REPORT FOR SUBMISSION TO
ONTARIO MINISTRY OF ENVIRONMENT & ENERGY
SITE-SPECIFIC RISK ASSESSMENT
GARDINER EXPRESSWAY DISMANTLING AND
LAKESHORE BOULEVARD EAST RECONSTRUCTION
AT LESLIE STREET
TORONTO, ONTARIO

Prepared For:

CITY OF TORONTO
C/O URS COLE SHERMAN

Prepared by:

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Project: SP3977
May 14, 2002

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Project: SP3977 **May 14, 2002**

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Attention: Keith Hutchinson, P. Eng.
Project Manager

Dear Mr. Hutchinson:

REPORT FOR SUBMISSION TO
ONTARIO MINISTRY OF ENVIRONMENT & ENERGY
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GARDINER EXPRESSWAY DISMANTLING AND
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AT LESLIE STREET
TORONTO, ONTARIO

This report is submitted by Shaheen & Peaker (S&P) Limited to the City of Toronto c/o URS Cole Sherman. The report presents the findings of a study that evaluates the risks to human health and the environment from impacted soils encountered during the dismantling of the Gardiner Expressway and the widening of Lakeshore Boulevard East in the vicinity of Leslie Street. This draft report was submitted for a third party peer review by Angus Environmental Limited (AEL), in accordance with the requirements of the MOEE SSRA process. The draft report was also reviewed by the City of Toronto Public Health Department (TPH). The peer review, TPH review and S&P's responses are also appended in this report, and portions of the report text were revised to reflect the reviewers' comments. In accordance with the Site-Specific Risk Assessment Process, this report can be submitted to the Ontario Ministry of Environment and Energy for its review.

We trust that the foregoing meets your current requirements. Please contact our office if you have any further questions.

Yours very truly,
SHAHEEN & PEAKER LIMITED

Cynthia L. Robins, P.Eng., C.Chem.
Senior Project Manager

REPORT FOR SUBMISSION TO ONTARIO MINISTRY OF ENVIRONMENT & ENERGY SITE-SPECIFIC RISK ASSESSMENT GARDINER EXPRESSWAY DISMANTLING AND LAKESHORE BOULEVARD EAST RECONSTRUCTION AT LESLIE STREET, TORONTO, ONTARIO

EXECUTIVE SUMMARY

This report is submitted by Shaheen & Peaker (S&P) Limited to the City of Toronto c/o URS Cole Sherman. The report presents the findings of a study that evaluates the risks to human health and the environment from environmentally impacted soils encountered during the dismantling of the Gardiner Expressway and the reconstruction of Lakeshore Boulevard East at Leslie Street, in Toronto, Ontario.

Past site characterization studies have shown that soil within the study area exceeds Ministry of Environment and Energy (MOEE) generic criteria. Exceedances were found for some heavy metals, petroleum hydrocarbons and polycyclic aromatic hydrocarbons (PAHs). The first location is along a portion of the north boulevard of Lakeshore Boulevard East. This location is impacted mainly by metals in surface and subsurface soils. The second area is located in the former Gardiner Expressway ramps at the southeast corner of Leslie Street and Lakeshore Boulevard East. This location has hydrocarbon and PAH impacted surface and subsurface soils and some metal impacted soils. The areas of impacted soil are heterogeneous fill soils. No chemical exceedances have been detected in the groundwater, which indicates that the impacts in the soil are not mobile or migrating off-site in groundwater. The source of the impacts is historical. There are no known active sources of contamination or sources that are further contributing to the conditions currently present.

The City of Toronto authorized S&P to carry out a Site Specific Risk Assessment (SSRA) of the impacted areas to determine if there were any health risks associated with the short or long term proposed use of the site. In the proposed Level 2 Risk Management Plan and Landscape Plan for the site, the City plan to cap the site with clean soil to prevent exposure to potentially impacted soil and provide for the various landscape features. Additional mitigation features such as geotextiles and some excavation were also planned to eliminate contact between humans, wildlife and plants with potentially impacted soil. The findings of the SSRA indicated that there were no short term or long term health concerns associated with the use of the site based on the proposed Level 2 Risk Management Plan.

In subsequent public consultation, members of the public expressed concern that capping was only one possible remedial option and that other remedial alternatives needed to be investigated. As a result, the City of Toronto initiated a study to evaluate alternative remedial options. The evaluation was completed and concluded that the Level 2 risk management measures associated with the SSRA were acceptable remedial options.

The Human Health SSRA identified the human receptors on the site as adults and children, using the site for transition from one place to another. The ecological component of the SSRA

identified the necessity of preventing contact with the soil by any of the vegetation planted on the site, and from burrowing animals. In summary, the SSRA determined that the major pathway of exposure to both humans and the environment was direct contact with impacted soil.

Based on the human health and ecological assessments, a Level 2 Risk Management Plan was developed. The Level 2 Risk Management measures include:

- A minimum of 30 cm (0.3 m) of clean fill or topsoil covering the entire site – this fill will meet the MOEE criteria for residential/parkland use. Most of the site will be covered with 50 cm (0.5 m) of topsoil, and the bermed areas will have up to 1.5 m of fill or topsoil. The areas of the site with less than 50 cm (0.5 m) of surface cover are only those between the bicycle paths and the roadways – these are not anticipated to be frequented by children or pets due to the danger from the close proximity to vehicles.
- Sidewalks and bicycle paths would be constructed of asphalt, concrete or lockstone
- Selective excavation and disposal of soil in areas where swales or deep rooted plants and trees may contact impacted soil
- Lining of excavated and bermed areas with permeable geotextile to prevent root penetration into impacted soil
- Ensuring that any fill used for berms or backfill will meet the MOEE criteria for residential/parkland land use
- Consultation with the City's landscape architect in the selection of planting species
- Regular inspections and maintenance of the clean soil cover
- Immediate repairs of any breaches in the clean soil cover (e.g. winter damage or digging by children or animals)
- Notification to utility providers of requirements regarding intrusive excavations into the study area (e.g. for repairs to utilities)
- Public consultation meetings that were held in 2001
- Consultation with other City departments (e.g. Public Health)
- Regular groundwater monitoring

This draft report was submitted for a third party peer review by Angus Environmental Limited (AEL), in accordance with the requirements of the MOEE SSRA process. AEL's review and S&P's responses are included as appendices in this report. The text of this report was revised to accommodate the Peer Reviewer's comments.

The draft report was also reviewed by the City of Toronto Public Health Department. The Department's review and S&P's responses are also appended to this report, and portions of the report text were revised to reflect the Health Department comments.

In accordance with the Site-Specific Risk Assessment Process, this report can be submitted to the Ontario Ministry of Environment and Energy for review.

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1. INTRODUCTION

This report is submitted by Shaheen & Peaker Limited (S&P) to the City of Toronto c/o URS Cole Sherman. The report presents the findings of a Site-Specific Risk Assessment (SSRA) that evaluates risks to human health and the environment for identified environmentally impacted areas within the larger project area involving the dismantling of the Gardiner Expressway and the widening of Lakeshore Boulevard East in the vicinity of Leslie Street (see **Drawing 1**). URS Cole Sherman is the Project Manager overseeing the entire Gardiner dismantling/Lakeshore restoration project and reports directly to the City of Toronto.

This SSRA addresses two specific areas within the Gardiner Dismantling project, as shown in **Drawing 2**. These two areas have been identified as having spot locations with concentrations in soil of some heavy metals, hydrocarbons and polycyclic aromatic hydrocarbons (PAHs) which exceed the Ontario Ministry of Environment and Energy (MOEE) commercial and industrial criteria for. The first area is located along the north boulevard of Lakeshore Boulevard East and the second area is the location of the former Gardiner Expressway off-ramp located at the southeast corner of Leslie Street and Lakeshore Boulevard East.

1.1 BACKGROUND INFORMATION

As part of the dismantling of the Gardiner Expressway a public consultation program was carried out, and the public was kept apprised of the work by the City of Toronto during regular Construction Monitoring Meetings. Members of the South Riverdale Community Association expressed concerns that there may be potential lead contamination associated with specific industries (e.g. the former Canada Metal facility) in the immediate area adjacent to the north of the project site. As a result of those concerns, a series of field investigations was carried out by Geo-Canada Limited, a division of S&P, in the summer of 2001. The findings as a result of those investigations are summarized as follows:

- Two areas of impact were identified and are shown in **Drawing 2**:
  - a portion of the site along the north boulevard of Lakeshore Boulevard East, between the eastern boundary of the Toronto Film Studio and Leslie Street, and
  - the area of the former Gardiner off-ramp at the southeast corner of Leslie Street and Lakeshore Boulevard East

- The impacted soil had exceedances of MOEE commercial and industrial criteria for some heavy metals, hydrocarbons and polycyclic aromatic hydrocarbons (PAHs)

- The groundwater in the study area met the MOEE criteria for non-potable groundwater for heavy metals

Leachate analyses indicated that some soil in the former off-ramp area would require classifiication as "hazardous waste" (benzene) according to the criteria in O.Reg. 347, should this soil require disposal as a waste

These findings were reported in 2001, and the report prepared by Geo-Canada/S&P was made available to members of the public who requested copies. The City of Toronto subsequently authorized S&P to carry out a site specific risk assessment (SSRA) of the impacted area to evaluate risks to human health and the environment associated with the short or long term proposed use of the site. At the time, the soil concentrations, depths and locations of the parameters described above indicated that the SSRA would require Level 2 Risk Management (engineering controls and mitigation measures to reduce or eliminate exposure to the on-site contaminants). Thus, the exposure assessment in this SSRA has incorporated the requisite Level 2 Risk Management measures.

The City of Toronto identified that landscape features will play a prominent role in the revitalization of this portion of the Lakeshore Boulevard. The area to the north of Lakeshore Boulevard East is being developed by the City as a publicly-accessible bicycle path and walkway. Extensive beds of shrubs, ground vegetation and trees are planned. The intent wais to dramatically improve the aesthetic qualities of this portion of Lakeshore Boulevard, with the purpose of making the area attractive to people and to encourage use by walkers, cyclists, etc. In the landscape plan the site is to be capped with clean soil to provide for the various landscape features.

The SSRA's proposed Level 2 Risk Management Plan was developed to enable the landscape plan to include protection of people who would use the bike path and walkways, as well as protection of the planted trees and other vegetation. Additional mitigation features such as geotextiles and some excavation were also planned to eliminate any potential for contact between humans, wildlife and plants with potentially impacted soil. The preliminary findings of the SSRA study were presented in a meeting to the South Riverdale Environmental Liaison Committee (ELC) at the regular Construction Monitoring Meeting on October 24, 2001. The findings of the SSRA indicated that there were no short term or long term health concerns associated with the use of the site based on the proposed Level 2 Risk Management Plan (capping, specific excavation for planted trees, geotextile, on-going monitoring).

1.2 OBJECTIVES OF SSRA

The overall objective of the SSRA was to evaluate an alternative site restoration approach with respect to its ability to provide adequate protection to human health and the environment during the final landscaping phase of the Lakeshore Boulevard East reconstruction, and future use of the area as a public walkway and bicycle path. The specific objectives of this SSRA are summarized as follows:

1. To identify the "contaminants of concern" (COCs), their degree of exceedances of MOEE generic criteria and COCs to be selected for detailed assessment

2. To identify the human and ecological receptors on the site

3. To develop a Level 2 Risk Management Plan to mitigate exposure to humans and planted vegetation on the site

4. To evaluate exposure to the receptors from the COCs selected for detailed assessment, incorporating the pertinent features of the Level 2 Risk Management Plan

5. To coordinate the Level 2 Risk Management Plan with the City's overall vision for the landscaping for this area.

The intent of the overall City of Toronto works project is to leave the majority of the existing soil in place on the site during construction and landscaping of the area. Certain areas of soil must be excavated for tree planting and construction of a swale. In order to achieve this, the SSRA has documented a Level 2 Risk Management Plan in this report, to be implemented by the City in order to protect on-site workers and the public at all times.

1.3 Scope of Work

The following activities were performed to achieve the objective of this assessment and include:

- A review of the current and historical use of the site and the surrounding area
- Additional soil and groundwater investigation, including drilling of boreholes, installation of monitoring wells,
- Laboratory analyses of soil and groundwater samples

2. BACKGROUND AND SITE CHARACTERIZATION

2.1 Study Area Boundaries

The general location of the subject site is shown on **Drawing 1**. The study area boundaries were developed in consultation with the City of Toronto based on concerns raised by the public regarding the possible presence of environmental impacts relating to the operation of a tannery and lead smelter on lands adjacent to the proposed widening of Lakeshore Boulevard East between Carlaw Avenue and Leslie Street; and based on previous environmental investigations along Lakeshore Boulevard East between the Don Roadway and Leslie Street. The exact

location of the study area is shown on **Drawing 2**. The rationale for determining the study area is included in Section 2.3.1.

For the purposes of this report, the study area includes two non-contiguous parcels of land described as follows:

Area "A" The north boulevard of Lakeshore Boulevard East (i.e. from the north curb to the north limit of the road allowance) between the eastern property line of the Toronto Film Studios and the western curb of Leslie Street. This area is a long, narrow strip of land approximately 25 to 30m wide by 500m in length.

Area "B" The road allowance for the former off-ramps from the Gardiner Expressway at the southeast corner of Leslie Street and Lakeshore Boulevard East. This area is roughly shaped like a "D" and has an approximate area of 15,000 m^2 (1.5 hectares).

2.2 PROPOSED LAND USE

The landscaped portion of the area adjacent to the roadway is a significant portion of the City's overall budget for the reconstruction of Lakeshore Boulevard, and it is the objective of the City to improve the overall ambiance of this area, while providing a safe thoroughfare along Lakeshore Blvd. for pedestrian and bicycle traffic. The landscaping work represents the final phase of the Gardiner Expressway dismantling and Lakeshore Boulevard East reconstruction project. Thus, the SSRA mitigation measures described in this report have been developed in close conjunction with Du Toit, Allsopp, Hillier, the landscape architect for this project. **Figures 1 to 4** were prepared by Du Toit, Allsopp, Hillier as part of the specifications for the landscape implementation, and incorporate all of the mitigation procedures recommened this SSRA.

2.2.1 Area "A" (North Boulevard)

The proposed land use within the Area "A" of the study area is a landscaped boulevard for the adjacent arterial surface roads (Lakeshore Boulevard East and Leslie Street), which will be used by the public for walking, cycling and viewing of public art. The western boundary of the area is coincident with the eastern boundary of the property currently occupied by the Toronto Film Studio, the southern boundary is Lakeshore Boulevard, and the eastern boundary of the site is Leslie Street. The northern boundary of the site is coincident with the edge of the right of way for the roadway. The landscaped areas will include a bicycle path, a walking path, planting beds (i.e. trees, shrubs, flowers and grass) and public art. The area bordering the road is only slightly elevated above the road grade, but slopes up to a bermed area at the northern edge of the site. Trees will be planted adjacent to the roadway, and the bermed area will contain extensive shrubs and trees. Both the bicycle path and the walkway run, for the most part, parallel to each other and to Lakeshore Boulevard. At the northwest corner of Leslie and Lakeshore, a publicly accessible area is planned, which will include a patio-like area, and

artwork exhibits. No picnic areas, or bus shelters are planned for this area. No park benches are planned for the grassed areas; however, some park benches may be installed in the future in the patio area near the public art. **Drawing 2** shows the outline of the site boundary. **Figures 1 to 3** show the landscaping plans in plan and section views, for this area.

2.2.2 Area "B" (Former Off-Ramp)

The area of the former off-ramp at the southeast corner of Leslie and Lakeshore will also be landscaped, but the landscaping plans differ. Only bicycle and pedestrian thoroughfares are planned for this area. No picnic areas, park benches or bus shelters are planned for this area. The center of the area will be built up to a minimum of 1.5m above the current grade. A bicycle path which runs along the east side of Leslie Street curves across the northern portion of the site and continues eastward along the south side of Lakeshore Blvd. towards Coxwell Ave. The sidewalk on the south side of Lakeshore Blvd. crosses Leslie St., and branches out into sections curving back toward Leslie St. and continuing along the south side of Lakeshore Blvd., eastward toward Coxwell Ave. For the most part, the area will be grassed with trees following the sidewalks and shrub areas at various interesting points. **Drawing 2** shows the site boundary. **Figure 4** shows the plan view of the planting bed layout.

2.3 PREVIOUS INVESTIGATIONS

A number of studies previously conducted by S&P (and Geo-Canada Ltd., which is a subsidiary of S&P) have included portions of the subject site. In addition, the subject site is adjacent to the Port Lands of Toronto, and there is a large body of environmental data that has been generated over the years for the Port Lands. This SSRA incorporates all of the previous technical data for the subject site, as well as information from the Port Lands reports that may be pertinent to the findings. The two types of information are discussed in separate sections, below.

2.3.1 Investigations Completed by S&P/Geo-Canada

The following reports were prepared by Geo-Canada and S&P:

- ***Geotechnical Investigation, Gardiner Expressway East Dismantling, Don Roadway to Leslie Street, Toronto, Ontario***, prepared by Geo-Canada Ltd. for The Municipality of Metropolitan Toronto, c/o Cole, Sherman & Associates Ltd., November 1997, Project G-97.0502 (Geo-Canada, 1997)

- ***Geotechnical and Geo-Environmental Investigation, Gardiner Expressway Noise Barrier and Bicycle Path Between Don Roadway and Leslie Street, Toronto, Ontario***, prepared by Geo-Canada Ltd. for The Municipality of Metropolitan Toronto, c/o Cole, Sherman & Associates Ltd., March 2000, Project G-99.1003 (Geo-Canada 2000)

- ***Soil & Groundwater Quality Assessment, Gardiner Expressway Dismantling, Toronto, Ontario***, prepared by Shaheen & Peaker Limited for URS Cole Sherman, August 22, 2001, Project SP3201C (S&P August 22, 2001)

The general environmental findings from these studies are discussed below. Pertinent drawings from the reports are included in **Appendix A**, borehole logs for the boreholes discussed are included in **Appendix B**, and tabulated analytical results are included in **Appendix C**.

In Geo-Canada's 1997 study, no boreholes were drilled within the study area (see **Appendix A** for sample locations). Four boreholes (BH15 - BH19) were drilled along Lakeshore Boulevard East between Carlaw Avenue and Leslie Street (south of the subject area), and one borehole (BH20 was drilled at the southwest corner of Leslie and Lakeshore). A limited amount of chemical soil analysis was done, mainly to classify soil for disposal. Surficial or near-surface samples from two of these boreholes (BH17 and BH20) were submitted for laboratory testing of inorganic parameters in the MOEE "Guideline for Use at Contaminated Sites in Ontario". At the time, the report concluded that the parameters met the applicable criteria for commercial/industrial land use, although the pH of the soil was slightly elevated above 9 for both samples. Concentrations of heavy metals were all well below the applicable MOEE criteria.

Geo-Canada's March 2000 report again focused on soil disposal issues in its environmental testing. However, several boreholes had been located within the study area, as this investigation also included foundation considerations and soil disposal issues for a potential noise barrier for the northern boundary of the right-of-way. Boreholes BH407 to BH415 were located within the study area and are included on **Drawing 3** along with S&P's environmental boreholes. The original geotechnical drawing showing the borehole locations is included in **Appendix A**. The borehole logs for these boreholes are also included in **Appendix B**. The report noted that soils in this area "are considered to be impacted with petroleum hydrocarbons" although the hydrocarbon concentrations met the MOEE criteria for soil at depths below 1.5m (Table D). Concentrations of VOCs, heavy metals (and other inorganic parameters), and PAHs from one soil sample collected at a depth below 1.5m were reported to be within the Table D limits, and PCBs were not detected. The tabulated results are included in **Appendix C**.

The study conducted by S&P in 2001 (S&P August 22, 2001) was commissioned to address concerns raised by the public, specifically the South Riverdale Neighbourhood Association, regarding potential impacts from lead and other heavy metals originating from the former Canada Metals plant and A.R. Clarke tannery located immediately adjacent to the north of the right-of-way. The City also indicated that the southeast former off-ramp at Leslie and Lakeshore was to be included in the study area.

As discussed in Section 2.4.1, the MOEE Table B criteria for commercial/industrial land use, non-potable groundwater, coarse-textured soils were determined to be appropriate for the site.

A total of six (6) boreholes (BH600 to BH605) and eight (8) test pits (TP1 to TP8) were advanced in the north boulevard from Carlaw to Leslie and in the southeast off-ramp area. Five

(5) of the boreholes were instrumented as monitoring wells to facilitate groundwater sampling. In ten (10) of the borehole/test pit locations, stained or odourous soil was encountered, and the report concluded that these areas were "impacted" with hydrocarbons or PAHs. The concentrations of beryllium, chromium, copper, lead and zinc measured in soil exceeded the applicable criteria, and at one location along the north boulevard (TP3), the surficial soil sample contained over 8000 µg/g chromium and over 12,000 µg/g lead. Concentrations of benzene, toluene and xylenes, and total petroleum hydrocarbons (TPH) in the gasoline, diesel and heavy oil ranges in soil exceeded the MOEE Table B criteria. The concentrations of PAHs in the two soil samples tested exceeded the MOEE Table B criteria for one or more parameters, and in the sample from the south off-ramp area, most PAH concentrations in soil were elevated. A waste class analysis of a soil sample from this area also showed that the benzene concentration required the sample to be classified as a hazardous waste for the purposes of soil disposal.

The locations of BH600, BH601 and TP1 were outside of the study area, and TP2 is located at the western boundary of the study area. As the soil in this area was either not impacted or was far less impacted than the soil in the eastern portion, the area west of the film studio was not considered for further investigation as part of the SSRA. However, the entire landscaped area from Carlaw Avenue to Leslie St. will be covered with a layer of clean fill or topsoil, as part of the landscaping plan.

In September 2001, S&P conducted a supplementary investigation that included advancement of eight boreholes (BH700 through BH707), six of which were completed with groundwater monitoring wells (described in **Appendix D**). The sampling locations are shown on **Drawing 3.** Soil samples were submitted for laboratory analysis of VOCs (three samples), TPH (three samples), and inorganic constituents and pH (eight samples). The results of the analyses are presented in **Appendix C**. Groundwater samples were collected in September 2001 from BH602 through BH605 and were submitted for laboratory analysis of VOCs, TPH, and PAHs. Groundwater samples were collected from BH700, BH702, and BH704 through BH707 and submitted for analysis of inorganic constituents, VOCs, TPH, and PAHs. The results are summarized in **Appendix C**. No free phase liquid hydrocarbons were observed in BH700, BH702, or BH704 through BH707. Indeno[1,2,3-c,d]pyrene and benzo[g,h,i]perylene were measured at concentrations slightly larger than the applicable MOEE Table B criteria in groundwater collected from BH707 in September 2001. Groundwater was collected from BH707, again in October 2001, and tested for PAHs. All measured concentrations were less than the applicable Table B criteria. The original, September 2001, sample is believed to have contained sediment, leading to the higher measured concentrations and is not considered representative of groundwater conditions at the site. Ongoing testing of the groundwater in BH707, for PAHs and TPH, is part of the proposed risk management plan for the site (see Section 4.3). No other constituents were measured at concentrations in excess of the Table B criteria. TPH (gas/diesel and/or heavy oil) were measured in groundwater collected from BH604, BH605, BH700, BH702, and BH704 through BH707. There are no Table B criteria for TPH.

2.3.2 Other Reports

The Toronto Port Area and Lower Don Lands have been extensively studied since the early 1990s, and many environmental reports have been published. Although the study area is outside the Port Area as defined by the Waterfront Regeneration Trust, it is near enough and has a similar enough history to warrant a brief review of some of the Lower Don and Port Area reports.

These reports were made available to S&P for review by the kind permission of Ms. Beth Benson of the Waterfront Regeneration Trust.

The previous reports that were included in the historical review of the subject site are included in the References section. The following resources were also used:

- Geologic and Topographic Maps
- Aerial Photographs
- Fire Insurance Maps
- City Directories
- Inventory of Industrial Sites Producing or Using Coal Tar and Related Tars in Ontario - Ontario MOEE 1988
- Waste Disposal Site Inventory - Ontario MOE
- Inventory of Coal Gasification Plant Waste Sites in Ontario - Ontario MOEE
- MOEE PCB Storage Site Database 1999
- MOEE Hazardous Waste Information System (HWIS) 2000
- Interviews with Residents in the area
- Toronto Harbour Commissioners (THC) condition plans for years between 1899 and 1990

The reports prepared by Duke (1998 a and b) on the results of the first two groundwater monitoring events for the "Area-Wide Initiative" (AWI), established by TEDCO, to evaluate groundwater quality at 13 locations in the Port Lands. One of the sample locations in this network (MW10) was located on the south side of Lakeshore Blvd. East, mid way between Carlaw Avenue and Leslie Street. This location is immediately south of Area "A", across Lakeshore Blvd. Duke (1998 a and b) reported that groundwater collected from this location, in October 1997 and again in January 1998, satisfied the Table B non-potable groundwater criteria for inorganic parameters, VOCs, and phenols. TPH (C_{10} to C_{24}) was not detected in the groundwater samples collected (detection limit of 100 μg/L).

2.4 Summary of Site History

Prior to 1912, much of what is now known as the Port Area was part of a marshy area at the mouth of the Don River (THC 1899). Between 1914-1918, this area was filled in, and a ship channel was created (THC 1914-18). This area was developed heavily, and Toronto Harbour Commissioners (THC) condition plans from the 40's, 50's, 60's and 70's (THC 1949, 1955,

1960, 1963, 1970, 1974) show a high density of heavy industries such as coal, oil, storage and shipping companies in the Port Area.

Fire Insurance Maps indicate that in 1899, the study area and surrounding areas to the north were undeveloped marshland. A roadway was present in the approximate location of Lakeshore Boulevard East (Lakeshore) and Ashbridge's Bay (Lake Ontario) is shown immediately south of the roadway. Carlaw Avenue, Eastern Avenue and Leslie Street are shown; however, there are no buildings on either Leslie St. or Carlaw Ave. south of Eastern Avenue except for six houses on the east side of Carlaw Ave. and only a few small buildings are shown on the south side of Eastern Avenue near Carlaw Ave.

The 1910 and 1923 Fire Insurance Maps indicate that three industrial type buildings were present north of the site (current 601 Eastern Avenue). Numerous houses and small industrial/commercial type buildings were present along Carlaw Ave. between Lakeshore Blvd. and Eastern Ave. However, the majority of the subject site and surrounding areas to the north remained undeveloped marsh.

The 1965 Fire Insurance Maps indicate that the Gardiner Expressway and Lakeshore Boulevard East had been constructed and that numerous industrial buildings and some houses occupied the areas adjacent to the site. The Port Industrial Area had been created by lake filling south of Lakeshore Boulevard East and the marsh areas north of Lakeshore Boulevard East are not shown indicating that land filling operations had been carried out to permit industrial redevelopment. The following is a list of the occupants of the areas surrounding the subject site in 1965:

East of Carlaw Avenue from Lakeshore Boulevard to Eastern Avenue

- Art Wire & Iron Co. Limited (a metal working company), 3 Carlaw Avenue.
- Swartz & Sons Motor Bodies situated east of the metal working company, 11-17 Carlaw Avenue. An underground storage tank and two fuel oil tanks were present in the west central portion of the property.
- A metal products manufacturing facility, 19 Carlaw Avenue.
- E. Myatt Co. (iron works), 21 Carlaw Avenue
- A boiler repair shop, 37 Carlaw Avenue
- General Printing Co. of Canada Ltd. (ink manufacturing), 45 Carlaw Avenue
- Salvage Co. (general salvage machinery), 53 Carlaw Avenue
- A cleaners and dyer, 65 Carlaw Avenue
- Residential houses, 63 and 67 to 103 Carlaw Avenue

South of Eastern Avenue from Carlaw Avenue to Leslie Street

- Canadian Industries Limited (a chemical manufacturer), 555 Eastern Avenue. Several aboveground fuel oil and chemical tanks were shown that contained Anhydrous Ammonia and Trichlorethylene. Cylinder storage areas and drum washing areas were also present on site.

- Toronto Iron Works (a steel fabrication and tank manufacturer), 629 Eastern Avenue. A paint shop was located in the southwest portion of the property.
- A.R. Clarke & Co. Ltd. (tannery), 633-661 Eastern Avenue. Numerous underground and aboveground storage tanks for fuel, benzene, sulphuric acid, varnish and oil were present. In addition, an incinerator was present at the southwest corner of the tannery property, near Lakeshore Boulevard East.
- The Canada Metal Co. Limited (lead smelter), 721-725 Eastern Avenue. An aboveground fuel oil storage tank was present in the southern portion of the property.
- Link Belt Co. Ltd., south of Eastern Avenue (and Mosely Street), west of Leslie Street.

South of the Lakeshore Boulevard East and North of Commissioners Street from Carlaw Avenue to Leslie Street

- An auto service station, located at the southwest corner of the intersection of Carlaw Avenue and Lakeshore Boulevard East (with an underground storage tank).
- Shell Oil Co. of Canada Ltd. (a fuel storage and distribution center) at 500 Commissioners Street. Numerous large capacity aboveground storage tanks were present across the entire property from Lakeshore Boulevard East to Commissioners Street.
- Brewers Retail Warehouse, 1015 Lakeshore Boulevard East.
- Dual Mix Concrete & Materials Co., at the northwest corner of Leslie and Commissioners Street (with an aboveground storage tank for bunker oil).

East of Leslie Street from Lake Ontario to Eastern Avenue

- Municipality of Metropolitan Toronto, Main Sewage Treatment Plant, East of Leslie Street and south of Lakeshore Boulevard East. Numerous aboveground storage tanks for settlement and digestion of sewage and chlorination are shown on the eastern and southern portions of the property. In addition, an underground fuel storage tank was present in the west central portion of the property near Leslie Street.
- Sherwin Williams Co. of Canada Ltd. (a paint and varnish manufacturing company), 1-15 Leslie Street.
- Corporation of the City of Toronto (central maintenance garage), 855 Eastern Avenue.
- An office building, 17 Leslie Street.

Table 1 presents a summary of the occupancy history of the properties surrounding the subject site. In addition, the following manufacturing facilities were noted for the area:

- Consumers Gas Co. (Station B) - a coal tar distillation/processing plant (pre 1910 to approximately 1960s).
- Dominion Tar & Chemical /Domtar Chemicals - a coal tar distillation/processing plant, 801 Lakeshore Boulevard, (1925 to 1974).
- Barrett Co., a coal tar distillation and roofing felt plant, 675 Lakeshore Boulevard, (1922 to 1960s).

- Imperial Varnish & Colour, a water, gas and tar handling facility, north side of Lakeshore Boulevard East between Logan and Morse Street, (1923 to 1950s).

Potential environmental impacts from these land uses include phenols, light aromatics and polynuclear aromatic hydrocarbons (PAH). As well, impacts from petroleum hydrocarbons (fuels, lubricating oils) and heavy metals, (formerly used in dyes, colours, pigments, etc.) may also be present.

The review of MOEE records of active and closed waste disposal sites indicate that a closed waste disposal site (Leslie Street Spit, Closed in 1982) was located approximately 3 km. to the south of the subject site. The Waste Disposal Inventory did not list any active landfill sites in the vicinity of the subject site.

A review of the MOEE Ontario Regulation 347 Waste Generators Summary indicated there are several waste generator sites in the vicinity of the subject site. The following is a list of waste generators in the vicinity of the subject site:

Carlaw Avenue

11 Carlaw Avenue	Great North American Graphics
21 Carlaw Avenue	A Little Feet
24 Carlaw Avenue	Jones & Morris Photo Enlarging
53 Carlaw Avenue	Gensco Equipment

Eastern Avenue

633 Eastern Avenue	A.R. Clarke Limited
721 Eastern Avenue	Canada Metal Co.

Commissioners Street

500 Commissioners Street	Toronto Hydro
545 Commissioners Street	City of Toronto
560 Commissioners Street	Canroof Corporation Ltd.
580 Commissioners Street	Lakeshore Garage
596 Commissioners Street	International
650 Commissioners Street	Dufferin Concrete Group

Lakeshore Boulevard East

685 Lakeshore Boulevard East	Greyhound Canada Transport
1015 Lakeshore Boulevard East	Brewers Retail Distribution Centre

Leslie Street

6 Leslie Street	Telesat Canada
7 Leslie Street	K.J Beamish Construction Co. Limited
7 Leslie Street	Metro Toronto Works Treatment Plant
17 Leslie Street	Loblaws

SUMMARY OF WASTE GENERATED AT 633 EASTERN AVENUE (A.R. CLARKE LIMITED)

TYPE OF WASTES	WASTE DESCRIPTIONS	CHARACTERISTIC
148T	inorganic laboratory chemicals	leachate toxic
211T	aromatic solvents	leachate toxic
212H	aliphatic solvents	hazardous industrial waste
243D	PCB'S	PCB'S waste
252H	waste oils & lubricants	hazardous industrial waste

SUMMARY OF WASTE GENERATED AT 721 EASTERN AVENUE (THE CANADIAN METAL CO. LTD.)

TYPE OF WASTES	WASTE DESCRIPTIONS	CHARACTERISTICS
112C	acid waste - heavy metals	corrosive
148T	inorganic laboratory chemicals	leachate toxic
148A	inorganic laboratory chemicals	acutely hazardous waste chem.
212L	aliphatic solvents	liquid industrial waste
221I	light fuels	ignitable
243D	PCB'S	PCB'S waste
252L	waste oils & lubricants	liquid industrial waste
253L	emulsified oils	liquid industrial waste
263A	organic laboratory chemicals	acutely hazardous waste chem.

2.5 SITE CHARACTERIZATION

A methodology was established to determine the rationale for selection of "Contaminants of Concern" (COCs) for detailed assessment in the SSRA. The following methodology was used:

- Determine the generic soil and groundwater criteria applicable to the site
- Determine what, if any, chemical parameters exceeded the generic criteria
- Identify these parameters as the COCs to be selected for detailed exposure assessment modelling

2.5.1 Rationale for Selection of Generic Soil and Groundwater Criteria

The results of the soil and groundwater chemical analyses were first evaluated using the 'Generic Approach' methodology of the Ontario Ministry of the Environment and Energy (MOEE) "Guideline for Use at Contaminated Sites in Ontario" (MOEE Guideline), revised, February 1997. This document presents generic soil and groundwater criteria derived from an effects- and background- based approach. The applicable generic criteria provided in the Guideline were used to assess whether concentrations of contaminants in soil and groundwater were sufficiently elevated to require restoration (remedial action) using the generic approach. The Guideline provides the following summary of the generic approach to site restoration:

"The generic approach involves use of soil and groundwater quality criteria which have been developed to provide protection against the potential adverse effects to human health, ecological health and the natural environment. The criteria may be applied to agricultural, residential/parkland and industrial/commercial land uses. Criteria are also provided for potable and non-potable groundwater use as well as fine to medium texture and coarse soils.

The potable criteria ensure that groundwater may be used as a source of drinking water. The non-potable criteria offers protection against vapours from groundwater and to aquatic life in receiving surface water."

The generic soil, groundwater and sediment criteria for the different land use categories and groundwater conditions are summarized in Tables A to F of the MOEE Guideline document. The selection of a specific set of generic criteria for the study area was based on the decision process outlined in the MOEE guideline document. The decision process is as follows:

Is the site a potentially sensitive site?
What is the intended land use?
Is the soil coarse textured or fine textured?

Is the site a potentially sensitive site?

A site must satisfy one of three conditions listed by the MOEE to be classified as potentially sensitive. These conditions are listed below and discussed with respect to the subject site:

(i) Does the site have or potentially have an effect on sensitive sites listed in the MOEE Guideline?

The MOEE identifies sensitive sites as nature reserves, areas of natural or scientific interest, environmentally sensitive areas, fish habitats, endangered species habitats, wetlands or provincial parks.

The subject site is situated in an industrial/commercial area of the City of Toronto and is presently used as a roadway (Lakeshore Boulevard East). According to topographic map 30M/11 (7th Edition), the ground surface in the vicinity of the subject site slopes gently to the southwest towards the Toronto Harbour and Lake Ontario. The Ship Channel and the Turning Basin, which drain into the Toronto Harbour, are located approximately 400 m south of the subject site. Groundwater flow is inferred from both topography and groundwater elevation measurements done for this SSRA to be in a southerly direction towards the Ship Channel and the Turning Basin.

In its document "Greening the Toronto Port Lands" (WRT, 1997), the Waterfront Regeneration Trust identified proposed areas of "green" infrastructure. In the north end of the Port Lands, major parks were identified for the Lower Don River and the north and south sides of the Keating Channel. Existing parkland, including McCleary Park, several smaller parks and the area along the southern portion of the Port Lands and the Leslie

Street Spit would remain. Several small new parks would be dotted around the Port Lands. However, no additional parkland areas were proposed for any of the lands north or south of Lakeshore Boulevard East between Carlaw Avenue and Leslie Street. In fact, there is no new parkland proposed for any of the areas between Commissioners Street and Eastern Avenue between Carlaw and Leslie. Thus, the study area is not adjacent to, nor will it have any direct influence on, any existing or proposed major or minor parks. As such, neither Area "A" nor Area "B" of the study area is considered to be a sensitive site.

(ii) Are there less than two metres of overburden and soil overlying bedrock or in a contaminant plume area downgradient of the site?

The drilling program confirmed that the total depth of overburden fill and native soil was greater than the minimum of 2 metres stated in the MOEE Guideline.

(iii) Is the pH of the soil less than 5 or greater than 9 for surface soil or less than 5 or greater than 11 for subsurface soil.

The pH of the soil samples submitted for analysis was 7.24 to 11.0. Only two of 31 soil samples analyzed had pH values greater than 9. All of the soil samples analyzed were found to be alkaline (i.e. pH greater than 7) and the average soil pH is 7.71.

Based on these considerations, it is concluded that the subject site is not a potentially sensitive site.

What is the intended land use?

Both Area "A" and Area "B" of the study area are part of the road allowance for Lakeshore Boulevard East, and the proposed land use for both areas is to be landscaped pedestrian traffic throughways (walkways and bicycle paths).

The City of Toronto, in its typical evaluations of environmental soil and groundwater conditions in road allowances, first establishes the land use of the area immediately surrounding the roadway. In the case of the study area, Lakeshore Boulevard East currently runs through a commercial and heavy industrial section of the city. Although the vision for this area is to attract more commercial and light industrial businesses, there are no plans to re-zone any of the adjacent properties as residential. This area of the City is serviced by municipal water which is taken from Lake Ontario, thus groundwater in the area is not used as potable water. Thus, the criteria for commercial and industrial land use, non-potable groundwater are appropriate to the site and future land use.

Is the soil coarse textured or fine textured?

The generic criteria for coarse textured material were applied to the site. The criteria for coarse textured material are more stringent than those that apply to medium/fine textured material.

In summary, the subject site was identified as non-sensitive and is supplied by municipal water. The texture of surficial soils encountered on site is considered to be coarse textured. Based on these considerations, the MOEE Table B criteria for industrial/commercial land use in a non-potable groundwater condition for coarse textured soils were used for comparison purposes to evaluate the environmental quality of the soil and groundwater encountered at the site.

2.5.2 SSRA Site Characterization - Soil

Subsurface soil sampling was carried at a total of 29 locations across the SSRA study area (22 borehole locations and 7 test pit locations). The locations of the boreholes and test pits are shown on **Drawing 3**. The subsurface soil sampling included three drilling programs and a test pit program. The first drilling program was carried out during the period January 28 to February 3, 2000 as part of the Geotechnical and Geo-Environmental Investigation previously carried out for the construction of the noise barrier and bicycle path at the subject site. The second drilling program and the testpit program were carried out during the period of July 11 to 12, 2001 as part of the Soil & Groundwater Quality Assessment previously carried out at the subject site. The third drilling program was carried out on September 18, 2001 in order to provide additional site characterization information regarding subsurface soil and groundwater conditions in order to complete the SSRA.

The first drilling program consisted of drilling nine boreholes in the study area (BH407, BH408, BH409, BH410, BH411, BH412, BH413, BH414 and BH415) to a maximum depth of 12.5 m. The second drilling program consisted of drilling four boreholes in the study area (BH602, BH603, BH604 and BH605) to a maximum depth of 6.6 m. The third drilling program consisted of drilling eight boreholes (BH700, BH701, BH702, BH703, BH704, BH705 BH706 and BH707) to a maximum depth of 5.1 m. All of the drilling operations were carried out under the direct supervision of experienced S&P and Geo-Canada Ltd. (a division off S&P) field personnel.

A test pit program was conducted at the site on July 11, 2001 and consisted of excavating seven test pits (TP1 to TP7) to a maximum depth of 4.0 m under the direct supervision of experienced S&P field personnel.

Surface soil sample locations were selected at random within a 0.5 m radius of the borehole and testpit locations in July 2001. Surface soil samples were collected from a total of 11 locations within the SSRA Study Area (at boreholes BH602, BH603, BH604 and BH605; and testpits TP2, TP3, TP4, TP5, TP6, TP7 and TP8). Surface soil samples were collected at each location from the upper 0.3 m of insitu fill soil.

Soil samples were examined in the field for soil classification and for aesthetic (visual and olfactory) evidence of environmental impact. Headspace combustible vapour measurements were also performed on the samples as a preliminary screening for hydrocarbons or volatile organic compounds (VOCs). **Appendix D** provides further details of the soil sampling methodology and laboratory analyses.

2.5.3 SSRA Site Characterization - Groundwater

A total of 11 groundwater monitoring wells were installed across the SSRA study area. One of the monitoring wells from the first drilling program (BH415) had been destroyed during construction activity within the study area and was thus unavailable for sampling. Groundwater monitoring wells were installed in four of the boreholes from the second drilling program (BH602, BH603, BH604 and BH605) and six of the boreholes from the third drilling program (BH700, BH702, BH704, BH705 BH706 and BH707) to permit groundwater observations and to obtain groundwater samples for laboratory analysis.

Groundwater observations were made at each monitoring well. These observations included: groundwater depth; groundwater elevation; and an examination of the groundwater in each monitoring well for colour, clarity, odour, hydrocarbon sheen and the possible presence of Light and Dense Non-Aqueous Phase Liquids (LNAPLs and DNAPLs, also known as free product).

At least one groundwater sample was collected from each monitoring well for laboratory analysis. Groundwater samples were collected in laboratory supplied containers and placed in a cooler with ice packs for storage and transport to the laboratory for analysis. **Appendix D** provides further details of the soil sampling methodology and laboratory analyses.

2.5.4 Overview of Soil Impacts

The boreholes and test pits encountered an extensive deposit of fill soil across the entire site. The fill deposit generally consists of three fill layers, an upper fill layer of sandy silt to gravely sand fill with organic matter (topsoil), a middle fill layer of sand to gravely sand fill and a lower fill layer of sandy silt to clayey silt fill. Ash, cinders, glass, steel, plastic, paper, reinforced concrete, concrete fragments, asphalt fragments, brick fragments, railway ties, wood, roots, grass, peat and topsoil pockets were observed in samples of the fill taken from the boreholes and test pits. The thickness of the fill deposit varied from 0.8 m to 4.0 m. Hydrocarbon odours and black hydrocarbon staining was detected in samples of the fill from boreholes BH407, BH408, BH409, BH410, BH411, BH414, BH605 and BH706; and test pits TP2, TP6, TP7 and TP8. An unidentified organic type odour was detected in the fill at test pit TP6. An oily sheen was observed on fill samples from test pit TP2 and TP7. Traces of free phase liquid hydrocarbons (free product) were observed in the fill at test pit TP7.

A stratum of native organic silt and peat was contacted below the fill at all of the borehole and test pit locations except test pits TP6 and TP8; and boreholes BH413, BH415 and BH704. This stratum consists of grey to dark grey and black sandy to clayey organic silt with interbedded lenses and layers of dark brown fibrous peat. Traces of grass and roots were observed in the organic silt indicating that this stratum was likely a surficial deposit prior to fill placement. The thickness of this stratum varied from 0.45 to 3.0 m at the test locations. Hydrocarbon odours and black hydrocarbon staining was detected in samples of the organic silt at boreholes BH602, BH604 and BH707; and test pits TP5 and TP7.

A stratum of sand and silty sand was contacted below the fill and organic silt at boreholes BH409, BH410, BH602 and BH605; and testpits TP4, TP5 and TP7. Some organic matter and traces of peat were observed in samples of the silty sand stratum at boreholes BH409 and BH602. The colour of this stratum is brown and grey. Hydrocarbon odours were detected in a sample of the silty sand at borehole BH409 and test pit TP7. The maximum thickness of the sand and silty sand stratum at the test locations was 3.8 m.

A stratum of clayey silt to silty clay with some to trace sand and trace gravel was contacted below the organic silt at boreholes BH407, BH408, BH409, BH411, BH412, BH413, BH414, BH415, BH603 BH604, BH700, BH704 and BH705. Occasional pockets and seams of clayey silt with some organic matter were observed in the clayey silt at boreholes BH413 and BH704. The colour of the clayey silt till varies from brown to grey with increasing depth. The maximum thickness of this stratum at the test locations was 9.5 m. No abnormal odour or stains were detected in samples taken from this stratum.

The site is underlain by a stratum of glacial till that consists of silty clay to clayey silt with some sand and trace gravel. The colour of this stratum varies from brown to grey with increasing depth. The glacial till stratum was contacted at boreholes BH407, BH408, BH409, BH410, BH411, BH412, BH413 and BH414. The maximum thickness of this stratum at the borehole locations was 2.9 m. No abnormal odour or stains were detected in samples taken from this stratum.

Table 2 provides a summary of the soil samples that exceeded the MOEE Table B soil criteria, along with the maximum concentrations measured, and the number of exceedances compared to the total number of samples analyzed. **Appendix A** contains the drawings from the previous investigations. **Appendix B** contains the borehole and test pit logs from all of the investigations, and **Appendix C** contains the tabulated results for all of the soil and groundwater analyses.

Table 3 summarizes the quantities of impacted soil, and the locations of the impacts within the study area are shown on **Drawing 4**. The following is a summary of the types and approximate extent of impacted soil within the study area:

- Metal (including lead) impacted soil was encountered across the entire study area in surficial soils and in some subsurface soils. Of the four soil samples submitted for leachate testing, two of the samples (from BH603 and BH604) would be classified as Hazardous Waste, due to elevated concentrations of lead, if excavated for offsite transportation and disposal; and

- PAH, TPH, benzene, toluene and xylene impacts were encountered in subsurface soils over much of the study area, especially in the eastern potion of the north boulevard of Lakeshore Boulevard East and at the southeast corner of Lakeshore Boulevard East and Leslie Street. Of the two soil samples submitted for leachate testing of organic constituents, one sample (from TP7) would be classified as Hazardous Waste, due to an elevated concentration of benzene, if excavated for offsite transportation and disposal. PAH impacted surficial soil was also contacted at one location (southeast corner of Lakeshore Boulevard East and Leslie Street).

2.5.5 Overview of Groundwater Impacts

No dense or light non-aqueous phase liquid (DNAPLs or LNAPLs), commonly called free product, was observed in any of the groundwater monitoring wells within the SSRA study area. No noticeable hydrocarbon sheen was observed on any of the groundwater samples obtained from the monitoring wells within the SSRA study area. No noticeable odours were detected in the groundwater samples obtained except from the sample from the monitoring well at borehole BH707 where a slight hydrocarbon odour was detected.

Tables C-11 to C-14 in **Appendix C** summarize the analytical results for all of the groundwater samples. The results of the laboratory analyses of groundwater samples obtained from all 12 monitoring wells were found to meet the MOEE Table B criteria for non-potable groundwater. Lead concentrations in the groundwater samples analyzed were found to meet the criterion for potable water. PAH concentrations in the groundwater samples met their respective criteria for non-potable groundwater, even in the area of BH707 and TP7 where elevated concentrations of these parameters were measured in soil samples.

In summary, groundwater samples from all monitoring wells met the appropriate MOEE Table B criteria for non-potable groundwater for heavy metals, pH, BTEX, PAHs and BNAs. No free product was observed on the groundwater from any of the monitoring wells. Based on these observations and analytical results, migration of chemicals in groundwater was determined not to be a pathway of concern in the exposure assessment.

2.5.6 Overview of Hydrogeology

Groundwater levels were measured on July 16, 2001; on September 7, 19, 20 and 26, 2001; and on October 2, 2001. Groundwater elevations in the monitoring wells appeared to have stabilized by the September 26, 2001 round of groundwater observations. Groundwater was measured on September 26, 2001 at depths ranging from 1.04 m at BH603 to 2.95 m at BH704. These depth measurements correspond to a maximum groundwater elevation of 75.14 m at BH603 and a minimum groundwater elevation of 73.97 m at BH704.

The groundwater elevation data obtained to date indicates that the direction of groundwater flow in the western portion of the subject site is towards the southeast; and in the eastern portion of the site towards the west. There appears to be a slight groundwater depression in the east central portion of the SSRA study area (between boreholes BH604 and BH705). This slight groundwater depression is likely the result of interference from underground utilities within the study area or the presence of a buried channel of more permeable soil. However, the subsurface investigation work completed to date has not detected the presence of a buried channel in this area of the site. Further, numerous underground utility lines cross the SSRA study area including several sewer pipes and sewer tunnels, any of which could result in the slight groundwater depression that is inferred to be present.

The rate of groundwater flow is expected to be relatively slow as the groundwater elevation data obtained to date indicates that the groundwater surface has only low relief features. Groundwater levels are expected to be subject to seasonal variations and periods of wet weather. Groundwater monitoring should be carried out at quarterly intervals to confirm whether any significant changes occur on a seasonal or periodic basis regarding the study areas hydrogeological conditions.

In their evaluation of groundwater flow direction for the Lower Don Lands, Beak/Raven Beck (1994) noted that radial groundwater flow was found in several locations, suggesting the influence of the utility trenches on shallow groundwater flow.

2.6 SUMMARY OF BACKGROUND AND SITE CHARACTERIZATION

The following is a summary of our conclusions regarding the presence and extent of environmental impacts within the study area:

- The site and surrounding area has a complex history with no active sources of potential environmental impacts;
- Landfilling was previously used to fill in a former marsh that occupied the site and surrounding areas and permit the construction of roads and buildings;
- The layering observed within the fill deposits across the study area indicates that several fill depositional events have occurred in the past;
- The 'SSRA approach' from the MOEE Guideline can be applied to the study area for evaluating the requirements for site restoration. The results of the soil and groundwater chemical analyses were also evaluated for comparison purposes only using the 'Generic Approach' methodology of the MOEE Guideline;
- Metal (including lead) impacted soil was encountered across the entire study area in surficial soils and in some subsurface soils;
- PAH, TPH, benzene, toluene and xylene impacts were encountered in subsurface soils over much of the study area, especially in the eastern portion of the north boulevard of Lakeshore Boulevard East and at the southeast corner of Lakeshore Boulevard East and Leslie Street; and
- No groundwater issues have been identified within the study area.

The results of the site characterization studies were used to determine the Contaminants of Concern (COCs), which are discussed in Section 3.3.1.

3. RISK ASSESSMENT PROCESS

3.1 MOEE GUIDELINE

The MOEE provides three options for the restoration of a contaminated site (MOEE, 1997):

1) ***Background Approach*** - Restoration of a site to ambient conditions, as found in the natural environment, or to the levels that existed prior to site contamination.

2) ***Generic Approach*** - The MOEE presents generic criteria for soil and groundwater for 117 chemicals of potential concern. There are criteria for various land uses, for potable and non-potable groundwater situations, and for surface soil and subsurface soil.

3) ***Site-Specific Risk Assessment Approach*** - The MOEE provides guidance to permit development of site-specific criteria that are protective of human and ecological health and of the natural environment at the site (MOEE, 1996a). Within the site-specific risk assessment approach there are two options:

Level 1 Risk Management

- This option involves site-specific modification to the parameters or models used by the MOEE to develop the generic criteria.
- Soil and groundwater objectives derived using this option must not exceed the MOE's upper concentration limits (provided in Appendix E of the risk assessment guidance document; MOEE, 1996a) or 50% of the aqueous solubility of the chemical.

Level 2 Risk Management

This option involves restricting access to the site or the blocking of a pathway of exposure and requires the development of a risk management plan. This is the option that will be utilized for the subject property.

3.2 RATIONALE FOR SSRA APPROACH

As outlined in Section 1.1 of the MOEE SSRA Guidelines (MOEE 1996a), the following decision process was used as a rationale for the SSRA approach on this site:

- Concentrations in soil of heavy metals, SAR, organics such as hydrocarbons and PAHs exceed the applicable criteria for this site
- Measured concentrations of these chemicals in groundwater meet the appropriate non-potable groundwater criteria
- The site is part of a roadway right-of-way through a commercial/industrial section of the City, and will remain in this use for the long-term.

