Quantity shipped / Quantité expédiée | Units L or kg / unités | Classification | Packing group / Groupe d'emballage | Packaging Contenants: No. Nbre | Codes Int.–ext. |
|---|---|---|---|---|---|---|---|---|---|
| L | Waste Poisonous Liquids, NOS (Malathion) | 241A | UN3902 | 200 | L | 6.1 | II | 02 | 01 |
| S | Waste Poisonous Solids, NOS (Demeral) | 261A | UN2811 | 50 | Kg | 6.1 | II | 01 | 01 |
| S | Waste Batteries, Dry Containing Potassium Hydroxide | 148C | UN3028 | 100 | Kg | 8 | II | 01 | 01 |
| L | Waste Oxidizing ~~Solvents~~ Liquid, NOS (Nitrates) | 148C | UN3098 | 50 | Kg | 5.1 | II | 01 | 01 |

| Quantity received / Quantité reçu | Units L or kg / unités | Identify any shipment discrepancy problems. Attach addendum if necessary. / Indiquer toute différence relative à l'expédition. Annexer une feuille au besoin. | Handling code / Code de manutention | Decontamination / Décontamination: Packaging Contenants Yes / Oui | Packaging Contenants No / Non | Vehicle / Véhicule Yes / Oui | Vehicle / Véhicule No / Non |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
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| | | | | | | | |

Special handling/Emergency instructions / Manutention spéciale/instructions d'urgence: ☐ Attached / Ci-jointes ☒ Below / Ci-dessous

Drain All Ltd 1-800-265-3269

Circulation no. – Quebec only / N° de circulation – Réservée au Québec

If handling code "Other" (specify) / Si code de manutention "divers", spécifier

Date shipped / Date d'expédition: Year / Année: 0,1 | Month / Mois: 1,0 | Day / Jour: 1,0

Time / Heure: 11:15 ☐ A.M. ☒ P.M.

Scheduled arrival date / Date d'arrivée prévue: Year / Année: 0,1 | Month / Mois: 1,0 | Day / Jour: 2,0

If waste to be transferred, specify intended company name / Si les déchets doivent être transférés, préciser le nom du destinataire:

Provincial ID No. / N° d'id. provinci:

Address / Adresse: | City / Ville: | Prov.:

*Consignor Certification: I declare that the information contained in Part A is correct and complete.*
*Déclaration de l'expéditeur : Je déclare que tous les renseignements à la partie A sont véridiques et complets.*

Name of authorized person (print) / Nom de l'agent autorisé (caractères d'imprimerie): Joanne Rouge-Drummond

Signature: Joanne Rouge-Drummond

Tel. no. / N° de tél.: (613) 524-2932

*Consignee Certification: I declare that the information contained in Part C is correct and complete. Déclaration du l'expéditeur : Je déclare que tous les renseignements à la partie C sont véridiques complets.*

Name of authorized person (print) / Nom de l'agent autorisé (caractères d'imprimerie):

Signature: | Tel. no / N° de tél.: ( )

# PART B

# 2001 HYDROGEOLOGICAL INVESTIGATION AND GROUNDWATER AND SURFACE WATER MONITORING PROGRAM

Golder Associates Ltd.

**Golder Associates Ltd.**

1796 Courtwood Crescent
Ottawa, Ontario, Canada K2C 2B5
Telephone (613) 224-5864
Fax (613) 224-9928

**REPORT ON**

# 2001
# HYDROGEOLOGICAL INVESTIGATION AND GROUNDWATER AND SURFACE WATER MONITORING PROGRAM CALEDONIA LANDFILL SITE CORPORATION OF THE NATION MUNICIPALITY ONTARIO

Submitted to:

Corporation of the Nation Municipality
958 Road 500 West
R.R. 3
Casselman, Ontario
K0A 1M0

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2 copies - Golder Associates Ltd.

March 2002

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## EXECUTIVE SUMMARY

The following Executive Summary highlights only key points from this report. For complete information and findings, as well as the limitations provided in Section 11.0, it is necessary for the reader to examine the complete report.

This report summarizes the results of the 2001 Hydrogeological Investigation and Groundwater and Surface Water Monitoring Program at the Caledonia Landfill Site. The Caledonia Landfill Site is located immediately north of Concession Road 7, between Caledonia Road and County Road 22 (St. Bernadin Road), on Part 1 of Lot 23, Concession VI, geographic Township of Caledonia, now part of the Nation Municipality, Ontario.

Field investigation activities included the installation of multi-level monitoring wells at one borehole location in close proximity to Paxton Creek; water level measurements and groundwater monitor sampling (spring and fall of 2001); and surface water sampling (spring, summer, fall and winter of 2001).

Based on the borehole data from the 2001 and previous hydrogeological investigations, the most common geological unit underlying the site consists of a silty sand/sand deposit. Groundwater elevations measured during the spring and fall 2001 monitoring sessions indicate that the direction of groundwater flow in the silty sand/sand deposit at the site is interpreted to be to the north. The average linear groundwater velocity within the silty sand/sand deposit between boreholes BH96-4 and BH01-8 is estimated to be <1 to about 20 metres per year.

Based on an interpretation of the existing groundwater quality data, it is concluded that the landfill site is in compliance with MOE Guideline B-7 (the "Reasonable Use Guideline") with the exception of the east property boundary. The proposed addition of a 30 metre wide buffer along the east side of the landfill site will address this non-compliance issue.

Based on the 2001 surface water quality data, it is concluded that the landfill site is not impacting adversely on surface water quality in Paxton Creek.

Site-specific groundwater and surface water trigger mechanisms were developed as required by Condition 21 of Provisional Certificate of Approval A471003 and are outlined in Section 10.0 of this report.

Groundwater and surface water monitoring programs should be continued in order to evaluate site compliance on an ongoing basis. A proposed groundwater and surface water monitoring program for 2002 is provided in Section 10.5 of this report.

## TABLE OF CONTENTS

**TABLE OF CONTENTS (continued)**



In Order
Following
Page 33

## TABLE OF CONTENTS (continued)

### LIST OF TABLES



### LIST OF FIGURES



### LIST OF APPENDICES

## 1.0 INTRODUCTION

This report summarizes the 2001 Hydrogeological Investigation and Groundwater and Surface Water Monitoring Program carried out by Golder Associates Ltd. (Golder Associates) at the Caledonia Landfill Site in the Nation Municipality, Ontario. The scope of work was originally described in the Golder Associates letter dated May 16, 2001.

The site is located immediately north of Concession Road 7, between Caledonia Road and County Road 22 (St. Bernadin Road), on Part 1 of Lot 23, Concession VI, geographic Township of Caledonia now part of the Nation Municipality, Ontario (see Key Plan, Figure 1). The landfill is located in a rural setting approximately four kilometres southwest of the Village of St. Bernadin. The site, which is owned and operated by the Corporation of the Nation Municipality, comprises an area of 14.57 hectares and currently operates under Provisional Certificate of Approval A471003. The landfill, which is licensed for the disposal of "municipal and non-hazardous solid industrial wastes including white goods, tires and woodwastes", occupies a 4.0 hectare area of the site. This area is bounded by an escarpment to the north, the property line to the east, and tree stands to west and south of the cleared area of the property (Beatty Franz and Associates Ltd., 1997). Both the former area of landfilling (defined by an area of replanted pine trees) and the area currently being landfilled are located on the Site Plan (see Figure 2).

The site is bounded by agricultural land to the east and west, a point just north of Paxton Creek to the north, and Concession Road 7 to the south. The nearest point of the South Nation River is located almost four kilometres northwest of the site. Surface water drainage observations are consistent with those made in the past. Surface water flows north following the surface topography of the site. Surface water from the east side of the property flows north into a stream which empties into Paxton Creek. Paxton Creek then flows in a northwest direction. Surface water from the west side of the property flows north into a small ephemeral stream which drains through a swampy area, which likely discharges into Paxton Creek.

Golder Associates received comments from the Ministry of the Environment (MOE) associated with their review of the report on the 2000 Operations and Development and 2000 Groundwater and Surface Water Monitoring Program at the Caledonia Landfill Site (Golder Associates, 2001) in September 2001. These comments, along with a response by Golder Associates (where applicable) dated December 3, 2001 is presented in Appendix E. Where applicable, recommendations provided by the MOE have been incorporated into the proposed 2002 monitoring program presented in Section 10.5 of this report.

Previous site investigations were performed by Beatty Franz and Associates Ltd. (Beatty Franz, 1997) and Golder Associates Ltd. (Golder Associates, 2000, 2001) as summarized below:

| DATE | CONSULTANT INVOLVED | INVESTIGATION |
|---|---|---|
| 1996 | Beatty Franz and Associates Ltd. | • *Hydrogeological Assessment*<br>Overburden boreholes BH96-1, BH96-2, BH96-3 and BH96-4 drilled and completed with one monitoring well each; groundwater and surface water sampling. |
| 1999 | Golder Associates Ltd. | • *Hydrogeological Investigation and Monitoring Program:*<br>Overburden boreholes BH99-5, BH99-6 and BH99-7 drilled and completed with one monitoring well each; groundwater and surface water sampling program. |
| 2000 | Golder Associates Ltd. | • *Monitoring Program:*<br>Groundwater and surface water sampling program. |

## 2.0 PROJECT OBJECTIVES

The objectives of the 2001 hydrogeological investigation and groundwater and surface water monitoring program as described in the Golder Associates letter dated May 16, 2001 were summarized as follows:

- Installation of additional multi-level monitoring wells in close proximity to Paxton Creek (prior to the fall sampling session);
- Measurement of groundwater levels in the summer and fall of 2001;
- Collection of groundwater samples from monitoring wells in the summer and fall of 2001 and from the new monitoring wells in fall of 2001;
- Collection of samples from surface water monitoring locations in the spring, summer, fall and winter of 2001; and
- Preparation of an annual groundwater and surface water monitoring report (consistent with the relevant sections of Condition 35 of Provisional Certificate of Approval A471003).

# 3.0 INVESTIGATION AND MONITORING PROCEDURES

The various hydrogeological activities undertaken during 2001 are discussed in this section in chronological order.

The locations of the monitoring wells and surface water sampling stations in the vicinity of the landfill site are shown on Figure 2.

## 3.1 Hydrogeological Investigation

### 3.1.1 Borehole Drilling and Monitoring Well Installation Program

The borehole drilling and monitoring well installation program was conducted on November 6, 2001 with the purpose of determining the extent of on-site landfill leachate impacts on groundwater.

During the 2001 borehole drilling and monitoring well installation program, two monitoring wells were installed at one on-site borehole location. Borehole BH01-8 is located south of the northern site boundary downgradient of areas past and presently landfilled as shown on Figure 2.

The borehole was drilled using a CME55 track mounted 200 millimetre outside diameter hollow stem auger/rotary drill rig supplied and operated by Marathon Drilling Co. of Ottawa, Ontario. All drilling activities were monitored in the field by a member of Golder Associates field technical staff.

The borehole was advanced to a depth of 5.5 metres below ground surface and completed in the overburden. Overburden samples were collected using a 50 millimetre diameter split spoon sampler in conjunction with performing the standard penetration test. The overburden lithology was logged by the Golder Associates technician at the drill rig during advancement of the augers. The soil samples recovered from the boreholes during the drilling program were visually described in the field and returned to the Golder Associates Ottawa Laboratory for further examination and classification.

After the completion of drilling, a shallow and deep monitoring well was installed in the same borehole in the silty sand layer. The convention adopted in this report is that the deeper monitoring well at this borehole location is designated as monitoring well "A" and the shallower well at this same borehole location is referred to as monitoring well "B".

The monitoring wells were installed in the borehole to allow subsequent measurement of groundwater levels and groundwater sampling. The deep monitoring well consists of a schedule 40 50-millimetre diameter, flush threaded, PVC riser pipe with a 1.5 metre length of

#10 slot PVC screen at the bottom of the well. The shallow monitoring well has a 32-millimetre diameter. Filter sand is present below, around and above the screened intervals in the monitoring wells. Bentonite seals were placed at various locations in the boreholes to provide seals to prevent vertical migration of groundwater along the well bore and/or surface water intrusion.

Both monitoring wells constructed during the borehole drilling and monitoring well installation program were provided with dedicated sampling devices 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.

Appendix A contains the Record of Borehole Sheets for the 2001 borehole as well as the boreholes previously drilled at the site. The ground surface and top of casing elevations at the 2001 borehole location were surveyed by Golder Associates relative an existing monitoring well (geodetic datum). A summary of the elevation data for all of the existing monitoring wells is presented in the following table.

| BOREHOLE AND MONITORING WELL SURVEY INFORMATION | | | | |
|---|---|---|---|---|
| Monitoring Well | Well Screen Stratigraphic Unit | Reference | Ground Surface Elevation (m) | Top of Casing Elevation (m) |
| BH96-1 | Silty Sand | Beatty Franz (1996) | 64.70 | 65.58 |
| BH96-2 | Silty Sand | Beatty Franz (1996) | 63.94 | 64.89 |
| BH96-3 | Silty Sand | Beatty Franz (1996) | 64.02 | 64.88 |
| BH96-4 | Silty Sand | Beatty Franz (1996) | 64.90 | 66.04 |
| BH99-5 | Silty Sand | Golder (2000) | 57.72 | 58.59 |
| BH99-6 | Silty Sand / Sand | Golder (2000) | 65.22 | 66.07 |
| BH99-7 | Silty Sand / Sand | Golder (2000) | 65.16 | 66.05 |
| BH01-8A | Silty Sand | This report | 57.05 | 57.86 |
| BH01-8B | Silty Sand | This report | 57.05 | 57.91 |

Note: Elevations relative to geodetic datum

## 3.2 Groundwater Monitoring Sessions

The groundwater monitoring and sampling program was carried out at the Caledonia Landfill Site in the spring and fall of 2001.

Prior to groundwater sampling, the depth to groundwater was measured in all existing monitoring wells. These depths are recorded in Section 5.1. During the spring and fall 2001 sampling sessions, groundwater samples were collected from pre-existing monitoring wells BH96-1, BH96-2, BH96-3, BH96-4, BH99-5, BH99-6 and BH99-7. In addition, groundwater samples were collected from newly installed monitoring wells BH01-8A and BH01-8B during the fall 2001 sampling session. The rationale for inclusion of these wells in the monitoring program is as follows:

| MONITORING WELL | RATIONALE |
|---|---|
| BH96-4 | • to monitor background (non-impacted) groundwater quality in the vicinity of the landfill |
| BH99-6 | • to monitor leachate-impacted groundwater quality in close proximity to the present and former landfilling areas |
| BH96-1 | • to monitor groundwater quality at the eastern property boundary of the landfill site |
| BH96-2, BH96-3, BH99-5, BH01-8A, BH01-8B | • to monitor groundwater quality downgradient of present and former landfilling areas |
| BH99-7 | • to monitor groundwater quality west of the landfill site |

A groundwater sample could not be collected from monitoring well BH96-2 during either groundwater monitoring session as it contained an insufficient volume of water.

Monitoring wells were developed by the removal of at least three standing volumes of water using dedicated samplers. Sampling of groundwater was performed immediately after well development. Field duplicates were prepared during each sampling session as part of the Quality Control/Quality Assurance (QA/QC) program.

The temperature, pH and 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 which was calibrated in the field prior to use. All samples were entered on a Chain of Custody form and placed in coolers with ice packs until they were delivered in person to the 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, aluminum, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, silicon, silver, strontium, sulphur, thallium, tin, titanium, vanadium, zinc | plastic bottle, field filtered to 0.45 microns and preserved to pH<2 with nitric acid |
| Alkalinity, chloride, nitrate, nitrite, ortho-phosphate, sulphate, total dissolved solids (TDS) | plastic bottle, unfiltered and unpreserved |
| Ammonia, total phosphorus | plastic bottle, unfiltered and preserved to pH<2 with sulphuric acid |
| Chemical oxygen demand (COD), dissolved organic carbon (DOC), phenols | amber glass bottle with teflon lined cap, unfiltered and preserved to pH<4 with sulphuric acid |
| Dissolved reactive phosphorus | plastic bottle, field filtered to 0.45 microns and unpreserved |

All laboratory chemical and physical analyses on groundwater samples were performed by Accutest Laboratories Ltd. in Ottawa, Ontario. The Report of Analyses sheets from Accutest Laboratories Ltd. for the spring and fall 2001 monitoring sessions are provided in Appendix B.

### 3.3 Surface Water Monitoring Sessions

The surface water monitoring and sampling program was carried out at the Caledonia Landfill Site in the spring, summer, fall and winter of 2001.

Surface water samples were collected from pre-existing sampling stations SW2, SW3, SW4, SW5, SW6, SW7 and SW8. Surface water sampling stations are shown on Figure 2. The rationale for inclusion of these sampling stations in the monitoring program is as follows:

| SURFACE WATER STATION | RATIONALE |
|---|---|
| SW6 | • to monitor background surface water quality in Paxton Creek upstream of the landfill site |
| SW7 | • to monitor background surface water conditions in the east drainage stream upstream of the landfill site |
| SW3, SW5 | • to monitor the surface water quality in the east drainage stream downstream of the landfill site |
| SW2 | • to monitor surface water quality in the ephemeral west drainage stream downstream of the landfill site |
| SW4 | • to monitor surface water quality in the swamp area downstream of the landfill site |
| SW8 | • to monitor the surface water quality in Paxton Creek at the west property boundary downstream of the landfill site |

Surface water samples could not be collected from surface water station SW2 during any of the monitoring sessions as it was dry. Surface water samples could not be collected from surface water station SW4 during the summer monitoring session as it was dry, and during the winter monitoring session as it was frozen. Field duplicates were prepared during each sampling session as part of the QA/QC program.

The temperature, pH, conductivity and dissolved oxygen of the surface water 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. The dissolved oxygen measurements were obtained using a dissolved oxygen meter which was calibrated in the field prior to use. All samples were entered on a Chain of Custody form and placed in coolers with ice packs until they were delivered in person to the private analytical laboratory.

The surface water 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, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, silicon, silver, strontium, sulphur, thallium, tin, titanium, vanadium, zinc | plastic bottle, unfiltered and preserved to pH<2 with nitric acid |
| Aluminum | plastic bottle, field filtered to 0.45 microns and preserved to pH<2 with nitric acid |
| Alkalinity, chloride, nitrate, nitrite, ortho-phosphate, sulphate, total dissolved solids | plastic bottle, unfiltered and unpreserved |
| Ammonia, total phosphorus | plastic bottle, unfiltered and preserved to pH<2 with sulphuric acid |
| Chemical oxygen demand, dissolved organic carbon, phenols | amber glass bottle with teflon lined cap, unfiltered and preserved to pH<4 with sulphuric acid |

All laboratory chemical and physical analyses on surface water samples were performed by Accutest Laboratories Ltd. in Ottawa, Ontario. The Report of Analyses sheets from Accutest Laboratories Ltd. for the spring, summer, fall and winter sampling sessions are provided in Appendix B.

# 4.0 GEOLOGICAL CONDITIONS

One borehole was drilled during the 2001 investigation in addition to the 7 boreholes drilled during the 1996 and 1999 investigations, for a total of 8 boreholes completed in the overburden at the Caledonia Landfill Site. The logs detailing the geological conditions encountered in each borehole augered during the previous and 2001 investigation programs are given on the Record of Borehole Sheets in Appendix A.

It must be 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 geological change. Natural variations other than those encountered in the boreholes should also be expected to exist.

The geological conditions encountered in the borehole drilled during 2001 are consistent with that reported in the 1996 and 1999 series of boreholes drilled by Beatty Franz and Associates and Golder Associates, respectively.

## 4.1 Overburden Geology

Overburden deposits native to the site occur at all boreholes and are fairly consistent throughout the site. Silty sand was encountered to depth at all boreholes with sand present in boreholes BH99-6 and BH99-7 at depths greater than 3.7 metres below ground surface. Topsoil was encountered at boreholes BH99-5, BH99-6, BH99-7 and BH01-8 with an average thickness of about 0.2 metres.

Regional surficial geological maps indicate that the silty sand loam is a Champlain Sea deposit. The silty sands are deltaic or estuarine deposits developed as the water level of the Champlain Sea dropped forming residual lakes and streams (Beatty Franz and Associates Ltd., 1997).

Boreholes were terminated in the overburden at a maximum depth of 6.1 metres below ground surface. Bedrock was not encountered at any of the borehole locations.

## 4.2 Bedrock Geology

Regional geological maps indicate that the bedrock is grey shale with limestone interbeds or grey and black shale.

Ministry of Environment Water Well records indicate that the nearest water well in the vicinity of the landfill encountered bedrock at a depth of approximately 33 metres below ground surface.

# 5.0 PHYSICAL HYDROGEOLOGY

## 5.1 Water Level Data

The following table presents the groundwater elevation data collected between December 1996 and November 2001.

| Monitoring Well | Groundwater Elevation (m) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Dec 19, 1996 | May 11, 1999 | Oct 12, 1999 | Aug 9, 2000 | Nov 28, 2000 | Jun 27, 2001 | Nov 21,2001 |
| BH96-1 | 61.99 | 62.70 | 61.50 | 62.15 | 61.63 | 62.03 | 61.28 |
| BH96-2 | 59.02 | 59.25 | 58.90 | 59.03 | 58.99 | 58.84 | 58.78 |
| BH96-3 | 59.99 | 60.29 | 59.86 | 60.12 | 59.84 | 59.96 | 59.66 |
| BH96-4 | 64.34 | 65.31 | 63.65 | 63.37 | 63.98 | 63.57 | 62.74 |
| BH99-5 | NI | 57.93 | 57.86 | 57.91 | 57.90 | 57.88 | 57.88 |
| BH99-6 | NI | 63.39 | 62.00 | 62.76 | 62.24 | 62.66 | 61.76 |
| BH99-7 | NI | 63.71 | 62.31 | 63.06 | 62.63 | 63.00 | 62.08 |
| BH01-8A | NI | NI | NI | NI | NI | NI | 55.67 |
| BH01-8B | NI | NI | NI | NI | NI | NI | 55.67 |

Notes: NI - Monitoring well not installed at time of monitoring session
Elevations are relative to the geodetic datum

## 5.2 Horizontal Hydraulic Gradients

### 5.2.1 Horizontal Component

The horizontal hydraulic gradients for the granular layer groundwater flow system at the site were estimated from the 2001 groundwater elevation data. The horizontal hydraulic gradient in the silty sand/sand overburden groundwater flow system between boreholes BH96-4 and BH01-8 in a direction roughly parallel to the interpreted direction of groundwater flow (see Section 5.3) is estimated to be about 0.015 metres per metre (m/m). This value is similar to that reported by Golder Associates (2000).

### 5.2.2 Vertical Component

Vertical gradients were assessed only at borehole BH01-8 as this is the only multi-level groundwater monitor presently existing at the site. No vertical gradient was observed at borehole BH01-8 (i.e., the groundwater level was the same in the shallow and the deep monitoring well), indicating that groundwater flow is essentially horizontal at this borehole location near Paxton Creek.

## 5.3 Groundwater Flow Direction

The direction of horizontal groundwater flow within the silty sand/sand overburden at the site was interpreted from the 2001 groundwater elevation data. The interpreted direction of horizontal

groundwater flow at the site is towards the north as illustrated on Figure 2. This is consistent with previous hydrogeological investigations (Beatty Franz, 1997, and Golder Associates, 2000, 2001).

## 5.4 Horizontal Hydraulic Conductivity

Estimates of the horizontal hydraulic conductivities (K) of the silty sand/sand overburden unit in the vicinity of the monitoring well intake screens were calculated from rising head tests performed on the monitoring wells during the 2001 and previous hydrogeological investigations. The data from rising head tests were analyzed using the Hvorslev method (Hvorslev, 1951). Test results for the rising head tests conducted in 2001 are given in Appendix C. A summary of the estimates of the horizontal hydraulic conductivities (K) of the silty sand/sand overburden unit in the vicinity of the monitoring well intake screens is presented below.

| Monitoring Well | Hyraulic Conductivity (centimetres per second) | Stratigraphic Unit | Reference |
|---|---|---|---|
| BH96-1 | $6.1 \times 10^{-4}$ cm/s | Silty Sand | Beatty Franz (1997) |
| BH96-3 | $4.3 \times 10^{-4}$ cm/s | Silty Sand | Beatty Franz (1997) |
| BH96-4 | $2.6 \times 10^{-4}$ cm/s | Silty Sand | Beatty Franz (1997) |
| BH99-5 | $2.8 \times 10^{-4}$ cm/s | Silty Sand | Golder (2000) |
| BH99-6 | $5.3 \times 10^{-4}$ cm/s | Silty Sand / Sand | Golder (2000) |
| BH99-7 | $1.3 \times 10^{-3}$ cm/s | Silty Sand / Sand | Golder (2000) |
| BH01-8A | $1.5 \times 10^{-4}$ cm/s | Silty Sand | This report |
| BH01-8B | $1.4 \times 10^{-5}$ cm/s | Silty Sand | This report |

Notes: Beatty Franz - Beatty Franz and Associates Ltd.
Golder - Golder Associates Ltd.

It is inferred that the horizontal hydraulic conductivity for the silty sand/sand overburden unit adjacent to the screened intervals in these monitors ranges from $1.4 \times 10^{-5}$ centimetres per second (cm/s) to $1.3 \times 10^{-3}$ cm/s, as noted in the above table. These values are considered representative of what would be expected for the silty sand/sand overburden present at the site.

## 5.5 Groundwater Flux

Groundwater flux or specific discharge, q, is the discharge of groundwater per unit area per unit time and is calculated from Darcy's equation. Because the groundwater flux has the dimensions of a velocity, it is sometimes known as the Darcy velocity or Darcy flux (Hubbert, 1940; Freeze and Cherry, 1979). The Darcy flux is calculated from the equation:

$$v_s = Ki$$

where $v_s$ = groundwater flux (units of length per time)
$K$ = horizontal hydraulic conductivity (units of length per time)
$i$ = horizontal hydraulic gradient in direction of $v_s$ (dimensionless)

Using a horizontal hydraulic gradient of 0.015 between boreholes BH96-4 and BH01-8 and a horizontal hydraulic conductivity for the silty sand/sand overburden layer of $1.4 \times 10^{-5}$ cm/s to $1.3 \times 10^{-3}$ cm/s, the corresponding Darcy flux within the overburden is calculated to be $2.2 \times 10^{-7}$ cm/s to $2.1 \times 10^{-5}$ cm/s.

## 5.6 Average Linear Groundwater Velocity

The average linear groundwater velocity (seepage velocity), $\bar{v}$, is directly proportional to the groundwater flux and inversely proportional to formation porosity. The average linear groundwater velocity is calculated using the equation:

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

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

For unconsolidated deposits such as silts and sands, typical porosity values can range from 25 to 50 percent (Freeze and Cherry, 1979). An average porosity of 30 to 35 percent for the sand deposit is assumed for the determination of average linear groundwater velocities in the vicinity of the landfill site.

The average linear groundwater velocity within the silty sand/sand deposit between boreholes BH96-4 and BH01-8 is estimated to be <1 to about 20 metres per year.

# 6.0 GROUNDWATER QUALITY

The groundwater quality in the vicinity of the Caledonia Landfill Site was assessed by collecting groundwater samples from the existing and newly installed monitoring wells and submitting them for chemical and physical analyses. The results of the field and laboratory chemical and physical analyses conducted during the 2001 monitoring program are presented in Appendix D along with relevant Ontario Drinking Water Standards/Objectives (MOE, 2001) and the data from previous monitoring sessions.

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

## 6.1 Natural Background Groundwater Quality

For the purpose of this site assessment, background conditions are assumed to be represented by data collected from monitoring well BH96-4. This monitoring well is located upgradient (south) of the current and former areas of landfilling (Figure 2). This monitoring well is therefore presumed to be unimpacted by landfill leachate.

The groundwater quality in the background monitoring well BH96-4 has been generally consistent over time with the exception of slightly variable aluminum, COD, iron and total phosphorus concentrations. Parameters which are typically elevated in landfill leachate impacted groundwater such as chloride, boron, manganese, strontium, sodium and TDS have low or non-detectable concentrations in BH96-4.

## 6.2 Leachate Conditions

Leachate conditions at the site are assumed to be represented by water quality from monitoring well BH99-6. This monitoring well is located between the active (immediately downgradient) and former landfill areas.

The inorganic groundwater quality at monitoring well BH99-6 is characterized by elevated concentrations of alkalinity, ammonia, barium, boron, chloride, cobalt, COD, conductivity, DOC, hardness, iron, manganese, phenols, potassium, sodium, strontium and TDS relative to the background groundwater quality represented by monitoring well BH96-4. Concentrations of DOC, iron, manganese and TDS (June only) at this monitoring location exceeded their respective ODWS/O during the 2001 monitoring program.

## 6.3 Impact Evaluation Monitoring Wells

The physical and chemical parameters with reported levels exceeding their respective ODWS/O; trends in groundwater quality (where applicable); a comparison of the groundwater quality to background conditions in monitoring well BH96-4; and, a hydrogeological interpretation of the groundwater quality data from the impact evaluation monitors are summarized in Table 1.

## 6.4 Discussion

Based on a review of the groundwater quality data, several parameters were identified as being useful groundwater quality indicator parameters with respect to impact from the landfill site. These ***Key Indicator Parameters*** include chloride, boron, manganese, strontium and TDS. In addition, several secondary parameters are also useful and include DOC, sodium and hardness. The concentrations of these indicator parameters in groundwater along with the physical hydrogeological setting of the study area were used during the interpretation of the 2001 groundwater quality data.

Based on the analyses presented in Table 1, groundwater quality at on-site groundwater monitors BH96-4, BH99-7 and BH01-8A is interpreted to not be impacted by landfill leachate. Groundwater quality at on-site monitoring wells BH96-1, BH96-3, BH99-5, BH99-6 and BH01-8B is interpreted to be impacted, or potentially impacted, by landfill leachate.

The only significant change in the interpretation of the 2001 groundwater quality data compared to the 2000 data is that groundwater quality in the vicinity of newly installed borehole BH01-8 is interpreted to be potentially impacted by landfill leachate based primarily on elevated concentrations of chloride, manganese, strontium, TDS, DOC and sodium for one sampling session.

## 7.0 GROUNDWATER COMPLIANCE ASSESSMENT

MOE Guideline B-7 (MOE, 1994a) addresses the level 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 remedial measure(s) would be warranted.

Under MOE Guideline B-7 (the "Reasonable Use Guideline"), 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.

For the purpose of this compliance evaluation under MOE Guideline B-7, the natural groundwater quality is assumed to be represented by the data available from monitor BH96-4 as discussed in Section 6.1.1.

MOE Guideline B-7 applies to groundwater quality impact at the existing site boundary, and is therefore directly applicable to monitoring well BH96-1. This monitor is located a few metres within the eastern site boundary in the area of former landfilling (Figure 2). The groundwater compliance assessment under MOE Guideline B-7 for the site is also applied to on-site downgradient monitoring wells BH96-2, BH96-3, BH99-5, BH99-7, BH01-8A and BH01-8B.

The historical range in natural background groundwater quality for each of the ***Key Indicator Parameters*** in monitoring well BH96-4 with respect to ODWS/O parameters for which a Maximum Acceptable Concentration (MAC), Interim Maximum Acceptable Concentration (IMAC) or Aesthetic Objective (AO) has been established is provided below, along with their respective Reasonable Use Performance Objectives (RUPO).

| Parameter | Units | ODWS/O (MOE, 2001) | Range in Background Concentration Based on Monitoring Well BH96-4 | RUPO Based on Monitoring Well BH96-4 |
|---|---|---|---|---|
| Boron | mg/L | 5 (IMAC) | <0.05 | 1.25 |
| Chloride | mg/L | 250 (AO) | 1 – 3 | 127 |
| DOC | mg/L | 5.0 (AO) | <0.5 – 2.2 | 3.6 |
| Hardness | mg/L | — | 145 – 177 | — |
| Manganese | mg/L | 0.05 (AO) | <0.01 – 0.07 | 0.07 |
| Sodium | mg/L | 200 (AO) | 5 – 8 | 104 |
| Strontium | mg/L | — | 0.073 – 0.121 | — |
| TDS | mg/L | 500 (AO) | 172 – 240 | 370 |

Notes: mg/L – milligrams per Litre
ODWO/S - Ontario Drinking Water Standard/Objective

A summary of the parameters with concentrations exceeding the maximum allowable under MOE Guideline B-7 at each monitoring well location selected for use in the groundwater compliance assessment based on the results of the 2001 monitoring program and using monitoring well BH96-4 as background is provided in Table 2.

Based on the results of the compliance assessment, the following conclusions are drawn:

- The groundwater quality in the landfill site eastern property boundary monitor BH96-1 is interpreted to be impacted by landfill leachate to a degree that is beyond that considered acceptable under MOE Guideline B-7. This conclusion is based primarily on concentrations of manganese and TDS which consistently exceed the Reasonable Use Performance Objectives. The proposed addition of a 30 metre wide buffer along the east side of the landfill will address this non-compliance issue.

- No groundwater monitors exist along the north (downgradient) boundary of the landfill site. A borehole equipped with multi-level monitoring wells was installed in 2001 between existing monitoring well BH99-5 and Paxton Creek. Groundwater quality at this on-site monitoring location is interpreted to be potentially impacted by landfill leachate to a degree that is beyond that considered acceptable under MOE Guideline B-7. This interim compliance conclusion is based primarily on concentrations of DOC, manganese and TDS which exceed the Reasonable Use Performance Objectives. The concentrations of manganese and TDS only marginally exceed the Reasonable use Performance Objectives. The DOC concentration of 9.6 mg/L exceeds the DOC levels at all other monitoring locations during November 2001 (except for monitor BH99-6). This suggests that the higher concentration at monitor BH01-8B may be related to factors other than leachate impacts from the landfill site. Based on groundwater quality and physical hydrogeology, the leachate-impacted groundwater plume emanating from the waste disposal site appears to be present in the shallow depths within the overburden (less than 3 metres below ground surface) and thus it is likely that leachate-impacted groundwater detected downgradient of the landfill areas at monitoring well BH01-8B is intercepted by Paxton Creek rather than migrating further north towards the northern property boundary. The landfill site is likely in compliance with MOE Guideline B-7 in terms of groundwater impacts at its northern boundary. It is noted that groundwater monitors BH01-8B and BH01-8A should be monitored closely as limited groundwater quality data exist at these locations.

- Groundwater at monitor BH99-7, located east of the western property boundary, is interpreted not to be impacted by landfill leachate. The western property boundary is therefore interpreted to be in compliance with MOE Guideline B-7.

# 8.0 SURFACE WATER QUALITY

Surface water enters the Caledonia Landfill Site from two sources. The first source is the drainage stream at the east end of the site which flows towards the northwest. Surface water sampling stations SW3, SW5 and SW7 are located in the east drainage stream. This stream empties into Paxton Creek, which is the second source of surface water. Paxton Creek is located between the north property boundary and the landfill area. Surface water sampling stations SW6 and SW8 are located in Paxton Creek. Paxton Creek is the main surface water course in the immediate area of the Caledonia Landfill Site.

Two drainage ditches are located to the east and west of the landfill, respectively. The west ditch (Figure 2) of the landfill site flows into the swampy low-lying area north of the waste footprint. The west ditch behaves as an ephemeral drainage stream for the landfill site. The east ditch (Figure 2) of the landfill site intersects the east drainage stream prior to the stream joining with Paxton Creek.

Surface water sampling stations are shown on Figure 2. Because of its location in Paxton Creek at the downstream western property boundary, SW8 is considered to represent the "point of compliance" for the surface water quality compliance assessment (refer to Section 9.0).

The results of the field and laboratory chemical and physical analyses conducted during the 2001 monitoring program are presented in Appendix D along with relevant Provincial Water Quality Objectives (PWQO) (MOE, 1994b) and the data from previous monitoring sessions.

## 8.1 Background Surface Water Quality

The background surface water quality in the eastern drainage stream is represented by the data available from SW7, located off-site and east of the Caledonia Landfill Site. The background surface water quality for Paxton Creek is represented by the data available from surface water station SW6 which is located on-site and upstream of the point where the east drainage stream intersects with Paxton Creek.

Surface water quality at SW7 is characterized by consistent exceedences of the PWQO for iron and total phosphorus. The surface water quality displays probable impacts from agricultural activities in the area, based on the elevated total phosphorus and nitrate concentrations.

