



A TETRA TECH COMPANY

May 23, 2012

ISSUED FOR USE
EBA FILE: L22101490

Village of Barons
P.O. Box 129
Barons AB T0L 0G0

Attention: Ms. Laurie Beck
Town Administrator

Subject: Risk Management Plan
Alberta Municipal Affairs Site 9557
202 Main Street
Barons, Alberta

1.0 INTRODUCTION

EBA Engineering Consultants Ltd. operating as EBA, A Tetra Tech Company (EBA), was retained by Ms. Laurie Beck, of the Village of Barons (Barons), to prepare a Risk Management Plan (RMP) for the property at 202 Main Street (legally described as Lot 1 and Lot 2, Block 7, Plan 2605X), in Barons, Alberta (Figure 1). The Alberta Municipal Affairs (AMA) number for the site is 9557.

This RMP is based on information collected during site investigations conducted by EBA and provides information relevant to the management of the environmental risks identified. Further information regarding other aspects of work to date can be found in the documents referenced in this report.

The objectives of the RMP are:

- To characterize the potential risk for adverse human health and ecological affects due to exposure to the affected soils and groundwater at the site.
- To evaluate mitigative options available to manage the risk of adverse effects by controlling the exposure routes.

2.0 BACKGROUND AND SITE DESCRIPTION

2.1 Site Description

The site is a rectangular-shaped property, approximately 950 m² in area, located on the southeast quarter of Section 16, Township 012, Range 23, West of the Forth Meridian at 202 Main Street in Barons, Alberta. A rectangular-shaped building, approximately 380 m², owned by Barons is present on the site. It is currently used as the Village of Barons maintenance building and wash bay (Village Public Works Building). The building's foundation is a slab-on-grade. Historically, the site operated as a gas service station (Tjostheim Transport Ltd.).

The site location is provided on Figure 1 (attached) and a site plan with monitoring well locations provided on Figure 2 (attached).

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2.2 Past Reports Summary

EBA conducted the Phase II and initial Phase III environmental site assessments (ESAs) in 2008 and 2009. The methods and results of the assessments are provided in the *Phase II and Phase III Environmental Site Assessment, 202 Main Street, Lot 1 and Lot 2, Block 7, Plan 2605X, Barons, Alberta* report, issued in October 2009 (EBA 2009).

The Phase II and initial Phase III ESAs followed a geotechnical evaluation for roadway improvement and waterline upgrade along Main Street from Railway Avenue to Prairie Avenue (EBA 2007). The geotechnical evaluation identified petroleum hydrocarbons (PHCs) within soil and groundwater to the north of the site. The detection of the PHCs triggered a land use history assessment that determined the site was previously operated as a gas service station (Tjostheim Transport Ltd.). According to the Petroleum Tank Management Association of Alberta (PTMAA), two underground storage tanks (USTs) were likely abandoned on site and signs of leakage were noted during site closure.

In December 2011, EBA conducted an additional Phase III ESA, *Additional Phase III Environmental Site Assessment, 202 Main Street, Lot 1 and Lot 2, Block 7, Plan 2605X, Barons, Alberta*, issued in December 2011 (EBA 2011). The objectives of the additional Phase III ESA were:

- To further evaluate the extent of the PHC impacts to the east and south-southeast of the former pump islands.
- To assess subsurface distribution (potential source areas) and potential migrations of PHC compounds beneath the site.

The 2009 and 2011 Phase II and Phase III ESAs identified the following soil and groundwater conditions:

- PHC impacts extended beyond the site boundary to the north and west.
- PHC impacts were encountered within soil samples collected at depths between 1.2 m below ground level (mbgl) and 4.8 mbgl during the 2009 assessment and between 2.4 mbgl and 4.8 mbgl during the 2011 assessment (towards the east and south-southeast of the former pump islands).
- During the 2009 and 2011 assessments, the bedrock appears to be restricting the vertical migration of the impacts because the PHCs were not identified below 4.8 mbgl in any of the soil samples obtained from wells drilled on site.
- In 2011, the deep groundwater in the bedrock was not impacted by the hydrocarbons discovered in the shallow groundwater.
- Distribution of PHC compounds near the monitoring locations 08MW02, 09BH17, and 09BH20 suggest that these are potential source areas.
- The shallow impacted saturated soils and bedrock may yield sufficient water for domestic use; therefore, the protection of drinking water pathway guidelines for benzene, toluene, ethylbenzene, and xylene (BTEX) and the protection of direct soil contact by ecological organisms pathway (most stringent pathway) for PHC fractions F1 to F4 are considered to be the applicable guidelines for the soil and groundwater remediation.

- Insufficient data exists to determine the dominant migration process (advective or dispersive). The uneven recharge rate through infiltration on paved and unpaved areas and the disturbed groundwater flow regime due to presence of utility corridor's along the main street (up-gradient of the site) may have caused seasonal changes in the groundwater flow direction's resulting in an uneven dispersion of the dissolved hydrocarbons.
- No remediation activities were reported following the closure of the service station.

Further details of the findings can be found in the referenced reports.

2.3 Data Evaluation

AENV's Tier 1 and Tier 2 Remediation Guidelines were applied to assist in determining the quality of soil and groundwater analyzed during the ESA.

To apply these guidelines, the background information summarized in Sections 2.1 and 2.2 were used to assess the land use and sensitivity of the site.

The site is located within an area of commercial buildings, residential dwellings, and parkland. The most sensitive land use within 30 m of the site is residential.

The chemicals of potential concern associated with PHCs include the monocyclic aromatic hydrocarbons (BTEX) and the aliphatic hydrocarbons F1 (C₆ to C₁₀ hydrocarbon chain), F2 (C₁₁ to C₁₆ hydrocarbon chain), F3 (C₁₇ to C₂₄ hydrocarbon chain), and F4 (longer than C₂₅ hydrocarbon chains). Concentrations in soil detected in 2011 are discussed in Section 3.1.1.

Drilling investigations determined the soil materials generally consisted of asphalt and/or clay fill from surface grade to approximately 0.7 mbgl, clay (lacustrine) with intermittent silt/sand lenses from 0.7 mbgl to 4.0 mbgl, and weathered sandstone (bedrock) from 4.0 mbgl to the maximum depth of investigation of 15.2 mbgl (EBA 2009).

During the 2011 drilling investigations at 11MW01 to 11MW03, the stratigraphy observed generally consisted of clay fill from surface grade to approximately 0.5 mbgl, clay (lacustrine) with intermittent silt/sand lenses between 0.5 mbgl and 3.8 mbgl, and weathered bedrock (sandstone, siltstone, and mudstone) between 3.8 mbgl and the maximum depth of investigation of 10.4 mbgl. The laboratory results of core samples collected from the bedrock describe soils as clay, silty, sandy (11MW01 and 11MW02), and shale to clay (11MW03).

In 2009, with the exception of the sample collected from 08MW01 (4.8 mbgl), which was coarse-grained, soil samples submitted for Particle Size Analysis (PSA) were determined to be fine-grained material (EBA 2009). In 2011, the samples collected from 11MW01 and 11MW03 were determined to be coarse-grained and samples collected from 11MW02 as fine-grained.

On March 14 and 15, 2011, EBA measured the organic vapour emission (OVE) concentrations and groundwater levels within all accessible monitoring locations. Monitoring wells 08MW06, 08MW07, and 09MW13 were not accessible during the site visit because the flush-mount monitoring wells were under standing water. OVE concentrations ranged between 10 parts per million (ppm) (09MW10) and 950 ppm (08MW08). Groundwater was encountered at depths ranging between 1.7 mbgl (08MW01) to 2.3 mbgl

(08MW02 and 09MW10). During the March 2009 monitoring event, approximately 8.5 cm of liquid PHCs were noted within 08MW06 (EBA 2009). This well was not accessible during the 2011 monitoring event.

Under the residential land use scenario for fine-grained soils, the Tier 1 Guidelines for aromatic hydrocarbons include the exposure pathway for the protection of drinking water. However, for the F1 to F4 hydrocarbons, the Tier 1 Guideline is based on the protection of ecological receptors and that is the pathway for direct soil contact by ecological organisms.

2.4 Geology and Hydrogeology

The surficial geology in the Barons area is characterized as a glaciolacustrine deposit, with clay, silt, and sand forming the dominant material types (Shetson 1981). Bedrock in the area consists of sandstone and shale strata from the St. Mary River Formation of late Cretaceous age.

Several ephemeral wetlands are located near the Village of Barons municipal boundaries; however, all identified wetlands are greater than 300 m from the site. Two water reservoirs are located approximately 420 m southwest of the site; however, they are no longer being used, and according to Ms. Beck, will be reclaimed in the near future. The nearest surface waterbody of significance is Keho Lake, located approximately 5.25 km southeast of the site.

Based on hydrogeological maps for the area, it is anticipated that shallow and regional groundwater flow would generally be southeast towards Keho Lake (Tokarsky 1974).

2.4.1 Land Use

According to Barons, the site is zoned Direct Control (DC). Within 30 m or less of the site the surrounding land is used for Residential (R1), Commercial (C1), and Direct Control (DC). The current use of the property is commercial. Based on the surrounding receptors and potential exposure pathways, a residential/parkland land use is appropriate for the site.

2.4.2 Groundwater Use

Provincial water well records (AENV 2008) indicate there are three registered water wells within approximately 300 m of the site. The information gathered for these registered water wells is tabulated below.

Water Wells within 300 m of the Site

Well ID No.	Location	Approximate Distance and Direction from Site	Approximate Depth	Year Installed	Owner
0194222	SE ¼ 16-012-23 W4M	75 m northeast	29 m	1958	Unknown
0194216	SE ¼ 16-012-23 W4M	300 m south	29 m	1971	AENV No. 0613E
2058577	SE ¼ 16-012-23 W4M	Not Verified	20 m	1971	AENV No. 0611E

According to Ms. Beck, Barons began importing its potable water from the Village of Nobleford in April 2008. The potable water is piped to Barons via Nobleford's water treatment plant.

2.4.3 Groundwater Flow Direction

Hydraulic conductivity tests conducted in 2009 within 08MW01 (3×10^{-6} m/s), 08MW02 (3×10^{-7} m/s), and 08MW06 (1×10^{-6} m/s) provide geometric mean value for the hydraulic conductivity of 5×10^{-6} m/s.

An average vertical hydraulic conductivity of the core samples collected from bedrock in 2011 is 1.5×10^{-10} m/s. The laboratory estimated values represent the vertical component of the hydraulic conductivity, which is one or two orders of magnitude less than the horizontal hydraulic conductivity. The horizontal hydraulic conductivity was determined by the monitoring well response tests.

The hydraulic parameters of the core samples analyzed are summarized in the following table.

Hydraulic Parameters of the Core Samples Analyzed, March 2011

Borehole Location	Depth Interval (mbgl)	Vertical hydraulic Conductivity (m/s)	Porosity	Dry Density (kg/m ³)	Moisture Content (%)	
					Initial	Final
11MW01	5.5 to 5.9	8.2×10^{-9}	20	2,110	11.4	13.3
11MW02	6.7 to 7.0	2.7×10^{-8}	20	2,018	12.1	12.5
11MW03	8.2 to 8.5	9.5×10^{-9}	22	2,041	10.6	12.6

A representative shallow groundwater flow direction could not be established from the 2008 and 2009 monitoring wells as insufficient data was available. The groundwater elevations available were widespread and do not follow any noticeable pattern. However, the previous groundwater monitoring results showed that the groundwater table is relatively flat with a slight hydraulic gradient to the south (EBA 2009).

Based on the measured groundwater elevations at the newly installed deep monitoring wells (11MW01 to 11MW03), the groundwater flow direction in the bedrock is inferred to be south-southeast (EBA 2011).

3.0 RISK CHARACTERIZATION

Risk characterization is used to identify a chemical of concern, a receptor that risks being in contact with the chemical, and a media pathway to link the chemical with the receptor. Risk of an adverse impact to human health and ecological receptors is identified by the linkages between the source areas, migration pathways, and receptors as described in Sections 3.1 to 3.3.

