Welsh Government

M4 Corridor around Newport

Land Contamination Assessment Report Annex D
CL-18 River Usk Pier Location

M4CaN-DJV-EGT-ZG_GEN-RP-EN-0016

At Issue | March 2016

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1 Introduction

1.1 Background

1.1.1 This report relates to an area of land potentially affected by contamination (CL-18) known as 'River Usk Pier Location' hereafter referred to as the 'Site'.

1.1.2 The Site is located between chainage 10,200 and 10,550 (shown in Figure 1), upon mudflats within the tidal range of the River Usk on its eastern bank.

1.2 Reporting Context

1.2.1 The Site has been assessed as part of ground investigations and monitoring associated with the wider works for the M4 Corridor around Newport (M4CaN) (hereafter referred to as the 'Scheme') and informs the baseline for the environmental impact assessment (EIA) for the Scheme. The EIA is reported in the M4CaN Environmental Statement (ES) of which this document is an appendix to the chapter on Geology and Soils

1.2.2 In 2014, a Preliminary Sources Study Report (2014 PSSR) was prepared as an initial land contamination appraisal (Ove, Arup & Partners, 2014) as part of the Design Manual for Roads and Bridges (DMRB) Stage 2 Assessments for a number of potential route options. This identified a number of individual areas that may be affected by contamination as a result of historical activities at the Site. In addition, this report draws upon the 2015 Supplementary Ground Investigation report on behalf of the Welsh Government (Geotechnical Engineering, 2015). This report relates to the area defined in the Site Plan Figure 1.

1.2.3 The overarching rationale and approach for the assessment of areas of land along the proposed new section of motorway with potential contamination is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES).

1.3 Objectives

1.3.1 The key objectives of this report are set out below:

- Undertake a risk assessment of the Site and determine whether potential risks to human health or controlled waters could exist based upon the Scheme.
- Identify the need for further assessment and investigation in order to refine potential land contamination risks and inform the need for remediation/mitigation.
- To provide information to support the Ground Investigation Report (GIR) and Geotechnical Design Report (GDR) required under DMRB HD22/08 (Highways Agency, 2008).

1.4 Report Structure

1.4.1 The subsequent report structure is as follows:

- Section 2: Site Location and Description.
- Section 3: The Scheme – This section details the new section of motorway alignment and associated features at the Site.
- Section 4: Site History – This section summarises the history of the Site based on historical maps and historical land photographs.
- Section 5: Environmental Setting – This section summarises the Site description, published geology, hydrology and hydrogeology and any relevant environmental information presented in the 2014 PSSR.
- Section 6: Scope of Ground Investigation Works – This section describes the previous and supplementary ground investigation data available for the Site.
- Section 7: Ground Conditions – This section describes the main findings of the intrusive site investigation including the ground conditions encountered and any visual or olfactory evidence of contamination identified.
- Section 8: Contamination Assessment – This section describes the findings of the Tier 1 and Tier 2 contamination risk assessment based upon potential contamination sources, potential receptors and potential contaminant linkages and presents the human health and controlled waters assessments.
- Section 9: Refined Conceptual Site Model – This section presents the Conceptual Site Model (CSM) for the Site and identifies potential contaminant linkages, based upon the findings of the data presented within Sections 2 to 7.
- Section 10: Conclusions and Recommendations – This section provides conclusions concerning the likelihood of land contamination associated with the Site affecting the Scheme and requirements for remediation/mitigation.

2 Site Location and Description

2.1.1 The Site comprises the footprint of the proposed bridge pier that will support the new motorway crossing of the River Usk. The River Usk is designated as a Special Area of Conservation (SAC).

2.1.2 The Site is located on the mudflats on the eastern bank of the River Usk, centred at National Grid Reference ST 325 854. Newport Docks and Stephenson Street Industrial Estate occupy the western and eastern banks of the river respectively (refer to Land Contamination Assessment Reports CL-14 and CL-15 (Annex D of Appendix 11.1 of the ES) for details), in the vicinity of the pier location.

2.1.3 The Site layout is shown in Figure 1.

3 The Scheme

3.1.1 The Scheme includes the construction of a new section of motorway, which would cross the River Usk near to Newport Docks at approximate chainage 10,000 to 10,500. This would require a bridge crossing with one pier located on the east bank of the river channel. For this assessment, the boundaries of the Site are determined by the footprint of the piers/foundations of the viaduct that would support the motorway.

3.1.2 The eastern pier would be situated approximately on the High Mean Water mark and approximately 200 m from the centre of the river channel.

3.1.3 The expected construction methodology is likely to involve a cofferdam to 6 m depth and piled foundations in the bedrock. Sheet piling will extend deep into the bedrock and part of the river channel alluvium will be excavated. The necessary piling foundations would be constructed within the rock and then be capped. On completion of works, the sheet piling would be removed.

4 Site History

4.1.1 The 2014 PSSR historical searches were based on Ordnance Survey plans, literature reviews, information provided by British Steel, Natural Resources Wales (NRW) (formerly Environment Agency Wales), Newport City Council and aerial photographic interpretation.

4.1.2 This is supplemented by a review of historical maps obtained in 2015 from the Welsh Government. Relevant extracts are presented in Appendix 6.

4.1.3 A detailed history of the docks on the east and west banks of the River Usk are presented in Land Contamination Assessment Reports for CL-14 and CL-15. A summary of the history in relation to the pier location is presented in Table 1.

Table 1: Site History

Date	Use	Source of Information
1843 - 1893	The site comprises mudflats on the eastern bank of the River Usk. Agricultural fields are to the east. An embankment runs along the eastern side.	1:10,560 Historical Mapping
1891 - 1912	No significant change. A footpath is identified along the embankment.	1:10,560 Historical Mapping
1904 - 1939	Dry docks have been constructed 300 m south on the eastern bank.	1:10,560 Historical Mapping
1964 - 1965	No significant change.	1:10,560 Historical Mapping
1970 - 1973	No significant change. Footpath no longer identified.	1:10,000 Historical Mapping
1979	Works have been built on the land to the east, including a jetty/pier to the River Usk beyond the northern boundary of the Site.	Aerial Photography
1981 - 1989	No significant change.	1:10,000 Historical Mapping
1985 - 1996	No significant change.	1:10,000 Historical Mapping
2006	No significant change.	Aerial Photography
2009 - 2010	No significant change.	Aerial Photography
2014	No significant change.	Aerial Photography

Notes: Potential sources of contamination are underlined.

4.1.4 The sources of information presented above supplement those used in the 2014 PSSR. In particular, the 1979 aerial photograph highlights works adjacent to the Site. Relevant extracts of the photographs are presented in Appendix 6.

4.1.5 Previous ground investigations on the eastern side of the River Usk have identified the Alluvium present to have been impacted by the industrial legacy around the watercourse with notably elevated polychlorinated biphenyl (PCB) concentrations.

4.1.6 Historically there is the potential for the Site to have been bombed during World War II which is discussed in detail within the Explosive Ordnance Threat Assessment Report (Bactec, 2014). There is thus a risk from unexploded ordnance at the Site which is categorised as medium-high risk (Bactec, 2014).

5 Environmental Setting

5.1 Geology

5.1.1 British Geological Survey (BGS) data indicates that the Site is underlain by Tidal Flat Deposits (TFD) overlying bedrock of the Mercia Mudstone Group. The more recent deposition of the Tidal Flat Deposits associated with the River Usk is referred to as Alluvium.

5.2 Hydrology

5.2.1 The Site is located on the River Usk within the mean high tidal range.

5.3 Hydrogeology

5.3.1 NRW classifies the Mercia Mudstone Group as a Secondary B Aquifer. The Tidal Flat Deposits are classified as non-productive (negligibly permeable) strata.

5.3.2 The Site does not lie within a groundwater source protection zone.

5.4 Environmental Information

5.4.1 There are no records of pollution incidents, abstraction licences or discharge consents being located within the Site boundary.

5.4.2 NRW records identify two pollution incidents occurring within 300 m of the Site, which had no impact on water. These incidents were related to unauthorised waste activities.

5.4.3 Three significant pollution incidents are, however, reported by NRW that may potentially have affected the Site.

5.4.4 Two pollution incidents with significant impact on water were recorded in 2010 and 2011 some 20 m north. The 2010 incident involved a release of oil and fuel. No information on the type of released substance in 2011 has been provided. This may potentially have an effect on sediment quality at the pier location.

5.4.5 In June 2002, a significant amount of oils and fuels (details regarding the type and amount of released hydrocarbons are unknown) were released to the River Usk, approximately 600 m downstream. The tidal conditions during the release are unknown and therefore, in the worst case scenario (i.e. incoming high tide during the incident), there could potentially have been transport of the dispersed plume of contamination upstream and the receding tidal waters could have allowed some of the plume to settle on the tidal mudflats. There is therefore the potential for the contamination to have affected the Site.

5.4.6 One discharge outlet is located directly to the east of the Site and is related to the industrial estate. The discharge consent was issued in 1995. No further details are available. This may potentially have an effect on sediments quality at the pier location.

5.4.7 The River Usk itself is classed as a SAC and a Site of Special Scientific Interest (SSSI).

5.4.8 Based on the above, a number of off site pollution incidents that could represent potential contamination sources require due consideration in relation to the new section of motorway.

6 Scope of Ground Investigation Works

6.1 General

6.1.1 Two intrusive ground investigations have been undertaken within the Site boundary. These are summarised below.

6.1.2 For the purpose of meeting the requirements of Volume 4, Section 1, Part 2 of the DMRB HD22/08 – Managing Geotechnical Risk – 2008 (Highways Agency, 2008), the historical data used to support the 2014 PSSR has been differentiated from additional 2015 Supplementary Ground Investigation data (Geotechnical Engineering, 2015).

6.1.3 The Site is located adjacent to the Stephenson Street Industrial Estate (CL-15). Summarised information relating to the industrial estate site is discussed in this report. Full details of the scope of works for CL-15, however, including findings, assessment and conclusions, are available within the Land Contamination Assessment Report for CL-15 (Annex D of Appendix 11.1 of the ES).

6.2 Scope of Works

6.2.1 Table 2 provides details on the intrusive ground investigations undertaken within the Site area.

Table 2: Site Investigation Summary

Date	Contractor	Site Location	Boreholes	Window Sampler	Trial Pits	Sampling
1997	Norwest Holst	West	BHG1	-	-	None
2015	Geotechnical Engineering	East	BH423	-	TP410	Soil, leachate and groundwater

6.2.2 The construction details of all boreholes installed on the Site are summarised in Table 3.

Table 3: Summary of Borehole Construction Details

Borehole ID	Diameter (mm)	Total Drilled Depth (m)	Top of Slotted Well Casing/Gravel Pack (mbGL)	Base of Slotted Well Casing/Gravel Pack (mbGL)	Targeted Geology
BHG1	Unknown	55	30	36.5	Mercia Mudstone Group
BH423	35	60	15	18	Tidal Flat Deposits/River Terrace Deposits
	50		25	40	Mercia Mudstone Group

6.3 Surface Water Quality Monitoring

6.3.1 Surface water quality monitoring was not undertaken during the previous ground investigations of the Site.Further information on surface water monitoring undertaken for the Scheme is provided in Chapter 16 of the ES.

6.4 Field Testing

6.4.1 Monitoring of Volatile Organic Compounds (VOCs) was undertaken on three soil samples from BH423 at 0.2-0.5 mbGL, 0.5-1.0 mbGL and 1.0-1.2 mbGL, and five soil samples from TP410 at 0.0-0.2 mbGL, 0.9-1.0 mbGL, 1.4-1.5 mbGL, 2.5-2.6 mbGL and 3.7-3.8 mbGL

6.5 Groundwater Monitoring

6.5.1 A summary of the groundwater sampling, groundwater/monitoring and ground gas monitoring is shown in Table 4 below.

Table 4: Summary of Monitoring Rounds

Borehole ID	Number of Rounds (Date of Sampling)	Monitoring Details	Notes
BHG1	**4 no**. (27 November 1997, 3 December 1997, 11 December 1997, 17 December 2015)	Groundwater - level	-
BH423	**4 no**. (28 April 2015, 6 May 2015, 11 May 2015, 19 May 2015)	Groundwater - level and sampling soil gas	Gas monitoring in the 35 mm shallow installation only.

6.6 Laboratory Chemical Testing

6.6.1 A summary of all laboratory analysis undertaken on soil, groundwater and leachate is summarised in Table 5 below.

Table 5: Summary of Previous Investigation Sampling

Site Investigation Date	Number of Soil Samples	Number of Leachate Samples	Number of Water Samples	Suites of Testing
1997	0	0	0	-
2015	4	1	6	Metals, PAH, TPH, pH, cyanide, phenols, asbestos, PCBs, BTEX (VOCs & SVOCs)*

Notes: ***** Groundwater only

Soil Analysis

6.6.2 The following sections summarise the results of the laboratory analysis for soil samples collected during the various intrusive investigation phases. The available data set has been tabulated and is presented in Appendix 3. Supporting laboratory certificates are available in the relevant original ground investigation reports (see Table 2).

6.6.3 To aid the development of the conceptual site model, the analytical data from the Made Ground has been assessed separately from those of the natural soils (Tidal Flat Deposits).

6.6.4 No historical data is available and all analytical data is from the 2015 investigation.

6.6.5 The available information used in this assessment has been summarised in Table 6.

Table 6: Summary of Analytical Soil Data

Formation Unit	Number of Soil Analyses per Analytical Suite - 2015 Data					
	Metals and Inorganics	PCBs	Polycyclic Aromatic Hydrocarbons	Total Petroleum Hydrocarbon	Phenol	Asbestos
Made Ground	2	1	2	2	2	2
Natural Soils	2	0	2	2	0	0

Soil Leaching Analysis

6.6.6 One soil sample from the Made Ground in TP410 was taken for soil leaching analysis. The available information is presented in Appendix 5 and is summarised in Table 7 below.

Table 7: Summary of Soil Leaching Analytical Data

Formation Unit	Number of Soil Leachate Analyses per Analytical Suite - 2015 Data					
	Metals and Inorganics	Total Petroleum Hydrocarbon	Phenols	BTEX	PCBs	PAHs
Made Ground	1	1	1	1	1	1

6.7 Groundwater Results

6.7.1 The following sections summarise the results of laboratory analysis for groundwater samples collected during the various intrusive investigation phases. The available dataset has been tabulated and is presented in Appendix 4. Supporting laboratory certificates are available in the relevant original reports.

6.7.2 The available data relates to groundwater samples taken from the wells installed within the groundwater of the River Terrace Deposits and the Mercia Mudstone Group and is summarised in Table 8.

Table 8: Summary of Analytical Groundwater Data

Groundwater Unit	Number of Groundwater Analyses per Analytical Suite (Number of Well Locations) –2015 Data/All GI Data						
	Metals and Inorganics	PAH	TPH	Phenol	BTEX	VOCs	SVOCs
Perched Groundwater (Tidal Flat Deposits/River Terrace Deposits)	3(1)/3(1)	3(1)/3(1)	3(1)/3(1)	2(1)/2(1)	3(1)/3(1)	3(1)/3(1)	2 (1)/2(1)
Groundwater Aquifer (Mercia Mudstone Group)	3(1)/3(1)	3(1)/3(1)	3(1)/3(1)	2(1)/2(1)	3(1)/3(1)	3(1)/3(1)	2(1)/2(1)

Notes: VOC – Volatile Organic Compounds, TPH – Total Petroleum Hydrocarbon, PAH – Polycyclic Aromatic Hydrocarbons, SVOC – Semi-Volatile Organic Compounds.

6.8 Gap Analysis of Available Data

6.8.1 There is no investigation data available from the current location of the proposed the pier. The exploratory boreholes and trial pits are located within 80 m of the pier.

6.8.2 There is no gas monitoring well targeting the depth zone to be excavated as part of the cofferdam construction.

6.8.3 Alluvium soils have not been analysed for PCB or vSVOCs and VOCs. PCB analyses have not been undertaken within the groundwaters.

7 Ground Conditions

7.1 Geology

7.1.1 The geological logs for all available exploratory holes excavated on or in close proximity to the Site are provided in Appendix 1. The observed geological sequence is consistent with that discussed in the 2014 PSSR report and is summarised in the following sections. Information from the Supplementary Ground Investigation (Geotechnical Engineering, 2015) has also been used.

Made Ground

7.1.2 Made Ground was encountered at one location (TP410) from ground level to a depth of 1.8 m. It comprised sandy gravelly silty peaty clay with gravels of brick. In the top 0.2 m there were frequent plastic bottles, steel cans, wood, timber and plastic.

7.1.3 It is thought that the location of TP410 represents the Mean High Water mark and as such incorporates variable detritus from the river within the substrate.

Superficial Deposits

7.1.4 Alluvium was encountered at all locations at ground level with the exception of TP410 where it was encountered beneath the Made Ground.

7.1.5 There are no obvious markers to differentiate the Alluvium from the Tidal Flat Deposits (TFD) and for the purpose of this report, the latter has been assumed to be the upper 2 m.

7.1.6 Beneath the assumed 2 m thick Alluvium, the Tidal Flat Deposits were proven to approximately 16 mbGL. Both the Alluvium and TFD generally comprised soft organic clay with occasional pockets of peat and organic material. The TFD were found to become sandy and gravelly with depth.

7.1.7 Beneath the TFD, coarser material representing River Terrace Deposits (RTD) was encountered. This generally comprised sand or gravel with occasional cobbles and was generally approximately 2 m in thickness.

Solid Geology

7.1.8 Below the RTD, weathered mudstone of the Mercia Mudstone Group (MMG) was encountered at depths of between 18.2 and 18.3 mbGL.

Geological Sequence Summary

7.1.9 The general geological sequence identified during the previous ground investigations is summarised in Table 9.

Table 9: Summary of Geological Sequence

Unit	Description	Thickness Range (m)	Basal Depth (mbGL)
Made Ground (TP410 Only)	Sandy, gravelly clay including plastic, wood, steel cans and brick fragments	1.8	1.8
Alluvium	Soft organic clay	2 (assumed)	2 - 3.8
Tidal Flat Deposits	Soft organic clay becoming sandy/gravelly with depth	14.2 - 14.6	16.2 - 16.6
River Terrace Deposits	Sand/gravel	1.7 - 2	18.2 - 18.3
Mercia Mudstone Group	Weathered reddish brown mudstone	>36.8 - >41.7	unproven

7.1.10 The conceptual site model included within the 2014 PSSR report has been revised in light of the 2015 information and is presented within Figure 2.

7.1.11 The ground conditions proven in the adjacent Stephens Street Industrial Estate (CL-15) is similar to the one proven beneath this Site, although Made Ground was found to range between 0.7 and 3.1 m in thickness. It was found to be predominantly coarse with ash, slag, brick and limestone inclusions.

7.2 Visual and Olfactory Evidence of Contamination

7.2.1 A summary of the visual and olfactory evidence of contamination encountered during the previous ground investigations is summarised in Table 10.

Table 10: Visual and Olfactory Evidence of Contamination Summary

Location ID	Depth (mbGL)	Strata	Evidence of Potential Contamination
TP410	0 - 0.2	Made Ground	Plastic bottles, steel cans, wood, timber and plastic
	0.2 - 1.8	Made Ground	Gravel of brick

7.2.2 PID monitoring was undertaken on three soil samples from BH423 and five soil samples from TP410. The PID meter recorded low levels of VOCs of between zero and 2.6 ppm (maximum within Tidal Flat Deposits).

7.2.3 Full details and observations noted during the drilling and trial pitting are presented on the exploratory logs attached in Appendix 1.

7.3 Gas Monitoring

7.3.1 The gas monitoring data set collected during each of the previous three monitoring rounds is summarised on the field data sheets provided in Appendix 2. The maximum gas concentrations are presented in Table 11 below.

Table 11: Summary of Gas Monitoring Data

Location ID	Flow (l/hr)	VOCs (ppm)	CH_4 (%/vol)	Peak LEL (%)	CO_2 (%/vol)	O_2 (%/vol)	CO (ppm)	H_2S (ppm)
	Max.	Max.	Max.	Max.	Max.	Min.	Max.	Max.
BH423 (35 mm)	0.0	3.3	1.0	24.2	0.3	19.8	0	0

7.4 Groundwater

Groundwater Encountered During Investigation

7.4.1 Groundwater strikes were encountered during the advancement of all on site locations as detailed on the geological logs provided in Appendix 1. This is summarised in Table 12.

Table 12: Summary of Groundwater Water Level Data

Location	Strike Depth (mbGL)	Geological Formation	Level After 20 Minutes (mbGL)	Comments
BHG1	12.9	Base of TFD	6.3	Dry condition recorded during drilling when borehole taken to 9 mbGL in the TFD
				Water level during drilling recorded at 4.1 - 7.6 mbGL when borehole taken into the MMG
BH432	1.2	TFD	0.54	-
TP410	0.9	Base of Made Ground	NR	Likely to represent surface water ingress

Groundwater Level during Monitoring Rounds

7.4.2 The entire groundwater level data set gathered on site is provided in Appendix 2 and is summarised in Table 13.

Table 13: Summary of Groundwater Level Data

Location	Installation[#1]	Depth of Response Zone (mbGL) and Geological Formation	Number of Measurements	Minimum Depth (mbGL)	Maximum Depth (mbGL)
BHG1	-	30 - 36.5 MMG	4	3.72	6.05
BH423	35 mm (S)	15 - 18 TFD / RTD	4	5.18	7.4
	50 mm (D)	25 - 40 MMG	4	5.27	6.9

Notes: #1 S denotes a shallow installation and D denotes deep installation.

7.4.3 There are two main groundwater bodies anticipated to be present at the Site. The main deep body is within the Mercia Mudstone at depth which appears to be confined. A shallower body within the Glaciofluvial Deposits was struck during drilling with groundwater observations showing a rise to a resting level at 3.7 to 6.4 mbGL. This implies the groundwater within the Glaciofluvial Deposits is confined by the overlying lower permeability Tidal Flat Deposits. This demonstrates the latter to represent an aquitard to the groundwater flow.

7.4.4 The variation seen between the minimum and maximum depths indicates possible tidal influence.

7.4.5 Discontinuous shallow perched water is observed within the upper Tidal Flat Deposits. This 'groundwater' is regarded as 'pore water' which does not contribute to advective flow within these strata.

7.4.6 Perched water is also identified at the base of the shallow Made Ground and this may represent delayed infiltration rather than a water body, given the granular content of the material.

7.4.7 The groundwater regime described above is similar to the one identified for the adjacent Stephens Street Industrial Estate (CL-15).

8 Contamination Assessment

8.1 Introduction

8.1.1 The following sections provide details of the assessment of land contamination at the Site.

8.1.2 The outline Conceptual Site Model presented within the 2014 PSSR has been reviewed and updated based on data from the Supplementary Ground Investigation (Geotechnical Engineering, 2015) and the proposed Scheme. The main alterations to the 2104 PSSR model are summarised as follow:

- Inclusion of groundwater quality and level data set.
- Inclusion of gas monitoring data set.
- Identification of Made Ground on site.
- Inclusion of Alluvium.
- Consideration of ground and groundwater conditions within the adjacent Stephens Street Industrial Estate (CL-15).
- Update of the source-pathway-receptor linkages taking account of above and more detailed assessments.

8.2 Preliminary Risk Assessments

Potential Sources

8.2.1 The historical neighbouring site uses are considered a potential source (see CL-15 report for full details). This may have had an effect on groundwater quality within the Glaciofluvial Deposits and Mercia Mudstone Group. Dewatering processes during construction may increase or draw off site contamination into the groundwater within the Site.

8.2.2 The presence of Made Ground was encountered at the High Mean Water level of the River Usk. Made Ground is anticipated to be absent at the currently proposed pier location at the Site. As such, Made Ground has not been considered as a viable source for the new section of motorway.

8.2.3 The Alluvium may include a number of potential contaminants transported and deposited by the River Usk from the industrial activities that have taken place over the years along its course.

8.2.4 The pier foundation may provide linkage between surface waters, perched groundwater and the deeper aquifer within the Glaciofluvial Deposits and Mercia Mudstone resulting in potential mixing of groundwater bodies. Perched groundwater and aquifer could therefore be regarded as a source of possible contaminants as well as receptors.

8.2.5 The pier construction may include excavation of a deep cofferdam and may involve man entry. Ground gas from soils (Alluvium and peaty Tidal Flat Deposits) and possible hydrocarbons from the groundwaters should be considered.

Potential Receptors

8.2.6 Receptors during the construction and the operational stages of the Scheme have been considered:

During Construction

- Construction workers during site development works.
- Site neighbours (industrial units to the east of the construction works).
- The River Usk.
- Groundwater in the Secondary B Aquifer within the Mercia Mudstone.

During Operation

- The River Usk.
- Groundwater in the Secondary B Aquifer within the bedrock.

Potential Pathways

8.2.7 The construction of the pier will require the removal of shallow soils which are to be replaced by new foundation structure. No viable pathways are identified from the potential sources to maintenance workers, general public end users and neighbouring general public. As such these have not been considered further in the conceptual site model.

8.2.8 Potential pathways include:

- Dermal contact, ingestion, inhalation pathways of potentially contaminated soils possible during construction and maintenance works.
- Mobilisation of potentially contaminated Alluvium material into surface water by construction and scouring action by the River Usk.
- Vertical or lateral migration of ground gas associated with Alluvium, Tidal Flat Deposits and possibly impacted groundwaters with hydrocarbon contamination. Dewatering process may draw possible off site contamination into cofferdam.
- Vertical migration of potentially contaminated surface water or perched groundwater within the Tidal Flat Deposits into the Glaciofluvial Deposits and Mercia Mudstone aquifer due to piling/cofferdam construction.
- Vertical migration of potentially contaminated perched groundwater within the Glaciofluvial Deposits and Mercia Mudstone into surface water or perched groundwater within the Tidal Flat Deposits due to piling/cofferdam construction.
- Lateral migration through newly imported Made Ground used to construct working platform.

8.3 Risk Evaluation

8.3.1 Source-pathway-receptor linkages were considered in the 2014 PSSR using the historical data available up to 2008. With review of the other data described herein, the following risk evaluation was reconsidered and included:

- The construction of the pier is anticipated to include the excavation of a cofferdam into the rockhead, from where piles are to be installed. The potentially contaminated shallow sediments of the Alluvium are therefore going to be removed in the process.
- The cofferdam is anticipated to be to 6 m depth and will comprise sheet pile wall. Large scale dewatering is therefore not anticipated.
- The Site lies adjacent to potentially contaminating land uses including a docks and industrial estate.
- Three significant pollution incidents have occurred in the vicinity of the Site, two involving fuel/oils.
- Made Ground has been identified on site, though limited to one location and outside the area of pier construction.
- Large thicknesses (>10 m) of cohesive Tidal Flat Deposits overlie a Secondary B Aquifer within the bedrock.
- The Site lies within the mean tidal range of the River Usk; however the proposed pier and associated construction compounds are set outside the Mean High Water level. As such the River Usk is not considered as a direct source of possible contamination.
- Lateral pathways between off site perched Made Ground (CL-15) and the River Usk/the Site have not been identified but may be altered with the off site construction of temporary working platform.
- Perched groundwater within the Tidal Flat Deposits is not considered a water resource due to its anticipated low vertical hydraulic continuity with the aquifer beneath, low permeability and low storage capacity. Low lateral pathways are also considered to be present with unlikely direct linkages with the River Usk receptor.

