Technical Note 006

Project:	**Centre for Integrated Semiconductor Materials (CISM), Swansea University**	Job No:	**60605215**
Subject:	**Summary of Ground Conditions for Planning Pre-App**		
Prepared by:	**Richard Sambrook**	Date:	**03/12/2019**
Checked / Approved by:	**Paul Wewer**	Date:	**03/12/2019**

The following technical note is required to summarise the ground condition information on the site, in support of the planning pre-application.

Previous Information

A site-specific ground investigation has not yet been completed for the CISM building. The site works for the ground investigation will commence in January 2020, with an interpretative report available in February 2020.

However, we have access to 3 previous ground investigation reports, completed for 3 adjacent buildings on the Bay campus (Computational Foundry, IMPACT and ESRI), which provide the basis for the following understanding of the possible ground conditions.

The following are the conclusions of the combined 3 ground investigation reports:

Ground Conditions

The anticipated ground conditions are as follows:

A 2-3m thick horizon of made ground (gravel, cobbles and sand) was observed across the site. Beneath the made ground was 8-13m deep layer of fine to medium grained sand, overlaying a 3-5m deep layer of stiff to very stiff gravelly clay. Bedrock was encountered at approximately 20.0m below ground level, comprising of extremely weak grey mudstone.

Summary of anticipated ground conditions

Strata	Depth range to top of stratum (m b.g.l)	Depth to base of stratum (m b.g.l)	Brief description
Made Ground	Ground Level	2.50-3.20	Gravelly fine to medium SAND with many cobbles and some boulders of Quartzitic Sandstone
Aeolian Sand	2.50-3.20	10.90-15.50	Medium dense to dense light brown and yellowish brown fine to medium SAND with calcareous shell fragments.
Fluvio-Glacial Till	10.90-15.50	20.30-23.00	Stiff in places very stiff dark brown and greyish brown slightly sandy gravelly CLAY with many subrounded cobbles.
Lower Coal Measures	20.30-23.00	Unknown	Extremely weak grey MUDSTONE received as clayey sub-angular fine to medium gravel sized fragments.

Made ground:

The investigation revealed a variable thickness of Made Ground across the site, ranging from 1.5m to 6.2m. The Made Ground was found to comprise of sandy gravel/ gravelly sand in the upper horizons, this is most likely to be associated with the up-filling works undertaken across the wider Swansea Bay Campus site. Underlying this layer the Made Ground is found to comprise of coarse gravel of mixed lithology and slag. It is anticipated that a proportion of the Made Ground will be removed and replaced with selected granular fill and/or lightweight fill. Stiffness of the Made Ground has been derived using SPT correlation E'=N60 (MPa) after CIRIA 580 (2003).

There are significant sandstone cobbles and boulders within the Glacial Deposits underlying the site. These obstructions are likely to limit the piling solution to pre-cast driven piles as there is the flexibility to remove and reinstall piles in the event of an obstruction; this is less feasible with other piling methods.

Ground Water

Ground water was encountered at depths from 0.5m – 5.4m BGL. However, from knowledge of the site we would suggest that ground water level should be assumed to be approximately 1.0m below ground level. Therefore, due to the combination of shallow ground water table and sandy soil conditions, there is a risk of excavation instability and collapse.

Ground Gas

The results of a site-specific ground investigation for an adjacent plot (ESRI) (maximum gas concentration and maximum flow rate) have been reviewed and interpret that the adjacent site should be classified as Characteristic Situation 2 (CS2) (low risk). Therefore, it is assumed that results of the site-specific ground gas monitoring for CISM will also identify it to be a CS2 classification.

The ground gas monitoring results for the adjacent building are as follows:

- Atmospheric pressure ranged between 1008 and 1023 mB
- Methane GSV Max was 0.804 l/hour
- Carbon dioxide GSV Max was 0.124 l/hour
- Oxygen ranged between 0.00% and 79.8% v.v; and
- Ground gas flow was recorded between -8.1 l/hr and 4.0 l/hr.

Note: It is also important to consider that the site used to be a BP transit site, so there is a risk of petrochemical contamination, so hydrocarbon vapours could be a risk.

Contamination

CISM is located in the north-east corner of the former BP Transit Site, which was previously used for storage of petroleum hydrocarbons and chemical products. It is understood that the Fabian Way site has undergone decommissioning, environmental assessments and remedial works since 2002. However, the extent or depth of remediation below the proposed CISM building is not clear. A 2013 site investigation report suggested that no active remedial works has been completed for ground below ESRI and only earthworks to raise site levels.

Note:

During a 2013 investigation, BH106 (shown on the attached borehole plan) encountered a reinforced concrete slab, below which hydrocarbon impacted sand deposits were observed from 3.2 to 4.0 below ground level. A strong hydrocarbon odour and sheens indicative of phase separated hydrocarbons were also noted in conjunction with the impact sand deposits. Globules of hydrocarbon product were also observed during the collection of ground water samples from BH106.

Soil contamination:

A review of the chemical analysis has highlighted elevated concentrations of lead and zinc in soil within TP3 located beneath the proposed ESRI building. Concentrations of Total Petroleum Hydrocarbons (TPH) were recorded within soil in BH106, albeit at lower concentrations than within groundwater and analysis.