3.1 Source Areas of Environmental Impairment

EBA identified one area of environmental concern at the site based on the results of previous site investigations.

- The USTs previously utilized on site during the operation of the former service station.

3.1.1 Soil Quality

The historical soil analytical results discussed in EBA's 2009 report are summarized in Table 1 (attached).

Indications of PHC staining and/or odours were noted during the drilling investigation at all three borehole locations; however, the vertical extent of the PHC indicators varied between borehole locations (attached as Appendix A).

Three soil samples from each borehole were submitted for chemical analysis. Ethylbenzene (5.5 mg/kg) and xylenes (16 mg/kg) at 2.4 m depth (11MW01), and hydrocarbon fraction F2 (1700 mg/kg) at 4.8 m depth (11MW03) were greater than the applicable guidelines (see attached Table 1). All of the remaining samples exhibited hydrocarbon parameter concentrations less than the applicable guidelines.

The bedrock at 4.8 mbgl appears to be restricting the vertical migration of PHCs, as PHCs were not identified in any of the wells drilled in 2011.

Selected samples were submitted to EBA's geotechnical laboratory in Calgary for the analysis of soil permeability, porosity, bulk density, and water content. The laboratory results of the core samples are also provided in Table 2 (attached).

3.1.2 Groundwater Quality

The historical groundwater analytical results in EBA's 2009 report are summarized in Table 2 (attached).

Three groundwater samples, plus one duplicate from Monitoring Well 11MW03 were submitted for chemical analysis of BTEX, PHC fractions F1 and F2. All of the samples analyzed had hydrocarbon concentrations less than the analytical detection limits (see attached Table 3).

3.1.3 Air Monitoring

Air monitoring has not been performed on site as part of EBA's past investigations.

3.2 Migration Pathways

All exposure pathways presented in the Alberta Tier 1 Guidelines for residential/parkland land use are considered for this site.

3.3 Potential Receptors

The final factor in the source-pathway-receptor framework is the receptor. If no receptor is available to come into contact with the affected soil or groundwater there is no potential for adverse health or ecological affects. Therefore, no risk can be characterized. This section outlines potential receptors at the site and exposure pathway(s) to identified sources (EBA 2011).

3.3.1 Human and Ecological Risks

Potential ecological receptors (and exposure pathways) include the following:

- Plants, through root uptake.
- Potable water, through groundwater migration.
- Vapour inhalation.

Hydrocarbon impacted soil remains within the location of the historical USTs (EBA 2011). As determined, a sample of PHC Fraction F1 impacted soil is situated approximately 4.8 mbgl. Impacted soils are not situated on or near the surface (within 3 m of the surface). The site is vegetated and contains an enclosed structure with a concrete pad foundation, which reduces surface runoff.

Testing of groundwater beneath the site yielded a geometric mean value for the maximum hydraulic conductivity value of 1×10^{-6} m/s with an aquifer thickness greater than 2.5 m (EBA 2009). These values were obtained from the wells completed within the impacted zone in the surficial till material and upper impacted bedrock material. These estimated hydraulic conductivity values are at the margin of values identified by Alberta Environment and Water (AEW) as representing a domestic use aquifer. This suggests that the saturated soils might yield sufficient water for domestic use. Therefore, the pathway for protection of drinking water cannot be excluded.

3.3.2 Assessment of Environmental Risk

The environmental risk from residual hydrocarbon impact to local receptors is considered low based on current site conditions. However, the need to ensure that site management is consistent with assumptions built into the risk assessment will require the use of exposure control.

4.0 MITIGATIVE OPTIONS (RISK MANAGEMENT PLAN)

The primary source of the hydrocarbon impact has not been removed to date and residential soil and groundwater PHC impacts remain.

The first stage of the RMP is to remove the source soils. The two USTs may be present on site as there is no documented proof of their removal. Approximately 400 m³ should be excavated and removed from the site. These soils can be land farmed until they meet specific criteria or can be landfilled.

Following removal of the source soils, five existing monitoring wells should be monitored (08MW02, 08MW07, 09MW10, 09MW13, and 09MW19, identified in the attached Figure 3). Monitoring activities should include, purging and sampling for BTEX, PHC fractions F1 to F2, manganese, iron, nitrate/nitrite, and sulphate. These wells should be sampled bi-annually (spring/fall) until the concentrations decrease below the selected guidelines. These five wells will be termed the compliance monitoring wells.

Following source soil removal, it is anticipated that the concentrations of previously identified chemicals in the groundwater will decrease with time due to natural attenuation. A summary report and RMP evaluation will be provided annually.

In situ natural biodegradation should occur over time and reduce concentrations of BTEX and PHCs in soil and groundwater. Hydrocarbons present at the site are considered readily degradable. However, more complex molecular structures, which are generally resistant to biodegradation, may be present on the site. Further evaluation to determine the effectiveness of natural processes to remediate the groundwater is required in the form of a contingency plan, outlined below. The contingency plan will be updated as necessary based on the monitoring results from the proposed RMP.

Contingency Plan

Potential Occurrence	Precautions	Responses	
		Action	Time Frame
PHC and BTEX fractions in soil increase relative to 2009 concentrations.	Monitor groundwater chemistry and field parameters annually (including alkalinity, dissolved iron, and manganese, nitrate/nitrite, sulphate, and total organic carbon) to ensure contamination is not transporting into groundwater.	Confirm analytical results and move from natural attenuation to active bioremediation.	Immediately, with discussion with Barons.
Free-phase Liquid Hydrocarbons are present in the compliance monitoring wells.	As determined by the interface probe, these compliance wells can no longer be sampled until the free-phase liquid is removed.	Install a passive skimmer in the wells that have free-phase product. Revise a monitoring plan. If the free-phase product continues to increase a more active method or capture may be required.	Immediately, with discussion with Barons.
Volatile organic compounds (VOCs) (i.e., BTEX) vapours migrate to the surface.	Surface vapour concentrations are greater than the acceptable limits.	Implement an active remediation process for the elevated vapours.	Immediately, with discussion with Barons.

If further action is required for groundwater applications, in situ bioremediation approaches that may be considered include biosparging with air or oxygen, introduction of oxygen releasing compounds, liquid delivery of nutrients, and/or electron acceptors.

5.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Village of Barons and their agents. EBA Engineering Consultants Ltd., does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the letter report when the report is used or relied upon by any party other than the Village of Barons, or for any project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in EBA's Services Agreement. EBA's General Conditions are provided in Appendix B (attached) of this report.

6.0 CLOSURE

We trust this letter report meets your present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

Sincerely,
EBA Engineering Consultants Ltd.



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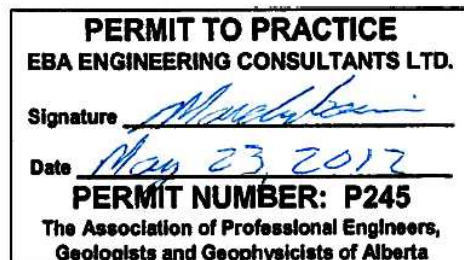
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Attachments Figure 1 - Site Location Plan
 Figure 2 - Detailed Site Plan with Monitoring Well Locations
 Figure 3 - Proposed RMP Source Removal and Compliance Wells
 Table 1 - Soil Analytical Results
 Table 2 - Groundwater Analytical Results
 Table 3 - Groundwater Analytical Results - AMA Site 9557
 Appendix A - Borehole Logs and Water Well Database Summary
 Appendix B - Geo-environmental Report - General Conditions



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REFERENCES

- Adams, J.D. et al. February 2006. Evaluating In Situ Bioremediation for Groundwater Cleanup. CEP Magazine.
- Alberta Geologic Survey. 1971. Geological Map of Alberta. Alberta Research Council, Natural Resources Division.
- Alberta Environment. December 2010. Alberta Tier 2 Soil and Groundwater Remediation Guidelines.
- EBA Engineering Consultants Ltd. October 2009. Phase II and Phase III Environmental Site Assessment, 202 Main Street, Lot 1 and Lot 2, Block 7, Plan 2605X, AMA Site 9557, Barons, Alberta. EBA File: L22101182.001.
- EBA Engineering Consultants Ltd. December 2011. Additional Phase III Environmental Site Assessment, 202 Main Street, Lot 1 and Lot 2, Block 7, Plan 2605X, AMA Site 9557, Barons, Alberta. EBA File: L22101182.002.

FIGURES

- | | |
|----------|---|
| Figure 1 | Site Location Plan |
| Figure 2 | Detailed Site Plan with Monitoring Well Locations |
| Figure 3 | Proposed RMP Source Removal and Compliance Wells |



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**RISK MANAGEMENT PLAN
202 MAIN STREET, BARONS, ALBERTA
AMA SITE 9557**

SITE LOCATION PLAN

NOTE
NOT TO SCALE

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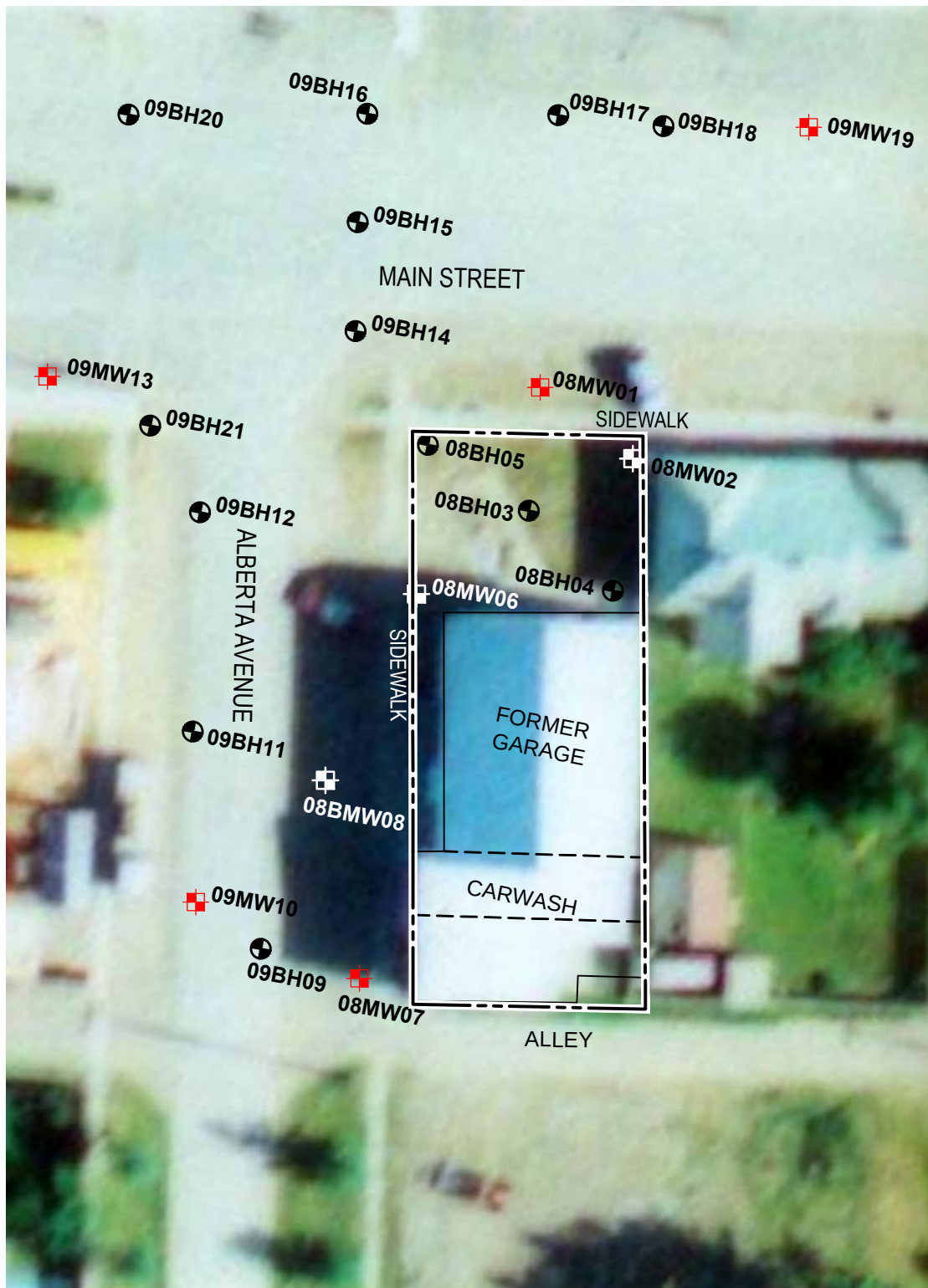
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EBA-Lethbridge