8.4 Human Health Risk Assessment

8.4.1 The rationale and approach for the human health (Tier 2) screening assessment is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the M4CaN ES). Soil chemical results and the findings of the Tier 2 generic human health risk assessment are presented in Appendix 3 of this report. No exceedances to the relevant generic risk assessment criteria have been identified from the analysed Made Ground and Alluvium.

8.4.2 Chromium concentrations are considered to be within the normal background range and therefore are not considered to represent a contaminant of concern. Further assessment is recommended during construction to confirm low risks (see Appendix 11.1 for more details).

8.4.3 It is noted that no PCB testing has been undertaken within the Alluvium. Elevated PCB levels have been reported to be present on the eastern bank of the River Usk.

8.5 Controlled Waters Screening Assessment

8.5.1 The rationale and approach for the controlled waters (Tier 1) screening assessment is detailed in the Land Contamination Assessment Report (Appendix

11.1 of the ES). The groundwater chemical results are presented in Appendix 4 of this report. All exceedances to the relevant generic criteria are summarised in Table 14 for soil leachate.

8.5.2 Where Environmental Quality Standards (EQS) are dependent on water hardness (e.g. some heavy metals), the hardness of the surface water receptor should normally be used. The Baseline Water Environment Report (Appendix 16.2 of the ES) indicates surface water to be generally moderately hard with hardness concentrations within a range of 100 to 150 mg/l as calcium carbonate. Therefore EQS within this water hardness range have been used for screening purposes.

Soil Leachate Results

8.5.3 One soil sample was subjected to leachate analysis. The majority of the soil leachate results were all below the applied screening criteria, with the exception of the contaminants shown in Table 14.

Table 14: Controlled Waters Screening Exceedances – Soil Leachate

Determinant	Units	Range	EQS	DWS	No. of Exceeded EQS Screening Criteria (Total Number of Results)	Location (Formation)	No. of Exceeded DWS Screening Criteria (Total Number of Results)	Location
Cadmium	µg/l	2.5	0.15	5	1 (1)	TP410 (MG)	0 (1)	-
Copper	µg/l	25	10	2,000	1 (1)	TP410 (MG)	0 (1)	-
Selenium	µg/l	13	-	10	0 (1)	-	1 (1)	TP410 (MG)

Notes: DWS – Drinking water Standards, EQS – Environmental Quality Standard.

8.5.4 The identified exceedances are considered to be minor and unlikely to pose a risk to controlled waters.

8.5.5 The laboratory detection levels for mercury, cyanide and some polycyclic aromatic hydrocarbons (PAHs) are higher than applied screening criteria. These are considered unlikely to pose a risk to controlled waters.

Groundwater Results

8.5.6 Groundwater analysis results have been assessed from samples collected over three monitoring rounds in borehole BH423 undertaken in 2015. The groundwater samples were taken from the shallow groundwater body within the superficial deposits and the aquifer body within the Mercia Mudstone Bedrock.

8.5.7 A summary of the exceedances of the screening criteria from all available ground results relating to the Site is presented in Table 15 and discussed below.

Table 15: Controlled Waters Screening Exceedances – Groundwater

Determinant	Unit	Range	EQS	DWS	No. of Exceeded Screening Criteria (Total Number of Results) Against EQS	Location	No. of Exceeded Screening Criteria (Total Number of Results) Against DWS	Location
Shallow Groundwater (Superficial Deposits)								
Arsenic	µg/l	19 - 24	50	10	0 (3)	-	3 (3)	BH423
Boron	µg/l	1,500 - 2,900	2,000	1,000	1 (3)	BH423	3 (3)	BH423
Chromium	µg/l	17 - 55	-	50	0 (3)	-	1 (3)	BH423
Copper	µg/l	7.8 - 29	10	2,000	2 (3)	BH423	0 (3)	-
Nickel	µg/l	3.1 - 6.1	4	20	2 (3)	BH423	0 (3)	-
Selenium	µg/l	19 - 34	-	10	-	-	3 (3)	BH423
Chloride	µg/l	5,600 - 6,800	250	250	2 (2)	BH423	2 (2)	BH423
Ammoniacal Nitrogen	µg/l	34 - 45	0.6	-	2(2)	BH423	-	-
Aquifer (Mercia Mudstone)								
Arsenic	µg/l	10 - 31	50	10	0 (3)	-	2(3)	BH423
Boron	µg/l	480 - 1,100	2,000	1,000	0 (3)	-	1 (3)	BH423
Copper	µg/l	3.5 - 16	10	2,000	1 (3)	BH423	0 (3)	-
Nickel	µg/l	<1 - 4.4	4	20	1 (3)	BH423	0 (3)	-
Selenium	µg/l	14 - 18	-	10	-	-	3 (3)	BH423
Chloride	µg/l	3,200 - 3,700	250	250	2 (2)	BH423	2 (2)	BH423
Ammoniacal Nitrogen	µg/l	1.6 - 2.5	0.6	-	2 (2)	BH423	-	-

8.5.8 The review of the groundwater chemical testing results indicated that both the shallow groundwater and deep groundwater beneath the Site have elevated levels of metals (arsenic, boron, copper, nickel and selenium) and inorganics (ammoniacal nitrogen and chloride).

8.5.9 The quality seen in both shallow and deep groundwater bodies is similar in terms of the contaminants in exceedance and their respective concentrations.

8.5.10 Saline intrusion may be inferred in each groundwater body when considering the elevated chloride concentration. The perched groundwater holds a higher concentration in ammoniacal nitrogen than the aquifer.

8.5.11 All phenols, benzene, toluene, ethylbenzene and xylenes (BTEX), PAH, volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) results were found to be below the limit of detection in both groundwater bodies. This is considered unlikely to pose a risk to controlled waters.

8.5.12 Further to the exceedances identified above, the analytical data indicate the presence of petroleum hydrocarbons in groundwater aquifer at borehole BH423 during one sampling round (total petroleum hydrocarbon (TPH) value of 3.7 mg/l). However, the concentrations were variable through the monitoring rounds with results below the limit of detection in some instances.

8.5.13 It is noted that the laboratory detection levels for mercury, cyanide, phenols, some PAH compounds, VOCs and SVOCs are higher than applied screening criteria. These are considered unlikely to pose a risk to controlled waters.

8.5.14 Considering the thickness of cohesive superficial deposits beneath the Site (approximately 16 m) and the absence of any obvious soil to groundwater contamination linkage, it is unlikely that the Site is the source of this contamination.

8.6 Ground Gas Risk Assessment

8.6.1 The only ground gas data available relates to borehole BH423 associated with a response zone within the base of the Tidal Flat Deposits and the River Terrace Deposits between depths of 15 to 18 mbGL. No data has been made available from the shallow Tidal Flat Deposits likely to be exposed through the construction of the cofferdam. Of the four monitoring rounds available, the following comments may be made:

- No monitoring was undertaken during a period of low barometric pressure (less than 1000 mb), with the lowest conditions being 1004 mb. As such, worst case atmospheric conditions for potential ground gas generation may have not been monitored.
- Gas flow was generally recorded as absent or negative.
- Methane was recorded at concentrations of up to 1 % on the first monitoring round but was absent in the subsequent three monitoring rounds. The concentrations are at or below the screening criteria of 1 %. The Lower Explosive Limit (LEL) of up to 24 % is noted for the first monitoring round reducing to 0-1 % on the second monitoring round and nil for the following two. Given the lack of correlation between methane concentration per volume and per LEL, it is considered that these marginal readings were likely to be caused by equipment inaccuracy rather than be representative of the presence of actual methane gas.
- Carbon dioxide was identified at concentrations of up to 0.3 % in the first monitoring round of monitoring but was absent in the following three. These concentrations are well below the screening criteria of 5 %.
- Trace Volatile Organic Compounds at concentrations of up to 3.3 ppm were recorded.
- Hydrogen sulphide and carbon monoxide were recorded zero throughout.
- Oxygen was recorded at relatively normal levels (ambient) with concentrations of between 19.9 and 20.4 %.

8.6.2 The available data do not identify abnormal gas concentration and are consistent with the expected gas regime given the ground conditions.

8.6.3 The gas regime at the Site does not appear to have been influenced by previous historical uses and is instead driven by soil gas within natural soils. A gas risk assessment has been undertaken and is set out within the Land Contamination Assessment Report (Appendix 11.1 of the ES).

8.6.4 The gas regime for the shallow Tidal Flat Deposits is, however, undetermined.

8.7 Summary

8.7.1 No contaminants included within the analytical suites were recorded at concentrations that could cause a potential risk to human health within the analysed Alluvium and Made Ground samples.

8.7.2 Moderate leachability of the Made Ground has been identified with marginal exceedances of cadmium, copper and selenium.

8.7.3 Both of the groundwater bodies present beneath the Site have elevated levels of metals (arsenic, boron, copper, mercury and selenium) and inorganics (ammoniacal nitrogen and chloride) when compared to Environment Quality Standards or Drinking Water Standards. The lack of available contamination linkage between the soil and groundwater data is noted. This, together with the ground and groundwater conditions encountered at the Site, would indicate that the quality of the aquifer observed may be affected by off site sources.

8.7.4 The groundwater quality identified within the Site is similar to the one proven in the adjacent Stephens Street Industrial Estate (CL-15). The contaminants of concern seen within the perched water of the Made Ground included lead, pH and organics (PCB, TPH and one compound of PAH). VOCs and SVOCs were all below the limit of detection.

9 Refined Conceptual Site Model

9.1.1 The incorporation of data from the 2015 Supplementary Ground Investigation has enabled the original CSM presented in the 2014 PSSR to be updated. Relevant contaminant (source-pathway-receptor) linkages have been considered within the refined CSM. The assessment was based on the Scheme during construction and operational phases.

9.1.2 A CSM representing the general ground conditions, the overall layout of the new section of motorway and the relevant source-pathway-receptors (each of which has a specific alpha-numerical symbol attached) are presented in Figure 1 and is described in Table 16.

Table 16: Conceptual Site Model

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Construction					
Potentially contaminated Alluvium	Construction workers (A)	Direct dermal (1)	Likely	Low	Low	Construction workers will possibly be exposed to potentially contaminated Tidal Flat Deposits during construction works. However, the exposure duration will be short-term only. Prior to construction, a specific risk assessment will be required in line with Construction (Design and Management) (CDM) Regulations 2015 requirements and other relevant health and safety (H&S) guidance. This will enable safe methodology and appropriate levels of Personal Protective Equipment (PPE) to be put in place. As such, all risks will be duly considered and suitably mitigated to protect construction workers. A construction mat will be placed over the area to enable piling and band drain installation as well as general construction. This will break dermal, ingestion and inhalation pathways once placed. Current data set identifies limited exceedances to the selected screening criteria. No obvious gross contamination identified within the shallow sediments/Tidal Flat Deposits. Current contamination status is not foreseen to represent abnormal constraints to construction workers health and safety, over and above those typical of a brownfield site. Data based on limited information and in particular no PCB tests have been undertaken to confirm the level of impact of the shallow Alluvial Deposits. Further investigations are required to delineate any potential contamination and confirm the risks and soil reuse potential.
		Ingestion (3)	Likely	Low	Low	
		Inhalation of soil dust (2)	Likely	Low	Low	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of ground gas or hydrocarbon vapours (2)	Likely	Low	Low	Low levels of VOCs were recorded within soils. No putrescible material identified within the shallow Tidal Flat Deposits. Significant abnormal gas regime not anticipated. Construction of the cofferdam will require specific risk assessment, control measures and PPE. Further investigations are required to delineate any potential contamination and confirm the risks.
	Site neighbours (B)	Dermal contact with soil dust (1)	Unlikely	Low	Very low	During construction there is the possibility of inhalation of soil dust during off site transport of the arising. This would lead to short-term exposure only. Covering of load and other dust mitigation measures are recommended during construction works. A construction mat will be in place to enable piling and band drain installation as well as general construction. This will break dermal, ingestion and inhalation pathways once placed. Construction within the tidal zone of the river and dust emission during excavation to be negligible given that the material will be wet.
		Ingestion of soil dust (3)	Unlikely	Low	Very low	
		Inhalation of soil dust (2)	Unlikely	Low	Very low	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	The River Usk (D)	Mobilisation of sediments (4)	Likely	Low	Low	Alluvium within the High Water Mark is likely to be mobilised during the cofferdam construction works, although this will be short-term only. Construction works and insertion of the cofferdam, should be undertaken, where possible, during low tide events. No obvious gross contamination identified although PCB results not available within the Alluvium. A foundations works risk assessment is required to confirm the absence of risk to controlled waters. This should provide a method statement to mitigate silt mobilisation. Further investigations are required to delineate any potential contamination and confirm the risks.
Tidal Flat Deposits with organic peat material potentially contaminated groundwater with hydrocarbons	Construction workers (A)	Inhalation of ground gas or hydrocarbon vapours (2)	Low	High	Moderate	Low levels of VOCs were recorded within soils. No significant peat bands within the Tidal Flat Deposits. No volatile organic compounds identified within the groundwater. Current gas data identified presence of some abnormal gas conditions including some methane concentration. Construction of the cofferdam will require specific risk assessment, control measures and PPE. Further gas monitoring is recommended to confirm the risks.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Perched water in Made Ground (off site; CL-15)	Surface waters River Usk (D)	Migration of contaminated surface water	Unlikely	Low	Very low	Newly imported granular material may provide a new pathway from potentially contaminated waters perched within the Made Ground beneath the adjacent Industrial Estate to the River Usk.
Perched groundwater/ groundwater (D) (Secondary B Aquifer)	Construction workers (A)	Dermal contact (1)	Likely	Moderate	Moderate	Both groundwaters identified to have marginal exceedances for some metals and inorganic contaminants when compared against Drinking Water Standards. Dewatering process may alter migration of potentially contaminated waters from off site sources. Construction workers will possibly be exposed to contaminated waters during Site construction works. However, exposure duration will be short-term only. Prior to construction, a specific risk assessment will be required in line with CDM Regulations 2015 requirements and other relevant H&S guidance. This will enable safe methodology and appropriate levels of PPE to be put in place. As such, all risks will be duly considered and suitably mitigated. VOCs and SVOCs determinants below level of detection within the Site and within adjacent industrial estate (CL-15).
		Ingestion (3)	Likely	Moderate	Moderate	
		Inhalation of hydrocarbon vapours (2)	Likely	Low	Low	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Perched groundwater (Cp)/groundwater (Ca) (Secondary B Aquifer)	Surface water River Usk (D)	Dewatering (4)	Likely	Moderate	Moderate	Both groundwater bodies shown to be of similar quality with marginally elevated metal and inorganic contaminants when compared against EQS. Dewatering process may alter migration of potentially contaminated waters from off site sources. A detailed dewatering risk assessment to determine likely influence on groundwater flow and potential contamination sources (on site/off site) is required. A suitable water management strategy is required to specify required mitigation measures.
Groundwater (Ca) (Secondary B Aquifer)	Surface water (D)	Contamination migration along the piles/cofferdam (4)	Likely	Low	Low	Upward migration gradient may exist, potentially linking groundwaters with surface waters via piers and surrounding TFD. The potentiometric surface of the groundwater within the Glaciofluvial Deposits and Mercia Mudstone may be above low tide level. Both groundwater bodies shown to be of similar quality with marginally elevated metal and inorganic contaminants. Dewatering process may alter migration of potentially contaminated waters from off site sources. A foundation risk assessment is required to confirm the risks.
Perched groundwater (Cp)	Groundwater (Ca) (Secondary B Aquifer)	Contamination migration along the piles/cofferdam (4)	Likely	Low	Low	
	Operation					

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Perched water in Made Ground (off site; CL-15)	Surface waters River Usk (D)	Migration of contaminated surface water	Unlikely	Low	Low	Newly imported granular material may provide a new pathway from potentially contaminated waters perched within the Made Ground beneath the adjacent industrial estate to the River Usk. It is likely the construction platform will be removed post-construction of the River Usk crossing.
Groundwater (Ca) (Secondary B Aquifer)	Surface water (D)	Contamination migration along the piles/cofferdam (4)	Likely	Low	Low	Upward migration gradient may exist, potentially linking groundwaters with surface waters via piers and surrounding TFD. The potentiometric surface of the groundwater within the Glaciofluvial Deposits and Mercia Mudstone may be above low tide level. Both groundwater bodies shown to be of similar quality with marginally elevated metal and inorganic contaminants. A foundation risk assessment is required to confirm the risks.
Perched groundwater (Cp)	Groundwater (Ca) (Secondary B Aquifer)	Contamination migration along the piles/cofferdam (4)	Likely	Low	Low	

10 Conclusions and Recommendations

10.1 Conclusions

10.1.1 Ground investigations have been undertaken at the Site to assess risks from land contamination associated with the construction and operation of the Scheme including human health and controlled waters.

10.1.2 The historical and 2015 laboratory testing results confirmed the on site observations and field testing, and showed that the materials encountered within the Site contain contaminant concentrations that are at levels that indicate moderate risk to human health and controlled waters.

10.1.3 During construction these risks are likely to be mitigated through appropriate health and safety protocols which are anticipated to be in line with typical brownfield sites. The presence of ground gas has been identified and further monitoring and a gas risk assessment should be considered.

10.1.4 There is no analytical data specific to the location of the proposed pier.

10.1.5 Materials are likely to be suitable for reuse subject to provision of reuse criteria under a Materials Management Plan.

10.1.6 A detailed dewatering risk assessment to determine the likely influence on groundwater flow and potential contamination sources (on site/off site) is required.

10.1.7 A suitable water management strategy is required to specify required mitigation measures.

10.1.8 The deep aquifer and the perched groundwater have been identified to have marginal exceedances to EQS and DWS and the implication to controlled waters and human health should be carefully considered, taking into account the potentiometric level of the aquifer and the possible creation of new pathways from the proposed deep foundation.

10.2 Recommendations

10.2.1 Given the identified gap in the data, in particular associated with the delineation of PCB contaminated soils (to support human health and material reuse) and soil gas regime (to support human health and the cofferdam design), an additional scope of ground investigation works has been agreed and this is awaiting to be completed. The current report shall be reviewed and updated accordingly once the findings of the additional investigation are made available. The additional investigation will include:

- Borehole advancement to collect soil samples.
- Installation of monitoring wells for the collection of groundwater samples and gas monitoring.

10.2.2 Upon review and assessment of the additional ground investigation information, any contamination identified that could cause an unacceptable risk to the identified receptors will require appropriate remedial mitigation measures. These

measures would be identified within a remediation strategy for the Scheme. The strategy is anticipated to include, but may not be limited to, the following:

- Addressing potential human health risk and risk to controlled waters identified during the proposed additional ground investigation.
- Risk assessment of cofferdam, piles and associated construction works creating pathways enabling the migration of contaminants.
- Dealing with unexpected contamination.
- Provision of a detailed dewatering risk assessment and suitable water management strategy to protect controlled waters during construction.
- Verification sampling to confirm suitability of soils for reuse.
- Control measures to prevent risks to construction workers and the general public during construction.

10.2.3 The remediation strategy should include a remediation options appraisal, remediation implementation plan and remediation verification plan.

10.2.4 The remediation strategy should be supported by a Scheme wide Materials Management Plan prepared in accordance with CL:AIRE Code of Practice (CL:AIRE 2011).

11 References

Bactec (2014) Explosive Ordnance Threat Assessment in respect of M4 Corridor around Newport for Hyder Consulting (UK) Limited, 5750TA

CL:AIRE (2011) Definition of Waste. Development Industry Code of Practice, Version 2, March 2011, ISBN 978-1-905046-23-2

Geotechnical Engineering Limited (2015) M4 Corridor Around Newport, Factual Report on Ground Investigation, 30238

Highways Agency (2008) Design Manual for Roads and Bridges. Vol. 4. Geotechnics and Drainage. Section 1. Earthworks; Part 2. HD22/08. Managing Geotechnical Risk.

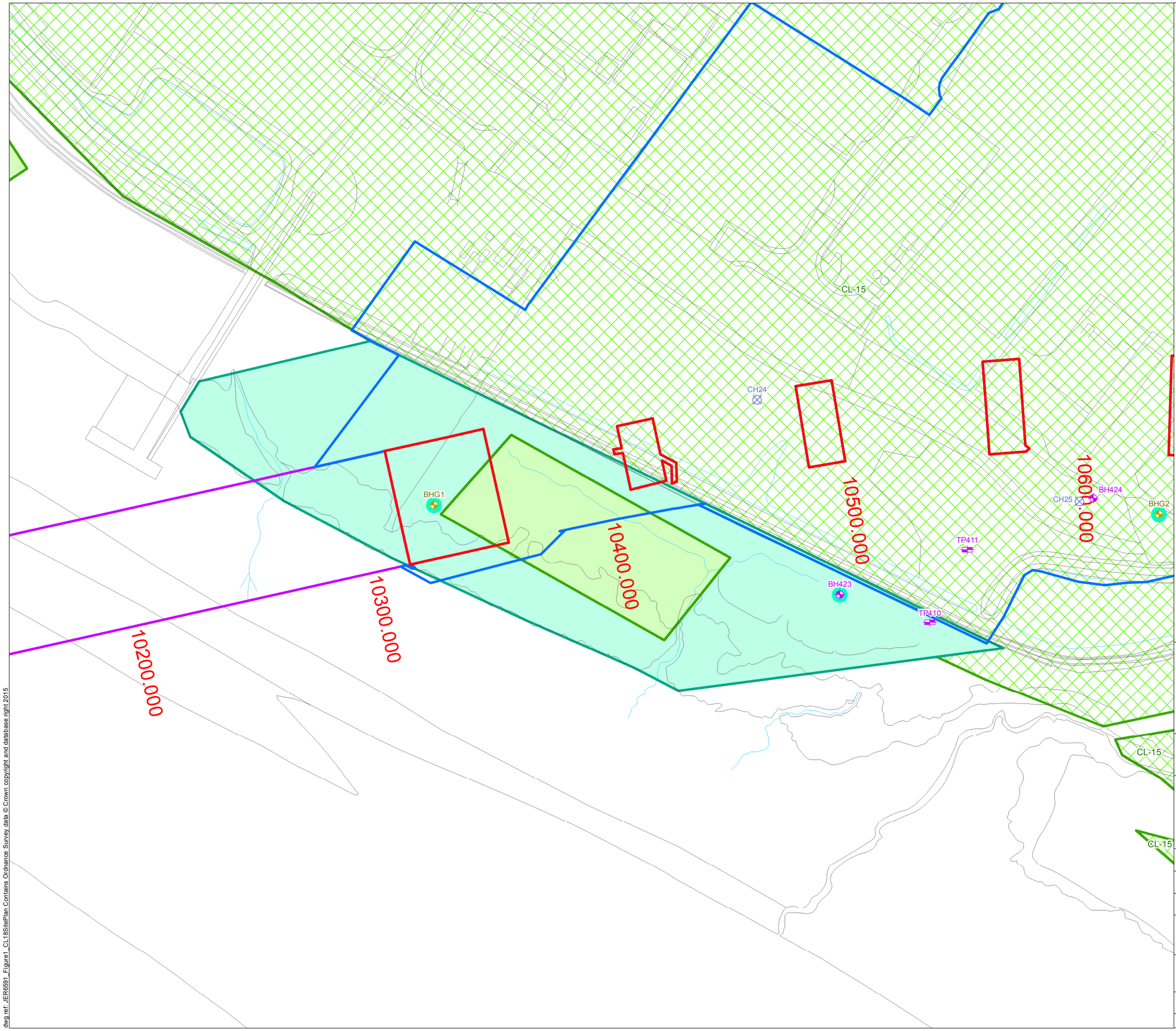
Ove Arup & Partners (2014) M4 Corridor Around Newport, Preliminary Sources Study Report, 14/9197

12 Glossary

BF	Blast Furnace
BGS	British Geological Survey
BOD	Biochemical Oxygen Demand
BOS	Basic Oxygen Slag
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CAT	Cable Avoidance Tool
CDM	Construction Design Management
CH_4	Methane
CLEA	Contaminated Land Exposure Assessment
CO_2	Carbon Dioxide
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CSM	Conceptual Site Model
DMRB	Design Manual for Roads and Bridges
DO	Dissolved Oxygen
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESG	Environmental Scientifics Group
EQS	Environmental Quality Standard
FTIR	Fourier Transform Infrared (spectroscopy)
GAC	Generic Assessment Criteria
GDR	Geotechnical Design Report
GIR	Ground Investigation Report
GRO	Gasoline Range Organics
LEL	Lower Explosive Limit
LOD	Limit of Detection
mAOD	Metres Above Ordnance Datum

mb	Millibars
mbGL	Metres below Ground Level
MTBE	Methyl Tert-butyl Ether
NRW	Natural Resources Wales
ORP	Oxidation Reduction Potential
O_2	Oxygen
OS	Ordnance Survey
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCSM	Preliminary Conceptual Site Model
PID	Photo Ionisation Detector
PPE	Personnel Protection Equipment
SGVs	Soil Guideline Values
SSAC	Site Specific Assessment Criteria
SSSI	Site of Special Scientific Interest
SVOCs	Semi-Volatile Organic Compounds
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
TPH CWG	Total Petroleum Hydrocarbon Criteria Working Group
UKAS	United Kingdom Accreditation Service
VOCs	Volatile Organic Compounds
WFD	Water Framework Directive
UXO	Unexploded Ordnance Survey

Figures



Legend

- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Temporary Construction Land
- Easement Only
- Potential Area of Land Contamination based on 2014 PSSR
- Revised Potential Area of Land Contamination
- Other Potential Area of Land Contamination

Investigation Locations

2015 (Geotechnical Engineering)

- Borehole
- Trial Pit

2000 (Exploration Associates)

- Window Sample

1997 (Norwest Holst)

- Borehole
- Monitoring Well Installation

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Appendix 11.1 Annex D CL-18

Site Plan for CL-18

Figure: 1	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Scale: A3 @ 1:1,500

0 25 50 m

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dwg ref: JER6591_Figure1_CL18SitePlan

