



Prepared for

**Harold Blize
Race Trac Gas
Highway 20 and Highway 39 (Junction)
Alsike, Alberta**

#5720 – Alsike General Store

**Phase III Hydrocarbon Environmental Site
Assessments (ESA) for Underground
Petroleum Storage Tank Sites in Alberta**

**Located at: Highway 20 and Highway 39
(Junction), Alsike, Alberta**

SUBMITTED BY

**KC Environmental Group Ltd.
October 15, 2002**

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October 15, 2002

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Dear Mr. Blize:

Re: Phase III Hydrocarbon Environmental Site Assessment (ESA) at Underground Petroleum Storage Tank Sites in Alberta - Site # 5720 (Further Delineation)

KC Environmental Group Ltd. (KC) conducted borehole drilling and analysis, of soil and groundwater for site #5720 located on Highway 20 and Highway 39 (Junction), Alsike, Alberta to completely delineate any petroleum hydrocarbon contaminated soil and groundwater on-site, off-site and beneath any building. The results of the soil and groundwater analysis for site # 5720 show that petroleum contamination is above the applicable Criteria for Fine-Grained Soil (Commercial Use) and Groundwater defined in the Alberta Environment's Risk Management Guidelines for Petroleum Storage Tank Sites (October, 2001).

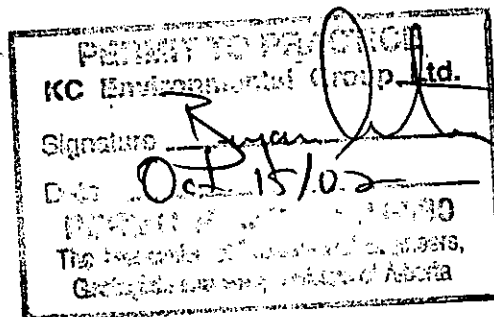
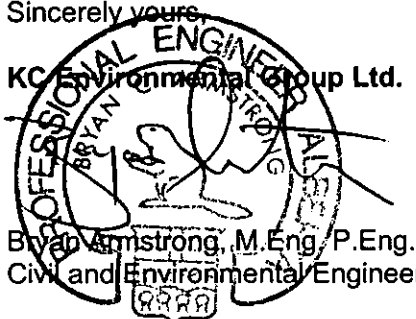
It is estimated that the depth to which the soil has been contaminated with petroleum hydrocarbon is approximately 4.50 m. The contaminated area on-site is estimated to be about 250 m². The total volume of impacted soil is about 1,100 m³ on-site based on a maximum contamination depth of 4.5 m. **In conclusion, as contamination is above the appropriate risk management criteria, remediation is recommended for the subject site.** The total estimated cost for remediation will be provided with the submission of the remediation plan.

Should you wish to discuss this information or have any questions, please contact me at (780) 488-7926.

Sincerely yours,

KC Environmental Group Ltd.

Bryan Armstrong, M.Eng, P.Eng.
Civil and Environmental Engineer



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EXECUTIVE SUMMARY

KC Environmental Group Ltd. (KC) was retained to conduct Phase III borehole drilling and monitoring well installation at the Alsike General Store, site # 5720 located at the Junction of Highway 20 and Highway 39, Alsike, Alberta. The purpose of this Phase III Environmental Site Assessment (ESA) is to completely delineate any petroleum hydrocarbon contaminated soil and groundwater on-site, off-site and beneath any building. KC is a fully qualified and insured environmental engineering firm capable of performing this work.

Soil samples at all sampling locations were tested for BTEX (Benzene, Toluene, Ethylbenzene and Xylenes), Petroleum Fractions (F1, F2, F3 and F4) and lead. One water sample was tested for BTEX and petroleum fractions F1 and F2.

The following recommendations were developed for the subject property and are based on the results of the Phase III Environmental Site Assessment conducted at the Alsike General Store, also referred to as site #5270, Race Trac Gas, Alsike.

- 1) The contaminated area is identified on the west side of the subject site where the pump island and the gasoline Underground Storage Tanks (USTs) are located.
- 2) It is estimated that the depth to which the soil has been contaminated with petroleum hydrocarbon is approximately 4.50m. The contaminated area on-site is estimated to be about 250 m². The total volume of impacted soil is about 1100 m³ on-site based on a maximum contamination depth of 4.5 m.
- 3) Based on drilling results, it is reasonable to believe that there is no contamination underneath the on-site building located north of the pump island. It should be noted, however, that no drilling was done underneath the onsite building.
- 4) The petroleum contaminants have migrated towards the groundwater system and were identified on the west side of the subject site.
- 5) Even though there is no petroleum contamination above the criteria on the east side of the subject site, it is recommended that a leak test be conducted at least once a year. Given the type and age of the tank (12 years old), a leak test will aid in ensuring that the diesel UST located east of the subject site is not leaking. Early detection of leakage can prevent widespread soil and groundwater petroleum hydrocarbon contamination.
- 6) Remediation criteria for the contaminated soil are the Generic Hydrocarbon and Lead Criteria for Fine-Grained Soil (Commercial Land Use) for the Petroleum Hydrocarbon Fractions (F1, F2, F3 and F4) and the Generic Hydrocarbon Criteria

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1.0 INTRODUCTION

The Safety Codes Council is responsible for implementing the Alberta Government's Underground Petroleum Storage Tank Site Remediation Program. To implement the Environmental Site Assessment (ESA) phase of this program, KC Environmental Group Ltd. (KC), of 15619 - 112 Ave, Edmonton, (780) 488-7926 (Tel) and (780) 452-8284 (fax) was retained to conduct borehole drilling and groundwater monitoring well installation. KC is a fully qualified and insured environmental engineering firm capable of performing this work.

The purpose of this Phase III ESA is to completely delineate any petroleum hydrocarbon contaminated soil and groundwater on-site, off-site and beneath any building. The Alsike General Store, Site #5720 (Race Trac - Alsike) is located at the junction of Highway 20 and Highway 39, Alsike, Alberta. Site #5720 is a gas service station owned by Mr. Harold Blize. The owner and contact person for this site is Mr. Harold Blize, telephone: (780) 775-2187.

2.0 SCOPE OF WORK

It should be noted that any major modifications made to the original plan as outlined in the delineation proposal submitted by KC was approved by the Safety Codes Council prior to being implemented. For example, drilling underneath buildings was not conducted, as originally planned, as there were no building plans for the onsite building available from the owner. A summary of the work conducted at site #5720 includes:

- Locating all utilities prior to drilling, Alberta First call issued ticket number 188357.
- Drilling eleven on-site boreholes and conducting field vapour screening of soil samples at 0.75m intervals in all boreholes.
- Completing 2 boreholes as monitoring wells to the design specified in Alberta Environment's Risk Management Guidelines for Petroleum Storage Tank Sites (October, 2001).
- Submitting nine soil samples and two water samples for detailed laboratory analysis. Selection of soil samples for analysis considered the need to identify soil that met criteria as well as soil that exceeded criteria. Soil samples selected for delineation purposes were those that had the highest hydrocarbon vapor reading for that particular borehole.
- Selecting wells for the collection of water samples in order to determine whether the groundwater has also been contaminated. Prior to taking a groundwater sample, the monitoring well was first purged using a dedicated bailer. Two groundwater



samples were collected using a bailer then submitted for detailed laboratory analysis.

- Analyzing soil samples for BTEX (Benzene, Toluene, Ethylbenzene, and Xylenes), Petroleum Hydrocarbon Fractions F1, F2, F3 and F4, as well as lead. Conducting grain size analysis on two soil samples.
- Documenting the presence of free product on the water table, and analyzing water samples for BTEX (Benzene, Toluene, Ethylbenzene, and Xylenes), Petroleum Hydrocarbon Fractions F1 and F2.
- Including data, for delineation purposes, from the previous Phase II ESA (February 15, 2002) prepared by KC.
- Reporting the analytical results as per relevant sections of the Risk Management Guidelines for Petroleum Storage Tank Sites (October, 2001).

A site sensitivity analysis (land use assessment and potential exposure pathways) was conducted for site #5720 to determine the appropriate Risk Management Criteria that would be applicable for the Petroleum Hydrocarbon Fractions, BTEX, and lead levels encountered at the subject site.

3.0 BACKGROUND

The subject site is a gasoline service station owned by Mr. Harold Blize. According to Mr. Blize, the site has been a service station since 1947. There was a leak test conducted on the underground petroleum storage tanks on May 1, 1998. The results of the leak test showed that there was no leakage from any of the three underground petroleum storage tanks.

3.1 Existence of Potable Groundwater Wells

Mr. Harold Blize said that there are two potable groundwater wells on the subject site. One is located underneath the Race Trac building (west side of the property) and the other is located on the east end of the property.

3.2 Three Underground and One Aboveground Storage Petroleum Storage Tanks

Currently there are three underground petroleum storage tanks (two 27,300 Litres and one 36,400 Litres) and one aboveground propane storage tank (1000 Imperial Gallons, 4500 Litres) in use. The age of the four storage tanks is approximately 12 years. The relative positions of the three petroleum storage tanks are shown on the site sketch (Appendix A).



Table1: A Summary of Information for the Petroleum Storage Tanks

	Volume (litres)	Contents	Status
2 underground steel storage tanks	27,300	1 gasoline 1 diesel	Currently in use
1 underground steel storage tank	36,400	gasoline	Currently in use
1 aboveground storage tank	45,000	propane	Currently in use

3.3 Results of the Previous Phase II ESA Report Prepared by KC

The results of the Phase II ESA Report prepared by KC (February 15, 2002) for site #5270 located in Alsike, Alberta show that there is an area of contamination on the west side of the property where two underground gasoline storage tanks and the pump island are located. It is estimated that the depth to which the soil has been contaminated with petroleum hydrocarbon is approximately 4.5 m and that the total volume of contaminated soil is approximately 400 m³. It is recommended in the Phase II ESA Report that further investigation be conducted around the pump island and the two underground gasoline storage tanks to further delineate the contaminated area.

