# PHASE II ENVIRONMENTAL SITE ASSESSMENT

## PROPOSED COMMERICAL DEVELOPMENT
## 14TH STREET AND ABERDEEN AVENUE
## BRANDON, MANITOBA

Submitted to:

**3829724 Manitoba Limited**
c/o Shindico Realty
Number 100 - One Evergreen Place
Winnipeg, Manitoba
R2L 0B9

Attention: Mr. Robert Shindleman

Submitted by:

**AMEC Earth & Environmental Limited**
440 Dovercourt Drive
Winnipeg, Manitoba
R3Y 1N4

14 June 2002

WX05421

## EXECUTIVE SUMMARY

AMEC Earth & Environmental Limited (AMEC) of Winnipeg, Manitoba was retained by Mr. Robert Shindleman of Shindico Realty, acting on behalf of 3829724 Manitoba Limited, to complete an environmental assessment at the site of a proposed commercial development in Brandon, Manitoba.

The proposed commercial development is located at the site of a former oil refinery which ceased operations in 1969. The primary oil refining operations were located northwest of the site, with the subject area apparently used for product and waste storage. The site conditions within the area of the proposed commercial development have been well documented through past investigations (AMEC and others) and the soil and groundwater at the site are known to be impacted with petroleum hydrocarbons. The purpose of AMEC's Phase II ESA was to determine the degree of impacts within the proposed building and parking areas and assess how these impacts may affect site development.

Petroleum hydrocarbon (PHC) staining was observed at the majority of test hole locations, typically near the observed water table which varied between about 2.0 and 3.0 m from grade. Significant staining of the surficial soils was not prevalent across the site, however, was observed at some locations. Elevated soil vapour concentrations were identified at a number of test holes, most notably at TH02-12, TH02-15, TH02-16, TH02-17, TH02-18 and TH02-25. Moderately elevated soil vapour concentrations were also noted at TH02-9, TH02-13, TH02-14 and TH02-23. The maximum vapour concentration of >100% LEL was measured at three locations; TH02-15, TH02-17 and TH02-18. The remaining soil vapour concentrations were considered to be at or near background levels.

Exceedances of the applicable guideline criteria were identified at TH02-15 (benzene, ethylbenzene, xylenes and F1 to F3), TH02-16 (toluene, xylenes and F1 to F3), TH02-17 (xylenes and F1 to F2) and TH02-25 (F1 to F3). The remaining six samples analysed contained PHC concentrations less that the applicable guideline criteria.

The site assessment confirmed the findings of previous investigations, which had identified hydrocarbon impacts throughout much of the western and southern portions of the proposed development area. The investigation did not, however, identify conditions which would alter previous recommendations which had indicated that commercial development could proceed. AMEC is of the opinion that the proposed food store can be developed at the site and that the items recommended in Section 5.0 provide adequate measures to limit future liabilities and protect the health and safety of users of the property.

While the potential for future remedial requirements cannot be fully discounted, the likelihood is considered to be low. Previous investigations have concluded that there is no substantial off-site contaminant migration and there are no sensitive receptors in the immediate vicinity of the property. Furthermore, Manitoba Conservation has indicated in writing that there are no current remedial requirements in this area of the site and that commercial development of the property could proceed. If remediation was required at a future date, the Manitoba Contaminated Sites legislation identifies that the polluting party will be held responsible for remedial requirements.

Design of the development should recognize the limitations imposed by the subsurface conditions and allow for contingencies in the event that unexpected conditions are encountered. Detailed review of the final design drawings for the development should be completed to assess environmental issues. As well, environmental controls and work plans will be required during construction to identify, evaluate and direct disposal of all impacted soils. Appropriate budgets should be allocated to address these issues during the construction program.

amec

## TABLE OF CONTENTS

## TABLE OF CONTENTS (cont)

### LIST OF TABLES



### LIST OF FIGURES



### LIST OF APPENDICES

## 1.0 INTRODUCTION

AMEC Earth & Environmental Limited (AMEC) of Winnipeg, Manitoba was retained by Mr. Robert Shindleman of Shindico Realty, acting on behalf of 3829724 Manitoba Limited, to complete a Phase II Environmental Site Assessment (ESA) at the site of a proposed commercial development in Brandon, Manitoba.

The proposed commercial development is located at the site of a former oil refinery which ceased operations in 1969. The primary oil refining operations were located northwest of the site, with the subject area apparently used for product and waste storage. The site conditions within the area of the proposed commercial development have been well documented through past investigations (AMEC and others) and the soil and groundwater at the site are known to be impacted with petroleum hydrocarbons. The purpose of AMEC's Phase II ESA was to determine the degree of impacts within the proposed building and parking areas and assess how these impacts may affect site development.

The investigation was completed concurrently with a geotechnical investigation of the site, the results of which have been reported under separate cover.

## 2.0 BACKGROUND INFORMATION

It was AMEC's understanding that the site development was to include a proposed office supplies store as well as a food store. The office supplies store was to be located at the northeast corner of the site and was to have a plan area in the order of 2400 $m^2$. The food store, with a plan area of 4000 $m^2$, was to be centrally located along the east side of the site, immediately south of the office supplies store. It was understood that both buildings would be basementless. The area to the west and southwest of the buildings was to be developed as a paved parking area. Small parking areas and loading docks for the two stores were also to be located to the east of the buildings. It is understood that the southeast corner of the site will not be developed. A site plan showing the proposed site layout is attached, Figure 1.

Prior to completion of the ESA, AMEC completed a detailed review of available information for the project site. Reports dating from 1972 to 1999 were provided to AMEC by Shindico Realty. AMEC completed two reports which summarized the findings of the previous investigations, the first dated 05 November 2001 and the second dated 1 May 2002. In brief, the reports identified the following information:

- Elevated subsurface hydrocarbon concentrations are present within much of the site (both parking and building areas) and may influence construction methods, procedures and costs;
- Hydrocarbon impacts are present in the form of dissolved hydrocarbons in the groundwater and residual hydrocarbons within the soil. Liquid hydrocarbons are present within isolated areas;

- The area of highest impacts appears to be located within the western portions of the parking lot, as well as within the southern end of the food store building area;
- It was expected that adequate measures could be put in place to provide protection against these contaminants such that they do not impact the proposed development or pose a future health and safety concern; and
- Manitoba Conservation (MC) had previously indicated that they are supportive of commercial development of this property and that remediation of the projects area was not necessary at this time nor was it likely to be required in future.

## 3.0 INVESTIGATIVE METHODOLOGY

### 3.1 SURROUNDING LAND USE

A visual survey of the surrounding land uses was conducted during the course of AMEC's site investigation. The purpose of the survey was to identify specific land uses (i.e. agricultural, residential, commercial or industrial) adjacent to the site in order to assess potential sensitivities to soil and groundwater impacts. The surrounding land uses are detailed in Section 3.1.

### 3.2 SERVICE LOCATIONS

Prior to the start of the drilling program, Manitoba Telecom Services, Manitoba Hydro, Centra Gas, Westman Cable and the City of Brandon were contacted with respect to underground utility locations. Drilling locations were cleared by the various utility companies.

### 3.3 DRILLING AND SAMPLING PROGRAM

The test hole drilling program was conducted on 30 and 31 May 2002 and consisted of a total of twenty-five test holes (TH02-1 to TH02-25). The test holes were drilled to depths of 3.1 to 12.2 m below grade, using a truck mounted drill rig equipped with both solid stem and hollow stem augers. The drill rig was supplied and operated by Paddock Drilling Ltd. of Brandon, Manitoba. Mr. Gord LaMonica, CET, of AMEC supervised the drilling program on a full time basis. The locations of the various test holes are summarized in Table 1 and are shown on Figure 2.

**TABLE 1: SUMMARY OF TEST HOLE LOCATIONS**

| Location | Test Hole Numbers | Test Hole Depths |
|---|---|---|
| Office Products – Building | TH02-1 to TH02-5 | 3.1 to 9.1 m |
| Office Products – Parking Lot | TH02-17 to TH02-19 | 3.1 m |
| Grocery Store – Building | TH02-6 to TH02-9 and TH02-20 to TH02-25 | 3.1 to 12.2 m |
| Grocery Store – Parking Lot | TH02-10 to TH02-16 | 3.1 m |

Soil samples were obtained from the auger cuttings and from a split spoon sampler during drilling at approximately 0.3 to 0.6 m depth intervals at each of the test hole locations (reduced frequency used below about 3 m from grade). Additional soil samples were obtained as required in zones of visual contamination and/or at stratigraphic changes. All disturbed soils from the outside of the samples were removed to minimize potential cross contamination between sample depths. As well, all sampling equipment was washed between sample locations and all augers and sampling equipment were steam cleaned between test holes.

Soil samples were classified according to the Modified Unified Soil Classification system and observed for visual evidence of hydrocarbon impacts. All soil samples were field screened for volatile hydrocarbon vapours using ambient temperature headspace (ATH) techniques and a hexane calibrated, GasTech combustible vapour analyzer set in the no methane response mode. The ATH method involved half filling and sealing a 3.0 litre plastic bag with soil and allowing the vapours to accumulate at warm ambient temperature for about twenty minutes prior to analyzing the headspace. Accumulated vapours were measured in percent lower explosive limit (% LEL). At select locations, duplicate soil samples were retained in laboratory prepared sample jars for possible laboratory analysis. All jarred samples were stored in an insulated cooler while on site and during transport to the laboratory. The field protocols and QA/QC procedures utilized by AMEC were in accordance with standard industry protocols. Test hole logs, summarizing the observed soil conditions and results of field testing, are shown in Appendix A.

At the completion of drilling, all test holes were backfilled with bentonite pellets to above the water table, followed by the drill cuttings to ground surface. All excess cuttings were left adjacent to the respective test holes.

Given that the groundwater conditions at the site had been well documented, and as a number of monitor wells were present in the site area, additional monitor wells were not installed as part of this study.

## 3.4 ASSESSMENT CRITERIA

### 3.4.1 Overview

MC currently references the environmental assessment criteria as outlined in the following two documents produced by the Canadian Council of Ministers of the Environment (CCME):

- CCME. 1999. Canadian Environmental Quality Guidelines (EQGs).
- CCME. 2001. Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil (CWS-PHC).

These CCME documents are directly referenced by federal, provincial and territorial governments as either the standard criteria or have provided the basis for the development of other provincial/territorial criteria. The above documents support various legislative acts, such as the Canadian Environmental Protection Act (CEPA, 1985) and the Guideline for Environmental Site Investigations in Manitoba (June, 1998), as published by MC.

The CCME documents are based on the assessment and consistent management of risks posed to humans, plants, animals and environmental processes from contaminant exposure. The criteria are laid out in a three tiered approach for dealing with contaminated sites in which each tier incorporates varying amounts of site specific information while maintaining the same environmental and human health protection goals. Tier 1 consists of the direct adoption of the criteria published in the EQGs and/or CWS-PHCs. Tier 2 involves the generation of site specific criteria when site conditions exist that significantly modify exposure and risk scenarios which were used to formulate the generic tier one values. Tier 3 relies on the use of risk assessment procedures to establish remediation objectives at contaminated sites on a site-specific basis. Tier 2 and 3 evaluations are to be applied where specific environmental quality guidelines are not available, detailed site specific information should be applied or where human health and/or environmental risks cannot be effectively quantified using generic criteria.

The Tier 1 criteria are derived according to generic use categories (i.e. agricultural, residential/parkland, commercial and industrial for soil and community (potable), agricultural, freshwater aquatic life for water). A generic use category is based on the expected receptors, exposure pathways and 'normal' activities carried out on/with the media (i.e. soil/water) of interest. The generic use categories are described in detail in the CCME publications.

The CCME criteria are not intended to provide a defined remedial requirement, rather they are to be used as a guideline to assess risk and evaluate the site conditions.

### 3.4.2 Site Specific

AMEC carried out a modified Tier 2 assessment of the Site, which involved an evaluation of the applicable exposure pathways, based on AMEC's sensitivity assessment of the Site and a visual evaluation of the predominant soil texture. The modified Tier 2 assessment did not include the modification or recalculation of the formulas used to derive the criteria values.

Given the expected future commercial use of the property and the receptor assessment completed for the site (Appendix B), AMEC has chosen the following commercial risk management criteria for the Site:

- the CCME generic EQG values for the BTEX parameters; and
- the CCME generic CWS-PHC values for VPHs and EPHs in the F1 to F4 range for coarse grained surface and subsurface soils. The limiting exposure pathways utilized include protection of potable aquifers, indoor vapour inhalation and ecological soil contact pathways. The protection of potable aquifer pathway has been assumed to be valid, although it is possible that a detailed water well review for the area may indicate that a non-potable groundwater condition exists. The protection of aquatic life has been determined non-applicable, given the distance to these specific receptors.

Grain size analysis was conducted at AMEC's Winnipeg materials laboratory on select samples collected during the field investigation to confirm the grain size designation. Based on these analyses, both surface soils (above 1.5 m) and subsurface soils (below 1.5 m) were determined to have less than 50% passing the 0.075 mm sieve. On this basis, the samples are considered to be coarse grained according to CCME guidelines.

A summary of AMEC's site sensitivity assessment is provided in Appendix B. The soil criteria utilized, based on the above assessment, are summarized in Table 4.

## 3.5 LABORATORY ANALYSIS

A total of ten soil samples were submitted for confirmatory laboratory analysis at AMEC's laboratory in Edmonton, Alberta. The soil samples submitted to the laboratory were based on an evaluation of the soil vapour levels, location, depth and soil type. In this regard, the samples submitted did not necessarily constitute "worst case" conditions, rather they were intended to represent a cross section of depths, soil types and apparent contaminant levels.

Given the known history of the site, and based on the previous investigations completed, the soil laboratory analysis program was developed to include the analyses of the primary petroleum hydrocarbon constituents; benzene, toluene, ethylbenzene, xylenes (BTEX) and the fractional PHC components; volatile petroleum hydrocarbons (VPH) and extractable petroleum hydrocarbons (EPH). AMEC's Edmonton laboratory is certified with the Canadian Association of Environmental Analytical Laboratories (CAEAL). The laboratory QA/QC is provided in Appendix C along with the certificates of analyses.

# 4.0 ASSESSMENT RESULTS

## 4.1 SITE AND AREA DESCRIPTION

### 4.1.1 Site and Surrounding Land Use

The surrounding land uses observed at the time of the test drilling program are summarized in Table 2.

**TABLE 2: SURROUNDING LAND USE**

| Direction | Land Use | Distance (m) |
|---|---|---|
| Site | Presently undeveloped and vacant; intended commercial development | -- |
| North | Car Dealership, petroleum bulk plant to the northwest | Adjacent |
| South | Aberdeen Avenue followed by cemetery | Adjacent / 20 |
| East | 14th Street followed by various commercial developments | Adjacent / 20 |
| West | Canadian Tire store and associated parking lot | Adjacent |

### 4.1.2 Site Description

Historically, since closure of the refinery in 1969, the site has been undeveloped and covered in a mixture of trees, brush and grasses. As part of the current site development, tree removal across much of the site was undertaken immediately prior to the site investigation in order to allow rig access to all areas of the site.

The Site is generally flat lying, although slopes towards the southeast corner of the property, where a marsh-like area exists. The approximate extent of the marsh area is shown on Figure 1. The marsh is typically wet year round, although the size of the marsh varies on a seasonal and annual basis. The water from the marsh drains through culverts below Aberdeen Avenue and 14th Street to a series of collection ditches.

The ground surface throughout much of the site consisted of sand and gravel fill, with miscellaneous debris evident at many locations. At the marsh, wet land vegetation such as bull rushes and reeds were evident. Some dykes/berms were previously present on site, however appear to have been leveled as part of the tree removal.

### 4.1.3 Service Locations

There were no underground utilities identified at the Site at the time of drilling.

## 4.2 SOIL CONDITIONS

### 4.2.1 Local Geology

Based on available geological maps (*Groundwater Availability Map Series,* Manitoba Natural Resources, Water Resources Division, 1985) and water well records, the surficial soils in this area of Brandon consist of alluvial sand, silt, gravel and clay, generally extending to a depth of 3 to 4 m from grade. Perched groundwater zones are typically present within these alluvial deposits. The surficial soils are underlain by a clay till which extends to depths of 12 to 15 m from grade. The clay till contains sand layers and seams, which are often water bearing. The underlying bedrock consists of a carbonaceous clay shale.

### 4.2.2 Stratigraphy

Based on the test holes completed for this study, the soil profile at the test hole locations, in descending order, generally consisted of a layer of fill materials, underlain by a zone of variable sand and clay, followed by glacial clay till to the depths explored.

Fill materials were present at the ground surface of each of the test holes and typically consisted of sand and gravel fill. The thickness of the fill varied from about 0.3 to 1.5 m at the test hole locations. The soil layer underlying the fill typically consisted of a fine grained silty sand, although clay and gravel were encountered at some of the test holes. A perched water tables was typically present within this zone, at about 2 to 2.5 m below grade. Clay till underlies the sand/clay/gravel zone and extended to the maximum depths explored (12.2 m).

The subsurface soil stratigraphy encountered at the test hole locations is summarized in detail on the test hole logs in Appendix A.

### 4.2.3 Field Observations and Soil Vapour Levels

Soil vapour levels measured during the field investigation are summarized in Table 3 and are shown in detail on the test hole logs in Appendix A.

**TABLE 3: FIELD OBSERVATIONS AND SOIL VAPOUR TESTING**

| Test Hole No. | Test Hole Depth (m) | Hydrocarbon Staining Zone (m) | Soil Vapour Levels > 10 %LEL (m) | Maximum Soil Vapour Level | |
|---|---|---|---|---|---|
| | | | | Level (%LEL) | Depth (m) |
| TH02-1 | 9.0 | 2.3 – 2.7 | None | 5 | 0.6 |
| TH02-2 | 9.1 | None | None | 2 | 0.3 |
| TH02-3 | 3.1 | 2.4 – 3.1 | None | 2.5 | 3.1 |
| TH02-4 | 4.6 | 2.4 – 4.0 | None | 2 | 0.3 |
| TH02-5 | 3.1 | 2.4 – 3.1 | None | 1 | 0.3, 1.5 |
| TH02-6 | 9.1 | 2.4 – 3.7 | None | 2 | 0.3, 9.1 |
| TH02-7 | 9.1 | 2.4 – 3.2 | None | 2.5 | 0.3 |
| TH02-8 | 9.1 | 2.1 – 2.7 | None | 3 | 0.3 |
| TH02-9 | 12.2 | 2.0 – 2.7 | 1.9 | 10 | 1.9 |
| TH02-10 | 3.1 | 2.4 | None | 0 | 0 to 3.1 |
| TH02-11 | 3.1 | None | None | 2.5 | 0.6 |
| TH02-12 | 3.1 | 2.3 – 2.5 | 0.6 – 1.2 | 40 | 0.9 |
| TH02-13 | 3.1 | 2.1 – 2.5 | 0.6 | 12 | 0.6 |
| TH02-14 | 3.1 | 2.1 – 2.7 | 0.6, 2.3 | 12 | 2.3 |
| TH02-15 | 3.7 | 1.5 – 3.1 | 0.6 – 3.1 | >100 | 0.9 – 1.5 |
| TH02-16 | 3.1 | 1.5 – 2.7 | 0.3, 0.6, 1.5 | 20 | 1.5 |
| TH02-17 | 3.1 | 2.1 – 2.4 | 2.3 | >100 | 2.3 |
| TH02-18 | 3.1 | 2.3 – 3.0 | 0.3, 1.5 – 2.3 | >100 | 2.3 |
| TH02-19 | 3.1 | None | None | 2.5 | 0.3 |
| TH02-20 | 3.1 | 2.3 – 3.1 | None | 2 | 0.3 |
| TH02-21 | 3.1 | 2.1 – 2.5 | None | 3 | 0.3 |
| TH02-22 | 3.1 | 2.5 – 3.1 | None | 3 | 0.3 |
| TH02-23 | 3.1 | 2.1 | 0.6 | 14 | 0.6 |
| TH02-24 | 3.1 | 2.4 – 3.1 | None | 5 | 2.3 |
| TH02-25 | 3.1 | 0.9 – 2.5 | 0.3 – 0.6 | 32 | 0.6 |

Notes:

- Headspace vapour concentrations measured with a GasTech combustible vapour analyzer in the full gas mode (including methane) and calibrated to hexane.
- %LEL - percent lower explosive limit.