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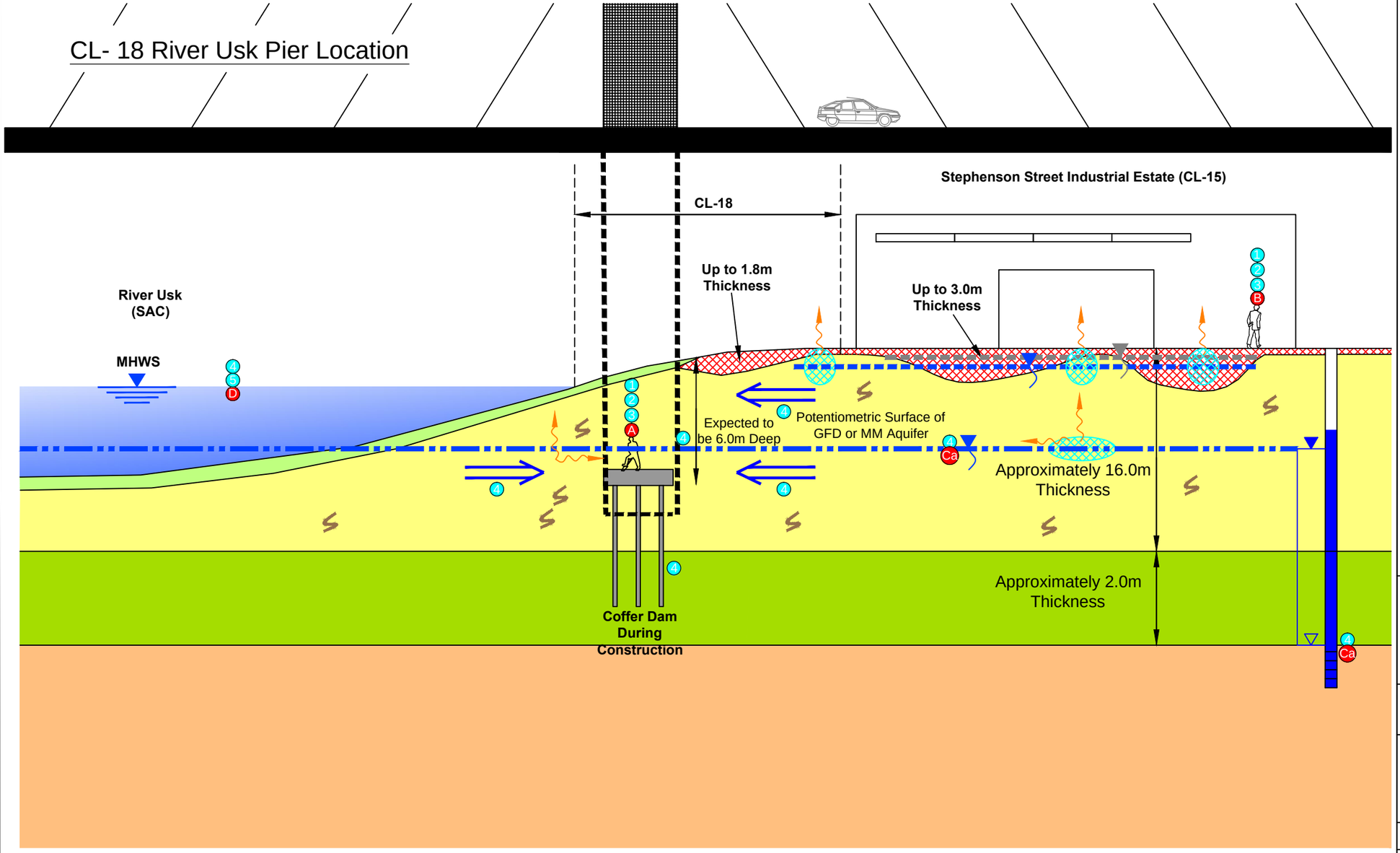

Ground conditions based on available information

Legend

- Made Ground
- Potentially Contaminated Waters
- Alluvium
- Tidal Flat Deposits - TFD
- Organic Matter within Tidal Flat Deposits
- Glaciofluvial Deposits (Predominantly Sand & Gravel) - GFD
- Mercia Mudstone - MM
- Perched Water (MG)
- Groundwater (GFD and MM)
- Induced Flow During Temporary Works (Dewatering)
- Water Strike
- Rest Water Level
- Gas Migration Pathway

Potential Receptors

- A Humans On-Site (Construction)
- B Humans Off-Site (Stephenson Street Industrial Estate Staff / Visitors)
- Ca Groundwater (Aquifer)
- D Surface Water

Potential Pathways

- 1 Dermal Contact
- 2 Inhalation
- 3 Ingestion
- 4 Leaching / Migration
- 5 Surface Run Off / Mobilisation

Potential Sources of Contamination

Possible contamination present on site associated with :

- Tidal deposits impacted by local industrial land use
- Surface water (River Usk)
- Groundwater Aquifers (Tidal Flat Deposits or Glaciofluvial Deposits/Mercia Mudstone)
- Organic inclusions within Tidal Flat Deposits

NOTE
Drawing refined from PSSR Drawing Reference M4-OA-17-00DR-Z-XX-0151 (February 2014)

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Appendix 11.1 Annex D CL-18

Conceptual Site Model for CL-18

Figure: 2	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Not to Scale

dwg ref:JER6591_Figure2_CL18ConceptualSiteModel

dwg ref: JER6591_Figure2_CL18ConceptualSiteModel

Appendices

A1 Appendix 1

Exploratory Records

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG1
Header

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332490.0 E 185472.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	6.20m AOD
Client	Welsh Office	Drillers	I.D/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	11/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	19/11/1997
		Core bit	Chunk		

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
11/11/1997	1800	11.00	9.00	Dry	
12/11/1997	0800	11.00	9.00	Dry	
12/11/1997	1800	19.50	19.20	7.60	
16/11/1997	1800	27.35	20.00	10.50	
17/11/1997	0800	27.35	20.00	4.10	
17/11/1997	1800	35.65	20.00	6.80	
18/11/1997	0800	35.65	20.00	6.80	
18/11/1997	1800	47.50	20.00	12.00	
19/11/1997	0800	47.50	20.00	6.50	
19/11/1997	1800	55.00	20.00	12.30	

CABLE PERCUSSION DETAILS

Hard strata from depth	Hard strata to depth	Hours	Remarks
16.50	16.90	1.00	
18.30	18.50	0.50	
19.00	19.50	1.00	

CASING

Hole diameter	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
150	19.50	150	19.20
120	55.00	140	20.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
12/11/1997	0000	12.90	6.30	20	fast	12.90	0.00

ROTARY DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
19.50	20.00	foam	moderate	92
20.00	55.00	air & water	good	92

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.50	S	N=2 (1,0,1,0,0,1)
3.50	S	1/450mm
5.50	S	1/450mm
7.50	S	1/450mm
10.50	S	1/450mm
13.50	S	N=8 (2,2,2,2,2,2)
16.50	S	30/0mm*
18.00	S	49/150mm
19.00	S	81/150mm
19.50	S	42/75mm*

* Seating blows only.

GENERAL NOTES

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, hard strata time in hours

Form	COMBINED HEADER
Version	2.00
Revised	26/06/1997

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG1
Sheet 1 of 6

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332490.0 E 185472.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	6.20 m AOD
Client	Welsh Office	Drillers	I.D/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	11/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	19/11/1997
		Core Bit	Chunk		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring			Blow count to drive U100	SPT N & depth		Installation
Soft to firm becoming very soft greyish brown thinly laminated slightly micaceous organic CLAY, with occasional rootlets. (Estuarine Alluvium)				U	0.50	- 1.00	(9)			
				D	1.20					
				B	1.50	- 2.00		S2	1.50 1.95	
				D	2.20					
		2.40	3.80							
Very soft dark grey slightly organic CLAY. (Estuarine Alluvium)										
				D	3.20					
				B	3.50	- 4.00	(2)	S1/450mm	3.50 3.95	
				D	4.20					
				U	4.50	- 5.00	(2)			
				D	5.20					
---from 5.50 to 5.95m slightly micaceous				B	5.50	- 6.00		S1/450mm	5.50 5.95	
				D	6.20					
				U	6.50	- 7.00	(2)			
				D	7.20					
---from 7.50m soft slightly micaceous slightly sandy				B	7.50	- 8.00		S1/450mm	7.50 7.95	
				D	8.20					
				B U	9.00 9.00	- 9.50 - 9.50	(3)			
				D	9.70					

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG1
Sheet 2 of 6

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332490.0 E 185472.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	6.20 m AOD
Client	Welsh Office	Drillers	I.D/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	11/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	19/11/1997
		Core Bit	Chunk		

Description of Strata	Depth Below G.L.	O.D. Level	Sampling & coring			Blow count to drive U100	SPT N & depth	Install-ation
Very soft dark grey slightly organic CLAY. (Estuarine Alluvium)			B	10.50 - 11.00			S1/450mm 10.50 10.95	
---at 10.50m occasionally mottled brown								
			D	11.50				
---at 11.50m sandy								
			U	12.00 - 12.50		(5)		
			D	12.70				
---from 12.70m very dark grey	12.90	-6.70						
Soft grey sandy CLAY with occasional sub-rounded siliceous gravel. (Estuarine Alluvium)			B	13.50 - 14.00			S8 13.50 13.95	
	13.80	-7.60						
Firm greyish brown sandy very silty CLAY with occasional fine to medium gravel size pockets of brownish yellow and black, brown woody fibrous peat. (Estuarine Alluvium)			D	14.50				
			U	15.00 - 15.50		(11)		
			D	15.70				
	16.20	-10.00						
Very dense greyish brown slightly sandy sub-angular to sub-rounded siliceous GRAVEL with many cobbles. (Fluvial Alluvium)			B	16.50 - 17.00			S30/0mm* 16.50 16.50	
			B	17.20 - 17.70				
							S49/150mm 18.00 18.30	
	18.20	-12.00						
Reddish brown mottled greyish green thinly laminated moderately to highly weathered slightly calcitic MUDSTONE, weak to moderately weak. (Mercia Mudstone Group)			D	18.80				
							S81/150mm 19.00 19.15	
---at 19.30m moderately weak to moderately strong	19.50	-13.30	D	19.50			S42/75mm* 19.50 19.58	

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG1
Sheet 3 of 6

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332490.0 E 185472.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	6.20 m AOD
Client	Welsh Office	Drillers	I.D/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	11/11/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	19/11/1997
		Core Bit	Chunk		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	Blow count to drive U100 / Fl	SPT N & depth	Install-ation
Reddish brown mottled green medium bedded moderately to highly weathered silty MUDSTONE, weak to moderately weak with closely spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group) ---from 20.40 to 20.50m calcitic ---from 21.50 to 21.60m highly weathered weak completely fractured ---from 21.90 to 22.30m highly weathered very weak completely fractured ---from 22.65 to 23.00m highly weathered weak ---from 23.00 to 23.40m completely fractured weak ---from 24.25 to 26.00m highly weathered very weak completely fractured				20.00 - 21.50	99	61	55	NI 2		
				21.50 - 23.00	100	20	0	NI 3 NI NI		
				23.00 - 24.25	92	38	26	8		
				24.25 - 25.80	100	0	0	NI		
		26.00	-19.80							
Reddish brown occasionally mottled green medium bedded moderately weathered slightly sandy silty MUDSTONE, moderately weak to moderately strong with medium to widely spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group) ---from 27.35 to 27.50m highly weathered very weak completely fractured ---from 27.95m moderately to highly weathered weak to moderately weak ---from 28.50 to 28.55m inclined fracture (45°) planar slightly open (15mm calcite infill) ---from 28.55 to 28.90m highly weathered very weak completely fractured ---from 28.90m very closely to closely spaced				25.80 - 27.35	100	71	35	NI 6		
				27.35 - 28.90	98	68	19	NI 10 NI		
				28.90 - 30.40	100	79	0	15		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG1
Sheet 4 of 6

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332490.0 E 185472.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	6.20 m AOD
Client	Welsh Office	Driller	I.D/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	11/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	19/11/1997
		Core bit	Chunk		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown occasionally mottled green medium bedded moderately weathered slightly sandy silty MUDSTONE, moderately weak to moderately strong with medium to widely spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group)				30.40 - 31.75	100	74	59	3		
---from 30.40 to 31.40m closely to medium spaced sub-horizontal fractures								NI		
---from 31.40 to 31.75m highly weathered weak completely fractured				31.75 - 32.95	100	83	30	10		
---from 31.70 to 32.55m moderately to highly weathered weak to moderately weak								2		
---from 32.95 to 33.70m highly weathered very weak completely fractured				32.95 - 34.45	100	40	13	NI		
---from 33.70 to 34.45m moderately to highly weathered weak to moderately weak		34.45	-28.25					7		
Reddish brown occasionally mottled green thinly to medium bedded highly weathered silty MUDSTONE, very weak completely fractured. (Mercia Mudstone Group)				34.45 - 35.65	100	0	0	NI		
---from 35.65 to 35.95m moderately weathered moderately weak with very closely spaced inclined fractures planar rough tight				35.65 - 35.95	100	50	0	4		
				35.95 - 37.45	97	13	0	NI		
---from 37.05 to 37.25m moderately weathered moderately weak with very closely spaced inclined fractures planar rough tight								4 NI		
				37.45 - 38.90	88	0	0	NI		
				38.90 - 40.30	100	0	0	NI		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG1

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332490.0 E 185472.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	6.20 m AOD
Client	Welsh Office	Driller	I.D/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	11/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	19/11/1997
		Core bit	Chunk		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown occasionally mottled green thinly to medium bedded highly weathered silty MUDSTONE, very weak completely fractured. (Mercia Mudstone Group)		41.00	-34.80	40.30 - 41.80	100	17	7	NI 3 NI 8		
Reddish brown thinly bedded moderately weathered silty MUDSTONE, moderately weak to moderately strong with very closely to closely spaced sub-horizontal fractures. (Mercia Mudstone Group)		41.80	-35.60	41.80 - 43.30	100	30	0	NI 10		
Reddish brown thinly to medium bedded highly weathered silty MUDSTONE, weak completely fractured. (Mercia Mudstone Group)		42.60	-36.40	43.30 - 44.75	100	72	30	4 NI 9		
Reddish brown thinly bedded moderately weathered silty MUDSTONE, moderately weak to moderately strong with very closely to closely spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group)		43.30	-37.10	44.75 - 46.20	100	77	36	NI 11		
Reddish brown occasionally mottled green thinly to medium bedded slightly weathered silty MUDSTONE, moderately strong with closely to medium spaced sub-horizontal to inclined thick laminations to very thin beds of calcite and closely to medium spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group) ---from 43.75 to 43.85m slightly to moderately weathered moderately weak completely fractured ---from 43.85m moderately weathered moderately weak ---from 44.75 to 44.95m completely fractured ---from 45.20m fresh to slightly weathered ---from 46.65 to 47.15m slightly to moderately weathered ---from 47.40 to 47.80m moderately to highly weathered weak completely fractured				46.20 - 47.50	100	69	39	9 NI		
				47.50 - 48.90	100	69	44	NI 4		
				48.90 - 50.30	100	75	39	8		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHG1

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	332490.0 E 185472.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/T30	Ground Level	6.20 m AOD
Client	Welsh Office	Driller	I.D/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	11/11/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	19/11/1997
		Core bit	Chunk		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown occasionally mottled green thinly to medium bedded slightly weathered silty MUDSTONE, moderately strong with closely to medium spaced sub-horizontal to inclined thick laminations to very thin beds of calcite and closely to medium spaced sub-horizontal to inclined fractures planar rough tight. (Mercia Mudstone Group) ---from 50.10 to 50.65m highly weathered very weak completely fractured ---from 50.85 to 51.05m highly weathered very weak completely fractured ----from 51.15 to 51.70m sub-vertical (075°) thick laminations of calcite (15mm) ---from 52.40 to 52.85m vertical to sub-vertical (90-75°) thick laminations of calcite (15-20mm)								NI NI I NI 2		
				50.30 - 51.70	93	44	29			
				51.70 - 52.40	86	60	37	3		
				52.40 - 53.35	86	84	53	6		
				53.35 - 54.25	83	78	37	9		
				54.25 - 55.00	89	89	83	6		
		55.00	-48.80							
Borehole complete at 55.00 m.										

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Geotechnical Engineering Limited

BOREHOLE LOG

BH423

CLIENT	WELSH GOVERNMENT					Sheet	1 of 7
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	10 March 2015	Easting	332656.3			Depth	60.00 m
End Date	27 March 2015	Northing	185435.3	Ground level	7.00mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
10/03/15 1150hrs	1B	0.20 - 0.50						Soft dark brownish grey slightly sandy CLAY with frequent roots (up to 20mm diam) and rootlets. (TFD)			
	2D*	0.20 - 0.50		Vo 0.0							
	3B	0.50 - 1.00									
	4D*	0.50 - 1.00		Vo 0.0							
	5B	1.00 - 1.20									
	6D*	1.00 - 1.20		Vo 0.0					1.00	6.00	
	UT	1.20 - 1.65	Nil					Very soft dark grey organic CLAY with rare fragments of fibrous organic material (up to 2mm diam). (TFD)			
	8X	1.20 - 1.70									
	9D*	1.20 - 1.40									
	10X	1.70 - 2.20									
	UT	2.20 - 2.65	Nil								
	12X	2.20 - 2.70									
	13D*	2.20 - 2.40									
10/03/15 1655hrs 0.00m	14X	2.70 - 3.20	Nil								
	15D*	3.00 - 3.20									
11/03/15 0930hrs 0.00m	16P	3.20 - 4.00	3.20		P/S						
	17X	4.00 - 4.60	3.20								
		4.50	3.20	V 29				4.50m: Low strength.			
	18P	4.60 - 5.40	4.60		P/S						
	19X	5.40 - 5.80									
		5.70	4.60	V 1				5.70m: Extremely low strength.			
	20P	5.80 - 6.60			P/S						
	21X	6.60 - 7.00									
		6.90	4.60	V 9				6.90m: Extremely low strength.			
	22P	7.00 - 7.80	7.00		P/S						
	23X	7.80 - 8.20									
								Continued Next Page	{8.00}		

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Dynamic sampled (128mm) 1.20-3.20m, (113mm) 4.00-15.20m. Waterflush rotary core drilled (116mm) 15.20-60.00m.

CASING: 140mm diam to 18.20m.

BACKFILL: On completion, borehole backfilled with bentonite 60.00-40.00m. A slotted standpipe (50mm) was installed to 40.00m, granular response zone 40.00-25.00m and bentonite seal 25.00-18.00m. A second slotted standpipe (35mm) was installed to 18.00m, granular response zone 18.00-15.00m, bentonite seal 15.00-0.30m and concrete and raised cover 0.30-0.00m.

REMARKS: Downhole magnetometry for UXO risk mitigation undertaken 0.00-15.20m. No anomalies encountered. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
1.20	Nil	0.54	20	

AGS

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH423

CLIENT	WELSH GOVERNMENT					Sheet	2 of 7
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	10 March 2015	Easting	332656.3				
End Date	27 March 2015	Northing	185435.3	Ground level	7.00mOD	Depth	60.00 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
		8.10		7.00	V 35				8.10m: Low strength.			
	24P	8.20	9.00	8.20		P/S			8.20m: Soft.			
	25X	9.00	10.00							9.20	-2.20	
									Soft dark grey organic silty CLAY. (TFD)			
11/03/15 1700hrs 0.00m		9.50		8.20	V 24				9.50m: Low strength.			
12/03/15 0850hrs 0.00m	26P	10.00	10.80	10.00		P/S						
	27X	10.80	11.80									
	28P	11.80	12.60	10.00		P/S						
	29X	12.60	13.60									
										13.20	-6.20	
									Dark grey thickly interlaminated fine SAND and CLAY with frequent fragments of organic material (up to 2mm). (TFD)	13.30	-6.30	
	30P	13.60	14.05	12.60		P/S			Soft dark grey organic silty CLAY with frequent thick laminae of fine sand. (TFD)			
	31D	14.05	14.50	14.05	S 4							
	32X	14.05	15.20									
										15.00	-8.00	
	33D	15.20	15.59	15.20	S*64				Very dense grey thickly laminated silty fine and medium SAND with rare fragments of fibrous organic material (up to 2mm). (TFD)			
	34C	15.20	16.60			100	NA					
										15.60	-8.60	
									Grey thickly bedded silty fine and medium SAND with rare fragments of fibrous organic material (up to 2mm). (TFD)	16.00	-9.00	
									Grey and reddish brown gravelly fine to coarse SAND with frequent bivalve shells (up to 10mm). Gravel is subangular to rounded fine and medium sandstone and quartz. (TFD)	16.20	-9.20	
12/03/15 1700hrs 0.00m										16.45	-9.45	
	35D	16.60	16.91	15.20	S*94					16.60	-9.60	
13/03/15 0915hrs 0.00m	36C	16.60	16.90	16.60		67			Grey fine to coarse SAND with frequent shells (up to 10mm). (TFD)	16.90	-9.90	
	37C	16.90	18.20	16.60		15			Grey and reddish brown sandy subangular to rounded fine to coarse sandstone and quartzite GRAVEL with a low subrounded sandstone and quartz cobble content. (RTD)			
									Limited recovery. Grey slightly sandy gravelly subangular to rounded sandstone COBBLES. Gravel is subangular to			
									Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

AGS

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BOREHOLE LOG

BH423

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	3 of 7
Start Date	10 March 2015	Easting	332656.3	Scale	1 : 50
End Date	27 March 2015	Northing	185435.3 Ground level 7.00mOD	Depth	60.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
		18.20 - 18.48	18.20	S*100				rounded coarse sandstone. Loss of fines. (RTD)	18.20	-11.20	
	38C	18.20 - 18.30			100				18.30	-11.30	
	39C	18.30 - 19.30	18.20		100	NA		Limited recovery. Soft reddish brown slightly sandy silty CLAY. (RTD)			
								Grey subrounded to well rounded sandstone and conglomerate COBBLES. (RTD)			
13/03/15 1600hrs 4.20m	40C	19.30 - 19.60	18.20		100			Hard fissured friable reddish brown gravelly silty CLAY locally tending to extremely weak mudstone frequent greenish grey reduction spots (up to 10mm). Gravel is angular fine and medium mudstone lithorelicts. Fissures are randomly orientated extremely closely spaced undulating rough. (MMG) (Grade III) 19.40m: Cobble sized lithorelict of weak mudstone.			
		19.60 - 19.85	18.20	C*125							
16/03/15 0955hrs 5.70m	41C	19.60 - 21.10			97						
	42C	21.10 - 22.60	18.20		97						
						NA		Hard fissured reddish brown silty CLAY with frequent fine sand sized gypsum crystals along fissure surfaces. Fissures are randomly orientated extremely closely spaced undulating rough. (MMG) (Grade III)	22.30	-15.30	
	43C	22.60 - 24.10	18.20		100						
						NA		Hard fissured friable reddish brown gravelly silty CLAY frequent greenish grey reduction spots (up to 10mm). Gravel is angular fine and medium mudstone lithorelicts. Locally tending to extremely weak mudstone. Fissures are randomly orientated extremely closely spaced undulating rough. (MMG) (Grade III)	24.00	-17.00	
	44C	24.10 - 25.60	18.20		100						
	45C	25.60 - 27.10	18.20		100			25.55m: 50° relict fissure infilled with fine sand sized gypsum crystals.			
	46C	27.10 - 28.60	18.20		100 7 7						
								Continued Next Page	{28.00}		

water strike (m) casing (m) rose to (m) time to rise (m) remarks

AGS

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BOREHOLE LOG

BH423

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	4 of 7
Start Date	10 March 2015	Easting	332656.3	Scale	1 : 50
End Date	27 March 2015	Northing	185435.3 Ground level 7.00mOD	Depth	60.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
								27.95 - 28.05m: Weak mudstone.			
16/03/15 1700hrs 5.10m									28.60	-21.60	
17/03/15 0930hrs 5.60m	47C	28.60 - 30.10	18.20		97 27 9	NI 80 150		Extremely weak reddish brown MUDSTONE locally disintegrated to gravelly clay with frequent greenish grey reduction spots (up to 40mm). Fractures are subhorizontal and 20° very closely and closely spaced undulating rough. (MMG) (Grade II)	29.50	-22.50	
						NA		Hard fissured reddish brown gravelly silty CLAY. Gravel is angular fine and medium mudstone lithorelicts. (MMG) (Grade III)			
	48C	30.10 - 31.60	18.20		93 45 32	NI 60 210		Extremely weak reddish brown MUDSTONE with rare greenish grey reduction spots (up to 20mm). Fractures are subhorizontal very closely to medium closely spaced undulating rough. (MMG) (Grade II)	30.30	-23.30	
	49C	31.60 - 33.10	18.20		97 19 0				32.50	-25.50	
						NA		Hard fissured reddish brown gravelly silty CLAY locally tending to extremely weak mudstone. Gravel is angular fine and medium extremely weak mudstone lithorelicts. Fissures are randomly orientated extremely closely spaced undulating rough. (MMG) (Grade III)			
	50C	33.10 - 34.60	18.20		100			34.20 - 34.75m: Frequent fine sand sized gypsum crystals along fissure surfaces.			
	51C	34.60 - 36.10	18.20		100 4 0	NI NI 60		Extremely weak reddish brown MUDSTONE. Fractures are subhorizontal, 20° and 70° extremely closely spaced undulating rough. (MMG) (Grade II)	34.75	-27.75	
						NA		Hard fissured reddish brown gravelly silty CLAY with rare greenish grey reduction spots (up to 30mm). Gravel is angular fine and medium extremely weak mudstone lithorelicts. Fissures are randomly orientated extremely closely spaced undulating rough. (MMG) (Grade III)	35.25	-28.25	
	52C	36.10 - 37.60	18.20		87						
17/03/15 1700hrs 6.20m											
18/03/15 0910hrs 5.60m	53C	37.60 - 39.10	18.20		90						
								Continued Next Page	{38.00}		

water strike (m) casing (m) rose to (m) time to rise (m) remarks

AGS

CONTRACT	CHECKED
30238	EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH423