4.0 SITE DESCRIPTION

Site #5720 is located in a rural area, at the junction of Highway 20 and Highway 39. The general store and the two underground gasoline storage tanks with the dispenser island are located on the west half of the property. The diesel underground storage tank with the dispenser island is located on the east half of the property. Approximately 70 m east of the general store are a denture clinic, Teddy Bear's Restaurant and a trailer, followed by a service centre located about 150 m from the general store. Further east, about 200 m, from the general store is an oilfield and industrial supplier (Monarch Supply Apex Distribution).

Adjacent land uses

North: Immediately north of the subject site is wooded area, followed by a farm field.

South: Immediately south of the subject site is a ditch located within a 30 m distance, followed by Highway 39 and then a cultivated farm field.

East: Immediately east of the subject site is a wooded area, followed by a farmhouse located approximately 200 m from the subject site.

West: Immediately west of the subject site is a wooded area.



5.0 SITE SENSITIVITY ASSESSMENT

Site #5720 is located in a rural area, at the junction of Highway 20 and Highway 39, and is zoned as highway commercial. The current uses of the subject site and immediately adjacent areas and their receptor sensitivities, including potential exposure pathways, are outlined below.

5.1 Site Conditions

The extent of the drilling on the subject site was to a depth of 7.5 m. From the drilling logs, site #5720 appears to be situated on a bed of clay till with a thin layer of sandy clay to a depth of approximately 7.5 m. The soil stratigraphy is generally a layer of clay till and sandy clay. The depth to water within the monitoring wells ranged from 2.13 m to 4.01 m below the ground surface. Stratigraphic details are provided in the Borehole Logs provided in Appendix C.

Table 2. General Soil Lithology

Depth (m)	General soil lithology
0.00 - 0.15	Generally covered by asphalt/gravel
0.75-3.75	Brown clay till with charcoal
3.75 - 5.25	Sandy clay with charcoal and iron oxides
5.25 - 7.50	Clay with iron oxides

5.2 Land Use Assessment - Surrounding Land Use and Receptors

Commercial buildings on site:

- Due to their proximity, the commercial buildings that would be most affected by contamination are Teddy Bear's Restaurant and the trailer, the denture clinic, and the service center.

Outdoor north, east and west of the subject site:

- Immediately north, east and west of the subject site are wooded areas.

Outdoor south of the subject site:

- Immediately south of the subject site is a ditch located within 30 m, followed by Highway 39 and then a cultivated farm field.

Since the subject site is zoned as commercial use and surrounded by wooded areas, the land use is considered to be commercial use.



5.3 Exposure Pathways

5.3.1 Human Pathway

Soil Ingestion and Soil Dermal Contact

This pathway is considered low, as incidental soil ingestion and soil dermal contact is unlikely for a commercial area.

Inhalation of Indoor Air

The main retail building on the subject site would be most affected by the contamination. Even though there are overhead (aboveground) power lines on the subject site, the potential impact from inhalation of vapors from soil and groundwater is considered high. This is based on pathways from underground piping for potable water and sewage disposal/collection systems.

Groundwater Ingestion Pathway

There are two potable groundwater wells on site. One is located underneath the general store (west end of the property) and the other is on the east end of the property. The potential contaminant migration plume from the underground storage tanks is predicated to be primarily in the direction of north east. This is due to the influence of the groundwater flow. The groundwater ingestion pathway is therefore considered high.

5.3.2 Ecological Pathway

Plant/Invertebrate Soil Contact

As the gas station is surrounded by wooded areas and field, the exposure of terrestrial organisms (plant and invertebrate) to contaminants is considered moderate to high.

Aquatic Life

There is a river located more than 3 km to the east. As this is the only surface water body and it is located more than 300 m from the subject site, the potential risk to freshwater aquatic life, from contaminants originating from the subject site, is not considered.

The potential pathways are therefore primarily through inhalation of vapor from soil and groundwater, and groundwater ingestion.

Based on the above land use assessment, the potential exposure pathways assessment and the particle size analysis (Section 7), the remediation criteria to be used for the soil are the Generic Hydrocarbon and Lead Criteria for Fine-Grained Soil (Commercial Land Use) and the Generic Hydrocarbon Criteria for Groundwater Ingestion Pathway (Fine-Grained Soil). The remediation criteria to be used for the



groundwater is the Generic Hydrocarbon Criteria for Groundwater (Fine-Grained Soil) and the Generic Hydrocarbon Criteria for Groundwater Ingestion Pathway. For any contamination encountered at this site, the more stringent values (the lower numerical values for each chemical parameter) between the two Criteria should be used.

The remediation criteria for the subject site soil are: Generic Hydrocarbon and Lead Criteria for Fine-Grained Soil (Commercial Land Use) for the petroleum hydrocarbon fractions (F1, F2, F3 and F4), and the Generic Hydrocarbon Criteria for the Groundwater Ingestion Pathway (Fine -Grained Soil) for the BTEX levels, as per the Alberta Environment's Risk Management Guidelines for Petroleum Storage Tank Sites (October, 2001). The remediation criteria for groundwater is the Generic Hydrocarbon Criteria for Groundwater Ingestion Pathway.

6.0 METHODOLOGY FOR COMPLETE DELINEATION

It was recommended in the Phase II ESA Report that further investigation be conducted around the pump island and the USTs to further delineate the contaminated area. The following is the detailed methodology for the Phase III delineation investigation.

6.1 Delineation of Contaminated Soil

6.1.1 West Side of the Subject Site

Eleven on-site boreholes were drilled around the area where the two USTs and the pump island are located, as shown on the site sketch.

West Side of the Pump Island and USTs

Two boreholes (W1 and W2) located to the west of borehole "B2 " (groundwater monitoring well "GW2") and west of the pump island were drilled to further delineate how far west the contamination extends from borehole "B2" (GW2). This was due to the previous analytical results that show "B2" as having petroleum hydrocarbon contamination above the applicable criteria. "W1" is approximately 3 m from "B2" and "W2 "is approximately 3 m west from the pump island.

South Side of the Pump Island

Two boreholes ("S1" and "S2") located approximately 2 m and 5 m to the south of the pump island, respectively, were drilled to confirm that there is not any contamination to the south of the pump island. Confirmation was required even though the previous borehole "B3" had low PID readings that ranged from 8.1 to 27.3 ppm.



East of the Pump Island

The proposed boreholes "E1" and "E2" were not drilled east of the UST nest, as there is a fence around the area and the area is inaccessible. In order to confirm that there is no contamination migrating in that direction, borehole "E4" was drilled to the southeast of the USTs.

Two boreholes (E3 and E5) located east of the pump island and approximately 2 m and 5m east from the pump island, respectively, were drilled. This was done to confirm there is no contamination in the area close to the east of the pump island. The previous borehole "B4" located more than 30 m from the pump island had petroleum hydrocarbon below the criteria.

North of the Pump Island

Buried utility lines prevented the drilling of a borehole north of previous borehole "B2", however, it is expected that borehole "W1" located northwest of the pump island would show any contamination migrating in the northerly direction.

6.1.2 East Side of the Subject Site

Investigation on the east side of the subject site consisted of drilling four on-site boreholes closer to the area where the diesel UST and the diesel pump island are located. It should be noted that one borehole in the corresponding direction is considered sufficient for confirmation purposes, as the PID readings from GW "8" and boreholes "5", "6" and "7" are relatively low, ranging from 9 to 209 ppm. However, because of the limited number of boreholes (8) and the large area covered by the subject site, the area around the diesel UST located on the east of the subject site was not fully addressed in the previous Phase II ESA.

One borehole (E7) was drilled to the east of the UST, as the area was not investigated in the Phase II ESA.

One borehole (W4) was drilled to the west of the diesel underground storage tank, to confirm the absence of contamination as the previous borehole "B8" had relatively low PID readings ranging from 0 to 111 ppm.

One borehole (E6) was drilled to confirm there is no contamination migrating to the east of the diesel pump island. The previous borehole "B5" had relatively low PID readings ranging from 9.0 ppm to 109 ppm.

One borehole (S3) was drilled to confirm there is no contamination migrating to the south of the diesel pump island. The previous borehole "B6" had relatively low PID readings ranging from 5.8 ppm to 209 ppm.



6.2 Delineation of Groundwater Contamination

Two groundwater wells were installed at boreholes "W1" and "E5". One groundwater sample from each of the two boreholes was collected and sent for laboratory analysis to determine whether or not the groundwater system has been impacted in the corresponding direction.

7.0 SITE ASSESSMENT SUMMARY

The following are the laboratory results and the findings for Site #5720 (Race Trac - Alsike). The laboratory results of the soil samples collected from the subject site on September 17th, 2002 are provided in Appendix B.

7.1 Soil Analysis

7.1.1 Particle Size and Texture

A total of eleven boreholes were drilled on September 17th, 2002 and nine soil samples were sent for laboratory analysis on September 18th, 2002. Two of the soil samples were sent for particle size and texture analysis. The following is a summary of the laboratory results:

- (a) **Borehole "S1"** - the soil sample at 1.50 m has 14.1% of particles greater than 75 microns and the reported soil composition is 39% clay, 25% sand and 36% silt. The soil sample has a soil texture of a sandy clay loam.
- (b) **Borehole "E5"** - the soil sample at 2.25 m has 26.2 % of particles greater than 75 microns and the reported soil composition is 24% clay, 39% sand and 37% silt. The soil sample has a soil texture of a loam.

The soil samples are classified as fine grained soils according to the McKeague's Soil Analysis Manual, the Canada Soil Survey Committee (CSSC) soil size criteria and the Alberta Environment's Risk Management Guidelines for Petroleum Storage Tank Sites (October, 2001).

It should be noted that the classification of the soil size at the above depths is different from the soil classification for the soil sample in the previous Phase II ESA report that was collected from borehole "B2" at a depth of 4.5 m. The sieve laboratory analysis for the soil sample collected from borehole 2 at the depth of 4.5 m found that the soil had 89.3% of particles having size greater than 75 microns. The soil sample is classified as a coarse-grained soil. As the PID readings for boreholes show that the high concentrations of contaminants were found mostly at the depth interval between 1.5 m



and 3.00 m, the governing soil type that controls contaminant migration is considered to be fine-grained soil.

7.1.2 Field Hydrocarbon Vapour Screening

The samples were screened in the field by photoionization detector (PID). The PID readings from the 2001 and 2002 ESA ranged from 0 ppm to 2,000 ppm. The soil sample field screening logs comprise Appendix C.