As noted in Table 3, petroleum hydrocarbon (PHC) staining was observed at the majority of test hole locations, typically near the observed water table which varied between about 2.0 and 3.0 m from grade. Significant staining of the surficial soils was not prevalent across the site, however, was observed at some locations.

Elevated soil vapour concentrations were identified at a number of test holes, most notably at TH02-12, TH02-15, TH02-16, TH02-17, TH02-18 and TH02-25. Moderately elevated soil vapour concentrations were also noted at TH02-9, TH02-13, TH02-14 and TH02-23. The remaining soil vapour concentrations were considered to be at or near background levels. The maximum vapour concentration of >100% LEL was measured at three locations; TH02-15, TH02-17 and TH02-18.

### 4.2.4 Laboratory Results

A total of ten soil samples were submitted for laboratory analysis. The results of the confirmatory laboratory analysis conducted on the selected soil samples are summarized in Table 4. Copies of the detailed analytical reports are provided in Appendix C.

**TABLE 4: SOIL LABORATORY RESULTS**

| Sample Location | Soil Vapour Level (% LEL) | Benzene | Toluene | Ethyl Benzene | Xylenes | VPH (F1) | EPH (F2) | EPH (F3) | EPH (F4) |
|---|---|---|---|---|---|---|---|---|---|
| TH02-1@ 0.6m | 5 | 0.24 | 0.033 | 0.34 | 0.97 | 6.3 | 61 | 100 | <10 |
| TH02-13@ 0.6m | 12 | 0.043 | <0.030 | 0.14 | 0.37 | 8.2 | 19 | 70 | <10 |
| TH02-15 @ 0.9m | >100 | **8.9** | 0.28 | **25** | **110** | **2100** | **4600** | **11000** | 2500 |
| TH02-23 @ 0.6m | 14 | 0.056 | <0.030 | 0.040 | 0.13 | 2.2 | 27 | 99 | <10 |
| TH02-25 @ 0.6m | 32 | 0.23 | 0.13 | 4.8 | 10 | **320** | **2700** | **11000** | 2500 |
| CCME Commercial EQG[1] | | 5 | 0.8 | 20 | 17 | N/A | | | |
| CCME Commercial CWS PHC – coarse grained surface soils[2] (≤1.5m below grade) | | | | | | 310[3] | 760[4] | 1700[4] | 3300[4] |
| TH02-4@ 3.1m | 1 | <0.020 | <0.030 | <0.020 | <0.030 | <1.5 | 10 | 50 | <10 |
| TH02-9 @ 2.0m | 10 | <0.020 | <0.030 | <0.020 | 0.044 | <1.5 | <10 | 20 | <10 |
| TH02-14 @ 2.3m | 12 | <0.020 | <0.030 | <0.020 | <0.030 | <1.5 | <10 | 51 | <10 |
| TH02-16 @ 1.5m | 20 | 1.7 | **2.8** | 5.9 | **23** | **400** | **15000** | **16000** | 1500 |
| TH02-17 @ 2.3m | >100 | 0.42 | 0.41 | 13 | **37** | **900** | **4300** | 2200 | 45 |
| CCME Commercial EQG[1] | | 5 | 0.8 | 20 | 17 | N/A | | | |
| CCME Commercial CWS PHC – fine grained sub-surface soils[5] (>1.5m below grade) | | | | | | 340[3] | 1200[6] | 3500[4] | 10000[4] |

Notes:

- Headspace vapour concentrations measured with a GasTech combustible vapour analyzer in the full gas mode (including methane) and calibrated to hexane.
- %LEL - percent lower explosive limit (approx. 1 %LEL = 100 parts per million total organic vapours ($ppm_v$))
- All concentrations in micrograms per gram (ug/g) unless otherwise stated
- VPH (F1) - volatile petroleum hydrocarbons (C6 – C10); corrected for BTEX
- EPH (F2) - extractable petroleum hydrocarbons (C10 – C16)
- EPH (F3) - extractable petroleum hydrocarbons (C16 – C34)
- EPH (F4) - extractable petroleum hydrocarbons (C34 – C50)
- < - less than the analytical detection limit
- **Bold and underlined** - indicates constituent concentration is at or exceeds the applicable criteria.
- [1] – CCME EQG - CCME commercial environmental quality guideline as outlined in Section 7, Table 1 of the CCME "*Canadian Environmental Quality Guidelines*", 1999.
- [2] – CCME Commercial CWS PHC – Coarse grained surface soils as outlined in Table 3 of the CCME document "*Canada-Wide Standards for Hydrocarbons in Soil*", 2001.
- [3] – CCME Commercial CWS PHC – Vapour inhalation (indoor) exposure pathway criteria
- [4] – CCME Commercial CWS PHC – Ecological soil contact exposure pathway criteria
- [5] – CCME Commercial CWS PHC – Coarse grained sub-surface soils as outlined in Table 5 of the CCME document "*Canada-Wide Standards for Hydrocarbons in Soil*", 2001.
- [6] – CCME Commercial CWS PHC – Protection of Potable Groundwater exposure pathway criteria
- See laboratory report for detection limits, testing protocols and QA/QC procedures. Laboratory analysis was performed by AMEC's Edmonton Laboratory.

Exceedances of the applicable guideline criteria were identified at TH02-15 (benzene, ethylbenzene, xylenes and F1 to F3), TH02-16 (toluene, xylenes and F1 to F3), TH02-17 (xylenes and F1 to F2) and TH02-25 (F1 to F3). The remaining six samples analysed contained PHC concentrations less that the applicable guideline criteria.

## 5.0 SUMMARY

As expected based on previous investigations conducted at the property, subsurface conditions at the site have been impacted by the historic refinery operations and petroleum hydrocarbon constituents are present at concentrations in excess of the applicable criteria within portions of the site.

Following is a summary of the conditions identified within each of the project areas and a discussion of the potential environmental issues.

## 5.1 PROPOSED OFFICE SUPPLIES STORE

### 5.1.1 Building Area

A total of five test holes were drilled within the proposed building area (TH02-1 to TH02-5). While some evidence of soil staining was observed between about 2 and 4 m from grade at four of the five test holes, both samples submitted for laboratory analysis from this zone had hydrocarbon concentrations below the applicable guideline criteria. The findings are consistent with previous assessment results which had indicated that this area was the least impacted portion of the site.

Based on the conditions observed, a synthetic liner is not considered necessary below the building, as the potential for elevated vapours to collect within the building is considered to be negligible. As well, near surface soils did not appear to be impacted, therefore surface works at the site should not be affected by environmental constraints, such as impacted soil disposal.

To limit the potential for future liabilities, it is recommended that all services should enter the building from the north end and all service trenches should be constructed with appropriate trench blocks near to the building perimeter. Any sumps, pits, etc., which extend more than about 1 m below grade should be provided with appropriate liners and seals. Attention should also be made to the connection between the two buildings, to reduce the potential for vapour migration from the adjacent building.

### 5.1.2 Parking Area

Three test holes were advanced within the proposed parking area of the office supplies store (TH02-17 to TH02-19). Evidence of significant hydrocarbon impacts were observed at TH02-17 and TH02-18, with no evidence of substantial impacts at TH02-19. At both TH02-17 and TH02-18, soil vapour concentrations were in excess of 100% LEL. At TH02-17, elevated

vapour concentrations were present only at the 2.3 m depth, while at TH02-18, soils with elevated vapour concentrations extended from near ground surface to 2.3 m from grade. A sample from TH02-17 (@ 2.3 m) was submitted for laboratory analysis and found to have PHC constituents in excess of the guideline criteria.

Given the presence of impacted soil at shallow depths near TH02-18, parking lot construction may be affected by the presence of impacted soils. In this regard, shallow soils excavated for parking lot construction may need to be removed from the site and disposed of at an appropriate facility. As well, it is likely that any soils excavated for utility trenches within the entire parking area will require off-site disposal. A plan showing the estimated extent of severely impacted soils, based on AMEC's test holes and previous site investigations, is shown in Figure 3.

## 5.2 FOOD STORE

### 5.2.1 Building Area

A total of ten test holes were drilled within the proposed building area (TH02-6 to TH02-9 and TH02-20 to TH02-25). Within the north end of the building (TH02-6 to TH02-8 and TH02-20), there was minimal evidence of significant hydrocarbon impacts, as was noted at the office supplies store. While some evidence of soil staining was observed between about 2 and 4 m from grade, there were no elevated soil vapour concentrations and near surface soils did not show signs of impact. There were no samples submitted for laboratory testing from within this area, however, hydrocarbon concentrations are expected to be similar to those at the office supplies store (i.e. below guideline criteria). Within the central portions of the building pad (TH02-9 and TH02-24), slightly elevated soil vapour concentrations were identified at about the 2 m depth (5 to 10% LEL); however, the sample submitted for lab analysis form TH02-9 did not exceed the guideline criteria. At the south end of the building pad (TH02-21 to TH02-23 and TH02-25), more significant evidence of hydrocarbon impacts were present. At TH02-23 and TH02-25, significantly elevated soil vapour concentrations were identified within the near surface soils. At TH02-25, exceedances of the guideline criteria were identified at 0.6 m.

The subsurface conditions are expected to impact site development in the following ways:

- A synthetic liner is recommended below the floor slab to limit the potential for elevated vapour concentrations to collect within the building. While it could be argued that the liner is only required within the southern one half of the building, it is considered prudent to place the liner under the entire building, in particular when considering that the building will be used as a food store. Alternatively, the impacted soils could be removed from the building area, although this is expected to be cost prohibitive. Connection of the liner to the exterior grade beams, all internal piles and all building services will be necessary.

- Shallow soils removed during slab preparation procedures at the south end of the store may need to be removed from the site and disposed of at an appropriate facility. This could possibly be avoided where a structural slab is utilized, as there would be no requirement for soil removal.
- It is likely that any soils excavated for utility trenches within the building area will require off-site disposal.
- As noted in Section 5.1.1, it is recommended that site services for the building enter from the north end of the development. Furthermore, all service trenches entering the building should be constructed with appropriate trench blocks just outside of the building perimeter and all sumps, pits, etc., which extend below the liner system should be appropriately sealed and lined.

A plan showing the estimated extent of severely impacted soils, based on AMEC's test holes and previous site investigations, is shown in Figure 3.

### 5.2.2 Parking Area

Seven test holes were drilled within the proposed parking area of the food store, two to the east of the store (TH02-10 and TH02-11), four to the west of the store (TH02-12 to TH02-14 and TH02-16) and one to the southwest of the store (TH02-15). Limited evidence of hydrocarbon impacts were observed within the test holes to the east of the store (slight staining at 2.4 m in TH02-10), while moderate to severe impacts were identified within the west and south parking areas. At each of the four test holes in the west parking area, moderately elevated soil vapour concentrations were observed (10 to 20% LEL), with the majority of impacts noted at about 1.5 to 2.5 m below grade. Exceedances of the applicable guideline criteria were present at TH02-16 only (1.5 m below grade). The sample obtained from TH02-13 at 0.6 m from grade had hydrocarbon concentrations below guideline criteria, although concentrations were slightly elevated. Within the south parking area, severe hydrocarbon impacts were identified, with hydrocarbon concentrations at TH02-15 (0.9 m) in excess of the guideline criteria.

Given the presence of impacted soil at shallow depths, parking lot construction will be affected by the presence of impacted soils. On this basis, excavation completed as part of parking lot grading may require disposal of soils, although this will be dependent on location and depth of the sub-cut. As well, it is likely that any soils excavated for utility trenches within the entire west and south parking areas will require off-site disposal. A plan showing the estimated extent of severely impacted soils, based on AMEC's test holes and previous site investigations, is shown in Figure 3.

## 6.0 CONCLUSIONS

The site assessment confirmed the findings of previous investigations, which had identified hydrocarbon impacts throughout much of the western and southern portions of the proposed development area. The investigation did not, however, identify conditions which would alter previous indications that commercial development could proceed. AMEC is of the opinion that the proposed food store can be developed at the site and that the items recommended in Section 5.0 provide adequate measures to reduce potential liabilities and protect the health and safety of users of the property.

The site conditions have been well documented, and while the potential for future remedial requirements cannot be fully discounted, the likelihood is considered to be low. Previous investigations have concluded that there is no substantial off-site contaminant migration and there are no sensitive receptors in the immediate vicinity of the property. Furthermore, Manitoba Conservation has indicated in writing that there are no current remedial requirements in this area of the site and that commercial development of the property could proceed. If remediation was required at a future date, the Manitoba Contaminated Sites legislation identifies that the polluting party will be held responsible for remedial costs.

Design of the development should recognize the limitations imposed by the subsurface conditions and allow for contingencies in the event that unexpected conditions are encountered. Detailed review of the final design drawings for the development should be completed to assess environmental issues. As well, environmental controls and work plans will be required during construction to identify, evaluate and direct disposal of all impacted soils. Appropriate budgets should be allocated to address these issues during the construction program.

## 7.0 CLOSURE

The American Society for Testing and Materials Standard of Practice notes that no environmental site assessment can wholly eliminate uncertainty regarding the potential for recognized environmental conditions in the connection with a property. Performance of a standardized environmental site assessment protocol is intended to reduce, but not eliminate, uncertainty regarding the potential for recognized environmental conditions in connection with the property, given reasonable limits of time and costs. The findings of this investigation are based on the interpretation of data from a limited number of test holes and analytical results pertaining to specific samples. The evaluation and interpretations do not preclude the existence of chemical substances other than those identified herein, or the possibility that contamination levels can vary between the areas of the investigation.

This report has been prepared for the exclusive use of 3829724 Manitoba Limited and their agents for specific application to the property identified in this report. The environmental assessment was conducted in accordance with generally accepted assessment practices. No other warranty, expressed or implied, is made. The general conditions of this report are specified in Appendix D.

We trust that this report meets your present requirements. If you have any questions or if we can be of further assistance, please contact our office.

Respectively submitted,
**AMEC Earth & Environmental Limited**

Harley Pankratz, P. Eng.
Manager, Winnipeg Operations
E-mail: harley.pankratz@amec.com

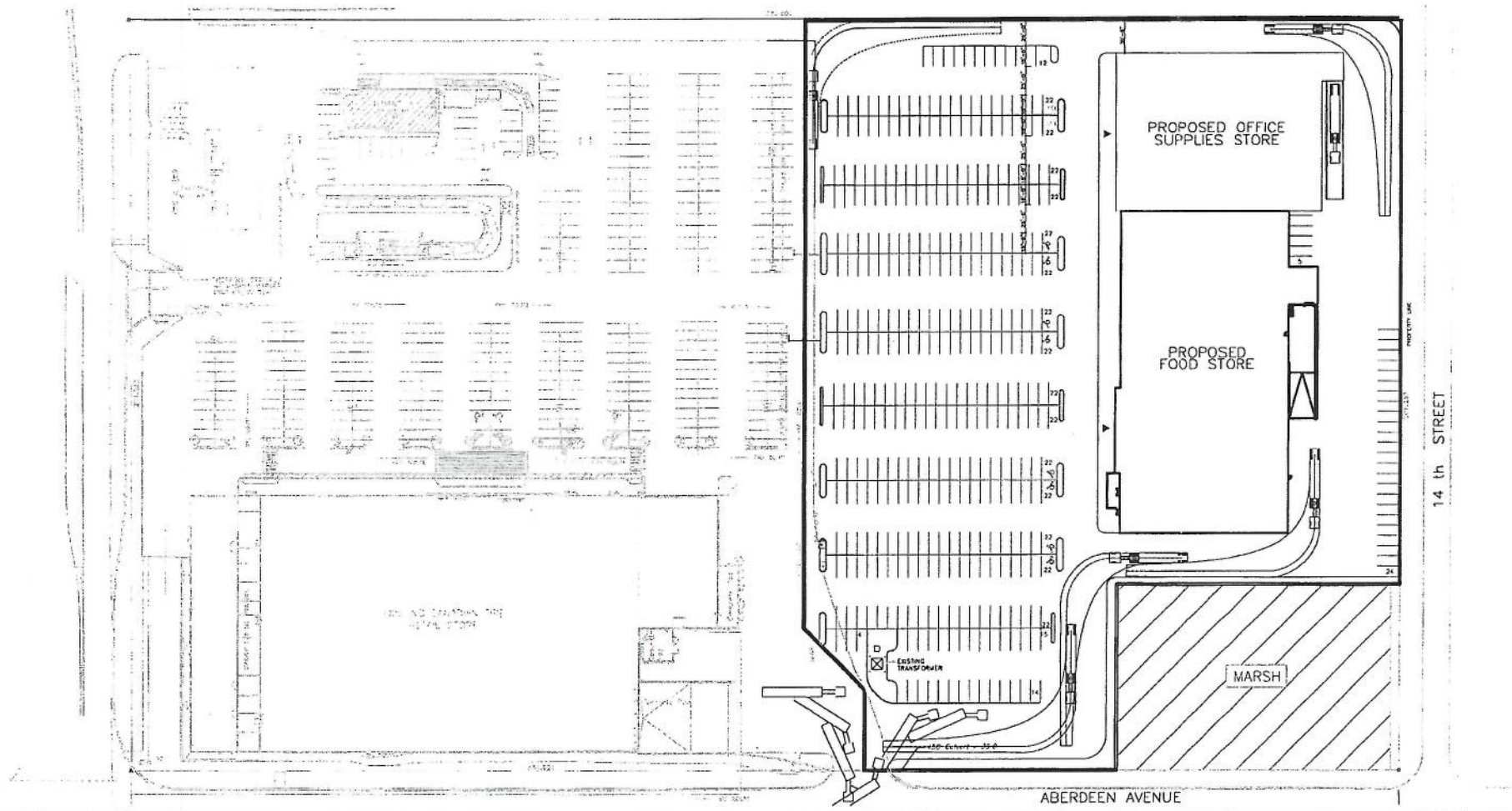
Reviewed by:

Mark Humbert, P. Eng.
Senior Environmental Engineer

HP/hdp

Dist: (5) Shindico Realty

# FIGURES




amec
EARTH & ENVIRONMENTAL LIMITED

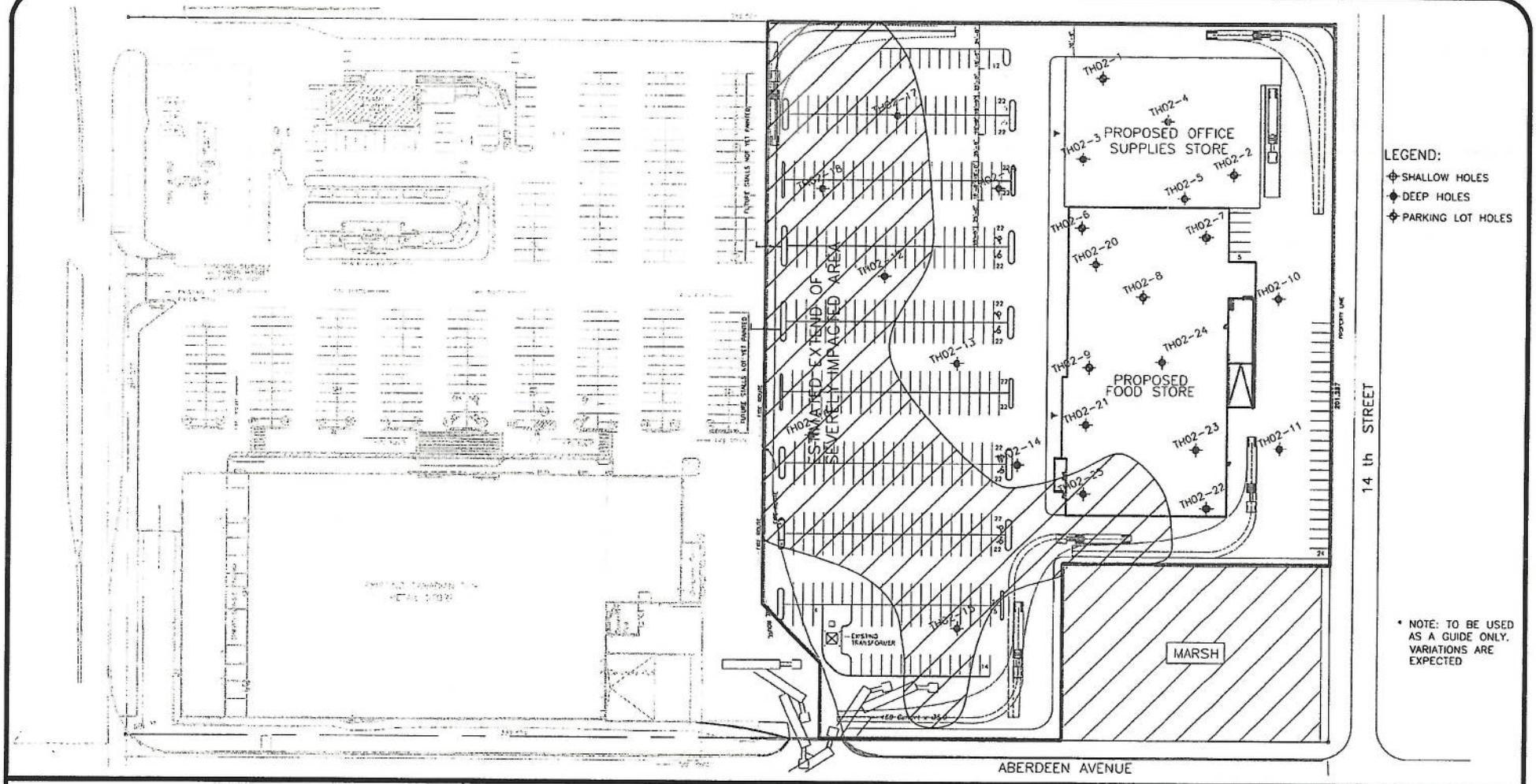
**PROPOSED COMMERCIAL DEVELOPMENT**

BRANDON, MANITOBA

PROPOSED SITE DEVELOPMENT

| | |
|---|---|
| SCALE: | 1 : 1,000 |
| DATE: | JUNE/2002 |
| DRAWN BY: | JB |
| PROJECT NO.: | WX-05421 |

**FIGURE 1**




amec
EARTH & ENVIRONMENTAL LIMITED

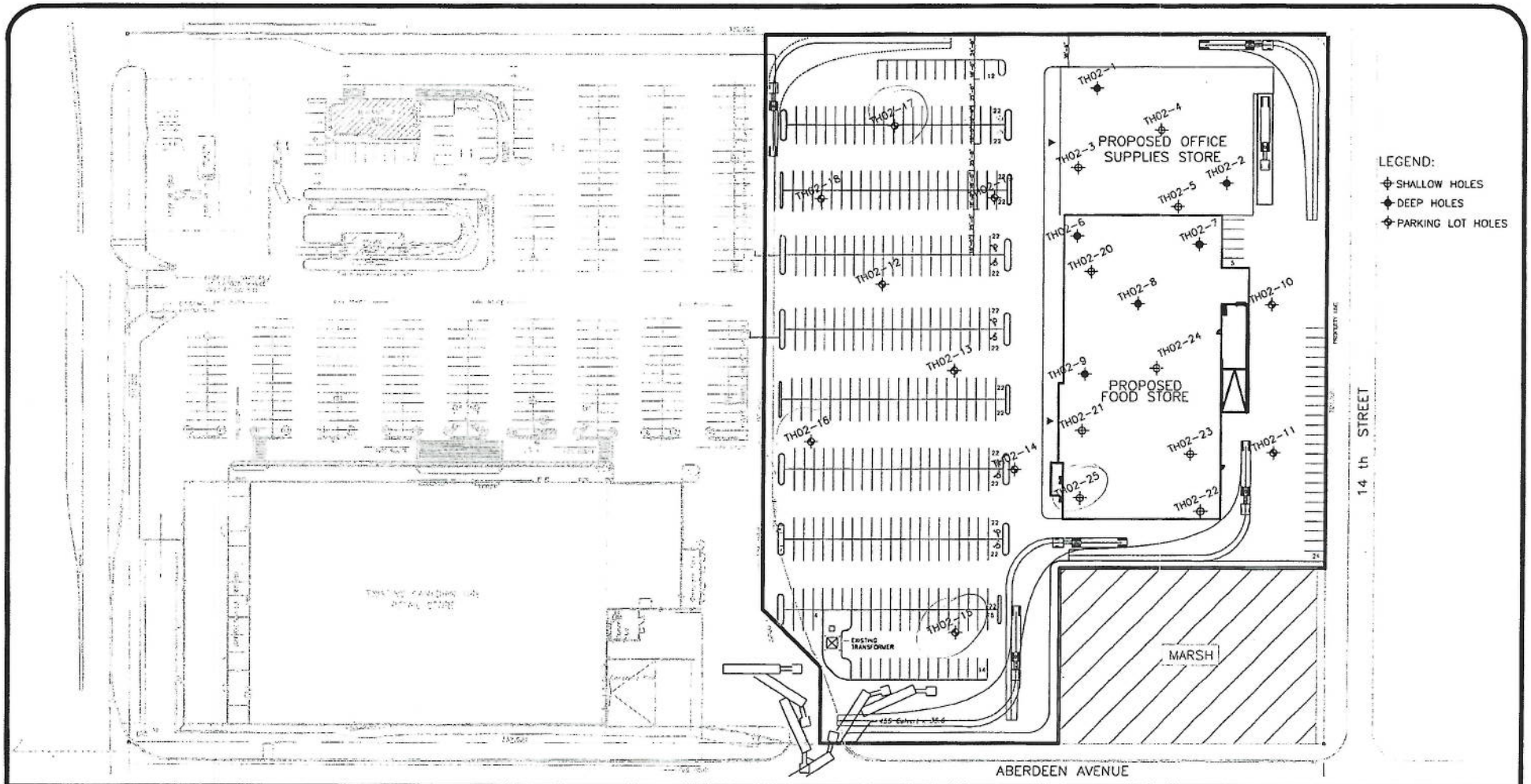
# PROPOSED COMMERCIAL DEVELOPMENT

BRANDON, MANITOBA

INFERRED EXTENT OF SEVERELY IMPACTED AREA

| | |
|---|---|
| SCALE: | 1 : 1,000 |
| DATE: | JUNE/2002 |
| DRAWN BY: | JB |
| PROJECT NO.: | WX-05421 |

**FIGURE 3**




amec
EARTH & ENVIRONMENTAL LIMITED

# PROPOSED COMMERCIAL DEVELOPMENT

BRANDON, MANITOBA

TESTHOLE SITE PLAN

| | |
|---|---|
| SCALE: | 1 : 1,000 |
| DATE: | JUNE/2002 |
| DRAWN BY: | JB |
| PROJECT NO.: | WX-05421 |

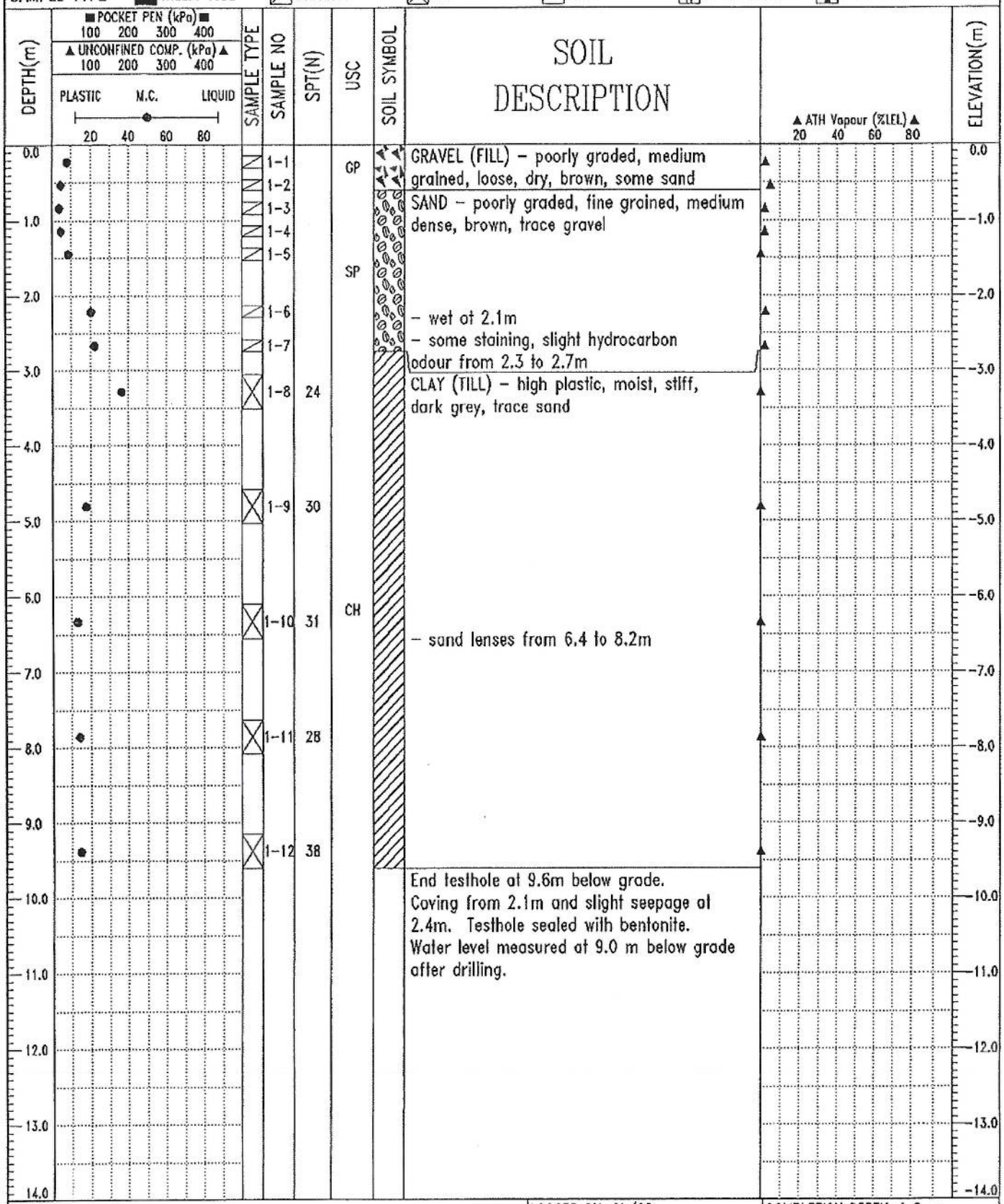
**FIGURE 2**

# APPENDIX A

# TEST HOLE LOGS

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-1 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE: ■ SHELBY TUBE ⊘ CUTTINGS ⊠ SPT ☰ CORE ▯ NO RECOVERY ▮ CONT. SAMPLE

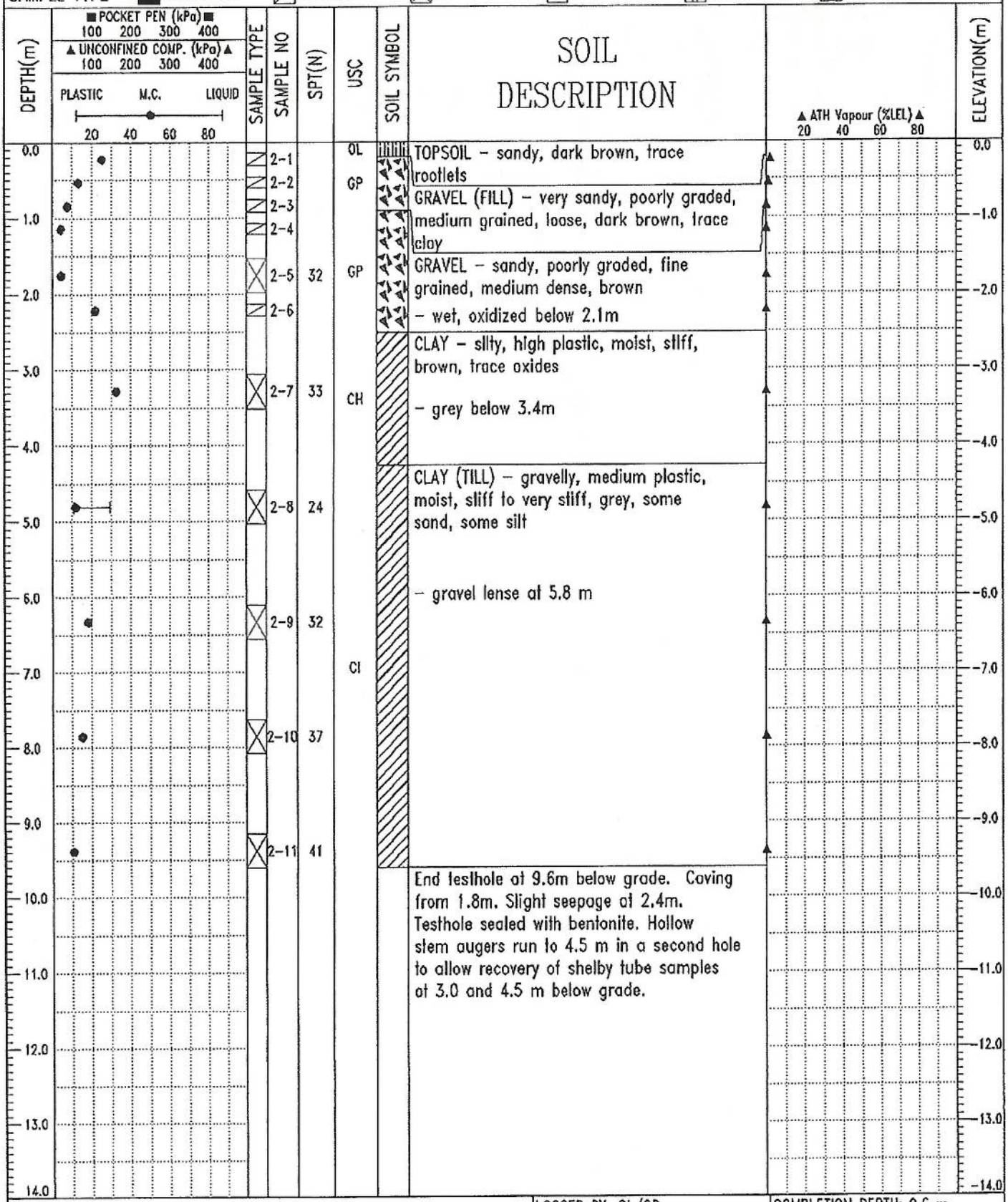



| | | |
|---|---|---|
| AMEC Earth & Environmental Limited<br>Winnipeg, Manitoba | LOGGED BY: GL/SD<br>REVIEWED BY: GL<br>Fig. No: 2 | COMPLETION DEPTH: 9.6 m<br>COMPLETE: 30/05/02<br>Page 1 of 1 |

02/05/14 01:22PM (GEO_W149)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-2 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE ■ SHELBY TUBE ⁄ CUTTINGS ⊠ SPT ⊟ CORE ▯ NO RECOVERY ▮ CONT. SAMPLE




| | | |
|---|---|---|
| AMEC Earth & Environmental Limited<br>Winnipeg, Manitoba | LOGGED BY: GL/SD<br>REVIEWED BY: GL<br>Fig. No: 3 | COMPLETION DEPTH: 9.6 m<br>COMPLETE: 30/05/02<br>Page 1 of 1 |

02/05/14 01:22PM (GEO_M14B)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-3 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE ■ SHELBY TUBE ⧄ CUTTINGS ⊠ SPT ▤ CORE ▥ NO RECOVERY ▮ CONT. SAMPLE

■ POCKET PEN (kPa) ■ 100 200 300 400
▲ UNCONFINED COMP. (kPa) ▲ 100 200 300 400
PLASTIC — M.C. — LIQUID 20 40 60 80

| DEPTH(m) | SAMPLE TYPE | SAMPLE NO | SPT(N) | USC | SOIL SYMBOL | SOIL DESCRIPTION | ▲ ATH Vapour (%LEL) ▲ 20 40 60 80 | ELEVATION(m) |
|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | 0.0 |
| | | 3-1 | | OL | | TOPSOIL – sandy, dark brown, trace rootlets | | |
| | | 3-2 | | | | SAND – gravelly, poorly graded, fine grained, loose, dry, brown | | |
| | | 3-3 | | | | | | |
| 1.0 | | 3-4 | | | | | | -1.0 |
| | | 3-5 | | SP | | | | |
| 2.0 | | | | | | – wet below 2.1m | | -2.0 |
| | | 3-6 | | | | – stained from 2.4 to 3.1m, slight hydrocarbon odour | | |
| 3.0 | | 3-7 | | | | | | -3.0 |
| | | | | | | End testhole at 3.1m below grade. No seepage or caving noted. Testhole sealed with bentonite. | | |
| 4.0 | | | | | | | | -4.0 |
| 5.0 | | | | | | | | -5.0 |
| 6.0 | | | | | | | | -6.0 |

