Appendix 8.1: Borehole Logs for the Permitted Borrow Pit

LEGEND

Borehole Locations

- Borehole

REFERENCE

COORDINATE SYSTEM: TM65 IRISH GRID

GEOLOGICAL DATA COPYRIGHT GSI 2015

1:1,503

CLIENT
AUGHINISH ALUMINA LTD

PROJECT
AUGHINISH BORROW PIT

TITLE
BORROW PIT - BOREHOLE LOCATION MAP

CONSULTANT
Golder Associates

YYYY-MM-DD	13 FEB 2017
PREPARED	CM
DESIGN	CM
REVIEW	KMG
APPROVED	CW

PROJECT No.	CONTROL	REV	FIGURE
1667376		B.0	X

25mm

0

BOREHOLE LOG

Project				BOREHOLE No
Aughinish Borrow Pit				**BH-1**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
1667376	23-01-17	17.123 mAOD	E 128154.914, N 152562.776	
Contractor				Sheet
JS Drilling				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
				16,02		(1,10) 1,10	Pale grey, silty gravelly OVERBURDEN with sub-angular to angular fragments < 6 m in diameter. Slight Fe-Ox stain on fragments.		
			1	2,12		(9.8m) 15,00	Pale to medium grey, fine grained Waulsortian LIMESTONE. Fragments are sub-angular to angular in shape, strong and < 5 cm in diameter. End of Hole @ 15 m.		

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To

GENERAL REMARKS

Water encountered at 13.3m during drilling and 24 hours later water settled at 9.8m. Slotted pipe installed from 13.5 to 7.5m and plain standpipe installed to the surface. Hole installed to 13.5 m due to collapse of hole from 13.5 to 15m.

All dimensions in metres Scale 1:93.75	Client Aughinish Alumina	Method/ Plant Used Beretta T44	Logged By C. Maguire

BOREHOLE LOG

Project				BOREHOLE No
Aughinish Borrow Pit				**BH-2**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
1667376	24-01-17	15.427 mAOD	E 128313.979, N 152754.954	
Contractor				Sheet
JS Drilling				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
				14,93		0,50	Pale grey silty gravelly OVERBURDEN. Fragments of limestone.		
							Pale to medium grey, fine grained Waulsortian LIMESTONE. Fragements are sub-angular to angular in shape and < 5 cm in diameter.		
			1 ▼			7.4			
						8,00			
						8,10	Cavity		
							Pale to medium grey, fine grained Waulsortian LIMESTONE. Fragements are sub-angular to angular in shape and < 5 cm in diameter. Slight Fe-Ox stain on some fragments from 10.5 to 15 m.		
				0,43		15,00			

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

Water encountered at 7.4m. Slotted pipe installed from 15 to 5 m and plain standpipe installed from 5 m to the surface.

All dimensions in metres Scale 1:93.75	Client Aughinish Alumina	Method/ Plant Used Beretta T44	Logged By C. Maguire

BOREHOLE LOG

Project				BOREHOLE No
Aughinish Borrow Pit				**BH-3**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
1667376	25-01-17	16.085 mAOD	E 128110.385, N 152794.836	
Contractor				Sheet
JS Drilling				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
				15,79		0,30	Pale to medium grey Silty Gravelly OVERBURDEN.		
						(2,70)	Pale to medium grey, fine grained Waulsortian LIMESTONE. Fragments are sub-angular to angular in shape, strong and < 6 cm in diameter.		
				13,09		3,00			
						(1,00)	Cavity		
				12,09		4,00			
							Pale to medium grey, fine grained Waulsortian LIMESTONE. Fragments are sub-angular to angular in shape, strong and < 5 cm in diameter. End of Hole @ 15 m.		
				1,09		15,00			

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To

GENERAL REMARKS

No water encountered. Hole left open for possible future installation.

All dimensions in metres Scale 1:93.75	Client Aughinish Alumina	Method/ Plant Used Beretta T44	Logged By C. Maguire

BOREHOLE LOG

Project				BOREHOLE No
Aughinish Borrow Pit				**BH-4**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
1667376	26-01-17	16.745 mAOD	E 128145.743, N 152721.134	
Contractor				Sheet
JS Drilling				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
							Pale to medium grey, fine grained Waulsortian LIMESTONE. Fragments are strong, sub-angular to angular in shape and < 6 cm in diameter. End of Hole @ 15 m.		
				1.75		15.00			

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To

GENERAL REMARKS

No water encountered. Hole left open for possible future installation.

All dimensions in metres Scale 1:93.75	Client Aughinish Alumina	Method/ Plant Used Beretta T44	Logged By C. Maguire

AGS3 UK BH AUGHINISH BORROW PIT.GPJ GINT STD AGS 3_1.GDT 13/2/17

BOREHOLE LOG

Project				BOREHOLE No
Aughinish Borrow Pit				**BH-5**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
1667376	26-01-17	18.024 mAOD	E 128167.348, N 152541.720	
Contractor				Sheet
JS Drilling				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
				17,80		0,20	Medium grey silty gravelly OVERBURDEN.		
						(2,80)	Pale to medium grey, fine grained Waulsortian LIMESTONE. Fragments are sub-angular to angular in shape and <6 cm in diameter.		
				15,00		3,00			
				14,50		3,50	Cavity.		
						(1,00)	LIMESTONE, same as previous.		
				13,50		4,50			
				13,00		5,00	Cavity.		
						(1,00)	LIMESTONE, same as previous.		
				12,00		6,00			
						(1,50)	Cavity. Hole terminated at 7.5 m.		
				10,50		7,50			

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To

GENERAL REMARKS

No water encountered. Hole left open for possible future installation. Hole terminated at 7.5 m due to bad drilling conditions and many cavities.

All dimensions in metres Scale 1:93.75	Client Aughinish Alumina	Method/ Plant Used Beretta T44	Logged By C. Maguire

AGS3 UK BH AUGHINISH BORROW PIT.GPJ GINT STD AGS 3_1.GDT 13/2/17

BOREHOLE LOG

Project				BOREHOLE No
Aughinish Borrow Pit				**BH-6**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
1667376	27-01-17	17.657 mAOD	E 128164.196, N 152554.594	
Contractor				Sheet
JS Drilling				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
				15,02		(3,00) 3,00	Pale to medium grey, fine grained Waulsortian LIMESTONE. Fragments are sub-angular to angular in shape, strong and < 5 cm in diameter.		
				13,02		(2,00) 5,00	Cavity.		
				3,02		(10,00) 15,00	LIMESTONE, same as previous. End of Hole at 15 m.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	No water encountered. Hole left open for possible future installation.

All dimensions in metres Scale 1:93.75	Client Aughinish Alumina	Method/ Plant Used Beretta T44	Logged By C. Maguire

AGS3 UK BH AUGHINISH BORROW PIT.GPJ GINT STD AGS 3_1.GDT 13/2/17

Appendix 8.2: Soil Quality Sampling Report (2016/2017)

June 2017

AUGHINISH ALUMINA LIMITED

SOIL QUALITY MONITORING REPORT, AUGHINISH, CO. LIMERICK

Submitted to:
Aughinish Alumina Limited,
Aughinish Island,
Askeaton,
Co. Limerick

REPORT

Report Number. 1663245.R01.A2

Distribution:

Aughinish Alumina Limited - 1 copy (pdf)
Golder Associates Ireland Limited - 1 copy (pdf)

Golder Associates

Table of Contents

1.0 INTRODUCTION

Aughinish Alumina Limited (AAL) requested Golder Associates Ireland Limited (Golder) to undertake a soil sampling and testing programme for its licensed facility on Aughinish Island, Askeaton, County Limerick (the Site). This work was undertaken to satisfy the requirements of Schedule C.6 - Soil Monitoring of the Industrial Emissions Licence (IEL) Reference Number P0035-06. The IEL specifies that soil monitoring be conducted every five years for relevant hazardous substances as specified in the *Aughinish Alumina: Baseline Soil and Groundwater Report*[1].

1.1 Background

AAL produces alumina (Al_2O_3) by treating bauxite ore, using the Bayer process which involves the dissolution of aluminium hydrate ($Al_2O_3.3H_2O$) from the bauxite under high pressure in sodium hydroxide (caustic soda).

Waste products from the refining process are bauxite residue and salt cake which comprises oxides of aluminium, iron and titanium and salt deposits and takes the form of a sand and red mud or salt cake respectively. Contained within the bauxite residue is a residual quantity of sodium aluminate which exists in this residue as a caustic solution. The bauxite residue and salt cake are deposited in an engineered contained facility, the Bauxite Residue Disposal Area (BRDA). Most of the waste types deposited in the BRDA are classified as non-hazardous according to the European Waste Catalogue. Salt cake is classified as hazardous and is deposited in a specially engineered cell with the BRDA. The BRDA falls within the scope of Directive 2006/21/EC on the management of waste from the extractive industries. The BRDA is a Category A waste facility.

The refined product is alumina. This is precipitated as white slurry and dried to form a fine white granular powder which is exported to aluminium smelters for processing into aluminium metal.

1.2 Site History – Soils

Prior to the construction of the plant which commenced in 1978, the area was a green field site. The topography of the proposed Plant Area in the northeast of the island was dominated by two limestone outcrops with elevations of 28.7 metres above ordnance datum (m AOD) and 19 m AOD. The outcrops were located in the middle of the current Plant Area, separated by a northeast-southwest trending valley, dipping towards the southwest. It is considered that this area would have been largely undeveloped or utilised for any purpose at this time.

Two phases of baseline soil data collection were completed prior to the construction and commissioning of the AAL plant. In 1978, a total of 25 soil samples were collected at a depth of between 0 and 100 cm^2 and were analysed for pH, phosphorous, potassium and magnesium. In 1979 a total of 514 samples were collected in an area covering an 8 km radius around the AAL plant[3]. Soils were systematically sampled at 20 m^2 gridline intersections. The samples were collected using a stainless steel sampler, where 20 cores (0 – 5 cm) were taken within a defined area and composited to give one sample. Samples were analysed for pH, phosphorous, potassium and occasionally arsenic.

During construction of the plant, the area underwent extensive regrading works. The two outcrops were blasted and the 2 million m^3 of crushed rock was used to infill the centre valley. Construction of the plant and ancillary structures took place between 1978 and 1983. The plant was commissioned in 1983. During this construction, the majority of soils present were stripped or covered over by either sealed concrete slabs in the Plant Area or engineered containment and bauxite residue in the BRDA area. It is thus considered that very little soil remains present at the Site and no direct comparison can be made between the results of the soil sampling in 2016 and the baseline soil data collected in 1978-1979.

[1] Golder Associates, June 2014 (Report reference 13514150608.501/A.0)

[2] An Foras Taluntais (1979), Soil Survey Report on Aughinish Island, Co. Limerick

[3] Fleming GA & Parle PJ, 1983, Baseline Survey in the vicinity of Aughinish Island.

1.2.1 Site Soils and Geology

The soils and sub-soils data (Teagasc) shows that the site is underlain by a combination of marine estuarine silts and clays, and glacial till derived from Carboniferous Limestones.

The bedrock geology of the site is understood to be comprised of Waulsortian Limestones in the northern and eastern parts of the site. These limestones are pale-grey, sparry, fossiliferous (bryozoan) poly-mud micritic limestones, often massive knoll forms, with crinoidal or pale cherty shaley interbeds (GSI, 1999). Dolomitisation is frequent in these limestones and is often associated with fracture zones. The development of karst features has been identified within bedrock in the immediate vicinity of area.

The southern (and western) parts of the site are underlain by the Rathkeale Formation. These rocks are dark-grey argillaceous limestones and shaley mudstones. This Formation is poorly exposed and is thought to have a maximum thickness of about 460 m.

2.0 METHODOLOGY AND APPROACH

The conditions of IEL P0035-06 specify that soil monitoring should be carried out for 'relevant hazardous substances' every five years. Relevant Hazardous Substances under Articles 3 and 22 of Regulation (EC) No 1272/2008 are those substances or mixtures which, as a result of their hazardousness, mobility, persistence and biodegradability (as well as other characteristics), are capable of contaminating soil or groundwater and are used, produced and/or released by the installation. The relevant hazardous substances specified for the Site are outlined below:

- Arsenic;
- Cadmium;
- Lead;
- Mercury;
- Nickel;
- Sodium hydroxide^;
- Compounds present in heavy fuel oil;
- Sulphuric acid^;
- Compounds present in antifoam;
- Compounds present in petrol;
- Compounds present in diesel; and
- Sodium aluminate^.

^These substances are non-hazardous but are outlined for consideration due to the quantities of use on the Site and the concentrated nature of their source.

2.1 Soil Sampling and Testing Methodology

Golder attended the Site in late 2016 and early 2017 and collected 20 soil samples. Sample locations were recorded using a GPS rover linked to the Irish National Grid (ING) base station at Shannon and the locations are shown in the Drawings Appendix at the back of the report. The sample details are provided in Table 1, below, and the full trial pit logs are included in Appendix A. Samples were collected using trial pitting methods to a maximum depth of approximately 50 cm and composite samples were compiled from each sampling location by homogenising the excavated material. The excavated material was comprised of sands, silts, and clays with many organics and root hairs and often contained large cobbles. Many trial pits were terminated at 0.2-0.3 m due to bedrock or large cobbles. Samples SL13 and SL14 contained shell fragments. Appropriate sub-samples were dispatched to Exova Jones Environmental Laboratory in the UK for a suite of testing to characterise the material in accordance with the substances specified above.

Table 1: Soil Monitoring Samples – Aughinish

Sample	Easting	Northing	Material	
SL-01	128370.794	154347.707	light brown slightly clayey sandy SILT	end of dig at 0.2 m (bedrock or large cobble)
SL-02	128628.362	153968.882	brown slightly sandy silty CLAY	end of dig at 0.2 m (bedrock or large cobble)
SL-03	128879.825	153688.531	light brown slightly clayey gravelly coarse SAND	bedrock at 0.2 m
SL-04	129001.079	153556.935	light brown slightly clayey gravelly coarse SAND	bedrock at 0.2 m
SL-05	128946.384	153326.264	light brown slightly clayey gravelly coarse SAND	bedrock at 0.25 m
SL-06	128910.733	152923.841	brown clayey sandy SILT	bedrock at 0.13 m
SL-07	128654.586	152598.566	light brown silty gravelly coarse SAND	large cobbles, end of dig at 0.4 m
SL-08	128106.016	152121.912	brown slightly sandy silty CLAY	large cobbles, end of dig at 0.4 m
SL-09	128579.088	151304.271	brown slightly sandy silty loose CLAY	large cobbles, end of dig at 0.4 m
SL-10	128688.837	150938.445	brown slightly gravelly sandy CLAY	large cobbles, end of dig at 0.3 m
SL-11	127539.915	150916.401	dark brown/black slightly sandy silty (cohesive) CLAY	odour, end of dig at 0.5 m
SL-12	127037.139	151497.803	blue/grey slightly sandy clayey SILT	end of dig at 0.5 m
SL-13	126549.807	152458.988	grey loose silty fine to coarse SAND	many shells, end of dig at 0.5 m
SL-14	127271.517	152765.477	light brown/grey cohesive slightly sandy SILT	some shells, end of dig at 0.5 m
SL-15	127673.827	153175.535	brown slightly sandy silty CLAY	large cobbles, hit rock at 0.3 m
SL-16	127988.416	153960.558	brown silty sandy CLAY	hit rock at 0.3 m
SL-17	126979.354	151570.483	dark brown slightly sandy silty CLAY	some shells, hit rock at 0.48 m
SL-18	127671.661	153236.998	brown cohesive slightly sandy silty CLAY	large cobbles, end of dig at 0.48 m
SL-19	127923.309	153464.621	brown sandy silty CLAY	hit rock at 0.18 m
SL-20	127309.60	151139.6	Cohesive soft brown slightly gravelly sandy CLAY with pockets of bluish grey SILT/CLAY	End of dig at 0.85 m

3.0 RESULTS

As noted in Section 1.2, no specific on-site soil sampling locations were identified for baseline sampling and hence only the regional composition in the vicinity to the site has been historically characterised. Given that samples at defined locations have been collected in December 2016 – April 2017, these can be considered a baseline for future soil monitoring at the same locations. The analytical results can be broadly categorised into metals, semi-volatile organic compounds (SVOCs), gasoline range organics (GRO), extractable petroleum hydrocarbons (EPH), and nonyl phenol ethoxylates. Summary statistics for the samples have been prepared in Table 1 and the analytical report is in Appendix B.

The operation of the Site uses caustic soda in the majority of processes but also uses acid in some processes; hence an understanding of the pH is an important indicator of the impact of the Site. The soil pH ranged from 6.07 to 8.53, with the majority of results around pH 8. This does not show any significant acidification or alkalinisation in soils from industrial activities to date.

Samples were analysed for aluminium, arsenic, cadmium, lead, mercury, nickel, sodium, and total sulphate. Aluminium is the third most abundant element in the Earth's crust and concentrations in soils can range from 4% to 5% regionally[4]. One sample, SL-01, contained an elevated aluminium concentration compared with the other samples (40,630 mg/kg (4.06%) vs median of 9,223 mg/kg (0.9%)). One sample, SL-10, contained an elevated lead concentration compared with the other samples (1195 mg/kg vs median concentration of 14 mg/kg). Samples SL-01 and SL-10 did not exhibit visible anthropogenic influence from the sampling logs. Concentrations of arsenic ranged from 2.9 to 23.1 mg/kg, which is below the geochemical signature for the area[5]. No mercury was detected in any samples.

Five samples exhibited potential evidence of impact from industrial activities with regards to hydrocarbons, albeit at low concentrations. SL-16 exhibited very low concentrations of polycyclic aromatic hydrocarbons (PAHs, maximum concentrations of <1 mg/kg), which are chemicals that are released from burning organic substances such as coal, oil, and gasoline. Samples SL-11, SL-12, SL-17, and SL-19 had extractable petroleum hydrocarbon results above detection (maximum concentration of 276 mg/kg). Gasoline range organics and sVOCs were detected in sample SL-19 at low concentrations (C4-C12 concentration = 0.416 mg/kg, sVOC 1,3 Cyclooctadiene concentration = 1.498 mg/kg).

Nonyl phenol ethoxylates are non-ionic surfactants that are used in lubricating oil additives, detergents, and emulsifiers that are of environmental concern due to their ability to mimic the hormone oestrogen, which is of special concern to the reproduction of aquatic organisms. They have a low mobility in soils and sediments and can bioaccumulate. No nonyl phenol ethoxylates were detected in any samples.

The Site has been operational for 34 years and thus these results do not constitute a pre-operational baseline. These results can be utilised as a starting point for comparison purposes and soil monitoring should be carried out in five years in accordance with the conditions of the licence.

[4] Teagasc (2007) Soil Geochemical Atlas of Ireland.

[5] Fleming. G.A, Parle. P.J (1983); Baseline Survey in the vicinity of Aughinish Island.

Table 2: Soil Sampling Summary Statistics (20 samples) - Aughinish Alumina Ltd, 2016/2017

Parameter	Units	Minimum	Maximum	Mean*	Median*
pH	pH units	6.07	8.53	7.9	8.1
Total Sulphate	mg/kg	100	2092	494	327
Aluminium	mg/kg	1,196	40,630	11,026	10,657
Arsenic	mg/kg	2.9	23.1	10.3	10.2
Cadmium	mg/kg	<0.1	2.3	0.78	0.6
Lead	mg/kg	<5	1195	87	18
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	8.1	67.3	28.4	24.8
Sodium	mg/kg	121	602	238	188
Extractable Petroleum Hydrocarbons (EPH, C8-C40)	mg/kg	detected in samples SL11 (276 mg/kg), SL12 (146 mg/kg), SL-17 (181 mg/kg), and SL-19 (125 mg/kg)			
Gasoline Range Organics (GRO)	µg/kg	Only detected in sample SL-19 (C4-C12 = 416 µg/kg)			
Nonyl phenol ethoxylates	mg/kg	<0.5	<0.5	<0.5	<0.5
sVOCs	µg/kg	Detected in sample SL-16 (speciated polycyclic aromatic hydrocarbons) and SL-19 (1,3-cyclooctadiene)			

*values below detection were not considered for mean and median concentrations

4.0 CONCLUSIONS AND RECOMMENDATIONS

The conditions of Licence P0035-06 specify that soil monitoring should be carried out for 'relevant hazardous substances' every five years. A programme of soil sampling and analysis was undertaken in late 2016 and early 2017 for purposes of establishing an understanding of existing soil quality for future monitoring purposes. Samples were analysed for metals, semi-volatile organic compounds (SVOCs), gasoline range organics (GRO), extractable petroleum hydrocarbons (EPH), and nonyl phenol ethoxylates. The soil pH ranged from 6.07 to 8.53, which does not show any significant acidification or alkalinisation. An elevated aluminium concentration above median values was observed in sample SL-01 and an elevated lead concentration above median values was observed in sample SL-10. Low concentrations of EPH and very low concentrations of sVOCs were observed in samples SL11, SL12, SL16, SL-17, and SL-19. GRO was detected in sample SL- 19 at a low concentration (<1 mg/kg). No nonyl phenol ethoxylates were observed in any samples.

The Site has been operational for 34 years and thus these results do not constitute a pre-operational baseline. Soil sampling should be carried out in five years in similar locations and analysed for the same group of parameters to compare results against this starting point.