D. The results of the analytical tests, as tabulated in **Appendix C**, were used to prepare this risk assessment.

Comparison of measured concentrations of chemicals in soil and groundwater with the generic criteria provided by the MOEE (MOEE, 1997) is used as the starting point for the risk assessment. The MOEE defines a "sensitive site" as a site for which the generic criteria are not deemed sufficiently restrictive, due to the presence of a sensitive receptor or due to site conditions different than those used to develop the generic criteria. For sensitive sites, the proponent must either complete a site-specific risk assessment or restore the site using the background (Table F) criteria. One example of a sensitive site is where inorganic chemical parameters exceed background concentrations and the soil pH is less than 5 or greater than 9 for surface soils or greater than 11 for subsurface soil. At two locations on the subject property, surface soil was found to have a pH greater than 9. For these soil samples, Table F (background) criteria for non-agricultural land use are used as the point of comparison with the measured concentrations. For the remaining samples, the generic criteria for full depth cleanup, non-potable groundwater scenario, commercial/industrial land use, coarse textured soil (i.e., Table B) are used. **Table 2** summarizes all of the exceedances of the MOEE Table B criteria. The results of the analyses of soil samples may be summarized as follows:

3.4.1 Volatile Organic Chemicals in Soil

Concentrations of the following VOCs exceeded the applicable MOEE Table B criteria at the following location:

- benzene, toluene, xylenes (all in TP7)

3.4.2 Petroleum Hydrocarbons in Soil

Concentrations of the following petroleum hydrocarbon fractions exceeded the applicable MOEE Table B criteria at the following locations:

- TPH (gas/diesel) (BH409, TP5 and TP7). The concentration in TP7 exceeded the MOEE upper concentration limit.

- TPH (heavy oil) (TP5 and TP7)

3.4.3 Base Neutral Extractables (including PAHs) in Soil

Concentrations of the following PAHs exceeded the applicable MOEE Table B criteria at the following locations:

- anthracene, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenzo[a,h]anthracene, fluoranthene, fluorene, indeno[1,2,3-cd]pyrene, 2-methylnaphthalene, naphthalene, phenanthrene, pyrene (all in TP7).

- benzo[a]pyrene (BH707, TP5, TP7). The concentration in TP7 exceeded the MOEE upper concentration limit.

Note that the detection limits for several of the base-neutral extractables (bis(2-chloroethyl)ether, bis(2-chloroisopropyl)ether, p-chloroaniline, 3,3'-dichlorobenzidine, diethyl phthalate, dimethyl phthalate, hexachlorobutadiene, and hexachlorobenzene) in soil collected from TP5 and TP7 exceeded the Table B criteria due to sample dilution. This is not anticipated to be a concern, as these chemicals are all semi-volatile and the risk management plan proposed for the site will prevent human and ecological receptors from contacting any semi-volatile chemicals contained in the soil.

3.4.4 Inorganic Parameters in Soil

For surface soil samples with a pH between 5.0 and 9.0, concentrations of the following inorganic parameters exceeded the MOEE Table B criteria.

- antimony (BH603, BH604, BH703, TP6)
- arsenic (BH603, BH604, TP6)
- beryllium (TP7)
- boron (BH706)
- cadmium (BH603)
- chromium (BH409, BH602, TP3)
- copper (BH602, BH603, BH605, TP6)
- lead (BH602, BH603, BH604, TP3, TP4, TP5, TP6). Lead in BH603 and TP3 exceeded the MOEE upper concentration limit.
- zinc (BH603, BH605, BH707, TP3)

For surface soil samples with a pH greater than 9.0, concentrations of the following parameters exceeded the MOEE (Table F) background criteria:

- antimony (BH701 and BH702)
- chromium (BH701)
- lead (BH701 and BH702)

The detection limit for molybdenum exceeds the Table F criterion.

3.4.5 Other Inorganic Parameters in Soil

For surface soil samples with a pH between 5.0 and 9.0, the following inorganic constituents did not comply with the MOEE Table B criteria:

electrical conductivity (BH409, GSA T5/1, TP5, TP7)
sodium adsorption ratio (BH409)

For surface soil samples with a pH greater than 9.0, the following parameters did not comply with the MOEE (Table F) background criteria:

electrical conductivity, sodium adsorption ratio (both in BH701, BH702)

3.4.6 Groundwater Quality

S&P installed five groundwater monitoring wells (BH601 through BH605) on the subject property in July 2001. Six additional monitoring wells (BH700, BH702, and BH704 through BH707) were installed in September 2001. Groundwater samples were collected in July 2001 from BH601 through BH605 and were submitted for laboratory analysis of inorganic constituents. Samples of groundwater were collected from BH602 through BH605 in September 2001 and were submitted for analysis of VOCs, TPH, and PAHs. Groundwater samples were collected from BH700, BH702, and BH704 through BH707 and submitted for analysis of inorganic constituents, VOCs, TPH, and PAHs.

No free phase liquid hydrocarbons were observed in BH700, BH702, or BH704 through BH707. The monitoring wells in BH601 through BH605 are screened below the top of the water table and no free phase liquid hydrocarbons have been observed in these monitoring wells. Indeno[1,2,3-c,d]pyrene and benzo[g,h,i]perylene were measured at concentrations slightly larger than the applicable MOEE Table B criteria in groundwater collected from BH707 in September 2001. Groundwater was collected from BH707 again in October 2001 and tested for PAHs. All measured concentrations were less than the applicable Table B criteria. The original, September 2001, sample is believed to have contained sediment, leading to the higher measured concentrations and is not considered representative of groundwater conditions at the site. Ongoing testing of the groundwater in BH707, for PAHs and TPH, is part of the proposed risk management plan for the site (see Section E-5.3). No other constituents were measured at concentrations in excess of the Table B criteria. TPH (gas/diesel and/or heavy oil) were measured in groundwater collected from BH604, BH605, BH700, BH702, and BH704 through BH707. There are no Table B criteria for TPH. Note, though, that the maximum measured concentration of TPH (gas/diesel) of 14,500 ug/L (BH705) is less than the sum of the allowable Table B criteria for benzene, toluene, ethylbenzene, and xylenes (41,400 ug/L), which are a part of TPH (gas/diesel).

In summary, there were no exceedances of the MOEE Table B criteria for non-potable groundwater, and no sheen or free phase product was observed in the monitoring wells.

3.4.7 Odours and Staining

Hydrocarbon odours and black hydrocarbon staining were detected in samples of fill from BH605 and test pits TP1, TP2, and TP6 through TP8 and in samples of organic silt at BH601, BH602, BH604, TP5, and TP7. Hydrocarbon odours were detected in a sample of silty sand collected from TP7. An unidentified "organic-type" odour was detected in the fill at test pit TP6. An oily sheen was observed on fill samples collected from TP2 and TP7. Traces of free phase liquid hydrocarbons were observed in the fill at TP7.

No noticeable odours or sheen were observed on the groundwater samples obtained from monitoring wells BH601 through BH605, BH700, BH702, and BH704 through BH706. Groundwater collected from BH707 was odorous; however, no sheen was observed.
Odours and staining of soil are generally considered to be aesthetic issues. The presence of petroleum-related hydrocarbons often results in odours. Odours were one of the factors used by the MOEE when developing the generic criteria. For soil, ceiling values were developed, based on the vapour pressure of the chemical, which was considered an indication of the likelihood of odours. These odour thresholds are applied in the MOEE Guideline on a chemical-specific basis and not to mixtures. The generic criteria for petroleum hydrocarbons include consideration of odours but, because the composition of the petroleum hydrocarbons at a particular site may vary widely from the composition at another site, the setting of criteria based on odour is difficult.

3.4.8 Selection of Contaminants of Concern

Contaminants of Concern (COCs) were selected for toxicity and exposure assessments based on the results of measurements in soil, as having concentrations in excess of the MOEE generic Table B (non-potable) criteria for commercial/industrial land use or, for samples where the soil pH is greater than 9, in excess of the Table F criteria for non-agricultural land use. In response to comments from the Peer Reviewer and Toronto Public Health (TPH), S&P has examined the analytical data with respect to the R/P criteria. **There are no new parameters which would be added to the list of contaminants of concern if R/P criteria had been used rather than I/C criteria**. Based on the information available, the COCs are:

COC's – Major Exposure Pathway is Direct Contact

Heavy Metals:	Antimony
	Arsenic
	Beryllium
	Boron
	Cadmium
	Chromium
	Copper
	Lead
	Zinc
PAHs:	Anthracene
	Benzo(a)anthracene

Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Chrysene
Dibenzo(a,h)anthracene
Fluoranthene
Fluorene
Indeno(1,2,3-c,d)pyrene
2-methylnaphthalene
Naphthalene
Phenanthrene
Pyrene

TPH: TPH heavy oil

COC's – Major or Significant Pathway May Be Vapour Inhalation

Hydrocarbons: Benzene
Toluene
Xylenes
TPH gas/diesel

Chemicals measured at concentrations greater than the MOEE upper concentration limits for soil are: lead, TPH (gas/diesel), and benzo[a]pyrene

3.4.9 Landscape Mitigation Plan to Block Exposure Pathways

3.4.9.1 Objectives

The primary purpose of the landscape mitigation program is to prevent inadvertent human contact, as well as contact between root systems and animal receptors, with potentially impacted soil. Thus, human and ecological receptors are examined with respect to the landscape mitigation design. Contact between root systems and contaminated soil was considered to be the major issue associated with this area as the area would be heavily landscaped. The issue of burrowing animals digging up contaminated soil was considered to be less of an issue as this area is not contiguous with other natural areas and the landscaped area would not provide habitat that would attract burrowing animals. The specific objectives of the study are listed below:

1. The elimination of contact between root systems and potentially impacted soil will reduce the potential for any adverse effects of heavy metals, hydrocarbons and PAHs in soil on plant health.

2. The elimination of contact between root systems and potentially impacted soil will reduce the potential for possible bio-accumulation in plants. Accumulation of contaminants in vegetation has been recognized as a potential transport pathway to wildlife and to humans as part of the SSRA.

3. To reduce the potential of any other form of transport between wildlife (i.e., burrowing animals), pets and people with potentially impacted soil.

The second purpose of the mitigation landscape plan is to maintain, to the greatest possible extent, the landscape vision for the project. The intent for the rebuilt roadway was to establish a people-friendly environment that included walkways and bicycle paths surrounded by beds of trees shrubs and ground vegetation. This setting would also incorporate extensive landscaping for aesthetic purposes, and art exhibits for viewing by the public.

3.4.9.2 Mitigation Design Principles

Factors including expected root system growth and spread as described above, aesthetic considerations, and site space constraints were used to establish design principles which were then used to develop the landscape design. As stated earlier, the primary purpose of the mitigation design is to minimize any chance for root system contact with potentially impacted soils and with potential receptors. A description and rationale for each the principles or guidelines used in the mitigation design are as follows. The mitigation design for the subject area is provided in **Figures 1 to 4**. Detailed descriptions of the mitigation procedures are included in Section 4.2.

General - The entire subject area will either be capped or covered with clean soil or covered in pavement or similar material. In the north boulevard area, the areas not covered with pavement (i.e., sidewalks, walkways) will be covered with fill and/or topsoil to a depth of at least 30 cm or greater. All areas covered in topsoil will be vegetated. No existing surface soil will be exposed.

The purpose of the capping is to reduce the chance for direct contact between potentially impacted soil with human or animal receptors and to reduce the possibility of contact through other potential exposure pathways. With the exception of sod, other plantings such as ornamental grasses, flowers, shrubs and trees will be planted in beds or in groups. Planting in beds will allow for the placement of a sufficient depth of topsoil under each plant type as will be described below.

Sod - A significant portion of the subject area (mainly areas adjacent to walkways and the road) will be covered by sod. In all areas to be sodded there will be a minimum of 30 cm or greater of topsoil. Root systems of sod rarely penetrate beyond 15 cm (see Section F-3.2.2). The proposed depth of 30 cm or greater of clean fill/soil will provide at least 15 cm of buffer between the expected limit of root growth and the existing surface layer.

Planting Beds – Planting beds will be comprised of ornamental grasses and flowers. Under all planting beds a depth of at least 60 cm of topsoil or greater is proposed. Although most root systems will not go beyond 15 cm, some dry adapted grasses may extend their root systems to

greater depths during dry periods. An additional buffer of soil is provided for species in planting beds to provide for the possibility of extended root growth.

Shrubs and Trees – A minimum of 1 m of fill and topsoil will be provided under all tree and shrub beds. All shrub beds and tree beds will be lined with a permeable geotextile that will prevent the growth of root systems into potentially impacted soil. As discussed earlier, in general, 80% of root systems of trees are confined to the top 60 cm of soil. The geotextile will prevent the further growth of any major roots networks that may extend 1 m below the surface. The geotextile will be laid in a manner to prevent for both the vertical and horizontal growth of the root systems in shrub and tree beds.

Excavation and Tree Pits – Where it is not feasible to provide 1 m of fill/topsoil over the existing grade due to area limitations, a vertical depth of 1 m or less will be excavated in order to provide a depth of at least 1 m of clean fill/topsoil where trees and shrubs are to be planted.

Geotextiles – A permeable continuous mat of geotextile will be provided under all shrub and tree beds and planting beds. The geotextile will be laid on the existing surface and covered with clean fill and topsoil. The primary purpose of the geotextile is to prevent for the vertical and horizontal movement of root systems and eliminate potential contact between root systems and potentially impacted soil. The secondary purpose of the geotextile is to prevent root system growth under the walkway and cycle path to prevent possible heaving and other physical damage caused by root growth. In areas where there are no geotextiles (i.e., sodded areas), it is highly unlikely that root systems will penetrate into the existing surface layer for several reasons. Firstly, root systems of sod are not anticipated to extend much beyond 15 cm in depth. Secondly, the existing surface layer will be compacted from construction activities and will contain minimal organic material, and will not provide a suitable medium for root penetration.

Species Planting - In the north boulevard (Area "A"), due to space limitations, capping with topsoil can only be carried out in certain locations and to a maximum height of 1 m due to aesthetic and slope considerations. In the Leslie Street ramp area (Area "B") the depth of fill and topsoil will exceed 1 m in most locations. In general, shrubs, trees, ornamental grasses and flowers will be confined to areas which have a sufficient depth of soil as described above. Where soil volume is limited, trees with low height and spread will be planted.

3.5 EXPOSURE ASSESSMENT

The purpose of an exposure assessment is to estimate the magnitude of exposure to the contaminants of concern. The exposure assessment typically consists of the following steps: characterization of the exposure setting, identification of the potentially exposed receptors and routes of exposure, estimation of the frequency and duration of site occupancy, and finally, quantification of the amount of chemical exposure to receptors at the site.

3.5.1 Proposed Land Use

As shown on **Figures 1 to 4**, the subject property is proposed to be developed for public conveyance and will include a concrete sidewalk, an asphalt covered bicycle path, and landscaped areas.

3.5.2 Identification of Receptors and Exposure Pathways

The exposure assessment considers those pathways by which the potential receptors may be exposed to the contaminants of concern. A pathway consists of a source, a transport medium, an exposure point and an exposure route at the point of contact.

3.5.3 Human Receptors

The human receptors are adults and children who would use the subject property for walking, biking, rollerblading, etc. The intent of the City's proposed landscape design was to make an attractive throughway for pedestrians and cyclists. Although there are no picnic or play areas (e.g. sandboxes, swings) within the study area, the Level 2 risk management plan does address persons resting for a short while on park benches in the art exhibit area at the northwest corner of Lakeshore Blvd. and Leslie St., as well as limited children's play activities on the grassed portions of the landscaped areas.

Typically, in risk assessments, one would consider the following pathways by which human receptors could potentially be exposed to the contaminants of concern, for such a land use:

- inhalation of soil particulates;
- incidental ingestion of impacted soil and suspended particulate matter;
- dermal contact with impacted soil; and
- inhalation of vapours arising from impacted soil or groundwater, outdoors.

Ingestion of groundwater is not considered a potential pathway of exposure as potable groundwater is supplied to the area via a municipal distribution system that obtains water from Lake Ontario.

The risk management plan developed for the site includes a minimum cover of 30 cm of topsoil or concrete (sidewalk) or asphalt (bicycle path). Therefore, there will be no opportunity for direct contact with the contaminants (inhalation of soil particulate, incidental ingestion of soil or dermal contact) by human receptors.

Most contaminants identified at the subject site are inorganic (and not volatile) or are semi-volatile (PAHs and TPH - heavy oils). Some volatile contaminants have been identified in soil at the subject property (benzene, toluene, xylenes, TPH – gas/diesel). Inhalation of vapours arising from the soil is a potential pathway of exposure to the users of the subject property;

however, due to the rapid dilution of vapours arising from the subsurface, with the outdoor air, inhalation of vapours outdoors is not usually a pathway of concern. **Table 4** presents the results of the estimation of human exposure via inhalation of vapours outdoors. The equations (**Appendix E)** developed by the U.S. Environmental Protection Agency (U.S. EPA, 1996) were used for these calculations. It was assumed that adults or children may use the area for 4 hours per day, 120 days per year. This exposure scenario is intended to describe potential exposures, daily, during the warmest months of the year (June through September), when the volatilization of chemicals would be greatest and there would be no snow cover. The warmest weather would also encourage longer exposures. This scenario is believed to be conservative. Note that, for xylenes, exposure is assumed to be daily (365 days per year) as the reference concentration for xylenes is based on a critical period of fetal development (see Section 3.6.3) and, thus, exposure to xylenes is not pro-rated.

3.5.4 Ecological Receptors-Wildlife

The ecological receptors potentially exposed to contaminants in the subsurface include small mammals and birds that may occasionally use the property, vegetation, and soil invertebrates. Typically, in risk assessments, one would consider the following pathways by which the ecological receptors could potentially be exposed to the contaminants of concern:

- direct contact (dermal and ingestion) by terrestrial animals and invertebrates;
- bioaccumulation and food chain entry; and
- consumption of vegetation.

There is potential that upon completion of the landscape plan that various wildlife species may be attracted to the area. If this occurs, there is potential for burrowing animals to come in contact with impacted soil, and bring that soil to the surface. There are a variety of animal species which are known to borrow and can live in naturalized urban environments. These include voles, moles, chipmunks, squirrels and woodchucks. It is unlikely that wildlife will become established in the area for several reasons. Firstly, the subject area is isolated. It is not contiguous with other natural areas; therefore, there is minimal opportunity for species to disperse from neighbouring areas into the subject area. Secondly, the subject area will provide suboptimal habitat for most wildlife species. Thirdly, it will be very difficult for wildlife species to thrive or establish a self sustaining population in the subject area that is relatively small and subject to frequent disturbance. The landscaped areas will take a number of years to mature and the grassed portions of the landscaped area will be cut on a regular basis. The area will be heavily frequented by humans and pets and will be constantly disturbed.

A list of potential burrowing species that could inhabit the area is provided below. The habits of each species will be described and the potential for each to exhume potentially impacted soil discussed. Information on the habits of species was extracted from Banfield (1987) and Barnes (1963).

- Woodchuck (Marmota monax)
- Meadow Vole (Microtus pennsylvanicus)

- Hairy-tailed Mole (Parascalops breweri)
- Chipmunk (Tamias striatus)
- Gray Squirrel (Sciurus carolinensis)
- Earthworms (Lumbricus sp.)

Woodchuck

Woodchucks prefer to excavate burrows in well drained soils. A woodchuck may excavate several dens generally about 1 m below the surface. Tunnels may be extensive and up to 12 m in length. Soil from the tunnels is usually pushed to the surface at the den entrance. As such, there is potential that impacted soil could be excavated and brought to the surface. Although it is unlikely that woodchucks will burrow through the geotextile due to its structural integrity, woodchuck activity could cause damage to the geotextile. Woodchucks also eat a wide variety of green herbaceous groundcover and can cause extensive damage to planting beds. Their burrows also have the potential to undermine man-made structures such as walkways and provide safety hazards to humans.

Given the highly urbanized environment in the subject area, the absence of suitable habitat nearby and the high water table, the site provides minimal habitat opportunities for woodchucks. Woodchucks are typically not found in exposed well used urban environments and it is highly unlikely they would ever establish in the subject area. However, it is recommended that as part of the long term inspection and maintenance program for the landscaped areas that any evidence of woodchuck activity (i.e., burrows) be gathered. If there is evidence of burrowing, then it is recommended that any animals be trapped and removed from the subject area.

Voles and Moles

The favoured habitat of moles is pastureland or forest with a well established layer of vegetation and surface litter. Moles favour areas with no human habitation and would not typically be found in the subject area. Moles may have two tunneling systems. The first is occurs at the surface and under the surface litter, and the second consists of rigid tunnels typically to a depth of about 25 to 50 cm. Voles prefer dry meadows with a well established vegetation layer. Their burrows are shallow and immediately beneath and within the vegetation layer and not in the soil layer. In summary, the habitat in the subject area will not be favourable for either species, especially to moles. If meadow voles became established in the subject area, it is highly unlikely they would exposed to or expose potentially impacted soil.

Chipmunks

Chipmunks will burrow extensively and tunnels will often be several meters in length. The central nesting chambers are usually less than 1 m below the surface. Any excavated soil is concealed and distributed over a wide area. The favoured habitat for chipmunks includes dry hardwood forests. Tunnelling is unlikely to occur in open areas where they could be exposed to predators. The subject area, as a whole, would provide suboptimal habitat. However, habitat conditions may improve for chipmunks over time as the treed areas become established. Since

the treed portions of the site occur in areas where the depth of fill is at least a meter deep, it is highly unlikely chipmunks would uncover potentially impacted soil if they were to become established in the area.

Squirrels

Squirrels do not burrow and would not represent a species that would be considered a risk in terms of exposing impacted soil. Squirrels would only become established in the subject area when trees reach a sufficient size to provide for nest sites and cover. Squirrels will dig in soil for bulbs and roots; however, the Level 2 Risk Management Plan provides for all planted vegetation to be located in clean fill or topsoil, and thus squirrels would not uncover potentially impacted soil.

Earthworms

Earthworm activity will be well established in the subject area. Earthworms overturn soil from below the surface by expelling their castings at the surface. Large volumes of subsoil can be overturned by such activity. Typically earthworms feed on decaying organic matter and are found mainly within the first 10-15 cm of soil. The Level 2 Risk Management Plan provides a minimum of 30 cm of clean fill or topsoil over the entire site; thus, the primary habitat for earthworms will be within the clean layer. In certain conditions, earthworms will burrow up to 2 to 3 m deep (e.g. during winter and dry periods). The fill layers under the topsoil layer have minimal organic material and will not be used for feeding by earthworms; thus, the probability of earthworms turning over impacted soil is very low, as they will not feed and therefore will not produce castings from this layer. Although fill below the topsoil may be used as refuge by earthworms during inclement weather, earthworms will not be able to penetrate the geotextile where it is present. In summary, although earthworm activity will be high in the subject area, the soil turnover will occur in the top organic layer. It is highly unlikely that earthworm activity will expose any significant quantities of potentially impacted soil due to the depth of clean fill and topsoil layers, the presence of the preferred nourishment within the clean layer only, and the presence of the geotextiles as barriers to earthworm movement into the impacted soil

3.5.5 Ecological Receptors - Vegetation

The major ecological receptors were determined to be the grasses, plants, flowers, shrubs and trees which would be planted in the landscaped portions of the study area. Landscape features in the study area are shown in **Figure 2** and **Figure 4**. A list of the proposed species of plants is included in **Appendix F**, and the different types of plants are summarized below:

Sod

Commercial sod will be laid over a major portion of the study area. All areas not otherwise covered in the planting beds described below or with pavement will be covered in sod.

Planting Beds

Planting beds will be comprised of mainly ornamental grasses and flowers. Planting beds will occur in select locations. Species will be planted in beds or groups and in specific areas mainly adjacent to walkways. Plants will include ornamental grasses, perennial wildflowers and vines.

Shrubs

Shrubs will be placed in compact beds adjacent to planting beds and tree beds.

Trees

Trees will be placed in groups. Some trees will be planted along the boulevard, between the sidewalk and the roadway. Other trees will be included within the planting beds. Proposed tree species include street trees such as maple and ash, flowering trees such as hawthorne and crabapple, deciduous trees for mixed woodland planting, and coniferous trees.

Root System Requirements - Growth

Because the landscape design was such an important feature of the Lakeshore Boulevard East reconstruction, the SSRA determined that minimization of root contact with the impacted soil was the most important feature of the ecological risk management program. Minimizing direct contact of root systems would mitigate any concern with respect to uptake of the chemicals and subsequent ingestion of vegetation by small mammals or birds.

The precise placement of plants and species in the landscape design is determined both by aesthetic criteria and to prevent root system contact with potentially impacted soil. A literature search was carried out for the purposes of determining the characteristics of root growth for the species proposed for the landscape design and to determine appropriate soil volumes to achieve healthy growth. The results of the search were intended to guide the landscape design team in terms of where and how plants of particular species were to be planted and the type of mitigation (i.e., depth of cap, excavation, geotextiles) that would be required in each area.

Woody plants have characteristic root forms when grown under differing environmental conditions. Inherent differences are especially evident in the young plants but root growth may change with age. Root systems can become greatly modified with age depending on soil profile and their ability to adapt to local conditions (Craul, 1992). In general, it is difficult to determine root form of a species because each species will adapt to site specific conditions (Craul, 1992). The horizontal distribution of roots tends to be more complex than the vertical distribution due to variability in urban soils and the inherent plasticity of root systems. In general, subsoil (i.e., under the topsoil) conditions are generally poor which encourages horizontal root growth. Root systems tend to follow the path of available opportunity if not inhibited by physical barriers. As a result, root system spread may be very variable and often extends well beyond the drip line of shrub or tree. Gilman (1988) reported 77% of the roots from transplanted poplar trees were

beyond the branch dripline and harvestable ball, and similarly 59% and 54% for honeylocust and ash, respectively.

Root penetration in the vertical and horizontal direction depends on a number of factors including total pore space and pore size, and their distribution in the soil matrix. These properties in turn are determined by soil texture, organic matter content and bulk density (Craul, 1992). In general, root systems avoid compacted soil layers and impermeable barriers. As a result, most roots of trees occur within 1 m (3 feet) of medium textured soils. The majority of fine non-woody roots are in the upper 15 cm (6 in.) of soil as a result of genetic control and the proximity of favourable growing conditions (Craul, 1992). Himelick (1986) reports that for urban trees as much as 90% of roots of urban trees less than 3 mm (1/8 in) in diameter grow in the top 15 cm (6 in.) of soil, and that most tree species will have 80% of their roots in the upper 30 cm (12 in.) of soil.

Craul (1992) has concluded that the surface 8-15 cm (3-6 in.) of soil depth is the most critical for root growth of trees as well as for shrubs and turf. Craul (1992) suggests that as a general rule, 30 cm (12 in) is a critical depth for woody plants in general.

Depth of Roots and Root Volume Requirements

To maintain healthy growth in a confined urban environment, trees require a volume of soil. Cox (1916) recommended, that in urban environments, planting strips have a minimum width of 1.8-2.4 m between the curb and sidewalk and a minimum soil depth of 0.9 m. Kopinga (1985) found that 7 m^3 was the minimum volume for adequate (but not optimum) growth of elms in the Netherlands. Urban (1990) in a survey of 1500 urban trees in the US has shown that the largest and healthiest trees had about 17 m^3 of soil available to them and that about 8.5 m^3 was the minimum for adequate vigour. In some cases a tree pit volume of 1.8 m^3 was found to be adequate for satisfactory tree growth where stress levels were low. The volume requirements for open planted species tend to be much less restrictive (Craul, 1992).

Rooting depth of trees is determined primarily by the aeration status of the soil in the absence of mechanical impedance. In general, for planting trees, pit depth does not have to exceed 60-90 cm (2-3 ft). Very few roots will extend below this depth even in well drained soil, with the only exception being well drained sands (Craul, 1992). As a general rule, the minimum depth of tree pit should not be less than 45-50 cm (18-20 in.) for large trees to prevent wind throw.

3.5.6 Off-Site Migration

The potential for contaminants to migrate offsite via groundwater has been considered. On one occasion, two PAHs were measured in groundwater collected from BH707 at concentrations in excess of the applicable Table B criteria. Resampling of the groundwater and analysis for PAHs resulted in measured concentrations less than the Table B criteria. No other chemicals were measured at concentrations greater than the Table B groundwater criteria and no free phase liquid hydrocarbons have been observed on the groundwater. In particular, free phase liquid

hydrocarbons were not observed in BH707, which is located downgradient of TP7 (the only location where free phase liquid hydrocarbons were observed on the soil). TPH (gas/diesel and/or heavy oil) was measured at concentrations greater than the Table A (potable) criteria in groundwater collected from BH605, BH700, BH705, and BH706. Although there are no Table B criteria for TPH in groundwater, there are Table B criteria for BTEX (a component of TPH gas/diesel) and, as pointed out in Section E-2.6, the maximum measured concentration of TPH (gas/diesel) is much less than the sum of the allowable criteria for BTEX. TPH (gas/diesel) represents the most water soluble and, therefore, most mobile fraction of TPH in groundwater. The TPH (heavy oil) is much less likely to migrate in groundwater. Ongoing monitoring of the groundwater for TPH, BTEX, and PAHs is recommended as part of the risk management plan in Section E-5. As discussed in Section 2.3.2, one of the sample locations for the Area Wide Initiative in the Portlands (MW10) is located on the south side of Lakeshore Blvd. East, between Carlaw Avenue and Leslie Street, and is downgradient of the subject site. Duke (1998 a and b) report that groundwater collected from this location, in October 1997 and again in January 1998, satisfied the Table B non-potable groundwater criteria for inorganic parameters, VOCs, and phenols. TPH (C_{10} to C_{24}) was not detected in the groundwater samples collected (detection limit of 100 µg/L).

3.6 TOXICITY ASSESSMENT

Regulatory agencies routinely evaluate quantitative relationships between the dose of a contaminant and the likelihood of adverse health effects. As described below, these relationships are different for a threshold contaminant and a non-threshold contaminant. In general, information from the CCME or Health Canada is sought. If the toxicity of a contaminant has not been evaluated by these agencies, then the Integrated Risk Information System (IRIS) database of the U.S. Environmental Protection Agency (U.S. EPA, 2001) is consulted. As described below, for the various fractions of petroleum hydrocarbons, toxicity information derived by the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG) (Edwards, et al. 1997) is used.

Threshold contaminants are contaminants for which a safe level of exposure (one which does not produce adverse health effects when exposed daily over a lifetime) can be defined. This safe level of exposure is termed a reference dose (RfD), a tolerable daily intake (TDI) or an acceptable daily intake (ADI). Exposure to chemicals via inhalation is usually evaluated using a reference concentration (RfC). The U.S. EPA (2001) defines an RfC as an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. The MOEE requires that site exposure not exceed 20% of the RfD or RfC for risk assessments that are part of a Level 1 risk management plan (MOEE, 1996a). This allows the receptors to be exposed to contamination from other sources (e.g. food or consumer products) without exceeding the RfD or RfC.

Non-threshold contaminants are believed to present a risk of adverse health effects at any dose. In Canada, this class of chemicals is currently restricted to mutagens and genotoxic

carcinogens. Benzene is an example of a non-threshold contaminant. The relationship between the risk of adverse health effects and dose is termed an inhalation unit risk factor or, for ingestion, a slope factor. Risk specific doses (RSDs) are calculated from the inhalation unit risk by assuming an allowable level of incremental risk. The MOEE requires that a lifetime risk of 1×10^{-6} be used in site-specific risk assessments that are part of a Level 1 risk management plan (MOEE, 1996a).

As described in Section 3.4.3, there are no complete exposure pathways for the non-volatile and semi-volatile chemicals of concern. A brief summary of the main uses and health effects of each of the non-volatile and semi-volatile chemicals of potential concern is provided in **Appendix E**. The inhalation unit risk factor and inhalation reference concentrations, used in this assessment, for the volatile chemicals of concern, are presented below.

3.6.1 Benzene

Benzene can be found in gasoline and diesel fuel, as well as in tobacco smoke (ATSDR, 1997a). Long-term exposure to benzene can harm the tissues that form blood cells, especially bone marrow, leading to effects such as anemia and excessive bleeding; these effects may end when exposure stops. Benzene is also believed to harm the immune system (ATSDR, 1997a). Benzene has been listed as a known human carcinogen by organizations such as Health Canada, the U.S. Environmental Protection Agency (EPA), the U.S. Department of Health and Human Services (DHHS) and the International Agency for Cancer Research (IARC). It has been associated with cancer of the blood-forming organs, specifically acute myeloid leukemia. Benzene is also believed to have reproductive effects, effects on fetuses, and to cause damage to chromosomes (ATSDR, 1997a). Health Canada considers benzene to be a substance for which there is no safe exposure level, and so exposure should be minimized as much as possible (EC/HC, 1993a). The U.S. EPA (2001) has estimated the increase in lifetime risk to an individual exposed to 1 ug/m^3 of benzene to range from 2.2×10^{-6} to 7.8×10^{-6}. The arithmetic mean value (5.0×10^{-6} per ug/m^3) is used as the unit risk value in calculation of exposure via inhalation of vapours outdoors (see **Table E-1**).

3.6.2 Toluene

Toluene is a component of petroleum products, including gasoline and diesel. Short-term exposure to high concentrations of toluene in air can lead to light-headedness, and eventually to dizziness, sleepiness and unconsciousness, by interfering with breathing and the heart (ATSDR, 1998a). Long-term exposure to toluene may result in liver, kidney and lung damage, as well as nervous system effects. Toluene may also have effects on the reproductive system and fetus development. Health Canada classifies toluene as Group IV-C (probably not carcinogenic to man) (EC/HC, 1992) and the U.S. EPA (2001) classifies toluene as Group D (not classified as to human carcinogenicity).

Health Canada (1996a) has established a threshold concentration of 3.8 mg/m^3 of toluene in air. The threshold concentration is based on a human clinical study in which volunteers were exposed to toluene in air. A no observed effect level (NOEL) of 150 mg/m^3 was established, based on a decrease in neurological function, an increase in neurological symptoms, and irritation of the respiratory tract (Health Canada, 1996b). The NOEL was adjusted to account for continuous exposure and an uncertainty factor of 10 was applied to account for intraspecies variation, resulting in a threshold concentration of 3.8 mg/m^3.

The U.S. EPA (2001) established a chronic reference concentration (RfC) of 0.4 mg/m^3. The chronic RfC is based on a study of female workers exposed to toluene by inhalation. Statistically significant differences in the results of neurobehavioural studies between exposed and unexposed workers were obtained. A lowest-observed-adverse-effects-level (LOAEL) of 119 mg/m^3 was determined. In addition to producing central nervous system effects, toluene is a known respiratory irritant. The effect on the central nervous system was judged to be a more critical and relevant endpoint. As the U.S. EPA (2001) RfC is lower than the Health Canada threshold concentration, the U.S. EPA value was conservatively selected for use in this risk assessment.

3.6.3 Xylenes

Xylenes are a component of petroleum products, found in gasoline and diesel; they are also used as solvents. Short-term exposure to high concentrations of xylenes in air can result in irritation of the skin, eyes and nose, breathing difficulties, delayed responses to visual stimuli, impaired memory, stomach discomfort, liver and kidney effects and hearing loss. Long-term exposure can result in nervous system effects, including headaches, lack of muscle coordination, dizziness, confusion and poor balance. At high doses, long-term exposure to xylenes can also cause kidney, lung and heart damage. Health Canada classifies xylenes as Group IV (probably not carcinogenic to humans) (EC/HC, 1993b) and the U.S. EPA classifies xylenes as Group D (not classifiable as to human carcinogenicity) (U.S. EPA, 2001).

Health Canada (1996a and b) has established a threshold concentration of 0.18 mg/m^3 xylenes in air, based on maternal effects and fetal skeletal retardation in a developmental study in rats. Inhalation exposure was continuous over days 7 to 15 of gestation. A lowest observed effect level (LOEL) of 250 mg/m^3 was reported. The LOEL was modified to account for differences in the ratio of the inhalation volume to body weight between rats and human children (aged 5 to 11 years) and an uncertainty factor of 1000 was applied to the LOEL (a factor of 10 each for intraspecies and interspecies variation and a factor of 10 for use of a LOEL rather than a NOEL).

3.6.4 TPH (gas/diesel and heavy oil)

The constituents of TPH may result in a variety of adverse health effects including cancer (for example, PAHs such as benzo[a]pyrene). Some TPH compounds may affect the liver, kidney,

lungs and reproductive systems at high doses (ATSDR, 1998b). Skin contact with TPH can cause irritation. It is also possible for many of the compounds in TPH to be absorbed through the skin, causing other health effects (such as effects on the nervous system or blood).

The approach used herein, to evaluate the risk posed by total petroleum hydrocarbons, is based on the work undertaken by the TPHCWG (Weisman, 1998; Potter and Simmons, 1998; Gustafson et al., 1997; Edwards et al., 1997). The work of the TPHCWG was adopted by the CCME in derivation of the Canada-Wide Standards for petroleum hydrocarbons in soil (CCME, 2000).

The TPHCWG recommends the use of a total of 14 fractions, divided between aliphatic and aromatic compounds and divided into fractions by carbon range. These fractions were devised based on a thorough and extensive compilation and evaluation of environmental fate and transport considerations by the TPHCWG. The toxicity information and physical/chemical properties recommended by the TPHCWG have been used herein. In general, the fractions considered appropriate in representing gasoline/diesel are those encompassing aliphatics and aromatics in the carbon range C_6 to C_{21}. Note that the groupings employed by the TPHCWG do not correspond directly with those used by the MOE. Generic criteria developed by the MOEE (MOEE, 1997) are for petroleum hydrocarbons (gas/diesel) in the C_5 to C_{24} range, and petroleum hydrocarbons (heavy oils) with $C_{\geq 25}$.

Edwards et al. (1997) present inhalation reference concentrations (RfCs) for each of the TPH fractions. Analytical information concerning the composition of the TPH found in the subsurface at the subject property is not available. Therefore, as a conservative measure in this assessment, the lowest RfC for TPH fractions within the C_5 to C_{10} range (0.2 mg/m^3) was assumed to represent all the TPH in that range. Similarly, the lowest RfC for the TPH fractions within the C_{11} to C_{24} range (0.2 mg/m^3) was assumed to represent all the TPH in that range. The higher carbon ranges (i.e., $C_{>24}$) are not believed to be a concern with respect to inhalation of vapour outdoors due to their low volatility.

3.6.5 Ecological Considerations

The applicable MOEE Table B criteria for the site, for the following chemicals of concern, are based on protection of ecological receptors: antimony, arsenic, boron, cadmium, chromium, copper, zinc, benzo[a]anthracene, naphthalene, phenanthrene, electrical conductivity, and SAR. The criteria for arsenic, chromium, copper, zinc, electrical conductivity and SAR are based primarily on phytotoxic effects. Direct contact with impaired soil, by the ecological receptors, including vegetation, will be blocked as part of the risk management plan.

Electrical conductivity and pH are frequently elevated at sites where concrete debris is found. The MOEE has established criteria for electrical conductivity for the protection of vegetation and soil dwelling organisms. The MOEE (1996b) describes electrical conductivity as "a measurement of the total concentration of soluble salts in the soil solution and can have a large osmotic influence on plant growth, as well as on soil organisms". The MOEE established a

guideline of 0.7 mS/cm for agricultural and residential/parkland land uses as this value is considered to represent the boundary between a "slightly stunted condition in most plants" and "slight to severe burning of most plants". The limit for commercial/industrial sites was set at two times the residential/parkland limit. As described in Section E-5, direct contact with the soil, by vegetation, will be prevented by institution of the risk management plan.

The pH limits for application of the MOEE generic soil criteria are 5.0 to 9.0 for surface soils and 5.0 to 11.0 for subsurface soils. These limits are employed because most ecotoxicity studies used to derive the generic criteria are applicable for this pH range (MOEE, 1996b). Also, some inorganic constituents are more bioavailable and/or more readily soluble in groundwater at either higher or lower pH values. The pH was found to be elevated in surface soil samples collected from BH701 and BH702 (values of 10.4 and 11, respectively). As described in the Landscape Mitigation Design, direct contact by ecological receptors, with the existing surface soil, will be prevented. Most heavy metals are more mobile under acid (low pH) conditions and increasing the pH of the soil reduces their bioavailability (Alloway, 1995). One exception is molybdate, which becomes more available with increasing pH (Alloway, 1995). Molybdenum has not been identified as a chemical of concern.

Criteria for sodium adsorption ratio (SAR) are intended to protect the health of the soil and the vegetation. The SAR measured in soil collected from BH701 and BH702 exceeded the applicable Table F criterion of 2.4, but not the Table B criterion of 12 for commercial/industrial land use. Table F is used for comparison for these samples as the pH was greater than 9. MOEE (1996b) cites a study which found that water penetration can be reduced and soil structure may deteriorate for SAR values greater than 5. Also, the growth of non-tolerant plant species may be restricted at SAR values greater than 12. As described in Section E-5, direct contact by ecological receptors, with the existing surface soil, will be prevented.

3.7 RISK CHARACTERIZATION

3.7.1 Human Health

The human exposure pathways of concern are direct contact with impacted soil (incidental ingestion of soil, inhalation of particulate matter and dermal contact with soil), and inhalation of vapours outdoors. The risk management plan (see Section E-5.3) will eliminate the pathways involving direct contact with soil. Exposure to human receptors, as a result of outdoor inhalation of vapours arising from the subsurface, is presented in Attachment E-1 and summarized in Table E-1. The results of the analysis show that the maximum measured concentration in soil, for toluene, xylenes, and TPH (gas/diesel) is much less than the soil concentration predicted to result in an air concentration corresponding to 20% of the reference concentration (the hazard level considered acceptable by the MOE). For benzene, the maximum measured concentration in soil is less than the concentration in soil predicted to result in an air concentration (incremental above background) corresponding to a 1×10^{-6} risk (the level of risk considered

4. LEVEL 2 RISK MANAGEMENT PLAN

4.1 GENERAL REQUIREMENTS

Lead, TPH (gas/diesel), and benzo[a]pyrene were measured in soil, at concentrations greater than the MOEE upper concentration limits. Therefore, if these constituents were not remediated, the risk assessment would, as defined by the MOE, be considered part of a Level 2 risk management plan.

The administrative requirements for the use of site-specific risk assessment (both Level 1 and Level 2), as outlined by the MOEE (1997), include:

- a community-based public communication program,
- communication with the municipality (i.e., the environment and/or health departments of the City of Toronto) concerning the use of site-specific risk assessment,
- preparation of a site-specific risk assessment report,
- independent peer review of the site-specific risk assessment, and
- MOEE review of the site-specific risk assessment.

In addition to the above requirements, for a Level 2 risk management plan, the following are required:

- development of a risk management plan, and
- registration of a Certificate of Prohibition on title to the land.

The risk management plan would include:

- a description of any controls required to limit exposure of receptors to contaminants,
- procedures for ongoing monitoring and maintenance of any control measures, and
- procedures for ensuring corrective action will be taken, if required.

The proposed risk management plan consists of the following elements:

- Blocking of Exposure Pathways
- Maintenance of Ground Cover
- Notification and Control of Future Excavations
- A regular program of Inspections and Groundwater Monitoring
- Public consultation and other administrative requirements

These items are discussed in detail in the following sections.

4.2 BLOCKING OF EXPOSURE PATHWAYS

4.2.1 Description of Proposed Mitigation Measures

A variety of mitigation measures have been considered in an attempt to eliminate any potential for root contact with potentially impacted soil and to reduce the potential of transport of contaminants to potential receptors. The following set of guidelines were used in the mitigation design in the study area:

4.2.1.1 Depth of Soil for Root Systems

It was determined that a minimum depth of at least 1 m of clean fill and topsoil was required for root system development of trees and shrubs (see Section 3.2 for rationale). Sod and other groundcover species would require at least 30 cm of topsoil or greater.

4.2.1.2 Depth of Surface Cover

The entire study area will be covered with a minimum of 30cm of clean fill or topsoil. Other types of covering include asphalt, concrete and/or lockstone for the sidewalks and bicycle paths and greater depths of fill for the bermed areas and planting beds. Areas which have been excavated for planting will also be backfilled with clean fill. All fill or topsoil used for grading, berming, site cover or backfill will meet the appropriate MOEE Table B criteria for residential/parkland land use, non-potable groundwater, coarse-textured soil.

Figure 1 shows the berming and grading plan for the north boulevard (Area "A"). **Figure 3** shows a cross-section of the grading plan along Area "A". **Figure 4** shows the grading plan for the former off-ramp (Area "B").

Where applicable, clean fill and topsoil would be added over the current grade to a level that was deemed suitable for root growth depending on the plant species present. It was determined that the maximum depth of soil that could be allowed along the north boulevard was 1 m. This level was determined based on aesthetic and slope criteria by the landscape architect firm of Du Toit, Allsopp, Hillier. A greater depth of soil could occur in the Leslie Street Ramp area. The entire area, excluding areas covered with concrete etc., will be covered with at least 30 cm of soil.

In order to determine whether the minimum of 30 cm of topsoil was sufficient to prevent breaches during normal use of the area, S&P contacted the City of Toronto Parks Department to ascertain the frequency of occurrence of digging within grassed areas of City Parks. The Parks Department representative reported that occurrences of children digging in a grassed area are extremely rare, because children prefer to play in sandboxes (or dirt), and because the turf cover is difficult to remove by hand. There are reported occurrences of digging in grassed areas by burrowing animals or dogs (family pets); however, the majority of the holes are less than 15 cm deep. Again, this digging only occurs where the turf cover is weak. The Parks Department immediately repairs any holes spotted by the Parks crews, and sends the crews to

material of construction will be compatible with the types of chemicals found on site. Since all of the geotextile will be buried, deterioration from exposure to sunlight is not a concern. Specifications for the geotextile material will include these requirements, and the candidate product will be reviewed for conformance with the Level 2 Risk Management requirements prior to final selection.

An example of an appropriate geotextile type is a TC Mirafi Filterweave (FW404) which is used for erosion control and filtration applications. The geotextile is a woven polypropylene that is inert to most chemicals and is highly permeable. It will allow movement of water but is sturdy enough to prevent major root penetration. The geotextile is considered to have an indefinite life based on the site conditions (i.e. not exposed to sunlight and there are no chemicals present in the study area which will readily react with the geotextile).

4.2.1.5 Selective Planting

There will be selective planting of plant species based on site location and depth of topsoil. Plant species of certain type (i.e., sod, groundcover, shrubs, trees) or of a certain species will be placed only in those areas that are deemed to be adequate in terms of root system growth so as to reduce the potential of root system contact with impacted soil.

In order to harmonize the risk management measures with the landscaping objectives, S&P's ecologist worked with the landscaping architect on the planting scheme. Where possible, the original tree and shrub species were retained. In some cases, more urban-hardy species or shallower root species were suggested. However, the overall philosophy of the landscape architecture was preserved, and the minor modifications to the planting scheme will not affect the aesthetic beauty of the landscaping.

4.2.2 Integration of Proposed Landscape Design with Mitigation Features

The integration of all the mitigation design principles into a landscape design is summarized in **Figures 1 to 4**. **Figures 1 to 3** show the landscape design layout for the area north of Lakeshore Boulevard (Area "A") and **Figure 4** the landscape design for the former Leslie Street ramp area (Area "B"). Both subject areas will be capped with fill and/or topsoil or pavement (see **Figures 1 and 4**). In the north Lakeshore area, the majority of the area between the road and the cycle path and between the walkway will be sodded. Built –up areas occur mainly to the area north of the path and will be covered with planting beds, shrubs, and trees. This entire area will be underlain with geotextile (see **Figure 2**). Each planting bed will occur in a depth of fill and/or topsoil that is deemed adequate for root growth (see Section F-3.2.2 and **Figure 2**). In Area "B", the former Leslie Street ramp area, all areas not covered in planting beds, or walkways will be sodded (**Figure 4**). Area "B" will have at least 1 m or more of fill/topsoil under planting beds.

The geotextile will be laid (see **Figure 4**) in such a way as to prevent for both the vertical and horizontal movement of root systems. In the north Boulevard area limited excavation will be

carried out in areas where berming cannot be carried out (**Figure 2**). Excavation will occur in the boulevard between Lakeshore and the cycle path for the placement of trees and adjacent to the boundary between the subject area and private properties to the north (see **Figure 2**). The excavation is to provide for an adequate depth of soil in areas that cannot be bermed. A typical cross section is provided in **Figure 4** to show how all the components of the landscape design will appear and how the geotextile will be laid to prevent for the horizontal movement of root systems.

4.3 ADMINISTRATIVE REQUIREMENTS

The Level 2 Risk Management Plan will comply with the MOEE requirements as follows:

- The requirements for community-based public communication programs have been met. The City of Toronto has been holding monthly Construction Monitoring meetings with neighbourhood residents on all facets of the Gardiner Expressway dismantling and Lakeshore Boulevard reconstruction. In October 2001, the findings of the SSRA were presented at the October meeting. Members of the public were given the opportunity of expressing their concerns and comments. One of the comments addressed by the City was a request for a technical and economic evaluation of ALL remedial alternatives, including SSRA. This was completed. The findings were presented in a special public meeting held on December 11, 2001, and a draft report was issued by S&P dated December 11, 2001. Prior to submission of the draft report for Peer Review, the City requested that burrowing wildlife species be included in the SSRA – this request was based on comments from the public input to this process.

- Requirements for communication with the City have been met. The City of Toronto Public Health department has been included in public meetings and internal meetings regarding the SSRA and was given a copy of the Remediation Alternatives report. Public Health has also reviewed the SSRA report that was submitted to the Peer Reviewer. **Appendix H** contains the Health Department review and S&P's responses.

- The peer review process has been completed, as described in Section 6.

4.4 MAINTENANCE AND MONITORING

Regular monitoring of the condition of the sidewalks, pathways and surface cover must be carried out, and any breaches of these cover materials repaired immediately.

The most important time for a detailed inspection is following the spring thaw, when the snowbanks have melted and any winter damage can be inspected and corrected. S&P proposes that a detailed formal inspection be conducted and documented twice annually (spring and fall). It is expected that the City will have regular maintenance of the area during the

growing season, for example grass cutting, planting and weeding. Thus, informal visual inspections can be conducted at those times.

The City of Toronto Parks Department has overall responsibility for maintenance and lawn care of the City's parks, boulevards and green spaces. The City of Toronto may retain a private contractor to conduct the regular maintenance, planting and lawn care in this area. S&P recommends that one of the conditions of the maintenance contract should be the requirement to repair any holes immediately upon discovery by the maintenance crew or notification by other parties (e.g. the public or City). This requirement would be in accordance the City Park Department's policy of protection of the public.

It is proposed that regular inspections of the surface cover be done during the landscaping season, coinciding with the frequencies of grass cutting and planting bed maintenance. This requirement will be included in an internal memorandum to the Parks Department and can be included in specifications for the landscaping contractor. If the frequency of breaches of the surface cover is greater than anticipated, the SSRA may require re-evaluation.

It is possible that, in the future, intrusive work may be required (e.g. excavations for repairs to buried services). The City of Toronto should notify the utility providers in the study area that environmental and health & safety and site restoration protocols must be followed when conducting intrusive work. The notification should also state that a detailed Health and Safety Plan and Site Restoration Plan are required to be submitted prior to commencement of any intrusive work. The Health & Safety Plan submitted to the City should contain details of personal protective equipment, protocols, contingency measures and emergency procedures for protection of workers and the public. The Site Restoration Plan should include a commitment to replace a minimum of 30cm of clean soil (clean cover) and the proper replacement of the geotextile barrier if encountered or disturbed.

Although groundwater was found to meet the MOEE non-potable criteria, S&P recommends a regular (quarterly) groundwater monitoring program of the existing monitoring wells, to document any changes in groundwater conditions. Groundwater samples will be collected for laboratory analysis of inorganic parameters, VOCs, PAHs and TPH.

The frequency of monitoring events can be reviewed after four consecutive monitoring events, and could be reduced if no significant change in groundwater conditions are observed. However, if the groundwater concentrations increase to levels exceeding the MOEE non-potable criteria or if free product is detected in the monitoring wells, a re-evaluation of the risk management plan may be required.