7.1.3 Laboratory Results

The laboratory results of the soil samples collected from the subject site on September 17th, 2002 are included in Appendix B. Soil samples were sent to the laboratory for analysis for BTEX (benzene, toluene, ethyl-benzene, and xylenes), Petroleum Hydrocarbon Fractions: F1 (C6-C10), F2 (C10-C16), F3 (C16-C34) and F4 (C34-C50), as well as lead. The soil criteria were chosen based on the Site Sensitivity Analysis and Land Use Assessment. The test results and the criteria used are listed in Table 3. The laboratory results from the previous Phase II ESA report are also tabulated below.

Table 3: Comparison of Soil Analysis Results to the applicable Criteria for Fine-Grained Soil

	Dep. m	PID ppm	Generic Hydrocarbon Criteria for Groundwater Ingestion Pathway (Fine-Grained Soil)				Generic Hydrocarbon for Soil (Commercial Use and Fine-Grained Soil)				
			Benz	Tol	Ethyl-Benz.	Xylene	F1	F2	F3	F4	Lead
Criteria			0.073	0.86	0.19	25	660	1,500	2,500	6,600	260
Borehole											
B1	7.5	291	<0.005	<0.005	<0.005	<0.005	<0.05	<10	20	<10	11.4
B2	2.25	780	0.019	0.207	1.10	10.9	745	80	30	<10	8.3
B4	3.75	372	<0.005	0.016	<0.005	0.074	1.63	<10	<10	<10	5.3
B6	6.00	209	<0.005	<0.005	<0.005	<0.005	<0.05	<10	10	<10	6.1
W1	3.75	4.3	<0.005	0.015	<0.005	0.014	0.22	<10	<10	<10	5.1
S1	0.75	645.0 **	0.006	0.015	0.011	0.029	0.70	<10	<10	<10	10.2
S1	2.25	333.0	0.087	0.193	0.730	1.87	38.7	30	10	10	9.8
S3	1.50	56.5	<0.005	0.028	0.014	0.066	0.69	<10	<10	<10	12.4
E3	2.25	2000	4.05	63.7	52.1	266	1730	280	10	10	16.5
E3	3.00	175.0	0.742	0.484	2.21	1.09	27.2	<10	<10	<10	10.3
E5	3.00	2000	0.479	0.702	6.08	13.7	250	50	<10	<10	10.3
E6	3.00	43.3	<0.005	0.037	0.007	0.036	0.38	<10	<10	<10	9.7
W2	2.25	27.7	<0.005	0.012	0.009	0.024	3.00	<10	30	30	11.8

Note: *data from the previous Phase II ESA Report (February, 2002) prepared by KC

** the anomaly in this soil sample is due to the issue with headspace in the sample jar, there is loss of volatile BTEX from the soil sample.

All values in mg/kg or µg/g, unless otherwise noted.
Levels that exceed criteria are in bold text.
Tol.: Toluene, Ethyl-Benz. : Ethyl-benzene



(A) Lead Levels

Based upon the laboratory results, none of the soil samples exceed the lead concentration criteria.

(B) Benzene, Toluene, Ethyl-Benzene and Xylene

All soil samples, except for boreholes "B2", "S1", "E3" and "E5" have levels of toluene, or ethyl-benzene or xylene above the criteria.

(C) Petroleum Hydrocarbon Fractions

F2, F3 and F4 - All samples have levels of F2, F3 and F4 below the criteria.

F1 - Two out of the thirteen (four from the Phase II ESA and nine from the Phase III ESA) samples sent for laboratory analysis have fraction F1 levels exceeding the criteria.

The above findings are consistent with the chemical characteristics of gasoline, which consists mainly of BTEX and petroleum hydrocarbon fraction F1.

7.2 Groundwater Analysis**7.2.1 Information from the Previous Phase II ESA Report Prepared by KC**

There were three groundwater wells ("W2", "W3", and "W8") installed during the Phase II ESA. The groundwater elevations are tabulated in Table 4. Slotted screen pipes with 2 mm slots were installed for the groundwater monitoring wells in order to obtain representative groundwater samples at the mixing zone. The detailed construction of all the monitoring wells including the well installed during the Phase II ESA (April, 2002) is as follows:

Table 4. Monitoring Well Construction Details

Groundwater well (year of installation)	Total depth (mBGL)	Ground water well Elevations (mASL)	Groundwater level in borehole (mBGL)	Screen Completion Interval Depth (mBGL)	Groundwater Level in monitoring well (mBGL) Jan/Sept, 02	Groundwater Level Elevations in the monitoring well (mASL) Jan/Sept, 02
W2 (Feb, 02)	4.5	806.40	4.5	1.5-4.5	2.62/1.47	802.53/802.39
W3 (Feb, 02)	4.5	806.13	3.0	1.5-4.5	2.89/1.80	802.60/802.36
W8 (Mar, 02)	4.5	802.97	3.0	1.5-4.5	3.72/2.33	800.76/800.84
W1 (Sept, 02)	7.52	---	3.00	4.52-7.52	---/3.90	---
E5 (Sept, 2002)	7.52	---	3.75	4.52-7.52	---/3.76	---

Note: mBGL - metres below ground level; mASL - metres above sea level

--- not measured



7.2.2 Field Observation for the Complete Delineation Phase III ESA Report

No free product was observed in any of the water purged from the groundwater wells. However, petroleum odour was noted in the groundwater sample collected from monitoring well "GW2" in January, 2002 and in the groundwater sample collected from monitoring well "E5" in September, 2002.

The groundwater samples from borehole "W1" and "E5" were sent to the laboratory for analysis of BTEX (benzene, toluene, ethyl-benzene, and xylenes) and petroleum hydrocarbon fractions F1 and F2.

The direction of groundwater flow is estimated to be to the northeast based on the measured water table elevations within the three groundwater wells "GW2", "GW3" and "GW8" which is consistent with the findings from the previous Phase II ESA. The test results were compared to the Criteria for Groundwater Ingestion Pathway, defined in the Alberta Environment's Risk Management Guidelines for Petroleum Storage Tank Sites (October, 2001).

Table 5: Comparison of Laboratory Analysis for Groundwater Samples to the Groundwater Ingestion Criteria

Sample name	Benzene	Toluene	Ethyl-Benzene	Xylene	F1	F2
Groundwater Ingestion Criteria	0.005	0.024	0.0024	0.3	5	2
GW2 (B2) (Jan, 02)	0.028	0.102	0.180	2.12	15.9	41
W1 (Sept, 02)	0.043	0.046	0.032	0.134	0.64	<0.1
E5 (Sept, 02)	<0.001	<0.001	<0.001	<0.001	<0.01	0.2

All values in (mg/L) ppm unless otherwise noted.
Levels that exceed criteria are in bold text and shaded.
NT - not tested

Based upon laboratory results, both of the groundwater samples from "W1" and "E5" have concentrations of petroleum hydrocarbons exceeding the criteria. This shows that petroleum contaminants have migrated towards the groundwater system.

8.0 RESULTS AND DISCUSSIONS

The results of the above laboratory analysis delineate the plume of the petroleum hydrocarbon contamination for site #5720. This is discussed in more detail below, however, it should be noted that due to cost-efficiency reasons, not all the samples obtained for delineation purposes were sent for laboratory analysis. Correlation of



vapour field screening readings using PID with laboratory results is used for delineation purposes for soil samples that were not sent for laboratory analysis.

For site #5720, a PID reading of 56 ppm was used for delineation purposes for soil samples collected in September 2002 and a PID reading of 372 ppm was used for delineation purposes for soil samples collected in January 2002 for the following reasons:

- (a) Soil samples collected in September, 2002 with a PID reading greater than 56.6 ppm and without laboratory analysis are considered to be above the criteria because the laboratory results of the soil sample from borehole "S3" with a PID reading of 56.5 ppm has BTEX below the criteria. However, the soil sample collected from borehole "W1" with a PID reading of 175 ppm has BTEX above the criteria.
- (b) Soil samples collected in January, 2002 with a PID reading greater than 372 ppm and without laboratory analysis are considered to be above the criteria because the laboratory results of the soil sample from borehole "B4" with a PID reading of 372 ppm has petroleum hydrocarbons below the criteria. However, the soil sample collected from borehole "B2" with a PID reading of 780 ppm has petroleum hydrocarbons above the criteria.

Table 6. Results of Delineation for Petroleum Hydrocarbon Contamination

	Corresponding depth	Highest PID reading at that particular borehole (ppm)	Criteria for determining the contamination level for sample without laboratory analysis	Contamination validated by lab analysis and PID readings	Odour
			(a) Above criteria if PID >56 ppm for year Sept 02 samples (a) Above criteria if PID >372 ppm for year Jan 02 samples		
borehole					
Jan/02					
B1*	7.50	291	below	PID& analysis	
B2*	4.50	780	above	PID& analysis	✓
B3*	3.75	27.3	below	PID & odor	
B4*	3.75	372	below	PID& analysis	✓
B5*	4.50	109	below	PID & odor	✓
B6*	6.00	209	below	PID& analysis	
B7*	7.50	156	below	PID & odor	✓
B8*	4.50	111	below	PID & odor	✓
Sept/02					
West side					
2002-S1	2.25	333.0	below	PID& analysis	✓
2002-S2	3.0	26.4	below	PID & odor	
2002-S3	1.5	56.5	below	PID& analysis	✓



	Corresponding depth	Highest PID reading at that particular borehole (ppm)	Criteria for determining the contamination level for sample without laboratory analysis	Contamination validated by lab analysis and PID readings	Odour
2002-E3	2.25	2000	above	PID& analysis	✓
2002-E4	2.25	8.4	below	PID & odor	✓
2002-E5	3.00	2000	above	PID& analysis	✓
2002-W1	7.50	16.8	below	PID & odor	
2002-W2	2.25	27.7	below	PID& analysis	
East Side					
2002-E6	3.00	43.3	below	PID& analysis	
2002-E7	2.25	60	below	PID & analysis	
2002-W4	5.25	35.2	below	PID & odor	
2002-S3	1.5	56.5	below	PID& analysis	✓

Note: ✓ (odor was detected), *data from the previous Phase II ESA Report (February, 2002) prepared by KC

8.1 Direction of Contaminant Migration Plume

Based on the laboratory results for the soil samples, the petroleum contaminant migration plume appears to run horizontally in an easterly direction. This is expected as the groundwater flow direction is estimated to be to the northeast and the location of the pump island is up slope toward the west.

