Nova Scotia Transportation and Infrastructure Renewal

Hydrogeological Investigation

Type of Document
Final

Project Name
Kurdistan and Arrow Oily Waste Disposal Sites
Fourchu, St.Peter's-Oban and Janvrin Island

Project Number
SYD-00020400-A0

Prepared By: Fred Baechler, M.Sc., P.Geo.

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Date Submitted
June 2012

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June 2012

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Prepared By: Fred Baechler, M.Sc., P.Geo.	Fred Baechler
Reviewed By: Steven Schaller, B.Tech, EP	S. Schaller

Executive Summary

Nova Scotia Transportation and Infrastructure Renewal and Nova Scotia Environment contracted **exp** Services Inc., the new identity of ADI Limited, to undertake intrusive investigations at three Provincial oily waste management sites located in Richmond County. These were associated with cleanup of two marine based oil spills from the 1970s.

On 04 February 1970 the tanker Arrow ran aground on Cerberus Rock in Chedabucto Bay, Nova Scotia, spilling approximately 5.9 x 10^6 litres of Bunker "C" oil into Chedabucto Bay. Approximately 2.3 x 10^6 litres was recovered and disposed of in nine sites. On 15 March 1979, the tanker Kurdistan split in two in the Cabot Straits, spilling 7.3 x 10^6 litres of Bunker "C" oil. Approximately 890,000 bags and 1,300 barrels of oil and oily debris were collected and disposed of in 10 sites. The three sites described in this report include the 30 year old Fourchu and St. Peter's-Oban sites, which were associated with the Kurdistan spill. The 40 year old Janvrin Island site was associated with the Arrow spill

The overall objectives for work on the Kurdistan sites were to delineate any impacts to soil, groundwater and surface waters and to provide recommendations for managing risks at the sites, including monitoring. Work on the Janvrin Island site was limited in scope to delineation activities.

Four types of potential contaminants were disposed in the Kurdistan sites, including Bunker "C" oil, polyethylene bags, organic matter (dead birds, seaweed, oiled fish) and miscellaneous materials (i.e., fish nets, oil booms, 205 litre drums). Details of materials disposed of in the Janvrin Island site, other than Bunker "C" oil are unknown. The composition of the buried oil was complicated by formation of a seawater-in-oil emulsion and weathering on the beaches prior to pick up and disposal. Once placed in the disposal sites, the oil was transferred from a high energy sea/beach environment to a low energy, subsurface environment. Therefore, the rate of natural degradation of the oil is minimized and the active life time of the sites extended. The chemical characteristics of the oily waste contacted water was generally characterized by elevated concentrations of total dissolved solids, pH, alkalinity, chloride, ammonia nitrogen, total organic carbon, iron, manganese and total petroleum hydrocarbons. Sampling of wells within the Kurdistan disposal trenches noted a reduction in concentration in these parameters over the 30 years since disposal ceased.

The main objectives for conducting the environmental site assessment work at the Kurdistan sites were to assess soil, groundwater and surface water conditions around the disposal areas to determine if any petroleum impacts, which may be cause for concern, had occurred as a result of the historical disposal activities. No such impacts were in evidence that would warrant a more detailed assessment. Care and maintenance, with long-term monitoring is recommended.

Fourchu Site

The Fourchu site, covering approximately 1 hectare, is located on Provincial Crown Land some 4.5 km west of the community of Fourchu in Richmond County, along the southeast coast of Cape Breton Island.

The 30 year old site employed an entombment disposal methodology within a low permeable glacial till. Approximately 126,000 bags of Bunker "C" oil, sea water and oiled debris were disposed of at this site.

Investigations included installation of four groundwater monitoring wells and two surface water stations.

There were preliminary indications for the presence of elevated inorganic parameters, (ammonia nitrogen) in groundwater at both background and downgradient sites. Hydrocarbons were not present.

Given minimal dwellings in the vicinity, there is a low human health risk from the site. The proper management approach would include regular monitoring, care and maintenance, removal of trees growing over the trench cover caps, construction of a gate to prevent unauthorized entrance and identifying the site on existing mapping to restrict any other future land use.

St. Peter's-Oban Site

The St. Peter's-Oban site, covering approximately 0.4 hectares, is located on Provincial Crown Land, 6.5 km northwest of the Village of St. Peter's, Richmond County, Nova Scotia.

The 30 year old site also employed an entombment disposal methodology within a low permeable glacial till. Approximately 202,000 bags and forty, 205 litre drums of Bunker "C" oil, sea water, oiled debris and 2,268 kg of oiled mackerel, as well as 6,819 to 9,092 litres of diesel fuel and organic solvent from a net laundromat were disposed of at this site.

Investigations included installation of six groundwater monitoring wells and one surface water station.

There was sporadic presence of hydrocarbons, but within guidelines. There were elevated concentrations in select non-organic parameters, but within applicable guidelines. The site hydrogeology is more complex than the Fourchu site, with less overburden and a strong downward gradient into the bedrock.

Given minimal dwellings in the vicinity, there is a low human health risk from the site. It is, however, situated on a watershed divide with some drainage directed into the Bras d'Or Lake Estuary. The proper management approach would include consideration for constructing mounded cover caps over each trench, removal of domestic wastes illegally dumped on-site, regular monitoring, care and maintenance, removal of trees growing over the site and trench cover caps, construction of a gate to prevent unauthorized entrance and identifying the site on existing mapping to restrict other future land use. Additional intrusive testing is recommended to aid in better understanding the hydrogeological conditions under the site.

Janvrin Island Site

The Janvrin Island site, covering approximately 0.2 hectares, is located some 1 km north of the community of Janvrin Harbour in Richmond County, Nova Scotia.

Since very little was documented concerning disposal operations, the intrusive program focussed solely on test pits to delineate the extent and method of disposal, as well as type of wastes. The 40 year old site did not employ any appropriate disposal methodology, as would be appropriate by today's standards. The disposal zone is placed near or within the water table, with no under till liner, minimal surface cover, no mounded cover cap and is overgrown with trees. The disposal area covers some 4600 m^2 to depths ranging from 1 to 2 metres, resulting in volumes of 4600 to 9200 m^3. The risk for release is, therefore, qualitatively high.

Investigations included excavating 19 test pits within and around the disposal area. While organic contaminants were visually noted scattered in discrete zones, lab analyses of product layers did not exhibit elevated values above guidelines. Hydrocarbons were not visually evident on surface.

1 Introduction

1.1 Contract

Nova Scotia Transportation and Infrastructure Renewal (NSTIR) and Nova Scotia Environment (NSE) contracted **exp** Services Inc., the new identity of ADI Limited, to undertake intrusive investigations at three Provincial oily waste management sites located in Richmond County. These were associated with the cleanup of two marine based oil spills from the 1970s.

The Fourchu and St. Peter's-Oban sites were associated with the 1979 Kurdistan oil spill. The Janvrin Island site was associated with the 1970 Arrow oil spill.

The initial field program was carried out between May and September 2010. Additional intrusive work and monitoring was undertaken during November and December 2010.

1.2 Location of Sites

The location of the three sites is provided in Figure 1-1. They were positioned primarily along the southeastern coast of the Island to accommodate cleanup of the most heavily oiled shorelines.

1.3 Structure of Report

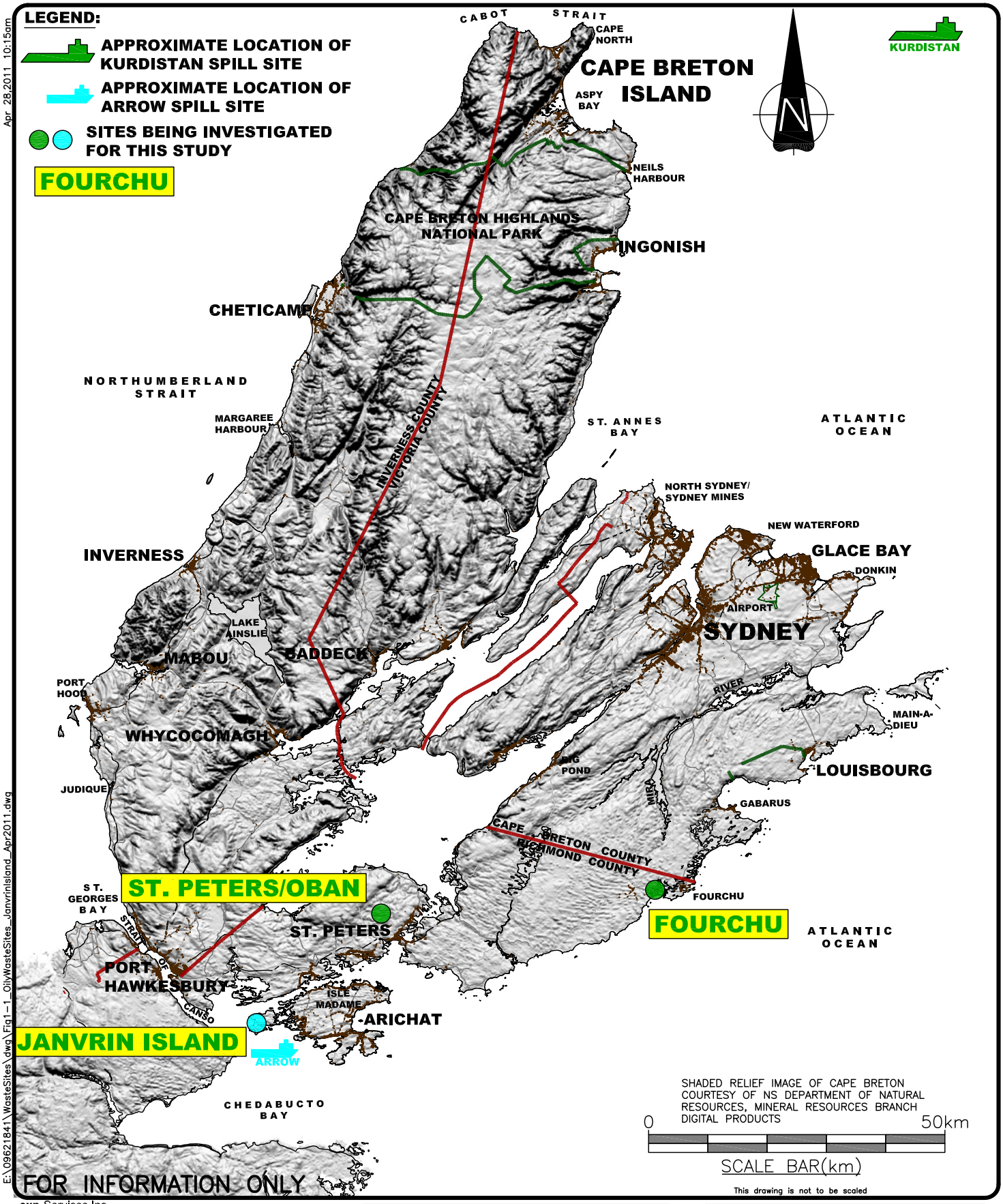
The report is structured to provide background information regarding the nature of the spills and reasons for selection of the sites in Section 2.0. Section 3.0 outlines the scope of work required for this assignment. Section 4 summarizes the field program employed to assess the sites. Sections 5.0, 6.0 and 7.0 outline the findings for the Fourchu, St. Peter's-Oban and Janvrin Island sites, respectively.

2 Background

2.1 Spill History

On 04 February 1970 the 18,000 DWT tanker Arrow, carrying 17.3 x of 10^6 litres of Bunker "C" fuel oil, ran aground on Cerberus Rock in Chedabucto Bay, Nova Scotia (Figure 1-1). Approximately one-third of the cargo was recovered from the tanker and one-third driven out to sea. The remaining 5.9 x of 10^6 (approximately) was trapped in Chedabucto Bay and was mainly on the beaches. Approximately 2.3 x of 10^6 was recovered from some 48 km of cleaned beaches and placed in nine selected disposal sites (Task Force Operation Oil, 1970). One of the sites was the Janvrin Island site discussed in this report. A preliminary assessment of the site was undertaken by Baechler et al (1976). Recommendations were made for intrusive investigations to better understand and monitor the impact of disposal operations.

On 15 March 1979 the tanker Kurdistan split in two in the Cabot Straits (Figure 1-1), spilling 7.3 x 10^6 litres of Bunker "C" oil. Approximately 890,000 bags and 1,300 barrels of oil and oily debris were collected on Cape Breton Island and the Canso Straits area; accounting for approximately 91% of all oil recovered (Baechler, 1980). Two of the specially designed containment sites were constructed at



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Proj.	INVESTIGATION OF OILY WASTE SITES
Dwg.	LOCATION OF OILY WASTE DISPOSAL SITES

Drawn By: NB	Proj. No. SYD-00020400-A0	
Dwg. Standards Chk. By:	Dwg. No. FIGURE 1-1	
Designed By: FB	Dwg. Design Chk. By: FB	Rev. 0

the Fourchu and St. Peter's-Oban locations discussed in this report. A report detailing design, construction and operations was provided by Baechler (1980). Recommendations were made for intrusive investigations to better understand and monitor the impact of disposal operations.

2.2 Site Selection

At the time of the Arrow incident disposal sites had not been pre-selected; therefore, sites selected were in proximity to the shorelines being cleaned up, i.e., Janvrin Island. A review of the sites 6 years after spill cleanup (Baechler et al, 1976) noted that as a result there was no time for intrusive investigations to assess and design the sites. Further, no information was collected during operations concerning the amount and type of oily waste disposed of, nor disposal methodology. No ground/surface water monitoring programs were established.

In the fall of 1975, NSE created a list of guidelines for selection of oily waste disposal sites (Brisco et al, 1977), giving consideration to land ownership, accessibility, surficial material, topography, bedrock and surface/groundwaters. Preliminary site selections were made over the Province, of which the St. Peter's-Oban site was one. However, no intrusive investigations were undertaken prior to the Kurdistan incident. In addition, due to the location of the Kurdistan spill and currents there were remote, heavily oiled shorelines requiring cleaning in areas for which sites had not been pre-selected, as exemplified by the Fourchu site. In the latter case, the guidelines outlined above were applied to quickly find a site in proximity to the shoreline to minimize travel time and costs (Baechler, 1980).

2.3 Site Operations

The Fourchu and St. Peter's-Oban sites were operational between approximately April and November 1979. These abandoned sites are now over 30 years old. The Janvrin Island site was operational during the winter of 1970; placing it at approximately 40 years old. Details are provided under the relevant sections describing each site.

2.4 Site Closure

No additional assessment and/or monitoring, except for visual assessment of general site conditions, have been undertaken on these sites since disposal operations ceased.

2.5 Wastes Disposed of and Potential Pathways for Release

Generally four types of wastes were disposed of within the Kurdistan sites including:

- Bunker "C" oil;
- polyethylene bags;
- organic matter (including dead birds, kelp, seaweed, oiled fish);
- miscellaneous materials (i.e., fish nets, oil booms, 205 litre drums, some domestic waste); and
- diesel oil and solvent at St. Peter's-Oban site.

No chemical dispersants were used in cleanup operations associated with the Kurdistan. Dispersants and cleaning solutions were experimented with on select beaches during the Arrow cleanup and, therefore, may be present in the Janvrin Island site.

The principal contaminant in the disposal sites is a heavy, residual #6 fuel oil or Bunker "C" (C20 and greater) being transported by both the Kurdistan and Arrow tankers. No complete analysis is available of either cargo. A preliminary analysis of the Arrow product (Baechler, 1980) indicated:

Hydrocarbons (oils including paraffins, isoparaffins, cycloparaffins, mono-aromatics, polyaromatics and sulfur compounds)	73.1% wt.
Non Hydrocarbons (Resins – little known about composition)	16.31% wt.
Asphaltenes (little known about composition)	9.28% wt.
Unrecovered (little known about composition)	1.31% wt.

Notable elements present (as % wt.) included carbon (86.13), hydrogen (11.56), sulfur (2.21), oxygen (1.25) and nitrogen (0.39). Notable metals (at greater than 10 ppm) included: vanadium (272 to 386), aluminium (100), barium (970), nickel (50), iron (50), titanium (40) and cadmium (10).

The quality certificate for the Kurdistan cargo indicated:

Penski-Martin Flash Point	93^{o}C
Specific Gravity at 15.6^{o}C	0.9561
Pour Point	7^{o}C

This chemical composition is complicated by the fact that the oil was initially spilled into seawater at a time of extreme agitation by heavy pack ice, high wind and waves. This allowed the oil to form a seawater-in-oil emulsion prior to pick up and disposal. Weathering processes likely to have occurred during this time include evaporation, emulsification, solution, dispersion, photo-chemical reaction, oxidation and biodegradation. All of these will have acted to change the chemical/physical characteristics of the initial oil.

In addition, once ashore and depending upon priority placed upon beach cleanup, the oil may have remained exposed for up to 4 to 5 months prior to removal; leaving the oil exposed to wave action, microbiological activity and sunlight. It was noted that as summer proceeded, heating of the oil on the beach caused it to mobilize and sink into the beach sediment. Hence bags disposed of during the summer months had more sediment and less oil than during the winter.

The ramifications of this characterization for assessing the risk of release at the disposal sites is four fold:

1. Once placed in the disposal sites, the oily wastes are transferred from an active, aerobic, high energy sea/beach environment to an anaerobic, low energy, low temperature subsurface environment. Therefore, the time for natural degradation of the oil is expected to be lengthened considerably and the life time during which the sites act as a source for release of contaminants is expanded.

2. Due to the low vapour pressure of Bunker "C", high carbon numbers (>C20) and ground temperature (10 to 15^{o}C) in the subsurface disposal regime, evaporation may be disregarded. This is expected to eliminate formation and transport of volatiles in the unsaturated zone.

3. The initial release of the oil will be controlled by the 100% polyethylene bags used for transporting the oil from the beaches to the disposal sites. This method of transport was characteristic of the Kurdistan spill; with bulk transport of debris from the beaches in dump trucks characterizing the Arrow spill. While the material comprising the bags can be broken down by contact with oil, the time frame is unknown.

4. This leaves the possibility of four pathways for transporting hydrocarbons off-site including:
   - non-soluble light non-aqueous phase liquid (LNAPL) components could move laterally downgradient on the water table/capillary fringe.
   - the soluble components could move throughout the groundwater flow system.
   - whether dense non-aqueous phase liquid (DNAPL) components were formed as a result of weathering and emulsification of the oil is unknown. Based upon the chemistry of the Arrow oil, this is considered a low probability. However, wells were monitored for its presence; none was found.
   - residual Phase will be present, adsorbed onto sediment within the trenches and available for leaching.

Minimal data was available in the literature concerning the composition of waste contacted water to be expected within an on-land disposal site for Bunker "C" from a marine based spill. To provide guidance in this regard and, therefore, indicator parameters to aid in detection of any plume movement, Baechler (1980) reported on samples collected from 11 in-trench wells at the Hadleyville, Fourchu and St. Peter's disposal sites. These samples represent water within the disposal trenches soon after capping. They, therefore, should represent the chemical characteristics of the waste contacted water in question. Details of each trench sample are reported within the discussion of the relevant disposal site. Overall comments are provided as summarized by Baechler (1980):

1. Generally the chemistry indicates a brackish to saline (total dissolved solids (TDS) of 748 to 12,832 mg/L), very hard (315 to 4,000 mg/L), encrusting, sodium-chloride to sodium bicarbonate type water, with a pH range of 6.6 to 7.5. Nutrients are characterized by elevated nitrogen (kejldahl N of 1 to 46 mg/L) and total organic carbon (27 to 1500 mg/L). Of the 20 metals analyzed for, iron (5.4 to 104 mg/L) and manganese (6 to 51 mg/L) were always elevated. There were also fluctuations in arsenic, barium, lead, antimony and selenium. Organics were characterized by non-detectable to 5 mg/L of total petroleum hydrocarbons (TPH). Microbiological traits were characterized by total and faecal coliforms ranging from 0 to plus 8000/100 ml.

2. Elevated concentrations of sodium and chloride, as well as sodium/chloride ratios of 0.83 (similar to seawater of 0.85) indicate the dominance of this source.

3. The relatively large concentration of nitrogen is predominately in the form of ammonia or organic nitrogen. Possible sources include hydrocarbons, biodegradation products, organics (kelp, dead birds, etc.).

4. Hydrocarbons were visually apparent in the leachate, but difficult for the lab to quantify. This was partly due to the large concentrations of sediment in the water and analytical techniques focused on <C20. Therefore, non-detects may still include the presence of higher carbon numbers. The data indicated a variable range of 0 to 5 mg/L in the liquid extract, with six out of 11 trenches showing nothing. The sediment extracts showed contamination in virtually the same trenches as the liquid extract. In those samples recording oil, large concentrations were found in the sediment involving a wide range of carbon numbers and a definite indication of the presence of C20 and above.

3 Scope of Work and Project Objectives

The overall objectives for the work performed on the Kurdistan Sites, as outlined by the NSTIR, were as follows:

1. Assess soil, groundwater and surface water conditions surrounding the disposal sites in order to determine if any contaminant impacts have occurred as a result of the historic disposal activities.

2. Provide recommendations for the risk management of the sites in the short and long-term (including any required immediate remedial or risk assessment activities, remedial plan or risk management plan) commensurate with the significance of identified impacts.

3. Provide recommendations for monitoring of the sites in the short and long-term, commensurate with the significance of identified impacts.

Work performed on the Janvrin Island site was solely to outline the disposal area using test pits.

4 Field Program

4.1 Field Reconnaissance

A field reconnaissance was carried out over the two Kurdistan sites between 18 and 26 May 2010. Prior to the visit, Nova Scotia Department of Natural Resources (NSDNR) personnel had cleared the access roads to both sites. Potential drill sites were selected and located with a hand-held GPS. These locations were provided to NSDNR, which provided cutting crews to clear access. Reconnaissance of the Janvrin Island site was undertaken on 16 November 2010.

Both the St. Peter's and Fourchu sites were flown by **exp** on 11 June 2010 to provide oblique aerial digital photographs. This supplemented oblique aerial photographs taken by NSDNR and NSE personnel in the fall of 2009.

4.2 Design of Intrusive Program

The approach in designing the intrusive program for the entombment disposal methodology utilized at the Kurdistan sites recognized that:

1. The release pathways for contaminants to be transported off-site could include:
   - Pathway 1: downward flow into the shallow bedrock and then laterally off-site within the active Groundwater Flow Field (GFF).
   - Pathway 2: vertical upward transport through the seal and cap, then flow through the interflow zone within the shallow groundwater Quick Flow System (QFS).
   - Pathway 3: lateral flow through the till.

2. The thickness of overburden between the base of the trenches and the top of rock was an important consideration for assessing Pathway 1. Given project scope it was decided that the first well on each site would go to approximately 19 metres. If bedrock was not encountered, then

Pathway 1 was not a focus of the investigation and subsequent drilling and monitoring well installation targeted Pathway 3 down to a depth of 2 to 3 metres below the base of the trenches.

3. For wells specifically targeting the overburden, the decision was made to focus on determining the presence of contamination, not to assess the horizontal and vertical components of the groundwater flow system in detail. Therefore, rather than short screened length piezometers, the entire length of the boreholes were screened to within approximately 2 metres of ground surface.

4. Monitoring wells were installed immediately downgradient of the operations area to detect the first sign of release, not at the edge of the property boundaries where regulatory compliance points maybe implemented. No intrusive testing was targeted directly within the operations area, to ensure the viability of the disposal trenches was not compromised.

5. Given the shallow nature of Pathway 2, assessment for the presence of contamination focused on: a) visual inspection of topographic depressions where interflow would come to the surface as storm saturated overland flow, b) evidence of staining and dead vegetation; and c) springs/seeps.

Given the absence of intrusive information and method of disposal for the Janvrin Island site, a test pit program was undertaken to delineate the lateral and vertical extent of the disposal area, as well as type of wastes disposed of, method of disposal and capping. To minimize contaminant transport to depth into the bedrock, test pits were excavated only to the bottom of the wastes. No monitoring wells were installed.

Submissions were made to NSDNR requesting access to the Crown lands on which the sites were located. This included provision of Health/Safety and Fire Protection Plans. GPS coordinates for proposed intrusive sites and an outline of what clearing was required to provide access for the drill rig or trackhoe were also provided.

4.3 Assessment and Evaluation Criteria

Discussions with the appropriate regulatory agencies defined the following guidelines to be applied to the sites.

1. Given that the sites in question are waste disposal areas, groundwater under and around the disposal areas, were to be deemed non potable.

2. TPH in soil and water would be screened against Atlantic PIRI Tier II screening for commercial use with coarse grained soil, based on ingestion.

3. Metals and volatile organic compounds (VOCs) in soils would be screened against Canadian Council of Ministers of the Environment (CCME) Industrial Land Use.

4. Metals, general inorganics, VOCs and polycyclic aromatic hydrocarbons (PAHs) in water would be screened against draft NSE guidelines for contaminated sites (2011).

5. PAHs in soil would be screened against CCME 2010 industrial guidelines.

Guidelines are provided in Appendices on summary soil and water tables for the respective sites.

4.4 Drilling and Well installation

Drilling, installation of monitoring wells and collection of soil samples for analysis at the Kurdistan sites was undertaken between 26 July and 07 August 2010. The drilling subcontractor was Boart Longyear, which provided equipment and personnel from their Sydney operation. All well sites were surveyed into geodetic for horizontal and vertical control.

Subsequent water monitoring was carried out between 30 August and 02 September 2010, representing a summer, non-rainfall event condition, including:

- collection of head levels and water samples for chemical analysis from the recently installed monitoring wells;
- collection of streamflow and water samples for chemical analysis from nearby pertinent surface waters/springs; and
- collection of head levels and indicator chemistry from select in-trench monitoring wells.

Based upon review of the initial results, additional drilling was undertaken at the St. Peter's-Oban site on 18/19 November 2010. A second suite of samples was collected at both sites in early December 2010 to represent fall recharge events.

Test pits on Janvrin Island were undertaken on 02 December 2010. These were located with a hand-held GPS instrument.

4.5 Laboratory Analyses and QA/QC

All soil and water samples were submitted to Maxxam Analytics Inc.'s (Maxxam) Sydney laboratory for chemical analysis. This laboratory is a Standards Council of Canada (SCC) and Canadian Association of Laboratory Accreditation (CALA) accredited laboratory.

A value of 10% of samples was duplicated as part of a Quality Assurance (QA)/Quality Control (QC) program through blind internal lab duplicates. QA/QC criteria included <10% ion balance error and 25% relative percent difference.

4.6 Risk Assessment

No detailed human and/or ecological risk evaluation was requested as part of this assignment. However, a qualitative evaluation of potential risks was developed, based upon existing land use, site reconnaissance and activity in the area.

4.7 Data Appended

A separate appendix is provided for each of the three sites. Within each, information is provided for well logs, hydraulic testing, water levels, soil geochemistry and water chemistry.

5 Fourchu Site

5.1 Location

The Fourchu site, covering approximately 1 hectare, is located some 4.5 km west of the community of Fourchu (Figure 5-1). Two overview oblique aerial photographs characterize conditions during operations (Plate 5-1) and testing for this assignment (Plate 5-2).

Plate 5-1: Oblique aerial view of the Fourchu site after closure (1979) looking northeast.

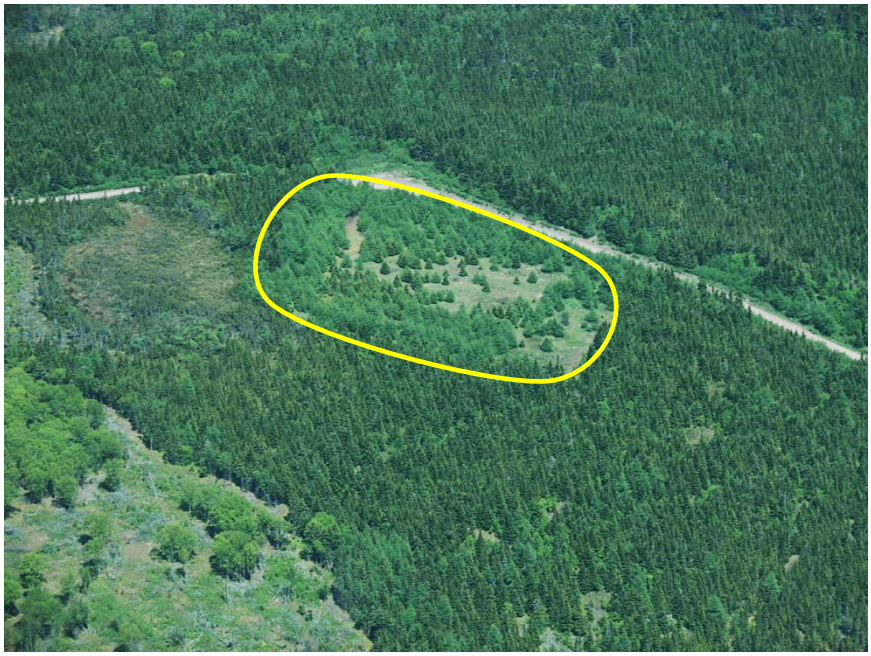

Plate 5-2: Oblique aerial view of the Fourchu site during this assignment (2010) looking to the northeast.

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PROPERTY PLAN
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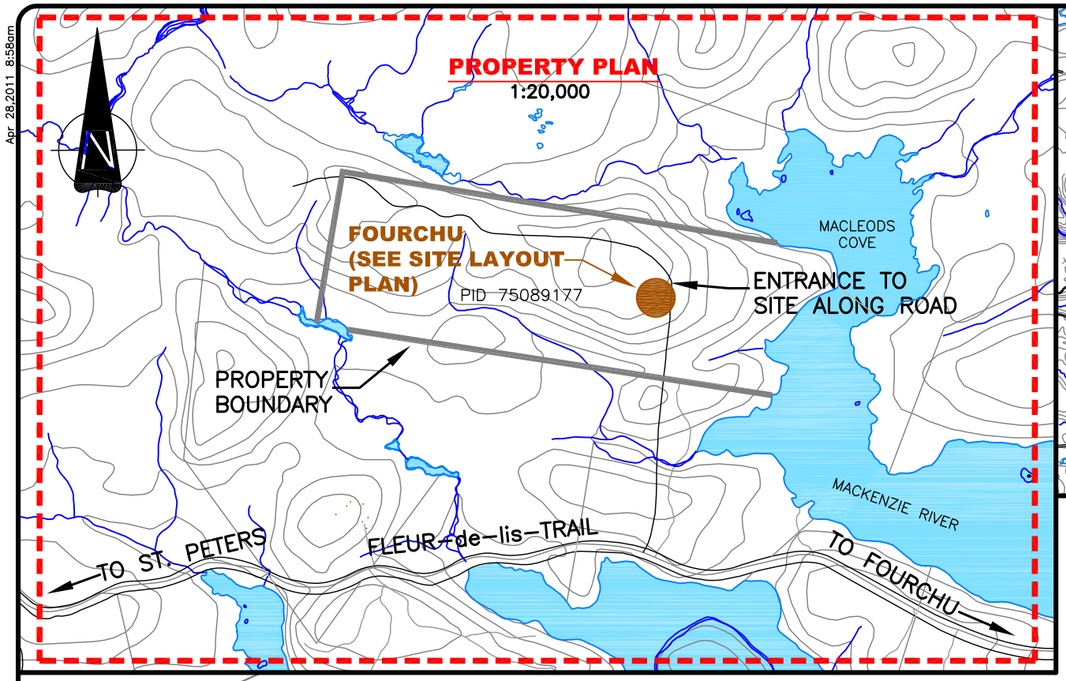

SITE LOCATION PLAN
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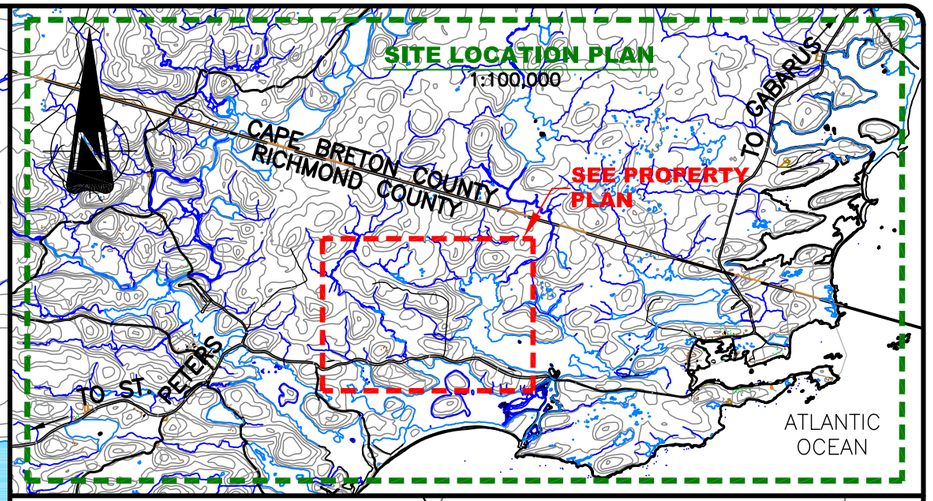

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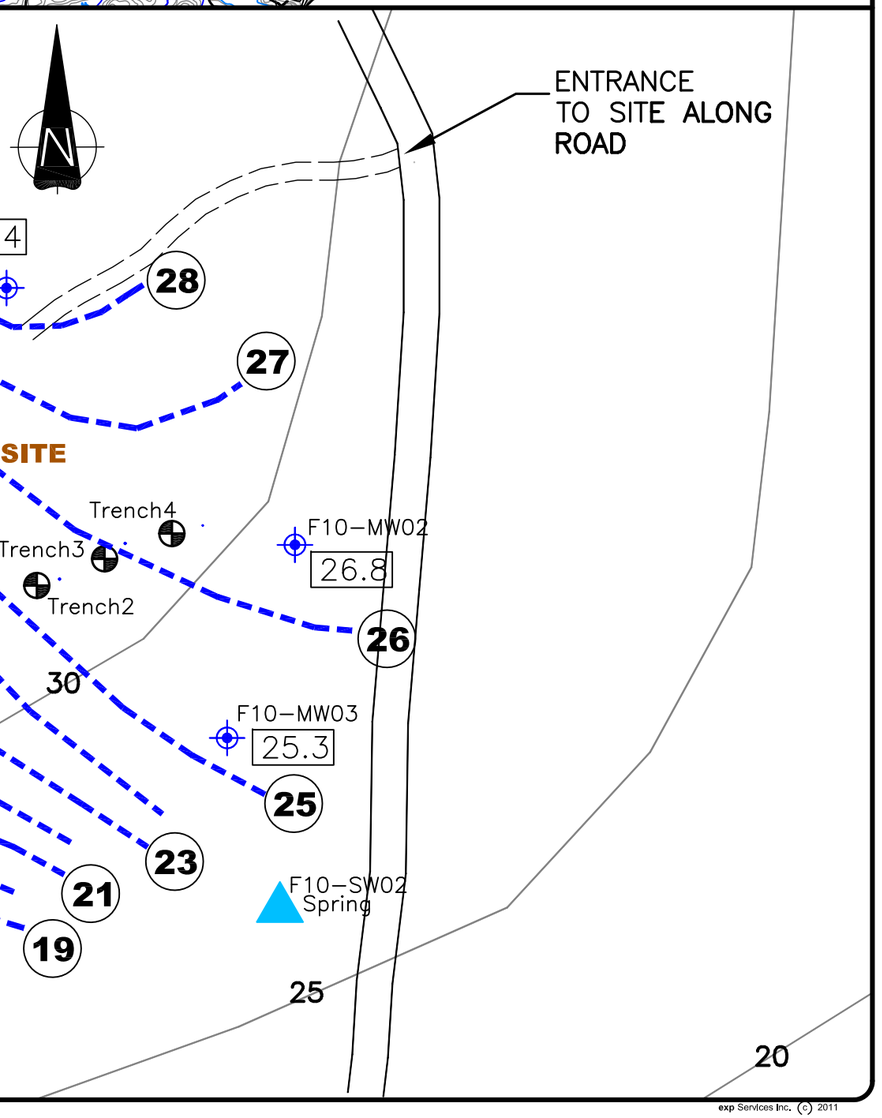


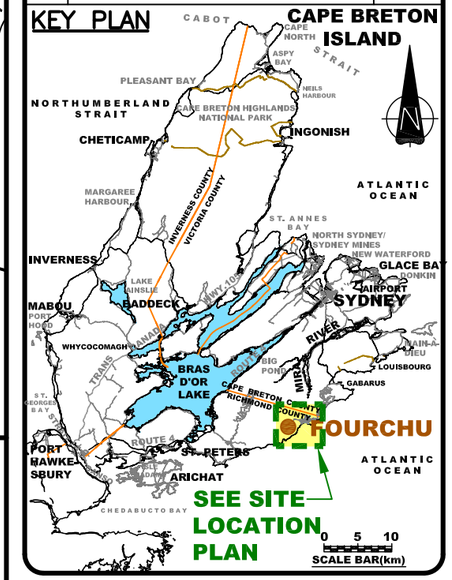
LEGEND:

- 28.4 / F10-MW01 — LOCATION & IDENTIFIER FOR MONITORING WELL(MW) LOCATIONS WITH WATER LEVEL ELEVATION(m)
- Trench1 — EXISTING IN-TRENCH MONITORING WELL LOCATIONS & IDENTIFIERS
- SURFACE WATER SAMPLING LOCATION
- 30 — GENERAL SURFACE CONTOUR ELEVATIONS(m) BASED UPON 1:10,000 DIGITAL MAPPING
- SITE ACCESS ROAD
- 28 — EQUIPOTENTIAL CONTOURS ON WATER TABLE WITHIN THE TILL HU (30 AUGUST 2010) (APPROXIMATE; ASSUMED)

SITE LAYOUT PLAN
1:1000

No.	Issue	Date
1	FOR INFORMATION ONLY	19-APR-11

KEY PLAN



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Dwg. Title
FOURCHU KURDISTAN OILY WASTE DISPOSAL SITE

Project No. SYD-00020400-A0
Dwg. No. **FIGURE 5-1**
Rev. No. 0
Scale **AS SHOWN**
This drawing is not to be scaled

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5.2 Land Ownership, Use and Access

The site is positioned on Provincial Crown land under the jurisdiction of the NSDNR.

The site is accessed off the Fleur-de-lis Trail, along a gravelled secondary woods road 0.9 km from the intersection with the former (Figure 5-1)

Prior to development for disposal, the site was clear cut (Plate 5-1). Since disposal ceased, the site is gradually growing back in with shrubs and spruce (Plates 5-2 and 5-3).

The gravelled secondary access road allowed for forestry operations on and around the site prior to disposal. The road was recently re-opened for continuation of such operations. No further developments have take place within 1 km of the site since disposal operations ceased.

Plate 5-3: Tree growth over the cover caps and around the in-trench monitoring wells for Trenches 2 (foreground) and 3 (center background) on 26 May 2010.

5.3 Site Reconnaissance

The site was visited by **exp** personnel on 26 May 2010. The site access road from the forestry road had been cleared recently by NSDNR personnel, with a locked wire gate still in place.

Forestry operations had not damaged the site. There was no indication of damage by off-road and/or recreational vehicles. No other wastes had been dumped on-site.

The site was growing over with shrubs and spruce. The growth of latter to heights of 2 to 4 metres on the cover caps was of concern, due to potential damage to the viability of the trench caps and seals (Plate 5-3).

All in-trench wells were still in place. Surrounding concrete caps were not cracked, but the ground had settled to varying degrees under them.

There were no visual or olfactory signs of hydrocarbon release at surface. One spring was located downstream of the eastern most trench (Figure 5-1), with no signs of hydrocarbon contamination. No zones of dead vegetation were in evidence.

5.4 Intrusive Program

For this assignment, a total of four sites were drilled and one monitoring well installed at each site (Figure 5-1), screened in the glacial till.

Monitoring well F10-MW01 was positioned upgradient of the disposal area to provide background conditions. The remaining three well sites were positioned immediately down topographic gradient of

the disposal trenches. This assumed that groundwater flow in the overburden would in large measure be controlled by topographic constraints.

5.5 Site Design and Operations

The Fourchu site was operational for the Kurdistan spill. It received oily wastes from approximately 90 km of shoreline from the mouth of Grand River to Louisbourg. Information reported by Baechler (1980) indicated:

1. The site was operational between May and August 1979.

2. An entombment disposal methodology was utilized in the design. This included selection of sites with thick, low permeability, basal glacial till. Subsurface burial was within four, 3 to 3.5 metre deep trenches (Plate 5-4).

Plate 5-4: Trench 3 ready for disposal with in trench well construction commencing within the east side wall.

3. Daily disposal of material was followed by a thin cover of fill, derived from on-site till, which was graded to drain any rainwater to a sump for pumping to keep the trenches dry for disposal. This daily cover created numerous mini cells within each trench. Disposal ceased within approximately 1 metre of ground surface.

4. A seal of fill (reworked till) was emplaced to bring the trench to grade, but without any permeability specification. The trench was then mounded above grade with the same fill (Plate 5-5) and seeded to both facilitate runoff and minimize erosion.