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	5 of 7
Start Date	10 March 2015	Easting	332656.3	Scale	1 : 50
End Date	27 March 2015	Northing	185435.3 Ground level 7.00mOD	Depth	60.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	54C	39.10 - 40.60	18.20		100	NI		Extremely weak reddish brown MUDSTONE locally disintegrated to gravelly clay. Recovered non intact. (MMG) (Grade II/III)	39.10	-32.10	
								Hard fissured reddish brown gravelly silty CLAY. Gravel is angular fine and medium extremely weak mudstone lithorelicts. (MMG) (Grade III)	39.70	-32.70	
								Extremely weak reddish brown MUDSTONE locally disintegrated to gravelly clay. Non-intact. (MMG) (Grade II/III)	39.90	-32.90	
	55C	40.60 - 42.10	18.20		100 5 0						
						NA		Hard fissured reddish brown gravelly silty CLAY. Gravel is angular fine and medium extremely weak mudstone lithorelicts. Fissures are randomly orientated extremely closely spaced undulating rough. (MMG) (Grade III)	41.10	-34.10	
						NI		41.20 - 41.30m: Frequent fine and medium sand sized gypsum crystals.	41.70	-34.70	
	56C	42.10 - 43.60	18.20		100 0 0			Extremely weak reddish brown MUDSTONE. Recovered non intact. (MMG) (Grade II)	42.40	-35.40	
						NA		Hard fissured reddish brown gravelly silty CLAY locally tending to extremely weak mudstone. Gravel is angular fine and medium extremely weak mudstone lithorelicts. Fissures are randomly orientated extremely closely spaced undulating rough. (MMG) (Grade III)			
	57C	43.60 - 45.10	18.20		87						
18/03/15 1600hrs 6.80m											
19/03/15 0940hrs 6.60m	58C	45.10 - 46.60	18.20		90 14 8						
						NI 80 190		Extremely weak locally weak reddish brown MUDSTONE with frequent gypsum veining along healed fractures (up to 3mm thick). Rare greenish grey reduction spots (up to 20mm). Fractures are subhorizontal, 20° and 60° extremely closely to closely spaced planar smooth. (MMG) (Grade II)	45.80	-38.80	
	59C	46.60 - 48.10	18.20		93 59 32			46.10m: Subvertical tending to 70° undulating gypsum vein (17mm thick).			
								47.05m: Subhorizontal and 70° intersecting planar gypsum veins (5mm thick).			
								47.50m: 60° planar gypsum vein (5mm thick).			
								47.80m: 20° undulating gypsum vein (15mm thick).			
								Continued Next Page	{48.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

BH423

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	6 of 7
Start Date	10 March 2015	Easting	332656.3	Scale	1 : 50
End Date	27 March 2015	Northing	185435.3 Ground level 7.00mOD	Depth	60.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	60C	48.10 - 49.10	18.20		85 39 19						
	61C	49.10 - 50.60	18.20		77 47 21						
19/03/15 1600hrs 7.00m								50.30m: 20° planar gypsum vein (up to 8mm thick).			
24/03/15 1220hrs 8.10m	62C	50.60 - 52.10	18.20		97 90 66				51.00	-44.00	
						160 180 250		Very weak and weak reddish brown MUDSTONE with frequent gypsum infill along healed fractures. Fractures are subhorizontal to 20° and 70° to subvertical, closely and medium spaced planar smooth. (MMG) (Grade I) 51.10 - 52.00m: Subvertical tending to 70° undulating gypsum vein (20mm thick).			
	63C	52.10 - 52.60	18.20		100 80 60						
	64C	52.60 - 54.10	18.20		100 76 61						
						50 100 160		53.25 - 54.60m: Fractures are subhorizontal, 20°, 50° and 70° very closely and closely spaced planar smooth. 53.55 - 53.80m: Frequent greenish grey reduction spots (up to 30mm thick).			
24/03/15 1745hrs 8.50m								53.90 - 54.05m: 70° undulating gypsum vein (15mm thick). 54.10 - 54.25m: 70° planar gypsum vein (12mm thick).			
25/03/15 0945hrs 8.60m	65C	54.10 - 55.60	18.20		97 90 53						
						40 150 300		54.60 - 58.60m: Fractures are subhorizontal, 20° and 30° closely and medium spaced planar smooth.			
	66C	55.60 - 57.10	18.20		93 78 57						
								55.90 - 56.10m: 70° undulating gypsum vein (12mm thick).			
	67C	57.10 - 58.60	18.20		97 79 63						
								57.10 - 57.20m: 70° undulating gypsum vein (30mm thick).			
								Continued Next Page	{58.00}		

water strike (m) casing (m) rose to (m) time to rise (m) remarks

AGS

CONTRACT	CHECKED
30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

BH423

CLIENT	WELSH GOVERNMENT						
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	7 of 7
Start Date	10 March 2015	Easting	332656.3			Scale	1 : 50
End Date	27 March 2015	Northing	185435.3	Ground level	7.00mOD	Depth	60.00 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
25/03/15 1530hrs 8.70m												
26/03/15 1020hrs 8.70m	68C	58.60	60.00	18.20		89 89 86	80 110 250		58.75 - 58.80m: 20° planar gypsum vein (4mm thick).			
26/03/15 1430hrs 8.50m									59.55 - 59.57m: 20° planar gypsum vein (7mm thick).	60.00	-53.00	
									Borehole completed at 60.00m.			
										{68.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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Geotechnical Engineering Limited

TRIAL PIT LOG

CLIENT	WELSH GOVERNMENT						**TP410**
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	1 of 1
Start Date	9 March 2015	Easting	332693.1			Scale	1 : 25
End Date	9 March 2015	Northing	185424.0	Ground level	7.20mOD	Depth	4.00 m

water record	sample/test no/type	result	depth (m)	description	depth (m)	level (m)	legend
	1B	Vo 0.0	0.00- 0.20	Grass over soft dark brown peaty silty CLAY with frequent roots (up to 5mm diam) and rootlets (up to 1mm diam). Frequent plastic bottles, steel cans and cobble sized fragments of wood, timber and plastic. (MG)			
	2D		0.10		0.20	7.00	
				Soft dark brownish grey slightly sandy slightly gravelly silty CLAY. Gravel is angular and subangular medium and coarse red brick, crystalline and sandstone. Low angular and subangular red brick, crystalline and sandstone cobble content. (MG)			
0.90m: Fast inflow.	3B	Vo 1.2	0.90- 1.00				
	4D		1.00				
	5B	Vo 1.1	1.40- 1.50				
	6D		1.50				
					1.80	5.40	
				Soft greenish brown silty CLAY with frequent partings of soft black organic CLAY. (TFD)			
		H 24	2.00				
	7B	Vo 2.6	2.50- 2.60				
	8D	H 22	2.50				
	9B	Vo 0.6	3.70- 3.80				
	10D		3.80				
3.85m					4.00	3.20	

Trial pit completed at 4.00m.

Notes

Trial pit excavated by JCB 3CX mechanical excavator.
Groundwater encountered below 0.90m.
Trial pit sides remained stable and vertical.
Trial pit dimensions 3.50x0.80x4.00m.
On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.

CONTRACT	CHECKED
30238	EC

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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A2 Appendix 2

Gas and Groundwater Monitoring Dataset

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH423	28/04/15 11:00:00	1016	0								0.0	10		53 litres purged, base depth 18.00m.
BH423	28/04/15 11:01:00										0.0			
BH423	28/04/15 11:02:00										0.0			
BH423	28/04/15 11:03:00										0.0			
BH423	28/04/15 11:04:00										0.0			
BH423	28/04/15 11:05:00			0.2	0.4	19.8	11.1	0	0	0.6				
BH423	28/04/15 11:06:00			0.3	0.4	19.9	9.3	0	0	0.6				
BH423	28/04/15 11:07:00			0.3	0.6	19.9	16.7	0	0	0.5				
BH423	28/04/15 11:08:00			0.2	0.9	19.8	23.0	0	0	0.5				
BH423	28/04/15 11:09:00			0.2	1.0	19.8	23.4	0	0	0.4				
BH423	28/04/15 11:10:00			0.2	1.0	19.8	23.4	0	0	0.4				
BH423	28/04/15 11:11:00			0.1	1.0	19.9	24.0	0	0	0.3				
BH423	28/04/15 11:12:00			0.1	1.0	19.9	24.2	0	0	0.3				
BH423	28/04/15 11:13:00			0.1	1.0	19.9	23.6	0	0	0.1				
BH423	28/04/15 11:14:00			0.1	1.0	19.9	23.6	0	0	0.1			6.21	
BH423	06/05/15 11:00:00	1004	-1.16								0.0	13		57 litres purged, base depth 18.00m.
BH423	06/05/15 11:01:00										0.0			
BH423	06/05/15 11:02:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH423	06/05/15 11:03:00										0.0			
BH423	06/05/15 11:04:00										0.0			
BH423	06/05/15 11:05:00			0.0	0.1	20.4	1.0	0	0	3.3				
BH423	06/05/15 11:06:00			0.0	0.1	20.5	1.0	0	0	3.0				
BH423	06/05/15 11:07:00			0.0	0.1	20.5	1.0	0	0	2.8				
BH423	06/05/15 11:08:00			0.0	0.1	20.6	1.0	0	0	2.7				
BH423	06/05/15 11:09:00			0.0	0.0	20.6	0.0	0	0	2.6				
BH423	06/05/15 11:10:00			0.0	0.0	20.6	0.0	0	0	2.6				
BH423	06/05/15 11:11:00			0.0	0.0	20.7	0.0	0	0	2.5				
BH423	06/05/15 11:12:00			0.0	0.0	20.7	0.0	0	0	2.4				
BH423	06/05/15 11:13:00			0.0	0.0	20.7	0.0	0	0	2.3				
BH423	06/05/15 11:14:00			0.0	0.0	20.7	0.0	0	0	2.3			5.18	
BH423	11/05/15 09:00:00	1015	0								0.0	15		52 litres purged, base depth 18.00m.
BH423	11/05/15 09:31:00										0.0			
BH423	11/05/15 10:02:00										0.0			
BH423	11/05/15 10:33:00										0.0			
BH423	11/05/15 11:04:00										0.0			
BH423	11/05/15 11:35:00			0.0	0.0	20.5	0.0	0	0	1.4				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH423	11/05/15 12:06:00			0.0	0.0	20.4	0.0	0	0	1.1				
BH423	11/05/15 12:37:00			0.0	0.0	20.4	0.0	0	0	1.0				
BH423	11/05/15 13:08:00			0.0	0.0	20.4	0.0	0	0	1.0				
BH423	11/05/15 13:39:00			0.0	0.0	20.4	0.0	0	0	0.9				
BH423	11/05/15 14:10:00			0.1	0.0	20.4	0.0	0	0	0.9				
BH423	11/05/15 14:41:00			0.0	0.0	20.3	0.0	0	0	0.8				
BH423	11/05/15 15:12:00			0.0	0.0	20.3	0.0	0	0	0.8				
BH423	11/05/15 15:43:00			0.0	0.0	20.3	0.0	0	0	0.8				
BH423	11/05/15 16:14:00			0.0	0.0	20.3	0.0	0	0	0.8			6.37	
BH423	19/05/15 09:38:00	1004	0								-3.4	12		
BH423	19/05/15 09:39:00										0.0			
BH423	19/05/15 09:40:00										-0.4			
BH423	19/05/15 09:41:00										0.0			
BH423	19/05/15 09:42:00										-1.6			
BH423	19/05/15 09:43:00			0.0	0.0	20.3	0.0	0	0	0.1				
BH423	19/05/15 09:44:00			0.0	0.0	20.3	0.0	0	0	0.1				
BH423	19/05/15 09:45:00			0.0	0.0	20.3	0.0	0	0	0.1				
BH423	19/05/15 09:46:00			0.0	0.0	20.3	0.0	0	0	0.1				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH423	19/05/15 09:47:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH423	19/05/15 09:48:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH423	19/05/15 09:49:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH423	19/05/15 09:50:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH423	19/05/15 09:51:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH423	19/05/15 09:52:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH423	19/05/15 09:53:00												7.40	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT **30238**

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Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH423	28/04/15 11:14:00												6.02	203 litres purged, base depth 40.00m.
BH423	06/05/15 11:14:00												5.27	208 litres purged, base depth 40.00m.
BH423	11/05/15 16:14:00												6.20	202 litres purged, base depth 40.00m.
BH423	19/05/15 09:54:00												6.90	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT **30238**

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A3 Appendix 3

Soil Laboratory Data

M4CAN
Soil Sample Analysis & Screening Assessment
CL-18
22/07/2015

Geological Formation Legend

MG	Made Ground
TFD	Tidal Flat Deposits

Screening Values and Assessment

	Exceeds S4ULs Criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD No Fibres Detected
NAD No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference	Units	TP410	TP410	BH423	BH423	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	Selected S4ULs Criteria	No. Data Exceeding S4ULs Criteria
Specimen Depth (m)		0 - 0.1	0.9 - 1	0.2 - 0.5	0.5 - 1							
OD Level (m)		7.2	6.3	6.8	6.5							
Sample Type		ES	ES	ES	ES							
Geology Code		MG	MG	TFD	TFD							
Cluster Code		2015 GI	2015 GI	2015 GI	2015 GI							
Metals												
Antimony	mg/kg					0	0	None > LOD	None > LOD			
Arsenic	mg/kg	8.9	31	26	17	4	4	31	8.9	TP410 @ 0.9 - 1mbGL	170	0
Barium	mg/kg					0	0	None > LOD	None > LOD			
Boron	mg/kg	4.4	3.3	7.6	6.8	4	4	7.6	3.3	BH423 @ 0.2 - 0.5mbGL	46000	0
Boron Water Soluble	mg/kg					0	0	None > LOD	None > LOD			
Cadmium	mg/kg	0.41	0.14	1.2	0.2	4	4	1.2	0.14	BH423 @ 0.2 - 0.5mbGL	190	0
Chromium	mg/kg	16	20	36	19	4	4	36	16	BH423 @ 0.2 - 0.5mbGL	33	1
Copper	mg/kg	17	18	42	25	4	4	42	17	BH423 @ 0.2 - 0.5mbGL	44000	0
Lead	mg/kg	120	53	99	46	4	4	120	46	TP410 @ 0 - 0.1mbGL	1300	0
Mercury	mg/kg	1.3	0.21	0.84	0.38	4	4	1.3	0.21	TP410 @ 0 - 0.1mbGL	30	0
Molybdenum	mg/kg					0	0	None > LOD	None > LOD			
Nickel	mg/kg	16	22	33	19	4	4	33	16	BH423 @ 0.2 - 0.5mbGL	980	0
Selenium	mg/kg	0.68	0	0.39	0	4	4	0.68	0	TP410 @ 0 - 0.1mbGL	1800	0
Tin	mg/kg					0	0	None > LOD	None > LOD			
Vanadium	mg/kg					0	0	None > LOD	None > LOD		5000	0
Zinc	mg/kg	150	86	260	130	4	4	260	86	BH423 @ 0.2 - 0.5mbGL	170000	0
Iron	mg/kg					0	0	None > LOD	None > LOD			
Hexavalent Chromium	mg/kg					0	0	None > LOD	None > LOD			
Non-Metal Inorganics												
Cyanide (total)	mg/kg	<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
Cyanide (free)	mg/kg	<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
Other												
Asbestos Presence Screen	None	NAD	NAD			2	0	None > LOD	None > LOD			
Asbestos Identification	%	0	0			2	2	0	0	TP410 @ 0 - 0.1mbGL		
pH Value	pH Units	7.9	8.4	8.3	8.7	4	4	8.7	7.9	BH423 @ 0.5 - 1mbGL	6-9	0
PCBs												
PCB 105	mg/kg		<0.01			1	0	None > LOD	None > LOD		0.24	0
PCB 114	mg/kg		<0.01			1	0	None > LOD	None > LOD		0.24	0
PCB 123	mg/kg		<0.01			1	0	None > LOD	None > LOD		0.24	0
PCB 126	mg/kg		<0.01			1	0	None > LOD	None > LOD		0.24	0
PCB 157	mg/kg		<0.01			1	0	None > LOD	None > LOD		0.24	0
PCB 167	mg/kg		<0.01			1	0	None > LOD	None > LOD		0.24	0
PCB 169	mg/kg		<0.01			1	0	None > LOD	None > LOD		0.24	0
PCB 189	mg/kg		<0.01			1	0	None > LOD	None > LOD		0.24	0
PCB 77	mg/kg		<0.01			1	0	None > LOD	None > LOD		0.24	0
PCB 81	mg/kg		<0.01			1	0	None > LOD	None > LOD		0.24	0
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl	mg/kg		<0.01			1	0	None > LOD	None > LOD		0.24	0
Pcb-156 2,3,3,4,4,5 - Hexachlorobiphenyl	mg/kg		<0.01			1	0	None > LOD	None > LOD		0.24	0
Phenols												
Phenols (total)	mg/kg	<0.3	<0.3			2	0	None > LOD	None > LOD		440	0
TPH												
TPH >C6-C8	mg/kg	<1	<1	<1	<1	4	0	None > LOD	None > LOD		7800	0
TPH >C8-C10	mg/kg	<1	<1	<1	<1	4	0	None > LOD	None > LOD		2000	0
TPH >C10-C12	mg/kg	<1	<1	<1	<1	4	0	None > LOD	None > LOD		9200	0
TPH >C12-C16	mg/kg	<1	<1	<1	<1	4	0	None > LOD	None > LOD		10000	0
TPH >C16-C21	mg/kg	<1	<1	<1	<1	4	0	None > LOD	None > LOD		7600	0
TPH >C21-C35	mg/kg	<1	<1	<1	<1	4	0	None > LOD	None > LOD		7800	0
PAH												
Acenaphthene	mg/kg	1.1	0.23	0.36	0.11	4	4	1.1	0.11	TP410 @ 0 - 0.1mbGL	29000	0
Acenaphthylene	mg/kg	0.5	<0.1	0.34	0.22	4	3	0.5	0.22	TP410 @ 0 - 0.1mbGL	29000	0
Anthracene	mg/kg	0.64	0.11	0.16	0.12	4	4	0.64	0.11	TP410 @ 0 - 0.1mbGL	150000	0
Benz(a)anthracene	mg/kg	1.1	<0.1	0.57	0.36	4	3	1.1	0.36	TP410 @ 0 - 0.1mbGL	49	0
Benzo(a)pyrene	mg/kg	1.3	<0.1	0.58	0.1	4	3	1.3	0.1	TP410 @ 0 - 0.1mbGL	11	0
Benzo(b)fluoranthene	mg/kg	2.1	<0.1	0.6	0.69	4	3	2.1	0.6	TP410 @ 0 - 0.1mbGL	13	0
Benzo(ghi)perylene	mg/kg	0.5	<0.1	0.33	<0.1	4	2	0.5	0.33	TP410 @ 0 - 0.1mbGL	1400	0
Benzo(k)fluoranthene	mg/kg	0.5	<0.1	0.14	0.14	4	3	0.5	0.14	TP410 @ 0 - 0.1mbGL	370	0
Chrysene	mg/kg	0.57	<0.1	0.85	0.24	4	3	0.85	0.24	BH423 @ 0.2 - 0.5mbGL	93	0
Dibenzo(ah)anthracene	mg/kg	0.61	<0.1	<0.1	<0.1	4	1	0.61	0.61	TP410 @ 0 - 0.1mbGL	1.1	0
Fluoranthene	mg/kg	3.1	0.67	1.3	0.93	4	4	3.1	0.67	TP410 @ 0 - 0.1mbGL	6300	0
Fluorene	mg/kg	0.52	0.27	0.36	0.19	4	4	0.52	0.19	TP410 @ 0 - 0.1mbGL	20000	0
Indeno(123cd)pyrene	mg/kg	0.67	<0.1	0.24	<0.1	4	2	0.67	0.24	TP410 @ 0 - 0.1mbGL	150	0
Naphthalene	mg/kg	0.58	0.3	0.61	0.3	4	4	0.61	0.3	BH423 @ 0.2 - 0.5mbGL	190	0
Phenanthrene	mg/kg	2.7	0.94	1.2	0.77	4	4	2.7	0.77	TP410 @ 0 - 0.1mbGL	6200	0
Pyrene	mg/kg	2.6	0.48	0.97	0.82	4	4	2.6	0.48	TP410 @ 0 - 0.1mbGL	15000	0
Coronene	mg/kg					0	0	None > LOD	None > LOD			
PAH 16 Total	mg/kg	19	3	8.6	5	4	4	19	3	TP410 @ 0 - 0.1mbGL		

A4 Appendix 4

Groundwater Laboratory Data

M4CAN
Groundwater Sample Analysis & Screening Assessment
CL-18
22/07/2015

Geological Formation Legend

TFD	Tidal Flat Deposits
RTD	River Terrace Deposits
MMG	Mercia Mudstone Group

Screening Values & Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: cadmium, copper and zinc	
N/A	No installation details on PDF. Not clear from fieldwork records