Report Signature Page

GOLDER ASSOCIATES IRELAND LIMITED

Martha Buckwalter-Davis
Geochemist

Ruth Treacy
Environmental Consultant

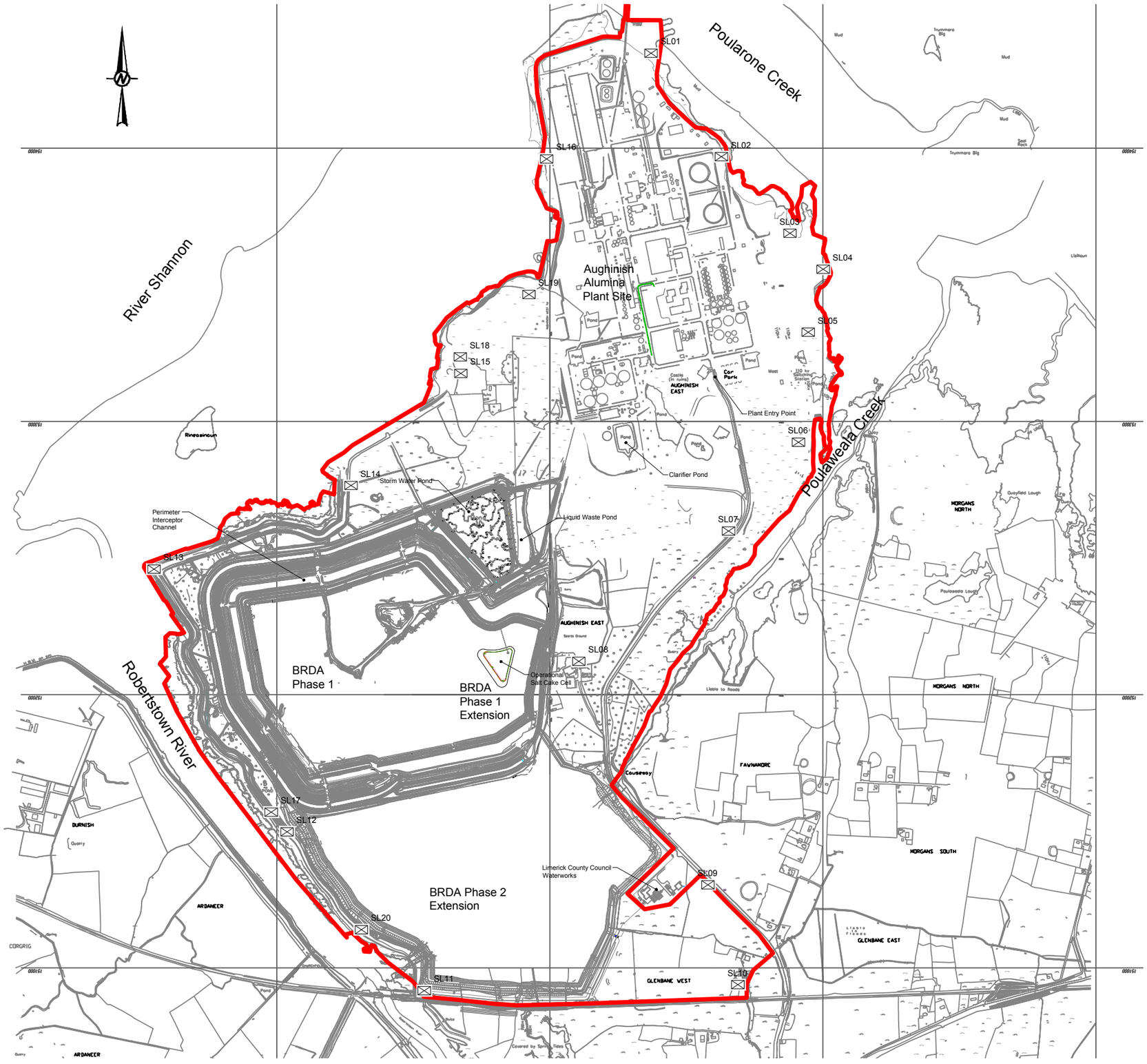
MBD/RT/pw

23 June 2017

Registered in Ireland Registration No. 297875
Town Centre House, Dublin Road, Naas, Co. Kildare, Ireland
Directors: S. Copping, A. Harris (British), DRV Jones
VAT No.: 8297875W

DRAWINGS

Drawing 01: Soil Sampling Location Plan



KEY PLAN

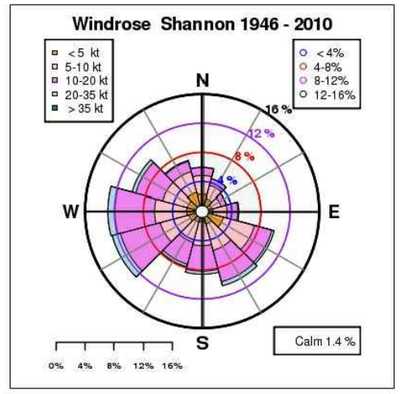
NOTES

1. Site survey based on topographical survey conducted for Proposed Mud Extension, Island Mac Teige, from Gerard Dore Surveyors, dated 23 November 2007
2. Windrose for Shannon Weather Station from met.ie

LEGEND

SL
SOIL SAMPLE LOCATION

IE LICENCE BOUNDARY



0 400 800
1:8,000 METRES

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED	DATE
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
E	2017-06-09	Revised following additional sampling location SL20	DC	BK	RW	RW	2017-06-09
D	2017-02-17	Revised following additional sampling location SL19	LMK	BK	RW	RW	2017-02-20
C	2017-02-16	Revised following addition of two sampling locations	BK	BK	RW	RW	2017-02-16
B	2017-01-27	Revised following survey of sampling points	BK	BK	RW	RW	2017-01-27
A	2016-12-02	Soil Sampling Location Plan	BK	BK	RW	RW	2016-12-12

CLIENT

AUGHINISH ALUMINA LIMITED

CONSULTANT

Golder Associates Ireland Limited
Town Centre House, Dublin Road
Naas, County Kildare
Republic of Ireland
+353 (0) 45 874411
www.golder.com

PROJECT

IEL COMPLIANCE FOR SOIL MONITORING AT AUGHINISH ALUMINA LTD

TITLE

UPDATED SOIL SAMPLING LOCATION PLAN

PROJECT No.	Scale	Rev.	1 of 1	Drawing
1663245	A3 as shown	E		1

APPENDIX A

Trial Pit Logs

Trial Pit Record : SL01

Site Location: Aughinish Alumina **Client :** AAL

Date: 13-Dec-16 **Job No. :** 1663245

Ground Level (mOD): 4.453

GPS Coordinates : 128370.794, 154347.707

Weather Conditions: o/c 10%, cold, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	TOPSOIL
0.1 - 0.2	lighht brown slightly clayey sandy SILT
	Organics/root hairs throughout

Trial Pit SL01

Water Strike (m) : N/A

Recorded By : *Lorcan McKenna*

Comments : End of dig @ 0.2m
Bedrock?

Sample Number	Sample Depth
SL01	0.20 m

Trial Pit Record : SL02

Site Location: Aughinish Alumina **Client :** AAL

Date: 13-Dec-16 **Job No. :** 1663245

Ground Level (mOD): 11.377

GPS Coordinates : 128628.362, 153968.882

Weather Conditions: o/c 10%, cold, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	TOPSOIL
0.1 - 0.25	brown slightly sandy silty CLAY
	organics/root hairs throughout

Trial pit SL02

Water Strike (m) : N/A

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.2m
Bedrock?

Sample Number	Sample Depth
SL02	0.3 m

Trial Pit Record : SL03

Site Location: Aughinsh Alumina **Client :** AAL

Date: 13-Dec-16 **Job No. :** 1663245

Ground Level (mOD): 5.510

GPS Coordinates : 128879.825, 153688.531

Weather Conditions: o/c 10%, cold, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	TOPSOIL
0.1 - 0.2	light brown slightly clayey gravelly coarse SAND
	organics/root hairs throughout

Trial Pit - SL03

Water Strike (m) : N/A

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.2m
Bedrock

Sample Number	Sample Depth
SL03	0.2 m

Trial Pit Record : SL04

Site Location: Aughinsh Alumina **Client :** AAL

Date: 13-Dec-16 **Job No. :** 1663245

Ground Level (mOD): 5.484

GPS Coordinates : 129001.079, 153556.935

Weather Conditions: o/c 10%, cold, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	TOPSOIL
0.1 - 0.2	light brown slightly clayey gravelly coarse SAND
	organics/root hairs throughout

Trial Pit - SL04

Water Strike (m) : N/A

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.2m
Bedrock

Sample Number	Sample Depth
SL04	0.2 m

Trial Pit Record : SL05

Site Location: Aughinsh Alumina **Client :** AAL

Date: 13-Dec-16 **Job No. :** 1663245

Ground Level (mOD): 4.831

GPS Coordinates : 128946.384, 153326.264

Weather Conditions: o/c 10%, cold, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	TOPSOIL
0.1 - 0.25	light brown slightly clayey gravelly coarse SAND
	organics/root hairs throughout

Trial Pit - SL05

Water Strike (m) : N/A

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.25m

Bedrock

Sample Number	Sample Depth
SL05	0.3 m

Trial Pit Record : SL06

Site Location: Aughinish Alumina **Client :** AAL

Date: 13-Dec-16 **Job No. :** 1663245

Ground Level (mOD): 11.921

GPS Coordinates : 128910.733, 152923.841

Weather Conditions: o/c 10%, cold, dry, sunny spells

Depth (m)	Material Description
0 - 0.075	TOPSOIL
0.075 - 0.13	brown clayey sandy SILT
	organics/root hairs throughout

Trial Pit - SL06

Water Strike (m) : N/A

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.13m
Bedrock

Sample Number	Sample Depth
SL06	0.1 m

Trial Pit Record : SL07

Site Location: Aughinish Alumina **Client :** AAL

Date: 13-Dec-16 **Job No. :** 1663245

Ground Level (mOD): 10.089

GPS Coordinates : 128654.586, 152598.566

Weather Conditions: o/c 10%, cold, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	TOPSOIL
0.1 - 0.4	light brown silty gravelly coarse SAND
	organics/root hairs throughout and occasional large cobbles

Trial Pit - SL07

Water Strike (m) : N/A

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.4m
Large cobble

Sample Number	Sample Depth
SL07	0.4 m

Trial Pit Record : SL08

Site Location: Aughinish Alumina **Client :** AAL

Date: 13-Dec-16 **Job No. :** 1663245

Ground Level (mOD): 15.184

GPS Coordinates : 128106.016, 152121.912

Weather Conditions: o/c 10%, cold, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	TOPSOIL
0.1 - 0.4	brown slightly sandy silty CLAY
	organics/root hairs and occasional large cobbles

Trial Pit - SL08

Water Strike (m) : N/A

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.4m
Large cobble

Sample Number	Sample Depth
SL08	0.4 m

Trial Pit Record : SL09

Site Location: Aughinish Alumina **Client :** AAL

Date: 14-Dec-16 **Job No. :** 1663245

Ground Level (mOD): 5.759

GPS Coordinates : 128579.088, 151304.271

Weather Conditions: o/c 10%, cold, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	TOPSOIL
0.1 - 0.4	brown slightly sandy silty loose CLAY
	many organics/root hairs and large cobbles

Trial Pit - SL09

Water Strike (m) : N/A

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.4m
Large cobble

Sample Number	Sample Depth
SL09	0.4 m

Trial Pit Record : SL10

Site Location: Aughinish Alumina **Client :** AAL

Date: 14-Dec-16 **Job No. :** 1663245

Ground Level (mOD): 2.938

GPS Coordinates : 128688.837, 150938.445

Weather Conditions: o/c 10%, cold, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	TOPSOIL
0.1 - 0.3	brown slightly gravelly sandy CLAY
	many organics/root hairs and large cobbles

Trial Pit - SL10

Water Strike (m) : N/A

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.3m
Large cobble

Sample Number	Sample Depth
SL10	0.3 m

Trial Pit Record : SL11

Site Location: Aughinish Alumina **Client :** AAL

Date: 14-Dec-16 **Job No. :** 1663245

Ground Level (mOD): 1.553

GPS Coordinates : 127539.915, 150916.401

Weather Conditions: o/c 10%, cold, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	TOPSOIL
0.1 - 0.5	dark brown/black slightly sandy silty (cohesive) CLAY
	many organics/root hairs and odour

Trial Pit - SL11

Water Strike (m) : 0.5m

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.5m

Sample Number	Sample Depth
SL11	0.5 m

Trial Pit Record : SL12

Site Location: Aughinish Alumina **Client :** AAL

Date: 14-Dec-16 **Job No. :** 1663245

Ground Level (mOD): 1.706

GPS Coordinates : 127037.139, 151497.803

Weather Conditions: o/c 10%, cold, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	TOPSOIL
0.1 - 0.5	blue/grey slightly sandy clayey SILT
	many organics/root hairs

Trial Pit - SL12

Water Strike (m) : N/A

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.5m

Sample Number	Sample Depth
SL12	0.5 m

Trial Pit Record : SL13

Site Location: Aughinish Alumina **Client :** AAL

Date: 14-Dec-16 **Job No. :** 1663245

Ground Level (mOD): 1.512

GPS Coordinates : 126549.807, 152458.988

Weather Conditions: o/c 10%, cold, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	TOPSOIL
0.1 - 0.5	grey loose silty fine to coarse SAND
	many shells and some organics

Trial Pit - SL13

Water Strike (m) : N/A

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.5m

Sample Number	Sample Depth
SL13	0.5 m

Trial Pit Record : SL14

Site Location: Aughinish Alumina **Client :** AAL

Date: 14-Dec-16 **Job No. :** 1663245

Ground Level (mOD):

GPS Coordinates :

Weather Conditions: o/c 10%, cold, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	mottled TOPSOIL
0.1 - 0.5	light brown/grey cohesive slightly sandy SILT
	organics and some shells

Trial Pit - SL14

Water Strike (m) : N/A

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.5m

Sample Number	Sample Depth
SL14	0.5 m

Trial Pit Record : SL15

Site Location: Aughinish Alumina **Client :** AAL

Date: 13-Dec-16 **Job No. :** 1663245

Ground Level (mOD): 9.363

GPS Coordinates : 127673.827, 153175.535

Weather Conditions: o/c 10%, cold, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	TOPSOIL
0.1 - 0.3	brown slightly sandy silty CLAY
	organics/root hairs and (large) cobbles

Trial Pit - SL15

Water Strike (m) : N/A

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.3m
Rock/large cobble

Sample Number	Sample Depth
SL15	0.3 m

Trial Pit Record : SL16

Site Location: Aughinish Alumina **Client :** AAL

Date: 13-Dec-16 **Job No. :** 1663245

Ground Level (mOD): 9.376

GPS Coordinates : 127988.416, 153960.558

Weather Conditions: o/c 10%, cold, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	TOPSOIL
0.1 - 0.3	brown silty sandy CLAY
	organics/root hairs throughout

Trial Pit - SL16

Water Strike (m) : N/A

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.3m
Rock

Sample Number	Sample Depth
SL16	0.3 m

Trial Pit Record : SL17

Site Location: Aughinish Alumina **Client :** AAL

Date: 14-Feb-17 **Job No. :** 1663245

Ground Level (mOD): 2.043

GPS Coordinates : E: 126979.354, N: 151570.483

Weather Conditions: o/c 60%, mild, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	TOPSOIL
0.1 - 0.3	grey cohesive slightly sandy (fine) SILT
0.3 - 0.48	dark brown/brown slightly sandy silty CLAY
	organics/root hairs throughout and occasional shells

Trial Pit - SL17

Soil Sample - SL17

Water Strike (m) : N/A

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.48m

Sample Number	Sample Depth
SL17	0.48 m

Trial Pit Record : SL18

Site Location: Aughinish Alumina **Client :** AAL

Date: 14-Feb-17 **Job No. :** 1663245

Ground Level (mOD): 9.489

GPS Coordinates : E: 127671.661, N: 153236.998

Weather Conditions: o/c 60%, mild, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	TOPSOIL
0.1 - 0.4	brown cohesive slightly sandy silty CLAY
	organics/root hairs throughout and small/medium limestone cobbles

Trial Pit - SL18

Soil Sample - SL18

Water Strike (m) : N/A

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.4m
Large cobbles/ROCK

Sample Number	Sample Depth
SL18	0.4 m

Trial Pit Record : SL19

Site Location: Aughinish Alumina **Client :** AAL

Date: 17-Feb-17 **Job No. :** 1663245

Ground Level (mOD): 13.125

GPS Coordinates : E: 127923.309, N: 153464.621

Weather Conditions: o/c 60%, mild, dry, sunny spells

Depth (m)	Material Description
0 - 0.1	TOPSOIL
0.1 - 0.17	brown sandy silty CLAY
	organics/root hairs throughout and many angular cobbles

Trial Pit - SL18

Soil Sample - SL18

Water Strike (m) : N/A

Recorded By : Lorcan McKenna

Comments : End of dig @ 0.4m

BEDROCK

Sample Number	Sample Depth
SL19	0.1-0.17 m

Trial Pit Record : SL20

Site Location: Aughinish Alumina **Client :** AAL

Date: 12-Apr-17 **Job No. :** 1663245

Ground Level (mOD): 2.15

GPS Coordinates : E:127309.60 , N:151139.6

Weather Conditions: o/c 80%, mild, showers, sunny spells

Depth (m)	Material Description
0 - 0.2	TOPSOIL
0.2 - 0.85	Cohesive soft brown slightly gravelly sandy CLAY with pockets of bluish grey SILT/CLAY
	organics/root hairs throughout and many angular cobbles

Trial Pit - SL20

Soil Sample - SL20

Water Strike (m) : 0.8 m

Recorded By : Darren Crowe

Comments : End of dig @ 0.85m

Sample Number	Sample Depth
SL 20	0.2 - 0.85 m

APPENDIX B

Analytical Report

Appendix B

Sample ID				SL01	SL02	SL03	SL04	SL05	SL06	SL07	SL08	SL09	SL10	SL11	SL12	SL13	SL14	SL15	SL16	SL-17	SL-18	SL-19	SL-20
Depth				0.20	0.30	0.20	0.20	0.30	0.10	0.40	0.40	0.40	0.30	0.50	0.50	0.50	0.50	0.30	0.30	0.48	0.4	0.10-0.17	0.2-0.85
Sample Type				Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sampled Date				15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	14/02/2017	14/02/2017	17/02/2017	12/04/2017
Sample Received Date				19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	16/02/2017	16/02/2017	21/02/2017	18/04/2017
Test	**Method**	**Units**	**LOD**																				
Aluminium	TM30/PM15	mg/kg	<50	40630	14960	5770	1196	1984	1893	3799	9072	13450	5387	14600	18630	6331	11940	16060	9374	12360	13400	7061	12630
Arsenic #	TM30/PM15	mg/kg	<0.5	12.4	9	6.1	3.5	2.9	3.4	10.7	11.9	18.5	9.9	13.7	10.2	6.7	10.5	19.4	10.1	10.8	23.1	4.2	8.3
Cadmium #	TM30/PM15	mg/kg	<0.1	0.8	0.8	0.3	0.4	0.4	0.5	0.7	1	1.5	0.9	0.3	<0.1	0.3	0.4	2.3	0.9	0.2	2.2	<0.1	0.2
Lead #	TM30/PM15	mg/kg	<5	14	18	9	<5	<5	<5	14	13	19	1195	38	18	13	13	21	12	23	19	19	13
Mercury #	TM30/PM15	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel #	TM30/PM15	mg/kg	<0.7	49.4	42	16.9	8.3	8.8	8.1	20.9	39	34.1	16.4	23.6	34.6	14.7	25.6	59.8	32.4	23.9	67.3	16.9	26.1
Sodium	TM30/PM15	mg/kg	<5	294	163	181	179	173	154	136	184	191	168	263	564	602	234	189	188	275	121	195	314
Total Sulphate as SO4 #	TM50/PM29	mg/kg	<50	240	330	179	168	186	267	100	468	796	552	2092	750	909	318	559	339	948	323	153	218
SVOC MS																							
Phenols																							
2-Chlorophenol #	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2-Methylphenol	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2-Nitrophenol	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2,4-Dichlorophenol #	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2,4-Dimethylphenol	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2,4,5-Trichlorophenol	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2,4,6-Trichlorophenol	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
4-Chloro-3-methylphenol	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
4-Methylphenol	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
4-Nitrophenol	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Pentachlorophenol	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Phenol #	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
PAHs																							
2-Chloronaphthalene #	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2-Methylnaphthalene #	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Naphthalene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthylene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluorene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Phenanthrene #	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Anthracene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluoranthene #	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	118	<10	<10	<10	<10
Pyrene #	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	102	<10	<10	<10	<10
Benzo(a)anthracene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	111	<10	<10	<10	<10
Chrysene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	120	<10	<10	<10	<10
Benzo(bk)fluoranthene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	173	<10	<10	<10	<10
Benzo(a)pyrene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	75	<10	<10	<10	<10
Indeno(123cd)pyrene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	44	<10	<10	<10	<10
Dibenzo(ah)anthracene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	19	<10	<10	<10	<10
Benzo(ghi)perylene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	47	<10	<10	<10	<10
Benzo(b)fluoranthene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	125	<10	<10	<10	<10
Benzo(k)fluoranthene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	48	<10	<10	<10	<10
Phthalates																							
Bis(2-ethylhexyl) phthalate	TM16/PM8	ug/kg	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Butylbenzyl phthalate	TM16/PM8	ug/kg	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Di-n-butyl phthalate	TM16/PM8	ug/kg	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Di-n-Octyl phthalate	TM16/PM8	ug/kg	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Diethyl phthalate	TM16/PM8	ug/kg	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Dimethyl phthalate #	TM16/PM8	ug/kg	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Other SVOCs																							
1,2-Dichlorobenzene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
1,2,4-Trichlorobenzene #	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
1,3-Dichlorobenzene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
1,4-Dichlorobenzene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2-Nitroaniline	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2,4-Dinitrotoluene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2,6-Dinitrotoluene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
3-Nitroaniline	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
4-Bromophenylphenylether #	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
4-Chloroaniline	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
4-Chlorophenylphenylether	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
4-Nitroaniline	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Azobenzene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Bis(2-chloroethoxy)methane	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Bis(2-chloroethyl)ether	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Carbazole	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Dibenzofuran #	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Hexachlorobenzene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Hexachlorobutadiene #	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Hexachlorocyclopentadiene	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Hexachloroethane	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Isophorone #	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
N-nitrosodi-n-propylamine #	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Nitrobenzene #	TM16/PM8	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Surrogate Recovery 2-Fluorobiphenyl	TM16/PM8	%	<0	90	103	98	94	94	104	119	91	106	99	114	117	126	99	94	104	46	57	85	55
Surrogate Recovery p-Terphenyl-d14	TM16/PM8	%	<0	119	123	116	122	121	90	97	118	126	119	128	123	136	108	115	127	89	92	118	96
SVOC TICs	TM16/PM8	None		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	See Attached	ND
1,3-Cyclooctadiene	TM16/PM8	ug/kg	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1498	-
EPH (C8-C40) #	TM5/PM8	mg/kg	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	276	146	<30	<30	<30	<30	181	<30	125	<30
GRO (>C4-C8) #	TM36/PM12	ug/kg	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	164	<100
GRO (>C8-C12) #	TM36/PM12	ug/kg	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	252	<100
GRO (>C4-12) #	TM36/PM12	ug/kg	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	416	<100
Natural Moisture Content	PM4/PM0	%	<0.1	28.4	25.8	12.2	13.5	14	11	11.3	24.6	31.6	19.7	77.1	38.9	37.1	43	35.6	24.6	52.5	20	48.9	35.5
pH #	TM73/PM11	pH units	<0.01	8.18	8.12	8.36	7.93	8.26	8.18	8.53	8.12	7.89	7.99	6.07	7.8	8.2	8.15	7.69	8.23	7.75	7.44	7.91	8.44

Exova Jones Environmental

Registered Address : Exova (UK) Ltd, Lochend Industrial Estate, Newbridge, Midlothian, EH28 8PL

Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

Tel: +44 (0) 1244 833780
Fax: +44 (0) 1244 833781

Golder Associates Ltd
Town Centre House
Dublin Road
Naas
Co Kildare
Ireland

4225

Attention :	Martha Buckwalter-Davis
Date :	16th May, 2017
Your reference :	1663245
Our reference :	Test Report 16/18828 Batch 1 17/4060 Batch 1 17/4274 Batch 1 17/7103 Batch 1
Location :	
Date samples received :	
Status :	Final report
Issue :	1

Compiled By:

Simon Gomery BSc
Project Manager

Client Name: Golder Associates Ltd
Reference: 1663245
Location:
Contact: Martha Buckwalter-Davis