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TABLES

TABLE 1: SUBJECT SITE AND VICINITY OCCUPANCY HISTORY

PROPERTY	HISTORY
East of Carlaw Avenue from Lakeshore Boulevard to Eastern Avenue	
(1- Carlaw Avenue)	Canadian Patent Leather Company Factory late 1920s, to 1975 Prince &Smith Type Foundry 1975-1990
(3 Carlaw Avenue)	Art Wire Iron Co. late 1920s to 1970, Henderson &Laing Ltd., Paper Rulers & Book Binders from 1970 to 1995
(11 to 17 Carlaw Avenue)	Toronto Wood Scouring, Swartz & Sons Motor Bodies Late 1920s to 1975, Beaver Brook Company Inc., Parliament Build. Supplies, Signal Inc. 19310-1995 Office building at present
(19 Carlaw Avenue)	Cambridge Auto Livery Ltd. 1931 to 1975 Myatt E. & Company (21 to 25 Carlaw Avenue) from Late 1920s Graphic Jam at present
(21 Carlaw Avenue)	Amerco Rentals Liberty Taxi 1951-1995
(31 Carlaw Avenue)	Boiler Repair at present
(37 Carlaw Avenue)	Barton Earle Industries Limited 1985, Scholl & Assoc. 1995
(45 Carlaw Avenue)	Gensco Equipment 1990 to present
(53 Carlaw Avenue)	Residential Houses
(69 to 103 Carlaw Avenue)	
South of Eastern Avenue and north of Lakeshore Blvd East between Carlaw Avenue and Leslie Street	
(20 Leslie Street)	- Office building
(721 Eastern Avenue)	- Canada Metal Co. from early 1930s to present
(633 Eastern Avenue)	- A.R. Clarke & Co. Ltd. From early 1900s to present
(629 Eastern Avenue, 944 Lakeshore Boulevard East)	- Toronto Iron Works Limited from early 1930sToronto - Film Studio Inc., at present

PROPERTY	HISTORY
(601 Eastern Avenue)	- Downtown Subaru at present
(561 to 541 Eastern Avenue)	- Canadian Industries from 1954 to **1970**(555 Eastern Avenue) - Residential and commercial buildings at present
South of Lakeshore Blvd East, from Carlaw Avenue to west of Leslie Street	
55-550 Commissioners	- Shell Oil Co. of Canada Ltd. Early 1930s to late 1980s - Toronto Hydro at present
560 Commissioners	- Showline Studios at present - Line of Canada
685 Lakeshore Boulevard East	- Canroof Corporation - Greyhound Lines
1015 Lakeshore Boulevard East	- Brewers Retail Distribution Centre, early 1930s to present
East of Leslie Street from Lake Ontario to Eastern Avenue	
	- Tommy Thompson Park - Main Sewage Treatment Plant prior to 1940 to present
(7 Leslie Street)	- Metro Toronto Roads Department, at present
(7 ½ Leslie Street)	- Construction company, 7 ½ Leslie at present
	- Lakeshore Boulevard East
1-15 Leslie Street	- Sherwin Williams company of Canada (Paint and Varnish Manufacturing from late 1930s to late 1980s - King Burger Inc. (11 Leslie Street) and a shopping plaza with Loblaws Supermarket at present
West of Leslie Street from Lake Ontario to Eastern Avenue	
	- Tommy Thompson Park - Eastern Marine System - Commissioners
	- Vacant area

PROPERTY	HISTORY
	- Two storey industrial building - Lakeshore Boulevard - Tim Horton & Wendys - Office building, 20 Leslie Street
West of Carlaw Street from South of Commissioners to south of Eastern Avenue	
(12 Carlaw)	- Harbour Coal Co. Limited - Imperial Oil - Gair Co. Canada Limited and Sun Oil Co. - Cities Service Oil Warehouse - Husband Transport - Can. Patent. Co. 1931 – 1950, Gray & Moore Handkerchief Imp. - Lakeshore Boulevard East - Imperial Varnish - Paper Production pior 1965 , Signal Chemical 1970 to 1990, - warehouse at present
(24 Carlaw)	- All Weld Co. Metalizine Welding, 1931-1985 - Jones & Morris from 1988 to present
East of Carlaw Street, South of Commissioner 450 Commissioners	Hydro Sub-Station

TABLE 2: SUMMARY OF EXCEEDANCES OF MOEE SOIL CRITERIA

PARAMETER	MOE Table B Soil Criteria (µg/g)	Maximum Tested Concentration (µg/g)	No. of Exceedances (Total No. of Samples Analyzed)	COMMENTS
Inorganics (including Heavy Metals)				
pH	5.0 – 9.0 units	11.0	2 (31)	Groundwater pH was between 5 - 9
Electrical Conductivity	1.4 mS/cm	2.66	4 (20)	
Sodium Adsorption Ratio	12 (no units)	34.13	1 (20)	
Antimony	40	431	4 (20)	No exceedances of any inorganics in groundwater No exceedances of Chromium (VI)
Arsenic	40	244	3 (20)	
Beryllium	1.2	1.7	1 (31)	
Boron (Available)	2.0	3.2	1 (20)	
Cadmium	12	29.8	1 (31)	
Chromium (Total)	750	8440	3 (31)	
Copper	225	467	6 (31)	
Lead	1000	23500	9 (31)	
Zinc	600	1270	5 (31)	
Petroleum Hydrocarbons				
Benzene	5.3	18.4	1 (8)	No free product or sheen on groundwater at monitor wells
Toluene	34	35.6	1 (8)	
Xylenes	34	700	1 (8)	
TPH (gasoline/diesel)	1000	21000	3 (9)	
TPH (heavy oil)	5000	9700	2 (9)	
Polycyclic Aromatic Hydrocarbons (PAH)				
Anthracene	28	281	1 (5)	No exceedances of PAH in groundwater
Benzo (a) anthracene	40	271	1 (5)	
Benzo (a) pyrene	1.9	267	3 (5)	
Benzo (b) fluoranthene	19	343	1 (5)	
Benzo (k) fluoranthene	19	150	1 (5)	
Chrysene	19	243	1 (5)	
Dibenzo (a,h) anthracene	1.9	12.0	1 (5)	
Fluoranthene	40	923	1 (5)	
Fluorene	350	379	1 (5)	
Indeno (1,2,3-cd) pyrene	19	47.4	1 (5)	
Methylnapthalene, 2-(1-)	280	583	1 (5)	
Napthalene	40	2140	1 (5)	
Phenanthrene	40	1310	1 (5)	
Pyrene	250	671	1 (5)	

NOTE:

1. All groundwater samples analyzed met the Non-potable groundwater criteria contained in Table B of the "Guideline for Use at Contaminated Sites in Ontario" published by the Ministry of Environment (MOE), revised 1997.

TABLE 3: ESTIMATED AMOUNT OF IMPACTED SOIL IN THE SUBJECT AREA

Type of Impacted Soil	Waste Classification (i)	Estimated Affected Volume
Area "A" North of Lakeshore Boulevard		
Heavy Metals	Non-Hazardous Solid Waste	5,740 m^3
Heavy Metals TPH PAHs	Hazardous Solid Waste	18,400 m^3
Heavy Metals TPH PAHs	Non-Hazardous Solid Waste	1,900 m^3
Area "B" South of Lakeshore Boulevard (Former off-ramp)		
Heavy Metals PAHs	Non-Hazardous Solid Waste	9,360 m^3
Heavy Metals TPH Benzene, Toluene and Xylenes PAHs	Hazardous Solid Waste	22,000 m^3

NOTES:
(i) Waste classification is applicable if soils are excavated for off-site transportation and disposal in accordance with Regulation 347 (as amended by Reg. 558/00).

TABLE 4: CALCULATION OF SCREENING LEVEL SOIL CONCENTRATION BASED ON INHALATION OF OUTDOOR VAPOURS

INPUTS (Non-chemical-specific)

	NAME	UNITS	VALUE	REFERENCE
foc	Organic carbon content of soil	g/g	0.006	U.S.EPA, 1996
pb	Dry soil bulk density	g/cm^3	1.5	U.S.EPA, 1996
θa	Air-filled soil porosity	L_{air}/L_{soil}	0.28	U.S.EPA, 1996
n	Total soil porosity	L_{pore}/L_{soil}	0.43	U.S.EPA, 1996
θw	Water-filled porosity	L_{water}/L_{soil}	0.15	U.S.EPA, 1996
ps	Soil particle density	g/cm^3	2.65	U.S.EPA, 1996
T	Exposure interval	s	9.5E+08	U.S.EPA, 1996
Q/C	Inverse of the mean conc. at centre of square source	$g/m^2/s$ per kg/m^3	72	U.S.EPA, 1996 - represents average value for a 1 acre (4000 m^2) source in EPA Zone V and VII.
	Carcinogens			
TR	Target cancer risk	unitless	1.E-06	MOEE, 1996a
AT	Averaging time	y	70	U.S.EPA, 1996
EF1	Exposure frequency	d/y	120	assumed
EF2	Exposure frequency	h/d	4	assumed
ED	Exposure duration	y	30	U.S.EPA, 1996
	Non-carcinogens			
THQ	Target hazard quotient	unitless	0.2	MOEE, 1996a
AT	Averaging time	y	30	U.S.EPA, 1996
EF1	Exposure frequency	d/y	120	assumed for toluene and TPH
		d/y	365	assumed for xylenes
EF2	Exposure frequency	h/d	4	assumed
ED	Exposure duration	y	30	U.S.EPA, 1996

INPUTS (Chemical-specific)

CHEMICAL	Inhalation unit risk (URF) $(ug/m^3)^{-1}$	Ref	Inhalation RfC (mg/m^3)	Ref	Diffusivity in Air (Di) (cm^2/s)	Ref	Henry's Law Constant (H') (unitless)	Ref	Diffusivity in Water (Dw) (cm^2/s)	Ref	Organic carbon partition coeffic. (Koc) (mL/g)	Ref	Calc. soil water partition coeffic. (Kd) (mL/g)
Benzene	5.0E-06	a			8.80E-02	d	0.228	d	9.80E-06	d	62	d	0.37
Toluene			0.4	a	8.70E-02	d	0.272	d	8.60E-06	d	140	d	0.84
Xylenes			0.18	b	7.80E-02	d	0.276	d	8.70E-06	d	249	d	1.5
TPH - aromatics (C>8 to C10)			0.2	c	6.60E-02	f	0.51	e	6.60E-06	f	1585	e	9.5
TPH - aromatics (C>12 to C16)			0.2	c	6.00E-02	f	0.045	e	6.00E-06	f	5000	e	30

References:

a - U.S. EPA (2001)
b - Health Canada (1996a and b)
c - Edwards, et al. (1997)
d - U.S. EPA (1996)
e - Gustafson, et al. (1997)
f - calculated as per Lyman et al. (1982)

RESULTS

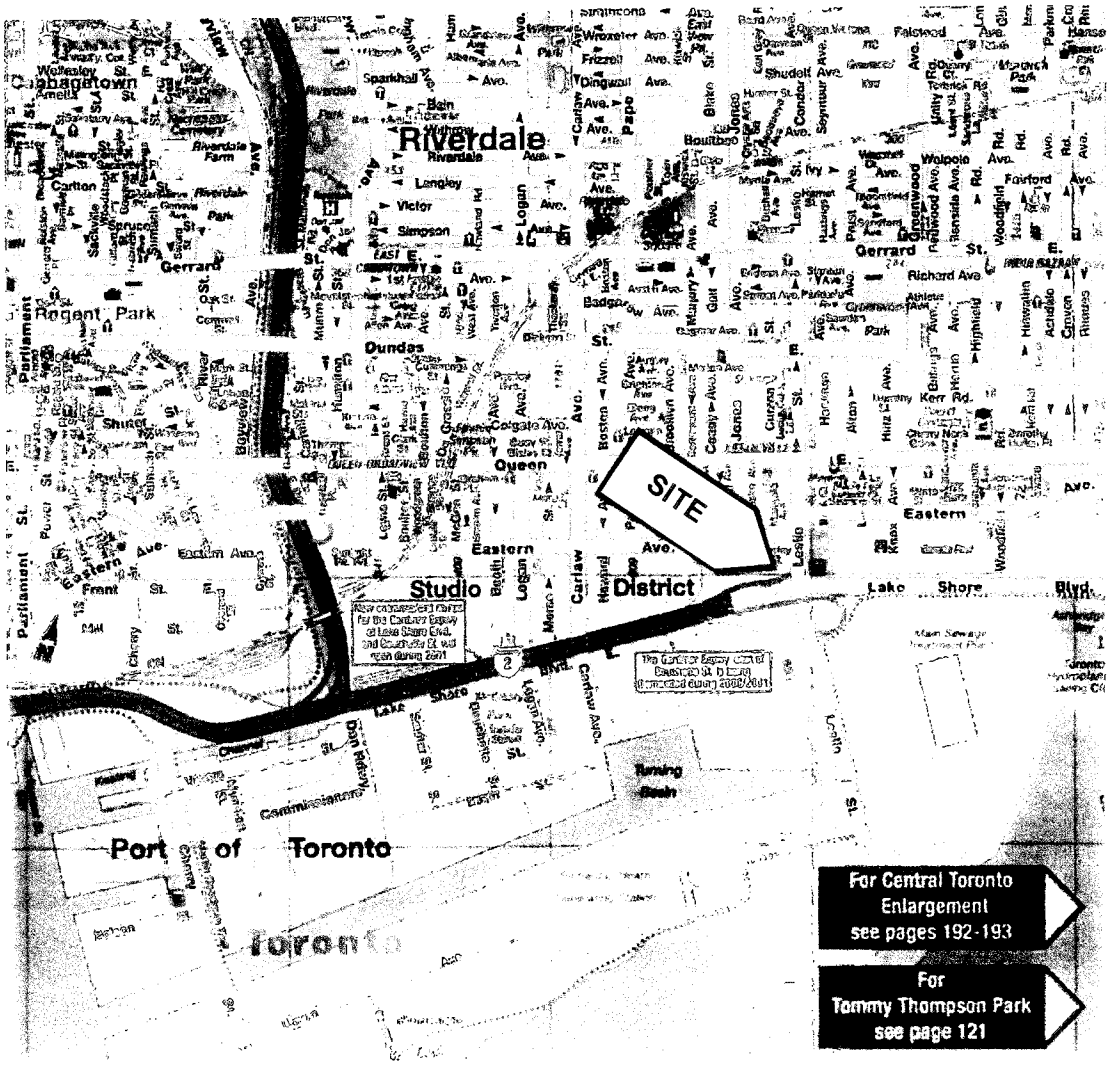
CHEMICAL	Apparent diffusivity (Da) (cm^2/s)	Volatilization Factor (VF) (m^3/kg)	Calculated conc. in soil (mg/kg)	Max. meas. conc. in soil (mg/kg)
Benzene	2.02E-03	2917	25	18.4
Toluene	1.24E-03	3727	5442	35.6
Xylenes	6.77E-04	5036	1088	700
TPH - aromatics (C>8 to C10)	1.80E-04	9781	7140	3200*
TPH - aromatics (C>12 to C16)	4.64E-06	60821	44400	18000**

NOTE:

* measured concentration represents sum of aliphatic and aromatic fractions C5 to C10
** measured concentration represents sum of aliphatic and aromatic fractions C11 to C24

2002/04/29- rev.2

DRAWINGS



SITE LOCATION

Scale:~1:25,000	SITE SPECIFIC RISK ASSESSMENT LAKESHORE BOULEVARD EAST AND LESLIE STREET TORONTO, ONTARIO	Prepared By: MV
Date: May, 2002		Reviewed By: DJB
Project:: SP3977	SHAHEEN & PEAKER LIMITED	Drawing No. 1

HYUNDAI
DOWNTOWN
SUBARU

ARLAW AVENUE

TORONTO FILM STUDIOS

A.R. CLARKE & CO. LTD

THE CANADIAN
METAL CO. LTD.

LOBLAWS

JUMBO VIDEO

AREA "A"

LAKESHORE
BOULEVARD EAST

TORONTO HYDRO

SHOWLINE
STUDIOS

CANROOF
CORPORATION

GREYHOUND

BREWERS RETAIL
DISTRICT CENTRE

LESLIE STREET

AREA "B"

LEGEND

Boundary of Study Area

Metres
approximately

STUDY AREA

Scale: AS SHOWN

Date: MAY 2002

SITE SPECIFIC EIS/EA ASSESSMENT

LAKESHORE BOULEVARD EAST AND LESLIE STREET

TORONTO, ONTARIO

Drawn By: MV

Approved By: DJB

SHAHEEN & PEAKER LIMITED

Drawing No.: 2

TORONTO FILM STUDIOS

A.R. CLARKE & CO. LTD.

THE CANADIAN METAL CO. LTD.

BH407 BH408 BH409 BH410 BH411 BH412 BH413 BH414 BH415

TP2 TP3 TP4 TP5 TP6

B-700 B-702 B-703 B-704 B-705 B-707

LAKESHORE BOULEVARD EAST

BREWERS RETAIL DISTRICTION CENTRE

CANROOF CORPORATION

GREYHOUND

LESLIE STREET

0 30 100 200

Metres (approximate)

LEGEND

Test Pit by Shaheen & Peaker Limited, April 2007

Borehole by Shaheen & Peaker Limited, April 2007

Monitoring Well by Shaheen & Peaker Limited, April 2007

Borehole by Canroof Corporation, May 2002

Monitoring Well by Canroof Corporation, May 2002

Benchmark

BOREHOLE AND TEST PIT LOCATION PLAN

SHAHEEN & PEAKER LIMITED

TORONTO FILM STUDIOS

A.R. CLARKE & CO. LTD.

THE CANADIAN METAL CO. LTD.

BH603
75.14

BH602
75.01

BH702
74.99

BH704
73.97

BH705
72.12

75.00 m

74.50 m

74.00 m

73.50 m

LAKESHORE BOULEVARD EAST

BH707
74.83

BREWERS RETAIL DISTRIBUTION CENTRE

73.50 m

CANROOF CORPORATION

GREYHOUND

74.00 m

ESLIE STREET

BH606
74.72

BH706
74.38

74.50 m

75.00 m

0 50 100 200
Metres
(approximate)

GROUNDWATER OBSERVATIONS - September 26, 2001

SHAHEEN & PEAKER LIMITED

TORONTO FILM STUDIOS

A.R. CLARKE & CO. LTD.

THE CANADIAN METAL CO. LTD.

LAKESHORE BOULEVARD EAST

CANROOF CORPORATION

GREYHOUND

BREWERS RETAIL DISTRIBUTION CENTRE

50 100 200

Metres

(scale approx.)

TYPE AND EXTENT OF IMPACTED SOIL

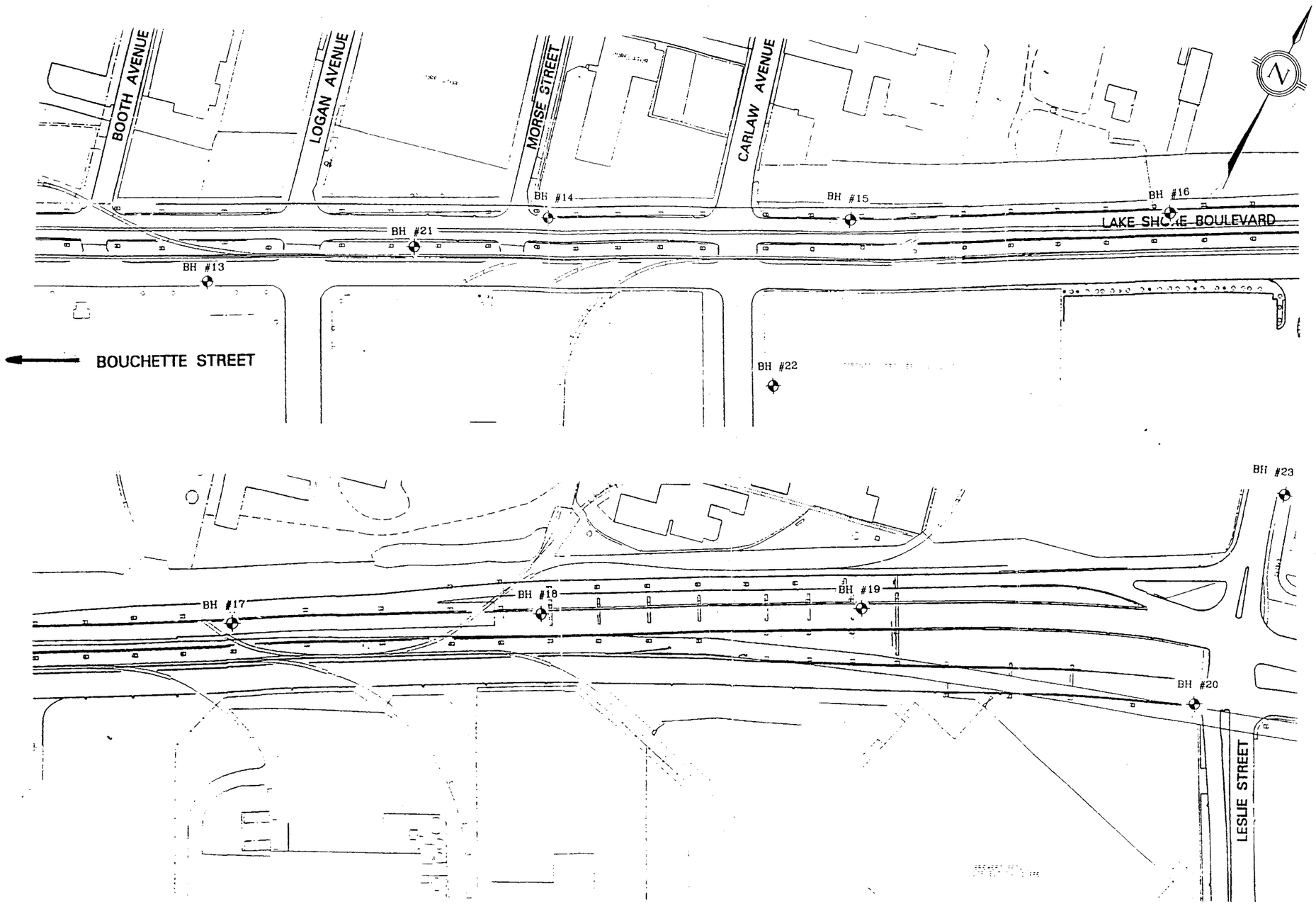
SHAHEEN & PEAKER LIMITED

FIGURES

OVERSIZE MAP ON THIS PAGE

APPENDIX A

DRAWINGS FROM PREVIOUS INVESTIGATIONS

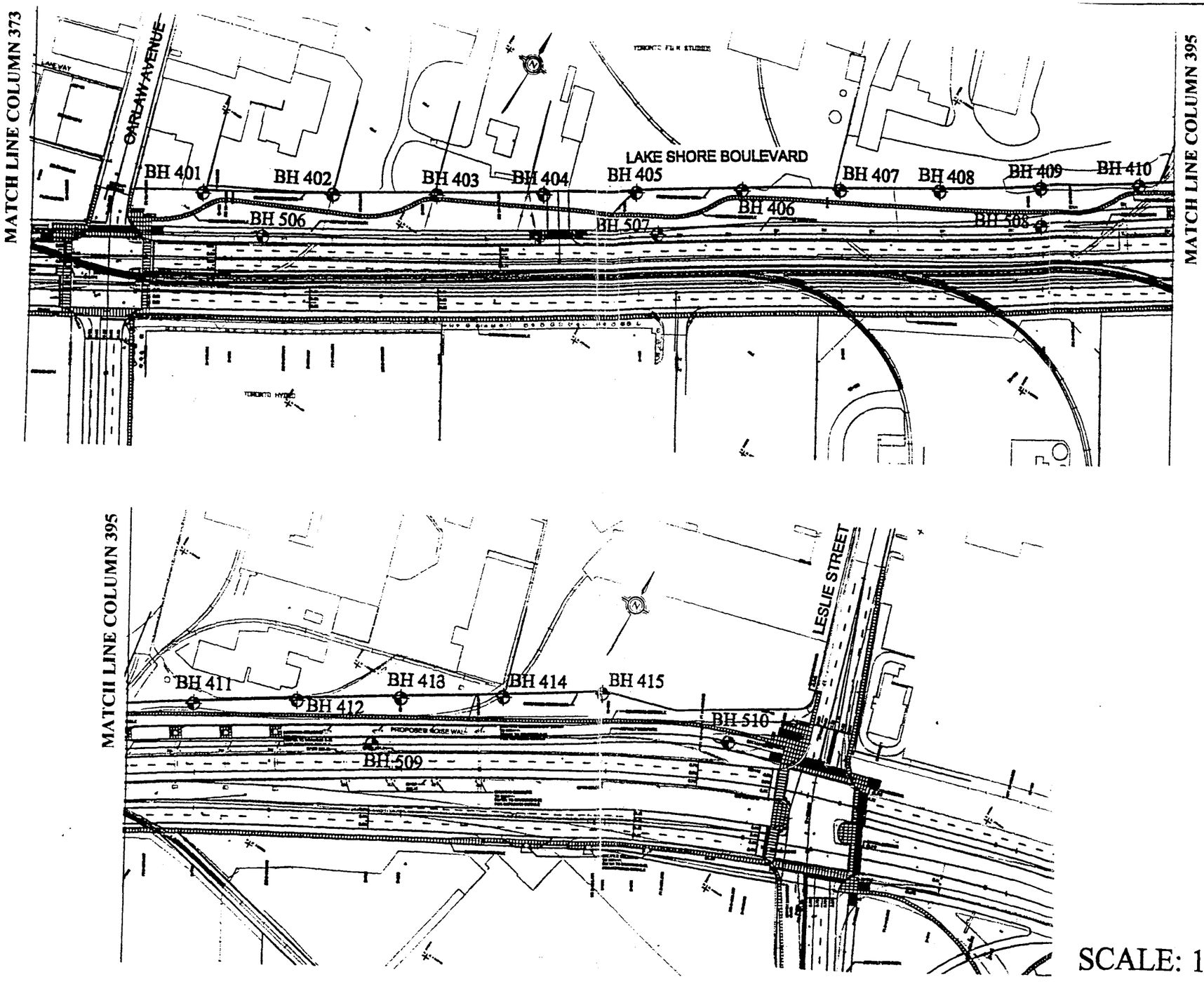


Borehole Location Plan

SCALE 1:2000

Gardiner Expressway East
Dismantling, Toronto, Ontario

Enclosure No. 2
Ref.No.: G-97.0502
Date: July 1997



SCALE: 1:2000

BOREHOLE LOCATION PLAN
Gardiner Expressway East Dismantling, Don Roadway to Lesile Street
Noise Barrier and Bicycle Path

G-99.1003
Encl. 2
Feb. 2000

APPENDIX B

BOREHOLE AND TEST PIT LOGS – ALL INVESTIGATIONS

LOG OF BOREHOLE 407

CLIENT : Cole Sherman & Associates
PROJECT : Noise Barrier
LOCATION : LakeShore Blvd.
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm
Date : Feb. 3, 1999

REF. NO. : G-99.1003
ENCL. NO. : 9

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 M 'N'	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.8	Ground Surface										
0.0	150mm TOPSOIL		1	SS	15				○		
	FILL sand to silty sand trace of gravel and decayed wood frag.						76				
75.2	grey, frozen		2	SS	15						
1.7	FILL, silty clay hydrocarbon odour					▽ W.L. 75.3 m 03/02/00					
74.5	grey, firm		3	SS	7						
2.3	FILL, sandy silt, trace of clay, grey		4	SS	6				○		
73.8	loose						74				
3.0	PEAT sandy silt layers below 3.7m		5	SS	3						
	black soft		6	SS	2						
72.2											
4.6	SILTY CLAY to CLAYEY SILT some sand below 5.1m grey to brown stiff		7	SS	6		72		○		
			8	SS	8						
			9	SS	8						
69.2							70				
7.6	SILTY CLAY (Glacial Till)		10	SS	13				⊢○⊣		
68.7	grey, stiff										
8.1	END OF BOREHOLE										

LOG OF BOREHOLE 408

CLIENT : Cole Sherman & Associates
PROJECT : Noise Barrier
LOCATION : LakeShore Blvd.
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm
Date : Jan. 28, 2000

REF. NO. : G-99.1003
ENCL. NO. : 10

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	BLOWS/0.3 M 'N'	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.1	Ground Surface										
0.0	150mm TOPSOIL		1	SS	56/275mm		Seal				
	FILL										
	silty sand, trace of gravel, hydrocarbon odour below 2.3m, frozen at the top		2	SS	30		76		○		
			3	SS	12	W.L 75.3 m 09/02/00					0 78 22
	brown to grey compact to loose		4	SS	5				○		
74.3											
2.8	PEAT and SAND (POSSIBLE FILL) hydrocarbon odour		5	SS	5		74			153 ○	
73.3	black, soft and loose										
3.8	SANDY SILT and PEAT hydrocarbon odour grey to black		6	SS	5						
72.4	loose and soft										
4.7	CLAYEY SILT to SILTY CLAY		7	SS	8		72				
	grey stiff		8	SS	10				⊢○⊣		
						Piezometer					
			9	SS	15						
							70				
			10	SS	15						
68.0											
9.1	SILTY SANDY CLAY (Glacial Till)		11	SS	19		68		○		
	some sand grey very stiff to hard		12	SS	24				⊢		1 30 45 24
							66				
65.1			13	SS	73				○		
12.0	END OF BOREHOLE										
	Refusal to augering on shale bedrock at El. 65.1m										
	Date W.L. 28/01/00 74.7m										

LOG OF BOREHOLE 409

CLIENT : Cole Sherman & Associates
PROJECT : Noise Barrier
LOCATION : LakeShore Blvd.
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm
Date : Feb. 1, 2000

REF. NO. : G-99.1003
ENCL. NO. : 11

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS/0.3 M 'N'	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT N (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.9	Ground Surface										
0.0	FILL mixture of silty sand and topsoil, some gravel, organic matter below 0.6m, frozen on the top, hydrocarbon odour below 1.6m brown to black		1	SS	30						
			2	SS	8		76				
			3	SS	6	▼ W.L. 75.2 m 01/02/00					
			4	SS	5		74				
73.9											
3.0	PEAT fibrous, black soft		5	SS	3					420	
72.9											
4.0	SILTY SAND to SANDY SILT trace of clay, some peat, hydrocarbon odour to 5.3m grey to black loose		6	SS	4						
			7	SS	6		72				
			8	SS	6					136	
70.7										90	
			9	SS	6						
6.2	CLAYEY SILT to SILYT CLAY grey firm						70				
			10	SS	5						
67.6											
9.1 67.3	SANDY SILTY CLAY (Glacial Till), grey, v. stiff		11	SS	25		68				
9.8	END OF BOREHOLE Borehole was dry upon completion										

LOG OF BOREHOLE 410

CLIENT : Cole Sherman & Associates
PROJECT : Noise Barrier
LOCATION : LakeShore Blvd.
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm
Date : Feb. 1, 2000

REF. NO. : G-99.1003
ENCL. NO. : 12

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 M 'N'	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.5	Ground Surface										
0.0	FILL		1	SS	13		76				
	sand and silt, trace of clay, some peat brown to black, frozen		2	SS	10					92	
75.0											
1.5	FILL, sandy silt and peat, grey to black very loose		3	SS	3					250	
74.2											
2.3	PEAT and SAND fibrous, trace of clay black soft to firm		4	SS	4		74			123	
						▼	W.L 73.6 m 01/02/00				
			5	SS	3						0 44 47 9
72.7											
3.8	SILTY SAND some gravel grey, loose to dense		6	SS	5		72				
			7	SS	4						
			8	SS	6						
			9	SS	38						1 85 14
							70				
68.9											
7.6	SILTY CLAY (Glacial Till) trace sand, grey, stiff		10	SS	14						
68.4											
8.1	END OF BOREHOLE										

LOG OF BOREHOLE 411

CLIENT : Cole Sherman & Associates
PROJECT : Noise Barrier
LOCATION : LakeShore Blvd.
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm
Date : Feb. 1, 2000

REF. NO. : G-99.1003
ENCL. NO. : 13

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3 M 'N'	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT N (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.6	Ground Surface										
1.0	FILL sand and gravel, some topsoil, some organic matter grey to brown loose		1	SS	9						
			2	SS	5						
75.1						▼ W.L. 75.2 m 01/02/00					
1.5	FILL, sandy silt, some organic matter grey to black, loose		3	SS	6						
74.2										263	
2.4	PEAT and SAND clayey below 3m black soft to firm and loose		4	SS	5		74				
			5	SS	4						
72.8											
3.8	SILTY CLAY sand seams below 4.6m grey stiff to very stiff		6	SS	5						
			7	SS	15		72				
			8	SS	18						
70.5											
6.1	SILTY CLAY (Glacial Till) some sand, trace of gravel very stiff to hard brown / grey		9	SS	34		70				
			10	SS	23						
68.5											
8.1	END OF BOREHOLE										

LOG OF BOREHOLE 413

CLIENT : Cole Sherman & Associates
PROJECT : Noise Barrier
LOCATION : LakeShore Blvd.
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm
Date : Jan. 31, 2000

REF. NO. : G-99.1003
ENCL. NO. : 15

(m) ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	BLOWS/0.3 M 'N'	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT N (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.8	Ground Surface										
0.0	150mm TOPSOIL		1	SS	11				○		
	FILL silty sand, trace of organic matter and rootlets, brown, frozen		2	SS	15		76				
75.2											
1.6	CLAYEY SILT (POSSIBLE FILL), some organic matter		3	SS	6						
74.6											
2.3	SANDY SILT (POSSIBLE FILL)		4	SS	9				○		0 33 61 6
73.8	some peat, loose						74				
3.0	CLAYEY SILT to SILTY CLAY		5	SS	3	▼	W.L 73.3 m 31/01/00				
	some organic matter to 3.7m, occasional sand seams brown to grey soft to stiff		6	SS	3						
			7	SS	8		72		○		
			8	SS	15						
70.7											
6.1	SILTY CLAY (Glacial Till) some sand grey very stiff		9	SS	19		70				
68.7			10	SS	21				○		
8.1	END OF BOREHOLE										

LOG OF BOREHOLE 414

CLIENT : Cole Sherman & Associates
PROJECT : Noise Barrier
LOCATION : LakeShore Blvd.
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm
Date : Jan. 31, 2000

REF. NO. : G-99.1003
ENCL. NO. : 16

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	'N' BLOWS/0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.5	Ground Surface										
0.0	FILL silty sand, some organic matter, grey, frozen at the top, loose		1	SS	17		76				
75.0			2	SS	7				○		
1.5	FILL, clayey silt hydrocarbon odour grey, firm		3	SS	7				○		
74.1											
2.4	PEAT black, firm		4	SS	5		74			92	
73.5									○		
3.0	SILTY CLAY trace of sand grey to mottled brown soft to stiff		5	SS	3						
			6	SS	5		72				
			7	SS	9	▼ W.L. 71.5 m 31/01/00			⊢		
			8	SS	6				○		
			9	SS	7		70				
69.0											
7.6	SILTY CLAY (Glacial Till) grey, very stiff		10	SS	25						
68.4											
8.1	END OF BOREHOLE										

LOG OF BOREHOLE 415

CLIENT : Cole Sherman & Associates
PROJECT : Noise Barrier
LOCATION : LakeShore Blvd.
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm
Date : Jan. 31, 2000

REF. NO. : G-99.1003
ENCL. NO. : 17

(m) ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	'N' BLOWS 0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.8	Ground Surface										
0.0	150mm TOPSOIL FILL sand and gravel to sandy silt, some organic matter, peat below 1.6m brown, frozen at top loose to compact		1	SS	22		Seal				
			2	SS	10		76				
			3	SS	11	W.L 75.2 m 09/02/00					
			4	SS	5		74				
73.8											
3.0	SILTY CLAY trace of sand, thin sand seams between 4.6m to 9.0m firm to stiff		5	SS	6						
			6	SS	6						
			7	SS	7		72				
	brown / grey		8	SS	8						
			9	SS	8	50mm dia. monitoring well					
							70				
			10	SS	10						
							68				
			11	SS	8						
							66				
			12	SS	11						
64.3			13	SS	72/180mm						
12.5	END OF BOREHOLE Refusal to augering on shale bedrock at El. 64.3m Date W.L. 31/01/00 74.5m										

Project No. SP3201C

Log of Borehole BH602

REVISED

Drawing No. _____

Project: Soil and Groundwater Quality Assessment

Sheet No. 1 of 1

Location: Gardiner Expressway Dismanting, Toronto, Ontario

Date Drilled: July 12, 2001

Drill Type: Hollow Stem Auger

Datum: Geodetic

Auger Sample ⊠
SPT (N) Value ○ ▨
Dynamic Cone Test ——
Shelby Tube □
Field Vane Test ✚ S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢—○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		FILL sand and gravel, some slag, with organic mattter, pockets of clayey silt and sandy silt, grey to dark grey, damp to moist, no abnormal odour or stains	76.60	0
			75.40	1
		ORGANIC SILT sandy to clayey, grey to dark grey, lenses of dark brown fibrous peat, moist to wet, hydrocarbon odour, no stains	75.05	2
			73.10	3
		SILTY SAND some organic matter, grey to dark grey, moist to wet, no abnormal odour or stains		4
			70.00	5
		END OF BOREHOLE		6

N Value: 20 40 60 80
Shear Strength: 0.1 0.2 MPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 10 20 30
SAMPLES
Natural Unit Weight kN/m³

LAGWGL02 SP3201C.GPJ LAGWGL02.GDT 04/10/01

S & P **Shaheen & Peaker Consulting Engineers**

Time	Water Level (m)	Depth to Cave (m)
At completion	4.40	
July 16, 2001	1.46	
September 7, 2001	1.61	
September 26, 2001	1.59	
October 2, 2001	1.55	

Project No. SP3201C

Log of Borehole BH603 REVISED

Drawing No. _____

Project: Soil and Groundwater Quality Assessment

Sheet No. 1 of 1

Location: Gardiner Expressway Dismanting, Toronto, Ontario

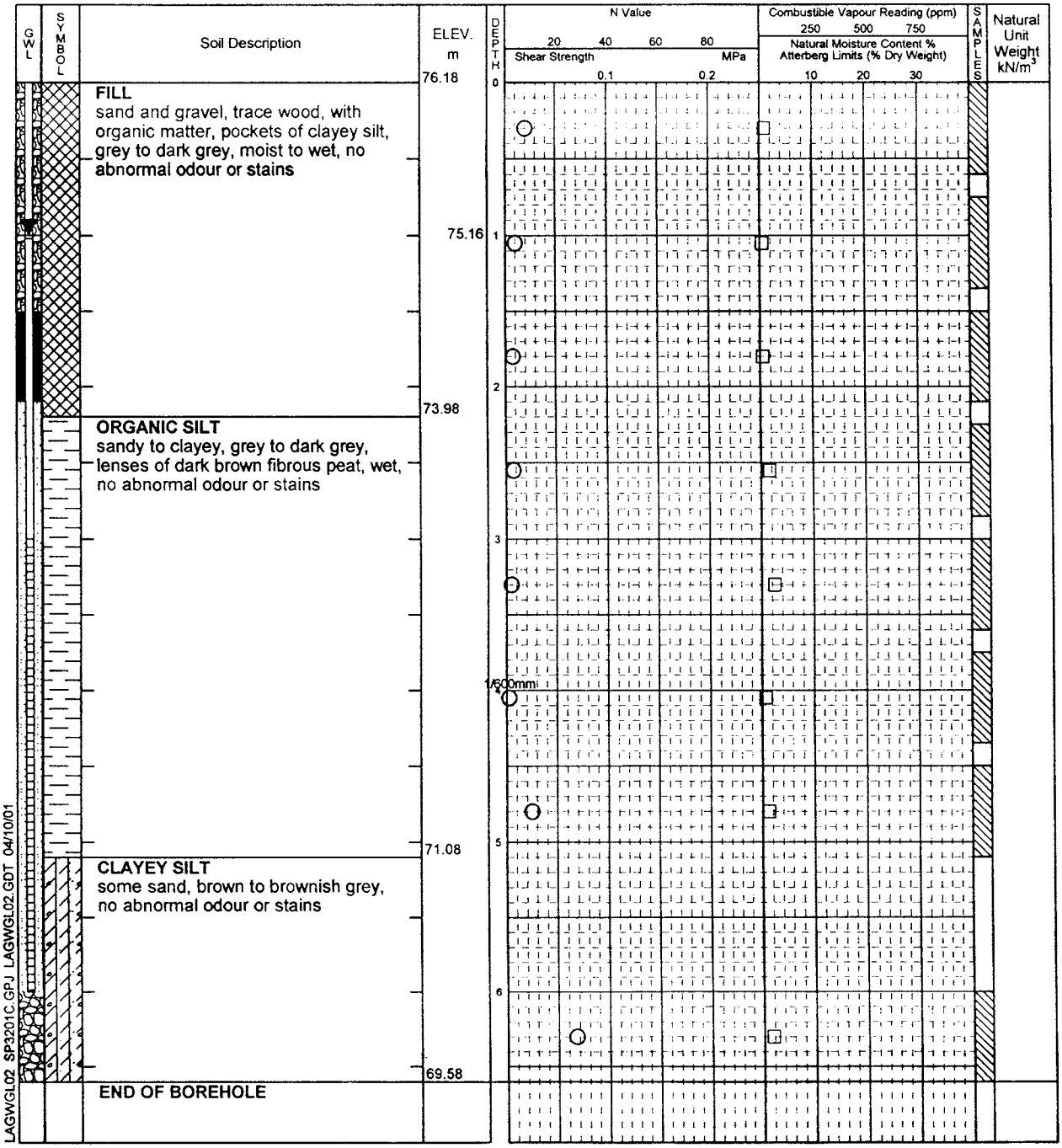
Date Drilled: July 12, 2001

Drill Type: Hollow Stem Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



LAGWGL02 SP3201C.GPJ LAGWGL02.GDT 04/10/01

S & P Shaheen & Peaker Consulting Engineers

Time	Water Level (m)	Depth to Cave (m)
At completion	3.15	
July 16, 2001	0.95	
September 7, 2001	1.16	
September 26, 2001	1.04	
October 2, 2001	1.02	

Project No. SP3201C

Log of Borehole BH604 REVISED

Drawing No. _____

Project: Soil and Groundwater Quality Assessment

Sheet No. 1 of 1

Location: Gardiner Expressway Dismanting, Toronto, Ontario

Date Drilled: July 11, 2001

Drill Type: Hollow Stem Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
			76.38	0
		TOPSOIL	76.28	
		FILL sandy silt, some gravel, wood and concrete, with organic matter, brown to dark brown, damp, no abnormal odour or stains		
			75.48	1
		ORGANIC SILT sandy to clayey, grey to dark grey, lenses of dark brown fibrous peat, moist to wet, hydrocarbon odour, no stains	75.01	
				1600mm
				2
				3
				1600mm
			72.48	4
		CLAYEY SILT some to trace sand, brown to brownish grey, grey below 6m, no abnormal odour or stains		5
				6
			69.78	
		END OF BOREHOLE		

N Value: 20 40 60 80
Shear Strength: 0.1 0.2 MPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
SAMPLES
Natural Unit Weight kN/m³

LAGWGL02 SP3201C.GPJ LAGWGL02.GDT 04/10/01

S & P **Shaheen & Peaker Consulting Engineers**

Time	Water Level (m)	Depth to Cave (m)
At completion	3.05	
July 16, 2001	1.28	
September 7, 2001	1.52	
September 26, 2001	1.38	
October 2, 2001	1.37	

Project No. SP3201C

Log of Borehole BH605 REVISED

Drawing No. _____

Project: Soil and Groundwater Quality Assessment

Sheet No. 1 of 1

Location: Gardiner Expressway Dismanting, Toronto, Ontario

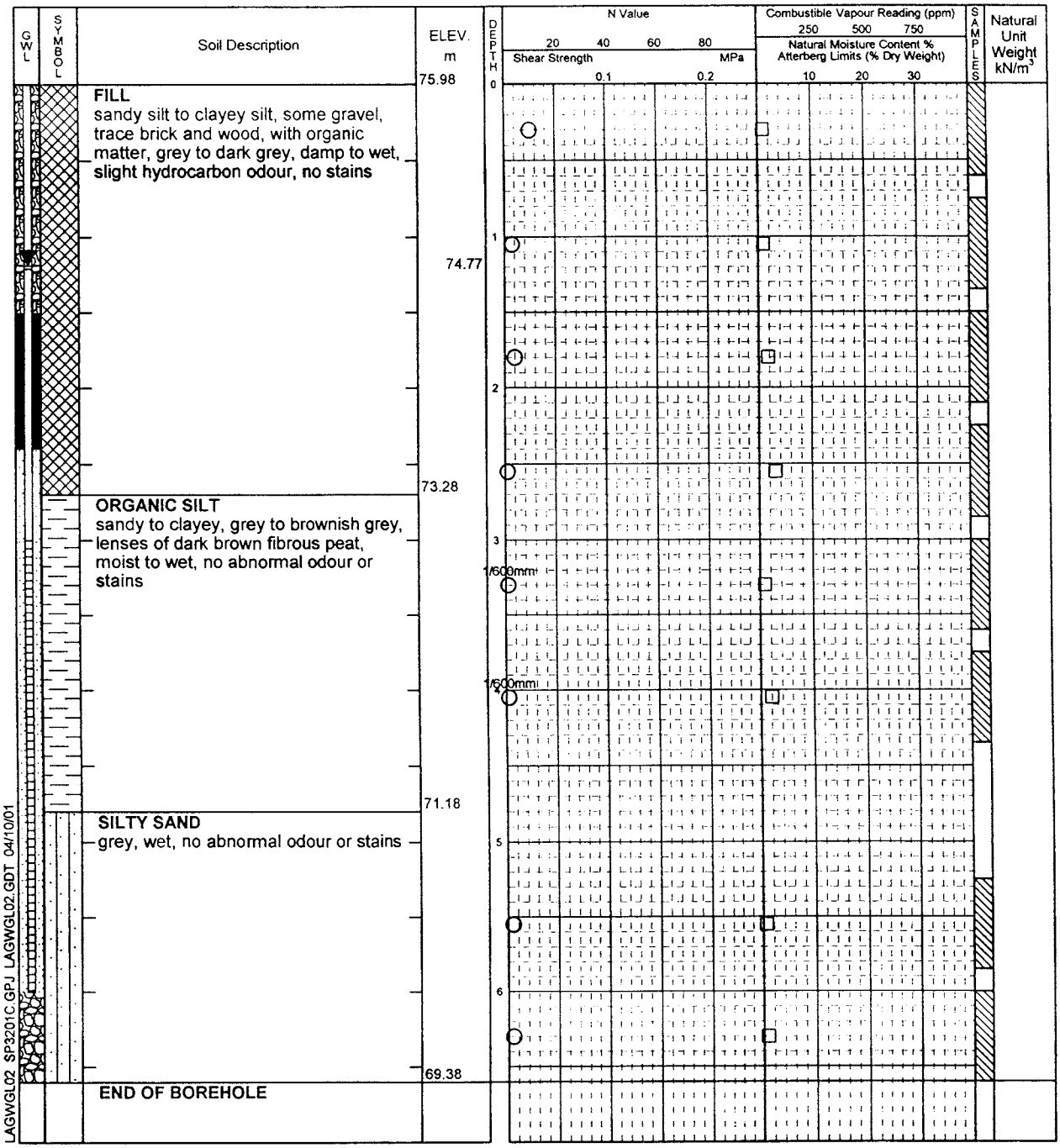
Date Drilled: July 11, 2001

Drill Type: Hollow Stem Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



S & P Shaheen & Peaker Consulting Engineers

Time	Water Level (m)	Depth to Cave (m)
At completion	1.70	
July 16, 2001	1.06	
September 7, 2001	1.15	
September 26, 2001	1.22	
October 2, 2001	1.21	

Project No. SP3977

Log of Borehole BH700

Drawing No. _____

Project: SSRA

Sheet No. 1 of 1

Location: Lakeshore Blvd. East at Leslie St., Toronto, Ontario

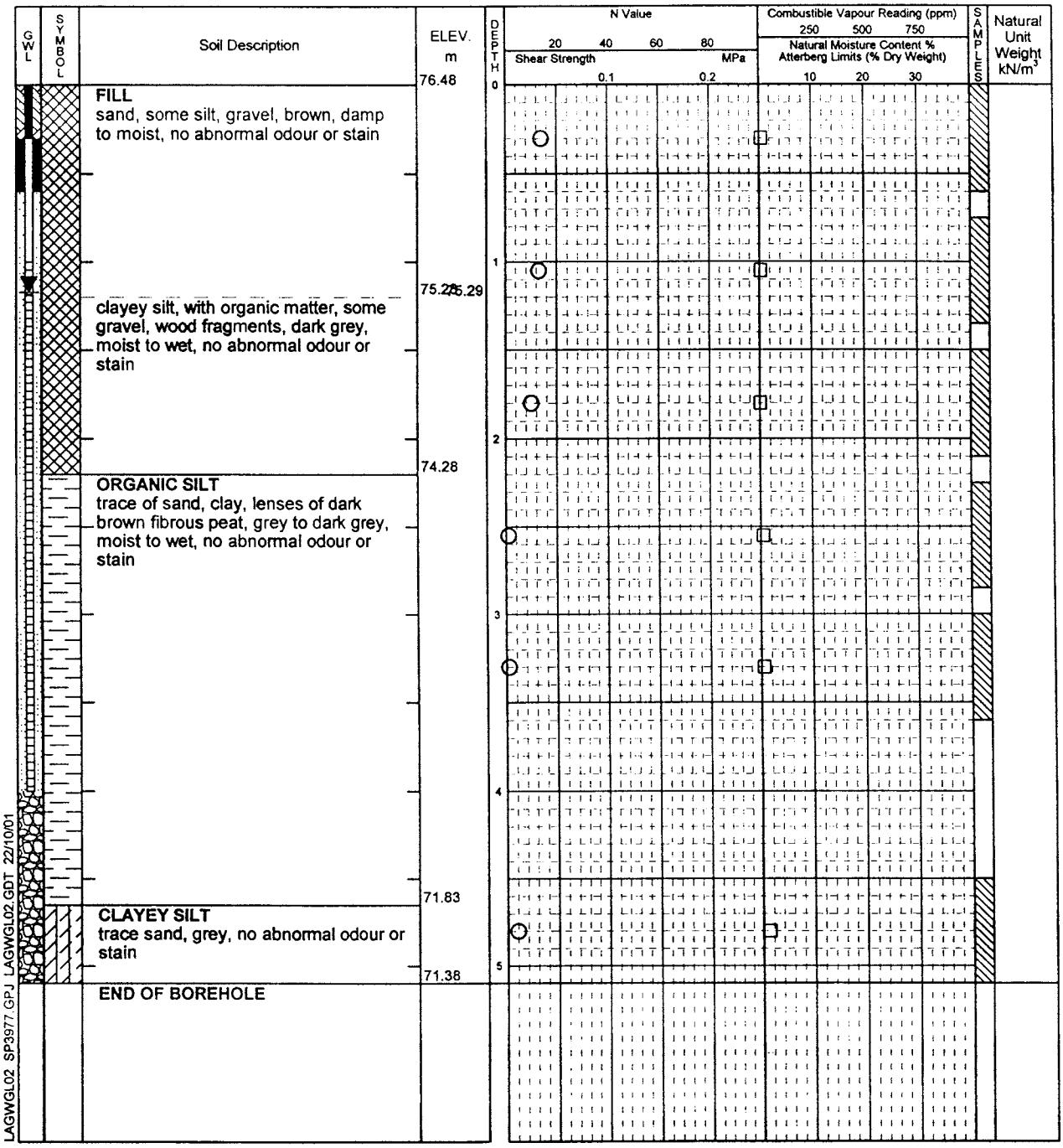
Date Drilled: September 18, 2001

Drill Type: Hollow Stem Auger

Datum: Geodetic

Auger Sample ⊠
SPT (N) Value ○ ▨
Dynamic Cone Test ——
Shelby Tube □
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢—○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲



LAGWGL02 SP3977.GPJ LAGWGL02.GDT 22/10/01

S & P Shaheen & Peaker Consulting Engineers

Time	Water Level (m)	Depth to Cave (m)
September 19, 2001	1.57	
September 20, 2001	1.54	
September 26, 2001	1.30	
October 2, 2001	1.19	

Project No. SP3977

Log of Borehole BH701

Drawing No. _____

Project: SSRA

Sheet No. 1 of 1

Location: Lakeshore Blvd. East at Leslie St., Toronto, Ontario

Date Drilled: September 18, 2001

Drill Type: Hollow Stem Auger

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test ——
Shelby Tube □
Field Vane Test ✚ S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢—○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		TOPSOIL	76.25	0
		FILL sand, some silt, gravel, trace of asphalt, concrete fragments, some organic matter, brown, damp to moist, no abnormal odour or stain	76.15	
▼			74.75	1
		ORGANIC SILT traces of dark brown fibrous peat, grey to dark grey, moist to wet, no abnormal odour or stain	74.60 74.15	2
		END OF BOREHOLE **Borehole Was Backfilled Upon Completion**		

N Value: 20 40 60 80
Shear Strength: 0.1 0.2 MPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
SAMPLES
Natural Unit Weight kN/m³

LAGWGL02 SP3977.GPJ LAGWGL02.GDT 22/10/01

S & P Shaheen & Peaker Consulting Engineers

Time	Water Level (m)	Depth to Cave (m)
At completion	1.5	

Project No. SP3977

Log of Borehole BH702

Drawing No. _____

Project: SSRA

Sheet No. 1 of 1

Location: Lakeshore Blvd. East at Leslie St., Toronto, Ontario

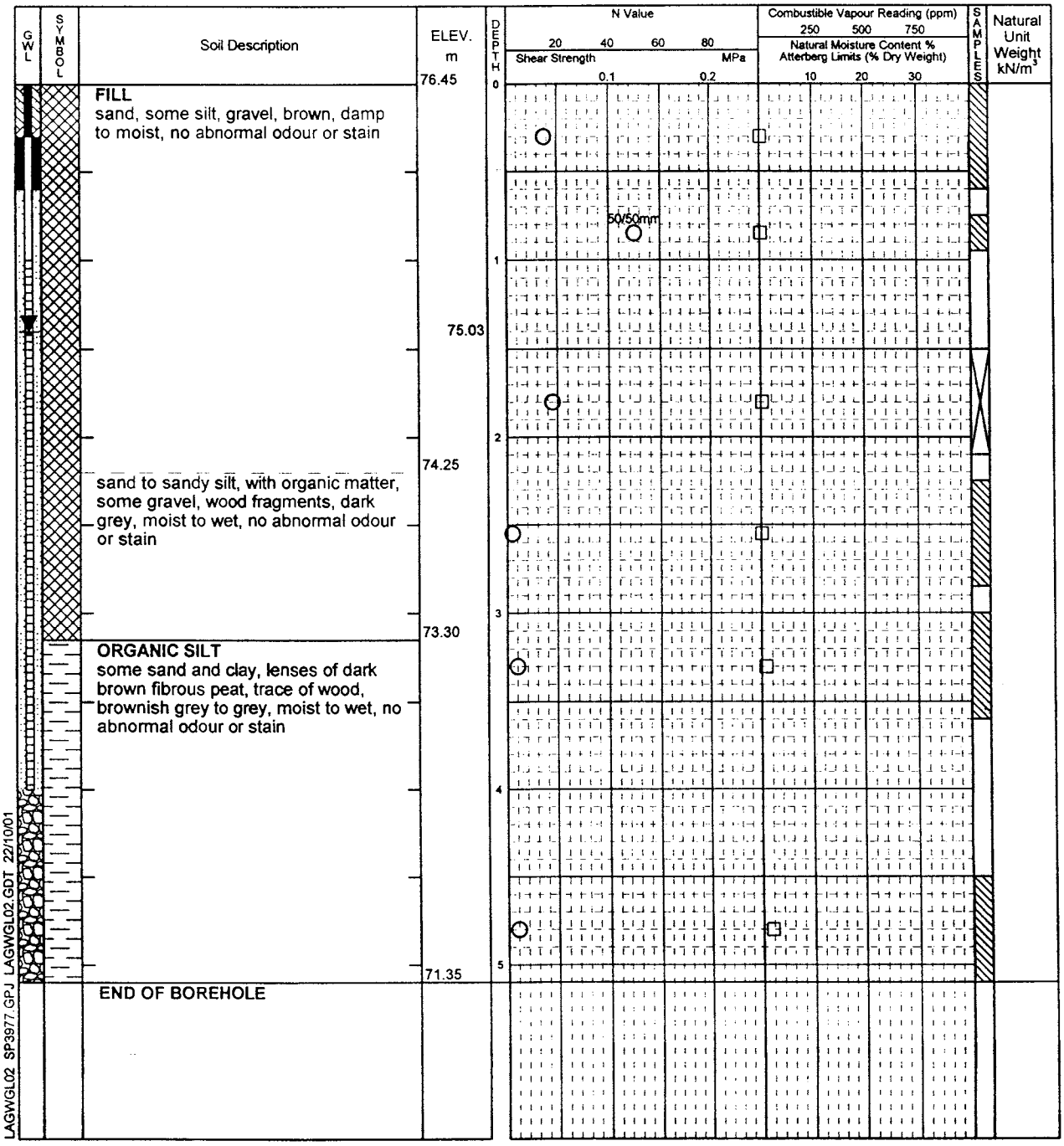
Date Drilled: September 18, 2001

Drill Type: Hollow Stem Auger

Datum: Geodetic

Auger Sample ⊠
SPT (N) Value ○ ◪
Dynamic Cone Test ——
Shelby Tube □
Field Vane Test ✚ S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢—○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲



LAGWGL02 SP3977.GPJ LAGWGL02.GDT 22/10/01

S & P Shaheen & Peaker Consulting Engineers

Time	Water Level (m)	Depth to Cave (m)
September 19, 2001	1.76	
September 20, 2001	1.72	
September 26, 2001	1.46	
October 2, 2001	1.42	

Project No. SP3977

Log of Borehole BH703

Drawing No. _____

Project: SSRA

Sheet No. 1 of 1

Location: Lakeshore Blvd. East at Leslie St., Toronto, Ontario

Date Drilled: September 18, 2001

Drill Type: Hollow Stem Auger

Datum: Geodetic

Auger Sample ⊠
SPT (N) Value ○ ⧅
Dynamic Cone Test ——
Shelby Tube □
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢—○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
			76.27	0
		TOPSOIL	76.17	
		FILL sand, some silt, gravel, brown, damp to moist, no abnormal odour or stain		
			75.37	
		ORGANIC SILT trace of sand, lenses of dark brown fibrous peat, grey to dark grey, moist to wet, no abnormal odour or stain		1
▼			74.77	
			74.17	2
		END OF BOREHOLE **Borehole Was Backfilled Upon Completion**		

N Value: 20 40 60 80
Shear Strength: 0.1 MPa 0.2
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
SAMPLES
Natural Unit Weight kN/m³

LAGWGL02 SP3977.GPJ LAGWGL02.GDT 22/10/01

S & P **Shaheen & Peaker Consulting Engineers**

Time	Water Level (m)	Depth to Cave (m)
At completion	1.5	

Project No. SP3977

Log of Borehole BH704

Drawing No. _____

Project: SSRA

Sheet No. 1 of 1

Location: Lakeshore Blvd. East at Leslie St., Toronto, Ontario

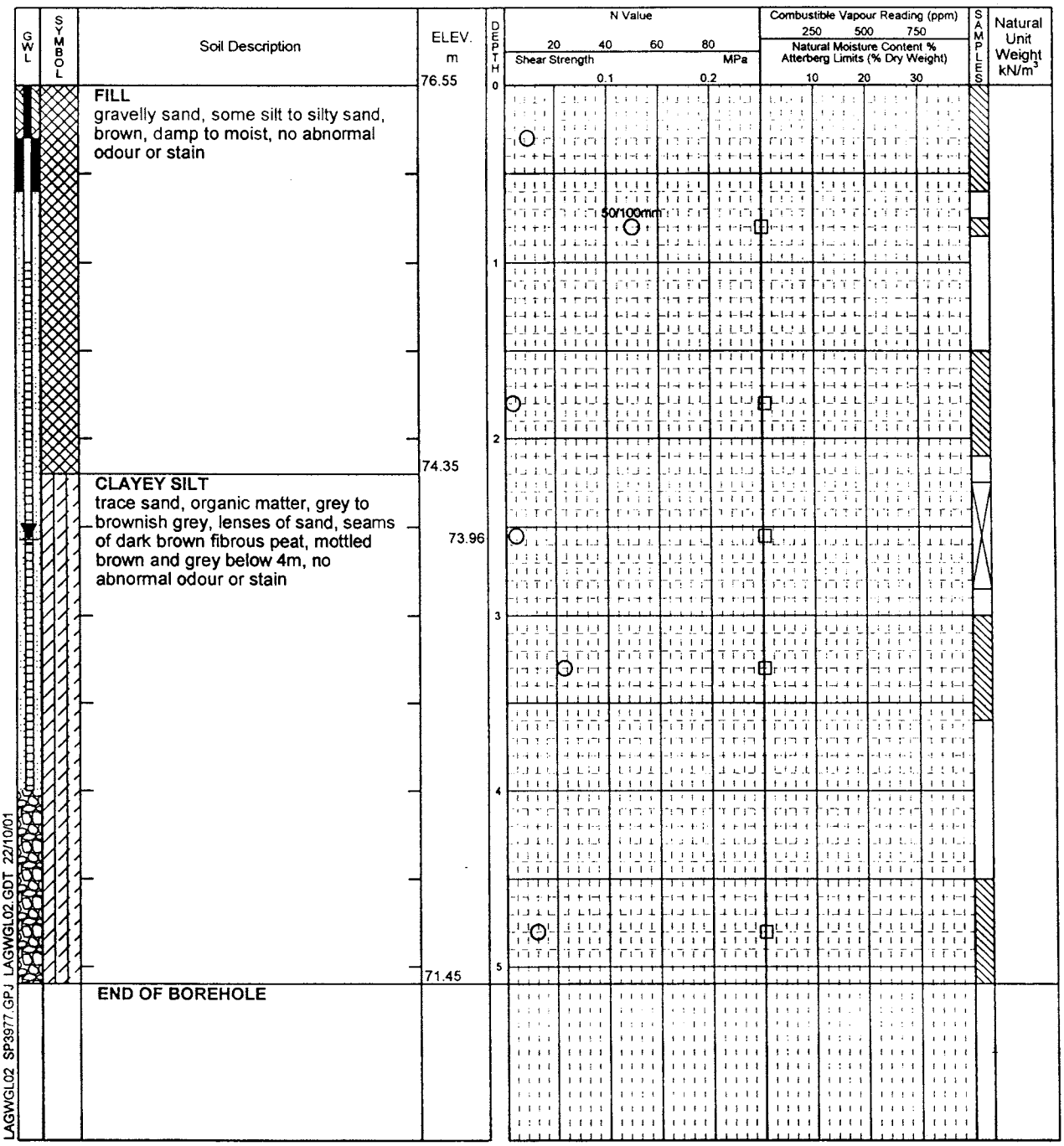
Date Drilled: September 18, 2001

Drill Type: Hollow Stem Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



LAGWGL02 SP3977.GPJ LAGWGL02.GDT 22/10/01

S & P Shaheen & Peaker Consulting Engineers

Time	Water Level (m)	Depth to Cave (m)
September 19, 2001	2.8	
September 20, 2001	2.78	
September 26, 2001	2.58	
October 2, 2001	2.59	

Project No. SP3977

Log of Borehole BH706

Drawing No. _____

Project: SSRA

Sheet No. 1 of 1

Location: Lakeshore Blvd. East at Leslie St., Toronto, Ontario

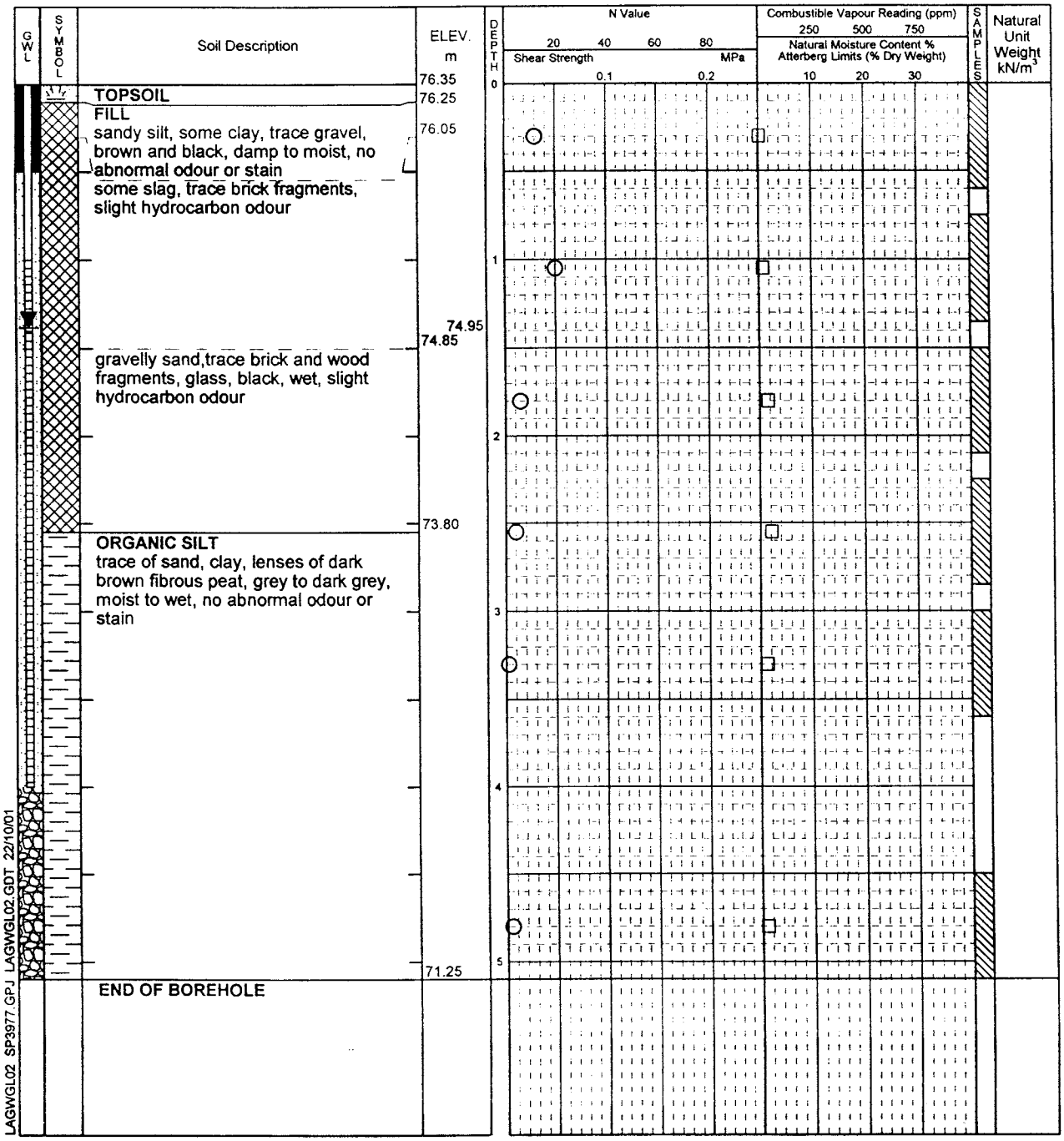
Date Drilled: September 18, 2001

Drill Type: Hollow Stem Auger

Datum: Geodetic

Auger Sample ⊠
SPT (N) Value ○ ◪
Dynamic Cone Test ——
Shelby Tube □
Field Vane Test ✚ S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢—○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲



LAGWGL02 SP3977.GPJ LAGWGL02.GDT 22/10/01

S & P Shaheen & Peaker Consulting Engineers

Time	Water Level (m)	Depth to Cave (m)
September 19, 2001	1.48	
September 20, 2001	1.55	
September 26, 2001	1.41	
October 2, 2001	1.40	

Project No. SP3977

Log of Borehole BH707

Drawing No. _____

Project: SSRA

Sheet No. 1 of 1

Location: Lakeshore Blvd. East at Leslie St., Toronto, Ontario

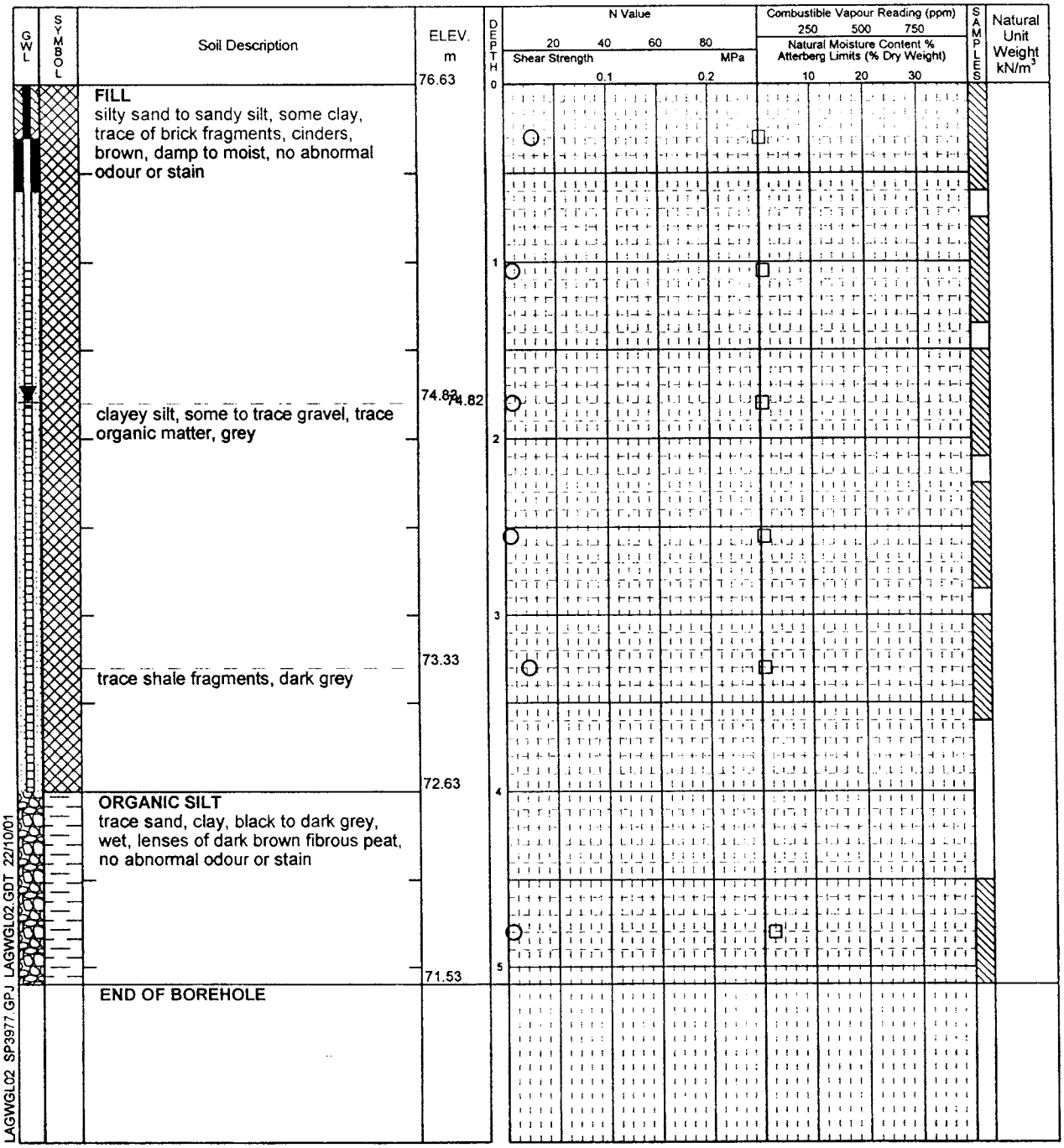
Date Drilled: September 18, 2001

Drill Type: Hollow Stem Auger

Datum: Geodetic

Auger Sample ⊠
SPT (N) Value ○ ◪
Dynamic Cone Test ——
Shelby Tube □
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit |—○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲



LAGWGL02 SP3977.GPJ LAGWGL02.GDT 22/10/01

S & P **Shaheen & Peaker Consulting Engineers**

Time	Water Level (m)	Depth to Cave (m)
September 19, 2001	2.01	
September 20, 2001	1.99	
September 26, 2001	1.80	
October 2, 2001	1.81	

Project No. SP3201C

Log of Test Pit TP1

Drawing No. _____

Project: Soil and Groundwater Quality Assessment

Sheet No. 1 of 1

Location: Gardiner Expressway Dismanting, Toronto, Ontario

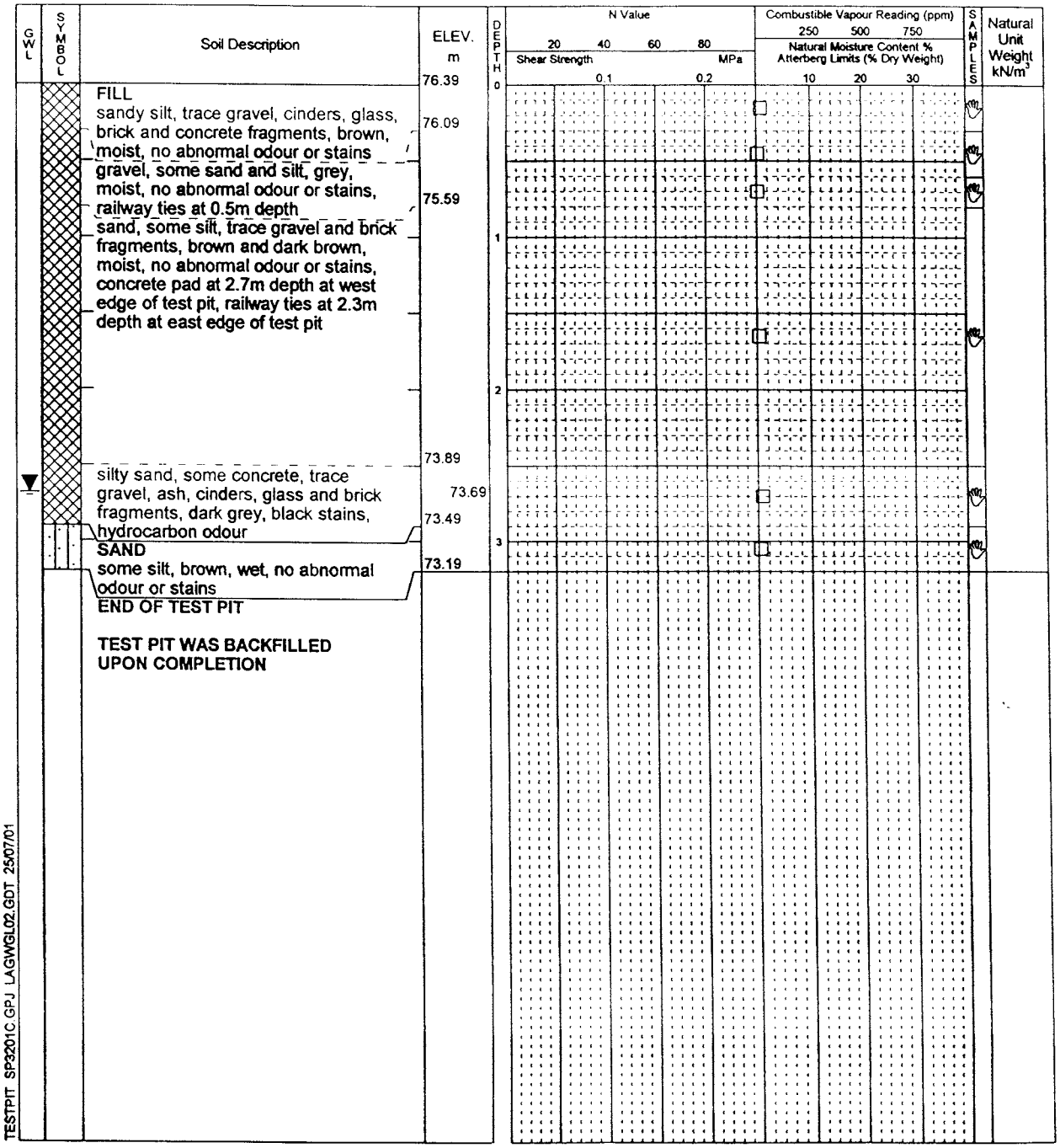
Date Drilled: July 11, 2001

Excavated By: Rubber Tire Backhoe

Datum: Geodetic

Auger Sample ⊠
SPT (N) Value ○ ▨
Dynamic Cone Test ——
Shelby Tube □
Field Vane Test ✚ S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢—⊖
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲



TESTPIT SP3201C.GPJ LAGWGL02.GDT 25/07/01

S & P **Shaheen & Peaker Limited**
Consulting Engineers

Time	Water Level (m)	Depth to Cave (m)
At completion	2.70	

Project No. SP3201C

Log of Test Pit TP2

Drawing No.

Project: Soil and Groundwater Quality Assessment

Sheet No. 1 of 1

Location: Gardiner Expressway Dismanting, Toronto, Ontario

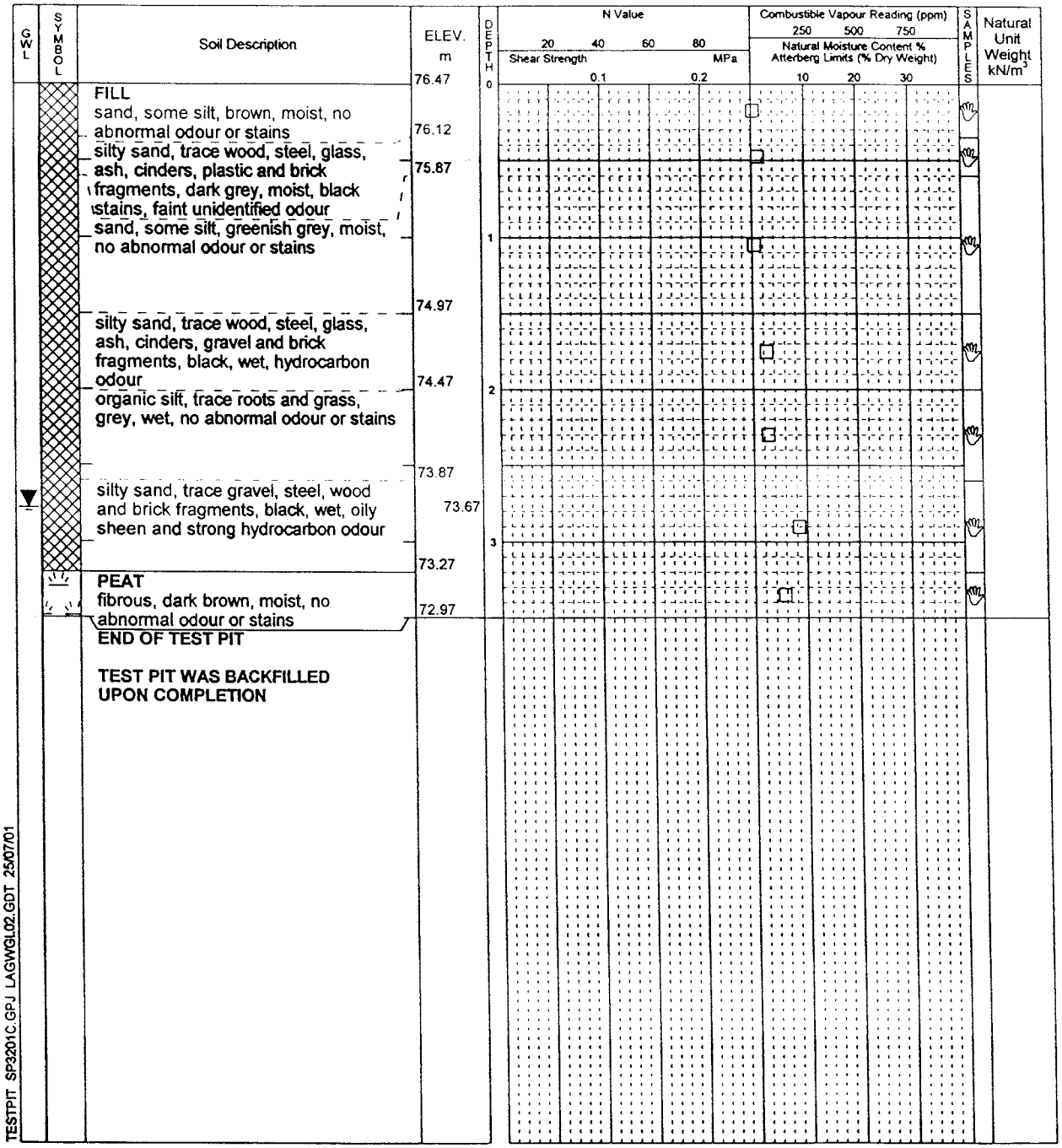
Date Drilled: July 11, 2001

Excavated By: Rubber Tire Backhoe

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



TESTPIT SP3201C.GPJ LAGWGL02.GDT 25/07/01

S & P **Shaheen & Peaker Limited**
Consulting Engineers

Time	Water Level (m)	Depth to Cave (m)
At completion	2.80	

Project No. SP3201C

Log of Test Pit TP3

Drawing No. _____

Project: Soil and Groundwater Quality Assessment

Sheet No. 1 of 1

Location: Gardiner Expressway Dismanting, Toronto, Ontario

Date Drilled: July 11, 2001

Excavated By: Rubber Tire Backhoe

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
			76.21	0
		TOPSOIL	76.06	
		FILL silty sand, brown, moist, no abnormal odour or stains	75.81	
		wood fibre, some sand and silt, dark orangeish brown	75.61	
		sand, trace silt, brown	75.41	
		ORGANIC SILT trace roots, lenses of dark brown fibrous peat, moist to wet, no abnormal odour or stains		1
				2
				3
			72.91	
		END OF TEST PIT TEST PIT WAS BACKFILLED UPON COMPLETION		

N Value: 20 40 60 80
Shear Strength: 0.1 0.2 MPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
SAMPLES
Natural Unit Weight kN/m³

TESTPIT SP3201C.GPJ LAGWGL02.GDT 25/07/01

S & P

Shaheen & Peaker Limited
Consulting Engineers

Time	Water Level (m)	Depth to Cave (m)
At completion	Dry	

Project No. SP3201C

Log of Test Pit TP4

Drawing No. _____

Project: Soil and Groundwater Quality Assessment

Sheet No. 1 of 1

Location: Gardiner Expressway Dismanting, Toronto, Ontario

Date Drilled: July 11, 2001

Excavated By: Rubber Tire Backhoe

Datum: Geodetic

Auger Sample ⊠
SPT (N) Value ○ ◪
Dynamic Cone Test —
Shelby Tube □
Field Vane Test ✚ S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢—○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
			76.22	0
		FILL silty sand, some topsoil with roots and grass, brown, damp, no abnormal odour or stains	75.82	
		sand, some silt, brown, moist	75.42	
		silty sand, trace steel, glass, ash and cinders, orangeish brown	74.72	1
		ORGANIC SILT some clay, trace of grass and roots, lenses of peat, dark grey, wet, no abnormal odour or stains	74.12	2
▼		**SILTY SAND** trace of organic matter, grey, wet, no abnormal odour or stains	73.52	
		END OF TEST PIT **TEST PIT WAS BACKFILLED UPON COMPLETION**	73.22	3

N Value: 20 40 60 80
Shear Strength: 0.1 0.2 MPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
SAMPLES
Natural Unit Weight kN/m³

TESTPIT SP3201C.GPJ LAGWGL02.GDT 25/07/01

S & P **Shaheen & Peaker Limited**
Consulting Engineers

Time	Water Level (m)	Depth to Cave (m)
At completion	2.70	

Project No. SP3201C

Log of Test Pit TP5

Drawing No. _____

Project: Soil and Groundwater Quality Assessment

Sheet No. 1 of 1

Location: Gardiner Expressway Dismanting, Toronto, Ontario

Date Drilled: July 11, 2001

Excavated By: Rubber Tire Backhoe

Datum: Geodetic

Auger Sample ⊠
SPT (N) Value ○ ⊠
Dynamic Cone Test —
Shelby Tube □
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit |—○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength (MPa)	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Weight kN/m³
		FILL silty sand, trace gravel, topsoil pockets, brown, damp, no abnormal odour or stains	76.36	0	20 40 60 80 / 0.1 0.2	250 500 750 / 10 20 30		
		sand, trace silt	75.86					
		ORGANIC SILT trace of sand and silt, trace of wood and grass, black, wet, slight hydrocarbon odour	75.56	1				
				2				
		SILTY SAND sandy silt to silty sand, some clay, grey, moist to wet, no abnormal odour or stains	73.96					
		END OF TEST PIT **TEST PIT WAS BACKFILLED UPON COMPLETION**	73.36	3				

TESTPIT SP3201C.GPJ LAGWGL02.GDT 25/07/01

S & P **Shaheen & Peaker Limited Consulting Engineers**

Time	Water Level (m)	Depth to Cave (m)
At completion	Dry	

Project No. SP3201C

Log of Test Pit TP6

Drawing No. _____

Project: Soil and Groundwater Quality Assessment

Sheet No. 1 of 1

Location: Gardiner Expressway Dismanting, Toronto, Ontario

Date Drilled: July 11, 2001

Excavated By: Rubber Tire Backhoe

Datum: Geodetic

Auger Sample ⊠
SPT (N) Value ○ ▨
Dynamic Cone Test —
Shelby Tube □
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢—○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		FILL gravel and sand, some silt, brown, damp, no abnormal odour or stains	76.81	0
		sand, trace silt	76.31	
		clayey silt, some sand, trace gravel, wood, ash, cinders, glass, bricks, concrete and reinforced concrete, brown, moderate unidentified odour, no stains	75.91	1
		dark grey, wet, hydrocarbon odour and pockets of black staining	74.51	2
▼			73.71	3
		END OF TEST PIT TEST PIT WAS BACKFILLED UPON COMPLETION	73.51	

N Value: 20 40 60 80
Shear Strength: 0.1 0.2 MPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
SAMPLES
Natural Unit Weight kN/m³

TESTPIT SP3201C.GPJ LAGWGL02.GDT 22/08/01

S & P **Shaheen & Peaker Limited**
Consulting Engineers

Time	Water Level (m)	Depth to Cave (m)
At completion	3.10	

Project No. SP3201C

Log of Test Pit TP7

Drawing No. _____

Project: Soil and Groundwater Quality Assessment

Sheet No. 1 of 1

Location: Gardiner Expressway Dismanting, Toronto, Ontario

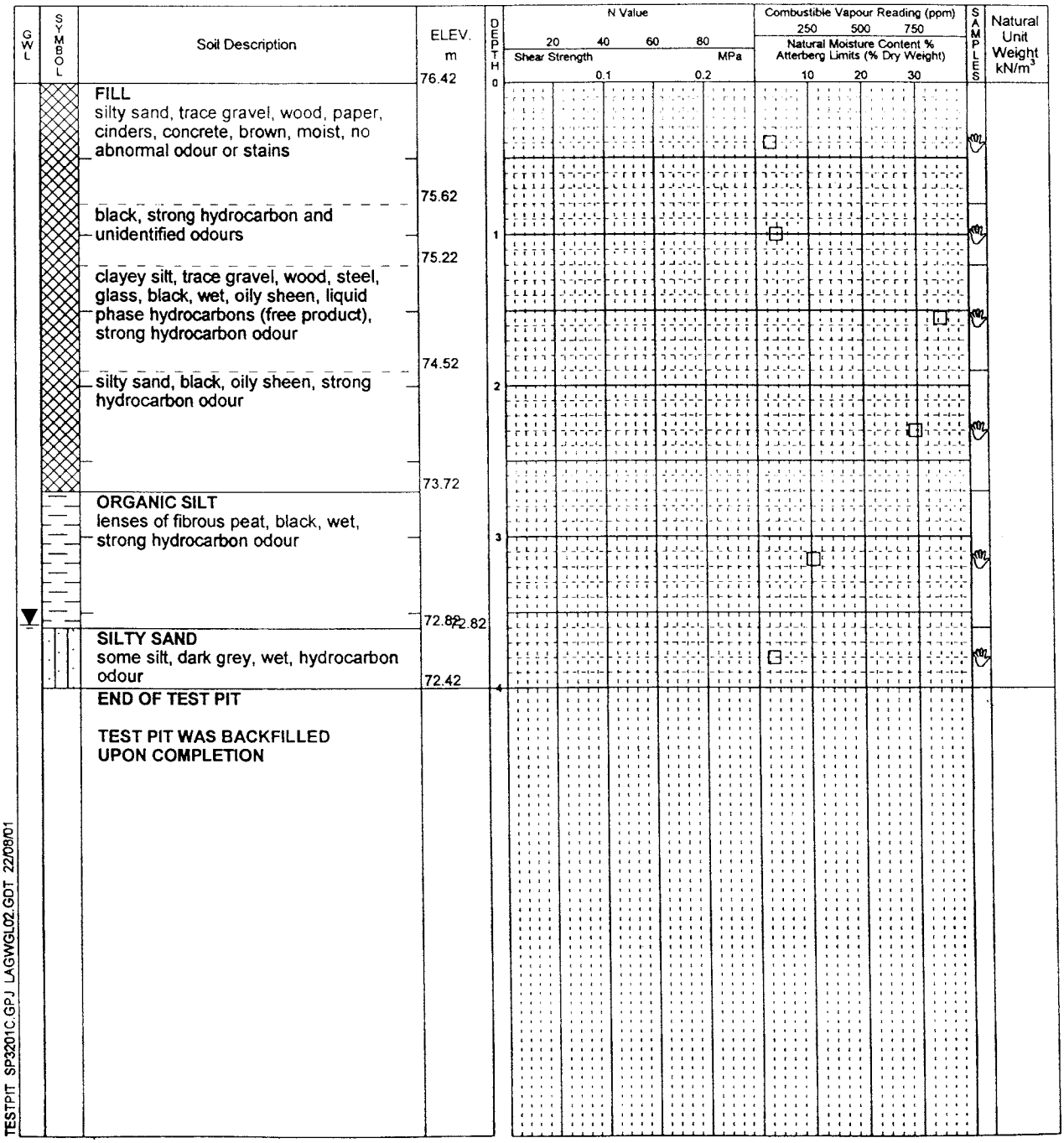
Date Drilled: July 11, 2001

Excavated By: Rubber Tire Backhoe

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test ——
Shelby Tube □
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢—○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲



TESTPIT SP3201C.GPJ LAGWGL02.GDT 22/08/01

S & P **Shaheen & Peaker Limited**
Consulting Engineers

Time	Water Level (m)	Depth to Cave (m)
At completion	3.6	

Project No. SP3201C

Log of Test Pit TP8

Drawing No. _____

Project: Soil and Groundwater Quality Assessment

Sheet No. 1 of 1

Location: Gardiner Expressway Dismanting, Toronto, Ontario

Date Drilled: July 11, 2001

Excavated By: Rubber Tire Backhoe

Datum: Geodetic

Auger Sample	⊠	Combustible Vapour Reading	□
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	——	Plastic and Liquid Limit	⊢—○
Shelby Tube	□	Undrained Triaxial at % Strain at Failure	⊕
Field Vane Test	S	Penetrometer	▲

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength (MPa)	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Weight kN/m³
		FILL silty sand, trace gravel, topsoil, steel, plastic, reinforced concrete and brick fragments, brown, moist, no abnormal odour or stains	77.32	0	N Value: 20 40 60 80 Shear Strength: 0.1 0.2 MPa	Combustible Vapour Reading (ppm): 250 500 750 Natural Moisture Content % / Atterberg Limits (% Dry Weight): 10 20 30		
		trace ash, cinders, glass and wood, black, strong unidentified odour	76.52	1				
▼		black, wet, oily sheen, strong hydrocarbon odour	75.32 75.12	2				
		silty sand, brown, no abnormal odour or stains	74.52	3				
		END OF TEST PIT TEST PIT WAS BACKFILLED UPON COMPLETION	74.02					

TESTPIT SP3201C.GPJ LAGWGL02.GDT 25/07/01

S & P **Shaheen & Peaker Limited**
Consulting Engineers

Time	Water Level (m)	Depth to Cave (m)
At completion	2.2	

APPENDIX C

ANALYTICAL RESULTS – ALL INVESTIGATIONS

APPENDIX C
ANALYTICAL RESULTS – ALL INVESTIGATIONS

TABLE OF CONTENTS

Table C-1: Groundwater Elevations

Borehole ID	BH602	BH603	BH604	BH605	BH700	BH702	BH704	BH705	BH706	BH707
Elevation of Top Riser, m	77.64	77.21	77.23	76.88	76.39	76.35	76.37	76.97	77.52	76.44
Elevation of Ground Surface, m	76.60	76.18	76.38	75.98	76.48	76.45	76.55	77.09	76.35	76.63
Groundwater Depth Below Ground Surface, m										
Date:										
16-Jul-01	1.46	0.95	1.28	1.06						
07-Sep-01	1.61	1.16	1.52	1.15						
19-Sep-01					1.57	1.76	2.80	3.09	1.48	2.01
20-Sep-01	1.70	1.21	1.56	1.20	1.54	1.72	2.78	3.07	1.55	1.99
26-Sep-01	1.59	1.04	1.38	1.22	1.30	1.46	2.58	2.95	1.41	1.80
02-Oct-01	1.55	1.02	1.37	1.21	1.19	1.42	2.59	2.94	1.40	1.81
Groundwater Elevation,m										
Date:										
16-Jul-01	75.14	75.23	75.10	74.92						
07-Sep-01	74.99	75.02	74.86	74.83						
19-Sep-01					74.91	74.69	73.75	74.00	74.87	74.62
20-Sep-01	74.90	74.97	74.82	74.78	74.94	74.73	73.77	74.02	74.80	74.64
26-Sep-01	75.01	75.14	75.00	74.76	75.18	74.99	73.97	74.14	74.94	74.83
02-Oct-01	75.05	75.16	75.01	74.77	75.29	75.03	73.96	74.15	74.95	74.82

Notes:

1. All elevations are geodetic, referenced to ground surface elevation at time of borehole drilling

Table C-2: Summary of Soil Samples Submitted for Chemical Analyses

Location	Sample ID	Sample Depth (m)	Analyses Conducted
BH 408	BH408 SS4	2.3 – 2.9	TPH, BTEX, VOCs, PAH
BH 409	BH409 SS4	2.3 – 2.9	Decom, TPH, BTEX, VOCs, PCB
BH 414	BH414 SS3	1.5 – 1.9	TPH
BH 602	GSA BH602/1	0 – 0.3	Decom
BH 602	BH602 - SS2	0.75 – 1.35	ICP metals
BH 602	BH602 - SS4	2.25 – 2.85	TPH, BTEX
BH 603	GSA BH603/1	0 – 0.3	Decom, Reg. 347/558 inorganics
BH 603	BH603 - SS1	0 – 0.6	ICP metals
BH 604	GSA BH604/1	0 – 0.3	Decom, Reg. 347/558 inorganics
BH 604	BH604 - SS2	0.75 – 1.35	ICP metals
BH 605	GSA BH605/1	0 – 0.3	Decom
BH 605	BH605 - SS1	0 – 0.6	ICP metals
BH 605	BH605 - SS3	1.5 – 2.1	BTEX, VOCs
BH 700	BH700 SS1	0 – 0.6	Decom
BH 701	BH701 SS1	0 – 0.6	Decom
BH 702	BH702 SS1	0 – 0.6	Decom
BH 703	BH703 SS1	0 – 0.6	Decom
BH 704	BH704 SS1	0 – 0.6	Decom, TPH, BTEX, VOCs, PAH
BH 705	BH705 SS1	0 – 0.6	Decom
BH 706	BH706 SS1	0 – 0.6	Decom, TPH, BTEX, VOCs, PAH
BH 707	BH707 SS1	0 – 0.6	Decom, TPH, BTEX, VOCs, PAH
TP 2	GSA T2/1	0 – 0.3	Decom
TP 2	TP2 - SA2	0.35 – 0.6	ICP metals
TP 2	TP2 - SA 7	3.2 – 3.5	BTEX, VOCs
TP 3	GSA T3/1	0 – 0.3	Decom
TP 3	TP3 - SA3	0.4 – 0.6	ICP metals
TP 4	GSA T4/1	0 – 0.3	Decom
TP 4	TP4 - SA2	0.4 – 0.8	ICP metals
TP 5	GSA T5/1	0 – 0.3	Decom
TP 5	TP5 - SA1	0 – 0.5	ICP metals
TP 5	TP5 - SA3	0.8 – 1.5	TPH, BTEX, PAH, BNE, PCB, Reg. 347/558 inorganics & VOCs
TP 6	GSA T6/1	0 – 0.3	Decom
TP 6	TP6 - SA3	0.9 – 2.3	ICP metals
TP 7	GSA T7/1	0 – 0.3	Decom
TP 7	TP7 - SA2	0.8 – 1.2	ICP metals
TP 7	TP7 - SA3	1.2 – 1.9	TPH, BTEX, PAH, BNE, PCB, Reg. 347/558 inorganics & VOCs
TP 8	GSA T8/1	0 – 0.3	Decom
TP 8	TP8 - SA2	0.8 – 2.0	ICP metals

NOTES:

1. Decom = Inorganic parameters, including pH, electrical conductivity, sodium adsorption ratio and metals contained in Table B of the "Guideline for Use at Contaminated Sites in Ontario" (revised, 1997)
2. ICP metals = a group of metals analyzed by Inductively Coupled Plasma
3. TPH = Total Petroleum Hydrocarbons
4. BTEX = Benzene, Toluene, Ethylbenzene and Xylenes
5. VOCs = Volatile Organic Compounds
6. BNE = Base Neutral Extractables
7. PAH = Polycyclic Aromatic Hydrocarbons
8. PCB = Polychlorinated Biphenyls
9. Reg. 347/558 = Regulation 347 analysis as amended by Regulation 558/00

Table C-3: Summary of Groundwater Samples Submitted for Chemical Analyses

Monitoring Well	Sample ID	Analyses Conducted
BH 602	BH 602	ICP metals, TPH g/d/ho, BTEX, VOCs, PAH
BH 603	BH603	ICP metals, TPH g/d/ho, BTEX, VOCs, PAH
BH 604	BH 604	ICP metals, TPH g/d/ho, BTEX, VOCs, PAH
BH 605	BH 605	ICP metals, TPH g/d/ho, BTEX, VOCs, PAH
BH 700	BH 700	ICP metals, TPH g/d/ho, BTEX, VOCs, PAH
BH 702	BH 702	ICP metals, TPH g/d/ho, BTEX, VOCs, PAH
BH 704	BH 704	ICP metals, TPH g/d/ho, BTEX, VOCs, PAH
BH 705	BH 705	ICP metals, TPH g/d/ho, BTEX, VOCs, PAH
BH 706	BH 706	ICP metals, TPH g/d/ho, BTEX, VOCs, PAH
BH 707	BH 707	ICP metals, TPH g/d/ho, BTEX, VOCs, PAH

NOTES:

1. ICP metals = a group of metals analyzed by Inductively Coupled Plasma
2. TPH g/d/ho = Total Petroleum Hydrocarbons in the gas/diesel/heavy oil range
3. BTEX = Benzene, Toluene, Ethylbenzene and Xylenes
4. VOCs = Volatile Organic Compounds
5. PAH = Polycyclic Aromatic Hydrocarbons

Table C-4: Summary of Inorganic Parameters in Soil (Page 1 of 5)

Parameter	Table B I/C	BH409 SS4 (2.3-2.9m)	BH602 SS2 (0.75-1.35m)	BH603 SS1 (0-0.6m)	BH604 SS2 (0.75-1.35m)	BH605 SS1 (0-0.6m)
pH (pH units)	5.0-9.0	8.4	7.89	7.67	7.51	7.51
Electrical Conductivity (mS/cm)	1.4	**2.144**	-	-	-	-
Sodium Adsorption Ratio (no units)	12	**34.13**	-	-	-	-
Antimony (Sb)	40	3	-	-	-	-
Arsenic(As)	40	35.14	-	-	-	-
Barium (Ba)	1500	82.8	237	293	237	176
Beryllium (Be)	1.2	<0.5	0.9	0.3	0.6	0.4
Boron (B) (Available)	2.0	<0.02	-	-	-	-
Cadmium (Cd)	12	1.3	0.7	10.3	0.8	6.6
Chromium (Cr) (Total)	750	**1108**	**1620**	128	96	129
Chromium (Cr) (VI)	8.0	<1	-	-	-	-
Cobalt (Co)	80	3.7	4	4	7	5
Copper (Cu)	225	24.1	**285**	**376**	84	143
Cyanide (Free) (CN)	100	<0.1	-	-	-	-
Lead (Pb)	1000	81.5	**1300**	**5440**	264	504
Mercury (Hg)	10	0.32	-	-	-	-
Molybdenum (Mo)	40	<2	<3	<3	<3	<3
Nickel (Ni)	150	11.0	16	36	21	27
Selenium (Se)	10	<1	-	-	-	-
Silver (Ag)	40	<0.5	<1	<1	<1	<1
Thallium (Tl)	32	-	-	-	-	-
Vanadium (V)	200	18.6	16	18	31	21
Zinc (Zn)	600	150	320	**876**	496	587

NOTES:

1. Units are in µg/g or mg/kg (ppm) unless otherwise indicated
2. Table B, I/C = Surface Soil Criteria for Industrial/Commercial land use for coarse textured soil in a non-potable groundwater condition, from MOE Guideline for Use at Contaminated Sites in Ontario, Revised February 1997
3. **Bold** = Concentration exceeds Table B criteria
4. < = Concentration less than Estimated Quantitization Limit (EQL)
5. = Parameter not analyzed
6. = 1 ms/cm = 1000 umhos/cm

Table C-4: Summary of Inorganic Parameters in Soil (Page 2 of 5)

Parameter	Table B I/C	GSA BH602/1 (0-0.3m)	GSA BH603/1 (0-0.3m)	GSA BH604/1 (0-0.3m)	GSA BH605/1 (0-0.3m)	GSA T2/1 (0-0.3m)
pH (pH units)	5.0-9.0	7.56	7.71	7.26	7.46	7.72
Electrical Conductivity (mS/cm)	1.4	0.23	0.51	0.41	0.24	0.31
Sodium Adsorption Ratio (no units)	12	0.32	2.78	0.74	0.32	0.25
Antimony (Sb)	40	4.3	**431**	**45.8**	11.3	1.6
Arsenic(As)	40	6.4	**244**	**74.4**	10.8	2.6
Barium (Ba)	1500	45	201	172	300	35
Beryllium (Be)	1.2	<0.2	0.3	0.4	0.7	<0.2
Boron (B) (Available)	2.0	<0.2	0.4	0.5	0.3	<0.2
Cadmium (Cd)	12	1.1	**29.8**	11.6	11.4	<0.5
Chromium (Cr) (Total)	750	20	99	52	238	13
Chromium (Cr) (VI)	8.0	<1	<1	<1	<1	<1
Cobalt (Co)	80	4	9	5	7	3
Copper (Cu)	225	43	**467**	217	**251**	20
Cyanide (Free) (CN)	100	<0.02	<0.02	<0.02	<0.02	<0.02
Lead (Pb)	1000	206	**23500**	**7080**	888	120
Mercury (Hg)	10	0.12	0.41	0.50	1.41	0.05
Molybdenum (Mo)	40	<3	<3	<3	<3	<3
Nickel (Ni)	150	11	73	22	46	8
Selenium (Se)	10	<0.2	4.8	0.8	0.9	<0.2
Silver (Ag)	40	<1	2	<1	2	<1
Thallium (Tl)	32	<1.0	<1.0	<1.0	<1.0	<1.0
Vanadium (V)	200	12	38	26	25	15
Zinc (Zn)	600	248	**1270**	550	**719**	107

NOTES:

1. Units are in µg/g or mg/kg (ppm) unless otherwise indicated
2. Table B, I/C = Surface Soil Criteria for Industrial/Commercial land use for coarse textured soil in a non-potable groundwater condition, from MOE Guideline for Use at Contaminated Sites in Ontario, Revised February 1997
3. **Bold** = Concentration exceeds Table B criteria
4. < = Concentration less than Estimated Quantitization Limit (EQL)
5. = Parameter not analyzed
6. = 1 ms/cm = 1000 umhos/cm

Table C-4: Summary of Inorganic Parameters in Soil (Page 3 of 5)

Parameter	Table B I/C	GSA T3/1 (0-0.3m)	GSA T4/1 (0-0.3m)	GSA T5/1 (0-0.3m)	GSA T6/1 (0-0.3m)	GSA T7/1 (0-0.3m)	GSA T8/1 (0-0.3m)
pH (pH units)	5.0-9.0	7.60	7.44	7.58	7.76	7.81	8.08
Electrical Conductivity (mS/cm)	1.4	0.46	0.24	**1.95**	0.43	**2.62**	0.82
Sodium Adsorption Ratio (no units)	12	1.97	0.35	1.70	0.44	9.23	2.28
Antimony (Sb)	40	11.0	20.5	8.5	**128**	3.2	4.8
Arsenic(As)	40	10.8	17.8	13.8	**110**	6.4	7.8
Barium (Ba)	1500	52	79	134	165	151	121
Beryllium (Be)	1.2	<0.2	0.4	0.20	0.5	0.5	0.3
Boron (B) (Available)	2.0	0.2	0.3	0.6	0.4	0.3	0.3
Cadmium (Cd)	12	1.4	6.6	2.8	9.8	1.3	2.9
Chromium (Cr)(Total)	750	71	76	36	32	50	78
Chromium (Cr)(VI)	8.0	<1	<1	<1	<1	<1	<1
Cobalt (Co)	80	5	4	3	7	6	5
Copper (Cu)	225	70	90	62	**246**	518	91
Cyanide (Free) (CN)	100	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
Lead (Pb)	1000	551	**1490**	421	**6260**	297	467
Mercury (Hg)	10	0.13	0.51	0.41	0.57	0.18	0.60
Molybdenum (Mo)	40	<3	<3	<3	<3	<3	<3
Nickel (Ni)	150	15	18	10	36	26	17
Selenium (Se)	10	0.2	0.3	0.2	1.1	0.4	0.2
Silver (Ag)	40	<1	<1	<1	1	<1	<1
Thallium (Tl)	32	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Vanadium (V)	200	16	14	13	26	29	19
Zinc (Zn)	600	270	254	190	579	370	351

NOTES:

1. Units are in µg/g or mg/kg (ppm) unless otherwise indicated
2. Table B, I/C = Surface Soil Criteria for Industrial/Commercial land use for coarse textured soil in a non-potable groundwater condition, from MOE Guideline for Use at Contaminated Sites in Ontario, Revised February 1997
3. **Bold** = Concentration exceeds Table B criteria
4. < = Concentration less than Estimated Quantitization Limit (EQL)
5. = Parameter not analyzed
6. = 1 ms/cm = 1000 umhos/cm

Table C-4: Summary of Inorganic Parameters in Soil (Page 4 of 5)

Parameter	Table B I/C	TP2-SA2 (0.35-0.6m)	TP3-SA3 (0.4-0.6m)	TP4-SA2 (0.4-0.8m)	TP5-SA1 (0-0.5m)	TP6-SA3 (0.9-2.3m)	TP7-SA2 (0.8-1.2m)	TP8-SA2 (0.8-2.0m)
pH (pH units)	5.0-9.0	7.41	7.72	8.06	7.50	8.30	7.76	7.24
Electrical Conductivity (mS/cm)	1.4	-	-	-	-	-	-	-
Sodium Adsorption Ratio (no units)	12	-	-	-	-	-	-	-
Antimony (Sb)	40	-	-	-	-	-	-	-
Arsenic (As)	40	-	-	-	-	-	-	-
Barium (Ba)	1500	99	487	44	122	103	481	217
Beryllium (Be)	1.2	<0.2	0.2	<0.2	0.3	0.6	**1.7**	0.3
Boron (B) (Available)	2.0							
Cadmium (Cd)	12	0.8	8.2	1.0	6.2	0.6	1.6	5.6
Chromium (Cr) (Total)	750	28	**8440**	39	41	22	23	69
Chromium (Cr) (VI)	8.0	-	-	-	-	-	-	-
Cobalt (Co)	80	3	3	3	3	7	7	4
Copper (Cu)	225	42	201	44	143	**269**	208	167
Cyanide (Free) (CN)	100	-	-	-	-	-	-	-
Lead (Pb)	1000	378	**12200**	**1970**	**2420**	260	97	431
Mercury (Hg)	10	-	-	-	-	-	-	-
Molybdenum (Mo)	40	<3	4	<3	<3	<3	4	<3
Nickel (Ni)	150	11	20	8	16	20	35	22
Selenium (Se)	10	-	-	-	-	-	-	-
Silver (Ag)	40	<1	<1	1	<1	<1	<1	<1
Thallium (Tl)	32	-	-	-	-	-	-	-
Vanadium (V)	200	14	14	18	17	24	42	12
Zinc (Zn)	600	286	**1090**	96	446	134	208	513