Monitoring Round	Units	Screening Criteria		1		2		3		No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
Location				BH423	BH423	BH423	BH423	BH423	BH423							
Location Type				BH												
Depth (m)				7.73	6.71	5.74	9.45	6.62	9.76							
Installation Details		EQS	DWS	Shallow	Deep	N/A	N/A	Shallow	Deep							
Response Zone				TFD/RTD	MMG	N/A	N/A	TFD/RTD	MMG							
Date Sampled				28/04/2015		06/05/2015		11/05/2015								
Metals																
Arsenic Dissolved	ug/l	50	10	24	10	24	12	19	31	6	6	31	10	BH423 @ 9.76mbGL	0	5
Boron	ug/l	2000	1000	1500	490	2900	1100	1800	480	6	6	2900	480	BH423 @ 5.74mbGL	1	4
Chromium Dissolved	ug/l		50	55	36	27	16	17	24	6	6	55	16	BH423 @ 7.73mbGL		1
Copper Dissolved	ug/l	10	2000	20	4.8	29	16	7.8	3.5	6	6	29	3.5	BH423 @ 5.74mbGL	3	0
Lead Dissolved	ug/l	1.2	10	<1	<1	<1	<1	<1	<1	6	0	None > LOD	None > LOD		0	0
Nickel Dissolved	ug/l	4	20	6.1	2.5	5.7	4.4	3.1	<1	6	5	6.1	2.5	BH423 @ 7.73mbGL	3	0
Selenium Dissolved	ug/l		10	34	15	19	18	23	14	6	6	34	14	BH423 @ 7.73mbGL		6
Cadmium Dissolved	ug/l	0.15	5	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	6	0	None > LOD	None > LOD		0	0
Zinc Dissolved	ug/l	75		6.4	31	9	38	14	34	6	6	38	6.4	BH423 @ 9.45mbGL	0	
Mercury Dissolved	ug/l	0.07	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	6	0	None > LOD	None > LOD		0	0
Non-Metal Inorganics																
Total Alkalinity as CaCO3	mg/l					1500	120	840	63	4	4	1500	63	BH423 @ 5.74mbGL		
Chloride	mg/l	250	250			6800	3200	5600	3700	4	4	6800	3200	BH423 @ 5.74mbGL	4	4
Ammoniacal Nitrogen as N	mg/l	0.6				45	2.5	34	1.6	4	4	45	1.6	BH423 @ 5.74mbGL	4	
Total Cyanide	mg/l	0.001	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	6	0	None > LOD	None > LOD		0	0
Free Cyanide	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	6	0	None > LOD	None > LOD			
pH Value	pH units	6-9	6.5-10	8.2	8.2	7.4	7.7	8	8	6	6	8.2	7.4	BH423 @ 7.73mbGL	0	0
Phenols																
Phenol	ug/l	7.7				<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD		0	
Phenols	mg/l	0.0077				<0.03	<0.03	<0.03	<0.03	4	0	None > LOD	None > LOD		0	
BTEX																
MTBE	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
Benzene	ug/l	10	1	<1	<1	<1	<1	<1	<1	6	0	None > LOD	None > LOD		0	0
Toluene	ug/l	50		<1	<1	<1	<1	<1	<1	6	0	None > LOD	None > LOD		0	
Ethyl benzene	ug/l	20		<1	<1	<1	<1	<1	<1	6	0	None > LOD	None > LOD		0	
m & p Xylene	ug/l	30		<1	<1	<1	<1	<1	<1	6	0	None > LOD	None > LOD		0	
o Xylene	ug/l	30		<1	<1	<1	<1	<1	<1	6	0	None > LOD	None > LOD		0	
TPH																
Aliphatics C5-C6	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD			
Aliphatics >C6-C8	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD			
Aliphatics >C8-C10	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD			
Aliphatics >C10-C12	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD			
Aliphatics >C12-C16 Aqueous	ug/l			<0.1	<0.1	<0.1	87	<0.1	<0.1	6	1	87	87	BH423 @ 9.45mbGL		
Aliphatics >C16-C21 Aqueous	ug/l			<0.1	<0.1	<0.1	77	<0.1	<0.1	6	1	77	77	BH423 @ 9.45mbGL		
Aliphatics >C21-C35 Aqueous	ug/l			<0.1	<0.1	<0.1	3000	<0.1	<0.1	6	1	3000	3000	BH423 @ 9.45mbGL		
Aliphatics >C35-44	ug/l			<0.1	<0.1	<0.1	240	<0.1	<0.1	6	1	240	240	BH423 @ 9.45mbGL		
Aromatics >C5-C7	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD			
Aromatics >C7-C8	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD			
Aromatics >EC8-EC10	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD			
Aromatics >EC10-EC12	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD			
Aromatics >EC12-EC16 Aqueous	ug/l			<0.1	<0.1	<0.1	23	<0.1	<0.1	6	1	23	23	BH423 @ 9.45mbGL		
Aromatics >EC16-EC21 Aqueous	ug/l			<0.1	<0.1	<0.1	25	<0.1	<0.1	6	1	25	25	BH423 @ 9.45mbGL		
Aromatics >EC21-EC35 Aqueous	ug/l			<0.1	<0.1	<0.1	180	<0.1	<0.1	6	1	180	180	BH423 @ 9.45mbGL		
Aromatics >C35-44	ug/l			<0.1	<0.1	<0.1	30	<0.1	<0.1	6	1	30	30	BH423 @ 9.45mbGL		
Total Aliphatic TPH	ug/l			<5	<5	<5	3400	<5	<5	6	1	3400	3400	BH423 @ 9.45mbGL		
Total Aromatic TPH	ug/l			<5	<5	<5	260	<5	<5	6	1	260	260	BH423 @ 9.45mbGL		
Total petroleum hydrocarbons	ug/l			<10	<10	<10	3700	<10	<10	6	1	3700	3700	BH423 @ 9.45mbGL		
Speciated PAHs																
Acenaphthene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD			
Acenaphthylene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD			
Anthracene	ug/l	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD		0	
Benzo(a)anthracene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD			
Benzo(a)pyrene	ug/l	0.00017	0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD		0	0
Benzo(b)fluoranthene	ug/l	0.017	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD		0	0
Benzo(k)fluoranthene	ug/l	0.017	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD		0	0
Benzo(ghi)perylene	ug/l	0.0082	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD		0	0
Indeno(1,2,3-cd)pyrene	ug/l		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD			0
Chrysene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD			
Dibenzo(a,h)anthracene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD			
Fluoranthene	ug/l	0.0063		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD		0	
Fluorene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD			
Naphthalene	ug/l	2		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD		0	
Phenanthrene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD			
Pyrene	ug/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6	0	None > LOD	None > LOD			
Total PAHs (USEPA 16)	ug/l			<2	<2	<2	<2	<2	<2	6	0	None > LOD	None > LOD			
VOCs																
1,1,1,2-Tetrachloroethane	ug/l					<2	<2	<2	<2	4	0	None > LOD	None > LOD			
1,1,1-Trichloroethane	ug/l	100				<1	<1	<1	<1	4	0	None > LOD	None > LOD		0	
1,1,2-Trichloroethane	ug/l	400				<10	<10	<10	<10	4	0	None > LOD	None > LOD		0	
1,1-Dichloroethane	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
1,1-Dichloroethene	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
1,1-Dichloropropene	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
1,2,3-Trichlorobenzene	ug/l	0.4				<2	<2	<2	<2	4	0	None > LOD	None > LOD		0	
1,2,3-Trichloropropane	ug/l					<50	<50	<50	<50	4	0	None > LOD	None > LOD			
1,2,4-Trichlorobenzene	ug/l	0.4				<1	<1	<1	<1	4	0	None > LOD	None > LOD		0	
1,2,4-Trimethylbenzene	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
1,2-Dibromo-3-Chloropropane	ug/l					<50	<50	<50	<50	4	0	None > LOD	None > LOD			
1,2-Dibromoethane	ug/l					<5	<5	<5	<5	4	0	None > LOD	None > LOD			
1,2-Dichlorobenzene	ug/l	20				<1	<1	<1	<1	4	0	None > LOD	None > LOD		0	
1,2-Dichloroethane	ug/l	10	3			<2	<2	<2	<2	4	0	None > LOD	None > LOD		0	0
1,2-Dichloropropane	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
1,3,5-Trimethylbenzene	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
1,3-Dichloropropane	ug/l					<2	<2	<2	<2	4	0	None > LOD	None > LOD			
1,4-Dichlorobenzene	ug/l	20				<1	<1	<1	<1	4	0	None > LOD	None > LOD		0	
2-Chlorotoluene	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
4-Chlorotoluene	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
4-Isopropyltoluene	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
Benzene	ug/l	10	1	<1	<1	<1	<1	<1	<1	6	0	None > LOD	None > LOD		0	0
Bromobenzene	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
Bromochloromethane	ug/l		100			<5	<5	<5	<5	4	0	None > LOD	None > LOD			0
Bromodichloromethane	ug/l					<5	<5	<5	<5	4	0	None > LOD	None > LOD			
Bromomethane	ug/l					<5	<5	<5	<5	4	0	None > LOD	None > LOD			
Chlorobenzene	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
Chloroethane	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
Chloroethene	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
Chloroform	ug/l	2.5	100			<1	<1	<1	<1	4	0	None > LOD	None > LOD		0	0
Chloromethane	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
cis-1,2-Dichloroethene	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
cis-1,3-Dichloropropene	ug/l					<10	<10	<10	<10	4	0	None > LOD	None > LOD			
Dibromochloromethane	ug/l		100			<10	<10	<10	<10	4	0	None > LOD	None > LOD			0
Dibromomethane	ug/l					<10	<10	<10	<10	4	0	None > LOD	None > LOD			
Dichlorodifluoromethane	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
Ethylbenzene	ug/l	20		<1	<1	<1	<1	<1	<1	6	0	None > LOD	None > LOD		0	
Hexachlorobutadiene (HCBD)	ug/l	0.6				<1	<1	<1	<1	4	0	None > LOD	None > LOD		0	
Isopropylbenzene	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
m,p xylenes	ug/l	30		<1	<1	<1	<1	<1	<1	6	0	None > LOD	None > LOD		0	
Methyl tert-butyl ether (MTBE)	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
n-Butylbenzene	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
n-propylbenzene	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
O-Xylene	ug/l	30		<1	<1	<1	<1	<1	<1	6	0	None > LOD	None > LOD		0	
Sec-Butylbenzene	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
Styrene	ug/l	50				<1	<1	<1	<1	4	0	None > LOD	None > LOD		0	
Tert-Butylbenzene	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
Tetrachloroethene	ug/l	10	10			<1	<1	<1	<1	4	0	None > LOD	None > LOD		0	0
Tetrachloromethane (Carbon Tetra Ch	ug/l	12	3			<1	<1	<1	<1	4	0	None > LOD	None > LOD		0	0
Toluene	ug/l	50		<1	<1	<1	<1	<1	<1	6	0	None > LOD	None > LOD		0	
trans-1,2-Dichloroethene	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
trans-1,3-Dichloropropene	ug/l					<10	<10	<10	<10	4	0	None > LOD	None > LOD			
Tribromomethane	ug/l		100			<1	<1	<1	<1	4	0	None > LOD	None > LOD			0
Trichloroethene	ug/l	10	10			<1	<1	<1	<1	4	0	None > LOD	None > LOD		0	0
Trichlorofluoromethane	ug/l					<1	<1	<1	<1	4	0	None > LOD	None > LOD			
SVOCs																
1,3-Dichlorobenzene	ug/l	20				<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD		0	
2,4,5-Trichlorophenol	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
2,4,6-Trichlorophenol	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
2,4-Dichlorophenol	ug/l	20				<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD		0	
2,4-Dimethylphenol	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
2,4-Dinitrotoluene	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
2,6-Dinitrotoluene	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
2-Chloronaphthalene	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
2-Chlorophenol	ug/l	50				<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD		0	
2-Methyl-4,6-Dinitrophenol	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
2-Methylnaphthalene	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
2-Methylphenol	ug/l	100				<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD		0	
2-Nitroaniline	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
2-Nitrophenol	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
3-Nitroaniline	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
4-Bromophenyl Phenyl Ether	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
4-Chloro-3-Methylphenol	ug/l	40				<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD		0	
4-Chloroaniline	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
4-Chlorophenyl Phenyl Ether	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
4-Methylphenol	ug/l	100				<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD		0	
4-Nitroaniline	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
Azobenzene	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
Bis(2-chloroethoxy)methane	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
Bis(2-chloroethyl)ether	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
Bis(2-chloroisopropyl)ether	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
Bis(2-ethylhexyl)phthalate	ug/l	1.3				<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD		0	
Butylbenzylphthalate	ug/l	20				<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD		0	
Carbazole	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
Dibenzofuran	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
Diethylphthalate	ug/l	200				<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD		0	
Dimethylphthalate	ug/l	800				<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD		0	
Di-N-Butyl Phthalate	ug/l	8				<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD		0	
Di-N-Octyl Phthalate	ug/l	20				<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD		0	
Hexachlorobenzene (HCB)	ug/l	0.05				<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD		0	
Hexachlorocyclopentadiene	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
Hexachloroethane	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
Isophorone	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
Nitrobenzene	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
n-nitrosodimethylamine	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
N-Nitroso-Di-N-Propylamine	ug/l					<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD			
Pentachlorophenol (PCP)	ug/l	0.4				<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD		0	
Phenol	ug/l	7.7				<0.5	<0.5	<0.5	<0.5	4	0	None > LOD	None > LOD		0	

A5 Appendix 5

Soil Leachate Laboratory Data

M4CAN
Leachate Sample Analysis & Screening Assessment
CL-18
22/07/2015

Geological Formation Legend

MG	Made Ground

Screening Values & Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: cadmium, copper and zinc

Sample Reference	Units	Screening Criteria		TP410	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
Specimen Depth (m)		EQS	DWS	0.9 - 1							
OD Level (m)				6.3							
Sample Type				ES							
Geology Code				MG							
Cluster Code				2015 GI							
2:1 Leachate Results											
Arsenic Dissolved	ug/l	50	10	8.4	1	1	8.4	8.4	TP410 @ 0.9 - 1mbGL	0	0
Boron Dissolved	ug/l	2000	1000		0	0	None > LOD	None > LOD		0	0
Boron	ug/l	2000	1000	370	1	1	370	370	TP410 @ 0.9 - 1mbGL	0	0
Barium Dissolved	ug/l				0	0	None > LOD	None > LOD			
Cadmium Dissolved	ug/l	0.15	5	2.5	1	1	2.5	2.5	TP410 @ 0.9 - 1mbGL	1	0
Chromium Dissolved	ug/l		50	22	1	1	22	22	TP410 @ 0.9 - 1mbGL		0
Copper Dissolved	ug/l	10	2000	25	1	1	25	25	TP410 @ 0.9 - 1mbGL	1	0
Mercury Dissolved	ug/l	0.07	1	<0.5	1	0	None > LOD	None > LOD		0	0
Molybdenum Dissolved	ug/l				0	0	None > LOD	None > LOD			
Nickel Dissolved	ug/l	4	20	2.7	1	1	2.7	2.7	TP410 @ 0.9 - 1mbGL	0	0
Lead Dissolved	ug/l	1.2	10	<1	1	0	None > LOD	None > LOD		0	0
Antimony Dissolved	ug/l		5		0	0	None > LOD	None > LOD			0
Selenium Dissolved	ug/l		10	13	1	1	13	13	TP410 @ 0.9 - 1mbGL		1
Zinc Dissolved	ug/l	75		7.2	1	1	7.2	7.2	TP410 @ 0.9 - 1mbGL	0	
Total Cyanide	mg/l	0.001	0.05	<0.05	1	0	None > LOD	None > LOD		0	0
Cyanide Free	mg/l			<0.05	1	0	None > LOD	None > LOD			
pH	pH units	6-9	6.5-10	8.3	1	1	8.3	8.3	TP410 @ 0.9 - 1mbGL	0	0
Organics											
Phenols	mg/l	0.0077		<0.03	1	0	None > LOD	None > LOD		0	
BTEX											
Benzene	ug/l	10	1	<1	1	0	None > LOD	None > LOD		0	0
Toluene	ug/l	50		<1	1	0	None > LOD	None > LOD		0	
Ethylbenzene	ug/l	20		<1	1	0	None > LOD	None > LOD		0	
m,p xylenes	ug/l	30		<1	1	0	None > LOD	None > LOD		0	
O-Xylene	ug/l	30		<1	1	0	None > LOD	None > LOD		0	
PCBs											
Pcb-101 2,2',4,5,5' - Pentachlorobiphenyl	ug/l			<0.01	1	0	None > LOD	None > LOD			
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl	ug/l			<0.01	1	0	None > LOD	None > LOD			
Pcb-138 2,2',3,4,4',5' - Hexachlorobiphenyl	ug/l			<0.01	1	0	None > LOD	None > LOD			
Pcb-153 2,2',4,4',5,5' - Hexachlorobiphenyl	ug/l			<0.01	1	0	None > LOD	None > LOD			
Pcb-180 2,2',3,4,4',5,5' - Heptachlorobiphenyl	ug/l			<0.01	1	0	None > LOD	None > LOD			
Pcb-28 2,4,4' - Trichlororbiphenyl	ug/l			<0.01	1	0	None > LOD	None > LOD			
Pcb-52 2,2',5,5' - Tetrachlorobiphenyl	ug/l			<0.01	1	0	None > LOD	None > LOD			
TPH											
Aliphatics >C5-C6	ug/l			<0.1	1	0	None > LOD	None > LOD			
Aliphatics >C6-C8	ug/l			<0.1	1	0	None > LOD	None > LOD			
Aliphatics >C8-C10	ug/l			<0.1	1	0	None > LOD	None > LOD			
Aliphatics >C10-C12	ug/l			<0.1	1	0	None > LOD	None > LOD			
Aliphatics >C12-C16	ug/l			<0.1	1	0	None > LOD	None > LOD			
Aliphatics >C16-C21	ug/l			<0.1	1	0	None > LOD	None > LOD			
Aliphatics >C21-C35	ug/l			<0.1	1	0	None > LOD	None > LOD			
Aliphatics >C35-44	ug/l			<0.1	1	0	None > LOD	None > LOD			
Aromatics >C5-C7	ug/l			<0.1	1	0	None > LOD	None > LOD			
Aromatics >C7-C8	ug/l			<0.1	1	0	None > LOD	None > LOD			
Aromatics >C8-C10	ug/l			<0.1	1	0	None > LOD	None > LOD			
Aromatics >C10-C12	ug/l			<0.1	1	0	None > LOD	None > LOD			
Aromatics >C12-C16	ug/l			<0.1	1	0	None > LOD	None > LOD			
Aromatics >C16-C21	ug/l			<0.1	1	0	None > LOD	None > LOD			
Aromatics >C21-C35	ug/l			<0.1	1	0	None > LOD	None > LOD			
Aromatics >C35-44	ug/l			<0.1	1	0	None > LOD	None > LOD			
Total Aliphatic TPH	ug/l			<5	1	0	None > LOD	None > LOD			
Total Aromatic TPH	ug/l			<5	1	0	None > LOD	None > LOD			
Total petroleum hydrocarbons	ug/l			<10	1	0	None > LOD	None > LOD			
PAH											
Acenaphthene	ug/l			<0.1	1	0	None > LOD	None > LOD			
Acenaphthylene	ug/l			<0.1	1	0	None > LOD	None > LOD			
Anthracene	ug/l	0.1		<0.1	1	0	None > LOD	None > LOD		0	
Benz(a)anthracene	ug/l			<0.1	1	0	None > LOD	None > LOD			
Benzo(a)pyrene	ug/l	0.00017	0.01	<0.1	1	0	None > LOD	None > LOD		0	0
Benzo(b)fluoranthene	ug/l	0.017	0.1	<0.1	1	0	None > LOD	None > LOD		0	0
Benzo(ghi)perylene	ug/l	0.0082	0.1	<0.1	1	0	None > LOD	None > LOD		0	0
Benzo(k)fluoranthene	ug/l	0.017	0.1	<0.1	1	0	None > LOD	None > LOD		0	0
Chrysene	ug/l			<0.1	1	0	None > LOD	None > LOD			
Dibenzo(ah)anthracene	ug/l			<0.1	1	0	None > LOD	None > LOD			
Fluoranthene	ug/l	0.0063		<0.1	1	0	None > LOD	None > LOD		0	
Fluorene	ug/l			<0.1	1	0	None > LOD	None > LOD			
Indeno(123cd)pyrene	ug/l	N/A	0.1	<0.1	1	0	None > LOD	None > LOD		0	0
Naphthalene	ug/l	2		<0.1	1	0	None > LOD	None > LOD		0	
Phenanthrene	ug/l			<0.1	1	0	None > LOD	None > LOD			
Pyrene	ug/l			<0.1	1	0	None > LOD	None > LOD			
PAH 16 Total	ug/l			<2	1	0	None > LOD	None > LOD			

A6 Appendix 6

Relevant Extract of Additional Environmental Data

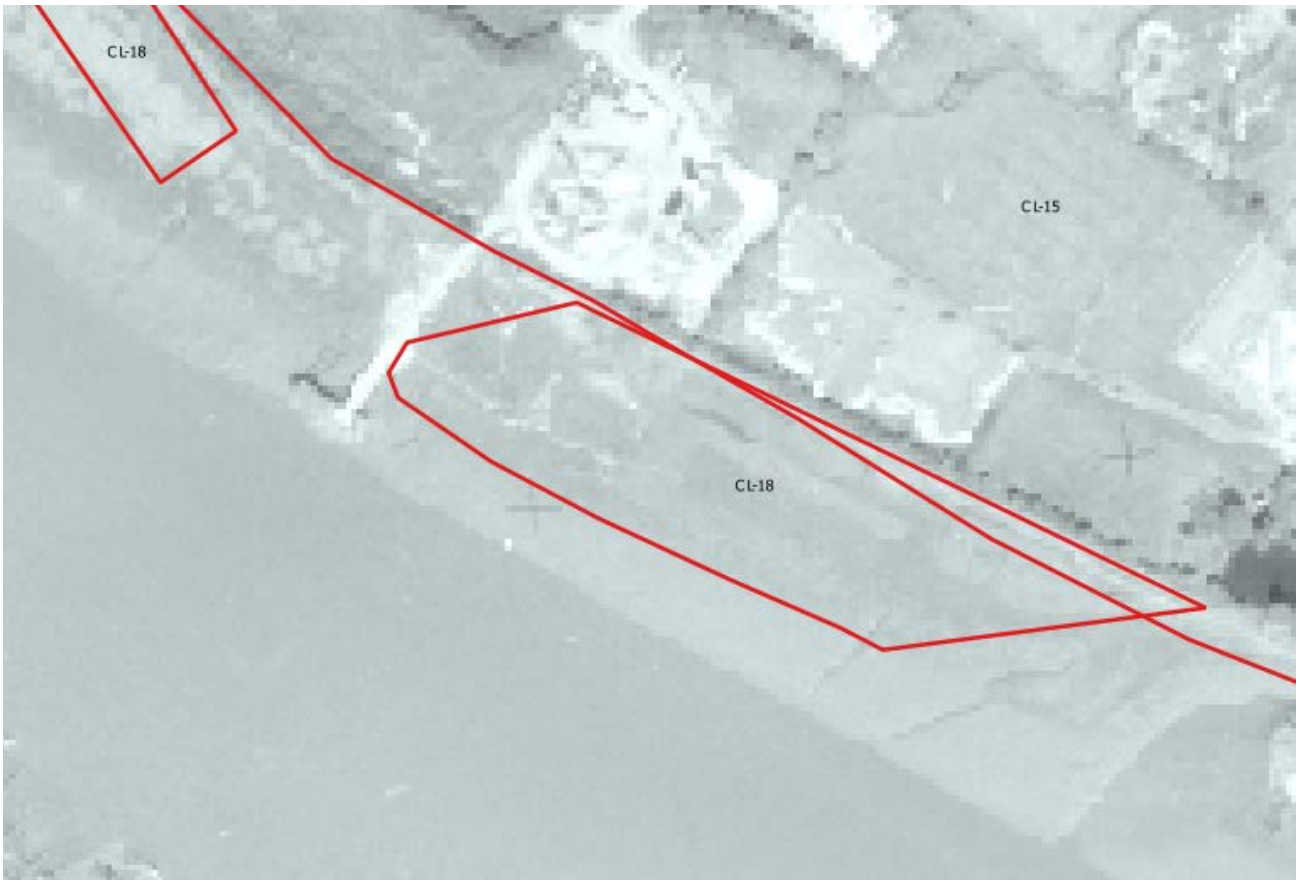

Plate 01: Extract of 1979 Aerial Photograph showing Works and jetty beyond the Site boundary.

Plate 02: Extract of 2014 High Resolution Aerial Photograph.

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591 Checked By: Date: Oct 2015

Welsh Government

M4 Corridor around Newport

Land Contamination Assessment Report Annex D CL-22 Former Llanwern Research Laboratories Land Contamination Report

M4CaN-DJV-EGT-ZG_GEN-RP_EN-0017

At Issue | March 2016

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Appendix 4 Groundwater Laboratory Data
Appendix 5 Surface Water Laboratory Data
Appendix 6 Soil Leachate Laboratory Data
Appendix 7 Benzene Pipeline Map

1 Introduction

1.1 Background

1.1.1 This report relates to an area of land potentially affected by contamination (CL-22) known as the 'Former Llanwern Research Laboratories' and hereafter referred to as the 'Site'.

1.1.2 The Site is located between chainage 12,400 and 12,800 (see Figure 1) and forms part of a former research complex.

1.2 Reporting Context

1.2.1 The Site has been assessed as part of ground investigations and monitoring associated with the wider works for the M4 Corridor around Newport (M4CaN) (hereafter referred to as the 'Scheme'). This report informs the baseline for the environmental impact assessment (EIA) for the Scheme. The EIA is reported in the M4CaN Environmental Statement (ES) of which this document is an appendix to the chapter on Geology and Soils.

1.2.2 In 2014, a Preliminary Sources Study Report (PSSR) was prepared as an initial land contamination appraisal (Ove Arup & Partners, 2014) as part of the Design Manual for Roads and Bridges (DMRB) Stage 2 Assessments for a number of route options. This identified a number of individual areas that may have been affected by contamination as a result of historical activities at the Site. In addition, this report draws upon the 2015 Supplementary Ground Investigation Works undertaken on behalf of the Welsh Government (Geotechnical Engineering, 2015). This report relates to the area defined on the Site Plan shown in Figure 1.

1.2.3 The overarching rationale and approach for the assessment of areas of land along the new section of motorway with potential contamination is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES).

1.3 Objectives

1.3.1 The key objectives of this report are as follows.

- Undertake a risk assessment of the Site and determine whether potential risks to human health or controlled waters could exist based upon the Scheme.
- Identify the need for further assessment and investigation in order to refine potential land contamination risks and inform the need for remediation/mitigation.
- To provide information to support the Ground Investigation Report (GIR) and Geotechnical Design Report (GDR) required under DMRB HD22/08 (Highways Agency, 2008).

1.4 Report Structure

1.4.1 The remainder of this report is structured as follows.

- Section 2: Site Location and Description – This section summarises the Site description.
- Section 3: The Scheme – This section details the alignment of the new section of motorway and associated features at the Site.
- Section 4: Site History – This section summarises the history of the Site based on historical maps and historical land photographs.
- Section 5: Environmental Setting – This section summarises the Site description, published geology, hydrology and hydrogeology and any relevant environmental information presented in the 2014 PSSR.
- Section 6: Scope of Investigations – This section describes the previous and supplementary ground investigation data available for the Site.
- Section 7: Ground Conditions – This section describes the main findings of the intrusive site investigation including the ground conditions encountered and significant visual or olfactory evidence of contamination identified.
- Section 8: Contamination Assessment – This section describes the findings of the Tier 1 and Tier 2 contamination risk assessment based upon potential contamination sources, potential receptors and potential contaminant linkages and presents the human health and controlled waters assessments.
- Section 9: Refined Conceptual Site Model – This section presents the Conceptual Site Model (CSM) for the Site and identifies potential contaminant linkages, based upon the findings of the data presented within Sections 2 to 7.
- Section 10: Conclusions and Recommendations – This section provides conclusions concerning the likelihood of land contamination associated with the Site affecting the Scheme and requirements for remediation/mitigation.
- Section 11: References – This section details the key reference documents referred to within the text.
- Section 12: Glossary – This section details the key terms and acronyms used throughout the report.

2 Site Location and Description

2.1.1 The area of the former Llanwern research laboratories is located in the central region of the new section of motorway, approximately 2 km to the west of Newport Docks and approximately 1.5 km west of the River Usk in an area of Newport called Pye Corner. The area is centred at national grid reference ST 347 853. The location and layout of the Site is presented on Figure 1. The proposed new section of motorway intersects the Site at chainage 12,400 to 12,800.

2.1.2 The Site is bounded to the south and south-east by Broad Street Common Road and to the north, east and west by open undeveloped fields and agricultural land used for grazing. Meadows Road and Nash Road are located to the west of the Site.

2.1.3 The Site is overgrown with trees, brambles and other rough vegetation. A network of roadways is present within the Site. A small building/structure is located within the eastern region of the Site surrounded by overgrowth.

2.1.4 A relatively new commercial building is located within the north-western reaches of the Site, just off Meadows Road and two electricity pylons are located within the central region of the Site, both of which carry cables traversing north-south across the Site. A number of drainage ditches traverse the Site.

2.1.5 The site walkover survey in 2014 identified the north-eastern part of the Site to have been redeveloped as a light industry/commercial unit accommodating Industrial Automation and Control Ltd. The north-western part appears to be overgrown and a light industrial unit is located to the west. No access could be gained to the north western section of the Site. The southern part of the Site is disused and fenced, preventing access. The Site is overgrown with young trees and shrubs. Derelict buildings are present including a corrugated steel tower and an office styled single storey building.

2.1.6 A drainage ditch runs along the south eastern Site boundary with standing water that appeared clear.

3 The Scheme

3.1.1 The new section of motorway would pass through the centre of the Site at approximate chainage 12400 to 12800 (refer to Figure 1 for the Site location in relation to the new section of motorway).

3.1.2 An embankment for the new section of motorway will be constructed on the Site with a carriageway level approximately 2 – 3 m above existing ground level. A link road is also located on an embankment that bridges the new section of motorway and joins Meadows Road in the north of the Site to Nash Road to the south.

3.1.3 Given the presence of soft compressible strata, the use of band drains is being considered in order to accelerate consolidation. The Nash Road Overbridge structure is expected to be piled as will the approach embankments.

3.1.4 The highway verges are to be landscaped and incorporate highway drainage which will predominantly be open swales/channels.

3.1.5 There is one proposed Water Treatment Area (WTA) located immediately north of the proposed link road. There are two further WTAs off-site to the west and east of the Site. The proposed WTAs comprise a lined storage/dilution lagoon to an approximate depth of 1.5 m below current ground level.

4 Site History

4.1.1 The 2014 PSSR historical searches have been based on Ordnance Survey plans, literature reviews, information provided by British Steel, Natural Resources Wales (NRW) (formerly Environment Agency Wales), Newport City Council and aerial photographic interpretation.

4.1.2 This is supplemented by a review of historical maps obtained in 2015 from Welsh Government. No relevant additional information has been identified from this review.

4.1.3 A summary of the Site's history is presented in Table 1below.

Table 1: Site History

Date	Use / Observation	Source of Information
1843 - 1893	The Site comprises agricultural fields traversed by drainage ditches. A road (Broad Street) and Julian's Reen run east-west along the southern boundary of Site. Nash Road and Lakes Reen run north-south to the west of the Site and Pye Corner including a burial ground is located to the south.	1:10,560 Historic Map
1891	No significant change.	1:10,560 Historic Map
1955	No significant change.	Aerial Photograph
1960	Accommodation block replaced by **research laboratories.**	Aerial Photograph
1962	Northern side of the Site seems to be full of white blocks, possibly caravans or containers. The southern side of the Site is occupied by buildings.	Aerial Photograph
1969	The northern part of Site is covered with **small buildings or caravans** whilst the southern part of the Site appears crisscrossed with **roads and development**.	Aerial Photograph
1970 - 1973	The northern part of the Site is a caravan park. The southern part of the Site has a number of **industrial/commercial units** and roadways on it. A number of pylons are present on site, supporting overhead wires running north-south. A camp site (disused) is present to the south.	1:10,000 Historic Map
1979	The Site looks to be in the process of being **demolished** with areas identified as being overgrown.	Aerial Photograph
1981	The majority of Site buildings have been **demolished**.	Aerial Photograph
1984	Meadows Road has been built through the Site.	Aerial Photograph
1985 - 1996	The caravan park appears disused. A small building has been constructed in the far west of the Site. An industrial unit has been built to the west of the Site and Queensway Meadow Industrial Estate has been developed to the north.	1:10,000 Historic Map
1991	The south east of the Site is overgrown with the remains of buildings indicated. The north-east of the Site is overgrown.	Aerial Photograph

Date	Use / Observation	Source of Information
1995	A Site walkover prior to 1995 identified a former construction work camp/research laboratories. Made Ground and slag were identified on the ground surface (no further data available).	Walkover survey prior to 1995 PSSR
2006	An industrial unit and associated road from the west has been built in the centre of the Site. The southern part of the Site is heavily vegetated, though the disused overgrown roadways are still visible.	Aerial Photograph
2014	No significant change.	Aerial Photograph

Notes. Potential sources of contamination are underlined. Those within the temporary and permanent land take are shown in **bold**.