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Job No.	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828	Please see attached notes for all abbreviations and acronyms		
J E Sample No.	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27	28-29			
Sample ID	SL01	SL02	SL03	SL04	SL05	SL06	SL07	SL08	SL09	SL10			
Depth	0.20	0.30	0.20	0.20	0.30	0.10	0.40	0.40	0.40	0.30			
COC No / misc													
Containers	V J	V J	V J	V J	V J	V J	V J	V J	V J	V J			
Sample Date	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	LOD/LOR	Units	Method No.
Aluminium	40630	14960	5770	1196	1984	1893	3799	9072	13450	5387	<50	mg/kg	TM30/PM15
Arsenic #	12.4	9.0	6.1	3.5	2.9	3.4	10.7	11.9	18.5	9.9	<0.5	mg/kg	TM30/PM15
Cadmium #	0.8	0.8	0.3	0.4	0.4	0.5	0.7	1.0	1.5	0.9	<0.1	mg/kg	TM30/PM15
Lead #	14	18	9	<5	<5	<5	14	13	19	1195	<5	mg/kg	TM30/PM15
Mercury #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM30/PM15
Nickel #	49.4	42.0	16.9	8.3	8.8	8.1	20.9	39.0	34.1	16.4	<0.7	mg/kg	TM30/PM15
Sodium	294	163	181	179	173	154	136	184	191	168	<5	mg/kg	TM30/PM15
Total Sulphate as SO4 #	240	330	179	168	186	267	100	468	796	552	<50	mg/kg	TM50/PM29
SVOC TICs	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		None	TM16/PM8
EPH (C8-C40) #	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	mg/kg	TM5/PM8
GRO (>C4-C8) #	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	ug/kg	TM36/PM12
GRO (>C8-C12) #	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	ug/kg	TM36/PM12
GRO (>C4-12) #	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	ug/kg	TM36/PM12
Natural Moisture Content	28.4	25.8	12.2	13.5	14.0	11.0	11.3	24.6	31.6	19.7	<0.1	%	PM4/PM0
pH #	8.18	8.12	8.36	7.93	8.26	8.18	8.53	8.12	7.89	7.99	<0.01	pH units	TM73/PM11
pH #	-	-	-	-	-	-	-	-	-	-	<0.01	pH units	TM73/PM11

Client Name: Golder Associates Ltd
Reference: 1663245
Location:
Contact: Martha Buckwalter-Davis

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Job No.	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828	17/4060	17/4060	17/4274	17/7103	LOD/LOR	Units	Method No.
J E Sample No.	30-32	33-35	36-38	39-41	42-44	45-47	1-3	4-6	1-3	1-2			
Sample ID	SL11	SL12	SL13	SL14	SL15	SL16	SL-17	SL-18	SL-19	SL-20			
Depth	0.50	0.50	0.50	0.50	0.30	0.30	0.48	0.4	0.10-0.17				
COC No / misc													
Containers	V J	V J	V J	V J	V J	V J	V J	V J	V J	V J			
Sample Date	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	14/02/2017	14/02/2017	17/02/2017	12/04/2017			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	16/02/2017	16/02/2017	21/02/2017	18/04/2017			
Aluminium	14600	18630	6331	11940	16060	9374	12360	13400	7061	12630	<50	mg/kg	TM30/PM15
Arsenic #	13.7	10.2	6.7	10.5	19.4	10.1	10.8	23.1	4.2	8.3	<0.5	mg/kg	TM30/PM15
Cadmium #	0.3	<0.1	0.3	0.4	2.3	0.9	0.2	2.2	<0.1	0.2	<0.1	mg/kg	TM30/PM15
Lead #	38	18	13	13	21	12	23	19	19	13	<5	mg/kg	TM30/PM15
Mercury #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM30/PM15
Nickel #	23.6	34.6	14.7	25.6	59.8	32.4	23.9	67.3	16.9	26.1	<0.7	mg/kg	TM30/PM15
Sodium	263	564	602	234	189	188	275	121	195	314	<5	mg/kg	TM30/PM15
Total Sulphate as SO4 #	2092	750	909	318	559	339	948	323	153	218	<50	mg/kg	TM50/PM29
SVOC TICs	ND	ND	ND	ND	ND	ND	ND	ND	See Attached	ND		None	TM16/PM8
EPH (C8-C40) #	276	146	<30	<30	<30	<30	181	<30	125	<30	<30	mg/kg	TM5/PM8
GRO (>C4-C8) #	<100	<100	<100	<100	<100	<100	<100	<100	164	<100	<100	ug/kg	TM36/PM12
GRO (>C8-C12) #	<100	<100	<100	<100	<100	<100	<100	<100	252	<100	<100	ug/kg	TM36/PM12
GRO (>C4-12) #	<100	<100	<100	<100	<100	<100	<100	<100	416	<100	<100	ug/kg	TM36/PM12
Natural Moisture Content	77.1	38.9	37.1	43.0	35.6	24.6	52.5	20.0	48.9	35.5	<0.1	%	PM4/PM0
pH #	6.07	7.80	8.20	8.15	7.69	8.23	7.75	7.44	7.91	-	<0.01	pH units	TM73/PM11
pH #	-	-	-	-	-	-	-	-	-	8.44	<0.01	pH units	TM73/PM11

Please see attached notes for all abbreviations and acronyms

Client Name: Golder Associates Ltd
Reference: 1663245
Location:
Contact: Martha Buckwalter-Davis

SVOC Report : **Solid**

J E Job No.	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828			
J E Sample No.	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27	28-29			
Sample ID	SL01	SL02	SL03	SL04	SL05	SL06	SL07	SL08	SL09	SL10			
Depth	0.20	0.30	0.20	0.20	0.30	0.10	0.40	0.40	0.40	0.30	Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V J	V J	V J	V J	V J	V J	V J	V J	V J	V J			
Sample Date	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	LOD/LOR	Units	Method No.
SVOC MS													
Phenols													
2-Chlorophenol #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2-Methylphenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2-Nitrophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,4-Dichlorophenol #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,4-Dimethylphenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,4,5-Trichlorophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,4,6-Trichlorophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Chloro-3-methylphenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Methylphenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Nitrophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Pentachlorophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Phenol #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
PAHs													
2-Chloronaphthalene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2-Methylnaphthalene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Naphthalene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Acenaphthylene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Acenaphthene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Fluorene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Phenanthrene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Anthracene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Fluoranthene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Pyrene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Benzo(a)anthracene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Chrysene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Benzo(bk)fluoranthene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Benzo(a)pyrene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Indeno(123cd)pyrene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Dibenzo(ah)anthracene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Benzo(ghi)perylene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Benzo(b)fluoranthene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Benzo(k)fluoranthene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Phthalates													
Bis(2-ethylhexyl) phthalate	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	ug/kg	TM16/PM8
Butylbenzyl phthalate	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	ug/kg	TM16/PM8
Di-n-butyl phthalate	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	ug/kg	TM16/PM8
Di-n-Octyl phthalate	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	ug/kg	TM16/PM8
Diethyl phthalate	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	ug/kg	TM16/PM8
Dimethyl phthalate #	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	ug/kg	TM16/PM8

Client Name: Golder Associates Ltd
Reference: 1663245
Location:
Contact: Martha Buckwalter-Davis

SVOC Report : **Solid**

J E Job No.	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828			
J E Sample No.	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27	28-29			
Sample ID	SL01	SL02	SL03	SL04	SL05	SL06	SL07	SL08	SL09	SL10			
Depth	0.20	0.30	0.20	0.20	0.30	0.10	0.40	0.40	0.40	0.30	Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V J	V J	V J	V J	V J	V J	V J	V J	V J	V J			
Sample Date	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	LOD/LOR	Units	Method No.
SVOC MS													
Other SVOCs													
1,2-Dichlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
1,2,4-Trichlorobenzene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
1,3-Dichlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
1,4-Dichlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2-Nitroaniline	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,4-Dinitrotoluene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,6-Dinitrotoluene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
3-Nitroaniline	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Bromophenylphenylether #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Chloroaniline	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Chlorophenylphenylether	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Nitroaniline	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Azobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Bis(2-chloroethoxy)methane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Bis(2-chloroethyl)ether	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Carbazole	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Dibenzofuran #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Hexachlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Hexachlorobutadiene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Hexachlorocyclopentadiene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Hexachloroethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Isophorone #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
N-nitrosodi-n-propylamine #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Nitrobenzene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Surrogate Recovery 2-Fluorobiphenyl	90	103	98	94	94	104	119	91	106	99	<0	%	TM16/PM8
Surrogate Recovery p-Terphenyl-d14	119	123	116	122	121	90	97	118	126	119	<0	%	TM16/PM8

Client Name: Golder Associates Ltd
Reference: 1663245
Location:
Contact: Martha Buckwalter-Davis

SVOC Report : **Solid**

J E Job No.	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828	17/4060	17/4060	17/4274	17/7103			
J E Sample No.	30-32	33-35	36-38	39-41	42-44	45-47	1-3	4-6	1-3	1-2			
Sample ID	SL11	SL12	SL13	SL14	SL15	SL16	SL-17	SL-18	SL-19	SL-20			
Depth	0.50	0.50	0.50	0.50	0.30	0.30	0.48	0.4	0.10-0.17		Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V J	V J	V J	V J	V J	V J	V J	V J	V J	V J			
Sample Date	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	14/02/2017	14/02/2017	17/02/2017	12/04/2017			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	16/02/2017	16/02/2017	21/02/2017	18/04/2017	LOD/LOR	Units	Method No.
SVOC MS													
Phenols													
2-Chlorophenol #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2-Methylphenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2-Nitrophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,4-Dichlorophenol #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,4-Dimethylphenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,4,5-Trichlorophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,4,6-Trichlorophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Chloro-3-methylphenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Methylphenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Nitrophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Pentachlorophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Phenol #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
PAHs													
2-Chloronaphthalene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2-Methylnaphthalene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Naphthalene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Acenaphthylene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Acenaphthene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Fluorene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Phenanthrene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Anthracene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Fluoranthene #	<10	<10	<10	<10	<10	118	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Pyrene #	<10	<10	<10	<10	<10	102	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Benzo(a)anthracene	<10	<10	<10	<10	<10	111	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Chrysene	<10	<10	<10	<10	<10	120	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Benzo(bk)fluoranthene	<10	<10	<10	<10	<10	173	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Benzo(a)pyrene	<10	<10	<10	<10	<10	75	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Indeno(123cd)pyrene	<10	<10	<10	<10	<10	44	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Dibenzo(ah)anthracene	<10	<10	<10	<10	<10	19	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Benzo(ghi)perylene	<10	<10	<10	<10	<10	47	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Benzo(b)fluoranthene	<10	<10	<10	<10	<10	125	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Benzo(k)fluoranthene	<10	<10	<10	<10	<10	48	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Phthalates													
Bis(2-ethylhexyl) phthalate	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	ug/kg	TM16/PM8
Butylbenzyl phthalate	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	ug/kg	TM16/PM8
Di-n-butyl phthalate	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	ug/kg	TM16/PM8
Di-n-Octyl phthalate	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	ug/kg	TM16/PM8
Diethyl phthalate	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	ug/kg	TM16/PM8
Dimethyl phthalate #	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	ug/kg	TM16/PM8

Client Name: Golder Associates Ltd
Reference: 1663245
Location:
Contact: Martha Buckwalter-Davis

SVOC Report : **Solid**

J E Job No.	16/18828	16/18828	16/18828	16/18828	16/18828	16/18828	17/4060	17/4060	17/4274	17/7103			
J E Sample No.	30-32	33-35	36-38	39-41	42-44	45-47	1-3	4-6	1-3	1-2			
Sample ID	SL11	SL12	SL13	SL14	SL15	SL16	SL-17	SL-18	SL-19	SL-20			
Depth	0.50	0.50	0.50	0.50	0.30	0.30	0.48	0.4	0.10-0.17		Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V J	V J	V J	V J	V J	V J	V J	V J	V J	V J			
Sample Date	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	15/12/2016	14/02/2017	14/02/2017	17/02/2017	12/04/2017			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	19/12/2016	16/02/2017	16/02/2017	21/02/2017	18/04/2017	LOD/LOR	Units	Method No.
SVOC MS													
Other SVOCs													
1,2-Dichlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
1,2,4-Trichlorobenzene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
1,3-Dichlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
1,4-Dichlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2-Nitroaniline	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,4-Dinitrotoluene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
2,6-Dinitrotoluene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
3-Nitroaniline	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Bromophenylphenylether #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Chloroaniline	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Chlorophenylphenylether	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
4-Nitroaniline	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Azobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Bis(2-chloroethoxy)methane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Bis(2-chloroethyl)ether	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Carbazole	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Dibenzofuran #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Hexachlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Hexachlorobutadiene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Hexachlorocyclopentadiene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Hexachloroethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Isophorone #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
N-nitrosodi-n-propylamine #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Nitrobenzene #	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	ug/kg	TM16/PM8
Surrogate Recovery 2-Fluorobiphenyl	114	117	126	99	94	104	46	57	85	55	<0	%	TM16/PM8
Surrogate Recovery p-Terphenyl-d14	128	123	136	108	115	127	89	92	118	96	<0	%	TM16/PM8

Job number: 17/4274
Sample number: 3
Sample identity: SL-19
Sample depth: 0.10-0.17
Sample Type: Soil
Units: ug/kg

Method: **SVOC**
Matrix: **Solid**

Note: Only samples with TICs (if requested) are reported. If TICs were requested but no compounds found they are not reported.

CAS No.	Tentative Compound Identification	Retention Time (minutes)	% Match	Concentration
1700-10-3	1,3-Cyclooctadiene	9.796	91	1498

Client Name: Golder Associates Ltd

Matrix : Solid

Reference: 1663245

Location:

Contact: Martha Buckwalter-Davis

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Analysis	Reason
16/18828	1	SL01	0.20	1-3	GRO	Sample holding time exceeded
16/18828	1	SL01	0.20	1-3	GRO	Solid Samples were received at a temperature above 9°C.
16/18828	1	SL02	0.30	4-6	GRO	Sample holding time exceeded
16/18828	1	SL02	0.30	4-6	GRO	Solid Samples were received at a temperature above 9°C.
16/18828	1	SL03	0.20	7-9	GRO	Sample holding time exceeded
16/18828	1	SL03	0.20	7-9	GRO	Solid Samples were received at a temperature above 9°C.
16/18828	1	SL04	0.20	10-12	GRO	Sample holding time exceeded
16/18828	1	SL04	0.20	10-12	GRO	Solid Samples were received at a temperature above 9°C.
16/18828	1	SL05	0.30	13-15	GRO	Sample holding time exceeded
16/18828	1	SL05	0.30	13-15	GRO	Solid Samples were received at a temperature above 9°C.
16/18828	1	SL06	0.10	16-18	GRO	Sample holding time exceeded
16/18828	1	SL06	0.10	16-18	GRO	Solid Samples were received at a temperature above 9°C.
16/18828	1	SL07	0.40	19-21	GRO	Sample holding time exceeded
16/18828	1	SL07	0.40	19-21	GRO	Solid Samples were received at a temperature above 9°C.
16/18828	1	SL08	0.40	22-24	GRO	Sample holding time exceeded
16/18828	1	SL08	0.40	22-24	GRO	Solid Samples were received at a temperature above 9°C.
16/18828	1	SL09	0.40	25-27	GRO	Sample holding time exceeded
16/18828	1	SL09	0.40	25-27	GRO	Solid Samples were received at a temperature above 9°C.
16/18828	1	SL10	0.30	28-29	GRO	Sample holding time exceeded
16/18828	1	SL10	0.30	28-29	GRO	Solid Samples were received at a temperature above 9°C.
16/18828	1	SL11	0.50	30-32	GRO	Sample holding time exceeded
16/18828	1	SL11	0.50	30-32	GRO	Solid Samples were received at a temperature above 9°C.
16/18828	1	SL12	0.50	33-35	GRO	Sample holding time exceeded

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.

Only analyses which are accredited are recorded as deviating if set criteria are not met.

Client Name: Golder Associates Ltd

Matrix : Solid

Reference: 1663245

Location:

Contact: Martha Buckwalter-Davis

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Analysis	Reason
16/18828	1	SL12	0.50	33-35	GRO	Solid Samples were received at a temperature above 9°C.
16/18828	1	SL13	0.50	36-38	GRO	Sample holding time exceeded
16/18828	1	SL13	0.50	36-38	GRO	Solid Samples were received at a temperature above 9°C.
16/18828	1	SL14	0.50	39-41	GRO	Sample holding time exceeded
16/18828	1	SL14	0.50	39-41	GRO	Solid Samples were received at a temperature above 9°C.
16/18828	1	SL15	0.30	42-44	GRO	Sample holding time exceeded
16/18828	1	SL15	0.30	42-44	GRO	Solid Samples were received at a temperature above 9°C.
16/18828	1	SL16	0.30	45-47	GRO	Sample holding time exceeded
16/18828	1	SL16	0.30	45-47	GRO	Solid Samples were received at a temperature above 9°C.

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.

Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 16/18828 17/4060 17/4274 17/7103

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS) accredited - UK.
SA	ISO17025 (SANAS) accredited - South Africa.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

JE Job No: 16/18828 17/4060 17/4274 17/7103

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.				
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM16	Modified USEPA 8270. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM16	Modified USEPA 8270. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.			AD	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM50	Acid soluble sulphate (Total Sulphate) analysed by ICP-OES	PM29	Dried and ground solid sample is boiled with dilute hydrochloric acid, the resulting liquor is then analysed.	Yes		AD	Yes
TM73	Modified US EPA methods 150.1 and 9045D and BS1377:1990. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No

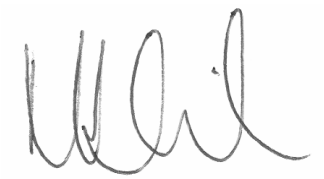
2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG6 1HE
T +44 (0)1462 480 400, **F** +44 (0)1462 480 403, **E** rpsmh@rpsgroup.com, **W** rpsgroup.com

Certificate of Analysis

Report No.: 16-58582-1

Issue No.: **1**
Date of Issue **12/01/2017**

Customer Details:	Jones Environmental Forensics Limited, Unit 3, Deeside Point, Deeside Indust. Estate Zone 3, Chester, Flintshire CH5 2UA
Customer Contact:	Paul-Lee Boden
Customer Order No.:	E20816000325
Customer Reference:	16-18828
Quotation Reference:	160816/10
Description:	16 soil samples
Date Received:	21/12/2016
Date Started:	06/01/2017
Date Completed:	11/01/2017
Test Methods:	Details available on request (refer to SOP code against relevant result/s)
Notes:	None



Approved By: **Matthew Hickson, Laboratory Manager**

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service.
Observations and interpretations are outside of the scope of UKAS accreditation.
Results reported herein relate only to the items supplied to the laboratory for testing.

2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG6 1HE
T +44 (0)1462 480 400, **F** +44 (0)1462 480 403, **E** rpsmh@rpsgroup.com, **W** rpsgroup.com

Results Summary

Report No.: 16-58582-1

Customer Reference: 16-18828

Customer Order No: E20816000325

					Customer Sample No	**2**	**5**	**8**	**11**	**14**	**17**	**20**	**23**	**26**	**29**	**31**
					RPS Sample No	317915	317916	317917	317918	317919	317920	317921	317922	317923	317924	317925
					Sample Type	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**
					Sample Depth (m)	0.2	0.3	0.2	0.2	0.3	0.1	0.4	0.4	0.4		0.5
					Sampling Date	13/12/2016	13/12/2016	13/12/2016	13/12/2016	13/12/2016	13/12/2016	13/12/2016	13/12/2016	13/12/2016		14/12/2016
Determinand	**CAS No**	**Codes**	**SOP**	**Units**	**RL**											
nonyl phenol ethoxylates			in house	mg/kg	0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG
T +44 (0)1462 480 400, **F** +44 (0)1462 480 403, **E** rpsmh@rpsgroup.com, **W** rpsgroup.

Results Summary

Report No.: 16-58582-1

Customer Reference: 16-18828

Customer Order No: E20816000325

					Customer Sample No	**34**	**37**	**40**	**43**	**46**
					RPS Sample No	317926	317927	317928	317929	317930
					Sample Type	**SOIL**	**SOIL**	**SOIL**	**SOIL**	**SOIL**
					Sample Depth (m)	0.5	0.5	0.5	0.3	0.3
					Sampling Date	14/12/2016	14/12/2016	14/12/2016	13/12/2016	13/12/2016
Determinand	**CAS No**	**Codes**	**SOP**	**Units**	**RL**					
nonyl phenol ethoxylates			in house	mg/kg	0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG6 1HE
T +44 (0)1462 480 400, **F** +44 (0)1462 480 403, **E** rpsmh@rpsgroup.com, **W** rpsgroup.com

Report No.: 16-58582-1
Customer Reference: 16-18828
Customer Order No: E20816000325

Comments

Job	Description	Job Comments
16-58582	16 soil samples	Nonyl Phenol Ethoxylate: The standard used for the analysis of nonylphenol ethoxylates (non-ionic detergents) is SURFAC NO100, an isononylphenol ethoxylate with 10 moles of ethylene oxide (supplied by Surfachem Group Limited).

2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG6 1HE
T +44 (0)1462 480 400, **F** +44 (0)1462 480 403, **E** rpsmh@rpsgroup.com, **W** rpsgroup.com

Report Information

Key to Report Codes

U	UKAS Accredited
M	MCERTS Accredited
S	Subcontracted to approved laboratory
US	Subcontracted to approved laboratory UKAS Accredited for the test
MS	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
SI	Subcontracted to internal RPS Group laboratory
USI	Subcontracted to internal RPS Group laboratory UKAS Accredited for the test
MSI	Subcontracted to internal RPS Group laboratory MCERTS/UKAS Accredited for the test
I/S (in results)	Insufficient Sample
U/S (in results)	Unsuitable Sample
S/C (in results)	See Comments
ND (in results)	Not Detected
DW (in units)	Results are expressed on a dry weight basis

Where the dry solids value of a sample is low (<50%), reporting limits are automatically raised for all determinants analysed on an as-received basis.

Soil Typing

Type 1	Clay - Brown
Type 2	Clay - Grey/Black
Type 3	Sand
Type 4	Top Soil (Standard)
Type 5	Top Soil (High Peat)
Type 6	Made Ground (>50% Clay)
Type 7	Made Ground (>50% Sand)
Type 8	Made Ground (>50% Top Soil)
Type X	Other

Sample Retention and Disposal

Samples will generally* be retained for the following times prior to disposal:

Perishables, e.g. foodstuffs	1 month (if frozen) from the issue date of this report
Waters	2 weeks from the issue date of this report
Other Liquids	1 month from the issue date of this report
Solids (including Soils)	1 month from the issue date of this report

*Sample retention may be subject to agreement with the customer for particular projects

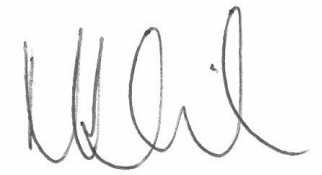
2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG6 1HE
T +44 (0)1462 480 400, **F** +44 (0)1462 480 403, **E** rpsmh@rpsgroup.com, **W** rpsgroup.com

Certificate of Analysis

Report No.: 17-59874-1

Issue No.: **1**
Date of Issue **27/02/2017**

Customer Details:	Exova (UK) Ltd, Unit 3, Deeside Point, Deeside Indust. Estate Zone 3, Chester, Flintshire, CH5 2UA
Customer Contact:	Laura Lamond
Customer Order No.:	E20817000354
Customer Reference:	17-4060
Quotation Reference:	170220/10
Description:	2 soil samples
Date Received:	20/02/2017
Date Started:	21/02/2017
Date Completed:	22/02/2017
Test Methods:	Details available on request (refer to SOP code against relevant result/s)
Notes:	None



Approved By: **Matthew Hickson, Laboratory Manager**

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service.
Observations and interpretations are outside of the scope of UKAS accreditation.
Results reported herein relate only to the items supplied to the laboratory for testing.