Remediation Works (2009-2012)

The works were designed to focus on the treatment of residual sources of petroleum hydrocarbon contamination within the ground and groundwater, ensuring the site was suitable for its intended end-use. The sources of residual contamination were reduced to meet the agreed target levels for human health and groundwater. A groundwater monitoring programme was set in place in order to demonstrate natural attenuation on the site to the satisfaction of Natural Resources Wales. The remedial works were completed successfully in 2011, however groundwater monitoring is on-going and continues to show degrading conditions of residual contaminants.

Geotechnical Hazards

The following ground-related hazards have been identified during the investigation:

1. Engineered Fill and Made Ground

   The ground investigation carried out has identified the presence of a significant thickness of Made Ground/Engineered Fill. The Made Ground stratum beneath the site is considered to be a low bearing capacity soils. Consequently, it is considered unsuitable for shallow foundations.

2. Shallow Groundwater

   Groundwater had been identified at shallow depth in some of the exploratory holes. Shallow excavations are likely to encounter groundwater and appropriate groundwater control will be required. If control of groundwater at shallow depth is likely to be difficult to achieve it is recommended that shallow excavations are limited wherever possible.

3. Obstructions

   Within the Glacial Deposits cobbles and boulders of sandstone were encountered at varying locations and depths throughout the site. During the site investigation many holes encountered hard drilling and chiselling was required to penetrate to the required depth. Any foundation solution should consider these obstructions.

4. Contamination at Depth

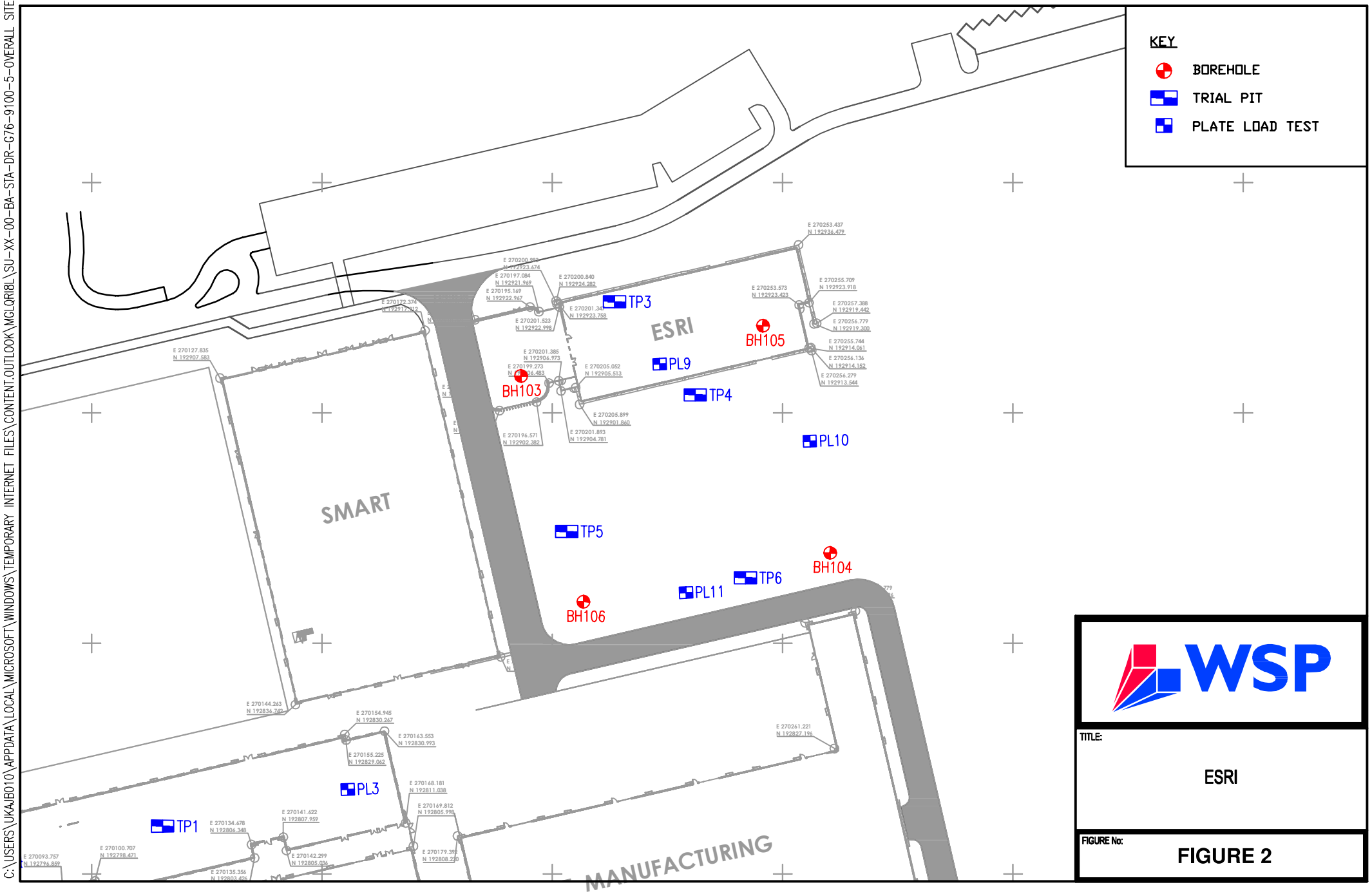
   The site has been remediated to a specific depth, therefore, there is a risk that ground may be contaminated at a much greater depth. Therefore, any intrusive investigations or any bored piles need to be aware of the risks associated and ensure mitigating measures.