4.1.4 A drawing provided by Newport City Council (presented in Appendix 7) shows a redundant benzene pipeline cutting through the northern half of the Site impacting upon the proposed link road. No further information was provided. The location differs from the location provided through other sources. Both locations are shown in Figure 1 and further enquiries are being made to ascertain the exact location.

4.1.5 Historically the Site is in proximity to a World War II decoy bombing site which is described in detail within the 2014 PSSR (Ove Arup & Partners 2014) and the Explosive Ordnance Threat Assessment Report (Bactec, 2014). There is thus a risk from unexploded ordnance at the Site which is categorised as a low - medium risk site.

5 Environmental Setting

5.1 Geology

5.1.1 The 2014 PSSR (Ove Arup & Partners, 2014) indicates that 1 m to 2 m of Made Ground (MG) is present at the Site.

5.1.2 The Made Ground is underlain by Tidal Flat Deposits (TFDs) comprising clay with silt and peat bands. This is in turn underlain at depth by the Mercia Mudstone Group (MM) bedrock comprising weathered mottled and often fractured mudstones.

5.1.3 Discrete pockets of Glaciofluvial Deposits (GFD) may also be present at the interface between the bedrock and the Tidal Flat Deposits.

5.2 Hydrology

5.2.1 The Site is bounded by two main reens: Lakes Reen in the west and Julian's Reen to the south and east. Lakes Reen joins Julian's Reen at Pye corner to the south-west of the Site. Field ditches drain the low lying area around the Site and provide connection with the main Reens.

5.3 Hydrogeology

5.3.1 Two separate groundwater bodies are anticipated to exist at the Site. Perched groundwater may be supported in granular Made Ground/fill that overlies the Tidal Flat Deposits. Groundwater is also present and assumed confined, within the Glaciofluvial Deposits and underlying bedrock.

5.3.2 NRW consider the Tidal Flat Deposits to be non-productive strata. The Mercia Mudstone Group strata are classified as a Secondary B aquifer.

5.4 Environmental Information

5.4.1 NRW reports the following pertinent information within the study area.

- No landfills, abstraction licences or discharge points have been recorded within the Site or within 300 m of the Site.
- One minor pollutant incident has been recorded within the Site in relation to fly tipping approximately 100 m to the north.
- Five significant impact pollution incidents have been recorded within approximately 110 m north-west of the Site boundary. All these incidents are in relation to an unauthorised waste management site. These incidents are listed in Table 2.
- Two minor pollution incidents are located near the north-west Site boundary, associated with fly-tipping of waste. Five other minor impact pollution incidents and four no impact pollutant incidents have also been recorded within 300 m of the Site boundary.

Table 2: NRW Significant Pollution Incidents Within 300 m of the Site

Date	Impact to Air	Impact to Land	Impact to Water	Pollutant
01/06/2006	Significant	Significant	Minor	Atmospheric pollutants, general biodegradable materials, inert materials and waste.
24/03/2006	No impact	Significant	No impact	General biodegradable materials and wastes.
24/05/2006	Significant	Significant	Minor	Atmospheric pollutants, general biodegradable materials, inert materials and waste.
11/11/2008	No impact	Significant	No impact	Inert materials and wastes.
26/01/2009	No impact	Significant	No impact	Inert materials and wastes.

5.4.2 Based on the above, the recorded on site fly tipping is the only pollution incident that could represent a potential contamination source that requires due consideration in relation to the Scheme.

6 Scope of Investigations

6.1 General

6.1.1 Four intrusive ground investigations have been undertaken at the Site since 1997 and these have been summarised in the following sections. The information provided covers the Site boundary which is being intersected in part by the new section of motorway.

6.1.2 Two phases of surface water sampling have also been undertaken and are summarised below.

6.1.3 For the purpose of meeting the requirements of DMRB HD22/08 (Highways Agency, 2008), the historical data used to support the PSSR has been differentiated from additional 2015 Supplementary Ground Investigation data (Geotechnical Engineering, 2015).

6.2 Scope of Works

6.2.1 The various intrusive ground investigations undertaken within the Site area are summarised in Table 3.

Table 3: Ground Investigation Summary

Date	Contractor	Site Location	Boreholes	Window Sampler	Trial Pits	Sampling
1997	Norwest Holst	North-east South-east	BHH6 BHH7	-	-	Soil
2000	Exploration Associates	Central area	-	-	CH49 - CH50	Soil and leachate
2008	Norwest Holst	South-west and central	SBHH06CP	-	STPH01 STPH02	Soil, leachate & groundwater
2015	Geotechnical Engineering Limited	South	BH504 BH505	-	-	Soil

6.2.2 It is noted that the 2014 PSSR considered findings of trial pit CH48 (analytical data and ground conditions). Given this falls outside the boundary, the investigation findings related to this exploratory location have been removed in the context of this report.

6.2.3 The construction details of all boreholes installed on the Site are summarised in Table 4.

Table 4: Summary of Borehole Construction Details

Borehole ID	Diameter (mm)	Total Drilled Depth (m)	Top of Slotted Well Casing / Gravel Pack (m bGL)	Base of Slotted Well Casing / Gravel Pack (m bGL)	Targeted Geology
SBHH06CP	50	15.0	10.3	12.3	Tidal Flat Deposits / Mercia Mudstone Group
BHH7	No data	35.5	13	15	Mercia Mudstone Group
BH505	35	19.5	12.5	14	Glaciofluvial Deposits
	50		15.0	19.0	Mercia Mudstone Group

6.3 Surface Water Quality Monitoring

6.3.1 Surface water monitoring in the vicinity of the Site was undertaken during two investigations, as summarised in . Two sample locations (R8 and R9) were included in the Titan Environmental Surveys Limited monitoring network, with four quarterly samples taken during 2007 and 2008 (Titan, 2008). The surface water quality sampling undertaken at points R8 and R9 are located approximately 150 m to the west and immediately south of the Site, on Lakes Reen and Julian's Reen respectively.

6.3.2 Additional sampling was undertaken in 2015 at four locations situated on Lakes Reen and Julian's Reen.

6.3.3 The results of monitoring are reported within the Baseline Water Environment Report (Appendix 16.2 of the ES).

Table 5: Surface Water Monitoring Locations

Surface Water Monitoring Point ID	Date of Sampling	Water Body	Position	Field Observations
R8/ IDB78	2007 / 2008	Lakes Reen	Approximately 150 m west of the Site.	Flow was noted as slack to slow
R9/ IDB77	2007 / 2008	Julian's Reen	To south of the Site.	Flow was noted as slack to slow
12.1	2015 Q1	Lakes Reen	Approximately 200 m west of the Site.	-
12.2	2015 Q1	Lakes Reen	Approximately 150 m west of the Site.	-
13.1	2015 Q1	Lakes Reen	West of the Site.	-
13.2	2015 Q1	Julian's Reen	Approximately 150 m south of the Site.	-

6.4 Field Testing

6.4.1 Photo ionisation detector (PID) monitoring for Volatile Organic Compounds (VOCs) was undertaken on shallow soil samples at boreholes SBHH06, BH504 and BH505.

6.5 Groundwater Monitoring

6.5.1 A summary of the groundwater sampling, groundwater monitoring and ground gas monitoring rounds is shown in Table 6.

Table 6: Summary of Monitoring Rounds

Location Ref.	Number and Date of Rounds	Monitoring Details	Notes
SBHH6CP	2 no. 21st February 2008, 17th March 2008	Groundwater level & sampling	
BHH7	No data		
BH505 (35 mm)	4 no. 23rd March 2015, 30th March 2015, 14th April 2015, 8th May 2015	Groundwater – level & sampling Soil Gas	Gas monitoring in shallow installation only
BH505 (50 mm)			

6.6 Laboratory Chemical Testing

6.6.1 A summary of all laboratory analysis undertaken on soil, groundwater, leachate and surface water is summarised in and below.

Table 7: Summary of Previous Investigation Sampling – Intrusive Exploratory Locations

Site Investigation Date	No. of Soil Samples	No. of Leachate Samples	No. of Water Samples	Suites of Testing
1997	3	0	0	Metals, pH, sulphate, cyanide, PAH screening, phenols
2000	4	2	0	Metals, pH, sulphate, cyanide, PAH screening, TPH FTIR, Oil FTIR, phenol
2008	7	2	2	Metals, pH, sulphate, asbestos, cyanide, phenol, MTBE, BTEX, GRO, TPHCWG, speciated PAH, SVOCs (water only)
2015	6	2	6	Metals, PAH, TPH, asbestos, pH, cyanide, organic matter, sulphate, sulphur, VOCs, SVOCs, nitrate, BTEX, phenols

Table 8: Summary of Previous Investigation Sampling – Surface Water

Site Investigation Date	No. of Water Sample Locations / Number of Rounds	Suites of Testing
2007/2008	2 locations / 4 rounds	Metals, inorganics
2015	4 locations / 1 round	Inorganics, PAH, TPH, BTEX

Soil Analysis

6.6.2 The following sections summarise the laboratory analytical results for soil samples collected during the various intrusive investigation phases. The available data set has been tabulated and is presented in Appendix 3 with the supporting laboratory certificates available in the relevant original ground investigation reports (see).

6.6.3 To inform the Conceptual Site Model, analytical data from the Made Ground samples have been assessed separately from those of the natural soils (Tidal Flat Deposits specifically).

6.6.4 For the purpose of meeting the requirements of the DMRB HD22/08 (Highway Agency, 2008), the historical data used to support the PSSR and the additional 2015 information (Geotechnical Engineering, 2015) have been differentiated in the following sections.

6.6.5 The available information used in this assessment is summarised in Table 9.

Table 9: Summary of Analytical Soil Data

Formation Unit	Number of Soil Analysis per Analytical Suite - 2015 data / All GI data							
	Metals & Inorganics	Asbestos	PAH	TPH	Phenol	BTEX	VOC	SVOC
Made Ground	5 / 14	4 / 8	5 / 14	5 / 11	0 / 5	4 / 8	1 / 1	1 / 1
Natural Soils	1 / 5	2 / 2	1 / 5	1 / 3	0 / 2	2 / 2	0 / 0	0 / 0

Soil Leaching Analysis

6.6.6 The available leachate information is presented in Appendix 6 and summarised in Table 10.

Table 10: Summary of Soil Leaching Analytical Data

Formation Unit	Number of Soil Leachate Analysis per Analytical Suite - 2015 data / All GI data						
	Metals & Inorganics	PAH	TPH	Phenol	BTEX	VOC	SVOC
Made Ground	2 / 6	2 / 2	2 / 2	2 / 2	2 / 2	0 / 0	0 / 0

Groundwater Analysis

6.6.7 The following section summarises the laboratory analytical results for groundwater samples collected during the various intrusive investigation phases. The available data set has been tabulated and is presented in Appendix 4 with the supporting laboratory certificates available in the relevant original reports.

6.6.8 The available data relate to groundwater samples taken from wells installed within the groundwater of the Glaciofluvial Deposits and/or Mercia Mudstone and is summarised in Table 11.

Table 11: Summary of Analytical Groundwater Data

Groundwater Unit	Number of Groundwater Analysis per Analytical Suite (Number of Well Locations) – 2015 data / All GI data							
	Metals & Inorganics	PAH	TPH	Phenol	BTEX	VOC	SVOC	PCB
Groundwater (Glaciofluvial Deposits / Mercia Mudstone Group)	6 (1) / 8 (2)	6 (1) / 7 (2)	6 (1) / 8 (2)	6 (1) / 7 (2)	6 (1) / 8 (2)	2 (1) / 2 (2)	2 (1) / 3 (2)	2 (1) / 2 (2)

Surface Water Analysis

6.6.9 The following sections summarise the laboratory analytical results for surface water samples collected during the various intrusive investigation phases. The available data set has been tabulated and is presented in Appendix 5 with the supporting laboratory certificates available in the relevant original reports.

Table 12: Summary of Analytical Surface Water Data

Surface Water System	Number of Water Analysis per Analytical Suite (Number of Locations) – 2015 data / All GI data				
	Metals & Inorganics	Water Quality Parameters	Polycyclic Aromatic Hydrocarbons (PAH)	Total Petroleum Hydrocarbon (TPH)	BTEX
Julian's Reen	0 (1) / 4 (2)	1 (1) / 5 (2)	1 (1) / 1 (2)	1 (1) / 5 (2)	1 (1) / 1 (2)
Lakes Reen	0 (3) / 4 (4)	3 (3) / 7 (4)	3 (3) / 3 (4)	3 (3) / 7 (4)	2 (3) / 2 (4)

6.7 Gap Analysis of Available Data

6.7.1 The information available is limited to the new section of motorway corridor and does not include the link road re-routing Meadows Road running north-south through the centre of the CL-22 site over the motorway corridor.

6.7.2 There are limited groundwater quality and gas monitoring data.

6.7.3 It is recommended that additional investigation is undertaken to supplement the existing data set and enable risk levels described later in the report to be verified.

7 Ground Conditions

7.1 Geology

7.1.1 The geological logs for all available exploratory holes excavated on or in close proximity to the Site are provided in Appendix 1. The observed geological sequence is consistent with that discussed in the PSSR report and is summarised in the following sections. Information from the Supplementary Ground Investigation (Geotechnical Engineering, 2015) has also been used.

Made Ground

7.1.2 Made Ground was encountered in all exploratory locations with a thickness generally around 1.3 m and appeared relatively consistent across the Site. The thickness ranged between 0.5 and 1.4 m as summarised in Table 13.

7.1.3 Made Ground was commonly present as a coarse material comprising slag, ash, bricks, tarmacadam and concrete. The following additional observations were also noted.

- Infrequent horizons of cobbles were encountered, specific to trial pit CH50 and borehole BH505.
- A buried concrete slab was encountered at STPH02 between 0.85 m and 1.3 m bGL.

Superficial Deposits

7.1.4 Unconsolidated superficial deposits were encountered beneath the Made Ground at all locations. These comprised Tidal Flat Deposits, generally firm bluish grey clays becoming soft or very soft with depth.

7.1.5 The deposits included one or two layers of peat. Whilst an upper layer was encountered at typically 2.4 to 6.0 m bGL and a second layer at typically 6.4 to 8.2 m bGL, the continuity of these layers remains unproven. The thickness of the peat layers was variable between 0.2 and 1 m.

7.1.6 Sand and gravel material considered to represent Glaciofluvial Deposits was found to underlie the predominantly fine soils of the Tidal Flat Deposits at depths below 11.3 to 12.2 m bGL. These coarse deposits were discontinuous across the Site and were present in boreholes SBHH06, BH504 and BH505 with thicknesses varying between 0.4 and 2.4 m. This material was absent in boreholes SBHH06CP and BHH6.

Solid Geology

7.1.7 Below the superficial deposits, the Mercia Mudstone Group was encountered at a depth of between 11 and 14.6 m bGL. The Mercia Mudstone Group was typically described as very stiff reddish brown clay.

7.1.8 Borehole BHH07 in the Mercia Mudstone Group encountered a sandstone formation below 33.8 m bGL (thickness unproven).

Geological Sequence Summary

7.1.9 The general geological sequence identified during the previous ground investigations is summarised in Table 13.

Table 13: Summary of Geological Sequence

Unit	Description	Thickness Range (m)	Basal Depth (m bGL)
Made Ground	Predominantly coarse including ash, clinker, brick, concrete and tarmacadam	0.5-1.4	0.5-1.4
Superficial Deposits (Tidal Flat Deposits)	Silty clay, organic in places with at least two defined peat layers, the shallowest being at 2.4-6.0 m bGL	10.1-10.8	11-12.2
Superficial Deposits (Glaciofluvial Deposits)	Sand and gravel	Absent - 2.4	11-14.6
Mercia Mudstone Group (Mudstone)	Very stiff clays becoming weak completely fractured Mudstone	21.2	33.8
Mercia Mudstone Group (Sandstone)	Strong sandstone with mudstone laminations	>1.7	unproven

7.1.10 The Conceptual Site Model included within the 2014 PSSR report has been amended in light of the 2015 information and is presented within Figure 2.

7.2 Visual and Olfactory Evidence of Contamination

7.2.1 A summary of visual and olfactory evidence of potential contamination encountered during the previous ground investigations is summarised in Table 14.

Table 14: Visual and Olfactory Evidence of Contamination Summary

Location ID	Depth (m bGL)	Strata	Evidence of Potential Contamination
Most locations	GL to 0.5-1.4	Made Ground	Ash, clinker, tarmacadam and demolition rubble.

7.2.2 No visual or olfactory evidence of hydrocarbon contamination was identified during any of the previous ground investigations. The PID meter recorded zero levels of VOCs.

7.3 Gas Monitoring

7.3.1 The ground gas monitoring dataset collected during each of the previous three monitoring rounds in 2015 is summarised on the field data sheets provided in Appendix 2. The maximum gas concentrations (minimum for oxygen) are presented in Table 15.

Table 15: Summary of Gas Monitoring Data

Location ID	Flow (l/hr)	VOCs (ppm)	CH_4 (%/vol)	Peak LEL (%)	CO_2 (%/vol)	O_2 (%/vol)	CO (ppm)	H_2S (ppm)
	Max	Max	Max	Max	Max	Min	Max	Max
SBHH06CP	No data							
BH505 35mm	0.8	4.5	2.2	50.6	3.6	18.6	1	0
BH505 50mm	No data							

7.4 Groundwater

Groundwater Encountered During Investigation

7.4.1 Groundwater strikes were encountered during the drilling of boreholes SBHH06CP, BHH6 and BHH7 as detailed on the geological logs provided in Appendix 1. These are summarised below in Table 16.

Table 16: Summary of Groundwater Level Data During Drilling

Location	Strike Depth (m bGL)	Geological Formation	Level after 20 minutes (m bGL)
SBHH06CP	5	Tidal Flat Deposits	4.7
BHH6	12.45	Mercia Mudstone Group	7.9
BHH7	13.5	Mercia Mudstone Group	8.4

7.4.2 Groundwater was not recorded in any other boreholes and trial pits during the previous investigations.

Groundwater Levels During Monitoring Rounds

7.4.3 The entire groundwater level dataset gathered on Site is provided in Appendix 2 and summarised in Table 17.

Table 17: Summary of Groundwater Level Data During Monitoring

Location	Installation	Depth of Response Zone (m bGL) and Geological Formation	No. Measurements	Min Depth (m bGL)	Max Depth (m bGL)	Comments
BH505	(S) 35 mm	12.5-14 (Glaciofluvial Deposits	3	1.48	4.02	Slow recharge
	(D) 50 mm	10.3-12.3 (Mercia Mudstone Group)	3	3.7	5.38	
SBHH06 CP	50 mm	10.3-12.3 (Tidal Flat Deposits / Mercia Mudstone Group)	2	3.76	3.88	
BHH7	No data	13-15 (Mercia Mudstone Group)	No data			

Notes. S denotes a shallow installation and D denotes deep installation.

Groundwater Summary

7.4.4 The main groundwater body identified is within the granular Glaciofluvial Deposits and/or the Mercia Mudstone Group, which is confined by the intervening Tidal Flat Deposits that represent a regional aquitard limiting vertical groundwater flow. Groundwater level observations during drilling have identified a potentiometric surface within the aquifer to be at a level ranging between the top of the Tidal Flat Deposits and the base of the Made Ground.

7.4.5 Discontinuous perched groundwater is observed within the upper Tidal Flat Deposits associated with limited zones of permeability associated with more granular lithologies. This ‘groundwater’ is regarded as ‘pore water’ which does not contribute to advective flow within these strata.

7.4.6 Whilst no perched groundwater was identified in the Made Ground during the intrusive works, it is possible that it may be present given the granular nature of the material and presence of the underlying cohesive Tidal Flat Deposits. Seasonally variable perched water bodies are anticipated within the Made Ground that will be influenced by both rainfall and surface water levels within surrounding reens and ditches.

8 Contamination Assessment

8.1 Introduction

8.1.1 The following sections provide details of the assessment of land contamination at the Site.

8.1.2 The outline Conceptual Site Model (CSM) presented within the 2014 PSSR has been reviewed and updated based on data from the Supplementary Ground Investigation (Geotechnical Engineering, 2015) and the Scheme. The main alterations to the PSSR model are summarised as follows.

- Addition of a second shallower peat layer.
- Laboratory data set from trial pit CH48 removed as outside the Site boundary (part of contamination area CL-17 instead).
- New contamination sources and pathways identified (potential perched water body within the Made Ground).
- Additional gas pollutant (methane and/or carbon dioxide) considered from Made Ground and peat.
- Proposed use of band drains to accelerate surcharging of soft soils during construction. These are anticipated to be vertical drains installed in a close grid pattern through the Made Ground and underlying Tidal Flat Deposits and into the Glaciofluvial Deposits or Mercia Mudstone Group.
- New ditch considered as a new pathway.
- Redundant benzene pipeline added as potential contamination source.
- Update of the source-pathway-receptor linkages taking account of above and more detailed assessments.

8.2 Preliminary Risk Assessments

Potential Sources

8.2.1 The Made Ground was identified through the 2014 PSSR as a potential source of contamination associated with historical land use of the Site. This is confirmed by the additional data from the 2015 supplementary ground investigation albeit some of the organic contaminants in soils were observed at lower concentrations than recorded in the previous 2007 ground investigation.

8.2.2 The potential of a transient (ephemeral) perched water body within the Made Ground is considered to represent a potential contaminant source rather than a receptor if it is actually present.

8.2.3 The benzene pipeline may cross the northern area of the Site and represents another potential source of contamination should any leakage be found to have occurred. The pipeline is understood to remain in place with the level of decommissioning remaining unknown.

8.2.4 The Made Ground and peat deposits may represent potential sources of ground gas. The potential of the latter may increase following consolidation associated with the surcharge loading of the embankment.

8.2.5 In addition to the above sources, the quality of surface waters, perched groundwater and the deeper aquifer within the Glaciofluvial Deposits and Mercia Mudstone Group bodies may influence or impact the quality of the others (for instance the groundwater within the Glaciofluvial Deposits and Mercia Mudstone Group is saline whilst the surface water is not). Surface water, perched groundwater and the deeper aquifer are therefore regarded as a source of possible contaminants as well as receptors.

Potential Receptors

8.2.6 Receptors during the construction and the operational stages of the Scheme that have been considered.

Construction

- Construction workers during site development works.
- General public/workers both adjacent to construction works and in a nearby commercial unit located some 40 m to the north of the new section of motorway.
- Groundwater within the Glaciofluvial Deposits and/or Mercia Mudstone Group.
- Nearby surface waters including the reens and existing surface water ditches within the Site and bordering the surrounding fields. This land drainage may be connected with the Gwent Levels Site of Special Scientific Interest (SSSI) wider network of reens and ditches, located some 180 m to the south of the new section of motorway.

Operational

- General public end users.
- General public/workers in a nearby commercial unit adjacent to permanent land take.
- Maintenance workers.
- Groundwater within the Glaciofluvial Deposits and/or Mercia Mudstone Group.
- Nearby surface waters including the reens and existing and/or proposed surface water ditches within the Site and bordering the surrounding fields.

Potential Pathways

8.2.7 Pathways during the construction and the operational stages of the Scheme that have been considered.

- Dermal contact, ingestion, inhalation pathways of potentially contaminated soils possible during construction and maintenance works.
- Dermal contact, ingestion, inhalation pathways possible for general public end users and adjacent general public/workers in a nearby commercial unit. The latter to be from soil dust only.
- Contaminated surface water run-off into existing/new drainage system and adjacent land.

- Vertical migration of impacted perched water within the Made Ground and/or leachate from the Made Ground into Glaciofluvial Deposits and/or Mercia Mudstone Group aquifer due to band drain installation.
- Vertical migration of impacted groundwater within the Tidal Flat Deposits from the benzene pipeline into Glaciofluvial Deposits and/or Mercia Mudstone Group aquifer due to band drain installation.
- Vertical migration of groundwater within Glaciofluvial Deposits and/or Mercia Mudstone Group possibly recharging perched groundwater and/or perched water within the Made Ground due to band drain installation.
- Lateral migration of perched water within the Made Ground to land drainage (surface waters).
- Leaching of contaminants from the Made Ground to shallow groundwater and migration to land drainage (surface waters).
- Vertical or lateral migration of ground gas associated with Made Ground and peat potential sources.

8.3 Risk Evaluation

8.3.1 Source-pathway-receptor linkages were considered in the 2014 PSSR using the historical data available up to 2008. With review of the data described herein, the risk evaluation has been reconsidered and includes the following.

- Proposed 2 m embankment and overlying hardstanding (carriage way) is to be constructed at the Site which is to cover most of the motorway corridor reducing pathways from any contamination in shallow soils left *in situ* to motorway users.
- The redundant benzene pipeline is anticipated to be intersected by the proposed new junction with Meadow Road. The pipeline is to be decommissioned fully during the construction phase. Therefore it will not represent a potential contamination source during the operation phase and associated risks have not been considered post construction.
- Tidal Flat Deposits are classified as non-productive and overlie an underlying secondary aquifer associated with the Glaciofluvial Deposits and/or the Mercia Mudstone Group.
- The low permeability Tidal Flat Deposits (of over 10 m thickness) separate the Made Ground and deeper aquifer.
- Perched groundwater within the Tidal Flat Deposits is not considered a water resource due to its anticipated low vertical hydraulic continuity with the aquifer beneath, low permeability and low storage capacity.
- Hardstanding cover is likely to limit infiltration thus reducing leaching.
- The proposed use of band drains could create pathways from any potentially contaminated soils within or under the motorway embankment to the secondary aquifer. The proposed use of band drains may allow the influx of pore water from the Tidal Flat Deposits into the Made Ground.
- Leachability of contaminants from the soil matrix of the Made Ground.

- Creation of new drainage system may increase leaching of any contaminants from the Made Ground with associated increase in the risk for migration into surface waters.
- Low concentrations of volatile contaminants and ground gas recorded.
- Motorway users will be within open environment with no proposed structures or other confined spaces.
- Risk of increased flux of gas emission due to induced consolidation of the Made Ground and peat from the proposed surcharge loading. However, potential receptors are limited, primarily associated to accumulation in confined spaces (such as underground services).