2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG6 1HE
T +44 (0)1462 480 400, **F** +44 (0)1462 480 403, **E** rpsmh@rpsgroup.com, **W** rpsgroup.com

Results Summary

Report No.: 17-59874-1

Customer Reference: 17-4060

Customer Order No: E20817000354

					Customer Sample No	**2**	**5**
					RPS Sample No	322478	322479
					Sample Type	**SOIL**	**SOIL**
					Sampling Date	14/02/2017	14/02/2017
Determinand	**CAS No**	**Codes**	**SOP**	**Units**	**RL**		
dry solids (at 105øC)			208	% w/w		60.8	78.6
nonyl phenol ethoxylates			in house	mg/kg DW	0.5	< 0.50	< 0.50

2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG6 1HE
T +44 (0)1462 480 400, **F** +44 (0)1462 480 403, **E** rpsmh@rpsgroup.com, **W** rpsgroup.com

Report No.: 17-59874-1
Customer Reference: 17-4060
Customer Order No: E20817000354

Comments

Job	Description	Job Comments
17-59874	2 soil samples	The standard used for the analysis of nonylphenol ethoxylates (non-ionic detergents) is SURFAC NO100, an isononylphenol ethoxylate with 10 moles of ethylene oxide (supplied by Surfachem Group Limited).

2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG6 1HE
T +44 (0)1462 480 400, **F** +44 (0)1462 480 403, **E** rpsmh@rpsgroup.com, **W** rpsgroup.com

Report Information

Key to Report Codes

U	UKAS Accredited
M	MCERTS Accredited
S	Subcontracted to approved laboratory
US	Subcontracted to approved laboratory UKAS Accredited for the test
MS	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
SI	Subcontracted to internal RPS Group laboratory
USI	Subcontracted to internal RPS Group laboratory UKAS Accredited for the test
MSI	Subcontracted to internal RPS Group laboratory MCERTS/UKAS Accredited for the test
I/S (in results)	Insufficient Sample
U/S (in results)	Unsuitable Sample
S/C (in results)	See Comments
ND (in results)	Not Detected
DW (in units)	Results are expressed on a dry weight basis

Where the dry solids value of a sample is low (<50%), reporting limits are automatically raised for all determinants analysed on an as-received basis.

Soil Typing

Type 1	Clay - Brown
Type 2	Clay - Grey/Black
Type 3	Sand
Type 4	Top Soil (Standard)
Type 5	Top Soil (High Peat)
Type 6	Made Ground (>50% Clay)
Type 7	Made Ground (>50% Sand)
Type 8	Made Ground (>50% Top Soil)
Type X	Other

Sample Retention and Disposal

Samples will generally* be retained for the following times prior to disposal:

Perishables, e.g. foodstuffs	1 month (if frozen) from the issue date of this report
Waters	2 weeks from the issue date of this report
Other Liquids	1 month from the issue date of this report
Solids (including Soils)	1 month from the issue date of this report

*Sample retention may be subject to agreement with the customer for particular projects

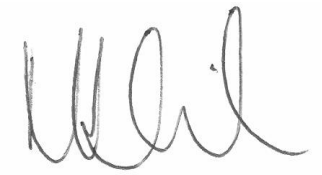
2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG6 1HE
T +44 (0)1462 480 400, **F** +44 (0)1462 480 403, **E** rpsmh@rpsgroup.com, **W** rpsgroup.com

Certificate of Analysis

Report No.: 17-59958-1

Issue No.: **1**
Date of Issue **06/03/2017**

Customer Details:	Exova (UK) Ltd, Unit 3, Deeside Point, Deeside Indust. Estate Zone 3, Chester, Flintshire, CH5 2UA
Customer Contact:	Laura Lamond (3)
Customer Order No.:	E20817000381
Customer Reference:	17-4274
Quotation Reference:	170220/10
Description:	1 soil sample
Date Received:	22/02/2017
Date Started:	23/02/2017
Date Completed:	06/03/2017
Test Methods:	Details available on request (refer to SOP code against relevant result/s)
Notes:	None



Approved By: **Matthew Hickson, Laboratory Manager**

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service.
Observations and interpretations are outside of the scope of UKAS accreditation.
Results reported herein relate only to the items supplied to the laboratory for testing.

2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG6 1HE
T +44 (0)1462 480 400, **F** +44 (0)1462 480 403, **E** rpsmh@rpsgroup.com, **W** rpsgroup.com

Results Summary

Report No.: 17-59958-1

Customer Reference: 17-4274

Customer Order No: E20817000381

					Customer Sample No	**2**
					RPS Sample No	322794
					Sample Type	**SOIL**
Determinand	**CAS No**	**Codes**	**SOP**	**Units**	**RL**	
dry solids (at 105øC)			208	% w/w		76.9
nonyl phenol ethoxylates			in house	mg/kg DW	0.5	< 0.50

2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG6 1HE
T +44 (0)1462 480 400, **F** +44 (0)1462 480 403, **E** rpsmh@rpsgroup.com, **W** rpsgroup.com

Report No.: 17-59958-1
Customer Reference: 17-4274
Customer Order No: E20817000381

Comments

RPS Sample Number	Customer Number	Sample Comments
322794	2	The standard used for the analysis of nonylphenol ethoxylates (non-ionic detergents) is SURFAC NO100, an isononylphenol ethoxylate with 10 moles of ethylene oxide (supplied by Surfachem Group Limited)

2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG6 1HE
T +44 (0)1462 480 400, **F** +44 (0)1462 480 403, **E** rpsmh@rpsgroup.com, **W** rpsgroup.com

Report Information

Key to Report Codes

U	UKAS Accredited
M	MCERTS Accredited
S	Subcontracted to approved laboratory
US	Subcontracted to approved laboratory UKAS Accredited for the test
MS	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
SI	Subcontracted to internal RPS Group laboratory
USI	Subcontracted to internal RPS Group laboratory UKAS Accredited for the test
MSI	Subcontracted to internal RPS Group laboratory MCERTS/UKAS Accredited for the test
I/S (in results)	Insufficient Sample
U/S (in results)	Unsuitable Sample
S/C (in results)	See Comments
ND (in results)	Not Detected
DW (in units)	Results are expressed on a dry weight basis

Where the dry solids value of a sample is low (<50%), reporting limits are automatically raised for all determinants analysed on an as-received basis.

Soil Typing

Type 1	Clay - Brown
Type 2	Clay - Grey/Black
Type 3	Sand
Type 4	Top Soil (Standard)
Type 5	Top Soil (High Peat)
Type 6	Made Ground (>50% Clay)
Type 7	Made Ground (>50% Sand)
Type 8	Made Ground (>50% Top Soil)
Type X	Other

Sample Retention and Disposal

Samples will generally* be retained for the following times prior to disposal:

Perishables, e.g. foodstuffs	1 month (if frozen) from the issue date of this report
Waters	2 weeks from the issue date of this report
Other Liquids	1 month from the issue date of this report
Solids (including Soils)	1 month from the issue date of this report

*Sample retention may be subject to agreement with the customer for particular projects

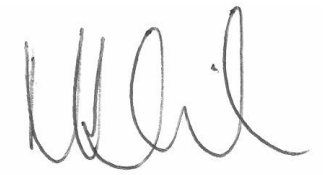
2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG6 1HE
T +44 (0)1462 480 400, **F** +44 (0)1462 480 403, **E** rpsmh@rpsgroup.com, **W** rpsgroup.com

Certificate of Analysis

Report No.: 17-61283-1

Issue No.: **1**
Date of Issue **03/05/2017**

Customer Details:	Exova (UK) Ltd, Unit 3, Deeside Point, Deeside Indust. Estate Zone 3, Chester, Flintshire, CH5 2UA
Customer Contact:	Paul Lee-Boden (4)
Customer Order No.:	E20817000778
Customer Reference:	17-7103
Quotation Reference:	170220/10
Description:	1 soil sample
Date Received:	21/04/2017
Date Started:	26/04/2017
Date Completed:	02/05/2017
Test Methods:	Details available on request (refer to SOP code against relevant result/s)
Notes:	None



Approved By: **Matthew Hickson, Laboratory Manager**

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service.
Observations and interpretations are outside of the scope of UKAS accreditation.
Results reported herein relate only to the items supplied to the laboratory for testing.

2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG6 1HE
T +44 (0)1462 480 400, **F** +44 (0)1462 480 403, **E** rpsmh@rpsgroup.com, **W** rpsgroup.com

Results Summary

Report No.: 17-61283-1

Customer Reference: 17-7103

Customer Order No: E20817000778

					Customer Sample No	**17-7103/2**
					Customer Sample ID	SL-20
					RPS Sample No	327128
					Sample Type	**SOIL**
Determinand	**CAS No**	**Codes**	**SOP**	**Units**	**RL**	
dry solids (at 105øC)		N	208	% w/w		72.8
nonyl phenol ethoxylates		N	in house	mg/kg DW	0.5	< 0.50

2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG6 1HE
T +44 (0)1462 480 400, **F** +44 (0)1462 480 403, **E** rpsmh@rpsgroup.com, **W** rpsgroup.com

Report No.: 17-61283-1
Customer Reference: 17-7103
Customer Order No: E20817000778

Comments

RPS Sample Number	Customer Number	Sample Comments
327128	17-7103/2	The standard used for the analysis of nonylphenol ethoxylates (non-ionic detergents) is SURFAC NO100, an isononylphenol ethoxylate with 10 moles of ethylene oxide (supplied by Surfachem Group Limited).

2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG6 1HE
T +44 (0)1462 480 400, **F** +44 (0)1462 480 403, **E** rpsmh@rpsgroup.com, **W** rpsgroup.com

Report Information

Key to Report Codes

U	UKAS Accredited
M	MCERTS Accredited
N	Not accredited
S	Subcontracted to approved laboratory
US	Subcontracted to approved laboratory UKAS Accredited for the test
MS	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
SI	Subcontracted to internal RPS Group laboratory
USI	Subcontracted to internal RPS Group laboratory UKAS Accredited for the test
MSI	Subcontracted to internal RPS Group laboratory MCERTS/UKAS Accredited for the test
I/S (in results)	Insufficient Sample
U/S (in results)	Unsuitable Sample
S/C (in results)	See Comments
ND (in results)	Not Detected
DW (in units)	Results are expressed on a dry weight basis

Where the dry solids value of a sample is low (<50%), reporting limits are automatically raised for all determinants analysed on an as-received basis.

Soil Typing

Type 1	Clay - Brown
Type 2	Clay - Grey/Black
Type 3	Sand
Type 4	Top Soil (Standard)
Type 5	Top Soil (High Peat)
Type 6	Made Ground (>50% Clay)
Type 7	Made Ground (>50% Sand)
Type 8	Made Ground (>50% Top Soil)
Type X	Other

Sample Retention and Disposal

Samples will generally* be retained for the following times prior to disposal:

Perishables, e.g. foodstuffs	1 month (if frozen) from the issue date of this report
Waters	2 weeks from the issue date of this report
Other Liquids	1 month from the issue date of this report
Solids (including Soils)	1 month from the issue date of this report

*Sample retention may be subject to agreement with the customer for particular projects

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

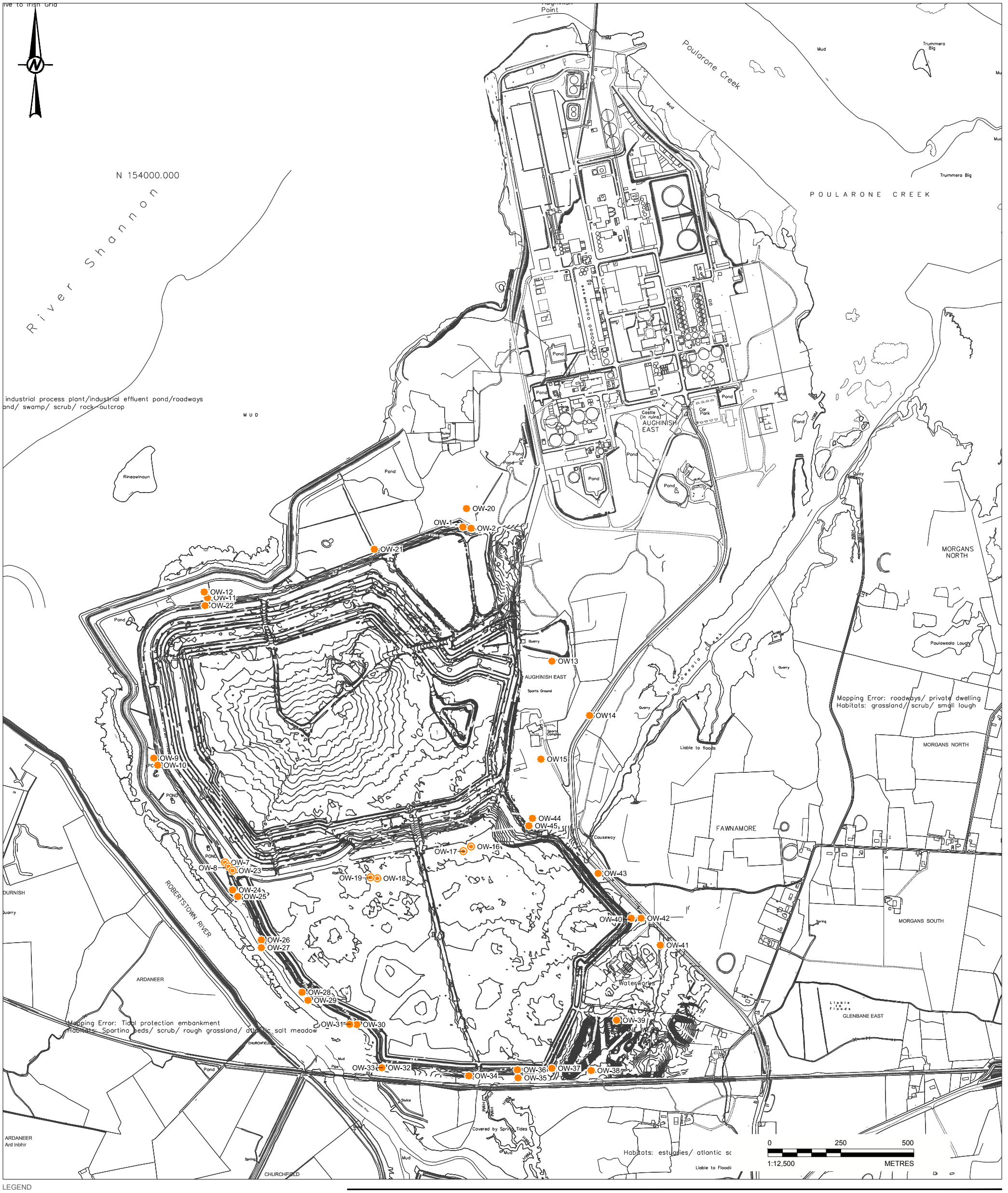
Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Ireland Limited
Town Centre House
Dublin Road
Naas
Co. Kildare
Ireland
T: +353 45 810200

Golder Associates

Appendix 8.3: Observation Well Locations and Borehole Logs



LEGEND

- GROUNDWATER MONITORING WELLS
- FORMER OW MONITORING LOCATIONS

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
A	2014-06-01	FIRST ISSUE	AD	RL	GDLT	DH

CLIENT
AUGHINISH ALUMINA LIMITED

PROJECT
BASELINE SOIL AND GROUNDWATER REPORT

CONSULTANT

NOTTINGHAM OFFICE
Browns Lane Business Park
Stanton-on-the-Wolds
UK
[+44] (0) 115 937 1111
www.golder.com

TITLE
SITE LAYOUT

PROJECT No.	CONTROL	Rev.	of	DRAWING
13514150608		A		2

ercon

AUGHINISH ALUMINA LIMITED

AUGHINISH PROJECT

RED MUD POND AREA 54A
CONSTRUCTION RECORD
STAGE II

August 1982

Engineering and Resources Consultants

Engineering and Resources Consultants Limited
Eastern Road Bracknell Berkshire RG12 2UZ
Telephone Bracknell (0344) 24151
Telex 847253 (Answerback SML ERCON BRACKL)
Telegrams Ercon Bracknell Berkshire

Australian Office
PO Box 707K Newcastle NSW2300 Australia

Nigerian Office
PO Box 787 Kano Nigeria

Report 7758/13

using glacial till compacted in 250 mm thick layers. A running surface of 150 mm thickness of modified Class II crushed rock was placed over the reinstated sections. Polyfelt fabric was placed beneath the running surface.

9 OBSERVATION WELLS

Twelve observation wells were installed in pairs at six positions around the RMP (see Dwg No 502). Working platforms were constructed from rockfill at each of the positions. Of each pair of wells, one was constructed to monitor groundwater flow in the limestone and the other to monitor flow in the overburden (see Dwg No 516).

Wells in limestone were constructed by drilling at least 1 m into limestone and grouting in a 100 mm diameter galvanised steel liner using 0.5 water/cement ratio cement grout. A 100 mm diameter hole was then drilled inside the liner to 4 m below the base of the liner. A 5.8 m length of 75 mm inside diameter (id) slotted well screen, wrapped in a single thickness of 150 micron nylon mesh was installed to the drilled depth with 75 mm id PVC plain well liner to the surface.

Wells in overburden were constructed by drilling a 200 mm minimum dia hole to rockhead. A bentonite seal was constructed to 500 mm above rock level. Slotted well screen, 75 mm id, was cut to length so that the top of the screen was installed to 500 mm below the base of the estuarine deposits. The screen was wrapped in a single thickness of 150 mm nylon mesh and installed with 75 mm id plain well liner to the surface. Sand backfill was placed around the well screen and clayey silt was tamped down around the plain section of the liner.

Further details of the construction of the individual wells are presented in Appendix A which also includes records of the ground conditions encountered during drilling.

10 ANCILLARY WORKS

10.1 Crest road

During construction the crest road was partially constructed to prevent disturbance of the embankment crest. A 150 mm thickness of Class II crushed limestone (see Fig 2) was placed over Polyfelt fabric and blinded with crushed limestone dust. At the end of construction work a 50 mm thickness of Class V crushed rock was placed to bring the crest road up to final level (see Dwg No 511). Where a thickness in excess of 50 mm was required, modified Class II crushed rock was used. The completed road was graded to a fall of 1 in 50 to the outside of the embankment and rolled.

A road edging of 150 mm thick concrete blocks was placed on the impermeable membrane on the crest of the LWP side of the embankment between the LWP and the SWP (see Dwg No 511) and the road constructed overlapping the membrane. The fabric used beneath road construction was extended over the impermeable membrane.

White painted marker stones were placed at 20 m intervals along the road edges on both sides of the crest road.

10.2 Surface water interception trench

A 500 mm deep surface water interception trench was dug across the east face above the LWP (see Dwg No 510). The trench was piped under the roadways to either side.

APPENDIX A

OBSERVATION WELLS - CONSTRUCTION DETAILS

Key.

Plain liner

Slotted screen

Grouted steel liner

Bentonite seal

Notes.

1. All depths shown are relative to top of concrete surround.

2. For details of observation well construction see Drawing No. 54 - G - 516

3. Slotted screen is not shown where inside permanent steel liner.

4. Descriptions of ground conditions are generally based on drillers description.

Drawn | Checked | Traced | Approved

ERCON
Engineering & Resources Consultants.

KEY TO OBSERVATION WELL RECORDS

Loc. No. 7758/13

Fig. A

OBSERVATION WELLS - CONSTRUCTION DETAILS

WELL NO 1 (Glacial till)

Drilling

Drilled 2.9.81 - 3.9.81

Depth drilled 7.3 m

Cased 250 mm 7.3 m

Installation

Installed 20.10.81

Problems were encountered in flushing out the hole prior to installation. Piping during withdrawl of temporary casing caused filter sand to come 1.3 m back up hole and lining sank 500 mm.

WELL NO 2 (Limestone)

Drilling

Drilled 1.9.81

Depth drilled 9.5 m

Cased 200 mm 7.6 m

150 mm 9.4 m

Brown limestone and a small cavity, probably a partly open fissure, was encountered at 8.4 m whilst drilling for permanent lining installation so drilling was continued to 9.5 m.

Grouting 19.10.81 - 20.10.81

Since grout loss resulted in a larger quantity of grout than anticipated being used, grouting was not completed in one operation. The top 3.4 m of the hole was grouted up the following day.

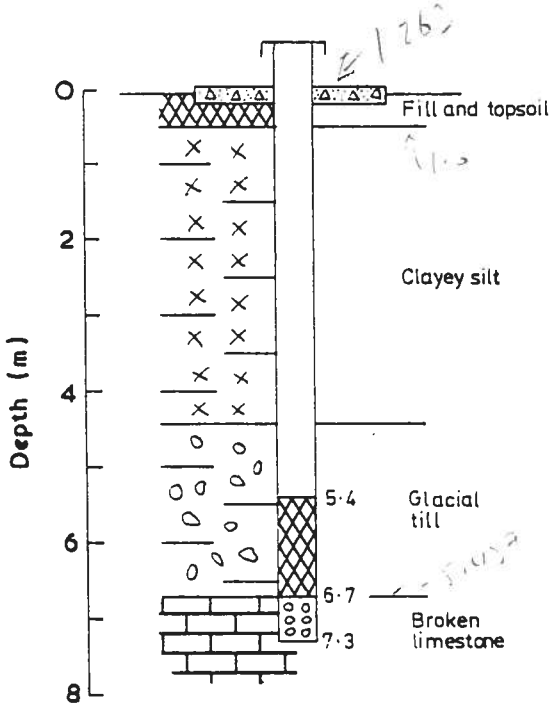
Drilling of response length 14.11.81

A pocket of clayey material was encountered just below the base of the permanent liner. Drilling was carried out to 14.0 m but the hole filled back to 13.1 m with fine clayey silty material. Water bubbled from the adjacent Well No 1 during drilling.

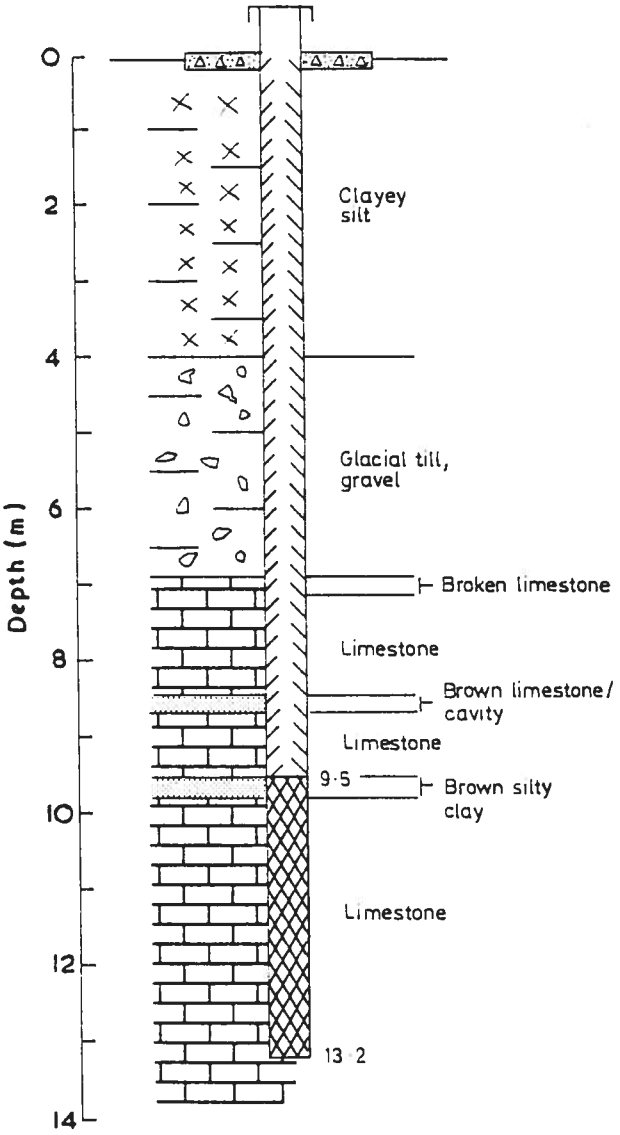
Installation of screen 27.11.81

The hole had filled back to 12.5 m so material was flushed out to 14.0 m. However screen could not be advanced below 13.2 m.