DATE
May 2012

Figure 1



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- SITE BOUNDARY
- 08BH# BOREHOLE LOCATION
- 08MW# MONITORING WELL

0 8 20m

APPROXIMATE SCALE 1:400

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RISK MANAGEMENT PLAN
202 MAIN STREET, BARONS, ALBERTA
AMA SITE 9557

DETAILED SITE PLAN WITH MONITORING WELL LOCATIONS

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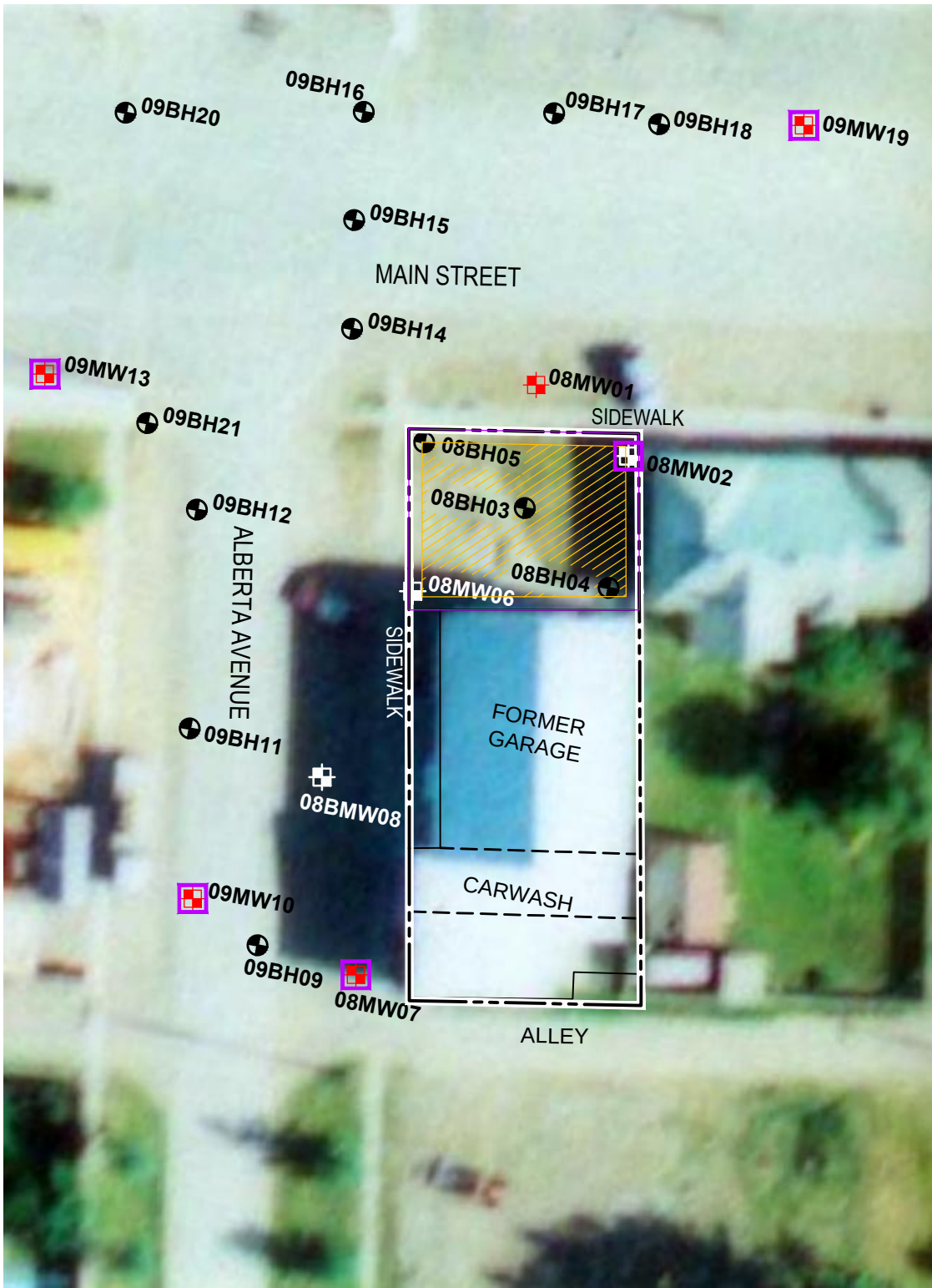
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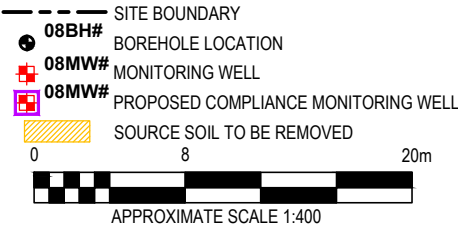
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Figure 2



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Village of Barons



RISK MANAGEMENT PLAN
202 MAIN STREET, BARONS, ALBERTA
AMA SITE 9557

PROPOSED RMP SOURCE
REMOVAL AND COMPLIANCE WELLS

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Figure 3

TABLES

Table 1	Soil Analytical Results
Table 2	Monitoring Well Completion Details and Field Monitoring Results
Table 3	Groundwater Analytical Results

Table 1: Soil Analytical Results – AMA Site 9557

Parameters	Detection Limits	Units	Protection of Domestic Use Aquifer		Ecological Direct Soil Contact	17-Nov-08																				
						08MW01			08MW02			08BH03			08BH04			08BH05			08MW06			08MW07		
			< 3.0 mbgl	> 3.0 mbgl		1.5 m	4.2 m	4.8 m	1.6 m	2.2 m	4.2 m	1.2 m	1.8 m*	4.8 m	1.9 m	3.0 m	5.4 m	1.8 m	2.4 m	4.8 m	1.6 m	2.4 m	5.4 m	3.0 m	4.2 m	6.0 m
Petroleum Hydrocarbons																										
Benzene	0.02	mg/kg	0.046	0.046	120	nd	6.3	nd	nd	3.2	nd	0.15	54	nd	nd	19	nd	nd	1.1	nd	nd	2	nd	nd	nd	nd
Toluene	0.01	mg/kg	0.52	0.52	220	nd	nd	nd	nd	nd	0.11	6.4	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
Ethylbenzene	0.04	mg/kg	0.11	0.11	240	nd	13	0.092	nd	41	nd	0.21	310	nd	nd	36	nd	nd	6.3	nd	nd	21	nd	nd	nd	nd
Xylenes	0.04	mg/kg	15	15	130	nd	16	0.16	nd	50	nd	1	1,500	nd	0.24	50	nd	nd	8	nd	nd	31	nd	nd	nd	nd
F1 (C6 to C10)	12	mg/kg	210	1,100	420	nd	710	nd	nd	1,000	nd	nd	5,300	nd	nd	1,300	nd	nd	140	nd	nd	280	nd	nd	nd	nd
F2 (C10 to C16)	10	mg/kg	150	1,500	300	nd	4,700	250	nd	310	23	nd	3,500	nd	nd	4,200	nd	nd	2,000	nd	nd	1,300	nd	nd	nd	nd
F3 (C16 to C34)	10	mg/kg	ng	ng	2,600	nd	2,100	140	nd	nd	21	360	9,400	nd	nd	1,700	nd	nd	1,000	nd	nd	510	nd	nd	nd	nd
F4 (C34 to C50)	10	mg/kg	ng	ng	11,200	nd	23	nd	nd	nd	nd	100	1,500	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
Metals																										
Lead (Pb)	1	mg/kg	ng	ng	300	9	8	6	8	13	5	46	67	7	21	17	7	6	16	9	9	14	8	9	9	8
Physical Properties																										
Soil Moisture Content	0.3	%	ng	ng	ng	22	14	5.3	20	26	6.1	16	24	14	20	20	19	17	23	12	24	23	11	24	14	10
<75 um Sieve	0.2	%	ng	ng	ng	94	nt	49	nt	nt	nt	nt	nt	nt	nt	73	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
>75 um Sieve	0.2	%	ng	ng	ng	6	nt	51	nt	nt	nt	nt	nt	nt	nt	27	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
CCME Class	0.2		ng	ng	ng	FINE	nt	COARSE	nt	nt	nt	nt	nt	nt	nt	FINE	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt

Parameters	Detection Limits	Units	Protection of Domestic Use Aquifer		Ecological Direct Soil Contact	12-Mar-09											
						09BH09		09BH11	09BH12		09MW13	09BH17		09MW19		09BH20	
			< 3.0 mbgl	> 3.0 mbgl		5.4 m	6.0 m	4.2 m	2.4 m	3.0 m	4.8 m	3.0 m	4.2 m	4.8 m	5.4 m	3.0 m	3.6 m
Petroleum Hydrocarbons																	
Benzene	0.02	mg/kg	0.046	0.046	120	nd	nd	0.023	0.016	1.5	0.054	0.97	0.036	0.02	0.018	9.7	0.53
Toluene	0.01	mg/kg	0.52	0.52	220	nd	nd	nd	nd	<0.020	nd	nd	nd	nd	nd	0.06	0.1
Ethylbenzene	0.04	mg/kg	0.11	0.11	240	d	d	0.028	d	12	0.057	19	0.051	nd	nd	21	0.2
Xylenes	0.04	mg/kg	15	15	130	nd	nd	0.11	nd	18	0.069	29	0.066	nd	nd	36	0.7
F1 (C ₆ to C ₁₀)	12	mg/kg	210	1,100	420	nd	nd	nd	nd	410	nd	580	nd	nd	nd	430	nd
F2 (C ₁₀ to C ₁₆)	10	mg/kg	150	1,500	300	13	11	nd	nd	180	69	1400	nd	nd	nd	660	nd
F3 (C ₁₆ to C ₃₄)	10	mg/kg	ng	ng	2,600	nd	nd	nd	d	24	nd	520	nd	nd	nd	230	nd
F4 (C ₃₄ to C ₅₀)	10	mg/kg	ng	ng	11,200	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Metals																	
Lead (Pb)	1	mg/kg	ng	ng	300	10	8	7	9	13	4	13	7	8	8	12	7
Physical Properties																	
Soil Moisture Content	0.3	%	ng	ng	ng	18	19	14	18	23	17	21	15	18	17	19	13
<75 um Sieve	0.2	%	ng	ng	ng	nt	51	nt	89	nt	71	90	nt	nt	52	nt	nt
>75 um Sieve	0.2	%	ng	ng	ng	0.2	49	nt	11	nt	29	10	nt	nt	48	nt	nt
CCME Class	0.2		ng	ng	ng	nt	FINE	nt	FINE	nt	FINE	FINE	nt	nt	FINE	nt	nt

Parameters	Detection Limits	Units	Protection of Domestic Use Aquifer		Ecological Direct Soil Contact	15-Mar-11								
						11MW01			11MW02			11MW03		
			< 3.0 mbgl	> 3.0 mbgl		1.8 m	2.4 m	4.2 m	1.6 m	2.2 m	6.0 m	3.6 m	4.8 m	5.4 m
Petroleum Hydrocarbons														
Benzene	0.02	mg/kg	0.046	0.046	120	nd	nd	nd	nd	nd	nd	nd	nd	nd
Toluene	0.01	mg/kg	0.52	0.52	220	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ethylbenzene	0.04	mg/kg	0.11	0.11	240	0.059	5.5	0.062	nd	nd	nd	nd	nd	nd
Xylenes	0.04	mg/kg	15	15	130	0.14	16	nd	nd	nd	nd	nd	nd	nd
F1 (C ₆ to C ₁₀)	12	mg/kg	210	1,100	420	nd	150	nd	nd	nd	nd	nd	260	nd
F2 (C ₁₀ to C ₁₆)	10	mg/kg	150	1,500	300	nd	21	nd	nd	nd	230	nd	1,700	nd
F3 (C ₁₆ to C ₃₄)	10	mg/kg	ng	ng	2,600	nd	nd	nd	nd	nd	110	nd	800	nd
F4 (C ₃₄ to C ₅₀)	10	mg/kg	ng	ng	11,200	nd	nd	nd	nd	nd	nd	nd	nd	nd
Physical Properties														
Soil Moisture Content	0.3	%	ng	ng	ng	22	13	15	15	16	10	13	15	12
<75 um Sieve	0.2	%	ng	ng	ng	nt	nt	48	nt	nt	60	nt	nt	41
>75 um Sieve	0.2	%	ng	ng	ng	nt	nt	52	nt	nt	40	nt	nt	59
CCME Class	0.2		ng	ng	ng		nt	Coarse	nt	nt	Fine	nt	nt	Coarse

Notes:
¹ Alberta Environment. December 2010. Alberta Tier 1 Soil Remediation Guideline Values for Soil and Groundwater for Residential Land Use for Fine-Grained Soils.
* Detection limits increased by one significant figure due to dilution of sample.
nt - Parameter not analyzed.
nd - Less than analytical detection limits.
ng - No guidelines established.
Bold and Underlined Greater than the referenced guideline.