8.2 The Maximum Depth of Contamination

The contamination levels appear to peak at a depth of 2.25 m and extend to a depth of 4.5 m, as shown in Table 5. For soil samples collected in January 2002, it is noted that the PID readings for hydrocarbon vapor concentration appear to increase slightly towards a depth of 4.50 m. The sudden increase of hydrocarbon vapor indicates that the petroleum hydrocarbons may have traveled through the thin thickness of sandy clay located at a depth between 3.75 m and 5.25 m. The maximum depth of contamination for the area is estimated to be approximately at 4.5 m.

8.3 The Source of Contamination

Based on laboratory analysis and PID readings of the soil samples from boreholes around the UST tank nest and the pump island on the west side of the subject site, the pump island located on the west side of the subject site with associated piping appears to be the source of contamination.

8.4 Boundaries of the Impacted Area

(A) Area around the Diesel UST on the east side of the subject site

Based on the laboratory results and the PID readings, the area around the diesel UST located on the east side of the subject site has no contamination above the applicable criteria.



(B) Area around the Pump Island and the USTs on the West Side of the Subject Site

East Boundary - Both boreholes "E3" and "E5" have petroleum hydrocarbon contamination above the criteria. There is a substantial reduction in the contaminant level from borehole "E3" to "E5" in the easterly direction. This is expected as the contamination plume is farther away from the pump island. As "E4" has relatively low PID readings ranging from 3.7 ppm from 64.0 ppm and "B3 (GW3)" has a relatively low PID readings ranging from 8.1 to 27.3 ppm, it is reasonable to believe that the contamination is defined by "E4". **For delineation purposes, it is assumed that the contamination is defined by "E4" which is about 10 m from the east end of the pump island.**

West Boundary - Previous laboratory analysis on the soil sample collected from former borehole "B2" at a depth of 4.5 m with a PID reading of 780 ppm shows that contamination levels are above the applicable criteria. The soil contamination plume from the pump island appears to extend as far west as borehole "W2", as both borehole "W1" and "W2" have petroleum hydrocarbon values below the criteria. **Therefore, it is reasonable to believe that the contamination is defined by borehole "W2" located about 3 m west from the west end of the pump island.**

South Boundary - Laboratory analysis show that the soil sample with a PID reading of 333 ppm from borehole "S1" at a depth of 2.25 m has contamination above the criteria. Borehole "S2" has relatively low PID readings ranging from 9.1 ppm to 42.2 ppm and it is therefore reasonable to believe that the contamination is defined by "S2". This is further supported by the low PID readings of previous borehole "B3 GW3" ranging from 8.1 ppm to 27.3 ppm. **For delineation purposes, it is reasonable to believe that the contamination is defined by "S2" which is about 5 m from the south end of the pump island.**

North Boundary - The former borehole "B2 (GW2)" has contamination above the criteria, as shown by the laboratory results. Therefore, it is reasonable to believe that there is contamination further north of "B2 (GW2)". However, drilling was not done north of the "B2" so as not to cause any property damage, given the close proximity of the utility lines and possible errors in lines locates.

Borehole "W1" located northwest of borehole "B2", however, does not have contamination above the criteria. It is therefore reasonable to believe that the contamination is defined by borehole "W1" to the northwest of the pump island. This is further supported by the laboratory analysis of borehole "B1", located immediately north of the USTs. Borehole "B1" has petroleum hydrocarbons level below the criteria. **Therefore, it is reasonable to believe that the contamination is defined by borehole "W1" located about 5 m north from the pump island.**



8.5 Conclusions and Recommendations

The following recommendations were developed for the subject property and are based on the results of the Phase III Environmental Site Assessment conducted at site the Alsike General Store, also referred to as site #5270, Race Trac Gas, Alsike.

- 1) The contaminated area is identified on the west side of the subject site where the pump island and the gasoline Underground Storage Tanks (USTs) are located.
- 2) It is estimated that the depth to which the soil has been contaminated with petroleum hydrocarbon is approximately 4.50m. The contaminated area on-site is estimated to be about 250 m². The total volume of impacted soil is about 1100 m³ on-site based on a maximum contamination depth of 4.5 m.
- 3) Based on drilling results, it is reasonable to believe that there is no contamination underneath the on-site building located north of the pump island. It should be noted, however, that no drilling was done underneath the onsite building.
- 4) The petroleum contaminants have migrated towards the groundwater system and were identified on the west side of the subject site.
- 5) Even though there is no petroleum contamination above the criteria on the east side of the subject site, it is recommended that a leak test be conducted at least once a year. Given the type and age of the tank (12 years old), a leak test will help ensure that the diesel UST located east of the subject site is not leaking. Early detection of leakage can prevent widespread soil and groundwater petroleum hydrocarbon contamination.
- 6) Remediation criteria for the contaminated soil are the Generic Hydrocarbon and Lead Criteria for Fine-Grained Soil (Commercial Land Use) for the Petroleum Hydrocarbon Fractions (F1, F2, F3 and F4) and the Generic Hydrocarbon Criteria for the Groundwater Ingestion Pathway (Fine -Grained Soil) for the BTEX levels as defined in the Alberta Environment's Risk Management Guidelines for Petroleum Storage Tank Sites (October, 2001) .
- 7) Remediation criteria for groundwater is the Generic Hydrocarbon Criteria for Groundwater Ingestion Pathway.
- 8) As contamination is above the appropriate risk management criteria, remediation is recommended for the subject site.



9.0 METHODOLOGY

The following is a summary of the general methodology followed for Environmental Site Assessments conducted for Alberta Government's Underground Petroleum Storage Tank Site Remediation Program. Changes made are stated in the Introduction of this report (Section 1.0).

9.1 Consultation with Client

Work is on a "grant recipient" approved basis. Grant recipients are to notify KC Environmental that work under the Alberta Government Underground Petroleum Storage Tank Site Remediation Program is requested. They are to advise KC Environmental on the particular scope of the work including location and depth factors as well as any unique conditions on the site that might assist in fully defining the methodology. Depending on the conditions of the work site the following methodology may be modified.

9.2 Boreholes and Soil Samples

1. All utilities in the area will be located.
2. Boreholes will be drilled using a truck-mounted auger rig equipped with solid stem or hollow stem augers as drilling conditions dictate. The boreholes will be drilled to a depth below any observed hydrocarbon contamination, or one meter below the lowest tank invert, which ever is lower. The first boreholes will be drilled in the area of least expected contamination to reduce contamination of sampling equipment between boreholes.
3. Soil samples will be collected off the auger flight at 0.75m intervals. At the sampling depth, the outer surface of the core will be removed to ensure that a clean sample is obtained.
4. Samples will be collected using sterile hand tools, which will be washed between each sample taken and rinsed with distilled water. Surgical gloves will be worn during the procedure and changed between samples.
5. Soil samples will be grab samples collected off the auger flight. At each sampling depth, two samples will be taken and placed in separate Ziploc bags. One sample will be kept at room temperature until it reaches approximately 20°C, at which time it will be tested with a Photoionization detector (PID) to determine the presence or absence of hydrocarbon contamination. As is standard practice, the instrument will be calibrated with 99.6 ppm of isobutylene to record the maximum level of contamination detected. PID analysis is used to conduct the field vapour screening as specified in the Terms of Reference.



6. Soil samples with high PID readings will be transferred from the duplicate unopened Ziploc bags to EPA certified glass jars and kept at or below 4°C until taken to the laboratory for analysis, or the decision is made to discard the sample. Soil samples will be selected from the areas of highest petroleum contamination for laboratory testing.
7. As boreholes are being drilled, soil samples collected will be observed and described according to the Unified Soil Classification System. Lithology logs will be prepared for each borehole.
8. Samples will be submitted to a CAEAL (Canadian Association for Environmental Analytical Laboratories) and SCC (Standards Council of Canada) accredited laboratory and will be received in accordance with the chain of custody documentation. The samples will not exceed the recommended holding times thus preserving sample integrity. One of the quality control procedures performed by the laboratory with each batch of samples involves the "spiking" of a sample replicate with a known concentration of analyte. The percent recovery of the spike is then determined by subtracting the analyte concentration of an unspiked sample replicate from that of the spiked replicate. If the spike recovery is within acceptable limits, matrix interference is deemed to be negligible and analytical results are accepted. This is standard laboratory practice.
9. The laboratory disposes of the water samples down the drain. This is standard laboratory practice and is acceptable according to the City of Edmonton Sewers Use By-Law as well as solid waste disposal guidelines.
10. Soil samples will be disposed of at the sampling location or in an approved landfill. This is standard laboratory practice, and is acceptable according to the sewer bylaw as well as solid waste disposal guidelines.

9.3 Monitoring Wells and Water Sampling

1. Monitoring wells will be installed in boreholes with expected contamination. The monitoring wells will consist of a 51mm diameter PVC pipe with 2mm slots. The annulus between the wall of the hole and the slotted pipe will be filled with Sil 7 frac sand to form a sand filter. The remainder of the fill will consist of 9.5mm granular bentonite chips up to the ground surface. The well will be capped with a locking cap, and the keys to each well held by the consultant.
2. A Waterra foot-valve and Waterra tubing will be installed in each groundwater monitoring well. The Waterra tubing is used to sample each well, and is a dedicated unit, thereby reducing the chance of cross-contamination being introduced with the sampling of many wells.



3. One groundwater sample will be collected directly from the Waterra tubing into the containers provided by the laboratory for each analysis. Wells will be purged approximately 24 hours prior to obtaining the water samples. The sample will be held at or below 4 °C until it is taken to the laboratory for analysis.

9.4 Analysis of Collected Soil and Groundwater Samples

Soil samples and groundwater samples will be submitted to a CAEAL approved laboratory for testing. These samples will be collected from the areas of highest petroleum contamination.

The tests requested for the soil samples are:

- a) BTEX (Benzene, Toluene, Ethylbenzene, Xylenes),
- b) Petroleum Hydrocarbon Fractions F1(C6 -C10), F2 (C10-C16), F3(C16-C34) and F4(C34-C50),
- c) Lead,
- d) Grain size analysis on one soil sample.