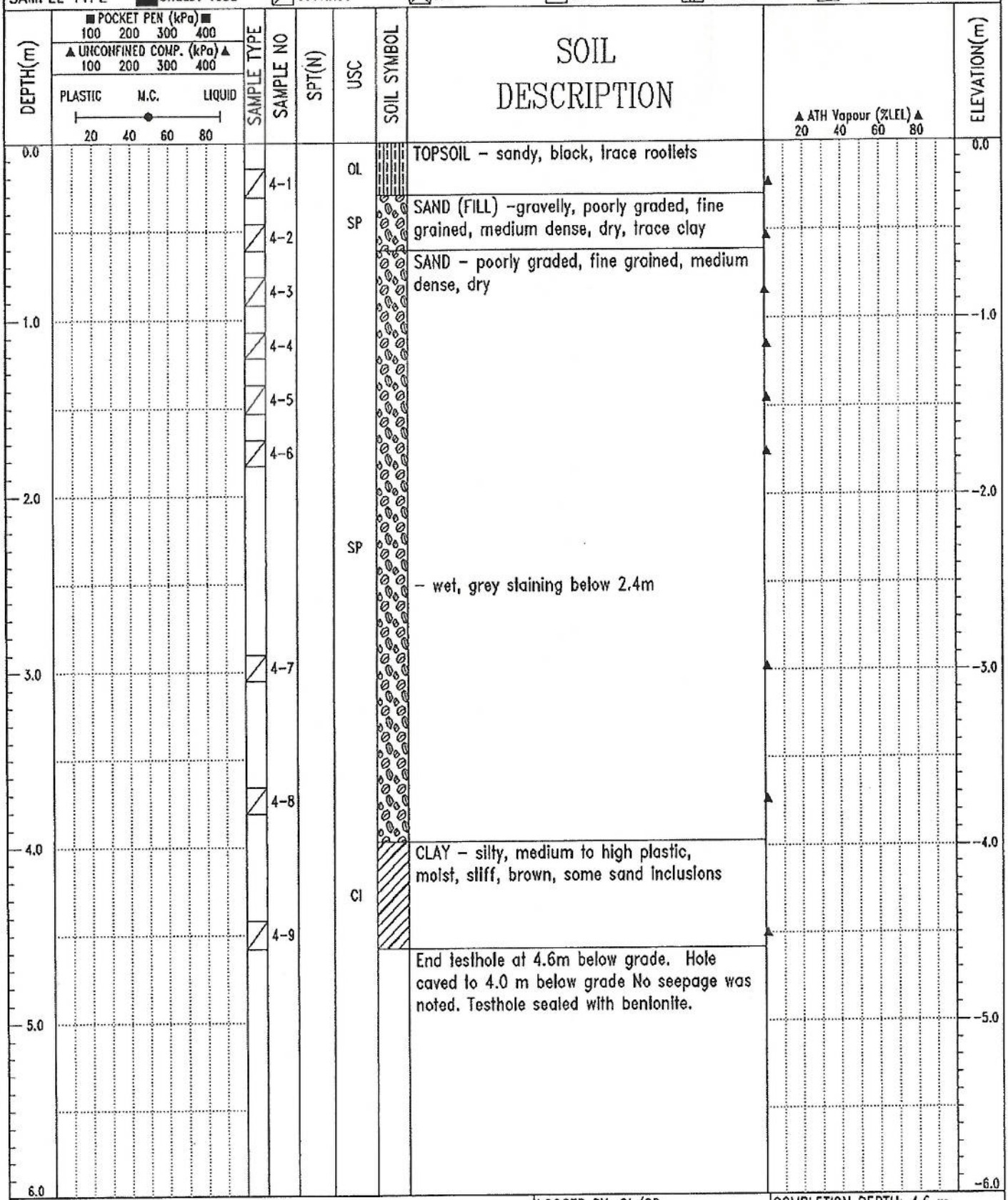
AMEC Earth & Environmental Limited
Winnipeg, Manitoba

| | |
|---|---|
| LOGGED BY: GL/SD | COMPLETION DEPTH: 3.1 m |
| REVIEWED BY: GL | COMPLETE: 30/05/02 |
| Fig. No: 4 | Page 1 of 1 |

02/05/14 01:22PM (GEO_MEB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-4 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE ■ SHELBY TUBE ⊘ CUTTINGS ⊠ SPT ▤ CORE ▥ NO RECOVERY ▮ CONT. SAMPLE




| | | |
|---|---|---|
| AMEC Earth & Environmental Limited<br>Winnipeg, Manitoba | LOGGED BY: GL/SD | COMPLETION DEPTH: 4.6 m |
| | REVIEWED BY: GL | COMPLETE: 30/05/02 |
| | Fig. No: 5 | Page 1 of 1 |

02/05/14 01:22PM (GEO_WEB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-5 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

■ POCKET PEN (kPa) ■ 100 200 300 400

▲ UNCONFINED COMP. (kPa) ▲ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

▲ ATH Vapour (%LEL) ▲ 20 40 60 80

| DEPTH(m) | SAMPLE TYPE | SAMPLE NO | SPT(N) | USC | SOIL SYMBOL | SOIL DESCRIPTION | ELEVATION(m) |
|---|---|---|---|---|---|---|---|
| 0.0 | | | | OL | | TOPSOIL – sandy, black, some rootlets | 0.0 |
| | | 5-1 | | SP | | SAND (FILL) – gravelly, poorly graded, fine grained, loose, brown, trace clay | |
| | | 5-2 | | | | | |
| | | 5-3 | | | | SAND – poorly graded, fine grained, loose, brown | |
| 1.0 | | 5-4 | | | | | 1.0 |
| | | 5-5 | | | | | |
| | | | | SP | | | |
| 2.0 | | 5-6 | | | | | 2.0 |
| | | | | | | – clean sand at 2.4m<br>– stained grey, faint odour, wet | |
| 3.0 | | 5-7 | | | | | 3.0 |
| | | | | | | End testhole at 3.1m below grade. Hole caved to 2.7m below grade. Slight seepage noted from 2.6 m. Water level measured at 2.7 m below grade after drilling. seepage. Testhole sealed with bentonite. | |
| 4.0 | | | | | | | 4.0 |
| 5.0 | | | | | | | 5.0 |
| 6.0 | | | | | | | 6.0 |

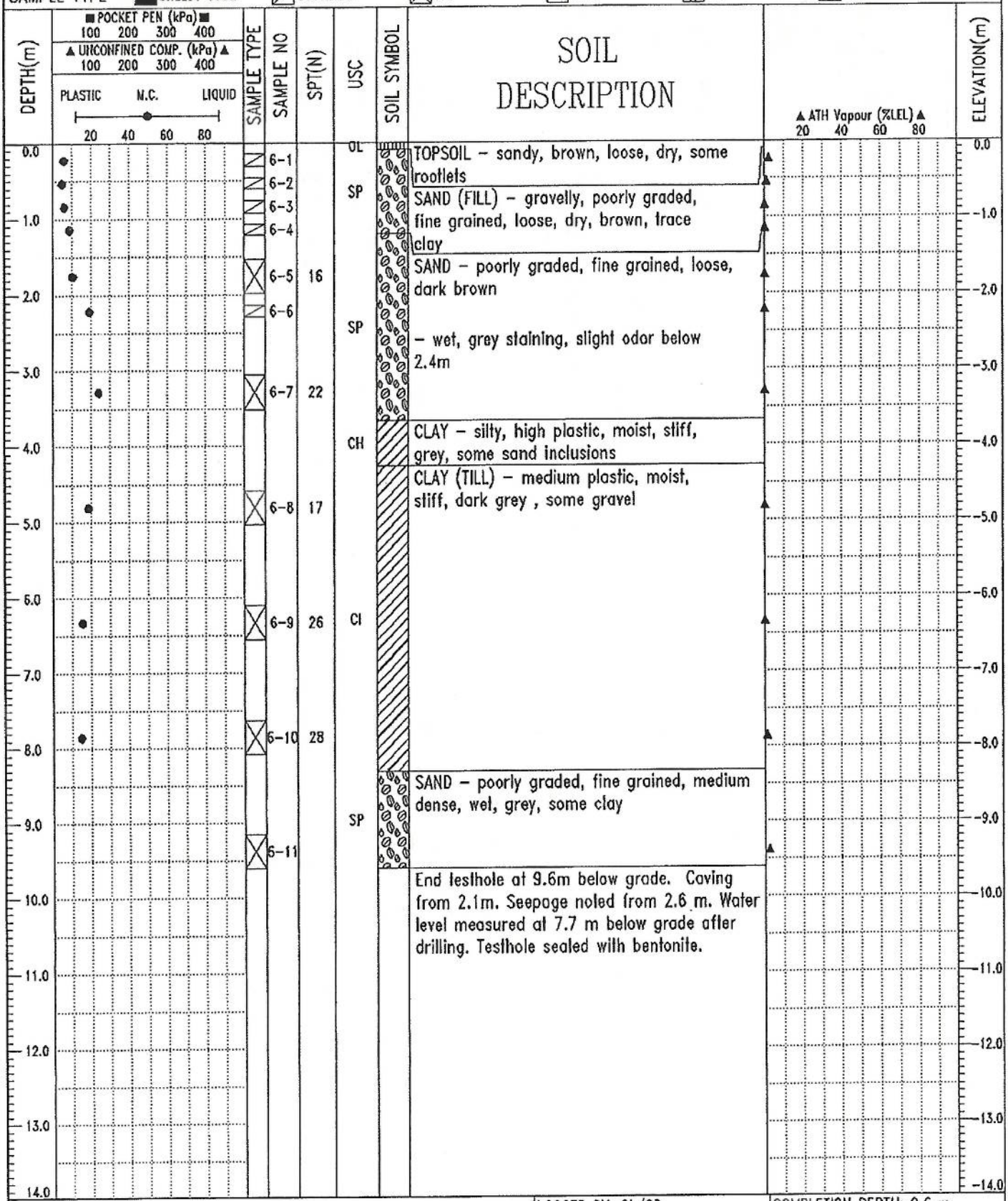
AMEC Earth & Environmental Limited
Winnipeg, Manitoba

| | |
|---|---|
| LOGGED BY: GL/SD | COMPLETION DEPTH: 3.1 m |
| REVIEWED BY: GL | COMPLETE: 30/05/02 |
| Fig. No: 6 | Page 1 of 1 |

02/05/14 01:22PM (GEO_WEB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-6 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE




| | | |
|---|---|---|
| AMEC Earth & Environmental Limited<br>Winnipeg, Manitoba | LOGGED BY: GL/SD | COMPLETION DEPTH: 9.6 m |
| | REVIEWED BY: GL | COMPLETE: 30/05/02 |
| | Fig. No: 7 | Page 1 of 1 |

02/05/14 11:37AM (GEO_M14B)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-7 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE ■ SHELBY TUBE ⊘ CUTTINGS ⊠ SPT ☰ CORE ▯ NO RECOVERY ▮ CONT. SAMPLE

■ POCKET PEN (kPa) ■ 100 200 300 400
▲ UNCONFINED COMP. (kPa) ▲ 100 200 300 400
PLASTIC M.C. LIQUID 20 40 60 80

| DEPTH(m) | SAMPLE TYPE | SAMPLE NO | SPT(N) | USC | SOIL SYMBOL | SOIL DESCRIPTION | ▲ ATH Vapour (%LEL) ▲ 20 40 60 80 | ELEVATION(m) |
|---|---|---|---|---|---|---|---|---|
| 0.0 | N | 7-1 | | OL | | TOPSOIL – sandy, black, some rootlets | | 0.0 |
| | N | 7-2 | | SP | | SAND (FILL) – clayey, poorly graded, fine grained, loose, dry, brown, some gravel | | |
| 1.0 | N | 7-3 | | | | | | -1.0 |
| | N | 7-4 | | | | SAND – gravelly, poorly graded, medium grained, loose to medium dense, brown | | |
| 2.0 | ⊠ | 7-5 | 8 | SP | | | | -2.0 |
| | N | 7-6 | | | | – wet, grey staining below 2.4m | | |
| 3.0 | ⊠ | 7-7 | 17 | CH | | CLAY – silty, high plastic, moist, stiff, brown | | -3.0 |
| | | | | | | – tried a tube at 3.4m. No recovery. | | |
| 4.0 | | | | | | CLAY (TILL) – medium plastic, moist, stiff to very stiff, grey, some sand, some gravel | | -4.0 |
| 5.0 | ⊠ | 7-8 | 12 | | | | | -5.0 |
| 6.0 | ⊠ | 7-9 | 21 | CI | | | | -6.0 |
| 7.0 | | | | | | | | -7.0 |
| 8.0 | ⊠ | 7-10 | 28 | | | – some cobbles at 7.6m | | -8.0 |
| 9.0 | ⊠ | 7-11 | 34 | | | End testhole at 9.2m below grade. No caving noted. Slight seepage below 2.4m. Water level measured at 8.2 m below grade after drilling. Testhole sealed with bentonite. | | -9.0 |
| 10.0 | | | | | | | | -10.0 |
| 11.0 | | | | | | | | -11.0 |
| 12.0 | | | | | | | | -12.0 |
| 13.0 | | | | | | | | -13.0 |
| 14.0 | | | | | | | | -14.0 |

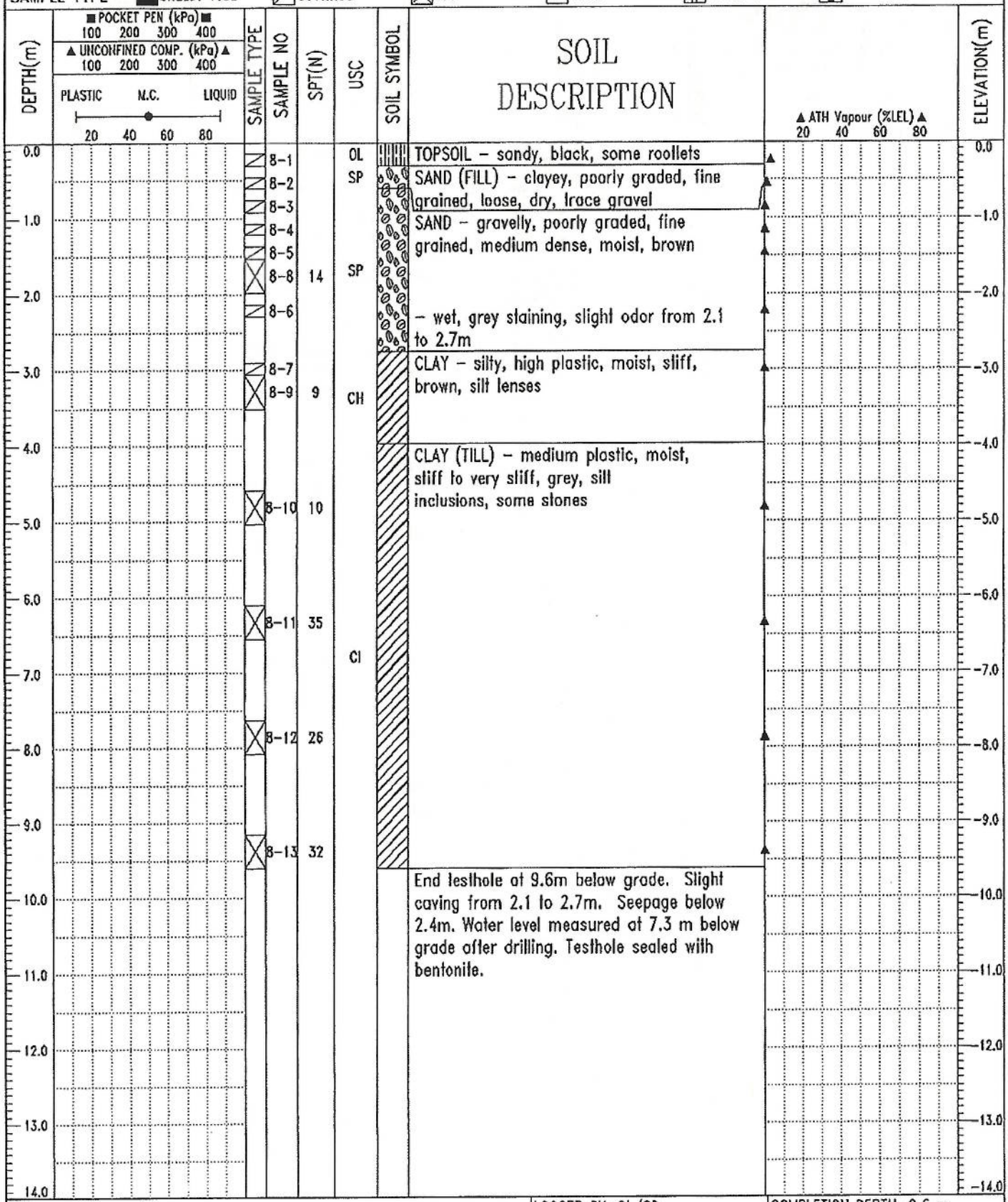
AMEC Earth & Environmental Limited
Winnipeg, Manitoba

| | |
|---|---|
| LOGGED BY: GL/SD | COMPLETION DEPTH: 9.2 m |
| REVIEWED BY: GL | COMPLETE: 30/05/02 |
| Fig. No: 8 | Page 1 of 1 |

02/05/14 11:52AM (GEO_M149)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-8 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