Appendix A

2013 Ground Investigation (ESRI)

Borehole Logs

C:\USERS\UKAJB010\APPDATA\LOCAL\MICROSOFT\WINDOWS\TEMPORARY INTERNET FILES\CONTENT.OUTLOOK\MCLQRI8L\SU-XX-00-BA-STA-DR-G76-9100-5-OVERALL SITE SETTING OUT



WSP

TITLE:

ESRI

FIGURE No:

FIGURE 2

wsp Telephone: Fax:	**BOREHOLE LOG**	Hole No. **BH103**
	Project: Fabian Way, Swansea	Sheet: 1 of 2
Job No: 37721	Client: Leadbitter	Date: 02-07-13 04-07-13

Contractor / Driller	Method/Plant Used	Logged By	Co-Ordinates (NGR)	Ground Level (m AOD)
Apex	Dando CP	MCL	E 70196.000 N 92922.000	

SAMPLES & TESTS							STRATA					Install / Backfill
Depth	Type	Test Result	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thick-ness)	Description	Legend	Geology	Dia. 50 mm
								(0.80) 0.80	MADE GROUND comprising yellowish brown gravelly fine to medium SAND with many cobbles. Gravel is subangular fine to coarse of sandstone and concrete. Cobbles are subangular and tabular of fine to medium grained sandstone and concrete (Piling Mat).		MG	
1.00	SPT	3,6,11 25,25,0 N=61/ 0.225(C)				1		(2.40)	MADE GROUND comprising greyish brown and dark brown fine sandy GRAVEL with some cobbles (5-20%). Gravel is angular to subangular fine to coarse of iron-ore slag, sandstone, red brick and calcareous shell fragments. Cobbles are subangular of iron-ore slag, sandstone and red brick.		MG	
1.00-1.50	B											
1.00-1.50	ES											
2.00	SPT	6,6,8 7,7,7 N=29(C)				1						
2.00-2.50	B											
2.00-2.50	ES											
3.00	SPT	2,3,8 11,17,11 N=47(S)						3.20				
3.00-3.50	B								Dense light brown gravelly fine to medium SAND with many cobbles. Gravel is subangular to subrounded fine to coarse fine to medium of sandstone and calcareous shell fragments. Cobbles are rounded of yellowish brown sandstone (Aeolian Sand).			
3.00-3.50	ES											
4.00	SPT	3,6,12 12,9,10 N=43(S)						(2.80)			AEOLD	
4.00-4.50	B											
5.00	SPT	4,5,10 12,12,13 N=47(S)				2						
								6.00				
6.00	SPT	3,2,2 3,5,6 N=16(S)							Medium dense to dense light brown fine to medium SAND with some calcareous shell fragments (Aeolian Sand).			
6.00-6.50	B							(2.60)			AEOLD	
7.50	SPT	5,6,8 9,16,15 N=48(S)										
7.50-8.00	B											
								8.60				
9.00	SPT	2,2,3 3,3,3 N=12(S)						(1.85)	Medium dense to dense grey and dark grey very silty fine SAND (Fluvio-Glacial Till).		GT	
9.00-9.50	B											

Boring Progress

Date	Time	Depth	Casing Dpt	Dia. (mm)	Water Dpt
				200	

Water Strikes

Date	Time	Strike	Minutes	Standing	Casing
03-07-13		2.50	20	1.00	2.50
03-07-13	15.45	5.30			10.00

Chiselling

From	To	Hours	Tool
0	0.5	0.45	Hammer
1	1.6	0.45	Hammer

Water Added

From	To
0	1

General Remarks

Borehole location obtained using hand-held GPS - accurate to approximately 5m.

Log is DRAFT status and subject to review following laboratory testing.

Scale 1:62.5

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.

WSP wsp Telephone: Fax:	**BOREHOLE LOG**	Hole No. **BH103**
	Project: Fabian Way, Swansea	Sheet: 2 of 2
Job No: 37721	Client: Leadbitter	Date: 02-07-13 04-07-13

Contractor / Driller	Method/Plant Used	Logged By	Co-Ordinates (NGR)	Ground Level (m AOD)
Apex	Dando CP	MCL	E 70196.000 N 92922.000	

SAMPLES & TESTS							STRATA					Install / Backfill
Depth	Type	Test Result	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thick-ness)	Description	Legend	Geology	Dia. 50 mm
10.00	SPT	2,3,4 6,10,14 N=34(S)						10.45	Medium dense to dense grey and dark grey very silty fine SAND (Fluvio-Glacial Till). *(continued)*		GT	

Boring Progress					
Date	Time	Depth	Casing Dpt	Dia. (mm)	Water Dpt
03-07-13	16.30	10.95	10.00		3.5

Chiselling				Water Added	
From	To	Hours	Tool	From	To

Water Strikes					
Date	Time	Strike	Minutes	Standing	Casing

General Remarks

Borehole location obtained using hand-held GPS - accurate to approximately 5m.