The tests requested for the water samples are:

- a) BTEX (Benzene, Toluene, Ethylbenzene, Xylenes),
- b) Petroleum Hydrocarbon Fractions F1(C6 -C10), F2 (C10-C16),
- c) Document the presence of free product on the water table.



10.0 PROJECT LIMITATIONS

10.1 Sampling Limitations

A limited number of samples were submitted for laboratory testing and only for components as determined by the Alberta Remediation program. Laboratory analysis is limited in that it only provides quantifiable data about specific samples tested and compounds tested for, and may not necessarily reflect the entire site. Interpretations are based on a limited number of laboratory results and the error in this must be recognized. Laboratory results were used to validate field data and to obtain a more accurate reading of hydrocarbon contamination levels.

10.2 Project Limitations

This project has been completed to the best of the consultant's abilities and in accordance to the APEGGA Code of Ethics. However, the report is based on the information reviewed to the extent that the information was available and to the extent considered reasonable within the allocated project time frame and project budget. KC Environmental Group Ltd. and the environmental consultants who prepared this report do not accept any liability for contamination that may be found later on the subject site and is not identified in this environmental report.

The purpose of the report is to provide the client with further information with respect to the extent of petroleum hydrocarbon contamination due to the past or the present site uses. One copy of the report is maintained in the consultant's files as required by APEGGA.



APPENDIX A

**SITE SKETCH WITH LOCATIONS OF
BOREHOLES AND GROUNDWATER
MONITORING WELLS**

Wooded Area

Wooded Area

Managers
Supply Ltd
Distribution

UST
diesel

Power
Pole

Diesel
Pump

Managers
Supply Ltd
Restaurant

Gravel
Parking
Area

Propane
tank

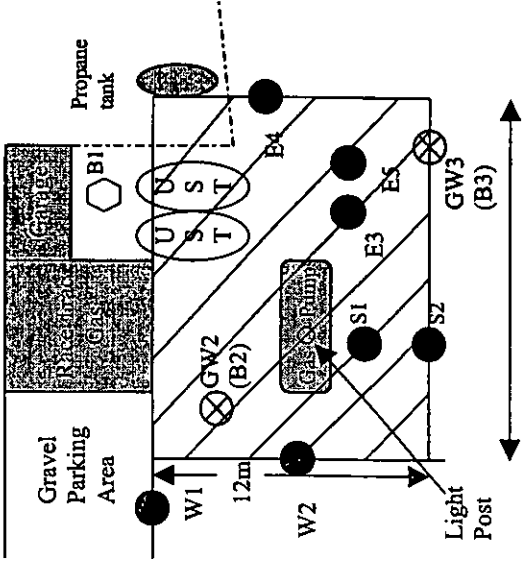
B4

Approximate
divide between asphalt
and gravel

Gravel

Ditch sloping from site and highway

Highway 39



Legend:

- B1 8.5m east and 12.3m north of light post
 - ⊗ GW2 6.0m west and 1.8m north of light post
 - ⊗ GW3 11.3m east and 4.9m south of light post
 - B4 44.0m east and 2.1m north of power pole
 - B5 7.5m south and 2.2m east of power pole
 - B6 4.6m north and 3.8m west of power pole
 - B7 1.85m south and 13.0m west of power pole
 - ⊗ GW8 15.7m north and 6.6m west of power pole
 - W1 3m west and 3m north of GW2 (well)
 - W2 3m west of pump
 - S1 2m south of pump
 - S2 3m south of S1
 - E3 2m east and 1m south of pump
 - E4 7.5m east and 4.5m north of E3
 - E5 3m east of E3 (well)
 - W4 3m west of diesel UST
 - S3 2m south of diesel pump
 - E6 2.94m east and 1m south of pump
- Note: Borehole locations are approximate and not to scale

APPENDIX B

LABORATORY RESULTS



Certificate of Analysis

CLIENT NAME KC ENVIRONMENTAL
ATTENTION MARGARET MARRA

AGAT WORK ORDE 02E024219

Petroleum Hydrocarbons in Soil

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	837441	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	W2-2/25m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Benzene	<0.005	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Toluene	0.012	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Ethylbenzene	0.009	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Xylenes	0.024	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
C6 - C10 (Fraction 1)	3.00	mg/kg	0.05	Oct 01, 2002	PM	Sep 20, 2002
C10 - C16 (Fraction 2)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
C16 - C34 (Fraction 3)	30	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
C34 - C50 (Fraction 4)	30	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
Total C6 - C50	60	mg/kg	10			
Gravimetric Heavy Hydrocarbons	N/A	mg/kg	1000			

COMMENTS:

M.D.L. - Method Detection Limit
 Sample Percent Moisture: 19%
 Results are based on the dry weight of the sample.
 The C6 - C10 fraction is calculated using the o-xylene response factor.
 The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
 Gravimetric Heavy Hydrocarbons are not included in the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
 Fraction 1 results have NOT been corrected for BTEX contributions
 N/A: Not Applicable

Certified By:



Certificate of Analysis

CLIENT NAME KC ENVIRONMENTAL
ATTENTION MARGARET MARRA

AGAT WORK ORDE 02E024219

Soil Analysis - Lead

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	337441	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	W2-2.25m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Lead	11.8	µg/g	0.4	Sep 23, 2002	IG	Sep 23, 2002

COMMENTS:

M.D.L. - Method Detection Limit

Certified By:



Certificate of Analysis

CLIENT NAME KC ENVIRONMENTAL
ATTENTION MARGARET MARRA

AGAT WORK ORDE 02E024219

Petroleum Hydrocarbons in Soil

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	337440	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	E6-3.00m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Benzene	<0.005	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Toluene	0.037	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Ethylbenzene	0.007	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Xylenes	0.036	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
C6 - C10 (Fraction 1)	0.38	mg/kg	0.05	Oct 01, 2002	PM	Sep 20, 2002
C10 - C16 (Fraction 2)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
C16 - C34 (Fraction 3)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
C34 - C50 (Fraction 4)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
Total C6 - C50	<10	mg/kg	10			
Gravimetric Heavy Hydrocarbons	N/A	mg/kg	1000			

COMMENTS:

M.D.L. - Method Detection Limit
 Sample Percent Moisture: 18%
 Results are based on the dry weight of the sample
 The C6 - C10 fraction is calculated using the o-xylene response factor.
 The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
 Gravimetric Heavy Hydrocarbons are not included in the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
 Fraction 1 results have NOT been corrected for BTEX contributions
 N/A: Not Applicable

Certified By:



Certificate of Analysis

CLIENT NAME **KC ENVIRONMENTAL**
 ATTENTION **MARGARET MARRA**

AGAT WORK ORDE **02E024219**

Soil Analysis - Lead

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	337440	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	E6-3.00m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Lead	9.7	µg/g	0.4	Sep 23, 2002	IG	Sep 23, 2002

COMMENTS:

M D L - Method Detection Limit

Certified By:



Certificate of Analysis

CLIENT NAME **KC ENVIRONMENTAL**
ATTENTION **MARGARET MARRA**

AGAT WORK ORDE **02E024219**

Petroleum Hydrocarbons in Soil

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	837439	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	S3-4.50m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Benzene	<0.005	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Toluene	0.028	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Ethylbenzene	0.014	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Xylenes	0.066	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
C6 - C10 (Fraction 1)	0.69	mg/kg	0.05	Oct 01, 2002	PM	Sep 20, 2002
C10 - C16 (Fraction 2)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
C16 - C34 (Fraction 3)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
C34 - C50 (Fraction 4)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
Total C6 - C50	<10	mg/kg	10			
Gravimetric Heavy Hydrocarbons	N/A	mg/kg	1000			

COMMENTS:

M.D.L. - Method Detection Limit
Sample Percent Moisture: 20%
Results are based on the dry weight of the sample.
The C6 - C10 fraction is calculated using the o-xylene response factor
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Fraction 1 results have NOT been corrected for BTEX contributions
N/A: Not Applicable

Certified By:



Certificate of Analysis

CLIENT NAME **KC ENVIRONMENTAL**
ATTENTION **MARGARET MARRA**

AGAT WORK ORDE **02E024219**

Soil Analysis - Lead

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	337439	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	S3-150m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Lead	12.4	µg/g	0.4	Sep 23, 2002	IG	Sep 23, 2002

COMMENTS:

M.D.L. - Method Detection Limit

Certified By:



Certificate of Analysis

CLIENT NAME KC ENVIRONMENTAL
ATTENTION MARGARET MARRA

AGAT WORK ORDE 02E024219

Petroleum Hydrocarbons in Soil

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	337438	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	E5-3.00m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Benzene	0.479	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Toluene	0.702	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Ethylbenzene	6.08	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Xylenes	13.7	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
C6 - C10 (Fraction 1)	250	mg/kg	0.05	Oct 01, 2002	PM	Sep 20, 2002
C10 - C16 (Fraction 2)	50	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
C16 - C34 (Fraction 3)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
C34 - C50 (Fraction 4)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
Total C6 - C50	300	mg/kg	10			
Gravimetric Heavy Hydrocarbons	N/A	mg/kg	1000			

COMMENTS:

M D.L. - Method Detection Limit
 Sample Percent Moisture: 15%
 Results are based on the dry weight of the sample.
 The C6 - C10 fraction is calculated using the o-xylene response factor.
 The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
 Gravimetric Heavy Hydrocarbons are not included in the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
 Fraction 1 results have NOT been corrected for BTEX contributions
 N/A. Not Applicable

Certified By:



Certificate of Analysis

CLIENT NAME **KC ENVIRONMENTAL**
ATTENTION **MARGARET MARRA**

AGAT WORK ORDE **02E024219**

Soil Analysis - Lead

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	337438	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	E5-3.00m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Lead	10.3	ug/g	0.4	Sep 23, 2002	IG	Sep 23, 2002

COMMENTS:

M.D.L. - Method Detection Limit

Certified By:



Certificate of Analysis

CLIENT NAME KC ENVIRONMENTAL
ATTENTION MARGARET MARRA

AGAT WORK ORDE 02E024219

Petroleum Hydrocarbons in Soil

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	337436	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	E3-3.00m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Benzene	0.742	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Toluene	0.484	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Ethylbenzene	2.21	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Xylenes	1.09	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
C6 - C10 (Fraction 1)	27.2	mg/kg	0.05	Oct 01, 2002	PM	Sep 20, 2002
C10 - C16 (Fraction 2)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
C16 - C34 (Fraction 3)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
C34 - C50 (Fraction 4)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
Total C6 - C50	30	mg/kg	10			
Gravimetric Heavy Hydrocarbons	N/A	mg/kg	1000			

COMMENTS:

M D.L. - Method Detection Limit
Sample Percent Moisture: 15%
Results are based on the dry weight of the sample
The C6 - C10 fraction is calculated using the o-xylene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Fraction 1 results have NOT been corrected for BTEX contributions
N/A: Not Applicable

Certified By:



Certificate of Analysis

CLIENT NAME **KC ENVIRONMENTAL**
ATTENTION **MARGARET MARRA**

AGAT WORK ORDE **02E024219**

Soil Analysis - Lead

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	337436	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	E3-3.00m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Lead	10.3	µg/g	0.4	Sep 23, 2002	IG	Sep 23, 2002

COMMENTS:

M.D.L. - Method Detection Limit

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Certificate of Analysis

CLIENT NAME KC ENVIRONMENTAL
ATTENTION MARGARET MARRA

AGAT WORK ORDE 02E024219

Soil Analysis - Lead

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	337435	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	E3-2/25m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Lead	16.5	µg/g	0.4	Sep 23, 2002	IG	Sep 23, 2002

COMMENTS:

M D.L. - Method Detection Limit

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CLIENT NAME **KC ENVIRONMENTAL**
ATTENTION **MARGARET MARRA**

AGAT WORK ORDE **02E024219**

Petroleum Hydrocarbons in Soil

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	837434	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	S1 - 2.25m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Benzene	0.087	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Toluene	0.193	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Ethylbenzene	0.730	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Xylenes	1.87	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
C6 - C10 (Fraction 1)	38.7	mg/kg	0.05	Oct 01, 2002	PM	Sep 20, 2002
C10 - C16 (Fraction 2)	30	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
C16 - C34 (Fraction 3)	10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
C34 - C50 (Fraction 4)	10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
Total C6 - C50	90	mg/kg	10			
Gravimetric Heavy Hydrocarbons	N/A	mg/kg	1000			

COMMENTS:

M.D.L. - Method Detection Limit
Sample Percent Moisture: 18%
Results are based on the dry weight of the sample.
The C6 - C10 fraction is calculated using the o-xylene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Fraction 1 results have NOT been corrected for BTEX contributions
N/A. Not Applicable

Certified By:



Certificate of Analysis

CLIENT NAME KC ENVIRONMENTAL
ATTENTION MARGARET MARRA

AGAT WORK ORDE 02E024219

Soil Analysis - Lead

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	337434	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	S1-225m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Lead	9.8	µg/g	0.4	Sep 23, 2002	IG	Sep 23, 2002

COMMENTS:

M D.L. - Method Detection Limit

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Certificate of Analysis

CLIENT NAME KC ENVIRONMENTAL
ATTENTION MARGARET MARRA

AGAT WORK ORDE 02E024219

Petroleum Hydrocarbons in Soil

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	337432	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	S1-0.75m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Benzene	0.006	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Toluene	0.015	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Ethylbenzene	0.011	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Xylenes	0.029	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
C6 - C10 (Fraction 1)	0.70	mg/kg	0.05	Oct 01, 2002	PM	Sep 20, 2002
C10 - C16 (Fraction 2)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
C16 - C34 (Fraction 3)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
C34 - C50 (Fraction 4)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
Total C6 - C50	<10	mg/kg	10			
Gravimetric Heavy Hydrocarbons	N/A	mg/kg	1000			

COMMENTS:

M.D.L. - Method Detection Limit
 Sample Percent Moisture: 18%
 Results are based on the dry weight of the sample.
 The C6 - C10 fraction is calculated using the o-xylene response factor.
 The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
 Gravimetric Heavy Hydrocarbons are not included in the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
 Fraction 1 results have NOT been corrected for BTEX contributions
 N/A. Not Applicable
 Sample arrived at laboratory with air (headspace) included in sample container.

Certified By:



Certificate of Analysis

CLIENT NAME KC ENVIRONMENTAL
ATTENTION MARGARET MARRA

AGAT WORK ORDE 02E024219

Soil Analysis - Lead

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	837432	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	S1-075m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Lead	10.2	µg/g	0.4	Sep 23, 2002	IG	Sep 23, 2002

COMMENTS:

M.D.L. - Method Detection Limit

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Certificate of Analysis

CLIENT NAME **KC ENVIRONMENTAL**
ATTENTION **MARGARET MARRA**

AGAT WORK ORDE **02E024219**

Petroleum Hydrocarbons in Soil

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	337431	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	W1-4750m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Benzene	<0.005	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Toluene	0.015	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Ethylbenzene	<0.005	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
Xylenes	0.014	mg/kg	0.005	Oct 01, 2002	PM	Sep 20, 2002
C6 - C10 (Fraction 1)	0.22	mg/kg	0.05	Oct 01, 2002	PM	Sep 20, 2002
C10 - C16 (Fraction 2)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
C16 - C34 (Fraction 3)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
C34 - C50 (Fraction 4)	<10	mg/kg	10	Sep 20, 2002	MCS	Sep 20, 2002
Total C6 - C50	<10	mg/kg	10			
Gravimetric Heavy Hydrocarbons	N/A	mg/kg	1000			

COMMENTS:

M.D.L. - Method Detection Limit
Sample Percent Moisture: 18%
Results are based on the dry weight of the sample.
The C6 - C10 fraction is calculated using the o-xylene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Fraction 1 results have NOT been corrected for BTEX contributions
N/A: Not Applicable

Certified By:



Certificate of Analysis

CLIENT NAME KC ENVIRONMENTAL
ATTENTION MARGARET MARRA

AGAT WORK ORDE 02E024219

Soil Analysis - Lead

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	337431	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	W1 -7.50m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Lead	5.1	µg/g	0.4	Sep 23, 2002	IG	Sep 23, 2002

COMMENTS:

M.D.L. - Method Detection Limit

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ATTENTION MARGARET MARRA

AGAT WORK ORDE 02E024219

Particle Size by Sieve

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	337437	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	E5-225m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Sieve Analysis - 75 microns	26.2	%	N/A	Sep 27, 2002	FC	Sep 27, 2002

COMMENTS:

M.D.L. - Method Detection Limit
Value reported is amount of sample retained on sieve after wash with water and represents proportion by weight particles larger than indicated sieve size

Certified By:

Margaret Munro



Certificate of Analysis

CLIENT NAME **KC ENVIRONMENTAL**
ATTENTION **MARGARET MARRA**

AGAT WORK ORDE **02E024219**

Particle Size by Sieve

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	337433	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	S1 -150m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Sieve Analysis - 75 microns	14.1	%	N/A	Sep 27, 2002	FC	Sep 27, 2002

COMMENTS:

M.D.L. - Method Detection Limit

Value reported is amount of sample retained on sieve after wash with water and represents proportion by weight particles larger than indicated sieve size.

Certified By:



Certificate of Analysis

CLIENT NAME KC ENVIRONMENTAL
ATTENTION MARGARET MARRA

AGAT WORK ORDE 02E024219

Soil Texture

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	337433	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	ST-1150m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Particle Size Distribution (Sand)	25	%	1	Sep 24, 2002	FC	Sep 24, 2002
Particle Size Distribution (Silt)	36	%	1	Sep 24, 2002	FC	Sep 24, 2002
Particle Size Distribution (Clay)	39	%	1	Sep 24, 2002	FC	Sep 24, 2002
Soil Texture	Clay Loam					

COMMENTS:

M D L - Method Detection Limit
 Results are based on the dry weight of the sample.

Certified By:



Certificate of Analysis

CLIENT NAME KC ENVIRONMENTAL
ATTENTION MARGARET MARRA

AGAT WORK ORDE 02E024219

Soil Texture

SAMPLE TYPE:	Soil	DATE SAMPLED:	Sep 17, 2002
SAMPLE ID:	837437	DATE RECEIVED:	Sep 19, 2002
SAMPLE DESCRIPTION:	E5-225m	DATE REPORTED:	Oct 01, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Particle Size Distribution (Sand)	39	%	1	Sep 24, 2002	FC	Sep 24, 2002
Particle Size Distribution (Silt)	37	%	1	Sep 24, 2002	FC	Sep 24, 2002
Particle Size Distribution (Clay)	24	%	1	Sep 24, 2002	FC	Sep 24, 2002
Soil Texture	Loam					

COMMENTS:

M D L - Method Detection Limit
Results are based on the dry weight of the sample.

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Certificate of Analysis

CLIENT NAME **KC ENVIRONMENTAL**
ATTENTION **Margaret Marra**

AGAT WORK ORDE **02E024383**

Petroleum Hydrocarbons in Water (PST)

SAMPLE TYPE:	Water	DATE SAMPLED:	Sep 19, 2002
SAMPLE ID:	337472	DATE RECEIVED:	Sep 20, 2002
SAMPLE DESCRIPTION:	w1	DATE REPORTED:	Sep 30, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Benzene	0.043	mg/L	0.001	Sep 30, 2002	RK	Sep 27, 2002
Toluene	0.046	mg/L	0.001	Sep 30, 2002	RK	Sep 27, 2002
Ethylbenzene	0.032	mg/L	0.001	Sep 30, 2002	RK	Sep 27, 2002
Xylenes	0.134	mg/L	0.001	Sep 30, 2002	RK	Sep 27, 2002
C>6 - C10 (Fraction 1)	0.64	mg/L	0.01	Sep 30, 2002	RK	Sep 27, 2002
C>10 - C16 (Fraction 2)	<0.1	mg/L	0.1	Sep 26, 2002	CM	Sep 26, 2002

COMMENTS:

M.D.L. - Method Detection Limit

Hydrocarbon fractions are determined by integrating all area counts from the end of the first n-alkane peak in the fraction, to the end of the last n-alkane peak in the fraction.

The C>6 - C10 fraction is calculated using the o-xylene response factor.