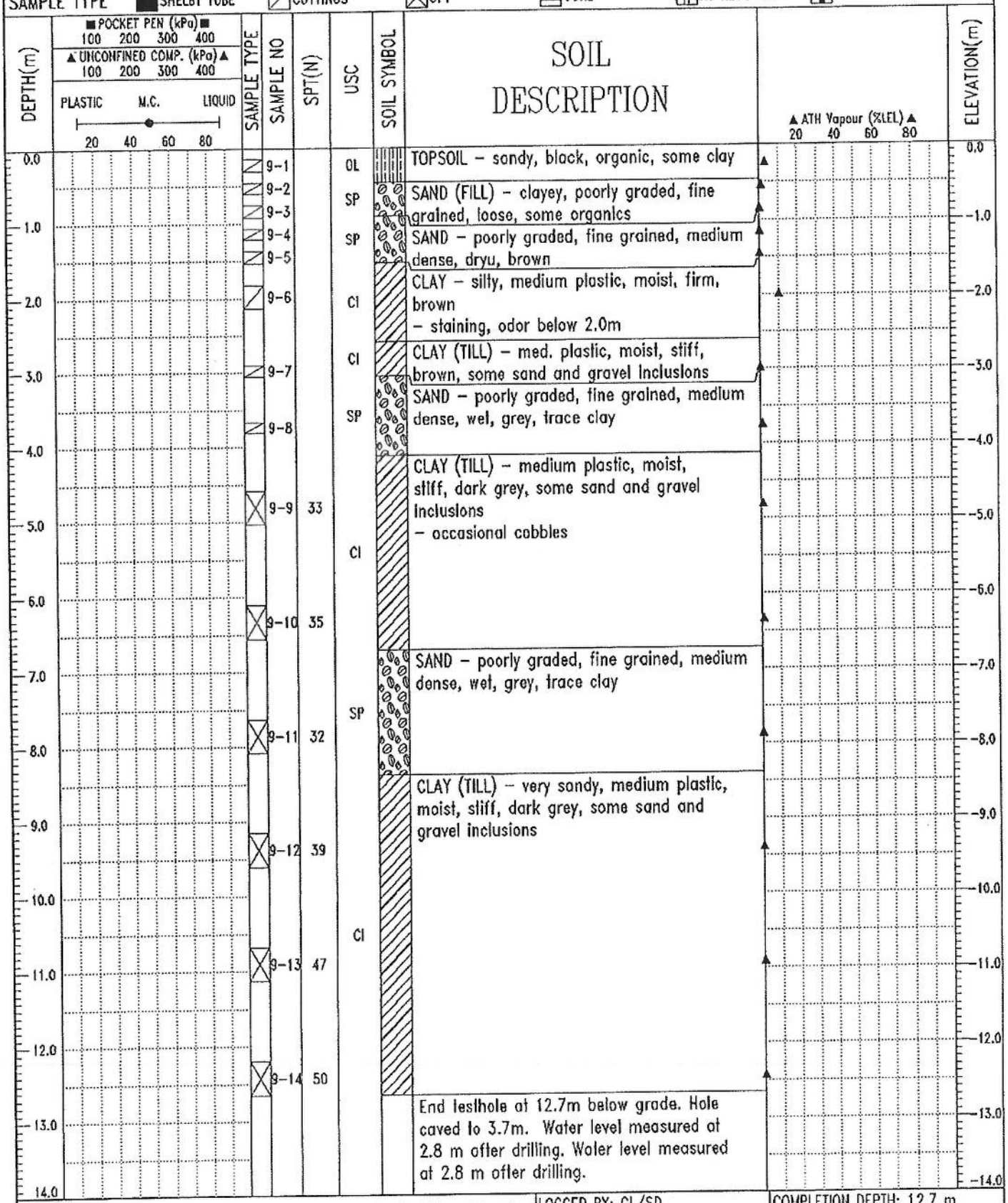



| | | |
|---|---|---|
| AMEC Earth & Environmental Limited<br>Winnipeg, Manitoba | LOGGED BY: GL/SD | COMPLETION DEPTH: 9.6 m |
| | REVIEWED BY: GL | COMPLETE: 30/05/02 |
| | Fig. No: 9 | Page 1 of 1 |

02/05/14 11:37AM (GEO_M14B)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-9 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE




| | | |
|---|---|---|
| AMEC Earth & Environmental Limited<br>Winnipeg, Manitoba | LOGGED BY: GL/SD<br>REVIEWED BY: GL<br>Fig. No: 10 | COMPLETION DEPTH: 12.7 m<br>COMPLETE: 31/05/02<br>Page 1 of 1 |

02/05/14 11:37AM (GEO_M14B)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-10 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE ■ SHELBY TUBE ⁄ CUTTINGS ⊠ SPT ☰ CORE ▯ NO RECOVERY ▮ CONT. SAMPLE

| DEPTH(m) | ■ POCKET PEN (kPa) ■ 100 200 300 400 / ▲ UNCONFINED COMP. (kPa) ▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80 | SAMPLE TYPE | SAMPLE NO | SPT(N) | USC | SOIL SYMBOL | SOIL DESCRIPTION | ▲ ATH Vapour (%LEL) ▲ 20 40 60 80 | ELEVATION(m) |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | TOPSOIL – sandy, black, some clay and some rootlets | | 0.0 |
| | | | 10-1 | | OL | | | | |
| | | | 10-2 | | | | | | |
| | | | 10-3 | | | | SAND – gravelly, poorly graded, fine grained, loose, dry, brown, oxidized | | |
| 1.0 | | | 10-4 | | | | | | -1.0 |
| | | | 10-5 | | SP | | | | |
| 2.0 | | | | | | | | | -2.0 |
| | | | 10-6 | | | | – wet below 2.3m<br>– slight staining below 2.4 m | | |
| | | | | | | | | | |
| 3.0 | | | 10-7 | | CH | | CLAY – silty, high plastic, moist, stiff, brown | | -3.0 |
| | | | | | | | End testhole at 3.1m below grade. Caving to 1.2m. No seepage noted. Testhole sealed with bentonite. | | |
| 4.0 | | | | | | | | | -4.0 |
| 5.0 | | | | | | | | | -5.0 |
| 6.0 | | | | | | | | | -6.0 |

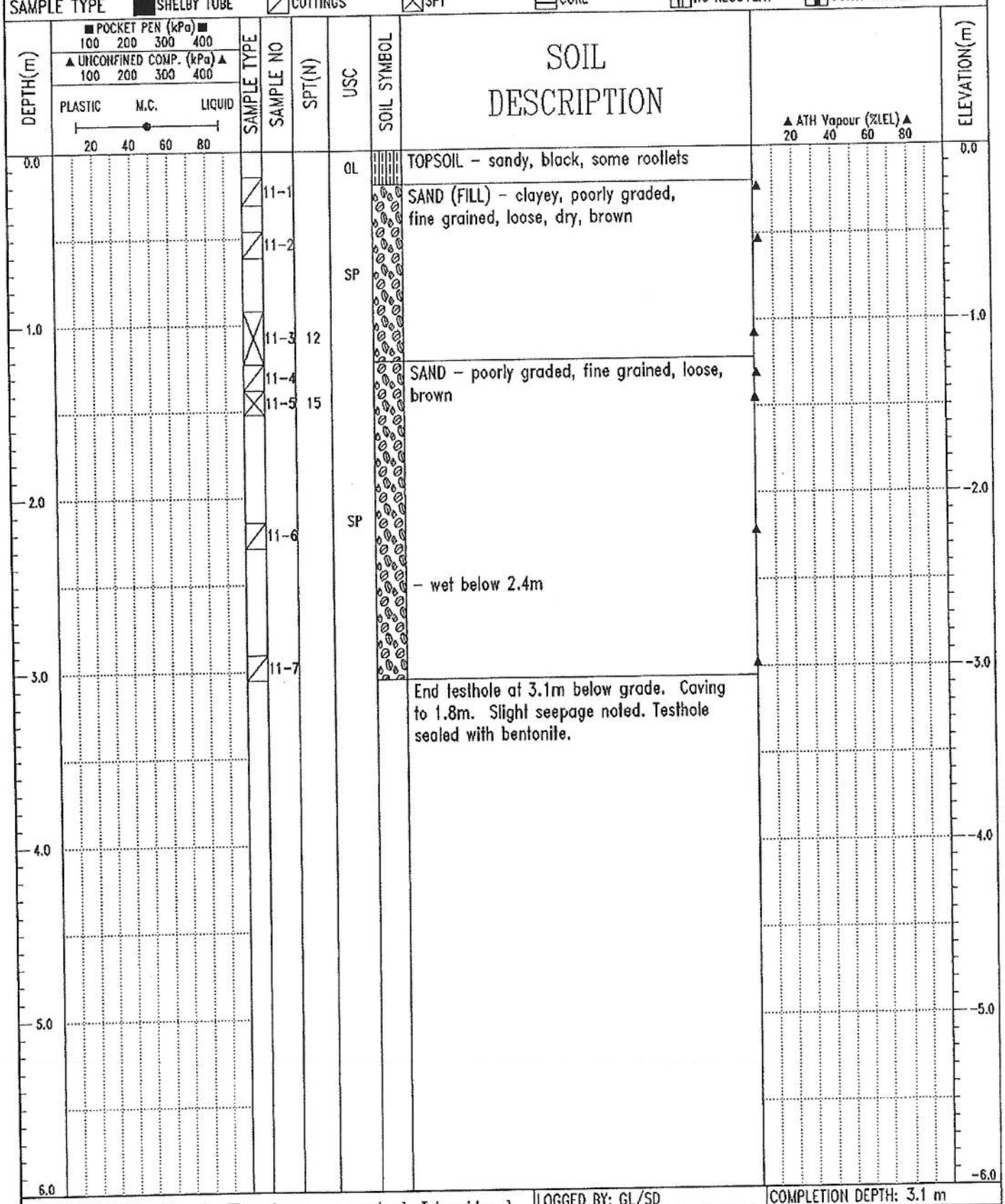
AMEC Earth & Environmental Limited
Winnipeg, Manitoba

| | |
|---|---|
| LOGGED BY: GL/SD | COMPLETION DEPTH: 3.1 m |
| REVIEWED BY: GL | COMPLETE: 31/05/02 |
| Fig. No: 11 | Page 1 of 1 |

02/05/14 11:05AM (GEO_MEB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-11 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

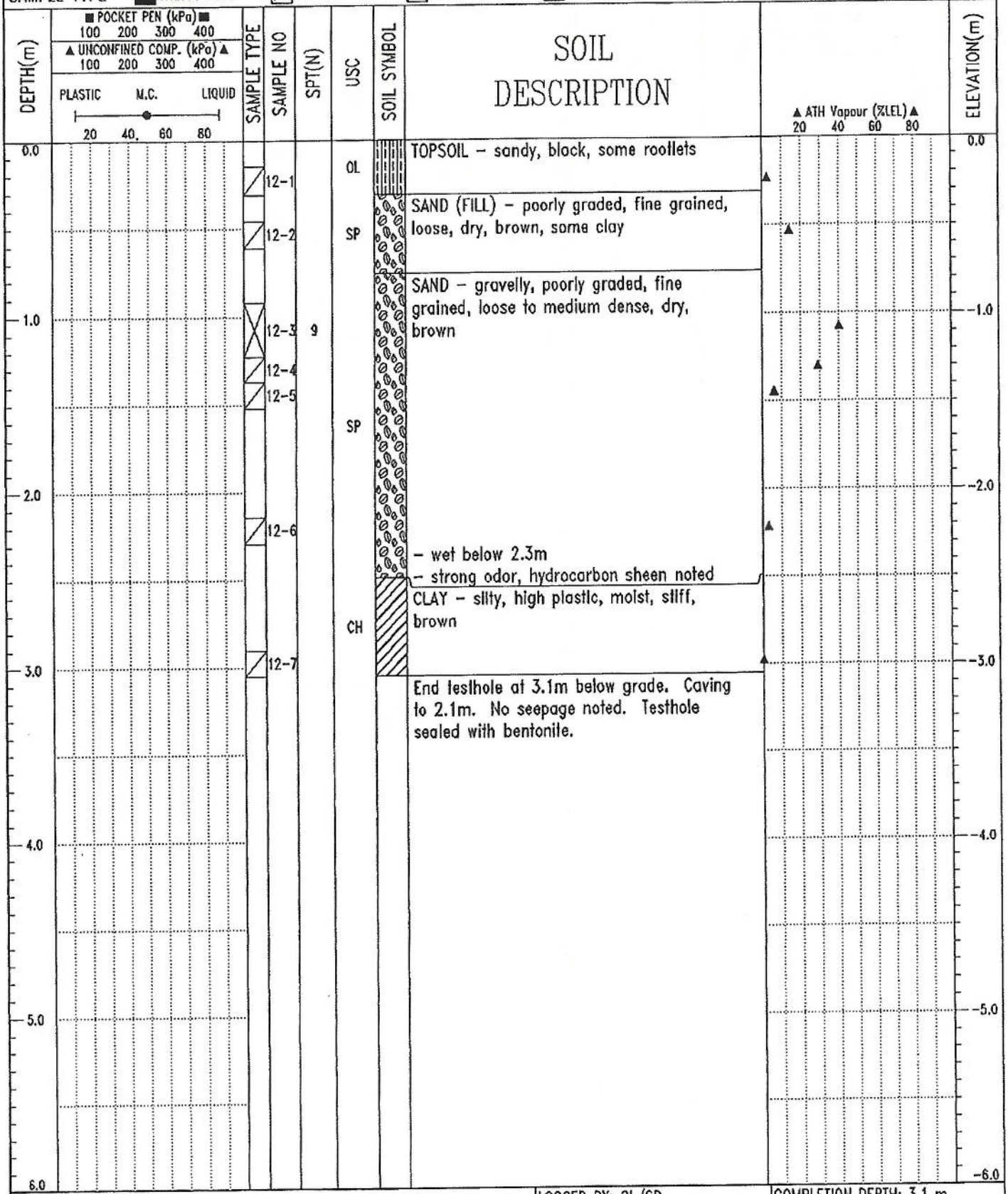



| | | |
|---|---|---|
| AMEC Earth & Environmental Limited<br>Winnipeg, Manitoba | LOGGED BY: GL/SD<br>REVIEWED BY: GL<br>Fig. No: 12 | COMPLETION DEPTH: 3.1 m<br>COMPLETE: 31/05/02<br>Page 1 of 1 |

02/05/14 11:05AM (GEO_WSB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-12 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE




| | | |
|---|---|---|
| AMEC Earth & Environmental Limited<br>Winnipeg, Manitoba | LOGGED BY: GL/SD<br>REVIEWED BY: GL<br>Fig. No: 13 | COMPLETION DEPTH: 3.1 m<br>COMPLETE: 31/05/02<br>Page 1 of 1 |

02/05/14 11:06AM (CEO_WEB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-13 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE ■ SHELBY TUBE ⧄ CUTTINGS ⊠ SPT ▭ CORE ▯ NO RECOVERY ▮ CONT. SAMPLE

| DEPTH(m) | ■ POCKET PEN (kPa) ■ 100 200 300 400 / ▲ UNCONFINED COMP. (kPa) ▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80 | SAMPLE TYPE | SAMPLE NO | SPT(N) | USC | SOIL SYMBOL | SOIL DESCRIPTION | ▲ ATH Vapour (%LEL) ▲ 20 40 60 80 | ELEVATION(m) |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | 13-1 | | OL | | TOPSOIL – sandy, black, some rootlets, trace clay and gravel | | 0.0 |
| | | | 13-2 | | SP | | SAND (FILL) – clayey, poorly graded, fine grained, loose, dry, brown, some gravel | | |
| 1.0 | | | 13-3 | 10 | | | SAND – gravelly, poorly graded, fine grained, loose, dry, brown, oxidized | | -1.0 |
| | | | 13-4 | | | | | | |
| | | | 13-5 | 8 | SP | | | | |
| 2.0 | | | 13-6 | | | | – wet at 2.1m<br>– grey staining, odour | | -2.0 |
| | | | | | CH | | CLAY – silty, high plastic, moist, stiff, brown | | |
| 3.0 | | | 13-7 | | | | End testhole at 3.1m below grade. Caving to 1.8m. No seepage noted. Testhole sealed with bentonite. | | -3.0 |
| 4.0 | | | | | | | | | -4.0 |
| 5.0 | | | | | | | | | -5.0 |
| 6.0 | | | | | | | | | -6.0 |

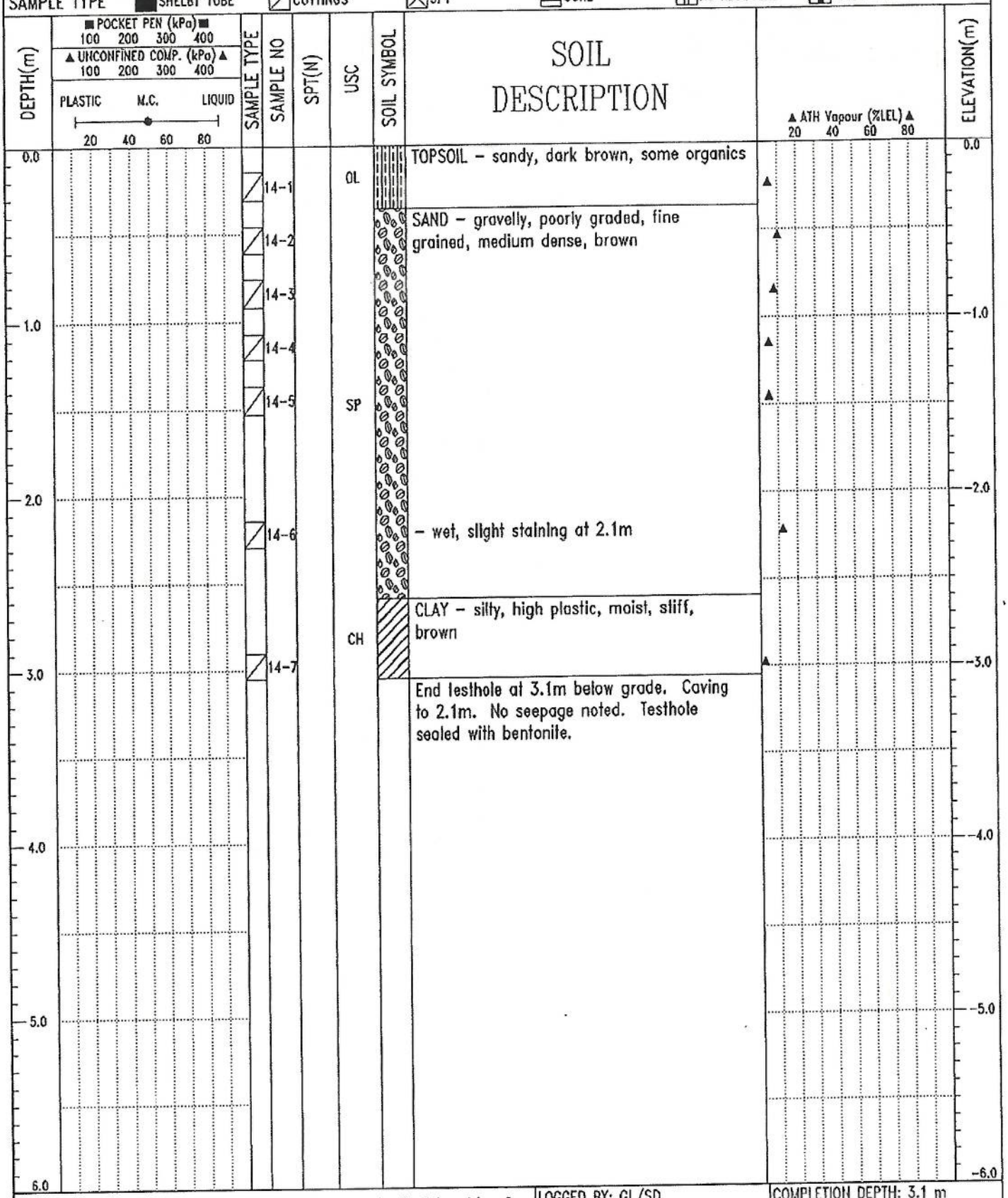
AMEC Earth & Environmental Limited
Winnipeg, Manitoba

| | |
|---|---|
| LOGGED BY: GL/SD | COMPLETION DEPTH: 3.1 m |
| REVIEWED BY: GL | COMPLETE: 31/05/02 |
| Fig. No: 14 | Page 1 of 1 |

02/05/14 11:06AM (GEO_WEB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-14 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE ■ SHELBY TUBE ⊘ CUTTINGS ⊠ SPT ▤ CORE ▥ NO RECOVERY ▮ CONT. SAMPLE