Similarly, surface water quality at SW6 is characterized by consistent exceedances of the PWQO for iron and total phosphorus. The surface water quality displays probable impacts from agricultural activities in the area, based on the elevated nitrate, total phosphorus and possibly TDS concentrations.

The surface water quality for the Paxton Creek monitoring station SW6 typically displays higher concentrations of most of the measured inorganic parameters compared to SW7. This is likely due to Paxton Creek being a local discharge point for several drainage streams in the area.

## 8.2 Discussion

The physical and chemical parameters with reported levels exceeding their respective PWQO; trends in surface water quality (where applicable); a comparison of the surface water quality to background conditions; and, an interpretation of the surface water quality data are summarized in Table 3.

Surface water quality at station SW4 (located in the swamp area north of the landfilling area) is not considered to be representative of the surface water quality regime in this area due to the stagnant nature of surface water at this location.

### 8.2.1 East Drainage Stream

Surface water quality at stations SW3, SW5 and SW7 all have similar PWQO exceedances of iron and total phosphorus. Downstream locations SW3 and SW5 have similar concentrations of boron and manganese and generally slightly higher concentrations of chloride, strontium and TDS than SW7 in 2001. Surface water quality at these stations is interpreted to not be impacted from landfill leachate.

### 8.2.2 Paxton Creek

Surface water quality at stations SW6 and SW8 both have similar PWQO exceedances of iron and total phosphorus. Surface water quality at station SW8 (located in Paxton Creek at the west property boundary) is similar to that at background station SW6 during each of the four monitoring sessions conducted during 2001. The consistency in quality between these stations indicates that potential discharge of leachate-impacted groundwater into Paxton Creek is not having a measurable effect on surface water quality at this location.

## 9.0 SURFACE WATER COMPLIANCE ASSESSMENT

This section provides a surface water compliance assessment under MOE Policy 2 (MOE, 1994b) based on the based on the results of the 2001 monitoring program.

For the purpose of this surface water quality compliance assessment, the PWQO are being applied to surface water sampling station SW8 because this sampling station is located downstream at the "point of compliance" where Paxton Creek flows off the landfill site.

Based on the available data on the surface water quality at station SW6, it is interpreted that the surface water at this location represents background surface water quality in Paxton Creek. Parameters consistently exceeding the PWQO at this background surface water quality monitoring location during the 2001 monitoring program were iron and total phosphorus. Therefore, it is assumed for the purpose of this assessment that the background surface water quality in Paxton Creek does not naturally meet the PWQO for all parameters. For this surface water quality compliance assessment, it is considered that Policy 2 (MOEE, 1994b) would apply to surface water quality in the vicinity of the landfill site. Policy 2 indicates that "water quality which presently does not meet the Provincial Water Quality Objectives shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the Objectives".

For the purpose of this surface water quality compliance assessment, the PWQO are being applied to surface water sampling station SW8 because this sampling station is located downstream at the "point of compliance" where Paxton Creek flows off the landfill site. Although the 2001 iron and total phosphorus concentrations at station SW8 exceed the PWQO, they are within the historical range reported at background station SW6.

Based on the interpretation of the 2001 surface water quality data, it is concluded that the leachate originating from the landfill site is not having a measurable impact on surface water quality in Paxton Creek (refer to Section 8.2). Therefore, leachate impact from the landfill site is not resulting in an increase in the level of any analytical parameter beyond the specified PWQO or in violation of Policy 2 at the point of compliance.

# 10.0 SITE-SPECIFIC MONITORING PROGRAM AND TRIGGER MECHANISMS

## 10.1 Preamble

The results of the hydrogeological investigations and monitoring programs conducted to date have largely defined the extent and degree of impacts on overburden groundwater and surface water resources as a result of leachate migration from the Caledonia Landfill Site.

## 10.2 Rationale for Selection of Key Indicator Parameters

A ***Key Indicator Parameter*** for a landfill site is defined as being a parameter which is useful in determining the presence/absence of landfill leachate impact on water resources; assessing the degree of leachate impact on water resources; and, is useful in determining the extent of leachate impact near the landfill site.

For a parameter to be useful as a ***Key Indicator Parameter*** for a landfill site, the following characteristics are desirable:

- the parameter is present in relatively low concentrations in background (natural) water quality near the site and characterized by significantly higher concentrations in leachate generated at the landfill site;

- the concentration of a ***Key Indicator Parameter*** should not vary significantly over time at background monitoring locations (i.e., low variability is desirable) in order to be a reliable indicator of leachate impact;

- the trend in the parameter concentration must be relatively consistent over time (allowing for seasonal variations in quality) in terms of the persistence of elevated levels in leachate relative to background conditions (i.e., parameter concentrations should not vary dramatically over short periods of time such that during one monitoring event the concentration is indicative of background conditions, whereas during another monitoring event the concentration at the same monitoring location is indicative of leachate impact);

- for natural attenuation landfill sites (such as the Caledonia Landfill Site), conservative parameters which are relatively mobile in the groundwater flow system and are not subject to significant attenuation mechanisms (e.g., adsorption, biological uptake, precipitation, etc.) are most appropriate for characterizing the extent of leachate impact from a landfill site on water resources; potential leachate constituents characterized by a lower mobility in the subsurface environment (e.g., heavy metals) are typically attenuated by the soil in close proximity to the fill area and thus the extent of impact on groundwater resources is minimal; and

- parameter concentrations in groundwater and surface water should exhibit spatial variations in concentration relative to the location of the fill area(s) and physical hydrogeological setting of the site (i.e., higher parameter concentrations immediately downgradient from the fill area with progressively lower concentrations with increasing distances downgradient from the fill area).

## 10.3 Rationale for the Selection of Surveillance Parameters

The site-specific ***Key Indicator Parameters*** should be evaluated on an annual basis based on the groundwater quality data available from selected sampling locations which are sampled on a regular basis for a more exhaustive list of ***Surveillance Parameters***. As discussed in Section 10.5.2, selected monitoring wells have been identified for the purpose of monitoring the groundwater concentrations of these ***Surveillance Parameters*** at the Caledonia Landfill Site.

Surveillance sampling locations are defined as monitoring locations where a more extensive suite of chemical and physical parameters are monitored on a routine basis for the purpose of providing a detailed data base pertaining to groundwater quality in the vicinity of the landfill site. The designation of surveillance sampling locations at a landfill site is essential when the site monitoring program is aimed towards the monitoring of previously identified site-specific ***Key Indicator Parameters***. The inclusion of surveillance sampling locations in a landfill site monitoring program permits a comprehensive assessment of water quality to be completed on a routine basis. This is advantageous for the following reasons:

- changes in background water quality in the area of the site can be monitored over time;

- temporal changes in leachate quality can be monitored;

- the rationale for the selection of the site-specific ***Key Indicator Parameters*** can be validated on an ongoing basis thus permitting the justified addition or deletion of parameters, as required to adequately monitor the environmental performance of the landfill site;

- as moderately mobile leachate constituents potentially become more widespread over time within the plume, additional parameters can be added to the list of site-specific ***Key Indicator Parameters*** in order to ensure that the site monitoring program is adequate;

- in the event that chemical characteristics of the leachate change over time the list of site-specific ***Key Indicator Parameters*** could be modified to ensure that the site monitoring program is adequate; and

- in the event that there is a significant increase in the concentrations of the ***Key Indicator Parameters*** and there is a requirement for a more extensive assessment of water quality characteristics in the vicinity of the site, the data available from the surveillance sampling

locations would permit the selection of the most appropriate parameters to be added to the site monitoring program based on factual information pertaining to leachate quality characteristics rather than the selection of additional parameters based solely on those parameters for which groundwater (or surface water) quality criteria have been established.

## 10.4 Evaluation of Site-Specific Key Indicator Parameters

The groundwater quality data at the site was reviewed for the purpose of selecting site-specific ***Key Indicator Parameters***. Based on the available data, the following table summarizes the ***Key Indicator Parameters*** for the landfill leachate-impacted groundwater plume/surface water impact (primary parameters) along with other secondary parameters which assist in the overall interpretation of water quality data and/or are relevant in terms of assessing site compliance under MOE Guideline B-7. Secondary parameters are characterized by variable concentrations over time which are not necessarily related to impacts from the landfill; as such, the concentrations of these secondary parameters must be evaluated in the context of the concentration trends for the primary parameters.

| KEY INDICATOR PARAMETERS | |
|---|---|
| **Landfill Leachate-Impacted Groundwater Plume (Primary Parameters)** | **Secondary Parameters** |
| Boron<br>Chloride<br>Manganese<br>Strontium<br>TDS | DOC<br>Sodium<br>Hardness |

Collectively, the parameters listed above represent the ***Key Indicator Parameters*** in terms of groundwater and surface water conditions in the vicinity of the Caledonia Landfill Site. As discussed in Sections 10.5.2 and 10.5.3, selected monitoring wells and surface water monitoring stations have been identified for the purpose of monitoring these ***Key Indicator Parameters*** in the vicinity of the Caledonia Landfill Site.

## 10.5 Proposed 2002 Monitoring Program

### 10.5.1 Objectives

A groundwater and surface water monitoring program forms an integral part of the management of a landfill during both the remaining operational period and post-closure. The purpose of such a program is to enable the trends in the concentrations of various analytical parameters to be established and compared with both the background quality and the regulatory water quality standards, and from this to determine the adequacy of any existing mitigation systems or the need to

implement contingency/remedial measures to reduce impacts from the landfill site on off-site groundwater and/or surface water regimes to an acceptable level.

The objectives of the proposed 2002 groundwater and surface water monitoring program are to monitor background water quality, leachate quality, and water quality within the areas affected by the landfill leachate-impacted groundwater plume.

### 10.5.2 Groundwater Component

The proposed groundwater monitoring program for 2002 is summarized in Table 4.

It is proposed that the groundwater monitoring sessions be carried out in the vicinity of the landfill site during the spring (April/May) and fall (September/October) of 2002.

During each monitoring session, a complete set of groundwater levels should be measured in all existing monitors. The *Routine Sampling Locations* and *Surveillance Sampling Locations* which are proposed to be included in the groundwater monitoring program, along with the rationale for their inclusion are described below:

| RATIONALE | SAMPLING LOCATIONS |
|---|---|
| Background Monitoring Locations | BH96-4* |
| Impact Evaluation Monitors | BH96-1*, BH96-3, BH99-5, BH99-6*, BH99-7, BH01-8A*, BH01-8B* |

Notes: * Surveillance Sampling Location; all others are Routine Sampling Locations

An appropriate number of field duplicates (i.e., approximately one duplicate for every 10 samples collected) should be prepared during each monitoring session as part of the QA/QC program.

The temperature, pH and conductivity of the groundwater samples should be measured in the field at the time of sample collection. The groundwater samples collected from the *Routine Sampling Locations* during the monitoring sessions should be submitted to a private laboratory for analysis of the site-specific ***Key Indicator Parameters***. The groundwater samples collected from the *Surveillance Sampling Locations* should be submitted to a private laboratory for analysis of the ***Surveillance Parameters***.

The groundwater sampling protocols followed during the 2001 monitoring program (refer to Section 3.2 of this report) should be adhered to during subsequent groundwater monitoring sessions. All laboratory analyses on groundwater 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 Provincial Water Quality Objectives (MOEE, 1994b) or the Ontario Drinking Water Standards/Objectives (MOE, 2001), whichever is lower.

### 10.5.3 Surface Water Component

The proposed surface water monitoring program during 2002 is summarized in Table 5.

It is proposed that the surface water monitoring sessions be carried out in the vicinity of the landfill site during the spring (April/May) and fall (September/October). An additional surface water session should be conducted within 24 hours of a significant precipitation event (>10 mm). If no such precipitation event is observed during the summer or early fall, the surface water session should be conducted in December 2002.

The *Routine Sampling Locations* and *Surveillance Sampling Locations* which are proposed to be included in the surface water monitoring program, along with the rationale for their inclusion are described below:

| RATIONALE | SAMPLING LOCATIONS |
|---|---|
| Background Sampling Locations | SW7*, SW6* |
| Evaluation Sampling Locations | SW2, SW3, SW5, SW8* |

Notes: * Surveillance Sampling Location; all others are Routine Sampling Locations

The deletion of surface water station SW4 (located in the swamp) is proposed as surface water quality at this location is not considered to be representative of the surface water quality regime in this area due to the stagnant nature of surface water at this location.

An appropriate number of field duplicates (i.e., approximately one duplicate for every 10 samples collected) should be prepared during each monitoring session as part of the QA/QC program.

The temperature, pH, conductivity and dissolved oxygen content of the surface water samples should be measured in the field at the time of sample collection. In addition, observations of aquatic invertebrates, algae growth, aquatic plants, and litter/debris should be made at each station as recommended by the MOE (Appendix E). The surface water samples collected from the *Routine Sampling Stations* during the monitoring sessions should be submitted to a private laboratory for analysis of the site-specific ***Key Indicator Parameters***. The surface water samples collected from the *Surveillance Sampling Locations* should be submitted to a private laboratory for analysis of the ***Surveillance Parameters***.

The surface water sampling protocols followed during the 2001 monitoring program (refer to Section 3.3 of this report) should be adhered to during subsequent surface water monitoring sessions. All laboratory analyses on surface 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 Provincial Water Quality Objectives (MOEE, 1994b) or the Ontario Drinking Water Standards/Objectives (MOE, 2000), whichever is lower.

### 10.5.4 Reporting

An annual groundwater and surface water monitoring report for the Caledonia Landfill Site must be prepared (as required by Condition 35 of Provisional Certificate of Approval A471003); this report must be submitted to the MOE by March 31 of each year. The annual monitoring report should provide a discussion of the general physical hydrogeological setting of the site and the groundwater and surface water geochemistry (including apparent trends over time) in the vicinity of the site. The report should also evaluate the performance of the landfill site relative to the regulatory requirements.

Each annual monitoring report should also include a re-evaluation of the groundwater and surface water monitoring requirements at the Caledonia Landfill Site. In the event that the monitoring program proposed in each annual report requires modification so as to adequately monitor the future performance of the site, the proposed modifications for the subsequent year should be discussed with the MOE in order to obtain their approval/concurrence for the changes prior to implementation.

## 10.6 Objectives and Introduction of Trigger Mechanisms

Site-specific groundwater and surface water trigger mechanisms were developed in accordance with Condition 21 of Provisional Certificate of Approval A471003 and are outlined in the following sections of this report.

The objectives of trigger mechanisms at the Caledonia Landfill Site are to utilize the results of the ongoing surface water and groundwater monitoring programs (with the main focus being the trends in the concentrations of the primary parameters as noted in Section 10.4) to assess site compliance and to trigger implementation of contingency plans when and if necessary. The purposes of the trigger mechanisms are to prevent leachate-impacted groundwater exceeding MOE Guideline B-7 from migrating beyond the site boundaries, and to prevent impact on surface water quality exceeding that permissible under MOE Policy 2 (should there be indications that this is likely to happen).

## 10.7 Compliance Evaluation Parameters and Trigger Concentrations

### 10.7.1 Preamble

***Compliance Evaluation Parameters*** are defined as the site-specific ***Key Indicator Parameters*** which have established Provincial Water Quality Objectives (surface water) or Ontario Drinking Water Standards/Objectives (groundwater).

***A Reasonable Use Performance Objective*** refers to the maximum allowable concentration for a ***Compliance Evaluation Parameter*** in groundwater at the point of compliance under MOE Guideline B-7. This value can also be referred to as the Groundwater Compliance Concentration.

A ***Surface Water Compliance Concentration*** refers to the higher of either the 75$^{th}$ percentile of measured background or the Provincial Water Quality Objectives for each ***Compliance Evaluation Parameter*** based on the existing background data.

A ***Trigger Concentration*** is a ***Compliance Evaluation Parameter*** concentration which exceeds the Reasonable Use Performance Objective for groundwater or the compliance concentration for surface water, and thus could be indicative of adverse leachate impact on the groundwater or surface water.

It is noted that future ***Compliance Evaluation Parameters*** may differ from those discussed herein due to the addition or deletion of site-specific ***Key Indicator Parameters*** or changes to the ODWO/S and/or PWQO in the future.

### 10.7.2 Groundwater

The highest background concentration from the background groundwater quality data set are used to derive the Reasonable Use Performance Objectives and corresponding trigger concentrations for each of the six ***Compliance Evaluation Parameters***. Where the background concentration is less than the detection limit for that parameter, a concentration of zero is used to derive the Reasonable Use Performance Objective and corresponding trigger concentration.

The background groundwater quality for each of the ***Key Indicator Parameters*** for background monitors, the Reasonable Use Performance Objectives and current trigger concentrations are presented below:

| Key Indicator Parameters | Units | ODWO/S | Range in Background Concentration Based on Monitoring Well BH96-4 | RUPO Based on Monitoring Well BH96-4 | Trigger Concentration |
|---|---|---|---|---|---|
| Chloride (P) | mg/L | 250 (AO) | 1 – 3 | 127 | >127 |
| Strontium (P) | mg/L | — | 0.073 – 0.121 | — | — |
| Manganese (P) | mg/L | 0.05 (AO) | <0.01 – 0.07 | 0.07 | >0.07 |
| Boron (P) | mg/L | 5 (IMAC) | <0.05 | 1.25 | >1.25 |
| Hardness (S) | mg/L | — | 145 – 177 | — | — |
| DOC (S) | mg/L | 5.0 (AO) | <0.5 – 2.2 | 3.6 | >3.6 |
| TDS (P) | mg/L | 500 (AO) | 172 – 240 | 370 | >370 |
| Sodium (S) | mg/L | 200 (AO) | 5 – 7.9 | 104 | >104 |

Notes:

mg/L – milligrams per Litre
S – Secondary Key Indicator Parameter
ODWO/S – Ontario Drinking Water Standard/Objective
P – Primary Key Indicator Parameter
RUPO – Reasonable Use Performance Objective
ODWO/S values presented relate specifically to non-health related parameters (i.e., aesthetic parameters) and health related parameters for which a maximum acceptable concentration (MAC) or interim maximum acceptable concentration (IMAC) has been established.

The calculated maximum allowable boundary concentrations for these parameters under MOE Guideline B-7 will be modified, as required, based on additional background groundwater quality data which will be obtained during future monitoring programs.

### 10.7.3 Surface Water

The background surface water quality for each of the ***Key Indicator Parameters*** for background surface water station SW6 (Paxton Creek), compliance concentrations, and current trigger concentrations are presented below:

| Key Indicator Parameters | Units | PWQO (mg/L) | SW6 Background Range | 75th Percentile of Compliance Concentrations | Trigger Concentration |
|---|---|---|---|---|---|
| | | | SW6 | SW6 | SW6 |
| Chloride (P) | mg/L | — | 23 – 92 | — | — |
| Strontium (P) | mg/L | — | 0.139 – 0.386 | — | — |
| Manganese (P) | mg/L | — | 0.02 – 0.23 | — | — |
| Boron (P) | mg/L | 0.2 | <0.05 – 0.04 | 0.04 | >0.2 |
| Hardness (S) | mg/L | — | 150 – 331 | — | — |
| DOC (S) | mg/L | — | 3.2 – 9.9 | — | — |
| TDS (P) | mg/L | — | 188 – 580 | — | — |
| Sodium (S) | mg/L | — | 16 – 60 | — | — |

Notes: mg/L – milligrams per Litre
P – Primary Key Indicator Parameter
S – Secondary Key Indicator Parameter
PWQO – Provincial Water Quality Objectives

The calculated trigger concentrations at surface water sampling station SW6 will be modified, as required, based on additional background surface water quality data which will be obtained during future monitoring programs.

## 10.8 Trigger Formats

### 10.8.1 Groundwater Trigger

The trigger parameters are chloride, manganese, boron, DOC, TDS and sodium. The trigger concentrations will be those calculated using MOE Guideline B-7 or the existing background if higher than ODWO/S. The calculated trigger concentrations will be based on all the background data which exists at the time of each comparison with the trigger criteria. These trigger concentrations may vary over time as background concentrations from future monitoring programs are added to the data base.

The groundwater trigger will be considered to have been exceeded when one or more of the above trigger parameters exceeds the maximum trigger concentration during two consecutive monitoring sessions (not including non-compliance verification re-sampling).

Any observed exceedances of the primary trigger concentrations will be verified, where appropriate, by re-sampling for the parameter(s) of concern within one month of the original sampling session at which time non-compliance was measured. The time frame of one month is to allow time for the initial chemical analyses to be performed, received from the analytical laboratory and interpreted. If the non-compliance is not confirmed by the follow-up sample, then the initial non-compliance will be considered anomalous and will be discounted. The historical trends in the ***Compliance Evaluation Parameter*** concentrations at the points of compliance would also be used in concluding that monitoring results are anomalous.

If exceedances of the primary trigger parameter concentrations are confirmed at the trigger location (i.e., confirmed non-compliance during two consecutive monitoring sessions), a three-step process will be initiated for the purpose of determining whether implementation of a contingency plan is warranted. The three-step process is as follows:

Step 1 - assess whether the non-compliance is due to migration of the leachate plume as a whole, or whether it is partially or wholly explicable by other factors. This will be achieved by considering trends in ***Key Indicator Parameter*** concentrations at all relevant monitoring locations as well as data available from ***Surveillance Monitors/Stations*** or could include an expanded suite of monitoring parameters (if warranted depending on the ongoing monitoring results from the ***Surveillance Groundwater Monitors*** and ***Surveillance Surface Water Stations***) and/or an increased sampling frequency

Step 2 - discussion of the results of Step 1 between the Municipality and the MOE to decide whether implementation of the contingency plan is warranted

Step 3 - if the conclusion of Step 2 is affirmative, then a groundwater contingency plan would be implemented

### 10.8.2 Surface Water Trigger

The trigger parameter is boron. For surface water stations SW6 (Paxton Creek), the trigger concentration will be based on all background data and PWQO which exists at the time of each comparison with the trigger concentration. These trigger concentrations derived from background data at station SW6 may vary over time as background concentrations from future monitoring programs are added to the data base.

The surface water trigger will be considered to have been exceeded when one or more of the above trigger parameter(s) exceeds the maximum allowable concentration (i.e., trigger concentrations) during two consecutive monitoring sessions (not including non-compliance verification re-sampling).

Any observed non-compliance will be verified, where appropriate, by re-sampling for the parameter(s) of concern within one month of the initial sampling session. The time frame of one month is to allow time for the initial chemical analyses to be performed, received from the analytical laboratory and interpreted. If the non-compliance is not confirmed by the follow-up sample, then the initial non-compliance will be considered anomalous and will be discounted. The historical trends in the ***Compliance Evaluation Parameter*** concentrations at the point of compliance would also be used in assuming whether or not these monitoring results are anomalous.

If non-compliance is confirmed at the trigger location (i.e., confirmed non-compliance during two consecutive monitoring sessions), a three-step process will be initiated for the purpose of determining whether implementation of the contingency plan is warranted. The three-step process is as follows:

Step 1 - assess whether the non-compliance is due to migration of the leachate plume as a whole, or whether it is partially or wholly explicable by other factors. This will be achieved by considering trends in ***Key Indicator Parameter*** concentrations at all relevant monitoring locations as well as data available from ***Surveillance Monitors/Stations*** or could include an expanded suite of monitoring parameters (if warranted depending on the ongoing monitoring results from the ***Surveillance Groundwater Monitors*** and ***Surveillance Surface Water Stations***) and/or an increased sampling frequency

Step 2 - discussion of the results of Step 1 between the Municipality and the MOE to decide whether implementation of the contingency plan is warranted

Step 3 - if the conclusion of Step 2 is affirmative, then a surface water contingency plan would be implemented

## 10.9 Trigger Locations

For the purpose of establishing distinct trigger mechanisms for this site, each of the four site boundaries are discussed separately in the following subsections. These site boundaries, together with their associated trigger mechanisms (where appropriate), are as follows, with rationale provided in subsections 10.9.1, 10.9.2 and 10.9.3.

- west boundary (no trigger required)
- south boundary (no trigger required)
- east boundary (groundwater trigger)
- north boundary (surface water trigger)

### 10.9.1 West and South Boundaries

Theoretically, the trigger mechanism for the west and south boundaries would likely be a groundwater trigger mechanism. Since the interpreted direction of groundwater flow is toward the north and there is no potential for adverse impact on water resources beyond the south and west property lines, no trigger mechanisms are required for these two boundaries.

### 10.9.2 East Boundary

The trigger mechanism for the east boundary (adjacent to the former area of landfilling) is a groundwater trigger. The groundwater trigger monitoring location along this property boundary would be monitor BH96-1.

### 10.9.3 North Boundary

Theoretically, the trigger mechanism for the north property boundary would likely be a groundwater trigger mechanism. However, Paxton Creek is understood to be within the landfill property and south of the northern site boundary. It is likely that any leachate-impacted groundwater downgradient of the landfill areas would likely be intercepted by Paxton Creek (as indicated by groundwater quality at multi-level groundwater monitoring location BH01-8), rather than migrating further north towards the northern property boundary. The trigger monitoring location along the north property boundary is surface water station SW8 (i.e., the "point of compliance" where Paxton Creek flows off the landfill property).

## 10.10 Modification to Trigger Mechanisms

If, depending on observations and ongoing site monitoring results, there is a need in the future to modify the trigger mechanisms, a formal application would be made by the Municipality to the MOE requesting the necessary changes.

## 11.0 LIMITATIONS AND USE OF REPORT

This report was prepared for the exclusive use of the Corporation of the Nation Municipality. The report, which specifically includes all tables, figures and appendices, is based on data and information collected by Golder Associates 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 Associates as described in this report, and in the previous reports prepared by Golder Associates (see *References* for list of previous reports). Each of these reports must be read and understood collectively, and can only be relied upon in their totality.

Golder Associates has relied in good faith on all information provided and does not accept responsibility for any deficiency, misstatements, or inaccuracies contained in the reports as a result of omissions, misinterpretation, or fraudulent acts of the persons contacted or errors or omissions in the reviewed documentation.

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 practicing 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 Associates 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 and conclusions 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 Associates 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 or previous investigations by Golder Associates have been left in place. These groundwater monitors are the property of the Corporation of the Nation Municipality and not Golder Associates.

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# TABLE 1

## INTERPRETATION OF 2001 GROUNDWATER QUALITY DATA
## IMPACT EVALUATION MONITORING WELLS

| Sampling Location | Monitoring Well | Parameters Exceeding ODWS/O | Trend(s) | Parameters Consistently Elevated Compared to Background Conditions at BH96-4 | Hydrogeological Interpretation |
|---|---|---|---|---|---|
| BH96-1 | BH96-1<br>Silty Sand | Manganese | • groundwater quality consistent over time<br>• variable aluminum, iron and manganese concentrations | boron, chloride, DOC, hardness, manganese, sodium, strontium, sulphate, TDS | • borehole BH96-1 is located within the past area of landfilling, northeast of the area presently being landfilled. This monitor is considered to be a site boundary monitor for the eastern boundary (see Figure 2).<br>• groundwater quality in monitoring well BH96-1 is interpreted to be impacted by landfill leachate (based on elevated concentrations of boron, chloride, DOC, manganese, strontium, TDS and sodium). |
| * BH96-2 | BH96-2<br>Silty Sand | — | • groundwater quality consistent over time<br>• variable iron concentrations<br>• decreasing trend in concentrations of chloride | — | • borehole BH96-2 is located south (upgradient) of the northern site boundary but downgradient of areas past and presently landfilled (see Figure 2).<br>• Groundwater monitoring well BH96-2 was dry and *could not be sampled in 2001*. Based on historical data, groundwater quality at this monitor is interpreted to exhibit a minor impact from landfill leachate (based primarily on elevated levels of boron, manganese, strontium and TDS). |
| BH96-3 | BH96-3<br>Silty Sand | Manganese<br>TDS | • groundwater quality generally consistent over time<br>• variable aluminum, ammonia, iron, nitrate and total phosphorus concentrations<br>• decreasing trend in concentrations of strontium, sulphate and TDS since October 1999 | alkalinity, boron, chloride, DOC, hardness, manganese, nitrate, sodium, strontium, sulphate, TDS | • borehole BH96-3 is located within the past area of landfilling, downgradient (north) of the area presently being landfilled (see Figure 2).<br>• groundwater quality in monitoring well BH96-3 is interpreted to be impacted by landfill leachate (based on elevated concentrations of boron, chloride, DOC, manganese, strontium, TDS and sodium). |
| BH96-4 | BH96-4<br>Silty Sand | [None] | • groundwater quality generally consistent over time<br>• variable aluminum, COD, iron, phosphate and total phosphorus concentrations | NA | • borehole BH96-4 is located south (hydrogeologically upgradient) of both current and past areas of landfilling (see Figure 2).<br>• groundwater quality at monitoring well BH96-4 does not appear to be impacted by landfill leachate and is considered representative of natural groundwater quality in the overburden. |

## TABLE 1 – Continued

| Sampling Location | Monitoring Well | Parameters Exceeding ODWS/O | Trend(s) | Parameters Consistently Elevated Compared to Background Conditions at BH96-4 | Hydrogeological Interpretation |
|---|---|---|---|---|---|
| BH99-5 | BH99-5<br><br>Silty Sand | Chloride (Nov)<br>DOC (Nov)<br>TDS | • increasing trend in concentrations of chloride, DOC, hardness, manganese, sodium, strontium, sulphate and TDS, with highest recorded concentrations in 2001<br>• decreasing trend in concentrations of total phosphorus<br>• variable aluminum, ammonia and COD concentrations | barium, chloride, COD, conductivity, hardness, sodium, strontium, sulphate, TDS | • borehole BH99-5 is located south (upgradient) of the northern site boundary but downgradient of areas past and presently landfilled (see Figure 2).<br>• groundwater quality in monitoring well BH99-5 is interpreted to be impacted by landfill leachate (based on elevated concentrations of chloride, strontium, TDS and sodium). |
| BH99-6 | BH99-6<br><br>Silty Sand / Sand | DOC<br>Iron<br>Manganese<br>TDS (Jun) | • groundwater quality consistent over time<br>• decreasing trend in concentrations of alkalinity and ammonia | alkalinity, ammonia, barium, boron, chloride, cobalt, COD, DOC, hardness, iron, manganese, phenols, potassium, sodium, strontium, TDS | • borehole BH99-6 is located between the active landfilling area (immediately downgradient) and the former landfill area (see Figure 2).<br>• leachate conditions at the site are represented by groundwater quality at monitoring well BH99-6, which is interpreted to be impacted by landfill leachate. |
| BH99-7 | BH99-7<br><br>Silty Sand / Sand | [None] | • groundwater quality consistent over time | [None] | • borehole BH99-7 is located northwest of the active landfill. This borehole is situated west of the access road but east of the western site boundary (see Figure 2).<br>• groundwater quality at monitoring well BH99-7 does not appear to be impacted by landfill leachate and is considered representative of natural groundwater quality in the overburden. |
| BH01-8 | BH01-8A<br><br>Silty Sand | [None] | • NA | ammonia, dissolved reactive phosphorus, phosphate, sodium | • borehole BH01-8 is located south of the northern site boundary downgradient of areas past and presently landfilled (see Figure 2).<br>• groundwater quality in monitoring well BH01-8A does not appear to be impacted by landfill leachate. |
| BH01-8 | BH01-8B<br><br>Silty Sand | DOC<br>Manganese | • NA | ammonia, boron, chloride, COD, DOC, hardness, manganese, sodium, strontium, sulphate, TDS | • borehole BH01-8 is located south of the northern site boundary downgradient of areas past and presently landfilled (see Figure 2).<br>• groundwater quality in monitoring well BH01-8B is interpreted to be potentially impacted by landfill leachate (based on elevated concentrations of chloride, DOC, manganese, strontium, TDS and sodium). Current data base includes only one monitoring session. |

NOTES: ODWS/O - Ontario Drinking Water Standards/Objectives (Ministry of the Environment, 2001)
NA - Not Applicable
* Groundwater monitor not sampled in 2001

## TABLE 2

## SUMMARY OF PARAMETERS EXCEEDING REASONABLE USE PERFORMANCE OBJECTIVES BASED ON BACKGROUND CONDITIONS AT MONITORING WELL BH96-4

| Monitor | Monitoring Session | | | |
|---|---|---|---|---|
| | June 2001 | | November 2001 | |
| | Parameter | Concentration (mg/L) | Parameter | Concentration (mg/L) |
| BH96-1 | Manganese<br>TDS | 0.13<br>480 | Manganese<br>TDS | 0.49<br>448 |
| BH96-2 | Dry | Dry | Dry | Dry |
| BH96-3 | <br>Manganese<br>TDS | <br>0.58<br>588 | DOC<br>Manganese<br>TDS | 3.7<br>1.08<br>604 |
| BH99-5 | Chloride<br><br>TDS | 232<br><br>780 | Chloride<br>DOC<br>TDS | 252<br>7.7<br>1150 |
| BH99-7 | [None] | — | [None] | — |
| BH01-8A | Not Sampled | Not Sampled | [None] | — |
| BH01-8B | Not Sampled | Not Sampled | DOC<br>Manganese<br>TDS | 9.6<br>0.12<br>388 |

Notes: mg/L – milligrams per litre

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## TABLE 3

## INTERPRETATION OF 2001 SURFACE WATER QUALITY DATA

| Surface Water Sampling Station | Parameters Consistently Exceeding PWQO | Trend(s) | Parameters Consistently Elevated Compared to Background Conditions | Interpretation |
|---|---|---|---|---|
| * SW-1 | — | • NA | — | • surface water drainage stream leading from the east side of the landfill flowing north into Paxton Creek.<br>• surface water station SW-1 has *not been sampled since 1996.* |
| SW-2 | — | • NA | — | • north flowing ephemeral stream located north of landfill and at the base of the north slope.<br>• surface water station SW-2 was dry and *could not be sampled in 2001.* Based on historical data, surface water quality at this station is interpreted to not be impacted by landfill leachate. |
| SW-3 | iron, total phosphorus | • surface water quality generally consistent over time<br>• variable iron concentrations<br>• increased concentrations of sulphate in 2001 | alkalinity, hardness, sodium, strontium, TDS | • surface water drainage stream leading from the east side of the landfill flowing north into Paxton Creek.<br>• monitoring station is located just north of the landfill and at the base of the north slope.<br>• surface water quality at SW-3 is interpreted to not be impacted by landfill leachate. |
| SW-4 | iron, total phosphorus | • variable alkalinity, aluminum, ammonia, COD, DOC, hardness, iron, nitrate, strontium concentrations | alkalinity, ammonia, boron, COD, DOC, hardness, iron, manganese, sodium, strontium, TDS | • surface water monitoring station is located in the marsh between Paxton Creek and the landfill.<br>• surface water quality from this location is not considered to be representative of the surface water regime in the area due to the stagnant nature of this location (swamp). |
| SW-5 | iron, total phosphorus | • surface water quality generally consistent over time<br>• variable COD, iron and phosphate concentrations | alkalinity, hardness, sodium, strontium, TDS | • surface water monitoring station is located in drainage stream leading from the east side of the landfill flowing north into Paxton Creek.<br>• monitoring station is located in stream just prior to entering Paxton Creek.<br>• surface water quality at SW-5 is interpreted to not be impacted by landfill leachate. |
| SW-6 | iron, total phosphorus | • variable aluminum, chloride, conductivity, iron, nitrate, sulphate concentrations<br>• highest chloride, sulphate and TDS concentrations in November 2001 | NA | • surface water monitoring station is located in Paxton Creek upstream of the point where the east drainage stream intersects with Paxton Creek.<br>• monitoring station SW-6 does not appear to be impacted by landfill leachate and is considered representative of the natural surface water quality in Paxton Creek. |

## TABLE 3 - continued

| Surface Water Sampling Station | Parameters Consistently Exceeding PWQO | Trend(s) | Parameters Consistently Elevated Compared to Background Conditions | Interpretation |
|---|---|---|---|---|
| SW-7 | iron, total phosphorus | • variable aluminum, ammonia, iron, nitrate, sulphate and total phosphorus concentrations | NA | • surface water monitoring station is located in the eastern drainage stream located off-site and east (upstream) of the Caledonia Landfill.<br>• monitoring station SW-7 does not appear to be impacted by landfill leachate and is considered representative of the natural surface water quality in the eastern drainage stream. |
| SW-8 | iron, total phosphorus | • surface water quality generally consistent over time<br>• variable aluminum and nitrate concentrations<br>• highest chloride, sulphate and TDS concentrations in November 2001 | [None] | • surface water monitoring station is located in Paxton Creek at the western property boundary.<br>• surface water quality at SW-8 is interpreted to not be impacted by landfill leachate. |

NOTES: PWQO – Provincial Water Quality Objectives (Ministry of the Environment, 1994b)
NA – Not Applicable
* Surface water station not sampled in 2001

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## TABLE 4

## PROPOSED 2002 GROUNDWATER MONITORING PROGRAM
## CALEDONIA LANDFILL SITE
## NATION MUNICIPALITY, ONTARIO

### 1.0 MONITORING SESSIONS

**1.1 Water Level and Quality Monitoring**

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

### 2.0 GROUNDWATER SAMPLING LOCATIONS

**2.1 Routine Sampling Locations**
BH96-2, BH96-3, BH99-5, BH99-7

**2.2 Surveillance Sampling Locations**
BH96-1, BH96-4, BH99-6, BH01-8A, BH01-8B

**2.3 Field Duplicate** (Surveillance Parameters)

### 3.0 FIELD MEASURED PARAMETERS

Groundwater levels in all accessible monitoring wells

temperature, conductivity, pH

### 4.0 LABORATORY MEASURED PARAMETERS

**4.1 Routine Sampling Locations**

***Key Indicator Parameters***
boron, chloride, manganese, strontium, TDS,
DOC, sodium and hardness

**4.2 Surveillance Sampling Locations**

***Surveillance Parameters***
calcium, magnesium, sodium, potassium, aluminum, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, phosphorus (dissolved reactive), silicon, silver, strontium, sulphur, thallium, tin, titanium, vanadium, zinc (ICP Scan)
hardness (calculated from laboratory calcium and magnesium analyses)
alkalinity, TDS, chloride, sulphate, nitrate, nitrite, ortho-phosphate
ammonia, DOC, COD
phenols

**Special Note For Parameters with Established Provincial Water Quality Criteria -** All laboratory analyses on groundwater samples will 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 Provincial Water Quality Objectives or the Ontario Drinking Water Standards/Objectives, whichever is lower.