Plate 5-5: An oblique aerial view of the site after capping looking toward the northeast. Note the French drain and swale diverting shallow groundwaters around the site.

5. A monitoring well was installed in the side wall of each trench (Plate 5-4) during operations to allow for monitoring of water level and chemistry within each trench after burial ceased.

6. A French drain was installed upgradient of the trenches to direct shallow subsurface flow around the site into a linear topographic depression on the west side of the operations area (Plate 5-5).

7. A total of 126,240 bags of Bunker "C" oil, sea water and oiled debris were disposed of at this site.

5.6 Hydrological Setting

5.6.1 Hydrological Region/District

The site is positioned within the Atlantic Coastal Plain Hydrological Region, Till Plain Hydrological District of Cape Breton (Baechler et al, 2009). This Region forms most of the southeastern coastline, northeast of St. Peter's, comprising some 8.8% of the island. Distinctive features generally include a low relief, gently undulating, eastward dipping plain. It is underlain by igneous and metamorphic bedrock with ubiquitous wetlands. Thick glacial till deposits allow for overburden controlled relief in

the form of ridges and drumlins. Unique climate conditions are created by proximity to the Atlantic Ocean, which creates extensive fog and exposure to strong winds, as well as relatively cool summers and warm winters in comparison with the rest of the Island.

A three-dimensional conceptual block model of this District (Figure 5-2) notes the active groundwater flow field is expected to be governed by the low permeable underlying bedrock Igneous $_{Plutonic}$ (I_P) and Igneous $_{Volcanic}$ Metamorphic (I_VM) Hydrostratigraphic Units (HUs). These are confined by a thick, fine grained Till HU. Ground surface water interaction is expected to be controlled predominately by the shallow groundwater quick-flow-system operating in the soil and upper weathered portion of the Till HU, usually within 1 to 2 metres of ground surface.

Hydrologically the site is positioned within provincial drainage basin 1FJ-SD9, locally identified as the Mackenzie River watershed. It drains to the east-southeast, discharging into the Atlantic Ocean at Framboise Cove. Specifically, it is positioned near the western shoreline of MacLeods Cove, which forms the upper reaches of the Framboise Estuary (Figure 5-1).

5.6.2 Hydrogeology

The drilling program confirmed the hydrological setting noted above, as well as the findings from the initial test pit program undertaken prior to site development (Baechler, 1980), which suggested good qualities for an entombment site. Specifically the background well (F10-MW01) and a downgradient well (F10-MW04) encountering over 19.2 metres of a compact to dense, gravelly, moderate brown, sandy silt basal glacial till; no bedrock was encountered. The initial test pit exposures also noted coarser sand lenses within the basal till and the presence of a possible 1 to 1.5 metre thick ablation till over the basal till. During construction of the trenches, the basal till was found to be sufficiently dense enough to require use of a ripper on a D7 to allow excavation to proceed.

Given this depth, the remaining two wells were drilled to 6.7 metres depth, some 3 metres below the depth of the disposal trenches.

One grain size analysis, taken from a sample at F10-MW01 at 2 metres depth, indicated gravel (16.1%), sand (33.7%) and silt/clay (50.3%). This generally agreed with six samples collected during the initial test pit investigations prior to disposal (Baechler, 1980). Those samples indicated percent gravel (range 16 to 30%; average 23%), percent sand (range 28 to 40%; average 35%) and percent silt/clay (range 32 to 48%; average 42%).

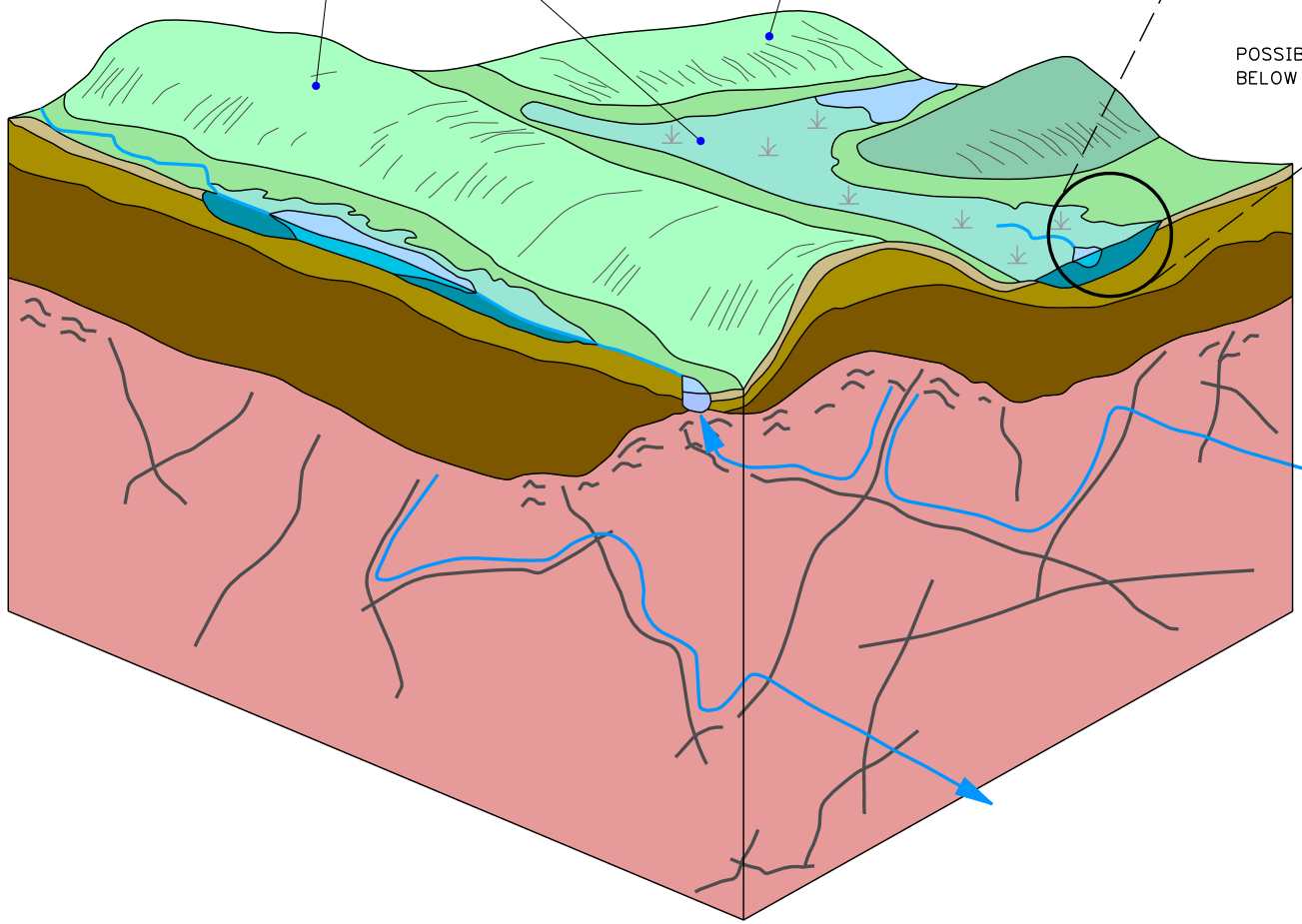
Geotechnically, the liquid limit of 22.7, plastic limit of 20.6 and plastic index of 2.2 indicated a soil symbol of ML (silt) or OL (organic silt) and Till soil type.

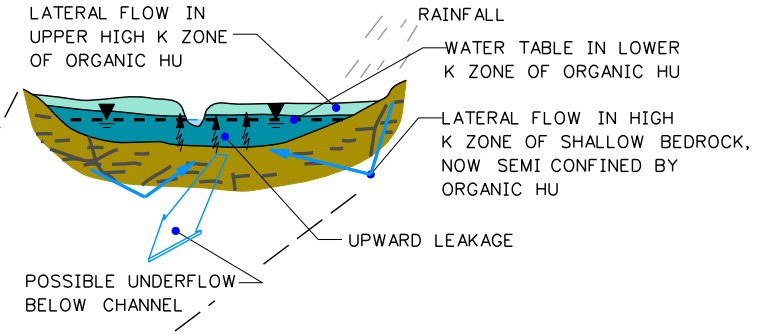
Hydraulic testing of the monitoring wells installed for this program indicated a range of hydraulic conductivity from 4.6×10^{-6} to 4.9×10^{-8} cm/sec, averaging 1.5×10^{-6} cm/sec.

During trench construction, seepage was noted out of the upper ablation till and the basal till was damp to wet. However, no major seepage problems or slope stability problems arose. Sumps and pumps were required for dealing with heavy rains.

Two sets of water levels were collected to characterize:

- summer groundwater recession conditions (low water levels, low gradients) on 30 August 2010; and





ROCK FRACTURING

EXFOLIATION

DISCRETE

CONCEPTUAL MODEL OF FLOW SYSTEMS

SHALLOW FLOW FIELD & INTERACTION WITH SURFACE WATERS - SEE INSETS

DEEPER 1st ORDER FLOW FIELDS

AVERAGE k (cm/sec)	HYDROSTRATIGRAPHIC UNITS
$10^{-3}/10^{-6}$	SOIL HU
$10^{-1}/10^{-5}$	ORGANIC HU
10^{-5}	SANDY TILL HU
10^{-6}	CLAYEY SILT TILL HU
10^{-5}	IGNEOUS METAMORPHIC HUs

N.T.S.

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Proj.

CAPE BRETON WATER RESOURCE MANAGEMENT DATABASE (Baechler et al, in Progress)

Dwg.

ATLANTIC COASTAL REGION CONCEPTUAL HYDROLOGIC MODEL

Drawn By: NB	Proj. No. SYD-00020400-A0
Dwg Standards Chk. By:	Dwg. No. FIGURE 5-2
Designed By: FB	Date Last Modified: 28-APR-11
Dwg. Design Chk. By: FB	Last Modified By: NB / Rev. 0

- fall groundwater recharge conditions (high water levels and elevated gradients) on 10 December 2010.

The water table within the Till HU was relatively high, resembling ground surface. It ranged between 1.2 and 2.0 metres in both the summer and fall. The only exception was at MW10-04, which ranged from 8.8 metres deep during the summer to 2.1 metres deep during the fall. Whether this is an accurate representation of fluctuating seasonal water levels, or slow response after well installation is unknown and will have to wait further monitoring. Subsequent monitoring on 02 May 2011 by NSE personnel indicated a water level of 1.83 metres, suggesting slow response was the reason for the initial low level. Generally there is a thin unsaturated zone and, therefore, wastes within the trenches are placed below the water table.

The equipotential lines for the water table during the August 2010 summer groundwater recession event are provided on Figure 5-1 (site layout plan). They indicate that direction of lateral groundwater flow within the Till HU (assuming a homogeneous, isotropic media) is from north-northeast to south-southwest at a maximum gradient of 9.5% due to the low water level in MW10-04. The vertical flow component is unknown.

Assuming a porosity range for the Till HU of 30 to 50%, the steep gradient and the range in hydraulic conductivity indicates a theoretical, average, linear, groundwater flow velocity of 1 to 1.5 m/year, ranging from 0.04 to 2.4 m/yr. If the lower fall gradient associated with the higher water level at MW10-04 is utilized, the flow velocity reduces to approximately 0.5 m/yr. Given the 30 year life time of the site, any waste contacted plume, if present, could have travelled a maximum of some 30 to 45 metres. The actual position of the end of the trenches is unknown; with the in-trench monitoring wells usually positioned near the middle, deepest part of the trench. Using the distance from the in-trench wells to the nearest downgradient monitoring well provides for a minimum travel distance of 45 to 50 metres; approximately 20 to 30 metres from the nearest end of the trench. Therefore, any conservative indicator of plume transport may be just past or upgradient of the wells.

5.6.3 Hydrology

No defined ephemeral or perennial stream channels were present on-site. No rills or gullies were developed over the former operations area. One broad, natural, heavily vegetated swale was present along the western boundary of the site, which forms the primary receptor surface water system for site drainage and outflow from the french drain dewatering system (Plate 5-5). A road side drainage ditch is present along the eastern perimeter of the site.

Two surface water sampling stations were established for this assignment (Figure 5-1). One located at the spring and one in the receptor swale, just downstream of the french drain discharge.

No flow was visually noticeable during either sampling event; standing water was sampled.

5.7 Soil Geochemistry

5.7.1 Geochemistry

One soil sample of the Till HU was analyzed per borehole (two in MW04). Each sample was analyzed for TPH/BTEX, as well as a suite of 32 metals and 19 PAH compounds. The results are provided in Appendix A.

Analysis of the data indicated:

1. No hydrocarbons monitored for were detectable in the samples of the Till HU either in background or downgradient wells (Table A-1).

2. Most metals analyzed for were detectable. For the select metals (Table A-2), the dominant ones in terms of concentration (exceeding 100 mg/Kg) were similar at all four sites and included in descending order of concentration:
   - iron (range 22,000 to 30,000 mg/Kg; background 23,000 mg/Kg);
   - aluminium (range 9,300 to 11,000 mg/Kg; background 9,800 mg/Kg);
   - manganese (range 460 to 700 mg/Kg; background 610 mg/Kg);
   - titanium (range 220 to 390 mg/Kg; background 330 mg/Kg); and
   - barium (range 120 to 190 mg/Kg; background 120 mg/Kg).

   As can be noted, the range of concentrations for these five metals resembles background concentrations and, therefore, are expected to be a result of normal geochemistry within the Till HU in this area.

3. All samples indicated non-detectable PAH concentrations (Table A-3, A-4 and A-5) except for sporadic, low concentrations of select parameters. Perylene was detected in the downstream wells at F10-MW03 (0.11 mg/Kg) and F10-MW04 (0.04 mg/Kg), as well as the background well F10-MW01 (0.02 mg/Kg) and is, therefore, not expected to be a function of contaminant release.

   Other low level concentrations were recorded at downgradient wells F10-MW03 (benzo(a)pyrene at 0.12 mg/Kg and naphthalene (0.04 mg/Kg)) and F10-MW02 (naphthalene at 0.02 mg/Kg). The source of these are unknown; however, given the low levels, forested nature of the site and shallow depth of the sampling these may be recording PAH compounds in natural organics washed in from the upper soil horizons.

5.7.2 Quality

There were no soil samples elevated above guidelines for hydrocarbons, metals or PAHs.

5.8 Water Chemistry and Quality

5.8.1 In-Trench Leachate wells

From examination of the initial in-trench monitoring well samples, Baechler (1980) noted that Trenches 1 and 3 provided the best and worst-case scenarios for oily waste contacted water (OWCW) chemistry. These were re-sampled during the first sampling event for this assignment to obtain a range in conditions after 30 years of dormancy. Based upon the results Trench 3 was resampled on the second event.

Nine “indicator” parameters were selected to allow for a comparison not only between trenches, but with the initial leachate composition and background groundwaters, as summarized in Table 5-1.

Table 5-1: Oily Waste Contacted Water Indicator Chemistry from Fourchu In-Trench Wells

Location	Date	TDS	pH	Cl	NH_4	Alk	Fe	Mn	TOC	TPH
	mg/L	mg/L	Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Trench 1	2010	427	6.9	61	0.53	290	31	11	100	ND[1]
	1979	748	6.7	300	1.46	195	29	12	37	Trace
Trench 2	2010(1)	988	6.7	150	3.8	740	34	17	55	ND[1]
	2010(2)	1030	7.0	130	4.1	750	44	21	54	ND[1]
	1979	7462	6.7	3100	<0.05	1600	67	41	780	ND
Background Groundwaters	2010	223 to 234	8.1 to 8.2	39 to 52	0.33 to 0.4	140	<0.1	0.36 to 0.45	1.6 to 2.7	ND[1]

Notes:
TDS - total dissolved solids
NH4 - nitrogen as ammonia nitrogen
Mn - manganese
TOC - total organic carbon
TPH - total petroleum hydrocarbons
Fe - iron
Background groundwater taken from F10-MW01
ND[1] - Non-detectable as modified TPH
Alk - Alkalinity (as HCO_3)
Cl - chloride

The indicator parameters noted continual elevated values for all parameters in comparison to background groundwaters in the Till HU, except for TPH. However, the indicators were considerably reduced in concentration compared with initial samples collected after operations ceased. This suggests that dilution and other chemical reactions have reduced the strength of the leachate composition within the trenches with time. This could be accounted for by: 1) groundwater flow through the trenches (given the wastes were buried below the water table and the direction and rate of groundwater flow) and/or 2) recharge through the cover cap.

No LNAPLs or DNAPLs were present in the in-trench wells during either monitoring event.

Detectable, but low concentrations of ethylbenzene (0.033 to 0.057 mg/L) were noted in both trenches during the summer sampling event. It was again noted in Trench 3 during the fall sampling, at a similar concentration (0.029 mg/L).

No PAH compounds were analyzed for during the initial 1979 sampling event. One sample from Trench 3 during the fall sampling event noted detectable, but relatively low concentrations of five compounds including 1-methylnaphthalene (0.15 µg/L), 2-methylnaphthalene (0.13 µg/L), acenaphthene (0.08 µg/L), fluorine (0.05 µg/L) and phenanthrene (0.05 µg/L). The primary PAH indicators of naphthalene and benzo(a)pyrene were non-detectable.

5.8.2 Groundwaters

In terms of major inorganic ion chemistry (Table A-6), the background chemistry of the Till HU at this site (F10-MW01) is characterized as a fresh (TDS of 223 to 234 mg/L), hard (170 mg/L), encrusting, calcium-bicarbonate type water with an alkaline pH (8.1 to 8.2) and alkalinity of 140 mg/L. Nutrients were exemplified by low concentrations of ammonia nitrogen (0.33 to 0.4 mg/L) and total organic compounds (TOC) of 1.6 to 2.7 mg/L. Of the 26 select metals analyzed for, nine were consistently detectable, but at low concentrations, including manganese (0.36 to 0.45 mg/L) and aluminium (0.019 to 0.023 mg/L).

Using the eight major OWCW indicators (Table 5-2) elevated concentrations above background were noted at MW02 and MW03. Therefore, inorganic chemical indicators suggest the presence of an oily waste contacted plume at these sites.

Table 5-2: Groundwaters Elevated Above Background In Inorganic Indicators - Fourchu

Location	TDS	Cl	NH_4	Alk	Fe	Mn	TOC
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
MW02	325 to 359	*	*	270	3.3 to 15	4.5 to 6.3	72 to 130
MW03	407 to 450	53 to 56	1.2 to 1.9	260 to 330	32 to 39	11 to 17	28 to 32
MW04	242 to 301	*	*	*	*	*	5.1 to 5.5
Background	223 to 224	39 to 52	0.33 to 0.4	140	<0.1	0.36 to 0.45	1.6 to 2.7

Notes:
TDS – total dissolved solids
NH4 – ammonia nitrogen
Fe – iron
Cl – chloride
Alk – alkalinity
Mn – manganese
TOC – total organic carbon
* not above background

No detectable TPH/BTEX were present in the wells during either monitoring event (Table A-7). No LNAPLs or DNAPLs were present during either monitoring event.

In terms of PAH compounds, which were monitored during the fall sampling event, all wells recorded a varying number of detectable compounds, but all at relatively low levels (Table A-8). The largest number (seven) was encountered at MW02. The two indicator PAH compounds, naphthalene and benzo(a) pyrene, were non-detectable in all wells.

All TPH and PAH compounds analyzed for in groundwaters were at concentrations lower than criteria. In terms of critical inorganic compounds in groundwater, the background well exhibited an elevated concentration for ammonia nitrogen (0.33 to 0.40 mg/L). Downgradient well MW03 (1.2 to 1.9 mg/L) also exhibited a similar elevated value, but at a concentration four to five times higher. Aluminium also exhibited elevated values in MW02 (0.13 to 0.68 mg/L) and MW03 (0.11 to 0.13 mg/L).

5.8.3 Surface Waters

There were no background surface water stations immediately adjacent the site. The two identified surface water stations represent springs where groundwater is coming to the surface, but with no defined channel downgradient.

Using the eight major inorganic leachate “indicators” elevated concentrations at the spring in TDS (90 to 101 mg/L), due in part to elevated alkalinity (56 to 57 mg/L), suggest some influence may be present, but will require additional sampling to confirm.

No detectable TPH/BTEX was present in the French drain or spring in the summer event and one low detectable concentration of ethylbenzene (0.002 mg/L) at the spring during the fall event. No PAH compounds were detectable at either station.

All TPH and PAH compounds analyzed for in surface waters met guideline criteria. In terms of critical inorganic compounds, only pH at SW01 (5.6 to 5.7); aluminum at SW01 (0.37 to 0.88 mg/L) and SW02 (0.11 to 0.17 mg/L); and iron at SW01 (0.0021 mg/L) and SW02 (0.0021 mg/L) were elevated above applicable guidelines.

5.9 Preliminary Evaluation of Risk Management Options

No domestic dwellings are present within 1 km of the site.

The site is owned by Provincial Crown, which allows for employing restrictions on land use.

The site is growing over with trees, some of which are positioned on top of the cover caps, possibly degrading the viability of the seal. If not addressed, this could allow for release of contaminants through the quick-flow-system.

Forestry operations are ongoing in the general area, which increases the probability of encroachment onto the site by cutting and/or vehicle access.

The site has not been adequately secured to prevent access by vehicles along the site access road. The site has not been identified as restricted land use on existing mapping or in the field to ensure restrictions to future land use of the site.

There was initial evidence of an oily waste contacted groundwater plume being transported off the operations area as detected through inorganic indicators at MW02 and 03 based upon two sets of samples. No exceedences in organics were recorded. Ammonia nitrogen was in exceedence in MW03.

5.10 Conclusions and Recommendations

The field program for this assignment has confirmed the entombment characteristics of the site. The wastes are encapsulated below the water table within a tight, dense, relatively low permeable glacial till. The trench seals and cover caps have not been disturbed. The primary pathway for OWCW transport appears to be through slow transport in the Till water table aquifer.

Based on the monitoring conducted to date, there is no indication of any organic contaminant impacts from hydrocarbons occurring immediately around the site some 30 years after waste disposal operations ceased. Additional monitoring data from the wells around the site (including background wells) have indicated elevated concentrations of certain compounds including ammonia, nitrogen and several metals. Overall, based on an evaluation of all monitoring data, site characteristics, relevant pathways and receptors, there is a qualitatively low human health or ecological risk at this site. Therefore, the proper management approach would indicate consideration of the following.

1. A regular monitoring program should include existing ground and surface water stations, as well as the in-trench monitoring wells. Initially the sampling should be on a quarterly basis. An analysis of the data should be on an annual basis to allow for refinements to the program when and where required.

2. It is recommended that all trees should be cut over the former operations area. Skidders or other heavy equipment should not be utilized to remove trees, to ensure minimal damage to the cover caps. A care and maintenance schedule should be developed for the site to manually keep forest and understory development to a minimum.

3. A permanent gate should be constructed at the entrance to the site access road and a treed buffer zone maintained around the site to ensure access by unauthorized vehicles does not occur.

4. The site should be identified on existing government mapping to ensure restricted future land use.

5. Consideration for research opportunities could entail autopsying one of the trenches to assess the extent of degradation of the bags holding the oil, as well as the oil itself. This would aid in understanding how long the sites pose a risk and require monitoring.

6 St. Peter's–Oban Site

6.1 Location

The St. Peter's-Oban site, covering approximately 0.4 hectares, is located 6.5 km northwest of the Village of St. Peter's (Figure 6-1). Two overview oblique aerial photographs characterize conditions during operations (Plate 6-1) and testing for this assignment (Plate 6-2).

Plate 6-1: Oblique aerial view of the St. Peter's-Oban site after closure (1979) looking toward the northeast.

Plate 6-2: Oblique aerial view of the St. Peter's-Oban site during this assignment (2010) looking to the southwest.

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PROPERTY PLAN
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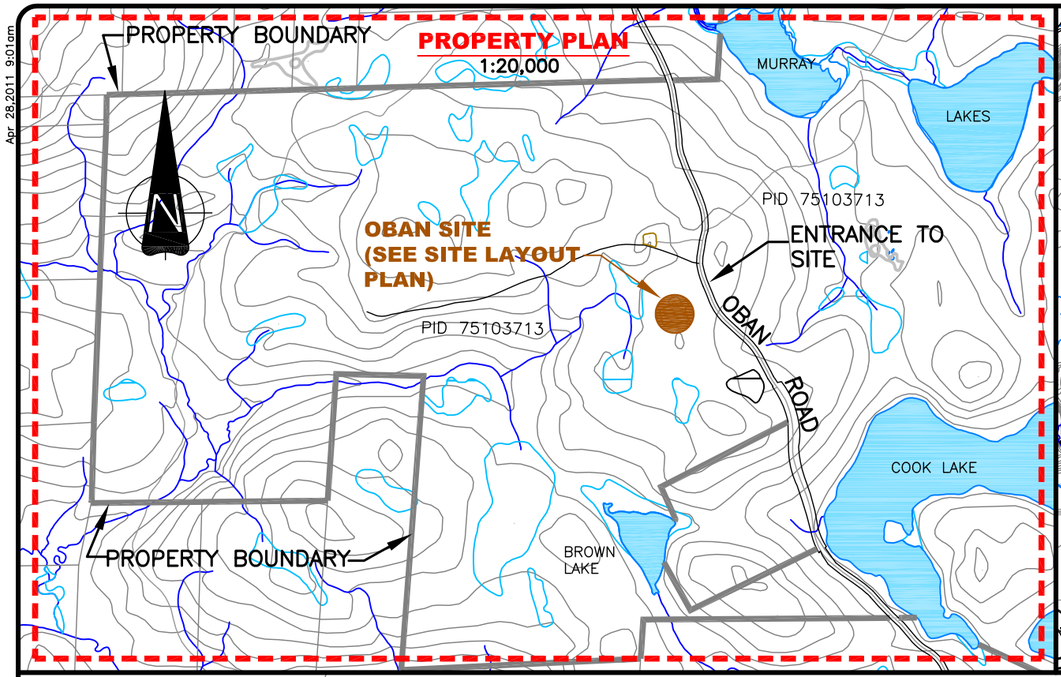
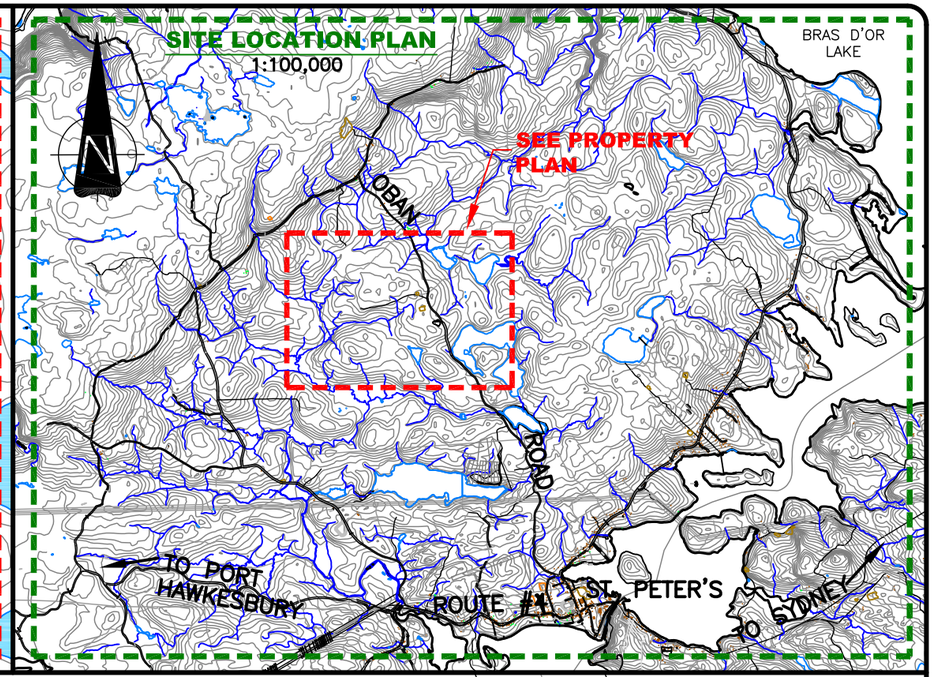


SITE LOCATION PLAN
1:100,000



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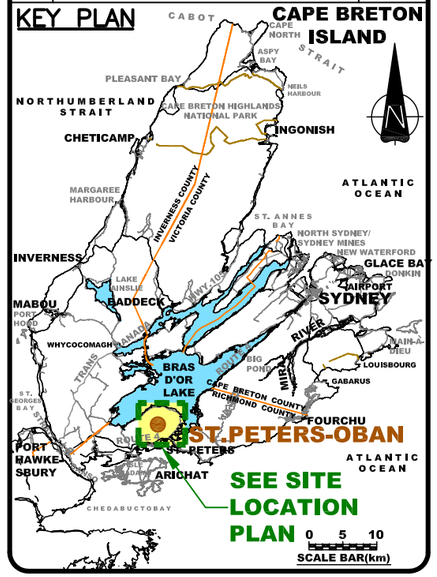
KEY PLAN



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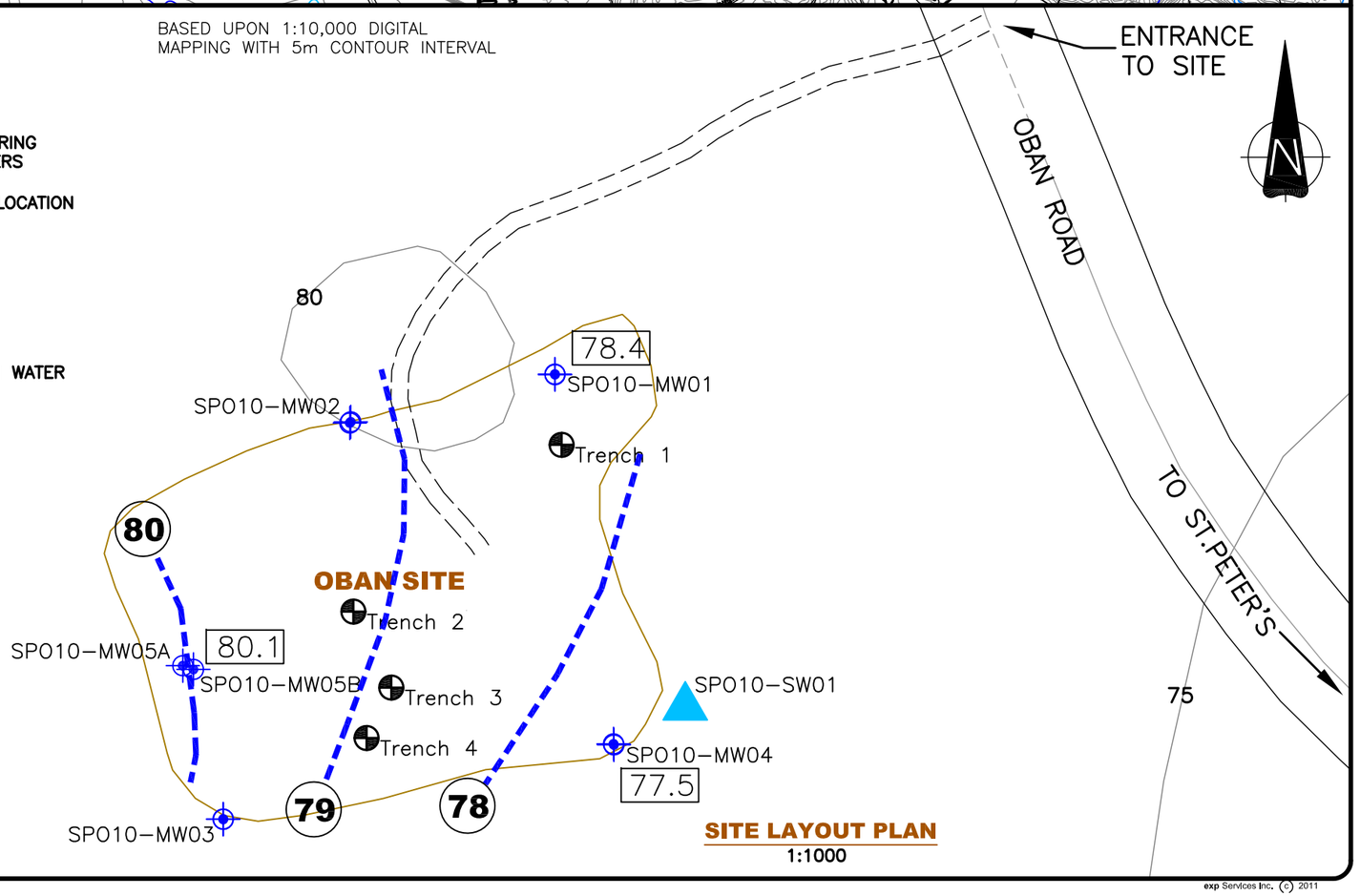
LEGEND:

- 77.5 / SP010-MW04 — LOCATION & IDENTIFIER FOR MONITORING WELL(MW) LOCATIONS WITH WATER LEVEL ELEVATION(m)
- Trench1 — EXISTING IN-TRENCH MONITORING WELL LOCATIONS & IDENTIFIERS
- SURFACE WATER SAMPLING LOCATION
- 75 — GENERAL SURFACE CONTOUR ELEVATIONS(m) BASED UPON 1:10,000 DIGITAL MAPPING
- SITE ACCESS ROAD
- 80 — EQUIPOTENTIAL CONTOURS ON WATER TABLE WITHIN THE TILL HU (20 DECEMBER 2010) (APPROXIMATE; ASSUMED)

BASED UPON 1:10,000 DIGITAL MAPPING WITH 5m CONTOUR INTERVAL



SITE LAYOUT PLAN
1:1000

Const. North	
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Dwg. Title

ST. PETERS – OBAN KURDISTAN OILY WASTE DISPOSAL SITE

Project No.	SYD-00020400-A0	
Dwg. No.	FIGURE 6-1	Rev. No. 0
Scale	AS SHOWN This drawing is not to be scaled	

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6.2 Land Ownership, Use and Access

The site is positioned on Provincial Crown land under the jurisdiction of NSDNR.

The site is accessed off the Oban Road, a gravelled secondary road, some 6 km from the intersection with the Sampsonville Road (Figure 6-1).

Prior to development for disposal the site was forested and required clearing (Plate 6-1). Since disposal operations ceased the site is gradually growing back in with shrubs and spruce (Plate 6-2 and 6-3).

No further developments have take place within 1 km of the site since disposal operations ceased. Test holes were drilled along the Oban Road looking for a water supply for the Village of St. Peter's. It is understood that this program was unsuccessful.

6.3 Site Reconnaissance

The site was visited by **exp** personnel on 19 May 2010. The site access road from the Oban Road had recently been cleared by NSDNR personnel; no gate was in-place.

The waste trenches were left as they were after disposal ceased, with seals, but no mounded cover caps. All in-trench wells were still in place, but not properly completed, awaiting final installation of the caps. There was no indication of damage by off-road and/or recreational vehicles. Some domestic wastes had been illegally dumped on-site.

The site was growing over with shrubs and conifers. The growth of latter to heights of over 7 metres on the surface of the trenches (Plate 6-3) was of concern, due to potential damage to the viability of the seal.

There were no visual or olfactory signs of hydrocarbon release at surface. No zones of dead vegetation were in evidence.

Plate 6-3: Tree growth over Trench 1. In-trench monitoring well (center foreground) awaits construction of mounded cover cap.

6.4 Intrusive Program

For this assignment a total of six monitoring wells were installed. Initially this included two wells in the Till HU and two wells in the shallow bedrock. Based upon the first round of sampling, an additional two wells, at site MW05, were installed in proximity to the areas of domestic waste disposal, including one in the overburden and one in shallow bedrock (Figure 6-1).

Monitoring wells SP010-MW01 and 02 were positioned in what was expected to be locations upgradient of the disposal area to provide background conditions. However, the site was relatively flat lying and flow directions were difficult to assign. The remaining three well sites were positioned immediately down topographic gradient of the disposal trenches, assuming that groundwater flow in the overburden would in large measure be controlled by topographic constraints.

6.5 Site Design and Operations

The St. Peter's-Oban site was operational for the Kurdistan spill. It received oily wastes from approximately 350 km of shoreline, positioned between the Canso Causeway and the mouth of the Grand River. Information reported by Baechler (1980) indicated:

1. The site was operational between May and November 1979.

2. An entombment disposal methodology was utilized in the design. This included selection of sites with thick, low permeability, basal glacial till. Subsurface burial was within four, 3.6 to 4.6 metre deep trenches.

3. Daily disposal of material was followed by a thin cover of fill, derived from on-site till, which was graded to drain any rainwater to a sump for pumping off-site to keep the trenches dry for disposal (Plate 6-4). This daily cover created numerous mini cells within each trench. Disposal ceased within approximately 1 metre of ground surface.

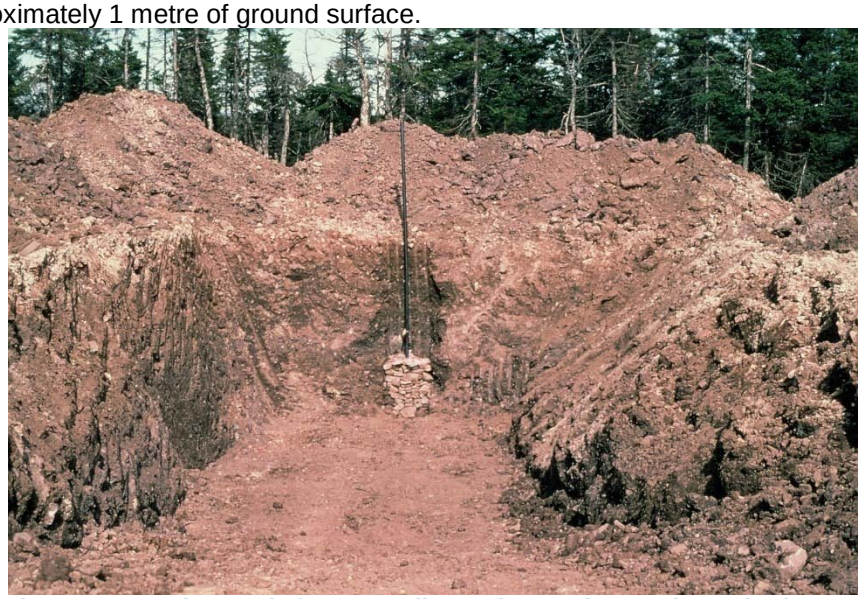


Plate 6-4: Trench 1 ready for waste disposal. Note in-trench monitoring well center background (also present in Plate 6-3).

4. A seal of fill (reworked till) was emplaced to bring the trench to-grade, but without any density or permeability requirements.

5. A monitoring well was installed in the side wall of each trench (Plate 6-4) during operations to allow for monitoring of water level and chemistry within each trench after burial ceased.

6. A total of 202,091 bags and forty, 205 litre drums of Bunker "C" oil, sea water, oiled debris (seaweed) and 2,268 kg of oiled mackerel were disposed of at this site. It also included 6,819 to 6,092 litres of diesel fuel and organic solvent from a net laundromat, which was ignited and burned in Trench 4.

6.6 Hydrological Setting

6.6.1 Hydrological Region/District

The site is positioned within the Lowland Hydrological Region, Sedimentary Plain Hydrological District of Cape Breton (Baechler et al, 2009). Distinctive features generally include a low relief, gently undulating, bedrock controlled topography, underlain by sedimentary bedrock, comprised predominately of sandstone, interbedded to varying degrees with siltstones and shales. The surface is blanketed by thin to thick continuous silty sand to clayey silt glacial till. It is influenced by a coastline of submergence, which has dissected the Region with deeply indented salt water embayments.