Log is DRAFT status and subject to review following laboratory testing.

Scale 1:62.5

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.

WSP wsp Telephone: Fax:	**BOREHOLE LOG**	Hole No. **BH104**
	Project: Fabian Way, Swansea	Sheet: 1 of 2
Job No: 37721	Client: Leadbitter	Date: 04-07-13 05-07-13

Contractor / Driller	Method/Plant Used	Logged By	Co-Ordinates (NGR)	Ground Level (m AOD)
Apex	Dando CP	MCL	E 70269.000 N 92884.000	

SAMPLES & TESTS							STRATA					Install / Backfill
Depth	Type	Test Result	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thick-ness)	Description	Legend	Geology	Dia. 50 mm
								(0.80) 0.80	MADE GROUND comprising yellowish brown gravelly fine to medium SAND with many cobbles and occassional boulders (up to 300mm diameter). Gravel is subangular fine to coarse of sandstone and concrete. Cobbles and boulders are subangular and tabular of fine to medium grained sandstone and concrete (Piling Mat).		MG	
1.00	SPT	25,25,25 0,0,0 N=25/ 0.015(C)				1		(1.70)	MADE GROUND comprising dark brown and greyish brown sandy GRAVEL with some cobbles. Gravel is angular to subangular fine to coarse of red brick iron ore slag concrete and sandstone. Cobbles are subangular of iron ore slag and sandstone.		MG	
1.00-1.50	B											
2.00	SPT	25,25,0 0,0,0 N=0/ 0(C)				1		2.50				
2.00-2.50	B											
3.00	SPT	1,1,3 4,4,6 N=17(S)							Medium dense light brown gravelly fine to medium SAND. Gravel is subangular to subrounded fine to medium of sandstone and calcareous shell fragments (Aeolian Sand).			
3.00-3.50	B											
4.00	SPT	2,2,1 2,4,6 N=13(S)						(3.70)			AEOLD	
4.00-4.50	B											
5.00	SPT	2,3,3 3,3,5 N=14(S)										
5.00-5.50	B											
6.00	SPT	3,3,3 4,5,7 N=19(S)						6.20				
6.00-6.50	B								Very loose to loose grey and dark grey very silty fine SAND with some cobbles. Cobbles are subangular of sandstone approximately 100-130mm diameter (Fluvio-Glacial Till).			
7.50	SPT	1,1,1 1,1,1 N=4(S)										
7.50-8.00	B							(3.90)			GT	
9.00	SPT	2,2,2 2,3,2 N=9(S)										
9.00-9.50	B											
9.50-10.00	B											

Boring Progress					
Date	Time	Depth	Casing Dpt	Dia. (mm)	Water Dpt
04-07-13	16.30	10.00	9.00	200	3.3

Chiselling			
From	To	Hours	Tool
0	1.6	0.45	Hammer
2	2.5	1	Hammer

Water Added	
From	To
1	1.50

Water Strikes					
Date	Time	Strike	Minutes	Standing	Casing
04-07-13		2.50	20	2.00	

General Remarks

Borehole location obtained using hand-held GPS - accurate to approximately 5m.

Log is DRAFT status and subject to review following laboratory testing.

Scale 1:62.5

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.

08 WSP BH LOG 37221-FABIAN WAY, SWANSEA.GPJ WSPETEMPLATE1.03.GDT 14/8/13

wsp Telephone: Fax:	**BOREHOLE LOG**	Hole No. **BH104**
	Project Fabian Way, Swansea	Sheet 2 of 2
Job No 37721	Client Leadbitter	Date 04-07-13 05-07-13

Contractor / Driller	Method/Plant Used	Logged By	Co-Ordinates (NGR)	Ground Level (m AOD)
Apex	Dando CP	MCL	E 70269.000 N 92884.000	

SAMPLES & TESTS							STRATA					Install / Backfill
Depth	Type	Test Result	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thick -ness)	Description	Legend	Geology	Dia. 50 mm
								10.10				

Boring Progress						Water Strikes					
Date	Time	Depth	Casing Dpt	Dia. (mm)	Water Dpt	Date	Time	Strike	Minutes	Standing	Casing

Chiselling				Water Added		General Remarks
From	To	Hours	Tool	From	To	Borehole location obtained using hand-held GPS - accurate to approximately 5m. Log is DRAFT status and subject to review following laboratory testing.

Scale 1:62.5	Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.