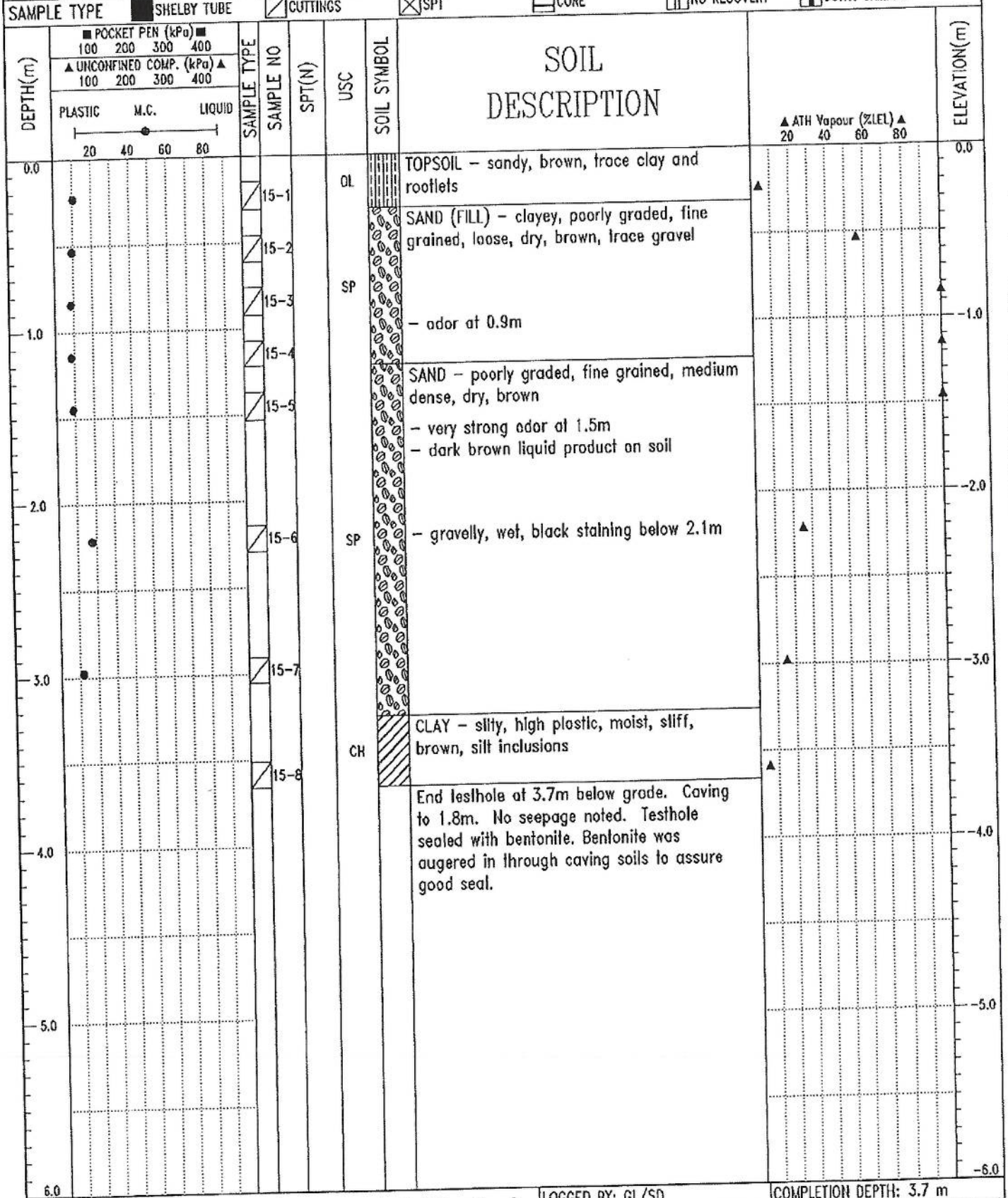



| | | |
|---|---|---|
| AMEC Earth & Environmental Limited<br>Winnipeg, Manitoba | LOGGED BY: GL/SD<br>REVIEWED BY: GL<br>Fig. No: 15 | COMPLETION DEPTH: 3.1 m<br>COMPLETE: 31/05/02<br>Page 1 of 1 |

02/05/14 11:06AM (GEO_MSB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-15 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE ■ SHELBY TUBE ⁄ CUTTINGS ⊠ SPT ▤ CORE ▯ NO RECOVERY ▮ CONT. SAMPLE

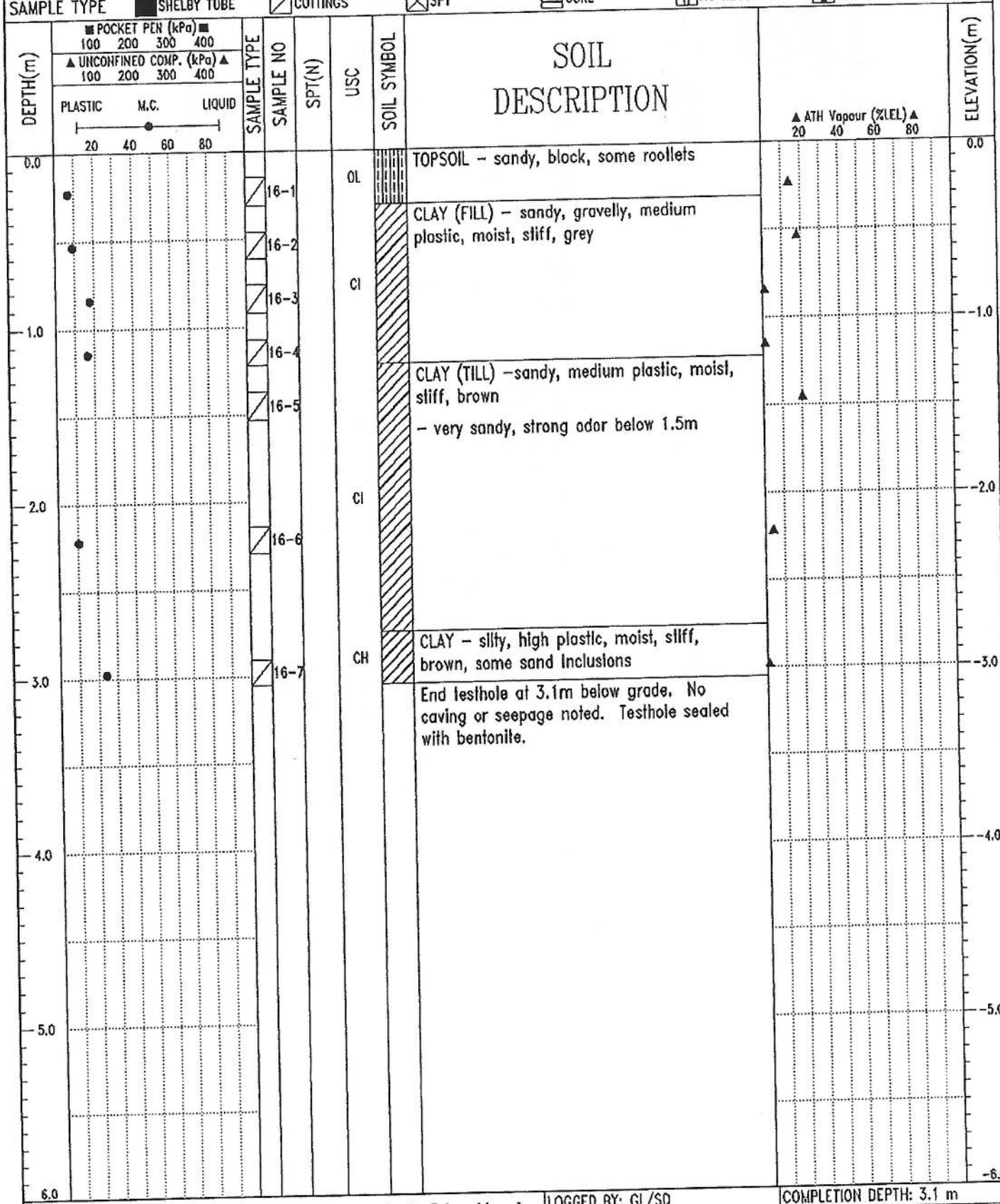



| | | |
|---|---|---|
| AMEC Earth & Environmental Limited<br>Winnipeg, Manitoba | LOGGED BY: GL/SD<br>REVIEWED BY: GL<br>Fig. No: 16 | COMPLETION DEPTH: 3.7 m<br>COMPLETE: 31/05/02<br>Page 1 of 1 |

02/05/14 11:06AM (GEO_WEB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-16 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

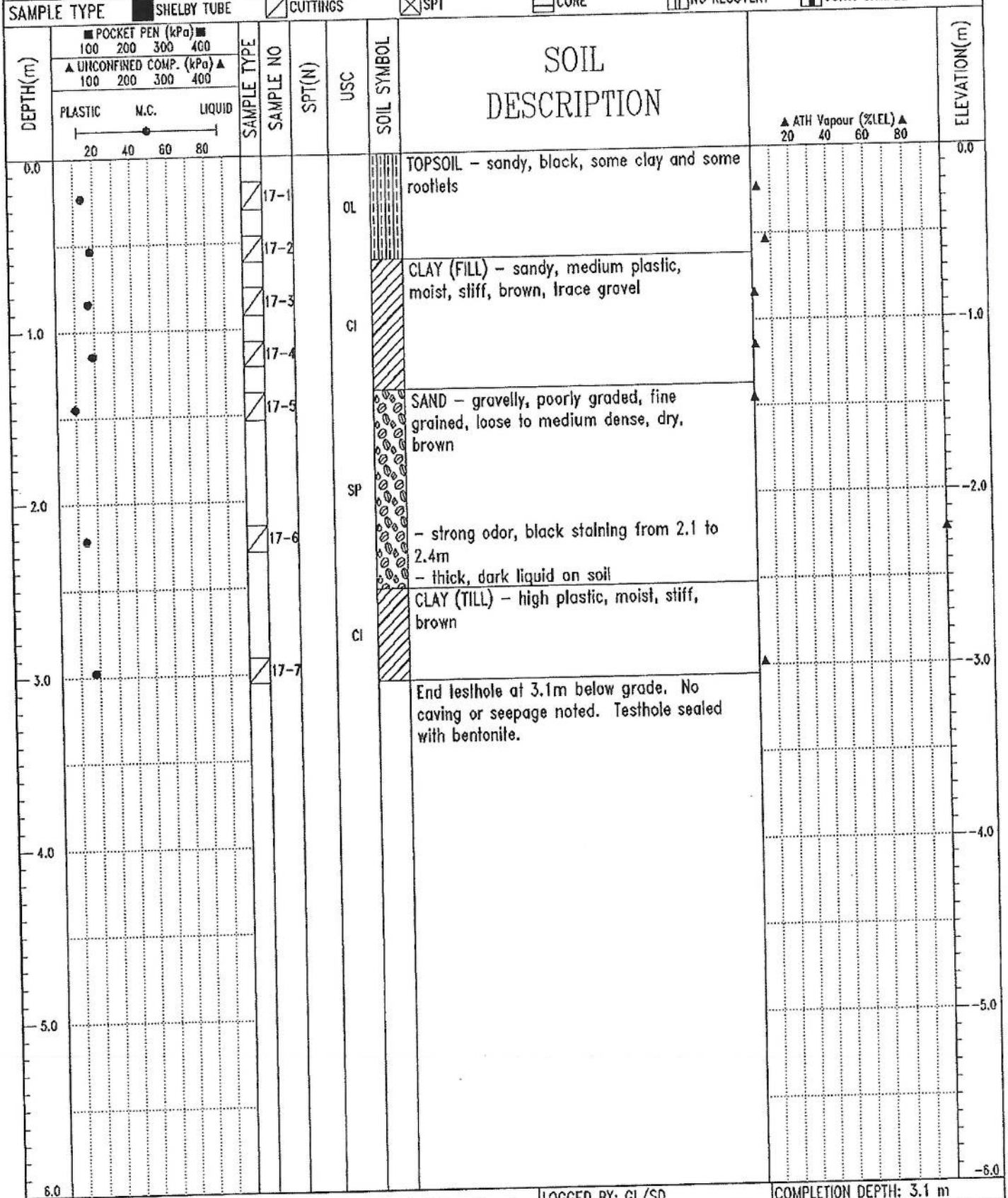



| | | |
|---|---|---|
| AMEC Earth & Environmental Limited<br>Winnipeg, Manitoba | LOGGED BY: GL/SD<br>REVIEWED BY: GL<br>Fig. No: 17 | COMPLETION DEPTH: 3.1 m<br>COMPLETE: 31/05/02<br>Page 1 of 1 |

02/05/14 11:06AM (GLO_MGB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-17 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE ■ SHELBY TUBE ▨ CUTTINGS ☒ SPT ▤ CORE ▥ NO RECOVERY ▮ CONT. SAMPLE

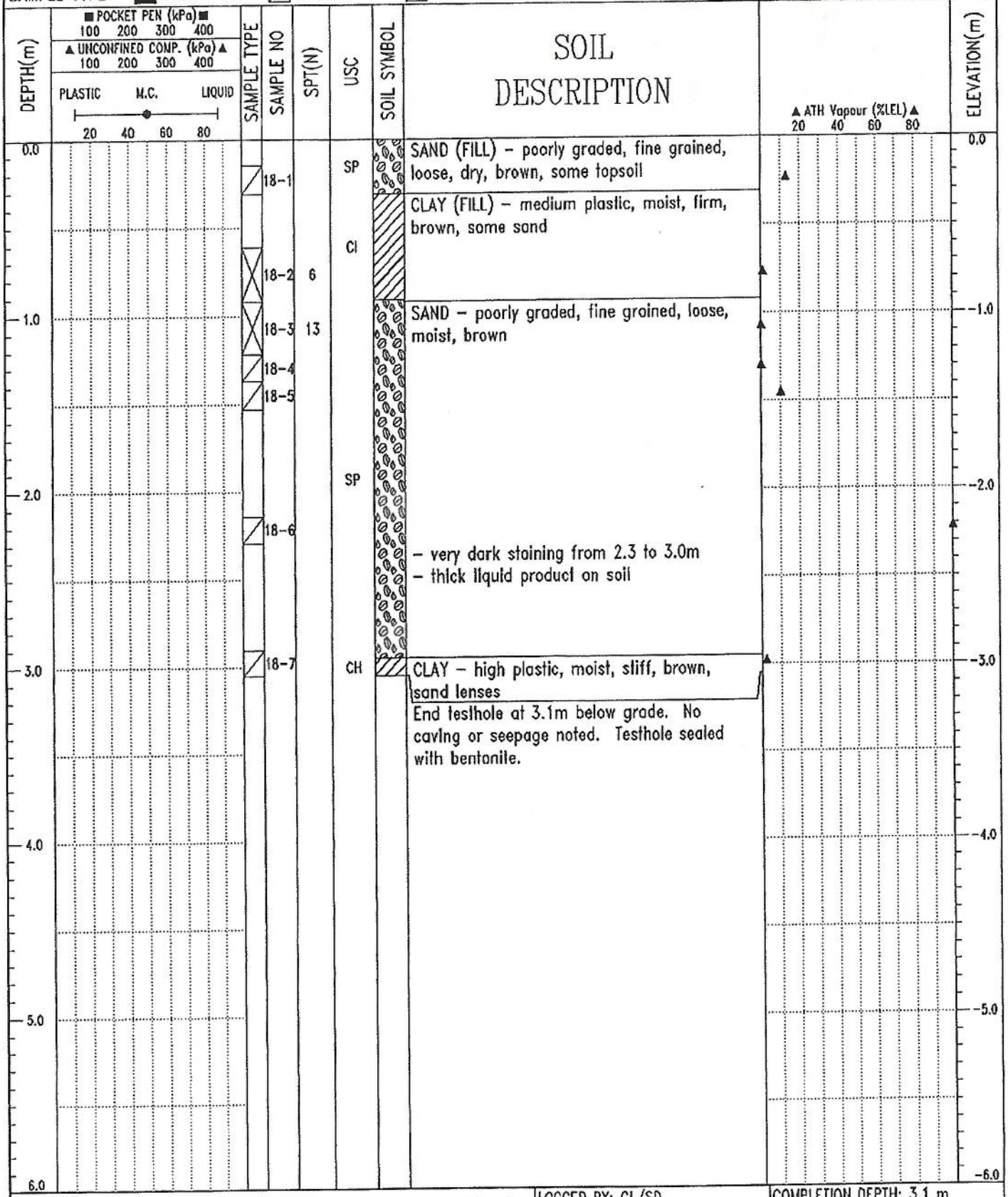



| | | |
|---|---|---|
| AMEC Earth & Environmental Limited<br>Winnipeg, Manitoba | LOGGED BY: GL/SD<br>REVIEWED BY: GL<br>Fig. No: 18 | COMPLETION DEPTH: 3.1 m<br>COMPLETE: 31/05/02<br>Page 1 of 1 |

02/05/14 11:06AM (GEO_WSB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-18 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE




| | | |
|---|---|---|
| AMEC Earth & Environmental Limited<br>Winnipeg, Manitoba | LOGGED BY: GL/SD<br>REVIEWED BY: GL<br>Fig. No: 19 | COMPLETION DEPTH: 3.1 m<br>COMPLETE: 31/05/02<br>Page 1 of 1 |

02/05/14 11:07AM (GEO_WEB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-19 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

■ POCKET PEN (kPa) ■ 100 200 300 400

▲ UNCONFINED COMP. (kPa) ▲ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

▲ ATH Vapour (%LEL) ▲ 20 40 60 80

| DEPTH(m) | SAMPLE TYPE | SAMPLE NO | SPT(N) | USC | SOIL SYMBOL | SOIL DESCRIPTION | ELEVATION(m) |
|---|---|---|---|---|---|---|---|
| 0.0 | | 19-1 | | OL | | TOPSOIL – sandy, black, some roollets, trace clay | 0.0 |
| | | 19-2 | | | | | |
| | | | | SP | | SAND (FILL) – clayey, poorly graded, fine grained, loose, brown, trace gravel | |
| 1.0 | | 19-3 | 12 | | | SAND – gravelly, poorly graded, fine grained, loose, brown | -1.0 |
| | | 19-4 | | | | | |
| | | | | SP | | | |
| | | 19-5 | 13 | | | | |
| 2.0 | | | | | | | -2.0 |
| | | 19-6 | | CI | | CLAY (TILL) – medium plastic, moist, very stiff, grey, silt and sand lenses, cobbles | |
| | | | | CH | | CLAY – silty, high plastic, moist, stiff, brown, silt lenses | |
| 3.0 | | 19-7 | | | | | -3.0 |
| | | | | | | End testhole at 3.1m below grade. Caving to 2.4m. No seepage noted. Testhole sealed with bentonite. Water level measured at 2.1 m below grade after drilling. | |
| 4.0 | | | | | | | -4.0 |
| 5.0 | | | | | | | -5.0 |
| 6.0 | | | | | | | -6.0 |