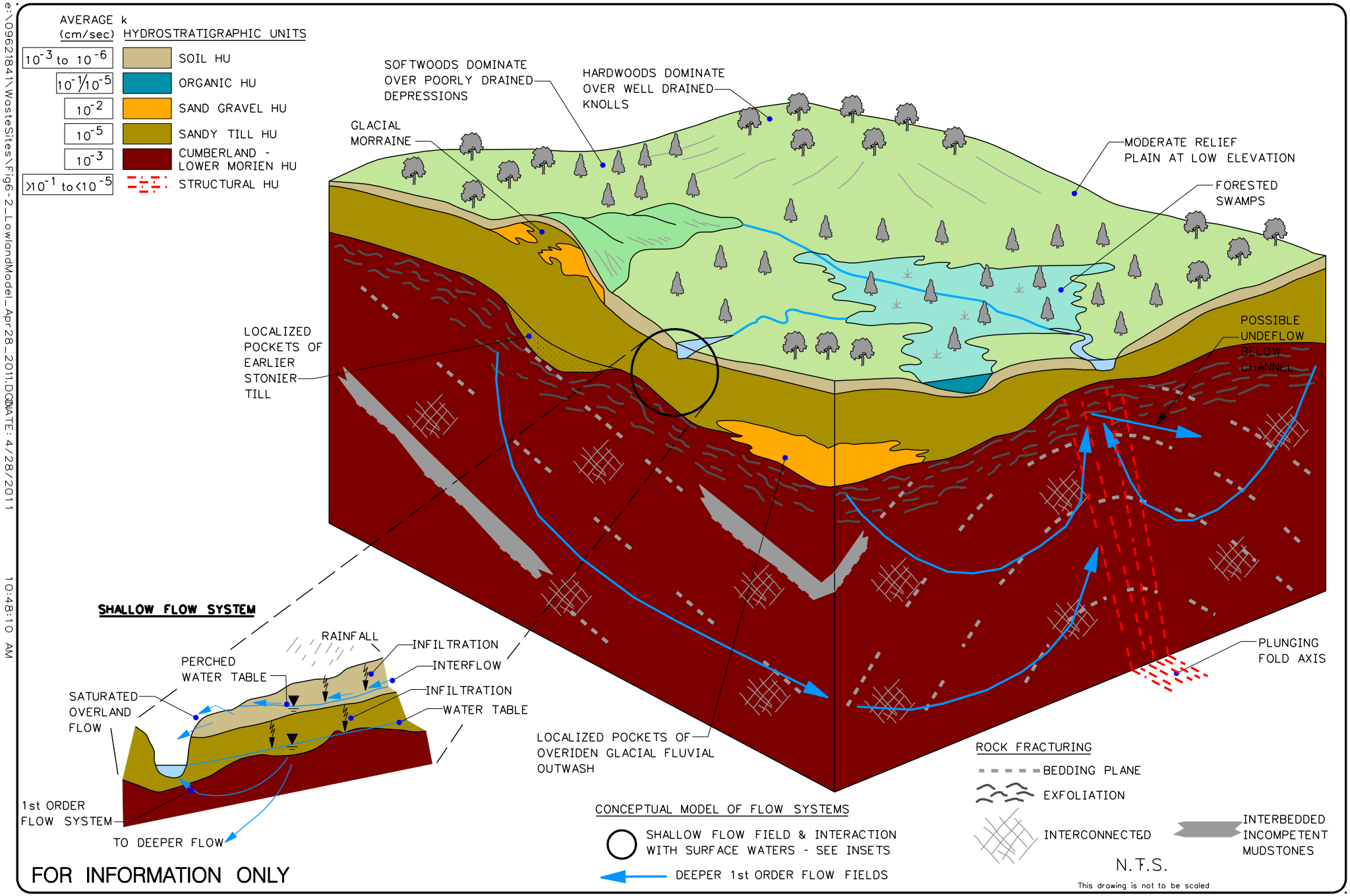
A three-dimensional conceptual block model of this District (Figure 6-2) notes the active groundwater flow field is expected to be governed by the hydrostructural fracture domain created in the Cumberland HU. This unit is semi-confined by a silty sand Till HU. Ground surface water interaction is expected to be controlled predominately by the shallow groundwater quick-flow-system operating in the soil and upper weathered portion of the Till HU, usually within 1 to 2 metres of ground surface.

Hydrologically the site is positioned on the watershed divide between two drainage basins. Topographic relief over the operations area is relatively low varying over only 3 metres between 78 and 81 metres geodetic. Southward directed flow is positioned within provincial drainage basin 1FH-2B, locally identified as the River Tillard watershed, which drains south to discharge into the ocean at St. Peter's Bay. Flow to the north is directed into provincial drainage basin 1FH-3, locally identified as the Scott Brook watershed, which drains into the Bras d'Or Lake Estuary within the St. Peter's Inlet. Most of the site surface drainage is to the former.

6.6.2 Hydrogeology

The drilling program generally confirmed the hydrological setting noted above. However, the depth of the glacial till was not as great as expected, varying between 9.1 to 12.2 metres; with a slight trend toward increasing depth under the topographic high where the waste trenches were located. This still provides some 5 to 8 metres of till between the base of the trench and top of bedrock.

The overburden comprised a compact to dense, gravelly, clayey silt basal glacial till over the entire depth. This agreed with the initial test pit program carried out by Baechler (1980) prior to disposal. Sites along the northern perimeter (MWs 01, 02 and 05) noted evidence of 2 to 2.5 metres of fill



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SEDIMENTARY PLAIN DISTRICT
CONCEPTUAL HYDROLOGIC MODEL

Drawn By: NB	Proj. No. SYD-00020400-A0	
Dwg Standards Chk. By:	Dwg. No. **FIGURE 6-2**	
Designed By: FB	Date Last Modified: 28-APR-11	
Dwg. Design Chk. By: FB	Last Modified By: NB	Rev. 0

overlying the till, probably as a result of re-worked till associated with push off during site clearing and development.

Given that bedrock was encountered within the initial target depth of 19 metres, monitoring wells were installed into the shallow bedrock at MWs 02, 03 and 05. At each location the bedrock consisted of argillaceous sedimentary rock, comprised of competent grey siltstone to mudstone. The bedrock subcrop surface elevation was generally flat lying at around 70 metres geodetic, with a possible slight dip to the northeast.

One grain size analysis taken from a sample of MW03 at 3.5 metre depth indicated gravel (11.4%), sand (25.3%) and silt/clay (63.3%). This generally agreed with five samples collected during the initial test pit investigations prior to disposal (Baechler, 1980). It indicated a massive, dry, very dense, stony, clayey silt basal till with a -200 mesh fraction (silt/clay) ranging between 61 and 64%.

Geotechnically the liquid limit of 31.7 and plastic limit of 26.5, with a plastic index of 5.3, indicated a soil symbol of ML (silt) or OL (organic silt) and Till soil type.

Hydraulic testing indicated a range of hydraulic conductivity (K) for the Till HU ranging from 1.1×10^{-7} to 8.3×10^{-8} cm/sec; averaging 9.6×10^{-8} cm/sec. However, at MW05B it was notably higher at 1.5×10^{-4} cm/sec; exemplifying the presence of lithologic discontinuities in the till. One K value for the bedrock noted a value of 6.7×10^{-5} cm/sec.

During trench construction, no groundwater seepage was noted and the trench walls remained stable. Sump/pumps were required for dealing with heavy rains.

Two sets of water levels were collected on 31 August and 20 December 2010. The latter was used for plotting given the additional monitoring well nest available. The water table within the Till HU was relatively high, resembling ground surface. It ranged between 1.5 and 3.1 metres below ground surface. Therefore, there is a very thin unsaturated zone and, as a result, the wastes within the trenches are placed below the water table.

The equipotential lines for the water table during the late fall event are provided on Figure 6-1. They indicate an “apparent” direction of lateral groundwater flow within the Till HU (assuming a homogeneous isotropic media) from the west-northwest to east-southeast at an apparent gradient of 3.5%.

An anomalous situation occurred within the bedrock piezometric surface, as two of the three shallow bedrock wells were dry during both sampling events. Initially this was thought to be a function of the low permeability of this argillaceous type bedrock. However, one well (MW03), which encountered highly fractured argillaceous bedrock, did record a water level at 19.4 metres below ground surface. This places it 10.4 metres below the subcrop surface; a very unusual event for this hydrological setting, which should be confirmed by long-term monitoring. This suggests a heavily fractured and, therefore, permeable Bedrock HU beneath the site, possibly a function of the structural activity associated with a number of northeast-southwest trending anticlinal and synclinal fold axes in the vicinity of the site. Such deep bedrock water levels will create a strong vertical downward flow component.

Assuming a porosity range for the Till HU of 30 to 50%, provides for a theoretical, average, linear, groundwater flow velocity of <0.1 m/year. This would indicate that any conservative indicator of OWCW plume transport would not have reached the monitoring wells.

6.6.3 Hydrology

No defined ephemeral or perennial stream channels were present on-site. No rills or gullies were developed over the former operations area. One broad, natural, heavily vegetated swale was present along the western boundary of the site, which forms part of the River Tillard watershed; no defined channel was present. Road side drainage along the access road drains into the Scott Brook watershed.

One surface water sampling station was established for this assignment, located in a seepage area just south of MW 4 (Figure 6-1).

6.7 Soil Geochemistry

6.7.1 Geochemistry

One soil sample of the Till HU was analyzed per borehole. Each sample was analyzed for TPH/BTEX, as well as a suite of 32 metals, 19 PAH compounds and 35 volatile organics. The results are provided in Appendix B.

Analysis of the data indicated:

1. Hydrocarbons monitored for were generally not detectable in the samples of the Till HU either in upgradient or downgradient wells (Table B-1). The only exceptions were at downgradient wells MW03-04 and MW05A, both of which exhibited 26 mg/Kg modified TPH due to >C10-C21 hydrocarbons.

2. Most metals analyzed for were detectable (Table B-2). Of the heavy metals, the dominant ones in terms of concentration (exceeding 100 mg/Kg) were similar at all five sites and included in descending order of concentration:
   - iron (range 30,000 to 36,000 mg/Kg; background 30,000 mg/Kg);
   - aluminum (range 4,400 to 11,000 mg/Kg; background 9,300 mg/Kg); and
   - manganese (range 470 to 620 mg/Kg; background 590 mg/Kg).

   As can be noted, the ranges of concentrations for these three metals resembles background concentrations and, therefore, are expected to be a result of normal geochemistry of the Till HU in this area.

3. The background sample for PAH analysis (Tables B-3, B-4 and B-5) noted detectable, but low level concentrations of PAH compounds including chrysene (0.01 mg/Kg), phenanthrene (0.02 mg/Kg) and pyrene (0.01 mg/Kg). This was also characteristic of MW01, MW03-04 and none were detected in MW05B. However, MWs 03-02 and 05A noted additional PAH compounds in the detectable range including 1-methylnaphthalene (0.02 to 0.05 mg/Kg), 2-methylnaphthalene (0.01 to 0.08 mg/Kg), fluorine (0.01 to 0.04 mg/Kg) and naphthalene (0.03 to 0.05 mg/Kg), with the larger concentrations in the latter. In addition, the latter also noted detectable concentrations of benzo(b)fluoranthene (0.02 mg/Kg) and benzo(g,h,i)perylene (0.02 mg/Kg). The source of these are unknown; however, the MW05B sample was collected at the 3 to 3.5 metres depth at the fill/till interface, at which depth an LNAPL sheen was visible on drill water and a hydrocarbon odour was detected. This suggests some transport via Pathway 2 in the quick-flow-system.

4. No VOC compounds were detectable in any of the samples (Tables B-6).

6.7.2 Quality

There were no soil exceedences for hydrocarbons, metals or PAHs.

6.8 Water Chemistry and Quality

6.8.1 In-Trench Leachate Wells

Examination of the initial in-trench monitoring well samples (Baechler, 1980) noted that Trenches 1, 3 and 4 provided a range to characterize leachate chemistry, especially with the light end hydrocarbons disposed of in Trench 4. These were re-sampled during the first sampling event for this assignment, to obtain a range in conditions after 30 years of dormancy. Based upon the results, Trench 4 was re-sampled on the second event.

Nine indicator parameters were selected to allow for a comparison not only between trenches, but with the initial leachate composition and background groundwaters, as summarized in Table 6-1.

Table 6-1: Oily Waste Leachate Indicator Chemistry for In-Trench Wells at St. Peter's-Oban Site

Location	Date	TDS	pH	Cl	NH_4	Alk	Fe	Mn	TOC	TPH
	mg/L	mg/L	Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Trench 1	2010	390	7.6	110	27	210	2.4	0.47	6.8	ND
	1979	11,142	7.0	5300	38	3200	5.4	10.4	250	NA
Trench 3	2010(1)	768	7.2	320	11	290	11	0.84	11	ND
	1979	6,383	6.9	750	22	2450	95	15.3	355	NA
Trench 4	2010(1)	1,250	8.0	510	15	520	6.5	1.1	13	ND
	2010(2)	1,530	7.7	540	15	680	6.6	1.9	14	ND
	1979	12,832	7.1	6500	24	3000	18	13.5	275	NA
Background Groundwaters	2010	716 to 805	7.8 to 8.1	35 to 69	0.14 to 0.22	260 to 290	<0.1 to 0.13	0.48 to 0.89	1.8 To 7	ND[1]

Notes:
TDS - total dissolved solids
TOC - total organic carbon
Background groundwater F10-MW01
ND[1] - Non-detectable as modified TPH
Mn - manganese
NH_4 - nitrogen as ammonia nitrogen
TPH - total petroleum hydrocarbons
Alk - Alkalinity (as HCO_3)
Fe - iron
Cl - chloride

The initial (1979) indicator parameters noted continual elevated values for all parameters in comparison to background groundwaters in the Till HU, except for TPH, which was not analyzed for. However, during the 2010 sampling the indicators were considerably reduced in concentration. This suggests that dilution and other chemical reactions have reduced the strength of the leachate composition within the trenches. This could be accounted for by: 1) groundwater flow through the trenches (given the wastes were buried below the water table and the direction and rate of groundwater flow) and/or 2) recharge through the cover cap. At this time chloride, ammonia nitrogen iron, manganese and TOC appear still to be elevated over background.

No LNAPLs or DNAPLs were present in the in-trench wells during either monitoring event.

Detectable, but low concentrations of ethylbenzene (0.024 to 0.21 mg/L) were noted in all three trenches during the summer sampling event (Table B-7). It was also noted in Trench 4 (0.002 mg/L) during the fall event. In addition, the summer event also noted detectable concentrations of toluene (0.001 to 0.002 mg/L) in Trenches 1 and 3, as well as 0.2 mg/L of <C10-C16 hydrocarbons in Trench 1. This was confirmed in the volatile organic scans in which during the summer event ethylbenzene (34 to 170 µg/L) and toluene (1 µg/L) were present in all three trenches. The latter also showed up in Trench 4 during the fall sampling at 5 µg/L.

No PAH compounds were analyzed for during the initial 1979 sampling event. One sample from Trench 4 during the fall sampling event (Table B-8)noted detectable but relatively low concentrations of phenanthrene (0.01 µg/L).

No VOCs other than ethylbenzene and toluene were detected.

6.8.2 Groundwaters

In terms of major inorganic ion chemistry (Table B-9), the background chemistry of the Till HU at this site (S10-MW01) is characterized as a fresh (TDS 716 to 805 mg/L), very hard (420 to 580 mg/L), encrusting, sodium-bicarbonate/sulfate to calcium-bicarbonate/sulfate type water with an alkaline pH (7.8 to 8.1) and alkalinity of 260 to 290 mg/L. Nutrients were exemplified by low concentrations of nitrate+nitrite (as N) (0.05 mg/L), ammonia nitrogen (0.22 to 0.14 mg/L) and TOC (1.8 to 7 mg/L). Of the 26 “heavy metals” analyzed for nine were consistently detectable, but at low concentrations, including iron (<0.1 to 0.13 mg/L), manganese (0.48 to 0.89 mg/L) and aluminum (0.01 to 0.034 mg/L).

Using the eight major inorganic ion leachate indicators (Table 6-2), no elevated concentrations were present. This would agree with the slow travel times calculated for the Till HU.

Table 6-2: Groundwater Elevated Above Background in Inorganic Indicators

Location	TDS	Cl	NH_4	Alk	Fe	Mn	TOC
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Till Background	716 to 805	35 to 69	0.11 to 0.22	260 to 290	<0.1 to 0.13	0.48 to 0.89	1.8 to 7
MW04	631 to 699	15 to 31	0.18 to 0.25	230 to 300	<0.1 to 0.17	0.43 to 0.7	1.4 to 2.4
MW5B	298	10	<0.05	220	<0.1	1.7	4.5

Notes:
TDS - total dissolved solids
NH4 - ammonia nitrogen
Fe - iron
Cl - chloride
Alk - alkalinity
Mn - manganese
TOC - total organic carbon

No detectable TPH/BTEX compounds were present in the wells during either monitoring event (Table B-7). No LNAPLs or DNAPLs were present during either monitoring event.

In terms of PAH compounds, which were monitored during the fall sampling event (Table B-8), all wells recorded a varying number of detectable compounds, but all at relatively low levels. The largest number (10) was encountered at MW05B. The two indicator PAH compounds naphthalene and benzo(a) pyrene, were non-detectable. This is the site where an LNAPL sheen was noted at the fill/till interface during drilling. However, whether this signifies a release from the trenches or is related to illegal dumping is unknown.

All TPH, PAH and VOC compounds (Table B-10) analyzed in groundwaters were below criteria.

In terms of critical inorganic compounds, those parameters not elevated in the background included iron at MW03 (0.51 mg/L) and cobalt (0.003 mg/L). Given the low concentration these could just as well by part of the normal variability in the HU.

6.8.3 Surface Waters

There were no background surface water stations immediately adjacent the site.

The one identified surface water station represented a groundwater seepage area with no defined channel downstream.

Using the eight major inorganic OWCW water indicators, no noticeable elevated concentrations were noted in the seepage area sampled during either event.

No detectable TPH/BTEX or PAH compounds were present in the seepage area during either event.

The only elevated value above guidelines was for aluminium (0.072 to 0.09 mg/L).

6.9 Evaluation of Risk Management Options

No domestic dwellings are present within 1 km of the site.

The site is owned by Provincial Crown, which allows for employing restrictions on land use.

Disposal sites at the other NSE sites (Fourchu and Hadleyville) were completed by the construction of mounded cover caps using on-site till. These were intended to shed water and minimize infiltration into the trenches. The four disposal trends at the Oban site do not have mounded cover caps.

The site is growing over with trees, some of which are positioned on top of the trenches, possibly degrading the viability of the seal. If not addressed, this could also promote increased infiltration into the trenches and hence contaminant transport.

Forestry operations are ongoing in the general area, which increases the probability of encroachment onto the site by cutting and/or vehicle access.

Illegal dumping of municipal solid wastes has occurred on-site.

The site resides on the watershed divide between the River Tillard watershed (1FH-2B) and Scott Brook (1FH-3) subbasin of the Bras d'Or Lake watershed.

The Village of St. Peter's has undertaken a water well drilling program southeast of the site along Oban Road in an effort to assess the underlying bedrock aquifer for a water supply. Given unfavourable results, the well field was positioned some 5 km to the east-southeast within a different subbasin (1FH-SD6).

The site has not been secured or identified as restricted land use on existing mapping or in the field.

6.9.1 Conclusions and Recommendations

The field program for this assignment has confirmed the entombment characteristics of the site. The wastes are encapsulated below the water table within a tight, dense, relatively low permeability glacial till. However, the depth of overburden beneath the base of the trenches is lower than expected (9 to 12 metres), but still providing some 5 to 8 metres of till between the base of the trench and top of bedrock.

The trench seals are in place but none have mounded cover caps in-place. The primary pathway for contaminant release appears to be through slow transport in the till water table aquifer. However, there is an indication of organics in transport through shallow near surface groundwaters at MW05. Whether this signifies a release from the trenches or is related to illegal dumping is unknown. However, all detectable organics met exceedence criteria.

The intrusive program to date has shown the site to be hydrogeologically complex. Additional drilling is recommended to further assess the Bedrock HU and test pits to assess the shallow groundwater flow under the site.

A preliminary evaluation of risk suggests that given minimal dwellings in the vicinity there is a low risk from the site. Therefore, the proper management approach would include consideration of:

1. A regular monitoring program should include existing ground and surface water stations, as well as the in-trench monitoring wells. Initially this should be on a quarterly basis. An analysis of the data on an annual basis should be carried out to allow for refinements to the program when and where needed.

2. While monitoring data from the site does not indicate any unacceptable contaminant impacts have occurred, it is recommended that mounded cover caps be installed over the trenches as part of the implementation of best management practices.

3. It is recommended that all trees should be cut over the former operations area. Skidders or other heavy equipment should not be utilized to remove trees, to ensure minimal damage to the trenches.

4. A care and maintenance schedule should be developed for the site to manually keep forest and understory development to a minimum.

5. A permanent gate should be constructed at the entrance to the site access road and a treed buffer zone maintained around the site to ensure access by unauthorized vehicles does not occur.

6. The site should be identified on existing government mapping to ensure no other land use is allowed in the future.

7. Consideration for research opportunities could entail autopsying one of the trenches to assess the extent of degradation of the bags holding the oil, as well as the oil itself. This would aid in understanding how long the sites pose a risk and will have to be monitored for.

7 Janvrin Island

7.1 Location

The Janvrin Island site, covering approximately 0.2 hectares (Plate 7-1), is located some 1 km north of the community of Janvrin Harbour (Figure 7-1).

Plate 7-1: Oblique aerial view of the Janvrin Island site looking southeast (2009) – courtesy of NSE.

7.2 Land Ownership, Use and Access

The site is positioned on Provincial Crown land under the jurisdiction of NSDNR.

The site is accessed off a gravelled secondary woods road created for forest harvesting operations (Figure 7-1)

Prior to development for disposal the site was an abandoned farm property. Since disposal the site was recently harvested for wood.

7.3 Site Reconnaissance

The site was visited by **exp** personnel on 16 November 2010.

May 02,2011 9:07am

PROPERTY PLAN
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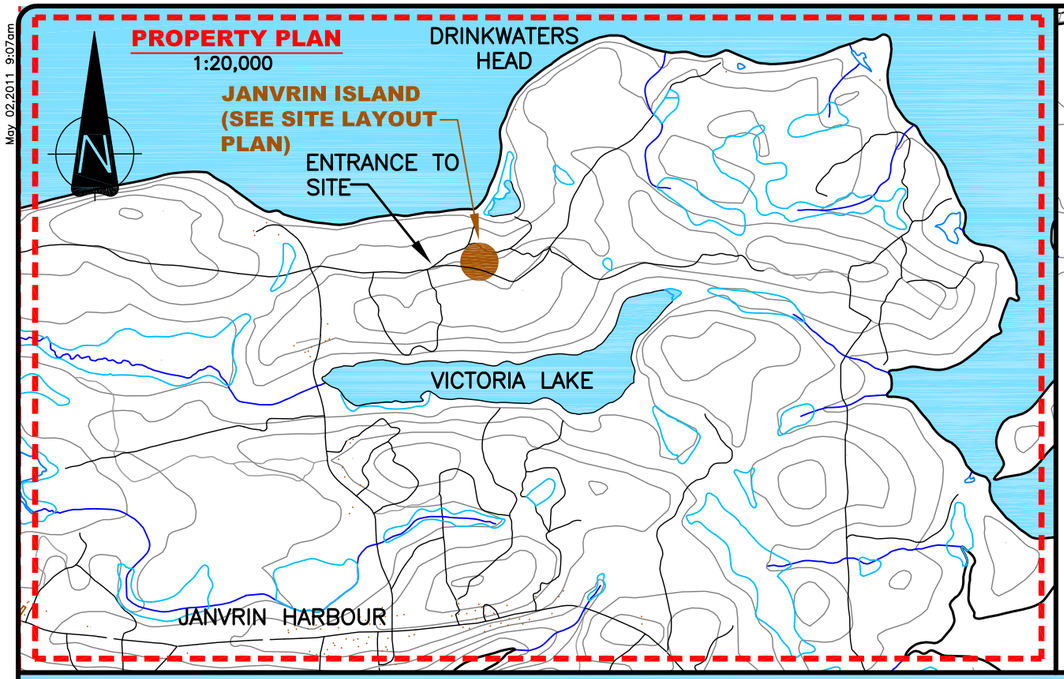

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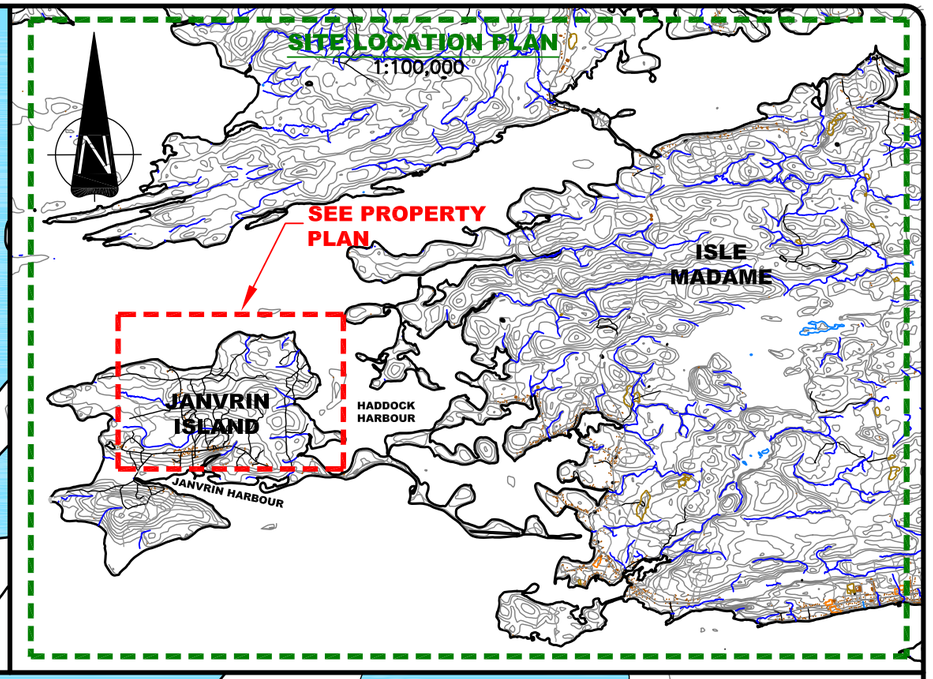
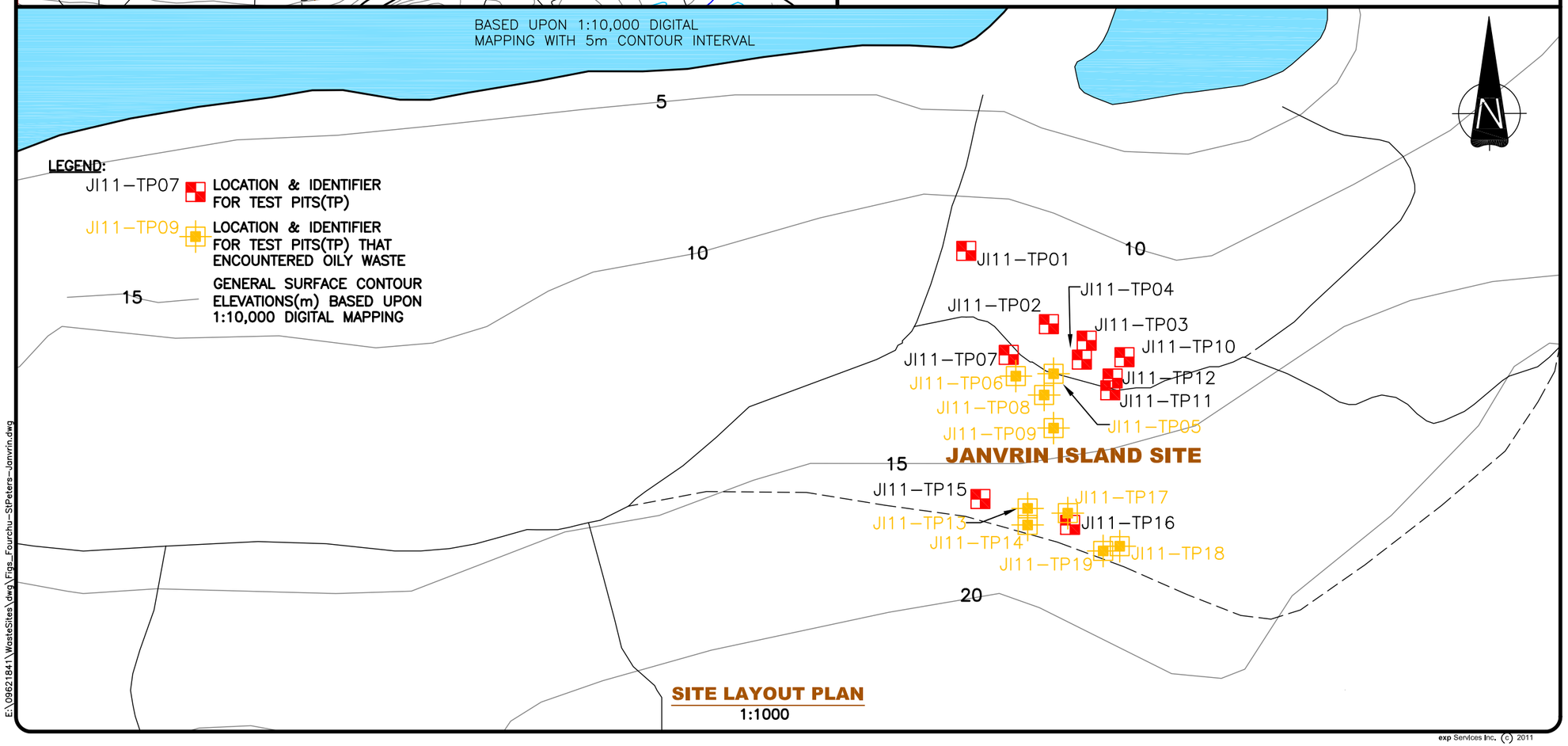


BASED UPON 1:10,000 DIGITAL MAPPING WITH 5m CONTOUR INTERVAL

LEGEND:

- JI11–TP07 — LOCATION & IDENTIFIER FOR TEST PITS(TP)
- JI11–TP09 — LOCATION & IDENTIFIER FOR TEST PITS(TP) THAT ENCOUNTERED OILY WASTE
- GENERAL SURFACE CONTOUR ELEVATIONS(m) BASED UPON 1:10,000 DIGITAL MAPPING



SITE LAYOUT PLAN
1:1000

No.	Issue	Date
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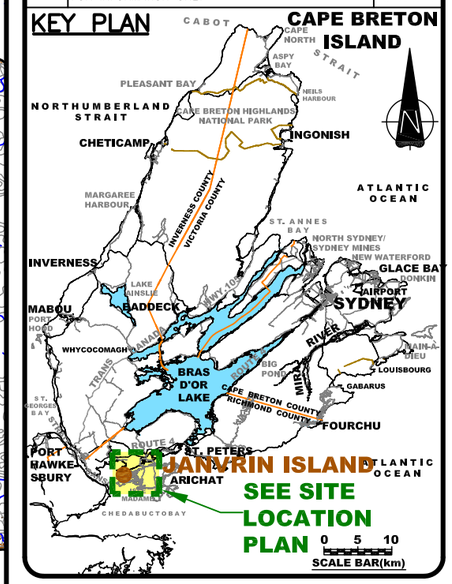
KEY PLAN



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Dwg. Title

JANVRIN ISLAND ARROW OILY WASTE DISPOSAL SITE

Project No.	SYD–00020400–A0	
Dwg. No.	FIGURE 7–1	Rev. No. 0
Scale	AS SHOWN This drawing is not to be scaled	

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The site access road was not gated. Forestry operations had not damaged the main portion of the site, but had cut into the southern corner. There was no indication of damage by off-road and/or recreational vehicles over the main part of the site. No other wastes had been dumped on-site.

The site was growing over with shrubs and trees, primarily spruce. The growth of the latter to heights of 2 to 4 metres was of concern, due to potential damage to the viability of whatever cover cap had been employed (Plates 7-1 and 7-2).

Plate 7-2: Tree growth over the disposal area to right of vehicles during site reconnaissance.

There were no visual or olfactory signs of hydrocarbon release at surface. No zones of dead vegetation were in evidence.

7.4 Intrusive Program

For this assignment a total of 19 test pits were excavated in a grid pattern over and around the site to determine: a) the areal and vertical extent, as well as method of disposal; b) nature of wastes; and c) groundwater level within the wastes. No monitoring wells were emplaced; soil samples were collected specifically of visually contaminated materials.

7.4.1 Site Design and Operations

Very little is known concerning disposal operations. Information reported by Baechler et al (1976) indicated the site was operational during cleanup of the beaches associated with the Arrow oil spill;

most probably between February and March 1970. The type of wastes were expected to include Bunker "C" oil associated with sand and gravel from beaches, as well as peat moss used as an absorbent. No data is available on quantity of wastes disposed of; the best estimate is "couple of tons of oil".

The site was apparently prepared by excavation of a depression to an unknown depth. A small berm was constructed across a seepage line draining northward along the western edge of the site, utilized to impound water and prevent transport of hydrocarbons off-site. Oily wastes were not placed into polyethylene bags prior to disposal, but excavated in bulk off the beaches and dumped in a loose state within the excavation. After disposal the site was covered with an unknown depth of re-worked till excavated from an area immediately east of the site.

The test pit program noted:

1. Oily wastes were present in test pits 05, 06, 08, 09, 13, 14, 17, 18 and 19 (Figure 7-1).

2. When present, hydrocarbons took the form of discrete layers (Plate 7-3) containing oil, sand and gravel in certain areas of the test pits (rarely throughout the excavation), staining on clasts, hydrocarbon odour and/or tar.

3. Test pits with oily wastes terminated on bedrock, suggesting the site was prepared for disposal by excavating down to rock.

4. When present, oily wastes were 0.25 to 0.75 metres below ground surface, suggesting a thin variable cover of loose fill (reworked till) was placed over the wastes.

Plate 7-3: Lense of oily waste in Test Pit 6.

The approximate aerial extent of the disposal area, as outlined in Figure 7-1 is 4600 m^2. Using a depth range for disposed material of 1 to 2 metres gives a preliminary volume estimate of 4600 to 9200 m^3.

7.5 Hydrological Setting

7.5.1 Hydrological Region/District

The site is positioned within the Lowland Hydrological Region, Windsor Lowland District of Cape Breton (Baechler et al, 2009).

Distinctive features generally include a low relief, gently undulating, bedrock controlled topography, underlain by fine grained sedimentary bedrock, comprising predominately siltstones, shales and evaporite sequences. The surface is blanketed by thin to thick continuous, generally clayey, silt glacial till. It is influenced by a coastline of submergence which has dissected the Region with deeply indented salt water embayments.

A three-dimensional conceptual block model of this District (Figure 7-2) notes the active groundwater flow field is expected to be governed by the hydrostructural fracture domain created in the Windsor-Mabou HU. This unit is semi-confined by the Till HU. Ground surface water interaction is expected to be controlled predominately by the shallow groundwater quick-flow-system operating in the soil and upper weathered portion of the Till HU, usually within 1 to 2 metres of ground surface.

Hydrologically the site is positioned within provincial drainage basin SD2, with no locally identified name. It drains northward discharging into the Atlantic Ocean within an unnamed cove west of Drinkwaters Head (Figure 7-1).

7.6 Hydrogeology

The test pit program and recent bedrock geological mapping (Giles et al, 2010) provided some confirmation for the hydrological setting described above.

Mapping noted the site is underlain geologically by the Mabou Group Pomquet Formation, encompassed by Baechler et al (in progress) within the Windsor Mabou HU. It is positioned in a zone of intense structure with bedding exposed along the shoreline striking northeast-southwest and overturned, dipping at 65 to 75 degrees to the southeast. Test pitting indicated a reddish brown sandy silt basal Till HU, 1 to 2 metres thick.

Generally no groundwater in flow was encountered in the test pits. However, slight seepage was noted at test pits 07, 11, 13, 15, 16 and 17; usually in the 1 to 1.5 metres depth range. Excavations were not allowed to remain open to determine static level. Therefore, it is expected that at least some of the oily wastes are buried below the water table.

7.6.1 Hydrology

No defined ephemeral or perennial stream channels were present on-site. No rills or gullies were developed over the former operations area. One broad, natural, heavily vegetated swale was present along the western boundary of the site.

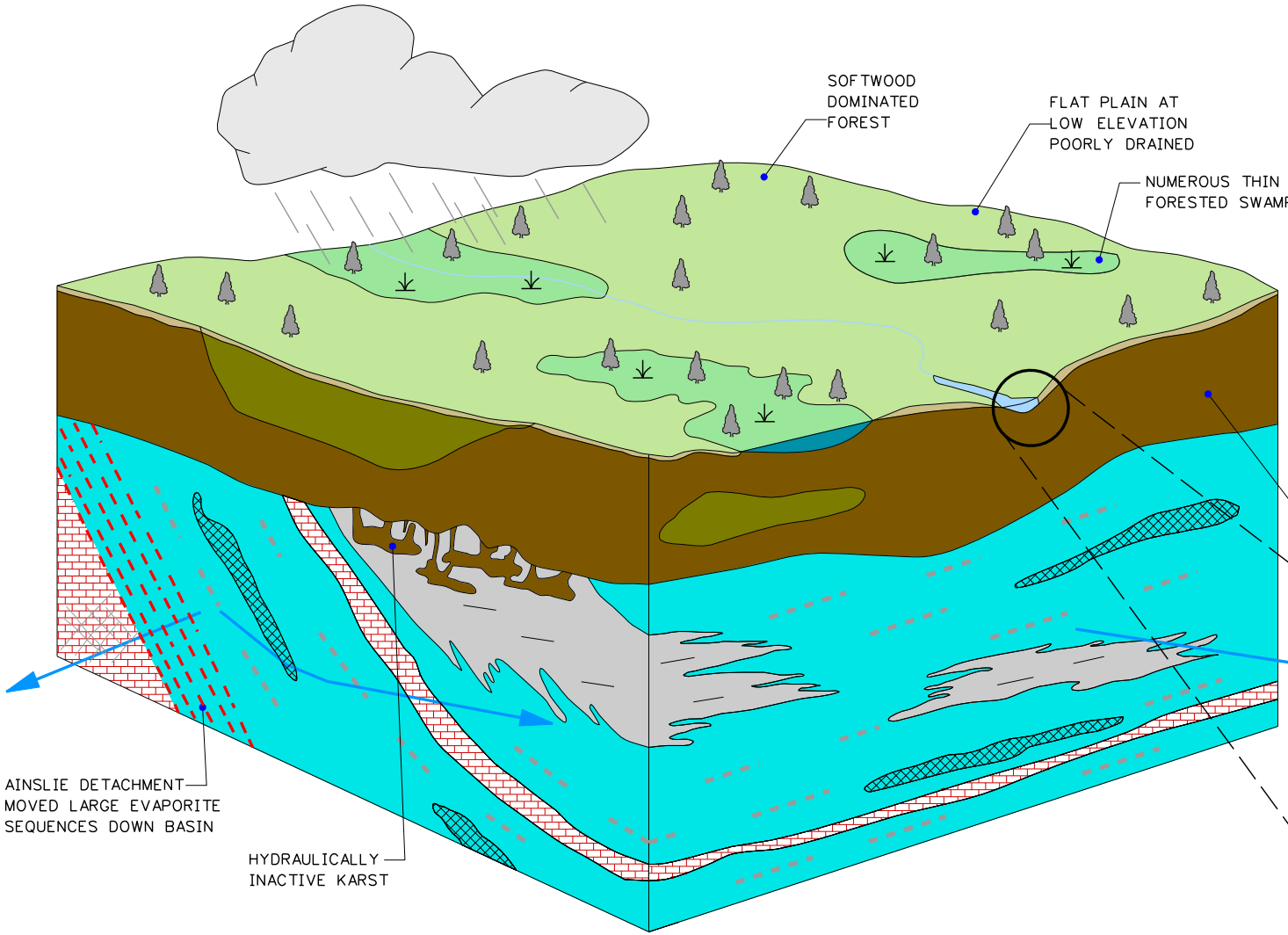
7.7 Soil Geochemistry

7.7.1 Geochemistry

Five soil samples were collected of visually contaminated soils within the disposal area; one each from test pits 05, 06, 09, 13 and 17. Each sample was analyzed for TPH/BTEX, as well as a suite of 32 metals and 19 PAH compounds. Two samples were further analyzed for 35 volatile organics. The results are provided in Appendix C.

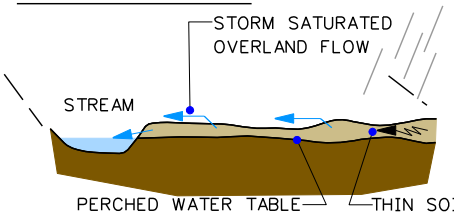
Analysis of the data indicated:

1. Modified TPH was detected in all five samples (Table C-1), ranging from 730 to 11,000 mg/Kg. Each sample indicated the same breakdown, as expected given the Bunker “C” nature of the oil. The >C21-<C32 forming the largest concentration (550 to 5,700 mg/Kg), followed by >C16-C21



AVERAGE k (cm/sec)	HYDROSTRATIGRAPHIC UNITS
10^{-3}	SOIL HU
$10^{-2}/10^{-6}$	ORGANIC HU
10^{-8}	LACUSTRINE HU
10^{-6}	CLAYEY SILT TILL HU
	WINDSOR MABOU HU
10^{-4}	ARGILLACEOUS
10^{-4}	LIMESTONE
10^{-5}	EVAPORITE
$>10^{-1}$ to $<10^{-5}$	STRUCTURAL HU

SHALLOW FLOW SYSTEM



CONCEPTUAL MODEL OF FLOW SYSTEMS

- SHALLOW FLOW FIELD & INTERACTION WITH SURFACE WATERS - SEE INSETS
- DEEPER 1st ORDER FLOW FIELDS

ROCK FRACTURING

- BEDDING PLANE
- INTERCONNECTED
- LENSES OF DISCRETE COMPETENT FRACTURED BEDS
- INACTIVE KARST

N.T.S.