## TABLE 5

## PROPOSED 2002 SURFACE WATER MONITORING PROGRAM
## CALEDONIA LANDFILL SITE
## NATION MUNICIPALITY, ONTARIO

### 1.0 MONITORING SESSIONS

**1.1 Water Quality Monitoring**

Spring (April/May)
Fall (September/October)
Precipitation Event (to be conducted within 24 hours of a significant precipitation event)*.

** If no significant (>10 mm) precipitation event is observed during the summer or early fall, this surface water session will be conducted in December*

### 2.0 SURFACE WATER SAMPLING STATIONS

**2.1 Routine Sampling Locations**
SW2, SW3, SW5

**2.2 Surveillance Sampling Locations**
SW7, SW8, SW6

**2.3 Field Duplicate** (Surveillance Parameters)

### 3.0 FIELD MEASURED PARAMETERS

temperature, conductivity, pH, dissolved oxygen, flow estimates,

Observations of aquatic invertebrates, algae growth, aquatic plants, and litter/debris at each station

### 4.0 LABORATORY MEASURED PARAMETERS

**4.1 Routine Sampling Stations**

***Key Indicator Parameters***
boron, chloride, manganese, strontium, TDS,
DOC, sodium and hardness

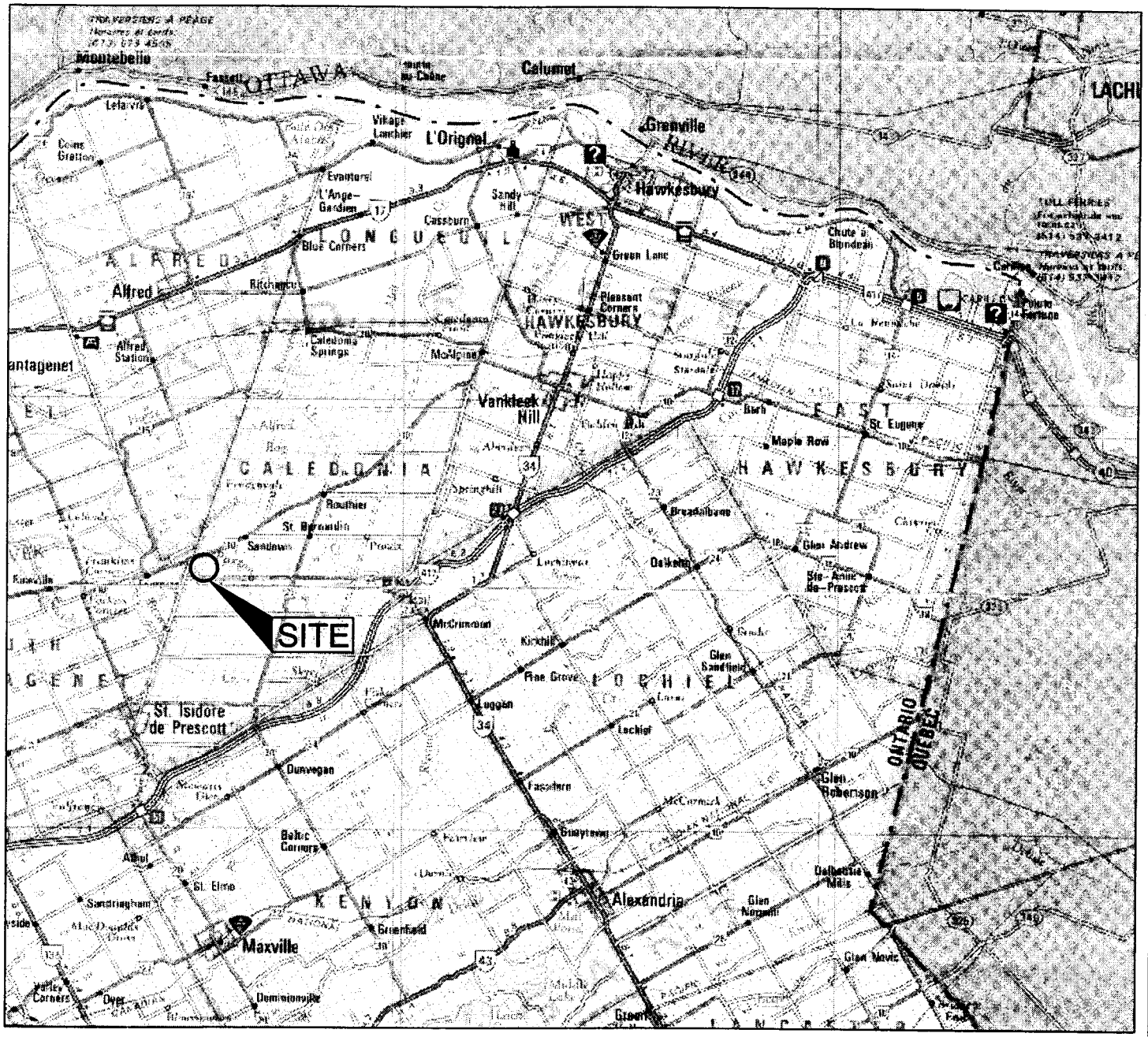
**4.3 Surveillance Sampling Locations**

***Surveillance Parameters***
calcium, magnesium, sodium, potassium, aluminum, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, phosphorus (total), silicon, silver, strontium, sulphur, thallium, tin, titanium, vanadium, zinc (ICP Scan)
hardness (calculated from laboratory calcium and magnesium analyses)
alkalinity, TDS, chloride, sulphate, nitrate, nitrite, ortho-phosphate
ammonia, DOC, COD
phenols

**Special Note For Parameters with Established Provincial Water Quality Criteria** - All laboratory analyses on surface water samples will 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 Provincial Water Quality Objectives or the Ontario Drinking Water Standards/Objectives, whichever is lower.

# KEY PLAN

FIGURE 1




SCALE 1 : 250,000

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

Date: MARCH 2002

Project: 011-2877

Golder Associates

Drawn: S.L.

Chkd: AH

N:\ACTIVE\2800\011-2877\ACAD\0112877-1000-01.DWG

# APPENDIX A

## RECORD OF BOREHOLE SHEETS

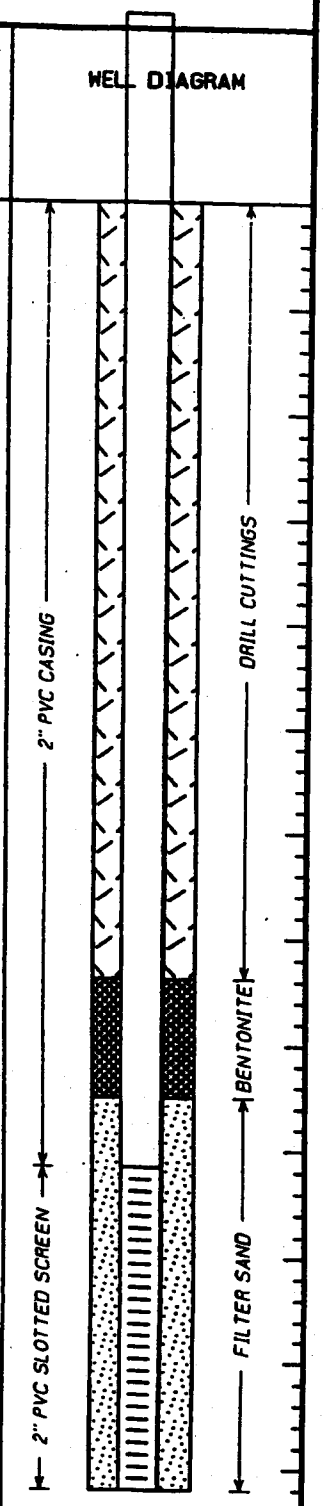
BEATTY FRANZ & ASSOCIATES

# Observation Well BH96-1

| | |
|---|---|
| PROJECT: *CALEDONIA LANDFILL* | LOCATION: *TOWNSHIP OF CALEDONIA ONTARIO* |
| PROJECT NO.: *141-961* | GROUND SURFACE ELEVATION: *64.70 M.A.S.L.* |
| DATE STARTED: *NOVEMBER 14, 1996* | TOC ELEVATION: *65.58 M.A.S.L.* |
| DATE FINISHED: *NOVEMBER 14, 1996* | WATER LEVEL: *61.99 M.A.S.L.* |
| DRILLING METHOD: *HOLLOW STEM* | TOTAL DEPTH: *6.10 metres* |
| DRILLING COMPANY: *DOWNING* | LOGGED BY: *D.B.* |

| DEPTH metres | ELEVATION | SAMPLE NO. | Sample Interval | HNU (ppm) VALUES | HNU (ppm) PROFILE 0 100 | GRAPHIC LOG | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|
| 0 | 64.5 | SS-1 | | | | | SILTY SAND, fine grained, light brown, trace organics, dry. |
| 1 | 64 | SS-2 | | | | | No organics |
| | 63.5 | | | | | | |
| 2 | 63 | SS-3 | | | | | |
| | 62.5 | | | | | | Moist at 2.29m. |
| | 62 | SS-4 | | | | | |
| 3 | 61.5 | SS-5 | | | | | Wet at 3.05m. |
| | 61 | | | | | | |
| 4 | 60.5 | SS-6 | | | | | |
| | 60 | SS-7 | | | | | |
| 5 | 59.5 | | | | | | |
| | 59 | SS-8 | | | | | |
| 6 | | | | | | | END OF HOLE |

WELL DIAGRAM




Note: This borehole log was prepared for hydrogeological and/or environmental assessment purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by Beatty Franz and Associates personnel before use by others.

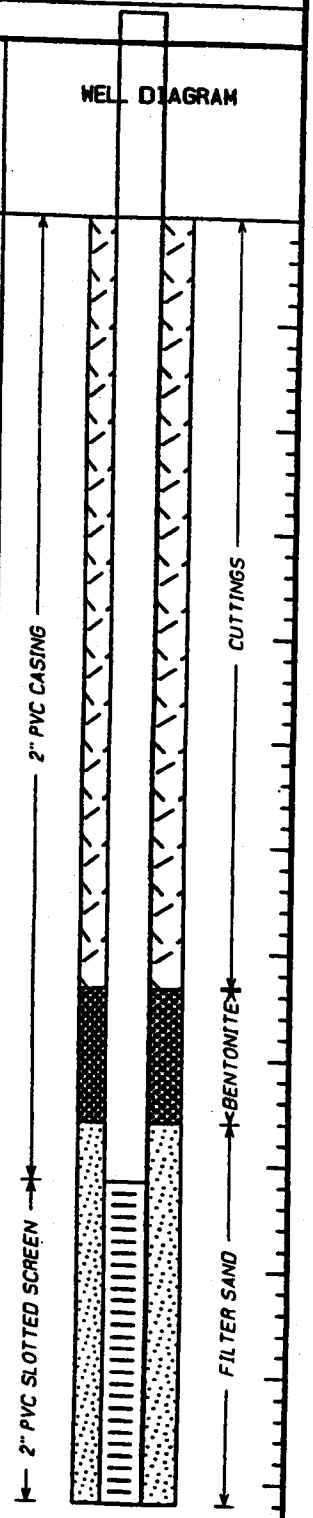
BEATTY FRANZ & ASSOCIATES

# Observation Well BH96-2

| | |
|---|---|
| PROJECT: *CALEDONIA LANDFILL* | LOCATION: *TOWNSHIP OF CALEDONIA, ONTARIO* |
| PROJECT NO.: *141-961* | GROUND SURFACE ELEVATION: *63.94 M.A.S.L.* |
| DATE STARTED: *NOVEMBER 14, 1996* | TOC ELEVATION: *64.89 M.A.S.L.* |
| DATE FINISHED: *NOVEMBER 14, 1996* | WATER LEVEL: *59.02 M.A.S.L.* |
| DRILLING METHOD: *HOLLOW STEM* | TOTAL DEPTH: *6.10 metres* |
| DRILLING COMPANY: *DOWNING* | LOGGED BY: *D.B.* |

| DEPTH metres | ELEVATION | SAMPLE NO. | Sample Interval | HNU (ppm) VALUES | HNU (ppm) PROFILE 0 100 | GRAPHIC LOG | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|
| 1 | 63.5 | | | | | | SILTY SAND, fine grained, light brown, dry. |
| | 63 | | | | | | |
| | 62.5 | | | | | | |
| 2 | 62 | SS-1 | | | | | |
| | 61.5 | SS-2 | | | | | |
| 3 | 61 | | | | | | Some clay. |
| | 60.5 | SS-3 | | | | | |
| 4 | 60 | SS-4 | | | | | Moist at 3.81m. |
| | 59.5 | | | | | | Wet at 4.57m. |
| 5 | 59 | SS-5 | | | | | |
| | 58.5 | | | | | | |
| 6 | 58 | SS-6 | | | | | END OF HOLE |

WELL DIAGRAM




Note: This borehole log was prepared for hydrogeological and/or environmental assessment purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by Beatty Franz and Associates personnel before use by others.

BEATTY FRANZ & ASSOCIATES

# Observation Well BH96-3

| | |
|---|---|
| PROJECT: *CALEDONIA LANDFILL* | LOCATION: *TOWNSHIP OF CALEDONIA, ONTARIO* |
| PROJECT NO.: *141-961* | GROUND SURFACE ELEVATION: *64.02 M.A.S.L.* |
| DATE STARTED: *NOVEMBER 15, 1996* | TOC ELEVATION: *64.88 M.A.S.L.* |
| DATE FINISHED: *NOVEMBER 15, 1996* | WATER LEVEL: *59.99 M.A.S.L.* |
| DRILLING METHOD: *HOLLOW STEM* | TOTAL DEPTH: *6.10 metres* |
| DRILLING COMPANY: *DOWNING* | LOGGED BY: *D.B.* |

| DEPTH metres | ELEVATION | SAMPLE NO. | Sample Interval | HNU (ppm) VALUES | HNU (ppm) PROFILE 0 100 | GRAPHIC LOG | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|
| 0 | 64 | | | | | | |
| | 63.5 | | | | | | SILTY SAND, with cross bedding, fine grained, light brown/grey, dry. |
| 1 | 63 | SS-1 | | | | | |
| | 62.5 | | | | | | SILTY SAND, fine grained, light brown, moist. |
| 2 | 62 | SS-2 | | | | | |
| | 61.5 | SS-3 | | | | | |
| 3 | 61 | | | | | | |
| | | SS-4 | | | | | |
| | 60.5 | | | | | | |
| 4 | 60 | SS-5 | | | | | |
| | 59.5 | | | | | | |
| | | SS-6 | | | | | |
| 5 | 59 | | | | | | |
| | 58.5 | SS-7 | | | | | |
| 6 | 58 | | | | | | END OF HOLE |

WELL DIAGRAM

2" PVC CASING

2" PVC SLOTTED SCREEN

BENTONITE

FILTER SAND

DRILL CUTTINGS

Note: This borehole log was prepared for hydrogeological and/or environmental assessment purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by Beatty Franz and Associates personnel before use by others.

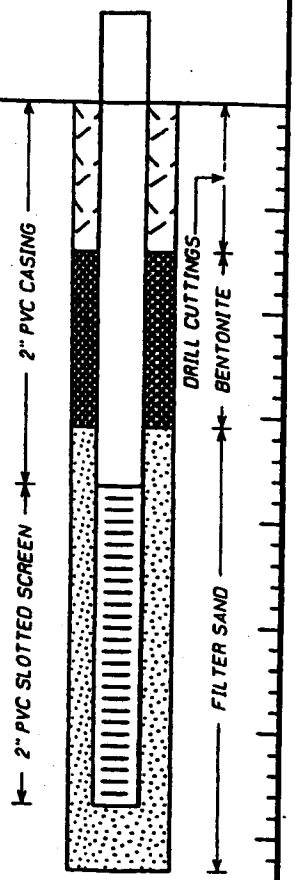
BEATTY FRANZ & ASSOCIATES

# Observation Well BH96-4

| | |
|---|---|
| PROJECT: *CALEDONIA LANDFILL* | LOCATION: *TOWNSHIP OF CALEDONIA, ONTARIO* |
| PROJECT NO.: *141-961* | GROUND SURFACE ELEVATION: *64.90 M.A.S.L.* |
| DATE STARTED: *NOVEMBER 15, 1996* | TOC ELEVATION: *65.35 M.A.S.L.* |
| DATE FINISHED: *NOVEMBER 15, 1996* | WATER LEVEL: *64.34 M.A.S.L.* |
| DRILLING METHOD: *HOLLOW STEM* | TOTAL DEPTH: *3.66 metres* |
| DRILLING COMPANY: *DOWNING* | LOGGED BY: *D.B.* |

| DEPTH metres | ELEVATION | SAMPLE NO. | Sample Interval | HNU (ppm) VALUES | HNU (ppm) PROFILE 0 100 | GRAPHIC LOG | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|
| 1 | 64.5 | | | | | | SILTY SAND, fine grained, light brown, moist. |
| | 64 | SS-1 | | | | | |
| | 63.5 | | | | | | Wet at 1.52m. |
| 2 | 63 | SS-2 | | | | | |
| | 62.5 | | | | | | |
| | | SS-3 | | | | | |
| 3 | 62 | | | | | | Some clay, wet. |
| | 61.5 | SS-4 | | | | | |
| | 61 | | | | | | END OF HOLE |
| 4 | 60.5 | | | | | | |
| | 60 | | | | | | |
| 5 | 59.5 | | | | | | |
| | 59 | | | | | | |
| 6 | | | | | | | |

WELL DIAGRAM




Note: This borehole log was prepared for hydrogeological and/or environmental assessment purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by Beatty Franz and Associates personnel before use by others.

# 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, $60^0$ 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 |

**Peizo-Cone Penetration Test (CPT):**
An electronic cone penetrometer with a $60^0$ 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 | $C_{u2}S_u$ Kpa | 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 limited |
| $w_l$ | liquid limit |
| C | consolidaiton (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) |
| $\gamma$ | unit weight |

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

# LIST OF SYMBOLS

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

## I. GENERAL

| | |
|---|---|
| $\pi$ | = 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

| | |
|---|---|
| $\gamma$ | shear strain |
| $\Delta$ | change in, e.g. in stress: $\Delta\sigma'$ |
| $\varepsilon$ | linear strain |
| $\varepsilon_v$ | volumetric strain |
| $\eta$ | coefficient of viscosity |
| $\nu$ | Poisson's ratio |
| $\sigma$ | total stress |
| $\sigma'$ | effective stress ($\sigma' = \sigma$"-u) |
| $\sigma'_{vo}$ | initial effective overburden stress |
| $\sigma_1\sigma_2\sigma_3$ | principal stresses (major, intermediate, minor) |
| $\sigma_{oct}$ | mean stress or octahedral stress $= (\sigma_1+\sigma_2+\sigma_3)/3$ |
| $\tau$ | 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 |
| $\gamma'$ | unit weight of submerged soil ($\gamma'=\gamma-\gamma_w$) |
| $D_R$ | relative density (specific gravity) of solid particles ($D_R = p_s/p_w$) formerly ($G_s$) |
| e | void ratio |
| n | porosity |
| S | degree of saturation |

* Density symbol is p. Unit weight symbol is $\gamma$ where $\gamma$=pg(i.e. mass density x acceleration due to gravity)

### (a) Index Properties (cont'd.)

| | |
|---|---|
| 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 poential |
| 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 |
| $C_a$ | 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 |
| $\sigma'_p$ | pre-consolidation pressure |
| OCR | Overconsolidation ratio=$\sigma'_p/\sigma'_{vo}$ |

### (e) Shear Strength

| | |
|---|---|
| $\tau_p\tau_r$ | peak and residual shear strength |
| $\phi'$ | effective angle of internal friction |
| $\delta$ | angle of interface friction |
| $\mu$ | coefficient of friction=tan $\delta$ |
| 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: 991-2834

# RECORD OF BOREHOLE: BH 99-5

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: May 3, 1999

DATUM: Geodetic

| DEPTH SCALE METRES | BORING METHOD | DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) |
|---|---|---|---|---|
| | | Ground Surface | | 57.72 |
| 0 | Wash Boring / BW Casing | Dark brown SILTY TOPSOIL. | | 0.00 / 57.54 |
| | | Brown to grey SILTY fine SAND, occasional sandy silt seam. | | 0.18 |
| 1 | | | | |
| 2 | | | | 54.98 |
| | | END OF BOREHOLE | | 2.74 |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

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: $10^{-3}$ $10^{-5}$ $10^{-7}$ $10^{-9}$

WATER CONTENT PERCENT: Wp — W — Wl; 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

100mm x 100mm Protective Casing

Bentonite Seal

Sand and Native Backfill

32mm PVC #10 Slot Screen

W.L. in Screen at Elev.57.86m, 0.14m Above Ground Surface Oct. 12, 1999

DEPTH SCALE 1 : 25

Golder Associates

LOGGED: DJS

CHECKED: AM

BOREHOLE 991-2834.GPJ HYDROGEO.GDT 3 29 00

PROJECT: 991-2834

# RECORD OF BOREHOLE: BH 99-6

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: May 3, 1999

DATUM: Geodetic

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Power Auger 200mm Diam. Hollow Stem | Ground Surface | | 65.22 | | | | | | | |
| | | Dark brown SILTY TOPSOIL. | | 0.00 / 65.07 | | | | | | | 100mm x 100mm Protective Casing |
| | | Loose brown to grey SILTY fine SAND, occasional thin sandy silt seam. (Stratified) | | 0.15 | | | | | | | Bentonite Seal |
| 1 | | | | | 1 | SS DO | 9 | | | | Native Backfill |
| | | | | | 2 | SS DO | 7 | | | | Bentonite Seal |
| 2 | | | | | 3 | SS DO | 5 | | | | Sand and Native Backfill |
| 3 | | | | | 4 | SS DO | 3 | | | | |
| | | Loose grey fine SAND, trace silt, occasional silty clay seam. | | 61.56 / 3.66 | | | | | | | 50mm PVC #10 Slot Screen |
| 4 | | | | | 5 | SS DO | 7 | | | | |
| | | END OF BOREHOLE | | 60.65 / 4.57 | | | | | | | W.L in Screen at Elev.62.00m Oct. 12, 1999 |
| 5 | | | | | | | | | | | |

BOREHOLE 991-2834.GPJ HYDROGEO.GDT 3 29 00

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: DJS

CHECKED: AM

PROJECT: 991-2834

# RECORD OF BOREHOLE: BH 99-7

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: May 3, 1999

DATUM: Geodetic

| 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; SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕) | HYDRAULIC CONDUCTIVITY, k, cm/s; WATER CONTENT PERCENT (Wp, W, Wl) | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ground Surface | | 65.16 | | | | | | | |
| 0 | Power Auger 200mm Diam. Hollow Stem | Dark brown SILTY TOPSOIL. | | 0.00 | | | | | | | 100mm x 100mm Protective Casing |
| | | | | 64.95 | | | | | | | |
| | | Loose brown stratified SILTY fine SAND, occasional sandy silt seam. | | 0.21 | | | | | | | Bentonite Seal |
| 1 | | | | | 1 | 50 DO | 7 | | | | Native Backfill |
| | | | | | | | | | | | Bentonite Seal |
| | | | | | 2 | 50 DO | 7 | | | | |
| 2 | | | | | | | | | | | |
| | | | | | 3 | 50 DO | 7 | | | | Sand and Native Backfill |
| 3 | | | | | | | | | | | |
| | | | | | 4 | 50 DO | 5 | | | | |
| | | Loose brown stratified fine SAND, trace silt. | | 61.56 3.60 | | | | | | | 50mm PVC #10 Slot Screen |
| 4 | | | | | 5 | 50 DO | 5 | | | | |
| | | END OF BOREHOLE | | 60.59 4.57 | | | | | | | W.L. in Screen at Elev.62.31m Oct. 12, 1999 |
| 5 | | | | | | | | | | | |

BOREHOLE 991-2834.GPJ HYDROGEO.GDT 3 29 00

DEPTH SCALE
1 : 25

Golder Associates

LOGGED: DJS

CHECKED: AH

PROJECT: 011-2877

# RECORD OF BOREHOLE: BH 01-8

SHEET 1 OF 1

LOCATION: SEE SITE PLAN

BORING DATE: NOV. 6, 2001

DATUM: Geodetic

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 | | 57.06 | | | |
| 0 | POWER AUGER 200 mm Diam. (Hollow Stem) | Dark brown silty TOPSOIL | | 0.00 / 56.81 | | | |
| | | Loose brown SILTY FINE SAND | | 0.24 / 56.43 | 1 | 50 DO | 3 |
| 1 | | | | | | | |
| | | Very loose dark brown SILTY SAND, some organic matter (alluvium) | | 1.62 / 53.33 | 2 | 50 DO | 1 |
| 2 | | | | | 3 | 50 DO | 2 |
| 3 | | | | | 4 | 50 DO | 1 |
| | | Loose grey stratified SILTY FINE SAND, occasional thin silty clay seam | | 3.72 / 51.56 | 5 | 50 DO | 4 |
| 4 | | | | | | | |
| | | | | | 6 | 50 DO | 4 |
| 5 | | | | | | | |
| | | END OF BOREHOLE | | 5.49 | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |

SAMPLES

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

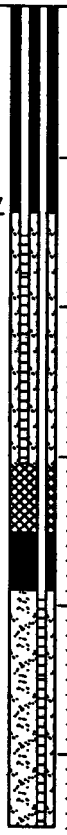
SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○

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 A at elev. 55.67 m (Nov. 21, 2001)

W.L. in screen B at elev. 55.67m (Nov. 21, 2001)

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: AMH

BOREHOLE 011-2877.GPJ GLDR_CAN.GDT 14/12/01 M.A.C.

# APPENDIX B

## REPORT OF ANALYSES
## ACCUTEST LABORATORIES LTD.

# APPENDIX B-I

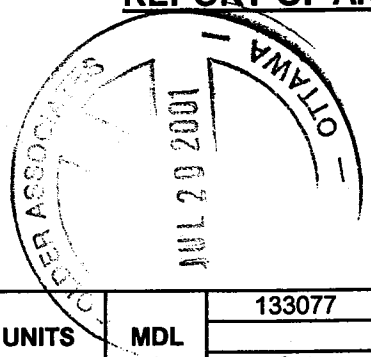
## SPRING MONITORING SESSION

**NOTES:**

**S-1 = BH96-4**
**S-2 = BH99-7**
**S-3 = BH99-6**
**S-5 = BH96-1**
**S-6 = BH96-3**
**S-7 = BH99-5**
**S-8 = BH99-5 duplicate**
**Dry = BH96-2**
**Dry = SW2**
**SW3 = SW3**
**SW4 = SW4**
**SW5 = SW5**
**SW6 = SW6**
**SW7 = SW7**
**SW8 = SW8**

# ACCUTEST LABORATORIES LTD.

## REPORT OF ANALYSIS




**Client:** Golder Associates Ltd.

**Attn:** Mr. John Miller

**Report Number:** 2107001
**Date:** 2001-07-17
**Date Submitted:** 2001-06-27
**Date Collected:** 2001-06-27
**Project:** 011-2877

**P.O. Number:** 210281
**Matrix:** Groundwater

| PARAMETER | UNITS | MDL | 133077 | 133078 | 133079 | 133080 | 133081 |
|---|---|---|---|---|---|---|---|
| | | | S-1 | S-2 | S-3 | S-5 | S-6 |
| Alkalinity as CaCO3 | mg/L | 5 | 146 | 18 | 398 | 204 | 371 |
| COD | mg/L | 5 | 14 | 8 | 95 | 16 | 22 |
| Ag | mg/L | 0.0001 | 0.0010 | 0.0010 | 0.0010 | 0.0010 | 0.0010 |
| Al | mg/L | 0.05 | <0.05 | <0.05 | 0.09 | <0.05 | <0.05 |
| As | mg/L | 0.01 | <0.01 | <0.01 | 0.22 | 0.20 | 0.42 |
| Ba | mg/L | 0.01 | 0.03 | <0.01 | 0.24 | 0.05 | 0.04 |
| Be | mg/L | 0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Ca | mg/L | 1 | 41 | 8 | 85 | 116 | 158 |
| Cd | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Cl | mg/L | 1 | 3 | 7 | 61 | 10 | 13 |
| Co | mg/L | 0.0002 | 0.0002 | <0.0002 | 0.0088 | 0.0003 | 0.0003 |
| Cr | mg/L | 0.001 | 0.005 | <0.001 | 0.010 | 0.002 | 0.004 |
| Cu | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| DOC | mg/L | 0.5 | 1.7 | 0.7 | 17.7 | 3.1 | 2.4 |
| F | mg/L | 0.01 | <0.01 | <0.01 | 49.5 | 0.03 | 0.01 |
| Hardness as CaCO3 | mg/L | 1 | 156 | 32 | 278 | 372 | 510 |
| Pb | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Mg | mg/L | 1 | 13 | 3 | 16 | 20 | 28 |
| Mn | mg/L | 0.01 | <0.01 | <0.01 | 12.0 | 0.13 | 0.58 |
| 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 | 0.11 | <0.02 | 17.7 | 0.05 | <0.02 |
| 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 | <0.10 | <0.10 | 0.10 |
| Phenols | mg/L | 0.001 | <0.001 | 0.002 | 0.011 | 0.003 | 0.002 |
| K | mg/L | 1 | 2 | <1 | 29 | 5 | 1 |
| Si | mg/L | 0.01 | 11.2 | 6.14 | 9.57 | 2.82 | 3.00 |
| Na | mg/L | 2 | 5 | 2 | 43 | 11 | 18 |
| Sr | mg/L | 0.003 | 0.101 | 0.097 | 0.972 | 0.663 | 0.882 |
| SO4 | mg/L | 1 | 22 | 9 | 21 | 170 | 143 |

MDL = Method Detection Limit INC = Incomplete

Comment:

APPROVAL: _____

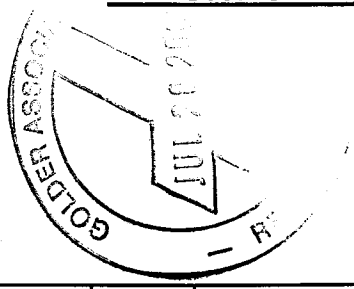
146 Colonnade Road, Unit 8, Nepean, Ontario, K2E 7Y1 Tel:(613)727-5692 Fax:(613)727-5222

# ACCUTEST LABORATORIES LTD.

## REPORT OF ANALYSIS

**Client: Golder Associates Ltd.**

**Attn: Mr. John Miller**



**Report Number:** 2107001
**Date:** 2001-07-17
**Date Submitted:** 2001-06-27
**Date Collected:** 2001-06-27
**Project:** 011-2877

**P.O. Number:** 210281
**Matrix:** Groundwater

| PARAMETER | UNITS | MDL | 133077 | 133078 | 133079 | 133080 | 133081 |
|---|---|---|---|---|---|---|---|
| | | | S-1 | S-2 | S-3 | S-5 | S-6 |
| [illegible] | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| [illegible] | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| [illegible] | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| DS | mg/L | 10 | 228 | 44 | 552 | 480 | 588 |
| [illegible] P | mg/L | 0.01 | 0.37 | 0.05 | 0.01 | 0.33 | 0.37 |
| [illegible] | mg/L | 0.001 | 0.003 | <0.001 | 0.003 | <0.001 | 0.002 |
| n | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| [illegible]O4 | mg/L | 0.03 | 0.26 | 0.03 | 0.03 | 0.04 | 0.04 |

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]ent: Golder Associates Ltd.**

**[redacted]T: Mr. John Miller**

**Report Number:** 2107001
**Date:** 2001-07-17
**Date Submitted:** 2001-06-27
**Date Collected:** 2001-06-27
**Project:** 011-2877

**P.O. Number:** 210281
**Matrix:** Groundwater

| PARAMETER | UNITS | MDL | 133082 | 133083 | | | |
|---|---|---|---|---|---|---|---|
| | | | S-7 | S-8 | | | |
| [redacted]alinity as CaCO3 | mg/L | 5 | 147 | 144 | | | |
| [redacted]D | mg/L | 5 | 22 | 22 | | | |
| Ag | mg/L | 0.0001 | 0.0010 | 0.0010 | | | |
| [redacted] | mg/L | 0.05 | <0.05 | <0.05 | | | |
| [redacted] | mg/L | 0.01 | 0.03 | 0.03 | | | |
| [redacted] | mg/L | 0.01 | 0.24 | 0.24 | | | |
| Be | mg/L | 0.002 | <0.002 | <0.002 | | | |
| [redacted] | mg/L | 1 | 165 | 159 | | | |
| [redacted] | mg/L | 0.0001 | <0.0001 | <0.0001 | | | |
| Cl | mg/L | 1 | 232 | 225 | | | |
| Co | mg/L | 0.0002 | 0.0003 | 0.0003 | | | |
| [redacted] | mg/L | 0.001 | <0.001 | <0.001 | | | |
| [redacted] | mg/L | 0.001 | <0.001 | <0.001 | | | |
| DOC | mg/L | 0.5 | 1.9 | 2.0 | | | |
| [redacted] | mg/L | 0.01 | 0.05 | 0.11 | | | |
| [redacted]rdness as CaCO3 | mg/L | 1 | 606 | 599 | | | |
| Pb | mg/L | 0.001 | <0.001 | <0.001 | | | |
| [redacted] | mg/L | 1 | 47 | 49 | | | |
| [redacted] | mg/L | 0.01 | 0.03 | 0.04 | | | |
| [redacted] | mg/L | 0.01 | <0.01 | <0.01 | | | |
| Ni | mg/L | 0.01 | <0.01 | <0.01 | | | |
| [redacted]NH3 | mg/L | 0.02 | 0.07 | 0.02 | | | |
| [redacted]NO2 | mg/L | 0.10 | <0.10 | <0.10 | | | |
| N-NO3 | mg/L | 0.10 | <0.10 | <0.10 | | | |
| Phenols | mg/L | 0.001 | 0.001 | <0.001 | | | |
| [redacted] | mg/L | 1 | 2 | 3 | | | |
| [redacted] | mg/L | 0.01 | 7.63 | 7.63 | | | |
| Na | mg/L | 2 | 30 | 29 | | | |
| [redacted] | mg/L | 0.003 | 0.353 | 0.358 | | | |
| [redacted]4 | mg/L | 1 | 161 | 183 | | | |

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

li t: Golder Associates Ltd.