08 WSP BH LOG 37221-FABIAN WAY, SWANSEA.GPJ WSPETEMPLATE1.03.GDT 14/8/13

wsp Telephone: Fax:	**BOREHOLE LOG**	Hole No. **BH105**
	Project: Fabian Way, Swansea	Sheet: 1 of 3
Job No: 37721	Client: Leadbitter	Date: 05-07-13 10-07-13

Contractor / Driller	Method/Plant Used	Logged By	Co-Ordinates (NGR)	Ground Level (m AOD)
Apex	Dando CP	MCL	E 70248.000 N 92938.000	

SAMPLES & TESTS							STRATA					Install / Backfill
Depth	Type	Test Result	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thick-ness)	Description	Legend	Geology	Dia. 50 mm
								(0.80) 0.80	MADE GROUND comprising yellowish brown gravelly fine to medium SAND with many cobbles and occassional boulders (up to 300mm diameter). Gravel is subangular fine to coarse of sandstone and concrete. Cobbles and boulders are subangular and tabular of fine to medium grained sandstone and concrete (Piling Mat).		MG	
1.00	SPT	15,10,25 25,0,0 N=50/ 0.045(C)						(1.70) 2.50	MADE GROUND comprising greyish brown and dark brown fine sandy GRAVEL with some cobbles (5-20%). Gravel is angular to subangular fine to coarse of iron-ore slag, sandstone, red brick and calcareous shell fragments. Cobbles are subangular of iron-ore slag, sandstone and red brick.		MG	
1.00-2.00	B											
2.00	SPT	50,0,0 0,0,0 N=0/ 0(C)										
2.00-2.50	B											
3.00	SPT	2,2,2 2,2,3 N=9(S)				1			Loose to dense light brown gravelly fine to medium SAND with many cobbles. Gravel subangular to subrounded fine to medium of sandstone and calcareous shell fragments. Cobbles are rounded of yellowish brown sandstone (Aeolian Sand).			
3.00-3.50	B											
4.00	SPT	2,3,5 12,12,16 N=45(S)										
4.00-4.50	B											
5.00	SPT	3,3,9 11,11,12 N=43(S)				2		(5.80)			AEOLD	
5.00-5.50	B											
6.00	SPT	5,5,7 7,10,10 N=34(S)										
6.00-6.50	B											
7.50	SPT	3,5,2 4,2,3 N=11(S)										
7.50-8.00	B							8.30				
9.00	SPT	2,2,2 2,4,4 N=12(S)							Medium dense in places very dense greyish brown and dark grey silty fine SAND with many cobbles. Cobbles are subrounded of quartzitic sandstone (Fluvio-Glacial Till). ...between 13.8-15.50mbgl: rounded medium to coarse gravel of quartzitic sandstone.		GT	
9.00-9.50	B											

Boring Progress					
Date	Time	Depth	Casing Dpt	Dia. (mm)	Water Dpt
05-07-13	16.30	3.00	3.00		2

Chiselling				Water Added	
From	To	Hours	Tool	From	To
1	1.5	1	Hammer	0	4
1.5	2	1	Hammer		
2	2.5	1	Hammer		

Water Strikes					
Date	Time	Strike	Minutes	Standing	Casing
10-07-13	07.45	3.30			19.00
09-07-13	16.05	5.40			19.00
08-07-13	16.00	5.49			11.50
09-07-13	07.45	5.50			11.50

General Remarks

Borehole location obtained using hand-held GPS - accurate to approximately 5m.

Log is DRAFT status and subject to review following laboratory testing.

Scale 1:62.5

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.

WSP wsp Telephone: Fax:	**BOREHOLE LOG**	Hole No. **BH105**
	Project: Fabian Way, Swansea	Sheet: 2 of 3
Job No: 37721	Client: Leadbitter	Date: 05-07-13 10-07-13

Contractor / Driller	Method/Plant Used	Logged By	Co-Ordinates (NGR)	Ground Level (m AOD)
Apex	Dando CP	MCL	E 70248.000 N 92938.000	

SAMPLES & TESTS							STRATA					Install / Backfill
Depth	Type	Test Result	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thick-ness)	Description	Legend	Geology	Dia. 50 mm
10.50	SPT	8,10,25 25,0,0 N=50/ 0.072(S)						(7.20)	Medium dense in places very dense greyish brown and dark grey silty fine SAND with many cobbles. Cobbles are subrounded of quartzitic sandstone (Fluvio-Glacial Till). ...between 13.8-15.50mbgl: rounded medium to coarse gravel of quartzitic sandstone. *(continued)*			
10.50-11.00	B											
12.00	SPT	25,25,25 0,0,0 N=25/ 0.02(S)									GT	
12.00-12.50	B											
13.50	SPT	2,3,5 5,7,8 N=25(C)										
13.50-14.00	B											
15.00	SPT	3,5,5 8,8,10 N=31(C)						15.50				
15.00-15.50	B								Stiff dark brown slightly sandy gravelly CLAY. Gravel is subangular to subrounded fine to medium of yellowish brown sandstone, dark grey siltstone and mudstone (Glacial Till).			
16.50	SPT	9,7,9 12,15,15 N=51(S)						(4.80)			GT	
16.50-17.00	B											
18.00	SPT	7,9,15 20,20,10 N=65(S)										
18.00-18.50	B											
19.50	SPT	5,6,8 12,11,20 N=51(S)										

Boring Progress

Date	Time	Depth	Casing Dpt	Dia. (mm)	Water Dpt
08-07-13	16.30	11.50	10.50	200	5.5
09-07-13	16.30	19.00	19.00		5.5

Chiselling

From	To	Hours	Tool
11.5	12	1	Hammer
12	12.50	1	Hammer
12.5	12.7	0.30	Hammer

Water Added

From	To

Water Strikes

Date	Time	Strike	Minutes	Standing	Casing

General Remarks

Borehole location obtained using hand-held GPS - accurate to approximately 5m.