This drawing is not to be scaled

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(Baechler et al, in Progress)

Dwg.
LOWLAND REGION
WINDSOR LOWLAND DISTRICT
CONCEPTUAL HYDROLOGIC MODEL

Drawn By: NB	Proj. No. SYD-00020400-A0	
Dwg Standards Chk. By:	Dwg. No. **FIGURE 7-2**	
Designed By: FB	Date Last Modified: 28-APR-11	
Dwg. Design Chk. By: FB	Last Modified By: NB	Rev. 0

(160 to 4,200 mg/Kg), then >C10-C16 (20 to 1,500 mg/Kg), with the lowest concentrations in the C6-C10 (less BTEX) ranging from <3 to 81 mg/Kg.

2. Lighter BTEX components were detectable in TP06 and TP09 with benzene (0.004 mg/Kg), ethylbenzene (0.58 to 0.25 mg/Kg) and xylene (total) (1.1 to 1.5 mg/Kg), respectively.

3. The PAH analysis (Tables C-2, C-3 and C-4) noted essentially non-detectable compounds except in TP06 and 09. In these two samples nearly all compounds were detectable. The two indicators of naphthalene and benzo(a)pyrene noted ranges of 1.9 mg/Kg and 0.3 to 0.5 mg/Kg, respectively. The highest concentrations were present in 1-methylnaphthalene (7.3 to 9.2 mg/Kg), 2-methylnaphthalene (8.3 to 12 mg/Kg) and phenanthrene (6.1 to 8.3 mg/Kg).

4. No VOC compounds (Table C-5) were detectable in the two samples tested, except for the BTEX components identified above.

5. The highest concentrations of select metals were consistently found with iron (14,000 to 25,000 mg/Kg), aluminium (4800 to 7800 mg/Kg) and manganese (390 to 1000 mg/Kg).

7.7.2 Quality

There were no soil values elevated above guidelines for hydrocarbons, metals and PAHs.

7.8 Conclusions and Recommendations

The field program for this assignment has confirmed the absence of any disposal methodology, as would be appropriate by today's standards. The disposal zone covers approximately 0.46 hectares. It is placed near or within the water table, with no under till liner, minimal surface cover, no mounded cover cap and is overgrown with trees.

While organic contaminants were visually noted scattered in discrete zones throughout the disposal area, lab analyses of product layers did not exceed applicable guidelines. There is no visual evidence on surface for release of hydrocarbons off-site.

8 List of References

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Brisco, C., C. Moir, and S. Thorne, 1977, Oily Waste Disposal Sites, Nova Scotia, Nova Scotia Department of the Environment, internal report, 12 pages

Giles, P.S., R.D. Naylor, P.J. Teniere, C.E. White, S.M. Barr, G. DeMont, and E.R. Force, 2010: Bedrock Geology Map of the Port Hawkesbury Area, part of NTDS sheets 11F/06, 11F/07, 11F/10, 11F/11 and 11F/15, Inverness, Richmond, Guysborough and Antigonish counties, Nova Scotia; Nova Scotia Department of Natural Resources, Mineral Resources Branch, open File Map ME 2010-6, scale 1:50,000

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Appendix A
Fourchu

Table A-1: Hydrocarbons in Soils
Fourchu Kurdistan Oily Waste Disposal Site

Maxxam ID	Units	RBCA Commercial Guideline**	GQ1840	GQ1841	GQ1842	GQ1843	GQ1844
Sampling Date			26-Jul-10	27-Jul-10	27-Jul-10	27-Jul-10	27-Jul-10
COC Number			B 130829	B 130829	B 130829	B 130829	B 130829
Sample ID			F10-MW01-4	F10-MW04-2	F10-MW04-4	F10-MW03-3	F10-MW02-2
TPH COMPOUNDS							
Benzene	mg/kg	**570**	<0.003	<0.003	<0.003	<0.003	<0.003
Toluene	mg/kg	**18000**	<0.03	<0.03	<0.03	<0.03	<0.03
Ethylbenzene	mg/kg	**10000**	<0.01	<0.01	<0.01	<0.01	<0.01
Xylene (Total)	mg/kg	**180000**	<0.05	<0.05	<0.05	<0.05	<0.05
C6 - C10 (less BTEX)	mg/kg	**13000**	<3	<3	<3	<3	<3
>C10-C21 Hydrocarbons	mg/kg	**7700**	<15	<15	<15	<15	<15
>C21-<C32 Hydrocarbons	mg/kg	**12000**	<15	<15	<15	<15	<15
Modified TPH (Tier1)	mg/kg	***	<20	<20	<20	<20	<20
Product Identifiecation	na	-	na	na	na	na	na

Notes:

RDL = Reportable Detection Limit, NG = No guideline

** Atlantic RBCA Version 2.0, Table 8 For Coarse-grained soils on **Commercial** receptor sites with non-potable water use, Soil Ingestion (2003 update).

(1) Fuel oil / lube oil range.

(2) Fuel oil fraction

(3) Lube oil fraciton. TEH surrogate not within acceptable limits due to sample matrix.

(4) Lube oil fraction

(5) Fuel Oil Fraction and Lube Oil Fraction

*** As per laboratory identified fraction and/or Atlantic RBCA Version 2.0 Table 5, Modified TPH concentration must be compared with appropriate fraction. Shading indicates exceedance of Residential guideline.

TABLE A-2: Metals in Soil
Fourchu Kurdistan Oily Waste Disposal Site

Maxxam ID	Units	CCME CEQG Industrial Guideline*	GS6087	GS6088	GS6089	GS6090	GS6091
Sampling Date			26/07/2010	27/07/2010	27/07/2010	27/07/2010	27/07/2010
COC Number			B 130829	B 130829	B 130829	B 130829	B 130829
			F10-MW01-4	F10-MW04-2	F10-MW04-4	F10-MW03-3	F10-MW02-2
Elements (ICP-MS)							
Aluminum (Al)	mg/kg	-	9800	10000	9900	9300	11000
Antimony (Sb)	mg/kg	**40**	<1	<1	<1	<1	<1
Arsenic (As)	mg/kg	**12**	3	4	4	5	3
Barium (Ba)	mg/kg	**2000**	120	190	160	120	130
Beryllium (Be)	mg/kg	**8**	<1	<1	<1	<1	<1
Boron (B)	mg/kg	-	<7	<7	<7	<7	<7
Cadmium (Cd)	mg/kg	**22**	0.2	<0.2	0.2	0.3	0.3
Calcium (Ca)	mg/kg	-	14000	22000	20000	3600	11000
Chromium (Cr)	mg/kg	**87**	19	21	42	19	19
Cobalt (Co)	mg/kg	**300**	10	12	11	11	11
Copper (Cu)	mg/kg	**91**	26	31	42	28	31
Iron (Fe)	mg/kg	-	23000	25000	30000	22000	24000
Lead (Pb)	mg/kg	**600**	11	17	13	12	11
Lithium (Li)	mg/kg	-	18	21	18	15	17
Magnesium (Mg)	mg/kg	-	7600	8100	7900	5900	7600
Manganese (Mn)	mg/kg	-	610	630	700	460	650
Mercury (Hg)	mg/kg	**50**	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum (Mo)	mg/kg	**40**	<1	<1	3	7	<1
Nickel (Ni)	mg/kg	**50**	17	21	26	17	17
Phosphorus (P)	mg/kg	-	420	490	430	420	470
Potassium (K)	mg/kg	-	720	900	1000	490	690
Selenium (Se)	mg/kg	**2.9**	1.1	0.7	1	1.4	1.1
Silver (Ag)	mg/kg	**40**	<1	<1	<1	<1	<1
Sodium (Na)	mg/kg	-	<400	<400	<400	<400	<400
Strontium (Sr)	mg/kg	-	30	48	81	22	30
Sulphur (S)	mg/kg	-					
Thallium (Tl)	mg/kg	**1**	<0.7	<0.7	<0.7	<0.7	<0.7
Tin (Sn)	mg/kg	**300**	<10	<10	<10	<10	<10
Titanium (Ti)	mg/kg	-	330	220	220	250	390
Uranium (U)	mg/kg	**300**	<1	<1	<1	3	<1
Vanadium (V)	mg/kg	**130**	27	30	29	28	32
Zinc (Zn)	mg/kg	**360**	71	88	78	72	74

Notes:

***** CCME Canadian Environmental Quality Guidelines for **Industrial** site land use (September 2007 update)

RDL = Reportable Detection Limit

Exceeds Industrial

Table A-3: PAHs in Soil
Fourchu Kurdistan Oily Waste Disposal Site

Maxxam ID	Units	CCME CEQG Industrial Guideline*	GS6087	GS6088	GS6089	GS6090	GS6091
Sampling Date			26-Jul-10	27-Jul-10	27-Jul-10	27-Jul-10	27-Jul-10
COC Number			B 130829	B 130829	B 130829	B 130829	B 130829
			F10-MW01-4	F10-MW04-2	F10-MW04-4	F10-MW03-3	F10-MW02-2
PAHs							
1-Methylnaphthalene	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01
2-Methylnaphthalene	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01
Anthracene	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)anthracene	mg/kg	**10**	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)pyrene	mg/kg	**0.7**	<0.01	<0.01	<0.01	0.12	<0.01
Benzo(b)fluoranthene	mg/kg	**10**	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	mg/kg	**10**	<0.01	<0.01	<0.01	<0.01	<0.01
Chrysene	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01
Dibenzo(a,h)anthracene	mg/kg	**10**	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01
Fluorene	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	mg/kg	**10**	<0.01	<0.01	<0.01	<0.01	<0.01
Naphthalene	mg/kg	**22**	<0.01	<0.01	<0.01	0.04	0.02
Perylene	mg/kg	-	0.02	<0.01	0.04	0.11	<0.01
Phenanthrene	mg/kg	**50**	<0.01	<0.01	<0.01	<0.01	<0.01
Pyrene	mg/kg	**100**	<0.01	<0.01	<0.01	<0.01	<0.01

Notes:

* CCME Canadian Environmental Quality Guidelines for **Industrial** site land use (September 2006 update)

RDL = Reportable Detection Limit

Exceeds Industrial

Table A-4: PAHs in Soil
Fourchu Kurdistan Oily Waste Disposal Site

Maxxam ID	Units	CCME Direct Contact	CCME PEFs	GS6087	Sample TPE	GS6088	Sample TPE	GS6089	Sample TPE	GS6090	Sample TPE	GS6091	Sample TPE
Sampling Date				26-Jul-10		27-Jul-10		27-Jul-10		27-Jul-10		27-Jul-10	
COC Number				B 130829		B 130829		B 130829		B 130829		B 130829	
				F10-MW01-4		F10-MW04-2		F10-MW04-4		F10-MW03-3		F10-MW02-2	
PAHs													
1-Methylnaphthalene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
2-Methylnaphthalene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Acenaphthene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Acenaphthylene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Anthracene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Benzo(a)anthracene	mg/kg	NV	0.1	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005
Benzo(a)pyrene	mg/kg	NV	1	0.005	0.005	0.005	0.005	0.005	0.005	0.12	0.12	0.005	0.005
Benzo(b)fluoranthene	mg/kg	NV	0.1	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005
Benzo(g,h,i)perylene	mg/kg	NV	0.01	0.005	0.00005	0.005	0.00005	0.005	0.00005	0.005	0.00005	0.005	0.00005
Benzo(k)fluoranthene	mg/kg	NV	0.1	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005
Chrysene	mg/kg	NV	0.01	0.005	0.00005	0.005	0.00005	0.005	0.00005	0.005	0.00005	0.005	0.00005
Dibenzo(a,h)anthracene	mg/kg	NV	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Fluoranthene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Fluorene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Indeno(1,2,3-cd)pyrene	mg/kg	NV	0.1	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005
Naphthalene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.04	-	0.02	-
Perylene	mg/kg	NV	-	0.02	-	0.005	-	0.04	-	0.11	-	0.005	-
Phenanthrene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Pyrene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
B (a) P TPE	mg/Kg	5.3	-	-	0.0121	-	0.0121	-	0.0121	-	0.1271	-	0.0121
Uncertainty Factor	mg/Kg	3	-	-	0.0363	-	0.0363	-	0.0363	-	0.3813	-	0.0363

Notes:
* CCME Canadian Environmental Quality Guidelines for the Protection of Envrionmental and Human Health (2010)

NV - No Value

PEF - Potency Equivalence Factor
Total Potency Equivalent -

Screening:
Bold - Indicates an exceedance of CCME guidelines
Red indicates value was below the reportable detection limit and half the RDL was used for the calculation.

References:

Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Soil Quality Guidelines (CEQG), Last Accessed October 2008 - Commercial land use, coarse textured soil

TableA-5: PAHs in Soil
Fourchu Kurdistan Oily Waste Disposal Site

Maxxam ID	Units	CCME Direct Contact	CCME PEFs	GS6087	Sample TPE	GS6088	Sample TPE	GS6089	Sample TPE	GS6090	Sample TPE	GS6091	Sample TPE
Sampling Date				26-Jul-10		27-Jul-10		27-Jul-10		27-Jul-10		27-Jul-10	
COC Number				B 130829		B 130829		B 130829		B 130829		B 130829	
				F10-MW01-4		F10-MW04-2		F10-MW04-4		F10-MW03-3		F10-MW02-2	
PAHs													
1-Methylnaphthalene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
2-Methylnaphthalene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Acenaphthene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Acenaphthylene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Anthracene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Benzo(a)anthracene	mg/kg	NV	0.33	0.005	0.00165	0.005	0.00165	0.005	0.00165	0.005	0.00165	0.005	0.00165
Benzo(a)pyrene	mg/kg	NV	0.37	0.005	0.00185	0.005	0.00185	0.005	0.00185	0.12	0.0444	0.005	0.00185
Benzo(b)fluoranthene	mg/kg	NV	0.16	0.005	0.0008	0.005	0.0008	0.005	0.0008	0.005	0.0008	0.005	0.0008
Benzo(g,h,i)perylene	mg/kg	NV	6.8	0.005	0.034	0.005	0.034	0.005	0.034	0.005	0.034	0.005	0.034
Benzo(k)fluoranthene	mg/kg	NV	0.16	0.005	0.0008	0.005	0.0008	0.005	0.0008	0.005	0.0008	0.005	0.0008
Chrysene	mg/kg	NV	2.1	0.005	0.0105	0.005	0.0105	0.005	0.0105	0.005	0.0105	0.005	0.0105
Dibenzo(a,h)anthracene	mg/kg	NV	0.23	0.005	0.00115	0.005	0.00115	0.005	0.00115	0.005	0.00115	0.005	0.00115
Fluoranthene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Fluorene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Indeno(1,2,3-cd)pyrene	mg/kg	NV	2.7	0.005	0.0135	0.005	0.0135	0.005	0.0135	0.005	0.0135	0.005	0.0135
Naphthalene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.04	-	0.02	-
Perylene	mg/kg	NV	-	0.02	-	0.005	-	0.04	-	0.11	-	0.005	-
Phenanthrene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Pyrene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
SQG PW IACR	mg/Kg	1	-	-	0.06425	-	0.06425	-	0.06425	-	0.1068	-	0.06425

Notes:

Notes:

All values expressed in µg/g unless otherwise indicated

NV - No Value

SQG_{PW} - Soil Quality Guideline for Protection of Potable Water

IACR - Index of Additive Cancer Risk

SQG_{PW} IACR - Index of Additive Cancer Risk for Protection of Potable Water - Calculated by dividing the concentration of each PAH in the sample by its SQG_{PW} and summing the results

Screening:

Bold - Indicates an exceedance of CCME guidelines

Red indicates value was below the reportable detection limit and half the RDL was used for the calculation.

References:

Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Soil Quality Guidelines (CEQG), Last Accessed October 2008 - Commercial land use, coarse textured soil

Table A-6: Inorganics and metals in Water
Fourchu Kurdistan Oily Waste Disposal Site

				Duplicate													Surface Water		Surface Water	
Maxxam ID	Units	NS EQS: Groundwater	GZ5737	GZ5730	GZ5738	GZ5739	GZ5740	GZ5741	GZ5742	IC9905	IC9909	IC9906	IC9907	IC9908	IC9910	NS EQS: Surface Water	GZ5743	GZ5744	IC9898	IC9904
Sampling Date			30/08/2010	30/08/2010	30/08/2010	30/08/2010	30/08/2010	30/08/2010	30/08/2010	10/12/2010	10/12/2010	10/12/2010	10/12/2010	10/12/2010	10/12/2010		30/08/2010	30/08/2010	10/12/2010	10/12/2010
COC Number			B124741	B124741	B124741	B124741	B124741	B124741	B124741	B124764	B124764	B124764	B124764	B124764	B124764		B124741	B124741	B124764	B124764
			F10-MW01	F10-MW00	F10-MW02	F10-MW03	F10-MW04	F10-TR01	F10-TR03	F10-MW01	F10-MW00	F10-MW02	F10-MW03	F10-MW04	TRENCH#3		F10-SW01	F10-SW02	F10-SW01	F10-SW02
RCAP CALCULATIONS																				
Anion Sum	me/L	-	4.04	4.06	5.95	6.72	5.17	7.64	19.1	4.39	4.38	5.97	8.15	4.37	18.8	-	0.29	1.64	0.460	1.76
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	-	140	140	274	257	139	294	740	140	138	265	333	146	751	-	<1	57	<1	56
Calculated TDS	mg/L	**500**	223	227	325	407	301	427	988	234	235	359	450	242	1030	-	30	90	32	101
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	2	2	<1	<1	2	<1	<1	2	2	<1	<1	2	<1	-	<1	<1	<1	<1
Cation Sum	me/L	-	4.23	4.44	6.35	8.07	5.25	8.25	18.20	4.21	4.28	7.65	8.55	4.20	20.3	-	0.76	1.66	0.620	1.92
Hardness (CaCO3)	mg/L	-	170	180	250	280	160	310	620	170	170	290	320	130	660	-	13	62	12	60
Ion Balance (% Difference)	%	-	2.3	4.47	3.25	9.130	0.770	3.840	2.550	2.09	1.15	12.3	2.40	1.98	3.88	-	44.800	0.610	14.8	4.35
Langelier Index (@ 20C)	N/A	-	0.606	0.728	0.428	-0.215	0.531	-0.062	0.28	0.707	0.700	0.452	0.152	0.589	0.595	-	NC	-1.09	NC	-1.43
Langelier Index (@ 4C)	N/A	-	0.356	0.478	0.179	-0.464	0.282	-0.31	0.034	0.457	0.451	0.203	-0.0960	0.340	0.350	-	NC	-1.34	NC	-1.68
Saturation pH (@ 20C)	N/A	-	7.49	7.47	7.07	7.12	7.57	6.96	6.42	7.49	7.50	7.05	6.95	7.61	6.41	-	NC	8.29	NC	8.33
Saturation pH (@ 4C)	N/A	-	7.74	7.72	7.32	7.36	7.82	7.21	6.67	7.74	7.75	7.30	7.20	7.86	6.65	-	NC	8.54	NC	8.58
Inorganics																				
Alkalinity (Total as CaCO3)	mg/L	-	140	140	270	260	140	290	740	140	140	270	330	150	750	-	<5	57	<5	56
Chloride (Cl)	mg/L	**250**	39	40	16	56	34	61	150	52	54	23	53	22	130	-	10	17	16	22
Colour	TCU	**15**	<5	<5	62	330	6	>500	>500	<5	<5	280	31	<5	30	**Narrative**	>500	110	150	160
Nitrate (N)	mg/L	**45**	<0.05	<0.05	<0.05	<0.05	<0.05	0.35	0.06	<0.06	<0.06	<0.06	<0.06	0.20	<0.06	**13**	0.08	0.12	<0.06	<0.06
Nitrite + Nitrate	mg/L	**0**	<0.05	<0.05	<0.05	<0.05	<0.05	0.41	0.06	<0.6 (1)	<0.6 (1)	<0.06	<1 (1)	<0.06	<3 (1)	-	0.08	0.12	<0.06	<0.06
Nitrite (N)	mg/L	**0.6**	<0.01	<0.01	<0.01	<0.01	0.01	0.05	<0.01	<0.6	<0.6	<0.06	<1	0.20	<3	**0.06**	<0.01	<0.01	<0.06	<0.06
Nitrogen (Ammonia Nitrogen)	mg/L	**0.19**	0.33	0.34	0.05	1.9	0.15	0.53	3.8	0.40	0.40	0.18	1.2	0.24	4.1	-	<0.05	0.14	<0.05	0.24
Total Organic Carbon (C)	mg/L	-	1.6	1.6	130	32	5.5	100	55	2.7	2.5	72	28	5.1	54	-	40	18	18	17
Orthophosphate (P)	mg/L	-	0.07	0.08	<0.01	<0.01	<0.01	0.02	<0.01	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	-	0.01	<0.01	<0.3	<0.3
pH	pH	**0**	8.1	8.2	7.5	6.90	8.10	6.90	6.70	8.20	8.20	7.50	7.10	8.20	7.00	**6.5 to 9.0**	5.70	7.20	5.60	6.90
Silica (SiO2)	mg/L	-	10	9.9	14	15	4.9	5.8	11	9.3	9.6	17	15	5.0	15	-	2.4	3	2.7	2.4
Sulphate (SO4)	mg/L	**500**	5	5	<2	<2	68	<2	<2	3	3	<4	<2	37	<20	**100**	<2	<2	<2	<2
Turbidity	NTU	-	510	460	>1000	>1000	360	140	460	>1000	>1000	>1000	>1000	>1000	550	-	18	9.9	1.9	59
Conductivity	uS/cm	-	400	400	570	650	510	730	1700	420	430	550	750	430	1700	-	56	170	69	180
Elements (ICP-MS)																				
Dissolved Aluminum (Al)	mg/L	**0.05**	0.019	0.015	0.13	0.11	0.029	0.13	0.04	0.023	0.032	0.68	0.13	0.031	0.062	**0.005**	0.88	0.11	0.37	0.17
Dissolved Antimony (Sb)	mg/L	**0.006**	<0.0004	<0.0004	0.0011	0.00063	0.0008	<0.0004	<0.0004	0.0005	<0.00040	<0.00040	<0.00040	0.00082	0.0011	**0.02**	<0.0004	<0.0004	0.0024	0.00082
Dissolved Arsenic (As)	mg/L	**0.01**	0.0096	0.0097	0.0093	0.011	<0.0003	0.0014	0.0056	0.0069	0.0069	0.0097	0.0065	0.0051	0.0094	**0.005**	0.00075	<0.0006	<0.00060	<0.00060
Dissolved Barium (Ba)	mg/L	**1**	0.16	0.16	0.27	0.5	0.085	0.12	0.3	0.18	0.18	0.3	0.42	0.1	0.38	**1**	0.01	0.013	0.0062	0.017
Dissolved Beryllium (Be)	mg/L	**0.004**	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**0.0053**	<0.0005	<0.0005	<0.00050	<0.00050
Dissolved Bismuth (Bi)	mg/L	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-	<0.002	<0.002	<0.002	<0.002
Dissolved Boron (B)	mg/L	**5**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.14	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.24	**1.2**	<0.1	<0.1	<0.1	<0.1
Dissolved Cadmium (Cd)	mg/L	**0.0001**	<0.000017	0.0001	<0.000017	0.00005	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	0.000046	<0.000017	0.000032	**0.00001**	0.000034	0.000023	0.000023	<0.000017
Dissolved Chromium (Cr)	mg/L	**0.05**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.0013	-	<0.001	<0.001	<0.001	< 0.001
Dissolved Cobalt (Co)	mg/L	**0.003**	<0.001	<0.001	0.0022	0.016	<0.001	<0.001	<0.001	< 0.001	< 0.001	0.0019	0.0092	< 0.001	< 0.001	**0.004**	0.0033	0.0013	< 0.001	0.0031
Dissolved Lead (Pb)	mg/L	**0.01**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**0.001**	0.0014	<0.001	< 0.001	< 0.001
Dissolved Lithium (Li)	mg/L	-	<0.001	<0.001	0.0039	0.0016	0.0041	<0.001	0.0061	< 0.001	< 0.001	0.0032	< 0.001	0.0029	0.0094	-	<0.001	<0.001	< 0.001	< 0.001
Total Mercury (Hg)	mg/L	**0.00026**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**0.000026**	NA	NA	NA	NA
Dissolved Molybdenum (Mo)	mg/L	**0.07**	0.016	0.015	0.01	0.006	0.028	<0.004	<0.004	0.014	0.014	0.0064	<0.004	0.051	<4.0	**0.073**	<0.004	<0.004	< 0.004	< 0.004
Dissolved Nickel (Ni)	mg/L	**0.1**	<0.003	<0.003	0.0039	0.0079	<0.003	<0.003	<0.003	< 0.003	< 0.003	0.0033	< 0.003	< 0.003	< 0.003	**0.025**	<0.003	<0.003	< 0.003	< 0.003
Dissolved Phosphorus (P)	mg/L	-	0.11	0.11	<0.1	<0.1	<0.1	<0.1	0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.5	-	<0.1	<0.1	< 0.1	< 0.1
Dissolved Selenium (Se)	mg/L	**0.01**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**0.001**	<0.001	<0.001	< 0.001	< 0.001
Dissolved Silver (Ag)	mg/L	**0.001**	<0.0001	<0.0001	0.00018	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**0.0001**	<0.0001	<0.0001	<0.00010	<0.00010
Dissolved Strontium (Sr)	mg/L	**4.4**	2	1.9	0.76	0.55	2.4	0.19	0.86	2.4	2.5	0.89	0.7	2.6	1.1	**21**	0.017	0.049	0.014	0.047
Dissolved Sulphur (S)	mg/L	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA	NA	NA
Dissolved Thallium (Tl)	mg/L	**0.002**	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.00080	<0.00080	<0.00080	<0.00080	<0.00080	<0.00080	**0.0008**	<0.0008	<0.0008	<0.00080	<0.00080
Dissolved Tin (Sn)	mg/L	**4.4**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02
Dissolved Titanium (Ti)	mg/L	-	<0.003	<0.003	0.0047	0.0036	<0.003	0.0056	<0.003	<0.003	<0.003	0.033	<0.003	<0.003	0.0036	-	0.015	0.0038	0.0038	0.0038
Dissolved Uranium (U)	mg/L	**0.02**	0.00089	0.0009	0.00099	0.0011	0.0023	<0.00015	<0.00015	0.00037	0.00041	0.00054	0.0003	0.0011	<0.00015	**0.3**	<0.00015	<0.00015	<0.00015	<0.00015
Dissolved Vanadium (V)	mg/L	**0.0062**	<0.002	<0.002	<0.002	0.0031	<0.002	0.0055	<0.002	<0.002	<0.002	0.0041	0.0033	<0.002	0.0041	**0.006**	0.0039	<0.002	<0.002	<0.002
Elements (ICP-OES)																				
Dissolved Calcium (Ca)	mg/L	-	57	60	83	85	51	110	180	57	58	92	97	42	190	-	3.3	19	2.7	18
Dissolved Copper (Cu)	mg/L	**0.02**	0.0027	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0053	<0.002	<0.002	<0.002	**0.002**	<0.002	<0.002	0.0021	0.0021
Dissolved Iron (Fe)	mg/L	**0.3**	<0.1	<0.1	3.3	39	<0.1	31	34	< 0.1	< 0.1	15	32	< 0.1	44	**0.3**	6.4	1.1	1.7	9
Dissolved Magnesium (Mg)	mg/L	-	7.3	7.5	11	17	7.2	11	40	6.9	7.2	15	19	6	47	-	1.1	3.3	1.2	3.4
Dissolved Manganese (Mn)	mg/L	**0.05**	0.36	0.35	4.5	17	0.18	11	17	0.45	0.45	6.3	11	0.23	21	**0.82**	0.6	1.8	0.1	2.5
Dissolved Potassium (K)	mg/L	-	2	2.1	3.6	1.9	9.5	2.3	7.2	1.8	1.9	3.6	1.4	5	8.2	-	<0.6	1.1	<0.6	0.92
Dissolved Sodium (Na)	mg/L	**200**	16	17	25	20	43	20	96	16	17	28	20	33	120	-	6.1	7.9	7.2	8.1
Dissolved Zinc (Zn)	mg/L	**0.3**	0.0073	0.0061	0.0066	0.023	0.0067	<0.005	0.0087	0.0064	0.0087	0.0018	0.0093	0.0097	0.0084	**0.03**	0.011	0.011	0.0076	0.0054

Notes:

Guideline 1: Rationale for the Development of Environmental Quality Standards for Contaminated Sites in Nova Scotia Tier 1: Table A-3 Tier 1 Environmental Quality Standards for Surface Water, Fresh Water, January 2011

Guideline 2: Rationale for the Development of Environmental Quality Standards for Contaminated Sites in Nova Scotia Tier 1: Table A-4 Tier 1 Environmental Quality Standards for Groundwater, January 2011

NM = Not measured due to insufficient water; N/A = Not applicable; NA = Not analysed

AO = Aesthetic Objective

Exceeds NS EGS Surface Water
Exceeds NS EQS Groundwater

Table A-7: Hydrocarbons in Groundwater
Fourchu Kurdistan Oily Waste Disposal Site

Maxxam ID	Units	Guideline 1	GZ5737	GZ5738	GZ5739	GZ5740	GZ5741	GZ5742	GZ5743	GZ5744	IC9898	IC9904	IC9905	IC9906	IC9907	IC9908	IC9909	IC9910
Sampling Date			**30/08/2010**	**30/08/2010**	**30/08/2010**	**30/08/2010**	**30/08/2010**	**30/08/2010**	**30/08/2010**	**30/08/2010**	**10/12/2010**	**10/12/2010**	**10/12/2010**	**10/12/2010**	**10/12/2010**	**10/12/2010**	**10/12/2010**	**10/12/2010**
COC Number			**B124741**	**B124741**	**B124741**	**B124741**	**B124741**	**B124741**	**B124741**	**B124741**	**B124764**	**B124764**	**B124764**	**B124764**	**B124764**	**B124764**	**B124764**	**B124764**
ADI Sample ID			**F10-MW01**	**F10-MW02**	**F10-MW03**	**F10-MW04**	**F10-TR01**	**F10-TR03**	**F10-SW01**	**F10-SW02**	**F10-SW01**	**F10-SW02**	**F10-MW01**	**F10-MW02**	**F10-MW03**	**F10-MW04**	**F10-MW00**	**TRENCH#3**
Petroleum Hydrocarbons																		
Benzene	mg/L	**NG**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Toluene	mg/L	**NG**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ethylbenzene	mg/L	**NG**	<0.001	<0.001	<0.001	<0.001	0.033	0.057	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.029
Xylene (Total)	mg/L	**NG**	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.003	<0.002	<0.002	<0.002	<0.002
C6 - C10 (less BTEX)	mg/L	**NG**	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01
>C10-C16 Hydrocarbons	mg/L	**NG**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
>C16-C21 Hydrocarbons	mg/L	**NG**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
>C21-<C32 Hydrocarbons	mg/L	**NG**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Modified TPH (Tier1)	mg/L	***	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Notes:

Guideline 1: Atlantic RBCA Version 2.0, Table 8 For Coarse-grained soils on Commercial receptor sites with Non-potable water use and

NG - No Guideline; ND - Not detected

*** As per laboratory identified fraction and/or Atlantic RBCA Version 2.0 Table 7, Modified TPH concentration must be compared with appropriate fraction.

Exceeds Guideline 1

Table A-8: PAH in Groundwater
Fourchu Kurdistan Oily Waste Disposal Site

Maxxam ID	Units	NS EQS: Groundwater	GZ5739	IC9905	IC9906	IC9907	IC9908	IC9909	IC9910	NS EQS: Surface Water	IC9898	IC9904
Sampling Date			30/08/2010	10/12/2010	10/12/2010	10/12/2010	10/12/2010	10/12/2010	10/12/2010		10/12/2010	10/12/2010
COC Number			B124741	B124764	B124764	B124764	B124764	B124764	B124764		B124764	B124764
ADI Sample ID			F10-MW03	F10-MW01	F10-MW02	F10-MW03	F10-MW04	F10-MW00	TRENCH#3		F10-SW01	F10-SW02
Polycyclic Aromatic Hydrocarbons												
1-Methylnaphthalene	ug/L	**20**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.15	**2**	<0.05	<0.05
2-Methylnaphthalene	ug/L	**20**	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	0.13	**2**	<0.05	<0.05
Acenaphthene	ug/L	**58**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.08	**5.8**	<0.01	<0.01
Acenaphthylene	ug/L	**0.45**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**4.6**	<0.01	<0.01
Anthracene	ug/L	**0.12**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.012**	<0.01	<0.01
Benzo(a)anthracene	ug/L	**0.18**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.018**	<0.01	<0.01
Benzo(a)pyrene	ug/L	**0.15**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.015**	<0.01	<0.01
Benzo(b)fluoranthene	ug/L	**4.8**	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	**0.48**	<0.01	<0.01
Benzo(g,h,i)perylene	ug/L	**1.7**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.17**	<0.01	<0.01
Benzo(k)fluoranthene	ug/L	**4.8**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.48**	<0.01	<0.01
Chrysene	ug/L	**14**	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	**1.4**	<0.01	<0.01
Dibenz(a,h)anthracene	ug/L	**2.6**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.26**	<0.01	<0.01
Fluoranthene	ug/L	**0.4**	<0.01	0.01	0.04	<0.01	<0.01	0.01	<0.01	**0.04**	<0.01	<0.01
Fluorene	ug/L	**30**	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.05	**3**	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	ug/L	**2.1**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.21**	<0.01	<0.01
Naphthalene	ug/L	**11**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	**1.1**	<0.2	<0.2
Perylene	ug/L	**-**	0.16	0.06	0.22	0.25	0.02	0.06	<0.01	**-**	<0.01	<0.01
Phenanthrene	ug/L	**4**	0.01	<0.01	0.03	<0.01	0.01	<0.01	0.05	**0.4**	<0.01	<0.01
Pyrene	ug/L	**0.25**	0.03	<0.01	0.03	<0.01	0.01	0.01	<0.01	**0.025**	<0.01	<0.01

Notes:

Guideline 1: Rationale for the Development of Environmental Quality Standards for Contaminated Sites in Nova Scotia Tier 1: Table A-3 Tier 1 Environmental Quality Standards for Surface Water, Fresh Water, January 2011

Guideline 2: Rationale for the Development of Environmental Quality Standards for Contaminated Sites in Nova Scotia Tier 1: Table A-4 Tier 1 Environmental Quality Standards for Groundwater, January 2011

NG - No Guideline; ND - Not detected

Exceeds Guideline 1

Exceeds Guideline 2

Exceeds Guideline 1 and 2

Table A-9
Fourchu groundwater elevations

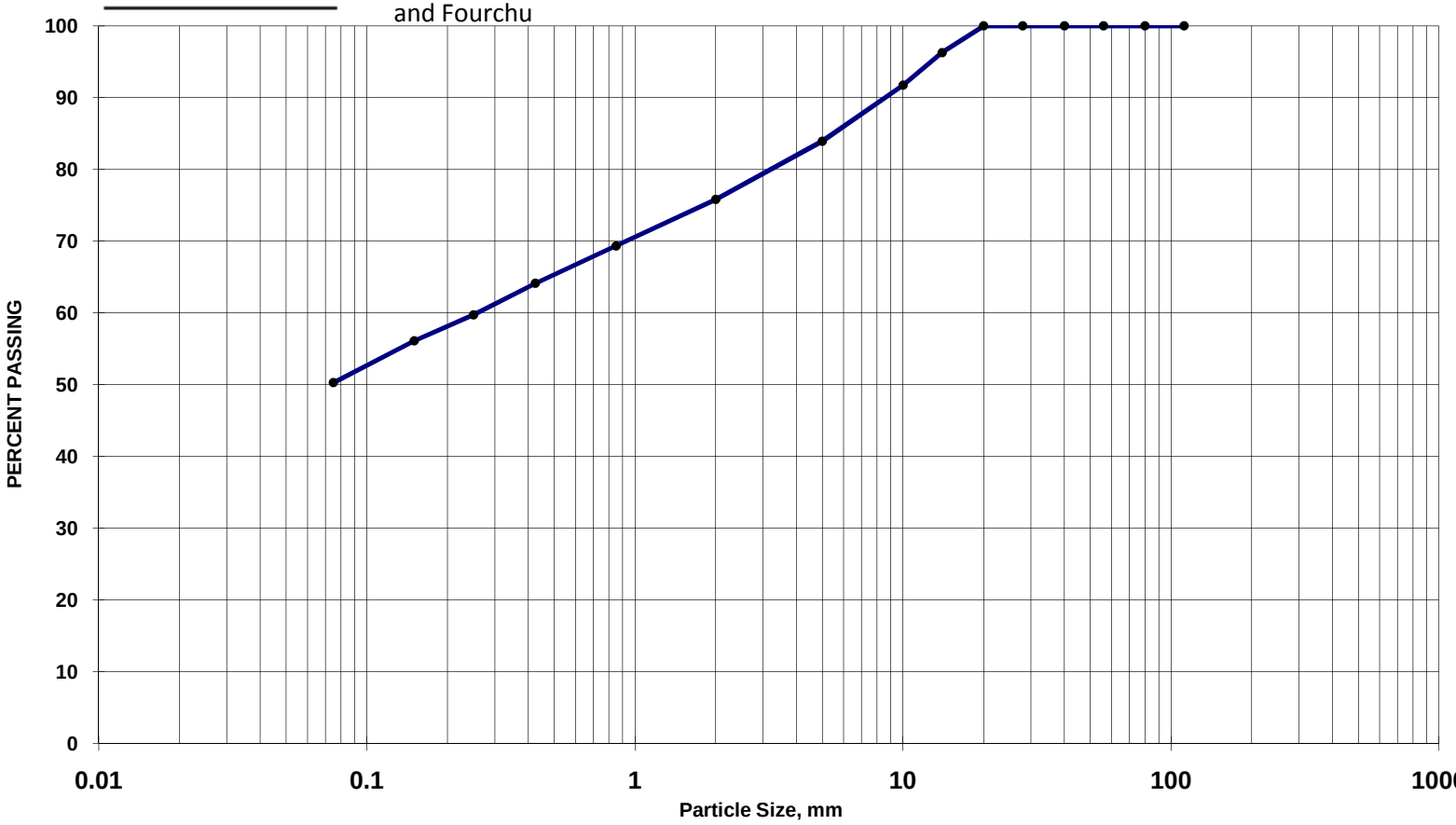
					30-Aug-10		10-Dec-11	
Monitoring Well ID	**Ground level, MASL**	**PVC pipe level, MASL**	**PVC stick up, m**	**Total PVC (well depth), m**	**Water level, m**	**Water elevation, MASL**	**Water level, m**	**Water elevation, MASL**
MW10-01 Fourchu	29.5239	30.2328	0.7089	19.3	1.885	28.3478	1.59	28.6428
MW10-02 Fourchu	27.4416	28.1079	0.6663	6	1.283	26.8249	1.205	26.9029
MW10-03 Fourchu	26.7278	27.3035	0.5757	6.76	2.005	25.2985	1.905	25.3985
MW10-04 Fourchu	26.6444	27.2666	0.6222	12.05	8.835	18.4316	2.045	25.2216

ADI Limited - ASTM/USCS Sieve Analysis

(L) 0962-183.1

Oily Waste Sites Cape Breton County- Kurdistan Sites Oban and Fourchu

30-Jul-10



TEST DATA	
Sieve Size (mm)	Percent Passing (%)
112	100.0
80	100.0
56	100.0
40	100.0
28	100.0
20	100.0
14	96.3
10	91.7
5	83.9
2	75.8
0.85	69.3
0.425	64.1
0.25	59.7
0.15	56.1
0.075	50.3

Client: NSTIR

Sample: MW-01-02

Soil Type: Till

USCS Soil Name: Sandy Silt with Gravel

Comment: Sample was collected from a Forchu well (F10-MW01-02).