8.4 Human Health Risk Assessment

8.4.1 The rationale and approach for the human health (Tier 2) screening assessment is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES). Soil chemical analysis results and the findings of the generic Tier 2 human health risk assessment are presented in Appendix 3. All exceedances of the relevant generic risk assessment criteria are summarised in Table 18.

Table 18: Summary of Human Health Soil Screening Exceedances (Natural Ground)

Determinand	Units	Range	Screening Criteria	No. Samples Exceeding Screening Criteria (Total Number of Results)	Location of Exceedances
pH	pH units	6.92-10.5	6-9	5 (19)	BHH6, CH49, CH50(x2), BH505 (x2)
Chromium	mg/kg	15-214	33	10 (19)	BHH6, BHH7(x2), CH49(x2), CH50(x2), SBHH06CP(x2), STPH01
PAH	mg/kg	15-102	3.5	3 (7)	49, 50(x2)

8.4.2 Elevated alkaline soil conditions were identified in nearly half of the samples, mainly within the Made Ground material but also in one sample of the Tidal Flat Deposits material.

8.4.3 Although exceedances of chromium are widespread in both Made Ground and natural soils, the screening criterion used is based on the hexavalent form. The majority of results are considered to be within normal background levels (<95 mg/kg) and therefore are not considered to represent a contaminant of concern (Appendix 11.1 of the ES). Two locations (CH49, BHH6) exceed this background range with a maximum of up to 214 mg/kg. Further sampling and speciation laboratory analysis may confirm chromium relates to a less toxic form.

8.4.4 Exceedances of PAH were identified in nearly half of the non-speciated samples analysed. In this instance the criterion for total PAH has been taken considering the most stringent PAH compound (Dibenzo(ah)anthracene). Whilst this is considered to be a conservative approach, it is noted that two of these exceedances (CH49 and CH50) relate to Made Ground material and are well above the remaining data set for the same geological unit. This may represent discrete area of contamination that requires delineation.

8.4.5 No other exceedances of the applied assessment criteria have been identified and no asbestos fibres were detected visually or in samples analysed in the laboratory.

8.5 Controlled Waters Screening Assessment

8.5.1 The rationale and approach for the controlled waters (Tier 1) screening assessment is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES) and the groundwater chemical results are presented in Appendix 4. All exceedances of the relevant generic criteria are summarised in Tables 19, 20 and 21 for soil leachate, groundwater and surface waters, respectively.

8.5.2 Where an Environmental Quality Standard (EQS) is dependent on water hardness i.e. some heavy metals, the hardness of the surface water receptor should normally be used. The Baseline Water Environment Report (Appendix 16.2 of the ES) indicates surface water to be generally moderately hard with hardness in a range of 100 to 150 mg/l (reported as calcium carbonate). Therefore EQSs within this water hardness range have been used for screening purposes.

Soil Leachate Results

8.5.3 Six soil samples were subjected to leachate analysis. The majority of the soil leachate results were all below the applied screening criteria, with the exception of the contaminants in Table 19.

Table 19: Controlled Waters Screening Exceedances – Soil Leachate

Determinand	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location (Formation)	No. Exceeded DWS Screening Criteria (Total Number of Results)	Location (Formation)
Copper	µg/l	2.4 - 12	6	2,000	1 (4)	STPH02 (Made Ground)	0 (4)	-
Antimony	µg/l	<5 - 22	-	5	-	-	1 (2)	STPH02 (Made Ground)
Nickel	µg/l	<1 - 6.1	4	20	1 (4)	STPH02 (Made Ground)	0 (4)	-
Lead	µg/l	1 - 4.7	1.2	10	3 (4)	STPH02, BH504 x 2 (Made Ground)	0 (4)	-

8.5.4 The identified exceedances are considered to be minor and unlikely to pose a significant risk to Controlled Waters.

8.5.5 Certain laboratory detection limits used for samples analysed during previous ground investigations, for cadmium and cyanide, are higher than the screening criterion.

Groundwater Results

8.5.6 The groundwater results assessment includes data from a number of monitoring rounds of groundwater monitoring results from SBHH6CP and BH505 undertaken in 2008 and 2015 respectively. The groundwater samples were taken from the aquifer body beneath the Site which are considered representative of the Glaciofluvial Deposits and Mercia Mudstone Group.

8.5.7 A summary of the exceedances of the screening criteria from all available ground results relating to the Site is presented in table 20 and discussed below.

Table 20: Controlled Waters Screening Exceedances - Groundwater

Determinand	Units	Range	EQS	DWS	No. Exceeded Screening Criteria (Total Number of Results) Against EQS	Location of Exceedance	No. Exceeded Screening Criteria (Total Number of Results) Against DWS	Location of Exceedance
Arsenic	µg/l	9.8-48	40	10	0 (8)	-	7 (8)	SBHH06CP & BH505
Boron	µg/l	270-1,200	2,000	1,000	0 (6)	-	2 (6)	BH505
Cadmium	µg/l	<0.08-6	0.09	5	2 (8)	SBHH06	1 (8)	SBHH06CP
Chromium	µg/l	17-210	-	50	-	SBHH06 & BH505	5 (8)	-
Copper	µg/l	3.1-86	6	2,000	6 (8)	BH505	0 (8)	-
Iron	µg/l	170-220	1,000	200	0 (2)	-	1 (2)	SBHH06CP
Lead	µg/l	<1 – 6.3	1.2	10	1 (8)		0 (8)	
Manganese	µg/l	510-830	-	50	-	-	2 (2)	SBHH06CP
Mercury	µg/l	<0.01-2.2	0.05	1	3 (8)	BH505	3 (8)	BH505
Selenium	µg/l	36-38	-	10	-	-	8 (8)	SBHH06CP
Zinc	µg/l	2.7-2,400	75		2 (8)	SBHH06	-	-

Determinand	Units	Range	EQS	DWS	No. Exceeded Screening Criteria (Total Number of Results) Against EQS	Location of Exceedance	No. Exceeded Screening Criteria (Total Number of Results) Against DWS	Location of Exceedance
Sodium	mg/l	3,500-3,800	-	200	-	-	2 (2)	SBHH06CP
Sulphate	mg/l	510-1,000	400	250	2 (2)	SBHH06	2 (2)	SBHH06CP
Chloride	mg/l	730-5,100	250	250	8 (8)	SBHH06 & BH505	8 (8)	SBHH06CP & BH505
Ammoniacal Nitrogen	mg/l	6.6-26	0.3	-	8 (8)	SBHH06 & BH505	-	-
Unionised Ammonia	mg/l	0.334-0.909	0.015	-	2 (2)	SBHH06	-	-
Total Ammonium (NH4)	mg/l	29	-	0.5	-	-	1 (1)	SBHH06CP
BOD	mg/l	<1-6	5	-	1 (2)	SBHH06	-	-
Phenols	mg/l	<0.03-0.74	(0.0077)[1]	-	6 (6)	BH505	-	-

Note: [1] based on phenol criteria

8.5.8 Within the aquifer bodies of the Glaciofluvial Deposits and Mercia Mudstone Group, the following comments are made when considering EQS criteria.

- Exceedance of metals (mainly copper, mercury, and to lesser extent cadmium, lead and zinc) and inorganics (mainly ammoniacal nitrogen, chloride sulphate) were identified.
- The elevated chloride concentrations indicate that the aquifer is saline.

8.5.9 The presence of elevated chloride and sodium concentrations indicate saline intrusion within the Aquifer.

8.5.10 Over and above the exceedances identified above, the analytical data indicates presence of hydrocarbon (TPH) in borehole BH505 although the concentrations were variable. Elevated TPH was not identified in samples taken during the third monitoring round in 2015 in either installation. Elevated TPH was identified in both installations installed in BH505 indicating contamination is present within the Glaciofluvial Deposits and Mercia Mudstone Group. . Speciated data shows the TPH concentrations to comprise heavier end hydrocarbons (volatile fractions typically < LOD).

8.5.11 Total phenols were found to be present in borehole BH505 during the first round of monitoring in both well installations. The phenols may be associated with hydrocarbons also observed in this borehole . The sample analysis results of speciated phenols were all below detection limits.

8.5.12 All PAH, VOCs, SVOCs and PCB results were found to be below the limit of detection.

8.5.13 Arsenic, chromium, manganese, selenium, mercury, sodium, sulphate, chloride and to lesser extent boron and iron were typically detected as exceeding DWS criteria. However, as the groundwater is saline and is not used for potable water supply, the exceedances are considered tolerable.

8.5.14 It is noted that the laboratory limit of detection for some metals, PAH compounds, VOCs and SVOCs are higher than those of their applied screening criterion.

8.5.15 Considering the thickness of cohesive superficial deposits beneath the Site (10 to 11 m), absence of obvious soil-groundwater contamination linkage and the sub-artesian pressure status of the aquifer, it is unlikely that the Site is a source of this contamination. These results are considered to represent the groundwater quality within the wider industrialised area of Newport.

Surface Water

8.5.16 A summary of the exceedances identified during the surface water quality screening assessment undertaken for the Site is presented in Table 21. This includes the results for the six monitoring locations identified in Table 5, situated on Lakes Reen and Julian's Reen.

8.5.17 The results of all sample locations are also presented in the baseline environment report (Appendix 16.2 of the ES).

Table 21: Summary Surface Water Screening Exceedances

Parameter	Unit	No. Analyses	No. Analyses Above LOD	Minimum Concentration	Maximum Concentration	Location & Round with Max. Concentration	EQS	No. Analyses Exceeding EQS	DWS	No. Analyses Exceeding DWS	CCW Trigger Level	No. Analyses Exceeding CCW Trigger Level
Lead	ug/l	8	2	9	25	R8 / E3	1.2	2	10	1	250	0
Cadmium	ug/l	8	3	0.5	2.7	R9 / E3	0.15	3	5	0	5	0
Zinc	ug/l	8	8	19	260	R9 / E4	75	1	-	-	1,000	0
BOD	mg/l	12	11	0	28	R9 / E4	5	3	-	-	18	1
Sulphate	mg/l	12	11	14	109	R9 / E4	400	0				
Phosphorus	mg/l	3	3	520	696	13.2 / Q1	120	3	-	-	-	-
Dissolved Oxygen	%	8	8	3.5	78.7	R9 / E2	60	1	-	-	-	-
Nitrate as NO_3	mg/l	12	7	0.609	3.54	R9 / E2	-	-	50	0	1	6
Phosphate	mg/l	8	8	0.2	2.1	R8 / E3	-	-	-	-	1	2

8.5.19 The water quality within Julian's Reen or Lakes Reen is generally good with only the occasional occurrence of certain parameters above their respective EQS. The observed results for BOD and phosphorous have on occasions exceeded the limits for Good water status under the Water Framework Directive (WFD).

8.5.20 TPH, BTEX compounds, PAHs and VOCs were analysed in the surface water samples taken from four locations in 2015 (Q1 location) and TPH was measured in samples taken on four occasions from two locations in 2007/2008. With the exception of a single occurrence of long-chain hydrocarbons (C21-C40) no organic contaminants were identified in the surface water samples from Julian's Reen or Lakes Reen.

8.5.21 No obvious link between contaminants identified in soils and groundwater on the Site and the water quality observed in adjacent surface water bodies has been established.

8.6 Ground Gas Risk Assessment

8.6.1 The only ground gas data available for the Site relate to borehole BH505 which has a response zone within the Glaciofluvial Deposits at a depth of between 12.5 m bGL and 15 m bGL. No data are available within the shallow Tidal Flat Deposits which are shown to have a high organic content in the form of peat. Of the four monitoring rounds available the following comments can be made.

- No monitoring was undertaken during low barometric pressure (less than 1000 mb), with the lowest conditions being 1014 mb. As such worst case atmospheric conditions for potential ground gas generation may have not been monitored.
- Gas flow was generally recorded as absent or negative, with a peak flow of 0.8 l/hr during the second monitoring round.
- Methane has been recorded up to 0.3 % in the third monitoring round, 2.2 % on the fourth monitoring round and absent for the first two monitoring rounds. The concentrations during the fourth monitoring round are above the initial screening criteria of 1 %. The Lower Explosion Limit of up to 50.6 % is consistent with these results.
- Carbon dioxide is identified in all monitoring rounds except the first, at up to 3.6 %. These concentrations are below the screening criteria of 5 %.
- Traces of Volatile Organic Compounds of up to 4.5 ppm have been recorded.
- Hydrogen sulphide was not detected throughout the monitoring.
- Carbon monoxide was recorded as absent except during the third monitoring round where it was identified up to 1 ppm, which is below the screening criteria.
- Oxygen has been recorded to be at ambient concentrations of between 18.6 - 20.4 %.

8.6.2 The available data do identify the presence of low methane concentrations which may be associated with organic material within the Glaciofluvial Deposits. This is consistent with other soil gas regimes proven in similar ground conditions.

8.6.3 Negative flows of up to -9.1 l/hr recorded during one monitoring round may be considered the result of a pressure gradient existing between the atmosphere and ground. A negative differential pressure of -0.65 was recorded during this monitoring round.

8.6.4 A gas risk assessment has been undertaken and is set out in the Land Contamination Assessment Report (Appendix 11.1 of the ES).

8.6.5 However, no data are available within the Made Ground and Tidal Flat Deposits. Further assessment of the gas regime at the site will be required to confirm associated risks.

8.7 Summary

8.7.1 Made Ground and natural soils have been shown to have elevated chromium concentrations. The majority of the results are considered to be within normal background data range (<95 mg/kg) and therefore are not considered to represent a contaminant of concern. Two locations exceed this background range with maximum of up to 214 mg/kg. Further speciation may confirm chromium relates to a lesser toxic form.

8.7.2 Discrete areas of elevated PAH that would cause a potential risk to human health have been identified within the Made Ground, although the lack of compound speciation within the analytical data required the use of conservative screening criteria.

8.7.3 Very limited leachability has been identified from the Made Ground with a marginal exceedance limited to copper on a single sample.

8.7.4 The aquifer has been identified to have elevated metals and inorganics contaminants when compared to the Environment Quality Standards or the Drinking Water Standards.

8.7.5 Elevated, albeit inconsistent levels ofTPH, and to a lesser degree phenols, were identified in both installations within BH505. However no visual evidence of contamination was identified during drilling nor were elevated TPH concentrations above laboratory detection limits identified in soil samples from this borehole. This indicates that the contamination observed is the result of a contamination source elsewhere that has migrated to the vicinity of BH505. . Generation of vapours is considered minimal given the heavier end nature of the hydrocarbons encountered. BH505 is outside of the permanent and temporary land take and thus should not be affected by the Scheme.

8.7.6 The lack of a plausible contamination linkage between the soil and groundwater data is noted. This together with the ground and groundwater conditions encountered at the Site would indicate the quality of the aquifer observed beneath the former Llanwern Research Laboratories may be impacted by off site source(s).

8.7.7 In general, there is no evidence of impact on surface water quality from contaminants of concern associated with Site soils. Furthermore, site soils have recorded low levels of contaminant leachability.

8.7.8 The use of band drains may allow the potential migration of contaminants in the Glaciofluvial Deposits and Mercia Mudstone Group aquifer into the surface water

courses if not controlled. The surface water, whilst impacted by cadmium, lead and zinc is observed to be at a better quality than the groundwater.

9 Refined Conceptual Site Model

9.1.1 The incorporation of data from the 2015 Supplementary Ground Investigation has enabled the original CSM presented in the 2014 PSSR to be updated. The assessment is based on the Scheme during construction and operation phases.

9.1.2 A CSM representing general ground conditions, overall Scheme layout and relevant source-pathway-receptors (each of which having a specific alpha-numerical symbol attached) are presented in Figure 2 and is described in Table 22.

Table 22: Conceptual Site Model

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
On Site The Made Ground, formerly used as a development platform for the buildings on Site (comprising ash, slag and demolition rubble).	**Construction**					
	Construction Workers (B)	Direct dermal (1)	Likely	Low	Low	Construction workers will possibly be exposed to Made Ground materials during site construction works; however exposure duration will be short term only. Prior to construction, a specific risk assessment will be required in line with CDM and health and safety legislation. This will enable safe methods of work and an appropriate level of PPE to be put in place. As such all risks will be duly considered and suitably mitigated to protect construction workers. Current data set identify limited exceedances of the selected screening criteria. The contamination status is not foreseen to represent abnormal constraints to construction workers' health and safety over and above those typical of a brownfield site. Absence of ground gas data from Made Ground formation. Additional monitoring data may be considered. No putrescible material identified within the Made
		Ingestion (3)	Likely	Low	Low	
		Inhalation of soil dust (2)	Likely	Low	Low	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of soil gas or vapours (2)	Likely	Low	Low	Ground. Significant abnormal gas regime not anticipated. Low concentration of VOCs and SVOCs recorded. Surcharge of superficial soils may temporarily increase gas flux. Made Ground generally granular and may represent a possible pathway for vertical and lateral migration. Construction to be largely within open space. Any earthworks within confined space would require specific risk assessment, control measures and appropriate PPE. A gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks.
	Off site users during construction works (C)	Dermal contact with dust (1)	Unlikely	Low	Very low	During construction there is the possibility of dermal contact and inhalation of soil dust, short term exposure only. Dust suppression measures are recommended during construction works. Off site receptors some 40 m from proposed earthworks. Screening criteria considered conservative when considering exposure and pathway mechanisms Absence of ground gas data from Made Ground formation. Additional monitoring data may be considered. No putrescible material identified within the Made
		Ingestion of dust (3)	Unlikely	Low	Very low	
		Inhalation of soil dust (2)	Unlikely	Low	Very low	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of soil gas or vapours (2)	Unlikely	Low	Very low	Ground. Significant abnormal gas regime not anticipated. Low concentration of VOCs and SVOCs recorded. Surcharge of superficial soils may temporarily increase gas flux. Made Ground generally granular and may represent a possible pathway for vertical and lateral migration.Construction Workers above. Limited potential for lateral gas migration given the presence of low permeability Tidal Flat Deposits to shallow depth. New pathways could be created with band drains A gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks.
	Groundwater - Aquifer (Da) from the Glaciofluvial Deposits and/or Mercia Mudstone Group	Leaching/migration (4) if contaminant in the Made Ground	Likely	Moderate	Moderate	Aquifer quality shown to be impacted by metal, inorganic and organic contaminants. Aquifer identified to be saline and therefore unlikely to be used as a potable water supply. No evidence of soil-groundwater contaminant linkage. Low leaching potential identified from soil materials. Increased vertical pathways between possible contaminant and receptor with construction of band drains. Hydrostatic pressures shown to be below or at base of the Made Ground. Possible increase in risk of Made Ground to become saturated during surcharging. Organic groundwater contamination in BH505 is inconsistent and the source is unknown. BH505 will not be affected by the Scheme.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
The Made Ground, formerly used as a development platform for the buildings on Site (comprising ash, slag and demolition rubble).	Surface water (land drainage) (E)	Saturated flow within perched groundwater (4)	Likely	Moderate	Moderate	Perched (shallow) groundwater is likely to be intercepted by the land drainage. The quality of perched groundwater may become impacted by contamination during the construction works, particularly in the area of excavation (new drains). Increase in water flux and leachate from Made Ground during surcharge loading via the band drains. Perched groundwater is likely to have low flow and may be absent seasonally. Further perched water quality testing within the Tidal Flat Deposits and possible perched water within the Made Ground is required to assess the risks.
		Surface water run-off (5)	Likely	Moderate	Moderate	Surface water run-off may deteriorate the quality of surface water. Construction process to adopt surface water control and management. Low leaching potential identified from soil materials.
Redundant Benzene Pipeline	Construction Workers (B)	Direct dermal (1)	Likely	Moderate	Moderate	No information in relation to the benzene pipeline. Works likely to intersect the redundant line at the junction with Meadow Road. Pipeline anticipated to be within the TFDs, of low permeability. Contamination through leakage, if present, is anticipated to be contained and localised. Prior to construction, a specific risk assessment will

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Ingestion (3)	Likely	Moderate	Moderate	be required in line with health and safety legislation. This will enable safe methods of work and appropriate level of PPE to be put in place. As such all risks will be duly considered and suitably mitigated to protect construction workers. Possible presence of elevated benzene would represent abnormal constraints to construction workers health and safety over and above those typical of a brownfield site. Appropriate decommissioning works will be necessary to remove risk in advance of normal highway construction works. A gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks.
		Inhalation of soil dust (2)	Likely	Moderate	Moderate	
		Inhalation of vapours (2)	Likely	High	High	
	Off site users during construction works (C)	Dermal contact with dust (1)	Low likelihood	Moderate	Moderate to low	During the construction period there is the possibility of inhalation/ingestion of soil dust and vapours. Dust and vapour suppression measures will be required during construction works. Benzene contamination, if present, is anticipated to be localised. Adjacent off site receptors present associated with industrial activities. No soil gas data available for the Site. Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks.
		Ingestion of dust (3)	Low likelihood	Moderate	Moderate to low	
		Inhalation of soil dust (2)	Low likelihood	Moderate	Moderate to low	
		Inhalation of vapours (2)	Likely	High	High	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Groundwater - Aquifer (Da) from the Glaciofluvial Deposits and/or Mercia Mudstone Group	Leaching/migration (4) if contaminant in the Made Ground	Low	Moderate	Moderate to low	Thick mantle of predominantly soft low permeability Tidal Flat Deposits overlying the Aquifer, reducing risk of downward migration. Increased vertical pathways between possible contaminant and receptor with construction of band drains. Groundwater quality impacted by metal and inorganic contaminants of concern and saline. Therefore aquifer unlikely to be used as a potable water supply. Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks to controlled waters.
	Surface water (land drainage) (E)	Saturated flow within perched groundwater (4)	Low likelihood	High	Moderate	Area potentially impacted by benzene contamination likely to be limited. Perched groundwater is likely to have low flow and may be absent seasonally. Application of appropriate surface water run-off control measures during the works is considered sufficient to break this pollution linkage. Further ground investigation and groundwater sampling and monitoring are required.
		Surface water run-off (5)	Low likelihood	High	Moderate	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Groundwater – Aquifer from the Glaciofluvial Deposits and/or Mercia Mudstone	Surface water (land drainage) (E)	Band drain (4)	Likely	Moderate	Moderate	Aquifer quality shown to be impacted by metal, inorganic and organic contaminants. Hydrostatic pressure of the Aquifer potentially near base of Made Ground and land drainage. Band drains will create vertical pathways connecting aquifer with land drains. Surface waters are of better quality than the groundwater. Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks. Organic groundwater contamination in BH505 is inconsistent and the source is unknown. BH505 will not be affected by the Scheme.
Peat	Construction Workers (B)	Inhalation of soil gas/explosion (2)	Low likelihood	High	Moderate	No soil gas data available to characterise gas regime from peat deposits. Peat likely to be associated with high methane concentration but with low or absent flux. Peat overlain by low permeability cohesive soils. Flux likely to increase during surcharge loading. New pathways to be created with band drain. Construction to be largely within open space. Any earthworks within confined space would require specific risk assessment, control measures and PPE. A gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks. Band drain installations could result in explosive risks during operations and risk assessment and gas mitigation controls will be needed.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Off site users during construction works (C)	Inhalation of soil gas/explosion (2)	Unlikely	High	Moderate to low	Off site receptors some 40 m from proposed earthworks. No soil gas data available to characterise gas regime from peat deposits. Peat likely to be associated with high methane concentration but with low or absent flux. Peat overlain by low permeability cohesive soils. Flux likely to increase during surcharge loading. New pathways to be created with band drain. Limited potential for lateral gas migration given the presence of low permeability Tidal Flat Deposits to shallow depth.
On Site The Made Ground, formerly used as a development platform for the	Operational					
	Maintenance Workers (B)	Direct dermal (1)	Unlikely	Low	Very low	Made Ground to be largely encapsulated by the embankment and therefore the exposure to contamination will be limited outside the motorway embankment. Areas outside the motorway hardstanding are likely
		Ingestion (3)	Unlikely	Low	Very low	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
buildings on Site (comprising ash, slag and demolition rubble).		Inhalation of soil dust (2)	Unlikely	Low	Very low	to receive topsoil cover and vegetation establishment, reducing potential of exposure. Exposure duration will be short term only. Site specific risk assessment will be required in line with health and safety guidance. This will enable safe methodology and an appropriate level of PPE to be put in place. As such all risks will be duly considered and suitably mitigated. Current data set identify limited exceedances of the selected screening criteria. Current contamination status is not foreseen to represent abnormal constraints to maintenance workers' health & safety over and above those typical of a brownfield site.
		Inhalation of soil gas or vapours (2)	Unlikely	Low	Very low	Absence of ground gas data from Made Ground formation. Additional monitoring data may be considered. No putrescible material identified within the Made Ground. Significant abnormal gas regime not anticipated. Low concentration of VOCs and SVOCs recorded. Surcharge of superficial soils completed and gas flux likely to have stabilised. Made ground generally granular and may represent a possible pathway for vertical and lateral migration. New pathways to be created with band drain. Construction to be largely within open space. Any earthworks within confined space would require specific risk assessment, control measures and PPE. A gap in the data has been identified and further
	Future Motorway users (A) & Off site users	Dermal contact (1)	Unlikely	Low	Very low	Made Ground to be largely encapsulated by the embankment and therefore exposure to contamination will be limited outside the motorway corridor. Exposure duration will be short term only

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	(C)	Ingestion (3)	Unlikely	Low	Very low	for Motorway users. Off site receptors some 40 m from proposed earthworks. Absence of ground gas data from Made Ground formation. Additional monitoring data may be considered. No putrescible material identified within the Made Ground. Significant abnormal gas regime not anticipated. Low concentration of VOCs and SVOCs recorded. Surcharge of superficial soils completed and gas flux likely to have stabilised. Made ground generally granular and may represent a possible pathway for vertical and lateral migration. New pathways to be created with band drain. Limited potential for lateral gas migration given the presence of low permeability Tidal Flat Deposits to shallow depth. Screening criteria considered conservative when considering exposure and pathway mechanisms.
		Inhalation of soil dust (2)	Unlikely	Low	Very low	
		Inhalation of soil gas or vapours (2)	Unlikely	Low	Very low	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Groundwater - Aquifer (Da) from the Glaciofluvial Deposits and/or Mercia Mudstone Group	Leaching/migration (4) if contamination in Made Ground	Low likelihood	Moderate	Moderate to low	Aquifer quality shown to be impacted by metal, inorganic and organic contaminants. Aquifer identified to have saline intrusion and therefore unlikely to be used as a potable water supply. During the operational phase, the embankment will cover part of the Site which will limit the infiltration of rainwater through the soils and thus potential leaching of soil contaminants into the groundwater. However, perched groundwater may be within the infill materials and could remain beneath the embankment. No evidence of soil-groundwater contaminant linkage. Low leaching potential identified from soil materials. Increased vertical pathways between possible contaminant and receptor with construction of band drains. Hydrostatic pressures shown to be below or at base of the Made Ground. Possible increase in risk of Made Ground to become saturated. Organic groundwater contamination in BH505 is inconsistent and the source is unknown. BH505 will not be affected by the Scheme. Further investigations are required to delineate any potential contamination and confirm the risks. A foundations works risk assessment is required to confirm the absence of risk to controlled waters.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
The Made Ground, formerly used as a development platform for the buildings on Site (comprising ash, slag and demolition rubble).	Surface water (land drainage) (E)	Saturated flow within perched groundwater (4)	Low likelihood	Moderate	Moderate to low	Ephemeral perched (shallow) groundwater is likely to be intercepted by the land drainage. Surface waters are of better quality than the groundwater. Hardstanding will reduce infiltration and thus reduce leaching potential. Further investigations are required to delineate any potential contamination and confirm the risks. A foundations works risk assessment is required to confirm the absence of risk to controlled waters.
		Surface water run-off (5)	Unlikely	Moderate	Low	Surface water run-off to be captured by designed drainage system collecting into purpose built water storage area and reedbed system.
Groundwater - Aquifer from the Glaciofluvial Deposits and/or Mercia Mudstone Group	Surface water (land drainage) (E)	Band drain (4)	Likely	Moderate	Moderate	Aquifer quality shown to be impacted by metal, inorganic and organic contaminants. Hydrostatic pressure of the Aquifer potentially near base of land drainage. Band drains to create vertical pathways connecting aquifer with land drains. Surface waters are of better quality than the groundwater. Organic groundwater contamination in BH505 is inconsistent and the source is unknown. BH505 will not be affected by the Scheme

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Peat	Maintenance Workers (B)	Inhalation of soil gas / explosion (2)	Unlikely	High	Moderate to low	No soil gas data available to characterise gas regime from peat deposits. Peat likely to be associated with high methane concentration but with low or absent flux. Peat overlain by low permeability cohesive soils. Flux likely to have stabilised now surcharge loading completed. New pathways to be created with band drain. Maintenance works to be largely within open space. Any works within confined space would require specific risk assessment, control measures and PPE.
	Motorway users (A) / Off site users (C)	Inhalation of soil gas / explosion (2)	Unlikely	High	Moderate to low	Ground gas data – comments as above. Limited potential for lateral gas migration given the presence of low permeability Tidal Flat Deposits to shallow depth. Off site receptors some 40 m from proposed earthworks. Motorway to be built on raised embankment providing a further barrier to migration gases. Band drain installations could result in explosive risks during operations and risk assessment and gas mitigation measures will be needed.