T Mr. John Miller

**Report Number:** 2107001
**Date:** 2001-07-17
**Date Submitted:** 2001-06-27
**Date Collected:** 2001-06-27
**Project:** 011-2877

**P.O. Number:** 210281
**Matrix:** Groundwater

| PARAMETER | UNITS | MDL | 133082 | 133083 | | | |
|---|---|---|---|---|---|---|---|
| | | | S-7 | S-8 | | | |
| | mg/L | 0.001 | <0.001 | <0.001 | | | |
| n | mg/L | 0.01 | <0.01 | <0.01 | | | |
| | mg/L | 0.01 | <0.01 | <0.01 | | | |
| DS | mg/L | 10 | 780 | 1190 | | | |
| P | mg/L | 0.01 | 0.11 | 0.18 | | | |
| | mg/L | 0.001 | 0.002 | 0.001 | | | |
| n | mg/L | 0.01 | <0.01 | <0.01 | | | |
| 04 | mg/L | 0.03 | 0.04 | 0.08 | | | |

IDL = Method Detection Limit INC = Incomplete

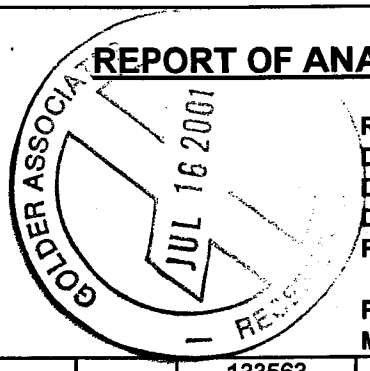
omment:

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.**

**Attn:** Mr. John Miller

**Report Number:** 2107086
**Date:** 2001-07-12
**Date Submitted:** 2001-06-29
**Date Collected:** 2001-06-28
**Project:** 011-2877

**P.O. Number:**
**Matrix:** Surfacewater

| PARAMETER | UNITS | MDL | 133563 | 133564 | 133565 | 133566 | 133567 |
|---|---|---|---|---|---|---|---|
| | | | SW3 | SW4 | SW5 | SW6 | SW7 |
| Alkalinity as CaCO3 | mg/L | 5 | 129 | 160 | 129 | 199 | 82 |
| COD | mg/L | 5 | 22 | 50 | 25 | 16 | 22 |
| Mg | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| K | mg/L | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | mg/L | 0.01 | 0.05 | 0.20 | 0.05 | 0.04 | <0.01 |
| Na | mg/L | 0.01 | 0.05 | 0.04 | 0.04 | 0.03 | 0.03 |
| Be | mg/L | 0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Ca | mg/L | 1 | 56 | 74 | 50 | 68 | 24 |
| Cd | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Si | mg/L | 1 | 25 | 38 | 24 | 40 | 7 |
| Conductivity | uS/cm | 5 | 430 | 545 | 418 | 532 | 192 |
| Co | mg/L | 0.0002 | 0.0004 | 0.0004 | <0.0002 | 0.0005 | <0.0002 |
| Cr | mg/L | 0.001 | 0.002 | 0.002 | <0.001 | 0.004 | <0.001 |
| Cu | mg/L | 0.001 | <0.001 | 0.002 | <0.001 | 0.003 | <0.001 |
| DOC | mg/L | 0.5 | 5.5 | 15.0 | 5.9 | 6.2 | 7.1 |
| Fe | mg/L | 0.01 | 0.61 | 8.81 | 0.36 | 0.88 | 0.15 |
| Hardness as CaCO3 | mg/L | 1 | 214 | 267 | 195 | 232 | 97 |
| Pb | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Mg | mg/L | 1 | 18 | 20 | 17 | 15 | 9 |
| Mn | mg/L | 0.01 | 0.14 | 0.98 | 0.07 | 0.07 | 0.26 |
| 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 | 0.06 | 0.13 | 0.07 | 0.12 | 0.16 |
| N-NO2 | mg/L | 0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| N-NO3 | mg/L | 0.10 | 0.40 | 0.52 | 0.38 | 0.72 | <0.10 |
| Phenols | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 |
| K | mg/L | 1 | 1 | 2 | 1 | 4 | <1 |
| Si | mg/L | 0.01 | 7.55 | 6.45 | 7.45 | 4.27 | 7.45 |
| Na | mg/L | 1 | 17 | 24 | 14 | 31 | 6 |
| Zn | mg/L | 0.003 | 0.214 | 0.468 | 0.216 | 0.304 | 0.105 |

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]nt: Golder Associates Ltd.

[redacted] Mr. John Miller

**Report Number:** 2107086
**Date:** 2001-07-12
**Date Submitted:** 2001-06-29
**Date Collected:** 2001-06-28
**Project:** 011-2877

**P.O. Number:**
**Matrix:** Surfacewater

| PARAMETER | UNITS | MDL | 133563 | 133564 | 133565 | 133566 | 133567 |
|---|---|---|---|---|---|---|---|
| | | | SW3 | SW4 | SW5 | SW6 | SW7 |
| [redacted] | mg/L | 1 | 72 | 82 | 58 | 27 | 9 |
| [redacted] | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| n | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| i | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | 0.02 | <0.01 |
| [redacted] | mg/L | 10 | 256 | 340 | 264 | 316 | 116 |
| otal P | mg/L | 0.01 | 0.09 | 0.38 | 0.16 | 0.21 | 0.06 |
| [redacted] | mg/L | 0.001 | 0.002 | 0.002 | 0.001 | 0.005 | <0.001 |
| [redacted] | mg/L | 0.01 | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 |
| [redacted]O4 | mg/L | 0.03 | 0.13 | 0.19 | 0.11 | 0.40 | 0.17 |

MDL = Method Detection Limit INC = Incomplete

Comment:

APPROVAL: [redacted]

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.

Attn: Mr. John Miller

Report Number: 2107086
Date: 2001-07-12
Date Submitted: 2001-06-29
Date Collected: 2001-06-28
Project: 011-2877
P.O. Number:
Matrix: Surfacewater

| PARAMETER | UNITS | MDL | 133668 | | | | |
|---|---|---|---|---|---|---|---|
| | | | SW8 | | | | |
| Alkalinity as CaCO3 | mg/L | 5 | 203 | | | | |
| COD | mg/L | 5 | 17 | | | | |
| Ag | mg/L | 0.0001 | <0.0001 | | | | |
| | mg/L | 0.05 | <0.05 | | | | |
| | mg/L | 0.01 | 0.04 | | | | |
| Ba | mg/L | 0.01 | 0.04 | | | | |
| Be | mg/L | 0.002 | <0.002 | | | | |
| | mg/L | 1 | 75 | | | | |
| | mg/L | 0.0001 | <0.0001 | | | | |
| Cl | mg/L | 1 | 41 | | | | |
| Conductivity | uS/cm | 5 | 547 | | | | |
| | mg/L | 0.0002 | 0.0003 | | | | |
| Cr | mg/L | 0.001 | 0.004 | | | | |
| Cu | mg/L | 0.001 | 0.002 | | | | |
| DOC | mg/L | 0.5 | 6.0 | | | | |
| | mg/L | 0.01 | 0.58 | | | | |
| Hardness as CaCO3 | mg/L | 1 | 253 | | | | |
| Pb | mg/L | 0.001 | <0.001 | | | | |
| | mg/L | 1 | 16 | | | | |
| Mn | mg/L | 0.01 | 0.07 | | | | |
| Mo | mg/L | 0.01 | <0.01 | | | | |
| Ni | mg/L | 0.01 | <0.01 | | | | |
| N-NH3 | mg/L | 0.02 | 0.16 | | | | |
| N-NO2 | mg/L | 0.10 | <0.10 | | | | |
| N-NO3 | mg/L | 0.10 | 0.72 | | | | |
| Phenols | mg/L | 0.001 | <0.001 | | | | |
| K | mg/L | 1 | 4 | | | | |
| Si | mg/L | 0.01 | 3.85 | | | | |
| Na | mg/L | 1 | 33 | | | | |
| S | mg/L | 0.003 | 0.304 | | | | |

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.

Attn: Mr. John Miller

**Report Number:** 2107086
**Date:** 2001-07-12
**Date Submitted:** 2001-06-29
**Date Collected:** 2001-06-28
**Project:** 011-2877

**P.O. Number:**
**Matrix:** Surfacewater

| PARAMETER | UNITS | MDL | 133568 | | | | |
|---|---|---|---|---|---|---|---|
| | | | SW8 | | | | |
| [illegible] | mg/L | 1 | 30 | | | | |
| [illegible] | mg/L | 0.001 | <0.001 | | | | |
| Sn | mg/L | 0.01 | <0.01 | | | | |
| [illegible] | mg/L | 0.01 | 0.01 | | | | |
| [illegible]S | mg/L | 10 | 300 | | | | |
| Total P | mg/L | 0.01 | 0.23 | | | | |
| [illegible] | mg/L | 0.001 | 0.005 | | | | |
| [illegible] | mg/L | 0.01 | <0.01 | | | | |
| [illegible]PO4 | mg/L | 0.03 | 0.46 | | | | |

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

# APPENDIX B-II

## SUMMER MONITORING SESSION

**NOTES:**

**Dry = SW2**
**Dry = SW4**
**S1 = SW3**
**S2 = SW6**
**S3 = SW5**
**S4 = SW8**
**S5 = SW7**
**S6 = SW7 duplicate**

# ACCUTEST LABORATORIES LTD.

## REPORT OF ANALYSIS

**Client: Golder Associates Ltd.**

**T** Mr. Andrew Harwood

**Report Number:** 2109833
**Date:** 2001-09-17
**Date Submitted:** 2001-08-31

**Project:** 011-2877

**P.O. Number:** 210282
**Matrix:** Surfacewater

| | LAB ID: | 142590 | 142591 | 142592 | 142593 | 142594 |
|---|---|---|---|---|---|---|
| | Sample Date: | 2001-08-30 | 2001-08-30 | 2001-08-30 | 2001-08-30 | 2001-08-30 |
| | Sample ID: | S1 | S2 | S3 | S4 | S5 |
| PARAMETER | UNITS | MDL | | | | |
| linity as CaCO3 | mg/L | 5 | 145 | 142 | 143 | 147 | 80 |
| OD | mg/L | 5 | 11 | 14 | 14 | 16 | 16 |
| g | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| l | mg/L | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | mg/L | 0.01 | 0.05 | 0.02 | 0.05 | 0.02 | <0.01 |
| a | mg/L | 0.01 | 0.08 | 0.02 | 0.05 | 0.02 | 0.03 |
| e | mg/L | 0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| a | mg/L | 1 | 52 | 42 | 49 | 39 | 25 |
| d | mg/L | 0.0001 | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| l | mg/L | 1 | 24 | 27 | 24 | 29 | 6 |
| c | mg/L | 0.0002 | 0.0017 | <0.0002 | 0.0006 | <0.0002 | 0.0006 |
| r | mg/L | 0.001 | 0.002 | <0.001 | 0.001 | <0.001 | <0.001 |
| u | mg/L | 0.001 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 |
| C | mg/L | 0.5 | 4.0 | 4.9 | 3.7 | 5.6 | 5.0 |
| e | mg/L | 0.01 | 2.86 | 0.59 | 1.17 | 0.51 | 0.66 |
| ardness as CaCO3 | mg/L | 1 | 204 | 150 | 192 | 143 | 100 |
| b | mg/L | 0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| g | mg/L | 1 | 18 | 11 | 17 | 11 | 9 |
| in | mg/L | 0.01 | 0.63 | 0.23 | 0.11 | 0.25 | 0.39 |
| lo | mg/L | 0.01 | <0.01 | 0.02 | 0.01 | 0.02 | <0.01 |
| i | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| H3 | mg/L | 0.02 | 0.06 | 0.16 | 0.04 | 0.16 | 0.13 |
| -NO2 | mg/L | 0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| -NO3 | mg/L | 0.10 | 0.47 | 0.20 | 0.31 | 0.14 | 0.13 |
| nols | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | mg/L | 1 | 2 | 3 | 1 | 3 | 1 |
| i | mg/L | 0.01 | 9.35 | 4.99 | 9.19 | 4.76 | 8.45 |
| a | mg/L | 2 | 14 | 20 | 19 | 19 | 6 |
| n | mg/L | 0.003 | 0.239 | 0.169 | 0.227 | 0.177 | 0.108 |
| O4 | mg/L | 1 | 79 | 15 | 76 | 17 | 27 |

DL = Method Detection Limit INC = Incomplete

ment:

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]t: Golder Associates Ltd.

[redacted] Mr. Andrew Harwood

**Report Number:** 2109833
**Date:** 2001-09-17
**Date Submitted:** 2001-08-31

**Project:** 011-2877

**P.O. Number:** 210282
**Matrix:** Surfacewater

| | LAB ID: | 142590 | 142591 | 142592 | 142593 | 142594 |
|---|---|---|---|---|---|---|
| | Sample Date: | 2001-08-30 | 2001-08-30 | 2001-08-30 | 2001-08-30 | 2001-08-30 |
| | Sample ID: | S1 | S2 | S3 | S4 | S5 |
| PARAMETER | UNITS | MDL | | | | |
| | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | mg/L | 0.01 | 0.03 | 0.02 | 0.04 | 0.01 | <0.01 |
| | mg/L | 10 | 308 | 188 | 308 | 236 | 164 |
| [redacted]P | mg/L | 0.01 | 0.10 | 0.16 | 0.05 | 0.16 | 0.06 |
| | mg/L | 0.001 | 0.004 | 0.002 | 0.002 | 0.002 | 0.001 |
| | mg/L | 0.01 | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| [redacted]4 | mg/L | 0.03 | 0.14 | 0.37 | 0.13 | 0.28 | 0.07 |

DL = Method Detection Limit INC = Incomplete

[redacted]ment:

APPROVAL: _____

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# ACCUTEST LABORATORIES LTD.

## REPORT OF ANALYSIS

[redacted]t: Golder Associates Ltd.

T[redacted] Mr. Andrew Harwood

**Report Number:** 2109833
**Date:** 2001-09-17
**Date Submitted:** 2001-08-31

**Project:** 011-2877

**P.O. Number:** 210282
**Matrix:** Surfacewater

| | LAB ID: | 142595 |
|---|---|---|
| | Sample Date: | 2001-08-30 |
| | Sample ID: | S6 |

| PARAMETER | UNITS | MDL | |
|---|---|---|---|
| I[redacted]inity as CaCO3 | mg/L | 5 | 80 |
| OD | mg/L | 5 | 16 |
| g | mg/L | 0.0001 | <0.0001 |
| l | mg/L | 0.05 | <0.05 |
| | mg/L | 0.01 | <0.01 |
| a | mg/L | 0.01 | 0.05 |
| e | mg/L | 0.002 | <0.002 |
| a | mg/L | 1 | 25 |
| d | mg/L | 0.0001 | 0.0001 |
| l | mg/L | 1 | 5 |
| o | mg/L | 0.0002 | 0.0016 |
| r | mg/L | 0.001 | 0.001 |
| u | mg/L | 0.001 | 0.002 |
| C | mg/L | 0.5 | 5.1 |
| e | mg/L | 0.01 | 1.44 |
| ardness as CaCO3 | mg/L | 1 | 95 |
| b | mg/L | 0.001 | 0.001 |
| g | mg/L | 1 | 8 |
| n | mg/L | 0.01 | 0.54 |
| lo | mg/L | 0.01 | <0.01 |
| i | mg/L | 0.01 | <0.01 |
| -[redacted]H3 | mg/L | 0.02 | 0.13 |
| -NO2 | mg/L | 0.10 | <0.10 |
| -NO3 | mg/L | 0.10 | 0.12 |
| H[redacted]ols | mg/L | 0.001 | <0.001 |
| | mg/L | 1 | 1 |
| i | mg/L | 0.01 | 8.88 |
| a | mg/L | 2 | 9 |
| r | mg/L | 0.003 | 0.111 |
| O4 | mg/L | 1 | 27 |

IDL = Method Detection Limit INC = Incomplete

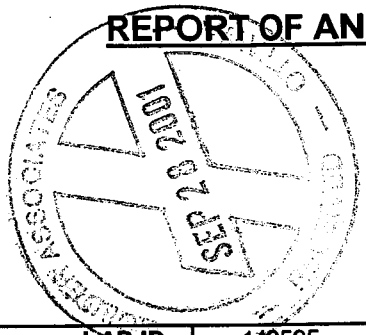
c[redacted]ment:

APPROVAL: [redacted]

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

# ACCUTEST LABORATORIES LTD.

## REPORT OF ANALYSIS



**Report Number:** 2109833
**Date:** 2001-09-17
**Date Submitted:** 2001-08-31

**Project:** 011-2877

**P.O. Number:** 210282
**Matrix:** Surfacewater

**t: Golder Associates Ltd.**

Mr. Andrew Harwood

| | LAB ID: | 142595 | | | | |
|---|---|---|---|---|---|---|
| | Sample Date: | 2001-08-30 | | | | |
| | Sample ID: | S6 | | | | |
| **PARAMETER** | **UNITS** | **MDL** | | | | |
| | mg/L | 0.001 | <0.001 | | | |
| n | mg/L | 0.01 | <0.01 | | | |
| | mg/L | 0.01 | 0.02 | | | |
| | mg/L | 10 | 140 | | | |
| otal P | mg/L | 0.01 | 0.06 | | | |
| | mg/L | 0.001 | 0.003 | | | |
| | mg/L | 0.01 | 0.01 | | | |
| O4 | mg/L | 0.03 | 0.06 | | | |

MDL = Method Detection Limit INC = Incomplete

mment:

APPROVAL: _____

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# APPENDIX B-III

## FALL MONITORING SESSION

**NOTES:**

**S-1 = SW6**
**S-2 = SW5**
**S-3 = SW6 duplicate**
**S-4 = SW3**
**S-5 = SW4**
**S-6 = SW8**
**S-7 = SW7**
**Dry = SW2**
**Dry = BH96-2**
**S-8 = BH96-4**
**S-9 = BH99-7**
**S-10 = BH99-6**
**S-11 = BH96-1**
**S-12 = BH96-3**
**S-13 = BH99-5**
**S-14 = BH01-8B**
**S-15 = BH01-8A**

# ACCUTEST LABORATORIES LTD.

## REPORT OF ANALYSIS

**Client: Golder Associates Ltd.**

Attn: Mr. Andrew Harwood

**Report Number:** 2113792
**Date:** 2001-12-14
**Date Submitted:** 2001-11-21
**Project:** 011-2877
**P.O. Number:** 210282
**Matrix:** Surfacewater

| | LAB ID: | 158938 | 158939 | 158940 | 158941 | 158942 |
|---|---|---|---|---|---|---|
| | Sample Date: | 2001-11-21 | 2001-11-21 | 2001-11-21 | 2001-11-21 | 2001-11-21 |
| | Sample ID: | S-1 | S-2 | S-3 | S-4 | S-5 |
| PARAMETER | UNITS | MDL | | | | |
| linity as CaCO3 | mg/L | 5 | 214 | 103 | 214 | 106 | 30 |
| OD | mg/L | 5 | 20 | 26 | 23 | 21 | 47 |
| | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| | mg/L | 0.05 | 0.14 | <0.05 | 0.14 | 0.45 | 0.80 |
| | mg/L | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| a | mg/L | 0.01 | 0.03 | 0.03 | 0.03 | 0.04 | 0.03 |
| | mg/L | 0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| | mg/L | 1 | 93 | 44 | 100 | 45 | 31 |
| d | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| | mg/L | 1 | 92 | 22 | 89 | 23 | 27 |
| | mg/L | 0.0002 | <0.0002 | <0.0002 | <0.0002 | 0.0006 | 0.0033 |
| | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 |
| u | mg/L | 0.001 | 0.002 | <0.001 | 0.001 | 0.001 | 0.002 |
| C | mg/L | 0.5 | 5.5 | 5.4 | 5.6 | 4.7 | 15.1 |
| | mg/L | 0.01 | 0.19 | 0.17 | 0.18 | 0.90 | 36.5 |
| ardness as CaCO3 | mg/L | 1 | 319 | 176 | 332 | 174 | 110 |
| | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 |
| | mg/L | 1 | 21 | 16 | 20 | 15 | 8 |
| | mg/L | 0.01 | 0.02 | 0.05 | 0.02 | 0.16 | 0.90 |
| lo | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| H3 | mg/L | 0.02 | 0.40 | 0.03 | 0.45 | 0.09 | 0.76 |
| -NO2 | mg/L | 0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| -NO3 | mg/L | 0.10 | 1.02 | 0.28 | 1.02 | 0.33 | 0.35 |
| nols | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | mg/L | 1 | 8 | 1 | 8 | 1 | 2 |
| i | mg/L | 0.01 | 3.80 | 6.46 | 3.73 | 6.87 | 7.18 |
| | mg/L | 2 | 60 | 13 | 60 | 12 | 9 |
| | mg/L | 0.003 | 0.303 | 0.170 | 0.301 | 0.162 | 0.172 |
| O4 | mg/L | 1 | 123 | 86 | 125 | 76 | 80 |

MDL = Method Detection Limit INC = Incomplete

mment:

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.

Attn: Mr. Andrew Harwood

**Report Number:** 2113792
**Date:** 2001-12-14
**Date Submitted:** 2001-11-21
**Project:** 011-2877
**P.O. Number:** 210282
**Matrix:** Surfacewater

| | | | LAB ID: | 158938 | 158939 | 158940 | 158941 | 158942 |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Date: | 2001-11-21 | 2001-11-21 | 2001-11-21 | 2001-11-21 | 2001-11-21 |
| | | | Sample ID: | S-1 | S-2 | S-3 | S-4 | S-5 |
| PARAMETER | UNITS | MDL | | | | | | |
| Nitrate | mg/L | 0.001 | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Nitrite | mg/L | 0.01 | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Ammonia | mg/L | 0.01 | | <0.01 | <0.01 | <0.01 | 0.02 | 0.03 |
| Chloride | mg/L | 10 | | 580 | 308 | 580 | 284 | 248 |
| Total P | mg/L | 0.01 | | 0.07 | 0.10 | 0.11 | 0.07 | 0.55 |
| Nitrate | mg/L | 0.001 | | 0.001 | <0.001 | 0.001 | 0.002 | 0.003 |
| Nitrite | mg/L | 0.01 | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| PO4 | mg/L | 0.03 | | 0.15 | 0.04 | 0.15 | 0.05 | <0.03 |

MDL = Method Detection Limit INC = Incomplete

Comment:

APPROVAL:

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# ACCUTEST LABORATORIES LTD.

## REPORT OF ANALYSIS

li t: Golder Associates Ltd.

T Mr. Andrew Harwood

**Report Number:** 2113792
**Date:** 2001-12-14
**Date Submitted:** 2001-11-21
**Project:** 011-2877
**P.O. Number:** 210282
**Matrix:** Surfacewater

| | LAB ID: | 158943 | 158944 | | | |
|---|---|---|---|---|---|---|
| | Sample Date: | 2001-11-21 | 2001-11-21 | | | |
| | Sample ID: | S-6 | S-7 | | | |
| PARAMETER | UNITS | MDL | | | | |
| lk nity as CaCO3 | mg/L | 5 | 206 | 41 | | |
| OD | mg/L | 5 | 19 | 27 | | |
| g | mg/L | 0.0001 | <0.0001 | <0.0001 | | |
| l | mg/L | 0.05 | 0.13 | 0.67 | | |
| | mg/L | 0.05 | <0.05 | <0.05 | | |
| a | mg/L | 0.01 | 0.03 | 0.05 | | |
| e | mg/L | 0.002 | <0.002 | <0.002 | | |
| a | mg/L | 1 | 89 | 32 | | |
| d | mg/L | 0.0001 | <0.0001 | 0.0002 | | |
| l | mg/L | 1 | 86 | 14 | | |
| c | mg/L | 0.0002 | <0.0002 | 0.0014 | | |
| r | mg/L | 0.001 | <0.001 | <0.001 | | |
| u | mg/L | 0.001 | 0.001 | 0.002 | | |
| C | mg/L | 0.5 | 5.7 | 9.4 | | |
| e | mg/L | 0.01 | 0.17 | 1.30 | | |
| ardness as CaCO3 | mg/L | 1 | 313 | 125 | | |
| b | mg/L | 0.001 | <0.001 | <0.001 | | |
| lg | mg/L | 1 | 22 | 11 | | |
| Ir | mg/L | 0.01 | 0.02 | 0.27 | | |
| lo | mg/L | 0.01 | <0.01 | <0.01 | | |
| li | mg/L | 0.01 | <0.01 | <0.01 | | |
| -H3 | mg/L | 0.02 | 0.45 | 0.09 | | |
| -NO2 | mg/L | 0.10 | <0.10 | <0.10 | | |
| -NO3 | mg/L | 0.10 | 1.03 | 0.24 | | |
| h ols | mg/L | 0.001 | <0.001 | <0.001 | | |
| | mg/L | 1 | 8 | 2 | | |
| i | mg/L | 0.01 | 3.71 | 6.68 | | |
| la | mg/L | 2 | 57 | 7 | | |
| r | mg/L | 0.003 | 0.292 | 0.125 | | |
| O4 | mg/L | 1 | 118 | 88 | | |

IDL = Method Detection Limit INC = Incomplete

c ment:

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.**

Attn: Mr. Andrew Harwood

**Report Number:** 2113792
**Date:** 2001-12-14
**Date Submitted:** 2001-11-21

**Project:** 011-2877

**P.O. Number:** 210282
**Matrix:** Surfacewater

| | LAB ID: | 158943 | 158944 | | | |
|---|---|---|---|---|---|---|
| | Sample Date: | 2001-11-21 | 2001-11-21 | | | |
| | Sample ID: | S-6 | S-7 | | | |
| PARAMETER | UNITS | MDL | | | | |
| | mg/L | 0.001 | <0.001 | <0.001 | | |
| Sn | mg/L | 0.01 | <0.01 | <0.01 | | |
| | mg/L | 0.01 | <0.01 | 0.01 | | |
| | mg/L | 10 | 568 | 248 | | |
| Total P | mg/L | 0.01 | 0.09 | 0.85 | | |
| / | mg/L | 0.001 | 0.001 | 0.002 | | |
| | mg/L | 0.01 | <0.01 | 0.02 | | |
| O4 | mg/L | 0.03 | 0.14 | 0.03 | | |

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.**

Mr. Andrew Harwood

**Report Number:** 2113793
**Date:** 2001-12-17
**Date Submitted:** 2001-11-21
**Project:** 011-2877
**P.O. Number:** 210281
**Matrix:** Groundwater

| | LAB ID: | 158945 | 158946 | 158947 | 158948 | 158949 |
|---|---|---|---|---|---|---|
| | Sample Date: | 2001-11-21 | 2001-11-21 | 2001-11-21 | 2001-11-21 | 2001-11-21 |
| | Sample ID: | S-8 | S-9 | S-10 | S-11 | S-12 |
| PARAMETER | UNITS | MDL | | | | |
| Alkalinity as CaCO3 | mg/L | 5 | 145 | 14 | 390 | 157 | 315 |
| COD | mg/L | 5 | <5 | <5 | 48 | 12 | 12 |
| [illegible] | 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 | <0.05 | <0.05 |
| [illegible] | mg/L | 0.05 | <0.05 | <0.05 | 0.17 | 0.13 | 0.25 |
| [illegible] | mg/L | 0.01 | 0.02 | <0.01 | 0.13 | 0.02 | 0.04 |
| [illegible] | mg/L | 0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| [illegible] | mg/L | 1 | 40 | 6 | 85 | 92 | 139 |
| [illegible] | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| [illegible] | mg/L | 1 | 3 | 4 | 39 | 7 | 13 |
| [illegible] | mg/L | 0.0002 | <0.0002 | <0.0002 | 0.0089 | 0.0002 | 0.0002 |
| [illegible] | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| [illegible] | mg/L | 0.001 | <0.001 | 0.001 | <0.001 | <0.001 | 0.002 |
| [illegible] | mg/L | 0.5 | <0.5 | <0.5 | 18.4 | 3.4 | 3.7 |
| Dissolved Reactive Phosphorus | mg/L | 0.01 | 0.03 | 0.01 | <0.01 | <0.01 | <0.01 |
| [illegible] | mg/L | 0.01 | <0.01 | <0.01 | 32.7 | <0.01 | <0.01 |
| Hardness as CaCO3 | mg/L | 1 | 154 | 23 | 274 | 308 | 438 |
| [illegible] | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| [illegible] | mg/L | 1 | 13 | 2 | 15 | 19 | 22 |
| [illegible] | mg/L | 0.01 | 0.01 | <0.01 | 7.61 | 0.49 | 1.08 |
| [illegible] | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| [illegible] | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| N-NH3 | mg/L | 0.02 | 0.06 | 0.04 | 13.5 | 0.05 | 0.05 |
| 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 | <0.10 | <0.10 | 0.84 |
| Phenols | mg/L | 0.001 | <0.001 | <0.001 | 0.006 | <0.001 | <0.001 |
| [illegible] | mg/L | 1 | 2 | <1 | 25 | 3 | 2 |
| [illegible] | mg/L | 0.01 | 9.52 | 5.35 | 7.83 | 2.47 | 2.56 |
| [illegible] | mg/L | 2 | 5 | 3 | 33 | 9 | 20 |
| [illegible] | mg/L | 0.003 | 0.073 | 0.059 | 0.611 | 0.429 | 0.681 |

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.**

Mr. Andrew Harwood

**Report Number:** 2113793
**Date:** 2001-12-17
**Date Submitted:** 2001-11-21

**Project:** 011-2877

**P.O. Number:** 210281
**Matrix:** Groundwater

| | LAB ID: | 158945 | 158946 | 158947 | 158948 | 158949 |
|---|---|---|---|---|---|---|
| | Sample Date: | 2001-11-21 | 2001-11-21 | 2001-11-21 | 2001-11-21 | 2001-11-21 |
| | Sample ID: | S-8 | S-9 | S-10 | S-11 | S-12 |
| PARAMETER | UNITS | MDL | | | | |
| [illegible] | mg/L | 1 | 27 | 11 | 14 | 160 | 135 |
| | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| [illegible] | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | mg/L | 0.01 | <0.01 | <0.01 | 0.03 | <0.01 | <0.01 |
| DS | mg/L | 10 | 240 | 52 | 488 | 448 | 604 |
| | mg/L | 0.001 | 0.002 | <0.001 | 0.002 | <0.001 | <0.001 |
| [illegible] | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| [illegible]O4 | mg/L | 0.03 | 0.09 | 0.03 | <0.03 | <0.03 | <0.03 |

MDL = Method Detection Limit INC = Incomplete

Comment:

APPROVAL: [illegible]

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.**

Mr. Andrew Harwood

**Report Number:** 2113793
**Date:** 2001-12-17
**Date Submitted:** 2001-11-21
**Project:** 011-2877
**P.O. Number:** 210281
**Matrix:** Groundwater

| | LAB ID: | 158950 | 158951 | 158952 | | |
|---|---|---|---|---|---|---|
| | Sample Date: | 2001-11-21 | 2001-11-21 | 2001-11-21 | | |
| | Sample ID: | S-13 | S-14 | S-15 | | |
| PARAMETER | UNITS | MDL | | | | |
| inity as CaCO3 | mg/L | 5 | 175 | 154 | 96 | |
| OD | mg/L | 5 | 22 | 26 | <5 | |
| g | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | |
| l | mg/L | 0.05 | <0.05 | <0.05 | <0.05 | |
| | mg/L | 0.05 | <0.05 | 0.07 | <0.05 | |
| a | mg/L | 0.01 | 0.20 | 0.04 | 0.03 | |
| e | mg/L | 0.002 | <0.002 | <0.002 | <0.002 | |
| a | mg/L | 1 | 184 | 61 | 22 | |
| d | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | |
| l | mg/L | 1 | 252 | 30 | 6 | |
| d | mg/L | 0.0002 | 0.0002 | 0.0003 | <0.0002 | |
| n | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | |
| u | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | |
| OC | mg/L | 0.5 | 7.7 | 9.6 | 2.4 | |
| is olved Reactive Phosphorus | mg/L | 0.01 | 0.02 | <0.01 | 0.15 | |
| e | mg/L | 0.01 | 0.01 | 0.20 | <0.01 | |
| ardness as CaCO3 | mg/L | 1 | 703 | 222 | 96 | |
| b | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | |
| lg | mg/L | 1 | 59 | 17 | 10 | |
| In | mg/L | 0.01 | 0.03 | 0.12 | 0.05 | |
| lc | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | |
| i | mg/L | 0.001 | <0.001 | <0.01 | <0.01 | |
| -NH3 | mg/L | 0.02 | 0.06 | 0.19 | 0.41 | |
| -NO2 | mg/L | 0.10 | <0.10 | <0.10 | <0.10 | |
| - O3 | mg/L | 0.10 | <0.10 | <0.10 | <0.10 | |
| H nols | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | |
| | mg/L | 1 | 3 | 1 | 2 | |
| i | mg/L | 0.01 | 6.58 | 5.42 | 7.26 | |
| a | mg/L | 2 | 35 | 29 | 12 | |
| r | mg/L | 0.003 | 0.302 | 0.203 | 0.084 | |

IDL = Method Detection Limit INC = Incomplete

d ment:

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.**

Attn: Mr. Andrew Harwood

**Report Number:** 2113793
**Date:** 2001-12-17
**Date Submitted:** 2001-11-21

**Project:** 011-2877

**P.O. Number:** 210281
**Matrix:** Groundwater

| | LAB ID: | 158950 | 158951 | 158952 | | |
|---|---|---|---|---|---|---|
| | Sample Date: | 2001-11-21 | 2001-11-21 | 2001-11-21 | | |
| | Sample ID: | S-13 | S-14 | S-15 | | |
| PARAMETER | UNITS | MDL | | | | |
| | mg/L | 1 | 202 | 84 | 14 | |
| | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | |
| | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | |
| | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | |
| | mg/L | 10 | 1150 | 388 | 168 | |
| | mg/L | 0.001 | 0.002 | <0.001 | <0.001 | |
| | mg/L | 0.001 | <0.001 | <0.01 | <0.01 | |
| O4 | mg/L | 0.03 | 0.06 | <0.03 | 0.45 | |

MDL = Method Detection Limit INC = Incomplete

Comment:

APPROVAL: _____

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# APPENDIX B-IV

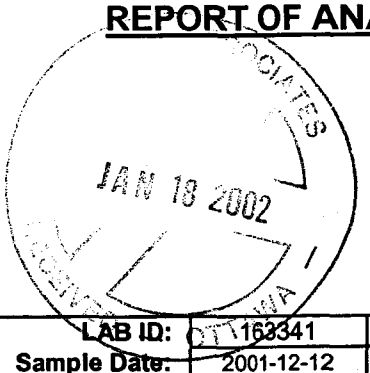
## WINTER MONITORING SESSION

**NOTES:**

**Dry = SW2**
**Frozen = SW4**
**S-1 = SW6**
**S-2 = SW6 duplicate**
**S-3 = SW3**
**S-4 = SW5**
**S-5 = SW7**
**S-6 = SW8**

# ACCUTEST LABORATORIES LTD.

## REPORT OF ANALYSIS




t: Golder Associates Ltd.