Gravel (%) 16.1

Sand (%) 33.7

Fines (%) 50.3

C_u NA

C_c NA

$W_{content}$(%) 8.8

USCS Symbol: ML

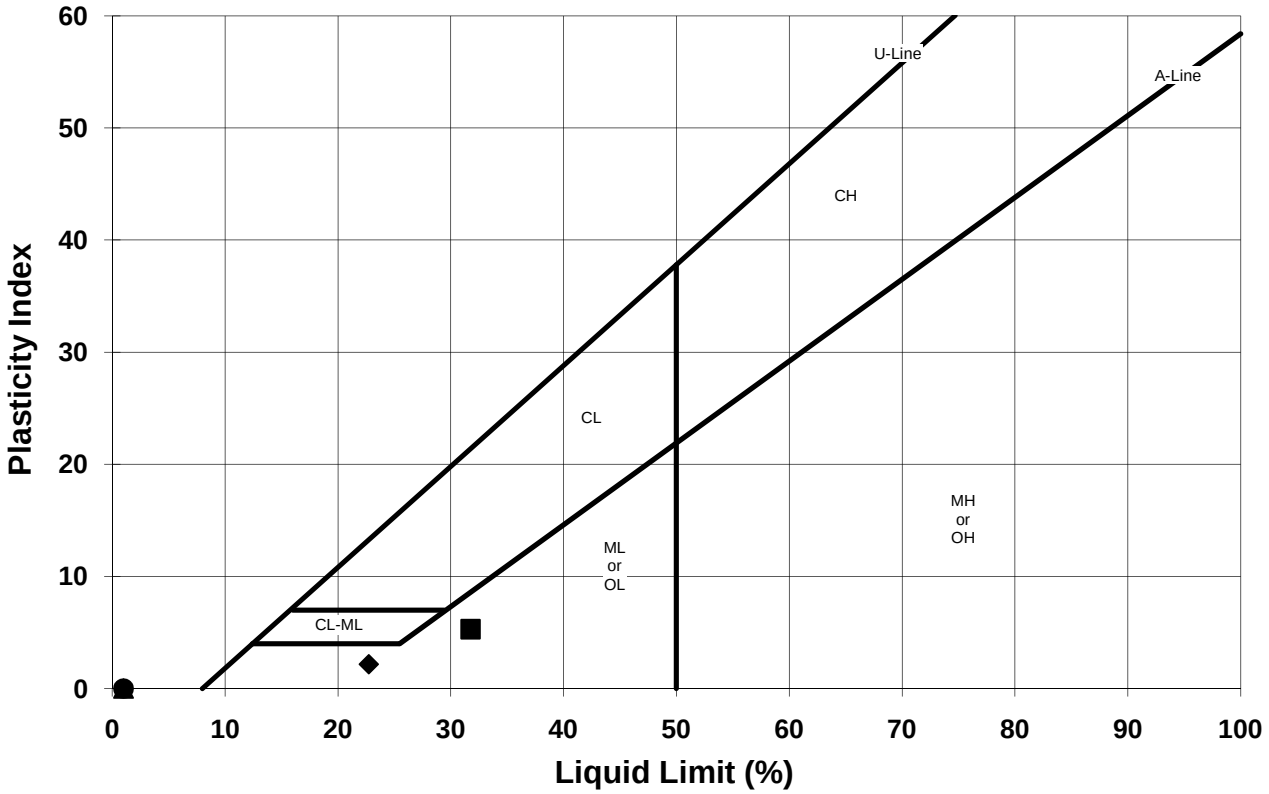
Test By: SC, DM

Specified Gradational Limits		
Size (mm)	Low Limit % Passing	High Limit % Passing
80		
56		
28		
14		
5		
0.16		
0.08		

ADI Limited - Plastic Limits
ASTM D4318

(L)0962-183.1

July 30, 2010



Client: NSTIR

Job No: (L)0962-183.1

Project: Oily Sites Cape Breton

Location: St. Peters/Forchu, NS

Sample Date: Various

Test Date: July 30, 2010

Sample By: SS

Test By: KR/JWB

DATA SUMMARY

Sample #	Liquid Limit	Plastic Limit	Plastic Index	Soil Symbol	Soil Type	Legend
S10-MW03-03	31.7	26.5	5.3	ML or OL	Till	■
F10-MW01-03	22.7	20.6	2.2	ML or OL	Till	◆
						▲
						●

Comment:

exp Services Inc.
77 Kings Road
Sydney, Nova Scotia, B1L 1A1
Telephone: 902-562-2394
Fax: 902-564-5660

WELL NUMBER F10-MW01

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Fourchu Kurdistan Site Hydrogeological Investigation
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Fourchu, Nova Scoita
DATE STARTED 26/7/10 **COMPLETED** 26/7/10
GROUND ELEVATION 30.24 m Geodetic
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD CME 55
AT TIME OF DRILLING ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
						Casing Top Elev: 30.23 (m)
	SS 1	62	Ground Surface was flat, moss cover. General Area is wooded. 16		0.15 ORGANICS: Rootlets, trace topsoil, loose, moist, black 30.09 FILL: Reworked Till, Sandy silt and gravel (angular clasts), compact, moist, moderate brown	
					1.52 28.72 TILL: Sandy Silt, some to trace gravel with depth, trace clay, compact, moist, moderate brown	
2	SS 2	100	21			Bentonite Seal
	SS 3	83	41			
4						
	SS 4	100	41 Water was not encountered. An occaisional water droplet was noted around the gravel clasts in the till.			
6	SS 5	25	56			
8			Used Core Barrel from 9.1 metres to termination of borehole.			
	SS 6	42	34			
10						

GENERAL BH / TP / WELL FOURCHU MW.GPJ GINT STD CANADA LAB.GDT 24/10/11

(Continued Next Page)

exp Services Inc.
77 Kings Road
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Telephone: 902-562-2394
Fax: 902-564-5660

WELL NUMBER F10-MW01

CLIENT Nova Scotia Transportation and Infrastructure Renewal

PROJECT NAME Fourchu Kurdistan Site Hydrogeological Investigation

PROJECT NUMBER SYD-00020400-A0

PROJECT LOCATION Fourchu, Nova Scoita

DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
					TILL: Sandy Silt, some to trace gravel with depth, trace clay, compact, moist, moderate brown *(continued)*	Screen in Sand
12						
	SS 7	83	37			
14						
	SS 8	75	38			
16						
18						
	SS 9	75	42			
					19.20	11.04 End Point
					Boredhole terminated in Till at 19.2 metres depth. Monitoring Well Installed. Bottom of borehole at 19.20 meters.	

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Telephone: 902-562-2394
Fax: 902-564-5660

WELL NUMBER F10-MW02

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Fourchu Kurdistan Site Hydrogeological Investigation
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Fourchu, Nova Scoita
DATE STARTED 27/7/10 **COMPLETED** 27/7/10
GROUND ELEVATION 28.11 m Geodetic
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD CME 55
AT TIME OF DRILLING ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
						Casing Top Elev: 28.11 (m)
	SS 1	25	Ground surface was sloping south. Grass cover. 16		0.15 ORGANICS: Rootlets, trace topsoil, loose, moist, black 27.96	Bentonite Seal
					FILL: Reworked Till, Sandy silt with gravel (angular clasts), trace organics (wood), compact, moist, moderate brown	Sand
2			Water was encountered at 3.66 metres depth.			
					3.10 25.01	
	SS 2	100	22		TILL: Sandy silt with gravel (rounded and angular),loose to compact, wet, moderate brown	Screen in Sand
4			Borehole was advanced using standard augers but had to use case pipe to keep hole from collapsing during installation.			
6						End Point
	SS 3	100	38		6.71 21.40	Cave In
					Boredhole terminated in Till at 6.7 metres depth. Monitoring Well Installed. Bottom of borehole at 6.71 meters.	

GENERAL BH / TP / WELL FOURCHU MW.GPJ GINT STD CANADA LAB.GDT 24/10/11

exp Services Inc.
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Sydney, Nova Scotia, B1L 1A1
Telephone: 902-562-2394
Fax: 902-564-5660

WELL NUMBER F10-MW03

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Fourchu Kurdistan Site Hydrogeological Investigation
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Fourchu, Nova Scoita
DATE STARTED 27/7/10 **COMPLETED** 27/7/10
GROUND ELEVATION 27.3 m Geodetic
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD CME 55
AT TIME OF DRILLING 3.65 m / Elev 23.65 m
LOGGED BY SRS **CHECKED BY** FEB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
						Casing Top Elev: 27.3 (m)
	SS 1	83	Ground surface was sloped south. 10		0.15 ORGANICS: Rootlets, trace topsoil, loose, moist, black	
					FILL: Reworked Till, Sandy silt with gravel (angular clasts), trace organics (wood), compact, moist, moderate brown	Bentonite Seal
						Sand
2			Water was encountered at 3.66 metres depth.			
					3.10	24.20
	SS 2	42	8		3.35 PEAT: Peat, loose, moist, black	23.95
					TILL: Sandy silt with gravel (rounded and angular),loose to compact, wet, moderate brown	Screen in Sand
4	SS 3	25	44 Borehole was advanced using standard augers but had to use case pipe to keep hole from collapsing during installation.			
						End Point
6	SS 4	42	20			Cave In
					6.70	20.60
					Boredhole terminated in Till at 6.7 metres depth. Monitoring Well Installed.	
					Bottom of borehole at 6.71 meters.	

GENERAL BH / TP / WELL FOURCHU MW.GPJ GINT STD CANADA LAB.GDT 24/10/11

exp Services Inc.
77 Kings Road
Sydney, Nova Scotia, B1L 1A1
Telephone: 902-562-2394
Fax: 902-564-5660

WELL NUMBER F10-MW04

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Fourchu Kurdistan Site Hydrogeological Investigation
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Fourchu, Nova Scoita
DATE STARTED 27/7/10 **COMPLETED** 27/7/10
GROUND ELEVATION 27.27 m Geodetic
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD CME 55
AT TIME OF DRILLING ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
						Casing Top Elev: 27.27 (m)
	SS 1	50	Ground Surface was sloped south. Grass cover. 14		0.15 ORGANICS: Rootlets, trace topsoil, loose, moist, black 27.12 FILL: Reworked Till, Sandy silt with gravel (angular clasts), compact, moist, moderate brown	Bentonite Seal
					1.52 25.75 TILL: Sandy silt with gravel (rounded and angular), compact, moist, moderate brown	
2						Sand
	SS 2	100	24			
4			Water was not encountered. An occaisional water droplet was noted around gravel clasats in the till.			
6	SS 3	100	40			
						Screen in Sand
8						
			Borehole was advanced using standard augers.			
	SS 4	75	40			
10						

GENERAL BH / TP / WELL FOURCHU MW.GPJ GINT STD CANADA LAB.GDT 24/10/11

(Continued Next Page)

exp Services Inc.
77 Kings Road
Sydney, Nova Scotia, B1L 1A1
Telephone: 902-562-2394
Fax: 902-564-5660

WELL NUMBER F10-MW04

CLIENT Nova Scotia Transportation and Infrastructure Renewal

PROJECT NAME Fourchu Kurdistan Site Hydrogeological Investigation

PROJECT NUMBER SYD-00020400-A0

PROJECT LOCATION Fourchu, Nova Scoita

DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
12	SS 5	100	48		TILL: Sandy silt with gravel (rounded and angular), compact, moist, moderate brown *(continued)*	End Point / Cave In
					12.80 Boredhole terminated in Till at 19.2 metres depth. Monitoring Well Installed. Bottom of borehole at 12.81 meters.	14.47

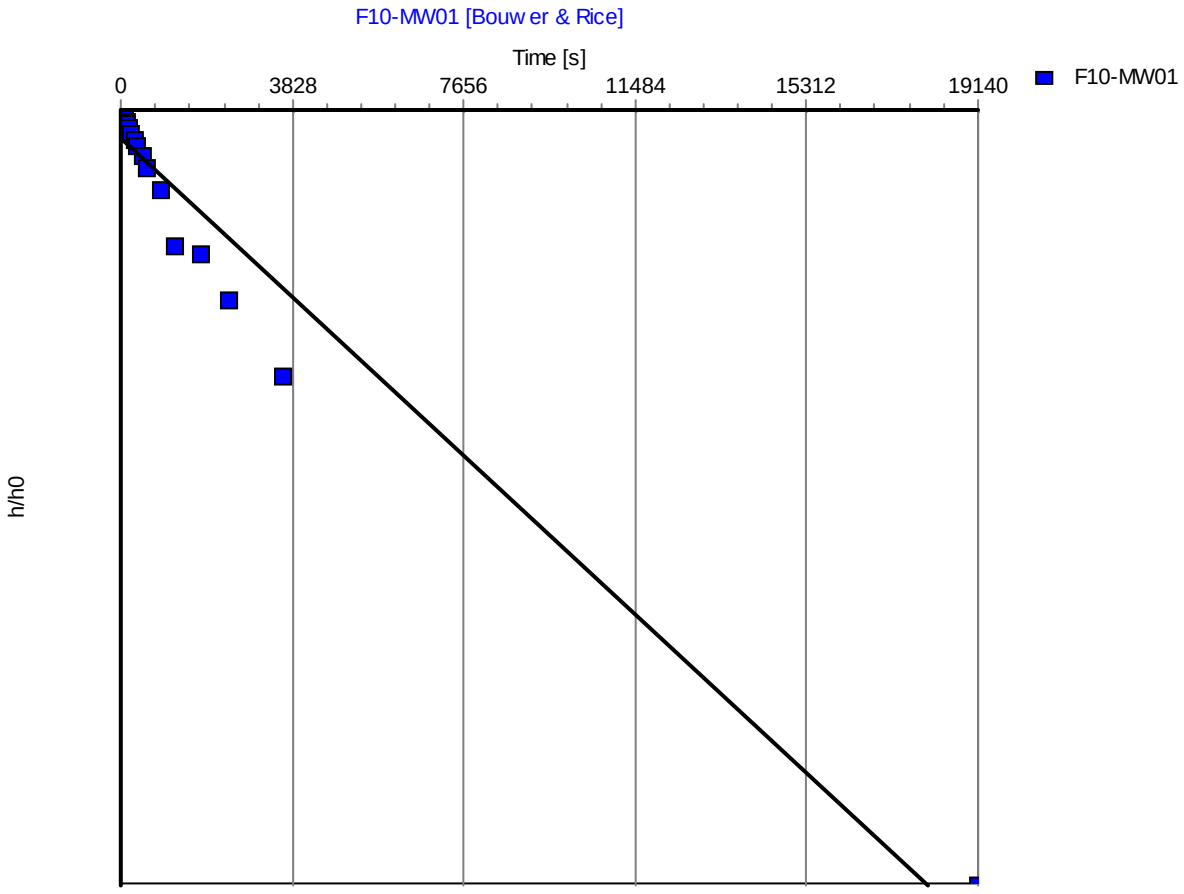
exp.
77 Kings Road
Sydney, NS
Phone: (902) 562-2394

Slug Test Analysis Report

Project: Fourchu Oily Waste Sites

Number: SYD-00020400-A0

Client: NSTIR



Slug Test: **F10-MW01**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 4.89E-9 [m/s]

Test parameters:

Test Well:	F10-MW01	Aquifer Thickness:	17.315 [m]
Casing radius:	0.0254 [m]	Gravel Pack Porosity (%)	25
Screen length:	15.2 [m]		
Boring radius:	0.0762 [m]		
r(eff):	0.044 [m]		

Comments:

Evaluated by: AEP

Evaluation Date: 9/17/2010

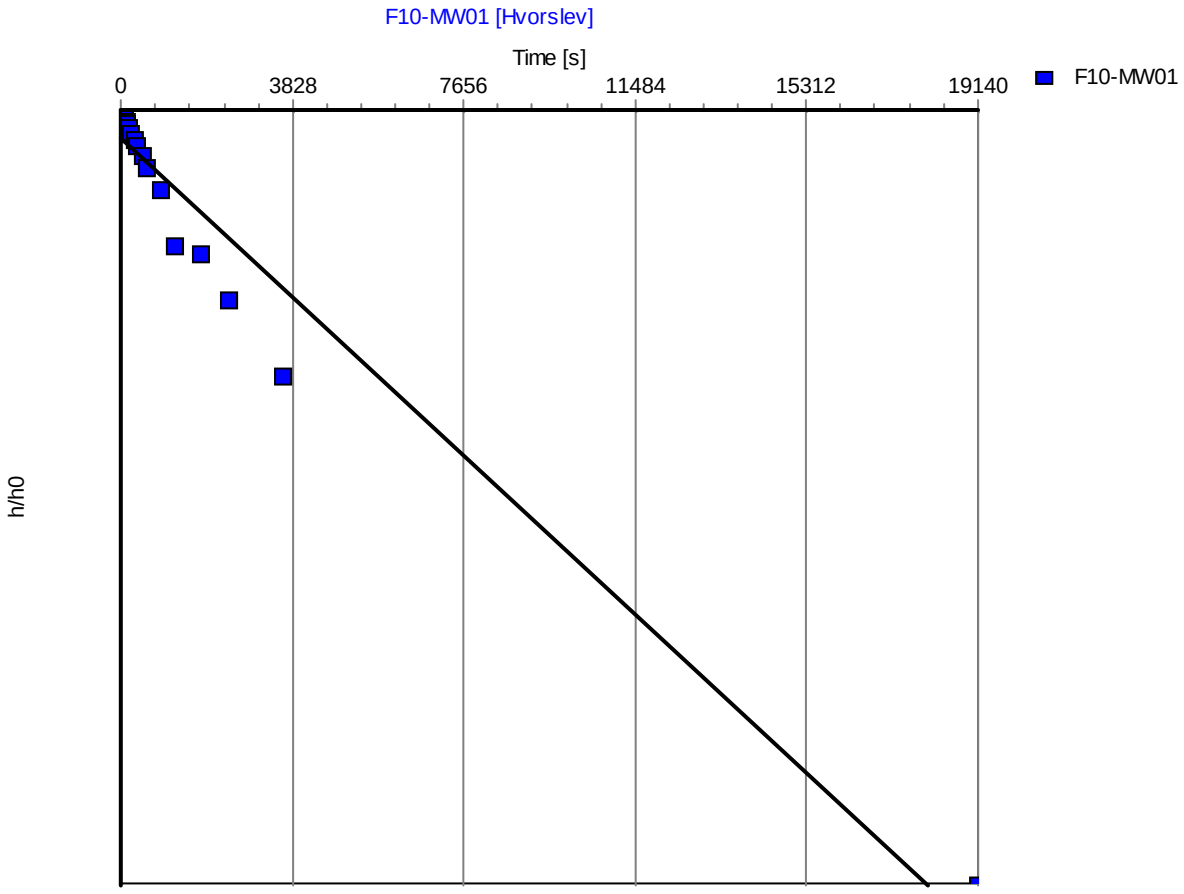
exp.
77 Kings Road
Sydney, NS
Phone: (902) 562-2394

Slug Test Analysis Report

Project: Fourchu Oily Waste Sites

Number: SYD-00020400-A0

Client: NSTIR



Slug Test: **F10-MW01**

Analysis Method: **Hvorslev**

Analysis Results:

Conductivity: 6.13E-9 [m/s]

Test parameters:

Test Well:	F10-MW01	Aquifer Thickness:	17.315 [m]
Casing radius:	0.0254 [m]		
Screen length:	15.2 [m]		
Boring radius:	0.0762 [m]		

Comments:

Evaluated by: AEP

Evaluation Date: 9/17/2010

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77 Kings Road
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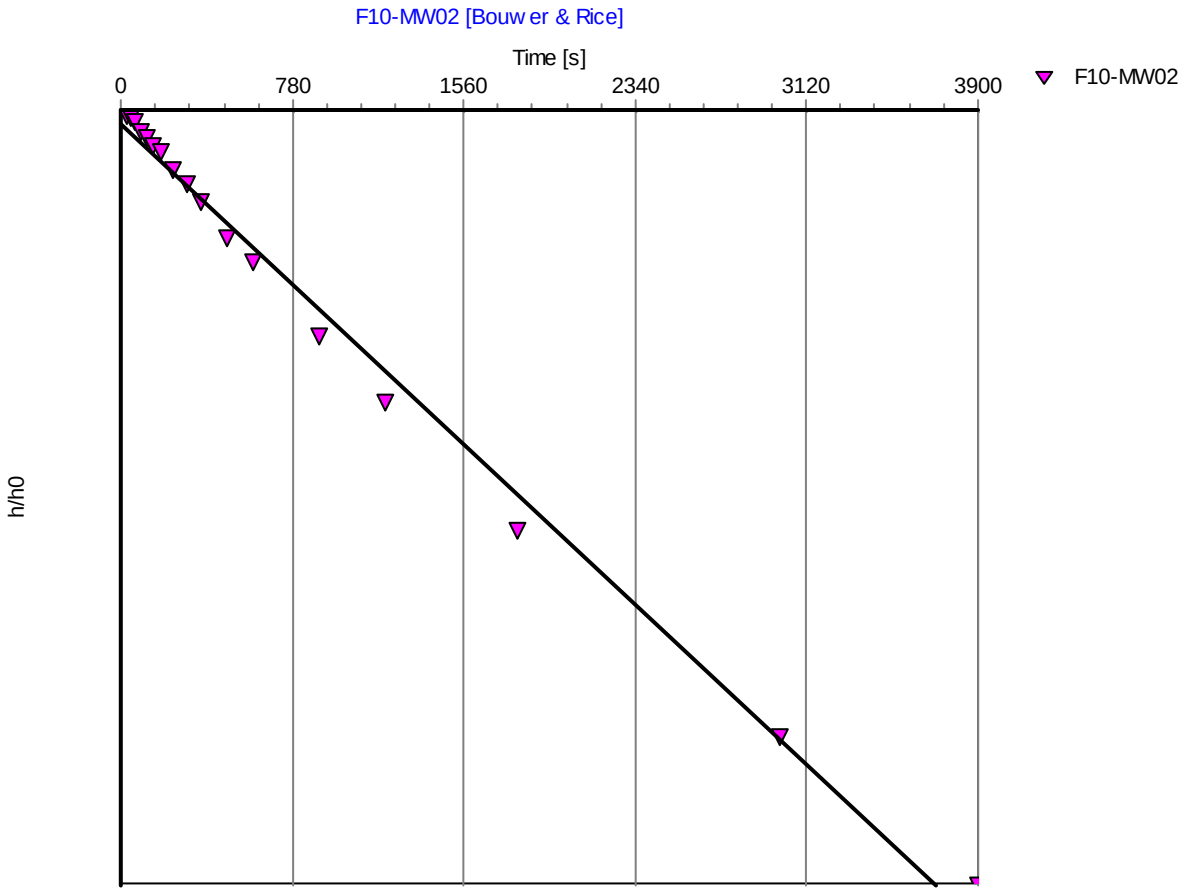
Slug Test Analysis Report

Project: Fourchu Oily Waste Sites

Number: SYD-00020400-A0

Client: NSTIR



Slug Test: **F10-MW02**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 3.59E-8 [m/s]

Test parameters:

Test Well:	F10-MW02	Aquifer Thickness:	5.417 [m]
Casing radius:	0.0254 [m]	Gravel Pack Porosity (%)	25
Screen length:	4.6 [m]		
Boring radius:	0.0762 [m]		
r(eff):	0.044 [m]		

Comments:

Evaluated by: AEP

Evaluation Date: 10/28/2011

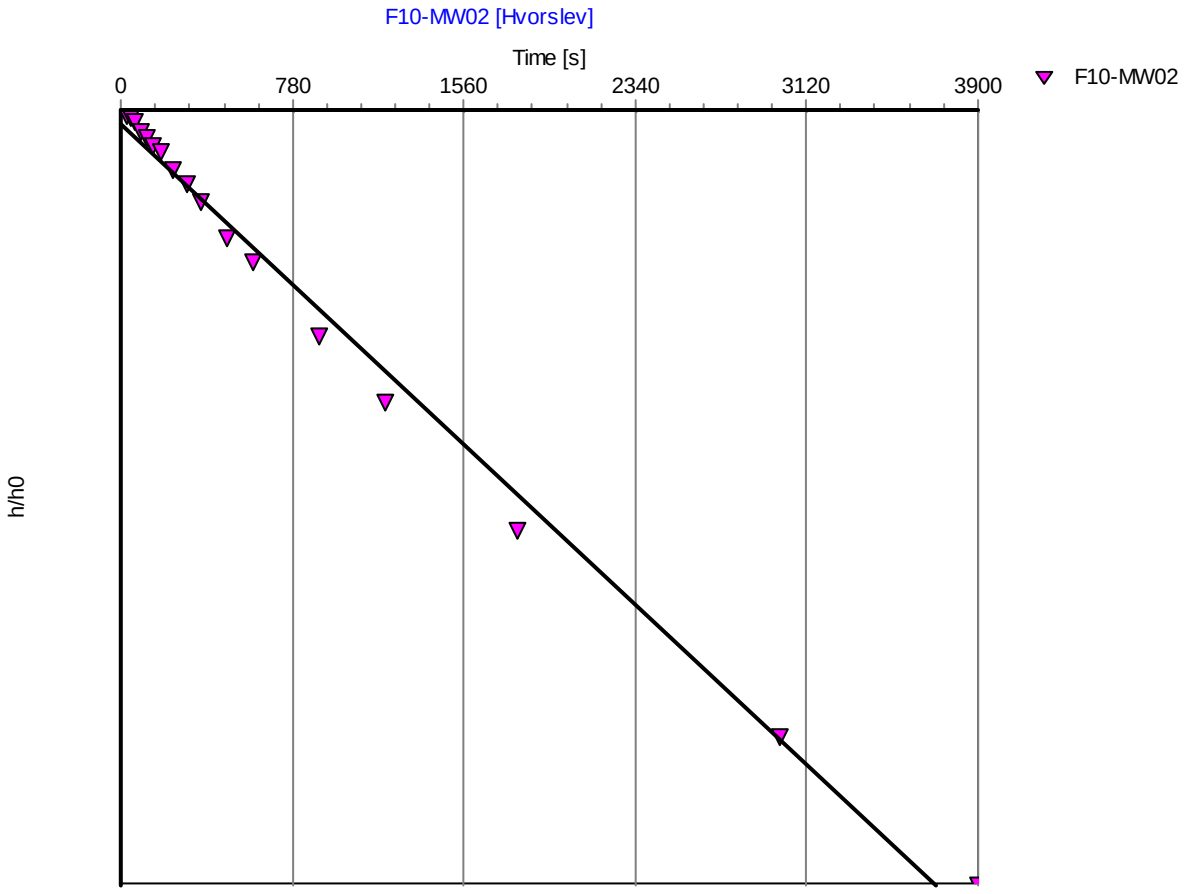
exp.
77 Kings Road
Sydney, NS
Phone: (902) 562-2394

Slug Test Analysis Report

Project: Fourchu Oily Waste Sites

Number: SYD-00020400-A0

Client: NSTIR



Slug Test: **F10-MW02**

Analysis Method: **Hvorslev**

Analysis Results:

Conductivity: 4.64E-8 [m/s]

Test parameters:

Test Well:	F10-MW02	Aquifer Thickness:	5.417 [m]
Casing radius:	0.0254 [m]		
Screen length:	4.6 [m]		
Boring radius:	0.0762 [m]		

Comments:

Evaluated by: AEP

Evaluation Date: 10/28/2011

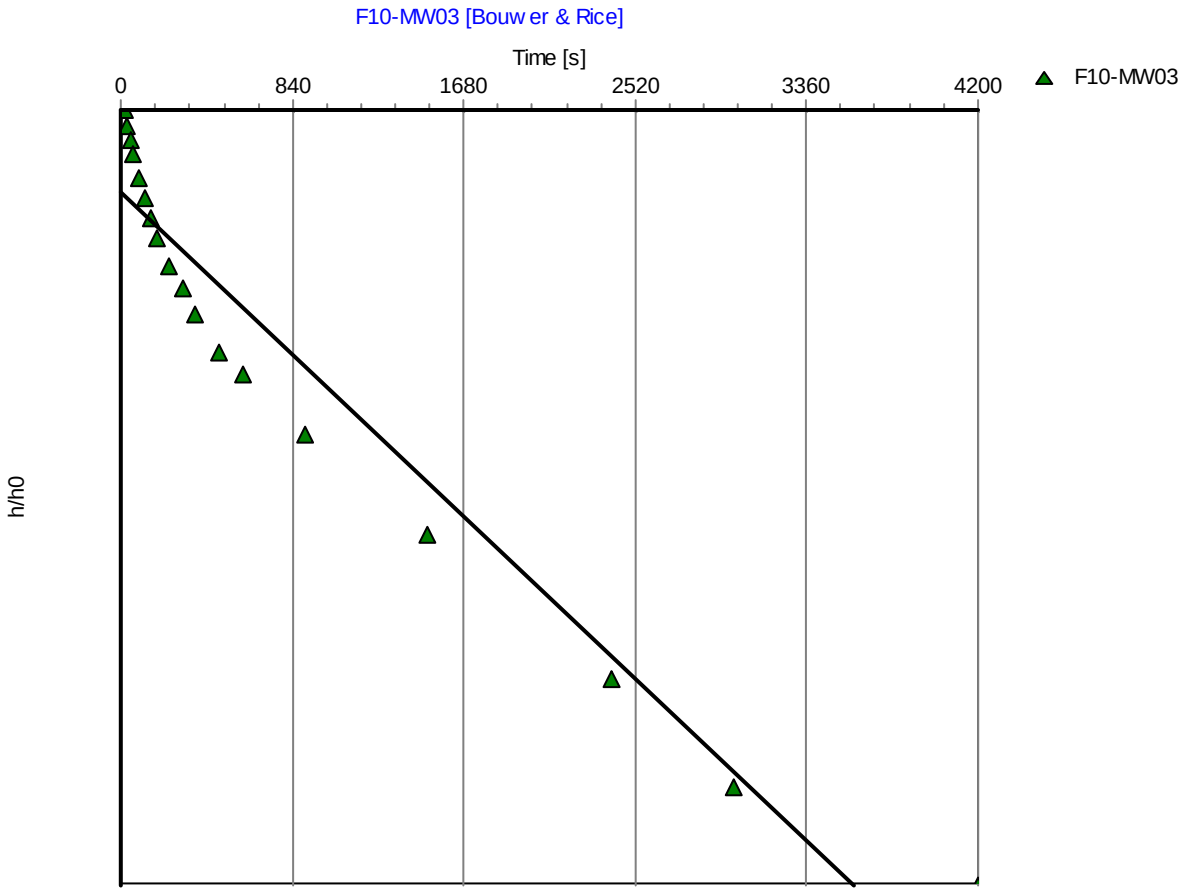
exp.
77 Kings Road
Sydney, NS
Phone: (902) 562-2394

Slug Test Analysis Report

Project: Fourchu Oily Waste Sites

Number: SYD-00020400-A0

Client: NSTIR



Slug Test: **F10-MW03**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 9.17E-8 [m/s]

Test parameters:

Test Well:	F10-MW03	Aquifer Thickness:	4.755 [m]
Casing radius:	0.0254 [m]	Gravel Pack Porosity (%)	25
Screen length:	4.6 [m]		
Boring radius:	0.0762 [m]		
r(eff):	0.044 [m]		

Comments:

Evaluated by: AEP

Evaluation Date: 9/17/2010

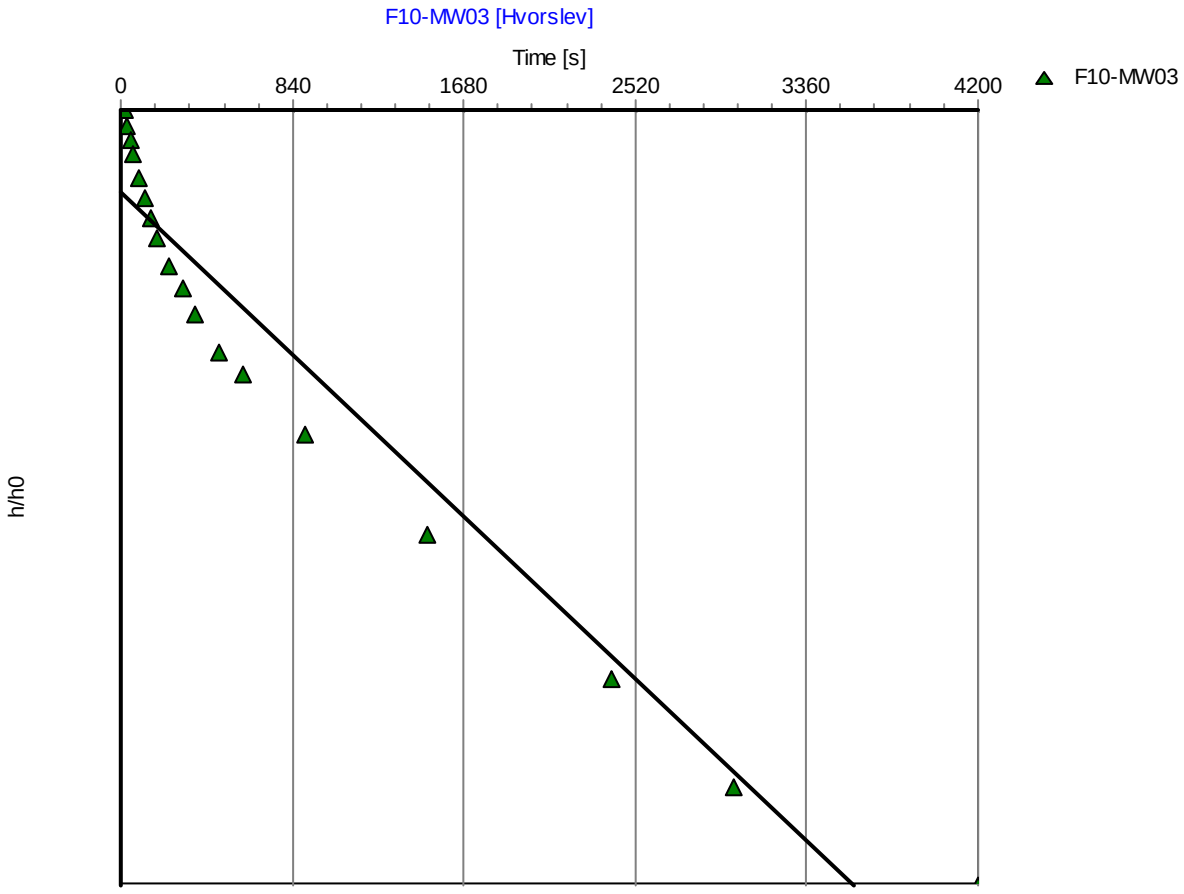
exp.
77 Kings Road
Sydney, NS
Phone: (902) 562-2394

Slug Test Analysis Report

Project: Fourchu Oily Waste Sites

Number: SYD-00020400-A0

Client: NSTIR



Slug Test: **F10-MW03**

Analysis Method: **Hvorslev**

Analysis Results:

Conductivity: 1.23E-7 [m/s]

Test parameters:

Test Well:	F10-MW03	Aquifer Thickness:	4.755 [m]
Casing radius:	0.0254 [m]		
Screen length:	4.6 [m]		
Boring radius:	0.0762 [m]		

Comments:

Evaluated by: AEP

Evaluation Date: 9/17/2010

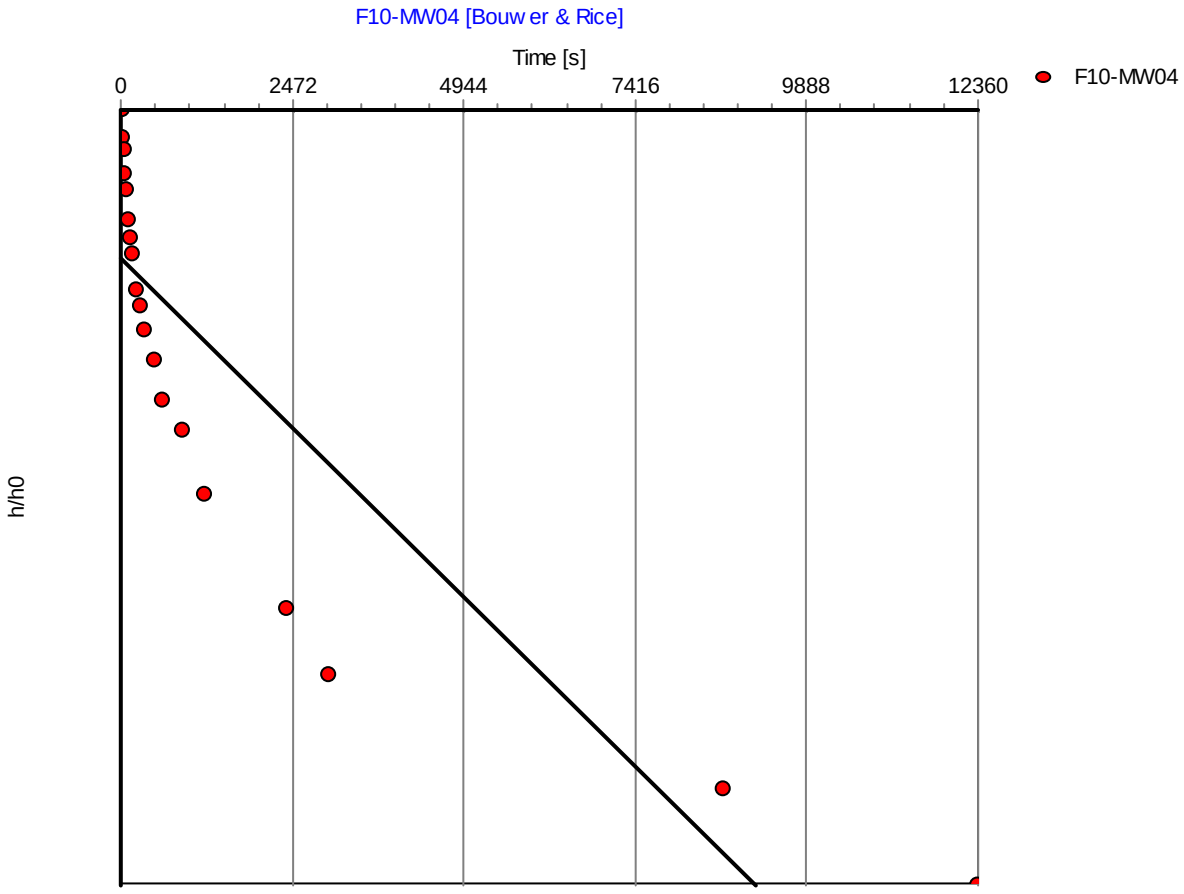
exp.
77 Kings Road
Sydney, NS
Phone: (902) 562-2394

Slug Test Analysis Report

Project: Fourchu Oily Waste Sites

Number: SYD-00020400-A0

Client: NSTIR



Slug Test: **F10-MW04**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 4.91E-10 [m/s]

Test parameters:

Test Well:	F10-MW04	Aquifer Thickness:	3.965 [m]
Casing radius:	0.0254 [m]	Gravel Pack Porosity (%)	25
Screen length:	9.2 [m]		
Boring radius:	0.0762 [m]		
r(eff):	0.044 [m]		

Comments:

Evaluated by: AEP

Evaluation Date: 9/17/2010

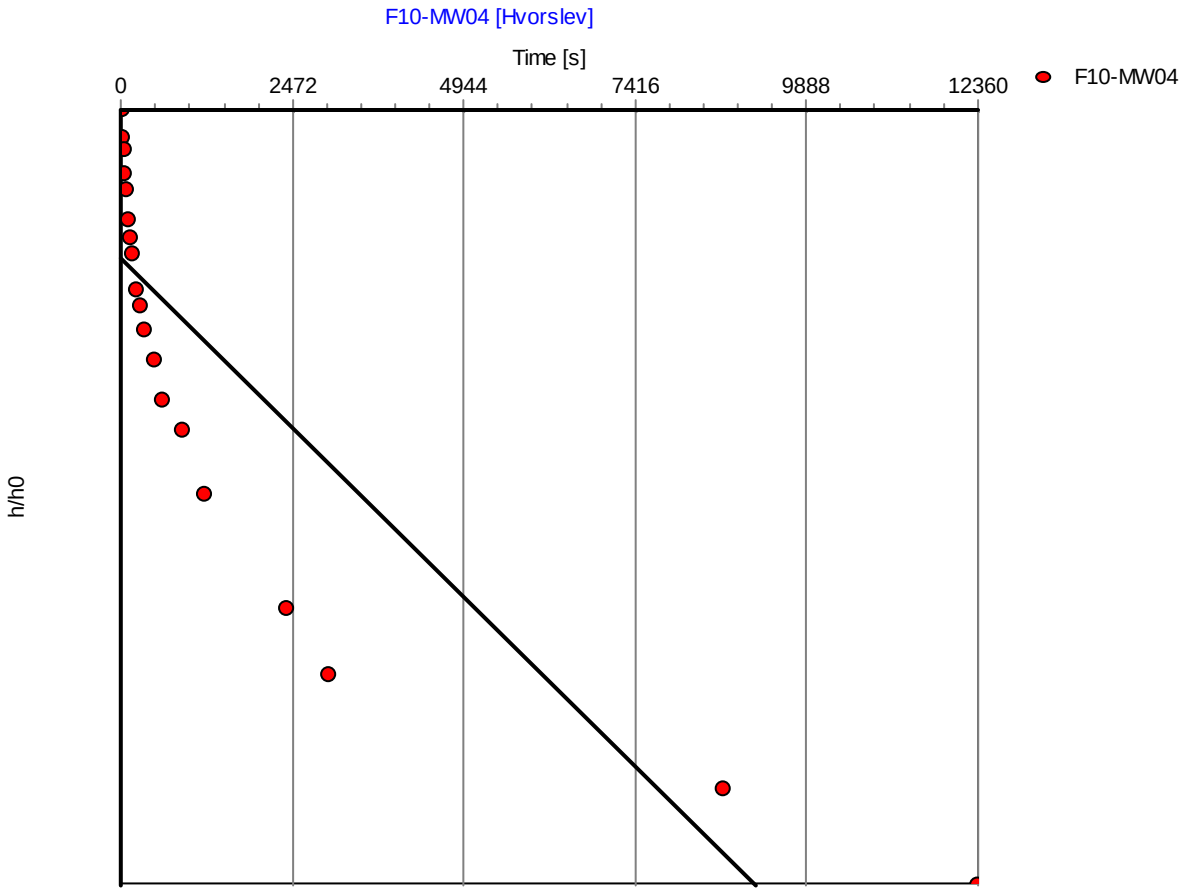
exp.
77 Kings Road
Sydney, NS
Phone: (902) 562-2394

Slug Test Analysis Report

Project: Fourchu Oily Waste Sites

Number: SYD-00020400-A0

Client: NSTIR



Slug Test: **F10-MW04**

Analysis Method: **Hvorslev**

Analysis Results:

Conductivity: 8.16E-10 [m/s]

Test parameters:

Test Well:	F10-MW04	Aquifer Thickness:	3.965 [m]
Casing radius:	0.0254 [m]		
Screen length:	9.2 [m]		
Boring radius:	0.0762 [m]		

Comments:

Evaluated by: AEP

Evaluation Date: 9/17/2010

Appendix B
St. Peter’s-Oban

Table B-1: HYDROCARBONS IN SOIL RESULTS
St. Peter's/Oban Kurdistan Oily Waste Site

Maxxam ID	Units	RBCA Commercial Guideline**	GR2216	GR2306	GR2307	GR2308	GR2309	HX8444	HX8445	HX8446
Sampling Date			29-Jul-10	28-Jul-10	30-Jul-10	30-Jul-10	30-Jul-10	18-Nov-10	19-Nov-10	19-Nov-10
COC Number			B124420	B124420	B124420	B124420	B124420	B0G7898	B0G7898	B0G7898
Sample ID			MW01-03	MW02-03	MW03-02	MW03-04	MW04-02	SPO10-MW05A-2	SPO10-MW05B-1	COOK LAKE
TPH COMPOUNDS										
Benzene	mg/kg	**570**	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Toluene	mg/kg	**18000**	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Ethylbenzene	mg/kg	**10000**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Xylene (Total)	mg/kg	**180000**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
C6 - C10 (less BTEX)	mg/kg	**13000**	<3	<3	<3	<3	<3	<3	<3	<3
>C10-C21 Hydrocarbons	mg/kg	**7700**	<15	<15	<15	26	<15	26	<10	<10
>C21-<C32 Hydrocarbons	mg/kg	**12000**	<15	<15	<15	<15	<15	<15	<15	<15
Modified TPH (Tier1)	mg/kg	***	<20	<20	<20	26	<20	26	<20	<20
Product Identifiecation	na	-	na	na	na	na	na	na	na	na

Notes:

RDL = Reportable Detection Limit, NG = No guideline

** Atlantic RBCA Version 2.0, Table 8 For Coarse-grained soils on Commercial receptor sites with non-potable water use, Soil Ingestion (2003 update).