WELL Nº 1



WELL Nº 2



Drawn	Checked	Traced	Approved

ERCON
Engineering & Resources Consultants,
Eastern Road, Bracknell, Berks.

OBSERVATION WELL RECORD

Loc. No. 7758/13

Fig. A1

WELL NO 3 (Glacial till)

Drilling

Drilling started in 300 mm diameter. 250 mm casing could not be advanced below 3.7 m due to the presence of boulders in the glacial till although two attempts were made. Drilling then proceeded with 213 mm diameter but 200 mm casing could not be advanced below 5.5 m. Again two attempts were made. The hole was then abandoned. A second attempt was made at a position 6 m to the north, starting in 438 mm diameter and was successful.

1st attempt 22.10.81 - 30.10.81

Depth drilled 7.6 m

Cased 250 mm 3.7 m

200 mm 5.5 m

2nd attempt 9.11.81 - 11.11.81

Depth drilled 16.2 m

Cased 325 mm 10.1 m

250 mm 16.2 m

Installation 11.11.81

Excess bentonite was placed so the screen was shortened by 300 mm to allow for the variation. Filter sand plugged up inside the temporary casing and pulled the screen back 300 mm.

WELL NO 4 (Limestone)

Drilling 31.10.81 - 4.11.81

Depth drilled 17.5 m

Cased 250 mm 4.6 m

200 mm 9.1 m

Drilling started in 438 mm diameter and continued to 7.3 m. However the rockfill beneath the rig started to fall in and since only 250 mm diameter casing was available this was used to line the hole to prevent undermining. The casing could only be advanced to 4.6 m due to the presence of boulders in the glacial till. 200 mm diameter casing could only be advanced to 9.1 m and had to be driven to achieve this depth. Drilling continued to 17.5 m and since the hole remained open overnight installation was allowed to proceed.

Grouting 5.11.81

The hole was thoroughly flushed out before installation. The 9.1 m length of 200 mm diameter casing could not be withdrawn and had to be left in the hole.

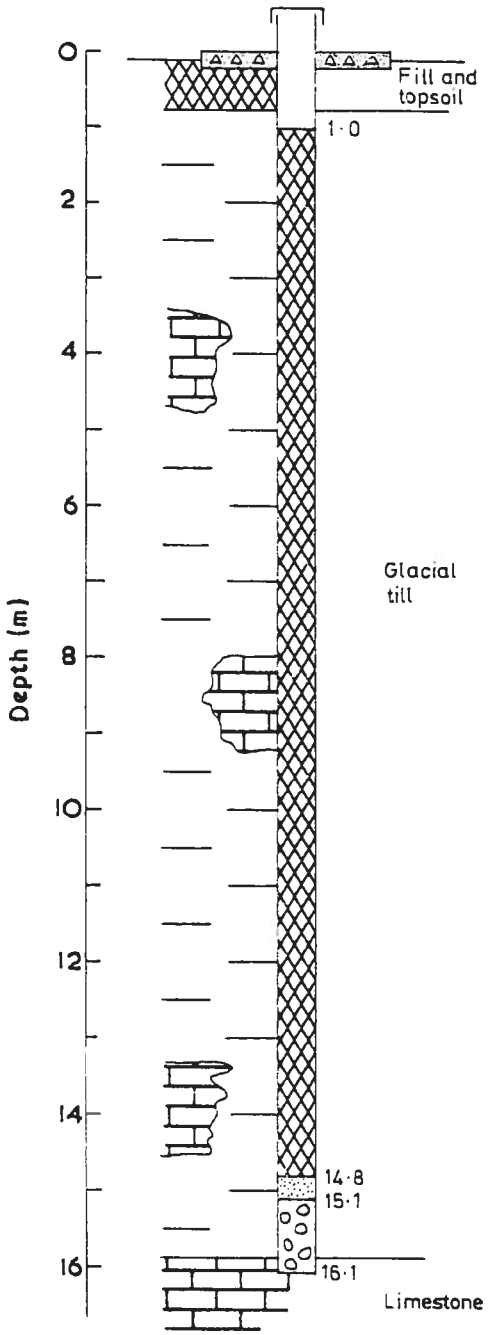
Drilling of response length 16.11.81

Overdrilled to 22.5 m

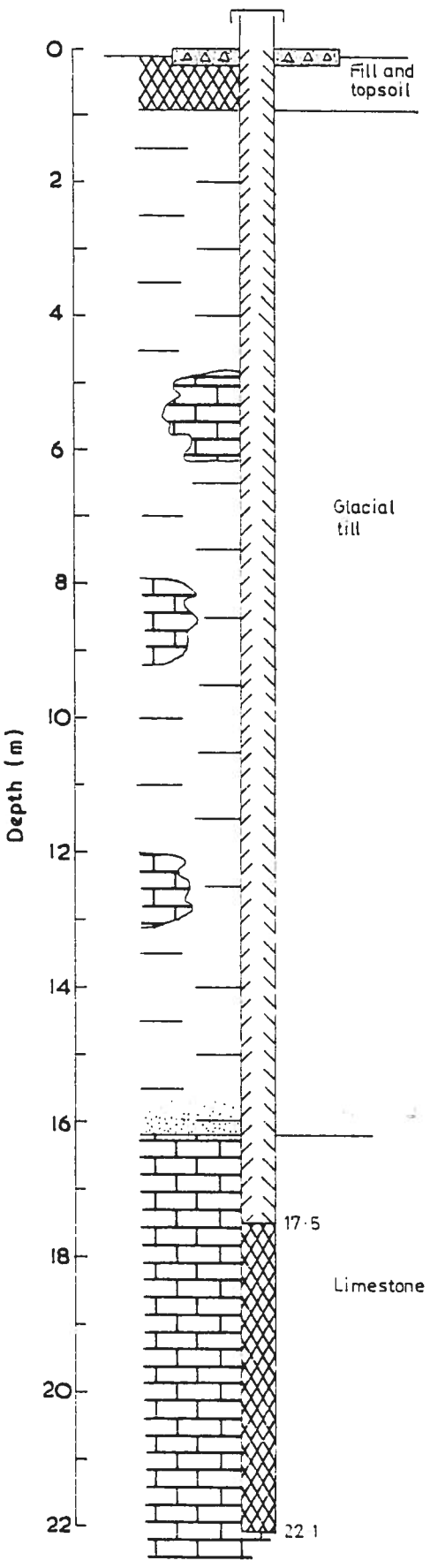
Installation of screen 30.11.81

Installed to 22.1 m

WELL Nº 3



WELL Nº 4



Drawn	Checked	Traced	Approved

ERCON
Engineering & Resources Consultants,
Eastern Road, Bracknell, Berks.

OBSERVATION WELL RECORD

Loc. No. 7758/13

Fig. A2

WELL NO 5 (Glacial till)

Drilling

A boulder was encountered at 2.4 m. This pushed the casing off at an angle to the vertical and drilling could not proceed below 6.9 m. A second attempt was made at a position about 3 m to the south and was successful.

1st attempt 22.9.81

Depth drilled 6.9 m

Casing 250 mm 3.0 m

200 mm 6.9 m

2nd attempt 25.9.81 - 28.9.81

Depth drilled 7.9 m

Cased 250 mm 5.2 m

200 mm 7.6 m

Installation 29.9.81

Immediately after installation the well was dipped and it was found that 2 m of material had collected at the base of the well. A small sample of the material was obtained and was found to consist of the finer portion of the filter sand. Since the sample contained material coarser than 150 micron, the specified mesh size, it was suspected that the nylon mesh of the screen was too coarse. Subsequent tests on samples of mesh confirmed this. An attempt was made on 17.11.81 to flush out the material. This proved unsuccessful so the well was replaced.

Redrilling 18.11.81 - 20.11.81

200 mm diameter casing was screwed down around the defective well to 7.6 m but could not be advanced below this. Material inside the casing was drilled out and most of the old screen and liner was removed. A short length remained but was eventually drilled out.

Installation 20.11.81 - 21.11.81

Since the hole was not cased to full depth, problems were encountered with clearing out the hole. However, this was achieved and the screen was installed to the required depth. During pulling of temporary casing the screen was pulled back 200 mm.

WELL NO 6 (Limestone)

Drilling 23.9.81 - 24.9.81

Depth drilled 9.1 m

Cased 300 mm 5.2 m

200 mm 5.4 m

150 mm 8.2 m

Casing was pushed off at an angle by a boulder (2^{o} to vertical) but drilling could still proceed. After pulling the outer casing it was found that the 150 mm casing remaining was reasonably straight.

Grouting

1st attempt 30.9.81

Grouting was attempted using grout mixed at the site batcher plant and delivered down a 13 mm diameter pipe. However, the pipe became blocked by pieces of aggregate contaminating the grout before any grout was introduced to the hole.

2nd attempt 8.10.81

A further attempt was made using batcher mixed grout which was passed through a sieve to remove any aggregate. The grout proved to be insufficiently mixed but by passing it through the sieve to break up balls of unmixed cement and by recirculating through the pump, a satisfactory grout was achieved. Grout was pumped down the permanent steel liner until it reappeared at the surface. Further grout was pumped down to restore the level after the temporary liner was pulled.

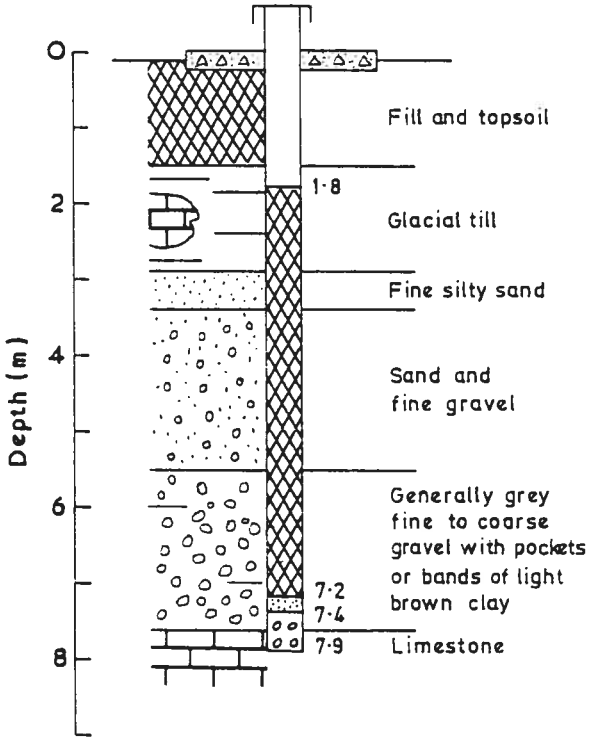
Drilling of response length 16.11.81

Drilled to 13.4 m

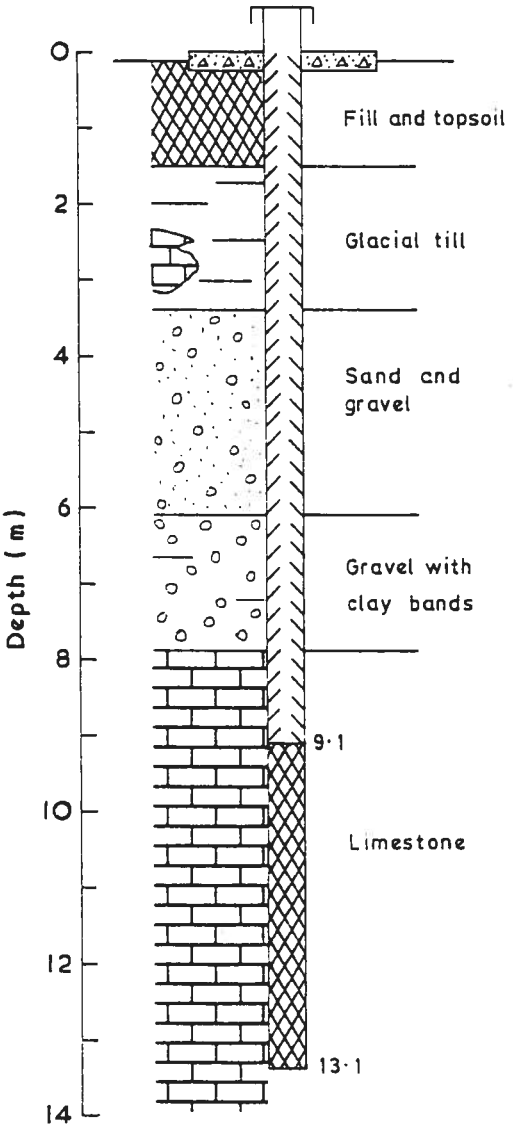
Installation of screen 30.11.81

Installed to 13.4 m

WELL Nº 5



WELL Nº 6



Drawn	Checked
Traced	Approved

ERCON
Engineering & Resources Consultants.

OBSERVATION WELL RECORD

Loc. No. 7758/13

Fig. A3

WELL NO 7	(Glacial till)
Drilled	19.9.81 - 22.9.81
Depth drilled	11.3 m
Cased 250 mm	10.7 m
200 mm	11.0 m
Installed	15.9.81

WELL NO 8 (Limestone)

Drilled 16.9.81 - 18.9.81

Depth drilled 11.7 m

Cased 250 mm 7.9 m

150 mm 11.7 m

Boulders were encountered from 6.4 to 7.0 m.

Grouted 14.10.81

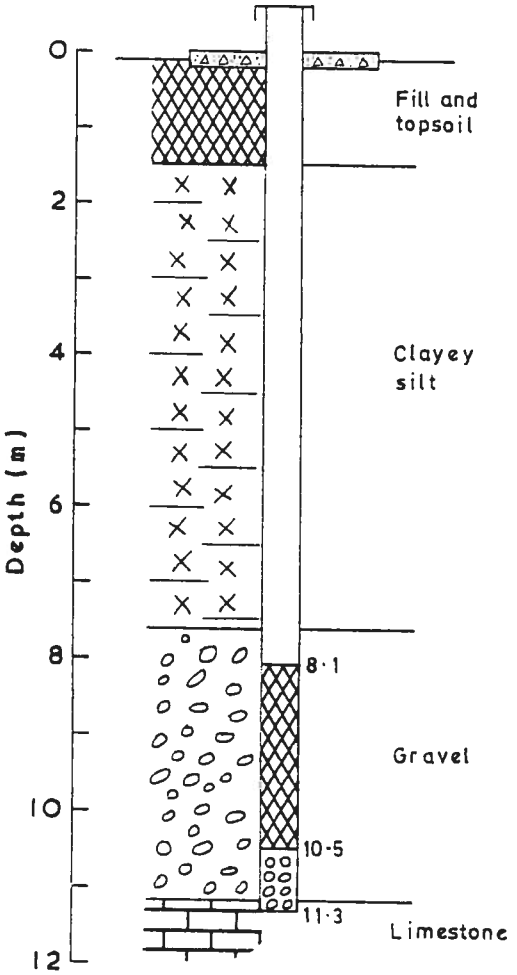
Drilling of response length 14.11.81

The hole was overdrilled to 18.2 m. Well jointed/fissured limestone was encountered. During drilling of the latter part of the hole (below 16 m) water bubbled from the adjacent Well No 7. The hole was dipped after two days and it was found that a fragment of broken rock had become dislodged and had jammed at 14.1 m. This was rodded down and became stuck at 15.7 m which was the required depth of the hole.

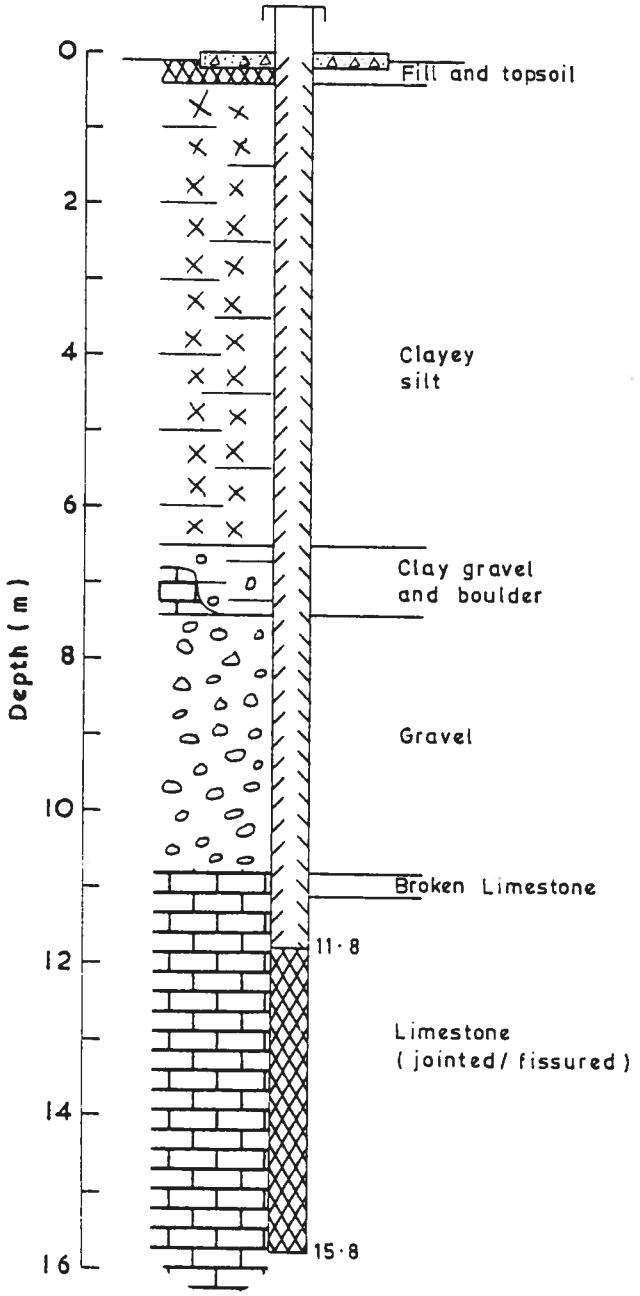
Installation of screen 30.11.81

Installed to the required depth (15.8 m below top of concrete)

WELL Nº 7



WELL Nº 8



Drawn	Checked	Traced	Approved

ERCON
Engineering & Resources Consultants,

OBSERVATION WELL RECORD

Loc. No. 7758/13

Fig. 4

WELL NO 9 (Glacial till)

Drilled 2.10.81 - 5.10.81

Depth drilled 13.5 m

Cased 250 mm 5.1 m

200 mm 7.6 m

Casing could not be advanced below 7.6 m but since the hole remained open overnight it was agreed that installation could proceed.

Installation 18.11.81

The hole was thoroughly cleaned out before installation. Excess bentonite was placed so the screen was lifted 200 mm.

WELL NO 10 (Limestone)

Drilled 6.10.81 - 12.10.81

Depth drilled 14.2 m

Cased 250 mm 5.7 m

200 mm 7.0 m

150 mm 10.7 m

Bit became blocked at 10.0 m and again at 12.5 m necessitating withdrawal of tools.

Grouted 14.10.81

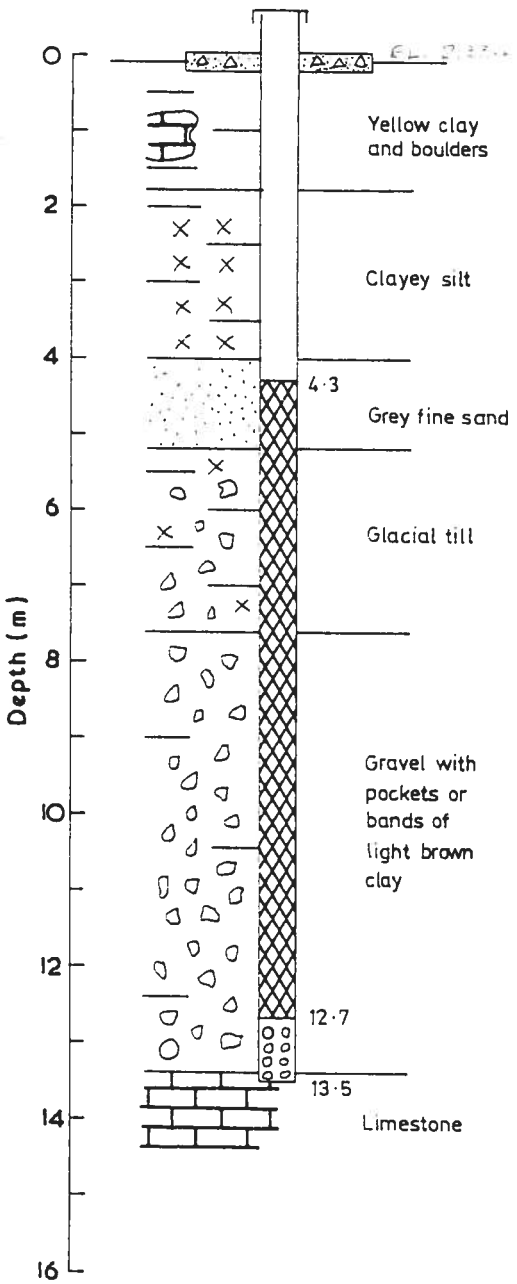
Drilling of response length 17.11.81

Drilled to 18.3 m

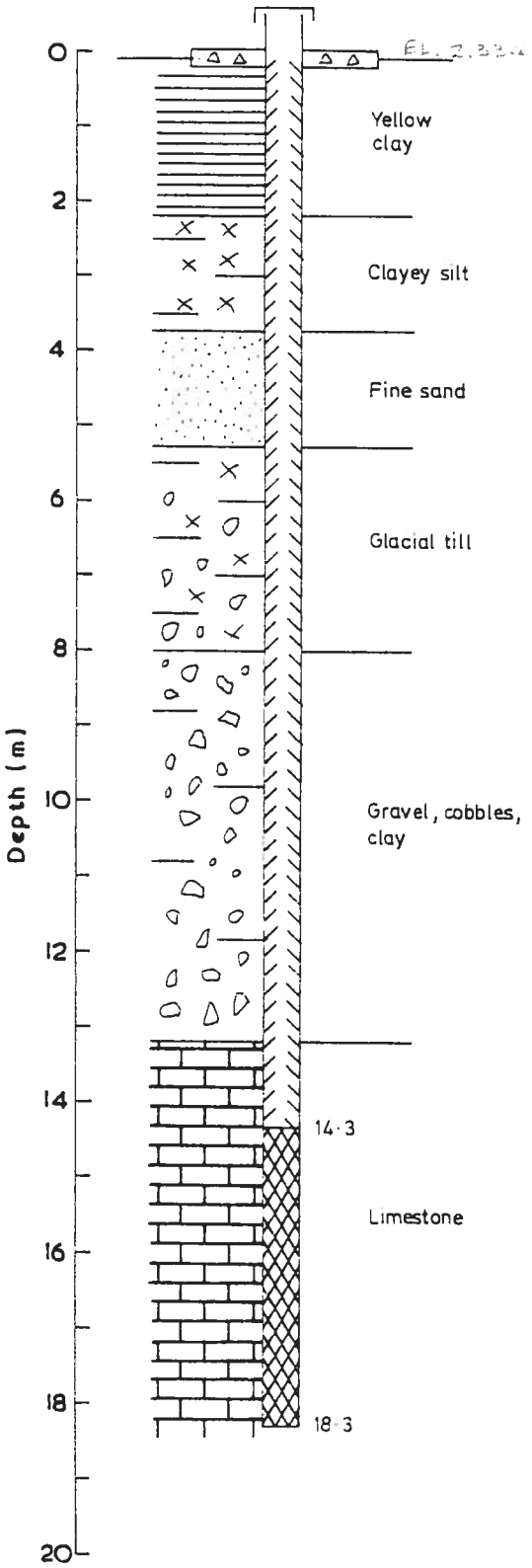
Installation of screen 1.12.81

Installed to 18.3 m

WELL Nº 9



WELL Nº 10



Drawn	Checked
Traced	Approved

ERCON
Engineering & Resources Consultants,
Eastern Road Bracknell Berks

OBSERVATION WELL RECORD

Loc. No. 7758/13

Fig. A5

WELL NO 11 (Glacial till)

Drilled 4.9.81 - 8.9.81

Depth drilled 28.0 m

Cased 250 mm 16.8 m

200 mm 26.8 m

250 mm diameter casing could not be advanced below 16.8 m due to a piece of timber encountered at this depth. Problems were also encountered with advancing casing below 25.6 m due to the presence of boulders.