NOTES:

1. Units are in µg/g or mg/kg (ppm) unless otherwise indicated
2. Table B, I/C = Surface Soil Criteria for Industrial/Commercial land use for coarse textured soil in a non-potable groundwater condition, from MOE Guideline for Use at Contaminated Sites in Ontario, Revised February 1997
3. **Bold** = Concentration exceeds Table B criteria
4. < = Concentration less than Estimated Quantitization Limit (EQL)
5. = Parameter not analyzed
6. = 1 ms/cm = 1000 umhos/cm

Table C-4: Summary of Inorganic Parameters in Soil (Page 5 of 5)

Parameter	Table B I/C	BH700 SS1 (0-0.6m)	BH701 SS1 (0-0.6m)	BH702 SS1 (0-0.6m)	BH703 SS1 (0-0.6m)	BH704 SS1 (0-0.6m)	BH705 SS1 (0-0.6m)	BH706 SS1 (0-0.6m)	BH707 SS1 (0-0.6m)
pH (pH units)	5.0-9.0	8.82	**10.4**	**11.0**	7.94	8.26	8.58	8.51	7.46
Electrical Conductivity (mS/cm)	1.4	0.38	0.82	1.34	0.28	0.48	0.13	0.99	**2.66**
Sodium Adsorption Ratio (no units)	12	2.50	2.90	4.30	1.89	1.19	0.57	5.30	1.20
Antimony (Sb)	40	4.7	8.5	2.5	**55.1**	7.0	0.7	2.1	4.7
Arsenic (As)	40	6.0	5.9	4.5	2.9	3.7	2.6	4.5	8.4
Barium (Ba)	1500	31	79	23	21	18	10	213	168
Beryllium (Be)	1.2	<0.2	0.3	<0.2	0.2	<0.2	<0.2	0.5	0.3
Boron (Bo) (Available)	2.0	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	3.2	0.4
Cadmium (Cd)	12	0.6	<0.5	0.5	<0.5	<0.5	<0.5	6.1	2.7
Chromium (Cr) (Total)	750	17	208	23	21	9	6	66	33
Chromium (Cr) (VI)	8.0	<1	<1	<1	<1	<1	<1	<1	<1
Cobalt (Co)	80	4	3	3	2	3	2	7	3
Copper (Cu)	225	30	49	18	11	19	7	111	87
Cyanide (Free) (CN)	100	<0.02	<0.02	<0.02	<0.02	0.27	<0.02	<0.02	0.56
Lead (Pb)	1000	454	368	246	849	324	49	193	552
Mercury (Hg)	10	0.03	0.08	0.02	0.02	0.02	<0.01	0.69	0.56
Molybdenum (Mo)	40	<3	<3	<3	<3	<3	<3	<3	<3
Nickel (Ni)	150	11	8	7	6	5	3	27	14
Selenium (Se)	10	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	0.7
Silver (Ag)	40	<1	<1	<1	<1	<1	<1	1	1
Thallium (Tl)	32	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Vanadium (V)	200	18	18	18	19	19	18	24	18
Zinc (Zn)	600	137	124	76	50	67	21	236	**727**

NOTES:

1. Units are in µg/g or mg/kg (ppm) unless otherwise indicated
2. Table B, I/C = Surface Soil Criteria for Industrial/Commercial land use for coarse textured soil in a non-potable groundwater condition, from MOE Guideline for Use at Contaminated Sites in Ontario, Revised February 1997
3. **Bold** = Concentration exceeds Table B criteria
4. < = Concentration less than Estimated Quantitization Limit (EQL)
5. = Parameter not analyzed
6. = 1 ms/cm = 1000 umhos/cm

Table C-5: Summary of TPH and BTEX in Soil

Parameter	Sample Depth	TPH gasoline/diesel (C_5-C_{24})	TPH heavy oil (>C_{24})	Benzene	Toluene	Ethylbenzene	Xylenes
Table B Criteria		1000	5000	5.3	34	290	34
BH408 SS4	2.3-2.9 m	950*	<80	<0.002	<0.002	<0.002	0.03
BH409 SS4	2.3-2.9 m	**1100***	<80	<0.002	0.03	0.007	0.047
BH414 SS3	1.5-1.9 m	400*	<80	-	-	-	-
BH602 SS4	2.25-2.85 m	110	800	<0.02	<0.02	<0.02	<0.06
TP5 SA3	0.8-1.5 m	**2900**	**9400**	<0.02	0.05	0.54	1.73
TP7 SA3	1.2-1.9 m	**21000**	**9700**	**18.4**	**35.6**	181	**700**
BH704 SS1	0-0.6 m	35.8	248	0.002	0.007	<0.002	0.006
BH706 SS1	0-0.6 m	685	1940	0.09	0.9	0.2	0.5
BH707 SS1	0-0.6 m	275	758	0.002	0.004	<0.002	0.002

NOTES:

1. Units are in µg/g (ppm)
2. Table B Criteria = Surface soil criteria for Industrial/Commercial land use for coarse texture soil in a non-potable groundwater condition, contained in Table B of the "Guideline for Use at Contaminated Sites in Ontario", published by the Ministry of Environment, revised February 1997
3. BTEX results for samples BH408 SS4, BH409 SS4, BH704 SS1, BH707, SS1 and BH707 SS1 obtained from VOC analysis. See Table 6 for complete VOC results
4. Bold and underlined value, if present (i.e. **1100**) indicates exceedance of Table B criteria
5. * indicates reported concentrations represent TPH in the diesel range only (C_{10} to C_{24})
6. -- = parameter not analyzed

Table C-6A: Summary of VOCs in Soil (February 2000)

Parameter	Table B I/C Criteria	MDL (µg/g)	BH408 SS4 (2.3-2.9m)	BH409 SS4 (2.3-2.9m)
Acetone	3.8	0.105	<	<
Benzene	5.3	0.002	<	<
Bromodichloromethane	25	0.002	<	<
Bromoform	2.3	0.002	<	<
Bromomethane	0.061	0.003	<	<
Carbon Tetrachloride	0.10	0.002	<	<
Chlorobenzene	8.0	0.003	<	<
Chloroform	0.79	0.003	<	<
Dibromochloromethane (see notes)	18	0.002	<	<
Dichlorobenzene, 1,2- (o-DCB)	30	0.001	<	<
Dichlorobenzene, 1,3- (m-DCB)	30	0.002	<	<
Dichlorobenzene, 1,4- (p-DCB)	30	0.002	<	<
Dichloroethane, 1,1-	22	0.002	<	<
Dichloroethane, 1,2-	0.022	0.002	<	<
Dichloroethylene, 1,1-	0.0024	0.002	<	<
Dichloroethylene, Cis-1,2-	2.3	0.003	<	<
Dichloroethylene, Trans-1,2-	4.1	0.003	<	<
Dichloropropane, 1,2-	0.019	0.002	<	<
Dichloropropene,1,3- (see notes)	0.0066	0.005	<	<
Ethylbenzene	290	0.002	<	0.007
Ethylene Dibromide	0.0056	0.002	<	<
Methyl Ethyl Ketone (MEK)	38	0.008	<	<
Methyl Isobutyl Ketone (MIBK)	58	0.070	<	<
Methyl Tert Butyl Ether (MTBE)	120	0.015	<	<
Methylene Chloride	140	0.003	<	<
Styrene	1.2	0.002	<	<
Tetrachloroethane, 1,1,1,2-	0.019	0.002	<	<
Tetrachloroethane, 1,1,2,2-	0.037	0.003	<	<
Tetrachloroethylene	0.45	0.002	<	<
Toluene	34	0.002	<	0.03
Trichloroethane, 1,1,1-	26	0.003	<	<
Trichloroethane, 1,1,2-	3.1	0.002	<	<
Trichloroethylene	1.1	0.003	<	<
Vinyl Chloride	0.003	0.003	<	<
Xylenes	34	0.004	0.03	0.047

NOTES:

1. Units are µg/g (ppm) unless otherwise indicated.
2. Table B I/C Criteria = Surface soil criteria for Industrial/Commercial land use for coarse texture soil in a non-potable groundwater condition, contained in Table B of the "Guideline for Use at Contaminated Sites in Ontario", published by the Ministry of Environment (MOE), revised February 1997
3. < indicates less than method detection limit (MDL) or estimated quantification limit (EQL). See Certificates of Analysis for the respective MDL or EQL
4. Bold and underlined value (e.g. **47**) indicates exceedance of Table B criteria
5. Dibromochloromethane also known as Chlorodibromomethane
6. Methylene Chloride also known as Dichloromethane
7. Dichloropropene,1,3- value represents the sum of Cis-1,3-Dichloropropene and Trans-1,3-Dichloropropene
8. See Certificate of Analysis for results of additional parameters for which no values are presented in the Table B Criteria

Table C-7: Summary of Base Neutral Extractables in Soil

Parameter	Table B Criteria	EQL	TP5 SA3 (0.8-1.5 m)	TP7 SA3 (1.2-1.9 m)
Acenaphthene	1300	1.0	2.9	51.2
Acenaphthylene	840	1.0	0.9***	264
Anthracene	28	1.0	6.3	**281**
Benzo(a)anthracene	40	1.0	6.3	**271**
Benzo(a)pyrene	1.9	1.0	**5.8**	**267**
Benzo(b)fluoranthene	19	1.0	7.4	**343**
Benzo(g,h,i)perylene	40	1.0	1.3	35.3
Benzo(k)fluoranthene	19	1.0	3.3	**150**
Biphenyl, 1,1-	4.3	1.0	<	<
Bis (2-Chloroethyl)ether	0.66	1.0**	<	<
Bis (2-Chloroisopropyl)ether	0.82	1.0**	<	<
Bis (2-Ethylhexyl)phthalate	330	5.0	<	<
Chloroaniline, p-	1.3	2.0**	<	<
Chrysene	19	1.0	8.4	**243**
Dibenzo(a,h)anthracene	1.9	1.0	<	**12.0**
Dichlorobenzene, 1,2-(o-DCB)	30	1.0	<	<
Dichlorobenzene, 1,3-(m-DCB)	30	1.0	<	<
Dichlorobenzene, 1,4-(p-DCB)	30	1.0	<	<
Dichlorobenzidine, 3,3'-	1.3	5.0**	<	<
Diethyl Phthalate	0.71	2.0**	<	<
Dimethyl Phthalate	0.7	2.0**	<	<
Dinitrotoluene, 2,4-	1.8	1.0	<	<
Fluoranthene	40	1.0	16.3	**923**
Fluorene	350	1.0	4.0	**379**
Hexachlorobutadiene	0.38	1.0**	<	<
Hexachloroethane	3.8	1.0	<	<
Hexachlorobenzene	0.76	1.0**	<	<
Indeno(1,2,3-cd)pyrene	19	1.0	1.7	**47.4**
Methylnaphthalene, 2-(*1-)	280	2.0	7.6	**583**
Naphthalene	40	1.0	4.1	**2140**
Phenanthrene	40	1.0	21.8	**1310**
Pyrene	250	1.0	17.7	**671**
Trichlorobenzene, 1,2,4-	30	1.0	<	<

NOTES:

1. Units are in µg/g (ppm)
2. Table B Criteria = Surface Soil Criteria for Industrial/Commercial land use for coarse textured soil in non-potable groundwater condition, contained in Table B of the "Guideline for Use at Contaminated Sites in Ontario", published by the Ministry of Environment (MOE), revised February 1997
3. EQL = Estimated Quantitation Limit (EQL)
4. < = Less than Estimated Quantitation Limit
5. * = Methylnaphthalene, 2- soil criterion is applicable to Methylnaphthalene, 1- with the provision that if both are detected in the soil, the sum of the two concentrations cannot exceed the soil criterion.
6. ** = EQL greater than Table B criterion due to dilution of samples by laboratory
7. *** = Parameter detected below adjusted EQL due to dilution, but passed compound identification criteria
8. Bold and underlined (i.e. **671**)indicates exceedance of Table B criterion

Table C-8A: Summary of PAH in Soil (February 2000)

Parameter	Table B Criteria	MDL	BH408 SS4 (2.3 – 2.9 m)
Acenaphthene	1300	0.004	0.13
Acenaphthylene	840	0.004	0.21
Anthracene	28	0.004	0.42
Benzo (a) anthracene	40	0.006	2.2
Benzo (a) pyrene	1.9	0.003	1.6
Benzo (b) fluoranthene	19	0.004	1.4
Benzo (g,h,i) perylene	40	0.004	0.97
Benzo (k) fluoranthene	19	0.008	1.1
Chrysene	19	0.005	1.4
Dibenzo (a,h) anthracene	1.9	0.003	0.27
Fluoranthene	40	0.003	3.2
Fluorene	350	0.007	0.19
Indeno (1,2,3-cd) pyrene	19	0.004	0.95
Methylnaphthalene, 2-(*1-)	280	n.a.	-
Naphthalene	40	0.007	0.54
Phenanthrene	40	0.006	0.91
Pyrene	250	0.002	2.7

NOTES:

1. Units are µg/g (ppm) unless otherwise indicated.
2. Table B Criteria = Surface soil criteria for Industrial/Commercial land use for coarse texture soil in a non-potable groundwater condition, contained in Table B of the "Guideline for Use at Contaminated Sites in Ontario", published by the Ministry of Environment (MOE), revised February 1997
3. MDL = Method Detection Limit
4. < indicates less than Method Detection Limit
5. * = Methylnaphthalene,2- soil criterion is applicable to Methylnaphthalene,1- with the provision that if both are detected in the soil, the sum of the two concentrations cannot exceed the soil criterion.
6. Bold and underlined value (i.e. **3.59**) indicates exceedance of Table B criterion
7. n.a. = Not applicable
8. - = Parameter not analyzed

Table C-9: Summary of PCBs in Soil

	Table B Criteria	BH409 SS4 2.3-2.9m February 2000	TP5 SA3 1.2-1.9m July 2001	TP7 SA3 1.2-1.9m July 2001
PCB	25	<0.01	<1.00	<5.00

Notes:

1. Table B Criteria = Surface soil criteria for Industrial/Commercial land use for coarse texture soil in a non-potable groundwater condition, contained in Table B of the "Guideline for Use at Contaminated Sites in Ontario", published by the Ministry of Environment (MOE), revised February 1997
2. Units are µg/g (ppm) unless otherwise indicated

Table C-10: Summary of Regulation 347/558 Analysis of Soil

Parameter (mg/L)	Reg. 347 Schedule 4 Limits	TP5 SA3 (0.8-1.5 m)	TP7 SA3 (1.2-1.9 m)	GSA BH603/1 (0-0.3m)	GSA BH604/1 (0-0.3m)
Arsenic	2.5	<0.2	<0.2	<0.2	<0.2
Barium	100	0.9	0.9	0.5	0.7
Boron	500	0.2	<0.1	<0.1	0.1
Cadmium	0.5	<0.05	<0.05	0.27	0.09
Chromium	5	0.1	<0.1	<0.1	<0.1
Cyanide free	20	<0.01	0.01	<0.01	<0.01
Fluoride	150	0.2	0.2	<0.1	<0.2
Lead	5	<0.1	0.6	**135**	**5.0**
Mercury	0.1	<0.01	<0.01	<0.01	<0.01
Nitrate+Nitrite-N	1000	<0.2	<0.2	<0.2	1.4
Selenium	1	<0.1	<0.1	<0.1	<0.1
Silver	5	<0.01	<0.01	<0.1	<0.1
Benzene	0.5	<0.01	**0.538**	-	-
Carbon tetrachloride	0.5	<0.02	<0.02	-	-
Chlorobenzene	8	<0.02	<0.02	-	-
Chloroform	10	<0.02	<0.02	-	-
1,2-dichlorobenzene	20	<0.02	<0.02	-	-
1,4-dichlorobenzene	0.5	<0.02	<0.02	-	-
1,2-dichloroethane	0.5	<0.02	<0.02	-	-
1,1-dichloroethylene	1.4	<0.02	<0.02	-	-
Methyl ethyl ketone	200	<0.50	<0.50	-	-
Methylene chloride	5	<0.20	<0.20	-	-
Tetrachloroethylene	3	<0.02	<0.02	-	-
Trichloroethylene	5	<0.02	<0.02	-	-
Uranium		<0.01	<0.01	-	-
Vinyl chloride	0.2	<0.02	<0.02	-	-

Notes:

1. Regulation 347 Schedule 4 leachate quality analyses for inorganics and VOCs, as amended to Regulation 558/00, in effect as of April 1, 2001
2. Units are mg/L (ppm) in soil leachate
3. - = parameter not analyzed
4. If all values less than the Schedule 4 Limits, the material can be classified as non-hazardous waste
5. Bold and underlined value (e.g. **0.538**) exceedance of Schedule 4 Limits, which requires classification as hazardous waste

Table C-11: Summary of Metal Scan and pH in Groundwater

Parameter	Table B Criteria	BH602	BH603	BH604	BH605	BH700	BH702	BH704	BH705	BH706	BH707
pH (pH units)	5.0-9.0	7.09	6.91	6.84	6.61	7.54	7.55	7.61	7.34	7.48	7.59
Antimony (Sb)	16000	<0.5	1	<0.5	<0.5	2.9	17.2	44.8	5.3	7.4	2.4
Arsenic (As)	480	<20	3	6	<2	11	<20	<20	36	6	<20
Barium (Ba)	23000	637	299	65	760	268	380	247	584	615	221
Beryllium (Be)	53	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1
Boron (B)	50000	116	598	1550	233	737	238	700	285	3340	846
Cadmium (Cd)	11	<1.0	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium (Cr) (Total)	2000	<50	<5	<5	<5	<5	<50	<50	<50	<50	<50
Cobalt (Co)	100	13.3	7.8	8.8	11.5	1.1	0.6	3.1	3.7	9.1	1.4
Copper (Cu)	23	<5.0	0.9	2.2	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5
Lead (Pb)	32	<5.0	<0.5	<0.5	<0.5	0.6	2.7	4.4	1.2	2.1	<0.5
Mercury (Hg)	0.12	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Molybdenum (Mo)	7300	<10	15	16	7	6	6	3	2	14	3
Nickel (Ni)	1600	<10	10	12	5	4	2	4	3	15	1
Selenium (Se)	50	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2
Silver (Ag)	1.2	<1.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Thallium (Th)	400	<0.5	<0.05	<0.05	<0.05	0.27	0.1	<0.05	<0.05	0.15	0.15
Vanadium (V)	200	<5.0	<50	0.6	<50	2.9	<5.0	<5.0	<5.0	5.1	<5.0
Zinc (Zn)	1100	<50	10	14	15	<5	<5	5	11	6	<5

NOTES:

1. Units are in µg/L (ppb) unless otherwise indicated
2. Table B criteria = Nonpotable groundwater criteria contained in Table B of the "Guideline for Use at Contaminated Sites in Ontario", published by the Ministry of the Environment (MOE), revised 1997.
3. Groundwater samples from BH602 to BH605 were collected in July 2001 and reported previously (S&P August 22, 2001). Groundwater samples from BH700 to BH707 were collected in September, 2001. Certificates of Analysis for BH700-BH707 are included in Appendix D.

Table C-12: Summary of TPH and BTEX in Groundwater

Sample ID	TPH gasoline/diesel (C_5-C_{24})	TPH heavy oil (>C_{24})	Benzene	Toluene	Ethylbenzene	Xylenes
Table B Criteria	N/V	N/V	1900	5900	28000	5600
BH 602	<200	<1000	0.1	<0.2	<0.2	0.7*
BH 603	<200	<1000	<0.1	0.3	<0.2	0.3*
BH 604	150	<1000	0.1	<0.2	<0.2	1.3
BH 605	1750	5000	0.1	0.2	<0.2	0.4
BH 700	898	5000	<0.1	0.2	<0.2	1.2
BH 702	<200	1000	<0.1	1.2	<0.2	0.3*
BH 704	<200	1000	0.7	0.2	0.4	0.3*
BH 705	14500	5000	<0.1	0.3	0.7	7.1
BH 706	175	8000	1.0	0.7	0.5	5.8
BH 707	552	1000	0.3	0.3	<0.2	1.3

NOTES:

1. Units are in µg/L (ppb)
2. Table B Criteria = Nonpotable groundwater criteria for coarse textured soils contained in Table B of the "Guideline for Use at Contaminated Sites in Ontario", published by the MOE, revised February 1997
3. BTEX results for samples obtained from VOC analysis. See Table 12 for complete VOC results
4. < Indicates less than Estimated Quantitation Limit (EQL)
5. Bold and underlined value, if present (i.e. **1100**) indicates exceedance of Table B criteria
6. *= Result shown is greater than the EQL of one of the isomers

Table C-13: Summary of VOCs in Groundwater (Page 1 of 2)

Parameter	Table B Criteria	EQL (µg/L)	BH602	BH603	BH604	BH605
Acetone	3300	10.0	<	<	<	<
Benzene	1900	0.1	0.1	<	0.1	0.1
Bromodichloromethane	50000	0.2	<	<	<	<
Bromoform	840	0.2	<	<	<	<
Bromomethane	3.7	0.5	<	<	<	<
Carbon Tetrachloride	17	0.2	<	<	<	<
Chlorobenzene	500	0.2	<	<	<	0.2
Chloroform	430	0.2	<	<	<	<
Dibromochloromethane (see notes)	50000	0.2	<	<	<	<
Dichlorobenzene, 1,2- (o-DCB)	7600	0.2	<	<	<	<
Dichlorobenzene, 1,3- (m-DCB)	7600	0.2	<	<	<	<
Dichlorobenzene, 1,4- (p-DCB)	7600	0.2	<	0.2	0.3	0.3
Dichloroethane, 1,1-	9000	0.2	<	<	<	<
Dichloroethane, 1,2-	17	0.2	<	<	<	<
Dichloroethylene, 1,1-	0.66	0.2	<	<	<	<
Dichloroethylene, Cis-1,2-	70	0.2	<	<	<	<
Dichloroethylene, Trans-1,2-	100	0.2	<	<	<	<
Dichloropropane, 1,2-	9.3	0.2	<	<	<	<
Dichloropropene,1,3- (see notes)	3.8	0.4	<	<	<	<
Ethylbenzene	28000	0.2	<	<	<	<
Ethylene Dibromide	3.8	0.2	<	<	<	<
Methyl Ethyl Ketone (MEK)	50000	5.0	<	<	<	<
Methyl Isobutyl Ketone (MIBK)	50000	5.0	<	<	<	<
Methyl Tert Butyl Ether (MTBE)	50000	0.2	<	<	<	<
Methylene Chloride	50000	1.0	<	<	<	<
Styrene	940	0.2	<	<	<	<
Tetrachloroethane, 1,1,1,2-	6.0	0.2	<	<	<	<
Tetrachloroethane, 1,1,2,2-	22	0.2	<	<	<	<
Tetrachloroethylene	5.0	0.2	<	<	<	<
Toluene	5900	0.2	<	0.3	<	0.2
Trichloroethane, 1,1,1-	200	0.2	<	<	<	<
Trichloroethane, 1,1,2-	16000	0.2	<	<	<	<
Trichloroethylene	50	0.2	<	<	<	<
Vinyl Chloride	0.5	0.2	<	<	<	<
Xylenes	5600	0.4	0.7	0.3*	1.3	0.4

NOTES:

1. Units are µg/L (ppb)
2. Table B Criteria = Nonpotable groundwater criteria for coarse textured soils contained in Table B of the "Guideline for Use at Contaminated Sites in Ontario", published by the MOE, revised February 1997
3. EQL = Estimated Quantitation Limit
4. < Indicates less than estimated quantitation limit
5. Bold and underlined value (e.g. **47**) indicates exceedance of Table B criteria
6. Dibromochloromethane also known as chlorodibromomethane
7. Dichloropropene,1,3- value represents the sum of Cis-1,3-Dichloropropene and Trans-1,3-Dichloropropene
8. See Certificate of Analysis for results of additional parameters for which no values are presented in the Table B Criteria
9. * = Result shown is greater than the EQL of one of the isomers

Table C-13: Summary of VOCs in Groundwater (Page 2 of 2)

Parameter	Table B Criteria	EQL (µg/L)	BH700	BH702	BH704	BH705	BH706	BH707
Acetone	3300	10.0	<	<	10.4	10.5	<	17.0
Benzene	1900	0.1	<	<	0.7	<	1.0	0.3
Bromodichloromethane	50000	0.2	<	<	<	<	<	<
Bromoform	840	0.2	<	<	<	<	<	<
Bromomethane	3.7	0.5	<	<	<	<	<	<
Carbon Tetrachloride	17	0.2	<	<	<	<	<	<
Chlorobenzene	500	0.2	<	<	<	<	1.1	<
Chloroform	430	0.2	<	<	<	<	<	<
Dibromochloromethane (see notes)	50000	0.2	<	<	<	<	<	<
Dichlorobenzene, 1,2- (o-DCB)	7600	0.2	<	<	<	<	0.2	<
Dichlorobenzene, 1,3- (m-DCB)	7600	0.2	<	<	<	<	<	<
Dichlorobenzene, 1,4- (p-DCB)	7600	0.2	<	<	<	<	5.2	<
Dichloroethane, 1,1-	9000	0.2	<	<	<	<	<	<
Dichloroethane, 1,2-	17	0.2	<	<	<	<	<	<
Dichloroethylene, 1,1-	0.66	0.2	<	0.3	<	<	<	<
Dichloroethylene, Cis-1,2-	70	0.2	<	<	<	<	<	<
Dichloroethylene, Trans-1,2-	100	0.2	<	<	<	<	<	<
Dichloropropane, 1,2-	9.3	0.2	<	<	<	<	<	<
Dichloropropene,1,3- (see notes)	3.8	0.4	<	<	<	<	<	<
Ethylbenzene	28000	0.2	<	<	0.4	0.7	0.5	<
Ethylene Dibromide	3.8	0.2	<	<	<	<	<	<
Methyl Ethyl Ketone (MEK)	50000	5.0	<	<	<	<	5.0	<
Methyl Isobutyl Ketone (MIBK)	50000	5.0	<	<	<	<	<	<
Methyl Tert Butyl Ether (MTBE)	50000	0.2	<	<	<	<	<	<
Methylene Chloride	50000	1.0	<	<	<	<	<	<
Styrene	940	0.2	<	<	<	<	<	<
Tetrachloroethane, 1,1,1,2-	6.0	0.2	<	<	<	<	<	<
Tetrachloroethane, 1,1,2,2-	22	0.2	<	<	<	0.3	<	<
Tetrachloroethylene	5.0	0.2	<	<	<	<	<	<
Toluene	5900	0.2	0.2	1.2	0.2	0.3	0.7	0.3
Trichloroethane, 1,1,1-	200	0.2	<	<	<	<	<	<
Trichloroethane, 1,1,2-	16000	0.2	<	<	2.8	<	2.7	<
Trichloroethylene	50	0.2	<	<	<	<	<	<
Vinyl Chloride	0.5	0.2	<	<	<	<	<	0.3
Xylenes	5600	0.4	1.2	0.3*	0.3*	7.1	5.8	1.3

NOTES:

1. Units are µg/L (ppb)
2. Table B Criteria = Nonpotable groundwater criteria for coarse textured soils contained in Table B of the "Guideline for Use at Contaminated Sites in Ontario", published by the MOE, revised February 1997
3. EQL = Estimated Quantitation Limit
4. < indicates less than estimated quantitation limit
5. Bold and underlined value (e.g. **47**) indicates exceedance of Table B criteria
6. Dibromochloromethane also known as chlorodibromomethane
7. Dichloropropene,1,3- value represents the sum of Cis-1,3-Dichloropropene and Trans-1,3-Dichloropropene
8. See Certificate of Analysis for results of additional parameters for which no values are presented in the Table B Criteria
9. * = result shown is greater than the EQL of one of the isomers

Table C-14: Summary of PAHs in Groundwater

Parameter	Table B Criteria	EQL (µg/L)	BH602	BH603	BH604	BH605	BH700	BH702	BH704	BH705	BH706	BH707	BH707 Retest
Acenaphthene	1700	0.2	<	<	0.2	<1.0	7.7	0.2	2.8	0.3	3.2	3.2	2.1
Acenaphthylene	2000	0.2	<	<	<	<1.0	<	<	<	<	<	0.3	<
Anthracene	12	0.2	<	<	<	<1.0	1.4	<	<	0.4	0.9	1.0	0.7
Benzo (a) anthracene	5.0	0.2	<	<	<	<1.0	<	<	<	<	0.2	0.6	<
Benzo (b) fluoranthene	7.0	0.2	<	<	<	0.7	<	<	<	<	0.2	0.5	<
Benzo (k) fluoranthene	0.4	0.2	<	<	<	<1.0**	<	<	<	<	<	0.2	<
Benzo (a) pyrene	1.9	0.2	<	<	<	<1.0	<	<	<	<	0.2	0.5	<
Benzo (g,h,i) perylene	0.2	0.2	<	<	<	<1.0**	<	<	<	<	<	**0.3**	<
Chrysene	3.0	0.2	<	<	<	0.8	0.2	<	<	<	0.3	0.7	<
Dibenzo (a,h) anthracene	0.25	0.2	<	<	<	<1.0**	<	<	<	<	<	<	<
Fluoranthene	130	0.2	<	0.2	<	1.6	1.1	<	0.3	0.2	0.9	2.5	1.1
Fluorene	290	0.2	<	0.2	0.2	0.6	6.6	0.2	0.4	0.4	2.2	2.1	1.5
Indeno (1,2,3-cd) pyrene	0.27	0.2	<	<	<	<1.0**	<	<	<	<	<	**0.3**	<
Methylnaphthalene, 2-(1-)	13000	0.4	<	0.2*	8.7	<2.0	43.5	1.9	<	6.5	7.4	6.2	3.2
Naphthalene	5900	0.2	0.2	<	2.5	<1.0	9.3	3.8	<	4.4	27.2	2.6	0.9
Phenanthrene	63	0.2	0.5	2.0	0.8	2.6	8.0	0.3	0.5	1.5	3.8	4.4	3.2
Pyrene	40	0.2	<	0.2	<	1.5	0.9	<	0.4	0.5	0.8	2.5	1.0

NOTES:

1. Units are µg/L (ppm) unless otherwise indicated.
2. Table B = Nonpotable groundwater criteria for coarse textured soil contained in Table B of the Guideline for Use at Contaminated Sites in Ontario, published by the Ministry of Environment (MOE), revised February 1997
3. EQL = Estimated Quantitation Limit
4. < Indicates less than EQL (see certificate of analysis for EQL)
5. 2-methyl naphthalene groundwater criterion is the sum of 2-methyl naphthalene and 1-methyl naphthalene
6. * =Result shown is greater than the EQL of one of the isomers
7. ** = EQL greater than Table B criterion
8. Bold and underlined value (e.g. **0.3**) indicates exceedance of the Table B criteria

APPENDIX D

SOIL AND GROUNDWATER INVESTIGATION, SEPTEMBER 2001
SITE CHARACTERIZATION METHODOLOGY

APPENDIX D
SOIL AND GROUNDWATER INVESTIGATION
SEPTEMBER 2001
SITE CHARACTERIZATION METHODOLOGY

TABLE OF CONTENTS

ATTACHMENTS

APPENDIX D
SOIL AND GROUNDWATER INVESTIGATION
SEPTEMBER 2001

SITE CHARACTERIZATION METHODOLOGY

D-1 INTRODUCTION

Previous reports (Geo-Canada, 1997, Geo-Canada 2000, Geo-Canada/S&P August 2001) have described the methodology for collection and analyses of environmental soil and groundwater samples. This Appendix describes the sampling methodology, and contains the Certificates of Analysis, for the samples collected and analyzed subsequent to the August 2001 report. **Appendix A** includes the borehole and test pit drawings from the previous studies.

The work described in this Appendix was conducted to provide additional data for the SSRA. The Reg. 347/558 waste class analyses of two soil samples were originally conducted to provide waste class information for S&P's Remedial Options Study (Draft report December, 2001), and the results and Certificates of Analysis are included in this SSRA report.

Field and laboratory analytical procedures were conducted in accordance with the MOE document. "***Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario***" (December, 1996). The locations of the boreholes and test pits within the SSRA study area are shown on **Drawing 3,** and the borehole and test pit logs from all of the investigations are presented in **Appendix B**.

D-2 SAMPLE COLLECTION

D-2.1 SURFACE SOILS

Surface soil sample locations were selected at random within a 0.5 m radius of the borehole and testpit locations in July 2001 (S&P report August 22, 2001, SP3201C). Surface soil samples were collected from a total of 11 locations within the SSRA Study Area (at boreholes BH602, BH603, BH604 and BH605; and testpits TP2, TP3, TP4, TP5, TP6, TP7 and TP8). These samples are identified in the reports, tables and certificates of analysis by the prefix "GSA" followed by the representative borehole or test pit name (e.g. GSA BH603). Surface soil samples were collected at each location using clean shovels and scoops from the upper 0.3 m of *in-situ* fill soil. The shovels and scoops were washed prior to each sampling event with phosphate free detergent in water, rinsed with municipal water and subsequently rinsed with distilled water. New disposable vinyl lab gloves were worn when placing the samples in plastic bags and glass jars for chemical analysis. Samples selected for laboratory analysis were stored in coolers with ice packs in the field and during transportation to S&P's laboratory. Soil samples were examined for soil classification and for aesthetic (visual and olfactory) evidence of environmental impact.

D-2.2 SUBSURFACE SOILS

Subsurface soil sampling was carried at a total of 29 locations across the SSRA study area (22 borehole locations and 7 testpit locations). The subsurface soil sampling included three drilling programs and a testpit program. The first drilling program had been carried out during the period January 28 to February 3, 2000 as part of the Geotechnical and Geo-Environmental Investigation previously reported for the construction of the noise barrier and bicycle path at the subject site (Geo-Canada 2000). The second drilling program and the testpit program were carried out during the period of July 11 to 12, 2001 and reported in the Soil & Groundwater Quality Assessment (S&P, August 22, 2001).

The third drilling program was carried out on September 18, 2001 in order to provide additional site characterization information regarding subsurface soil and groundwater conditions in order to complete the SSRA. Prior to initiating the drilling and testpit programs, the drilling and testpit locations were cleared for public underground utilities.

Geo-Environmental Drilling Inc. of Milton, Ontario carried out the second drilling program using a truck mounted CME 75 drilling rig. The third drilling program consisted of drilling eight boreholes (BH700, BH701, BH702, BH703, BH704, BH705 BH706 and BH707) to a maximum depth of 5.1 m. Eastern Soil Investigations Limited of Clarington, Ontario carried out the drilling using a truck mounted CME 75 drilling rig. All of the drilling operations were carried out under the direct supervision of experienced S&P and Geo-Canada Ltd. (a division off S&P) field personnel.

Soil samples were collected from each borehole using a 50mm outer diameter (OD) split spoon sampler at frequent depth intervals through the fill and native soil. Soil samples were collected from each test pit using shovels and scoops from each layer of fill and native soil encountered in the testpits. Soil samples recovered from the boreholes and testpits were examined for soil classification and for aesthetic (visual and olfactory) evidence of environmental impact. Soil samples collected from the boreholes and testpits were split in the field – some of the soil was transferred to glass jars for laboratory analysis, and the remainder of the soil sample was placed into airtight zip lock plastic bags.

The following precautions were taken by S&P while collecting soil samples to prevent cross-contamination and maintain sample integrity: A clean split spoon sampler was used by the drilling contractor to obtain soil samples in all of the boreholes. The split spoon soil sampler, shovels and scoops were washed prior to each sampling event with phosphate free detergent in water, rinsed with municipal water and subsequently rinsed with distilled water. New disposable vinyl lab gloves were worn when removing the soil cores from the sampler and placing the samples in plastic bags and glass jars for chemical analysis. Samples selected for laboratory analysis were stored in coolers in the field and kept under refrigerated conditions during storage and transportation to the analytical laboratory.

Headspace combustible vapour measurements (excluding methane) were made within the plastic sample bags using a Trace-techtor™ combustible vapour meter calibrated to hexane, with the methane elimination setting enabled. Headspace measurements were made after the samples had been stored indoors for at least two hours and the samples equilibrated to room temperature. The headspace monitoring was performed on the samples as a preliminary screening for hydrocarbons or volatile organic compounds (VOCs). The final selection of soil samples for laboratory analysis was based on an evaluation of: headspace readings; presence of organic and foreign matter; and soil staining.

The ground surface elevations at the testpit, borehole and monitoring well locations were surveyed by S&P personnel and referenced to the following City of Toronto benchmark:

> *Benchmark #157 (Rec.#1780) located on the wall of the Brewers Retail Distribution Centre on the west side of Leslie Street just south of Lakeshore Boulevard East (Geodetic elevation 76.986 metres).*

These elevations are included in **Table C-1 (Appendix C)**.

D-2.3 GROUNDWATER MONITORING

Groundwater monitoring wells were installed in six (6) of the boreholes (BH700, BH702, BH704, BH705 BH706 and BH707), to permit groundwater observations and to obtain groundwater samples for laboratory analysis.

The monitoring wells were constructed of 50 mm diameter Schedule 40 Polyvinyl Chloride (PVC) screen with a factory machined slot width of 0.25 mm and completed with a PVC riser pipe. All the pipe sections were wrapped in plastic, which was removed just prior to installation to minimize the potential for contamination. The base of each well was covered with a PVC cap to prevent the influx of sediment. Clean filter sand (silica sand) was placed in the annular space between the well and the well bore to about 0.5-0.6 m above the screen level to obtain relatively sediment free water. A bentonite seal was added to the annular space above the sand pack to an approximate thickness of 0.6 to 0.8 m to prevent infiltration of surface water. Lubricants or glue were not used in the monitoring well construction. The construction of the groundwater monitoring wells is illustrated on the borehole logs presented in **Appendix B**.

One of the monitoring wells from the first drilling program (BH415) was destroyed during construction activity within the study area. Groundwater monitoring wells had previously been installed in four of the boreholes from the July 2001 drilling program (BH602, BH603, BH604 and BH 605). Thus, a total of ten (10) monitoring wells were available for groundwater sampling and analysis.

ATTACHMENT D-1
CERTIFICATES OF ANALYSIS

ANALYTICAL SERVICES

Client: Shaheen & Peaker Ltd.
250 Galaxy Blvd.
Etobicoke, ON, CANADA
M9W 5R8

Fax: 416-213-1260

Attn: Sergiy Tchernikov

Date Received: September 7/2001
Date Reported: September 18/2001
Lab Ref#: G214323
Lab Quote#:

Client Ref#: SP3977
Sampled By: S.T.

Certificate of Analysis

Analysis Performed: GUIDELINES(CONTAMINATED SITES)
Thallium, Graphite Furnace, Digestion Required
Boron(hot water soluble) by ICP

Methodology:

1) Determination of mercury in soils/sediment by cold vapour atomic absorption spectrophotometry.
U.S. EPA SW846 Methods No. 7471A & 7470A
2) Analysis of thallium in soil by Graphite Furnace Atomic Absorption.
U.S. EPA Method No. 7841
3) Analysis of arsenic in soil by Hydride Generation Atomic Absorption.
U.S. EPA Method No. 7061(Modifications)
4) Analysis of antimony in soil by hydride generation.
U.S. EPA Method No. 7042
5) Analysis of selenium in soil by hydride generation.
U.S. EPA Method No. 7741(Modification)
6) Colourimetric determination of chromium VI in soil, in a continuous liquid flow.
EPL CR6 Internal Refer. Method for soils
Refer - Method No. 1102304 Issue 121489

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ANALYTICAL SERVICES

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Etobicoke, ON, CANADA
M9W 5R8

Fax: 416-213-1260

Attn: Sergiy Tchernikov

Date Received: September 7/2001
Date Reported: September 18/2001
Lab Ref#: G214323
Lab Quote#:

Client Ref#: SP3977
Sampled By: S.T.

Certificate of Analysis

Methodology: (Cont'd)

12) Analysis of pH in soil by electrode.
U.S. EPA Method No. 9045

Instrumentation:

1) Thermo Separation Products Mercury Analyzer
2) Varian Spectro AA 400/Zeeman Graphite Tube Atomizer
3) Varian VGA 76
4, 5) Thermo Jarrell Ash Smith-Hieftje 22 AA/Varian VGA 76
6) Skalar Segmented Flow Analyzer, Model SA 20/40
7) Lachat Flow Injection Analyzer, Model Quick-Chem 8000
8, 9,10) Thermo Jarrell Ash ICAP 61E Plasma Spectrophotometer
11) Radiometer CopenHagen CDM83 Conductivity Meter
12) Orion Research Expandable Ion Analyzer EA940

Sample Description: Soil

QA/QC: Refer to CERTIFICATE OF QUALITY CONTROL report.

Results: Refer to REPORT of ANALYSIS attached.

Certified By
Melissa Mone
Account Manager

Certified By
Laboratory Supervisor

5735 McADAM ROAD, MISSISSAUGA, ONTARIO, CANADA L4Z 1N9 TEL (905) 890-8566 FAX (905) 890-8575

Philip Analytical Services Corp

Certificate of Quality Control

Date Reported: September 18/2001
Lab Ref # : G214323
Lab Quote#: .

Client : Shaheen & Peaker Ltd.
Contact: Sergiy Tchernikov

Client Ref#: SP3977

Analysis of Soil, expressed on a dry weight basis

				Process Blank			Process % Recovery				Matrix Spike					Overall
Parameter	SAMPLE ID (spike)	EQL	Units	Result	Upper Limit	Accept	Result	Lower Limit	Upper Limit	Accept	Result	Target	Lower Limit	Upper Limit	Accept	QC Acceptable
Mercury	na	0.01	mg/kg	nd	0.02	yes	100	73	127	yes	na	na	na	na	na	yes
Thallium	na	1.0	mg/kg	nd	2.0	yes	100	80	120	yes	na	na	na	na	na	yes
Arsenic	na	0.2	mg/kg	nd	0.5	yes	98	84	120	yes	na	na	na	na	na	yes
Antimony	na	0.2	mg/kg	nd	0.5	yes	129	29	157	yes	na	na	na	na	na	yes
Selenium	na	0.2	mg/kg	nd	0.5	yes	100	60	140	yes	na	na	na	na	na	yes
Chromium, hexavalent	na	1	mg/kg	nd	5.0	yes	98	85	115	yes	na	na	na	na	na	yes
Cyanide, Free	na	0.02	mg/kg	nd	0.04	yes	100	72	120	yes	na	na	na	na	na	yes
Boron(Hot water soluble)	na	0.2	mg/kg	nd	0.4	yes	98	80	120	yes	na	na	na	na	na	yes
Barium	na	5	mg/kg	nd	10	yes	93	84	116	yes	na	na	na	na	na	yes
Beryllium	na	0.2	mg/kg	nd	0.4	yes	117	67	132	yes	na	na	na	na	na	yes
Cadmium	na	0.5	mg/kg	nd	1.0	yes	149	0	184	yes	na	na	na	na	na	yes
Chromium	na	1	mg/kg	nd	2	yes	101	87	113	yes	na	na	na	na	na	yes
Cobalt	na	2	mg/kg	nd	4	yes	98	89	111	yes	na	na	na	na	na	yes
Copper	na	1	mg/kg	nd	2	yes	99	81	119	yes	na	na	na	na	na	yes
Lead	na	5	mg/kg	nd	10	yes	146	54	147	yes	na	na	na	na	na	yes
Molybdenum	na	3	mg/kg	nd	6	yes	85	0	377	yes	na	na	na	na	na	yes
Nickel	na	2	mg/kg	nd	4	yes	100	88	111	yes	na	na	na	na	na	yes
Silver	na	1	mg/kg	nd	2	yes	81	64	137	yes	na	na	na	na	na	yes
Vanadium	na	1	mg/kg	nd	2	yes	100	84	116	yes	na	na	na	na	na	yes
Zinc	na	5	mg/kg	nd	10	yes	106	90	111	yes	na	na	na	na	na	yes

EQL = Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence
* = Unavailable due to dilution required for analysis
na = Not Applicable
ns = Insufficient Sample Submitted
nd = parameter not detected
TR = trace level less than EQL

Philip Analytical Services Corp

Certificate of Quality Control

Date Reported: September 18/2001

Client : Shaheen & Peaker Ltd.
Contact: Sergiy Tchernikov

Lab Ref # : G214323
Lab Quote#: .

Client Ref#: SP3977

Analysis of Soil, expressed on a dry weight basis

				Process Blank			Process % Recovery				Matrix Spike					Overall
Parameter	SAMPLE ID (spike)	EQL	Units	Result	Upper Limit	Accept	Result	Lower Limit	Upper Limit	Accept	Result	Target	Lower Limit	Upper Limit	Accept	QC Acceptable
Conductivity - @25°C	na	0.01	mS/cm	nd	0.02	yes	113	85	115	yes	na	na	na	na	na	yes
pH	na	0.01	Units	na	na	na	100	90	110	yes	na	na	na	na	na	yes

EQL = Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence
* = Unavailable due to dilution required for analysis
na = Not Applicable
ns = Insufficient Sample Submitted
nd = parameter not detected
TR = trace level less than EQL

Philip Analytical Services Corp

Report of Analysis

Client : Shaheen & Peaker Ltd.
Contact: Sergiy Tchernikov

Report Date: September 18/2001
Lab Ref # : G214323
Lab Quote #: .

Analysis of Soil, expressed on a dry weight basis

Client Ref#: SP3977

Parameter	EQL	Units	G SA BH 60 2/1 2001/09/07	G SA BH 60 3/1 2001/09/07	G SA BH 60 4/1 2001/09/07	G SA BH 60 5/1 2001/09/07	G SA T2/1 2001/09/07
Mercury	0.01	mg/kg	0.12	0.41	0.50	1.41	0.05
Thallium	1.0	mg/kg	nd	nd	nd	nd	nd
Antimony	0.2	mg/kg	4.3	431	45.8	11.3	1.6
Arsenic	0.2	mg/kg	6.4	244	74.4	10.8	2.6
Selenium	0.2	mg/kg	nd	4.8	0.8	0.9	nd
Chromium, hexavalent	1	mg/kg	nd	nd	nd	nd	nd
Cyanide, Free	0.02	mg/kg	nd	nd	nd	nd	nd
Sodium Adsorption Ratio	0.05	na	0.32	2.78	0.74	0.32	0.25
Barium	5	mg/kg	45	201	172	300	35
Beryllium	0.2	mg/kg	nd	0.3	0.4	0.7	nd
Boron(Hot water soluble)	0.2	mg/kg	nd	0.4	0.5	0.3	nd
Cadmium	0.5	mg/kg	1.1	29.8	11.6	11.4	nd
Chromium	1	mg/kg	20	99	52	238	13
Cobalt	2	mg/kg	4	9	5	7	3
Copper	1	mg/kg	43	467	217	251	20
Lead	5	mg/kg	206	23500	7080	888	120
Molybdenum	3	mg/kg	nd	nd	nd	nd	nd
Nickel	2	mg/kg	11	73	22	46	8
Silver	1	mg/kg	nd	2	nd	2	nd
Vanadium	1	mg/kg	12	38	26	25	15
Zinc	5	mg/kg	248	1270	550	719	107
Conductivity - @25°C	0.01	mS/cm	0.23	0.51	0.41	0.24	0.31
pH	0.01	Units	7.56	7.71	7.26	7.46	7.72

EQL Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence.
na Not Applicable
nd parameter not detected ! = EQL higher than listed due to dilution ( ) Adjusted EQL

Philip Analytical Services Corp

Report of Analysis

Client : Shaheen & Peaker Ltd.
Contact: Sergiy Tchernikov

Report Date: September 18/2001
Lab Ref # : G214323
Lab Quote #:

Analysis of Soil, expressed on a dry weight basis

Client Ref#: SP3977

Parameter	EQL	Units	G SA T3/1 2001/09/07	G SA T4/1 2001/09/07	G SA T5/1 2001/09/07	G SA T6/1 2001/09/07	G SA T7/1 2001/09/07
Mercury	0.01	mg/kg	0.13	0.51	0.41	0.57	0.18
Thallium	1.0	mg/kg	nd	nd	nd	nd	nd
Antimony	0.2	mg/kg	11.0	20.5	8.5	128	3.2
Arsenic	0.2	mg/kg	10.8	17.8	13.8	110	6.4
Selenium	0.2	mg/kg	0.2	0.3	0.2	1.1	0.4
Chromium, hexavalent	1	mg/kg	nd	nd	nd	nd	nd
Cyanide, Free	0.02	mg/kg	nd	nd	nd	nd	0.65
Sodium Adsorption Ratio	0.05	na	1.97	0.35	1.70	0.44	9.23
Barium	5	mg/kg	52	79	134	165	151
Beryllium	0.2	mg/kg	nd	0.4	0.2	0.5	0.5
Boron(Hot water soluble)	0.2	mg/kg	0.2	0.3	0.6	0.4	0.3
Cadmium	0.5	mg/kg	1.4	6.6	2.8	9.8	1.3
Chromium	1	mg/kg	71	76	36	32	50
Cobalt	2	mg/kg	5	4	3	7	6
Copper	1	mg/kg	70	90	62	246	518
Lead	5	mg/kg	551	1490	421	6260	297
Molybdenum	3	mg/kg	nd	nd	nd	nd	nd
Nickel	2	mg/kg	15	18	10	36	26
Silver	1	mg/kg	nd	nd	nd	1	nd
Vanadium	1	mg/kg	16	14	13	26	29
Zinc	5	mg/kg	270	254	190	579	370
Conductivity - @25°C	0.01	mS/cm	0.46	0.24	1.95	0.43	2.62
pH	0.01	Units	7.60	7.44	7.58	7.76	7.81

EQL Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence.
na Not Applicable
nd parameter not detected ! = EQL higher than listed due to dilution ( ) Adjusted EQL

ANALYTICAL SERVICES

Client: Shaheen & Peaker Ltd.
250 Galaxy Blvd.
Etobicoke, ON, CANADA
M9W 5R8

Fax: 416-213-1260

Attn: David Baigent

Date Received:	September 19/2001
Date Reported:	September 26/2001
Lab Ref#:	G214601
Lab Quote#:	S&P2001
Client PO#:	SP3977
Client Ref#:	SP3977
Sampled By:	Seriv Tcherniko

Certificate of Analysis

Analysis Performed:

GUIDELINES(CONTAMINATED SITES)
Thallium, Graphite Furnace, Digestion Required
Boron(hot water soluble) by ICP

Methodology:

1) Determination of mercury in soils/sediment by cold vapour atomic absorption spectrophotometry.
U.S. EPA SW846 Methods No. 7471A & 7470A
2) Analysis of thallium in soil by Graphite Furnace Atomic Absorption.
U.S. EPA Method No. 7841
3) Analysis of arsenic in soil by Hydride Generation Atomic Absorption.
U.S. EPA Method No. 7061(Modifications)
4) Analysis of antimony in soil by hydride generation.
U.S. EPA Method No. 7042
5) Analysis of selenium in soil by hydride generation.
U.S. EPA Method No. 7741(Modification)
6) Colourimetric determination of chromium VI in soil, in a continuous liquid flow.
EPL CR6 Internal Refer. Method for soils
Refer - Method No. 1102304 Issue 121489

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ANALYTICAL SERVICES

Client: Shaheen & Peaker Ltd.
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M9W 5R8

Fax: 416-213-1260

Attn: David Baigent

Date Received:	September 19/2001
Date Reported:	September 26/2001
Lab Ref#:	G214601
Lab Quote#:	S&P2001
Client PO#:	SP3977
Client Ref#:	SP3977
Sampled By:	Seriv Tcherniko

Certificate of Analysis

Methodology: (Cont'd)

7) The determination of free cyanide in a soil by automated colourimetry following an aqueous extraction.
Lachat Method No. 10-204-00-1-A(Mod)
(Prep-MOEE Guidance, Analytical Methods)

8) Calculation of sodium adsorption ratio after determination of cations by ICP AES(Aqueous extraction done using 1:2 soil:water ratio).
McKeague Methods of Soil Analysis 3.23
McKeague Methods of Soil Analysis 3.26

9) Analysis of hot water soluble boron in soil by performing a hot aqueous extraction prior to the analysis using ICPAES.
U.S. EPA Method No. 6010
Canadian Council Min.Environ. Criteria

10) Analysis of trace metals in soil by Inductively Coupled Plasma Atomic Emission Spectrophotometry.
U.S. EPA Method No. 6010(Modification)

11) Conductivity is determined by the measured resistance and reported in milli siemens/cm.
U.S. EPA Method No. 9050

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Client: Shaheen & Peaker Ltd.
250 Galaxy Blvd.
Etobicoke, ON, CANADA
M9W 5R8

Fax: 416-213-1260

Attn: David Baigent

Date Received: September 19/2001
Date Reported: September 26/2001
Lab Ref#: G214601
Lab Quote#: S&P2001
Client PO#: SP3977
Client Ref#: SP3977
Sampled By: Seriv Tcherniko

Certificate of Analysis

Methodology: (Cont'd)

12) Analysis of pH in soil by electrode.
U.S. EPA Method No. 9045

Instrumentation:

1) Thermo Separation Products Mercury Analyzer
2) Varian Spectro AA 400/Zeeman Graphite Tube Atomizer
3) Varian VGA 76
4, 5) Thermo Jarrell Ash Smith-Hieftje 22 AA/Varian VGA 76
6) Skalar Segmented Flow Analyzer, Model SA 20/40
7) Lachat Flow Injection Analyzer, Model Quick-Chem 8000
8, 9,10) Thermo Jarrell Ash ICAP 61E Plasma Spectrophotometer
11) Radiometer CopenHagen CDM83 Conductivity Meter
12) Orion Research Expandable Ion Analyzer EA940

Sample Description: Soil

QA/QC: Refer to CERTIFICATE OF QUALITY CONTROL report.