(1) Fuel oil / lube oil range.

(2) Fuel oil fraction

(3) Lube oil fraciton. TEH surrogate not within acceptable limits due to sample matrix.

(4) Lube oil fraction

(5) Fuel Oil Fraction and Lube Oil Fraction

*** As per laboratory identified fraction and/or Atlantic RBCA Version 2.0 Table 5, Modified TPH concentration must be compared with appropriate fraction. Shading indicates exceedance of Residential guideline.

TABLE B-2: METALS IN SOIL RESULTS
St. Peter's/Oban Kurdistan Oily Waste Site

Maxxam ID	Units	CCME CEQG Industrial Guideline*	GS6052	GS6053	GS6054	GS6055	GS6056	HX8444	HX8445
Sampling Date			29-Jul-10	28-Jul-10	30-Jul-10	30-Jul-10	30-Jul-10	18-Nov-10	19-Nov-10
COC Number			B124420	B124420	B124420	B124420	B124420	B0G7898	B0G7898
			MW01-03	MW02-03	MW03-02	MW03-04	MW04-02	SPO10-MW05A-2	SPO10-MW05B-1
Elements (ICP-MS)									
Aluminum (Al)	mg/kg	-	10000	9300	11000	4400	9100	11000	11000
Antimony (Sb)	mg/kg	**40**	<1	<1	<1	<1	<1	<1	<1
Arsenic (As)	mg/kg	**12**	8	9	11	10	8	9	9
Barium (Ba)	mg/kg	**2000**	100	96	60	40	88	74	180
Beryllium (Be)	mg/kg	**8**	<1	<1	<1	<1	<1	<1	<1
Boron (B)	mg/kg	-	<7	<7	<7	<7	<7	<7	<7
Cadmium (Cd)	mg/kg	**22**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Calcium (Ca)	mg/kg	-	18000	23000	14000	48000	19000	20000	5900
Chromium (Cr)	mg/kg	**87**	23	20	23	7	21	23	21
Cobalt (Co)	mg/kg	**300**	16	15	18	14	15	17	14
Copper (Cu)	mg/kg	**91**	23	23	29	19	27	26	25
Iron (Fe)	mg/kg	-	35000	30000	36000	31000	32000	31000	31000
Lead (Pb)	mg/kg	**600**	16	17	17	21	18	18	16
Lithium (Li)	mg/kg	-	26	25	26	17	24	22	17
Magnesium (Mg)	mg/kg	-	6700	6800	5800	2900	6200	6200	4000
Manganese (Mn)	mg/kg	-	530	590	470	470	620	540	560
Mercury (Hg)	mg/kg	**50**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum (Mo)	mg/kg	**40**	<1	<1	<1	1	<1	<1	<1
Nickel (Ni)	mg/kg	**50**	34	32	38	30	33	35	29
Phosphorus (P)	mg/kg	-	340	320	260	250	290	360	270
Potassium (K)	mg/kg	-	1200	1200	1200	870	1000	1200	670
Selenium (Se)	mg/kg	**2.9**	0.8	1	1.2	1.1	0.6	<0.6	<0.6
Silver (Ag)	mg/kg	**40**	<1	<1	<1	<1	<1	<1	<1
Sodium (Na)	mg/kg	-	<400	<400	<400	<400	<400	<400	<400
Strontium (Sr)	mg/kg	-	41	53	38	42	40	50	17
Sulphur (S)	mg/kg	-	NA	NA	NA	NA	NA	NA	NA
Thallium (Tl)	mg/kg	**1**	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Tin (Sn)	mg/kg	**300**	<10	<10	<10	<10	<10	<10	<10
Titanium (Ti)	mg/kg	-	78	71	43	6	72	66	54
Uranium (U)	mg/kg	**300**	<1	<1	<1	<1	<1	<1	<1
Vanadium (V)	mg/kg	**130**	19	19	17	4	19	20	22
Zinc (Zn)	mg/kg	**360**	68	100	68	<50	69	69	62

Notes:

***** CCME Canadian Environmental Quality Guidelines for **Industrial** site land use (September 2007

RDL = Reportable Detection Limit

Exceeds Commercial

Table B-3: PAHs IN SOIL RESULTS
St. Peter's/Oban Kurdistan Oily Waste Site

Maxxam ID	Units	CCME CEQG Industrial Guideline*	GS6052	GS6053	GS6054	GS6055	GS6056	HX8444	HX8445
Sampling Date			29-Jul-10	28-Jul-10	30-Jul-10	30-Jul-10	30-Jul-10	18-Nov-10	19-Nov-10
COC Number			B124420	B124420	B124420	B124420	B124420	B0G7898	B0G7898
			MW01-03	MW02-03	MW03-02	MW03-04	MW04-02	SPO10-MW05A-2	SPO10-MW05B-1
PAHs									
1-Methylnaphthalene	mg/kg	-	<0.01	<0.01	0.02	<0.01	<0.01	0.05	<0.01
2-Methylnaphthalene	mg/kg	-	<0.01	<0.01	0.01	<0.01	<0.01	0.08	<0.01
Acenaphthene	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Anthracene	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)anthracene	mg/kg	10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)pyrene	mg/kg	0.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	mg/kg	10	<0.01	<0.01	<0.01	<0.01	0.01	0.02	<0.01
Benzo(g,h,i)perylene	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01
Benzo(k)fluoranthene	mg/kg	10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chrysene	mg/kg	-	0.01	0.01	0.01	0.01	0.01	0.02	<0.01
Dibenzo(a,h)anthracene	mg/kg	10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01
Fluorene	mg/kg	-	<0.01	<0.01	0.01	0.02	<0.01	0.04	<0.01
Indeno(1,2,3-cd)pyrene	mg/kg	10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Naphthalene	mg/kg	22	0.01	<0.01	0.03	<0.01	0.01	0.05	<0.01
Perylene	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	mg/kg	50	0.02	0.02	0.04	0.04	0.02	0.07	<0.01
Pyrene	mg/kg	100	0.01	0.01	0.01	0.01	0.01	0.03	<0.01

Notes:

* CCME Canadian Environmental Quality Guidelines for **Industrial** site land use (September 2006 update)

RDL = Reportable Detection Limit

Exceeds Commercial

Table B-4: PAHs in Soil
St. Peter's/Oban Kurdistan Oily Waste Site

Maxxam ID	Units	CCME Direct Contact	CCME PEFs	GS6052	Sample TPE	GS6053	Sample TPE	GS6054	Sample TPE	GS6055	Sample TPE	GS6056	Sample TPE	HX8444	Sample TPE	HX8445	Sample TPE
Sampling Date				29-Jul-10		28-Jul-10		30-Jul-10		30-Jul-10		30-Jul-10		18-Nov-10		19-Nov-10	
COC Number				B124420		B124420		B124420		B124420		B124420		B0G7898		B0G7898	
				MW01-03		MW02-03		MW03-02		MW03-04		MW04-02		SPO10-MW05A-2		SPO10-MW05B-1	
PAHs																	
1-Methylnaphthalene	mg/kg	NV	-	0.005	-	0.005	-	0.02	-	0.005	-	0.005	-	0.05	-	0.005	-
2-Methylnaphthalene	mg/kg	NV	-	0.005	-	0.005	-	0.01	-	0.005	-	0.005	-	0.08	-	0.005	-
Acenaphthene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Acenaphthylene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Anthracene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Benzo(a)anthracene	mg/kg	NV	0.1	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005
Benzo(a)pyrene	mg/kg	NV	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Benzo(b)fluoranthene	mg/kg	NV	0.1	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.01	0.001	0.02	0.002	0.005	0.0005
Benzo(g,h,i)perylene	mg/kg	NV	0.01	0.005	0.00005	0.005	0.00005	0.005	0.00005	0.005	0.00005	0.005	0.00005	0.02	0.0002	0.005	0.00005
Benzo(k)fluoranthene	mg/kg	NV	0.1	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005
Chrysene	mg/kg	NV	0.01	0.01	0.0001	0.01	0.0001	0.01	0.0001	0.01	0.0001	0.01	0.0001	0.02	0.0002	0.005	0.00005
Dibenzo(a,h)anthracene	mg/kg	NV	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Fluoranthene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.02	-	0.005	-
Fluorene	mg/kg	NV	-	0.005	-	0.005	-	0.01	-	0.02	-	0.005	-	0.04	-	0.005	-
Indeno(1,2,3-cd)pyrene	mg/kg	NV	0.1	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005	0.005	0.0005
Naphthalene	mg/kg	NV	-	0.01	-	0.005	-	0.03	-	0.005	-	0.01	-	0.05	-	0.005	-
Perylene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Phenanthrene	mg/kg	NV	-	0.02	-	0.02	-	0.04	-	0.04	-	0.02	-	0.07	-	0.005	-
Pyrene	mg/kg	NV	-	0.01	-	0.01	-	0.01	-	0.01	-	0.01	-	0.03	-	0.005	-
B (a) P TPE	mg/Kg	5.3	-	-	0.01215	-	0.01215	-	0.01215	-	0.01215	-	0.01265		0.0139		0.0121
Uncertainty Factor	mg/Kg	3	-	-	0.03645	-	0.03645	-	0.03645	-	0.03645	-	0.03795		0.0417		0.0363

Notes:

* CCME Canadian Environmental Quality Guidelines for the Protection of Envrionmental and Human Health (2010)

NV - No Value

PEF - Potency Equivalence Factor
Potency Equivalent - Calculated

Screening:
Bold - Indicates an exceedance of CCME guidelines
Red indicates value was below the reportable detection limit and half the RDL was used for the calculation.

Table B-5: PAHs in Soil
St. Peter's/Oban Kurdistan Oily Waste Site

Maxxam ID	Units	CCME Direct Contact	CCME PEFs	GS6052	Sample TPE	GS6053	Sample TPE	GS6054	Sample TPE	GS6055	Sample TPE	GS6056	Sample TPE	HX8444	Sample TPE	HX8445	Sample TPE
Sampling Date				29-Jul-10		28-Jul-10		30-Jul-10		30-Jul-10		30-Jul-10		18-Nov-10		19-Nov-10	
COC Number				B124420		B124420		B124420		B124420		B124420		B0G7898		B0G7898	
				MW01-03		MW02-03		MW03-02		MW03-04		MW04-02		SPO10.MWO5A-2		SPO10-MW05B-1	
PAHs																	
1-Methylnaphthalene	mg/kg	NV	-	0.005	-	0.005	-	0.02	-	0.005	-	0.005	-	0.05	-	0.005	-
2-Methylnaphthalene	mg/kg	NV	-	0.005	-	0.005	-	0.01	-	0.005	-	0.005	-	0.08	-	0.005	-
Acenaphthene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Acenaphthylene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Anthracene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Benzo(a)anthracene	mg/kg	NV	0.33	0.005	0.00165	0.005	0.00165	0.005	0.00165	0.005	0.00165	0.005	0.00165	0.005	0.00165	0.005	0.00165
Benzo(a)pyrene	mg/kg	NV	0.37	0.005	0.00185	0.005	0.00185	0.005	0.00185	0.005	0.00185	0.005	0.00185	0.005	0.00185	0.005	0.00185
Benzo(b)fluoranthene	mg/kg	NV	0.16	0.005	0.0008	0.005	0.0008	0.005	0.0008	0.005	0.0008	0.01	0.0016	0.02	0.0032	0.005	0.0008
Benzo(g,h,i)perylene	mg/kg	NV	6.8	0.005	0.034	0.005	0.034	0.005	0.034	0.005	0.034	0.005	0.034	0.02	0.136	0.005	0.034
Benzo(k)fluoranthene	mg/kg	NV	0.16	0.005	0.0008	0.005	0.0008	0.005	0.0008	0.005	0.0008	0.005	0.0008	0.005	0.0008	0.005	0.0008
Chrysene	mg/kg	NV	2.1	0.01	0.021	0.01	0.021	0.01	0.021	0.01	0.021	0.01	0.021	0.02	0.042	0.005	0.0105
Dibenzo(a,h)anthracene	mg/kg	NV	0.23	0.005	0.00115	0.005	0.00115	0.005	0.00115	0.005	0.00115	0.005	0.00115	0.005	0.00115	0.005	0.00115
Fluoranthene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.02	-	0.005	-
Fluorene	mg/kg	NV	-	0.005	-	0.005	-	0.01	-	0.02	-	0.005	-	0.04	-	0.005	-
Indeno(1,2,3-cd)pyrene	mg/kg	NV	2.7	0.005	0.0135	0.005	0.0135	0.005	0.0135	0.005	0.0135	0.005	0.0135	0.005	0.0135	0.005	0.0135
Naphthalene	mg/kg	NV	-	0.01	-	0.005	-	0.03	-	0.005	-	0.01	-	0.05	-	0.005	-
Perylene	mg/kg	NV	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-	0.005	-
Phenanthrene	mg/kg	NV	-	0.02	-	0.02	-	0.04	-	0.04	-	0.02	-	0.07	-	0.005	-
Pyrene	mg/kg	NV	-	0.01	-	0.01	-	0.01	-	0.01	-	0.01	-	0.03	-	0.005	-
SQG PW IACR	mg/Kg	1	-	-	0.07475	-	0.07475	-	0.07475	-	0.07475	-	0.07555		0.20015		0.06425

Notes:

Notes:

All values expressed in µg/g unless otherwise indicated

NV - No Value

SQG_{PW} - Soil Quality Guideline for Protection of Potable Water

IACR - Index of Additive Cancer Risk

SQG_{PW} IACR - Index of Additive Cancer Risk for Protection of Potable Water - Calculated by dividing the concentration of each PAH in the sample by its SQG_{PW} and summing the results

Screening:

Bold - Indicates an exceedance of CCME guidelines

Red indicates value was below the reportable detection limit and half the RDL was used for the calculation.

References:

Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Soil Quality Guidelines (CEQG), Last Accessed October 2008 - Commercial land use, coarse textured soil

TABLE B-6 Volatile Organics in Soil Results
St. Peter's/Oban Kurdistan Oily Waste Site

	Maxxam ID		Guideline[1]	GR2216	GR2306	GR2307	GR2308	GR2309
	Sample ID			MW01-03	MW02-03	MW03-02	MW03-04	MW04-02
	Date Sampled			29-Jul-10	28-Jul-10	30-Jul-10	30-Jul-10	30-Jul-10
PARAMETER	***UNITS***	***EQL*** [2]		MW01-03	MW02-03	MW03-02	MW03-04	MW04-02
VOC's								
CHLOROBENZENES								
1,2-Dichlorobenzene	ug/kg	30	10000*	<30	<30	<30	<30	<30
1,3-Dichlorobenzene	ug/kg	30	10000*	<30	<30	<30	<30	<30
1,4-Dichlorobenzene	ug/kg	30	10000*	<30	<30	<30	<30	<30
Chlorobenzene	ug/kg	30	10000*	<30	<30	<30	<30	<30
VOLATILES								
1,1,1-Trichloroethane	ug/kg	30	50000*	<30	<30	<30	<30	<30
1,1,2,2-Tetrachloroethane	ug/kg	30	50000*	<30	<30	<30	<30	<30
1,1,2-Trichloroethane	ug/kg	30	50000*	<30	<30	<30	<30	<30
1,1-Dichloroethane	ug/kg	30	50000*	<30	<30	<30	<30	<30
1,1-Dichloroethylene	ug/kg	30	50000*	<30	<30	<30	<30	<30
1,2-Dichloroethane	ug/kg	30	50000*	<30	<30	<30	<30	<30
1,2-Dichloropropane	ug/kg	30	50000*	<30	<30	<30	<30	<30
Benzene	ug/kg	0.003	5000	<30	<30	<30	<30	<30
Bromodichloromethane	ug/kg	30	NG	<30	<30	<30	<30	<30
Bromoform	ug/kg	30	NG	<30	<30	<30	<30	<30
Bromomethane	ug/kg	200	NG	<200	<200	<200	<200	<200
Carbon Tetrachloride	ug/kg	30	50000*	<30	<30	<30	<30	<30
Chloroethane	ug/kg	200	NG	<30	<30	<30	<30	<30
Chloroform	ug/kg	30	50000*	<30	<30	<30	<30	<30
Chloromethane	ug/kg	30	NG	<30	<30	<30	<30	<30
cis-1,2-Dichloroethylene	ug/kg	30	NG	<30	<30	<30	<30	<30
cis-1,3-Dichloropropene	ug/kg	30	50000*	<30	<30	<30	<30	<30
Dibromochloromethane	ug/kg	30	NG	<30	<30	<30	<30	<30
Ethylbenzene	ug/kg	0.01	20000	<30	<30	<30	<30	<30
Ethylene Dibromide	ug/kg	30	NG	<30	<30	<30	<30	<30
Methylene Chloride(Dichloromethane)	ug/kg	30	50000*	<30	<30	<30	<30	<30
o-Xylene	ug/kg	30	20000	<30	<30	<30	<30	<30
p+m-Xylene	ug/kg	30	20000	<30	<30	<30	<30	<30
Styrene	ug/kg	30	50000*	<30	<30	<30	<30	<30
Tetrachloroethylene	ug/kg	30	600	<30	<30	<30	<30	<30
Toluene	ug/kg	0.03	800	<30	<30	<30	<30	<30
trans-1,2-Dichloroethylene	ug/kg	30	50000*	<30	<30	<30	<30	<30
trans-1,3-Dichloropropene	ug/kg	30	50000*	<30	<30	<30	<30	<30
Trichloroethylene	ug/kg	30	31000	<30	<30	<30	<30	<30
Trichlorofluoromethane (FREON 11)	ug/kg	30	NG	<30	<30	<30	<30	<30
Vinyl Chloride	ug/kg	30	NG	<30	<30	<30	<30	<30

NOTES:

Samples analyzed at Maxxam Analytics Inc. - CAEAL accredited

EPA 8260 Analytical Methodology followed

[1] - CCME Canadian Environmental Quality Guidelines for Soils on Industrial Properties (2006 Update).

[2] - Estimated Quantitation Limit

*** - see narrative with guideline regarding use and origin of guideline**

Equals or Exceeds Guidelines

Table B7: HYDROCARBONS IN WATER RESULTS

St. Peter's/Oban Kurdistan Oily Waste Site

Maxxam ID	Units	Guideline 1	GZ8391	GZ8410	GZ8411	GZ8412	GZ8417	GZ8418	GZ8419	IF3907	IF3922	IF3923	IF3924	IF3925	IF3926	IF4055
Sampling Date			31-Aug-10	31-Aug-10	31-Aug-10	31-Aug-10	31-Aug-10	31-Aug-10	31-Aug-10	20-Dec-10	20-Dec-10	20-Dec-10	20-Dec-10	20-Dec-10	20-Dec-10	20-Dec-10
COC Number			B124742	B124742	B124742	B124742	B124742	B124742	B124742	B124763	B124763	B124763	B124763	B124763	B124763	B124763
exp Sample ID			SP10-MW01	SP10-MW03	SP10-MW04	SP10-TR01	SP10-TR03	SP10-TR04	SP10-SW01	SP10-MW01	SP10-MW03	SP10-MW04	SP10-MW05B	SP10-MW00	SP10-SW01	TRENCH #4
Petroleum Hydrocarbons																
Benzene	mg/L	**NG**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Toluene	mg/L	**NG**	<0.001	<0.001	<0.001	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ethylbenzene	mg/L	**NG**	<0.001	<0.001	<0.001	0.21(1)	0.044	0.024	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Xylene (Total)	mg/L	**NG**	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
C6 - C10 (less BTEX)	mg/L	**NG**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
<C10-C16 Hydrocarbons	mg/L	**NG**	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
>C16-C21 Hydrocarbons	mg/L	**NG**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
>C21-<C32 Hydrocarbons	mg/L	**NG**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Modified TPH (Tier1)	mg/L	***	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Notes:

Guideline 1: Atlantic RBCA Version 2.0, Table 8 For Coarse-grained soils on Commercial receptor sites with Non-potable water use and Ingestion

(1) VPH analisis performed on previously opened vial

(2) Fuel oil range

NG - No Guideline; ND - Not detected

*** As per laboratory identified fraction and/or Atlantic RBCA Version 2.0 Table 7, Modified TPH concentration must be compared with appropriate fraction.

Exceeds Guideline 1

Table B8: INORGANICS and METALS IN WATER RESULTS

St. Peter's/Oban Kurdistan Oily Waste Site

Maxxam ID	Units	NS EQS: Groundwater	GZ8391	GZ8410	GZ8411	GZ8412	GZ8417	GZ8420 (Duplicate)	GZ8418	IF3907	IF3922	IF3923	IF3924	IF3925	IF4055 (Duplicate)	NS EQS: Surface Water	GZ8419	IF3926
Sampling Date			31-Aug-10	31-Aug-10	31-Aug-10	31-Aug-10	31-Aug-10	31-Aug-10	31-Aug-10	20-Dec-10	20-Dec-10	20-Dec-10	20-Dec-10	20-Dec-10	20-Dec-10		31-Aug-10	20-Dec-10
COC Number			B124742	B124742	B124742	B124742	B124742	B124742	B124742	B124763	B124763	B124763	B124763	B124763	B124763		B124742	B124763
exp Sample ID			SP10-MW01	SP10-MW03	SP10-MW04	SP10-TR01	SP10-TR03	SP10-TR00	SP10-TR04	SP10-MW01	SP10-MW03	SP10-MW04	SP10-MW05B	SP10-MW00	TRENCH #4		SP10-SW01	SP10-SW01
RCAP CALCULATIONS																		
Anion Sum	me/L	-	12.5	6.8	11.1	7.57	14.8	15.9	25	14.0	7.16	11.9	4.76	4.99	29.0	-	0.86	2.03
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	-	261	268	229	206	289	418	519	288	292	294	215	225	680	-	37	58
Calculated TDS	mg/L	500	716	291	631	390	768	812	1250	805	387	699	298	301	1530	-	48	114
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	3	5	2	<1	<1	8	5	2	2	3	<1	<1	3	-	<1	<1
Cation Sum	me/L	-	10.4	3	9.7	6.65	13.1	13.9	19.8	13.2	6.89	11.9	6.96	6.74	27.4	-	1.04	1.99
Hardness (CaCO3)	mg/L	-	420	94	370	68	260	280	360	580	300	510	300	290	500	-	46	86
Ion Balance (% Difference)	%	-	9.19	38.8	10	6.47	6.1	6.67	11.5	2.87	1.92	0.290	18.8	14.9	2.86	-	9.47	1.00
Langelier Index (@ 20C)	N/A	-	1.12	0.798	0.918	-0.354	-0.121	1.16	1.03	0.961	0.902	1.14	0.268	0.266	0.931	-	-1.19	-0.369
Langelier Index (@ 4C)	N/A	-	0.875	0.549	0.67	-0.603	-0.368	0.916	0.78	0.714	0.653	0.893	0.0190	0.0160	0.687	-	-1.44	-0.619
Saturation pH (@ 20C)	N/A	-	6.98	7.5	7.08	7.95	7.32	7.14	6.98	6.84	7.00	6.86	7.13	7.13	6.77	-	8.59	8.17
Saturation pH (@ 4C)	N/A	-	7.23	7.75	7.33	8.2	7.57	7.38	7.22	7.09	7.25	7.11	7.38	7.38	7.01	-	8.84	8.42
INORGANICS																		
Alkalinity (Total as CaCO3)	mg/L	-	260	270	230	210	290	430	520	290	290	300	220	230	680	-	37	58
Chloride (Cl)	mg/L	250	35	15	31	110	320	260	510	69	9	15	10	10	540	-	4	15
Colour	TCU	15	<5	<5	<5	36	18	17	20	7	6	<5	280	300	150	Narrative	230	62
Nitrate (N)	mg/L	45	0.05	0.05	<0.05	<0.05	<0.05	<0.05	0.08	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	13	0.05	<0.06
Nitrite (N)	mg/L	0	0.01	<0.01	0.01	<0.01	0.01	0.01	<0.01	<1	<0.06	<0.06	<0.06	<0.06	<1	-	<0.01	<0.06
Nitrite + Nitrate	mg/L	0.6	0.06	0.05	<0.05	<0.05	0.06	<0.05	0.08	<1	<0.06	<0.06	<0.06	<0.06	<1	0.06	0.05	<0.06
Nitrogen (Ammonia Nitrogen)	mg/L	0.19	0.22	0.09	0.25	27	11	9.4	15	0.14	0.09	0.18	<0.05	<0.05	15	-	<0.05	<0.05
Total Organic Carbon (C)	mg/L	-	7	1.4	2.4	6.8	11	9.3	13	1.8	1.7	1.4	4.5	4.7	14	-	24	12
Orthophosphate (P)	mg/L	-	<0.01	0.02	<0.01	4.6	<0.01	<0.01	<0.01	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	-	<0.01	<0.3
pH	pH	0	8.1	8.3	8	7.60	7.2	8.3	8	7.80	7.90	8.00	7.40	7.40	7.70	6.5 to 9.0	7.4	7.80
Silica (SiO2)	mg/L	-	12	6.4	9.6	1.2	4	4.5	5.8	13	20	12	16	16	9.6	-	2.2	4.7
Sulphate (SO4)	mg/L	500	300	44	270	<2	<2	<2	<2	300	48	270	8	10	<2	100	<2	21
Turbidity	NTU	-	>1000	>1000	>1000	12	140	120	80	660	>1000	>1000	>1000	>1000	120	-	62	3.2
Conductivity	uS/cm	-	1100	610	1100	790	1800	1500	2500	1200	630	1000	440	450	3000	-	110	200
Elements (ICP-MS)																		
Dissolved Aluminum (Al)	mg/L	0.05	0.01	0.015	0.0094	0.019	0.025	0.022	0.017	0.034	0.024	0.048	0.021	0.03	<0.050	0.005	0.072	0.09
Dissolved Antimony (Sb)	mg/L	0.006	0.0015	0.0016	0.0011	<0.0004	0.0015	<0.0004	<0.0004	0.0015	0.00074	0.0015	0.0011	0.001	<0.004	0.02	<0.0004	<0.00040
Dissolved Arsenic (As)	mg/L	0.01	<0.0006	<0.0006	0.00063	0.0021	0.0014	0.0014	0.0012	0.0012	0.00063	0.003	0.0055	0.0054	<0.006	0.005	<0.0006	<0.00060
Dissolved Barium (Ba)	mg/L	1	0.065	0.062	0.074	0.079	0.27	0.27	0.74	0.044	0.052	0.04	0.13	0.13	0.95	1	0.0083	0.0083
Dissolved Beryllium (Be)	mg/L	0.004	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.005	0.0053	<0.0005	<0.0005
Dissolved Bismuth (Bi)	mg/L	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.02	-	<0.002	<0.002
Dissolved Boron (B)	mg/L	5	<0.1	<0.1	<0.1	0.17	0.45	0.49	0.69	<0.1	<0.1	<0.1	<0.1	<0.1	1.1	1.2	<0.1	<0.1
Dissolved Cadmium (Cd)	mg/L	0.0001	<0.000017	<0.000017	0.000029	0.00013	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.00017	0.00001	0.000022	<0.000017
Dissolved Chromium (Cr)	mg/L	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	-	<0.001	<0.001
Dissolved Cobalt (Co)	mg/L	0.003	0.0016	<0.001	0.0018	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	0.0031	0.0019	0.0019	<0.01	0.004	<0.001	<0.001
Dissolved Lead (Pb)	mg/L	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	0.001	<0.001	<0.001
Dissolved Lithium (Li)	mg/L	-	0.023	0.01	0.023	0.002	0.01	0.01	0.0064	0.022	0.012	0.019	0.015	0.015	0.013	-	<0.001	<0.001
Total Mercury (Hg)	mg/L	0.00026	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.000026	NA	NA
Dissolved Molybdenum (Mo)	mg/L	0.07	0.017	0.018	0.014	<0.004	<0.004	<0.004	<0.004	0.0053	<0.004	0.0061	0.0044	0.0044	<0.04	0.073	<0.004	<0.004
Dissolved Nickel (Ni)	mg/L	0.1	0.0041	<0.003	0.0032	<0.003	<0.003	<0.003	<0.003	0.0039	<0.003	0.011	0.0039	0.004	<0.03	0.025	<0.003	<0.003
Dissolved Phosphorus (P)	mg/L	-	<0.1	<0.1	<0.1	5.1	0.26	0.3	0.37	<0.1	<0.1	<0.1	<0.1	<0.1	<1.0	-	<0.1	<0.1
Dissolved Selenium (Se)	mg/L	0.01	0.0037	<0.001	0.0056	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	0.001	<0.001	<0.001
Dissolved Silver (Ag)	mg/L	0.001	0.00018	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.001	0.0001	<0.0001	<0.0001
Dissolved Strontium (Sr)	mg/L	4.4	1.1	0.31	1.2	0.37	0.84	0.85	1.4	1.3	0.89	1.5	0.63	0.62	2.1	21	0.03	0.048
Dissolved Sulphur (S)	mg/L	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA
Dissolved Thallium (Tl)	mg/L	0.002	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.008	0.0008	<0.0008	<0.0008
Dissolved Tin (Sn)	mg/L	4.4	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	-	<0.02	<0.02
Dissolved Titanium (Ti)	mg/L	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.03	-	<0.003	<0.003
Dissolved Uranium (U)	mg/L	0.02	0.02	0.00072	0.018	<0.00015	<0.00015	<0.00015	<0.00015	0.007	<0.00015	0.0095	0.003	0.0029	<0.0015	0.3	<0.00015	<0.00015
Dissolved Vanadium (V)	mg/L	0.0062	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.02	0.006	<0.002	<0.002
Elements (ICP-OES)																		
Dissolved Calcium (Ca)	mg/L	-	41	29	35	78	150	160	300	170	95	150	90	86	100	-	2.6	26
Dissolved Copper (Cu)	mg/L	0.02	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.02	0.002	<0.002	<0.002
Dissolved Iron (Fe)	mg/L	0.3	<0.1	<0.1	<0.1	2.4	11	11	6.5	0.13	0.51	0.17	<0.1	<0.1	6.6	0.3	0.29	<0.1
Dissolved Magnesium (Mg)	mg/L	-	26	5.3	25	8.6	29	32	48	38	15	33	18	18	60	-	2.6	4.9
Dissolved Manganese (Mn)	mg/L	0.05	0.48	0.12	0.43	0.47	0.84	0.87	1.1	0.89	0.15	0.7	1.7	1.6	1.9	0.82	0.08	0.0047
Dissolved Potassium (K)	mg/L	-	20	3.6	18	15	16	17	17	12	2.3	11	6.2	6.1	2.1	-	<0.6	0.81
Dissolved Sodium (Na)	mg/L	200	140	35	130	16	54	58	85	31	19	31	18	18	360	-	14	5.9
Dissolved Zinc (Zn)	mg/L	0.3	<0.005	0.17	<0.005	0.0078	0.0061	0.011	0.0053	0.058	0.012	<0.005	<0.005	<0.005	<0.05	0.03	0.0096	<0.005

Notes:

Guideline 1: Rationale for the Development of Environmental Quality Standards for Contaminated Sites in Nova Scotia Tier 1: Table A-3 Tier 1 Environmental Quality Standards for Surface Water, Fresh Water, January 2011

Guideline 2: Rationale for the Development of Environmental Quality Standards for Contaminated Sites in Nova Scotia Tier 1: Table A-4 Tier 1 Environmental Quality Standards for Groundwater,

NM = Not measured due to insufficient water;
N/A = Not applicable; NA = Not analysed

AO = Aesthetic Objective

Exceeds NS EQS:Surface Water
Exceeds NS EQS:Groundwater
Exceeds both Guidelines

Table B9: PAH IN GROUNDWATER RESULTS

St. Peter's/Oban Kurdistan Oily Waste Site

Maxxam ID	Units	NS EQS: Groundwater	GZ8410	IF3907	IF3922	IF3923	IF3924	IF3925	IF4055	NS EQS: Surface Water	IF3926
Sampling Date			31-Aug-10	20-Dec-10	20-Dec-10	20-Dec-10	20-Dec-10	20-Dec-10	20-Dec-10		20-Dec-10
COC Number			B124742	B124763	B124763	B124763	B124763	B124763	B124763		B124763
exp Sample ID			SP10-MW03	SP10-MW01	SP10-MW03	SP10-MW04	SP10-MW05B	SP10-MW00	TRENCH #4		SP10-SW01
Polycyclic Aromatic Hydrocarbons											
1-Methylnaphthalene	ug/L	**20**	<0.05	<0.05	<0.05	<0.05	0.06	0.06	<0.05	**2**	<0.05
2-Methylnaphthalene	ug/L	**20**	<0.05	<0.05	<0.05	<0.05	0.10	0.10	<0.05	**2**	<0.05
Acenaphthene	ug/L	**58**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**5.8**	<0.01
Acenaphthylene	ug/L	**0.45**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**4.6**	<0.01
Anthracene	ug/L	**0.12**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.012**	<0.01
Benzo(a)anthracene	ug/L	**0.18**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.018**	<0.01
Benzo(a)pyrene	ug/L	**0.15**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.015**	<0.01
Benzo(b)fluoranthene	ug/L	**4.8**	<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.01	**0.48**	<0.01
Benzo(g,h,i)perylene	ug/L	**1.7**	<0.01	<0.01	<0.01	0.01	0.02	0.02	<0.01	**0.17**	<0.01
Benzo(k)fluoranthene	ug/L	**4.8**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.48**	<0.01
Chrysene	ug/L	**14**	0.01	<0.01	0.03	0.02	0.03	0.03	<0.01	**1.4**	<0.01
Dibenz(a,h)anthracene	ug/L	**2.6**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.26**	<0.01
Fluoranthene	ug/L	**0.4**	<0.01	0.01	0.02	0.03	0.05	0.04	<0.01	**0.04**	<0.01
Fluorene	ug/L	**30**	0.02	<0.01	0.07	0.03	0.05	0.05	<0.01	**3**	<0.01
Indeno(1,2,3-cd)pyrene	ug/L	**2.1**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.21**	<0.01
Naphthalene	ug/L	**11**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	**1.1**	<0.2
Perylene	ug/L	**-**	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	**-**	<0.01
Phenanthrene	ug/L	**4**	0.04	0.02	0.11	0.10	0.13	0.14	0.01	**0.4**	0.01
Pyrene	ug/L	**0.25**	0.01	0.01	0.03	0.03	0.05	0.05	<0.01	**0.025**	<0.01

Notes:

Guideline 1: Rationale for the Development of Environmental Quality Standards for Contaminated Sites in Nova Scotia Tier 1: Table A-3 Tier 1 Environmental Quality Standards for Surface Water, Fresh Water, January 2011

Guideline 2: Rationale for the Development of Environmental Quality Standards for Contaminated Sites in Nova Scotia Tier 1: Table A-4 Tier 1 Environmental Quality Standards for Groundwater, January 2011

NG - No Guideline; ND - Not detected

Exceeds Guideline 1

Exceeds Guideline 2

Exceeds Guideline 1 and 2

Table B10: VOC`s in Water

St. Peter's/Oban Kurdistan Oily Waste Site

Maxxam ID			GZ8391	GZ8410	GZ8411	GZ8412	GZ8417	GZ8418	IF3907	IF3922	IF3923	IF3924	IF3925	IF3926	IF4055
Sample ID	*UNITS*	NSE EQS	40421	40421	40421	40421	40421	40421	B124763	B124763	B124763	B124763	B124763	B124763	B124763
Date Sampled		Groundwater	B124742	B124742	B124742	B124742	B124742	B124742	20-Dec-10	20-Dec-10	20-Dec-10	20-Dec-10	20-Dec-10	20-Dec-10	20-Dec-10
exp Sample ID			SP10-MW01	SP10-MW03	SP10-MW04	SP10-TR01	SP10-TR03	SP10-TR04	SP10-MW01	SP10-MW03	SP10-MW04	SP10-TR01	SP10-TR03	SP10-TR04	SP10-TR04
PARAMETER															
VOC's															
CHLOROBENZENES															
1,2-Dichlorobenzene	ug/L	**7**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichlorobenzene	ug/L	**59**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,4-Dichlorobenzene	ug/L	**5**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlorobenzene	ug/L	**13**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
VOLATILES															
1,1,1-Trichloroethane	ug/L	**100**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2,2-Tetrachloroethane	ug/L	**1**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-Trichloroethane	ug/L	**5**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-Dichloroethane	ug/L	**5**	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1-Dichloroethylene	ug/L	**14**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethane	ug/L	**5**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dichloropropane	ug/L	**5**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Benzene	ug/L	**5**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromodichloromethane	ug/L	**190**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromoform	ug/L	**25**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromomethane	ug/L	**0.89**	<3	<3	<3	<3	<3	<3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Carbon Tetrachloride	ug/L	**5**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloroethane	ug/L	**11000**	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8
Chloroform	ug/L	**18**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloromethane	ug/L	**38**	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8
cis-1,2-Dichloroethylene	ug/L	**20**	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
cis-1,3-Dichloropropene	ug/L	**0.5**	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromochloromethane	ug/L	**190**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	ug/L	**2.4**	<1	<1	<1	170	47	34	<1	<1	<1	<1	<1	<1	5
Ethylene Dibromide	ug/L	**0.05**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Methylene Chloride(Dichloromethane)	ug/L	**50**	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
o-Xylene	ug/L	**NG**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
p+m-Xylene	ug/L	**NG**	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Styrene	ug/L	**100**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tetrachloroethylene	ug/L	**30**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	ug/L	**24**	<1	<1	<1	1	2	1	<1	<1	<1	<1	<1	<1	<1
trans-1,2-Dichloroethylene	ug/L	**20**	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
trans-1,3-Dichloropropene	ug/L	**0.5**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Trichloroethylene	ug/L	**5**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Trichlorofluoromethane (FREON 11)	ug/L	**NG**	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8
Vinyl Chloride	ug/L	**2**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

NOTES:

Samples analyzed at Maxxam Analytics Inc. - CAEAL accredited

Guideline 1: Rationale for the Development of Environmental Quality Standards for Contaminated Sites in Nova Scotia Tier 1: Table A-4 Tier 1 Environmental Quality Standards for Groundwater, January 2011