Installation 15.10.81 - 16.10.81

The screen sank about 100 mm on pulling the first length of temporary casing. Clayey silt backfill was tamped down around the liner using a small plate to which lengths of rod could be added. A rising head permeability test carried out on 2.11.81 showed the well to be blocked. It was found that a lump of clayey silt material had become lodged at 19 m. This was cleared by blowing out the well using an air-line. A sample jar was lost down the well restricting the depth to 26.2 m.

WELL NO 12 (Limestone)

Drilled 9.9.81 - 15.9.81

Depth drilled 28.1 m

Cased 250 mm 21.6 m

150 mm 26.2 m

Grouted 16.10.81 - 17.10.81

Grout was pumped down the permanent liner until grout appeared at the surface. The 150 mm diameter casing was then pulled and further grout was pumped in until the grout level was near ground level. However, it required a large quantity of grout to achieve this and when pumping stopped the grout level dropped indicating that grout was running away through the ground. The consistency of the grout was thickened to a 0.4 water/cement ratio and the grout loss was reduced by doing this. By this time grout at the base of the hole started to go off and pumping through the permanent liner had to be abandoned due to a pressure build up. Grout was then pumped through a 50 mm diameter hose down the outside of the permanent liner. The 250 mm diameter casing was pulled and the grout level again was brought to ground level. The grout level was still found to drop when pumping stopped. For this reason a 4 m length of 200 mm diameter casing was left in the hole so as to keep the hole open if the grout level dropped overnight. The grout level dropped to 1.5 m below ground level and was topped up the following day. A total of 6 tonnes (120 bags) of cement was used and the grouting operation took nearly 5 hours.

Drilling of response length

1st attempt 12.11.81 - 13.11.81

Drilling out the grout inside the permanent liner was slow for this well. After drilling 1.4 m through limestone to 29.5 m, gravel was encountered

for the remainder of the response length. Drilling continued to 32.1 m but was dipped afterwards and found to have fallen in back to 29.7 m. The limestone into which the liner is grouted must either be the caprock over an infilled solution feature or a large boulder in the overburden.

2nd attempt 26.11.81

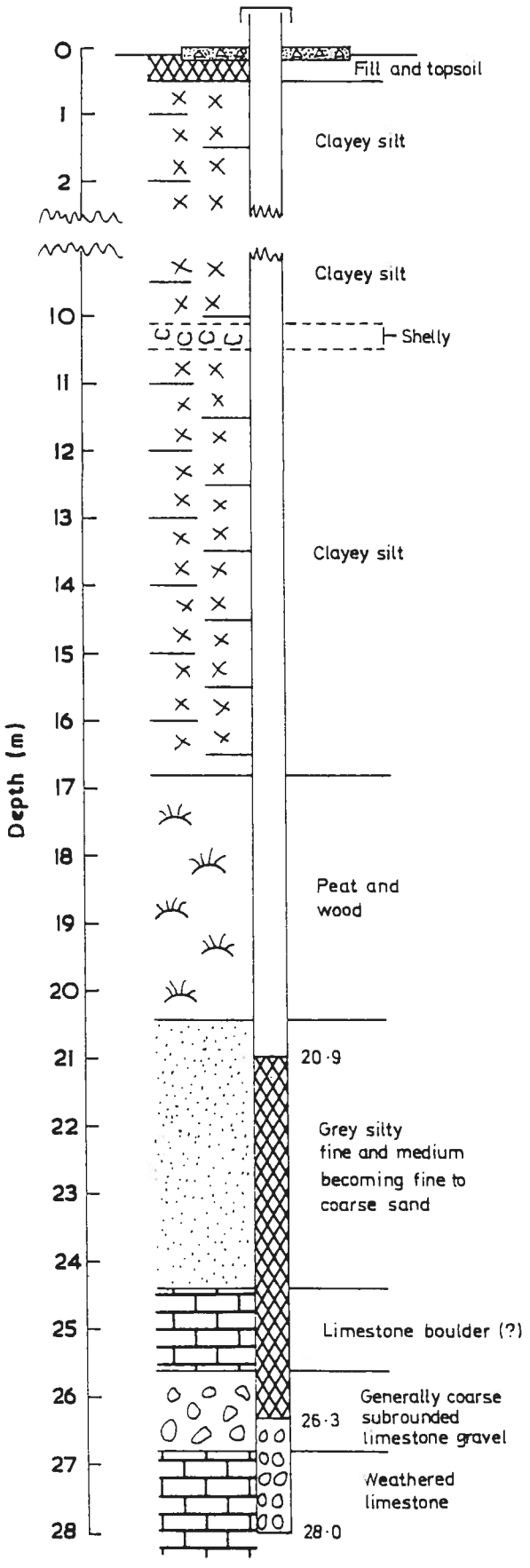
An attempt was made to install a screen in limestone by drilling using air/foam flush. Limestone was again encountered at 32.3 m and drilling was continued to 37.8 m.

Installation of screen 26.11.81

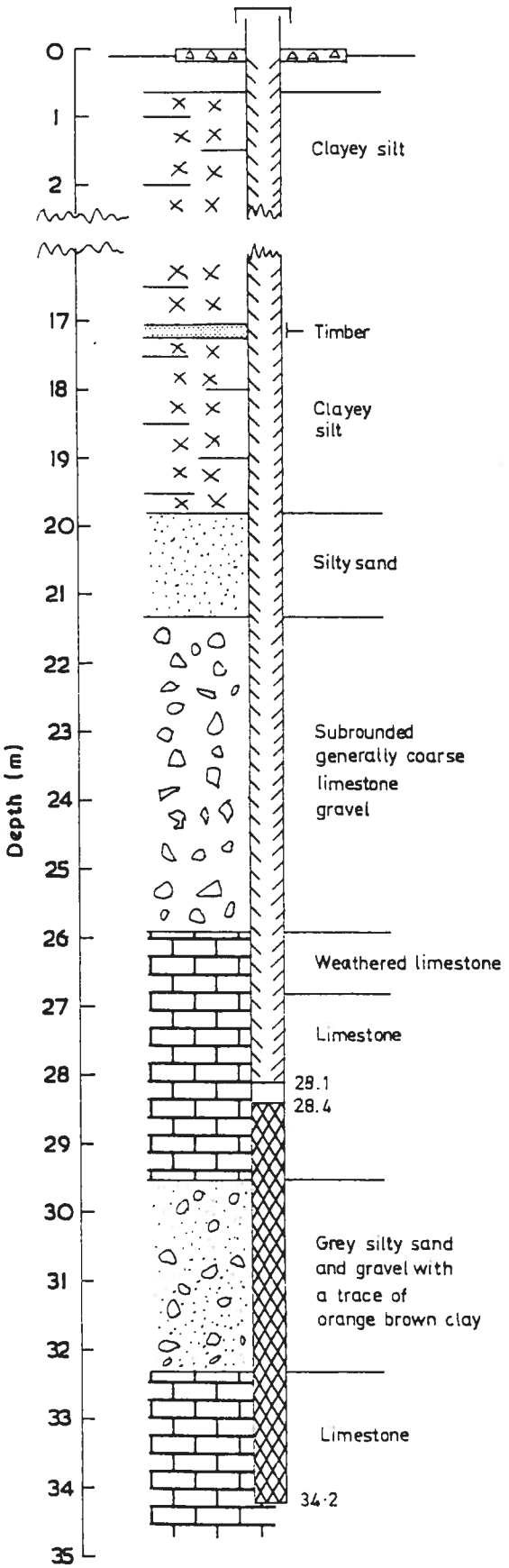
A 5.8 m length of screen was installed but during installation the hole filled back to 34.2 m. The screen was installed to this depth.

DT/MS/7758

WELL Nº 11



WELL Nº 12



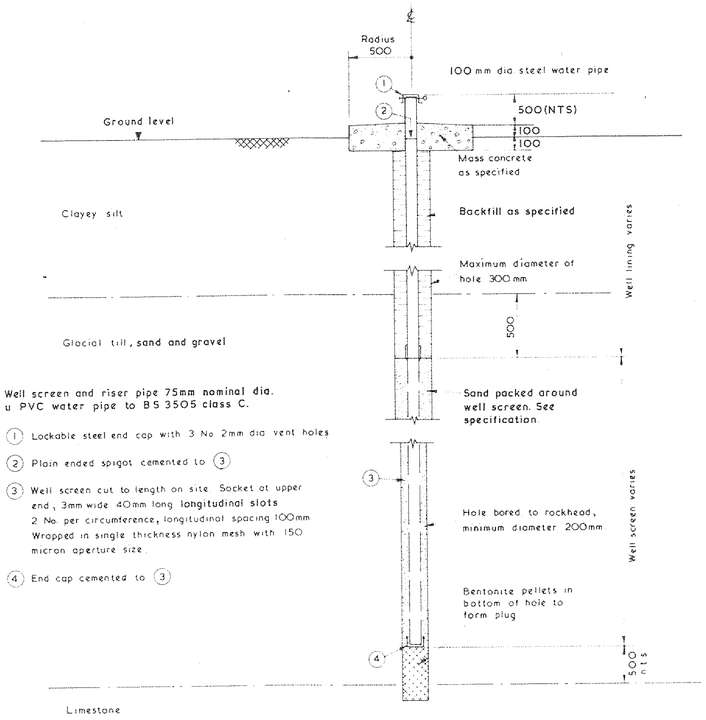
Drawn	Checked	Traced	Approved

ERCON
Engineering & Resources Consultants,

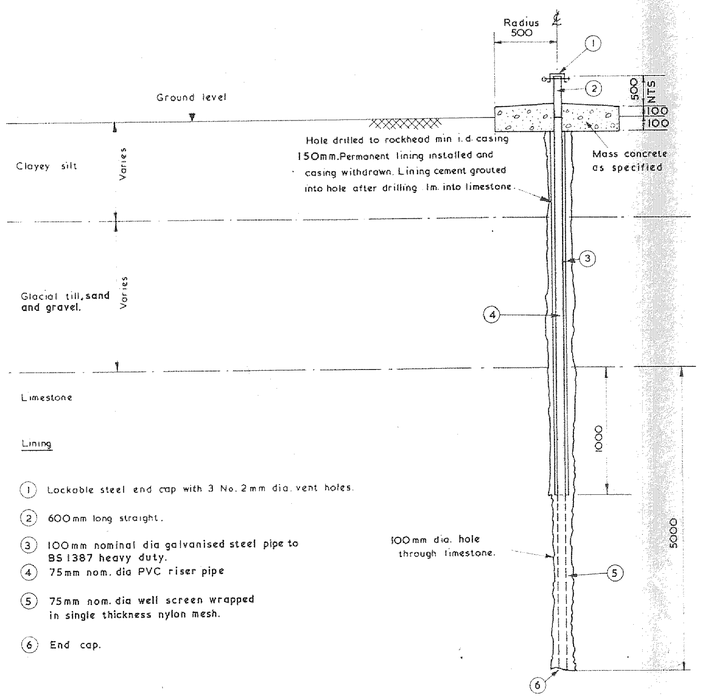
OBSERVATION WELL RECORD

Loc. No. 7758/13

Fig. A6



WELL IN GLACIAL TILL Nos. 1.3.5.7.9.11



Lining

1. Lockable steel end cap with 3 No. 2mm dia. vent holes.
2. 600mm long straight.
3. 100mm nominal dia galvanised steel pipe to BS 1387 heavy duty.
4. 75mm nom. dia PVC riser pipe
5. 75mm nom. dia well screen wrapped in single thickness nylon mesh.
6. End cap.

WELL IN LIMESTONE Nos. 2.4.6.8.10.12

Notes

1. Figured dimensions only to be taken from this drawing.
2. The positions of observation wells shown on drawing No. DI-0275-54-G-502. Detailed positions will be as instructed by the Engineer.
3. Wells are to be clearly numbered on site in 80mm high (minimum) figures to the approval of the Engineer
4. (2)
5. All dimensions are in mm unless otherwise specified.
6. All levels are related to mean sea level which is 2.67m above old Irish O.S. low water (DUBLIN) datum.
7. All works to be carried out in accordance with the specification.

TABLE 1

DETAILS OF OBSERVATION WELLS AS INSTALLED

Well Number	1	2	3	4	5	6	7	8	9	10	11	12
Type	GT	LS	GT	LS	GT	LS	GT	LS	GT	LS	GT	LS
Depth to base of hole (m)	7·3	13·2	16·1	22·1	7·9	13·4	11·3	15·8	13·5	18·3	28·0	34·2
Depth to base of clayey silt (m)	4·4	4·0	0·9+	0·9+	1·5+	1·5+	7·6	6·5	4·0	3·8	20·4	19·8
Depth to top of limestone (m)	6·7	6·9‡	15·9	16·2	7·6	7·9	11·2	10·8‡	13·4	13·2	26·8	25·9*
Depth to top of bentonite (m)	6·7	—	15·1	—	7·4	—	10·5	—	12·7	—	26·3	—
Depth to base of steel liner (m)	—	9·5	—	17·5	—	9·1	—	11·8	—	14·3	—	28·1
Depth to base of slotted screen (m)	6·7	13·2	14·8	22·1	7·2	13·4	10·5	15·8	12·7	18·3	26·3	34·2
Depth to top of slotted screen (m)	5·4	7·4	1·0	16·3	1·8	7·6	8·1	10·0	4·3	12·5	20·9	28·4

KEY

GT Indicates well in Glacial till

LS Indicates well in Limestone.

All tabulated depths are relative to top of concrete surround.

\+ No clayey silt encountered. Depth shown indicates base of fill and topsoil.

‡ Fissures or infilled pockets present in limestone linked to overburden (indicated by bubbling from adjacent wells during drilling)

* After drilling through limestone to 29·5m sand and gravel was encountered. Limestone was again penetrated at 32·3m.

"This document was prepared under contract 027554000 Dated 12th March 1979 between Alumina Contractors Limited and Engineering and Resources Consultants Limited"

REV. No.	DATE	DESCRIPTION
4	Jan. 1982	As constructed
3	14th March 1981	Riser pipe material specified for wells in glacial till.
2	Feb. 1981	Note 4 deleted. Submersible pump deleted. Dimensions revised, well 11 and 12 added.
1	17th July 1978	Concrete class deleted

ALUMINUM COMPANY OF CANADA LTD
Alcan Engineering Services
Montreal, Canada

ERCON
Engineering and Resources Consultants
Foundation House
Eastern Road
Bracknell Berks U.K.

Released to Project

Designed PLH
Drawn MAP
Checked
Approved

Date 17/4/78
Area Engineer
Date 17.5.78
Project Engineer

Approved Date 22nd Dec 1978

RED MUD POND, AREA 54A

OBSERVATION WELL DETAILS

For AUGHINISH PROJECT

AUGHINISH ALUMINA LIMITED

WO No.	Drg. Schedule No	Scale	Date	Drg No.
0275-54-50-3	DS-0275-54-G-501	1:25		DI 0275 54 G 516 R04

Third Angle

Dimensions in millimetres (mm) except as noted

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 24

SHEET 1 OF 2

LOCATION: Ch 100 approx. (adjacent to sump at west tie-in) Phase 2 BRDA BORING DATE: 20 to 21/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE										Top of Pipe Elev. 1.72
0	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Combination of estuarine clays and glacial till. Transition unknown. (Taken from driller's logs and inspection of arisings where possible)		0.00				1				Concrete for headworks
1								0				
2								-1				
3								-2				Bentonite surrounding solid pipe
4								-3				
5								-4				
6								-5				
7								-6				Sand
8				-7.17				-7				Gravel surrounding soild pipe
		Weathered LIMESTONE		8.50								
9								-8				Gravel surrounding slotted pipe
		LIMESTONE		-8.17 9.50								
10		--- CONTINUED NEXT PAGE ---										

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JM

CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 24

SHEET 2 OF 2

LOCATION: Ch 100 approx. (adjacent to sump at west tie-in) Phase 2 BRDA BORING DATE: 20 to 21/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
10		*--- CONTINUED FROM PREVIOUS PAGE ---*										
10	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	LIMESTONE						-9				Gravel surrounding slotted pipe
11								-10				
12								-11				
13								-12				
14				-12.67 / 14.00								
15												
16												
17												
18												
19												
20												

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JM
CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 25

SHEET 1 OF 1

LOCATION: Ch 100 approx. (adjacent to sump at west tie-in) Phase 2 BRDA BORING DATE: 22/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE										Top of Pipe Elev. 1.94
0	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Combination of estuarine clays and glacial till. Transition unknown. (Taken from driller's logs and inspection of arisings where possible)		0.00				1				Concrete for headworks
1								0				Bentonite surround to solid pipe
2								-1				Sand
3								-2				Gravel surround to solid pipe
4								-3				Gravel surround to slotted pipe
5								-4				
6				-4.53 6.00								Bentonite plug
7												
8												
9												
10												

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JM
CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 26

SHEET 1 OF 1

LOCATION: Ch 300 approx. (west wall) Phase 2 BRDA

BORING DATE: 20/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE										Top of Pipe Elev. 2.02
0	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Combination of estuarine clays and glacial till. Transition unknown. (Taken from driller's logs and inspection of arisings where possible)		0.00				1				Concrete for headworks
1								0				Bentonite surround to solid pipe
2								-1				Sand
3								-2				Gravel surround to solid pipe
4								-3				Gravel surround to slotted pipe
5								-4				
6				-4.52 6.00								Bentonite plug
7												
8												
9												
10												

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JM
CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 27

SHEET 1 OF 2

LOCATION: Ch 300 approx. (west wall) Phase 2 BRDA

BORING DATE: 17 to 20/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE										Top of Pipe Elev. 1.83
0	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Combination of estuarine clays and glacial till. Transition unknown. (Taken from driller's logs and inspection of arisings where possible)		0.00				1				Concrete for headworks
1								0				
2								-1				
3								-2				
4								-3				Bentonite surround to solid pipe
5								-4				
6								-5				
7								-6				
8								-7				Sand
9		Weathered LIMESTONE		-7.55 9.00				-8				Gravel surround to solid pipe
10		--- CONTINUED NEXT PAGE ---										Gravel surround to slotted pipe

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JM

CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 27

SHEET 2 OF 2

LOCATION: Ch 300 approx. (west wall) Phase 2 BRDA

BORING DATE: 17 to 20/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---										
10	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Weathered LIMESTONE						-9				Gravel surround to slotted pipe
11								-10				
12								-11				
13								-12				
14								-13				
15				-13.55 / 15.00								
16												
17												
18												
19												
20												

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JM
CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 28

SHEET 1 OF 1

LOCATION: Ch 500 approx. (west wall near ramp to flap valve) Phase 2 BRDA BORING DATE: 17/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE										Top of Pipe Elev. 2.43
0	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Combination of estuarine clays and glacial till. Transition unknown. (Taken from driller's logs and inspection of arisings where possible)		0.00				1				Concrete for headworks
1								0				Bentonite surround to solid pipe
2								-1				Sand
3								-2				Gravel surround to solid pipe
4								-3				Gravel surround to slotted pipe
5								-4				Bentonite plug
6				-4.15 6.00								
7												
8												
9												
10												

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JM
CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 29

SHEET 1 OF 2

LOCATION: Ch 500 approx. (west wall near ramp to flap valve) Phase 2 BRDA BORING DATE: 16 to 17/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE										Top of Pipe Elev. 2.32
0	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Combination of estuarine clays and glacial till. Transition unknown. (Taken from driller's logs and inspection of arisings where possible)		0.00				1				Concrete for headworks
1								0				
2								-1				
3								-2				
4								-3				Bentonite surround to solid pipe
5								-4				
6								-5				
7								-6				
8								-7				Sand
9								-8				Gravel surround to solid pipe
10		Weathered LIMESTONE		-7.77 / 9.50								Gravel surround to slotted pipe
		--- CONTINUED NEXT PAGE ---										

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JM
CHECKED: PC

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 29

SHEET 2 OF 2

LOCATION: Ch 500 approx. (west wall near ramp to flap valve) Phase 2 BRDA BORING DATE: 16 to 17/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---										
10	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Weathered LIMESTONE						-9				Gravel surround to slotted pipe
11								-10				
12												
13								-11				
14								-12				
15				-13.27 15.00				-13				
16												
17												
18												
19												
20												

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JM
CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 30

SHEET 1 OF 1

LOCATION: Ch 700 approx. (west wall near Poulaweala Creek) Phase 2 BRDA BORING DATE: 15 to 16/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE										Top of Pipe Elev. 2.97
0	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Combination of estuarine clays and glacial till. Transition unknown. (Taken from driller's logs and inspection of arisings where possible)		0.00				2				Concrete for headworks
1												Bentonite surround to solid pipe
								1				Sand
2												Gravel surround to solid pipe
3								0				
								-1				
4												Gravel surround to slotted pipe
								-2				
5												
								-3				
6				-3.40								Bentonite plug
				6.00								
7												
8												
9												
10												

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JM
CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 31

SHEET 1 OF 2

LOCATION: Ch 700 approx. (west wall near Poulaweala Creek) Phase 2 BRDA BORING DATE: 14 to 15/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE										Top of Pipe Elev. 3.08
0	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Combination of estuarine clays and glacial till. Transition unknown. (Taken from driller's logs and inspection of arisings where possible)		0.00				2				Concrete for headworks
1								1				
2								0				
3								-1				Bentonite surround to solid pipe
4								-2				
5								-3				
6								-4				
7								-5				Sand
8				-5.90								Gravel surround to solid pipe
9		Weathered LIMESTONE		8.50				-6				Gravel surround to slotted pipe
10								-7				
		--- CONTINUED NEXT PAGE ---										