Results: Refer to REPORT of ANALYSIS attached.

Certified By
Melissa Mone
Account Manager

Certified By
Laboratory Supervisor

5735 McAdam Road, Mississauga, Ontario, Canada L4Z 1N9 Tel: (905) 890-8566 Fax: (905) 890-8575

Philip Analytical Services Corp

Certificate of Quality Control

Client : Shaheen & Peaker Ltd.
Contact: David Baigent

Date Reported: September 26/2001
Lab Ref # : G214601
Lab Quote#: S&P2001
Client PO#: SP3977
Client Ref#: SP3977

Analysis of Soil, expressed on a dry weight basis

				Process Blank			Process % Recovery				Matrix Spike					Overall
Parameter	SAMPLE ID (spike)	EQL	Units	Result	Upper Limit	Accept	Result	Lower Limit	Upper Limit	Accept	Result	Target	Lower Limit	Upper Limit	Accept	QC Acceptable
Conductivity - @25°C	na	0.01	mS/cm	nd	0.02	yes	100	85	115	yes	na	na	na	na	na	yes
pH	na	0.01	Units	na	na	na	92	90	110	yes	na	na	na	na	na	yes

EQL = Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence
* = Unavailable due to dilution required for analysis
na = Not Applicable
ns = Insufficient Sample Submitted
nd = parameter not detected
TR = trace level less than EQL

Philip Analytical Services Corp

Report of Analysis

Client : Shaheen & Peaker Ltd.
Contact: David Baigent

Report Date: September 26/2001
Lab Ref # : G214601
Lab Quote #: S&P2001
Client PO#: SP3977
Client Ref#: SP3977

Analysis of Soil, expressed on a dry weight basis

Parameter	EQL	Units	BH700 SS1 2001/09/18	BH700 SS1 Replicate	BH701 SS1 2001/09/18	BH702 SS1 2001/09/18	BH703 SS1 2001/09/18
Mercury	0.01	mg/kg	0.03	0.04	0.08	0.02	0.02
Thallium	1.0	mg/kg	nd	nd	nd	nd	nd
Antimony	0.2	mg/kg	4.7	3.7	8.5	2.5	55.1
Arsenic	0.2	mg/kg	6.0	5.1	5.9	4.5	2.9
Selenium	0.2	mg/kg	nd	nd	nd	nd	nd
Chromium, hexavalent	1	mg/kg	nd	nd	nd	nd	nd
Cyanide, Free	0.02	mg/kg	nd	nd	nd	nd	nd
Sodium Adsorption Ratio	0.05	na	2.50	2.60	2.90	4.30	1.89
Barium	5	mg/kg	31	29	79	23	21
Beryllium	0.2	mg/kg	nd	nd	0.3	nd	0.2
Boron(Hot water soluble)	0.2	mg/kg	0.2	nd	nd	nd	nd
Cadmium	0.5	mg/kg	0.6	0.8	nd	0.5	nd
Chromium	1	mg/kg	17	16	208	23	21
Cobalt	2	mg/kg	4	3	3	3	2
Copper	1	mg/kg	30	29	49	18	11
Lead	5	mg/kg	454	395	368	246	849
Molybdenum	3	mg/kg	nd	nd	nd	nd	nd
Nickel	2	mg/kg	11	10	8	7	6
Silver	1	mg/kg	nd	nd	nd	nd	nd
Vanadium	1	mg/kg	18	16	18	18	19
Zinc	5	mg/kg	137	125	124	76	50
Conductivity - @25°C	0.01	mS/cm	0.38	0.38	0.82	1.34	0.28
pH	0.01	Units	8.82	8.81	10.4	11.0	7.94

EQL Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence.
na Not Applicable
nd parameter not detected ! = EQL higher than listed due to dilution ( ) Adjusted EQL

Philip Analytical Services Corp

Report of Analysis

Client : Shaheen & Peaker Ltd.
Contact: David Baigent

Report Date: September 26/2001
Lab Ref # : G214601
Lab Quote #: S&P2001
Client PO#: SP3977
Client Ref#: SP3977

Analysis of Soil, expressed on a dry weight basis

Parameter	EQL	Units	BH704 SS1 2001/09/18	BH705 SS1 2001/09/18	BH706 SS1 2001/09/18	BH707 SS1 2001/09/18	
Mercury	0.01	mg/kg	0.02	nd	0.69	0.56	
Thallium	1.0	mg/kg	nd	nd	nd	nd	
Antimony	0.2	mg/kg	7.0	0.7	2.1	4.7	
Arsenic	0.2	mg/kg	3.7	2.6	4.5	8.4	
Selenium	0.2	mg/kg	nd	nd	0.2	0.7	
Chromium, hexavalent	1	mg/kg	nd	nd	nd	nd	
Cyanide, Free	0.02	mg/kg	0.27	nd	nd	0.56	
Sodium Adsorption Ratio	0.05	na	1.19	0.57	5.30	1.20	
Barium	5	mg/kg	18	10	213	168	
Beryllium	0.2	mg/kg	nd	nd	0.5	0.3	
Boron(Hot water soluble)	0.2	mg/kg	nd	nd	3.2	0.4	
Cadmium	0.5	mg/kg	nd	nd	6.1	2.7	
Chromium	1	mg/kg	9	6	66	33	
Cobalt	2	mg/kg	3	2	7	3	
Copper	1	mg/kg	19	7	111	87	
Lead	5	mg/kg	324	49	193	552	
Molybdenum	3	mg/kg	nd	nd	nd	nd	
Nickel	2	mg/kg	5	3	27	14	
Silver	1	mg/kg	nd	nd	1	1	
Vanadium	1	mg/kg	19	18	24	18	
Zinc	5	mg/kg	67	21	236	727	
Conductivity - @25°C	0.01	mS/cm	0.48	0.13	0.99	2.66	
pH	0.01	Units	8.26	8.58	8.51	7.46	

EQL Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence.
na Not Applicable
nd parameter not detected ! = EQL higher than listed due to dilution ( ) Adjusted EQL

ANALYTICAL SERVICES

Client: Shaheen & Peaker Ltd.
250 Galaxy Blvd.
Etobicoke, ON, CANADA
M9W 5R8

Fax: 416-213-1260

Attn: David Baigent

Date Received:	September 19/2001
Date Reported:	September 26/2001
Lab Ref#:	G214601
Lab Quote#:	S&P2001
Client PO#:	SP3977
Client Ref#:	SP3977
Sampled By:	Seriv Tcherniko

Certificate of Analysis

Analysis Performed:

Extractable Hydrocarbon Analysis(MUST), C10-C24
TPH(Hot Extractable), Gravimetry
Total Purgeable Hydrocarbons

Methodology:

1) The characterization of HydroCarbon in soil by GC analysis, following a solvent extraction.
U.S. EPA Method No.8011(microextraction)
2) Determination of TPH(hot extractable) in soil, using solvent extraction. Analysis of evaporated extract by gravimetry.
U.S. EPA Method No. 9071(Modification)
3) Purge & Trap capillary GC/MS analysis of Soil samples for Total Purgeable Hydrocarbons.
U.S. EPA Method No. 5030

Instrumentation:

1) GC/FID/FID, Hewlett-PackardII GC, Dual injector, Dual FID, A/S
2) Precision Mechanical Convention Oven/Sartorius Research Balance
3) Purge & Trap-GC/MS

ANALYTICAL SERVICES

Client: Shaheen & Peaker Ltd.
250 Galaxy Blvd.
Etobicoke, ON, CANADA
M9W 5R8

Fax: 416-213-1260

Attn: David Baigent

Date Received:	September 19/2001
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Lab Ref#:	G214601
Lab Quote#:	S&P2001
Client PO#:	SP3977
Client Ref#:	SP3977
Sampled By:	Seriv Tcherniko

Certificate of Analysis

Sample Description: Soil

QA/QC: Refer to CERTIFICATE OF QUALITY CONTROL report.

Results: Refer to REPORT of ANALYSIS attached.

Certified By
Melissa Mone
Account Manager

Certified By
Laboratory Supervisor

5735 McAdam Road, Mississauga, Ontario, Canada L4Z 1N9 Tel: (905) 890-8566 Fax: (905) 890-8575

Philip Analytical Services Corp

Report of Analysis

Client : Shaheen & Peaker Ltd.
Contact: David Baigent

Report Date: September 26/2001
Lab Ref # : G214601
Lab Quote #: S&P2001
Client PO#: SP3977
Client Ref#: SP3977

Analysis of Soil, expressed on a dry weight basis

Parameter	EQL	Units	BH704 SS1 2001/09/18	BH704 SS1 Replicate	BH706 SS1 2001/09/18	BH707 SS1 2001/09/18	
Resemblance	na	na	EDMO?	EDMO?	EDMO?	EDMO?	
Total Extractable Hydrocarbons(C10-C24)	10.0	ug/g	35.8	39.3	663	275	
TPH(Hot Extractable)	100.0	ug/g	248	206	1940	758	
Total Purgeable Hydrocarbons	10	ug/g	nd	nd	22	nd	

EQL Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence.
EDMO? Contaminant elutes across the diesel/motor oil range but does not match reference standards.
na Not Applicable
nd parameter not detected ! = EQL higher than listed due to dilution ( ) Adjusted EQL

ANALYTICAL SERVICES

Client: Shaheen & Peaker Limited
Project Reference: SP3977
Work Order: G214601
Matrix: Soil

VOLATILE ORGANIC COMPOUNDS

Units: micrograms/gram (ug/g) dry weight

Date: 26-Sep-01

Compound	EQL ug/g	BH704 SS1	BH704 SS1 Dup.	BH707 SS1
Chloromethane	0.005	nd	nd	nd
Vinyl Chloride	0.002	nd	nd	nd
Bromomethane	0.005	nd	nd	nd
Chloroethane	0.005	nd	nd	nd
Trichlorofluoromethane	0.005	nd	nd	nd
Acetone	0.100	nd	nd	nd
1,1-Dichloroethene	0.002	nd	nd	nd
Dichloromethane (Methylene Chloride)	0.010	nd	nd	nd
trans-1,2-Dichloroethene	0.002	nd	nd	nd
Methyl-t-Butyl Ether	0.002	nd	nd	nd
1,1-Dichloroethane	0.002	nd	nd	nd
Methyl Ethyl Ketone (MEK)	0.025	nd	nd	nd
cis-1,2-Dichloroethene	0.002	nd	nd	nd
Chloroform	0.002	nd	nd	nd
1,2-Dichloroethane	0.002	nd	nd	nd
1,1,1-Trichloroethane	0.002	nd	nd	nd
Carbon Tetrachloride	0.002	nd	nd	nd
Benzene	0.002	0.002	*0.001	0.002
1,2-Dichloropropane	0.002	nd	nd	nd
Trichloroethene (Trichloroethylene)	0.002	nd	nd	nd
Bromodichloromethane	0.002	nd	nd	nd
cis-1,3-Dichloropropene	0.002	nd	nd	nd
Methyl Isobutyl Ketone (MIBK)	0.025	nd	nd	nd
trans-1,3-Dichloropropene	0.002	nd	nd	nd
1,1,2-Trichloroethane	0.002	nd	nd	nd
Toluene	0.002	0.007	0.005	0.004
2-Hexanone	0.025	nd	nd	nd
Dibromochloromethane	0.002	nd	nd	nd
1,2-Dibromoethane (Ethylene dibromide)	0.002	nd	nd	nd
Tetrachloroethene (Perchloroethylene)	0.002	nd	nd	nd
1,1,1,2-Tetrachloroethane	0.002	nd	nd	nd
Chlorobenzene	0.002	nd	nd	nd
Ethylbenzene	0.002	nd	nd	nd
m-Xylene & p-Xylene	0.002	0.006	0.003	0.002
Bromoform	0.002	nd	nd	nd
Styrene	0.002	nd	nd	nd
1,1,2,2-Tetrachloroethane	0.002	nd	nd	nd
o-Xylene	0.002	nd	nd	nd
1,3-Dichlorobenzene	0.002	nd	nd	nd
1,4-Dichlorobenzene	0.002	nd	nd	nd
1,2-Dichlorobenzene	0.002	nd	nd	nd
Surrogate Standard Recoveries	(Control Limits)			
Dibromofluoromethane (70-130%)		97%	94%	94%
Toluene-d8 (70-130%)		110%	116%	114%
4-Bromofluorobenzene (70-130%)		81%	77%	82%

ANALYTICAL SERVICES

lient: Shaheen & Peaker Limited
ject Reference: SP3977
k Order: G214601
latrix: Soil

VOLATILE ORGANIC COMPOUNDS
(by high level purge & trap)

Units: micrograms/gram (ug/g) dry weight

Date: 26-Sep-01

ompound	EQL ug/g	BH706 SS1
oromethane	1.0	nd
yl Chloride	0.5	nd
romomethane	1.0	nd
hloroethane	0.5	nd
hlorofluoromethane	0.2	nd
tone	10.0	nd
,1-Dichloroethene	0.1	nd
hloromethane (Methylene Chloride)	0.5	nd
s-1,2-Dichloroethene	0.1	nd
ethyl-t-Butyl Ether	0.1	nd
.1-Dichloroethane	0.1	nd
thyl Ethyl Ketone (MEK)	5.0	nd
-1,2-Dichloroethene	0.1	0.1
hloroform	0.1	nd
-Dichloroethane	0.1	nd
,1-Trichloroethane	0.1	nd
arbon Tetrachloride	0.1	nd
enzene	0.05	0.09
-Dichloropropane	0.1	nd
chloroethene (Trichloroethylene)	0.1	nd
romodichloromethane	0.1	nd
-1,3-Dichloropropene	0.1	nd
thyl Isobutyl Ketone (MIBK)	5.0	nd
ans-1,3-Dichloropropene	0.1	nd
1,2-Trichloroethane	0.1	nd
uene	0.1	0.9
lexanone	5.0	nd
ibromochloromethane	0.1	nd
-Dibromoethane (Ethylene dibromide)	0.1	nd
rachloroethene (Perchloroethylene)	0.1	nd
,1,1,2-Tetrachloroethane	0.1	nd
hlorobenzene	0.1	nd
ylbenzene	0.1	0.2
Xylene & p-Xylene	0.1	0.4
romoform	0.1	nd
rene	0.1	nd
,2,2-Tetrachloroethane	0.1	nd
-Xylene	0.1	0.1
,3-Dichlorobenzene	0.1	nd
-Dichlorobenzene	0.1	nd
-Dichlorobenzene	0.1	nd
Surrogate Standard Recoveries	(Control Limits)	
romofluoromethane (70-130%)		103%
luene-d8 (70-130%)		96%
4-Bromofluorobenzene (70-130%)		89%

ANALYTICAL SERVICES

Client: Shaheen & Peaker Limited
Project Reference: SP3977
Work Order: G214601
Matrix: Soil

VOLATILE ORGANIC COMPOUNDS
(by high level purge & trap)

Units: micrograms/gram (ug/g) dry weight

Date: 26-Sep-01

		Method Blank			Spiked Method Blank			
Compound	EQL ug/g	Result	Upper Limit	Accept	% Recovery	Lower Limit	Upper Limit	Accept
Chloromethane	1.0	nd	1.0	yes	125	60	140	yes
Vinyl Chloride	0.5	nd	0.5	yes	102	60	140	yes
Bromomethane	1.0	nd	1.0	yes	114	60	140	yes
Chloroethane	0.5	nd	0.5	yes	115	60	140	yes
Trichlorofluoromethane	0.2	nd	0.2	yes	107	60	140	yes
Acetone	10.0	nd	10.0	yes	139	60	140	yes
1,1-Dichloroethene	0.1	nd	0.1	yes	110	70	130	yes
Dichloromethane (Methylene Chloride)	0.5	nd	0.5	yes	106	70	130	yes
trans-1,2-Dichloroethene	0.1	nd	0.1	yes	107	70	130	yes
Methyl-t-Butyl Ether	0.1	nd	0.1	yes	108	70	130	yes
1,1-Dichloroethane	0.1	nd	0.1	yes	108	70	130	yes
Methyl Ethyl Ketone (MEK)	5.0	nd	5.0	yes	123	60	140	yes
cis-1,2-Dichloroethene	0.1	nd	0.1	yes	108	70	130	yes
Chloroform	0.1	nd	0.1	yes	106	70	130	yes
1,2-Dichloroethane	0.1	nd	0.1	yes	108	70	130	yes
1,1,1-Trichloroethane	0.1	nd	0.1	yes	103	70	130	yes
Carbon Tetrachloride	0.1	nd	0.1	yes	102	70	130	yes
Benzene	0.05	nd	0.05	yes	107	70	130	yes
1,2-Dichloropropane	0.1	nd	0.1	yes	107	70	130	yes
Trichloroethene (Trichloroethylene)	0.1	nd	0.1	yes	107	70	130	yes
Bromodichloromethane	0.1	nd	0.1	yes	101	70	130	yes
cis-1,3-Dichloropropene	0.1	nd	0.1	yes	103	70	130	yes
Methyl Isobutyl Ketone (MIBK)	5.0	nd	5.0	yes	102	60	140	yes
trans-1,3-Dichloropropene	0.1	nd	0.1	yes	100	70	130	yes
1,1,2-Trichloroethane	0.1	nd	0.1	yes	108	70	130	yes
Toluene	0.1	nd	0.1	yes	107	70	130	yes
2-Hexanone	5.0	nd	5.0	yes	106	60	140	yes
Dibromochloromethane	0.1	nd	0.1	yes	101	70	130	yes
1,2-Dibromoethane (Ethylene dibromide)	0.1	nd	0.1	yes	103	70	130	yes
Tetrachloroethene (Perchloroethylene)	0.1	nd	0.1	yes	108	70	130	yes
1,1,1,2-Tetrachloroethane	0.1	nd	0.1	yes	102	70	130	yes
Chlorobenzene	0.1	nd	0.1	yes	108	70	130	yes
Ethylbenzene	0.1	nd	0.1	yes	108	70	130	yes
m-Xylene & p-Xylene	0.1	nd	0.1	yes	107	70	130	yes
Bromoform	0.1	nd	0.1	yes	102	70	130	yes
Styrene	0.1	nd	0.1	yes	107	70	130	yes
1,1,2,2-Tetrachloroethane	0.1	nd	0.1	yes	108	70	130	yes
o-Xylene	0.1	nd	0.1	yes	108	70	130	yes
1,3-Dichlorobenzene	0.1	nd	0.1	yes	109	70	130	yes
1,4-Dichlorobenzene	0.1	nd	0.1	yes	107	70	130	yes
1,2-Dichlorobenzene	0.1	nd	0.1	yes	108	70	130	yes
Surrogate Standard Recoveries	(Control Limits)							
Dibromofluoromethane		104%	70-130%	yes	100	70	130	yes
Toluene-d8		**97%**	70-130%	**yes**	**100**	**70**	**130**	**yes**
4-Bromofluorobenzene		**97%**	70-130%	**yes**	101	70	130	yes

ANALYTICAL SERVICES

Client: Shaheen & Peaker Limited
Project Reference: SP3977
Work Order: G214601
Matrix: Soil

VOLATILE ORGANIC COMPOUNDS

Date: 26-Sep-01

Legend: EQL = Estimated Quantitation Limit for undiluted samples
nd = Not Detected Above EQL
Dup. = Duplicate
* = Detected below EQL but passed compound identification criteria

Date of sample receipt: September 19, 2001
Date of sample analysis: September 24 & 26, 2001

Analytical Method:

The soil samples (except as noted below) were analysed by low level purge & trap (US EPA Method 5035) gas chromatography/ mass spectrometry using US EPA Method 8260B (modified).

Due to a level of petroleum hydrocarbon compounds beyond the appropriate range, sample BH706 SS1 could not be analysed by the low level direct purge method. A portion of the sample was preextracted in methanol and the extract analysed by high level purge & trap (US EPA Method 5035) gas chromatography/mass spectrometry using US EPA Method 8260B (modified).

Note: Estimated quantitation limit is the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

NOTE: All work recorded herein has been done in accordance with normal professional standards using accepted testing methodologies and QA/QC procedures. Philip Analytical is limited in liability to the actual cost of the pertinent analysis done. Your samples will be retained by PAS for a period of 30 days following reporting or as per specific contractual arrangement.

Job Approved By:

Anne Trebaul, M.Sc.
Chemist

ANALYTICAL SERVICES

Client: Shaheen & Peaker Ltd.
Project Reference: SP3977
Work Order Number: G214601B
Matrix: Soil

Polynuclear Aromatic Hydrocarbons (PAH's)

Units: Micrograms/gram (µg/g) dry weight

Date: 28-Sep-01

Compound	EQL µg/g	BH704 SS1	EQL µg/g	BH706 SS1 DF=4	BH707 SS1 DF=4
Naphthalene	0.05	nd	0.20	*0.10	*0.14
2-Methylnaphthalene	0.05	nd	0.20	*0.12	nd
1-Methylnaphthalene	0.05	nd	0.20	*0.10	nd
Acenaphthylene	0.05	nd	0.20	*0.12	1.03
Acenaphthene	0.05	nd	0.20	*0.12	*0.12
Fluorene	0.05	nd	0.20	*0.15	0.63
Phenanthrene	0.05	0.09	0.20	0.53	6.18
Anthracene	0.05	nd	0.20	0.21	1.58
Fluoranthene	0.05	0.19	0.20	0.89	9.45
Pyrene	0.05	0.25	0.20	0.82	7.36
Benzo(a)anthracene	0.05	0.12	0.20	0.46	3.74
Chrysene	0.05	0.15	0.20	0.44	3.35
Benzo(b)fluoranthene	0.05	0.19	0.20	0.60	4.25
Benzo(k)fluoranthene	0.05	0.07	0.20	0.24	1.70
Benzo(a)pyrene	0.05	0.10	0.20	0.55	3.59
Indeno(1,2,3-cd)pyrene	0.05	0.10	0.20	0.45	2.22
Dibenzo(a,h)anthracene	0.05	nd	0.20	*0.12	0.45
Benzo(ghi)perylene	0.05	0.10	0.20	0.47	2.02
Surrogate Standard Recoveries (Control Limits)					
Acenaphthene-d10 (19-121%)		79%		73%	75%
Anthracene-d10 (27-126%)		73%		69%	70%
Benzo(a)pyrene-d12 (44-136%)		71%		64%	66%

ANALYTICAL SERVICES

Client: Shaheen & Peaker Ltd.
Project Reference: SP3977
Work Order Number: G214601B
Matrix: Soil

Polynuclear Aromatic Hydrocarbons (PAH's)

Date: 28-Sep-01

Legend: EQL = Estimated Quantitation Limit
nd = Not detected above EQL
DF = Dilution Factor
* = Detected below EQL but passed compound identification criteria

Date received: September 19, 2001
Date extracted: September 27, 2001
Date analysed: September 27-28, 2001

ANALYTICAL METHOD:

The soil samples (10 grams wet weight) were mixed with sodium sulfate and extracted with a 1:1 mixture of acetone:dichloromethane. The extracts were cleaned up using alumina column chromatography. Analysis was performed by gas chromatography/mass spectrometry using U.S. EPA Method 8270C (modified).

REPORT DISCUSSION:

Samples BH706-SS1 and BH707 SS1 were run at a dilution factor of 4 due to elevated levels of target and nontarget compounds present which would exceed the calibration range of the instrument and cause contamination of the equipment if run undiluted. The quantitation limits for these samples are higher than the EQL's for the undiluted sample as indicated above. The amounts reported have been corrected for the dilution factor that was used.

Note: Estimated quantitation limit is the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

NOTE: All work recorded herein has been done in accordance with normal professional standards using accepted testing methodologies and QA/QC procedures. Philip Analytical is limited in liability to the actual cost of the pertinent analysis done. Your samples will be retained by PASC for a period of 30 days following reporting or as per specific contractual arrangement.

JOB APPROVED BY:

Michael Wang, Ph.D.
Chemist

ANALYTICAL SERVICES

Client: Shaheen & Peaker Ltd.
250 Galaxy Blvd.
Etobicoke, ON, CANADA
M9W 5R8

Fax: 416-213-1260

Attn: Sergiy Tchernikov

Date Received: November 15/2001
Date Reported: November 21/2001
Lab Ref#: G216046
Lab Quote#:

Client Ref#: SP3977
Sampled By: S.T.

Certificate of Analysis

4) Hach One Laboratory pH Meter - Ion Selective Electrode

Sample Description: TCLP Extraction

QA/QC: Refer to CERTIFICATE OF QUALITY CONTROL report.

Results: Refer to REPORT of ANALYSIS attached.

Certified By
Melissa Mone
Account Manager

Certified By
Laboratory Supervisor

5735 McAdam Road, Mississauga, Ontario, Canada L4Z 1N9 Tel: (905) 890-8566 Fax: (905) 890-8575

Philip Analytical Services Corp

Certificate of Quality Control

Date Reported: November 21/2001
Lab Ref # : G216046
Lab Quote#: .

Client : Shaheen & Peaker Ltd.
Contact: Sergiy Tchernikov

Client Ref#: SP3977

Analysis of TCLP Extraction, Soil

				Process Blank			Process % Recovery				Matrix Spike					Overall
Parameter	SAMPLE ID (spike)	EQL	Units	Result	Upper Limit	Accept	Result	Lower Limit	Upper Limit	Accept	Result	Target	Lower Limit	Upper Limit	Accept	QC Acceptable
Nitrite(as N) and Nitrate(as N)	na	0.2	mg/L	nd	0.5	yes	98	83	116	yes	na	na	na	na	na	yes
Cyanide, Free	na	0.01	mg/L	nd	0.02	yes	100	72	120	yes	na	na	na	na	na	yes
Arsenic	na	0.2	mg/L	nd	0.4	yes	105	80	120	yes	na	na	na	na	na	yes
Barium	na	0.2	mg/L	nd	0.4	yes	107	80	120	yes	na	na	na	na	na	yes
Boron	na	0.1	mg/L	nd	0.2	yes	103	60	140	yes	na	na	na	na	na	yes
Cadmium	na	0.05	mg/L	nd	0.1	yes	101	80	120	yes	na	na	na	na	na	yes
Chromium	na	0.1	mg/L	nd	0.2	yes	102	80	120	yes	na	na	na	na	na	yes
Lead	na	0.1	mg/L	nd	0.2	yes	105	80	120	yes	na	na	na	na	na	yes
Mercury	na	0.01	mg/L	nd	0.02	yes	96	60	140	yes	na	na	na	na	na	yes
Selenium	na	0.1	mg/L	nd	0.2	yes	102	80	120	yes	na	na	na	na	na	yes
Silver	na	0.01	mg/L	nd	0.05	yes	65	50	150	yes	na	na	na	na	na	yes
Uranium	na	0.01	mg/L	nd	0.02	yes	103	80	120	yes	na	na	na	na	na	yes
Fluoride	na	0.1	mg/L	nd	0.2	yes	105	89	112	yes	na	na	na	na	na	yes

EQL = Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence
* = Unavailable due to dilution required for analysis
na = Not Applicable
ns = Insufficient Sample Submitted
nd = parameter not detected
TR = trace level less than EQL

Philip Analytical Services Corp

Report of Analysis

Client : Shaheen & Peaker Ltd.
Contact: Sergiy Tchernikov

Report Date: November 21/2001
Lab Ref # : G216046
Lab Quote #: .

Analysis of TCLP Extraction, Soil

Client Ref#: SP3977

Parameter	EQL	Units	GSA BH603/ 1	GSA BH603/ 1 Replicate	GSA BH604/ 1		
Nitrite(as N) and Nitrate(as N)	0.2	mg/L	nd	0.2	1.4		
Cyanide, Free	0.01	mg/L	nd	nd	nd		
Arsenic	0.2	mg/L	nd	nd	nd		
Barium	0.2	mg/L	0.5	0.5	0.7		
Boron	0.1	mg/L	nd	nd	0.1		
Cadmium	0.05	mg/L	0.27	0.29	0.09		
Chromium	0.1	mg/L	nd	nd	nd		
Lead	0.1	mg/L	135	154	5.0		
Mercury	0.01	mg/L	nd	nd	nd		
Selenium	0.1	mg/L	nd	nd	nd		
Silver	0.01	mg/L	nd	nd	nd		
Uranium	0.01	mg/L	nd	nd	nd		
Fluoride	0.1	mg/L	nd	nd	0.2		

EQL Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence.
nd parameter not detected ! = EQL higher than listed due to dilution ( ) Adjusted EQL

Philip Analytical Services Corp

Certificate of Quality Control

Date Reported: September 26/2001
Lab Ref # : G214618
Lab Quote#: .
Client PO#: SP3977
Client Ref#: SP3977

Client : Shaheen & Peaker Ltd.
Contact: David Baigent

Analysis of Water

				Process Blank			Process % Recovery				Matrix Spike					Overall
Parameter	SAMPLE ID (spike)	EQL	Units	Result	Upper Limit	Accept	Result	Lower Limit	Upper Limit	Accept	Result	Target	Lower Limit	Upper Limit	Accept	QC Acceptable
Mercury	na	.00005	mg/L	nd	0.0001	yes	106	85	115	yes	na	na	na	na	na	yes
Aluminum	BH.700	0.005	mg/L	nd	0.01	yes	103	80	120	yes	0.503	0.5	0.35	0.65	yes	yes
Antimony	BH.700	0.0005	mg/L	nd	0.001	yes	102	80	120	yes	0.4980	0.5	0.35	0.65	yes	yes
Arsenic	BH.700	0.002	mg/L	nd	0.004	yes	106	80	120	yes	0.512	0.5	0.35	0.65	yes	yes
Barium	BH.700	0.005	mg/L	nd	0.01	yes	100	80	120	yes	0.500	0.5	0.35	0.65	yes	yes
Beryllium	BH.700	0.001	mg/L	nd	0.002	yes	104	80	120	yes	0.493	0.5	0.35	0.65	yes	yes
Bismuth	na	0.001	mg/L	nd	0.002	yes	98	80	120	yes	na	na	na	na	na	yes
Boron	na	0.005	mg/L	nd	0.02	yes	102	80	120	yes	na	na	na	na	na	yes
Cadmium	BH.700	0.0001	mg/L	nd	0.0002	yes	100	80	120	yes	0.4850	0.5	0.35	0.65	yes	yes
Calcium	na	0.5	mg/L	nd	0.5	yes	99	80	120	yes	na	na	na	na	na	yes
Chromium	BH.700	0.005	mg/L	nd	0.01	yes	103	80	120	yes	0.497	0.5	0.35	0.65	yes	yes
Cobalt	BH.700	0.0001	mg/L	nd	0.0002	yes	100	80	120	yes	0.4900	0.5	0.35	0.65	yes	yes
Copper	BH.700	0.0005	mg/L	nd	0.001	yes	101	80	120	yes	0.4800	0.5	0.35	0.65	yes	yes
Iron	BH.700	0.03	mg/L	nd	0.05	yes	110	80	120	yes	0.45	0.5	0.35	0.65	yes	yes
Lead	BH.700	0.0005	mg/L	nd	0.001	yes	100	80	120	yes	0.4880	0.5	0.35	0.65	yes	yes
Magnesium	na	0.05	mg/L	nd	0.1	yes	101	80	120	yes	na	na	na	na	na	yes
Manganese	BH.700	0.005	mg/L	nd	0.01	yes	100	80	120	yes	0.499	0.5	0.35	0.65	yes	yes
Molybdenum	BH.700	0.001	mg/L	nd	0.002	yes	112	80	120	yes	0.497	0.5	0.35	0.65	yes	yes
Nickel	BH.700	0.001	mg/L	nd	0.002	yes	101	80	120	yes	0.481	0.5	0.35	0.65	yes	yes
Phosphorus	na	0.05	mg/L	nd	0.1	yes	105	80	120	yes	na	na	na	na	na	yes

EQL = Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence
* = Unavailable due to dilution required for analysis
na = Not Applicable
ns = Insufficient Sample Submitted
nd = parameter not detected
TR = trace level less than EQL

Philip Analytical Services Corp

Report of Analysis

Client : Shaheen & Peaker Ltd.
Contact: David Baigent

Report Date: September 26/2001
Lab Ref # : G214618
Lab Quote #: .
Client PO#: SP3977
Client Ref#: SP3977

Analysis of Water

Parameter	EQL	Units	BH.700 2001/09/19	BH.700 Replicate	BH.702 2001/09/19	BH.704 2001/09/19	BH.705 2001/09/19
Mercury	.00005	mg/L	nd	nd	nd	nd	nd
Aluminum	0.005	mg/L	0.009	0.009	0.016	0.041	0.021
Antimony	0.0005	mg/L	0.0029	0.0028	0.0172	0.0448	0.0053
Arsenic	0.002	mg/L	0.011	0.011	nd!(0.020)	nd!(0.020)	0.036
Barium	0.005	mg/L	0.268	0.263	0.380	0.247	0.584
Beryllium	0.001	mg/L	nd	nd	nd	nd	nd
Bismuth	0.001	mg/L	nd	nd	nd	nd	nd
Boron	0.005	mg/L	0.737	0.716	0.238	0.700	0.285
Cadmium	0.0001	mg/L	nd	nd	nd	nd	nd
Calcium	0.5	mg/L	148	141	254	293	279
Chromium	0.005	mg/L	nd	nd	nd!(0.050)	nd!(0.050)	nd!(0.050)
Cobalt	0.0001	mg/L	0.0011	0.0010	0.0006	0.0031	0.0037
Copper	0.0005	mg/L	nd	nd	0.0006	nd	nd
Iron	0.03	mg/L	0.37	0.35	0.28	0.66	1.86
Lead	0.0005	mg/L	0.0006	0.0005	0.0027	0.0044	0.0012
Magnesium	0.05	mg/L	30.5	29.5	34.7	34.7	41.5
Manganese	0.005	mg/L	0.572	0.542	0.883	1.41	1.99
Molybdenum	0.001	mg/L	0.006	0.006	0.006	0.003	0.002
Nickel	0.001	mg/L	0.004	0.004	0.002	0.004	0.003
Phosphorus	0.05	mg/L	nd	nd	nd	nd	nd
Potassium	0.1	mg/L	21.6	21.2	43.9	27.6	14.6
Selenium	0.002	mg/L	nd	nd	nd	nd	nd
Silver	0.0001	mg/L	nd	nd	nd	nd	nd
Sodium	0.1	mg/L	284	274	1800	2420	1720
Strontium	0.001	mg/L	0.694	0.659	1.66	1.50	1.29
Thallium	.00005	mg/L	0.00027	0.00025	0.00010	nd	nd
Tin	0.001	mg/L	nd	nd	nd	nd	nd

EQL Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence.
nd parameter not detected ! = EQL higher than listed due to dilution ( ) Adjusted EQL

Philip Analytical Services Corp

Report of Analysis

Client : Shaheen & Peaker Ltd.
Contact: David Baigent

Report Date: September 26/2001
Lab Ref # : G214618
Lab Quote #: .
Client PO#: SP3977
Client Ref#: SP3977

Analysis of Water

Parameter	EQL	Units	BH.700 2001/09/19	BH.700 Replicate	BH.702 2001/09/19	BH.704 2001/09/19	BH.705 2001/09/19
Titanium	0.005	mg/L	nd	nd	nd	nd	nd
Uranium	0.0001	mg/L	0.0005	0.0005	0.0014	0.0011	0.0013
Vanadium	0.0005	mg/L	0.0029	0.0026	nd!(0.0050)	nd!(0.0050)	nd!(0.0050)
Zinc	0.005	mg/L	nd	nd	nd	0.005	0.011
pH	0.01	Units	7.54	7.58	7.55	7.61	7.34

EQL Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence.
nd parameter not detected ! = EQL higher than listed due to dilution ( ) Adjusted EQL

ANALYTICAL SERVICES

Client: Shaheen & Peaker Ltd.
250 Galaxy Blvd.
Etobicoke, ON, CANADA
M9W 5R8

x: 416-213-1260

Attn: Sergiy Tchernikov

Date Received: September 7/2001
Date Reported: September 17/2001
Lab Ref#: G214323
Lab Quote#:

Client Ref#: SP3977
Sampled By: S.T.

Certificate of Analysis

Analysis Performed:	Extractable Hydrocarbon Analysis(MUST), C10-C24 TPH(Hot Extractable), Gravimetry Total Purgeable Hydrocarbons
Methodology:	1) The characterization of HydroCarbon in water by GC analysis, following a solvent extraction. U.S. EPA Method No.8011(microextraction) 2) Determination of TPH(hot extractable) in water, using solvent extraction. Analysis of evaporated extract by gravimetry. U.S. EPA Method No. 413.1(Modification) U.S. EPA Method No. 9070(Modification) U.S. EPA Method No. 9071(Modification) 3) Analysis of total purgeable hydrocarbons in water by Purge & Trap capillary GC/MS. U.S. EPA Method No. 5030
Instrumentation:	1) GC/FID/FID, Hewlett-PackardII GC, Dual injector, Dual FID, A/S 2) Precision Mechanical Convention Oven/Ainsworth Digital Balance

Certificate of Quality Control

Date Reported: September 17/2001
Lab Ref # : G214323
Lab Quote#: .

Client : Shaheen & Peaker Ltd.
Contact: Sergiy Tchernikov

Client Ref#: SP3977

Analysis of Water

				Process Blank			Process % Recovery				Matrix Spike					Overall
Parameter	SAMPLE ID (spike)	EQL	Units	Result	Upper Limit	Accept	Result	Lower Limit	Upper Limit	Accept	Result	Target	Lower Limit	Upper Limit	Accept	QC Acceptable
Total Extractable Hydrocarbons(C10-C24)	na	100.0	ug/L	nd	200.0	yes	95	70	120	yes	na	na	na	na	na	yes
TPH(Hot Extractable)	na	1.0	mg/L	nd	5.0	yes	90	80	120	yes	na	na	na	na	na	yes
Total Purgeable Hydrocarbons	na	100.0	ug/L	nd	200.0	yes	na	na	na	na	na	na	na	na	na	yes

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ns = Insufficient Sample Submitted
nd = parameter not detected
TR = trace level less than EQL

Philip Analytical Services Corp

Report of Analysis

Client : Shaheen & Peaker Ltd.
Contact: Sergiy Tchernikov

Report Date: September 17/2001
Lab Ref # : G214323
Lab Quote #: .

Analysis of Water

Client Ref#: SP3977

Parameter	EQL	Units	BH 602 2001/09/07	BH 603 2001/09/07	BH 604 2001/09/07	BH 605 2001/09/07	BH 605 Replicate
Resemblance	na	na	na	EMO?	EKDMO?	EDMO?	-
Total Extractable Hydrocarbons(C10-C24)	100.0	ug/L	nd	nd	150	1750	-
TPH(Hot Extractable)	1.0	mg/L	nd	nd	nd	5.0	na
Total Purgeable Hydrocarbons	100.0	ug/L	nd	nd	nd	nd	nd

EQL Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence.
- Not Requested
EDMO? Contaminant elutes across the diesel/motor oil range but does not match reference standards.
EKDMO? Contaminant elutes in the kerosene/diesel/motor oil range but does not match reference standards.
EMO? Contaminant elutes in the motor oil range but does not match reference standard.
na Not Applicable
nd parameter not detected ! = EQL higher than listed due to dilution ( ) Adjusted EQL

ANALYTICAL SERVICES

ent: Shaheen & Peaker Ltd.
250 Galaxy Blvd.
Etobicoke, ON, CANADA
M9W 5R8

: 416-213-1260

Attn: David Baigent

Date Received:	September 20/2001
Date Reported:	September 26/2001
Lab Ref#:	G214618
Lab Quote#:	
Client PO#:	SP3977
Client Ref#:	SP3977

Certificate of Analysis

Analysis Performed:

Extractable Hydrocarbon Analysis(MUST), C10-C24
TPH(Hot Extractable), Gravimetry
Total Purgeable Hydrocarbons

Methodology:

1) The characterization of HydroCarbon in water by GC analysis, following a solvent extraction.
U.S. EPA Method No.8011(microextraction)
2) Determination of TPH(hot extractable) in water, using solvent extraction. Analysis of evaporated extract by gravimetry.
U.S. EPA Method No. 413.1(Modification)
U.S. EPA Method No. 9070(Modification)
U.S. EPA Method No. 9071(Modification)
3) Analysis of total purgeable hydrocarbons in water by Purge & Trap capillary GC/MS.
U.S. EPA Method No. 5030

Instrumentation:

1) GC/FID/FID, Hewlett-PackardII GC, Dual injector, Dual FID, A/S
2) Precision Mechanical Convention Oven/Ainsworth Digital Balance

5735 McAdam Road, Mississauga, Ontario, Canada L4Z 1N9 Tel: (905) 890-8566 Fax: (905) 890-8575

Phili[illegible]alyt[illegible]Servi[illegible]Corp

Certificate of Quality Control

Client : Shaheen & Peaker Ltd.
Contact: David Baigent

Date Reported: September 26/2001
Lab Ref # : G214618
Lab Quote#: .
Client PO#: SP3977
Client Ref#: SP3977

Analysis of Water

				Process Blank			Process % Recovery				Matrix Spike					Overall
Parameter	SAMPLE ID (spike)	EQL	Units	Result	Upper Limit	Accept	Result	Lower Limit	Upper Limit	Accept	Result	Target	Lower Limit	Upper Limit	Accept	QC Acceptable
Total Extractable Hydrocarbons(C10-C24)	na	100.0	ug/L	nd	200.0	yes	71	70	120	yes	na	na	na	na	na	yes
TPH(Hot Extractable)	na	1.0	mg/L	nd	5.0	yes	97	80	120	yes	na	na	na	na	na	yes
Total Purgeable Hydrocarbons	na	100.0	ug/L	nd	200.0	yes	na	na	na	na	na	na	na	na	na	yes

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ns = Insufficient Sample Submitted
nd = parameter not detected
TR = trace level less than EQL

Client:	Shaheen & Peaker Ltd. 250 Galaxy Blvd. Etobicoke, ON, CANADA M9W 5R8	Date Received: Date Reported: Lab Ref#: Lab Quote#: Client PO#: Client Ref#:	September 20/2001 September 26/2001 G214618 SP3977 SP3977
Fax:	416-213-1260		
Attn:	David Baigent		

Certificate of Analysis

Additional Comments:

Philip Analytical Services Corp

Report of Analysis

Client : Shaheen & Peaker Ltd.
Contact: David Baigent

Report Date: September 26/2001
Lab Ref # : G214618
Lab Quote #: .
Client PO#: SP3977
Client Ref#: SP3977

Analysis of Water

Parameter	EQL	Units	BH.700 9/19/01	BH.700 Replicate	BH.702 9/19/01	BH.704 9/19/01	BH.705 9/19/01
Resemblance	na	na	EMO?	-	na	na	ED?
Total Extractable Hydrocarbons(C10-C24)	100	ug/L	898	-	nd	nd	14500
TPH(Hot Extractable)	1000	ug/L	5000	-	1000	1000	5000
Total Purgeable Hydrocarbons	100	ug/L	nd	-	nd	nd	nd

EQL Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence.
- Not Requested
ED? Contaminant elutes in the diesel range but does not match reference standard.
EMO? Contaminant elutes in the motor oil range but does not match reference standard.
na Not Applicable
nd parameter not detected ! = EQL higher than listed due to dilution ( ) Adjusted EQL

Philip Analytical Services Corp

Report of Analysis

Client : Shaheen & Peaker Ltd.
Contact: David Baigent

Report Date: September 26/2001
Lab Ref # : G214618
Lab Quote #:
Client PO#: SP3977
Client Ref#: SP3977

Analysis of Water

Parameter	EQL	Units	BH.706 9/19/01	BH.707 9/19/01			
Resemblance	na	na	UPFMO	EMO?			
Total Extractable Hydrocarbons(C10-C24)	100	ug/L	175	552			
TPH(Hot Extractable)	1000	ug/L	8000	1000			
Total Purgeable Hydrocarbons	100	ug/L	nd	nd			

EQL Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence.
EMO? Contaminant elutes in the motor oil range but does not match reference standard.
na Not Applicable
nd parameter not detected ! = EQL higher than listed due to dilution ( ) Adjusted EQL
UPFMO Unidentified peaks in fuel & motor oil range.

ANALYTICAL SERVICES

lient: Shaheen & Peaker Ltd.
roject Reference: SP3977
rk Order: G214323
rix: Water

VOLATILE ORGANIC COMPOUNDS

Date: 14-Sep-01

Units: micrograms/liter (ug/L)

		Method Blank			Spiked Method Blank			
mpound	EQL ug/L	Result	Upper Limit	Accept	% Recovery	Lower Limit	Upper Limit	Accept
hloromethane	1.0	nd	1.0	yes	105	60	140	yes
yl Chloride	0.2	nd	0.2	yes	104	60	140	yes
momethane	0.5	nd	0.5	yes	142	60	140	(1)
hloroethane	0.5	nd	0.5	yes	104	60	140	yes
richlorofluoromethane	0.5	nd	0.5	yes	107	60	140	yes
tone	10.0	nd	10.0	yes	103	60	140	yes
-Dichloroethene	0.2	nd	0.2	yes	104	70	130	yes
ichloromethane (Methylene Chloride)	1.0	nd	1.0	yes	102	70	130	yes
s-1,2-Dichloroethene	0.2	nd	0.2	yes	103	70	130	yes
thyl-t-Butyl Ether	0.2	nd	0.2	yes	102	70	130	yes
,1-Dichloroethane	0.2	nd	0.2	yes	102	70	130	yes
ethyl Ethyl Ketone (MEK)	5.0	nd	5.0	yes	100	60	140	yes
1,2-Dichloroethene	0.2	nd	0.2	yes	103	70	130	yes
oroform	0.2	nd	0.2	yes	102	70	130	yes
,2-Dichloroethane	0.2	nd	0.2	yes	102	70	130	yes
,1-Trichloroethane	0.2	nd	0.2	yes	103	70	130	yes
bon Tetrachloride	0.2	nd	0.2	yes	104	70	130	yes
enzene	0.1	nd	0.1	yes	103	70	130	yes
2-Dichloropropane	0.2	nd	0.2	yes	101	70	130	yes
hloroethene (Trichloroethylene)	0.2	nd	0.2	yes	103	70	130	yes
omodichloromethane	0.2	nd	0.2	yes	101	70	130	yes
is-1,3-Dichloropropene	0.2	nd	0.2	yes	100	70	130	yes
thyl Isobutyl Ketone (MIBK)	5.0	nd	5.0	yes	102	60	140	yes
s-1,3-Dichloropropene	0.2	nd	0.2	yes	101	70	130	yes
,1,2-Trichloroethane	0.2	nd	0.2	yes	102	70	130	yes
oluene	0.2	nd	0.2	yes	105	70	130	yes
lexanone	5.0	nd	5.0	yes	104	60	140	yes
romochloromethane	0.2	nd	0.2	yes	104	70	130	yes
,2-Dibromoethane (Ethylene dibromide)	0.2	nd	0.2	yes	103	70	130	yes
rachloroethene (Perchloroethylene)	0.2	nd	0.2	yes	104	70	130	yes
,1,2-Tetrachloroethane	0.2	nd	0.2	yes	104	70	130	yes
hlorobenzene	0.2	nd	0.2	yes	102	70	130	yes
thylbenzene	0.2	nd	0.2	yes	103	70	130	yes
Xylene & p-Xylene	0.2	nd	0.2	yes	104	70	130	yes
omoform	0.2	nd	0.2	yes	104	70	130	yes
tyrene	0.2	nd	0.2	yes	104	70	130	yes
,2,2-Tetrachloroethane	0.2	nd	0.2	yes	103	70	130	yes
Xylene	0.2	nd	0.2	yes	104	70	130	yes
1,3-Dichlorobenzene	0.2	nd	0.2	yes	105	70	130	yes
4-Dichlorobenzene	0.2	nd	0.2	yes	103	70	130	yes
-Dichlorobenzene	0.2	nd	0.2	yes	103	70	130	yes
urrogate Standard Recoveries	(Control Limits)							
Dibromofluoromethane		94%	70-130%	yes	99	70	130	yes
uene-d8		108%	70-130%	yes	100	70	130	yes
Bromofluorobenzene		86%	70-130%	yes	100	70	130	yes

ANALYTICAL SERVICES

Client: Shaheen & Peaker Ltd.
Project Reference: SP3977
Work Order: G214323
Matrix: Water

VOLATILE ORGANIC COMPOUNDS

Date: 14-Sep-01

Legend: EQL = Estimated Quantitation Limit for undiluted samples
nd = Not Detected Above EQL
Dup. = Duplicate
* = Detected below EQL but passed compound identification criteria

Date of sample receipt: September 7, 2001
Date of sample analysis: September 14, 2001

Analytical Method:

The water samples were analysed by purge & trap gas chromatography/mass spectrometry using US EPA Method 8260B (modified).

Report Discussion:

(1) Recovery for bromomethane in the spiked method blank was slightly above the control limit. However, since this compound was not detected above the EQL for the samples analysed, this has been evaluated as having no significant effect on the results reported.

Note: Estimated quantitation limit is the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

NOTE: All work recorded herein has been done in accordance with normal professional standards using accepted testing methodologies and QA/QC procedures. Philip Analytical is limited in liability to the actual cost of the pertinent analysis done. Your samples will be retained by PAS for a period of 30 days following reporting or as per specific contractual arrangement.

Job Approved By:

Dinesh Rangarajan M.Sc.
Chemist

ANALYTICAL SERVICES

Client: Shaheen & Peaker Ltd.
Project Reference: SP3977
Work Order: G214618
Matrix: Water

VOLATILE ORGANIC COMPOUNDS
(Revised Final Report)
Units: micrograms/liter (ug/L)

Date: 26-Sep-01

		Method Blank			Spiked Method Blank			
Compound	EQL ug/L	Result	Upper Limit	Accept	% Recovery	Lower Limit	Upper Limit	Accept
Chloromethane	1.0	nd	1.0	yes	104	60	140	yes
Vinyl Chloride	0.2	nd	0.2	yes	104	60	140	yes
Bromomethane	0.5	nd	0.5	yes	136	60	140	yes
Chloroethane	0.5	nd	0.5	yes	105	60	140	yes
Trichlorofluoromethane	0.5	nd	0.5	yes	105	60	140	yes
Acetone	10.0	nd	10.0	yes	101	60	140	yes
1,1-Dichloroethene	0.2	nd	0.2	yes	105	70	130	yes
Dichloromethane (Methylene Chloride)	1.0	nd	1.0	yes	104	70	130	yes
trans-1,2-Dichloroethene	0.2	nd	0.2	yes	105	70	130	yes
Methyl-t-Butyl Ether	0.2	nd	0.2	yes	103	70	130	yes
1,1-Dichloroethane	0.2	nd	0.2	yes	105	70	130	yes
Methyl Ethyl Ketone (MEK)	5.0	nd	5.0	yes	101	60	140	yes
cis-1,2-Dichloroethene	0.2	nd	0.2	yes	105	70	130	yes
Chloroform	0.2	nd	0.2	yes	105	70	130	yes
1,2-Dichloroethane	0.2	nd	0.2	yes	103	70	130	yes
1,1,1-Trichloroethane	0.2	nd	0.2	yes	105	70	130	yes
Carbon Tetrachloride	0.2	nd	0.2	yes	106	70	130	yes
Benzene	0.1	nd	0.1	yes	105	70	130	yes
1,2-Dichloropropane	0.2	nd	0.2	yes	104	70	130	yes
Trichloroethene (Trichloroethylene)	0.2	nd	0.2	yes	105	70	130	yes
Bromodichloromethane	0.2	nd	0.2	yes	105	70	130	yes
cis-1,3-Dichloropropene	0.2	nd	0.2	yes	104	70	130	yes
Methyl Isobutyl Ketone (MIBK)	5.0	nd	5.0	yes	101	60	140	yes
trans-1,3-Dichloropropene	0.2	nd	0.2	yes	104	70	130	yes
1,1,2-Trichloroethane	0.2	nd	0.2	yes	102	70	130	yes
Toluene	0.2	nd	0.2	yes	104	70	130	yes
2-Hexanone	5.0	nd	5.0	yes	100	60	140	yes
Dibromochloromethane	0.2	nd	0.2	yes	104	70	130	yes
1,2-Dibromoethane (Ethylene dibromide)	0.2	nd	0.2	yes	102	70	130	yes
Tetrachloroethene (Perchloroethylene)	0.2	nd	0.2	yes	105	70	130	yes
1,1,1,2-Tetrachloroethane	0.2	nd	0.2	yes	104	70	130	yes
Chlorobenzene	0.2	nd	0.2	yes	104	70	130	yes
Ethylbenzene	0.2	nd	0.2	yes	104	70	130	yes
m-Xylene & p-Xylene	0.2	nd	0.2	yes	103	70	130	yes
Bromoform	0.2	nd	0.2	yes	104	70	130	yes
Styrene	0.2	nd	0.2	yes	103	70	130	yes
1,1,2,2-Tetrachloroethane	0.2	nd	0.2	yes	100	70	130	yes
o-Xylene	0.2	nd	0.2	yes	103	70	130	yes
1,3-Dichlorobenzene	0.2	nd	0.2	yes	98	70	130	yes
1,4-Dichlorobenzene	0.2	nd	0.2	yes	98	70	130	yes
1,2-Dichlorobenzene	0.2	nd	0.2	yes	96	70	130	yes
Surrogate Standard Recoveries	(Control Limits)							
Dibromofluoromethane		99%	70-130%	yes	101	70	130	yes
Toluene-d8		102%	70-130%	yes	99	70	130	yes
4-Bromofluorobenzene		94%	70-130%	yes	99	70	130	yes

ANALYTICAL SERVICES

Client: Shaheen & Peaker Ltd.
Project Reference: SP3977
Work Order: G214618
Matrix: Water

VOLATILE ORGANIC COMPOUNDS
(Revised Final Report)

Date: 26-Sep-01

Legend: EQL = Estimated Quantitation Limit for undiluted samples
nd = Not Detected Above EQL

Date of sample receipt: September 20, 2001
Date of sample analysis: September 24, 2001

Analytical Method:

The water samples were analysed by purge & trap gas chromatography/mass spectrometry using US EPA Method 8260B (modified).