[6] - Aesthetic Objective

EPA 8260 Analytical Methodology followed

NG - No guideline cited

NA - not applicable

Exceeds Guideline 1

Table B11
St. Peters groundwater elevations

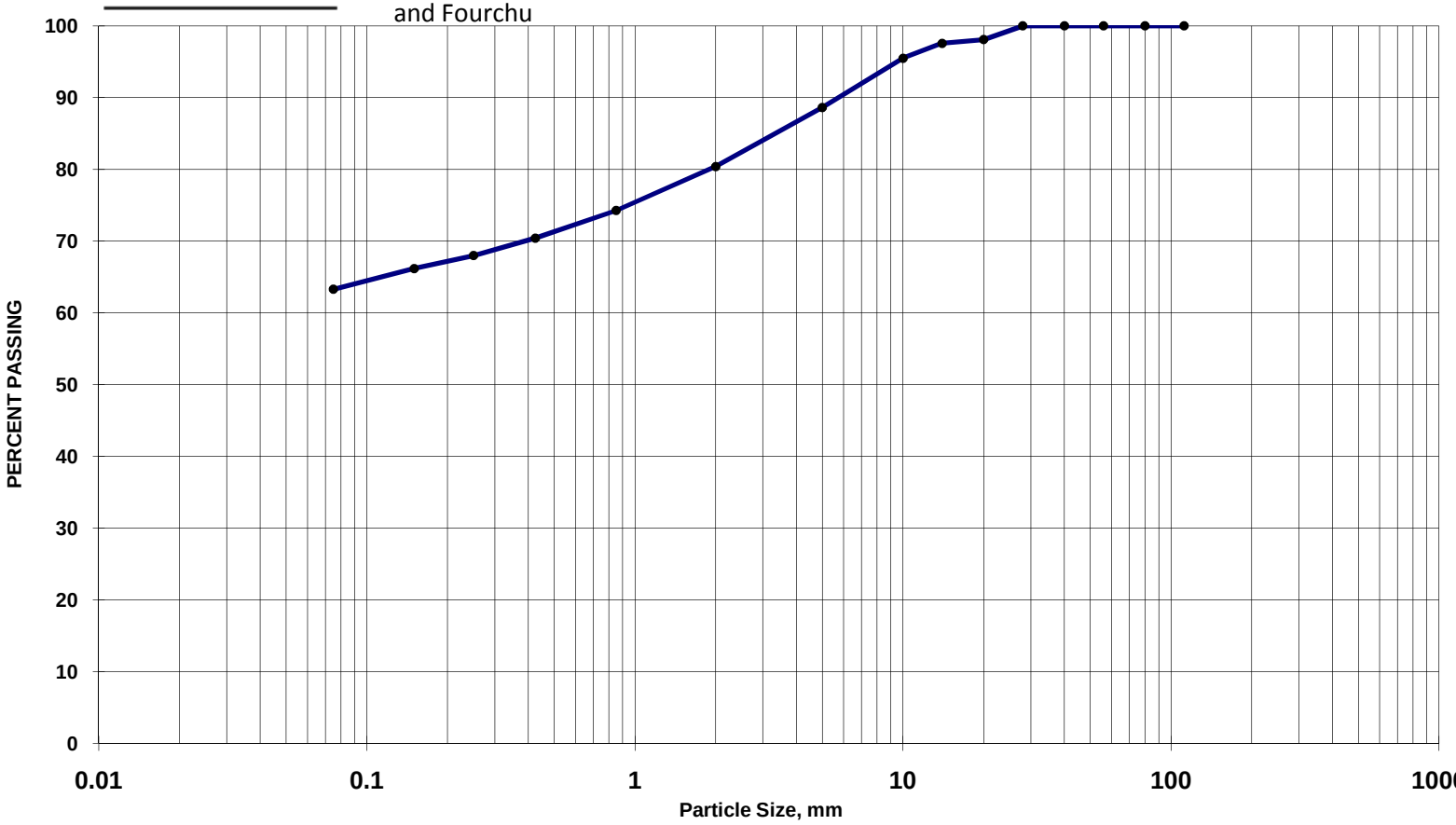
					31-Aug-10		20-Dec-10	
Monitoring Well ID	Ground level, MASL	PVC pipe level, MASL	PVC stick up, m	Total PVC (well depth), m	Water level, m	Water elevation, MASL	Water level, m	Water elevation, MASL
SP10-MW-01	80.8208	81.446	0.6252	9.16	7.86	73.586	3.11	78.336
SP10-MW-02	81.0835	81.7668	0.6833	16.18	dry	dry	dry 16.18	dry
SP10-MW-03	78.9515	79.5729	0.6214	13.8 (23.8?)	19.403	60.1699	19.41	60.1629
SP10-MW-04	79.3882	80.0466	0.6584	9.45	7.63	72.4166	2.573	77.4736
SP10-MW-05A	80.9449	81.5768	0.6319	20.51	NM	NM	dry	dry
SP10-MW-05B	80.9571	81.6189	0.6618	9.24	NM	NM	1.51	80.1089

ADI Limited - ASTM/USCS Sieve Analysis

(L) 0962-183.1

Oily Waste Sites Cape Breton County- Kurdistan Sites Oban and Fourchu

30-Jul-10



TEST DATA	
Sieve Size (mm)	Percent Passing (%)
112	100.0
80	100.0
56	100.0
40	100.0
28	100.0
20	98.1
14	97.6
10	95.5
5	88.6
2	80.4
0.85	74.3
0.425	70.4
0.25	68.0
0.15	66.2
0.075	63.3

Client: NSTIR

Sample: S10-MW03-02

Soil Type: Till

USCS Soil Name: Sandy Silt

Comment: Sample was collected from St. Peter's/Oban

Gravel (%) 11.4

Sand (%) 25.3

Fines (%) 63.3

C_u NA

C_c NA

$W_{content}$(%) 13.2

USCS Symbol: ML

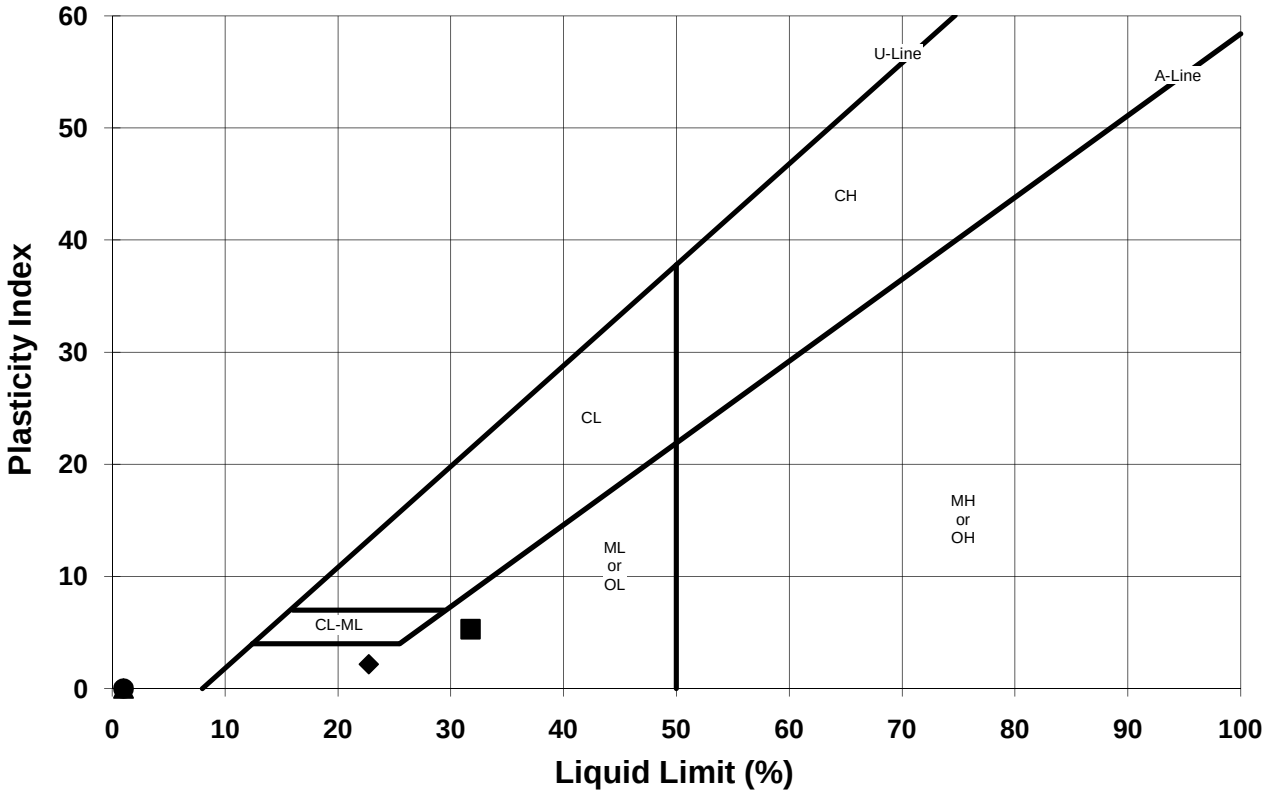
Test By: SC, DM

Specified Gradational Limits		
Size (mm)	Low Limit % Passing	High Limit % Passing
80		
56		
28		
14		
5		
0.16		
0.08		

ADI Limited - Plastic Limits
ASTM D4318

(L)0962-183.1

July 30, 2010



Client: NSTIR

Job No: (L)0962-183.1

Project: Oily Sites Cape Breton

Location: St. Peters/Forchu, NS

Sample Date: Various

Test Date: July 30, 2010

Sample By: SS

Test By: KR/JWB

DATA SUMMARY

Sample #	Liquid Limit	Plastic Limit	Plastic Index	Soil Symbol	Soil Type	Legend
S10-MW03-03	31.7	26.5	5.3	ML or OL	Till	■
F10-MW01-03	22.7	20.6	2.2	ML or OL	Till	◆
						▲
						●

Comment:

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WELL NUMBER SP10-MW05-A

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME St. Peters/Oban Kurdistan Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Oban, Nova Scotia
DATE STARTED 18/11/10 **COMPLETED** 18/11/10
GROUND ELEVATION 81.58 m Geodetic
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD CME 55
AT TIME OF DRILLING ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
						Casing Top Elev: 81.58 (m)
	AS 1				FILL: Silty Sand with gravel, wet from 3 m depth, yellowish to moderate brown, loose to compact	Bentonite seal
2						
	SS 2	70	27 LNAPL sheen was noted on drill water.		3.30	
4	AS 3				TILL: Sandy Silt with some Gravel, compact, moist to dry, greish brown, compact	Cavings and sand
6	SS 4	79	32			
	AS 5					
8						
	SS 6	50	39			
10	RC 7	50 (0)			78.28	Bentonite seal

GENERAL BH / TP / WELL ST PETERS MW.GPJ GINT STD CANADA LAB.GDT 24/10/11

(Continued Next Page)

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WELL NUMBER SP10-MW05-A

CLIENT Nova Scotia Transportation and Infrastructure Renewal

PROJECT NAME St. Peters/Oban Kurdistan Oily Waste Site

PROJECT NUMBER SYD-00020400-A0

PROJECT LOCATION Oban, Nova Scotia

DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
					10.97 70.61 BEDROCK: Mudstone/Siltstone, highly fractured, layered, soft, grey	
12	RC 8	53 (0)				
	RC 9	100 (30)				
14	RC 10	100 (100)				
16	RC 11	100 (100)				Bentonite seal
	RC 12	100 (100)				
18					18.30 63.28 BEDROCK: Siltstone, higly fractured, solid, grey	
	RC 13	40 (40)				Screen in sand
20					20.50 61.08 Borehole terminated at 20.5 metres depth in shallow bedrock. Monitroing well installed. Bottom of borehole at 20.50 meters.	End Cap

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WELL NUMBER SP10-MW05-B

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME St. Peters/Oban Kurdistan Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Oban, Nova Scotia
DATE STARTED 19/11/10 **COMPLETED** 19/11/10
GROUND ELEVATION 81.62 m Geodetic
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD CME 55
AT TIME OF DRILLING 5.00 m / Elev 76.62 m
LOGGED BY SRS **CHECKED BY** FEB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
						Casing Top Elev: 81.62 (m)
	AS 1				FILL: Sandy Silt, trace of debris (wood), grey mottling, hydrocarbon slight odor, loose, wet, grey and yellowish brown	Bentonite seal
2	SS 2	57	3			
	AS 3		Slight hydrocarbon odour was encountered at 3 to 4 meters depth.			Cavings and sand
					3.35 / 78.27 TILL: Sandy Silt, trace gravel, compact. moist to wet, greyish brown	
4						Bentonite seal
	SS 4	70	29 Water was encountered at 5 metres depth.		▽	
6	AS 5					Screen in sand
8	SS 6	100	43		8.22 / 73.40 Bottom of borehole at 8.22 meters.	End Cap

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WELL NUMBER SPO10-MW01

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME St. Peters/Oban Kurdistan Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Oban, Nova Scotia
DATE STARTED 29/7/10 **COMPLETED** 29/7/10
GROUND ELEVATION 81.45 m Geodetic
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD CME 55
AT TIME OF DRILLING ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
						Casing Top Elev: 81.45 (m)
	SS 1	41	8 Ground surface was uneven, low lying vegetation cover.		FILL: Reworked till, Sandy silt, trace gravel, loose to compact, moist, moderate brown, some iron staining	Bentonite seal
2	SS 2	100	16		1.88	79.57
	SS 3	100	Trace weathered sandstone clasts observed in the till at 3.05 to 4.57 metres depth. 29		TILL: Sandy silt, trace gravel (increase to some with depth), compact, moist, greyish brown	Cavings and sand
4	SS 4	100	41			
6	SS 5	100	37			Screen in sand
8	SS 6	100	23 Water was not encountered during drilling.			
	SS 7	100	32		9.75	71.70 End Cap Cavinings
					Borehole terminated at 9.75 metres in Till. Monitoring well installed. Bottom of borehole at 9.75 meters.	

GENERAL BH / TP / WELL ST PETERS MW.GPJ GINT STD CANADA LAB.GDT 24/10/11

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WELL NUMBER SPO10-MW02

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME St. Peters/Oban Kurdistan Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Oban, Nova Scotia
DATE STARTED 28/7/10 **COMPLETED** 28/7/10
GROUND ELEVATION 81.77 m Geodetic
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD CME 55
AT TIME OF DRILLING ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
						Casing Top Elev: 81.77 (m)
	SS 1	0	Ground surface was flat. Grass cover. General area was wooded. 6		FILL: Sand and gravel, some silt, loose to compact, moist, moderate brown	
2	SS 2	16	35		2.13	
					TILL: Sandy Silt, trace gravel, compact, moist, greyish brown	
	SS 3	100	24			
4						
	SS 4	100	25			Cavings and sand
6						
	SS 5	100	27			
8						
	SS 6	100	66			
10			Case pipe run to 12.2 metres.		79.64	Bentonite

GENERAL BH / TP / WELL ST PETERS MW.GPJ GINT STD CANADA LAB.GDT 24/10/11

(Continued Next Page)

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WELL NUMBER SPO10-MW02

CLIENT Nova Scotia Transportation and Infrastructure Renewal

PROJECT NAME St. Peters/Oban Kurdistan Oily Waste Site

PROJECT NUMBER SYD-00020400-A0

PROJECT LOCATION Oban, Nova Scotia

DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
					TILL: Sandy Silt, trace gravel, compact, moist, greyish brown *(continued)*	
12			Occaisional black film on rinse water.			
	SS 7	0	50/0		12.20	69.57
	RC 8	100 (0)	Some silt infilling in fractures at depth.		BEDROCK: Siltstone, highly fractured (sub-horizontal and horizontal), grey	Sand
	RC 9	100 (0)				
14						
	RC 10	100 (0)				Screen in sand
					15.70	66.07 End Cap
					Borehole terminated at 15.7 metres in bedrock. Monitoring well installed. Bottom of borehole at 15.70 meters.	

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WELL NUMBER SPO10-MW03

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME St. Peters/Oban Kurdistan Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Oban, Nova Scotia
DATE STARTED 29/7/10 **COMPLETED** 29/7/10
GROUND ELEVATION 79.57 m Geodetic
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD CME 55
AT TIME OF DRILLING ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
						Casing Top Elev: 79.57 (m)
	SS 1	58	Ground surface was uneven, low lying vegetation cover. 4		0.15 ORGANICS: Rootlets, some topsoil, loose, moist, black 79.42	
					0.61 FILL: Reworked till, Sandy silt, trace gravel, loose to compact, moist, moderate brown, some iron staining 78.96	Bentonite seal
2					TILL: Sandy Silt, trace gravel increase to some with depth, compact, moist, greyish brown	
	SS 2	100	30			
4						
6	SS 3	100	31			
8			Water was not encountered during drilling.			
					9.14 70.43	
	SS 4	100	42		BEDROCK: Mudstone, grey, highly fractured becoming competent with depth	Cavings and sand
10	RC	20				

GENERAL BH / TP / WELL ST PETERS MW.GPJ GINT STD CANADA LAB.GDT 24/10/11

(Continued Next Page)

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WELL NUMBER SPO10-MW03

CLIENT Nova Scotia Transportation and Infrastructure Renewal **PROJECT NAME** St. Peters/Oban Kurdistan Oily Waste Site

PROJECT NUMBER SYD-00020400-A0 **PROJECT LOCATION** Oban, Nova Scotia

DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
	5	(0)			BEDROCK: Mudstone, grey, highly fractured becoming competent with depth *(continued)*	
12	RC 6	20 (0)				
	RC 7	68 (0)				
14	RC 8	100 (0)				
16	RC 9	100 (0)				
18	RC 10	100 (100)	Flecks of mica coming out in wash water.			Bentonite Seal
	RC 11	100 (100)				Sand
20	RC 12	65 (18)				
22	RC	43				Screen in sand

GENERAL BH / TP / WELL ST PETERS MW.GPJ GINT STD CANADA LAB.GDT 24/10/11

(Continued Next Page)

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WELL NUMBER SPO10-MW03

CLIENT Nova Scotia Transportation and Infrastructure Renewal

PROJECT NAME St. Peters/Oban Kurdistan Oily Waste Site

PROJECT NUMBER SYD-00020400-A0

PROJECT LOCATION Oban, Nova Scotia

DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
	13	(0)			BEDROCK: Mudstone, grey, highly fractured becoming competent with depth *(continued)*	
				23.32	Borehole terminated at 23.32 metres in Till. Monitoring well installed. Bottom of borehole at 23.32 meters.	56.25 End Cap

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WELL NUMBER SPO10-MW04

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME St. Peters/Oban Kurdistan Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Oban, Nova Scotia
DATE STARTED 30/7/10 **COMPLETED** 30/7/10
GROUND ELEVATION 80.05 m Geodetic
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD CME 55
AT TIME OF DRILLING ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
						Casing Top Elev: 80.05 (m)
	SS 1	50	Ground surface was uneven, low lying vegetation cover, DNR cleared drill area. 4		0.10 ORGANICS: Rootlets, some topsoil, loose, moist, black 79.95	
					FILL: Reworked till, Sandy silt, trace organics (rootlets), loose, moist, yellowish brown, some iron staining	Bentonite seal
					1.52 78.53	
2					TILL: Sandy silt, trace gravel increase to some with depth, compact, moist, greyish brown	Cavings and sand
	SS 2	92	26			
4						
6	SS 3	71	33			Screen in sand
8			Water was not encountered during drilling.			
	SS 4	25	29			End Cap
					9.75 70.30	Cavinings

Borehole terminated at 9.75 metres in Till. Monitoring well installed.

Bottom of borehole at 9.75 meters.

GENERAL BH / TP / WELL ST PETERS MW.GPJ GINT STD CANADA LAB.GDT 24/10/11

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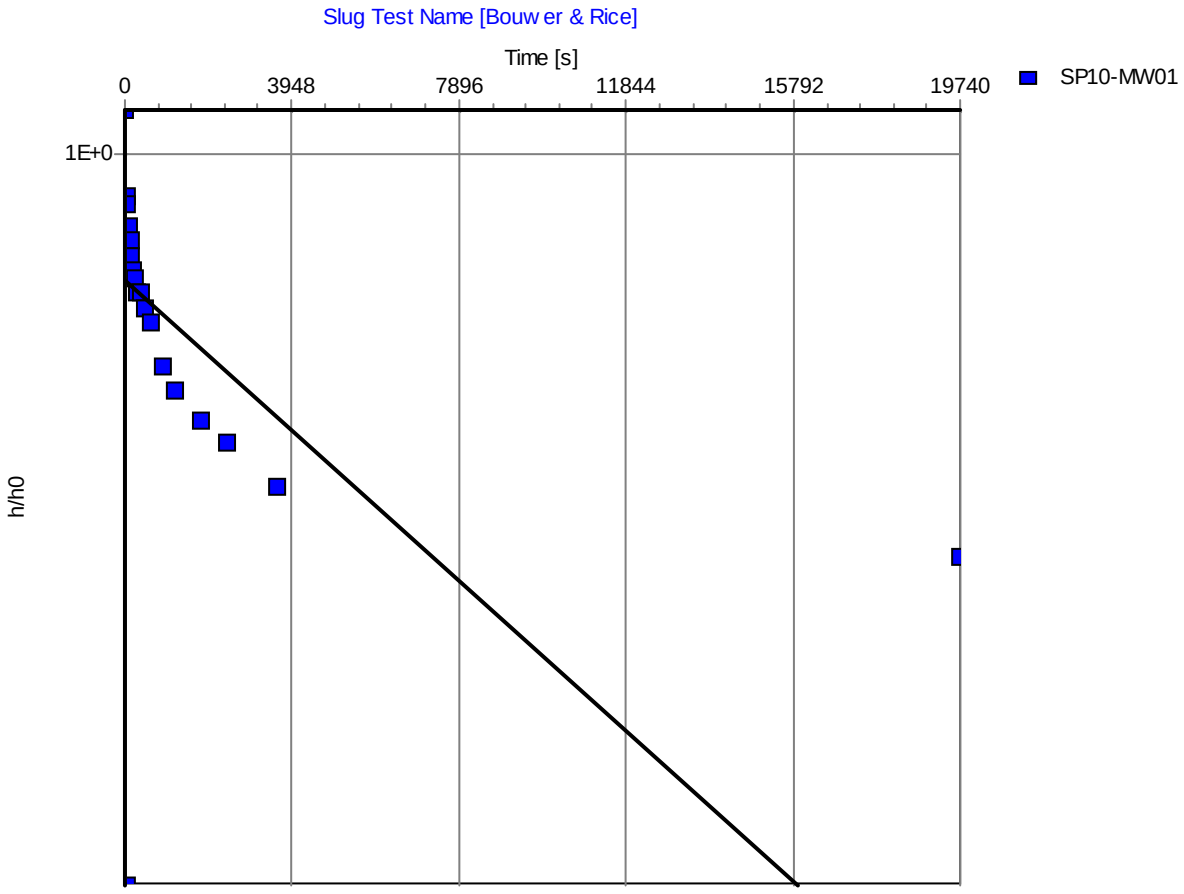
Slug Test Analysis Report

Project: Oban Oily Waste Site

Number: SYD-00020400-A0

Client: NSTIR



Slug Test: **SP10-MW01**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 5.68E-10 [m/s]

Test parameters:

Test Well:	SP10-MW01	Aquifer Thickness:	1.89 [m]
Casing radius:	0.0254 [m]	Gravel Pack Porosity (%)	25
Screen length:	6.75 [m]		
Boring radius:	0.0762 [m]		
r(eff):	0.044 [m]		

Comments:

Evaluated by: AEP

Evaluation Date: 9/17/2010

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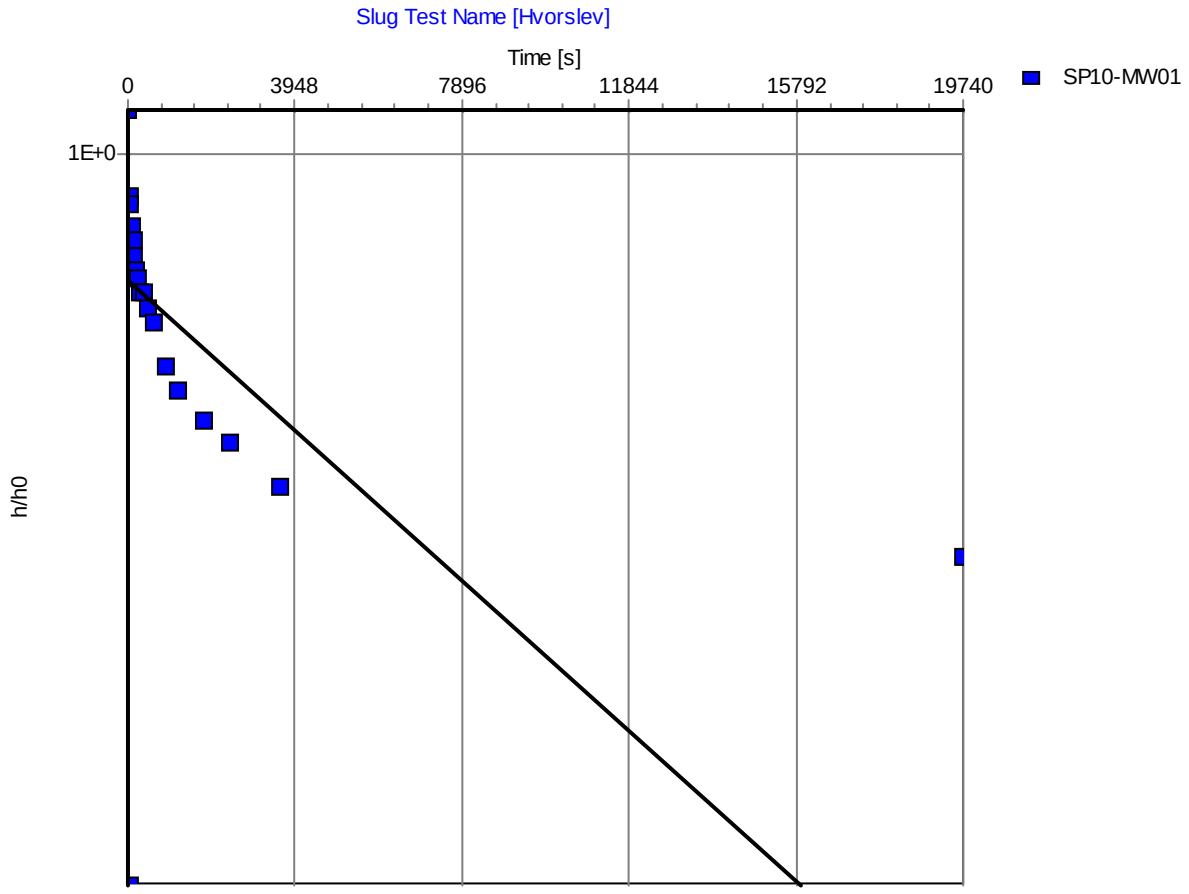
Sydney, NS
Phone: (902) 562-2394

Slug Test Analysis Report

Project: Oban Oily Waste Site

Number: SYD-00020400-A0

Client: NSTIR



Slug Test: **SP10-MW01**

Analysis Method: **Hvorslev**

Analysis Results:

Conductivity: 1.10E-9 [m/s]

Test parameters:

Test Well:	SP10-MW01	Aquifer Thickness:	1.89 [m]
Casing radius:	0.0254 [m]		
Screen length:	6.75 [m]		
Boring radius:	0.0762 [m]		

Comments:

Evaluated by: AEP

Evaluation Date: 9/17/2010

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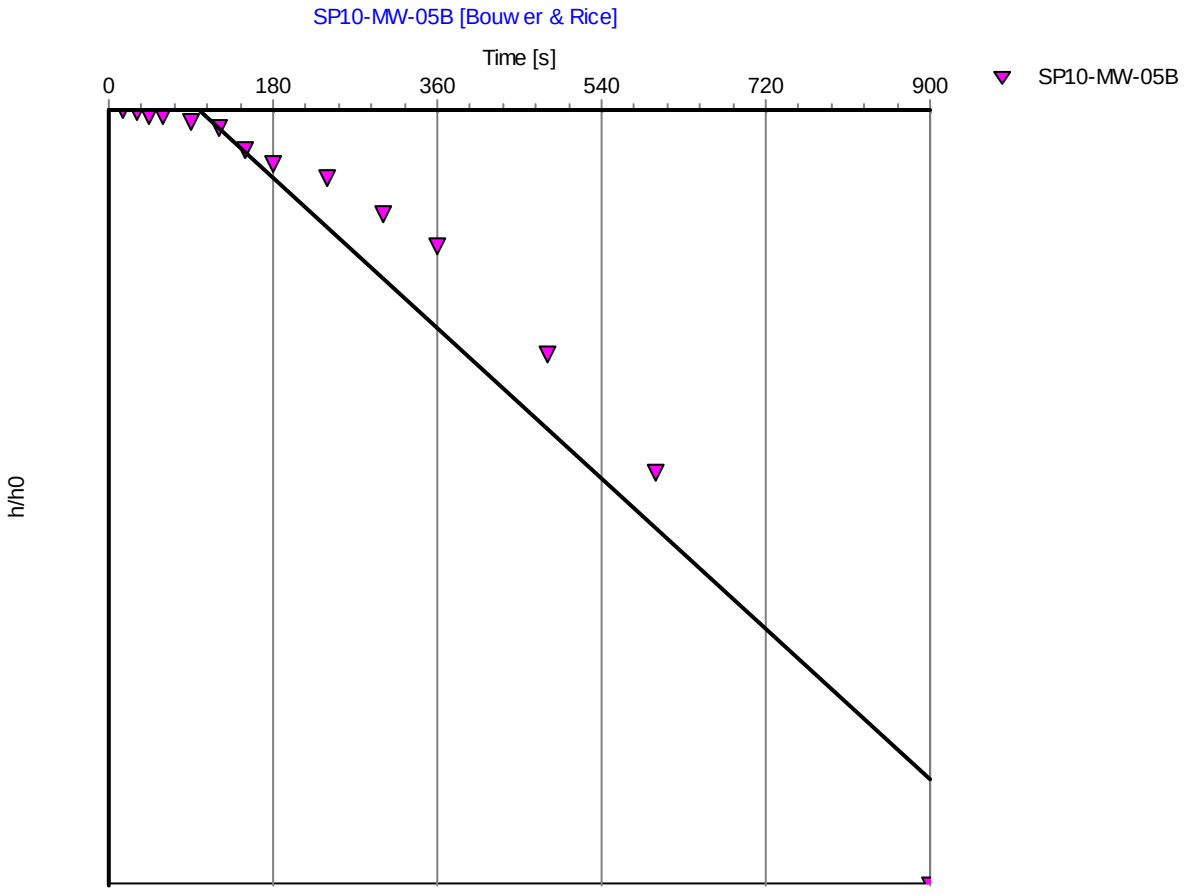
Slug Test Analysis Report

Project: Oban Oily Waste Site

Number: SYD-00020400-A0

Client: NSTIR



Slug Test: **SP10-MW-05B**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 1.54E-6 [m/s]

Test parameters:

Test Well:	SP10-MW-05B	Aquifer Thickness:	7.7 [m]
Casing radius:	0.0254 [m]	Gravel Pack Porosity (%)	25
Screen length:	1.52 [m]		
Boring radius:	0.0762 [m]		
r(eff):	0.044 [m]		

Comments:

Evaluated by: AEP

Evaluation Date: 4/18/2011

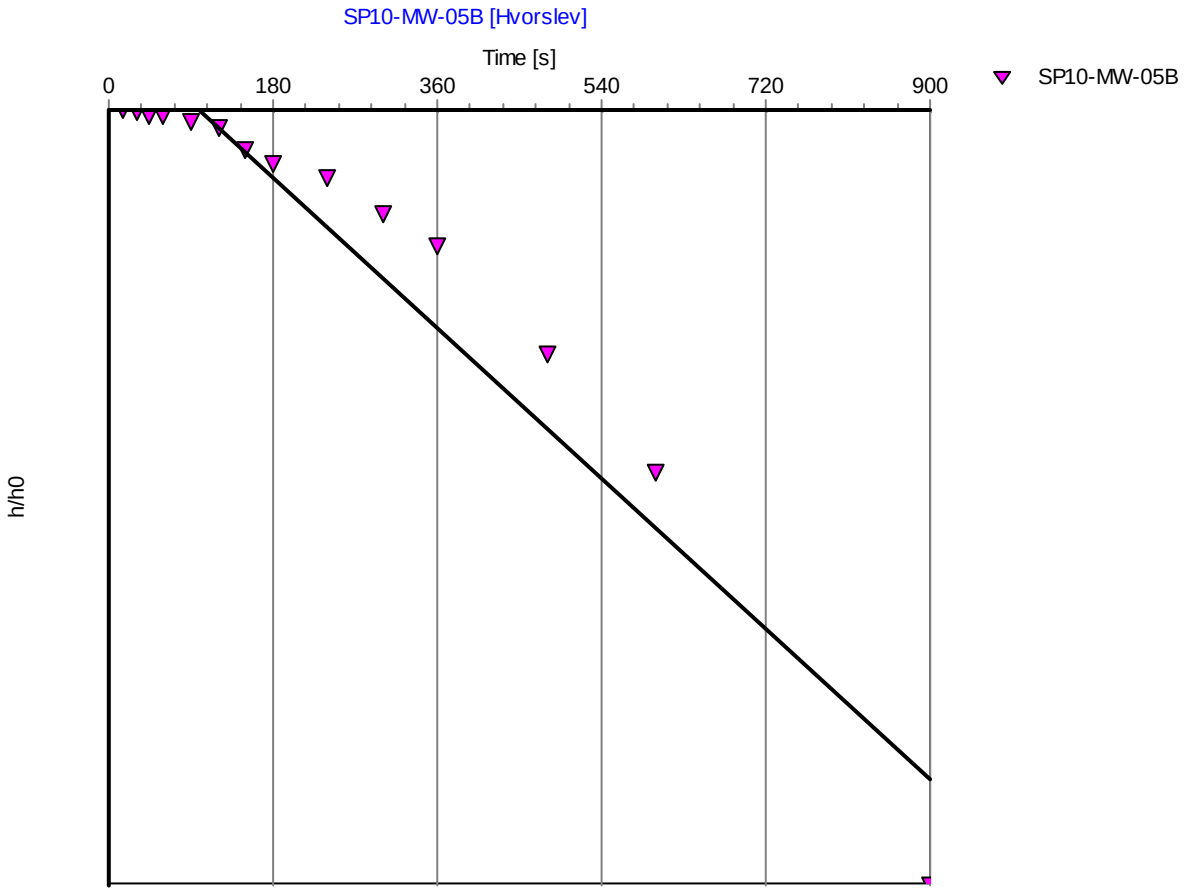
exp.
77 Kings Road
Sydney, NS
Phone: (902) 562-2394

Slug Test Analysis Report

Project: Oban Oily Waste Site

Number: SYD-00020400-A0

Client: NSTIR



Slug Test: **SP10-MW-05B**

Analysis Method: **Hvorslev**

Analysis Results:

Conductivity: 1.45E-6 [m/s]

Test parameters:

Test Well:	SP10-MW-05B	Aquifer Thickness:	7.7 [m]
Casing radius:	0.0254 [m]		
Screen length:	1.52 [m]		
Boring radius:	0.0762 [m]		

Comments:

Evaluated by: AEP

Evaluation Date: 4/18/2011

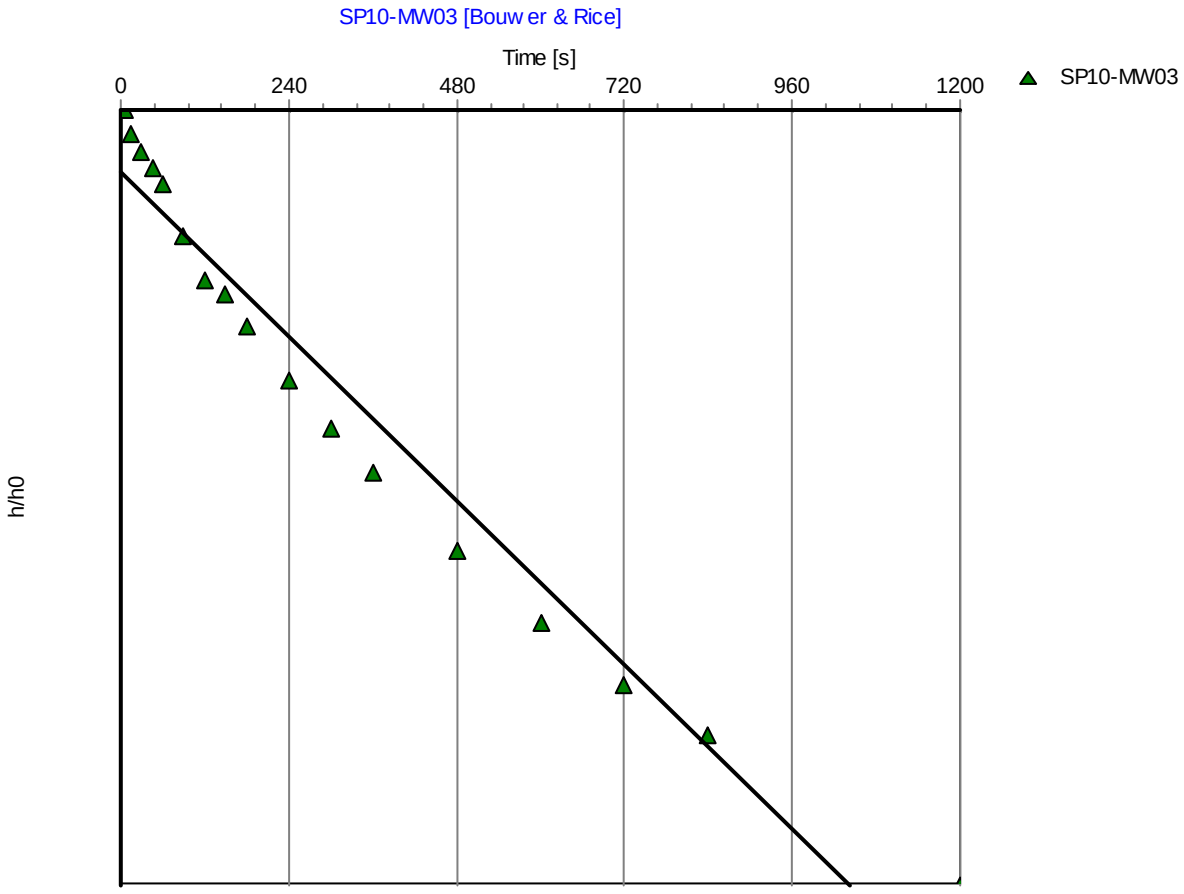
exp.
77 Kings Road
Sydney, NS
Phone: (902) 562-2394

Slug Test Analysis Report

Project: Oban Oily Waste Site

Number: SYD-00020400-A0

Client: NSTIR



Slug Test: **SP10-MW03**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 5.90E-7 [m/s]

Test parameters:

Test Well:	SP10-MW03	Aquifer Thickness:	3.12 [m]
Casing radius:	0.0254 [m]	Gravel Pack Porosity (%)	25
Screen length:	3.12 [m]		
Boring radius:	0.076 [m]		
r(eff):	0.044 [m]		

Comments:

Evaluated by: AEP

Evaluation Date: 9/17/2010

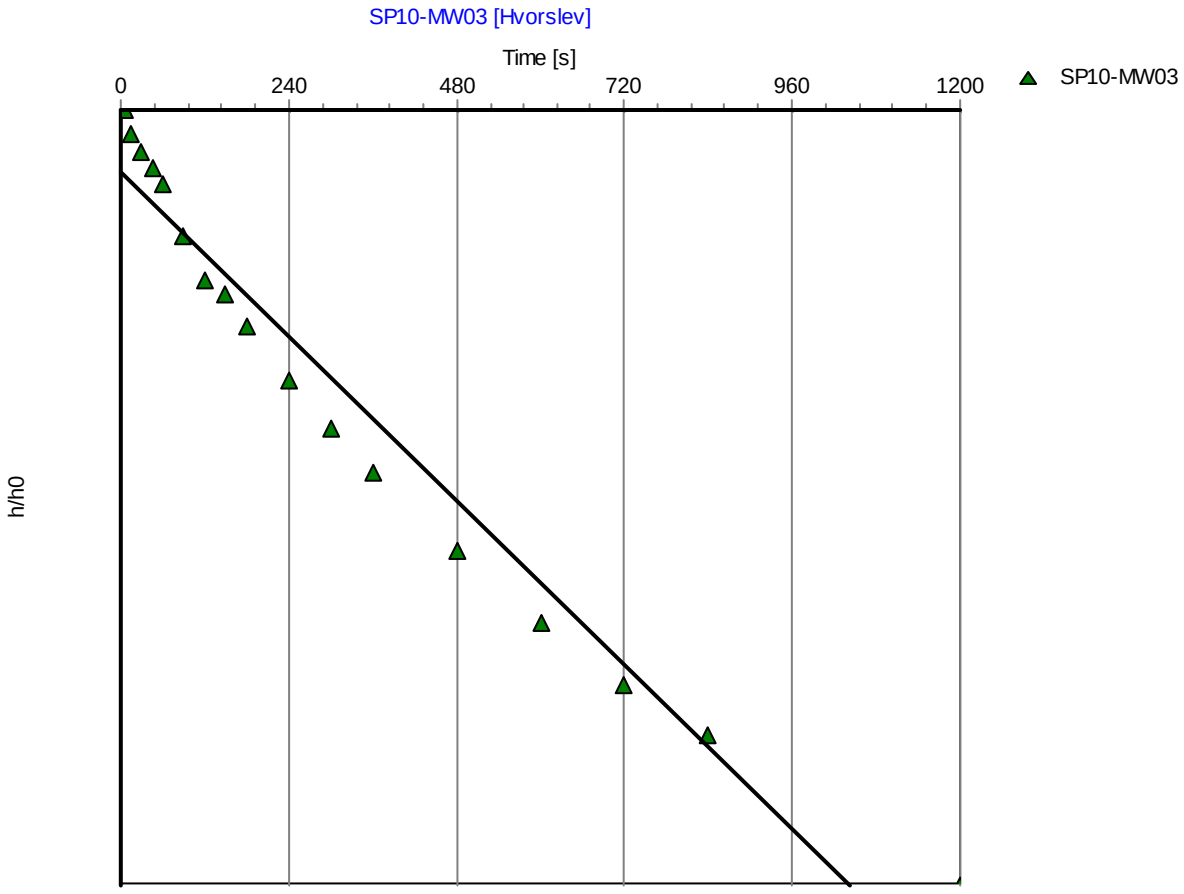
exp.
77 Kings Road
Sydney, NS
Phone: (902) 562-2394