Table 2: Monitoring Well Completion Details and Field Monitoring Results – AMA Site 9557

Monitoring Well Identifier	Date of Installation	TOC Elevation ¹ (m)	Monitoring Well Depth (mBTOC) ²	Screen Interval (mbg) ³	Screened In	Free Product (mBTOC)	Depth to Groundwater (mBTOC)	Groundwater Elevation (m)	Organic Vapour Emissions ⁴	Free Product (mBTOC)	Depth to Groundwater (mBTOC)	Groundwater Elevation (m)	Organic Vapour Emissions ⁴
						26-Mar-09				31-Mar-11			
08MW01	17-Nov-08	99.22	4.62	1.5 to 4.5	Clay and bedrock	nd	2.83	96.39	2% LEL	nd	1.70	97.52	130 ppm
08MW02	17-Nov-08	99.33	5.25	2.2 to 5.2	Clay and bedrock	nd	2.90	96.43	390 ppm	nd	2.32	97.01	400 ppm
08MW06	17-Nov-08	99.17	5.81	1.5 to 6.1	Clay and bedrock	2.77	2.86	96.32	20% LEL	Flush mount well under water			
08MW07	17-Nov-08	99.13	4.90	1.5 to 6.1	Clay and bedrock	nd	2.74	96.39	190 ppm	Flush mount well under water			
08MW08	19-Nov-08	99.15	14.30	10.5 to 15.2	Bedrock	nd	2.55	96.60	50 ppm	nd	1.87	97.28	950 ppm
09MW10	12-Mar-09	99.29	6.10	3.1 to 6.1	Clay and bedrock	nd	2.91	96.38	50 ppm	nd	2.33	96.96	10 ppm
09MW13	12-Mar-09	98.86	6.10	3.1 to 6.1	Clay and bedrock	nd	2.50	96.36	2% LEL	Flush mount well under water			
09MW19	12-Mar-09	99.38	6.10	3.1 to 6.1	Clay and bedrock	nd	3.00	96.38	150 ppm	nd	0.00	99.38	10 ppm
												0.00	
												0.00	
11MW01	15-Mar-11	99.22	9.690	8.2 - 9.7	Bedrock					nd	1.990	97.23	5 ppm
11MW02	15-Mar-11	99.24	10.030	8.5 - 10.0	Bedrock					nd	2.010	97.23	10 ppm
11MW03	15-Mar-11	99.16	9.400	7.9 - 9.4	Bedrock					nd	2.120	97.04	15 ppm

Notes:

Benchmark: Top bolt of fire hydrant located on the northwest corner of Main Street and Alberta Avenue.

¹ Elevation of top of plastic casing.

² Meters below top of plastic casing.

³ Meters below grade.

⁴ Organic vapour emissions recorded using a Gastech 1238 ME™ calibrated to hexane and operated in methane elimination mode.

nd - Not detected.

ppm - Parts per million.

%LEL - Percentage of the lower explosive limit.

Table 3: Groundwater Analytical Results – AMA Site 9557

Parameter	Detection Limits	Units	AENV Tier ¹	28-Nov-08					26-Mar-09				31-Mar-11			
				08MW01	08MW02	08MW06	08MW07	08MW08	09MW10	09DUP02*	09MW13	09MW19	11MW01	11MW02	11MW03	11MW03 Duplicate
Petroleum Hydrocarbons																
Benzene	0.0009	mg/L	0.005	<u>5.5</u>	<u>1.6</u>	<u>1.2</u>	<u>0.056</u>	nd	<u>0.13</u>	<u>0.13</u>	<u>0.7</u>	<u>0.23</u>	nd	nd	nd	nd
Toluene	0.0009	mg/L	0.024	0.0005	0.0017	0.0022	nd	nd	0.0007	0.0007	0.0013	0.0007	nd	nd	nd	nd
Ethylbenzene	0.0009	mg/L	0.0024	<u>0.47</u>	<u>0.4</u>	<u>0.35</u>	nd	nd	0.0004	0.0006	<u>0.28</u>	nd	nd	nd	nd	nd
Xylenes	0.002	mg/L	0.3	<u>0.5</u>	<u>0.5</u>	<u>0.52</u>	0.014	nd	0.027	0.028	<u>0.37</u>	0.0017	nd	nd	nd	nd
F1 (C ₆ to C ₁₀)	0.2	mg/L	2.2	nd	1	2	0.5	nd	0.3	0.2	<u>3.9</u>	nd	nd	nd	nd	nd
F2 (C ₁₀ to C ₁₆)	0.1	mg/L	1.1	<u>6.4</u>	<u>8.2</u>	<u>31.9</u>	0.7	nd	0.2	0.2	<u>28.4</u>	nd	nd	nd	nd	nd
Metals																
Lead (Pb)	1	mg/L	0.01	0.0059	nd	nd	0.0002	nd	nd	nd	nd	nd				

Notes:

¹ Alberta Environment. December 2010. Alberta Tier 1 Soil and Groundwater Remediation Guidelines for Fine-Grained Soils on Residential Land Use.

nt - Parameter not analyzed.

nd - Below analytical detection limits.

ng - No guidelines established.

Bold and Underlined Greater than the referenced guideline.

*09DUP02 - Duplicate sample of 09MW10.

APPENDIX A

BOREHOLE LOGS AND WATER WELL DATABASE SUMMARY

TERMS USED ON BOREHOLE LOGS

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on 0.075mm sieve): Includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as inferred from laboratory or in situ tests.

DESCRIPTIVE TERM	RELATIVE DENSITY	N (blows per 0.3m)
Very Loose	0 TO 20%	0 to 4
Loose	20 TO 40%	4 to 10
Compact	40 TO 75%	10 to 30
Dense	75 TO 90%	30 to 50
Very Dense	90 TO 100%	greater than 50

The number of blows, N, on a 51mm O.D. split spoon sampler of a 63.5kg weight falling 0.76m, required to drive the sampler a distance of 0.3m from 0.15m to 0.45m.

FINE GRAINED SOILS (major portion passing 0.075mm sieve): Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as estimated from laboratory or in situ tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH (KPA)
Very Soft	Less than 25
Soft	25 to 50
Firm	50 to 100
Stiff	100 to 200
Very Stiff	200 to 400
Hard	Greater than 400

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil.

GENERAL DESCRIPTIVE TERMS

Slickensided - having inclined planes of weakness that are slick and glossy in appearance.

Fissured - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.

Laminated - composed of thin layers of varying colour and texture.

Interbedded - composed of alternate layers of different soil types.

Calcareous - containing appreciable quantities of calcium carbonate.;

Well graded - having wide range in grain sizes and substantial amounts of intermediate particle sizes.

Poorly graded - predominantly of one grain size, or having a range of sizes with some intermediate size missing.

MODIFIED UNIFIED SOIL CLASSIFICATION

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA				
COARSE-GRAINED SOILS More than 50% retained on 75 µm sieve*	GRAVELS 50% or more of coarse fraction retained on 4.75 mm sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	GW, GP, SW, SP GM, GC, SM, SC Borderline Classification requiring use of dual symbols	$C_u = D_{60}/D_{10}$ Greater than 4			
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines		$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3			
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures		Not meeting both criteria for GW			
			GC	Clayey gravels, gravel-sand-clay mixtures					
	SANDS More than 50% of coarse fraction passes 4.75 mm sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines		Classification on basis of percentage of fines Less than 5% Pass 75 µm sieve More than 12% Pass 75 µm sieve 5% to 12% Pass 75 µm sieve	Atterberg limits plot below "A" line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols	
			SP	Poorly graded sands and gravelly sands, little or no fines			Atterberg limits plot above "A" line or plasticity index greater than 7		
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures			$C_u = D_{60}/D_{10}$ Greater than 6		
			SC	Clayey sands, sand-clay mixtures			$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	Not meeting both criteria for SW	
							Atterberg limits plot below "A" line or plasticity index less than 4		Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
							Atterberg limits plot above "A" line or plasticity index greater than 7		
FINE-GRAINED SOILS (by behavior) 50% or more passes 75 µm sieve*	SILTS	Liquid limit	<50	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands of slight plasticity	For classification of fine-grained soils and fine fraction of coarse-grained soils. PLASTICITY CHART *Based on the material passing the 75 mm sieve Reference: ASTM Designation D2487, for identification procedure see D2488. USC as modified by PFRA			
			>50	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts				
	CLAYS	Liquid limit	<30	CL	Inorganic clays of low plasticity, gravelly clays, sandy clays, silty clays, lean clays				
			30-50	CI	Inorganic clays of medium plasticity, silty clays				
			>50	CH	Inorganic clays of high plasticity, fat clays				
	ORGANIC SILTS AND CLAYS	Liquid limit	<50	OL	Organic silts and organic silty clays of low plasticity				
			>50	OH	Organic clays of medium to high plasticity				
	HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils				
	SOIL COMPONENTS							OVERSIZE MATERIAL	
FRACTION	SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY MASS OF MINOR COMPONENTS		Rounded or subrounded				
	PASSING	RETAINED	PERCENTAGE	DESCRIPTOR	COBBLES 75 mm to 300 mm BOULDERS > 300 mm				
GRAVEL					Not rounded				
coarse	75 mm	19 mm	>35 %	"and"	ROCK FRAGMENTS >75 mm				
fine	19 mm	4.75 mm	21 to 35 %	"y-adjective"	ROCKS > 0.76 cubic metre in volume				
SAND									
coarse	4.75 mm	2.00 mm	10 to 20 %	"some"					
medium	2.00 mm	425 µm	>0 to 10 %	"trace"					
fine	425 µm	75 µm							
SILT (non plastic) or CLAY (plastic)	75 µm		as above but by behavior						
					 A TETRA TECH COMPANY				

SOIL COMPONENTS					OVERSIZE MATERIAL
FRACTION	SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY MASS OF MINOR COMPONENTS		Rounded or subrounded COBBLES 75 mm to 300 mm BOULDERS > 300 mm
	PASSING	RETAINED	PERCENTAGE	DESCRIPTOR	
GRAVEL					Not rounded ROCK FRAGMENTS >75 mm ROCKS > 0.76 cubic metre in volume
coarse	75 mm	19 mm	>35 %	"and"	
fine	19 mm	4.75 mm	21 to 35 %	"y-adjective"	
SAND			10 to 20 %	"some"	
coarse	4.75 mm	2.00 mm	>0 to 10 %	"trace"	
medium	2.00 mm	425 µm			
fine	425 µm	75 µm			
SILT (non plastic) or CLAY (plastic)	75 µm		as above but by behavior		

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.						
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 08MW01						
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN		ELEVATION: 99.22m						
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND										
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Monitoring well	Elevation (m)
				200	400	600	800			
0	CLAY (FILL) - silty, sandy, some gravel, moist, stiff, low to medium plastic, dark brown									99.0
1	CLAY - silty, trace to some sand, very moist, firm to stiff, medium plastic, grey brown		B1							98.0
2	... moist, stiff, dark brown mottling, high plastic clay inclusions ... dark grey to black staining, strong hydrocarbon odor		B2							97.0
3	... grey ... sandy, low to medium plastic, dark brown with grey mottling		B3							96.0
4	BEDROCK - sandstone, silty, damp, low to moderate strength, weathered, yellow brown with dark grey mottling ... no staining, slight odor ... light grey		B4				1875			95.0
5	End of Borehole @ 5.5m		B5				3125			94.0
6	Auger Refusal @ 5.5m No Seepage or Sloughing on Completion 50mm PVC Standpipe Installed to 5.5m, Bottom 3.0m Screened		B6				10000			93.0
7			B7							92.0
8			B8							91.0
9			B9							90.0
10			B10							



EBA Engineering Consultants Ltd.