Log is DRAFT status and subject to review following laboratory testing.

Scale 1:62.5

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.

wsp Telephone: Fax:	**BOREHOLE LOG**	Hole No. **BH105**
	Project Fabian Way, Swansea	Sheet 3 of 3
Job No 37721	Client Leadbitter	Date 05-07-13 10-07-13

Contractor / Driller	Method/Plant Used	Logged By	Co-Ordinates (NGR)	Ground Level (m AOD)
Apex	Dando CP	MCL	E 70248.000 N 92938.000	

SAMPLES & TESTS							STRATA					Install / Backfill
Depth	Type	Test Result	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thick-ness)	Description	Legend	Geology	Dia. 50 mm
19.50-20.00	B							20.30			GT	
20.50	SPT	25,25,25 0,0,0 N=25/ 0.005(S)						20.50	Extremely weak grey MUDSTONE recovered as clayey angular to subangular fine to medium gravel sized fragments (Lower Coal Measures).		SWLCM	

Boring Progress						Water Strikes					
Date	Time	Depth	Casing Dpt	Dia. (mm)	Water Dpt	Date	Time	Strike	Minutes	Standing	Casing
10-07-13	16.30	20.50	20.50	100	5.5						

Chiselling				Water Added	
From	To	Hours	Tool	From	To

General Remarks

Borehole location obtained using hand-held GPS - accurate to approximately 5m.

Log is DRAFT status and subject to review following laboratory testing.

Scale 1:62.5

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.

WSP wsp Telephone: Fax:	**BOREHOLE LOG**	Hole No. **BH106**
	Project: Fabian Way, Swansea	Sheet: 1 of 1
Job No: 37721	Client: Leadbitter	Date: 10-07-13 12-07-13

Contractor / Driller	Method/Plant Used	Logged By	Co-Ordinates (NGR)	Ground Level (m AOD)
Apex	Dando CP	MCL	E 70205.000 N 92862.000	

SAMPLES & TESTS							STRATA					Install / Backfill
Depth	Type	Test Result	PID (ppmV)	HSV (kN/m2)	P.Pen (kN/m2)	Water	Elev. (mAOD)	Depth (Thick-ness)	Description	Legend	Geology	Dia. 50 mm
						1		(0.80) 0.80	MADE GROUND comprising yellowish brown gravelly fine to medium SAND with many cobbles and occassional boulders (up to 300mm diameter). Gravel is subangular fine to coarse of sandstone and concrete. Cobbles and boulders are subangular and tabular of fine to medium grained sandstone and concrete (Piling Mat).		MG	
1.00 1.00-1.50	SPT B	3,2,4 4,4,4 N=16(S)						(1.20) 2.00	MADE GROUND comprising dark brown and greyish brown sandy GRAVEL with some cobbles. Gravel is angular to subangular fine to coarse of red brick iron ore slag concrete and sandstone. Cobbles are subangular of iron ore slag and sandstone.		MG	
2.00 2.00-2.50	SPT B	2,6,12 25,25,0 N=62/ 0.225(S)						(0.60) 2.60	MADE GROUND comprising brown slightly gravelly SAND. Gravel is subangular to subrounded medium to coarse of quartzitic sandstone and red brick. Black subangular fine gravel sized fragments of coal measure observed throughout horizon.		MG	
3.00 3.20-3.50	SPT ES	25,25,0 0,0,0 N=0/ 0(C)						(0.60) 3.20	MADE GROUND comprising reinforced concrete (buried concrete foundation slab).		MG	
								(0.80) 4.00	MADE GROUND comprising dark grey and black fine to medium SAND impacted with hydrocarbon. Strong HC odour noted.		MG	
						2		(0.50) 4.50	Probably medium dense light brown gravelly fine to medium SAND. Gravel is subangular to subrounded fine to medium of sandstone and calcareous shell fragments (Aeolian Sand).		AEOLD	

Boring Progress					
Date	Time	Depth	Casing Dpt	Dia. (mm)	Water Dpt
10-07-13	16.30	2.00	2.00	200	1.00
11-07-13	16.30	4.50	4.50		1.5

Water Strikes					
Date	Time	Strike	Minutes	Standing	Casing
10-07-13		0.50			1.00
11-07-13		4.50			4.50

Chiselling				Water Added	
From	To	Hours	Tool	From	To
2.6	3	1	Hammer	0	0.5
3	3.2	0.45	Hammer		

General Remarks

Borehole location obtained using hand-held GPS - accurate to approximately 5m.