Note: This revised final report removes values for 1,2-dichloropropane, 1,1,2-trichloroethane and 1,3-dichlorobenzene which were incorrectly identified in the previous report.

Note: Estimated quantitation limit is the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

NOTE: All work recorded herein has been done in accordance with normal professional standards using accepted testing methodologies and QA/QC procedures. Philip Analytical is limited in liability to the actual cost of the pertinent analysis done. Your samples will be retained by PAS for a period of 30 days following reporting or as per specific contractual arrangement.

Job Approved By:

Dinesh Rangarajan M.Sc.
Chemist

ANALYTICAL SERVICES

Client: Shaheen & Peaker Ltd
Project Reference: SP3977
Work Order Number: G214323B
Matrix: Water

Polynuclear Aromatic Hydrocarbons (PAH's)

Units: Micrograms/Liter (µg/L)

Date: 19-Sep-01

Compound	**EQL µg/L**	BH 602	BH 603	BH 604	**EQL µg/L**	BH 605 DF=5
Naphthalene	0.2	0.2	nd	2.5	1.0	nd
2-Methylnaphthalene	0.2	nd	0.2	3.9	1.0	nd
1-Methylnaphthalene	0.2	nd	nd	4.8	1.0	nd
Acenaphthylene	0.2	nd	nd	nd	1.0	nd
Acenaphthene	0.2	nd	nd	0.2	1.0	nd
Fluorene	0.2	nd	0.2	0.2	1.0	*0.6
Phenanthrene	0.2	0.5	2.0	0.8	1.0	2.6
Anthracene	0.2	nd	nd	nd	1.0	nd
Fluoranthene	0.2	nd	0.2	nd	1.0	1.6
Pyrene	0.2	nd	0.2	nd	1.0	1.5
Benzo(a)anthracene	0.2	nd	nd	nd	1.0	nd
Chrysene	0.2	nd	nd	nd	1.0	*0.8
Benzo(b)fluoranthene	0.2	nd	nd	nd	1.0	*0.7
Benzo(k)fluoranthene	0.2	nd	nd	nd	1.0	nd
Benzo(a)pyrene	0.2	nd	nd	nd	1.0	nd
Indeno(1,2,3-cd)pyrene	0.2	nd	nd	nd	1.0	nd
Dibenzo(a,h)anthracene	0.2	nd	nd	nd	1.0	nd
Benzo(ghi)perylene	0.2	nd	nd	nd	1.0	nd
Surrogate Standard Recoveries (Control Limits)						
Acenaphthene-d10 (25-120%)		103%	108%	67%		97%
Anthracene-d10 (30-120%)		96%	106%	66%		84%
Benzo(a)pyrene-d12 (40-125%)		80%	87%	59%		69%

ANALYTICAL SERVICES

Client: Shaheen & Peaker Ltd.
Project Reference: SP 3977
Work Order Number: G214618B
Matrix: Water

Polynuclear Aromatic Hydrocarbons (PAH's)

Date: 25-Sep-01

Units: Micrograms/Liter (µg/L)

Compound	**EQL µg/L**	BH.700	BH.702	BH.704	BH.705	BH.706	BH.707
Naphthalene	0.2	9.3	3.8	nd	4.4	27.2	2.6
2-Methylnaphthalene	0.2	11.5	0.9	nd	3.7	3.4	2.6
1-Methylnaphthalene	0.2	32.0	1.0	nd	2.8	4.0	3.6
Acenaphthylene	0.2	nd	nd	nd	nd	nd	0.3
Acenaphthene	0.2	7.7	0.2	2.8	0.3	3.2	3.2
Fluorene	0.2	6.6	0.2	0.4	0.4	2.2	2.1
Phenanthrene	0.2	8.0	0.3	0.5	1.5	3.8	4.4
Anthracene	0.2	1.4	nd	nd	0.4	0.9	1.0
Fluoranthene	0.2	1.1	nd	0.3	0.2	0.9	2.5
Pyrene	0.2	0.9	nd	0.4	0.5	0.8	2.5
Benzo(a)anthracene	0.2	nd	nd	nd	nd	0.2	0.6
Chrysene	0.2	0.2	nd	nd	nd	0.3	0.7
Benzo(b)fluoranthene	0.2	nd	nd	nd	nd	0.2	0.5
Benzo(k)fluoranthene	0.2	nd	nd	nd	nd	nd	0.2
Benzo(a)pyrene	0.2	nd	nd	nd	nd	0.2	0.5
Indeno(1,2,3-cd)pyrene	0.2	nd	nd	nd	nd	nd	0.3
Dibenzo(a,h)anthracene	0.2	nd	nd	nd	nd	nd	nd
Benzo(ghi)perylene	0.2	nd	nd	nd	nd	nd	0.3
Surrogate Standard Recoveries (Control Limits)							
Acenaphthene-d10 (25-120%)		81%	79%	84%	68%	66%	83%
Anthracene-d10 (30-120%)		86%	80%	85%	69%	67%	81%
Benzo(a)pyrene-d12 (40-125%)		84%	73%	81%	63%	64%	78%

ANALYTICAL SERVICES

Client: Shaheen & Peaker Ltd.
Project Reference: SP 3977
Work Order Number: G214618B
Matrix: Water

Polynuclear Aromatic Hydrocarbons (PAH's)

Units: micrograms/liter (µg/L)

Date: 25-Sep-01

		Method Blank			Spiked Method Blank			
Compound	**EQL µg/L**	**Result**	**Upper Limit**	**Accept**	**% Recovery**	**Lower Limit**	**Upper Limit**	**Accept**
Naphthalene	0.2	nd	0.2	yes	66	43	106	yes
2-Methylnaphthalene	0.2	nd	0.2	yes	85	40	121	yes
1-Methylnaphthalene	0.2	nd	0.2	yes	85	43	124	yes
Acenaphthylene	0.2	nd	0.2	yes	70	40	113	yes
Acenaphthene	0.2	nd	0.2	yes	67	38	102	yes
Fluorene	0.2	nd	0.2	yes	71	42	106	yes
Phenanthrene	0.2	nd	0.2	yes	71	44	107	yes
Anthracene	0.2	nd	0.2	yes	69	45	108	yes
Fluoranthene	0.2	nd	0.2	yes	77	47	117	yes
Pyrene	0.2	nd	0.2	yes	77	45	116	yes
Benzo(a)anthracene	0.2	nd	0.2	yes	72	52	123	yes
Chrysene	0.2	nd	0.2	yes	72	50	129	yes
Benzo(b)fluoranthene	0.2	nd	0.2	yes	78	45	132	yes
Benzo(k)fluoranthene	0.2	nd	0.2	yes	77	49	128	yes
Benzo(a)pyrene	0.2	nd	0.2	yes	74	48	117	yes
Indeno(1,2,3-cd)pyrene	0.2	nd	0.2	yes	72	33	126	yes
Dibenzo(a,h)anthracene	0.2	nd	0.2	yes	79	37	126	yes
Benzo(ghi)perylene	0.2	nd	0.2	yes	76	36	123	yes
Surrogate Standard Recoveries								
Acenaphthene-d10		83%			82	25	120	yes
Anthracene-d10		85%			85	30	120	yes
Benzo(a)pyrene-d12		82%			83	40	125	yes

ANALYTICAL SERVICES

Client: Shaheen & Peaker Ltd.
Project Reference: SP 3977
Work Order Number: G214618B
Matrix: Water

Polynuclear Aromatic Hydrocarbons (PAH'S)

Date: 25-Sep-01

Legend: EQL = Estimated Quantitation Limit
nd = Not detected above EQL

Date received: September 20, 2001
Date extracted: September 24, 2001
Date analysed: September 24-25, 2001

ANALYTICAL METHOD:

The water samples were prepared by liquid-liquid extraction and analysed by gas chromatography/mass spectrometry using U.S. EPA Method 8270C (modified).

Note: Estimated quantitation limit is the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

NOTE: All work recorded herein has been done in accordance with normal professional standards using accepted testing methodologies and QA/QC procedures. Philip Analytical is limited in liability to the actual cost of the pertinent analysis done. Your samples will be retained by PAS for a period of 30 days following reporting or as per specific contractual arrangement.

JOB APPROVED BY:

Michael Wang, Ph.D.
Chemist

ANALYTICAL SERVICES

: :: Shaheen & Peaker Ltd.
)ject Reference: SP3977
ork Order Number: G214998B
r x: Water

Polynuclear Aromatic Hydrocarbons (PAH's)

Date: 10-Oct-01

Units: Micrograms/Liter (µg/L)

pound	EQL µg/L	BH 707 Filtered	BH 707 Unfiltered
phthalene	0.2	0.8	0.9
thylnaphthalene	0.2	0.9	1.2
ethylnaphthalene	0.2	1.7	2.0
enaphthylene	0.2	nd	nd
aphthene	0.2	1.8	2.1
ene	0.2	1.3	1.5
enanthrene	0.2	2.9	3.2
racene	0.2	0.5	0.7
anthene	0.2	0.9	1.1
rene	0.2	0.7	1.0
nzo(a)anthracene	0.2	nd	nd
sene	0.2	nd	nd
nzo(b)fluoranthene	0.2	nd	nd
nzo(k)fluoranthene	0.2	nd	nd
zo(a)pyrene	0.2	nd	nd
eno(1,2,3-cd)pyrene	0.2	nd	nd
benzo(a,h)anthracene	0.2	nd	nd
zo(ghi)perylene	0.2	nd	nd
rrogate Standard Recoveries (Control Limits)			
naphthene-d10 (25-120%)		78%	85%
nthracene-d10 (30-120%)		78%	85%
nzo(a)pyrene-d12 (40-125%)		71%	74%

Client: Shaheen & Peaker Ltd.
Project Reference: SP3977
Work Order Number: G214998B
Matrix: Water

Polynuclear Aromatic Hydrocarbons (PAH'S)

Date: 10-Oct-01

Legend: EQL = Estimated Quantitation Limit
nd = Not detected above EQL

Date received: October 5, 2001
Date extracted: October 9, 2001
Date analysed: October 9, 2001

ANALYTICAL METHOD:

The water samples were prepared by liquid-liquid extraction and analysed by gas chromatography/mass spectrometry using U.S. EPA Method 8270C (modified).

Note: Estimated quantitation limit is the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

NOTE: All work recorded herein has been done in accordance with normal professional standards using accepted testing methodologies and QA/QC procedures. Philip Analytical is limited in liability to the actual cost of the pertinent analysis done. Your samples will be retained by PAS for a period of 30 days following reporting or as per specific contractual arrangement.

JOB APPROVED BY:

Michael Wang, Ph.D.
Chemist

APPENDIX E

HEALTH EFFECTS INFORMATION AND INHALATION EXPOSURE EQUATIONS

APPENDIX E

ESTIMATION OF HUMAN EXPOSURE TO OUTDOOR VAPOURS

U.S. EPA (1996) presents a methodology for estimating human exposure, via inhalation of vapours, as a result of the presence of volatile organic chemicals in the subsurface. A target risk (for carcinogens) or target hazard quotient (for non-carcinogens) is first specified, then the equations in U.S. EPA (1996) are used to back-calculate the concentration of the chemical in soil that would result in that target risk or hazard quotient. The concentration of the chemical in soil can then be compared to site-specific measured concentrations. The assumed values for all input parameters are summarized in **Table 4**.

The concentration of chemical in soil, C_S (in mg/kg), is calculated from the following equation (for carcinogens):

$$C_S = \frac{TR \times AT \times VF \times 365d/y \times 24h/d}{URF \times EF_1 \times EF_2 \times ED \times 1000\mu g/mg}$$

where,

TR	=	Target cancer risk (1×10^{-6})
AT	=	Averaging time (y)
VF	=	Volatilization factor (m^3/kg) (calculated below)
URF	=	Inhalation unit risk factor $(ug/m^3)^{-1}$
EF_1	=	Exposure frequency (d/y)
EF_2	=	Exposure frequency (h/d)
ED	=	Exposure duration (y)

For non-carcinogens, the concentration of chemical in soil, C_S (in mg/kg), is calculated from the following:

$$C_S = \frac{THQ \times AT \times RfC \times VF \times 365d/y \times 24h/d}{EF_1 \times EF_2 \times ED}$$

where,

THQ	=	Target hazard quotient (unitless) (0.2)
RfC	=	Inhalation reference concentration (mg/m^3)

The volatilization factor, VF, is chemical-specific and uses either site-specific or default information for soil moisture, dry bulk density, and fraction of organic carbon in soil. It represents the relationship between the concentration of the chemical in soil and the flux of the chemical to air. The volatilization factor is calculated by the following equation, which is based on the volatilization model developed by Jury et al. (1990) (cited in U.S. EPA, 1996) for infinite sources:

$$VF = \frac{(3.14 \times D_A \times T)^{0.5} \times Q/C \times 10^{-4} m^2/cm^2}{2 \times \rho_b \times D_A}$$

where,

D_A	=	Apparent diffusivity (cm^2/s) (calculated below)
T	=	Exposure interval (s)
Q/C	=	Inverse of the mean concentration at centre of square source ($g/m^2/s$ per kg/m^3)
r_b	=	Dry soil bulk density (g/cm^3)

The term Q/C represents the dispersion of the chemical in the atmosphere. U.S. EPA (1996) presents default values, which depend upon the climate and the size of the source. The area of impacted soil was assumed to be approximately 4000 m^2 (1 acre).

The apparent diffusivity, D_A (in cm^2/s), is calculated from the following equation:

$$D_A = \frac{(\theta_a^{10/3} D_i H' + \theta_w^{10/3} D_w)/n^2}{\rho_b K_d + \theta_w + \theta_a H'}$$

where,

θ_a	=	Air-filled soil porosity (L_{air}/L_{soil})
D_i	=	Diffusivity in air (cm^2/s)
H'	=	Henry's Law Constant (dimensionless)
θ_w	=	Water-filled soil porosity (L_{water}/L_{soil})
D_w	=	Diffusivity in water (cm^2/s)
n	=	Total soil porosity (L_{pore}/L_{soil})

The results of the calculations are shown in Table E-1. The maximum measured concentration in soil, for toluene, xylenes, and TPH (gas/diesel) is much less than the soil concentration predicted to result in an air concentration corresponding to 20% of the reference concentration (the hazard level considered acceptable by the MOE). For benzene, the maximum measured concentration in soil is less than the concentration in soil predicted to result in an air concentration (incremental above background) corresponding to a 1×10^{-6} risk (the level of risk considered acceptable by the MOE).

APPENDIX E
HEALTH EFFECTS INFORMATION

A brief summary of the main uses and health effects of each of the non-volatile and semi-volatile chemicals of potential concern is provided below. References for the information are listed in Section 8.

Inorganics

Antimony

As an alloy, antimony is used in lead storage batteries, solder, sheet and pipe metal, bearings, castings, and pewter (ATSDR, 1995). Antimony oxide is used in paints, ceramics, and fireworks, and as an enamel for plastic, metal, and glass. Antimony oxide is also used as a fire retardant for textiles and plastics. Long-term inhalation of low concentrations of antimony has resulted in eye irritation, hair loss, lung damage, heart problems, and fertility problems in animals (ATSDR, 1995). Antimony has not been classified with respect to human carcinogenicity by the U.S. EPA, the International Agency for Research on Cancer (IARC), or the U.S. Department of Health and Human Services (ATSDR, 1995).

Arsenic

Arsenic was used as a pesticide and is still used in pressure treated wood (as copper chromium arsenate) and in the manufacture of semiconductors such as computer chips and other electronic devices. The principal effects of acute exposure to arsenic are irritation of the gastrointestinal tract followed by nausea, vomiting, abdominal pain, diarrhoea and cardiovascular arrhythmia (Environment Canada, 1996a). Symptoms of chronic exposure to arsenic are darkening of the skin, loss of appetite, loss of weight, fainting, nausea, dry throat, shooting pains, diarrhoea, nervous weakness, and tingling of hands and feet (ATSDR, 1989). Health Canada considers certain inorganic forms of arsenic to be human carcinogens (Health and Welfare Canada, 1992). Inhalation of inorganic arsenic dust has been linked to an increased incidence of lung cancer in copper smelter workers. Ingestion of arsenic in drinking water has been correlated with an increased incidence of skin cancer, as well as with increased liver, kidney, bladder, and lung cancer.

Beryllium

Beryllium is a hard, grayish metal, used in electrical parts, machine parts, aircraft parts, ceramics, and mirrors (ATSDR, 1993). Beryllium is also found in tobacco smoke. Exposure to high levels of beryllium in air can cause lung damage and a disease that resembles pneumonia (ATSDR, 1993). Some individuals may develop a hypersensitivity to beryllium. In these individuals, an inflammatory reaction is produced when they are exposed to low levels of beryllium. Based on animal studies and studies of exposed workers, the U.S. Department of Health and Human Services has determined that beryllium is reasonably anticipated to be a carcinogen (ATSDR, 1993).

Cadmium

Cadmium is used in batteries, metal coatings, pigments, and plastics (ATSDR, 1999). Cadmium is also found in tobacco smoke and in many foods (ATSDR, 1999). Inhalation of high concentrations of cadmium can produce severe lung damage and death. Ingestion of high concentrations of cadmium severely irritates the stomach. Long term exposure to low levels of cadmium in air, food, or water results in accumulation of cadmium in the kidneys and possibly kidney disease. Other long-term effects are lung damage and fragile bones (ATSDR, 1999). The U.S. Department of Health and Human Services has determined that cadmium is reasonably anticipated to be a carcinogen (ATSDR, 1999).

Chromium

Chromium III and chromium VI are used for chrome plating, dyes and pigments, leather tanning, and wood preserving (ATSDR, 2001). Chromium III is an essential nutrient that helps the body use sugar, protein, and fat (ATSDR, 2001). Inhaling high concentrations of Chromium VI irritates the nose and ingesting high concentrations of chromium VI damages the stomach, kidney, and liver. Skin contact with certain chromium VI compounds results in skin ulcers. Some individuals develop allergic reactions to chromium III or chromium VI, resulting in redness and swelling of the skin. The World Health Organization, the U.S. EPA, and the U.S. Department of Health and Human Services have determined that chromium VI in air is a carcinogen (ATSDR, 2001).

Copper

Copper and its alloys are frequently used in electrical wiring and conductors, fixtures and pipes (including water pipes), coins, roofing materials and cooking utensils. Copper is commonly used in fertilizers for copper-deficient soils or in animal feed as a nutritional supplement (CCME, 1997). Some copper compounds, including chromated copper arsenate (CCA) and ammoniacal copper arsenate (ACA) are used as heavy-duty wood preservatives for power poles, fence poles, pilings and building components.

Copper is an essential element, and is needed by all plants and animals. An intake of approximately 2 mg/d is needed for an adult human to maintain normal metabolic function (Health Canada, 1992a). There are very little data available on the potential carcinogenicity of copper. Neither Health Canada nor the International Agency for Research on Cancer have assessed the carcinogenicity of copper (Health Canada, 1992a); the U.S. Environmental Protection Agency has classified copper as Class D (not classified) due to a lack of human data and inadequate animal data. Chronic exposure to copper, through ingestion, is usually dealt with by the body's regulatory mechanisms. Acute effects of ingesting high levels of copper can include nausea, vomiting, epigastric pain, diarrhea, jaundice, haemolysis (breakdown of red blood cells), blood in urine, and decreased urine production (Health Canada, 1992a; ATSDR, 1990).

Lead

Lead is used in battery production, cable sheathing, chemical production, phosphate fertilizers, lead alloys, copper alloys, metal products (such as sheet lead, solder and pipes), ammunition, automobile radiators, and scientific, medical and military equipment (Environment Canada, 1996b; ATSDR, 1997b; Health Canada, 1996). Lead arsenate was used as an insecticide, especially in fruit tree orchards (Environment Canada, 1996b).

Lead is considered to be a cumulative general poison, with health effects increasing as it accumulates in the body. Fetuses, infants, children and pregnant women are most susceptible to its effects (Health Canada, 1992b). The effects of short-term exposure to lead include dullness, restlessness, irritability, poor attention span, headaches, muscle tremors, hallucinations and loss of memory (Health Canada, 1992b). Effects of chronic exposure to lead may include tiredness, sleeplessness, irritability, headaches, joint pain, and gastrointestinal symptoms. Measurement of lead in blood is a good indicator of exposure to lead (Health Canada, 1992b).

Health Canada considers lead to be a possible carcinogen (Group IIIB) due to inadequate human data and limited evidence of carcinogenicity in animals (Health Canada, 1992b). The U.S.EPA lists lead and inorganic lead compounds as Group B2, a probable human carcinogen, and the International Agency for Research on Cancer lists inorganic lead as Group 2B, possibly carcinogenic to humans, and organic lead compounds as Group 3, not classifiable as to carcinogenicity to humans (MOEE, 1994). The MOEE has not established a threshold level for lead, below which toxic effects are not believed to occur; instead, the MOEE established an intake of concern, based on neurobehavioural effects in children (MOEE, 1994).

Zinc

Zinc is an essential element required by all plants and animals and Health Canada has established a recommended daily intake for ingestion of zinc by humans (Health Canada, 1987). The human body has innate mechanisms to control zinc levels, reducing the effects of chronic exposure; however, chronic ingestion of zinc can cause anaemia, damage to the pancreas, and lowered HDL cholesterol.

APPENDIX F
LANDSCAPE FEATURES

Landscape features in the study area are shown in **Figure 2** and **Figure 4**. Commercial sod will be laid over a major portion of the study area. All areas not otherwise covered in the planting beds described below or with pavement will be covered in sod.

PLANTING BEDS

Planting beds will be comprised of mainly ornamental grasses and flowers. Planting beds will occur in select locations. Species will be planted in beds or groups and in specific areas mainly adjacent to walkways.

A. Ornamental Grasses

Reed Grass (*Calamagrostris arundinacea 'Brachytrichia'*)
Gardener's Garters (*Phalaris arundinacea picta*)
Mosquito Grass (*Bouteloua gracilis*)
Feather Reed Grass (*Calamagrostris acutiflora*)
Miscanthus Berlin (*Miscanthus sinensis 'Berlin'*)
Chinese Silver Grass (*Miscanthus sinensis 'Nippon'*)
Tall Purple Moor Grass (*Molina caerulea arundinacea*)
Switch Grass (*Pancium virgatum 'Warrior'*)
Fountain Grass (*Pennisetum alopecuroides 'Hamelin'*)

B. Perennial Wildflowers

Threadleaf Coreopsis (*Coreopsis verticallata 'Golden Showers'*)
Threadleaf Coreopsis (*Coreopsis verticallata 'Moonbeam'*)
Blanket Flower (*Gaillardia aristata*)
Daylily (*Hemerocallis 'Happy Returns'*)
Black-eyed Susan (*Rudbeckia fulgida 'Goldstrum'*)
Black-eyed Susan (*Rudbeckia hirta*)

C. Vines

Engelman's Ivy (*Parthenocissus quinquefolia 'Engelmannii'*)

SHRUBS

Shrubs will be placed in compact beds adjacent planting beds and tree beds. Proposed shrubs include:

Gray Dogwood (*Cornus racemosa*)
Winter Beauty Dogwood (*Cornus sanquinea 'Winter Beauty'*)
Red-osier Dogwood (*Cornus sericea/stolonifera*)
Yellowtwig Dogwood (*Cornus sericea 'Flaviramea'*)
Dwarf Winged Burning Bush (*Euonymus alatus 'Compactus'*)
Bayberry (*Myrica pennsylvanica*)
Fragrant Sumac (*Rhus aromatica*)
Lo Grow Sumac (*Rhus aromatica 'Lo Grow'*)
Staghorn Sumac (*Rhus typhina*)
White Japanese Rose (*Rosa rugosa 'Alba'*)
Nearly Wild Rose (*Rosa rugosa 'Nearly Wild'*)
False Spirea (*Spirea japonica 'Froebelii'*)
Arrowwood (*Viburnum dentatum 'Autumn Jazz'*)
Nannyberry (*Viburnum lentago*)

TREES

Trees will be placed in groups. Proposed tree species include:

(i) Street Trees

Autumn Blaze Maple (*Acer X freemanii 'Jeffersred*) 13S, 16H
Common Hackberry (*Celtis occidentalis*)
Summit Green Ash (*Fraxinus pennsylvanica 'Summit'*)
Autumn Gold Maidenhair (*Gingko biloba 'Princeton Sentry'*)

(ii) Flowering Trees

Downy Serviceberry (*Amelanchier canadensis*)
Crimson Cloud Hawthorn (*Crataegus laevigata 'Crimson Cloud'*)
White Angel Crab Apple (*Malus 'White Angel'*)
Purple Mayday Tree (*Prunus padus 'Colorata'*)
Ornamental Pear (*Pyrus calleranya 'Chanticlear'*)

(iii) Mixed Woodland Planting – Deciduous Trees

Flame Maple (*Acer ginnala 'Flame'*)
Carolina Poplar (*Populus x canadensis 'Eugenei'*)
Cottonwood (*Populus deltoides*)
Trembling Aspen (*Populus tremuloides*)
Columnar Trembling Aspen (*Populus tremuloides 'Erecta'*)
Black Locust (*Robinia pseudoacacia*)

(iv) Mixed Woodland Planting – Coniferous Trees

Colorado Spruce (*Picea pungens*)
Scot's Pine (*Pinus slyvestris*)

APPENDIX F
LANDSCAPE FEATURES

APPENDIX F
LANDSCAPE FEATURES

Landscape features in the study area are shown in **Figure 2** and **Figure 4**. Commercial sod will be laid over a major portion of the study area. All areas not otherwise covered in the planting beds described below or with pavement will be covered in sod.

PLANTING BEDS

Planting beds will be comprised of mainly ornamental grasses and flowers. Planting beds will occur in select locations. Species will be planted in beds or groups and in specific areas mainly adjacent to walkways.

A. Ornamental Grasses

Reed Grass (*Calamagrostris arundinacea 'Brachytrichia'*)
Gardener's Garters (*Phalaris arundinacea picta*)
Mosquito Grass (*Bouteloua gracilis*)
Feather Reed Grass (*Calamagrostris acutiflora*)
Miscanthus Berlin (*Miscanthus sinensis 'Berlin'*)
Chinese Silver Grass (*Miscanthus sinensis 'Nippon'*)
Tall Purple Moor Grass (*Molina caerulea arundinacea*)
Switch Grass (*Pancium virgatum 'Warrior'*)
Fountain Grass (*Pennisetum alopecuroides 'Hamelin'*)

B. Perennial Wildflowers

Threadleaf Coreopsis (*Coreopsis verticallata 'Golden Showers'*)
Threadleaf Coreopsis (*Coreopsis verticallata 'Moonbeam'*)
Blanket Flower (*Gaillardia aristata*)
Daylily (*Hemerocallis 'Happy Returns'*)
Black-eyed Susan (*Rudbeckia fulgida 'Goldstrum'*)
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C. Vines

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Yellowtwig Dogwood (*Cornus sericea 'Flaviramea'*)
Dwarf Winged Burning Bush (*Euonymus alatus 'Compactus'*)
Bayberry (*Myrica pennsylvanica*)
Fragrant Sumac (*Rhus aromatica*)
Lo Grow Sumac (*Rhus aromatica 'Lo Grow'*)
Staghorn Sumac (*Rhus typhina*)
White Japanese Rose (*Rosa rugosa 'Alba'*)
Nearly Wild Rose (*Rosa rugosa 'Nearly Wild'*)
False Spirea (*Spirea japonica 'Froebelii'*)
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Trees will be placed in groups. Proposed tree species include:

(i) Street Trees

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(ii) Flowering Trees

Downy Serviceberry (*Amelanchier canadensis*)
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White Angel Crab Apple (*Malus 'White Angel'*)
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Ornamental Pear (*Pyrus calleranya 'Chanticlear'*)

(iii) Mixed Woodland Planting – Deciduous Trees

Flame Maple (*Acer ginnala 'Flame'*)
Carolina Poplar (*Populus x canadensis 'Eugenei'*)
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Trembling Aspen (*Populus tremuloides*)
Columnar Trembling Aspen (*Populus tremuloides 'Erecta'*)
Black Locust (*Robinia pseudoacacia*)

(iv) Mixed Woodland Planting – Coniferous Trees

Colorado Spruce (*Picea pungens*)
Scot's Pine (*Pinus slyvestris*)

APPENDIX G

PEER REVIEW INFORMATION

GENERAL QUALIFICATIONS

The engineers and scientists at AEL provide environmental consulting services to industry, government, and the private sector. Since its creation in 1990, AEL has undertaken more than 1,200 assignments for clients across Canada, the United States, several Caribbean nations, and the Australia and New Zealand Environment Commission (ANZEC).

The types of services that AEL provides include:

- peer reviews;
- risk assessment;
- exposure assessment;
- environmental modelling;
- environmental site assessment;
- environmental auditing;
- site remediation and decommissioning; and
- liaison with regulatory agencies.

This Statement of Qualifications focuses on AEL's expertise in peer review of environmental documents.

AEL staff members include engineers from several disciplines as well as environmental technologists and technicians. They average more than 12 years of experience in environmental consulting. Most have more than one degree and/or certification.

AEL is a wholly owned Canadian corporation registered in the Province of Ontario. It is certified by the Professional Engineers of Ontario as a consulting engineering firm. It maintains extensive professional liability insurance and public liability insurance.

PEER REVIEWER OF ENVIRONMENTAL DOCUMENTS

AEL is thoroughly familiar and comfortable with the role of peer reviewer. Over the past several years, AEL has undertaken peer reviews of more than 200 packages of environmental reports.

- X For the municipal or regional governments of North York and East York (now the City of Toronto), and the Region of York, AEL peer reviews packages of environmental reports submitted in support of redevelopment applications, rezoning applications, and plans of subdivision. These and other municipalities have determined that they need access to this type of expertise to replace the former reliance on the MOE. In almost all cases, the peer reviewer is asked to comment on the suitability (from an environmental perspective) of the property for the proposed use.

- X For other consultants and their clients, AEL has reviewed risk assessment reports for numerous locations and chemicals of concern. Examples include Belleville (hydrocarbons), Courtice (hydrocarbons), Kanata (sodium), Kingston (coal tar), Kitchener (chlorinated solvents), Midland (metals), Mississauga (vinyl chloride), Ottawa (hydrocarbons), Parry Sound (hydrocarbons), Sarnia (boron and vinyl chloride), Toronto (chlorinated solvents), and several communities in northern Quebec (gasoline and diesel fuel).

- X For the Professional Engineers of Ontario (PEO), AEL has reviewed environmental documents related to a complaint about the methods used by professional engineers to assess and report site contamination concerns.

- X For Hydro One Networks Inc. and Ontario Power Generation Inc. (HONI and OPG, respectively, both formerly Ontario Hydro), AEL has prepared independent third party reviews of proposals, Phase I and Phase II environmental site assessments, site specific risk assessments, and remedial action plans for numerous hydroelectric generating stations, transmission stations, distribution stations, and other properties. Some of these reviews are a requirement of an MOE Director's Order, and AEL works closely with HONI and OPG on that assignment.

- X For prospective purchasers of property and facilities, AEL has reviewed environmental documents produced by current owners to determine if environmental liabilities are well understood and managed.

- X For past owners and tenants of properties, AEL has reviewed environmental documents produced by current owners to determine how responsibilities for contamination might be distributed.

- X For regulatory agencies, AEL has been selected to review proposed remedial work plans, environmental criteria, and other environmental documents. These agencies include the Province of Alberta, the State of New Jersey, and the State of Minnesota

KEY AEL STAFF

2001748 Angus Environmental Limited

Brett G. Ibbotson, M.Eng., P.Eng., Founding Principal at AEL. Brett has participated in numerous risk assessments and peer reviews for more than 20 years. He has directed risk assessment projects for regulatory agencies (Health Canada, Canadian Council of Ministers of the Environment, Alberta Environment, the Australia and New Zealand Environment Council, City of Mississauga, City of North Bay, etc.), numerous industrial clients, and land developers. A risk assessment directed by Brett of a large petroleum distribution facility in the Port Area of Toronto has been described as setting the precedent in Ontario for incorporating risk assessment into major site remediation efforts.

Brett often has been consulted by regulatory agencies for advice about various topics such as: environmental standards setting and risk assessment, including hazard identification, exposure assessment, and risk characterization; and conducting and peer reviewing SSRAs.

Brett has presented his work at numerous workshops and conferences. He was the Vice Chair of the Canadian Standards Association (CSA) ESA Technical Committee and was a member of the Ontario Advisory Committee on Environmental Standards (ACES). A co-author of the *Handbook of Environmental Compliance in Ontario*, Brett teaches a course in environmental compliance at the University of Toronto.

Brett's curriculum vitae is included in Appendix A of this Statement of Qualifications. Brett can be reached at (416) 383-0957, x. 27, or at bibbotson@angusenvironmental.com.

Jeanette M. Southwood, M.A.Sc., P. Eng., Senior Environmental Engineer and Partner at AEL. For more than a decade, Jeanette has managed and participated in numerous peer reviews, exposure and risk assessments and environmental site assessments, as well as environmental database and information system development for government, commercial, and industrial clients. Jeanette is a member of the CSA Technical Committee for Environmental Risk Assessment.

For Health Canada, Jeanette assessed exposures of Canadians to new chemical substances under CEPA and managed a project to survey, review and recommend receptor characteristics for multi-media risk assessment. She was a participant in the project for ANZEC to develop clean-up criteria. For Alberta Environment, Jeanette evaluated the mathematical risk assessment model used to set the soil quality guideline for benzene proposed for the MUST program. She has contributed to projects to set site-specific soil and ground water clean-up guidelines for sites in Alberta and Ontario.

Jeanette has prepared papers and presentations on exposure and risk assessment, and environmental modelling. She has lectured on *Environmental Pathways* at the University of Toronto Institute of Environmental Studies and Department of Chemical Engineering and Applied Chemistry. Jeanette is a recent winner of the Professional Engineers Ontario (PEO) Young Engineer Award.

Jeanette's curriculum vitae is included in Appendix A of this Statement of Qualifications. Jeanette can be reached at (416) 383-0957, x. 23, or at jsouthwood@angusenvironmental.com.

Quality Management and Control

Quality management and control are a top priority to all AEL staff. As partners at the firm, Mr. Ibbotson and Ms. Southwood have corporate responsibility for all work produced by AEL. All draft and final reports are reviewed by a principal and are only signed by designated staff members, each of whom is a professional engineer.

APPENDIX A

CURRICULA VITAE

16 Μαψ 2002

BRETT G. IBBOTSON

EDUCATION

M.Eng., Environmental Engineering, 1976, University of Toronto
B.A.Sc., Civil Engineering, 1975, University of Toronto
Dr. A.E. Berry Scholarship, 1975

PROFESSIONAL AFFILIATIONS

Advisory Committee on Environmental Standards (1995)
Association of Professional Engineers of Ontario
Association for the Environmental Health of Soils
Canadian Standards Association, Environmental Site Assessment Technical Committee, Vice-Chair
Society for Risk Analysis

EXPERIENCE

1990 - date **Founding Principal, Angus Environmental Limited**

Responsible for directing company activities pertaining to soil quality assessment, site decommissioning and redevelopment, pathways analysis, and risk assessment.

Project director for numerous site investigations to characterize contamination, evaluate remediation technologies, and negotiate clean-up programs with regulatory agencies.

Project director of studies deriving clean-up guidelines for organic and inorganic compounds in soil. Results are used to assess the redevelopment potential of contaminated sites. Directed the development of "interim" criteria for the National Contaminated Sites Remediation Program.

Manager of multi-disciplinary teams of environmental specialists for major redevelopment projects, assessments of large property portfolios, and environmental impact studies.

Specialist advisor to potential buyers and sellers concerning environmental liabilities posed by contaminated properties.

Vice-chair of the Canadian Standards Association sub-committee which wrote *Phase I Environmental Site Assessment* (CSA Z768-94).

Third party reviewer of site assessments, clean-up objectives, and proposed soil management plans for sites in Ontario, British Columbia, and New Jersey.

Peer reviewer of environmental reports that support redevelopment applications to North York, East York, and the Region of York. Reviewer for Professional Engineers of Ontario.

1980-1990 Senior Environmental Engineer, SENES Consultants Limited. Specialized in risk assessment, water quality assessment, soil quality assessment, and special studies.

Project manager for developing site-specific guidelines for sites in Alberta, Ontario, and Quebec.

Responsible for creating computer models that calculate acceptable soil concentrations based on physico-chemical, environmental fate, and toxicological risk information. One model incorporated environmental and risk assessment procedures within an expert system programming environment, one of the first such ventures in North America.

Project manager of drinking water quality assessments of more than 30 organic compounds. Objectives were recommended based on information about chemical properties, environmental behaviour, and toxicological effects.

Major contributor in developing a method for prioritizing chemicals found in the environment by taking into account the environmental and toxicological hazards each presents.

Major contributor to studies of the philosophy underlying environmental regulation. Involved in several studies incorporating risk assessment explicitly into regulation development. Examples include a review of the possible applications of the *de minimis* concept in regulatory reform.

Environmental engineer and project coordinator on several site selection and environmental impact assessment studies. Examples include a proposed LNG storage facility in Ontario, coal projects in Alberta and British Columbia, proposed uranium mining in Virginia, waste management facilities in Ontario, a molybdenum deposit in British Columbia, the close-out of a uranium mining operation in Saskatchewan, and a uranium deposit in Newfoundland.

Project engineer on the development and application of innovative computer models to simulate water quality or the environmental fate of substances. Models were used to evaluate the relative effects of different mill processes, tailings area close-out proposals, a uranium refinery expansion, and the fate of organic compounds in a major Canadian river.

Contributor to an oil spill contingency plan for a pipeline from Norman Wells, Northwest Territories, to northern Alberta.

1976-1980 Project Engineer, James F. MacLaren Limited. Assisted in the preparation of the environmental assessment for the expansion of the Elliot Lake uranium mines. Responsibilities included analysis of water quality data, water quality modelling, effluent characterization, and project co-ordination.

Program coordinator for the search and recovery operation of the Cosmos 954 satellite during the summer of 1978. Coordinated activities of field teams involved the recovery of radioactive debris.

Lead author of a federal contingency plan for major oil spills occurring in the eastern Arctic and a study to develop a contingency plan for an oil refinery complex in the Northwest Territories.

Co-author of an assessment of the effects of Ontario pulp and paper mills on water quality in the Great Lakes Basin.

Contributor to reports for three participants at the British Columbia Royal Inquiry into uranium mining. Responsibilities included analysis of water quality data, and effluent characterization.

Project Manager of the Canadian environmental impact study for a proposed hydro-electric project on the Saint John River.

1975-1976 Telesat Canada. Supervisor of field work on projects in Quebec, Ontario, Manitoba, Alberta and Northwest Territories.

BOOKS

Environmental Management in Canada. (with J-D. Phyper). McGraw-Hill Ryerson. 1995.

An Overview of Remediating and Redeveloping Contaminated Property in Canada. Chapter in "Land Recycling" (Brachflächen und Flächenrecycling). P. Noll and D. Genske, editors. Ernst & Sohn Publishers, Berlin. 1995.

The Handbook of Environmental Compliance in Ontario. (with J-D. Phyper). McGraw-Hill Ryerson. Second Edition, 1994. First Edition, 1991.

ARTICLES

Is it Time for Risk Assessment and Management to Take on a Larger Role? Environmental Science and Engineering, 9(2):16-19. May 1996.

Soil Guidelines in Ontario - Are There More Questions than Answers? Environmental Science and Engineering, 4(6). December 1991/January 1992.

The Challenges of Site Decommissioning in Canada. In Canadian Ceramics Quarterly, 60(1)17-20, February 1991.

Uranium Mill Tailings - An Illustration of Hazardous Waste Management Practice. Article in Canadian Consulting Engineer Magazine, Special Supplement on Waste Management, January 1981 (with D.B. Chambers and D.M. Gorber).

Bacterial Oxidation of Inorganic Compounds in Mining Water. Conservation & Recycling, 5(1):47-53 (with J.M. Scharer)

COURSES TAUGHT

Environmental Legislation and Audits. University of Toronto, Faculty of Applied Science and Engineering, Professional Development Centre. Topics include: waste management and transportation, PCBs, contaminated sites, spills and emergency planning, environmental site assessment. Fall 1993, Spring and Fall 1994, Spring and Fall 1995, Spring and Fall 1996, Spring and Fall 1997, Spring and Fall 1998, Fall 1999, Fall 2000.

Environmental Aspects of Facility Management. University of Toronto, Faculty of Applied Science and Engineering, Professional Development Centre. Topics include: indoor air quality, managing hazardous materials, waste management, audits, site assessment, and environmental management systems. May to June 1999, February to April 2000, February to April 2001.

TECHNICAL PAPERS AND PRESENTATIONS

An Area-Wide Approach to Managing Soil and Ground Water in the Toronto Port Area. Presented at the Air & Waste Management Association's 90th Annual Meeting and Exhibition. Toronto, Ontario. 10 June 1997 (with B. Benson, M. Conway, P. Beck, and R. Lall).

Brownfields: The Challenge of Restoring Contaminated Sites. Presented at Compliance '97. Toronto, Ontario. 28 March 1997.

The Challenges of Restoring Contaminated Sites. Presented at "Brownfields and the New Ontario Guideline", a workshop of the Canadian Environmental Defence Fund. Toronto, Ontario. 05 October 1996.

The New MOEE Guideline - A Consultant's Perspective. Presented at "How Clean is Clean?", a joint program of the Canadian Bar Association - Ontario, and Professional Engineers of Ontario, Toronto, Ontario. 13 September 1996.

The Past, Present and Future of Criteria Used at Contaminated Sites in Ontario. Presented at Compliance '96, Toronto, Ontario. 07 May 1996.

Site Assessment and Remediation: One Perspective on Improving the Remediation Sector's Interactions With the MOEE. Presented at The Environmental Industry Training Course conducted by the Ontario Ministry of Environment and Energy, Toronto, Ontario. 20 February 1996.

Risk-Based Solutions For An Old Problem: The Ataratiri Lands. Presented at the Ontario Ministry of Environment and Energy Conference, Toronto, Ontario. 03 November 1995 (with B. Benson).

Assessing Environmental Risks. Presented to the Insurance Bureau of Canada, Toronto, Ontario. 07 June 1995.

Recent Developments Affecting the Clean-up of Contaminated Sites in Ontario. Presented at Compliance '95, Toronto, Ontario. 09 May 1995.

An Overview of Decommissioning and Redeveloping Contaminated Sites in Canada. Presented at the Canadian Environmental Regulations for U.S. Businesses presented by Executive Enterprises, Chicago, Illinois. 07 October 1994.

The Evolving Nature of Environmental Audits. Presented at the 4th biennial scientific conference of the Canadian National Asbestos Council, Toronto, Ontario. 20 September 1994.

Assessment and Management of Contaminated Sites. Presented at The 8th Annual Toronto Environment Show, Toronto, Ontario. 11 May 1994.

Environmental Site Assessments and Audits. Presented at the "Building Connections" Seminar of the Ontario Management Board Secretariat, Toronto, Ontario. 2 and 3 November 1993.

An Overview of Decommissioning and Redeveloping Contaminated Sites. Presented at the National Environmental Regulation Update Course presented by Executive Enterprises, Toronto, Ontario. 22 and 23 April 1993.

An Overview of Risk Assessment and Its Role in Site Remediation. Presented at the Canadian Petroleum Products Institute Workshop on the Application of Risk Assessment to Site Remediation, Winnipeg, Manitoba. 3 to 5 November 1992.

Using an Expert System to Facilitate the Development of Clean-up Guidelines. Presented at the 1988 Annual Conference of the Society for Environmental Toxicology and Chemistry, Washington, D.C., November 1988 (with J-D. Phyper and B.P. Powers).

Decommissioning Contaminated Sites - Current Status and Recent Developments. Presented at the Environmental Certification Course for Environmental Engineers and Corporate Officials, York University, Toronto, Ontario. 7 October 1988 (with D.M. Gorber).

An Innovative Approach to Establishing Clean-up Guidelines. Invited paper at Haztech Canada 1988, Toronto, Ontario. June 1988 (with M.J. Riddle).

Development of a Method to Set Clean-up Guidelines for Contaminated Soil at Decommissioned Industrial Sites. Invited paper at the International Conference on Contaminated Soil, Hamburg, West Germany, April 1988 (with T.L. Bulman, K.R. Hosler, D. Hockley, and M.J. Riddle).

Incorporating Risk into the Development of Soil Clean-up Guidelines for Trace Organic Compounds. Presented at the Society for Risk Analysis Annual Conference, Houston, Texas. November 1987 (with D.M. Gorber and D.W. Reades).

A Site-Specific Approach for the Development of Soil Clean-up Guidelines for Trace Organic Compounds. Presented at the Second Conference on Environmental and Public Health Effects of Soil Contaminated with Petroleum Products, Amherst, Massachusetts. September 1987.

Overview of Uranium Tailings Management Practice. Invited paper presented at the International Conference on Radioactive Waste Management, Winnipeg, Manitoba. September 1982 (with D.B. Chambers, R.A. Knapp, L.M. Lowe).

Environmental Considerations Related to Uranium Exploration. Presented at the Twenty-Second Annual International Conference of the Canadian Nuclear Association, Toronto, Ontario. June 1982 (with D.B. Chambers and V.J. Cassaday).

The Canadian Experience - A Review of Environmental Considerations Associated with Uranium Mining Operations in Elliot Lake. Presented at the Operation Action UP Conference on Uranium Mining and Radiation Safety at Michigan Tech University, Houghton, Michigan. September 1980 (with D.B. Chambers and D.M. Gorber).

Radium in Water: Sources, Treatment and Health Effects. Presented at the Annual Conference of the Ontario Section, American Water Works Association, Toronto, Ontario. April 1980 (with D.M. Gorber).

Environmental Assessment of Uranium Mining in Elliot Lake Ontario. Presented at the Second Symposium on Uranium Tailings Management, Fort Collins, Colorado, November 1979 (with D.M. Gorber).

Water Utilization and Tailings Management. Presented at Extractive Metallurgy of Uranium - A Short Course, University of Toronto, Ontario. May 1979 (with D.M. Gorber and R.A. Knapp).

JEANETTE M. SOUTHWOOD, M.A.Sc., P.ENG.

EDUCATION

M.A.Sc., Chemical and Environmental Engineering, 1988, University of Toronto
B.A.Sc., Chemical Engineering, 1986, University of Toronto

PROFESSIONAL AFFILIATIONS

Canadian Environmental Defence Fund, Former President, Board of Directors
Canadian Standards Association Environmental Risk Assessment Technical Committee
CEDF Environment Fund - President, Board of Directors
City of North York Environment Committee Advisory Board, Former Board Member
Professional Engineers Ontario, Awards Committee, Member
Professional Engineers Ontario, Willowdale-Thornhill Chapter Executive, Former Member
Society of Environmental Toxicology and Chemistry

AWARDS

Professional Engineers Ontario, Engineering Medal, Young Engineer Award, 1997
City of North York (now the City of Toronto), Award of Excellence, 1997

SECURITY CLEARANCE

Health Canada Security Screening Certificate - Enhanced Reliability

EXPERIENCE

1990 - date **Senior Environmental Engineer, Angus Environmental Limited**
Responsible for managing and undertaking projects and activities pertaining to risk assessment, pathways analysis, site decommissioning, environmental site assessment (ESA), and training.

Manager and co-author of guidelines prepared for Environment Canada under the Canadian Environmental Protection Act (CEPA) New Substances Program. Managed pathways analysis of 13 PSL2 substances in project for Environment Canada. Manager of projects for Health Canada to assess exposure to methyl *tert*-butyl ether (MTBE) and new chemical substances under CEPA, to review and recommend receptor characteristics for multi-media risk assessment, and to assess the exposure of Canadians to nitrogen oxides. For Health Canada, screened and assessed transitional substances notified under the CEPA New Substances Notification Regulations. Qualified by the Pesticide Management Regulatory Agency (PMRA) to be placed on the contractors list for Environmental Evaluations and Efficacy Assessment. Researcher in an assessment of exposure from a petroleum distribution centre in downtown Toronto. For the Australian and New Zealand Environment Council, used pathways analysis and risk assessment techniques to develop clean-up criteria. Peer reviewer of a risk assessment undertaken for the City of Halifax of proposed waste management options.

Project manager for environmental modelling of effluent for the University of Toronto Pulp & Paper Centre and to assess water quality on the Caribbean island of St. Lucia. Creator of a fugacity model for Fisheries and Oceans Canada of pesticide dissipation following deposition on surface micro-layers. Manager to assess chemical fate and exposure at fire training areas for Transport Canada. Manager investigating ethylene oxide fate in hospital sterilizers.

Independent third party reviewer of Phase I and II ESAs, site specific risk assessments, and remedial work plans prepared for Hydro One Networks and Ontario Power Generation Inc. (formerly Ontario Hydro). For prospective purchasers of property and facilities, reviewed environmental

database for base metal tailings. Project manager for an assessment of the environmental effects of acidic mine tailings spill water on lake water quality. Participant in a project evaluating close-out options at a uranium mine by utilizing the uranium tailings assessment program - UTAP, a probabilistic assessment model for predicting the long-term effects of uranium mine tailings.

Project manager to assess pesticide exposures to humans via inhalation of basement air. Project manager to determine bioconcentration factors for fish in Lake Ontario using a fugacity model. Chemicals evaluated included polynuclear aromatic hydrocarbons (PAHs), PCBs, dioxins and furans. Researcher to develop chemical/ toxicological database for an expert-system based site redevelopment model (AERIS) for human health risk assessment. Co-author of the AERIS User's Manual. Estimated disposal costs for soil containing dioxins and furans including calculating toxicity equivalency factors (TEFs). Co-author of a review of di-n-butyl phthalate, a chemical on the Priority Substances List, for Health and Welfare Canada to assist in toxicity assessment for CEPA. Researcher/co-author to establish soil quality guidelines for use in site remediation. Involved in the management of in-house computing facilities. Responsibilities included evaluating and recommending software packages.

1988 Engineer, City of Toronto Environmental Protection Office. Contracted to provide consultation on the assessment of alternative sources of drinking water and purification methods used in home water treatment. Developed a database summarizing chemical/bacteriological analysis results.

1988 Environmental Engineer, CMC Ecological Consulting. Contracted to research and write the mathematical modelling section in a report for Environment Canada on the use of exposure models to assess the hazards and media of accumulation of organic chemicals covered by CEPA. Modified a computer model to facilitate comparisons with the National Research Council Persistence Model.

1987 - 1988 M.A.Sc. Studies at the University of Toronto. Thesis Topic: Computer Modelling the Fate of Organic Chemicals in the Aquatic Environment.

1985 - 1986 Research Assistant, University of Toronto. Developed a spreadsheet model with macros for scientific data management. Analyzed crude oil samples using gas chromatography. Developed experiments and a computer model to simulate oil spill weathering in the environment.

COURSES TAUGHT

Brownfields and Contaminated Land: The Essential Introductory Course. Session Chair at Environmental Management, Compliance & Engineering 2001. 10 April 2001.

Brownfields and Contaminated Land: New Opportunities and Developments. Session Chair at Environmental Management, Compliance & Engineering 2001. 10 April 2001.

Site Assessment, SSRAs and Right-to-Know. Session Chair at Environmental Management and Compliance 2000. 26 April 2000.

Site Specific Risk Assessment and the Record of Site Condition. Session Chair at Environmental Management, Compliance, and Best Available Technologies '99, Toronto, Ontario. 7 April 1999.

Brownfields and Ontario's New Guideline for Use at Contaminated Sites. Session Chair at Environmental Compliance '98 and Environmental Compliance '97, Toronto, Ontario. 9 April 1998 and 13 March 1997.

Environmental Pathways. Graduate Course offered at the University of Toronto Department of Chemical Engineering and Applied Chemistry. 1997.

Pathways Analysis of PSL2 Chemicals using Fugacity Modelling. Environment Canada CEPA PSL2 Workshop on Volatile Compounds, Hull, Québec. 8 May 1996.

Phase I Environmental Site Assessments: Visual Inspections and Preparing a Report. Presented at the Environmental Compliance Show, Toronto, Ontario. 9 May 1995, 6 May 1996, 13 March 1997, 9 April 1998.

Understanding the Site Decommissioning Process. Presented at the Canadian Environmental Regulations and Compliance Strategies Conference presented by Executive Enterprises, Toronto, Ontario. 6 to 7 April 1995.

Assessment and Management of Contaminated Sites. Presented at The 8th Annual Toronto Environment Show, Toronto, Ontario. 11 May 1994.

COURSES TAKEN

Site Assessment and Sampling, Engineering Extension Service, Texas A&M University, 1992
Soil Remediation Workshop, Shell Development Company, 1992
Site Characterization for Subsurface Remediations, U.S. Environmental Protection Agency, 1990

BOOKS AND ARTICLES

Modelling Agrochemical Dissipation in Surface Microlayers following Aerial Deposition. Chemosphere, 38(1):121-141. 1999 (with D.C.G. Muir and D. Mackay).