LOGGED BY: JL

REVIEWED BY: DM

DRAWING NO: B1

COMPLETION DEPTH: 5.5m

COMPLETE: 11/17/2008

Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 08MW02	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN		ELEVATION: 99.33m	
SAMPLE TYPE DISTURBED NO RECOVERY SPT A-CASING SHELBY TUBE CORE BACKFILL TYPE BENTONITE PEA GRAVEL SLOUGH GROUT DRILL CUTTINGS SAND					

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Monitoring well	Elevation (m)
				200	400	600	800			
0	CLAY (FILL) - silty, sandy, some gravel, damp, stiff, medium plastic, dark brown									99.0
1	CLAY - silty, trace to some sand, wet, soft to firm, medium plastic, grey brown		B1							98.0
	... dark brown mottling, high plastic clay inclusions		B2							
	... grey staining, strong hydrocarbon odor		B3							
2			B4				3125			97.0
3	... sandy, low to medium plastic		B5				1875			96.0
4	BEDROCK - sandstone, silty, damp, low to moderate strength, weathered, yellow brown, trace hydrocarbon odor		B6							
	... light grey		B7							95.0
5			B8							
	End of Borehole @ 5.2m		B9							94.0
6	Auger Refusal @ 5.2m No Seepage or Sloughing on Completion 50mm PVC Standpipe installed to 5.5m, Bottom 3.0m Screened									93.0
7										92.0
8										91.0
9										90.0
10										

	EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 5.2m
		REVIEWED BY: DM	COMPLETE: 11/17/2008
		DRAWING NO: B2	Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.		
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 08BH03		
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN				
SAMPLE TYPE ☒ DISTURBED ☒ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE BACKFILL TYPE ☒ BENTONITE ☒ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND						
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	NOTES & COMMENTS		Depth (ft)
0	CLAY (FILL) - silty, sandy, some gravel, stiff, damp, medium plastic, dark brown					0
1	... black staining, wood and debris		B1			5
2	CLAY - silty, trace to some sand, moist, stiff, medium plastic, dark grey to black, high plastic clay inclusions, hydrocarbon odor		B2			10
3	... sandy, low plastic, grey		B3			15
4	... black mottling		B4			20
5	BEDROCK - sandstone, silty, damp, low to moderate strength, weathered, yellow brown with grey black mottling		B5			25
6	... light grey mottling, slight odor		B6			30
7	... grey brown		B7			33
8	End of Borehole @ 6.1m		B8			
9	No Seepage or Sloughing on Completion Backfilled with Bentonite and Cuttings		B9			
10			B10			

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 11/17/2008
	DRAWING NO: B3	Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.		
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 08BH04		
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN				
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND						
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm) 200 400 600 800	NOTES & COMMENTS	Depth (ft)
0	CLAY (FILL) - silty, sandy, some gravel, damp, stiff, medium plastic, brown					0
1	... dark brown ... wet, soft to firm, grey staining		B1			5
2	CLAY - silty, trace sand, moist, stiff, high plastic, grey brown with brown mottling ... grey staining		B2			10
3	... sandy, moist, low to medium plastic, dark black		B3			15
4	BEDROCK - sandstone, silty, damp, low to moderate strength, weathered, yellow brown with grey staining, trace hydrocarbon odor		B4			20
5	... moist ... yellow brown, no staining or odors		B5			25
6	End of Borehole @ 6.1m No Seepage or Sloughing on Completion Backfilled with Bentonite and Cuttings		B6			30
7			B7			33
8			B8			
9			B9			
10			B10			



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LOGGED BY: JL

REVIEWED BY: DM

DRAWING NO: B4

COMPLETION DEPTH: 6.1m

COMPLETE: 11/17/2008

Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 08BH05	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN			
SAMPLE TYPE ☒ DISTURBED ☒ NO RECOVERY ☒ SPT		☒ A-CASING ☒ SHELBY TUBE ☒ CORE			
BACKFILL TYPE ☒ BENTONITE ☒ PEA GRAVEL ☒ SLOUGH		☒ GROUT ☒ DRILL CUTTINGS ☒ SAND			

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Depth (ft)
				200	400	600	800		
0	CLAY (FILL) - silty, sandy, some gravel, damp, stiff, medium plastic, dark brown								0
1	CLAY - silty, trace to some sand, moist, stiff, medium plastic, grey brown with brown mottling ... very moist to wet, soft to firm		B1						
	... dark brown mottling, high plastic clay inclusions ... grey blue staining		B2						5
2			B3						
			B4				1250		10
3	... sandy, moist, low to medium plastic, trace grey staining, slight hydrocarbon odor		B5						
			B6						15
4	BEDROCK - sandstone, silty, damp, low to moderate strength, weathered, yellow brown with grey staining, no hydrocarbon odor ... thin grey seams		B7						
			B8						20
5	End of Borehole @ 5.2m		B9						25
6	Auger Refusal @ 5.2m No Seepage or Sloughing on Completion Backfilled with Bentonite and Cuttings								30
7									33
8									
9									
10									

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 5.2m
	REVIEWED BY: DM	COMPLETE: 11/17/2008
	DRAWING NO: B5	Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 08MW06	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN		ELEVATION: 99.17m	
SAMPLE TYPE DISTURBED NO RECOVERY SPT A-CASING SHELBY TUBE CORE					
BACKFILL TYPE BENTONITE PEA GRAVEL SLOUGH GROUT DRILL CUTTINGS SAND					

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Monitoring well	Elevation (m)
				200	400	600	800			
0	CLAY (FILL) - silty, sandy, some gravel, damp, stiff, medium plastic, dark brown									99.0
1	CLAY - silty, trace to some sand, very moist to wet, firm, medium plastic, grey brown with brown mottling		B1							98.0
	... dark brown mottling, high plastic clay inclusions		B2							
2	... grey blue staining		B3							
			B4				2500			
3	... sandy, moist, low to medium plastic, trace grey staining, slight hydrocarbon odor		B5				1875			98.0
			B6							
4	BEDROCK - sandstone, silty, damp, low to moderate strength, weathered, yellow brown, slight hydrocarbon odor		B7							95.0
	... grey white		B8							
5			B9							94.0
	... yellow brown		B10							93.0
6	End of Borehole @ 6.1m									
7	Auger Refusal @ 6.1m No Seepage or Sloughing on Completion 50mm PVC Standpipe Installed to 6.1m, Bottom 4.5m Screened									
8										92.0
9										91.0
10										90.0

EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 11/17/2008
	DRAWING NO: B6	Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 08MW07	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN		ELEVATION: 99.13m	
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE					
BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND					

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Monitoring well	Elevation (m)
				200	400	600	800			
0	CLAY (FILL) - silty, sandy, some gravel, damp, stiff, medium plastic, dark brown									99.0
1	CLAY - silty, trace to some sand, moist, stiff, medium plastic, grey brown		B1							98.0
2	... dark brown mottling, high plastic clay inclusions		B2							97.0
3			B3							96.0
4			B4							95.0
5			B5							94.0
6			B6							93.0
7	BEDROCK - sandstone, silty, damp, low to moderate strength, weathered, yellow brown, ... hydrocarbon odor		B7					3125		92.0
8	... grey white, slight hydrocarbon odor		B8					1250		91.0
9			B9							90.0
10	End of Borehole @ 6.1m		B10							
	Auger Refusal @ 6.1m No Seepage or Sloughing on Completion 50mm PVC Standpipe Installed to 6.1m, Bottom 4.5m Screened									

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 11/17/2008
	DRAWING NO: B7	Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm CORE		L22101182.001 - 08MW08	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN		ELEVATION: 99.15m	
SAMPLE TYPE ☒ DISTURBED ☒ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE					
BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND					

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Monitoring well	Elevation (m)
				200	400	600	800			
0	CLAY (FILL) - silty, sandy, some gravel, damp, stiff, medium plastic, dark brown									99.0
1	CLAY - silty, trace to some sand, moist, stiff, medium plastic, grey brown		B1							98.0
	... dark brown mottling, high plastic clay inclusions		B2							
2			B3							97.0
			B4							96.0
3	... hydrocarbon odor									95.0
4	BEDROCK - sandstone, silty, damp, low to moderate strength, weathered, yellow brown									94.0
5	... hydrocarbon odor									93.0
	... grey white, slight hydrocarbon odor		C1							92.0
7	... trace shells and coal									91.0
8	... grey brown									90.0
9			C3							89.0
10	... dark grey brown									88.0
11			C2							87.0
12										86.0
13	... dark brown,									85.0
14	... dark grey		C4							84.0
15	End of Borehole @ 15.2m									83.0
16	No Seepage or Sloughing on Completion 50mm PVC Standpipe Installed to 15.2m, Bottom 4.5m Screened									
17										

EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 15.2m
	REVIEWED BY: DM	COMPLETE: 11/17/2008
	DRAWING NO: B8	Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 09BH09	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN			
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE					
BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND					

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Depth (ft)
				200	400	600	800		
0	ASPHALT								0
	CLAY (FILL) - some silt, sandy, some gravel (sizes to 25 mm), frozen, low plastic, very dark brown, trace white precipitates.	☒	B1						
1	CLAY (Lacustrine) - silty, trace sand, frozen, medium plastic, light greyish brown, trace white precipitates.	☒	B2						
	... firm, damp, olive brown.	☒	B3						5
2	... soft, moist, medium to high plastic.	☒	B4						
3	... dark brown high plastic mottle, olive brown.	☒	B5						10
	... sandy, soft, wet, low plastic, brown, trace coal and oxide inclusions.	☒	B6						
4	... trace sandstone inclusions.	☒	B7						15
	BEDROCK - sandstone, silty, moist, low to moderate strength, weathered, yellowish brown, trace odor.	☒	B8						
5		☒	B9						
6		☒	B10						20
	End of Borehole @ 6.1m								
7									25
8									
9									30
10									33

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 3/12/2009
	DRAWING NO: B9	Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 09MW10	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN		ELEVATION: 99.29m	
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE					
BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND					