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JM
CHECKED: PC

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 31

SHEET 2 OF 2

LOCATION: Ch 700 approx. (west wall near Poulaweala Creek) Phase 2 BRDA BORING DATE: 14 to 15/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---										
10	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Weathered LIMESTONE		-8.90				-8				Gravel surround to slotted pipe
11		LIMESTONE (some fractures)		11.50				-9				
12								-10				
13								-11				
14		LIMESTONE (very fractured), hole collapsed between 14 and 15m depth		-11.40 14.00				-12				
15				-12.40 15.00								
16												
17												
18												
19												
20												

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JM
CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 32

SHEET 1 OF 2

LOCATION: Ch 900 approx. (south west corner) Phase 2 BRDA

BORING DATE: 13 to 14/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE										Top of Pipe Elev. 2.60
0	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Combination of estuarine clays and glacial till. Transition unknown. (Taken from driller's logs and inspection of arisings where possible)		0.00				2				Concrete for headworks
1								1				
2								0				
3								-1				
4								-2				Bentonite surround to solid pipe
5								-3				
6								-4				
7								-5				Sand
8								-6				Gravel surround to solid pipe
9				-6.91				-7				
		Weathered LIMESTONE		9.00								Gravel surround to slotted pipe
10		*--- CONTINUED NEXT PAGE ---*										

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JM

CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 32

LOCATION: Ch 900 approx. (south west corner) Phase 2 BRDA

BORING DATE: 13 to 14/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---										
10	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Weathered LIMESTONE						-8				
11								-9				
12				-10.41				-10				Gravel surround to slotted pipe
13		LIMESTONE (very fractured with hole collaping below 14.5m depth)		12.50				-11				
14								-12				
15				-12.91 15.00								
16												
17												
18												
19												
20												

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JM
CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 33

SHEET 1 OF 1

LOCATION: Ch 900 approx. (south west corner) Phase 2 BRDA

BORING DATE: 12 to 13/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE										Top of Pipe Elev. 2.64
0	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Combination of estuarine clays and glacial till. Transition unknown. (Taken from driller's logs and inspection of arisings where possible)		0.00				2				Concrete for headworks
1								1				Bentonite surround to solid pipe
												Sand
2								0				Gravel surround to solid pipe
3								-1				
4								-2				Gravel surround to slotted pipe
5								-3				
6				-3.95 6.00								Bentonite plug
7												
8												
9												
10												

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JM
CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 35

SHEET 1 OF 1

LOCATION: Ch 1350 approx. (south wall) Phase 2 BRDA

BORING DATE: 09/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE										Top of Pipe Elev. 2.63
0	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Combination of estuarine clays and glacial till. Transition unknown. (Taken from driller's logs and inspection of arisings where possible)		0.00				2				Concrete for headworks
1								1				Bentonite surround to solid pipe
2								0				Sand
3								-1				Gravel surround to solid pipe
4								-2				
5								-3				Gravel surround to slotted pipe
6				-4.48				-4				Bentonite plug
				6.50								
7												
8												
9												
10												

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JM
CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 36

SHEET 1 OF 2

LOCATION: Ch 1350 approx. (south wall) Phase 2 BRDA

BORING DATE: 08 to 09/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE										Top of Pipe Elev. 2.62
0	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Combination of estuarine clays and glacial till. Transition unknown. (Taken from driller's logs and inspection of arisings where possible)		0.00				2				Concrete for headworks
1								1				
2								0				
3								-1				Bentonite surround to solid pipe
4								-2				
5								-3				
6				-4.46				-4				Sand
		Weathered LIMESTONE		6.50								Gravel surround to solid pipe
7								-5				
8								-6				Gravel surround to slotted pipe
9								-7				
10		--- CONTINUED NEXT PAGE ---										

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JM
CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 36

SHEET 2 OF 2

LOCATION: Ch 1350 approx. (south wall) Phase 2 BRDA

BORING DATE: 08 to 09/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---										
10	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Weathered LIMESTONE		-9.96				-8				Gravel surround to slotted pipe
11								-9				
12		LIMESTONE		12.00				-10				
13				-11.66				-11				
		POSSIBLE VOID - containing sand and water		13.70								
14				-11.96				-12				
		LIMESTONE (fractured), collapsing to 13m depth.		14.00								
15				-12.96								
				15.00								
16												
17												
18												
19												
20												

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JM
CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 42

SHEET 1 OF 2

LOCATION: Ch 2175 approx. (in field adjacent to perimeter wall) Phase 2 BRDABORING DATE: 16 to 17/06/2011

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE										Top of Pipe Elev. 6.51
0	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Brown gravelly sandy CLAY/SILT with occasional cobbles - glacial till. (taken from driller's logs and inspection of arisings where possible)		0.00				5				Concrete for headworks
1												
2		Weathered LIMESTONE		3.97 2.00				4				
3								3				
4		LIMESTONE		1.97 4.00				2				Bentonite surround to solid pipe
5								1				
6								0				
7								-1				
8								-2				Sand Gravel surround to solid pipe
9								-3				
10		--- CONTINUED NEXT PAGE ---						-4				Gravel surround to slotted pipe

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JM
CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 42

SHEET 2 OF 2

LOCATION: Ch 2175 approx. (in field adjacent to perimeter wall) Phase 2 BRDABORING DATE: 16 to 17/06/2011

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
10		--- *CONTINUED FROM PREVIOUS PAGE* ---										
10	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	LIMESTONE										*Damp 16/06/2011*
11								-5				
12								-6				
13								-7				
14								-8				Gravel surround to slotted pipe
15								-9				
16								-10				
17								-11				
18				-12.03 / 18.00				-12				
19												
20												

DEPTH SCALE
1 : 50

LOGGED: JM
CHECKED: PC

Golder Associates

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 45

SHEET 1 OF 2

LOCATION: Ch 2650 approx. (east wall near ramp no. 4) Phase 2 BRDA

BORING DATE: 22 to 23/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE										Top of Pipe Elev. 15.95
0	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	Brown gravelly sandy CLAY/SILT with occasional cobbles - glacial till. (taken from driller's logs and inspection of arisings where possible)		0.00				15				Concrete for headworks
1												
2								14				
3												
4								13				
5												Bentonite surround to solid pipe
				10.55				12				
		LIMESTONE		5.00								
6								11				
7												
8								10				Sand
8												Gravel surround to solid pipe
9								9				
9								8				
								7				
												Gravel surround to slotted pipe
10				5.55				6				
		--- CONTINUED NEXT PAGE ---										

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JM

CHECKED: PC

PROJECT: Installation of Additional Observation Wells

RECORD OF BOREHOLE OW 45

SHEET 2 OF 2

LOCATION: Ch 2650 approx. (east wall near ramp no. 4) Phase 2 BRDA

BORING DATE: 22 to 23/12/2010

DATUM: AMSL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: GEOTECH NO.	SAMPLES: ENV NO.	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
10		*--- CONTINUED FROM PREVIOUS PAGE ---*										
10	Rotary Coring (Tricone method) Hilliard Ltd. (Drilling Subcontractor retained by BAM Civil Ltd.)	LIMESTONE (fractured) and colapsing below 14.5.		10.00				5				Gravel surround to slotted pipe
11								4				
12								3				
13								2				
14								1				
15				0.55 15.00								
16												
17												
18												
19												
20												

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JM
CHECKED: PC

2 AUGHINISH PHASE 2 BRDA OW INSTALLATIONS.GPJ GLDR_LDN.GDT 27/2/12 DATA INPUT:

PROJECT No.: Aughinish Alumina

RECORD OF MONITORING WELL: W1

SHEET 1 OF 1

LOCATION: Aughinish

BORING DATE: 13/10/05

DATUM:

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION: 110mm
0		Ground Surface									
		Topsoil		0.15							Concrete Plug
		Broken Limestone									
2				1.95							
	O'Driscoll Air Rotary										Riser with Gravel
4											
		Pale Grey Limestone									
6											
											Screen with Gravel
8											
		End of MONITORING WELL.		9.37							
10											
12											
14											
16											
18											
20											

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: AS

CHECKED: RW

BOREHOLE BOREHOLES LOGS OCT_2005.GPJ GLDR_CAN.GDT 3/11/05

PROJECT No.: Aughinish Alumina

RECORD OF MONITORING WELL: W2

SHEET 1 OF 1

LOCATION: Aughinish

BORING DATE: 14/10/05

DATUM:

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa — nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION 110mm
0		Ground Surface											
		Topsoil		0.15									
2		Broken Limestone											Concrete Plug
				3.15									
4													14/10/05
6	O'Driscoll Air Rotary												Riser with Gravel
8		Pale Grey Limestone											
10													Screen with Gravel
12													
		End of MONITORING WELL.		12.14									
14													
16													
18													
20													

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: AS

CHECKED: RW

BOREHOLE BOREHOLES LOGS OCT_2005.GPJ GLDR_CAN.GDT 3/11/05

PROJECT No.: Aughinish Alumina

RECORD OF MONITORING WELL: W3

SHEET 1 OF 1

LOCATION: Aughinish

BORING DATE: 13/10/05

DATUM:

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION: 110mm
		Ground Surface											
0	O'Driscoll Air Rotary	MADEGROUND comprising of broken limestone and concrete		0.00									Concrete Plug
2		Broken Limestone		1.80									
				2.40									Riser with Gravel
4													
6		Pale Grey Limestone											Screen with Gravel
8													
10		End of MONITORING WELL.		9.75									
12													
14													
16													
18													
20													

BOREHOLE BOREHOLES LOGS OCT_2005.GPJ GLDR_CAN.GDT 3/11/05

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: AS

CHECKED: RW

PROJECT No.: Aughinish Alumina

RECORD OF MONITORING WELL: W4

SHEET 1 OF 1

LOCATION: Aughinish

BORING DATE: 13/10/05

DATUM:

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface											
0		Topsoil		0.15									Concrete Plug
2													
4	O'Driscoll Air Rotary												Riser with Gravel
6		Pale Grey Limestone											13/10/05 ▽
8													
10													Screen with Gravel
10		End of MONITORING WELL.		10.40									
12													
14													
16													
18													
20													

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: AS

CHECKED: RW

BOREHOLE BOREHOLES LOGS OCT_2005.GPJ GLDR_CAN.GDT 3/11/05

PROJECT No.: Aughinish Alumina

RECORD OF MONITORING WELL: W5

SHEET 1 OF 1

LOCATION: Aughinish

BORING DATE: 13/10/05

DATUM:

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION 110mm
0		Ground Surface									
0	O'Driscoll Air Rotary	Broken Limestone		0.00							Concrete Plug
2				1.50							
4											Riser with Gravel
6											
8		Pale Grey Limestone									
10											Screen with Gravel
12											
14		End of MONITORING WELL.		14.00							
16											
18											
20											

BOREHOLE BOREHOLES LOGS OCT_2005.GPJ GLDR_CAN.GDT 3/11/05

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: AS

CHECKED: RW

PROJECT No.: Aughinish Alumina

RECORD OF MONITORING WELL: W6

SHEET 1 OF 1

LOCATION: Aughinish

BORING DATE: 13/10/05

DATUM:

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp ⊖W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface											
0		Topsoil		0.00									
		Broken Limestone		0.60									Concrete Plug
2				1.80									
4													
6													Riser with Gravel
8	O'Driscoll Air Rotary												
10		Pale Grey Limestone											
12													
14													
16													Screen with Gravel
18													
		End of MONITORING WELL.		18.39									
20													

BOREHOLE BOREHOLES LOGS OCT_2005.GPJ GLDR_CAN.GDT 3/11/05

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: AS

CHECKED: RW

PROJECT No.: Aughinish Alumina

RECORD OF MONITORING WELL: W7

SHEET 1 OF 1

LOCATION: Aughinish

BORING DATE: 13/10/05

DATUM:

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION: 110mm
0		Ground Surface									
		Topsoil		0.15							Concrete Plug
2		Broken Limestone									
	O'Driscoll Air Rotrary			3.15							Riser with Gravel
4											
6											
8		Pale Grey Limestone									
10											
12											Screen with Gravel
14											
		End of MONITORING WELL.		14.93							
16											
18											
20											

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: AS

CHECKED: RW

BOREHOLE BOREHOLES LOGS OCT_2005.GPJ GLDR_CAN.GDT 3/11/05

PROJECT No.: Aughinish Alumina

RECORD OF MONITORING WELL: W8

SHEET 1 OF 1

LOCATION: Aughinish

BORING DATE: 13/10/05

DATUM:

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION 110mm
		Ground Surface									
0		Topsoil		0.15							Concrete Plug
2											
4											
6											
8	O'Driscoll Air Rotary	Boulder Clay with some gravel horizons. 2m diameter boulder encountered at 16m									Riser with Gravel
10											
12											
14											
16											Screen with Gravel
18		End of MONITORING WELL.		18.11							
20											

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: AS

CHECKED: RW

BOREHOLE BOREHOLES LOGS OCT_2005.GPJ GLDR_CAN.GDT 3/11/05

PROJECT No.: Aughinish Alumina

RECORD OF MONITORING WELL: W9

SHEET 1 OF 1

LOCATION: Aughinish

BORING DATE: 14/10/05

DATUM:

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface									
	O'Driscoll Air Rotary	Topsoil		0.15							
2		Pale Grey Limestone									Backfilled 110mm
		End of MONITORING WELL.		3.00							
4											
6											
8											
10											
12											
14											
16											
18											
20											

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: AS

CHECKED: RW

BOREHOLE BOREHOLES LOGS OCT_2005.GPJ GLDR_CAN.GDT 3/11/05

PROJECT No.: Aughinish Alumina

RECORD OF MONITORING WELL: W9a

SHEET 1 OF 1

LOCATION: Aughinish

BORING DATE: 14/10/05

DATUM:

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION: 110mm
		Spoil Heap									
0	O'Driscoll Air Rotary	MADEGROUND comprising of broken rock		0.00							Concrete Plug
2											
4		Pale Grey Limestone		3.70							Riser with Gravel
6											
8											
10											
		Soft Brown Bedrock		11.00							
12				11.30							
14		Pale Grey Limestone									Screen with Gravel
16											
18											
		End of MONITORING WELL.		18.42							
20											

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: AS

CHECKED: RW

BOREHOLE BOREHOLES LOGS OCT_2005.GPJ GLDR_CAN.GDT 3/11/05

Appendix 8.4: Geophysical Survey for the Permitted Borrow Pit (2017)

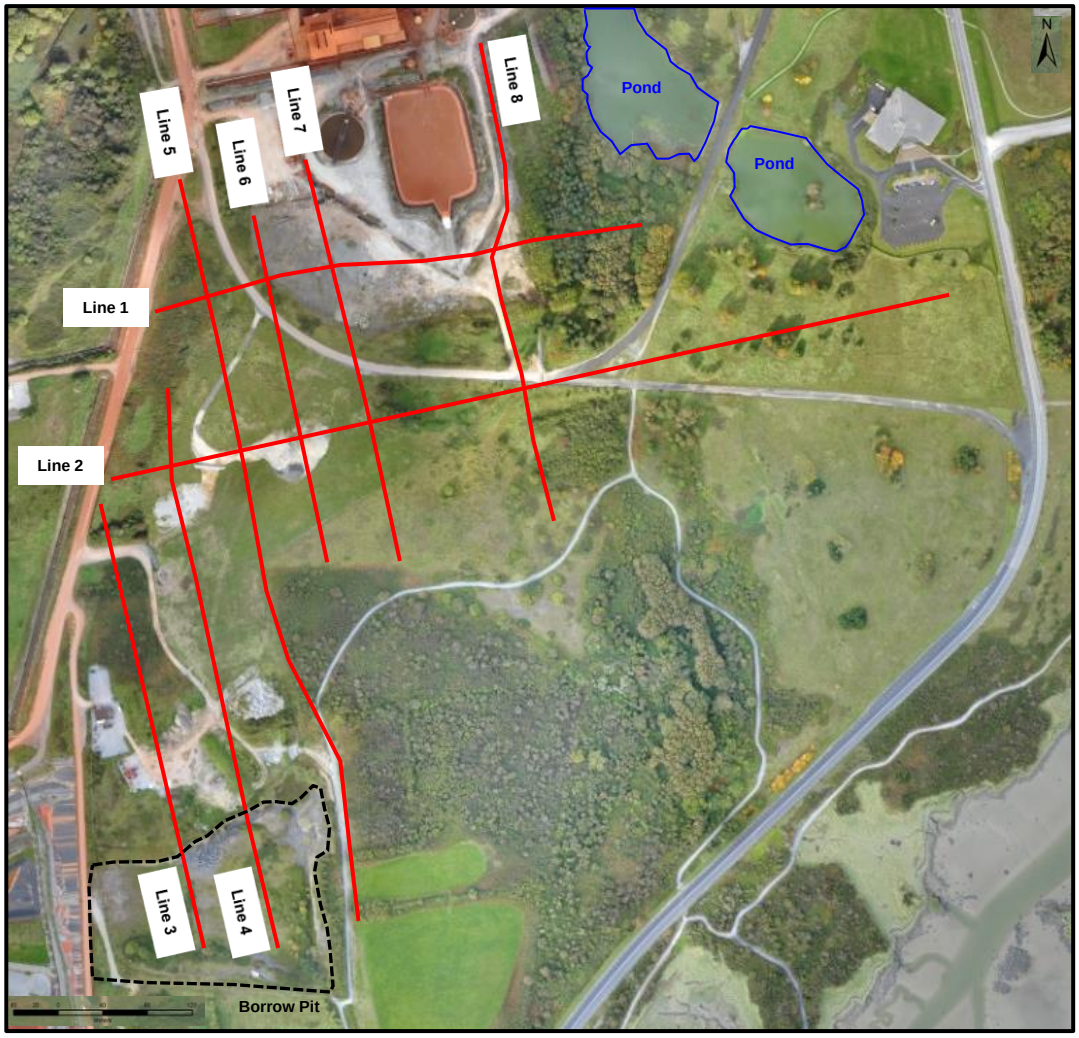
Borrow Pit Design

(February 2017)

RUSAL

Golder Associates

Aughinish: Location of Resistivity Lines



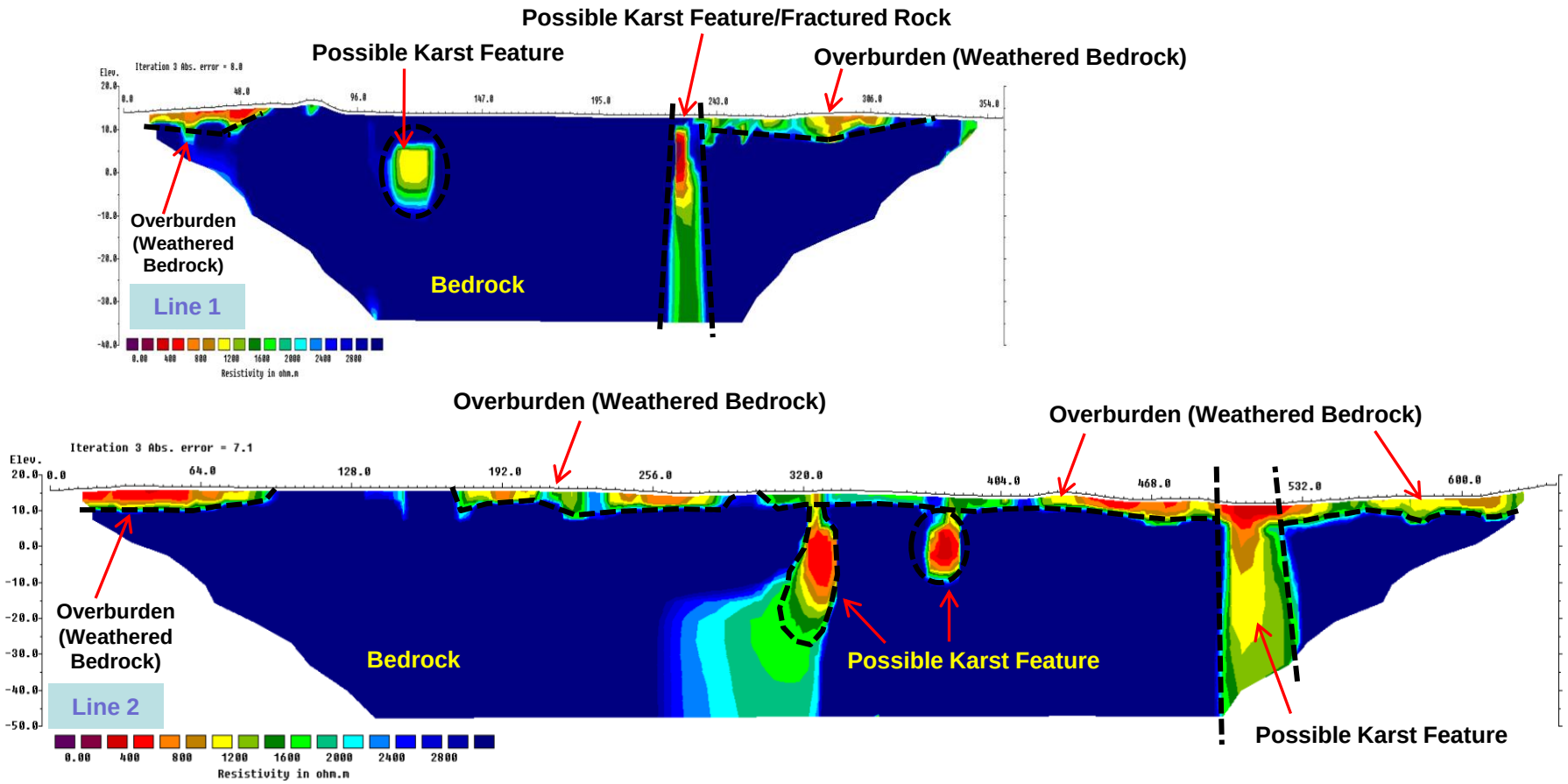
Lines 1 & 2 are from west to east - looking north
Lines 3 & 4 are from south to north - looking west
Lines 5, 6, 7 & 8 are from north to south - looking east

Resistivity Lines

- Line 1 - 360m
- Line 2 - 640m
- Line 3 - 327m
- Line 4 - 420m
- Line 5 - 540m
- Line 6 - 300m
- Line 7 - 300m
- Line 8 - 360m