Log is DRAFT status and subject to review following laboratory testing.

Borehole terminated due to potential hydrocarbon contamination

Scale 1:62.5

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.

Appendix B

2013 Ground Investigation (ESRI)

Ground Gas Monitoring

Groundwater and Ground Gas Monitoring Form

VISIT 1

Site Name	Fabian Way, Swansea
Client	Leadbetter
Job No.	00037221
Date	05/08/2013
Start Time	09:30:00
End Time	16:30:00

Operator	Kirsty Meyer
Pressure at Start mB	1008
Pressure at End mB	1008
Weather Conditions	Heavey rain
Temperature oC	15 degress Celcius

Equipment	Serial No.	Calibrated
Gas Analyser	GA2000	Yes
Dipmeter		
Interface Probe		
PID		

	Borehole	Response Zone (m)		Gas Flow (l/hr)		Borehole Pressure	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Other Gasses (ppmV)			Depth to Water	Depth to Base	Thickness of product	Sampled?
		Top	Bottom	Initial	Steady	(mB)	Initial	Steady	Initial	Steady	Initial	Steady	PID	H2S	CO	(m)	(m)	(mm)	(Y/N)
1	BH100(s)	0.50	3.00	-0.3	-0.3		0	0	2.6	2.6	4.5	0.8	1	0	0		3.01	0	No
2	BH100(d)	3.50	11.20	0	0		0	0	20.1	20.1	79.2	79.8	1	0	0	2.97	8.89	0	Yes
3	BH101(s)	0.50	3.00	2.5	2.5		1.7	1.7	3.5	3.5	1.6	0.0	2	0	0		3.04	0	No
4	BH101(d)	3.50	10.00	-0.3	-0.3		0	0	0.1	0	20.1	20.5	2	0	0	3.11	9.78	0	Yes
5	BH102(s)	0.50	3.00	2.2	2.2		3.1	3	2.6	2.5	0.2	0.1	0	0	0		3.06	0	No
6	BH102(d)	3.50	10.00	1.8	1.8		0.5	1.2	0.7	1.4	8.2	1.1	0	0	0	3.13	9.01	0	Yes
7	BH103(s)	0.50	3.00	3.0	3.1		0.1	0.1	1.5	1.5	0.5	0.0	0	0	0	2.51	3.10	0	No
8	BH103(d)	3.50	10.00	0.1	-0.1		0	0.1	0.9	0.9	12.6	11.0	0	0	0	2.49	9.77	0	Yes
9	BH104(s)	0.50	3.00	3.2	3.1		0	0	4.4	4.4	2.7	2.6	0	0	0	2.62	2.98	0	No
10	BH104(d)	3.50	10.10	2.9	2.5		0	0	3.2	4	5.2	3.2	0	0	0	2.57	9.78	0	Yes
11	BH105(s)	0.50	3.00	2.2	2.2		0	0	0	0	2.7	2.7	0	0	0	2.5	3.52	0	No
12	BH105(d)	3.50	15.50	2.2	1.8		0.1	0.1	0.5	0.1	12.8	3.5	0	0	0	2.5	14.09	0	Yes
13	BH106(s)	1.00	4.00	4.0	4.0		0	0	4	4.7	1.9	1.8	0	0	0	2.53	4.01	0	Yes
14																			
15																			
16																			

COMMENTS & GROUND CONDITIONS: BH101 (S) LEL = 33% BH102(S) LEL = 60% BH102(d) LEL = 24% BH103(s) LEL=2% BH104(S) and BH105(s) vent air noticeably.

Groundwater and Ground Gas Monitoring Form

VISIT 2

Site Name	Fabian Way, Swansea
Client	Leadbetter
Job No.	00037221
Date	16/08/2013
Start Time	10:00:00
End Time	14:00:00

Operator	K Meyer
Pressure at Start mB	1014
Pressure at End mB	1016
Weather Conditions	Sunny
Temperature oC	18

Equipment	Serial No.	Calibrated
Gas Analyser	GA5000	Yes
Dipmeter		
Interface Probe	Bristol	N/A
PID	Rem	No