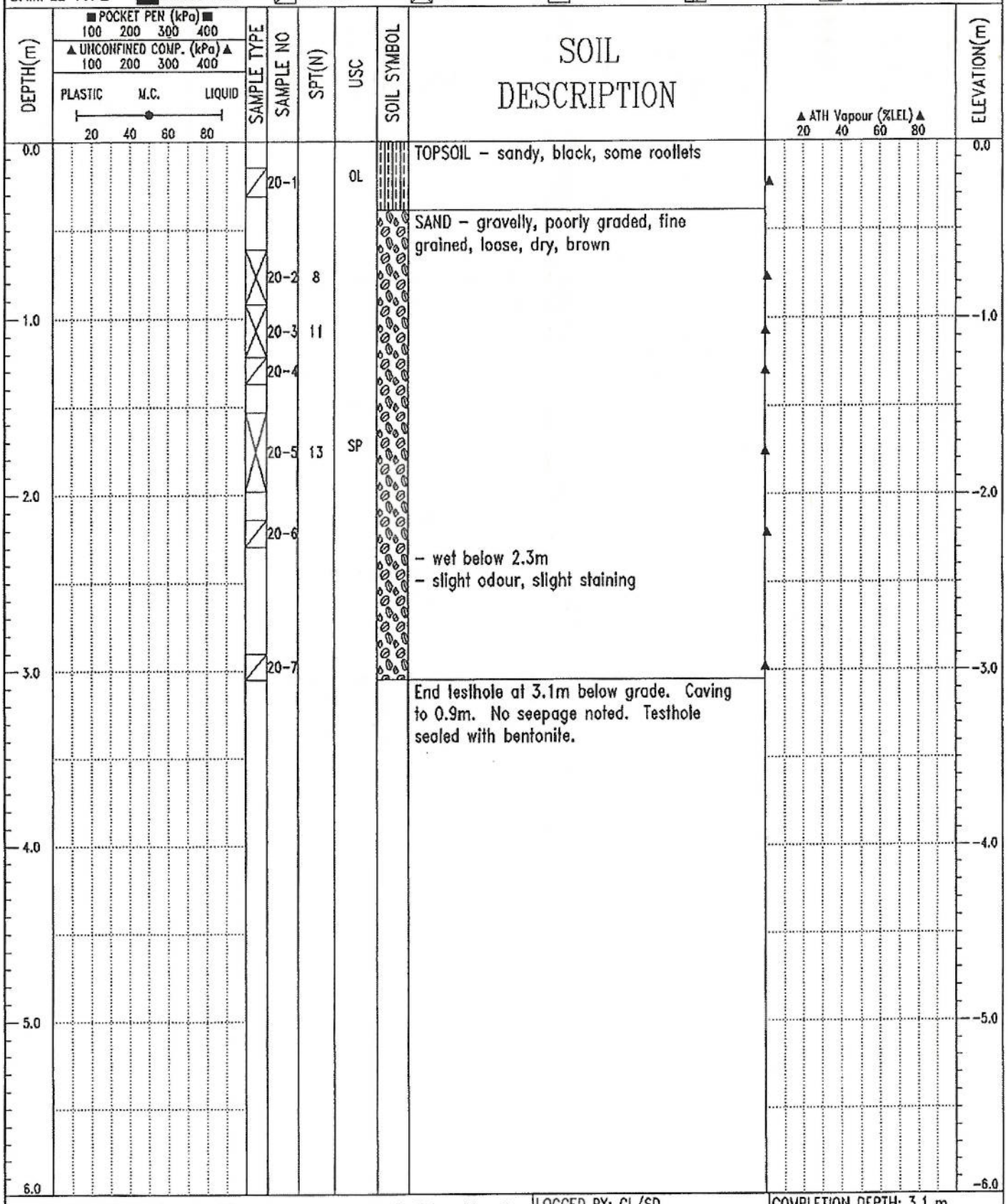
AMEC Earth & Environmental Limited
Winnipeg, Manitoba

| | |
|---|---|
| LOGGED BY: GL/SD | COMPLETION DEPTH: 3.1 m |
| REVIEWED BY: GL | COMPLETE: 31/05/02 |
| Fig. No: 20 | Page 1 of 1 |

02/05/14 11:07AM (CEO_WEB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-20 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

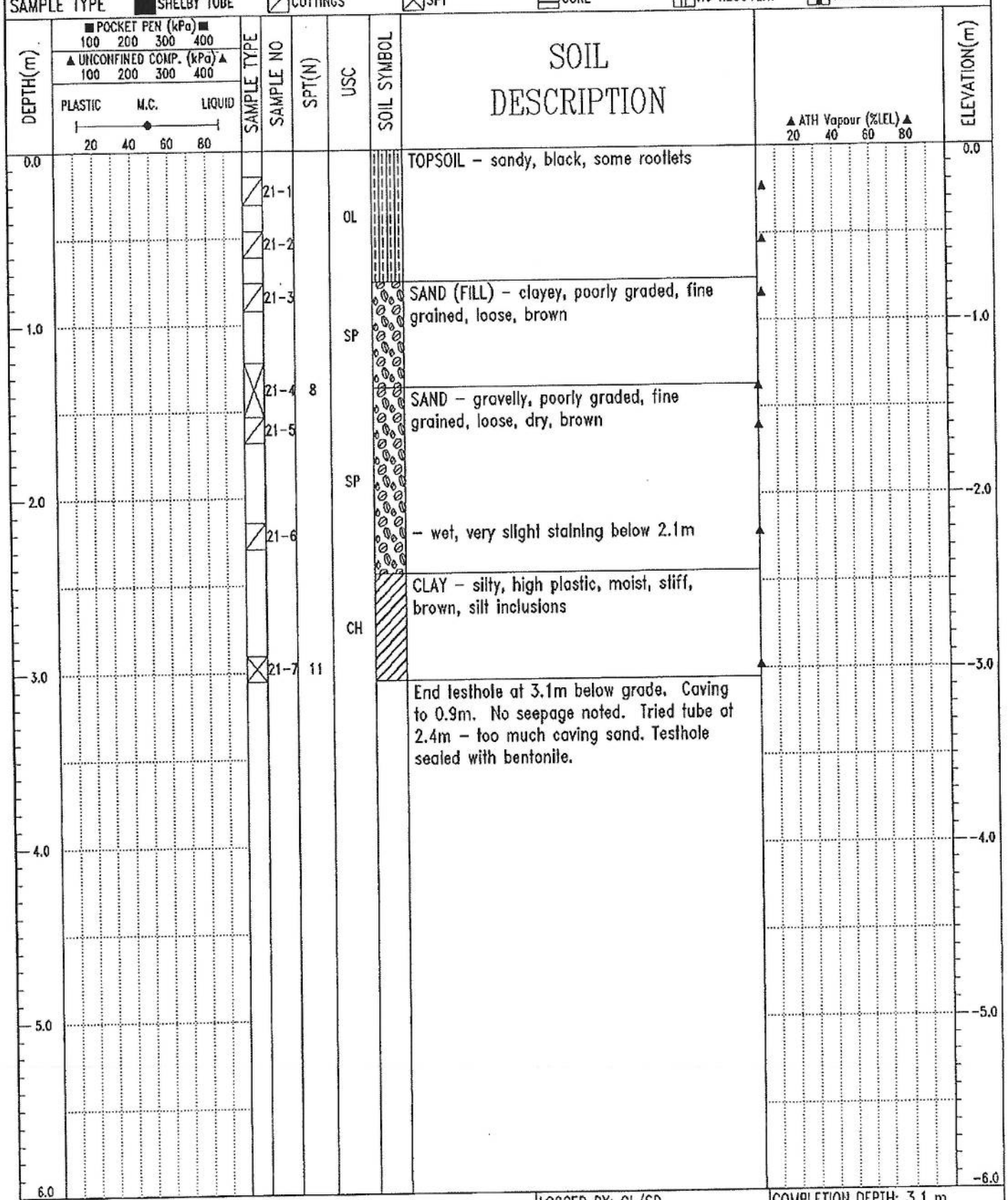



| | | |
|---|---|---|
| AMEC Earth & Environmental Limited<br>Winnipeg, Manitoba | LOGGED BY: GL/SD<br>REVIEWED BY: GL<br>Fig. No: 21 | COMPLETION DEPTH: 3.1 m<br>COMPLETE: 30/05/02<br>Page 1 of 1 |

02/05/14 11:07AM (GEO_WEB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-21 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE




| | | |
|---|---|---|
| AMEC Earth & Environmental Limited<br>Winnipeg, Manitoba | LOGGED BY: GL/SD<br>REVIEWED BY: GL<br>Fig. No: 22 | COMPLETION DEPTH: 3.1 m<br>COMPLETE: 31/05/02<br>Page 1 of 1 |

02/05/14 11:30AM (GEO_WEB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-22 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE ■ SHELBY TUBE ⁄ CUTTINGS ⊠ SPT ▤ CORE ▥ NO RECOVERY ▮▮ CONT. SAMPLE

■ POCKET PEN (kPa) ■ 100 200 300 400
▲ UNCONFINED COMP. (kPa) ▲ 100 200 300 400
PLASTIC M.C. LIQUID 20 40 60 80

| DEPTH(m) | SAMPLE TYPE | SAMPLE NO | SPT(N) | USC | SOIL SYMBOL | SOIL DESCRIPTION | ▲ ATH Vapour (%LEL) ▲ 20 40 60 80 | ELEVATION(m) |
|---|---|---|---|---|---|---|---|---|
| 0.0 | ⁄ | 22-1 | | OL | | TOPSOIL – sandy, black, some rootlets, trace clay | ▲ | 0.0 |
| | ⁄ | 22-2 | | | | SAND – gravelly, poorly graded, fine grained, loose, dry, brown | ▲ | |
| 1.0 | ⊠ | 22-3 | 12 | | | | ▲ | -1.0 |
| | ⁄ | 22-4 | | | | | ▲ | |
| | ⁄ | 22-5 | | | | | ▲ | |
| | | | | SP | | | | |
| 2.0 | ⁄ | 22-6 | | | | | ▲ | -2.0 |
| | | | | | | – wet below 2.4m<br>– slight odour, slight staining | | |
| 3.0 | ⁄ | 22-7 | | | | | ▲ | -3.0 |
| | | | | | | End testhole at 3.1m below grade. Caving to 0.9m. Testhole sealed with bentonite. | | |
| 4.0 | | | | | | | | -4.0 |
| 5.0 | | | | | | | | -5.0 |
| 6.0 | | | | | | | | -6.0 |

AMEC Earth & Environmental Limited
Winnipeg, Manitoba

| | |
|---|---|
| LOGGED BY: GL/SD | COMPLETION DEPTH: 3.1 m |
| REVIEWED BY: GL | COMPLETE: 31/05/02 |
| Fig. No: 23 | Page 1 of 1 |

02/05/14 11:07AM (GEO_WEB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-23 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE ■ SHELBY TUBE ⁄ CUTTINGS ⊠ SPT ▤ CORE ▥ NO RECOVERY ▮ CONT. SAMPLE

■ POCKET PEN (kPa) ■ 100 200 300 400
▲ UNCONFINED COMP. (kPa) ▲ 100 200 300 400
PLASTIC M.C. LIQUID 20 40 60 80

| DEPTH(m) | SAMPLE TYPE | SAMPLE NO | SPT(N) | USC | SOIL SYMBOL | SOIL DESCRIPTION | ▲ ATH Vapour (%LEL) ▲ 20 40 60 80 | ELEVATION(m) |
|---|---|---|---|---|---|---|---|---|
| 0.0 | ⁄ | 23-1 | | OL | | TOPSOIL – sandy, dark brown, some clay, trace rootlets | ▲ | 0.0 |
| | ⁄ | 23-2 | | SP | | SAND (FILL) – clayey, poorly graded, fine grained, loose, moist, brown, some gravel | ▲ | |
| 1.0 | ⊠ | 23-3 | 15 | | | SAND – gravelly, poorly graded, fine grained, loose, dry, brown | ▲ | -1.0 |
| | ⁄ | 23-4 | | | | | ▲ | |
| | ⁄ | 23-5 | | SP | | | ▲ | |
| 2.0 | | | | | | | | -2.0 |
| | ⁄ | 23-6 | | | | – wet, slight staining below 2.1m | ▲ | |
| | | | | CH | | CLAY – silty, high plastic, moist, stiff, brown, sand lenses | | |
| 3.0 | ⊠ | 23-7 | 11 | | | | ▲ | -3.0 |
| | | | | | | End testhole at 3.1m below grade. Caving to 0.9m. No seepage noted. Tried tube at 2.4m – too much sand. Testhole sealed with bentonite. | | |
| 4.0 | | | | | | | | -4.0 |
| 5.0 | | | | | | | | -5.0 |
| 6.0 | | | | | | | | -6.0 |

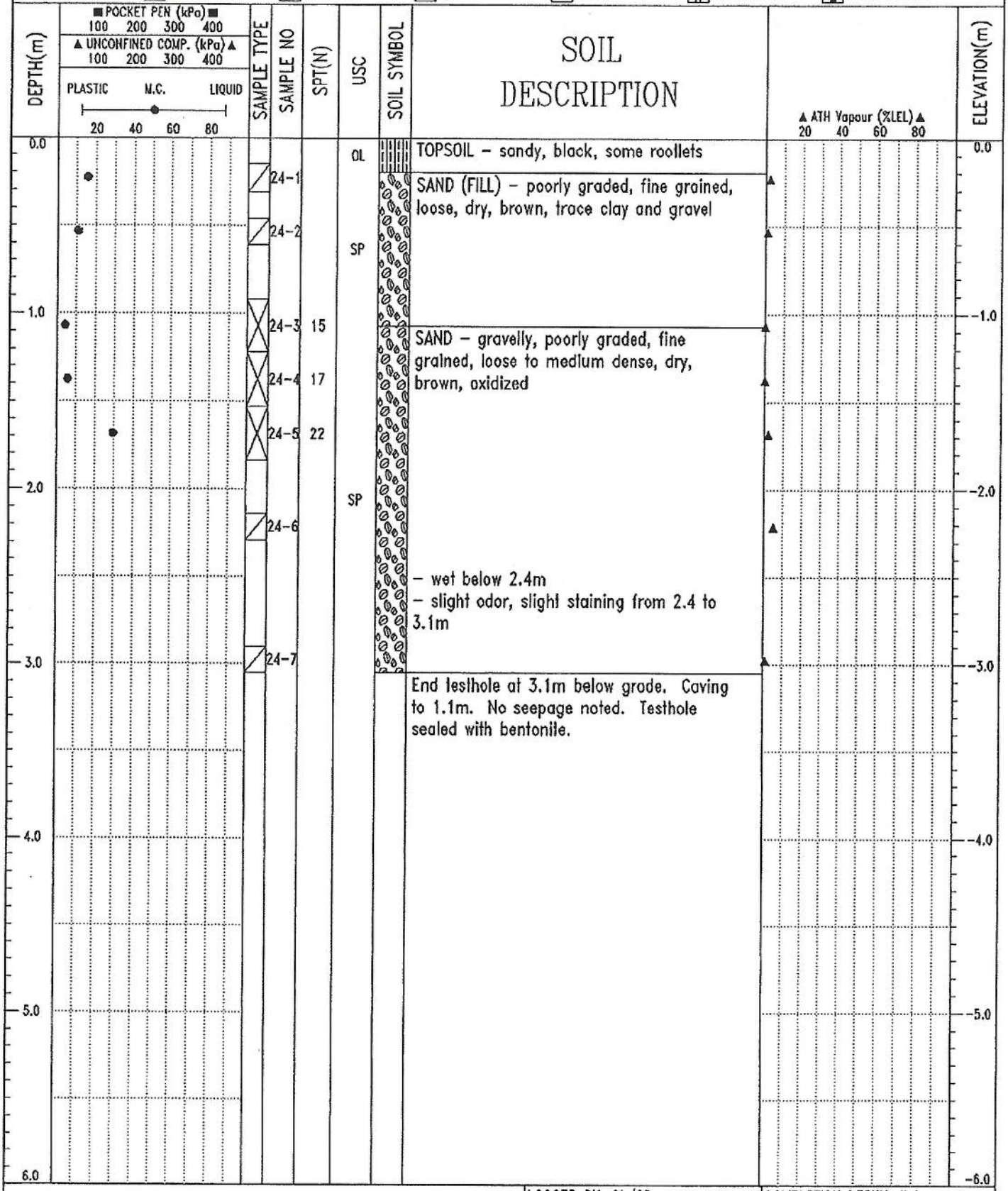
AMEC Earth & Environmental Limited
Winnipeg, Manitoba

| | |
|---|---|
| LOGGED BY: GL/SD | COMPLETION DEPTH: 3.1 m |
| REVIEWED BY: GL | COMPLETE: 31/05/02 |
| Fig. No: 24 | Page 1 of 1 |

02/05/14 11:31AM (GEO_WEB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-24 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

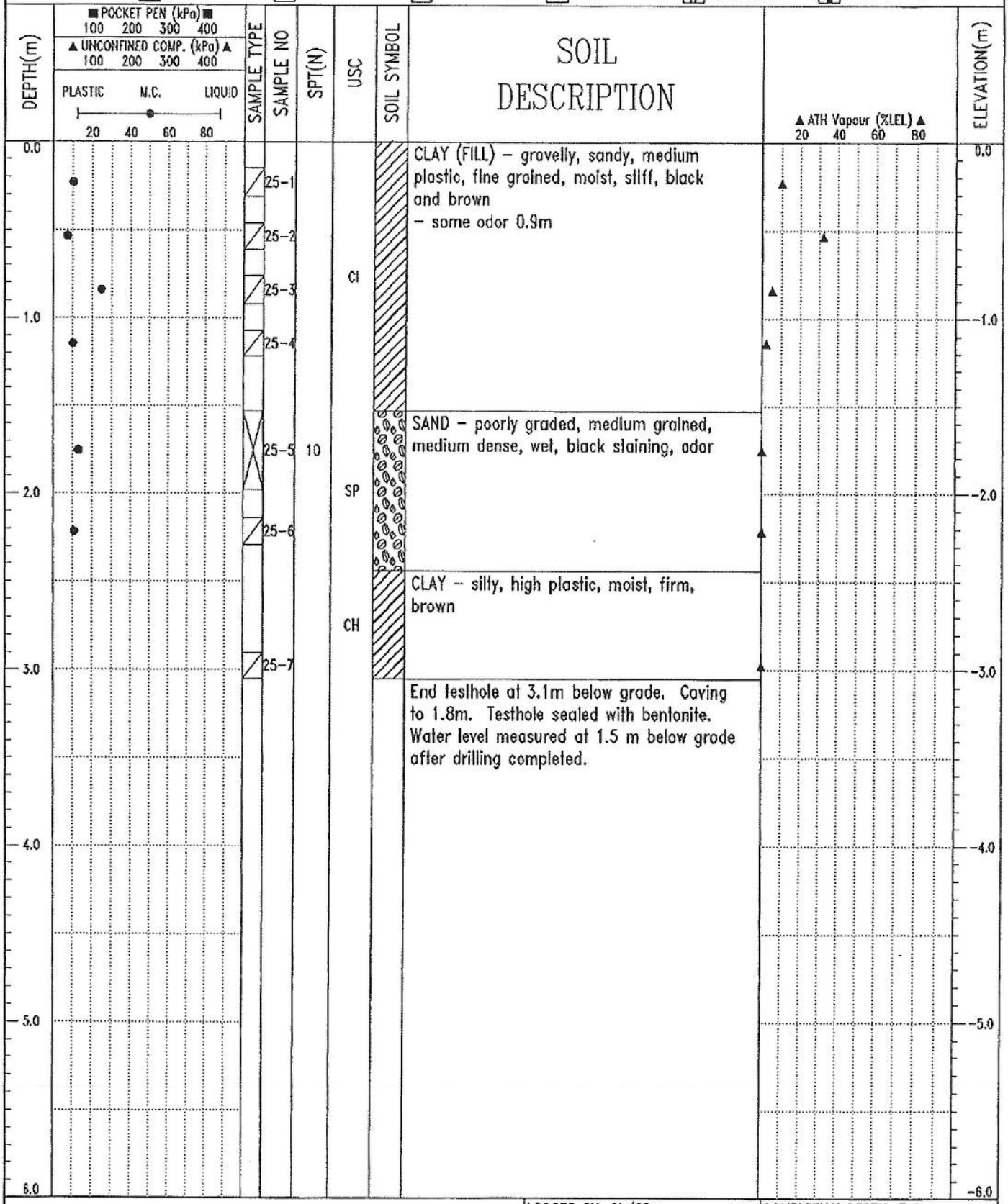



| | | |
|---|---|---|
| AMEC Earth & Environmental Limited<br>Winnipeg, Manitoba | LOGGED BY: GL/SD<br>REVIEWED BY: GL<br>Fig. No: 25 | COMPLETION DEPTH: 3.1 m<br>COMPLETE: 31/05/02<br>Page 1 of 1 |