Slug Test Analysis Report

Project: Oban Oily Waste Site

Number: SYD-00020400-A0

Client: NSTIR



Slug Test: **SP10-MW03**

Analysis Method: **Hvorslev**

Analysis Results:

Conductivity: 7.40E-7 [m/s]

Test parameters:

Test Well:	SP10-MW03	Aquifer Thickness:	3.12 [m]
Casing radius:	0.0254 [m]		
Screen length:	3.12 [m]		
Boring radius:	0.076 [m]		

Comments:

Evaluated by: AEP

Evaluation Date: 9/17/2010

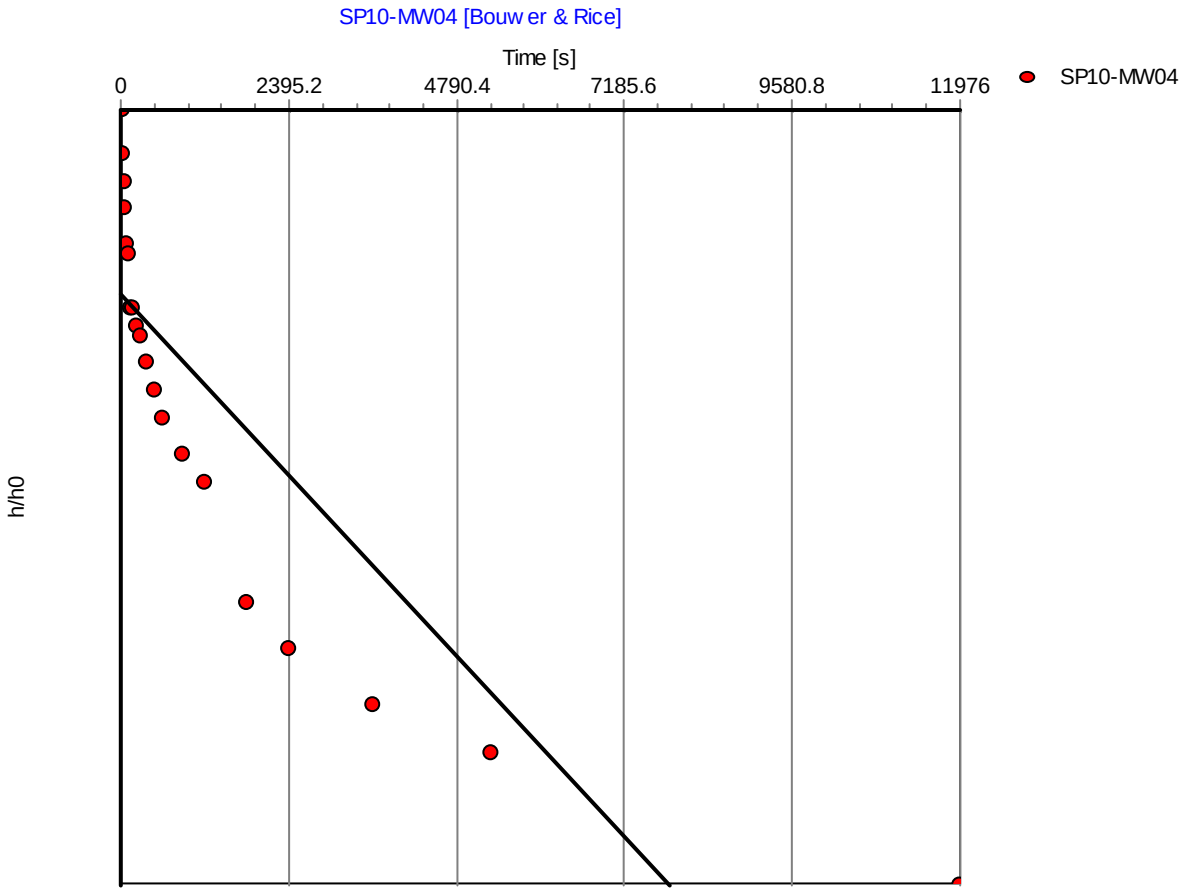
exp.
77 Kings Road
Sydney, NS
Phone: (902) 562-2394

Slug Test Analysis Report

Project: Oban Oily Waste Site

Number: SYD-00020400-A0

Client: NSTIR



Slug Test: **SP10-MW04**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 7.63E-10 [m/s]

Test parameters:

Test Well:	SP10-MW04	Aquifer Thickness:	2.12 [m]
Casing radius:	0.0254 [m]	Gravel Pack Porosity (%)	25
Screen length:	6.1 [m]		
Boring radius:	0.0762 [m]		
r(eff):	0.044 [m]		

Comments:

Evaluated by: AEP

Evaluation Date: 9/17/2010

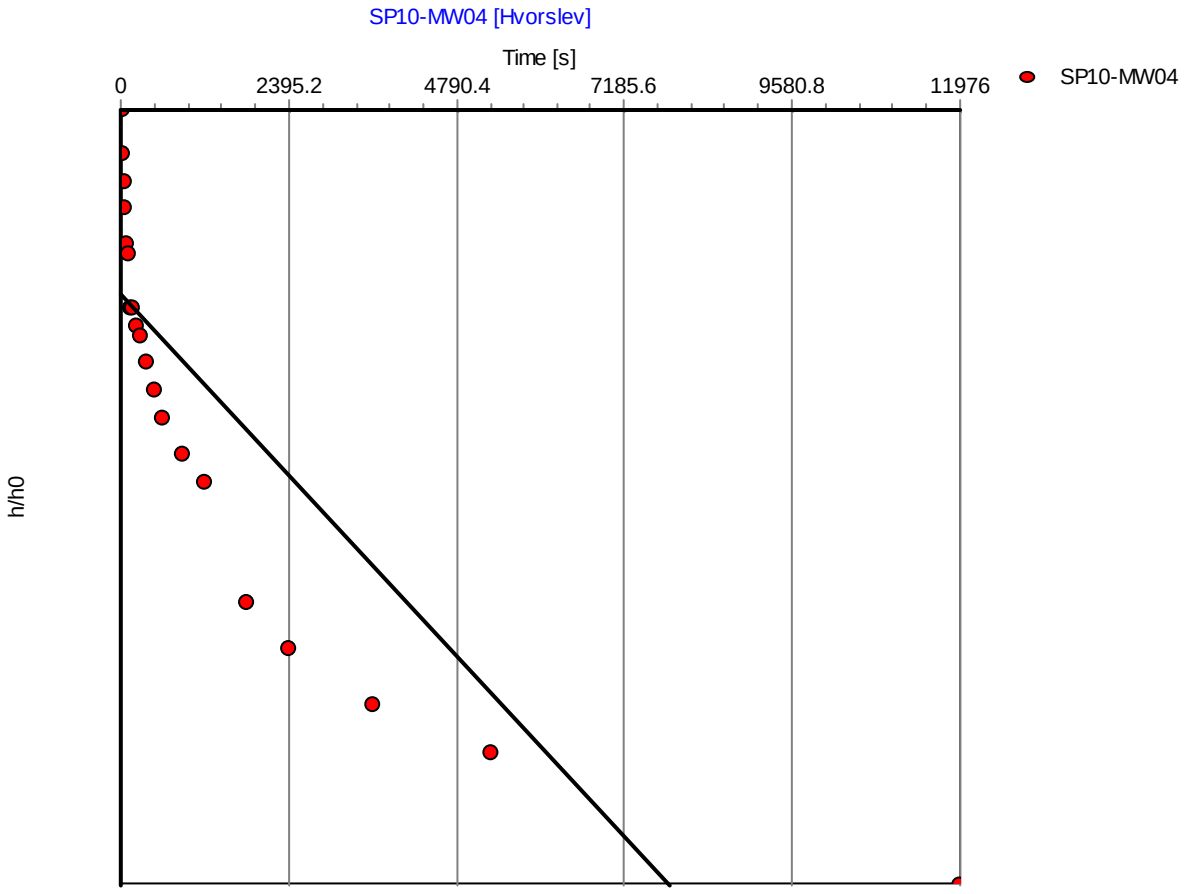
exp.
77 Kings Road
Sydney, NS
Phone: (902) 562-2394

Slug Test Analysis Report

Project: Oban Oily Waste Site

Number: SYD-00020400-A0

Client: NSTIR



Slug Test: **SP10-MW04**

Analysis Method: **Hvorslev**

Analysis Results:

Conductivity: 1.40E-9 [m/s]

Test parameters:

Test Well:	SP10-MW04	Aquifer Thickness:	2.12 [m]
Casing radius:	0.0254 [m]		
Screen length:	6.1 [m]		
Boring radius:	0.0762 [m]		

Comments:

Evaluated by: AEP

Evaluation Date: 9/17/2010

Appendix C
Janvin Island

Table C-1: HYDROCARBONS IN SOIL RESULTS

Janvrins Oily Waste Disposal Site

Maxxam ID	Units	RBCA Commercial Guideline**	IA9826	IA9833	IA9834	IA9835	IA9836
Sampling Date			2-Dec-10	2-Dec-10	2-Dec-10	2-Dec-10	2-Dec-10
COC Number			B124761	B124761	B124761	B124761	B124761
Sample ID			J1A10-TP05	J1A10-TP06	J1A10-TP09	J1A10-TP13	J1A10-TP17
TPH COMPOUNDS							
Benzene	mg/kg	**570**	<0.003	0.004	0.004	<0.003	<0.003
Toluene	mg/kg	**18000**	<0.03	<0.03	<0.03	<0.03	<0.03
Ethylbenzene	mg/kg	**10000**	<0.01	0.58	0.25	<0.01	<0.01
Xylene (Total)	mg/kg	**180000**	<0.05	1.1	1.5	<0.05	<0.05
C6 - C10 (less BTEX)	mg/kg	**13000**	<3	81	63	<3	<3
>C10-C16 Hydrocarbons	mg/kg	**7700**	34	1500	1500	81	20
>C16-C21 Hydrocarbons	mg/kg		250	3800	4200	310	160
>C21-<C32 Hydrocarbons	mg/kg	**12000**	810	5600	5700	890	550
Modified TPH (Tier1)	mg/kg	***	1100	11000	11000	1300	730
Product Identification	na		na	na	na	na	na

Notes:

RDL = Reportable Detection Limit, NG = No guideline

** Atlantic RBCA Version 2.0, Table 8 For Coarse-grained soils on Commercial receptor sites with non-potable water use, Soil Ingestion (2003 update).

(1) Fuel oil / lube oil range.

(2) Fuel oil fraction

(3) Lube oil fraciton. TEH surrogate not within acceptable limits due to sample matrix.

(4) Lube oil fraction

(5) Fuel Oil Fraction and Lube Oil Fraction

*** As per laboratory identified fraction and/or Atlantic RBCA Version 2.0 Table 5, Modified TPH concentration must be compared with appropriate fraction. Shading indicates exceedance of Residential guideline.

TABLE C-2: METALS IN SOIL RESULTS
Janvrins Oily Waste Disposal Site

Maxxam ID	Units	CCME CEQG Industrial Guideline*	IA9826	IA9833	IA9834	IA9835	IA9836
Sampling Date			2-Dec-10	2-Dec-10	2-Dec-10	2-Dec-10	2-Dec-10
COC Number			B124761	B124761	B124761	B124761	B124761
Sample ID			J1A10-TP05	J1A10-TP06	J1A10-TP09	J1A10-TP13	J1A10-TP17
Elements (ICP-MS)							
Aluminum (Al)	mg/kg	-	5500	4800	5100	6500	7600
Antimony (Sb)	mg/kg	**40**	<1	<1	<1	<1	<1
Arsenic (As)	mg/kg	**12**	3	6	3	5	4
Barium (Ba)	mg/kg	**2000**	54	42	31	66	74
Beryllium (Be)	mg/kg	**8**	<1	<1	<1	<1	<1
Boron (B)	mg/kg	-	<7	<7	<7	<7	<7
Cadmium (Cd)	mg/kg	**22**	<0.2	<0.2	<0.2	<0.2	<0.2
Calcium (Ca)	mg/kg	-	4700	7500	7900	2900	2200
Chromium (Cr)	mg/kg	**87**	10	8	9	12	14
Cobalt (Co)	mg/kg	**300**	6	5	6	7	9
Copper (Cu)	mg/kg	**91**	<10	46	<10	13	13
Iron (Fe)	mg/kg	-	15000	25000	14000	18000	18000
Lead (Pb)	mg/kg	**600**	9	11	8	12	9
Lithium (Li)	mg/kg	-	11	12	11	13	16
Magnesium (Mg)	mg/kg	-	3700	3000	4000	3500	4200
Manganese (Mn)	mg/kg	-	390	1000	470	750	990
Mercury (Hg)	mg/kg	**50**	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum (Mo)	mg/kg	**40**	<1	1	<1	<1	<1
Nickel (Ni)	mg/kg	**50**	12	16	12	14	18
Phosphorus (P)	mg/kg	-	250	450	270	280	310
Potassium (K)	mg/kg	-	<400	<400	<400	<400	420
Selenium (Se)	mg/kg	**2.9**	<0.6	<0.6	<0.6	<0.6	<0.6
Silver (Ag)	mg/kg	**40**	<1	<1	<1	<1	<1
Sodium (Na)	mg/kg	-	<400	<400	<400	<400	<400
Strontium (Sr)	mg/kg	-	8	16	13	7	7
Sulphur (S)	mg/kg	-	N/A	N/A	N/A	N/A	N/A
Thallium (Tl)	mg/kg	**1**	<0.7	<0.7	<0.7	<0.7	<0.7
Tin (Sn)	mg/kg	**300**	<10	<10	<10	<10	<10
Titanium (Ti)	mg/kg	-	72	37	44	66	75
Uranium (U)	mg/kg	**300**	<1	<1	<1	<1	<1
Vanadium (V)	mg/kg	**130**	20	24	32	21	29
Zinc (Zn)	mg/kg	**360**	<50	59	59	57	56

Notes:
***** CCME Canadian Environmental Quality Guidelines for **Industrial** site land use (September 2010)
RDL = Reportable Detection Limit
Exceeds Industrial

Table C-3: PAHs IN SOIL RESULTS
Janvrins Oily Waste Disposal Site

Maxxam ID	Units	CCME CEQG Industrial Guideline*	IA9826	IA9833	IA9834	IA9835	IA9836
Sampling Date			2-Dec-10	2-Dec-10	2-Dec-10	2-Dec-10	2-Dec-10
COC Number			B124761	B124761	B124761	B124761	B124761
Sample ID			J1A10-TP05	J1A10-TP06	J1A10-TP09	J1A10-TP13	J1A10-TP17
PAHs							
1-Methylnaphthalene	mg/kg	-	<0.1	7.3	9.2	<0.1	<0.1
2-Methylnaphthalene	mg/kg	-	<0.1	8.3	12	<0.1	<0.1
Acenaphthene	mg/kg	-	<0.1	0.5	0.7	<0.1	<0.1
Acenaphthylene	mg/kg	-	<0.1	0.1	0.2	<0.1	<0.1
Anthracene	mg/kg	-	<0.1	0.2	0.3	<0.1	<0.1
Benzo(a)anthracene	mg/kg	**10**	<0.1	0.5	0.7	<0.1	<0.1
Benzo(a)pyrene	mg/kg	**0.7**	<0.1	0.2	0.3	<0.1	<0.1
Benzo(b)fluoranthene	mg/kg	**10**	<0.1	0.3	0.5	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	-	0.1	0.2	0.3	<0.1	0.1
Benzo(k)fluoranthene	mg/kg	**10**	<0.1	<0.1	0.1	<0.1	<0.1
Chrysene	mg/kg	-	<0.1	1.8	2.6	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	**10**	<0.1	<0.1	0.2	<0.1	<0.1
Fluoranthene	mg/kg	-	<0.1	0.3	0.2	<0.1	<0.1
Fluorene	mg/kg	-	<0.1	2.1	2.5	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	mg/kg	**10**	<0.1	<0.1	0.1	<0.1	<0.1
Naphthalene	mg/kg	**22**	<0.1	1.9	1.9	<0.1	<0.1
Perylene	mg/kg	-	<0.1	0.2	0.3	<0.1	<0.1
Phenanthrene	mg/kg	**50**	<0.1	6.1	8.3	<0.1	<0.1
Pyrene	mg/kg	**100**	<0.1	0.9	1.3	<0.1	<0.1

Notes:

* CCME Canadian Environmental Quality Guidelines for Industrial site land use (September 2006 update)

RDL = Reportable Detection Limit

Exceeds Industrial

Table C-4: PAHs in Soil
Janvrins Oily Waste Disposal Site

Maxxam ID	Units	CCME Direct Contact	CCME PEFs	IA9826	Sample TPE	IA9833	Sample TPE	IA9834	Sample TPE	IA9835	Sample TPE	IA9836	Sample TPE
Sampling Date				2-Dec-10		2-Dec-10		2-Dec-10		2-Dec-10		2-Dec-10	
COC Number				B124761		B124761		B124761		B124761		B124761	
				J1A10-TP05		J1A10-TP06		J1A10-TP09		J1A10-TP13		J1A10-TP17	
PAHs													
1-Methylnaphthalene	mg/kg	NV	-	0.05	-	7.3	-	9.2	-	0.05	-	0.05	-
2-Methylnaphthalene	mg/kg	NV	-	0.05	-	8.3	-	12	-	0.05	-	0.05	-
Acenaphthene	mg/kg	NV	-	0.05	-	0.5	-	0.7	-	0.05	-	0.05	-
Acenaphthylene	mg/kg	NV	-	0.05	-	0.1	-	0.2	-	0.05	-	0.05	-
Anthracene	mg/kg	NV	-	0.05	-	0.2	-	0.3	-	0.05	-	0.05	-
Benzo(a)anthracene	mg/kg	NV	0.1	0.05	0.005	0.5	0.05	0.7	0.07	0.05	0.005	0.05	0.005
Benzo(a)pyrene	mg/kg	NV	1	0.05	0.05	0.2	0.2	0.3	0.3	0.05	0.05	0.05	0.05
Benzo(b)fluoranthene	mg/kg	NV	0.1	0.05	0.005	0.3	0.03	0.5	0.05	0.05	0.005	0.05	0.005
Benzo(g,h,i)perylene	mg/kg	NV	0.01	0.1	0.001	0.2	0.002	0.3	0.003	0.05	0.0005	0.1	0.001
Benzo(k)fluoranthene	mg/kg	NV	0.1	0.05	0.005	0.05	0.005	0.1	0.01	0.05	0.005	0.05	0.005
Chrysene	mg/kg	NV	0.01	0.05	0.0005	1.8	0.018	2.6	0.026	0.05	0.0005	0.05	0.0005
Dibenzo(a,h)anthracene	mg/kg	NV	1	0.05	0.05	0.05	0.05	0.2	0.2	0.05	0.05	0.05	0.05
Fluoranthene	mg/kg	NV	-	0.05	-	0.3	-	0.2	-	0.05	-	0.05	-
Fluorene	mg/kg	NV	-	0.05	-	2.1	-	2.5	-	0.05	-	0.05	-
Indeno(1,2,3-cd)pyrene	mg/kg	NV	0.1	0.05	0.005	0.05	0.005	0.1	0.01	0.05	0.005	0.05	0.005
Naphthalene	mg/kg	NV	-	0.05	-	1.9	-	1.9	-	0.05	-	0.05	-
Perylene	mg/kg	NV	-	0.05	-	0.2	-	0.3	-	0.05	-	0.05	-
Phenanthrene	mg/kg	NV	-	0.05	-	6.1	-	8.3	-	0.05	-	0.05	-
Pyrene	mg/kg	NV	-	0.05	-	0.9	-	1.3	-	0.05	-	0.05	-
B (a) P TPE	mg/Kg	5.3	-	-	0.1215	-	0.36	-	0.669	-	0.121	-	0.1215
Uncertainty Factor	mg/Kg	3	-	-	0.3645	-	1.08	-	2.007	-	0.363	-	0.3645

Notes:

* CCME Canadian Environmental Quality Guidelines for the Protection of Envrionmental and Human Health (2010)

NV - No Value

PEF - Potency Equivalence Factor

Total Potency Equivalent -

Screening:

Bold - Indicates an exceedance of CCME guidelines

Red indicates value was below the reportable detection limit and half the RDL was used for the calculation.

Table C-5: PAHs in Soil
Janvrins Oily Waste Disposal Site

Maxxam ID	Units	CCME Direct Contact	CCME PEFs	IA9826	Sample TPE	IA9833	Sample TPE	IA9834	Sample TPE	IA9835	Sample TPE	IA9836	Sample TPE
Sampling Date				2-Dec-10		2-Dec-10		2-Dec-10		2-Dec-10		2-Dec-10	
COC Number				B124761		B124761		B124761		B124761		B124761	
				J1A10-TP05		J1A10-TP06		J1A10-TP09		J1A10-TP13		J1A10-TP17	
PAHs													
1-Methylnaphthalene	mg/kg	NV	-	0.05	-	7.3	-	9.2	-	0.05	-	0.05	-
2-Methylnaphthalene	mg/kg	NV	-	0.05	-	8.3	-	12	-	0.05	-	0.05	-
Acenaphthene	mg/kg	NV	-	0.05	-	0.5	-	0.7	-	0.05	-	0.05	-
Acenaphthylene	mg/kg	NV	-	0.05	-	0.1	-	0.2	-	0.05	-	0.05	-
Anthracene	mg/kg	NV	-	0.05	-	0.2	-	0.3	-	0.05	-	0.05	-
Benzo(a)anthracene	mg/kg	NV	0.33	0.05	0.0165	0.5	0.165	0.7	0.231	0.05	0.0165	0.05	0.0165
Benzo(a)pyrene	mg/kg	NV	0.37	0.05	0.0185	0.2	0.074	0.3	0.111	0.05	0.0185	0.05	0.0185
Benzo(b)fluoranthene	mg/kg	NV	0.16	0.05	0.008	0.3	0.048	0.5	0.08	0.05	0.008	0.05	0.008
Benzo(g,h,i)perylene	mg/kg	NV	6.8	0.1	0.68	0.2	1.36	0.3	2.04	0.05	0.34	0.1	0.68
Benzo(k)fluoranthene	mg/kg	NV	0.16	0.05	0.008	0.05	0.008	0.1	0.016	0.05	0.008	0.05	0.008
Chrysene	mg/kg	NV	2.1	0.05	0.105	1.8	3.78	2.6	5.46	0.05	0.105	0.05	0.105
Dibenzo(a,h)anthracene	mg/kg	NV	0.23	0.05	0.0115	0.05	0.0115	0.2	0.046	0.05	0.0115	0.05	0.0115
Fluoranthene	mg/kg	NV	-	0.05	-	0.3	-	0.2	-	0.05	-	0.05	-
Fluorene	mg/kg	NV	-	0.05	-	2.1	-	2.5	-	0.05	-	0.05	-
Indeno(1,2,3-cd)pyrene	mg/kg	NV	2.7	0.05	0.135	0.05	0.135	0.1	0.27	0.05	0.135	0.05	0.135
Naphthalene	mg/kg	NV	-	0.05	-	1.9	-	1.9	-	0.05	-	0.05	-
Perylene	mg/kg	NV	-	0.05	-	0.2	-	0.3	-	0.05	-	0.05	-
Phenanthrene	mg/kg	NV	-	0.05	-	6.1	-	8.3	-	0.05	-	0.05	-
Pyrene	mg/kg	NV	-	0.05	-	0.9	-	1.3	-	0.05	-	0.05	-
SQG PW IACR	mg/Kg	1	-	-	0.9825	-	**5.5815**	-	**8.254**	-	0.6425	-	0.9825

Notes:

Notes:

All values expressed in µg/g unless otherwise indicated

NV - No Value

SQG_{PW} - Soil Quality Guideline for Protection of Potable Water

IACR - Index of Additive Cancer Risk

SQG_{PW} IACR - Index of Additive Cancer Risk for Protection of Potable Water - Calculated by dividing the concentration of each PAH in the sample by its SQG_{PW} and summing the results

Screening:

Bold - Indicates an exceedance of CCME guidelines

Red indicates value was below the reportable detection limit and half the RDL was used for the calculation.

References:

Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Soil Quality Guidelines (CEQG), Last Accessed October 2008 - Commercial land use, coarse textured soil

TABLE C-6 Volatile Organics in Soil Results
Janvrins Oily Waste Disposal Site

Maxxam ID	***UNITS***	***EQL*** [2]	**Guideline**[1]	**IA9826**	**IA9834**
Sample ID				**J1A10-TP05**	**J1A10-TP09**
Date Sampled				**2-Dec-10**	**2-Dec-10**
Sample Depth (m)				**JIA10-TP05**	**JIA10-TP09**
PARAMETER					
VOC's					
CHLOROBENZENES					
1,2-Dichlorobenzene	ug/kg	30	10000*	<30	<30
1,3-Dichlorobenzene	ug/kg	30	10000*	<30	<30
1,4-Dichlorobenzene	ug/kg	30	10000*	<30	<30
Chlorobenzene	ug/kg	30	10000*	<30	<30
VOLATILES					
1,1,1-Trichloroethane	ug/kg	30	50000*	<30	<30
1,1,2,2-Tetrachloroethane	ug/kg	30	50000*	<30	<30
1,1,2-Trichloroethane	ug/kg	30	50000*	<30	<30
1,1-Dichloroethane	ug/kg	30	50000*	<30	<30
1,1-Dichloroethylene	ug/kg	30	50000*	<30	<30
1,2-Dichloroethane	ug/kg	30	50000*	<30	<30
1,2-Dichloropropane	ug/kg	30	50000*	<30	<30
Benzene	ug/kg	0.003	5000	<30	<30
Bromodichloromethane	ug/kg	30	NG	<30	<30
Bromoform	ug/kg	30	NG	<30	<30
Bromomethane	ug/kg	200	NG	N/A	N/A
Carbon Tetrachloride	ug/kg	30	50000*	<30	<30
Chloroethane	ug/kg	200	NG	<30	<30
Chloroform	ug/kg	30	50000*	<30	<30
Chloromethane	ug/kg	30	NG	<30	<30
cis-1,2-Dichloroethylene	ug/kg	30		<30	<30
cis-1,3-Dichloropropene	ug/kg	30	50000*	<30	<30
Dibromochloromethane	ug/kg	30	NG	<30	<30
Ethylbenzene	ug/kg	0.01	20000	<30	190
Ethylene Dibromide	ug/kg	30		<30	<30
Methylene Chloride(Dichloromethane)	ug/kg	30	50000*	<30	<30
o-Xylene	ug/kg	30	20000	<30	310
p+m-Xylene	ug/kg	30	20000	<30	510
Styrene	ug/kg	30	50000*	<30	<30
Tetrachloroethylene	ug/kg	30	600	<30	<30
Toluene	ug/kg	0.03	800	<30	52
trans-1,2-Dichloroethylene	ug/kg	30	50000*	<30	<30
trans-1,3-Dichloropropene	ug/kg	30	50000*	<30	<30
Trichloroethylene	ug/kg	30	31000	<30	<30
Trichlorofluoromethane (FREON 11)	ug/kg	30	NG	<30	<30
Vinyl Chloride	ug/kg	30	NG	<30	<30

NOTES:
Samples analyzed at Maxxam Analytics Inc. - CAEAL accredited
EPA 8260 Analytical Methodology followed

[1] **- CCME Canadian Environmental Quality Guidelines for Soils on Industrial Properties (2006 Update).**
[2] **- Estimated Quantitation Limit**
*** - see narrative with guideline regarding use and origin of guideline**
Equals or Exceeds Guidelines

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TEST PIT NUMBER TP JI10-TP01

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Ground surface was flat, test pit oriented east to west, sod cover.		0.08 ORGANICS: Rootmat, trace sand, loose, moist, brown
		No water was encountered.		TILL: Silt, trace sand and gravel, loose, moist, reddish brown
0.5		No oily waste was encountered.		
				0.76

Test pit terminated at 0.76 metres depth on Bedrock refusal. Test pit was backfilled.
Bottom of test pit at 0.76 meters.

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TEST PIT NUMBER TP JI10-TP02

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Ground surface was flat, test pit oriented north to south, field grass cover, just south of foundation.		0.08 ORGANICS: Rootmat, trace sand, loose, moist, brown
				TILL: Silt, trace sand and gravel, compact, moist, reddish brown
0.5		No water was encountered.		
		No oily waste was encountered.		
1.0				
1.5				1.55

Test pit terminated at 1.55 metres depth on Bedrock refusal. Test pit was backfilled.
Bottom of test pit at 1.55 meters.

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TEST PIT NUMBER TP JI10-TP03

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Ground surface was flat, test pit oriented north to south, field grass, root and bark cover.	0.08	ORGANICS: Rootmat, trace sand, loose, moist, brown
				TILL: Silt, trace sand and gravel, compact, moist, reddish brown
0.5		No oily waste was encountered.		
		No water was encountered.		
1.0				
			1.42	

Test pit terminated at 1.42 metres depth on Bedrock refusal. Test pit was backfilled.
Bottom of test pit at 1.42 meters.

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TEST PIT NUMBER TP JI10-TP04

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Ground surface was flat, test pit oriented north to south, dead foliage cover, surrounded by spruce. No oily waste was encountered.		ORGANICS: Rootmat, trace sand, loose, moist, brown
			0.15	TILL: Silt, trace sand and gravel, compact, moist, reddish brown
0.5		No water was encountered.		
			0.76	Test pit terminated at 0.76 metres depth on Bedrock refusal. Test pit was backfilled. Bottom of test pit at 0.76 meters.

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TEST PIT NUMBER TP JI10-TP05

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Ground surface sloping west, test pit oriented north to south, field grass cover.		ORGANICS: Rootmat, trace sand, loose, moist, brown
			0.15	
				FILL: Reworked till, Silt, trace sand and gravel, loose, reddish brown
			0.25	
		Hydrocarbon odour, oily waste encountered at 0.25 to 0.69 metres depth.		FILL: Sand and Gravel, loose, moist, dusky brown
0.5				
			0.69	
				TILL: Silt, trace sand and gravel, loose, compact, moist, reddish brown
1.0		No water was encountered.		
1.5			1.63	

Test Pit terminated at 1.63 metres depth on Bedrock refusal. Test pit was backfilled.
Bottom of test pit at 1.63 meters.

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TEST PIT NUMBER TP JI10-TP06

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Ground surface was level, test pit oriented northeast to southwest, sod cover.		ORGANICS: Rootmat
				0.15
				FILL: Reworked till, Silt, trace sand and gravel, loose, reddish brown
0.5		Oily waste, some tar, strong hydrocarbon odour encountered at 0.74 to 1.09 metres depth.		
				0.74
				FILL: Sand and Gravel, loose, moist, dusky brown
1.0				
				1.09
				TILL: Silt, trace sand and gravel, loose, moist, reddish brown
1.5		No water was encountered.		
				1.85

Test pit terminated at 1.85 metres depth on Bedrock refusal. Test pit was backfilled.
Bottom of test pit at 1.85 meters.

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TEST PIT NUMBER TP JI10-TP07

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION 1.25 m
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Ground surface sloping west, test pit oriented east to west, moss and alder cover.		0.10 ORGANICS: Rootmat, trace sand, loose, moist, brown
				TILL: Silt, trace sand and gravel, loose to compact, moist, reddish brown
0.5		No oily waste was encountered.		
		Water slowly trickling into test pit at depth, slight manganese precipitate on surface		
1.0				
				1.24 ▽

Test pit terminated at 1.25 metres depth on Bedrock refusal. Test pit was backfilled.
Bottom of test pit at 1.24 meters.

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TEST PIT NUMBER TP JI10-TP08

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Ground surface flat, test pit oriented east to west, middle of clearing, sod cover. Oily waste, no tar, strong hydrocarbon odour encountered at 0.28 to 0.81 metres depth.		0.08 ORGANICS: Rootmat, trace sand, loose, moist, brown
				FILL: Reworked till, Silt, rootlets, trace sand and gravel, loose, moist, reddish brown
				0.28 FILL: Sand and Gravel, loose, moist, dusky brown
0.5				
				0.81 TILL: Silt, some sand and gravel, loose, moist, reddish brown
		No water was encountered.		
1.0				1.09

Test pit terminated at 1.09 metres depth in Till. Test pit was backfilled.
Bottom of test pit at 1.09 meters.

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TEST PIT NUMBER TP JI10-TP09

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Ground surface was sloped west, test pit oriented east to west.		0.05 ORGANICS: Rootmat, trace sand, loose, moist, brown
				FILL: Reworked till, Silt, trace sand and gravel, loose, moist, reddish brown
		Oily waste, strong hydrocarbon odour encountered at 0.36 to 0.84 metres depth.		0.36
0.5				FILL: Sand and Gravel, trace tar, loose, moist, dusky brown and black
				0.84
1.0		Sample Collected		TILL: Silt, trace sand and gravel, some cobbles at depth, compact, moist, reddish brown
		No water was encountered.		1.40

Test pit terminated at 1.40 metres depth in Till. Test pit was backfilled.
Bottom of test pit at 1.40 meters.

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TEST PIT NUMBER TP JI10-TP10

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Ground surface was flat, test pit oriented east to west.		0.05 ORGANICS: Rootmat, some sand, loose, moist, brown
				FILL: Reworked till, Silt, trace cobble and boulders, loose, moist, moderate brown
0.5		No water was encountered. No oily waste was encountered.		
				0.84 TILL: Silt, trace sand and gravel, some cobble at depth, compact, moist, moderate brown
1.0				
1.5				1.52

Test pit terminated at 1.52 metres depth on Bedrock. Test pit was backfilled.
Bottom of test pit at 1.52 meters.

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TEST PIT NUMBER TP JI10-TP11

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
▽ **AT TIME OF EXCAVATION** 0.76 m
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Cut transect line in north to south, test pit oriented north to south, dead vegetation (leaves) on surface.	0.08	ORGANICS: Rootmat, trace sand, loose, moist, brown
				TILL: Silt, trace gravel and cobble, loose, moist, reddish brown
0.5		No oily waste was encountered.		
		Slight water seepage at 0.76 metres oriented North to South in a 0.31 meter diameter area.	▽	
1.0				
			1.40	

Test pit terminated at 1.40 metres depth in till. Test pit was backfilled.
Bottom of test pit at 1.40 meters.

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TEST PIT NUMBER TP JI10-TP12

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Ground surface slopes north, test pit oriented north to south, ground surface was moss covered with alders.		0.08 ORGANICS: Rootmat, trace sand, loose, moist, brown
				FILL: Reworked till, Silt, some gravel and cobbles, trace boulder, loose, moist, reddish brown
0.5				
1.0		No water was encountered.		1.09
				TILL: Silt, some gravel and cobbles, loose to compact, moist, reddish brown
1.5		No oily waste was encountered.		
2.0				2.03

Test pit terminated at 2.032 metres depth on friable mudstone bedrock. Test pit was backfilled.
Bottom of test pit at 2.03 meters.

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TEST PIT NUMBER TP JI10-TP13

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Ground surface uneven, located north of road 3.05 metres inside the tree line, test pit oriented north to south, sod cover.		0.05 ORGANICS: Rootmat, trace sand, loose, moist, brown
				FILL: Reworked till, Silt, trace sand and gravel, loost, moist, reddish brown
				0.25 FILL: Sand and Gravel, loose, moist, dusky brown
0.5		Oily waste, slight hydrocarbon odour		
1.0				
		Water inflow at fill/till interface.		1.37 TILL: Silt, trace sand, gravel and cobbles, compact, moist, reddish brown
1.5		Sample collected.		1.80
				1.83 Test pit terminated at 1.83 metres depth in Till. Test pit was backfilled. Bottom of test pit at 1.80 meters.

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TEST PIT NUMBER TP JI10-TP14

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Ground surface was uneven, located in ditch for road, oriented north to south.	0.05	ORGANICS: Rootmat, some sand, loose, moist, brown
				FILL: Reworked till, Silt, some cobble and roots, loose, moist, reddish brown
0.5		Oily waste on north face from 0.43 to 0.56 metres depth.		FILL: Sand and Gravel, loose, moist, dusky brown
			0.56	
			0.86	
1.0		Water was not encountered.		TILL: Silt, loost to compact, moist, reddish brown
			1.22	

Test pit terminated at 1.22 metres depth in Till. Test pit was backfilled.
Bottom of test pit at 1.22 meters.

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TEST PIT NUMBER TP JI10-TP15

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION 1.27 m
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Ground surface was sloping north, test pit oriented north to south.		FILL: Sand and gravel, rootlets, loose, moist, dusky brown
				0.30
				TILL: Silt, some sand, gravel and cobble, compact, moist, reddish brown
0.5				
1.0		Water inflow from south at 1.27 metres depth.		▽
1.5		No oily waste was encountered.		
				1.93
				Test pit terminated at 1.93 metres depth in Till. Test pit was backfilled. Bottom of test pit at 1.93 meters.

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TEST PIT NUMBER TP JI10-TP16

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Ground surface was uneven, moss cover, located north of road and south of berm.	0.05	ORGANICS: Rootmat, trace sand, loose, moist, brown
				FILL: Reworked till, Silt, some cobble and boulder, loose, moist, reddish brown
0.5		No oily waste was encountered.		
		Water inflow at 0.70 metres depth.	0.69	TILL: Silt, trace sand and gravel, compact, moist, reddish brown
1.0				
1.5			1.63	Test pit terminated at 1.63 metres depth. Test pit was backfilled. Bottom of test pit at 1.63 meters.

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TEST PIT NUMBER TP JI10-TP17

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION 0.99 m
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		At request of NSDNR, dug through berm/embankment, test pit oriented north to south, ground surface was flat.		0.05 ORGANICS: Rootmat, trace sand, loose, moist, brown
				FILL: Reworked till, Silt, trace rootlets, loose, moist, reddish brown
				0.41
0.5		Oily Waste from 0.41 to 0.61 metres.		FILL: Sand and gravel, loose, moist, dusky brown
				0.61
				TILL: Silt, trace sand and gravel, compact, moist, reddish brown
		Sample collected.		
		Water inflow at 0.99 metres depth		0.99 ▽
				Test pit terminated at 0.99 metres depth in Till. Test pit was backfilled. Bottom of test pit at 0.99 meters.

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TEST PIT NUMBER TP JI10-TP18

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Ground surface was mounded, test pit oriented north to south. Oily waste on west face only at 0.15 to 0.36 metres depth.	0.05	ORGANICS: Rootmat, trace sand, loose, moist, brown
			0.15	FILL: Reworked till, Silt, some boulders, loose, moist, reddish brown
				FILL: Sand and Gravel, loose, moist, dusky brown
			0.36	TILL: Silt, some sand, compact, moist, reddish brown
0.5				
		No water was encountered.		
1.0			1.02	

Test pit terminated at 1.02 metres depth in Till. Test pit was backfilled.
Bottom of test pit at 1.02 meters.

exp Services Inc.
77 Kings Road
Sydney, Nova Scotia, B1L 1A1
Telephone: 902-562-2394
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TEST PIT NUMBER TP JI10-TP19

CLIENT Nova Scotia Transportation and Infrastructure Renewal
PROJECT NAME Janvrins Island Oily Waste Site
PROJECT NUMBER SYD-00020400-A0
PROJECT LOCATION Janvrins Island
DATE STARTED 2/12/10 **COMPLETED** 2/12/10
GROUND ELEVATION
EXCAVATION CONTRACTOR Norvon Construction
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 311C
AT TIME OF EXCAVATION ---
LOGGED BY SRS **CHECKED BY** FEB
AT END OF EXCAVATION ---
NOTES Located via hand held Garmin e-trex Summit GPS
AFTER EXCAVATION ---

DEPTH (m)	SAMPLE TYPE NUMBER	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
		Ground surface was uneven, test pit oriented east to west, located in a ditch north of the road.		0.05 ORGANICS: Rootmat, trace sand, loose, moist, brown
				FILL: Reworked till, Silt, compact, moist, reddish brown
0.5		No water was encountered.		
		Black staining around one cobble but no odour, possible organics.		0.81 TILL: Silt, compact, trace cobble and gravel, moist, reddish brown
1.0				
				1.40

Test pit terminated at 1.40 metres depth in Till. Test pit was backfilled.
Bottom of test pit at 1.40 meters.