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Monitoring well	Elevation (m)
				200	400	600	800			
0	ASPHALT CLAY (FILL) - some silt, sandy, some gravel (sizes to 20 mm), frozen, low plastic, dark brown, trace white precipitates.		B1							99.0
1	CLAY (Lacustrine) - silty, trace sand, frozen, medium plastic, light greyish brown, trace white precipitates. ... firm, damp. ... soft, moist, dark brown high plastic mottle, olive brown.		B2							98.0
2			B3							97.0
3			B4							96.0
3.26/2009			B5							95.0
4	... sandy, soft, wet, low plastic, brown, trace coal and oxide inclusions, dark olive brown. ... trace sandstone inclusions.		B6							94.0
5	BEDROCK - sandstone, silty, moist, low to moderate strength, weathered, yellowish brown. ... trace odor. ... grey.		B7							93.0
6	... no distinct odor.		B8							92.0
7	End of Borehole @ 6.1m No Seepage or Sloughing on Completion 50mm PVC Standpipe Installed to 6.1m, Bottom 3.0 m Screened		B9							91.0
8			B10							90.0

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 3/12/2009
	DRAWING NO: B10	Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 09BH11	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN			
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☐ SPT		☐ A-CASING ☐ SHELBY TUBE ☐ CORE			
BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH		☐ GROUT ☐ DRILL CUTTINGS ☐ SAND			

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Depth (ft)
				200	400	600	800		
0	ASPHALT								0
	CLAY (FILL) - some silt, sandy, gravel (sizes to 25 mm), frozen, low plastic, dark brown, trace white precipitates.	☒	B1						
1	CLAY (Lacustrine) - silty, trace sand, frozen, medium plastic, light greyish brown, trace white precipitates.	☒	B2						
	... firm, damp.								
	... soft, moist, medium to high plastic, dark grey to black staining, strong odor.	☒	B3						5
2		☒	B4						
		☒	B5						10
3		☒	B6						
	... sandy, dark brown, trace coal and oxide inclusions.	☒	B7						15
4	... no staining, olive brown, trace odor.	☒	B8						
	BEDROCK - sandstone, silty, moist, low to moderate strength, weathered, yellowish brown, trace odor.	☒	B9						20
5		☒	B10						
6	... trace odor.								25
	End of Borehole @ 6.1m								30
7									33
8									
9									
10									

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 3/12/2009
	DRAWING NO: B11	Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.				
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 09BH12				
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN						
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND								
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm)		NOTES & COMMENTS	Depth (ft)	
0	TOPSOIL			200	400	600	800	0
	CLAY (Lacustrine) - silty, trace sand, frozen, medium plastic, light greyish brown, trace white precipitates.		B1					
1	... firm, damp.		B2					
	... soft, moist, dark brown high plastic mottled, olive brown.		B3					5
2			B4					
	... dark grey to black staining, strong odor.		B5					10
3	End of Borehole @ 3.0 m							
4								15
5								
6								20
 EBA Engineering Consultants Ltd.			LOGGED BY: JL		COMPLETION DEPTH: 3m			
			REVIEWED BY: DM		COMPLETE: 3/12/2009			
			DRAWING NO: B12		Page 1 of 1			

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 09MW13	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN		ELEVATION: 98.86m	
SAMPLE TYPE		☒ DISTURBED ☒ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE			
BACKFILL TYPE		☒ BENTONITE ☒ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND			

Depth (m)	SOIL DESCRIPTION	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Monitoring well	Elevation (m)
			200	400	600	800			
0	ASPHALT								
	CLAY (FILL) - some silt, sandy, gravel (sizes to 20 mm), frozen, low plastic, dark brown, trace white precipitates.	B1							98.0
1	CLAY (Lacustrine) - silty, trace sand, frozen, medium plastic, light greyish brown, trace white precipitates. ... firm, damp, olive brown.	B2							
	... soft, moist, dark brown high plastic mottle, olive brown.	B3							97.0
2		B4							
		B5							96.0
	... sandy, soft, wet, low plastic, brown, dark olive brown, trace coal and oxide inclusions.	B6							95.0
4	... trace sandstone inclusions.	B7							
	BEDROCK - sandstone, silty, moist, low to moderate strength, weathered, yellowish brown.	B8							94.0
5		B9							
	... trace odor.								93.0
6	... grey.	B10							
	End of Borehole @ 6.1m No Seepage or Sloughing on Completion 50mm PVC Standpipe Installed to 6.1m, Bottom 3.0 m Screened								92.0
7									91.0
8									90.0
9									89.0
10									

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 3/12/2009
	DRAWING NO: B13	Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.		
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 09BH14		
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN				
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND						
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm) 200 400 600 800	NOTES & COMMENTS	Depth (ft)
0	TOPSOIL					0
	CLAY (Fill) - silty, sandy, frozen low plastic, dark brown.					
	CLAY (Lacustrine) - silty, trace sand, frozen, low plastic, light greyish brown, trace white precipitates.	☒	B1	■		
1	... dark grey to black staining, strong odor.					
	... firm, damp.	☒	B2	■		
	... soft, moist.	☒	B3			5
2		☒	B4			
		☒	B5			
3	End of Borehole @ 3.0 m					10
4						
5						15
6						20
 EBA Engineering Consultants Ltd.			LOGGED BY: JL REVIEWED BY: DM DRAWING NO: B14		COMPLETION DEPTH: 3m COMPLETE: 3/12/2009 Page 1 of 1	

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.		
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 09BH15		
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN				
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE						
BACKFILL TYPE ☒ BENTONITE ☒ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND						
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm) 200 400 600 800	NOTES & COMMENTS	Depth (ft)
0	ASPHALT					0
	CLAY (Fill) - silty, sandy, frozen low plastic, dark brown.					
		☒	B1	■		
1	CLAY (Lacustrine) - silty, trace sand, frozen, low plastic, light greyish brown, trace white precipitates. ... firm, damp, olive brown.					
		☒	B2	■		
	... soft, moist, dark grey to black staining, strong odor.					
		☒	B3	■		
2						
		☒	B4			
		☒	B5			
3	End of Borehole @ 3.0 m					10
4						
5						
6						20

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 3m
	REVIEWED BY: DM	COMPLETE: 3/12/2009
	DRAWING NO: B15	Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 09BH16	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN			
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE					
BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND					

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Depth (ft)
				200	400	600	800		
0	ASPHALT								0
	CLAY (Fill) - silty, sandy, gravel, frozen low plastic, dark brown.								
		☒	B1						
1	CLAY (Lacustrine) - silty, trace sand, frozen, low plastic, light greyish brown, trace white precipitates. ... firm, damp, olive brown.								
	... soft, moist.								
	...dark grey to black staining, strong odor.								
		☒	B2						
		☒	B3						
2									
		☒	B4						
		☒	B5						
3	... sandy, soft, wet.								
		☒	B6						
4	BEDROCK - sandstone, silty, moist, low to moderate strength, weathered, yellowish brown, no distinct odor.								
		☒	B7						
	End of Borehole @ 4.5 m								
5									
6									

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 4.5m
	REVIEWED BY: DM	COMPLETE: 3/12/2009
	DRAWING NO: B16	Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 09BH17	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN			
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE					
BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND					

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Depth (ft)
				200	400	600	800		
0	ASPHALT								0
	CLAY (Fill) - silty, sandy, gravel, frozen low plastic, dark brown.								
		☒	B1						
1	CLAY (Lacustrine) - silty, trace sand, frozen, low plastic, light greyish brown, trace white precipitates. ... firm, damp.								
		☒	B2						
	... soft, moist, dark brown high plastic mottle, olive brown.								5
		☒	B3						
2	...dark grey to black staining, strong odor.								
		☒	B4						
3	... sandy, soft, wet, trace coal and oxide inclusions.								10
		☒	B5						
		☒	B6						
4	BEDROCK - sandstone, silty, moist, low to moderate strength, weathered, yellowish brown, no distinct odor.								
		☒	B7						
	End of Borehole @ 4.5 m								15
5									
6									20

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 4.5m
	REVIEWED BY: DM	COMPLETE: 3/12/2009
	DRAWING NO: B17	Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.		
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 09BH18		
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN				
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE BACKFILL TYPE ☐ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND						
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm) 200 400 600 800	NOTES & COMMENTS	Depth (ft)
0	ASPHALT					0
	CLAY (Fill) - silty, sandy, gravel, frozen low plastic, dark brown.		B1			
1	CLAY (Lacustrine) - silty, trace sand, frozen, low plastic, light greyish brown, trace white precipitates. ... firm, damp, olive brown. ... soft, moist, dark brown high plastic mottle, olive brown.		B2			5
2	... dark grey to black staining, strong odor.		B3			
			B4			
3	... sandy, soft, wet, trace coal and oxide inclusions.		B5			10
			B6			
4	BEDROCK - sandstone, silty, moist, low to moderate strength, weathered, yellowish brown, no distinct odor.		B7			15
	End of Borehole @ 4.5 m					20
5						
6						

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 4.5m
	REVIEWED BY: DM	COMPLETE: 3/12/2009
	DRAWING NO: B18	Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.			
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 09MW19			
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN		ELEVATION: 99.38m			
SAMPLE TYPE ☒ DISTURBED ☒ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND							
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm)	NOTES & COMMENTS	Monitoring well	Elevation (m)
0	ASPHALT						99.0
	CLAY (FILL) - some silt, sandy, gravel (sizes to 20 mm), frozen, low plastic, dark brown, trace white precipitates.		B1				
1	CLAY (Lacustrine) - silty, trace sand, frozen, medium plastic, light greyish brown, trace white precipitates.		B2				98.0
	... firm, damp, olive brown.		B3				
	... soft, moist, dark brown high plastic mottle, olive brown.		B4				97.0
2			B5				
	... sandy, soft, wet, low plastic, brown, dark olive brown, trace coal and oxide inclusions.		B6				96.0
3			B7				95.0
	BEDROCK - sandstone, silty, moist, low to moderate strength, weathered, yellowish brown, no distinct odor.		B8				
	... greyish brown.		B9				94.0
	... trace odor.		B10				
4							93.0
5							92.0
6							91.0
7							90.0
8							
9							
10							
End of Borehole @ 6.1m No Seepage or Sloughing on Completion 50mm PVC Standpipe Installed to 6.1m, Bottom 3.0 m Screened							

EBA Engineering Consultants Ltd.
ENVIRONMENTAL L22101182 PHASE II DRILLING BARONS.GPJ EBA.GDT 09/08/21

LOGGED BY: JL	COMPLETION DEPTH: 6.1m
REVIEWED BY: DM	COMPLETE: 3/12/2009
DRAWING NO: B19	Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.		
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 09BH20		
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN				
SAMPLE TYPE		DISTURBED		NO RECOVERY		
BACKFILL TYPE		BENTONITE		PEA GRAVEL		
		SPT		A-CASING		
		SHELBY TUBE		CORE		
		SLOUGH		GROUT		
		DRILL CUTTINGS		SAND		
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm)	NOTES & COMMENTS	Depth (ft)
0	ASPHALT					0
	CLAY (Fill) - some silt, sandy, gravel, frozen low plastic, dark brown.					
		B1				
1	CLAY (Lacustrine) - silty, trace sand, frozen, low plastic, light greyish brown, trace white precipitates. ... firm, damp, olive brown.					
	... soft, moist, dark brown high plastic mottle, olive brown. ...dark grey to black staining, strong odor.	B2				
		B3				
2		B4				
		B5				
3	... no staining or odor.					
	... sandy, soft, wet, trace coal and oxide inclusions, dark olive brown.	B6				
4	BEDROCK - sandstone, silty, moist, low to moderate strength, weathered, yellowish brown, no distinct odor.	B7				
	End of Borehole @ 4.5 m					
5						
6						


EBA Engineering Consultants Ltd.