Mr. Andrew Harwood

**Report Number:** 2114991
**Date:** 2002-01-07
**Date Submitted:** 2001-12-13

**Project:** 011-2877

**P.O. Number:** 210282
**Matrix:** Surfacewater

| | LAB ID: | 163341 | 163342 | 163343 | 163344 | 163345 |
|---|---|---|---|---|---|---|
| | Sample Date: | 2001-12-12 | 2001-12-12 | 2001-12-12 | 2001-12-12 | 2001-12-12 |
| | Sample ID: | S-1 | S-2 | S-3 | S-4 | S-5 |
| PARAMETER | UNITS | MDL | | | | |
| linity as CaCO3 | mg/L | 5 | 248 | 247 | 132 | 131 | 71 |
| OD | mg/L | 5 | 10 | 12 | 10 | 10 | 12 |
| | 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 |
| | mg/L | 0.05 | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | mg/L | 0.01 | 0.04 | 0.04 | 0.04 | 0.04 | 0.05 |
| | mg/L | 0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| | mg/L | 1 | 98 | 100 | 50 | 48 | 29 |
| | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0001 |
| | mg/L | 1 | 49 | 55 | 25 | 24 | 17 |
| ductivity | uS/cm | 5 | 828 | 826 | 473 | 471 | 278 |
| | mg/L | 0.0002 | 0.0003 | 0.0003 | <0.0002 | <0.0002 | 0.0010 |
| | mg/L | 0.001 | 0.002 | 0.002 | <0.001 | <0.001 | 0.002 |
| | mg/L | 0.001 | 0.002 | 0.002 | <0.001 | <0.001 | 0.002 |
| | mg/L | 0.5 | 3.2 | 3.3 | 3.1 | 3.1 | 3.3 |
| | mg/L | 0.01 | 0.34 | 0.35 | 0.28 | 0.19 | 3.15 |
| ness as CaCO3 | mg/L | 1 | 331 | 332 | 207 | 198 | 122 |
| | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 |
| | mg/L | 1 | 21 | 20 | 20 | 19 | 12 |
| | mg/L | 0.01 | 0.02 | 0.02 | 0.14 | 0.11 | 0.18 |
| | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| I-NH3 | mg/L | 0.02 | 0.07 | 0.03 | 0.03 | 0.02 | <0.02 |
| I-NO2 | mg/L | 0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| I-O3 | mg/L | 0.10 | 2.85 | 2.98 | 0.95 | 0.94 | 1.53 |
| henols | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | mg/L | 1 | 5 | 5 | 1 | 1 | 1 |
| | mg/L | 0.01 | 4.33 | 4.28 | 9.03 | 9.00 | 9.56 |
| | mg/L | 2 | 39 | 43 | 13 | 13 | 8 |
| ir | mg/L | 0.003 | 0.386 | 0.383 | 0.199 | 0.199 | 0.117 |

MDL = Method Detection Limit INC = Incomplete

mment:

APPROVAL: _____

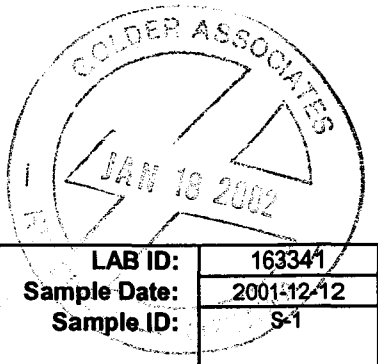
146 Colonnade Road, Unit 8, Nepean, Ontario, K2E 7Y1 Tel:(613)727-5692 Fax:(613)727-5222

# ACCUTEST LABORATORIES LTD.

## REPORT OF ANALYSIS

nt: Golder Associates Ltd.

: Mr. Andrew Harwood




**Report Number:** 2114991
**Date:** 2002-01-07
**Date Submitted:** 2001-12-13

**Project:** 011-2877

**P.O. Number:** 210282
**Matrix:** Surfacewater

| | LAB ID: | 163341 | 163342 | 163343 | 163344 | 163345 |
|---|---|---|---|---|---|---|
| | Sample Date: | 2001-12-12 | 2001-12-12 | 2001-12-12 | 2001-12-12 | 2001-12-12 |
| | Sample ID: | S-1 | S-2 | S-3 | S-4 | S-5 |
| PARAMETER | UNITS | MDL | | | | |
| | mg/L | 1 | 98 | 94 | 72 | 72 | 37 |
| l | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | mg/L | 0.01 | 0.01 | <0.01 | <0.01 | <0.01 | 0.04 |
| otal P | mg/L | 0.01 | 0.06 | 0.07 | 0.06 | 0.06 | 0.34 |
| | mg/L | 0.001 | 0.002 | 0.002 | <0.001 | <0.001 | 0.005 |
| | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 |
| O4 | mg/L | 0.03 | 0.05 | 0.06 | <0.03 | <0.03 | <0.03 |
| DS (COND - CALC) | mg/L | 5 | 538 | 537 | 307 | 306 | 181 |

MDL = Method Detection Limit INC = Incomplete
mment:

APPROVAL: _____

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# ACCUTEST LABORATORIES LTD.

## REPORT OF ANALYSIS

Client: Golder Associates Ltd.

Attn: Mr. Andrew Harwood

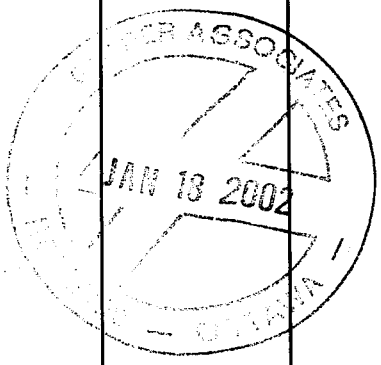
**Report Number:** 2114991
**Date:** 2002-01-07
**Date Submitted:** 2001-12-13

**Project:** 011-2877

**P.O. Number:** 210282
**Matrix:** Surfacewater

| | LAB ID: | 163346 |
|---|---|---|
| | Sample Date: | 2001-12-12 |
| | Sample ID: | S-6 |

| PARAMETER | UNITS | MDL | |
|---|---|---|---|
| Alkalinity as CaCO3 | mg/L | 5 | 246 |
| COD | mg/L | 5 | 12 |
| | mg/L | 0.0001 | <0.0001 |
| | mg/L | 0.05 | <0.05 |
| | mg/L | 0.05 | <0.05 |
| | mg/L | 0.01 | 0.04 |
| | mg/L | 0.002 | <0.002 |
| | mg/L | 1 | 105 |
| Cd | mg/L | 0.0001 | <0.0001 |
| | mg/L | 1 | 54 |
| Conductivity | uS/cm | 5 | 831 |
| Co | mg/L | 0.0002 | 0.0002 |
| Cr | mg/L | 0.001 | 0.002 |
| | mg/L | 0.001 | 0.002 |
| DOC | mg/L | 0.5 | 3.4 |
| Fe | mg/L | 0.01 | 0.36 |
| Hardness as CaCO3 | mg/L | 1 | 349 |
| Pb | mg/L | 0.001 | <0.001 |
| Mg | mg/L | 1 | 21 |
| Mn | mg/L | 0.01 | 0.02 |
| | mg/L | 0.01 | <0.01 |
| | mg/L | 0.01 | <0.01 |
| N-NH3 | mg/L | 0.02 | <0.02 |
| N-NO2 | mg/L | 0.10 | <0.10 |
| N-NO3 | mg/L | 0.10 | 2.98 |
| Phenols | mg/L | 0.001 | <0.001 |
| | mg/L | 1 | 5 |
| Si | mg/L | 0.01 | 4.27 |
| | mg/L | 2 | 39 |
| Sr | mg/L | 0.003 | 0.383 |




MDL = Method Detection Limit INC = Incomplete

Comment:

APPROVAL:

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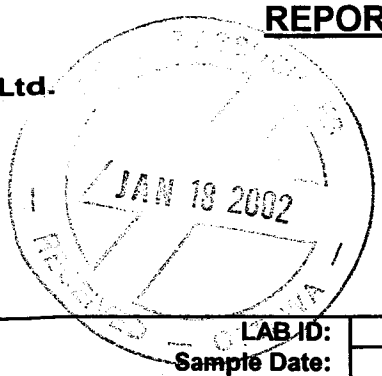
# ACCUTEST LABORATORIES LTD.

## REPORT OF ANALYSIS




li t: Golder Associates Ltd.

T Mr. Andrew Harwood

**Report Number:** 2114991
**Date:** 2002-01-07
**Date Submitted:** 2001-12-13

**Project:** 011-2877

**P.O. Number:** 210282
**Matrix:** Surfacewater

| | LAB ID: | 163346 | | | | |
|---|---|---|---|---|---|---|
| | Sample Date: | 2001-12-12 | | | | |
| | Sample ID: | S-6 | | | | |
| **PARAMETER** | **UNITS** | **MDL** | | | | |
| C | mg/L | 1 | 94 | | | |
| I | mg/L | 0.001 | <0.001 | | | |
| n | mg/L | 0.01 | <0.01 | | | |
| i | mg/L | 0.01 | 0.01 | | | |
| otal P | mg/L | 0.01 | 0.05 | | | |
| | mg/L | 0.001 | 0.002 | | | |
| n | mg/L | 0.01 | <0.01 | | | |
| -O4 | mg/L | 0.03 | 0.06 | | | |
| DS (COND - CALC) | mg/L | 5 | 540 | | | |

MDL = Method Detection Limit INC = Incomplete

Comment:

APPROVAL: _____

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# APPENDIX C

## RISING HEAD TEST DATA AND GRAPHS

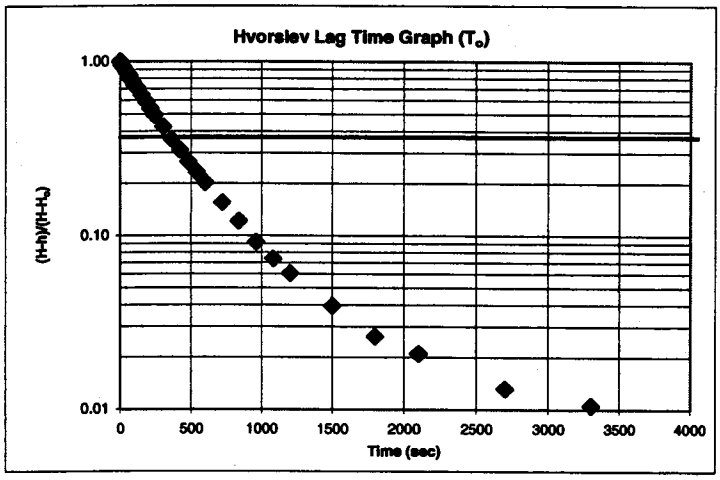
Hvorslev Calculation
(for Hydraulic Conductivity from Rising Head Tests)

Well Name = **BH01-8A (deep)**

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

| | | |
|---|---|---|
| Initial WL ($H_o$) = | 2.19 m | (Static) |
| Radius of pipe (r) = | 0.025 m | (2 inch diameter) |
| Radius of hole (R) = | 0.102 m | (8 inch diameter) |
| Length of screen (L) = | 1.830 m | (5 feet) |
| $H-H_o$ = | 3.800 m | |
| Lag time ($T_o$) = | 345 sec | (time at $(H-h)/(H-H_o)$ = 0.37 on graph) |
| **Hydraulic Cond.(K) =** | **1.48E-06 m/s** | |
| | **1.48E-04 cm/s** | |

| Time (sec) | WL (m) | H-h (m) | $(H-h)/(H-H_o)$ |
|---|---|---|---|
| 0 | 5.99 | 3.80 | 1.00 |
| 10 | 5.83 | 3.64 | 0.96 |
| 20 | 5.73 | 3.54 | 0.93 |
| 30 | 5.63 | 3.44 | 0.91 |
| 40 | 5.53 | 3.34 | 0.88 |
| 50 | 5.44 | 3.25 | 0.86 |
| 60 | 5.37 | 3.18 | 0.84 |
| 70 | 5.23 | 3.04 | 0.80 |
| 80 | 5.16 | 2.97 | 0.78 |
| 90 | 5.06 | 2.87 | 0.76 |
| 100 | 4.98 | 2.79 | 0.73 |
| 110 | 4.92 | 2.73 | 0.72 |
| 120 | 4.84 | 2.65 | 0.70 |
| 150 | 4.63 | 2.44 | 0.64 |
| 180 | 4.43 | 2.24 | 0.59 |
| 210 | 4.24 | 2.05 | 0.54 |
| 240 | 4.07 | 1.88 | 0.49 |
| 300 | 3.80 | 1.61 | 0.42 |
| 360 | 3.56 | 1.37 | 0.36 |
| 420 | 3.37 | 1.18 | 0.31 |
| 480 | 3.20 | 1.01 | 0.27 |
| 540 | 3.07 | 0.88 | 0.23 |
| 600 | 2.96 | 0.77 | 0.20 |
| 720 | 2.78 | 0.59 | 0.16 |
| 840 | 2.65 | 0.46 | 0.12 |
| 960 | 2.54 | 0.35 | 0.09 |
| 1080 | 2.47 | 0.28 | 0.07 |
| 1200 | 2.42 | 0.23 | 0.06 |
| 1500 | 2.34 | 0.15 | 0.04 |
| 1800 | 2.29 | 0.10 | 0.03 |
| 2100 | 2.27 | 0.08 | 0.02 |
| 2700 | 2.24 | 0.05 | 0.01 |
| 3300 | 2.23 | 0.04 | 0.01 |
| 3960 | 2.22 | 0.03 | 0.01 |




Prepared by: MAV
Checked by: JO

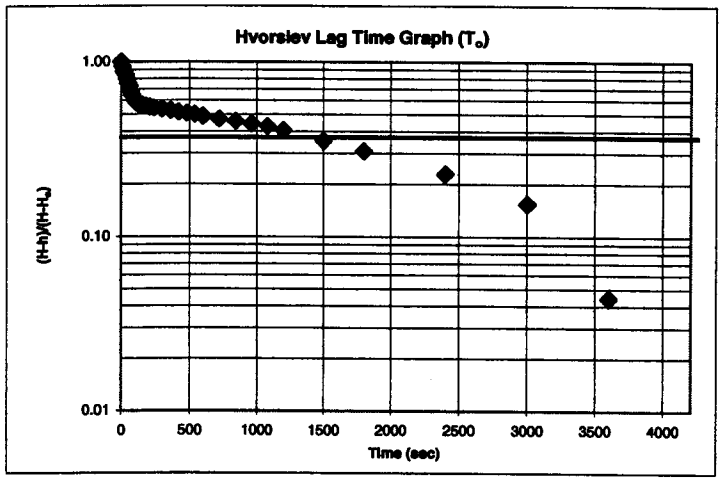
Hvorslev Calculation
(for Hydraulic Conductivity from Rising Head Tests)

Well Name = **BH01-8B (shallow)**

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

| | | |
|---|---|---|
| Initial WL ($H_o$) = | 2.24 m | (Static) |
| Radius of pipe (r) = | 0.016 m | (1.25 inch diameter) |
| Radius of hole (R) = | 0.102 m | (8 inch diameter) |
| Length of screen (L) = | 1.830 m | (5 feet) |
| $H-H_o$ = | 1.360 m | |
| Lag time ($T_o$) = | 1380 sec | (time at $(H-h)/(H-H_o) = 0.37$ on graph) |
| **Hydraulic Cond.(K) =** | **1.44E-07 m/s** | |
| | **1.44E-05 cm/s** | |

| Time (sec) | WL (m) | H-h (m) | $(H-h)/(H-H_o)$ |
|---|---|---|---|
| 0 | 3.60 | 1.36 | 1.00 |
| 10 | 3.52 | 1.28 | 0.94 |
| 20 | 3.44 | 1.20 | 0.88 |
| 30 | 3.39 | 1.15 | 0.85 |
| 40 | 3.33 | 1.09 | 0.80 |
| 50 | 3.27 | 1.03 | 0.76 |
| 60 | 3.23 | 0.99 | 0.73 |
| 70 | 3.17 | 0.93 | 0.68 |
| 80 | 3.12 | 0.88 | 0.65 |
| 90 | 3.09 | 0.85 | 0.63 |
| 100 | 3.06 | 0.82 | 0.60 |
| 110 | 3.03 | 0.79 | 0.58 |
| 120 | 3.02 | 0.78 | 0.57 |
| 150 | 3.01 | 0.77 | 0.57 |
| 180 | 3.00 | 0.76 | 0.56 |
| 210 | 2.99 | 0.75 | 0.55 |
| 240 | 2.98 | 0.74 | 0.54 |
| 300 | 2.97 | 0.73 | 0.54 |
| 360 | 2.96 | 0.72 | 0.53 |
| 420 | 2.94 | 0.70 | 0.51 |
| 480 | 2.93 | 0.69 | 0.51 |
| 540 | 2.92 | 0.68 | 0.50 |
| 600 | 2.91 | 0.67 | 0.49 |
| 720 | 2.88 | 0.64 | 0.47 |
| 840 | 2.86 | 0.62 | 0.46 |
| 960 | 2.84 | 0.60 | 0.44 |
| 1080 | 2.82 | 0.58 | 0.43 |
| 1200 | 2.79 | 0.55 | 0.40 |
| 1500 | 2.72 | 0.48 | 0.35 |
| 1800 | 2.66 | 0.42 | 0.31 |
| 2400 | 2.55 | 0.31 | 0.23 |
| 3000 | 2.45 | 0.21 | 0.15 |
| 3600 | 2.30 | 0.06 | 0.04 |
| 4200 | 2.25 | 0.01 | 0.01 |




Prepared by: MAV
Checked by: JO

# APPENDIX D

## RESULTS OF FIELD AND LABORATORY CHEMICAL AND PHYSICAL ANALYSES (NOVEMBER 1996 TO DECEMBER 2001)

## LIST OF ABBREVIATIONS

The abbreviations commonly employed on the "Chemical and Physical Analyses Data Sheets", on the figures, in the tables and in the text of the report as related to the water quality monitoring programs are as follows:

| | |
|---|---|
| ODWS/O | Ontario Drinking Water Standards / Objective (Ministry of the Environment, 2001) |
| PWQO | Provincial Water Quality Objective (Ministry of the Environment, 1994b) (Includes Interim PWQO also) |
| N | nitrogen |
| P | phosphorus |
| $CaCO_3$ | calcium carbonate |
| C | degrees Celsius |
| microS/cm | microsiemens per centimetre |
| NTU | Nephelometric Turbidity Unit |
| TCU | True Colour Unit |
| mL | millilitre |
| mg/L | milligrams per litre |
| ppm | parts per million |
| COND. | conductivity |
| DIS. OXYGEN | dissolved oxygen |
| TKN | total Kjeldahl nitrogen |
| BOD | biochemical oxygen demand |
| COD | chemical oxygen demand |
| DOC | dissolved organic carbon |
| TOC | total organic carbon |
| TS | total solids |
| TSS | total suspended solids |
| TDS | total dissolved solids |
| f (Alk) | PWQO related to alkalinity of surface water |
| f (Hardness) | PWQO related to hardness of surface water |
| f (Temp) | PWQO related to temperature of surface water |
| f (pH,Temp) | PWQO related to pH and temperature of surface water |
| f (pH) | PWQO related to pH of surface water |
| * | See Ministry of Environment and Energy (2001) for narrative guideline |

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH96-1** Sheet: 1

| Date Sampled: | | 19-Nov-1996 | 12-May-1999 | 14-Oct-1999 | 09-Aug-2000 | 29-Nov-2000 |
|---|---|---|---|---|---|---|
| Parameter | ODWS/O | | | | | |
| Alkalinity (CaCO3) | 30-500 | 250 | 226 | 253 | 244 | 241 |
| Aluminum | 0.1 | 0.300 | <0.030 | 0.090 | 0.130 | 0.330 |
| Ammonia (as N) | | 0.04 | <0.02 | <0.02 | 0.05 | 0.03 |
| Barium | 1 | 0.072 | 0.060 | NA | 0.070 | 0.050 |
| Beryllium | | <0.001 | <0.010 | <0.010 | <0.002 | <0.002 |
| Bicarbonate | | 250.00 | | | | |
| Boron | 5 | 0.310 | 0.220 | NA | 0.250 | 0.290 |
| Bromide | | 0.12 | | | | |
| Cadmium | 0.005 | <0.00200 | <0.00500 | <0.00500 | <0.00010 | <0.00010 |
| Calcium | | 110.0 | 128.0 | 145.0 | 120.0 | 122.0 |
| Carbonate | | <1.00 | | | | |
| Chloride | 250 | 9.9 | 4.0 | 5.0 | 29.0 | 19.0 |
| Chromium | 0.05 | <0.004 | <0.010 | <0.010 | <0.010 | <0.010 |
| Cobalt | | <0.0100 | <0.0100 | <0.0100 | 0.0005 | 0.0008 |
| COD | | | 11 | 11 | 15 | <4 |
| Colour (TCU) | 5 | 4 | | | | |
| Conductivity (uS/cm) | | 790 | 350 | 490 | 723 | 870 |
| Copper | 1 | <0.0060 | <0.0050 | <0.0050 | <0.0100 | 0.0030 |
| DOC | 5 | | 3.6 | 4.6 | 3.4 | 3.8 |
| Fluoride | 1.5 | 0.08 | | | | |
| Hardness (CaCO3) | 80-100 | 350 | 414 | 486 | 378 | 404 |
| Iron | 0.3 | 0.32 | <0.01 | 0.11 | 0.11 | 0.40 |
| Lead | 0.01 | <0.0200 | <0.0020 | <0.0020 | <0.0010 | <0.0010 |
| Magnesium | | 22.00 | 23.00 | 30.00 | 19.00 | 24.00 |
| Manganese | 0.05 | 3.300 | 0.370 | 4.560 | 0.280 | 1.860 |
| Molybdenum | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nickel | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nitrate (as N) | 10 | <0.05 | 0.23 | <0.10 | <0.10 | <0.10 |
| Nitrite (as N) | 1 | <0.05 | <0.10 | <0.10 | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | 7.1 | 7.2 | 6.8 | 7.4 | 6.2 |
| Phenols | | | <0.001 | <0.001 | <0.001 | 0.010 |
| Phosphate (as P) | | <0.10 | <0.03 | 0.03 | 0.02 | <0.03 |
| Phosphorus | | <0.06 | | | | |
| Phosphorus (dissolved reactive) | | | | | | |
| Phosphorus (total) | | | 0.80 | 1.48 | 0.83 | 2.14 |
| Potassium | | 4.9 | 7.0 | 3.0 | 8.0 | 3.0 |
| Silicon | | 4.20 | 2.30 | 3.60 | 2.96 | 3.66 |
| Silver | | <0.0100 | <0.0100 | <0.0100 | <0.0001 | <0.0001 |
| Sodium | 200 | 15.0 | 11.0 | 14.0 | 12.0 | 12.0 |
| Strontium | | 0.750 | 0.610 | 0.974 | 0.653 | 0.807 |
| Sulphate | 500 | 170.0 | 179.0 | 258.0 | 138.0 | 186.0 |
| Sulphur | | 50 | 55 | 79 | 51 | 186 |
| TDS | 500 | 481 | 444 | 672 | 464 | 568 |
| Temperature (C) | 15 | | 8.5 | 4.5 | 9.8 | 8.1 |
| Thallium | | <0.06000 | <0.20000 | <0.50000 | <0.00100 | <0.00100 |
| Tin | | <0.050 | <0.050 | | <0.010 | <0.010 |
| Titanium | | 0.018 | <0.010 | <0.010 | <0.010 | 0.010 |
| TOC | | 5 | | | | |
| Turbidity (NTU) | 1 | 2.9 | | | | |
| Vanadium | | <0.0050 | <0.0100 | <0.0100 | <0.0100 | 0.0010 |
| Zinc | 5 | 0.010 | <0.010 | 0.260 | <0.010 | <0.010 |
| Zirconium | | <0.01 | | | | |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH96-1**



| Date Sampled: | | 27-Jun-2001 | 21-Nov-2001 |
|---|---|---|---|
| Parameter | ODWS/O | | |
| Alkalinity (CaCO3) | 30-500 | 204 | 157 |
| Aluminum | 0.1 | <0.050 | <0.050 |
| Ammonia (as N) | | 0.05 | 0.05 |
| Barium | 1 | 0.050 | 0.020 |
| Beryllium | | <0.002 | <0.002 |
| Bicarbonate | | | |
| Boron | 5 | 0.200 | 0.130 |
| Bromide | | | |
| Cadmium | 0.005 | <0.00010 | <0.00010 |
| Calcium | | 116.0 | 92.0 |
| Carbonate | | | |
| Chloride | 250 | 10.0 | 7.0 |
| Chromium | 0.05 | 0.002 | <0.001 |
| Cobalt | | 0.0003 | 0.0002 |
| COD | | 16 | 12 |
| Colour (TCU) | 5 | | |
| Conductivity (uS/cm) | | 1200 | 442 |
| Copper | 1 | <0.0010 | <0.0010 |
| DOC | 5 | 3.1 | 3.4 |
| Fluoride | 1.5 | | |
| Hardness (CaCO3) | 80-100 | 372 | 308 |
| Iron | 0.3 | 0.03 | <0.01 |
| Lead | 0.01 | <0.0010 | <0.0010 |
| Magnesium | | 20.00 | 19.00 |
| Manganese | 0.05 | 0.130 | 0.490 |
| 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 | 7.3 | 6.6 |
| Phenols | | 0.003 | <0.001 |
| Phosphate (as P) | | 0.04 | <0.03 |
| Phosphorus | | | |
| Phosphorus (dissolved reactive) | | | <0.01 |
| Phosphorus (total) | | 0.33 | |
| Potassium | | 5.0 | 3.0 |
| Silicon | | 2.82 | 2.47 |
| Silver | | 0.0010 | <0.0001 |
| Sodium | 200 | 11.0 | 9.0 |
| Strontium | | 0.663 | 0.429 |
| Sulphate | 500 | 170.0 | 160.0 |
| Sulphur | | | |
| TDS | 500 | 480 | 448 |
| Temperature (C) | 15 | 10.0 | 7.2 |
| Thallium | | <0.00100 | <0.00100 |
| Tin | | <0.010 | <0.010 |
| Titanium | | <0.010 | <0.010 |
| TOC | | | |
| Turbidity (NTU) | 1 | | |
| Vanadium | | <0.0010 | <0.0010 |
| Zinc | 5 | <0.010 | <0.010 |
| Zirconium | | | |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH96-2** Sheet: 1

| Date Sampled: | | 19-Nov-1996 | 12-May-1999 | 14-Oct-1999 | 09-Aug-2000 | 29-Nov-2000 |
|---|---|---|---|---|---|---|
| Parameter | ODWS/O | | | | | |
| Alkalinity (CaCO3) | 30-500 | 190 | 304 | 244 | 269 | 177 |
| Aluminum | 0.1 | 0.045 | <0.030 | 0.290 | 0.220 | 0.720 |
| Ammonia (as N) | | 0.13 | 0.03 | <0.02 | 0.03 | <0.02 |
| Barium | 1 | 0.042 | 0.040 | NA | 0.040 | 0.040 |
| Beryllium | | <0.001 | <0.010 | <0.010 | <0.002 | <0.002 |
| Bicarbonate | | 190.00 | | | | |
| Boron | 5 | 0.130 | 0.120 | NA | 0.140 | 0.110 |
| Bromide | | <0.10 | | | | |
| Cadmium | 0.005 | <0.00200 | <0.00500 | <0.00500 | 0.00020 | 0.00010 |
| Calcium | | 59.0 | 84.0 | 69.0 | 78.0 | 45.0 |
| Carbonate | | <1.00 | | | | |
| Chloride | 250 | 5.1 | 3.0 | 4.0 | 3.0 | 1.0 |
| Chromium | 0.05 | <0.004 | <0.010 | <0.010 | <0.010 | <0.010 |
| Cobalt | | <0.0100 | <0.0100 | <0.0100 | 0.0006 | 0.0005 |
| COD | | | 9 | 11 | 15 | <4 |
| Colour (TCU) | 5 | 32 | | | | |
| Conductivity (uS/cm) | | 460 | 325 | 310 | 520 | 460 |
| Copper | 1 | <0.0060 | <0.0050 | <0.0050 | 0.0200 | 0.0040 |
| DOC | 5 | | 3.5 | 2.8 | 2.8 | 2.5 |
| Fluoride | 1.5 | 0.07 | | | | |
| Hardness (CaCO3) | 80-100 | 200 | 329 | 259 | 286 | 162 |
| Iron | 0.3 | 0.11 | <0.01 | 0.23 | 0.17 | 0.87 |
| Lead | 0.01 | <0.0200 | <0.0020 | <0.0020 | <0.0010 | <0.0010 |
| Magnesium | | 13.00 | 29.00 | 21.00 | 22.00 | 12.00 |
| Manganese | 0.05 | 0.220 | 3.540 | 1.650 | 2.720 | 1.510 |
| Molybdenum | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nickel | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nitrate (as N) | 10 | 0.81 | 0.50 | 0.66 | 0.19 | <0.10 |
| Nitrite (as N) | 1 | <0.05 | <0.10 | <0.10 | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | 7.1 | 7.1 | 6.5 | 7.7 | 6.3 |
| Phenols | | | <0.001 | <0.001 | <0.001 | <0.001 |
| Phosphate (as P) | | <0.10 | 0.06 | 0.03 | 0.04 | 0.03 |
| Phosphorus | | <0.06 | | | | |
| Phosphorus (total) | | | 4.62 | 2.13 | 2.70 | 17.20 |
| Potassium | | 2.1 | 2.0 | 1.0 | 1.0 | 1.0 |
| Silicon | | 4.50 | 5.80 | 6.30 | 7.21 | 7.46 |
| Silver | | <0.0100 | <0.0100 | <0.0100 | <0.0001 | <0.0001 |
| Sodium | 200 | 13.0 | 4.0 | 5.0 | 4.0 | 4.0 |
| Strontium | | 0.480 | 0.598 | 0.648 | 0.656 | 0.463 |
| Sulphate | 500 | 55.0 | 34.0 | 34.0 | 36.0 | 16.0 |
| Sulphur | | 19 | 12 | 10 | 15 | 16 |
| TDS | 500 | 259 | 336 | 312 | 304 | 176 |
| Temperature (C) | 15 | | 8.0 | 4.0 | 11.6 | 9.0 |
| Thallium | | <0.06000 | <0.20000 | <0.50000 | <0.00100 | <0.00100 |
| Tin | | <0.050 | <0.050 | | <0.010 | <0.010 |
| Titanium | | <0.010 | <0.010 | <0.010 | <0.010 | 0.030 |
| TOC | | 9 | | | | |
| Turbidity (NTU) | 1 | 3.3 | | | | |
| Vanadium | | <0.0050 | <0.0100 | <0.0100 | <0.0100 | 0.0030 |
| Zinc | 5 | 0.019 | <0.010 | 0.360 | <0.010 | <0.010 |
| Zirconium | | <0.01 | | | | |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH96-2**



| Date Sampled: | | 27-Jun-2001 | 21-Nov-2001 |
|---|---|---|---|
| Parameter | ODWS/O | | |
| Alkalinity (CaCO3) | 30-500 | DRY | DRY |
| Aluminum | 0.1 | | |
| Ammonia (as N) | | | |
| Barium | 1 | | |
| Beryllium | | | |
| Bicarbonate | | | |
| Boron | 5 | | |
| Bromide | | | |
| Cadmium | 0.005 | | |
| Calcium | | | |
| Carbonate | | | |
| Chloride | 250 | | |
| Chromium | 0.05 | | |
| Cobalt | | | |
| COD | | | |
| Colour (TCU) | 5 | | |
| Conductivity (uS/cm) | | | |
| Copper | 1 | | |
| DOC | 5 | | |
| Fluoride | 1.5 | | |
| Hardness (CaCO3) | 80-100 | | |
| Iron | 0.3 | | |
| Lead | 0.01 | | |
| Magnesium | | | |
| Manganese | 0.05 | | |
| Molybdenum | | | |
| Nickel | | | |
| Nitrate (as N) | 10 | | |
| Nitrite (as N) | 1 | | |
| pH (pH units) | 6.5-8.5 | | |
| Phenols | | | |
| Phosphate (as P) | | | |
| Phosphorus | | | |
| Phosphorus (total) | | | |
| Potassium | | | |
| Silicon | | | |
| Silver | | | |
| Sodium | 200 | | |
| Strontium | | | |
| Sulphate | 500 | | |
| Sulphur | | | |
| TDS | 500 | | |
| Temperature (C) | 15 | | |
| Thallium | | | |
| Tin | | | |
| Titanium | | | |
| TOC | | | |
| Turbidity (NTU) | 1 | | |
| Vanadium | | | |
| Zinc | 5 | | |
| Zirconium | | | |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH96-3** Sheet: 1

| Date Sampled: | | 19-Nov-1996 | 12-May-1999 | 14-Oct-1999 | 09-Aug-2000 | 29-Nov-2000 |
|---|---|---|---|---|---|---|
| Parameter | ODWS/O | | | | | |
| Alkalinity (CaCO3) | 30-500 | 160 | 382 | 311 | 397 | 288 |
| Aluminum | 0.1 | 0.290 | <0.030 | 0.070 | 0.160 | 0.240 |
| Ammonia (as N) | | 0.06 | 0.03 | <0.02 | 0.03 | 0.02 |
| Barium | 1 | 0.033 | 0.030 | NA | 0.070 | 0.050 |
| Beryllium | | <0.001 | 0.010 | <0.010 | <0.002 | <0.002 |
| Bicarbonate | | 160.00 | | | | |
| Boron | 5 | 0.330 | 0.530 | NA | 0.460 | 0.400 |
| Bromide | | 0.22 | | | | |
| Cadmium | 0.005 | <0.00200 | <0.00500 | <0.00500 | 0.00020 | 0.00010 |
| Calcium | | 140.0 | 137.0 | 204.0 | 214.0 | 143.0 |
| Carbonate | | <1.00 | | | | |
| Chloride | 250 | 86.0 | 14.0 | 24.0 | 33.0 | 13.0 |
| Chromium | 0.05 | <0.004 | <0.010 | <0.010 | <0.010 | <0.010 |
| Cobalt | | <0.0100 | <0.0100 | <0.0100 | 0.0008 | 0.0006 |
| COD | | | 9 | 11 | 18 | 8 |
| Colour (TCU) | 5 | 8 | | | | |
| Conductivity (uS/cm) | | 1100 | 450 | 540 | 1210 | 980 |
| Copper | 1 | <0.0060 | <0.0050 | <0.0050 | 0.0100 | 0.0030 |
| DOC | 5 | | 4.9 | 4.4 | 4.5 | 3.4 |
| Fluoride | 1.5 | 0.06 | | | | |
| Hardness (CaCO3) | 80-100 | 470 | 466 | 666 | 687 | 460 |
| Iron | 0.3 | 0.35 | <0.01 | 0.07 | 0.20 | 0.31 |
| Lead | 0.01 | <0.0200 | <0.0020 | <0.0020 | <0.0010 | <0.0010 |
| Magnesium | | 30.00 | 30.00 | 38.00 | 37.00 | 25.00 |
| Manganese | 0.05 | 1.300 | 2.020 | 1.930 | 1.620 | 1.270 |
| Molybdenum | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nickel | | 0.011 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nitrate (as N) | 10 | 0.14 | 0.36 | 0.20 | 0.56 | <0.10 |
| Nitrite (as N) | 1 | <0.05 | <0.10 | <0.10 | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | 6.9 | 7.3 | 7.1 | 7.6 | 6.3 |
| Phenols | | | 0.002 | <0.001 | <0.001 | <0.001 |
| Phosphate (as P) | | <0.10 | <0.03 | 0.03 | 0.03 | <0.03 |
| Phosphorus | | <0.06 | | | | |
| Phosphorus (dissolved reactive) | | | | | | |
| Phosphorus (total) | | | 4.74 | 4.13 | 2.84 | 19.60 |
| Potassium | | 2.4 | 2.0 | 2.0 | 2.0 | 2.0 |
| Silicon | | 5.50 | 2.30 | 2.90 | 3.59 | 3.33 |
| Silver | | <0.0100 | <0.0100 | <0.0100 | <0.0001 | <0.0001 |
| Sodium | 200 | 40.0 | 26.0 | 25.0 | 22.0 | 28.0 |
| Strontium | | 1.000 | 1.070 | 1.550 | 1.380 | 0.981 |
| Sulphate | 500 | 310.0 | 111.0 | 359.0 | 278.0 | 227.0 |
| Sulphur | | 99 | 27 | 106 | 101 | 227 |
| TDS | 500 | 707 | 608 | 868 | 872 | 656 |
| Temperature (C) | 15 | | 8.5 | 2.5 | 10.8 | 9.2 |
| Thallium | | <0.06000 | <0.20000 | <0.50000 | <0.00100 | <0.00100 |
| Tin | | <0.050 | <0.050 | | <0.010 | <0.010 |
| Titanium | | 0.027 | <0.010 | <0.010 | <0.010 | 0.010 |
| TOC | | 9 | | | | |
| Turbidity (NTU) | 1 | 3.8 | | | | |
| Vanadium | | <0.0050 | <0.0100 | <0.0100 | <0.0100 | 0.0020 |
| Zinc | 5 | 0.008 | <0.010 | 0.380 | <0.010 | <0.010 |
| Zirconium | | <0.01 | | | | |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH96-3**



| Date Sampled: | | 27-Jun-2001 | 21-Nov-2001 |
|---|---|---|---|
| Parameter | ODWS/O | | |
| Alkalinity (CaCO3) | 30-500 | 371 | 315 |
| Aluminum | 0.1 | <0.050 | <0.050 |
| Ammonia (as N) | | <0.02 | 0.05 |
| Barium | 1 | 0.040 | 0.040 |
| Beryllium | | <0.002 | <0.002 |
| Bicarbonate | | | |
| Boron | 5 | 0.420 | 0.250 |
| Bromide | | | |
| Cadmium | 0.005 | <0.00010 | <0.00010 |
| Calcium | | 158.0 | 139.0 |
| Carbonate | | | |
| Chloride | 250 | 13.0 | 13.0 |
| Chromium | 0.05 | 0.004 | <0.001 |
| Cobalt | | 0.0003 | 0.0002 |
| COD | | 22 | 12 |
| Colour (TCU) | 5 | | |
| Conductivity (uS/cm) | | 873 | 607 |
| Copper | 1 | <0.0010 | 0.0020 |
| DOC | 5 | 2.4 | 3.7 |
| Fluoride | 1.5 | | |
| Hardness (CaCO3) | 80-100 | 510 | 438 |
| Iron | 0.3 | 0.01 | <0.01 |
| Lead | 0.01 | <0.0010 | <0.0010 |
| Magnesium | | 28.00 | 22.00 |
| Manganese | 0.05 | 0.580 | 1.080 |
| Molybdenum | | <0.010 | <0.010 |
| Nickel | | <0.010 | <0.010 |
| Nitrate (as N) | 10 | 0.10 | 0.84 |
| Nitrite (as N) | 1 | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | 7.0 | 6.5 |
| Phenols | | 0.002 | <0.001 |
| Phosphate (as P) | | 0.04 | <0.03 |
| Phosphorus | | | |
| Phosphorus (dissolved reactive) | | | <0.01 |
| Phosphorus (total) | | 0.37 | |
| Potassium | | 1.0 | 2.0 |
| Silicon | | 3.00 | 2.56 |
| Silver | | 0.0010 | <0.0001 |
| Sodium | 200 | 18.0 | 20.0 |
| Strontium | | 0.882 | 0.681 |
| Sulphate | 500 | 143.0 | 135.0 |
| Sulphur | | | |
| TDS | 500 | 588 | 604 |
| Temperature (C) | 15 | 10.0 | 8.6 |
| Thallium | | <0.00100 | <0.00100 |
| Tin | | <0.010 | <0.010 |
| Titanium | | <0.010 | <0.010 |
| TOC | | | |
| Turbidity (NTU) | 1 | | |
| Vanadium | | 0.0020 | <0.0010 |
| Zinc | 5 | <0.010 | <0.010 |
| Zirconium | | | |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH96-3**