02/05/14 11:08AM (GEO_WEB)

| | | |
|---|---|---|
| PROPOSED DEVELOPMENT | CONTRACTOR: PADDOCK DRILLING LIMITED | TEST HOLE NO: TH02-25 |
| 3829724 MANITOBA LTD. | DRILL RIG: CANTERRA CT250 | PROJECT NO: WX05421 |
| LOCATION: BRANDON, MANITOBA | AUGER: 150mm SOLID STEM | ELEVATION: |

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE




| | | |
|---|---|---|
| AMEC Earth & Environmental Limited<br>Winnipeg, Manitoba | LOGGED BY: GL/SD | COMPLETION DEPTH: 3.1 m |
| | REVIEWED BY: GL | COMPLETE: 31/05/02 |
| | Fig. No: 26 | Page 1 of 1 |

02/05/14 11:08AM (GEO_MEB)

# APPENDIX B

# SITE SENSITIVITY ASSESSMENT

**Table 1 : On-Site Land-uses, key receptors and exposure pathways (CCME, 2001)**
**(Surface soils < 1.5 m below grade)**

| | On-Site Land Use Classification (applicable land use in black) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Exposure Pathway | Agriculture | | Residential/Parkland | | Commercial | | Industrial | |
| Soil Contact | Nutrient cycling<br>Soil invertebrates<br>Crops (plants)<br>Human (child) | | Nutrient cycling<br>Invertebrates<br>Plants<br>Human (child) | | Nutrient cycling<br>Invertebrates<br>Plants<br>Human (child) | PR<br>PR<br>PR<br>1 | Nutrient cycling<br>Invertebrates<br>Plants<br>Human (adult) | |
| Soil Ingestion | Herbivores<br>Human (child) | | (wildlife)<br>Human (child) | | (wildlife)<br>Human (child) | 1<br>1 | (wildlife)<br>Human (adult) | |
| Soil Particulate Inhalation | Human (child) | | Human (child) | | Human (child) | 1 | Human (adult) | |
| Groundwater | Livestock Watering<br>Human (child) | | Human (child) | | Human (child) | PR | Human (adult) | |
| Surface Water | Aquatic life/Livestock Watering<br>Human (child) | | Aquatic Life<br>Human (child) | | Aquatic Life<br>Human (child) | 2<br>2 | Aquatic Life<br>Human (adult) | |
| Vapour Inhalation (humans only) | Child, outdoor | | Child, indoor | | Child, indoor | PR | Adult, indoor | |
| Produce, meat and milk produced on site (humans only) | Child | | Child (produce only) | | | | | |
| Off-site migration of Soil/dust | | | | | | | Human/Eco | |

- PR Potential Receptor. Likelihood is low but possible.
- [1] Does not apply at this site. Surface will be covered with concrete slabs and/or asphalt pavement.
- [2] Does not apply at this site. Aquatic environment is >10 m from site.

| Table 2 : On-Site Land-uses, key receptors and exposure pathways (CCME, 2001) (Sub-Surface soils >1.5 m below grade) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | On-Site Land Use Classification (applicable land use in black) | | | | | | | |
| Exposure Pathway | Agriculture | | Residential/Parkland | | Commercial | | Industrial | |
| Soil Contact | Nutrient cycling<br>Soil invertebrates<br>Crops (plants)<br>Human (child) | | Nutrient cycling<br>Invertebrates<br>Plants<br>Human (child) | | Nutrient cycling<br>Invertebrates<br>Plants<br>Human (child) | PR<br>PR<br>PR<br>1 | Nutrient cycling<br>Invertebrates<br>Plants<br>Human (adult) | |
| Soil Ingestion | Herbivores<br>Human (child) | | (wildlife)<br>Human (child) | | (wildlife)<br>Human (child) | 1<br>1 | (wildlife)<br>Human (adult) | |
| Soil Particulate Inhalation | Human (child) | | Human (child) | | Human (child) | 1 | Human (adult) | |
| Groundwater | Livestock Watering<br>Human (child) | | Human (child) | | Human (child) | PR | Human (adult) | |
| Surface Water | Aquatic life/Livestock Watering<br>Human (child) | | Aquatic Life<br>Human (child) | | Aquatic Life<br>Human (child) | 2<br>2 | Aquatic Life<br>Human (adult) | |
| Vapour Inhalation (humans only) | Child, outdoor | | Child, indoor | | Child, indoor | PR | Adult, indoor | |
| Produce, meat and milk produced on site (humans only) | Child | | Child (produce only) | | | | | |
| Off-site migration of Soil/dust | | | | | | | Human/Eco | |

- [1] Does not apply below 1.5 m as soil contact and soil ingestion are not practical at this depth.
- [2] Does not apply at this site. Aquatic environment is >10 m from site.

# APPENDIX C

# CERTIFICATES OF ANALYSES

**AMEC Earth & Environmental**
**Analytical Chemistry Laboratory**

**Date Required:** June 11/02

# SOIL ANALYSIS
## PRELIMINARY RESULTS

**Attn:** AMEC Earth & Enviro.
**Attn:** Pankratz, Harley
**Date:** June 4/02

10

**File#** 43110
**Project#** WX05421
**Date Sampled:** May 31/02

| Analyst | Date of Analysis | Parameter | Reference Method | Lab. No. | 4304 | 4305 | 4306 | 4307 | 4308 | 4309 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Sample I.D. | 02-9-6 | 02-15-3 | 02-16-5 | 02-17-6 | 02-23-2 | 02-25-2 |
| | | | | Trifluorotoluene Recovery(%) | 112 | 100 | 104 | 109 | 99 | 99 |
| | | | | MDL | | | ug/g (ppm) dry weight | | | |
| KL | 6/5/02 | Benzene | EPA 5021/CCME | 0.020 | <0.020 | 8.9 | 1.7 | 0.42 | 0.056 | 0.23 |
| KL | 6/5/02 | Toluene | EPA 5021/CCME | 0.030 | <0.030 | 0.28 | 2.8 | 0.41 | <0.030 | 0.13 |
| KL | 6/5/02 | Ethylbenzene | EPA 5021/CCME | 0.020 | <0.020 | 25 | 5.9 | 13 | 0.040 | 4.8 |
| KL | 6/5/02 | Xylenes | EPA 5021/CCME | 0.030 | 0.044 | 110 | 23 | 37 | 0.13 | 10 |
| KL | 6/5/02 | F1 - VPH ($C_6$-$C_{10}$) | EPA 5021/CCME | 1.5 | <1.5 | 2100 | 400 | 900 | 2.2 | 320 |
| KL | 6/5/02 | F2 - EPH ($C_{10}$-$C_{16}$) | EPA 3550/CCME | 10 | <10 | 4600 | 15000 | 4300 | 27 | 2700 |
| KL | 6/5/02 | F3 - EPH ($C_{16}$-$C_{34}$) | EPA 3550/CCME | 10 | 20 | 11000 | 16000 | 2200 | 99 | 11000 |
| KL | 6/5/02 | F4 - EPH ($C_{34}$-$C_{50}$) | EPA 3550/CCME | 10 | <10 | 2500 | 1500 | 45 | <10 | 2500 |
| KL | 6/5/02 | Moisture | CCME | % | 21.5 | 5.9 | 28.9 | 10.3 | 18.1 | 5.4 |

MDL: Method detection limit
EPA: U.S. Environmental Protection Agency. 1997. Test Methods of Evaluation of Solid Waste 3rd Ed through Update III. Office Solid Waste Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.
VPH -Volatile Petroleum Hydrocarbons (TVH with BTEX subtracted)
EPH: Extractable Petroleum Hydrocarbon - not corrected for PAH content.
CCME - Canadian Council of Ministers of the Environment - Method for Canada Wide Standards for Petroleum Hydrocarbon in Soil - Tier 1 Method, 2001

Report reviewed by:

James A. LeBlanc, B.Sc.
QA/QC Manager
Laboratory Services

Brenda Chomin
Manager
Laboratory Services

**AMEC Earth & Environmental**
**Analytical Chemistry Laboratory**

**Date Required:** June 11/02

## SOIL ANALYSIS
## PRELIMINARY RESULTS

**Attn:** AMEC Earth & Enviro.
**Attn:** Pankratz, Harley
**Date:** June 4/02

**File#** 43110
**Project#** WX05421
**Date Sampled:** May 31/02

| Analyst | Date of Analysis | Parameter | Reference Method | Lab. No. | 4310 | 4311 | 4312 | 4313 | 4313 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sample I.D. | 02-1-2 | 02-4-7 | 02-13-2 | 02-14-6 | 02-14-6 |
| | | | | Trifluorotoluene Recovery(%) | 104 | 101 | 100 | 121 | 105 |
| | | | | MDL | ug/g (ppm) dry weight | | | | Lab Duplicate |
| KL | 6/5/02 | Benzene | EPA 5021/CCME | 0.020 | 0.24 | <0.020 | 0.043 | <0.020 | <0.020 |
| KL | 6/5/02 | Toluene | EPA 5021/CCME | 0.030 | 0.033 | <0.030 | <0.030 | <0.030 | <0.030 |
| KL | 6/5/02 | Ethylbenzene | EPA 5021/CCME | 0.020 | 0.34 | <0.020 | 0.14 | <0.020 | <0.020 |
| KL | 6/5/02 | Xylenes | EPA 5021/CCME | 0.030 | 0.97 | <0.030 | 0.37 | <0.030 | <0.030 |
| KL | 6/5/02 | F1 - VPH ($C_6$-$C_{10}$) | EPA 5021/CCME | 1.5 | 6.3 | <1.5 | 8.2 | <1.5 | <1.5 |
| KL | 6/5/02 | F2 - EPH ($C_{10}$-$C_{16}$) | EPA 3550/CCME | 10 | 61 | 10 | 19 | <10 | <10 |
| KL | 6/5/02 | F3 - EPH ($C_{16}$-$C_{34}$) | EPA 3550/CCME | 10 | 100 | 50 | 70 | 51 | 49 |
| KL | 6/5/02 | F4 - EPH ($C_{34}$-$C_{50}$) | EPA 3550/CCME | 10 | <10 | <10 | <10 | <10 | <10 |
| KL | 6/5/02 | Moisture | CCME | % | 19.8 | 11.3 | 14.2 | 14.6 | 14.8 |

MDL: Method detection limit
EPA: U.S. Environmental Protection Agency. 1997. Test Methods of Evaluation of Solid Waste 3rd Ed through Update III. Office Solid Waste Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.
VPH -Volatile Petroleum Hydrocarbons (TVH with BTEX subtracted)
EPH: Extractable Petroleum Hydrocarbon - not corrected for PAH content.
CCME - Canadian Council of Ministers of the Environment - Method for Canada Wide Standards for Petroleum Hydrocarbon in Soil - Tier 1 Method, 2001

Report reviewed by:

James A. LeBlanc, B.Sc.
QA/QC Manager
Laboratory Services

Brenda Chomin
Manager
Laboratory Services

# APPENDIX D

# GENERAL CONDITIONS

## AMEC Earth & Environmental Limited
## STATEMENT OF GENERAL CONDITIONS - ENVIRONMENTAL SERVICES

1. STANDARD OF CARE - In the performance of professional services, the CONSULTANT will use that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its professional practicing in the same or similar localities. No other warranty expressed or implied is made or intended by this agreement or by furnishing oral or written reports of the findings made. The CONSULTANT is to be liable only for damage approximately caused by the negligence of the CONSULTANT. The CLIENT recognizes that subsurface conditions may vary from those encountered at the location where borings, surveys, or explorations are made by the CONSULTANT and that the data, interpretations and recommendation of the CONSULTANT are based solely on the information available to him. The CONSULTANT will not be responsible for the interpretation by others of the information developed.

2. SITE INFORMATION - The CLIENT agrees to fully cooperate with the CONSULTANT with respect to the provision of all available information on the past, present and proposed conditions of the Site known to it or otherwise requested by the CONSULTANT.

The CONSULTANT agrees to include a review of all historical information obtained by the CLIENT or provided by the Client to assist in the investigation of the Site unless and except to the extent that such a review is limited or excluded from the scope of work to be performed by the CONSULTANT.

3. FULL DISCLOSURE - The CLIENT acknowledges that in order for the CONSULTANT to properly advise and assist the CLIENT in respect of the investigation of the Site, the CONSULTANT is relying upon full disclosure by the CLIENT of all matters pertinent to an investigation of the Site.

4. DELAYS AND INTERRUPTIONS - Should the CONSULTANT be delayed or interrupted by others in the performance of its services or be required to perform additional services as a result of any delay or interruption caused by others, the CONSULTANT shall be equitably compensated by the CLIENT for all costs, charges and expenses which it may incur as a result of such delay or interruption and any such additional services to be performed and any and all consequences resulting from such delay or interruption.

5. USE OF WORK PRODUCT - The CONSULTANT agrees to provide to the CLIENT interim reports outlining the progress of the investigation of the Site on a periodic basis and a final comprehensive report upon the completion of the investigation of the Site.

6. COMPLETE REPORT - This document being a part of the Report is of a summary nature and is not intended to stand alone without reference to the instructions given to the CONSULTANT by the CLIENT, communications between the CONSULTANT and the CLIENT, and to any other reports, writings or documents prepared by the CONSULTANT for the CLIENT relative to the specific Site described herein, all of which constitute the Report. Wherever the word "Report" is used herein, it shall refer to any and all of the documents referred to herein.

In order to properly understand the suggestions, recommendations and opinions expressed herein, reference must be made to the whole of the Report. The CONSULTANT cannot be responsible for use by any part of portions of the report without reference to the whole report.

7. LIMITATIONS ON SCOPE OF INVESTIGATION AND WARRANTY DISCLAIMER
There is no warranty, expressed or implied, by the CONSULTANT that:
a) The investigation shall uncover all potential contaminants, including asbestos, on the Site; or
b) The Site will be entirely free of all Targeted Contaminants or other contaminants as a result of any cleanup work undertaken on the Site, since it is not possible, even with exhaustive sampling, testing and analysis, to document all potential contaminants on the Site.

Classification and identification of soils, rocks, geological units, contaminated materials and contaminant quantities have been based on commonly accepted practices in environmental consulting practice in this area.
The CLIENT acknowledges that:

a) The investigation findings are based solely on the information generated as a result of the specific scope of the investigation authorized by the CLIENT;
b) any assessment regarding the presence of contamination of the Site is based on the interpretation of conditions determined at specific sampling locations and depths and that conditions may vary between sampling locations;
c) there can be no assurance that isolated pockets of contaminants are not located on the Site;
d) any assessment is also dependent on and limited by the accuracy of the analytical data generated by the sample analyses;
e) any assessment is also limited by the scientific possibility of determining the presence of contaminants for which scientific analyses have been conducted; and
f) the analytical parameters selected are limited to those outlined in the CLIENT's authorized scope of investigation (in the absence of any evidence of potential contamination sources on the Site, which may warrant expanding the analytical parameters).

8. REMEDIATION COST ESTIMATES - Estimates of remediation costs can only be based on the specific information generated and the technical limitations of the investigation authorized by the CLIENT. Accordingly, estimated costs for remediation only represent the cost to clean up known contaminants that have been identified during the course of the investigation. As remediation of a Site is often an iterative exercise, estimated costs for remediation should only be interpreted to cover the first stage of any Site remediation until such time as verification samples indicate that the Site has been fully remediated and the CONSULTANT shall therefore not be liable for the accuracy of any estimates of remediation costs provided.

9. CONTROL OF WORK AND JOBSITE SAFETY - The CONSULTANT is only responsible for the activities of its employees on the jobsite. The presence of CONSULTANT personnel on the Site shall not be construed in any way to relieve the CLIENT or any contractors on Site from their responsibilities for Site safety. The CLIENT undertakes to inform the CONSULTANT of all hazardous conditions, or possible hazardous conditions which are known to him. The CLIENT also recognizes that the activities of the CONSULTANT may uncover previously unknown hazardous materials and that such a discovery may result in the necessity to undertake emergency procedures to protect CONSULTANT employees as well as the public at large and the environment in general. The CLIENT also acknowledges that in some cases the discovery of hazardous conditions and materials will require that certain regulatory bodies be informed and the CLIENT agrees that notification to such bodies by the CONSULTANT will not be a cause of action or dispute.

10. LIMITATION OF RESPONSIBILITY

Limitation of Liability - The CLIENT hereby agrees that to the fullest extent permitted by the law the CONSULTANT's total liability to CLIENT for any and all injuries, claims losses, expenses or damages whatsoever arising out of or in anyway relating to the Project, the Site, or this agreement from any cause or causes including but not limited to the CONSULTANT's negligence, errors, omissions, strict liability, breach of contract, or breach of warranty shall not exceed the total amount paid by the CLIENT for the services of the CONSULTANT under this contract or $50,000, whichever is greater.

No Special or Consequential Damages - CLIENT and CONSULTANT agree that to the fullest extent permitted by law the CONSULTANT shall not be liable to CLIENT for any special, indirect or consequential damages whatsoever, whether caused by the CONSULTANT's negligence, errors omissions, strict liability, breach of contract, breach of warranty or other cause of causes whatsoever.

Indemnification - To the fullest extent permitted by law, the CLIENT agrees to defend, indemnify and hold the CONSULTANT, its agents, subcontractors, and employees harmless from and against any and all claims, defense costs, including attorney's fees, damages, and other liabilities arising out of or in any way related to CONSULTANT's reports or recommendations concerning this Agreement, CONSULTANT's presence on the project property, or the presence, release, or threatened release of asbestos, hazardous substances, or pollutants on or from the project property; provided that the CLIENT shall not indemnify CONSULTANT against liability for damages to the extent caused by the negligence or intentional misconduct of CONSULTANT, its agents, subcontractors, or employees.