Modelling the Fate of 2,4,6-Trichlorophenol in Pulp and Paper Mill Effluent in Lake Saimaa, Finland. Chapter in: Environmental Fate and Effects of Pulp and Paper Mill Effluents, edited by M.R. Servos, K.R. Munkittrick, J.H. Carey, and G.J. Van Der Kraak, St. Lucie Press. 1996 (with D. Mackay, J. Kukkonen, W.Y. Shiu, D.D. Tam, D. Varhaní©kova, and R. Lun).

Sour-gas Facility to Pasture Land: Setting Site-Specific Soil Quality Guidelines for Change of Land Use, Chapter 41 in: Hydrocarbon Contaminated Soils, Volume 3, edited by E. Calabrese and P. Kostecki, Lewis Publishers. 1993 (with B.G. Ibbotson and J.T. Dance).

Modelling the Fate of Organochlorine Chemicals in Pulp Mill Effluents. Water Poll. Res. J. Canada, 27(3):509-537. 1992 (with D. Mackay).

Modelling Chemical Reactions in Reactive Tailings. Proceedings of the Acid Mine Drainage Conference, Geological Association of Canada - Mineralogical Association of Canada Joint Annual Meeting. 1990 (with B.E. Halbert, J.M. Scharer, W.J. Snodgrass and H.F. Steger).

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The Influence of Surface Films on the Fate of Deltamethrin following Aerial Application to Natural Ponds on the Canadian Prairies. A Poster Presentation at the ACS/CIC Chemical Congress, Environmental Chemistry Division, Toronto, Ontario. June 1988 (with D.C.G. Muir, A.L. Yarechewski, G.R. Giesbrecht, B.R. Neal and D. Mackay).

The Use of Spreadsheet and Graphics Software for Interpreting the Results of a Chemical Spill in Ponds and Lakes. Presented at the 5th Technical Seminar on Chemical Spills, Montreal, Québec. February 1988 (with R.C. Harris and D. Mackay).

PEER REVIEW OF
SITE SPECIFIC RISK ASSESSMENT
GARDINER EXPRESSWAY DISMANTLING AND
LAKE SHORE BOULEVARD EAST RECONSTRUCTION
AT LESLIE STREET
TORONTO, ONTARIO

Prepared for

City of Toronto
Works & Emergency Services
Technical Services
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Angus Environmental Limited
44 Upjohn Road
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March 2002

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 TERMS OF REFERENCE

Angus Environmental Limited (AEL) was retained by the City of Toronto to undertake a peer review of a report entitled *Site-Specific Risk Assessment, Gardiner Expressway Dismantling and Lakeshore Boulevard East Reconstruction at Leslie Street, Toronto, Ontario* prepared by Shaheen & Peaker Limited (S&P) for the City of Toronto and dated 8 March 2002.

In general terms, the purpose of the peer review is to offer an opinion as to whether or not the Site Specific Risk Assessment (SSRA) has been undertaken competently in accordance with the 1996 document from the Ontario Ministry of the Environment (MOE, formerly the Ontario Ministry of Environment and Energy) entitled *Guideline for Use at Contaminated Sites in Ontario* and the associated *Errata* issued in 1997 (the *Guideline*). The peer review must also comment on whether or not the conclusions reached are appropriate and defensible.

To achieve those goals, this peer review examines the information presented in the S&P report that describes current site conditions, the relationships between current conditions and past activities or conditions, the rationale for identifying chemicals of interest, the fate and toxicological characteristics of those chemicals, the rationale for selecting appropriate exposure scenarios, the equations and/or models used to estimate the potential for receptors to come into contact with chemicals, the interpretation of the exposure estimates, and the subsequent conclusions and recommendations.

The peer review reflects a format presented in the 1996 MOE document entitled *Guidance on Site Specific Risk Assessment for Use at Contaminated Sites in Ontario*. AEL also examined the "Checklist for Reviewers" in that MOE document (updated 31 March 1998) prior to preparing the review.

1.2 LIMITING CONDITIONS

This report has been prepared for S&P and the City of Toronto. Any use which a third party makes of this report, any reliance on the report, or decisions based upon the report, are the responsibility of those third parties unless authorized by AEL in writing. AEL accepts no responsibility for damages suffered by any unauthorized third party as a result of decisions made or actions taken based upon this report.

This report has been written by Jeanette Southwood, M.A.Sc., P.Eng., Brett Ibbotson, M.Eng., P.Eng., and Vera Lusney, B.Sc., of AEL.

2.0 STATEMENT OF OBJECTIVES AND SCOPE

2.1 OBJECTIVES OF THE SSRA

The main objectives of the SSRA, as described in Section 1.2 of the S&P report are:

- "To identify the 'contaminants of concern' (COCs), their degree of exceedances of MOE generic criteria and COCs to be selected for detailed assessment";
- "To identify the human and ecological receptors on the site";
- "To develop a Level 2 Risk Management Plan to mitigate exposure to humans and planted vegetation on the site";
- "To evaluate exposure to the receptors from the COCs selected for detailed assessment, incorporating the pertinent features of the Level 2 Risk Management Plan"; and
- "To coordinate the Level 2 Risk Management Plan with the City's overall vision for the landscaping for this area".

2.2 SCOPE OF THE SSRA

Section 1.3 of the SSRA describes the scope of work. In Appendix E, S&P explains how the SSRA is organized in response to the four standard tasks of risk assessment and indicates that the methodology employed is this SSRA is consistent with MOE guidance, the approach and framework provided by the Canadian Council of Ministers of the Environment (CCME), and the United States Envionmental Protection Agency (U.S. EPA). Section 1.1 of the S&P report indicates that a Level 2 approach to risk management is to be used.

The SSRA should include a References section that lists all of the references cited.

The current structure of the SSRA frequently requires a reader to move from the main body of the report, to an appendix, to an attachment to an appendix, and back again. The SSRA would benefit from re-organization. However, such a change is not essential.

appendices of the SSRA summarize the information that has been collected previously induding borehole and test pit logs from all investigations and analytical results from all investigations. The SSRA also provides lists of previous reports.

3.2 DATA COLLECTION

Sections 2.3.1 and 2.3.2 of the SSRA summarize the subsurface investigations undertaken at the subject property. These included the collection of samples of soil and ground water at the locations shown on Drawing 3 of the SSRA. It would be useful to the reader if S&P summarized the investigation carried out in September 2001 in this section of the report. Further details about this investigation are provided in Appendix D. Tables C-2 and C-3 of Appendix C summarize the results of analyses of soil and ground water samples. Table C-1 of Appendix C provides ground water elevations and the calculated depth to ground water.

3.3 DATA EVALUATION

Section 2.5.1 describes the rationale for the selection of the MOE criteria to be used to evaluate data collected at the property. S&P concludes that MOE Table B criteria for industrial/commercial land use in a non-potable groundwater condition for coarse textured soils are appropriate for evaluating the environmental quality of the soil and ground water encountered at the site. S&P indicates that although the land is to be used as public open space (analogous to a long, narrow park), it is assessed as industrial/commercial because adjacent lands are used for industrial/commercial purposes. This seems logical but must have limits. For example, parts of Area B are up to 100 m from thoroughfares. At some point, these or similar areas are parkland and should be assessed with parkland criteria. Overall, the rationale for using industrial/commercial criteria is not compelling and likely is adequate for Area A, but perhaps not for Area B. This part of the SSRA should be strengthened.

In addition, AEL notes that some MOE staff (including SSRA reviewers at the Standards Development Branch) have indicated that sites may be "potentially sensitive" when the water table is less than 2 m below grade. The SSRA indicates that the depth to ground water at some locations on the property is less than 2 m; whether the site is "potentially sensitive" can be clarified by consulting the local MOE office.

Leachate tests were performed on two surface samples for inorganic parameters including heavy metals and for two deeper samples for inorganic parameters as well as for VOCs (induding benzene). Section 2.5.4 of the SSRA indicates that some of the impacted soil would be classified as hazardous waste if excavated for offsite transportation and disposal. It would be useful if Section 2.5.4 identified which samples were subjected to a leachate test and which did not satisfy O. Regulation 558. Table C-10 of Appendix C provides a summary of the leachate test results.

Section 2.5.4 of the SSRA states that "the locations of impacts within the study area are shown on Drawing 4"? Should this statement be revised to refer to "Drawing 2"?

3.4 PARAMETERS SELECTED FOR DETAILED ANALYSIS

Section 2.5.4 discusses the soil impacts and where they were found. A list of soil samples with concentrations that exceed MOE criteria is provided in Table 2 of the SSRA. Sections E-2.1 to E-2.5 of Appendix E provide details of where each COC was found. In Section E-2.8, the COCs in excess of Table B criteria and, where applicable, Table F criteria are listed. These selections appear to be appropriate. Missing from the list are indeno[1,2,3-c,d]pyrene and benzo[g,h,i]perylene in ground water which were measured at concentrations slightly higher than the applicable criteria in September 2001; however, S&P provides an explanation in Section E-2.6 for why these results are not included.

In Section 3.3.1, the COCs are divided between those for which the major exposure pathway is direct contact (i.e., heavy metals and PAHs) and those for which the major or significant pathway may be vapour inhalation (i.e., benzene, toluene, xylenes, and TPH (gas/diesel)). It is also indicated that "concentrations of lead, TPH (gas/diesel) and benzo(a)pyrene exceeded the MOE upper concentration limits for these parameters".

4.4 OVERALL ECOLOGICAL RISK ASSESSMENT

Overall, AEL agrees that the types of measure described in the risk management plan have the potential to minimize or possibly eliminate exposures of the COCs to the ecological receptors; therefore, there is no need to prepare a quantitative ecological risk assessment for the property.

5.0 HUMAN HEALTH RISK ASSESSMENT

5.1 TOXICITY ASSESSMENT

A toxicity assessment is provided in Chapter E-4 of Appendix E for the volatile COCs which include benzene, toluene, xylenes, and TPH (gas/diesel and heavy oils). Human health toxicity values for these COCs are described in Section E-4.1. Explanations should be provided if the values used by S&P in the SSRA differ from those selected by the MOE.

5.2 RECEPTOR CHARACTERIZATION

Section E-3.2.1 of the SSRA describes the human receptors as "adults and children who would occasionally use the subject property for walking, biking, etc.". The types of receptors listed are appropriate. Although the description of the receptors is brief, AEL agrees that no additional detail is necessary.

5.3 EXPOSURE ASSESSMENT

Chapter E-4 states that there will be "no complete exposure pathways for the non-volatile and semi-volatile chemicals of concern".

Section E-3.2.1 of the SSRA provides a brief rationale for eliminating exposure pathways such as inhalation of soil particulate, incidental ingestion of impacted soil and suspended particulate matter; dermal contact with impacted soil, and ingestion of ground water. These rationales are adequate. The only pathway that is assessed is the inhalation outdoors of vapours from impacted soil; however, S&P indicates that "due to the rapid dilution of vapours arising from the subsurface, with the outdoor air, inhalation of vapours outdoors is not usually a pathway of concern". This is appropriate.

5.4 RISK CHARACTERIZATION

Risk characterization is presented in Section 3.5 of the SSRA. Additional detail is provided in Section E-5.1.

One of the conclusions listed in Chapter 5 of the SSRA is: "The major pathway of exposure was determined to be direct contact with the impacted soil". This is inconsistent with the preceding conclusions that identify the inhalation of vapours as another exposure pathway. The text in Chapter 5 should indicate that direct contact will not occur if the risk management plan is implemented. Section E-3.2.1 of Appendix E clearly states that "there will be no opportunity for direct contact with the contaminants ... by human receptors".

7.0 OVERALL OPINION

As mentioned in Chapter 1.0 of this review, the purpose of this peer review is to offer an opinion as to whether or not the SSRA has been undertaken competently in accordance with the 1996 MOE document entitled *Guideline for Use at Contaminated Sites in Ontario* and the associated *Errata* issued in 1997 and associated documents. The peer review also comments on whether or not the conclusions reached are appropriate and defensible.

This peer review finds that the work has been undertaken competently and that the conclusions reached by S&P are appropriate. However, the conclusions would be more defensible and the SSRA report would be strengthened if more details were provided in the RMP.

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File: SP3977 **May 14, 2002**

Angus Environmental Ltd.
44 Upjohn Road
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M3B 2W1

Attention: Jeanette Southwood, M.Sc., P. Eng.

Dear Ms. Southwood:

Response to Third Party Peer Review
Site-Specific Risk Assessment
Gardiner Expressway Dismantling and Lakeshore Boulevard East Reconstruction
at Leslie Street
Toronto, ON

Shaheen & Peaker Limited (S&P) is pleased to present herein our response to the third party peer review conducted by Angus Environmental Limited (AEL), dated March, 2002 for the draft site-specific risk assessment (SSRA) report prepared by S&P for the above-noted site. Concurrent with AEL's review, the City of Toronto Public Health (TPH) also reviewed the draft SSRA report. S&P and the City of Toronto met with representatives of TPH to discuss their comments on April 24, 2002. We have included the TPH comments and our response. Please note that the text of the SSRA report has been revised to the comments of both the third party peer review and TPH review.

The peer review comments (organized by their headings from the peer review report and identified in *italics*), and S&P's responses, are itemized below.

1.0 INTRODUCTION

No reply necessary.

2.0 STATEMENT OF OBJECTIVES AND SCOPE

2.1 Objectives of the SSRA

No reply necessary.

2.2 Scope of the SSRA

***AEL Comment**: The SSRA should include a References section that lists all of the references cited.*

***AEL Comment**: Section 2.5.4 of the SSRA states that "the locations of impacts within the study area are shown on Drawing 4"? Should this statement be revised to refer to "Drawing 2"?*

Response: This was a typographical error and should originally have read Drawing 2. This Drawing shows the entire study area. Although there were some areas where the concentrations of the parameters met the criteria, the impacts are assumed to be present throughout the entire study area.

For one of the public meetings, S&P had prepared a drawing showing the locations of the different types of impacts. The locations of soil which failed the "hazardous waste" test (see previous comment) are also shown on the drawing. We have now included this drawing as **Drawing 5** in the SSRA report. A copy of **Drawing 5** is attached to this letter. The text of the SSRA report has been revised to read "the locations of impacts within the study area are shown on **Drawing 5**".

3.4 Parameters Selected for Detailed Analysis

No reply necessary.

4.0 ECOLOGICAL RISK ASSESSMENT

4.1 Toxicity Assessment

***AEL Comment**: The toxicity assessment for ecological components in Section E-4.2 of the SSRA includes a discussion of the sodium adsorption ratio (SAR) and pH. It is not clear why this discussion does not include the other contaminants of concern such as heavy metals, TPH (gas/diesel), TPH (heavy oils), BTEX, and PAHs.*

Response: The risk management plan proposed for the site includes blocking of exposure pathways such as direct contact with impaired soil by ecological receptors and uptake by vegetation. The potential for contaminants to migrate in groundwater remains a concern and, thus, monitoring of the contaminants of concern in groundwater will be part of the risk management plan. The "other inorganic parameters" (i.e., the electrical conductivity, pH, and SAR) describe the general quality of the soil and the intent of the discussion in Section E-4.2 was to evaluate the potential for elevated or decreased values of these parameters to affect migration of metals in groundwater. Because direct exposure to the metals, TPH and PAHs will be blocked as part of the risk management plan, a toxicity assessment for these constituents was not included.

***AEL Comment**: It would be useful, but not essential, if the ERA contained ecological information from the MOE Rationale document about concentrations of the COCs which have been reported to cause ecological effects and a comparison of those benchmarks to concentrations of the COCs measured at the property.*

Response: The following text will be added to Section 3.6.5 of the revised report (formerly Section E-4.2 in the draft SSRA report):

> The applicable MOE Table B criteria for the site, for the following chemicals of concern, are based on protection of ecological receptors: antimony, arsenic, boron, cadmium, chromium, copper, zinc, benzo[a]anthracene, naphthalene, phenanthrene, electrical conductivity, and SAR. The criteria for arsenic,

- Benzene - the MOE used a unit risk value of 8.3×10^{-6} per $\mu g/m^3$ from U.S. EPA/IRIS (1993). U.S. EPA has since revised their risk estimate and the current EPA values were used in the SSRA (arithmetic mean of 5.0×10^{-6} per $\mu g/m^3$; range of 2.2×10^{-6} to 7.8×10^{-6} per $\mu g/m^3$).

- Xylenes - the MOE used a reference concentration of 300 $\mu g/m^3$ from U.S. EPA/HEAST (1992). A more conservative value of 180 $\mu g/m^3$ was developed by Health Canada and was used in the SSRA. In their review of the SSRA, the TPH pointed out that the reference concentration for xylenes should not be pro-rated to determine an annual exposure, as the critical effect upon which the reference concentration was based is a critical period of fetal development. The SSRA has been revised so that the exposure frequency for xylenes is 365 days per year, four hours per day. The previous conclusion of the SSRA remains unchanged (the calculated concentration of xylenes in soil that would result in an air concentration in soil corresponding to 20% of the reference concentration is less than the maximum measured concentration at the site). **Table 4**, which shows the results of the revised exposure calculations, is included as an attachment to this letter.

- TPH - human health toxicity information was not explicitly used by MOE.

The toxicity assessment for the volatile chemicals is now located in Section 3.5 of the revised report.

5.2 Receptor Characterization

No reply necessary.

5.3 Exposure Assessment

No reply necessary.

5.4 Risk Characterization

***AEL Comment**: One of the conclusions listed in Chapter 5 of the SSRA is: "The major pathway of exposure was determined to be direct contact with the impacted soil". This is inconsistent with the preceding conclusions that identify the inhalation of vapours as another exposure pathway. The text in Chapter 5 should indicate that direct contact will not occur if the risk management plan is implemented. Section E-3.2.1 of Appendix E clearly states that "there will be no opportunity for direct contact with the contaminants ... by human receptors".*

Response: The bullet in Chapter 5 will be modified to read: "In the absence of a Risk Management Plan, the major pathway of exposure was determined to be direct contact with the impacted soil. Inhalation of vapours outdoors was also identified as a pathway of exposure".

6.0 RISK MANAGEMENT PLAN

***AEL Comment**: The types of activities described in the RMP appear to be capable of eliminating exposures to humans and ecological receptors; however, it would be useful if additional details were provided including the following.*

Where will the geotextile membrane be placed? When specifications for the material are being set, who will do that and will they be aware of the SSRA?

Response: The location of the geotextile is shown in Figures 2, 3 and 4 for Areas A and B and for a typical cross-section in Area A. A brief written description of the location of the geotextile is provided in Section 4.2.3.4. In brief, geotextile will be placed under all tree, shrub and planting beds.

The selection of the type of geotextile was determined as part of the SSRA process. The requirements of the SSRA and risk management were determined prior to the selection of the geotextile. Early in the discussion process, a strategy had to be developed to preserve the landscape vision for the site, yet at the same time, eliminate potential contact between ecological and human receptors with impacted soil. The methods used to achieve this goal are described based on the root growth requirements, as well as the necessity to allow flow-through of groundwater. The selection of the type of geotextile was determined in consultation between a representative of the geotextile manufacturer, the landscape architect, and with input from S&P's ecologist. The SSRA does not include specifications, as that will be the responsibility of the city and/or its landscape architect. However, the functional quality of the geotextile is described.

The product that was deemed appropriate for this site and its conditions, was a TC Mirafli Filterweave (FW404). Equivalent products may also be suitable, if approved by the landscape architect. The material currently being recommended is a loosely woven polypropylene fabric. The material will last indefinitely in a buried condition. It is porous to allow for the movement of water yet strong enough to act as an impediment to root movement and the burrowing activities of small animals. The geotextile will also function as a physical barrier to prevent the mixing of impacted soil with the clean surface soil. It will also impede the growth of root systems under walkways to prevent root heave. The presence of the geotextile will also act a boundary marker between the two layers so that if there occurs any digging in the future (i.e., replacement of trees, sidewalk construction etc.), the location of the impacted layer will be noted.

***AEL Comment**: The SSRA appears to indicate that the northern swale crosses through lead-impacted soil that is hazardous waste. Is this correct? If so, is it correct to assume that the soil that is excavated will be disposed of as hazardous waste but that the neighbouring hazardous waste that is not excavated for the swale will remain in place?*

Response: Yes, your assumption is correct. Note that there are different types of standards used to classify waste (hazardous versus non-hazardous) than criteria for evaluating the environmental quality of soil in place (soil meeting MOE criteria versus "impacted" soil exceeding MOE criteria). As a result of the excavation of the northern swale, there is a chance that soil containing high concentrations of lead may be excavated. The materials removed from the swale will be tested at regular intervals to determine the nature of the waste. If the tests indicate the materials are hazardous they will be disposed of appropriately. This is required by Ontario Regulation 347 (as amended by O.Reg. 558/00). Soil in adjacent areas will not be removed as per the plan as presented in the SSRA, even though the concentrations of lead may be high. However, note that the swale and adjacent areas on the site will be lined with geotextile and covered with up to 1.5 m of soil to minimize contact between the roots of trees and shrubs with impacted soil. **Any impacted material on the site will thus be effectively covered by a layer of topsoil varying from 30 cm to 1.5 m in thickness**. This is

demonstrated in the typical cross-section in Figure 3.

AEL Comment: *What is the rationale for a minimum depth of 30 cm of clean fill or topsoil to cover the entire site? Why not a depth less than or greater than 30 cm?*

Response: The root depth of sod typically extends to about 15 cm. As root growth is variable depending on site conditions, it was reasoned that an additional buffer of 15 cm of clean soil would be adequate to prevent any potential root contact between sodded areas and impacted soil if root growth were to extend beyond 15 cm. Secondly, a search of the literature (see references) indicates, that as a general rule, 30 cm of top soil is also critical for root growth for most woody plants. Most root growth for trees and shrubs occurs in the top 15-30 cm of soil; therefore, a depth of 30 cm of top soil would provide adequate conditions for the viable growth of plants as per the landscape design.

This comment was also brought up by TPH, whose major concern was the inadvertent breach of the surface cover into the impacted soil by small children or pets. The following paragraphs are now included in Section 4.2.3.2 of the revised SSRA report to address the 30 cm issue:

> In order to determine whether the minimum of 30 cm of topsoil was sufficient to prevent breaches during normal use of the area, S&P contacted the City of Toronto Parks Department to ascertain the frequency of occurrence of digging within grassed areas of City Parks. The Parks Department representative reported that occurrences of children digging in a grassed area are extremely rare, because children prefer to play in sandboxes (or dirt), and because the turf cover is difficult to remove by hand. There are reported occurrences of digging in grassed areas by burrowing animals or dogs (family pets); however, the majority of the holes are less than 15 cm deep. Again, this digging only occurs where the turf cover is weak. The Parks Department immediately repairs any holes spotted by the Parks crews, and sends the crews to repair any holes reported by the public. The Parks department indicated that immediate repairing of holes was a policy for protection of the public.
>
> It should be noted that the depth of 30 cm is the <u>minimum</u> depth of surface cover. The only areas covered by 30 cm of topsoil are the boulevard areas between the bicycle path and the roadway. In both Area "A" and Area "B", the gradation of the site slopes upward with increasing distance away from the roads. Thus, the depth of most of the site cover is greater than 30 cm. The areas most frequented by the public will be the bicycle path and the sidewalk. The depth of surface cover in the areas between the bicycle path and sidewalk is between 50-60 cm, and the depth of surface cover in the bermed areas containing the planting beds is 1 m or greater. The City of Toronto has indicated that public art will be located along the north side of Lakeshore Boulevard East, just west of Leslie, in the area between the bicycle path and the sidewalk. This area will have a surface cover of approximately 50 cm, which is considered to be sufficient cover to protect small children and animals from digging into the impacted soil. In addition, the Parks Department has indicated that any holes in the public areas are immediately filled in.

Section 4.4 has been revised to describe the frequency of the routine inspections, and the following sentences have been added:

> The City of Toronto Parks Department has overall responsibility for maintenance and lawn care of the City's parks, boulevards and green spaces.
>
> It is proposed that regular inspections of the surface cover be done during the landscaping season, coinciding with the assumed frequencies of grass cutting and planting bed maintenance. This requirement will be included in an internal memorandum to the Parks department and can be included in specifications for the landscaping contractor. If the frequency of breaches of the surface cover is greater than anticipated, the SSRA may require re-evaluation.

***AEL Comment**: It appears that free product is to be left at TP7 in Area B. This material has chemical characteristics that suggest it is gasoline. Are there concerns as to the source of this material, its mobility, and potential for impacted groundwater to migrate off-site?*

Response: Traces of visible oil were observed in soil excavated during the test pit program (TP7). Monitoring well BH707 was located near and downgradient of TP7 for the express purpose of determining whether there was free product on the groundwater. No free product was detected during two monitoring rounds, and S&P concluded that the traces of visible oil had remained within the soil. In addition, the historical review determined that the impacted soil had likely been in place for many years, below the Gardiner Expressway off-ramp. Thus, if free product migration were to have occurred, it likely would have been detected in S&P's investigations. However, despite the fact that free product was not observed on the groundwater, an important part of the Risk Management Plan will be to monitor groundwater downgradient from this area for TPH, BTEX, and PAHs. As discussed in Section 4.4 (formerly Section E-5.3), an increase in the measured concentrations, compared to current concentrations, or the detection of free phase liquid hydrocarbons in the monitoring wells would necessitate a re-evaluation of the risk management plan. The following is the revised text of Section 4.4:

> Although groundwater was found to meet the MOE non-potable criteria, S&P recommends a regular (quarterly) groundwater monitoring program of the existing monitoring wells, to document any changes in groundwater conditions. Groundwater samples will be collected for laboratory analysis of inorganic parameters, VOCs, PAHs and TPH.
>
> The frequency of monitoring events can be reviewed after four consecutive monitoring events, and could be reduced if no significant change in groundwater conditions are observed. However, if the groundwater concentrations increase to levels exceeding the MOE non-potable criteria or if free product is detected in the monitoring wells, a re-evaluation of the risk management plan may be required.

***AEL Comment**: Soil quality exceeds Upper Concentration Limits (UCLs) at a few locations. It is not clear if all these locations are to be excavated. AEL is unaware of situations where the MOE has concurred that soil exceeding UCLs can be left in place; however, if S&P or the City of Toronto are confident that this can be done, this point will be moot.*

Response: Appendix E of the MOE document "Guidance on Site-Specific Risk Assessment at Contaminated Sites in Ontario (1996, revised 1998) states that the UCLs "may not be exceeded by criteria developed through an SSRA process without some form of level 2 risk management...". We note that the chemicals whose concentrations exceeded the UCLs are lead, TPH gas/diesel and some PAHs. These were shown in S&P's investigations not to be mobile into groundwater, and the lead and PAHs did not have inhalation as a pathway of concern. Exposure to TPH gas/diesel via inhalation was modelled using the most conservative toxicity factors for the TPH fractions, and the risks from exposure did not exceed acceptable levels. This SSRA contains several Level 2 Risk Management measures to protect the identified receptors against the chemicals, even though concentrations exceeded the UCL's. Some soil containing concentrations in excess of the UCLs will be excavated and disposed, but the rationale for this location depends on tree planting or swale excavation, not on specific chemicals or concentrations. An integral part of the proposed Risk Management Plan is ongoing monitoring of the groundwater for metals, TPH, PAHs, and BTEX. As discussed above, an increase in the measured concentrations or the detection of free phase liquid hydrocarbons in the monitoring wells would necessitate a re-evaluation of the Level 2 Risk Management Plan.

7.0 OVERALL OPINION

This section presents a summary of comments in earlier sections. No additional reply is necessary.

CLOSURE

Please address correspondence to my attention. If you have any questions, please do not hesitate to call me at this office.

Yours very truly,
SHAHEEN & PEAKER LIMITED

CR:cr

Cynthia L. Robins, P.Eng., C.Chem.
Project Manager – Environmental Services

Attachments:
- Table of Contents (revised)
- Drawing 5 (new)
- Table 4 (revised, formerly Table E-1)
- S&P's response to TPH Comments

Cc: David Crichton, City of Toronto
Reg Ayre, City of Toronto

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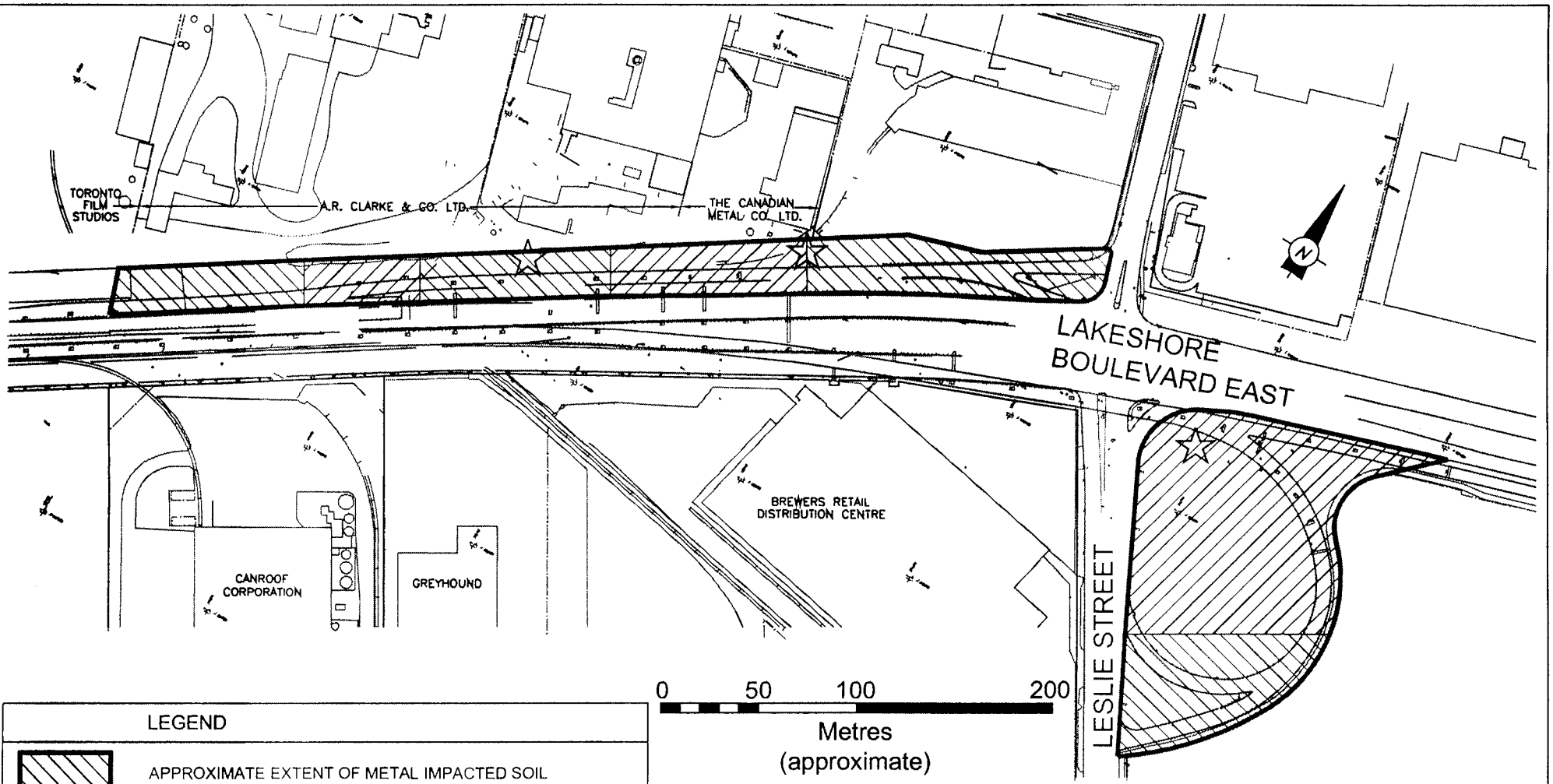

LEGEND

- APPROXIMATE EXTENT OF METAL IMPACTED SOIL
- APPROXIMATE EXTENT OF SOIL IMPACTED BY BOTH METALS AND ORGANICS
- Location of soil which, if removed from site, may be classified as "Hazardous Waste"

TYPE AND EXTENT OF IMPACTED SOIL

Scale: ~1:2000	SITE-SPECIFIC RISK ASSESSMENT	Drawn By: MV
Date: MAY 2002	LAKESHORE BOULEVARD EAST AND LESLIE STREET	Approved By: DJB
	TORONTO, ONTARIO	
Project No.: SP 3977	SHAHEEN & PEAKER LIMITED	Drawing No.: 5

TABLE 4: CALCULATION OF SCREENING LEVEL SOIL CONCENTRATION BASED ON INHALATION OF OUTDOOR VAPOURS

INPUTS (Non-chemical-specific)

	NAME	UNITS	VALUE	REFERENCE
foc	Organic carbon content of soil	g/g	0.006	U.S.EPA, 1996
pb	Dry soil bulk density	g/cm^3	1.5	U.S.EPA, 1996
θa	Air-filled soil porosity	L_{air}/L_{soil}	0.28	U.S.EPA, 1996
n	Total soil porosity	L_{pore}/L_{soil}	0.43	U.S.EPA, 1996
θw	Water-filled porosity	L_{water}/L_{soil}	0.15	U.S.EPA, 1996
ps	Soil particle density	g/cm^3	2.65	U.S.EPA, 1996
T	Exposure interval	s	9.5E+08	U.S.EPA, 1996
Q/C	Inverse of the mean conc. at centre of square source	$g/m^2/s$ per kg/m^3	72	U.S.EPA, 1996 - represents average value for a 1 acre (4000 m^2) source in EPA Zone V and VII.
	Carcinogens			
TR	Target cancer risk	unitless	1.E-06	MOEE, 1996a
AT	Averaging time	y	70	U.S.EPA, 1996
EF1	Exposure frequency	d/y	120	assumed
EF2	Exposure frequency	h/d	4	assumed
ED	Exposure duration	y	30	U.S.EPA, 1996
	Non-carcinogens			
THQ	Target hazard quotient	unitless	0.2	MOEE, 1996a
AT	Averaging time	y	30	U.S.EPA, 1996
EF1	Exposure frequency	d/y	120	assumed for toluene and TPH
		d/y	365	assumed for xylenes
EF2	Exposure frequency	h/d	4	assumed
ED	Exposure duration	y	30	U.S.EPA, 1996

INPUTS (Chemical-specific)

CHEMICAL	Inhalation unit risk (URF) $(ug/m^3)^{-1}$	Ref	Inhalation RfC (mg/m^3)	Ref	Diffusivity in Air (Di) (cm^2/s)	Ref	Henry's Law Constant (H') (unitless)	Ref	Diffusivity in Water (Dw) (cm^2/s)	Ref	Organic carbon partition coeffic. (Koc) (mL/g)	Ref	Calc. soil water partition coeffic. (Kd) (mL/g)
Benzene	5.0E-06	a			8.80E-02	d	0.228	d	9.80E-06	d	62	d	0.37
Toluene			0.4	a	8.70E-02	d	0.272	d	8.60E-06	d	140	d	0.84
Xylenes			0.18	b	7.80E-02	d	0.276	d	8.70E-06	d	249	d	1.5
TPH - aromatics (C>8 to C10)			0.2	c	6.60E-02	f	0.51	e	6.60E-06	f	1585	e	9.5
TPH - aromatics (C>12 to C16)			0.2	c	6.00E-02	f	0.045	e	6.00E-06	f	5000	e	30

References:

a - U.S. EPA (2001)
b - Health Canada (1996a and b)
c - Edwards, et al. (1997)
d - U.S. EPA (1996)
e - Gustafson, et al. (1997)
f - calculated as per Lyman et al. (1982)

RESULTS

CHEMICAL	Apparent diffusivity (Da) (cm^2/s)	Volatilization Factor (VF) (m^3/kg)	Calculated conc. in soil (mg/kg)	Max. meas. conc. in soil (mg/kg)
Benzene	2.02E-03	2917	25	18.4
Toluene	1.24E-03	3727	5442	35.6
Xylenes	6.77E-04	5036	1088	700
TPH - aromatics (C>8 to C10)	1.80E-04	9781	7140	3200*
TPH - aromatics (C>12 to C16)	4.64E-06	60821	44400	18000**

NOTE:

* measured concentration represents sum of aliphatic and aromatic fractions C5 to C10
** measured concentration represents sum of aliphatic and aromatic fractions C11 to C24

2002/04/29- rev.2

SP3977

Angus Environmental Limited

Facsimile Transmission

To: Cynthia Robins, Shaheen & Peaker Limited
Facsimile: (416) 213-1260
cc: David Crichton, City of Toronto, (416) 392-6279

Number of pages: 1
(including cover sheet)

From: Jeanette Southwood
Telephone: (416) 383-0957, Ext. 23

Date: 10 May 2002
AEL File: 2002038

Angus Environmental Limited (AEL) was retained by the City of Toronto to undertake a peer review of the report entitled *Site-Specific Risk Assessment, Gardiner Expressway Dismantling and Lakeshore Boulevard East Reconstruction at Leslie Street, Toronto, Ontario* prepared by Shaheen & Peaker Limited (S & P) for the City of Toronto and dated 8 March 2002. AEL completed and submitted the review to S & P on 27 March 2002.

AEL has reviewed a letter regarding *Response to Third Party Peer Review, Site-Specific Risk Assessment, Gardiner Expressway Dismantling and Lakeshore Boulevard East Reconstruction at Leslie Street, Toronto, Ontario* from Ms. Cynthia Robins of S & P dated 8 May 2002. The S & P letter is appropriate with two minor exceptions.

- On page 5 of the S & P letter, the phrase "the potential for elevated values of the parameters" should be changed to "the potential for elevated or decreased values of the parameters". For example, a decrease in pH value may result in dissolution of metals in ground water and may increase the potential for migration of these metals.

- On page 10 of the letter, S & P quotes from the Ontario Ministry of the Environment (MOE) *Guidance on Site Specific Risk Assessment for Use at Contaminated Sites in Ontario* regarding UCLs. However, regardless of what is stated in this MOE document, there is little precedent for the MOE concurring with site specific criteria that exceed UCLs. This AEL comment is a cautionary note. AEL agrees that site specific criteria that exceed UCLs can be acceptable under certain circumstances.

- JMS -

44 Upjohn Road · Don Mills, Ontario · Canada · M3B 2W1 · Facsimile: (416) 383-0956

Angus Environmental Limited

2002038

14 May 2002

Mr. David Crichton
City of Toronto
Works & Emergency Services, Technical Services
Metro Hall, 16th Floor, Station 1170
55 John Street
Toronto, Ontario
M5V 3C6

Re: Independent Third Party Review - *Site-Specific Risk Assessment, Gardiner Expressway Dismantling and Lakeshore Boulevard East Reconstruction at Leslie Street, Toronto, Ontario*

Dear Mr. Crichton:

Angus Environmental Limited (AEL) was retained by the City of Toronto to undertake a peer review of the report entitled *Site-Specific Risk Assessment, Gardiner Expressway Dismantling and Lakeshore Boulevard East Reconstruction at Leslie Street, Toronto, Ontario* prepared by Shaheen & Peaker Limited (S & P) for the City of Toronto and dated 8 March 2002. AEL completed and submitted the review to S & P on 27 March 2002. Two minor additional comments were sent by AEL to S & P on 10 May 2002.

AEL has reviewed a letter from Ms. Cynthia Robins of S & P dated 14 May 2002 regarding *Response to Third Party Peer Review, Site-Specific Risk Assessment, Gardiner Expressway Dismantling and Lakeshore Boulevard East Reconstruction at Leslie Street, Toronto, ON*. AEL concludes that the S & P letter is appropriate.

Please call me at (416) 383-0957, Ext. 23, if you have any questions or comments.

Yours truly,
Angus Environmental Limited

Jeanette M. Southwood, M.A.Sc., P.Eng.

cc: Ms. Cynthia Robins, Shaheen & Peaker Limited

APPENDIX H

REVIEW BY CITY OF TORONTO PUBLIC HEALTH DEPARTMENT

TORONTO

Dr. Sheela V. Basrur
Medical Officer of Health

Community & Neighbourhood Services
Eric Gam, Acting Commissioner

Public Health
277 Victoria Street
5th Floor
Toronto, Ontario M5B 1W2

tel: 416-392-7402
Fax: 416-392-0713

Memorandum

To: David Crichton, Manager, Engineering and Surveys, Works and Emergency Services

From: Reg Ayre, Manager, Healthy Environments, Toronto Public Health

Date: April 12, 2002

Subject: Gardiner Dismantling Project – Comments on Site Specific Risk Assessment

As per your request, please find attached a copy of Toronto Public Health's comments on the Shaheen & Peaker Site Specific Risk Assessment (SSRA) for the Gardiner Dismantling Project site. The comments are divided into two sections: the Major Comments are those of particular relevancy to human health; and the Other Comments include suggestions that may not affect the outcome of the SSRA but would improve the scientific credibility and readability of the document.

Should you have any further comments, please do not hesitate to contact me at 416-338-8037.

Reg Ayre

[Attachment]

Other Comments:

Making revision to accommodate the following comments may not affect the outcome of the assessment, however, it would improve the scientific credibility and readability of the report.

- Purpose of the assessment

  The purpose for conducting the SSRA needs to be described at the outset. At the present, one has to get to section 3 of Appendix E before one finds out whether the SSRA is meant to evaluate risk based on current conditions or on conditions of a remediated site or of a site managed according to a specific management plan.

- Organization of the report is inappropriate. The title of the report is site-specific risk assessment but only 3-4 pages of the 30 page main document are dedicated to the subject. The actual SSRA is provided in appendix E. The emphasis of the presentation is a case of misplaced priority, suggesting that SSRA is an unimportant part of the exercise even though the theme of the report is exactly an SSRA.

  Organization of the report is confusing. In order to read the report, one has to move back and forth not only between the main document and numerous appendices but also among appendices even though the report can be structured in a much more straightforward manner. There are appendices to an appendix. The way it is structured makes the report difficult to read and to follow. The reader may not be able to get a clear picture of the assessment even after spending a lot of time with the document.

- The first step of human health SSRA is hazard identification. This section should include a discussion of the potential health effect of contaminants of concern on receptors and physical effects, which would affect the assessment (e.g. solubility, transport and fate). Although this information is contained in a separate appendix, a short discussion and reference should be made in the SSRA main text.

- The first step of ecological risk assessment (ERA) is receptor characterization, which should include what effects ERA is intended to protect the species (receptors identified) against and other pertinent information. This kind of information is missing.

- Pertinent findings (e.g. that the groundwater meets MOE criteria with respect to all identified COC's) are not explicitly and comprehensively described. The reader has to review the actual lab reports and other appendices to appreciate the extent of site contamination.

Prepared by: Angela Li-Muller, Karl Kabasele, & Tomislav Svoboda
Toronto Public Health
April 12, 2002

S & P
SHAHEEN & PEAKER LIMITED
CONSULTING ENGINEERS AND SCIENTISTS

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File: SP3977

May 14, 2002

City of Toronto
Community & Neighbourhood Services
Public Health
277 Victoria Street
3rd Floor
TORONTO ON M5B 1W1

Attention: Mr. Reg Ayre
Manager, Healthy Environments

Dear Mr. Ayre:

Response to Toronto Public Health (TPH) Review
Site-Specific Risk Assessment
Gardiner Expressway Dismantling and Lakeshore Boulevard East Reconstruction
at Leslie Street
Toronto, ON

Shaheen & Peaker Limited (S&P) is pleased to present herein our response to the City of Toronto Public Health (TPH) review (memo, Reg Ayre to David Crichton, April 12, 2002) for the draft site-specific risk assessment (SSRA) report prepared by S&P for the above-noted site. Concurrent with the third party peer review conducted by Angus Environmental Limited (AEL), the TPH also reviewed the draft SSRA report. We understand that TPH was provided with a copy of the Peer Reviewer's comments. We have included our response to the third party Peer Review as an attachment to this letter. S&P and the City of Toronto met with representatives of the TPH to discuss TPH's comments on April 24, 2002. Please note that the text of the SSRA report has been revised to address the comments of to both the third party peer review and TPH review.

The TPH Review comments (identified in *italics*), and S&P's responses, are itemized below.

The risk management plan proposes capping contaminated soil with 30 cm of clean soil. As a result, the authors suggested that it is not necessary to evaluate health risk resulting from the direct contact pathway for humans. Unless the 30 cm clean soil is put on top of a geotextile membrane capping the contaminated soil, the contaminated soil is still present in the top 1.5 m of soil, which is considered surface soil under the MOE guideline. Given that there is a real possibility that the soil below 30 cm can be brought to the surface (e.g. by burrowing animals as described in Appendix F, or other future activities such as landscaping), the SSRA needs to consider direct contact pathway (soil ingestion and dermal exposure) for humans based on

existing soil contamination where there will not be any concrete or asphalt barrier or geotextile lining. Alternatively, S & P has to guarantee that the 30 cm clean soil cap is adequate to prevent any contaminated soil from being exposed in the long term.

Response: The root depth of sod typically extends to about 15 cm. As root growth is variable depending on site conditions, it was reasoned that an additional buffer of 15 cm of clean soil would be adequate to prevent any potential root contact between sodded areas and impacted soil if root growth were to extend beyond 15 cm. Secondly, a search of the literature (see references) indicates, that as a general rule, 30 cm of top soil is also critical for root growth for most woody plants. Most root growth for trees and shrubs occurs in the top 15-30 cm of soil; therefore, a depth of 30 cm of top soil would provide adequate conditions for the viable growth of plants as per the landscape design.

We understand that the major concern was the inadvertent breach of the surface cover into the impacted soil by small children, burrowing animals or pets. The following paragraphs are now included in Section 4.2.3.2 of the revised SSRA report to address the 30 cm issue:

> In order to determine whether the minimum of 30 cm of topsoil was sufficient to prevent breaches during normal use of the area, S&P contacted the City of Toronto Parks Department to ascertain the frequency of occurrence of digging within grassed areas of City Parks. The Parks Department representative reported that occurrences of children digging in a grassed area are extremely rare, because children prefer to play in sandboxes (or dirt), and because the turf cover is difficult to remove by hand. There are reported occurrences of digging in grassed areas by burrowing animals or dogs (family pets); however, the majority of the holes are less than 15 cm deep. Again, this digging only occurs where the turf cover is weak. The Parks Department immediately repairs any holes spotted by the Parks crews, and sends the crews to repair any holes reported by the public. The Parks department indicated that immediate repairing of holes was a policy for protection of the public.
>
> It should be noted that the depth of 30 cm is the minimum depth of surface cover. The only areas covered by 30 cm of topsoil are the boulevard areas between the bicycle path and the roadway. In both Area "A" and Area "B", the gradation of the site slopes upward with increasing distance away from the roads. Thus, the depth of most of the site cover is greater than 30 cm. The areas most frequented by the public will be the bicycle path and the sidewalk. The depth of surface cover in the areas between the bicycle path and sidewalk is between 50-60 cm, and the depth of surface cover in the bermed areas containing the planting beds is 1 m or greater. The City of Toronto has indicated that public art will be located along the north side of Lakeshore Boulevard East, just west of Leslie, in the area between the bicycle path and the sidewalk. This area will have a surface cover of approximately 50 cm, which is considered to be sufficient cover to protect small children and animals from digging into the impacted soil. In addition, the Parks Department has indicated that any holes in the public areas are immediately filled in.

Section 4.4 has been revised to describe the frequency of the routine inspections, and the following sentences have been added:

parameters, VOCs, PAHs and TPH.

The frequency of monitoring events can be reviewed after four consecutive monitoring events, and could be reduced if no significant change in groundwater conditions are observed. However, if the groundwater concentrations increase to levels exceeding the MOE non-potable criteria or if free product is detected in the monitoring wells, a re-evaluation of the risk management plan may be required.

Given the continuous development and redevelopment proposed for this part of the city, it is reasonable to assume that there will be future occasions where this tract of land would have to be dug up or disturbed in some way. At a minimum, it is foreseeable that the land would have to be dug up to allow access to underground utilities. Because of this distinct possibility, the SSRA should specify that the situation would need to be reevaluated in the event that any changes are made to the site. After remediation, the state of the contamination on site should be kept on record and made readily accessible to inform the process of reevaluation.

In the same vein, the SSRA should explicitly discuss those measures that will ensure occupational health and safety for those workers who are required to make incursions into the cap.

Response: The following paragraphs are included in Section 4.4 of the revised SSRA report:

It is possible that, in the future, intrusive work may be required (e.g. excavations for repairs to buried services). The City of Toronto should notify the utility providers in the study area that environmental and health & safety and site restoration protocols must be followed when conducting intrusive work. The notification should also state that a detailed Health and Safety Plan and Site Restoration Plan are required to be submitted prior to commencement of any intrusive work. The Health & Safety Plan submitted to the City should contain details of personal protective equipment, protocols, contingency measures and emergency procedures for protection of workers and the public. The Site Restoration Plan should include a commitment to replace a minimum of 30cm of clean soil (clean cover) and the proper replacement of the geotextile barrier if encountered or disturbed.

The purpose for conducting the SSRA needs to be described at the outset. At the present, one has to get to section 3 of Appendix E before one finds out whether the SSRA is meant to evaluate risk based on current conditions or on conditions of a remediated site or of a site managed according to a specific management plan.

Response: Section 1.2 states the objectives of the SSRA. The following paragraph has been added to this section:

The overall objective of the SSRA was to evaluate an alternative site restoration approach with respect to its ability to provide adequate protection to human health and the environment during the final landscaping phase of the Lakeshore

> Boulevard East reconstruction, and future use of the area as a public walkway and bicycle path.

Organization of the report is inappropriate. The title of the report is site-specific risk assessment but only 3-4 pages of the 30 page main document are dedicated to the subject. The actual SSRA is provided in appendix E. The emphasis of the presentation is a case of misplaced priority, suggesting that SSRA is an unimportant part of the exercise even though the theme of the report is exactly an SSRA.

Organization of the report is confusing. In order to read the report, one has to move back and forth not only between the main document and numerous appendices but also among appendices even though the report can be structured in a much more straightforward manner. There are appendices to an appendix. The way it is structured makes the report difficult to read and to follow. The reader may not be able to get a clear picture of the assessment even after spending a lot of time with the document.

The first step of human health SSRA is hazard identification. This section should include a discussion of the potential health effect of contaminants of concern on receptors and physical effects, which would affect the assessment (e.g. solubility, transport and fate). Although this information is contained in a separate appendix, a short discussion and reference should be made in the SSRA main text.

The first step of ecological risk assessment (ERA) is receptor characterization, which should include what effects ERA is intended to protect the species (receptors identified) against and other pertinent information. This kind of information is missing.

Response: This was also a comment of the Peer Reviewer. The report has been reorganized so that the hazard assessment, human and ecological receptor descriptions, exposure assessment, toxicity assessment, risk characterization, uncertainty discussion and landscape mitigation design are included into the body of the main report. The results of the inhalation exposure assessment have been moved from **Appendix E** to **Table 4** of the main report. A section has been added to the end of "Hazard Evaluation/Problem Formulation" (Section 3.4.9), titiled "Proposed Exposure Mitigation Strategy". The objective and summary of the landscaping plan would be moved to this section, and at the end of the section, a reference would be made to the details of the mitigation strategy in Section 4.2. This will introduce the mitigation program ahead of the exposure assessment, but still leave all the details to be described within the Level 2 Risk Management Section. The first portion of the new Section 3.4.9 will be re-worded to introduce the mitigation strategy design as it directly affects both human and ecological exposure:

> The primary purpose of the landscape mitigation program is to prevent inadvertent human contact, as well as contact between root systems and animal receptors, with potentially impacted soil. Thus, human and ecological receptors are examined with respect to the landscape mitigation design.

The Table of Contents of the reorganized report is attached to this letter.

Pertinent findings (e.g. that the groundwater meets MOE criteria with respect to all identified COC's) are not explicitly and comprehensively described. The reader has to review the actual lab reports and other appendices to appreciate the extent of site contamination.

Response: The purpose of **Table 2** was to distill the information from the laboratory analyses and summarize the exceedances. **Table 2** includes the specific chemicals that exceeded the criteria, the maximum concentration measured, and the total number of samples anlayzed for each chemical. The table also contains comments pertaining to the groundwater condition with respect to exceedances. The findings in **Table 2** are discussed in Section 2.5.4 – Overview of Soil Impacts.

For one of the public meetings, S&P had prepared a drawing showing the locations of the different types of impacts. The locations of soil which failed the "hazardous waste" test are also shown on the drawing. We have now included this drawing as **Drawing 5** in the SSRA report. A copy of **Drawing 5** is attached to this letter.

The following paragraph has been added to Section 2.5.5 – Overview of Groundwater Impacts:

> In summary, groundwater samples from all monitoring wells met the appropriate MOE Table B criteria for non-potable groundwater for heavy metals, pH, VOCs, PAHs and BNAs. No free product was observed on the groundwater from any of the monitoring wells. Based on these observations and analytical results, migration of chemicals in groundwater was determined not to be a pathway of concern in the exposure assessment.

CLOSURE

Please address correspondence to my attention. If you have any questions, please do not hesitate to call me at this office.

Yours very truly,
SHAHEEN & PEAKER LIMITED

CR:cr

Cynthia L. Robins, P.Eng., C.Chem.
Project Manager – Environmental Services

Attachments:
- Table of Contents (revised)
- Drawing 5 (new)
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Cc: David Crichton, City of Toronto
Jeanette Southwood, Angus Environmental Limited

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