The C>10 - C16 fraction is calculated using the average response factor for n-C10.

BTEX has NOT been subtracted from Fraction 1.

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Certificate of Analysis

CLIENT NAME KC ENVIRONMENTAL
ATTENTION Margaret Marra

AGAT WORK ORDE 02E024383

Petroleum Hydrocarbons in Water (PST)

SAMPLE TYPE:	Water	DATE SAMPLED:	Sep 19, 2002
SAMPLE ID:	337485	DATE RECEIVED:	Sep 20, 2002
SAMPLE DESCRIPTION:	ES	DATE REPORTED:	Sep 30, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Benzene	<0.001	mg/L	0.001	Sep 30, 2002	RK	Sep 27, 2002
Toluene	<0.001	mg/L	0.001	Sep 30, 2002	RK	Sep 27, 2002
Ethylbenzene	<0.001	mg/L	0.001	Sep 30, 2002	RK	Sep 27, 2002
Xylenes	0.001	mg/L	0.001	Sep 30, 2002	RK	Sep 27, 2002
C>6 - C10 (Fraction 1)	0.01	mg/L	0.01	Sep 30, 2002	RK	Sep 27, 2002
C>10 - C16 (Fraction 2)	0.2	mg/L	0.1	Sep 26, 2002	CM	Sep 26, 2002

COMMENTS:

M.D.L. - Method Detection Limit
 Hydrocarbon fractions are determined by integrating all area counts from the end of the first n-alkane peak in the fraction, to the end of the last n-alkane peak in the fraction.
 The C>6 - C10 fraction is calculated using the o-xylene response factor.
 The C>10 - C16 fraction is calculated using the average response factor for n-C10.
 BTEX has NOT been subtracted from Fraction 1.

Certified By:



Certificate of Analysis

CLIENT NAME KC ENVIRONMENTAL
ATTENTION Margaret Marra

AGAT WORK ORDE 02E024383

Water Analysis

SAMPLE TYPE:	Water	DATE SAMPLED:	Sep 19, 2002
SAMPLE ID:	337472	DATE RECEIVED:	Sep 20, 2002
SAMPLE DESCRIPTION:	W1	DATE REPORTED:	Sep 30, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Lead	<0.01	mg/L	0.01	Sep 29, 2002	MG	Sep 26, 2002

COMMENTS:

M.D.L. - Method Detection Limit
< - Value refers to Method Detection Limit.

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Certificate of Analysis

CLIENT NAME KC ENVIRONMENTAL
ATTENTION Margaret Marra

AGAT WORK ORDE 02E024383

Water Analysis

SAMPLE TYPE:	Water	DATE SAMPLED:	Sep 19, 2002
SAMPLE ID:	337485	DATE RECEIVED:	Sep 20, 2002
SAMPLE DESCRIPTION:	E5	DATE REPORTED:	Sep 30, 2002

PARAMETER	RESULTS	UNITS	M.D.L.	DATE ANALYZED	INITIALS	DATE PREPARED
Lead	<0.01	mg/L	0.01	Sep 29, 2002	MG	Sep 26, 2002

COMMENTS:

M.D.L. - Method Detection Limit

Certified By:

APPENDIX C

SOIL LITHOLOGY AND PID READINGS

DRILLER'S LOG REPORT

PROJECT	801-01-367-Site 5720	DATE	17-Sep-02
BOREHOLE	W1	LOGGED	Margaret Marra
START TIME	09:00 AM	END TIME	10:15 AM

Depth in m	Sample Number	Soil Type	TOTAL ORGANIC HYDROCARBON VAPOUR (ppm)
0			
0.75	W1 0.75		3.1
1.5	W1 1.5		
2.25	W1 2.25		8.8
3	W1 3.00		8.5
3.75	W1 3.75		
4.5	W1 4.5	▼	7.4
5.25	W1 5.25		4.3
6	W1 6.00		
6.75	W1 6.75		4
*7.5	W1 7.5 *		4.3
END OF DRILLING			
			5.6
			13.7
			10.8

- fines (clay and silt)
- fine sand
- med sand
- coarse sand
- gravel
- cobbles

*Sample sent to laboratory ▼ Water Table

SOLID AUGER USED.

SUNALTA DRILLING

DRILLER'S LOG REPORT

PROJECT.	801-01-367-Site 5720	DATE:	17-Sep-02
BOREHOLE.	W2	LOGGED:	Margaret Marra
START TIME:	10.20am	END TIME:	11.15 AM

Depth in m	Sample Number	Soil Type	TOTAL ORGANIC HYDROCARBON VAPOUR (ppm)
0			
0.75	Light brown clay till, charcoal W2-0.75		1.6
1.5	Light brown clay till, charcoal W2-1.5		0
2.25	Sandy clay till, charcoal W2-2.25		27.7
3	Sandy clay till, charcoal W2-3.00		3.0
3.75	Sandy clay, charcoal W2-3.75	▼	3.4
4.5	Wet sand W2-4.5		1.4
5.25	Wet sand W2-5.25		4.3
6	Wet sand W2-6.00		3.6
6.75	Wet sandy clay, charcoal W2-6.75		0.2
END OF DRILLING - wet, mixed sample, very little on auger			

- fines (clay and silt)
- fine sand
- med sand
- coarse sand
- gravel
- cobbles

*Sample sent to laboratory ▼ Water Table

SOLID AUGER USED.

SUNALTA DRILLING

DRILLER'S LOG REPORT

PROJECT:	801-01-367-Site 5720	DATE:	17-Sep-02
BOREHOLE	S1	LOGGED:	Margaret Marra
START TIME	11:20 AM	END TIME:	11:55 AM

Depth in m	Sample Number	Soil Type	TOTAL ORGANIC HYDROCARBON VAPOUR (ppm)
0			
0.75	Hard clay till S1 0.75		◆ 645
1.5	Hard clay till S1-1.5		
2.25	Light brown clay till, charcoals S1-2.25		◆ 177
3	Light brown clay till, charcoals S1 3.00	▼	
3.75	Wet sand S1-3.75		◆ 353
4.5	Wet sand S1 4.5		◆ 100
5.25	Sandy clay, charcoal S1-5.25		◆ 80.5
END OF DRILLING - wet sample, very little on auger, mixed sample			◆ 32.8

- fines (clay and silt)
- fine sand
- med sand
- coarse sand
- gravel
- cobbles

*Sample sent to laboratory ▼ Water Table

SOLID AUGER USED.

SUNALTA DRILLING

DRILLER'S LOG REPORT

PROJECT:	801-01-367-Site 5720	DATE:	17-Sep-02
BOREHOLE:	S2	LOGGED:	Margaret Marra
START TIME:	12 00 PM	END TIME:	12.25 PM

Depth in m	Sample Number	Soil Type	TOTAL ORGANIC HYDROCARBON VAPOUR (ppm)
0			
0.75	Hard clay till	S2-0.75	
1.5	Hard clay till	S2-1.5	
2.25	Sandy clay, charcoal	S2-2.25	19
3	Sandy clay, charcoal	S2-3.00	42.2
3.75	Wet sand	S2-3.75	24.6
4.5	Wet sand, some charcoal	S2-4.5	13.3
5.25	Wet sand, charcoal	S2-5.25	18.9
6	Wet sand, charcoal	S2-6.00	23.2
6.75	END OF DRILLING-wet, mixed sample, very little on auger		0.1

- fines (clay and silt)
- fine sand
- med sand
- coarse sand
- gravel
- cobbles

*Sample sent to laboratory ▼ Water Table

SOLID AUGER USED.

SUNALTA DRILLING

DRILLER'S LOG REPORT

PROJECT:	801-01-367-Site 5720	DATE:	17-Sep-02
BOREHOLE:	E3	LOGGED:	Margaret Marra
START TIME	12.30 PM	END TIME:	01:10 PM

Depth in m	Sample Number	Soil Type	TOTAL ORGANIC HYDROCARBON VAPOUR (ppm)
0			
0.75	Hard clay till E3-0.75		53.7
1.5	Hard clay till, charcoal E3-1.5		255
2.25	Clay till with whites E3-2.25		
3	Clay till with charcoal E3-3.00	▼	2000
3.75	Wet sandy clay E3-3.75		
4.5	Wet sandy clay with charcoal E3-4.5		175
5.25	Wet sandy clay with charcoal E3-5.25		25.1
6	Wet sand with charcoal E3-6.00		30.2
6.75	Wet sandy clay E3-6.75		58.7
7.5	Hard dark grey clay E3-7.5		57.1
END OF DRILLING			40.8
			20.8

- fines (clay and silt)
- fine sand
- med sand
- coarse sand
- gravel
- cobbles

*Sample sent to laboratory ▼ Water Table

SOLID AUGER USED. SUNALTA DRILLING

DRILLER'S LOG REPORT

PROJECT:	801-01-367-Site 5720	DATE:	17-Sep-02
BOREHOLE:	E4	LOGGED:	Margaret Marra
START TIME:	02.20 PM	END TIME:	03.00 PM

Depth in m	Sample Number	Soil Type	TOTAL ORGANIC HYDROCARBON VAPOUR (ppm)
0			
0.75	Clay till E4-0.75		3.9
1.5	Clay till E4-1.5		
2.25	Silty clay till with charcoal E4-2.25		8.4
3	Silty clay till with charcoal E4-3.00		8.4
3.75	Wet silty sandy clay, charcoal E4-3.75		21.1
4.5	Wet silty sandy clay, charcoal E4-4.5		22.7
5.25	Wet silty sandy clay, charcoal E4-5.25		18.3
6	Wet silty sandy clay, charcoal E4-6.00		11.8
6.75	Wet silty sandy clay, charcoal E4-6.75		0.5
7.5	Wet sand E4-7.5		9.2
	END OF DRILLING - wet, mixed sample, little on auger		3.7

- fines (clay and silt)
- fine sand
- med sand
- coarse sand
- gravel
- cobbles

*Sample sent to laboratory ▼ Water Table

SOLID AUGER USED. SUNALTA DRILLING

DRILLER'S LOG REPORT

PROJECT:	801-01-367-site 5720	DATE:	17-Sep-02
BOREHOLE:	E5	LOGGED:	Margaret Marra
START TIME:	03:30 PM	END TIME:	04:30 PM

Depth in m	Sample Number	Soil Type	TOTAL ORGANIC HYDROCARBON VAPOUR (ppm)
0			
0.75	Hard clay till	E5-0.75	22.3
1.5	Hard clay till	E5-1.5	
2.25	Silty clay till, charcoals, oxides	E5-2.25	98.0
3	Silty clay till, charcoals, oxides	E5-3.00	
3.75	Silty clay till	E5-3.75	1021
4.5	Wet sand	E5-4.5	2000
5.25	Wet sandy silty clay	E5-5.25	
6	Wet sandy silty clay	E5-6.00	48.7
6.75	Wet sand, silt	E5-6.75	34.9
7.5	Wet sand, silt	E5-7.5	23.9
END OF DRILLING			22.9
			22.9
			16.4

- fines (clay and silt)
- fine sand
- med sand
- coarse sand
- gravel
- cobbles

*Sample sent to laboratory ▼ Water Table

SOLID AUGER USED.