Sheet: 1

Date Sampled: 09-Aug-2000

| Parameter | ODWS/O | |
|---|---|---|
| 1,1,1,2-Tetrachloroethane | | <0.60 |
| 1,1,1-Trichloroethane | | <0.40 |
| 1,1,2,2-Tetrachloroethane | | <0.60 |
| 1,1,2-Trichloroethane | | <0.40 |
| 1,1-Dichloroethane | | <0.40 |
| 1,1-Dichloroethylene | 14 | <0.5000 |
| 1,2-Dibromoethane | | <1.00 |
| 1,2-Dichlorobenzene | 200 | <1.00 |
| 1,2-Dichloroethane | 5 | <0.700 |
| 1,2-Dichloropropane | | <0.70 |
| 1,3,5-Trimethylbenzene | | <0.30 |
| 1,3-Dichlorobenzene | | <1.00 |
| 1,4-Dichlorobenzene | 5 | <1.000 |
| Benzene | 5 | <0.5000 |
| Bromodichloromethane | | <0.300 |
| Bromoform | | <0.400 |
| Bromomethane | | <0.500 |
| c-1,3-Dichloropropylene | | <0.20 |
| Carbon Tetrachloride | 5 | <0.900 |
| Chlorobenzene | 80 | <0.200 |
| Chloroethane | | <1.0 |
| Chloroform | | <0.50 |
| Chloromethane | | <1.000 |
| cis-1,2-Dichloroethylene | | <0.40 |
| Dibromochloromethane | | <0.30 |
| Ethylbenzene | 2.4 | <0.5000 |
| Methylene Chloride | 50 | <4.00 |
| Styrene | | <0.50 |
| t-1,2-Dichloroethylene | | <0.4000 |
| t-1,3-Dichloropropylene | | <0.20 |
| Tetrachloroethylene | 30 | <0.30 |
| Toluene | 24 | <0.5000 |
| Trichloroethylene | 50 | <0.30 |
| Trichlorofluoromethane | | <0.50 |
| Vinyl Chloride | 2 | <0.500 |
| Xylene-m/p | | <0.5000 |
| Xylene-o | | <0.5000 |

All VOC's reported in µg/L. All other values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH96-4** Sheet: 1

| Date Sampled: | | 19-Nov-1996 | 12-May-1999 | 14-Oct-1999 | 09-Aug-2000 | 29-Nov-2000 |
|---|---|---|---|---|---|---|
| Parameter | ODWS/O | | | | | |
| Alkalinity (CaCO3) | 30-500 | 160 | 153 | 142 | 158 | 143 |
| Aluminum | 0.1 | 0.530 | <0.030 | 3.560 | 0.360 | 0.300 |
| Ammonia (as N) | | 0.08 | 0.03 | 0.07 | 0.06 | 0.04 |
| Barium | 1 | 0.041 | 0.030 | NA | 0.040 | 0.040 |
| Beryllium | | <0.001 | <0.010 | <0.010 | <0.002 | <0.002 |
| Bicarbonate | | 150.00 | | | | |
| Boron | 5 | <0.010 | <0.010 | NA | <0.010 | <0.010 |
| Bromide | | <0.10 | | | | |
| Cadmium | 0.005 | <0.00200 | <0.00500 | <0.00500 | <0.00010 | <0.00010 |
| Calcium | | 42.0 | 48.0 | 39.0 | 44.0 | 40.0 |
| Carbonate | | <1.00 | | | | |
| Chloride | 250 | 1.8 | 2.0 | 2.0 | 1.0 | 2.0 |
| Chromium | 0.05 | <0.004 | <0.010 | <0.010 | <0.010 | <0.010 |
| Cobalt | | <0.0100 | <0.0100 | <0.0100 | 0.0007 | 0.0005 |
| COD | | | <3 | 11 | 10 | <4 |
| Colour (TCU) | 5 | 18 | | | | |
| Conductivity (uS/cm) | | 320 | 285 | 210 | 307 | 341 |
| Copper | 1 | <0.0060 | <0.0050 | <0.0050 | <0.0100 | 0.0020 |
| DOC | 5 | | 1.8 | 2.2 | 1.7 | 2.1 |
| Fluoride | 1.5 | 0.10 | | | | |
| Hardness (CaCO3) | 80-100 | 160 | 177 | 151 | 168 | 145 |
| Iron | 0.3 | 0.51 | <0.01 | 2.31 | 0.35 | 0.35 |
| Lead | 0.01 | <0.0200 | <0.0020 | <0.0020 | <0.0010 | <0.0010 |
| Magnesium | | 13.00 | 14.00 | 13.00 | 14.00 | 11.00 |
| Manganese | 0.05 | 0.016 | 0.010 | 0.070 | 0.030 | 0.020 |
| Molybdenum | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nickel | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nitrate (as N) | 10 | <0.05 | <0.10 | <0.10 | <0.10 | <0.10 |
| Nitrite (as N) | 1 | <0.05 | <0.10 | <0.10 | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | 7.8 | 6.9 | 7.7 | 7.2 | 7.1 |
| Phenols | | | <0.001 | <0.001 | <0.001 | <0.001 |
| Phosphate (as P) | | <0.10 | 0.18 | 0.15 | 0.11 | 0.23 |
| Phosphorus | | <0.06 | | | | |
| Phosphorus (dissolved reactive) | | | | | | |
| Phosphorus (total) | | | 0.22 | 4.51 | 31.70 | 1.23 |
| Potassium | | 2.0 | 3.0 | 2.0 | 2.0 | 2.0 |
| Silicon | | 11.00 | 9.70 | 13.70 | 12.60 | 12.40 |
| Silver | | <0.0100 | <0.0100 | <0.0100 | <0.0001 | <0.0001 |
| Sodium | 200 | 7.9 | 7.0 | 6.0 | 6.0 | 6.0 |
| Strontium | | 0.110 | 0.093 | 0.121 | 0.103 | 0.100 |
| Sulphate | 500 | 26.0 | 24.0 | 25.0 | 24.0 | 25.0 |
| Sulphur | | 9 | 8 | 8 | 10 | 25 |
| TDS | 500 | 186 | 184 | 196 | 236 | 172 |
| Temperature (C) | 15 | | 7.0 | 5.0 | 11.4 | 8.6 |
| Thallium | | <0.06000 | <0.20000 | <0.50000 | <0.00100 | <0.00100 |
| Tin | | <0.050 | <0.050 | | <0.010 | <0.010 |
| Titanium | | 0.030 | <0.010 | 0.010 | 0.010 | 0.010 |
| TOC | | 5 | | | | |
| Turbidity (NTU) | 1 | 690.0 | | | | |
| Vanadium | | <0.0050 | <0.0100 | <0.0100 | <0.0100 | 0.0030 |
| Zinc | 5 | <0.005 | <0.010 | 0.020 | <0.010 | <0.010 |
| Zirconium | | <0.01 | | | | |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH96-4**



| Date Sampled: | | 27-Jun-2001 | 21-Nov-2001 |
|---|---|---|---|
| Parameter | ODWS/O | | |
| Alkalinity (CaCO3) | 30-500 | 146 | 145 |
| Aluminum | 0.1 | <0.050 | <0.050 |
| Ammonia (as N) | | 0.11 | 0.06 |
| Barium | 1 | 0.030 | 0.020 |
| Beryllium | | <0.002 | <0.002 |
| Bicarbonate | | | |
| Boron | 5 | <0.010 | <0.050 |
| Bromide | | | |
| Cadmium | 0.005 | <0.00010 | <0.00010 |
| Calcium | | 41.0 | 40.0 |
| Carbonate | | | |
| Chloride | 250 | 3.0 | 3.0 |
| Chromium | 0.05 | 0.005 | <0.001 |
| Cobalt | | 0.0002 | <0.0002 |
| COD | | 14 | <5 |
| Colour (TCU) | 5 | | |
| Conductivity (uS/cm) | | NV | 245 |
| Copper | 1 | <0.0010 | <0.0010 |
| DOC | 5 | 1.7 | <0.5 |
| Fluoride | 1.5 | | |
| Hardness (CaCO3) | 80-100 | 156 | 154 |
| Iron | 0.3 | <0.01 | <0.01 |
| Lead | 0.01 | <0.0010 | <0.0010 |
| Magnesium | | 13.00 | 13.00 |
| Manganese | 0.05 | <0.010 | 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 | <0.10 |
| pH (pH units) | 6.5-8.5 | 8.1 | 7.6 |
| Phenols | | <0.001 | <0.001 |
| Phosphate (as P) | | 0.26 | 0.09 |
| Phosphorus | | | |
| Phosphorus (dissolved reactive) | | | 0.03 |
| Phosphorus (total) | | 0.37 | 0.50 |
| Potassium | | 2.0 | 2.0 |
| Silicon | | 11.20 | 9.52 |
| Silver | | 0.0010 | <0.0001 |
| Sodium | 200 | 5.0 | 5.0 |
| Strontium | | 0.101 | 0.073 |
| Sulphate | 500 | 22.0 | 27.0 |
| Sulphur | | | |
| TDS | 500 | 228 | 240 |
| Temperature (C) | 15 | 10.5 | 6.8 |
| Thallium | | <0.00100 | <0.00100 |
| Tin | | <0.010 | <0.010 |
| Titanium | | <0.010 | <0.010 |
| TOC | | | |
| Turbidity (NTU) | 1 | | |
| Vanadium | | 0.0030 | 0.0020 |
| Zinc | 5 | <0.010 | <0.010 |
| Zirconium | | | |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH96-4** Sheet: 1

Date Sampled: 09-Aug-2000

| Parameter | ODWS/O | |
|---|---|---|
| 1,1,1,2-Tetrachloroethane | | <0.60 |
| 1,1,1-Trichloroethane | | <0.40 |
| 1,1,2,2-Tetrachloroethane | | <0.60 |
| 1,1,2-Trichloroethane | | <0.40 |
| 1,1-Dichloroethane | | <0.40 |
| 1,1-Dichloroethylene | 14 | <0.5000 |
| 1,2-Dibromoethane | | <1.00 |
| 1,2-Dichlorobenzene | 200 | <1.00 |
| 1,2-Dichloroethane | 5 | <0.700 |
| 1,2-Dichloropropane | | <0.70 |
| 1,3,5-Trimethylbenzene | | <0.30 |
| 1,3-Dichlorobenzene | | <1.00 |
| 1,4-Dichlorobenzene | 5 | <1.000 |
| Benzene | 5 | <0.5000 |
| Bromodichloromethane | | <0.300 |
| Bromoform | | <0.400 |
| Bromomethane | | <0.500 |
| c-1,3-Dichloropropylene | | <0.20 |
| Carbon Tetrachloride | 5 | <0.900 |
| Chlorobenzene | 80 | <0.200 |
| Chloroethane | | <1.0 |
| Chloroform | | <0.50 |
| Chloromethane | | <1.000 |
| cis-1,2-Dichloroethylene | | <0.40 |
| Dibromochloromethane | | <0.30 |
| Ethylbenzene | 2.4 | <0.5000 |
| Methylene Chloride | 50 | <4.00 |
| Styrene | | <0.50 |
| t-1,2-Dichloroethylene | | <0.4000 |
| t-1,3-Dichloropropylene | | <0.20 |
| Tetrachloroethylene | 30 | <0.30 |
| Toluene | 24 | <0.5000 |
| Trichloroethylene | 50 | <0.30 |
| Trichlorofluoromethane | | <0.50 |
| Vinyl Chloride | 2 | <0.500 |
| Xylene-m/p | | <0.5000 |
| Xylene-o | | <0.5000 |

All VOC's reported in µg/L. All other values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH99-5** Sheet: 1

| Date Sampled: | | 12-May-1999 | 14-Oct-1999 | 09-Aug-2000 | 29-Nov-2000 | 27-Jun-2001 |
|---|---|---|---|---|---|---|
| Parameter | ODWS/O | | | | | |
| Alkalinity (CaCO3) | 30-500 | 140 | 141 | 155 | 130 | 147 |
| Aluminum | 0.1 | <0.030 | 0.830 | 0.050 | 0.120 | <0.050 |
| Ammonia (as N) | | 0.04 | <0.02 | 0.03 | <0.02 | 0.07 |
| Barium | 1 | 0.060 | NA | 0.160 | 0.210 | 0.240 |
| Beryllium | | <0.010 | <0.010 | <0.002 | <0.002 | <0.002 |
| Boron | 5 | 0.020 | NA | 0.040 | 0.040 | 0.030 |
| Cadmium | 0.005 | <0.00500 | <0.00500 | <0.00010 | <0.00010 | <0.00010 |
| Calcium | | 63.0 | 71.0 | 117.0 | 114.0 | 165.0 |
| Chloride | 250 | 43.0 | 79.0 | 149.0 | 195.0 | 232.0 |
| Chromium | 0.05 | <0.010 | <0.010 | <0.010 | <0.010 | <0.001 |
| Cobalt | | <0.0100 | <0.0100 | 0.0006 | 0.0004 | 0.0003 |
| COD | | 14 | 8 | 10 | <4 | 22 |
| Conductivity (uS/cm) | | 250 | 350 | 970 | 1100 | 1260 |
| Copper | 1 | <0.0050 | <0.0050 | <0.0100 | 0.0010 | <0.0010 |
| DOC | 5 | 2.1 | 1.8 | 0.9 | 1.3 | 1.9 |
| Hardness (CaCO3) | 80-100 | 240 | 272 | 441 | 433 | 606 |
| Iron | 0.3 | <0.01 | 0.51 | 0.11 | 0.10 | 0.05 |
| Lead | 0.01 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 |
| Magnesium | | 20.00 | 23.00 | 36.00 | 36.00 | 47.00 |
| Manganese | 0.05 | <0.010 | <0.010 | 0.020 | 0.020 | 0.030 |
| Molybdenum | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nickel | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nitrate (as N) | 10 | 0.24 | 0.13 | <0.10 | <0.10 | <0.10 |
| Nitrite (as N) | 1 | 0.11 | <0.10 | <0.10 | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | 7.6 | 7.5 | 7.6 | 6.9 | 7.3 |
| Phenols | | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 |
| Phosphate (as P) | | 0.12 | 0.09 | 0.06 | 0.06 | 0.04 |
| Phosphorus (dissolved reactive) | | | | | | |
| Phosphorus (total) | | 3.29 | 2.19 | 0.54 | 0.80 | 0.11 |
| Potassium | | 2.0 | 2.0 | 2.0 | 3.0 | 2.0 |
| Silicon | | 6.70 | 8.80 | 8.45 | 8.43 | 7.63 |
| Silver | | <0.0100 | <0.0100 | <0.0001 | <0.0001 | 0.0010 |
| Sodium | 200 | 14.0 | 20.0 | 26.0 | 26.0 | 30.0 |
| Strontium | | <0.007 | 0.184 | 0.246 | 0.299 | 0.353 |
| Sulphate | 500 | 72.0 | 82.0 | 122.0 | 128.0 | 161.0 |
| Sulphur | | 21 | 26 | 44 | 128 | |
| TDS | 500 | 312 | 396 | 728 | 716 | 780 |
| Temperature (C) | 15 | 6.0 | 1.0 | 12.2 | 7.0 | 10.0 |
| Thallium | | <0.20000 | <0.50000 | <0.00100 | <0.00100 | <0.00100 |
| Tin | | <0.050 | | <0.010 | <0.010 | <0.010 |
| Titanium | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Vanadium | | <0.0100 | <0.0100 | <0.0100 | 0.0040 | 0.0020 |
| Zinc | 5 | 0.010 | 0.070 | <0.010 | <0.010 | <0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH99-5**



Date Sampled: 21-Nov-2001

| Parameter | ODWS/O | |
|---|---|---|
| Alkalinity (CaCO3) | 30-500 | 175 |
| Aluminum | 0.1 | <0.050 |
| Ammonia (as N) | | 0.06 |
| Barium | 1 | 0.200 |
| Beryllium | | <0.002 |
| Boron | 5 | <0.050 |
| Cadmium | 0.005 | <0.00010 |
| Calcium | | 184.0 |
| Chloride | 250 | 252.0 |
| Chromium | 0.05 | <0.001 |
| Cobalt | | 0.0002 |
| COD | | 22 |
| Conductivity (uS/cm) | | 1580 |
| Copper | 1 | <0.0010 |
| DOC | 5 | 7.7 |
| Hardness (CaCO3) | 80-100 | 703 |
| Iron | 0.3 | 0.01 |
| Lead | 0.01 | <0.0010 |
| Magnesium | | 59.00 |
| Manganese | 0.05 | 0.030 |
| Molybdenum | | <0.010 |
| Nickel | | <0.001 |
| Nitrate (as N) | 10 | <0.10 |
| Nitrite (as N) | 1 | <0.10 |
| pH (pH units) | 6.5-8.5 | 7.6 |
| Phenols | | <0.001 |
| Phosphate (as P) | | 0.06 |
| Phosphorus (dissolved reactive) | | 0.02 |
| Phosphorus (total) | | |
| Potassium | | 3.0 |
| Silicon | | 6.58 |
| Silver | | <0.0001 |
| Sodium | 200 | 35.0 |
| Strontium | | 0.302 |
| Sulphate | 500 | 202.0 |
| Sulphur | | |
| TDS | 500 | 1150 |
| Temperature (C) | 15 | 8.0 |
| Thallium | | <0.00100 |
| Tin | | <0.010 |
| Titanium | | <0.010 |
| Vanadium | | 0.0020 |
| Zinc | 5 | <0.001 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH99-6** Sheet: 1

| Date Sampled: | | 12-May-1999 | 14-Oct-1999 | 09-Aug-2000 | 29-Nov-2000 | 27-Jun-2001 |
|---|---|---|---|---|---|---|
| Parameter | ODWS/O | | | | | |
| Alkalinity (CaCO3) | 30-500 | 589 | 507 | 452 | 457 | 398 |
| Aluminum | 0.1 | 0.100 | 0.100 | 0.100 | 0.100 | 0.090 |
| Ammonia (as N) | | 22.90 | 22.00 | 17.80 | 19.40 | 17.70 |
| Barium | 1 | 0.240 | NA | 0.240 | 0.210 | 0.240 |
| Beryllium | | <0.010 | <0.010 | <0.002 | <0.002 | <0.002 |
| Boron | 5 | 0.280 | NA | 0.220 | 0.250 | 0.220 |
| Cadmium | 0.005 | <0.00500 | <0.00500 | <0.00010 | <0.00010 | <0.00010 |
| Calcium | | 139.0 | 103.0 | 114.0 | 90.0 | 85.0 |
| Chloride | 250 | 62.0 | 49.0 | 88.0 | 36.0 | 61.0 |
| Chromium | 0.05 | <0.010 | <0.010 | <0.010 | <0.010 | 0.010 |
| Cobalt | | <0.0100 | <0.0100 | 0.0153 | 0.0173 | 0.0088 |
| COD | | 98 | 100 | 75 | 62 | 95 |
| Conductivity (uS/cm) | | 560 | 590 | 1340 | 1080 | 1030 |
| Copper | 1 | <0.0050 | <0.0050 | <0.0100 | 0.0020 | <0.0010 |
| DOC | 5 | 37.5 | 29.3 | 22.2 | 23.4 | 17.7 |
| Hardness (CaCO3) | 80-100 | 446 | 335 | 384 | 287 | 278 |
| Iron | 0.3 | 65.60 | 50.20 | 56.20 | 39.00 | 49.50 |
| Lead | 0.01 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 |
| Magnesium | | 24.00 | 19.00 | 24.00 | 15.00 | 16.00 |
| Manganese | 0.05 | 15.100 | 13.600 | 14.800 | 11.600 | 12.000 |
| Molybdenum | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nickel | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nitrate (as N) | 10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Nitrite (as N) | 1 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | 7.6 | 6.4 | 7.3 | 5.9 | 6.7 |
| Phenols | | 0.015 | 0.012 | 0.007 | 0.010 | 0.011 |
| Phosphate (as P) | | 0.21 | <0.01 | <0.03 | 0.05 | 0.03 |
| Phosphorus (dissolved reactive) | | | | | | |
| Phosphorus (total) | | 2.55 | 0.49 | 0.45 | 0.55 | 0.01 |
| Potassium | | 26.0 | 16.0 | 27.0 | 28.0 | 29.0 |
| Silicon | | 7.90 | 9.10 | 10.50 | 9.85 | 9.57 |
| Silver | | 0.0200 | <0.0100 | <0.0001 | <0.0001 | 0.0010 |
| Sodium | 200 | 55.0 | 45.0 | 57.0 | 37.0 | 43.0 |
| Strontium | | 1.160 | 1.320 | 1.090 | 0.913 | 0.972 |
| Sulphate | 500 | 12.0 | 4.0 | 39.0 | 7.0 | 21.0 |
| Sulphur | | 6 | <1 | 18 | 7 | |
| TDS | 500 | 728 | 628 | 688 | 528 | 552 |
| Temperature (C) | 15 | 9.0 | 5.0 | 10.7 | 9.9 | 12.7 |
| Thallium | | <0.20000 | <0.50000 | <0.00100 | <0.00100 | <0.00100 |
| Tin | | <0.050 | | <0.010 | <0.010 | <0.010 |
| Titanium | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Vanadium | | <0.0100 | <0.0100 | 0.0100 | 0.0060 | 0.0030 |
| Zinc | 5 | 0.010 | 0.330 | <0.010 | <0.010 | <0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**



Sample Source: **BH99-6**

Date Sampled: 21-Nov-2001

| Parameter | ODWS/O | |
|---|---|---|
| Alkalinity (CaCO3) | 30-500 | 390 |
| Aluminum | 0.1 | <0.050 |
| Ammonia (as N) | | 13.50 |
| Barium | 1 | 0.130 |
| Beryllium | | <0.002 |
| Boron | 5 | 0.170 |
| Cadmium | 0.005 | <0.00010 |
| Calcium | | 85.0 |
| Chloride | 250 | 39.0 |
| Chromium | 0.05 | <0.001 |
| Cobalt | | 0.0089 |
| COD | | 48 |
| Conductivity (uS/cm) | | 722 |
| Copper | 1 | <0.0010 |
| DOC | 5 | 18.4 |
| Hardness (CaCO3) | 80-100 | 274 |
| Iron | 0.3 | 32.70 |
| Lead | 0.01 | <0.0010 |
| Magnesium | | 15.00 |
| Manganese | 0.05 | 7.610 |
| Molybdenum | | <0.010 |
| Nickel | | <0.010 |
| Nitrate (as N) | 10 | <0.10 |
| Nitrite (as N) | 1 | <0.10 |
| pH (pH units) | 6.5-8.5 | 6.2 |
| Phenols | | 0.006 |
| Phosphate (as P) | | <0.03 |
| Phosphorus (dissolved reactive) | | <0.01 |
| Phosphorus (total) | | |
| Potassium | | 25.0 |
| Silicon | | 7.83 |
| Silver | | <0.0001 |
| Sodium | 200 | 33.0 |
| Strontium | | 0.611 |
| Sulphate | 500 | 14.0 |
| Sulphur | | |
| TDS | 500 | 488 |
| Temperature (C) | 15 | 8.1 |
| Thallium | | <0.00100 |
| Tin | | <0.010 |
| Titanium | | 0.030 |
| Vanadium | | 0.0020 |
| Zinc | 5 | <0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH99-6**



Date Sampled: 09-Aug-2000

| Parameter | ODWS/O | |
|---|---|---|
| 1,1,1,2-Tetrachloroethane | | <0.60 |
| 1,1,1-Trichloroethane | | <0.40 |
| 1,1,2,2-Tetrachloroethane | | <0.60 |
| 1,1,2-Trichloroethane | | <0.40 |
| 1,1-Dichloroethane | | 0.50 |
| 1,1-Dichloroethylene | 14 | <0.5000 |
| 1,2-Dibromoethane | | <1.00 |
| 1,2-Dichlorobenzene | 200 | <1.00 |
| 1,2-Dichloroethane | 5 | <0.700 |
| 1,2-Dichloropropane | | <0.70 |
| 1,3,5-Trimethylbenzene | | 0.60 |
| 1,3-Dichlorobenzene | | 2.00 |
| 1,4-Dichlorobenzene | 5 | 2.000 |
| Benzene | 5 | 2.1000 |
| Bromodichloromethane | | <0.300 |
| Bromoform | | <0.400 |
| Bromomethane | | <0.500 |
| c-1,3-Dichloropropylene | | <0.20 |
| Carbon Tetrachloride | 5 | <0.900 |
| Chlorobenzene | 80 | <0.200 |
| Chloroethane | | <1.0 |
| Chloroform | | <0.50 |
| Chloromethane | | <1.000 |
| cis-1,2-Dichloroethylene | | 1.90 |
| Dibromochloromethane | | <0.30 |
| Ethylbenzene | 2.4 | 28.9000 |
| Methylene Chloride | 50 | <4.00 |
| Styrene | | <0.50 |
| t-1,2-Dichloroethylene | | <0.4000 |
| t-1,3-Dichloropropylene | | <0.20 |
| Tetrachloroethylene | 30 | <0.30 |
| Toluene | 24 | <0.5000 |
| Trichloroethylene | 50 | <0.30 |
| Trichlorofluoromethane | | <0.50 |
| Vinyl Chloride | 2 | <0.500 |
| Xylene-m/p | | 44.4000 |
| Xylene-o | | 2.3000 |

All VOC's reported in µg/L. All other values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH99-7** Sheet: 1

| Date Sampled: | | 12-May-1999 | 14-Oct-1999 | 09-Aug-2000 | 29-Nov-2000 | 27-Jun-2001 |
|---|---|---|---|---|---|---|
| Parameter | ODWS/O | | | | | |
| Alkalinity (CaCO3) | 30-500 | 26 | 15 | 28 | 17 | 18 |
| Aluminum | 0.1 | <0.030 | 0.070 | 0.060 | 0.150 | <0.050 |
| Ammonia (as N) | | 0.05 | <0.02 | 0.03 | <0.02 | <0.02 |
| Barium | 1 | 0.010 | NA | <0.010 | <0.010 | <0.010 |
| Beryllium | | <0.010 | <0.010 | <0.002 | <0.002 | <0.002 |
| Boron | 5 | <0.010 | NA | <0.010 | <0.010 | <0.010 |
| Cadmium | 0.005 | <0.00500 | <0.00500 | <0.00010 | <0.00010 | <0.00010 |
| Calcium | | 8.0 | 8.0 | 8.0 | 7.0 | 8.0 |
| Chloride | 250 | 4.0 | 4.0 | 6.0 | 5.0 | 7.0 |
| Chromium | 0.05 | <0.010 | <0.010 | <0.010 | <0.010 | <0.001 |
| Cobalt | | <0.0100 | <0.0100 | <0.0001 | 0.0002 | <0.0002 |
| COD | | 5 | <3 | 8 | <4 | 8 |
| Conductivity (uS/cm) | | 240 | 76 | 74 | 92 | 293 |
| Copper | 1 | <0.0050 | <0.0050 | <0.0100 | <0.0010 | <0.0010 |
| DOC | 5 | 1.8 | 0.8 | 0.4 | 0.9 | 0.7 |
| Hardness (CaCO3) | 80-100 | 28 | 28 | 28 | 22 | 32 |
| Iron | 0.3 | 0.07 | 0.04 | 0.11 | 0.10 | <0.01 |
| Lead | 0.01 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 |
| Magnesium | | 2.00 | 2.00 | 2.00 | 1.00 | 3.00 |
| Manganese | 0.05 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Molybdenum | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nickel | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nitrate (as N) | 10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Nitrite (as N) | 1 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | 6.7 | 6.0 | 5.9 | 6.5 | 6.6 |
| Phenols | | <0.001 | <0.001 | <0.001 | <0.001 | 0.002 |
| Phosphate (as P) | | 0.06 | 0.06 | 0.04 | 0.24 | 0.03 |
| Phosphorus (dissolved reactive) | | | | | | |
| Phosphorus (total) | | 3.36 | 0.11 | 0.40 | 0.74 | 0.05 |
| Potassium | | 2.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| Silicon | | 6.00 | 6.90 | 6.85 | 6.49 | 6.14 |
| Silver | | <0.0100 | <0.0100 | <0.0001 | <0.0001 | 0.0010 |
| Sodium | 200 | 3.0 | 4.0 | 3.0 | 4.0 | 2.0 |
| Strontium | | 0.079 | 0.067 | 0.086 | 0.081 | 0.097 |
| Sulphate | 500 | 11.0 | 17.0 | 10.0 | 10.0 | 9.0 |
| Sulphur | | 4 | 5 | 4 | 10 | |
| TDS | 500 | 44 | 52 | 68 | 44 | 44 |
| Temperature (C) | 15 | 8.0 | 5.0 | 10.1 | 8.6 | 10.8 |
| Thallium | | <0.20000 | <0.50000 | <0.00100 | <0.00100 | <0.00100 |
| Tin | | <0.050 | | <0.010 | <0.010 | <0.010 |
| Titanium | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Vanadium | | <0.0100 | <0.0100 | <0.0100 | <0.0010 | <0.0010 |
| Zinc | 5 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH99-7**



Date Sampled: 21-Nov-2001

| Parameter | ODWS/O | |
|---|---|---|
| Alkalinity (CaCO3) | 30-500 | 14 |
| Aluminum | 0.1 | <0.050 |
| Ammonia (as N) | | 0.04 |
| Barium | 1 | <0.010 |
| Beryllium | | <0.002 |
| Boron | 5 | <0.050 |
| Cadmium | 0.005 | <0.00010 |
| Calcium | | 6.0 |
| Chloride | 250 | 4.0 |
| Chromium | 0.05 | <0.001 |
| Cobalt | | <0.0002 |
| COD | | <5 |
| Conductivity (uS/cm) | | 49 |
| Copper | 1 | 0.0010 |
| DOC | 5 | <0.5 |
| Hardness (CaCO3) | 80-100 | 23 |
| Iron | 0.3 | <0.01 |
| Lead | 0.01 | <0.0010 |
| Magnesium | | 2.00 |
| Manganese | 0.05 | <0.010 |
| Molybdenum | | <0.010 |
| Nickel | | <0.010 |
| Nitrate (as N) | 10 | <0.10 |
| Nitrite (as N) | 1 | <0.10 |
| pH (pH units) | 6.5-8.5 | 6.5 |
| Phenols | | <0.001 |
| Phosphate (as P) | | 0.03 |
| Phosphorus (dissolved reactive) | | 0.01 |
| Phosphorus (total) | | |
| Potassium | | <1.0 |
| Silicon | | 5.35 |
| Silver | | <0.0001 |
| Sodium | 200 | 3.0 |
| Strontium | | 0.059 |
| Sulphate | 500 | 11.0 |
| Sulphur | | |
| TDS | 500 | 52 |
| Temperature (C) | 15 | 7.3 |
| Thallium | | <0.00100 |
| Tin | | <0.010 |
| Titanium | | <0.010 |
| Vanadium | | <0.0010 |
| Zinc | 5 | <0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH01-8A**

Sheet: 1

Date Sampled: 21-Nov-2001

| Parameter | ODWS/O | |
|---|---|---|
| Alkalinity (CaCO3) | 30-500 | 96 |
| Aluminum | 0.1 | <0.050 |
| Ammonia (as N) | | 0.41 |
| Barium | 1 | 0.030 |
| Beryllium | | <0.002 |
| Boron | 5 | <0.050 |
| Cadmium | 0.005 | <0.00010 |
| Calcium | | 22.0 |
| Chloride | 250 | 6.0 |
| Chromium | 0.05 | <0.001 |
| Cobalt | | <0.0002 |
| COD | | <5 |
| Conductivity (uS/cm) | | 174 |
| Copper | 1 | <0.0010 |
| DOC | 5 | 2.4 |
| Hardness (CaCO3) | 80-100 | 96 |
| Iron | 0.3 | <0.01 |
| Lead | 0.01 | <0.0010 |
| Magnesium | | 10.00 |
| Manganese | 0.05 | 0.050 |
| Molybdenum | | <0.010 |
| Nickel | | <0.010 |
| Nitrate (as N) | 10 | <0.10 |
| Nitrite (as N) | 1 | <0.10 |
| pH (pH units) | 6.5-8.5 | 8.0 |
| Phenols | | <0.001 |
| Phosphate (as P) | | 0.45 |
| Phosphorus (dissolved reactive) | | 0.15 |
| Potassium | | 2.0 |
| Silicon | | 7.26 |
| Silver | | <0.0001 |
| Sodium | 200 | 12.0 |
| Strontium | | 0.084 |
| Sulphate | 500 | 14.0 |
| TDS | 500 | 168 |
| Temperature (C) | 15 | 7.7 |
| Thallium | | <0.00100 |
| Tin | | <0.010 |
| Titanium | | <0.010 |
| Vanadium | | <0.0010 |
| Zinc | 5 | <0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **BH01-8B**

Sheet: 1

Date Sampled: 21-Nov-2001

| Parameter | ODWS/O | |
|---|---|---|
| Alkalinity (CaCO3) | 30-500 | 154 |
| Aluminum | 0.1 | <0.050 |
| Ammonia (as N) | | 0.19 |
| Barium | 1 | 0.040 |
| Beryllium | | <0.002 |
| Boron | 5 | 0.070 |
| Cadmium | 0.005 | <0.00010 |
| Calcium | | 61.0 |
| Chloride | 250 | 30.0 |
| Chromium | 0.05 | <0.001 |
| Cobalt | | 0.0003 |
| COD | | 26 |
| Conductivity (uS/cm) | | 436 |
| Copper | 1 | <0.0010 |
| DOC | 5 | 9.6 |
| Hardness (CaCO3) | 80-100 | 222 |
| Iron | 0.3 | 0.20 |
| Lead | 0.01 | <0.0010 |
| Magnesium | | 17.00 |
| Manganese | 0.05 | 0.120 |
| Molybdenum | | <0.010 |
| Nickel | | <0.010 |
| Nitrate (as N) | 10 | <0.10 |
| Nitrite (as N) | 1 | <0.10 |
| pH (pH units) | 6.5-8.5 | 6.8 |
| Phenols | | <0.001 |
| Phosphate (as P) | | <0.03 |
| Phosphorus (dissolved reactive) | | <0.01 |
| Potassium | | 1.0 |
| Silicon | | 5.42 |
| Silver | | <0.0001 |
| Sodium | 200 | 29.0 |
| Strontium | | 0.203 |
| Sulphate | 500 | 84.0 |
| TDS | 500 | 388 |
| Temperature (C) | 15 | 8.0 |
| Thallium | | <0.00100 |
| Tin | | <0.010 |
| Titanium | | <0.010 |
| Vanadium | | <0.0010 |
| Zinc | 5 | <0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-1**