LOGGED BY: JL
REVIEWED BY: DM
DRAWING NO: B20

COMPLETION DEPTH: 6.1m
COMPLETE: 3/12/2009
Page 1 of 1

PROJECT: PHASE II ESA		CLIENT: Village of Barons		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 202 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101182.001 - 09BH21	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN			
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☐ SPT		☐ A-CASING ☐ SHELBY TUBE ☐ CORE			
BACKFILL TYPE ☒ BENTONITE ☐ PEA GRAVEL ☐ SLOUGH		☐ GROUT ☐ DRILL CUTTINGS ☐ SAND			

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Depth (ft)
				200	400	600	800		
0	Topsoil								0
	CLAY (Fill) - silty, sandy, frozen low plastic, dark brown.								
	CLAY (Lacustrine) - silty, trace sand, frozen, low plastic, light greyish brown, trace white precipitates.	☒	B1	☒					
1	... firm, damp, olive brown.	☒	B2	☒					
	... soft, moist, dark brown high plastic mottle, olive brown.								5
		☒	B3	☒					
2									
		☒	B4	☒					
	... dark grey to black staining, strong odor.								
3	End of Borehole @ 3.0 m	☒	B5						10
4									
									15
5									
6									20

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 4.5m
	REVIEWED BY: DM	COMPLETE: 3/12/2009
	DRAWING NO: B20	Page 1 of 1



Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.: 0194222
 Map Verified: Not Verified
 Date Report Received:
 Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: INTERPROVINCIAL DRLG Drilling Company Approval No.:
 Mailing Address: City or Town: Postal Code:
 Well Owner's Name: Well Location Identifier:
 P.O. Box Number: Mailing Address: Postal Code:
 City: Province: Country:

2. Well Location

1/4 or Sec Twp Rge West of
 LSD M
 EH 16 012 23 4

Location in Quarter
 0 FT from Boundary
 0 FT from Boundary
 Lot Block Plan

Well Elev: 3165 FT
 How Obtain: Estimated

3. Drilling Information

Type of Work: Well Inventory
 Reclaimed Well
 Date Reclaimed: Materials Used:
 Method of Drilling: Drilled
 Flowing Well: No
 Gas Present: No Rate: Gallons
 Oil Present: No 0 Gallons

Proposed well use:
 Domestic
 Anticipated Water
 Requirements/day
 0 Gallons

6. Well Yield

Test Date(yyyy/mm/dd): Start Time:
 1958/02/10 11:00 AM
 Test Method: Bailor
 Non pumping 32 FT
 static level:
 Rate of water 15 Gallons/Min
 removal:
 Depth of pump 0 FT
 intake:
 Water level at FT
 end of
 pumping:
 Distance from top of inches
 casing to ground level:
 Depth To water level (feet)
 Elapsed Time
 Drawdown Minutes: Sec Recovery
 Total Drawdown: 0 FT
 If water removal was less than 2 hr
 duration, reason why:

4. Formation Log

Depth from
 ground
 level (feet) Lithology Description

1 Topsoil
 10 Gravel & Boulders
 21 Sand & Gravel
 23 Silty Sand & Gravel
 44 Blue Shale
 59 Gray Shale
 63 Sand & Shale
 79 Gray Shale
 83 Gray Sandy Shale
 90 Gray Water Bearing Sandstone
 96 Blue Shale

5. Well Completion

Date Started(yyyy/mm/dd): Date Completed(yyyy/mm/dd):
 1958/02/10
 Well Depth: 96 FT Borehole Diameter: 0 Inches
 Casing Type: Unknown Liner Type:
 Size OD: 5 Inches Size OD: 0 Inches
 Wall Thickness: 0 Inches Wall Thickness: 0 Inches
 Bottom at: 96 FT Top: 0 FT Bottom: 0 FT
 Perforations Perforations Size:
 from: 0 FT to: 0 FT 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches

Perforated by:

Seal:
 from: 0 FT to: 0 FT
 Seal:
 from: 0 FT to: 0 FT
 Seal:
 from: 0 FT to: 0 FT

Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches
 Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches

Screen Installation Method:

Fittings
 Top: Bottom:
 Pack:
 Grain Size: Amount:

Geophysical Log Taken:

Retained on Files:

Additional Test and/or Pump Data

Chemistries taken By Driller: No
 Held: 0 Documents Held: 1

Pitless Adapter Type:

Drop Pipe Type:
 Length: FT Diameter: Inches

Comments:

OWNER STATES CEALR, MEDIUM HARD WATER.

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER

Certification No.:

This well was constructed in accordance with the Water Well
 regulation of the Alberta Environmental Protection &
 Enhancement Act. All information in this report is true.

Signature

Yr Mo Day

Recommended pumping rate: 0
 Gallons/Min

Recommended pump intake: 0 FT

Type Pump Installed

Pump Type:

Pump Model:

H.P.:

Any further pump test information?



Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.: 0194216
 Map Verified: Field
 Date Report Received:
 Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: ALBERTA ENVIRONMENT/EARTH SCIENCES DIVISION
 Mailing Address: 9820-106 ST, OXBRIDGE PLACE
 City or Town: EDMONTON AB CA
 Well Owner's Name: ALTA ENV #0613E
 P.O. Box Number:
 Mailing Address:
 Postal Code:
 City:
 Province:
 Country:

Drilling Company Approval No.: 99998
 Postal Code: T5K 2J6

2. Well Location

1/4 or Sec Twp Rge West of
 LSD M
 SE 16 012 23 4

Location in Quarter
 0 FT from Boundary
 0 FT from Boundary
 Lot Block Plan

Well Elev: FT
 How Obtain: Not Obtain

3. Drilling Information

Type of Work: Test Hole
 Reclaimed Well
 Date Reclaimed:
 Method of Drilling: Drilled
 Flowing Well: No
 Gas Present: No
 Materials Used:
 Rate: Gallons
 Oil Present: No
 Proposed well use:
 Unknown
 Anticipated Water
 Requirements/day
 0 Gallons

6. Well Yield

Test Date(yyyy/mm/dd): Start Time:
 Test Method:
 Non pumping FT
 static level:
 Rate of water Gallons/Min
 removal:
 Depth of pump FT
 intake:
 Water level at FT
 end of
 pumping:
 Distance from inches
 top of casing to
 ground level:
 Depth To water level (feet)
 Elapsed Time
 Drawdown Minutes:Sec Recovery

4. Formation Log

Depth from ground level (feet)	Lithology Description
9	Clay
12	Hard Shale
28	Shale
35	Hard Shale & Sandstone
47	Siltstone
55	Hard Sandstone
56	Shale
63	Hard Sandstone
64	Shale
80	Water Bearing Sandstone
95	Shale & Sandstone

5. Well Completion

Date Started(yyyy/mm/dd): 1971/03/01
 Date Completed(yyyy/mm/dd):
 Well Depth: 95 FT
 Borehole Diameter: 0 Inches
 Casing Type:
 Liner Type:
 Size OD: 0 Inches
 Size OD: 0 Inches
 Wall Thickness: 0 Inches
 Wall Thickness: 0 Inches
 Bottom at: 0 FT
 Top: 0 FT Bottom: 0 FT
 Perforations
 from: 0 FT to: 0 FT
 from: 0 FT to: 0 FT
 from: 0 FT to: 0 FT
 Perforations Size:
 0 Inches x 0 Inches
 0 Inches x 0 Inches
 0 Inches x 0 Inches

Perforated by:
 Seal:
 from: 0 FT to: 0 FT
 Seal:
 from: 0 FT to: 0 FT
 Seal:
 from: 0 FT to: 0 FT
 Screen Type:
 from: 0 FT to: 0 FT
 Screen ID: 0 Inches
 Slot Size: 0 Inches
 Screen Type:
 from: 0 FT to: 0 FT
 Screen ID: 0 Inches
 Slot Size: 0 Inches
 Screen Installation Method:
 Fittings
 Top: Bottom:
 Pack:
 Grain Size: Amount:
 Geophysical Log Taken:
 Retained on Files:
 Additional Test and/or Pump Data
 Chemistries taken By Driller: No
 Held: 0 Documents Held: 1
 Pitless Adapter Type:
 Drop Pipe Type:
 Length: Diameter:
 Comments:
 OWNER STATES AIR DRILLED 100FT W. & 25FT S. OF 612-E.

Total Drawdown: FT
 If water removal was less than 2 hr duration, reason why:
 Recommended pumping rate:
 Gallons/Min
 Recommended pump intake: FT
 Type pump installed
 Pump type:
 Pump model:
 H.P.:
 Any further pumptest information?

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER
 Certification No.:
 This well was constructed in accordance with the Water Well regulation of the Alberta Environmental Protection & Enhancement Act. All information in this report is true.
 Signature Yr Mo Day



Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

The Information contained in this "Water Well Drilling Report" is unverified by Alberta Environment

Well I.D.: 2058577
Map Verified: Not Verified
Date Report Received: 2007/03/09
Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: UNKNOWN DRILLING COMP. 10 Drilling Company Approval No.: 10
Mailing Address: UNKNOWN City or Town: Postal Code:

Well Owner's Name: ALTA ENV - 611E Well Location Identifier:

P.O. Box Number: Mailing Address: Postal Code:

City: EDMONTON Province: AB Country: CA

2. Well Location

1/4 or Sec Twp Rge West of
LSD SE 16 012 23 M
4

Location in Quarter
FT from N Boundary
FT from E Boundary

Lot Block Plan

Well Elev: FT How Obtain: Not Obtain

3. Drilling Information

Type of Work: Test Hole
Reclaimed Well
Date Reclaimed: Materials Used: Unknown
Method of Drilling: Rotary
Flowing Well: No Rate: Gallons
Gas Present: No Oil Present: No
Proposed well use:
Observation
Anticipated Water
Requirements/day
Gallons

6. Well Yield

Test Date(yyyy/mm/dd): Start Time:

Test Method:

Non pumping FT
static level:

Rate of water Gallons/Min
removal:

Depth of pump FT
intake:

Water level at FT
end of
pumping:

Distance from Inches
top of casing to
ground level:

Depth To water level (feet)
Elapsed Time
Drawdown Minutes:Sec Recovery

4. Formation Log

Depth from
ground
level (feet) Lithology Description

5. Well Completion

Date Started(yyyy/mm/dd): 1971/03/12 Date Completed(yyyy/mm/dd): 1971/03/12

Well Depth: 65 FT Borehole Diameter: Inches

Casing Type: Unknown Liner Type: Unknown

Size OD: Inches Size OD: Inches

Wall Thickness: Inches Wall Thickness: Inches

Bottom at: FT Top: FT Bottom: FT

Perforations
from: FT to: FT
from: FT to: FT
from: FT to: FT
Perforations Size:
Inches x Inches
Inches x Inches
Inches x Inches

Perforated by: Unknown

Seal: Unknown
from: FT to: FT

Seal: Unknown
from: FT to: FT

Seal: Unknown
from: FT to: FT

Screen Type: Unknown Screen ID: Inches
from: FT to: FT Slot Size: Inches

Screen Type: Unknown Screen ID: Inches
from: FT to: FT Slot Size: Inches

Screen Installation Method: Unknown

Fittings
Top: Unknown Bottom: Unknown

Pack: Unknown
Grain Size: Amount: Unknown

Geophysical Log Taken:
Retained on Files:

Additional Test and/or Pump Data

Chemistries taken By Driller: No

Held: Documents Held:

Pitless Adapter Type:

Drop Pipe Type:
Length: Diameter:

Comments:

Total Drawdown: FT

If water removal was less than 2 hr
duration, reason why:

Recommended pumping rate:
Gallons/Min

Recommended pump intake: FT

Type pump installed

Pump type:

Pump model:

H.P.:

Any further pump test information?

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER10
Certification No.: 10

This well was constructed in accordance with the Water Well
regulation of the Alberta Environmental Protection &
Enhancement Act. All information in this report is true.