SUNALTA DRILLING

DRILLER'S LOG REPORT

PROJECT.	801-01-367-Site 5720	DATE	17-Sep-02
BOREHOLE.	E6	LOGGED	Margaret Marra
START TIME	06 15 PM	END TIME	06 40 PM

Depth in m	Sample Number	Soil Type	TOTAL ORGANIC HYDROCARBON VAPOUR (ppm)
0			
0.75	Fill		
1.5	Light brown clay till, charcoals		3
2.25	Light brown clay till, charcoals		33
*3	Moist brown clay till		35.6
3.75	Moist brown clay till		43.3
4.5	Moist brown clay till	▼	34.4
5.25	Wet sand		27.4
6	Hard grey clay till, oxides		
END OF DRILLING - wet sample, very little on auger, mixed sample			

- fines (clay and silt)
- fine sand
- med sand
- coarse sand
- gravel
- cobbles

*Sample sent to laboratory ▼ Water Table

SOLID AUGER USED. SUNALTA DRILLING

DRILLER'S LOG REPORT

PROJECT	801-01-367-Site 5720	DATE	17-Sep-02
BOREHOLE	E7	LOGGED	Margaret Marra
START TIME	06:45 PM	END TIME	07:15 PM

Depth in m	Sample Number	Soil Type	TOTAL ORGANIC HYDROCARBON VAPOUR (ppm)
0			
0.75	Fill		
1.5	Light grey clay till, sand lens		
2.25	Clay till, charcoal		22
3	Clay till, charcoal		19.4
3.75	Wet sand	▼	21.8
4.5	Wet sand, grey		19.5
5.25	END OF DRILLING-wet, mixed sample, very little on auger		18.8

- fines (clay and silt)
- fine sand
- med sand
- coarse sand
- gravel
- cobbles

*Sample sent to laboratory ▼ Water Table

SOLID AUGER USED.

SUNALTA DRILLING

DRILLER'S LOG REPORT

PROJECT	801-01-367-Site 5720	DATE:	17-Sep-02
BOREHOLE:	S3	LOGGED:	Margaret Marra
START TIME:	05:45 PM	END TIME	06:10 PM

Depth in m	Sample Number	Soil Type	TOTAL ORGANIC HYDROCARBON VAPOUR (ppm)
0			
0.75	Fill	S3-0.75	32
1.5	Light brown clay till, charcoal	S3-1.5	56.5
2.25	Light brown clay till, charcoal, white	S3-2.25	51
3	Brown clay till, charcoal	S3-3.00	40
3.75	Brown clay till, charcoal	S3-3.75	50.6
4.5	Wet sandy clay till	S3-4.5	50.2
5.25	Wet sand, charcoal	S3-5.25	37.9
END OF DRILLING - wet, mixed sample, very little on auger			

- fines (clay and silt)
- fine sand
- med sand
- coarse sand
- gravel
- cobbles

*Sample sent to laboratory ▼ Water Table

SOLID AUGER USED.

SUNALTA DRILLING

DRILLER'S LOG REPORT

PROJECT:	801-01-367-Site 5720	DATE:	17-Sep-02
BOREHOLE:	W4	LOGGED:	Margaret Marra
START TIME:	05 15 PM	END TIME:	05:40 PM

Depth in m	Sample Number	Soil Type	TOTAL ORGANIC HYDROCARBON VAPOUR (ppm)
0			0
0.75	Fill		0
1.5	Light brown clay till		21.3
2.25	Light brown clay till, whites		22.1
3	Grey and brown silty clay till, charcoal		23.2
3.75	Lt brown clay till, oxide, charcoal, sand lens	▼	25
4.5	Sandy clay, charcoal		30
5.25	Wet sand		35.2
END OF DRILLING - wet, mixed sample, little on auger			

- fines (clay and silt)
- fine sand
- med sand
- coarse sand
- gravel
- cobbles

*Sample sent to laboratory ▼ Water Table

SOLID AUGER USED. SUNALTA DRILLING

PID Readings (ppm) - Alsike (Site 5720)

Sample name	Location & Depth	PID Readings (ppm)	HC Odour
W1-0.75	W1, 0.75m	3.1	none
W1-1.50	W1, 1.50m	6.8	none
W1-2.25	W1, 2.25m	6.5	none
W1-3.00	W1, 3.00m	7.4	none
W1-3.75	W1, 3.75m	4.3	none
W1-4.50	W1, 4.50m	4.0	none
W1-5.25	W1, 5.25m	4.3	none
W1-6.00	W1, 6.00m	5.6	none
W1-6.75	W1, 6.75m	13.7	none
W1-7.50	W1, 7.50m	16.8	none
W2-0.75	W2, 0.75m	1.6	none
W2-1.5	W2, 1.5m	0.0	none
W2-2.25	W2, 2.25m	27.7	none
W2-3.00	W2, 3.00m	3.6	none
W2-3.75	W2, 3.75m	3.4	none
W2-4.50	W2, 4.50m	1.4	none
W2-5.25	W2, 5.25m	4.3	none
W2-6.00	W2, 6.00m	3.6	none
W2-6.75	W2, 6.75m	8.2	none
S1-0.75	S1, 0.75m	645.0	none
S1-1.50	S1, 1.50m	177.0	slight
S1-2.25	S1, 2.25m	333.0	strong
S1-3.00	S1, 3.00m	100.0	very slight
S1-3.75	S1, 3.75m	80.6	very slight
S1-4.50	S1, 4.50	32.8	none
S1-5.25	S1, 5.25m	25.5	none
S2-0.75	S2, 0.75m	22.9	none
S2-1.50	S2, 1.50m	19.0	none
S2-2.25	S2, 2.25m	42.2	none
S2-3.00	S2, 3.00m	24.5	none
S2-3.75	S2, 3.75m	13.3	none
S2-4.50	S2, 4.50m	18.9	none
S2-5.25	S2, 5.25m	23.2	none
S2-6.00	S2, 6.00m	9.1	none
E3-0.75	E3, 0.75m	53.7	none
E3-1.50	E3, 1.50m	255.0	none
E3-2.25	E3, 2.25m	2000.0	strong
E3-3.00	E3, 3.00m	175.0	moderate
E3-3.75	E3, 3.75m	25.1	none
E3-4.50	E3, 4.50m	30.2	none
E3-5.25	E3, 5.25m	58.7	none
E3-6.00	E3, 6.00m	97.1	none
E3-6.75	E3, 6.75m	40.6	none
E3-7.50	E3, 7.50m	20.8	none

Sample name	Location & Depth	PID Readings (ppm)	HC Odour
E4-0.75	E4, 0.75m	3.9	none
E4-1.50	E4, 1.50m	64.0	none
E4-2.25	E4, 2.25m	8.4	none
E4-3.00	E4, 3.00m	21.1	none
E4-3.75	E4, 3.75m	22.7	slight
E4-4.50	E4, 4.50m	16.3	none
E4-5.25	E4, 5.25m	11.8	none
E4-6.00	E4, 6.00m	6.5	none
E4-6.75	E4, 6.75m	9.2	none
E4-7.50	E4, 7.50m	3.7	none
E5-0.75	E5, 0.75m	22.3	none
E5-1.50	E5, 1.50m	98.6	none
E5-2.25	E5, 2.25m	1621.0	strong
E5-3.00	E5, 3.00m	2000.0	strong
E5-3.75	E5, 3.75m	48.7	none
E5-4.50	E5, 4.50m	34.9	none
E5-5.25	E5, 5.25m	23.9	none
E5-6.00	E5, 6.00m	22.9	none
E5-6.75	E5, 6.75m	22.6	none
E5-7.50	E5, 7.50m	16.4	none
W4-0.75	W4, 0.75m	0.0	none
W4-1.5	W4, 1.5m	21.3	none
W4-2.25	W4, 2.25m	22.1	none
W4-3.00	W4, 3.00m	23.2	none
W4-3.75	W4, 3.75m	25.0	none
W4-4.50	W4, 4.50m	30.0	none
W4-5.25	W4, 5.25m	35.2	none
S3-0.75	S3, 0.75m	32.0	slight
S3-1.50	S3, 1.50m	56.5	strong
S3-2.25	S3, 2.25m	51.0	slight
S3-3.00	S3, 3.00m	40.0	none
S3-3.75	S3, 3.75m	59.6	none
S3-4.50	S3, 4.50m	59.2	slight
S3-5.25	S3, 5.25m	37.9	none
E6-0.75	E6, 0.75m	3.0	none
E6-1.50	E6, 1.50m	33.0	none
E6-2.25	E6, 2.25m	35.6	none
E6-3.00	E6, 3.00m	43.3	none
E6-3.75	E6, 3.75m	34.4	none
E6-4.50	E6, 4.50m	27.4	none
E6-5.25	E6, 5.25m	36.3	none
E6-6.00	E6, 6.00m	32.9	none

PID Readings (ppm) - Alsike (Site 5720)

Sample name	Location & Depth	PID Readings (ppm)	HC Odour
E7-0.75	E7, 0.75m	3.0	none
E7-1.50	E7, 1.50m	33.0	none
E7-2.25	E7, 2.25m	35.6	none
E7-3.00	E7, 3.00m	43.3	none
E7-3.75	E7, 3.75m	34.4	none
E7-4.50	E7, 4.50m	27.4	none