Sheet: 1

Date Sampled: 19-Nov-1996

| Parameter | PWQO | |
|---|---|---|
| Alkalinity (CaCO3) | 75% Bkgd | 58 |
| Aluminum | f (pH) | 8.700 |
| Ammonia (as N) | | 0.17 |
| Barium | | 0.110 |
| Beryllium | f (Hardness) | <0.001 |
| Bicarbonate | | 58.00 |
| Boron | 0.2 | 0.023 |
| Bromide | | <0.10 |
| Cadmium | 0.0002 | <0.00200 |
| Calcium | | 29.0 |
| Carbonate | | <1.00 |
| Chloride | | 8.4 |
| Chromium | | 0.023 |
| Cobalt | 0.0009 | <0.0100 |
| Colour (TCU) | | 25 |
| Conductivity (uS/cm) | | 220 |
| Copper | 0.005 | 0.0100 |
| Fluoride | | 0.06 |
| Hardness (CaCO3) | | 110 |
| Iron | 0.3 | 10.00 |
| Lead | f (Alk) | 0.0055 |
| Magnesium | | 9.90 |
| Manganese | | 0.430 |
| Molybdenum | 0.04 | <0.010 |
| Nickel | 0.025 | 0.015 |
| Nitrate (as N) | | 0.74 |
| Nitrite (as N) | | <0.05 |
| pH (pH units) | 6.5-8.5 | 6.8 |
| Phosphate (as P) | | <0.10 |
| Phosphorus | | 0.58 |
| Phosphorus (total) | 0.03 | 0.15 |
| Potassium | | 2.4 |
| Silicon | | 18.00 |
| Silver | 0.0001 | <0.0100 |
| Sodium | | 7.2 |
| Strontium | | 0.180 |
| Sulphate | | 33.0 |
| Sulphur | | 10 |
| TDS | | 124 |
| Thallium | 0.0003 | <0.06000 |
| Tin | | <0.050 |
| Titanium | | 0.530 |
| TOC | | 6 |
| Turbidity (NTU) | | 30.0 |
| Vanadium | 0.006 | 0.0220 |
| Zinc | 0.03 | 0.094 |
| Zirconium | | <0.01 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-2**

Sheet: 1

| Date Sampled: | | 19-Nov-1996 | 12-May-1999 | 28-Aug-1999 | 14-Oct-1999 | 08-Aug-2000 |
|---|---|---|---|---|---|---|
| Parameter | PWQO | | | | | |
| Alkalinity (CaCO3) | 75% Bkgd | 51 | 91 | NS | NS | 52 |
| Aluminum | f (pH) | 8.100 | <0.030 | | | 0.050 |
| Ammonia (as N) | | 0.10 | 0.04 | | | 0.06 |
| Barium | | 0.064 | 0.030 | | | 0.010 |
| Beryllium | f (Hardness) | <0.001 | <0.010 | | | <0.002 |
| Bicarbonate | | 51.00 | | | | |
| Boron | 0.2 | 0.015 | 0.020 | | | 0.010 |
| Bromide | | <0.10 | | | | |
| Cadmium | 0.0002 | <0.00200 | <0.00015 | | | <0.00010 |
| Calcium | | 23.0 | 32.0 | | | 18.0 |
| Carbonate | | <1.00 | | | | |
| Chloride | | 10.0 | 12.0 | | | 5.0 |
| Chromium | | 0.017 | <0.010 | | | <0.010 |
| Cobalt | 0.0009 | <0.0100 | <0.0004 | | | 0.0006 |
| COD | | | 14 | | | 10 |
| Colour (TCU) | | 2 | | | | |
| Conductivity (uS/cm) | | 170 | 130 | | | 136 |
| Copper | 0.005 | 0.0067 | <0.0050 | | | <0.0010 |
| Dissolved Oxygen | f (Temp) | | 9.8 | | | 8.4 |
| DOC | | | 4.9 | | | 4.8 |
| Fluoride | | 0.06 | | | | |
| Hardness (CaCO3) | | 84 | 121 | | | 57 |
| Iron | 0.3 | 12.00 | 0.24 | | | 0.39 |
| Lead | f (Alk) | 0.0046 | <0.0020 | | | 0.0010 |
| Magnesium | | 6.50 | 10.00 | | | 3.00 |
| Manganese | | 0.660 | 0.060 | | | 0.130 |
| Molybdenum | 0.04 | <0.010 | <0.010 | | | <0.010 |
| Nickel | 0.025 | 0.010 | <0.010 | | | <0.010 |
| Nitrate (as N) | | 0.11 | 1.14 | | | 0.11 |
| Nitrite (as N) | | <0.05 | <0.10 | | | <0.10 |
| pH (pH units) | 6.5-8.5 | 6.6 | 7.2 | | | 7.0 |
| Phenols | 0.001 | | <0.001 | | | 0.001 |
| Phosphate (as P) | | <0.10 | 0.03 | | | 0.03 |
| Phosphorus | | 0.22 | | | | |
| Phosphorus (total) | 0.03 | 0.12 | 0.03 | | | 0.08 |
| Potassium | | 1.8 | 1.0 | | | <1.0 |
| Silicon | | 17.00 | 6.80 | | | 6.47 |
| Silver | 0.0001 | <0.0100 | <0.0001 | | | <0.0001 |
| Sodium | | 4.7 | 10.0 | | | 4.0 |
| Strontium | | 0.190 | 0.154 | | | 0.139 |
| Sulphate | | 12.0 | 35.0 | | | 14.0 |
| Sulphur | | 4 | 11 | | | 6 |
| TDS | | 88 | 160 | | | 104 |
| Temperature (C) | | | 6.0 | | | 17.0 |
| Thallium | 0.0003 | <0.06000 | <0.00500 | | | <0.00100 |
| Tin | | <0.050 | <0.050 | | | <0.010 |
| Titanium | | 0.510 | <0.010 | | | 0.020 |
| TOC | | 7 | | | | |
| Turbidity (NTU) | | 17.0 | | | | |
| Unionized Ammonia | 0.02 | | <0.02 | | | <0.02 |
| Vanadium | 0.006 | 0.0160 | <0.0070 | | | <0.0010 |
| Zinc | 0.03 | 0.023 | <0.010 | | | <0.010 |
| Zirconium | | <0.01 | | | | |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-2** Sheet: 2

| Date Sampled: | | 29-Nov-2000 | 23-Dec-2000 | 28-Jun-2001 | 30-Aug-2001 | 21-Nov-2001 |
|---|---|---|---|---|---|---|
| Parameter | PWQO | | | | | |
| Alkalinity (CaCO3) | 75% Bkgd | DRY | NS | DRY | DRY | DRY |
| Aluminum | f (pH) | | | | | |
| Ammonia (as N) | | | | | | |
| Barium | | | | | | |
| Beryllium | f (Hardness) | | | | | |
| Bicarbonate | | | | | | |
| Boron | 0.2 | | | | | |
| Bromide | | | | | | |
| Cadmium | 0.0002 | | | | | |
| Calcium | | | | | | |
| Carbonate | | | | | | |
| Chloride | | | | | | |
| Chromium | | | | | | |
| Cobalt | 0.0009 | | | | | |
| COD | | | | | | |
| Colour (TCU) | | | | | | |
| Conductivity (uS/cm) | | | | | | |
| Copper | 0.005 | | | | | |
| Dissolved Oxygen | f (Temp) | | | | | |
| DOC | | | | | | |
| Fluoride | | | | | | |
| Hardness (CaCO3) | | | | | | |
| Iron | 0.3 | | | | | |
| Lead | f (Alk) | | | | | |
| Magnesium | | | | | | |
| Manganese | | | | | | |
| Molybdenum | 0.04 | | | | | |
| Nickel | 0.025 | | | | | |
| Nitrate (as N) | | | | | | |
| Nitrite (as N) | | | | | | |
| pH (pH units) | 6.5-8.5 | | | | | |
| Phenols | 0.001 | | | | | |
| Phosphate (as P) | | | | | | |
| Phosphorus | | | | | | |
| Phosphorus (total) | 0.03 | | | | | |
| Potassium | | | | | | |
| Silicon | | | | | | |
| Silver | 0.0001 | | | | | |
| Sodium | | | | | | |
| Strontium | | | | | | |
| Sulphate | | | | | | |
| Sulphur | | | | | | |
| TDS | | | | | | |
| Temperature (C) | | | | | | |
| Thallium | 0.0003 | | | | | |
| Tin | | | | | | |
| Titanium | | | | | | |
| TOC | | | | | | |
| Turbidity (NTU) | | | | | | |
| Unionized Ammonia | 0.02 | | | | | |
| Vanadium | 0.006 | | | | | |
| Zinc | 0.03 | | | | | |
| Zirconium | | | | | | |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-2**



| Date Sampled: | | 13-Dec-2001 |
|---|---|---|
| Parameter | PWQO | |
| Alkalinity (CaCO3) | 75% Bkgd | DRY |
| Aluminum | f (pH) | |
| Ammonia (as N) | | |
| Barium | | |
| Beryllium | f (Hardness) | |
| Bicarbonate | | |
| Boron | 0.2 | |
| Bromide | | |
| Cadmium | 0.0002 | |
| Calcium | | |
| Carbonate | | |
| Chloride | | |
| Chromium | | |
| Cobalt | 0.0009 | |
| COD | | |
| Colour (TCU) | | |
| Conductivity (uS/cm) | | |
| Copper | 0.005 | |
| Dissolved Oxygen | f (Temp) | |
| DOC | | |
| Fluoride | | |
| Hardness (CaCO3) | | |
| Iron | 0.3 | |
| Lead | f (Alk) | |
| Magnesium | | |
| Manganese | | |
| Molybdenum | 0.04 | |
| Nickel | 0.025 | |
| Nitrate (as N) | | |
| Nitrite (as N) | | |
| pH (pH units) | 6.5-8.5 | |
| Phenols | 0.001 | |
| Phosphate (as P) | | |
| Phosphorus | | |
| Phosphorus (total) | 0.03 | |
| Potassium | | |
| Silicon | | |
| Silver | 0.0001 | |
| Sodium | | |
| Strontium | | |
| Sulphate | | |
| Sulphur | | |
| TDS | | |
| Temperature (C) | | |
| Thallium | 0.0003 | |
| Tin | | |
| Titanium | | |
| TOC | | |
| Turbidity (NTU) | | |
| Unionized Ammonia | 0.02 | |
| Vanadium | 0.006 | |
| Zinc | 0.03 | |
| Zirconium | | |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-3** Sheet: 1

| Date Sampled: | | 12-May-1999 | 28-Aug-1999 | 14-Oct-1999 | 08-Aug-2000 | 29-Nov-2000 |
|---|---|---|---|---|---|---|
| Parameter | PWQO | | | | | |
| Alkalinity (CaCO3) | 75% Bkgd | 86 | 133 | 77 | 87 | 77 |
| Aluminum | f (pH) | <0.030 | <0.030 | <0.030 | <0.050 | 0.140 |
| Ammonia (as N) | | 0.10 | 0.04 | <0.02 | 0.08 | <0.02 |
| Barium | | 0.020 | <0.010 | 0.050 | 0.030 | 0.040 |
| Beryllium | f (Hardness) | <0.010 | <0.010 | <0.010 | <0.002 | <0.002 |
| Boron | 0.2 | 0.020 | 0.040 | <0.010 | 0.030 | <0.010 |
| Cadmium | 0.0002 | <0.00015 | <0.00015 | <0.00500 | <0.00010 | <0.00010 |
| Calcium | | 32.0 | 52.0 | 35.0 | 29.0 | 36.0 |
| Chloride | | 10.0 | 27.0 | 25.0 | 12.0 | 23.0 |
| Chromium | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Cobalt | 0.0009 | <0.0004 | <0.0004 | <0.0100 | 0.0003 | 0.0003 |
| COD | | 9 | 18 | 33 | 21 | 5 |
| Conductivity (uS/cm) | | 150 | 320 | 230 | 240 | 450 |
| Copper | 0.005 | <0.0050 | <0.0050 | <0.0050 | <0.0010 | 0.0010 |
| Dissolved Oxygen | f (Temp) | 12.3 | 7.5 | 9.6 | 9.7 | 11.7 |
| DOC | | 4.4 | 5.3 | 9.0 | 7.1 | 4.0 |
| Hardness (CaCO3) | | 121 | 196 | 137 | 110 | 135 |
| Iron | 0.3 | 0.20 | 0.55 | 0.39 | 0.46 | 0.23 |
| Lead | f (Alk) | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 |
| Magnesium | | 10.00 | 16.00 | 12.00 | 9.00 | 11.00 |
| Manganese | | 0.060 | 0.150 | 0.040 | 0.120 | 0.030 |
| Molybdenum | 0.04 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nickel | 0.025 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nitrate (as N) | | 1.27 | 0.44 | 4.07 | 0.45 | 9.69 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | 7.4 | 7.2 | 7.1 | 7.1 | 6.8 |
| Phenols | 0.001 | <0.001 | <0.001 | <0.001 | 0.003 | <0.001 |
| Phosphate (as P) | | 0.03 | 0.03 | 0.06 | 0.09 | 0.04 |
| Phosphorus (total) | 0.03 | 0.02 | 0.08 | 0.09 | 0.05 | 0.05 |
| Potassium | | 1.0 | 1.0 | 2.0 | 1.0 | 1.0 |
| Silicon | | 6.90 | 9.20 | 8.40 | 7.98 | 9.23 |
| Silver | 0.0001 | <0.0001 | <0.0001 | <0.0100 | <0.0001 | <0.0001 |
| Sodium | | 9.0 | 16.0 | 8.0 | 8.0 | 8.0 |
| Strontium | | 0.127 | 0.209 | 0.167 | 0.153 | 0.173 |
| Sulphate | | 27.0 | 53.0 | 28.0 | 30.0 | 21.0 |
| Sulphur | | 9 | 16 | 9 | 12 | 7 |
| TDS | | 144 | 256 | 204 | 204 | 248 |
| Temperature (C) | | 5.0 | 27.0 | 4.5 | 15.2 | 6.0 |
| Thallium | 0.0003 | <0.00500 | <0.00500 | <0.50000 | <0.00100 | <0.00100 |
| Tin | | <0.050 | <0.050 | | <0.010 | <0.010 |
| Titanium | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Unionized Ammonia | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Vanadium | 0.006 | <0.0070 | <0.0070 | <0.0100 | <0.0010 | 0.0010 |
| Zinc | 0.03 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-3**



| Date Sampled: | | 23-Dec-2000 | 28-Jun-2001 | 30-Aug-2001 | 21-Nov-2001 | 13-Dec-2001 |
|---|---|---|---|---|---|---|
| Parameter | PWQO | | | | | |
| Alkalinity (CaCO3) | 75% Bkgd | NS | 129 | 145 | 106 | 132 |
| Aluminum | f (pH) | | <0.050 | <0.050 | 0.450 | <0.050 |
| Ammonia (as N) | | | 0.06 | 0.06 | 0.09 | 0.03 |
| Barium | | | 0.050 | 0.080 | 0.040 | 0.040 |
| Beryllium | f (Hardness) | | <0.002 | <0.002 | <0.002 | <0.002 |
| Boron | 0.2 | | 0.050 | 0.050 | <0.050 | <0.050 |
| Cadmium | 0.0002 | | <0.00010 | 0.00010 | <0.00010 | <0.00010 |
| Calcium | | | 56.0 | 52.0 | 45.0 | 50.0 |
| Chloride | | | 25.0 | 24.0 | 23.0 | 25.0 |
| Chromium | | | 0.002 | 0.002 | <0.001 | <0.001 |
| Cobalt | 0.0009 | | 0.0004 | 0.0017 | 0.0006 | <0.0002 |
| COD | | | 22 | 11 | 21 | 10 |
| Conductivity (uS/cm) | | | 430 | 351 | 325 | 320 |
| Copper | 0.005 | | <0.0010 | 0.0020 | 0.0010 | <0.0010 |
| Dissolved Oxygen | f (Temp) | | 9.5 | 12.4 | 9.1 | 9.9 |
| DOC | | | 5.5 | 4.0 | 4.7 | 3.1 |
| Hardness (CaCO3) | | | 214 | 204 | 174 | 207 |
| Iron | 0.3 | | 0.61 | 2.86 | 0.90 | 0.28 |
| Lead | f (Alk) | | <0.0010 | 0.0010 | <0.0010 | <0.0010 |
| Magnesium | | | 18.00 | 18.00 | 15.00 | 20.00 |
| Manganese | | | 0.140 | 0.630 | 0.160 | 0.140 |
| Molybdenum | 0.04 | | <0.010 | <0.010 | <0.010 | <0.010 |
| Nickel | 0.025 | | <0.010 | <0.010 | <0.010 | <0.010 |
| Nitrate (as N) | | | 0.40 | 0.47 | 0.33 | 0.95 |
| Nitrite (as N) | | | <0.10 | <0.10 | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | | 6.9 | 7.5 | 7.3 | 7.6 |
| Phenols | 0.001 | | <0.001 | <0.001 | <0.001 | <0.001 |
| Phosphate (as P) | | | 0.13 | 0.14 | 0.05 | <0.03 |
| Phosphorus (total) | 0.03 | | 0.09 | 0.10 | 0.07 | 0.06 |
| Potassium | | | 1.0 | 2.0 | 1.0 | 1.0 |
| Silicon | | | 7.55 | 9.35 | 6.87 | 9.03 |
| Silver | 0.0001 | | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Sodium | | | 17.0 | 14.0 | 12.0 | 13.0 |
| Strontium | | | 0.214 | 0.239 | 0.162 | 0.199 |
| Sulphate | | | 72.0 | 79.0 | 76.0 | 72.0 |
| Sulphur | | | | | | |
| TDS | | | 256 | 308 | 284 | 307 |
| Temperature (C) | | | 15.5 | 12.7 | 3.8 | 3.0 |
| Thallium | 0.0003 | | <0.00100 | <0.00100 | <0.00100 | <0.00100 |
| Tin | | | <0.010 | <0.010 | <0.010 | <0.010 |
| Titanium | | | <0.010 | 0.030 | 0.020 | <0.010 |
| Unionized Ammonia | 0.02 | | <0.02 | <0.02 | <0.02 | <0.02 |
| Vanadium | 0.006 | | 0.0020 | 0.0040 | 0.0020 | <0.0010 |
| Zinc | 0.03 | | <0.010 | 0.010 | <0.010 | <0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-4** Sheet: 1

| Date Sampled: | | 12-May-1999 | 08-Aug-2000 | 29-Nov-2000 | 23-Dec-2000 | 28-Jun-2001 |
|---|---|---|---|---|---|---|
| Parameter | PWQO | | | | | |
| Alkalinity (CaCO3) | 75% Bkgd | 156 | 164 | 96 | NS | 160 |
| Aluminum | f (pH) | 0.340 | <0.050 | <0.050 | | <0.050 |
| Ammonia (as N) | | 0.05 | 0.20 | 0.05 | | 0.13 |
| Barium | | 0.030 | 0.030 | 0.010 | | 0.040 |
| Beryllium | f (Hardness) | <0.010 | <0.002 | <0.002 | | <0.002 |
| Boron | 0.2 | 0.180 | 0.210 | 0.100 | | 0.200 |
| Cadmium | 0.0002 | <0.00015 | <0.00010 | <0.00010 | | <0.00010 |
| Calcium | | 75.0 | 70.0 | 44.0 | | 74.0 |
| Chloride | | 22.0 | 31.0 | 26.0 | | 38.0 |
| Chromium | | <0.010 | <0.010 | <0.010 | | 0.002 |
| Cobalt | 0.0009 | <0.0004 | 0.0003 | 0.0003 | | 0.0004 |
| COD | | 20 | 33 | 8 | | 50 |
| Conductivity (uS/cm) | | 320 | 580 | 530 | | 545 |
| Copper | 0.005 | <0.0050 | 0.0010 | <0.0010 | | 0.0020 |
| Dissolved Oxygen | f (Temp) | 10.0 | 8.1 | 15.5 | | 11.4 |
| DOC | | 9.3 | 10.8 | 7.1 | | 15.0 |
| Hardness (CaCO3) | | 270 | 253 | 164 | | 267 |
| Iron | 0.3 | 2.47 | 4.36 | 0.85 | | 8.81 |
| Lead | f (Alk) | <0.0020 | <0.0010 | <0.0010 | | <0.0010 |
| Magnesium | | 20.00 | 19.00 | 13.00 | | 20.00 |
| Manganese | | 0.260 | 0.180 | 0.200 | | 0.980 |
| Molybdenum | 0.04 | <0.010 | <0.010 | <0.010 | | <0.010 |
| Nickel | 0.025 | <0.010 | <0.010 | <0.010 | | <0.010 |
| Nitrate (as N) | | 0.19 | <0.10 | <0.10 | | 0.52 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | | <0.10 |
| pH (pH units) | 6.5-8.5 | 7.2 | 7.2 | 6.8 | | 6.3 |
| Phenols | 0.001 | <0.001 | 0.002 | <0.001 | | <0.001 |
| Phosphate (as P) | | 0.15 | 0.36 | 0.04 | | 0.19 |
| Phosphorus (total) | 0.03 | 0.28 | 0.27 | 0.07 | | 0.38 |
| Potassium | | 2.0 | 1.0 | 1.0 | | 2.0 |
| Silicon | | 4.80 | 7.13 | 4.70 | | 6.45 |
| Silver | 0.0001 | <0.0001 | <0.0001 | <0.0001 | | <0.0001 |
| Sodium | | 26.0 | 22.0 | 14.0 | | 24.0 |
| Strontium | | 0.450 | 0.500 | 0.328 | | 0.468 |
| Sulphate | | 103.0 | 99.0 | 82.0 | | 82.0 |
| Sulphur | | 32 | 41 | 27 | | |
| TDS | | 320 | 400 | 244 | | 340 |
| Temperature (C) | | 7.0 | 17.4 | 1.0 | | 18.0 |
| Thallium | 0.0003 | <0.00500 | <0.00100 | <0.00100 | | <0.00100 |
| Tin | | <0.050 | <0.010 | <0.010 | | <0.010 |
| Titanium | | <0.010 | 0.020 | <0.010 | | <0.010 |
| Unionized Ammonia | 0.02 | | <0.02 | <0.02 | | <0.02 |
| Vanadium | 0.006 | <0.0070 | <0.0010 | <0.0010 | | 0.0020 |
| Zinc | 0.03 | <0.010 | <0.010 | <0.010 | | 0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-4**



| Date Sampled: | | 30-Aug-2001 | 21-Nov-2001 | 13-Dec-2001 |
|---|---|---|---|---|
| Parameter | PWQO | | | |
| Alkalinity (CaCO3) | 75% Bkgd | DRY | 30 | DRY |
| Aluminum | f (pH) | | 0.800 | |
| Ammonia (as N) | | | 0.76 | |
| Barium | | | 0.030 | |
| Beryllium | f (Hardness) | | <0.002 | |
| Boron | 0.2 | | <0.050 | |
| Cadmium | 0.0002 | | <0.00010 | |
| Calcium | | | 31.0 | |
| Chloride | | | 27.0 | |
| Chromium | | | 0.001 | |
| Cobalt | 0.0009 | | 0.0033 | |
| COD | | | 47 | |
| Conductivity (uS/cm) | | | 327 | |
| Copper | 0.005 | | 0.0020 | |
| Dissolved Oxygen | f (Temp) | | 6.4 | |
| DOC | | | 15.1 | |
| Hardness (CaCO3) | | | 110 | |
| Iron | 0.3 | | 36.50 | |
| Lead | f (Alk) | | 0.0010 | |
| Magnesium | | | 8.00 | |
| Manganese | | | 0.900 | |
| Molybdenum | 0.04 | | <0.010 | |
| Nickel | 0.025 | | <0.010 | |
| Nitrate (as N) | | | 0.35 | |
| Nitrite (as N) | | | <0.10 | |
| pH (pH units) | 6.5-8.5 | | 6.2 | |
| Phenols | 0.001 | | <0.001 | |
| Phosphate (as P) | | | <0.03 | |
| Phosphorus (total) | 0.03 | | 0.55 | |
| Potassium | | | 2.0 | |
| Silicon | | | 7.18 | |
| Silver | 0.0001 | | <0.0001 | |
| Sodium | | | 9.0 | |
| Strontium | | | 0.172 | |
| Sulphate | | | 80.0 | |
| Sulphur | | | | |
| TDS | | | 248 | |
| Temperature (C) | | | 3.7 | |
| Thallium | 0.0003 | | <0.00100 | |
| Tin | | | <0.010 | |
| Titanium | | | 0.030 | |
| Unionized Ammonia | 0.02 | | <0.02 | |
| Vanadium | 0.006 | | 0.0030 | |
| Zinc | 0.03 | | <0.010 | |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-5**

Sheet: 1

| Date Sampled: | | 12-May-1999 | 28-Aug-1999 | 14-Oct-1999 | 08-Aug-2000 | 29-Nov-2000 |
|---|---|---|---|---|---|---|
| Parameter | PWQO | | | | | |
| Alkalinity (CaCO3) | 75% Bkgd | 92 | 132 | 79 | 96 | 79 |
| Aluminum | f (pH) | <0.030 | <0.030 | 0.490 | <0.050 | 0.160 |
| Ammonia (as N) | | 0.18 | 0.04 | <0.02 | 0.07 | <0.02 |
| Barium | | 0.020 | 0.040 | 0.050 | 0.030 | 0.040 |
| Beryllium | f (Hardness) | <0.010 | <0.010 | <0.010 | <0.002 | <0.002 |
| Boron | 0.2 | <0.010 | 0.040 | <0.010 | 0.040 | <0.010 |
| Cadmium | 0.0002 | <0.00015 | <0.00015 | <0.00500 | <0.00010 | <0.00010 |
| Calcium | | 38.0 | 54.0 | 36.0 | 32.0 | 37.0 |
| Chloride | | 10.0 | 26.0 | 27.0 | 14.0 | 24.0 |
| Chromium | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Cobalt | 0.0009 | 0.0010 | <0.0004 | <0.0100 | 0.0003 | 0.0003 |
| COD | | 9 | 15 | 32 | 23 | 5 |
| Conductivity (uS/cm) | | 160 | 320 | 230 | 270 | 460 |
| Copper | 0.005 | <0.0050 | <0.0050 | <0.0050 | <0.0010 | 0.0020 |
| Dissolved Oxygen | f (Temp) | 10.6 | 11.2 | 9.8 | 9.3 | 11.3 |
| DOC | | 6.4 | 5.8 | 9.5 | 7.6 | 3.5 |
| Hardness (CaCO3) | | 120 | 205 | 139 | 117 | 138 |
| Iron | 0.3 | 1.25 | 0.55 | 0.67 | 0.52 | 0.33 |
| Lead | f (Alk) | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 |
| Magnesium | | 6.00 | 17.00 | 12.00 | 9.00 | 11.00 |
| Manganese | | 0.120 | 0.080 | 0.080 | 0.090 | 0.040 |
| Molybdenum | 0.04 | <0.010 | <0.010 | <0.010 | <0.010 | 0.020 |
| Nickel | 0.025 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nitrate (as N) | | 1.42 | 0.45 | 3.78 | 0.40 | 9.77 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | 7.4 | 7.0 | 7.1 | 7.1 | 7.1 |
| Phenols | 0.001 | <0.001 | <0.001 | <0.001 | 0.003 | <0.001 |
| Phosphate (as P) | | <0.03 | 0.03 | 0.06 | 0.09 | 0.04 |
| Phosphorus (total) | 0.03 | 0.16 | 0.10 | 0.12 | 0.27 | 0.04 |
| Potassium | | 3.0 | 2.0 | 2.0 | 1.0 | 1.0 |
| Silicon | | 4.40 | 9.30 | 8.30 | 8.06 | 9.19 |
| Silver | 0.0001 | <0.0001 | <0.0001 | <0.0100 | <0.0001 | <0.0001 |
| Sodium | | 4.0 | 17.0 | 9.0 | 9.0 | 9.0 |
| Strontium | | 0.227 | 0.215 | 0.170 | 0.177 | 0.177 |
| Sulphate | | 19.0 | 53.0 | 32.0 | 35.0 | 24.0 |
| Sulphur | | 6 | 17 | 10 | 14 | 8 |
| TDS | | 144 | 256 | 212 | 192 | 172 |
| Temperature (C) | | 8.0 | 18.0 | 4.5 | 15.3 | 5.0 |
| Thallium | 0.0003 | <0.00500 | <0.00500 | <0.50000 | <0.00100 | <0.00100 |
| Tin | | <0.050 | <0.050 | | <0.010 | <0.010 |
| Titanium | | <0.010 | <0.010 | <0.010 | <0.010 | 0.020 |
| Unionized Ammonia | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Vanadium | 0.006 | <0.0070 | <0.0070 | <0.0100 | <0.0010 | 0.0020 |
| Zinc | 0.03 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-5** Sheet: 2

| Date Sampled: | | 23-Dec-2000 | 28-Jun-2001 | 30-Aug-2001 | 21-Nov-2001 | 13-Dec-2001 |
|---|---|---|---|---|---|---|
| Parameter | PWQO | | | | | |
| Alkalinity (CaCO3) | 75% Bkgd | NS | 129 | 143 | 103 | 131 |
| Aluminum | f (pH) | | <0.050 | <0.050 | <0.050 | <0.050 |
| Ammonia (as N) | | | 0.07 | 0.04 | 0.03 | 0.02 |
| Barium | | | 0.040 | 0.050 | 0.030 | 0.040 |
| Beryllium | f (Hardness) | | <0.002 | <0.002 | <0.002 | <0.002 |
| Boron | 0.2 | | 0.050 | 0.050 | <0.050 | <0.050 |
| Cadmium | 0.0002 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Calcium | | | 50.0 | 49.0 | 44.0 | 48.0 |
| Chloride | | | 24.0 | 24.0 | 22.0 | 24.0 |
| Chromium | | | <0.001 | 0.001 | <0.001 | <0.001 |
| Cobalt | 0.0009 | | <0.0002 | 0.0006 | <0.0002 | <0.0002 |
| COD | | | 25 | 14 | 26 | 10 |
| Conductivity (uS/cm) | | | 418 | 259 | 335 | 240 |
| Copper | 0.005 | | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Dissolved Oxygen | f (Temp) | | 9.5 | 11.8 | 11.1 | 10.1 |
| DOC | | | 5.9 | 3.7 | 5.4 | 3.1 |
| Hardness (CaCO3) | | | 195 | 192 | 176 | 198 |
| Iron | 0.3 | | 0.36 | 1.17 | 0.17 | 0.19 |
| Lead | f (Alk) | | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Magnesium | | | 17.00 | 17.00 | 16.00 | 19.00 |
| Manganese | | | 0.070 | 0.110 | 0.050 | 0.110 |
| Molybdenum | 0.04 | | <0.010 | 0.010 | <0.010 | <0.010 |
| Nickel | 0.025 | | <0.010 | <0.010 | <0.010 | <0.010 |
| Nitrate (as N) | | | 0.38 | 0.31 | 0.28 | 0.94 |
| Nitrite (as N) | | | <0.10 | <0.10 | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | | 7.2 | 7.3 | 7.2 | 7.4 |
| Phenols | 0.001 | | <0.001 | <0.001 | <0.001 | <0.001 |
| Phosphate (as P) | | | 0.11 | 0.13 | 0.04 | <0.03 |
| Phosphorus (total) | 0.03 | | 0.16 | 0.05 | 0.10 | 0.06 |
| Potassium | | | 1.0 | 1.0 | 1.0 | 1.0 |
| Silicon | | | 7.45 | 9.19 | 6.46 | 9.00 |
| Silver | 0.0001 | | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Sodium | | | 14.0 | 19.0 | 13.0 | 13.0 |
| Strontium | | | 0.216 | 0.227 | 0.170 | 0.199 |
| Sulphate | | | 58.0 | 76.0 | 86.0 | 72.0 |
| Sulphur | | | | | | |
| TDS | | | 264 | 308 | 308 | 306 |
| Temperature (C) | | | 15.8 | 12.9 | 3.8 | 4.0 |
| Thallium | 0.0003 | | <0.00100 | <0.00100 | <0.00100 | <0.00100 |
| Tin | | | <0.010 | <0.010 | <0.010 | <0.010 |
| Titanium | | | <0.010 | 0.040 | <0.010 | <0.010 |
| Unionized Ammonia | 0.02 | | <0.02 | <0.02 | <0.02 | <0.02 |
| Vanadium | 0.006 | | 0.0010 | 0.0020 | <0.0010 | <0.0010 |
| Zinc | 0.03 | | <0.010 | <0.010 | <0.010 | <0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-6** Sheet: 1

| Date Sampled: | | 12-May-1999 | 28-Aug-1999 | 14-Oct-1999 | 08-Aug-2000 | 29-Nov-2000 |
|---|---|---|---|---|---|---|
| Parameter | PWQO | | | | | |
| Alkalinity (CaCO3) | 75% Bkgd | 252 | 135 | 174 | 173 | 225 |
| Aluminum | f (pH) | <0.030 | <0.030 | <0.030 | 0.090 | 0.100 |
| Ammonia (as N) | | 0.08 | 0.06 | 0.19 | 0.19 | 0.13 |
| Barium | | 0.020 | 0.030 | 0.060 | 0.040 | 0.040 |
| Beryllium | f (Hardness) | <0.010 | <0.010 | <0.010 | <0.002 | <0.002 |
| Boron | 0.2 | 0.020 | 0.020 | 0.030 | 0.030 | 0.040 |
| Cadmium | 0.0002 | <0.00015 | <0.00015 | <0.00500 | <0.00010 | 0.00010 |
| Calcium | | 91.0 | 43.0 | 63.0 | 55.0 | 73.0 |
| Chloride | | 28.0 | 28.0 | 44.0 | 23.0 | 32.0 |
| Chromium | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Cobalt | 0.0009 | <0.0004 | <0.0004 | <0.0100 | 0.0006 | 0.0003 |
| COD | | <3 | 15 | 29 | 26 | 11 |
| Conductivity (uS/cm) | | 330 | 300 | 330 | 420 | 890 |
| Copper | 0.005 | <0.0050 | <0.0050 | <0.0050 | 0.0030 | 0.0030 |
| Dissolved Oxygen | f (Temp) | 9.8 | 8.4 | 9.1 | 5.7 | 13.5 |
| DOC | | 5.9 | 5.5 | 9.9 | 7.7 | 5.2 |
| Hardness (CaCO3) | | 293 | 153 | 219 | 183 | 257 |
| Iron | 0.3 | 0.03 | 0.60 | 1.01 | 0.92 | 0.68 |
| Lead | f (Alk) | <0.0020 | <0.0020 | <0.0020 | 0.0010 | <0.0010 |
| Magnesium | | 16.00 | 11.00 | 15.00 | 11.00 | 18.00 |
| Manganese | | 0.030 | 0.090 | 0.060 | 0.090 | 0.040 |
| Molybdenum | 0.04 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nickel | 0.025 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nitrate (as N) | | 0.74 | 0.26 | 2.00 | 0.43 | 6.62 |
| Nitrite (as N) | | 0.11 | <0.10 | <0.10 | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | 7.5 | 7.4 | 7.6 | 7.2 | 7.2 |
| Phenols | 0.001 | <0.001 | <0.001 | <0.001 | 0.002 | <0.001 |
| Phosphate (as P) | | 0.06 | 0.12 | 0.52 | 0.48 | 0.19 |
| Phosphorus (total) | 0.03 | 0.09 | 0.27 | 0.35 | 0.14 | 0.15 |
| Potassium | | 4.0 | 4.0 | 11.0 | 6.0 | 5.0 |
| Silicon | | 1.30 | 5.50 | 5.60 | 4.09 | 6.65 |
| Silver | 0.0001 | <0.0001 | <0.0001 | <0.0100 | <0.0001 | <0.0001 |
| Sodium | | 30.0 | 22.0 | 26.0 | 16.0 | 33.0 |
| Strontium | | 0.292 | 0.179 | 0.296 | 0.258 | 0.301 |
| Sulphate | | 30.0 | 16.0 | 53.0 | 21.0 | 69.0 |
| Sulphur | | 10 | 5 | 17 | 9 | 23 |
| TDS | | 332 | 252 | 360 | 288 | 428 |
| Temperature (C) | | 10.5 | 20.0 | 4.5 | 18.5 | 4.0 |
| Thallium | 0.0003 | <0.00500 | <0.00500 | <0.50000 | <0.00100 | <0.00100 |
| Tin | | <0.050 | <0.050 | | <0.010 | <0.010 |
| Titanium | | <0.010 | <0.010 | 0.020 | 0.020 | 0.020 |
| Unionized Ammonia | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Vanadium | 0.006 | <0.0070 | <0.0070 | <0.0100 | <0.0010 | 0.0010 |
| Zinc | 0.03 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-6** Sheet: 2

| Date Sampled: | | 23-Dec-2000 | 28-Jun-2001 | 30-Aug-2001 | 21-Nov-2001 | 13-Dec-2001 |
|---|---|---|---|---|---|---|
| Parameter | PWQO | | | | | |
| Alkalinity (CaCO3) | 75% Bkgd | NS | 199 | 142 | 214 | 248 |
| Aluminum | f (pH) | | <0.050 | <0.050 | 0.140 | <0.050 |
| Ammonia (as N) | | | 0.12 | 0.16 | 0.40 | 0.07 |
| Barium | | | 0.030 | 0.020 | 0.030 | 0.040 |
| Beryllium | f (Hardness) | | <0.002 | <0.002 | <0.002 | <0.002 |
| Boron | 0.2 | | 0.040 | 0.020 | <0.050 | 0.050 |
| Cadmium | 0.0002 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Calcium | | | 68.0 | 42.0 | 93.0 | 98.0 |
| Chloride | | | 40.0 | 27.0 | 92.0 | 49.0 |
| Chromium | | | 0.004 | <0.001 | <0.001 | 0.002 |
| Cobalt | 0.0009 | | 0.0005 | <0.0002 | <0.0002 | 0.0003 |
| COD | | | 16 | 14 | 20 | 10 |
| Conductivity (uS/cm) | | | 532 | 279 | 670 | 260 |
| Copper | 0.005 | | 0.0030 | <0.0010 | 0.0020 | 0.0020 |
| Dissolved Oxygen | f (Temp) | | 4.2 | 3.7 | 8.9 | 6.3 |
| DOC | | | 6.2 | 4.9 | 5.5 | 3.2 |
| Hardness (CaCO3) | | | 232 | 150 | 319 | 331 |
| Iron | 0.3 | | 0.88 | 0.59 | 0.19 | 0.34 |
| Lead | f (Alk) | | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Magnesium | | | 15.00 | 11.00 | 21.00 | 21.00 |
| Manganese | | | 0.070 | 0.230 | 0.020 | 0.020 |
| Molybdenum | 0.04 | | <0.010 | 0.020 | <0.010 | <0.010 |
| Nickel | 0.025 | | <0.010 | <0.010 | <0.010 | <0.010 |
| Nitrate (as N) | | | 0.72 | 0.20 | 1.02 | 2.85 |
| Nitrite (as N) | | | <0.10 | <0.10 | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | | 7.2 | 7.3 | 7.1 | 7.3 |
| Phenols | 0.001 | | <0.001 | <0.001 | <0.001 | <0.001 |
| Phosphate (as P) | | | 0.40 | 0.37 | 0.15 | 0.05 |
| Phosphorus (total) | 0.03 | | 0.21 | 0.16 | 0.07 | 0.06 |
| Potassium | | | 4.0 | 3.0 | 8.0 | 5.0 |
| Silicon | | | 4.27 | 4.99 | 3.80 | 4.33 |
| Silver | 0.0001 | | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Sodium | | | 31.0 | 20.0 | 60.0 | 39.0 |
| Strontium | | | 0.304 | 0.169 | 0.303 | 0.386 |
| Sulphate | | | 27.0 | 15.0 | 123.0 | 98.0 |
| Sulphur | | | | | | |
| TDS | | | 316 | 188 | 580 | 538 |
| Temperature (C) | | | 21.8 | 14.9 | 4.1 | 2.0 |
| Thallium | 0.0003 | | <0.00100 | <0.00100 | <0.00100 | <0.00100 |
| Tin | | | <0.010 | <0.010 | <0.010 | <0.010 |
| Titanium | | | 0.020 | 0.020 | <0.010 | 0.010 |
| Unionized Ammonia | 0.02 | | <0.02 | <0.02 | <0.02 | <0.02 |
| Vanadium | 0.006 | | 0.0050 | 0.0020 | 0.0010 | 0.0020 |
| Zinc | 0.03 | | <0.010 | <0.010 | <0.010 | <0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-6**