	Borehole	Response Zone (m)		Gas Flow (l/hr)		Borehole Pressure	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Other Gasses (ppmV)			Depth to Water	Depth to Base	Thickness of product	Sampled?
		Top	Bottom	Initial	Steady	(mB)	Initial	Steady	Initial	Steady	Initial	Steady	PID	H2S	CO	(m)	(m)	(mm)	(Y/N)
1	BH100(s)	0.50	3.00	0.0	0.0	-0.14	0	0	1	2.1	14.7	8.4	0	1	1	2.4185	3.04		No
2	BH100(d)	3.50	11.20	0.0	0.0	-0.55	0	0	0.3	0.4	13.2	13.2	0	1	2	2.82	8.82		No
3	BH101(s)	0.50	3.00	-0.7	-0.7	0.20	0.4	0.3	1.2	1.6	8.1	1.6	0	0	0	2.98	3.04		No
4	BH101(d)	3.50	10.00	-0.1	-0.1	0.30	0	0	0.1	0.1	18.8	19.9	0	0	1	2.98	9.73		No
5	BH102(s)	0.50	3.00	-0.9	-0.9	0.34	0.1	0	0.7	0.8	11.4	8.5	0	0	1	2.96	3.03		No
6	BH102(d)	3.50	10.00	-5.0	-5.0	-0.20	0	0	0.3	0.3	19.1	15.0	0	0	1	2.96	8.92		No
7	BH103(s)	0.50	3.00	-1.3	-1.3	-0.03	0.3	0.3	1.4	1.4	0.2	0.2	1	0	1	2.33	3.10		No
8	BH103(d)	3.50	10.00	-1.3	-1.3	-0.05	0	0	0.1	0	20.6	21.0	3	0	1	2.325	9.69		No
9	BH104(s)	0.50	3.00	-1.1	-1.1	0.10	0	0	2.5	4.3	9.8	2.3	0	0	1	2.52	2.97		No
10	BH104(d)	3.50	10.10	-7.0	-7.0	0.27	0	0	0.6	0.6	18.0	18.0	0	0	2	2.515	9.73		No
11	BH105(s)	0.50	3.00	-1.1	-1.1	0.00	0.21	0.1	0	0	2.2	2.1	0	0	2	2.32	3.20		No
12	BH105(d)	3.50	15.50	-1.2	-1.2	0.00	0.3	0.5	0.3	0.5	7.6	4.7	0	0	1	2.325	13.91		No
13	BH106(s)	1.00	4.00	-1.3	-1.3	0.17	0	0	5	5.3	1.6	1.4	1	0	1	2.55	4.02		No
14																			
15																			
16																			

COMMENTS & GROUND CONDITIONS:

Groundwater and Ground Gas Monitoring Form

VISIT 3

Site Name	Fabian Way, Swansea
Client	Leadbetter
Job No.	00037221
Date	21/08/2013
Start Time	08:00:00
End Time	11:15:00

Operator	Kirsty Meyer
Pressure at Start mB	1023
Pressure at End mB	1023
Weather Conditions	o/cast
Temperature oC	19

Equipment	Serial No.	Calibrated
Gas Analyser	GA5000	Yes
Dipmeter		
Interface Probe		
PID	WSP REM	No

	Borehole	Response Zone (m)		Gas Flow (l/hr)		Borehole Pressure	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Other Gasses (ppmV)			Depth to Water	Depth to Base	Thickness of product	Sampled?
		Top	Bottom	Initial	Steady	(mB)	Initial	Steady	Initial	Steady	Initial	Steady	PID	H2S	CO	(m)	(m)	(mm)	(Y/N)
1	BH100(s)	0.50	3.00	1.4	1.4	-0.09	0	0	2.3	2.6	7.9	5.9	0	0	1	2.8	3.03		No
2	BH100(d)	3.50	11.20	-8.1	-7.0	0.14	0.1	0	0.2	1.1	18.3	11.3	0	1	1	2.8	8.83		
3	BH101(s)	0.50	3.00	0.8	1.0	0.12	0.7	0.7	2.2	2.3	1.4	0.3	0	0	0	2.97	3.04		
4	BH101(d)	3.50	10.00	1.2	1.2	0.03	0.3	0.2	0.8	0.6	11.9	13.9	0	0	0	2.97	9.73		
5	BH102(s)	0.50	3.00	1.0	1.0	0.22	0	0.2	0.2	1.4	19.2	10.1	0	0	0	2.96	3.05		
6	BH102(d)	3.50	10.00	-7.0	-7.0	0.40	0.1	0.1	0.3	0.3	18.8	19.0	0	0	2	2.96	8.92		
7	BH103(s)	0.50	3.00	0.8	0.8	0.70	0.4	0.4	1.4	1.4	1.3	0.5	1	0	1	2.35	3.09		
8	BH103(d)	3.50	10.00	0.6	0.6	0.00	0	0	0.1	0.1	20.0	21.0	0	0	1	2.35	9.69		
9	BH104(s)	0.50	3.00	0.1	0.1	-0.10	0	0	4.8	4.9	3.5	3.0	0	0	1	2.55	2.97		
10	BH104(d)	3.50	10.10	-0.2	-0.2	-0.20	0	0	1.3	0.5	14.8	18.9	0	0	2	2.55	9.73		
11	BH105(s)	0.50	3.00	0.4	0.4	-0.60	0	0	0.2	0.1	16.0	8.6	0	0	1	2.35	3.21		
12	BH105(d)	3.50	15.50	0.2	0.2	-0.03	0	0	0.2	0.2	17.8	18.2	0	0	1	2.35	13.86		
13	BH106(s)	1.00	4.00	-0.1	-0.1	0.15	0	0	4.8	5.4	2.9	1.5	1	0	1	2.56	3.99		
14																			
15																			
16																			

COMMENTS & GROUND CONDITIONS: BH401 &BH402-Vacume created as well is flooded, flow was negative . BH401-had to remove bung as water being pulled and was blocked, no steady results. BH402, BH403, BH407, BH410A, BH411 continual rising borehole pressures, do not use the values. BH405-Missed.