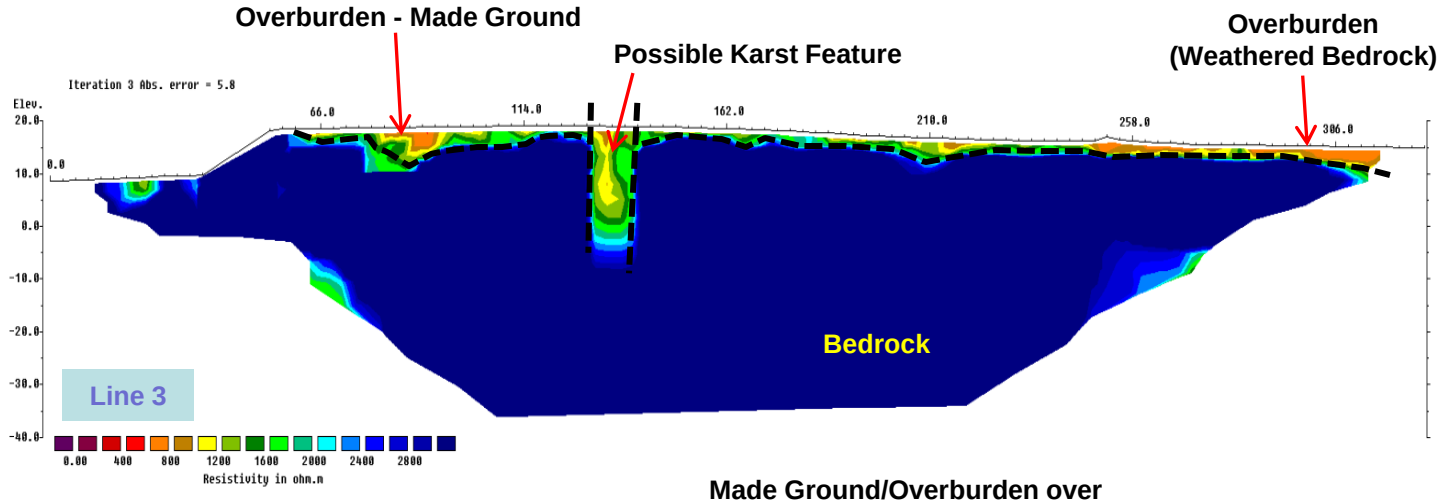
Golder Associates

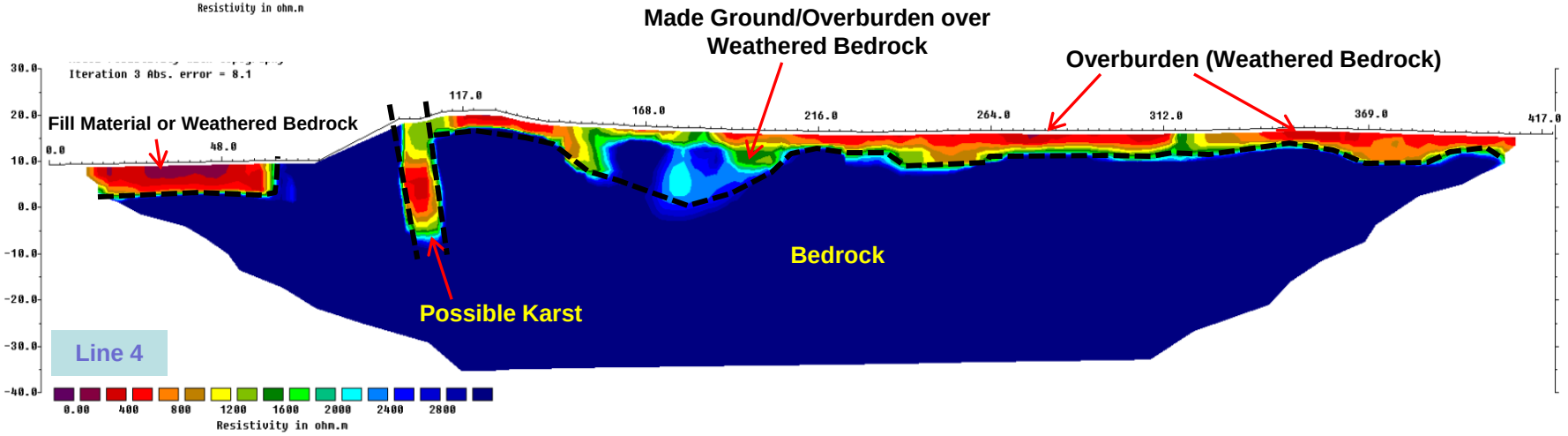
Aughinish: Lines 1 & 2 (W-E, Looking North)



200 ohm metre contour intervals

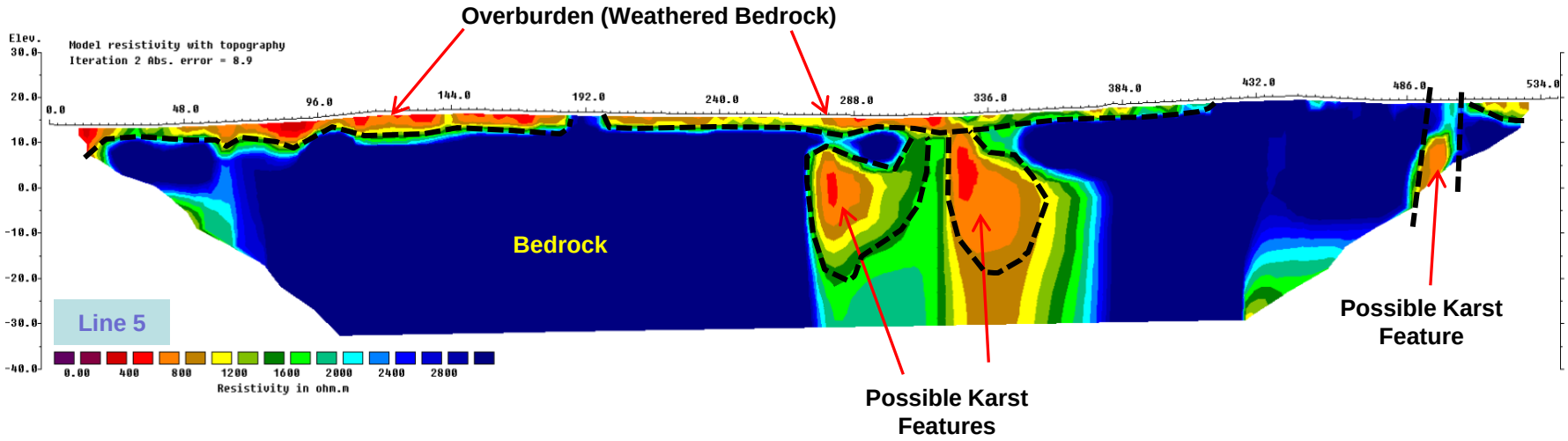
Aughinish: Lines 3 & 4 (S-N, Looking West)

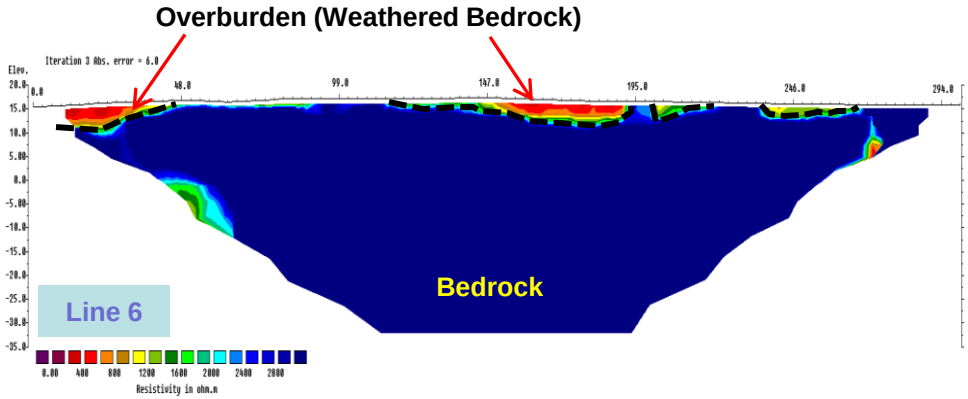




200 ohm metre contour intervals

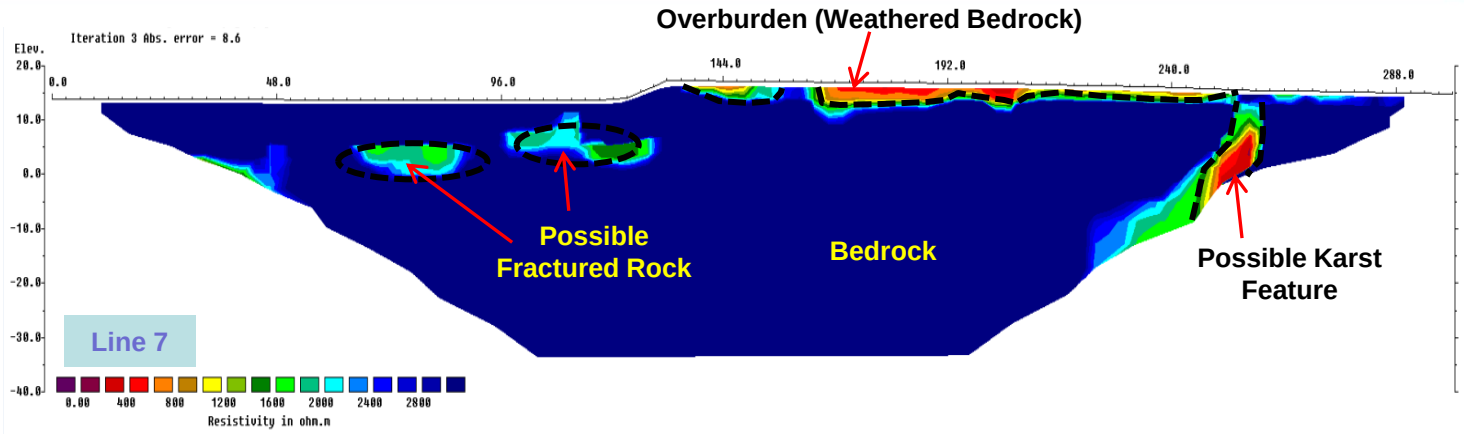
Aughinish: Lines 5 & 6 (N-S, Looking East)

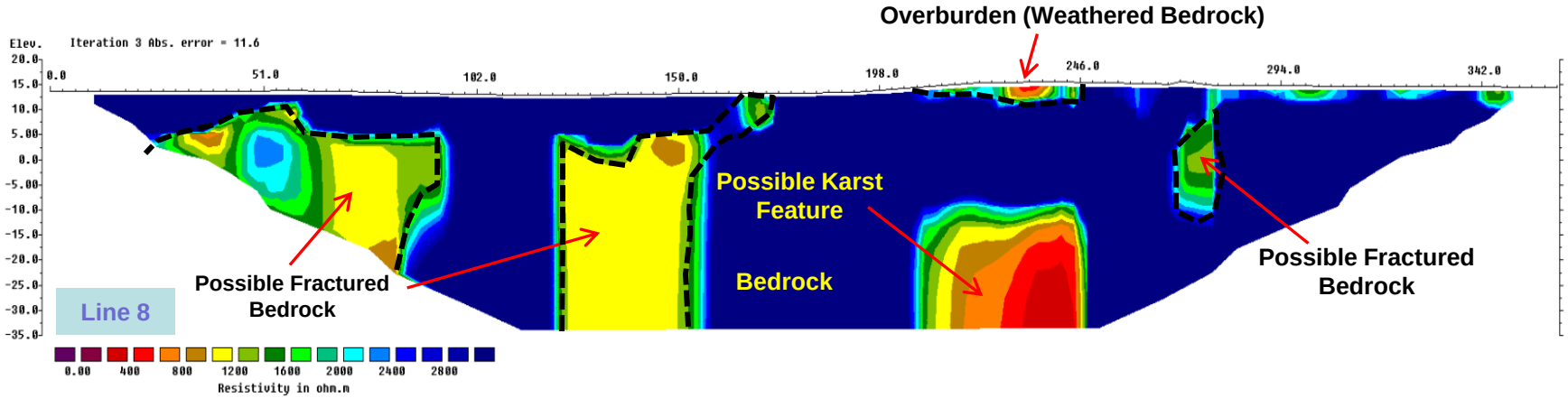




200 ohm metre contour intervals

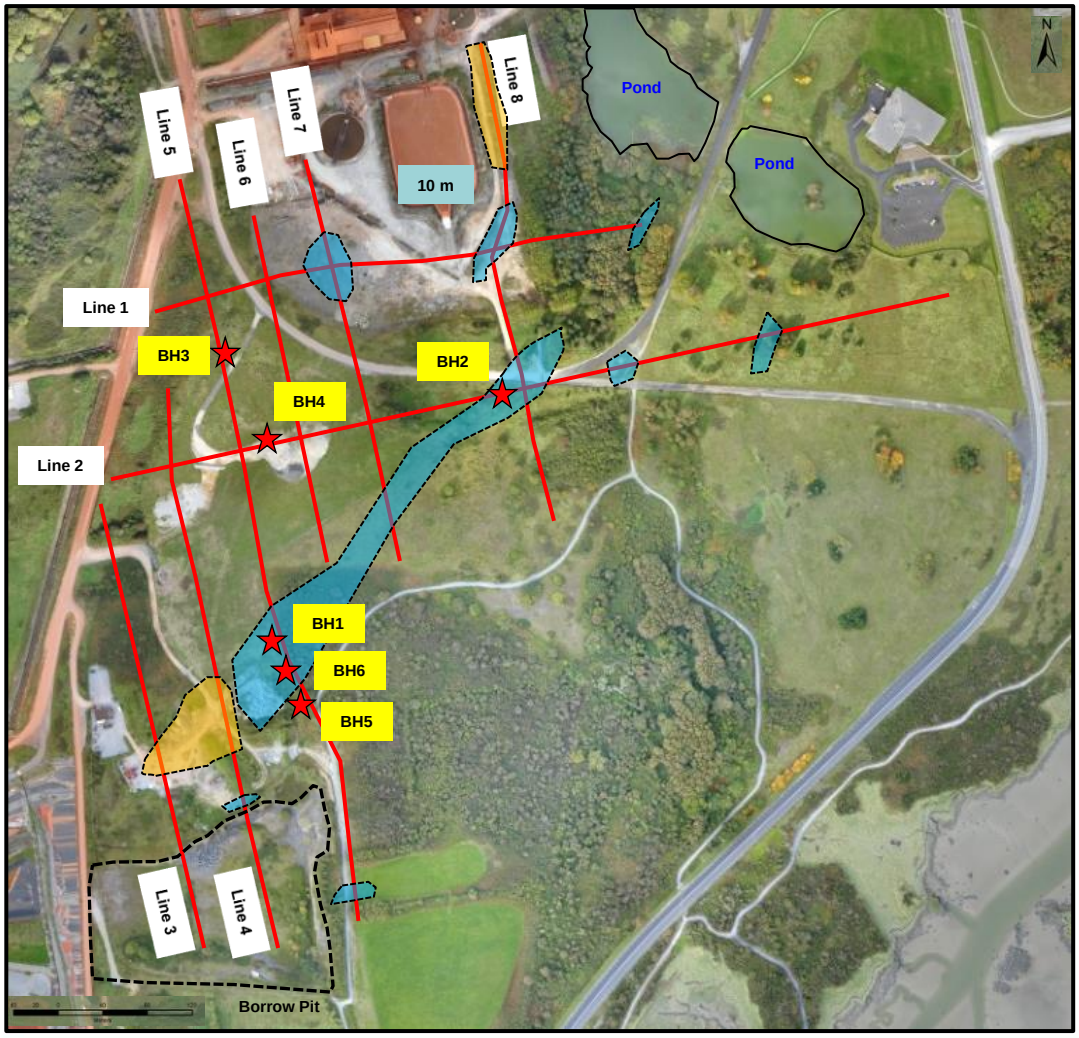
Aughinish: Lines 7 & 8 (N-S, Looking East)





200 ohm metre contour intervals

Aughinish: Karst & Fractured Bedrock



SUMMARY

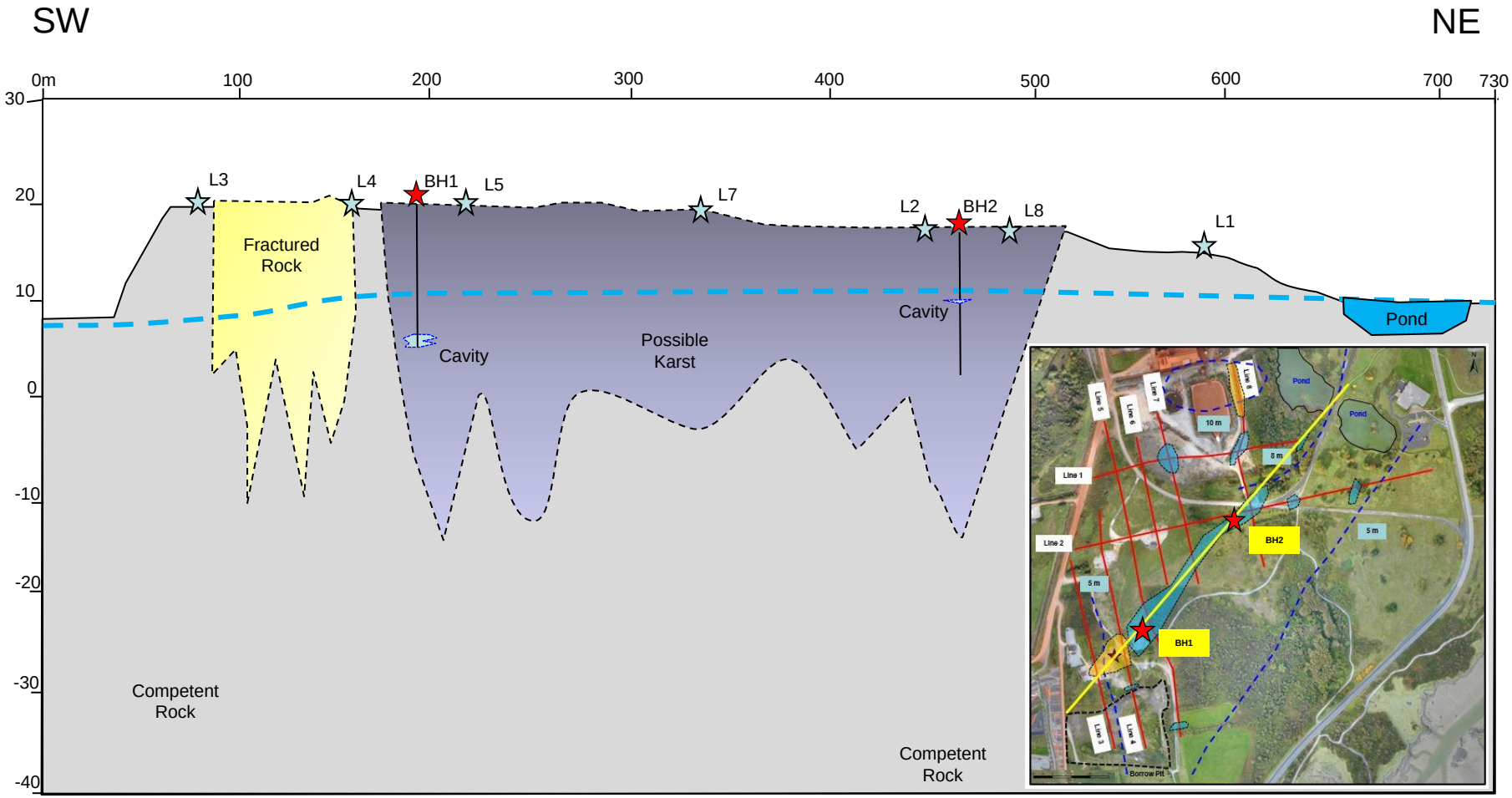
- NE/SW trending area of possible karst trending towards/from the pond(s) to an area just north of the existing borrow area.
- The Resistivity Survey indicates that there may be a possible connection – conduit for water to flow between the ponds and the borrow area.
- The Resistivity Survey shows that most of the bedrock has an apparent resistivity of >2,000 ohm metres and can be expected to be of good quality. Where resistivity values are less than ca. 400 ohm metres, lesser quality rock, fractured rock and/or karst features can be expected. The significance of these features is often much smaller than area shown in the resistivity survey sections.
- 6 BHs (**red star**) were drilled, with cavities encountered in BH1, BH2, BH3, BH5 & BH6

Possible karst feature

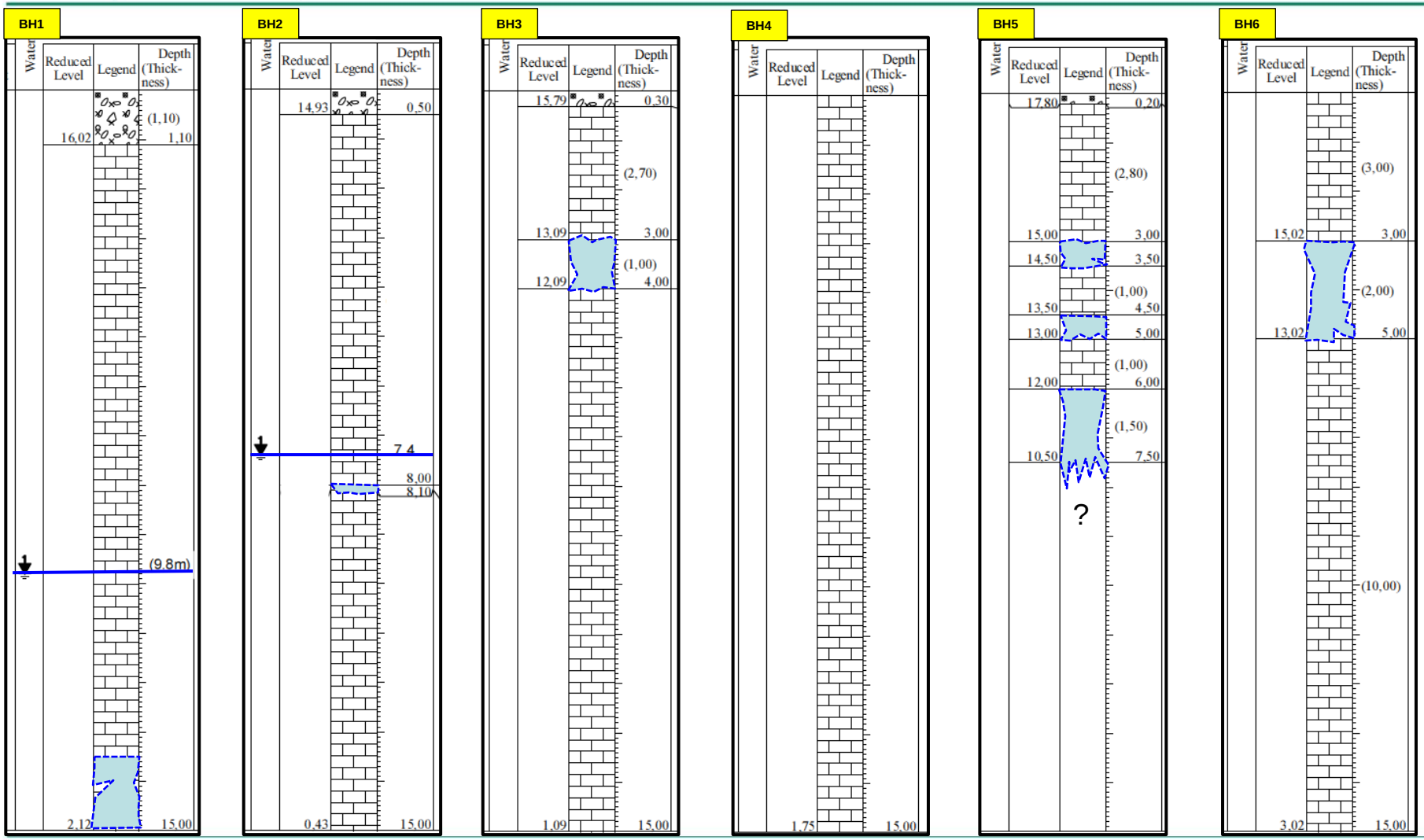
Possible fractured bedrock

Golder Associates

Cross Section Looking NW



BH Logs (Cavities in Blue)



BH5 was abandoned due to poor ground conditions

Golder Associates