Signature Yr Mo Day



Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.: 0194195
 Map Verified: Field
 Date Report Received: 1981/05/27
 Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: ALBERTA ENVIRONMENT/EARTH SCIENCES DIVISION
 Drilling Company Approval No.: 99998
 Mailing Address: 9820-106 ST, OXBRIDGE PLACE City or Town: EDMONTON AB CA Postal Code: T5K 2J6
 Well Owner's Name: ALTA ENV #1998E Well Location Identifier:
 P.O. Box Number: Mailing Address: Postal Code:
 City: Province: Country:

2. Well Location

1/4 or Sec Twp Rge West of
 LSD M
 SW 15 012 23 4

Location in Quarter
 0 FT from Boundary
 0 FT from Boundary

Lot Block Plan

Well Elev: 3175 FT
 How Obtain: Estimated

3. Drilling Information

Type of Work: Test Hole
 Reclaimed Well
 Date Reclaimed: Materials Used:
 Method of Drilling: Rotary
 Flowing Well: No
 Gas Present: No Rate: Gallons
 Oil Present: No

Proposed well use:
 Unknown
 Anticipated Water
 Requirements/day
 0 Gallons

6. Well Yield

Test Date(yyyy/mm/dd): Start Time:

Test Method:

Non pumping FT

static level:

Rate of water Gallons/Min
 removal:

Depth of pump FT
 intake:

Water level at FT

end of

pumping:

Distance from Inches

top of casing to

ground level:

Depth To water level (feet)
 Elapsed Time
 Drawdown Minutes: Sec Recovery

Total Drawdown: FT

If water removal was less than 2 hr
 duration, reason why:

Recommended pumping rate:
 Gallons/Min

Recommended pump intake: FT

Type pump installed

Pump type:

Pump model:

H.P.:

Any further pump test information?

4. Formation Log

Depth from
 ground
 level (feet) Lithology Description

10 Silt
 25 Shale
 71 Silty Shale
 72 Sandstone
 84 Shale
 89 Sandstone
 98 Shale
 100 Sandstone
 104 Shale
 107 Sandstone
 110 Shale
 112 Sandstone
 115 Shale
 120 Sandstone
 135 Shale
 137 Sandstone
 138 Shale
 140 Sandstone
 141 Shale
 148 Sandstone
 190 Shale
 196 Sandstone
 198 Shale
 200 Sandstone

5. Well Completion

Date Started(yyyy/mm/dd): 1980/11/09 Date Completed(yyyy/mm/dd): 1980/11/20

Well Depth: 200 FT Borehole Diameter: 0 Inches

Casing Type: Liner Type:

Size OD: 0 Inches Size OD: 0 Inches

Wall Thickness: 0 Inches Wall Thickness: 0 Inches

Bottom at: 0 FT Top: 0 FT Bottom: 0 FT

Perforations from: 0 FT to: 0 FT Perforations Size: 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches

Perforated by:

Seal: to: 0 FT
 from: 0 FT to: 0 FT
 Seal: to: 0 FT
 from: 0 FT to: 0 FT
 Seal: to: 0 FT
 from: 0 FT to: 0 FT

Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches
 Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches

Screen Installation Method:

Fittings Top: Bottom:

Pack: Grain Size: Amount:

Geophysical Log Taken:
 Retained on Files:

Additional Test and/or Pump Data
 Chemistries taken By Driller: No
 Held: 0 Documents Held: 4

Pitless Adapter Type:
 Drop Pipe Type:
 Length: Diameter:

Comments:
 OWNER STATES WELL CORED.

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER

Certification No.:

This well was constructed in accordance with the Water Well
 regulation of the Alberta Environmental Protection &
 Enhancement Act. All information in this report is true.

Signature Yr Mo Day



Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.: 0194421
 Map Verified: Field
 Date Report Received: 1986/02/17
 Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: UNKNOWN DRILLER Drilling Company Approval No.: 99999
 Mailing Address: UNKNOWN City or Town: UNKNOWN AB CA Postal Code:
 Well Owner's Name: ARC# TH 28-76 Well Location Identifier:
 P.O. Box Number: Mailing Address: Postal Code:
 City: Province: Country:

2. Well Location

1/4 or Sec Twp Rge West of
 LSD M
 14 16 012 23 4

Location in Quarter
 0 FT from Boundary
 0 FT from Boundary

Lot Block Plan

Well Elev: 3153 FT How Obtain: Survey-Tra

3. Drilling Information

Type of Work: Coal Test Hole
 Reclaimed Well
 Date Reclaimed: Materials Used: Proposed well use: Other
 Method of Drilling: Unknown Anticipated Water Requirements/day 0 Gallons
 Flowing Well: No Rate: Gallons
 Gas Present: No Oil Present: No

6. Well Yield

Test Date(yyyy/mm/dd): Start Time:

Test Method:

Non pumping FT

static level:

Rate of water Gallons/Min
 removal:

Depth of pump FT
 intake:

Water level at FT

end of

pumping:

Distance from Inches

top of casing to

ground level:

Depth To water level (feet)

Elapsed Time

Drawdown Minutes:Sec Recovery

Total Drawdown: FT

If water removal was less than 2 hr
 duration, reason why:

Recommended pumping rate:

Gallons/Min

Recommended pump intake: FT

Type pump installed

Pump type:

Pump model:

H.P.:

Any further pump test information?

4. Formation Log

Depth from ground level (feet)	Lithology Description
5	Brown Till
15	Brownish Yellow Till
20	Brown Medium Grained Sandstone
24	Till
25	Brownish Yellow Shale
30	Light Gray Shale
35	Greenish Gray Shale
40	Light Gray Fine Grained Sandstone
75	Gray Fine Grained Shale & Sandstone
80	Gray Silty Shale & Sandstone
85	Gray Fine Grained Shale & Sandstone
90	Greenish Gray Fine Grained Shale & Sandstone
95	Greenish Gray Shale
100	Greenish Gray Fine Grained Shale & Sandstone
110	Greenish Gray Fine Grained Shale & Sandstone
120	Greenish Gray Bentonitic Shale & Sandstone
130	Greenish Gray Silty Shale & Sandstone
135	Brownish Gray Bentonitic Shale & Sandstone
145	Greenish Gray Shale & Sandstone
150	Brownish Gray Bentonitic Shale & Sandstone
165	Greenish Gray Bentonitic Shale & Sandstone
175	Brownish Green Bentonitic Shale & Sandstone
180	Brownish Gray Fine Grained Shale & Sandstone
185	Gray Fine Grained Shale & Sandstone
190	Brownish Gray Shale & Sandstone
195	Brownish Gray Bentonitic Shale & Sandstone
200	Brownish Gray Shale
205	Brown Shale & Coal
210	Brownish Gray Bentonitic Shale
215	Brownish Gray Bentonitic Shale & Sandstone
220	Dark Gray Bentonitic Shale
225	Gray Bentonitic Shale & Sandstone
235	Brownish Gray Fine Grained Shale & Sandstone
240	Dark Brown Carbonaceous Shale
245	Brown Shale
250	Brownish Gray Bentonitic Shale & Sandstone
260	Brownish Gray Shale

5. Well Completion

Date Started(yyyy/mm/dd): 1976/06/13 Date Completed(yyyy/mm/dd): 1976/06/13
 Well Depth: 674 FT Borehole Diameter: 0 Inches
 Casing Type: Liner Type:
 Size OD: 0 Inches Size OD: 0 Inches
 Wall Thickness: 0 Inches Wall Thickness: 0 Inches
 Bottom at: 0 FT Top: 0 FT Bottom: 0 FT
 Perforations Perforations Size:
 from: 0 FT to: 0 FT 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches
 Perforated by:
 Seal:
 from: 0 FT to: 0 FT
 Seal:
 from: 0 FT to: 0 FT
 Seal:
 from: 0 FT to: 0 FT
 Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches
 Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches
 Screen Installation Method:
 Fittings
 Top: Bottom:
 Pack:
 Grain Size: Amount:
 Geophysical Log Taken: ELECTRIC and GAMMA
 Retained on Files: ELECTRIC yes and GAMMA yes
 Additional Test and/or Pump Data
 Chemistries taken By Driller: No
 Held: 0 Documents Held: 6
 Pitless Adapter Type:
 Drop Pipe Type:
 Length: Diameter:
 Comments:
 345'-365' SHALE, SILT & FOSSILS

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER
 Certification No.:
 This well was constructed in accordance with the Water Well
 regulation of the Alberta Environmental Protection &
 Enhancement Act. All information in this report is true.
 Signature Yr Mo Day

265	Brownish Gray Bentonitic Shale		
275	Brownish Gray Bentonitic Shale & Sandstone		
285	Gray Shale		



Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.: 0194196
 Map Verified: Not Verified
 Date Report Received: 1969/12/10
 Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: HENNING DRILLING LTD. Drilling Company Approval No.:
 Mailing Address: City or Town: Postal Code:
 Well Owner's Name: BARONS OIL Well Location Identifier:
 P.O. Box Number: Mailing Address: BARONS Postal Code:
 City: Province: Country:

2. Well Location

1/4 or Sec Twp Rge West of
 LSD M
 14 15 012 23 4
 Location in Quarter
 0 FT from Boundary
 0 FT from Boundary
 Lot Block Plan
 Well Elev: How Obtain:
 FT Not Obtain

3. Drilling Information

Type of Work: New Well
 Reclaimed Well
 Date Reclaimed: Materials Used:
 Method of Drilling: Rotary
 Flowing Well: No Rate: Gallons
 Gas Present: No Oil Present: No
 Proposed well use:
 Injection
 Anticipated Water
 Requirements/day
 0 Gallons

6. Well Yield

Test Date (yyyy/mm/dd): Start Time:
 Test Method:
 Non pumping FT
 static level:
 Rate of water Gallons/Min
 removal:
 Depth of pump FT
 intake:
 Water level at FT
 end of
 pumping:
 Distance from Inches
 top of casing to
 ground level:
 Depth To water level (feet)
 Elapsed Time
 Drawdown Minutes: Sec Recovery

4. Formation Log

Depth from ground level (feet)	Lithology Description
4	Brown Clay
20	Shale
48	Dark Shale
49	Sandstone
381	Sandstone
391	Hard Unknown
532	Hard Unknown
542	Hard Unknown
555	Shale

5. Well Completion

Date Started (yyyy/mm/dd): Date Completed (yyyy/mm/dd):
 1967/02/01
 Well Depth: 555 FT Borehole Diameter: 0 Inches
 Casing Type: Liner Type: Unknown
 Size OD: 0 Inches Size OD: 0 Inches
 Wall Thickness: 0 Inches Wall Thickness: 0 Inches
 Bottom at: 0 FT Top: 0 FT Bottom: 547 FT
 Perforations Perforations Size:
 from: 316 FT to: 354 FT 0 Inches x 0 Inches
 from: 370 FT to: 407 FT 0 Inches x 0 Inches
 from: 510 FT to: 547 FT 0 Inches x 0 Inches
 Perforated by:
 Seal:
 from: 0 FT to: 0 FT
 Seal:
 from: 0 FT to: 0 FT
 Seal:
 from: 0 FT to: 0 FT
 Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches
 Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches
 Screen Installation Method:
 Fittings
 Top: Bottom:
 Pack:
 Grain Size: Amount:
 Geophysical Log Taken: ELECTRIC
 Retained on Files: ELECTRIC yes
 Additional Test and/or Pump Data
 Chemistries taken By Driller: No
 Held: 0 Documents Held: 7
 Pitless Adapter Type:
 Drop Pipe Type:
 Length: Diameter:
 Comments:
 OWNER STATES INJECTION TEST INCLUDED IN FILE.

Total Drawdown: FT

If water removal was less than 2 hr duration, reason why:

Recommended pumping rate:
 Gallons/Min

Recommended pump intake: FT

Type pump installed

Pump type:

Pump model:

H.P.:

Any further pump test information?

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER
 Certification No.:
 This well was constructed in accordance with the Water Well regulation of the Alberta Environmental Protection & Enhancement Act. All information in this report is true.
 Signature Yr Mo Day

APPENDIX B

GEO-ENVIRONMENTAL REPORT – GENERAL CONDITIONS

GENERAL CONDITIONS

GEO-ENVIRONMENTAL REPORT

This report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT AND OWNERSHIP

This report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

This report and the assessments and recommendations contained in it are intended for the sole use of EBA's client. EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's Client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

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2.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. The Client warrants that EBA's instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

3.0 NOTIFICATION OF AUTHORITIES

In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by EBA in its reasonably exercised discretion.

4.0 INFORMATION PROVIDED TO EBA BY OTHERS

During the performance of the work and the preparation of the report, EBA may rely on information provided by persons other than the Client. While EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.