Sheet: 1

Date Sampled: 08-Aug-2000

| Parameter | PWQO | |
|---|---|---|
| 1,1,1,2-Tetrachloroethane | 20 | <0.60 |
| 1,1,1-Trichloroethane | 10 | <0.40 |
| 1,1,2,2-Tetrachloroethane | | <0.60 |
| 1,1,2-Trichloroethane | 800 | <0.40 |
| 1,1-Dichloroethane | 200 | <0.40 |
| 1,1-Dichloroethylene | 40 | <0.5000 |
| 1,2-Dibromoethane | | <1.00 |
| 1,2-Dichlorobenzene | 2.5 | <1.00 |
| 1,2-Dichloroethane | 100 | <0.700 |
| 1,2-Dichloropropane | 0.7 | <0.70 |
| 1,3,5-Trimethylbenzene | | <0.30 |
| 1,3-Dichlorobenzene | 2.5 | <1.00 |
| 1,4-Dichlorobenzene | 4 | <1.000 |
| Benzene | 100 | <0.5000 |
| Bromodichloromethane | 200 | <0.300 |
| Bromoform | 60 | <0.400 |
| Bromomethane | 0.9 | <0.500 |
| c-1,3-Dichloropropylene | | <0.20 |
| Carbon Tetrachloride | | <0.900 |
| Chlorobenzene | 15 | <0.200 |
| Chloroethane | | <1.0 |
| Chloroform | | <0.50 |
| Chloromethane | 700 | <1.000 |
| cis-1,2-Dichloroethylene | | <0.40 |
| Dibromochloromethane | | <0.30 |
| Ethylbenzene | 8 | <0.5000 |
| Methylene Chloride | 100 | <4.00 |
| Styrene | 4 | <0.50 |
| t-1,2-Dichloroethylene | | <0.4000 |
| t-1,3-Dichloropropylene | 7 | <0.20 |
| Tetrachloroethylene | 50 | <0.30 |
| Toluene | 0.8 | <0.5000 |
| Trichloroethylene | 20 | <0.30 |
| Trichlorofluoromethane | | <0.50 |
| Vinyl Chloride | 600 | <0.500 |
| Xylene-m/p | 32 | <0.5000 |
| Xylene-o | 40 | <0.5000 |

All VOC's reported in µg/L. All other values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-7**

Sheet: 1

| Date Sampled: | | 12-May-1999 | 28-Aug-1999 | 14-Oct-1999 | 08-Aug-2000 | 29-Nov-2000 |
|---|---|---|---|---|---|---|
| Parameter | PWQO | | | | | |
| Alkalinity (CaCO3) | 75% Bkgd | 66 | 51 | 83 | 62 | 79 |
| Aluminum | f (pH) | 0.190 | <0.030 | 0.030 | 0.070 | 0.160 |
| Ammonia (as N) | | 0.05 | 0.09 | <0.02 | 0.14 | 0.02 |
| Barium | | 0.020 | 0.020 | 0.060 | 0.020 | 0.050 |
| Beryllium | f (Hardness) | <0.010 | <0.010 | <0.010 | <0.002 | <0.002 |
| Boron | 0.2 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Cadmium | 0.0002 | <0.00015 | <0.00015 | <0.00500 | 0.00010 | <0.00010 |
| Calcium | | 20.0 | 16.0 | 35.0 | 16.0 | 37.0 |
| Chloride | | 6.0 | 6.0 | 48.0 | 7.0 | 24.0 |
| Chromium | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Cobalt | 0.0009 | <0.0004 | <0.0004 | <0.0100 | 0.0005 | 0.0003 |
| COD | | 14 | 20 | 29 | 28 | <4 |
| Conductivity (uS/cm) | | 105 | 140 | 225 | 130 | 470 |
| Copper | 0.005 | <0.0050 | <0.0050 | <0.0050 | 0.0060 | 0.0010 |
| Dissolved Oxygen | f (Temp) | 9.3 | 7.6 | 9.4 | 8.6 | 10.7 |
| DOC | | 5.1 | 6.0 | 7.6 | 8.1 | 3.6 |
| Hardness (CaCO3) | | 79 | 61 | 137 | 61 | 142 |
| Iron | 0.3 | 0.11 | 1.57 | 0.33 | 0.37 | 0.21 |
| Lead | f (Alk) | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 |
| Magnesium | | 7.00 | 5.00 | 12.00 | 5.00 | 12.00 |
| Manganese | | 0.050 | 0.170 | 0.020 | 0.130 | 0.030 |
| Molybdenum | 0.04 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nickel | 0.025 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Nitrate (as N) | | 1.40 | 0.52 | 4.65 | 0.51 | 11.40 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | 7.6 | 7.1 | 7.1 | 6.8 | 7.0 |
| Phenols | 0.001 | <0.001 | <0.001 | <0.001 | 0.002 | <0.001 |
| Phosphate (as P) | | 0.03 | <0.03 | 0.06 | 0.09 | 0.04 |
| Phosphorus (total) | 0.03 | 0.07 | 0.15 | 0.06 | 0.08 | 0.06 |
| Potassium | | 1.0 | 1.0 | 1.0 | 1.0 | 2.0 |
| Silicon | | 7.40 | 8.50 | 8.80 | 8.22 | 9.56 |
| Silver | 0.0001 | <0.0001 | <0.0001 | <0.0100 | <0.0001 | <0.0001 |
| Sodium | | 5.0 | 6.0 | 8.0 | 5.0 | 8.0 |
| Strontium | | 0.087 | 0.087 | 0.163 | 0.091 | 0.175 |
| Sulphate | | 13.0 | 8.0 | 24.0 | 9.0 | 18.0 |
| Sulphur | | 5 | 3 | 8 | 3 | 6 |
| TDS | | 96 | 92 | 212 | 108 | 208 |
| Temperature (C) | | 13.0 | 19.0 | 3.0 | 16.2 | 6.0 |
| Thallium | 0.0003 | <0.00500 | <0.00500 | <0.50000 | <0.00100 | <0.00100 |
| Tin | | <0.050 | <0.050 | | <0.010 | <0.010 |
| Titanium | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Unionized Ammonia | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Vanadium | 0.006 | <0.0070 | <0.0070 | <0.0100 | <0.0010 | <0.0010 |
| Zinc | 0.03 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-7** Sheet: 2

| Date Sampled: | | 23-Dec-2000 | 28-Jun-2001 | 30-Aug-2001 | 21-Nov-2001 | 13-Dec-2001 |
|---|---|---|---|---|---|---|
| Parameter | PWQO | | | | | |
| Alkalinity (CaCO3) | 75% Bkgd | NS | 82 | 80 | 41 | 71 |
| Aluminum | f (pH) | | <0.050 | <0.050 | 0.670 | <0.050 |
| Ammonia (as N) | | | 0.16 | 0.13 | 0.09 | <0.02 |
| Barium | | | 0.030 | 0.030 | 0.050 | 0.050 |
| Beryllium | f (Hardness) | | <0.002 | <0.002 | <0.002 | <0.002 |
| Boron | 0.2 | | <0.010 | <0.010 | <0.050 | <0.050 |
| Cadmium | 0.0002 | | <0.00010 | <0.00010 | 0.00020 | 0.00010 |
| Calcium | | | 24.0 | 25.0 | 32.0 | 29.0 |
| Chloride | | | 7.0 | 6.0 | 14.0 | 17.0 |
| Chromium | | | <0.001 | <0.001 | <0.001 | 0.002 |
| Cobalt | 0.0009 | | <0.0002 | 0.0006 | 0.0014 | 0.0010 |
| COD | | | 22 | 16 | 27 | 12 |
| Conductivity (uS/cm) | | | 192 | 167 | 250 | 181 |
| Copper | 0.005 | | <0.0010 | <0.0010 | 0.0020 | 0.0020 |
| Dissolved Oxygen | f (Temp) | | 3.4 | 3.3 | 7.0 | 5.6 |
| DOC | | | 7.1 | 5.0 | 9.4 | 3.3 |
| Hardness (CaCO3) | | | 97 | 100 | 125 | 122 |
| Iron | 0.3 | | 0.15 | 0.66 | 1.30 | 3.15 |
| Lead | f (Alk) | | <0.0010 | <0.0010 | <0.0010 | 0.0010 |
| Magnesium | | | 9.00 | 9.00 | 11.00 | 12.00 |
| Manganese | | | 0.260 | 0.390 | 0.270 | 0.180 |
| Molybdenum | 0.04 | | <0.010 | <0.010 | <0.010 | <0.010 |
| Nickel | 0.025 | | <0.010 | <0.010 | <0.010 | <0.010 |
| Nitrate (as N) | | | <0.10 | 0.13 | 0.24 | 1.53 |
| Nitrite (as N) | | | <0.10 | <0.10 | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | | 7.3 | 7.0 | 7.6 | 6.9 |
| Phenols | 0.001 | | 0.001 | <0.001 | <0.001 | <0.001 |
| Phosphate (as P) | | | 0.17 | 0.07 | 0.03 | <0.03 |
| Phosphorus (total) | 0.03 | | 0.06 | 0.06 | 0.85 | 0.34 |
| Potassium | | | <1.0 | 1.0 | 2.0 | 1.0 |
| Silicon | | | 7.45 | 8.45 | 6.68 | 9.56 |
| Silver | 0.0001 | | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Sodium | | | 6.0 | 6.0 | 7.0 | 8.0 |
| Strontium | | | 0.105 | 0.108 | 0.125 | 0.117 |
| Sulphate | | | 9.0 | 27.0 | 88.0 | 37.0 |
| Sulphur | | | | | | |
| TDS | | | 116 | 164 | 248 | 181 |
| Temperature (C) | | | 16.9 | 13.5 | 3.3 | 3.0 |
| Thallium | 0.0003 | | <0.00100 | <0.00100 | <0.00100 | <0.00100 |
| Tin | | | <0.010 | <0.010 | <0.010 | <0.010 |
| Titanium | | | <0.010 | <0.010 | 0.010 | 0.040 |
| Unionized Ammonia | 0.02 | | <0.02 | <0.02 | <0.02 | <0.02 |
| Vanadium | 0.006 | | <0.0010 | 0.0010 | 0.0020 | 0.0050 |
| Zinc | 0.03 | | <0.010 | <0.010 | 0.020 | 0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-8** Sheet: 1

| Date Sampled: | | 08-Aug-2000 | 29-Nov-2000 | 23-Dec-2000 | 28-Jun-2001 | 30-Aug-2001 |
|---|---|---|---|---|---|---|
| Parameter | PWQO | | | | | |
| Alkalinity (CaCO3) | 75% Bkgd | 173 | 281 | NS | 203 | 147 |
| Aluminum | f (pH) | 0.120 | <0.050 | | <0.050 | <0.050 |
| Ammonia (as N) | | 0.19 | 0.17 | | 0.16 | 0.16 |
| Barium | | 0.040 | 0.040 | | 0.040 | 0.020 |
| Beryllium | f (Hardness) | <0.002 | <0.002 | | <0.002 | <0.002 |
| Boron | 0.2 | 0.030 | 0.050 | | 0.040 | 0.020 |
| Cadmium | 0.0002 | <0.00010 | <0.00010 | | <0.00010 | <0.00010 |
| Calcium | | 54.0 | 85.0 | | 75.0 | 39.0 |
| Chloride | | 23.0 | 35.0 | | 41.0 | 29.0 |
| Chromium | | <0.010 | <0.010 | | 0.004 | <0.001 |
| Cobalt | 0.0009 | 0.0006 | 0.0008 | | 0.0003 | <0.0002 |
| COD | | 23 | 10 | | 17 | 16 |
| Conductivity (uS/cm) | | 420 | 860 | | 547 | 290 |
| Copper | 0.005 | 0.0030 | 0.0060 | | 0.0020 | <0.0010 |
| Dissolved Oxygen | f (Temp) | 5.2 | 11.6 | | 4.4 | 4.9 |
| DOC | | 7.7 | 5.7 | | 6.0 | 5.6 |
| Hardness (CaCO3) | | 176 | 311 | | 253 | 143 |
| Iron | 0.3 | 0.97 | 0.95 | | 0.58 | 0.51 |
| Lead | f (Alk) | <0.0010 | <0.0010 | | <0.0010 | <0.0010 |
| Magnesium | | 10.00 | 24.00 | | 16.00 | 11.00 |
| Manganese | | 0.080 | 0.050 | | 0.070 | 0.250 |
| Molybdenum | 0.04 | <0.010 | <0.010 | | <0.010 | 0.020 |
| Nickel | 0.025 | <0.010 | <0.010 | | <0.010 | <0.010 |
| Nitrate (as N) | | 0.43 | 5.48 | | 0.72 | 0.14 |
| Nitrite (as N) | | <0.10 | <0.10 | | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | 7.1 | 7.2 | | 7.4 | 7.4 |
| Phenols | 0.001 | 0.002 | <0.001 | | <0.001 | <0.001 |
| Phosphate (as P) | | 0.39 | 0.23 | | 0.46 | 0.28 |
| Phosphorus (total) | 0.03 | 0.26 | 0.18 | | 0.23 | 0.16 |
| Potassium | | 6.0 | 6.0 | | 4.0 | 3.0 |
| Silicon | | 4.43 | 5.24 | | 3.85 | 4.76 |
| Silver | 0.0001 | <0.0001 | <0.0001 | | <0.0001 | <0.0001 |
| Sodium | | 16.0 | 43.0 | | 33.0 | 19.0 |
| Strontium | | 0.256 | 0.347 | | 0.304 | 0.177 |
| Sulphate | | 21.0 | 81.0 | | 30.0 | 17.0 |
| Sulphur | | 9 | 27 | | | |
| TDS | | 264 | 512 | | 300 | 236 |
| Temperature (C) | | 18.6 | 5.0 | | 22.3 | 15.4 |
| Thallium | 0.0003 | <0.00100 | <0.00100 | | <0.00100 | <0.00100 |
| Tin | | <0.010 | <0.010 | | <0.010 | <0.010 |
| Titanium | | 0.030 | 0.020 | | 0.010 | 0.010 |
| Unionized Ammonia | 0.02 | <0.02 | <0.02 | | <0.02 | <0.02 |
| Vanadium | 0.006 | 0.0100 | 0.0030 | | 0.0050 | 0.0020 |
| Zinc | 0.03 | <0.010 | <0.010 | | <0.010 | <0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-8**



| Date Sampled: | | 21-Nov-2001 | 13-Dec-2001 |
|---|---|---|---|
| Parameter | PWQO | | |
| Alkalinity (CaCO3) | 75% Bkgd | 206 | 246 |
| Aluminum | f (pH) | 0.130 | <0.050 |
| Ammonia (as N) | | 0.45 | <0.02 |
| Barium | | 0.030 | 0.040 |
| Beryllium | f (Hardness) | <0.002 | <0.002 |
| Boron | 0.2 | <0.050 | <0.050 |
| Cadmium | 0.0002 | <0.00010 | <0.00010 |
| Calcium | | 89.0 | 105.0 |
| Chloride | | 86.0 | 54.0 |
| Chromium | | <0.001 | 0.002 |
| Cobalt | 0.0009 | <0.0002 | 0.0002 |
| COD | | 19 | 12 |
| Conductivity (uS/cm) | | 688 | 290 |
| Copper | 0.005 | 0.0010 | 0.0020 |
| Dissolved Oxygen | f (Temp) | 9.5 | 6.2 |
| DOC | | 5.7 | 3.4 |
| Hardness (CaCO3) | | 313 | 349 |
| Iron | 0.3 | 0.17 | 0.36 |
| Lead | f (Alk) | <0.0010 | <0.0010 |
| Magnesium | | 22.00 | 21.00 |
| Manganese | | 0.020 | 0.020 |
| Molybdenum | 0.04 | <0.010 | <0.010 |
| Nickel | 0.025 | <0.010 | <0.010 |
| Nitrate (as N) | | 1.03 | 2.98 |
| Nitrite (as N) | | <0.10 | <0.10 |
| pH (pH units) | 6.5-8.5 | 7.2 | 7.5 |
| Phenols | 0.001 | <0.001 | <0.001 |
| Phosphate (as P) | | 0.14 | 0.06 |
| Phosphorus (total) | 0.03 | 0.09 | 0.05 |
| Potassium | | 8.0 | 5.0 |
| Silicon | | 3.71 | 4.27 |
| Silver | 0.0001 | <0.0001 | <0.0001 |
| Sodium | | 57.0 | 39.0 |
| Strontium | | 0.292 | 0.383 |
| Sulphate | | 118.0 | 94.0 |
| Sulphur | | | |
| TDS | | 568 | 540 |
| Temperature (C) | | 4.2 | 2.0 |
| Thallium | 0.0003 | <0.00100 | <0.00100 |
| Tin | | <0.010 | <0.010 |
| Titanium | | <0.010 | 0.010 |
| Unionized Ammonia | 0.02 | <0.02 | <0.02 |
| Vanadium | 0.006 | 0.0010 | 0.0020 |
| Zinc | 0.03 | <0.010 | <0.010 |

All values reported in mg/L unless otherwise noted.

**Golder Associates**

**CALEDONIA LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS**

Sample Source: **SW-8**

Sheet: 1

Date Sampled: 08-Aug-2000

| Parameter | PWQO | |
|---|---|---|
| 1,1,1,2-Tetrachloroethane | 20 | <0.60 |
| 1,1,1-Trichloroethane | 10 | <0.40 |
| 1,1,2,2-Tetrachloroethane | | <0.60 |
| 1,1,2-Trichloroethane | 800 | <0.40 |
| 1,1-Dichloroethane | 200 | <0.40 |
| 1,1-Dichloroethylene | 40 | <0.5000 |
| 1,2-Dibromoethane | | <1.00 |
| 1,2-Dichlorobenzene | 2.5 | <1.00 |
| 1,2-Dichloroethane | 100 | <0.700 |
| 1,2-Dichloropropane | 0.7 | <0.70 |
| 1,3,5-Trimethylbenzene | | <0.30 |
| 1,3-Dichlorobenzene | 2.5 | <1.00 |
| 1,4-Dichlorobenzene | 4 | <1.000 |
| Benzene | 100 | <0.5000 |
| Bromodichloromethane | 200 | <0.300 |
| Bromoform | 60 | <0.400 |
| Bromomethane | 0.9 | <0.500 |
| c-1,3-Dichloropropylene | | <0.20 |
| Carbon Tetrachloride | | <0.900 |
| Chlorobenzene | 15 | <0.200 |
| Chloroethane | | <1.0 |
| Chloroform | | <0.50 |
| Chloromethane | 700 | <1.000 |
| cis-1,2-Dichloroethylene | | <0.40 |
| Dibromochloromethane | | <0.30 |
| Ethylbenzene | 8 | <0.5000 |
| Methylene Chloride | 100 | <4.00 |
| Styrene | 4 | <0.50 |
| t-1,2-Dichloroethylene | | <0.4000 |
| t-1,3-Dichloropropylene | 7 | <0.20 |
| Tetrachloroethylene | 50 | <0.30 |
| Toluene | 0.8 | <0.5000 |
| Trichloroethylene | 20 | <0.30 |
| Trichlorofluoromethane | | <0.50 |
| Vinyl Chloride | 600 | <0.500 |
| Xylene-m/p | 32 | <0.5000 |
| Xylene-o | 40 | <0.5000 |

All VOC's reported in µg/L. All other values reported in mg/L unless otherwise noted.

# APPENDIX E

## MOE REVIEW (WITH RESPONSE BY GOLDER ASSOCIATES) OF THE 2000 OPERATIONS AND DEVELOPMENT AND GROUNDWATER AND SURFACE WATER MONITORING ACTIVITIES REPORT FOR THE CALEDONIA LANDFILL SITE

**Golder Associates Ltd.**

1796 Courtwood Crescent
Ottawa, Ontario, Canada K2C 2B5
Telephone (613) 224-5864
Fax (613) 224-9928

December 3, 2001

011-2877-7000

Corporation of the Nation Municipality
958 Road 500 West
R.R. 3
Casselman, Ontario
K0A 1M0

Attention: Ms. Mary J. McCuaig, AMCT

**RE: RESPONSE TO MOE REVIEW OF THE ANNUAL REPORT ON THE 2000 OPERATIONS AND DEVELOPMENT AND GROUNDWATER AND SURFACE WATER MONITORING ACTIVITIES**
**CALEDONIA LANDFILL SITE**
**NATION MUNICIPALITY, ONTARIO**

Dear Madam:

Golder Associates Ltd. (Golder Associates) received comments in September 2001 from the Ministry of the Environment (MOE) associated with their review of the report on the 2000 Operations and Development and 2000 Groundwater and Surface Water Monitoring Program at the Caledonia Landfill Site. These comments have been reviewed by Golder Associates and, where applicable, a response has been prepared. Attached are the comments received from the MOE with a response by Golder Associates (where applicable) presented in ***bold italics*** directly beneath the relevant MOE text.

BEST MANAGED PRIVATE COMPANIES

We trust this is sufficient for your present needs. If you have any questions, please do not hesitate to contact the undersigned.

Yours truly,

GOLDER ASSOCIATES LTD.
Environmental Division

A M Harwood

Andrew M. Harwood, B.Eng.
E.I.T.

K.A. Marentette, M.Sc.
Senior Hydrogeologist/Associate

AMH:KAM:ml
n:\active\28000011-2877 caledonia landfill\task 7000 - response to moe letter\ltr-001 01nov14 moe response.doc

Attachment:

MOE comments (with response by Golder Associates)

NOTE: Golder Associates' response to MOE comments are printed in ***bold italics***.

MEMORANDUM August 23, 2001

TO: M. Robert
Sr. Environmental Officer
Cornwall Area Office
Eastern Region

FROM: F. Crossley
Hydrogeologist
Technical Support Section
Eastern Region

RE: 2000 Operation and Development
Groundwater and Surface Water Monitoring Program
Caledonia Landfill Site, Lot 23, Concession VI
Nation Municipality
A471003

Having reviewed the above noted report dated March, 2001 (received May, 2001) by Golder Associates Limited (GAL) and Stantec Consultants Limited, I offer the following comments. The report is subdivided into Part A "Operation and Development" by Stantec and Part B "Groundwater and Surface Water Monitoring Program" by GAL.

The site is licensed under Certificate of Approval, A471003. The site is licensed for the use and operation of a 4.0 hectare landfill within a total site area of 14.57 hectares. The site is licensed to receive municipal and non-hazardous solid industrial waste including white goods, tires and wood waste. Formerly this site was a trench and fill operation, however it has been changed to an area fill operation. The landfill operates as a naturally attenuating site.

GAL determined the geology to be:

- silty sand
- sand
- bedrock was not encountered at a maximum depth of borehole investigation (6.1 metres). Based on the water well record information bedrock consists of shale and limestone and is encountered approximately 30 metres below ground surface.

Previously GAL determined the hydrogeological characteristics to be:

- The horizontal hydraulic gradient ranges from 0.012 to 0.015.
- The estimated hydraulic conductivity (rising head) ranges from $2.8 \times 10^{-4}$ to $1.3 \times 10^{-3}$ cm/sec. with a geometric mean of $6.0 \times 10^{-4}$ cm/sec.
- The shallow groundwater flow is to the north which is towards the wetland and Paxton Creek (Figure 2).

Monitoring Well BH-96-4 is located upgradient, with respect to groundwater flow, of the waste. The water quality in this monitoring well is representative of background water quality.

Monitoring Well BH-99-6 is located directly downgradient of the active landfilling area. The water quality in this monitoring well shows elevated concentrations of numerous typical leachate indicator parameters. The water quality in this monitoring well is representative of leachate. Leachate impacts are evident in monitoring wells: 96-1; 96-2 (slight); 96-3; 99-5; and 99-6.

Guideline B-7, Reasonable Use Concept, applies to this waste disposal site operation. GAL determined the Reasonable Use Limits. Exceedances of the guideline occur along the eastern property boundary (BH-96-1) and at BH-96-2 and BH-99-5 which are the furthest downgradient (north) monitoring wells.

***It is noted that while the Reasonable Use Limits are exceeded at monitoring locations BH96-2 and BH99-5, these monitors are well within the northern boundary limit and the landfill site is likely in compliance with MOE Guideline B-7 in terms of groundwater impacts at its northern boundary.***

Table 5 outlines the proposed groundwater and surface water monitoring program. The proposed 2001 groundwater monitoring is to remain similar to the 2000 Groundwater Monitoring Program with the elimination of volatile organic compound scans.

I offer the following conclusions and recommendations:

- This site is not in compliance with Guideline B-7 along the eastern property boundary. Stantec state that the Township is in the process of acquiring an additional 30 metre wide strip of land along the eastern boundary for the purpose of buffer and contaminant attenuation zone. This additional land will likely bring the site into compliance along the eastern property boundary. The Certificate of Approval should be amended to recognize these lands as buffer and contaminant attenuation zone.

- The horizontal extent of the leachate plume has not been determined as leachate impacts occur at the furtherest downgradient monitoring wells. An additional multi-level monitoring well should be placed between the existing monitoring wells and the suspected discharge point (Paxton Creek).

***A multi-level monitoring location was installed between existing monitoring wells and Paxton Creek in November 2001. This monitoring location will be included in the next sampling session and the results included in the 2001 Annual Report.***

- The vertical extent of the leachate plume cannot be determined as all the monitoring wells are completed as single level. A deeper monitoring well is required to better define the groundwater flow regime. This can be done at the recommended new monitoring well location. This additional information could be used to support the consultants hypothesis that the creek is acting as a groundwater interceptor.

***A multi-level monitoring location was installed between existing monitoring wells and Paxton Creek in November 2001. This monitoring location will be included in the next sampling session and the results included in the 2001 Annual Report.***

- The potential exists for impacts to the surface water as a result of leachate impacted groundwater discharging to the surface water course (drainage ditches/wetland and/or Paxton Creek).

- I concur with the consultants recommended groundwater monitoring program.

Frank Crossley
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NOTE: Golder Associates' response to MOE comments are printed in ***bold italics***.

MEMORANDUM 17 August, 2001

TO: Marc Robert
Sr. Environmental Officer
Cornwall District Office
Eastern Region

FROM: Dana Cruikshank
Surface Water Specialist
Technical Support Section
Eastern Region

RE: Caledonia Waste Disposal Site
2000 Annual Report
Certificate of Approval A471003
Corporation of the Nation Municipality
Lot 23, Concession 6, former Township of Caledonia

I have reviewed the above report with respect to surface water concerns. Groundwater comments will be sent under separate cover.

WDS Summary

The Caledonia Waste Disposal Site provides disposal services to the former Township of Caledonia. It accepts municipal and non-hazardous solid industrial waste, white goods, tires and wood waste. The landfill is situated on flat land with less than 1 metre difference in elevation and is transected in the north end by a 7-8 metre escarpment. The site is underlain by silty sand over glacial till and bedrock. Surface water on the west side of the property flows north into an ephemeral stream that drains through a swampy area which discharges to Paxton Creek. The east side of the property flows north into a stream which empties into Paxton Creek. Paxton Creek is a tributary of the South Nation River which is located about 4 kilometres from the waste disposal site. Groundwater flows are interpreted to flow towards the swamp and to the creek north of the waste disposal site.

Three surface water sampling periods were conducted in 2000 (August 08, November 29 and December 23). All stations were frozen in December and no data was collected. Seven surface water stations have been established to monitor flows off the site to assess impact on Paxton Creek.

Report Conclusions:

Based on the 2000 surface water quality data the consultant concludes that leachate originating from the WDS is not adversely impacting water quality in Paxton Creek. Golder Associates is proposing to sample the site in spring, summer, fall and winter at all seven (7) stations. Parameters are listed in Table 5 of the report.

Reviewer's Comments:

Golder Associates has selected good surface water station locations that should alert the South Nation Municipality should any impacts occur from the Caledonia WDS.

East Side Drainage

SW7 is the background station on the stream and is located upgradient of the WDS. The data collected to date from this station show background water quality that has exceedances of PWQO's. Exceedances are seen in aluminum, cadmium, cobalt, copper, iron, phenols, total phosphorus, thallium and vanadium. Some of these exceedances are likely natural water quality conditions and others are agricultural impacts.

SW3 and SW5 are located downgradient of the WDS prior to the stream's entrance into Paxton Creek. Results from both stations are very similar and tracked almost identically with the background station SW7. Some increases in concentrations were observed at SW3 in boron, calcium, alkalinity, TDS, and strontium over the background data.

From the data collected to date it does not appear that the WDS east drainage area is having an impact on the tributary stream to Paxton Creek.

West Side Drainage

The west side drainage is characterized by SW2 located in the ephemeral stream downgradient of the WDS and SW4 in the swamp area downgradient of the WDS.

Data shows exceedances in the same parameters and concentrations similar to those found in the East Side Drainage area. One interesting difference was a higher than average concentration including a PWQO exceedance for boron at SW4. Boron has been used at other waste disposal sites as a tracer of groundwater leachate. There is currently not enough data to make any conclusions regarding contamination of surface water at SW4 from either surface water or groundwater flows.

***It should be noted that surface water location SW4 (swamp location) is typically stagnant and is not considered to be representative of the surface water quality regime in this area.***

Paxton Creek has two surface water stations. SW6 is located upstream of the WDS and is considered the background station and SW8 is located at the edge of the property line downgradient from the WDS and the two inflows off the WDS. 2000 data indicates that there is little difference in water quality between the two stations. Exceedances of PWQO's in iron, aluminum, total phosphorus and possibly thallium and vanadium are in the same range as other stations.

I am therefore in agreement with Golder Associates in stating that the 2000 data does not indicate an impact from the Caledonia WDS on local surface water.

Recommendations:

1. The sampling frequency is adequate for this site at this time. I would recommend a sampling session done in summer or early fall within 24 hours after a significant precipitation event (>10 mm). The samples in 2000 were collected during periods of low flow and likely little runoff from the WDS. Samples after a rainfall event would provide some data on flushing from the site. Since the 2000 data shows the site is relatively benign in impacts I would be willing to drop the winter sampling period in 2001 for precipitation event in late summer or early fall. For 2002 I would similarly be willing to trade off the winter sampling period for a precipitation sampling event in summer.

***A significant precipitation event (>10 mm) has not been observed since receipt of MOE comments. If a significant precipitation event is observed in the near future, a surface water sampling session will be conducted within 24 hours of the precipitation event. If no such precipitation event is observed, surface water sampling locations will be sampled in December 2001 as originally scheduled.***

2. The suggested list of parameters is acceptable. In addition to field measurements of DO, pH and temperature I would like to see discharge estimates of the east drainage stream and Paxton Creek made during each sampling visit. This will provide data to better evaluate impacts should they occur in the future.

***Surface water flow estimates were recorded at each station in 2000 and are being recorded in 2001.***

3. Observations of aquatic invertebrates, algae growth, aquatic plants, litter, debris, etc. should be made at each station.

***Field observations will be recorded at each station in 2002 and will be presented in the 2002 Annual Report.***

4. It would be appreciated if the water chemistry spreadsheet summaries provided in Appendix C could be provided on disk or sent electronically upon request.

***Surface water chemistry will be provided electronically upon request.***

If you have any questions regarding the above comments or recommendations I would be pleased to discuss them with you. I can be reached at (613) 549-4000, extension 2619.

Dana Cruikshank
DRC/sh

c: Dana Cruikshank
Frank Crossley
File SW-05-04 (Caledonia Waste Disposal Site)
File SW-13-06-02 (Paxton Creek)