10 Conclusions and Recommendations

10.1 Conclusions

10.1.1 Ground investigations have been undertaken at the Site to assess risks from land contamination associated with the construction and operation of the Scheme including human health and controlled waters risks.

10.1.2 Widespread gross contamination associated with the Site's historical use has not been identified. The risk assessment has identified that some residual risks to human health and controlled waters could exist and control measures are required to facilitate the construction and ongoing operation of the Scheme.

10.1.3 The laboratory testing results from previous ground investigations confirmed the on site observations and field testing and showed that the materials encountered within the Site are at tolerable levels of risk to human health. However, due to elevated chromium and total PAHs in soils being detected above a conservative screening assessment in natural and Made Ground soils, verification sampling and analysis for hexavalent chromium and speciated PAHs is recommended during operational phases.

10.1.4 During the construction phase, specific mitigation measures will be required to prevent inhalation pathways of dust to the general public off site and construction workers, although such measures would be no more than typically expected in a construction site. Suitable water management strategy will also be required to prevent potential impact to surface waters from contaminant run-off.

10.1.5 Any soil arisings are considered likely to be suitable for reuse within the Scheme subject to development of a remediation strategy including reuse criteria and adoption of a Material Management Plan.

10.1.6 During the operational phase, the embankment will cover part of the Site which will limit the infiltration of rainwater through the soils and potential leaching of any soil contaminants into the groundwater. However, perched groundwater may be within the Made Ground materials and could remain beneath the embankment.

10.1.7 Adoption of band drains may provide new pathways which may lead to groundwater within the Tidal Flat Deposits and possibly any water bodies within the Made Ground entering the currently confined aquifer within the Glaciofluvial and Mercia Mudstone Group. Control measures may be needed to mitigate risk of contamination in soils (if present) migrating along band drains.

10.1.8 The deep aquifer is identified to be impacted with metals, organic and inorganic contaminants which may reduce surface water quality if the band drain pathways allow direct or indirect linkage. Organic groundwater contamination in BH505 is inconsistent and the source is unknown, however, BH505 will not be affected by the Scheme and thus remediation is not required other than ensuring a discovery strategy is adopted during construction in the unlikely event that the source of the contamination is encountered within the land take.

10.1.9 Further consideration and a foundation risk assessment will be undertaken to mitigate the potential impact of the band drains to allow specific mitigation measures to be implemented.

10.1.10 Post construction, the embankment itself and topsoil and subsoil cover along the motorway corridor will break potential human health pathways to end users and maintenance workers. However, placed topsoil materials will need to be checked for contamination.

10.1.11 Water quality within the Made Ground and quality of the perched groundwater is currently unknown. Therefore further investigations and risk assessments are required to confirm the risks.

10.1.12 Surface water quality recorded in the two nearest reens to the Site is generally of good quality with typically low concentrations of metals. In general, there is no evidence of impact on surface water quality from contaminants of concern associated with Site soils. Furthermore, site soils have recorded low levels of contaminant leachability.

10.1.13 There is limited analytical data specific to the land of the former Llanwern Research Laboratories Site which falls within the footprint of the motorway corridor and link road. Details of the former benzene pipeline and its potential impact to soils and controlled waters are also not known.

10.2 Recommendations

10.2.1 Given the identified gap in the data and in order to confirm the low to moderate risks associated with the Site in relation to both construction and operational phases, an additional scope of ground investigation works is required. Upon completion this report shall be reviewed and updated accordingly once the findings of the additional investigation are made available. The additional investigation will include:

- trial pitting and borehole drilling to collect soil samples;
- installation of groundwater monitoring wells in boreholes;
- collection of groundwater samples; and
- gas monitoring.

10.2.2 The investigation should target:

- Site coverage to include permanent and temporary land take;
- benzene pipeline;
- shallow perched water within Made Ground to determine if contaminated; and
- perched groundwater to determine if contaminated.

10.2.3 Upon review and assessment of the additional ground investigation information, any contamination identified that could cause an unacceptable risk to the identified receptors will require appropriate remedial mitigation measures to be implemented. These measures would be identified within a remedial strategy for the Scheme. The remediation strategy is anticipated to include, but is not limited to the following.

- Addressing uncertain human health risk and controlled waters risk identified by the proposed additional ground investigation.

- Detailed risk assessment of band drains that may create pathways enabling contaminants to enter surface water courses.
- Monitoring and detailed risk assessment of perched groundwater.
- Dealing with unexpected contamination.
- Verification sampling to confirm suitability of soils for reuse.
- Control measures to prevent risks to construction workers and the general public during construction.
- Verification of imported topsoils for suitability of use.

10.2.4 The remediation strategy should include a remediation options appraisal, remediation implementation plan and remediation verification plan. The remediation strategy should be supported by a Scheme wide Material Management Plan prepared in accordance with CL:AIRE Code of Practice (CL:AIRE).

11 References

Bactec (2014) Explosive Ordnance Threat Assessment in respect of M4 Corridor around Newport for Hyder Consulting (UK) Limited, 5750TA

CL:AIRE (2011) Definition of Waste. Development Industry Code of Practice, Version 2, March 2011, ISBN 978-1-905046-23-2

Environment Agency (2001) Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention. NC/99/73

Environment Agency (2002) Piling into contaminated sites. National Groundwater and Contaminated Land Centre, February 2002

Geotechnical Engineering Limited (2015) M4 Corridor Around Newport, Factual Report on Ground Investigation, 30238

Highways Agency (2008) Design Manual for Roads and Bridges. Vol. 4. Geotechnics and Drainage. Section 1. Earthworks; Part 2. HD22/08. Managing Geotechnical Risk

Ove Arup & Partners (2014) M4 Corridor Around Newport, Preliminary Sources Study Report, 14/9197

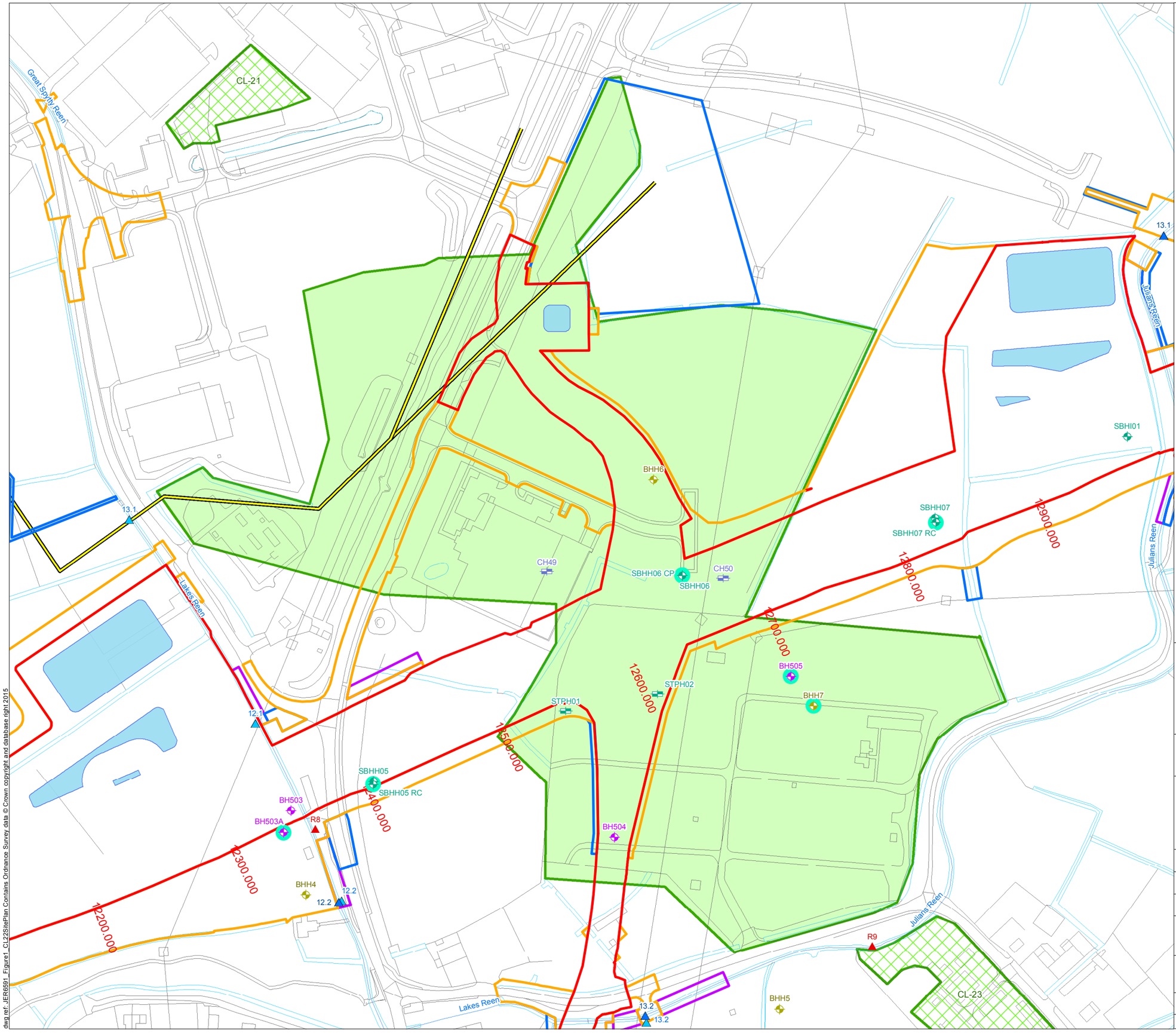
Titan Environmental Surveys Ltd (2008) New M4 Magor to Castleton Baseline Surface Water Quality Final Report for Arup, Report Number HS0442/F1/2

12 Glossary

BF	Blast Furnace
BGS	British Geological Survey
BOD	Biochemical Oxygen Demand
BOS	Basic Oxygen Slag
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CAT	Cable Avoidance Tool
CDM	Construction Design Management
CH_4	Methane
CLEA	Contaminated Land Exposure Assessment
CO_2	Carbon Dioxide
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CSM	Conceptual Site Model
DMRB	Design Manual for Roads and Bridges
DO	Dissolved Oxygen
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESG	Environmental Scientifics Group
EQS	Environmental Quality Standard
FTIR	Fourier Transform Infrared (spectroscopy)
GAC	Generic Assessment Criteria
GDR	Geotechnical Design Report
GIR	Ground Investigation Report
GRO	Gasoline Range Organics
LEL	Lower Explosive Limit
LOD	Limit of Detection
mAOD	Metres Above Ordnance Datum

mb	Millibars
mbGL	Metres below Ground Level
MTBE	Methyl Tert-butyl Ether
NRW	Natural Resources Wales
ORP	Oxidation Reduction Potential
O_2	Oxygen
OS	Ordnance Survey
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCSM	Preliminary Conceptual Site Model
PID	Photo Ionisation Detector
PPE	Personnel Protection Equipment
SGVs	Soil Guideline Values
SSAC	Site Specific Assessment Criteria
SSSI	Site of Special Scientific Interest
SVOCs	Semi-Volatile Organic Compounds
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
TPH CWG	Total Petroleum Hydrocarbon Criteria Working Group
UKAS	United Kingdom Accreditation Service
VOCs	Volatile Organic Compounds
WFD	Water Framework Directive
UXO	Unexploded Ordnance Survey

13 Figures



Legend

- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Other Permanent Land Take
- Temporary Construction Land
- Easement Only
- Proposed Water Treatment Area (WTA)
- Potential Area of Land Contamination based on 2014 PSSR
- Other Potential Area of Land Contamination
- Redundant Benzene Pipeline

Investigation Locations

2015 (RPS)

- Surface Water Monitoring Location - Q2
- Surface Water Monitoring Location - Q1

2015 (Geotechnical Engineering)

- Borehole

2008-2009 (Titan Surveys)

- Surface Water Monitoring Location

2007 (Norwest Holst)

- Borehole
- Trial Pit

2000 (Exploration Associates)

- Trial Pit

1997 (Norwest Holst)

- Borehole
- Monitoring Well Installation

Llywodraeth Cymru
Welsh Government

Appendix 11.1 Annex D CL-22

Site Plan for CL-22

Figure: 1	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Scale: A3 @ 1:2,500
0 40 80 m

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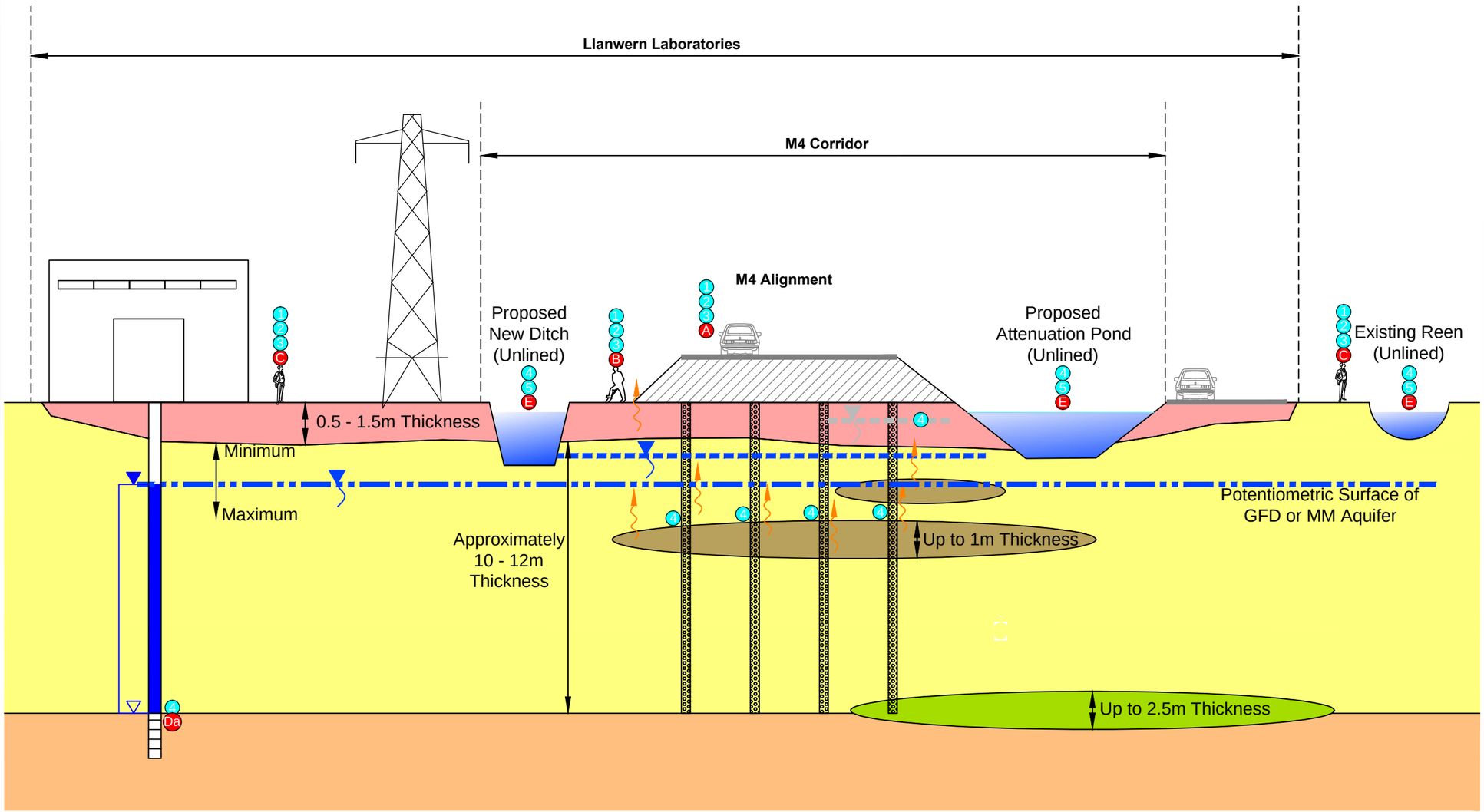
dwg ref: JER6591_Figure1_CL22SitePlan

dwg ref: JER6591_Figure1_CL22SitePlan Contains Ordnance Survey data © Crown copyright and database right 2015

CL- 22 Llanwern Laboratories



Ground conditions based on available information

Legend

- Made Ground - MG
- Tidal Flat Deposits (Predominantly Clay) - TFD
- Peat
- Glaciofluvial Deposits (Predominantly Sand & Gravel) - GFD
- Mercia Mudstone - MM
- Proposed Embankment
- Proposed Band Drain
- Perched Water (MG)
- Perched Groundwater (Top of TFD)
- Groundwater (GFD and MM)
- Water Strike
- Rest Water Level
- Gas Migration Pathway

Potential Receptors

- A Humans On-Site (M4 User)
- B Humans On-Site (Construction/Maintenance)
- C Humans Off-Site (Site Neighbours)
- Da Groundwater (Aquifer)
- E Surface Water

Potential Pathways

- 1 Dermal Contact
- 2 Inhalation
- 3 Ingestion
- 4 Leaching / Migration
- 5 Surface Run Off

Potential Sources of Contamination

Possible contamination present on site associated with :

On-Site

- Made Ground Associated with Former Land Use (Research Laboratories)
- Gas Emission from Peat & Made Ground
- Possible Perched Waterbody within the Made Ground
- Aquifer

Off-Site

No significant sources have been identified

NOTE
Drawing refined from PSSR Drawing Reference M4-OA-17-00DR-Z-XX-0148 (February 2014)

Llywodraeth Cymru
Welsh Government

Appendix 11.1 Annex D CL-22

Conceptual Site Model for CL-22

Figure: 2	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Not to Scale

dwg ref:JER6591_Figure2_CL22ConceptualSiteModel

dwg ref: JER6591_Figure2_CL22ConceptualSiteModel

14 Appendices

A1 Appendix 1

Exploratory Records

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Borehole No.
BHH6
Header

Contract No.	F10895	Method	Cable Percussion	Coordinates	334670.8 E 185488.1 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon	Ground Level	7.30m AOD
Client	Welsh Office	Driller	I.M	Orientation	Vertical
		Logged by	C.D	Date Started	28/10/1997
Consultant	Ove Arup and Partners			Date Completed	28/10/1997

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
28/10/1997	1800	14.55	14.00	6.25	

DRILLING DETAILS

Hardbore from depth	Hardbore to depth	Chiselling hours	Remarks
0.60	0.70	0.25	
13.80	14.55	2.00	

CASING

Hole diameter	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
150	14.55	150	14.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
28/10/1997	0000	12.45	7.90	15.0	fast	12.00	0.00

GENERAL NOTES

1. Borehole grouted to ground level.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
2.00	S	N=7 (1,2,1,1,2,3)
4.00	S	N=14 (1,2,4,3,3,4)
5.50	S	N=5 (1,1,0,2,1,2)
8.10	S	N=3 (1,0,1,0,1,1)
12.40	S	N=43 (7,8,10,10,11,12)
13.80	S	50/75mm (17,31,50)
14.40	S	76/150mm*

* Seating blows only.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	CP HEADER
Version	2.00
Revised	25/06/1997

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Borehole No.
BHH6
Sheet 1 of 2

Contract No.	F10895	Method	Cable Percussion	Coordinates	334670.8 E
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon		185488.1 N
		Driller	I.M	Ground Level	7.30m AOD
Client	Welsh Office	Logged by	C.D	Orientation	Vertical
				Date Started	28/10/1997
Consultant	Ove Arup and Partners			Date Completed	28/10/1997

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Black to brown clayey very sandy angular to sub-angular gravel size brick, clinker and ash fragments.				B	0.00 - 0.80				
		0.80	6.50	D	0.90				
Firm greyish brown mottled brown thinly laminated CLAY. (Estuarine Alluvium)				U	1.10 - 1.55	(10)			
				D	1.55				
---at 0.90m with occasional rootlets and occasional subangular gravel of sandstone and coal		1.85	5.45	D	1.85				
				D	2.00 - 2.45	S7	S	2.00 2.45	
Soft to firm grey occasional thinly laminated CLAY. (Estuarine Alluvium)				B	2.45 - 3.00				
				U	3.00 - 3.45	(6)			
				D	3.45				
---at 3.45m grey mottled greyish brown				D	3.70				
				B	4.00 - 4.60	S14	S	4.00 4.45	
---at 4.00m firm				D	4.00				
		4.60	2.70	D	4.70				
Soft blackish brown fibrous PEAT. (Peat)				U	4.80 - 5.25	(5)			
---at 4.70m with some gravel size pockets of soft grey clay		5.35	1.95	D	5.40				
				B	5.50 - 6.20	S5	S	5.50 5.95	
				D	5.50				
Soft grey organic CLAY with occasional to some fine to medium gravel size pockets of brownish black spongy and firm fibrous peat. (Estuarine Alluvium)		6.20	1.10	D	6.25				
				D	6.30				
				U	6.60 - 7.05	(7)			
Soft blackish brown fibrous occasionally slightly clayey PEAT. (Peat)		6.90	0.40	D	7.05				
Soft dark grey thinly laminated organic CLAY with occasional fine to medium gravel size pockets of brownish black firm fibrous peat. (Estuarine Alluvium)				D	7.50				
				W	7.90				
				W	7.90				
---from 8.10m soft occasionally thinly laminated silty				D	8.10	S3	S	8.10 8.55	
				B	8.55 - 9.00				
		9.20	-1.90	D	9.20				
CLAY - ST As Sheet 2				U	9.50 - 9.95	(2)			
				D	9.95				

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH CP LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Borehole No.
BHH6
Sheet 2 of 2

Contract No.	F10895	Method	Cable Percussion	Coordinates	334670.8 E
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon		185488.1 N
		Driller	I.M	Ground Level	7.30m AOD
Client	Welsh Office	Logged by	C.D	Orientation	Vertical
				Date Started	28/10/1997
Consultant	Ove Arup and Partners			Date Completed	28/10/1997

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Soft grey very silty CLAY with very occasionally fine to medium gravel size pockets of brownish black firm fibrous peat. (Estuarine Alluvium)				D	10.50				
---from 10.50m very silty and fine sandy		11.00	-3.70	D	11.00				
				U	11.20 - 11.65	(40)			
Reddish brown mottled greyish green occasionally thinly laminated moderately to highly weathered MUDSTONE, very weak to weak. (Mercia Mudstone Group)				D	11.65				
				D	12.00				
				D	12.40	S43	S	12.40 12.85	
				B	12.85 - 13.70				
				D	13.80	S50/75mm	S	13.80 14.03	
---from 13.80m highly weathered moderately weak to moderately strong									
---from 14.40m sandy		14.55	-7.25	D	14.40	S76/150mm*	S	14.40 14.55	
Cable Percussion boring complete at 14.55 m.									

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH CP LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHH7
Header

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	334780.0 E 185334.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Edeco	Ground Level	7.02m AOD
Client	Welsh Office	Drillers	A.M/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	28/10/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	13/11/1997
		Core bit	P.C.D		

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
28/10/1997	1800	8.10	8.00	Dry	
29/10/1997	0800	8.10	8.00	Dry	
29/10/1997	1800	14.35	13.60	8.40	
10/11/1997	1800	15.75	15.00	4.30	
11/11/1997	0800	15.75	15.00	3.80	
11/11/1997	1800	19.30	18.00	5.60	
12/11/1997	0800	19.30	18.00	4.10	
12/11/1997	1800	25.70	21.50	12.00	
13/11/1997	0800	25.70	21.50	4.10	
13/11/1997	1800	35.50	21.50	4.20	

CABLE PERCUSSION DETAILS

Hard strata from depth	Hard strata to depth	Hours	Remarks
0.90	1.25	0.50	
13.85	14.10	1.00	

CASING

Hole diameter	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
150	14.35	150	13.60
120	35.50	140	21.50

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
29/10/1997	0000	13.85	8.40	15	fast	0.00	0.00

ROTARY DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
14.35	15.75	mist	good	92
15.75	19.30	foam	moderate	92
19.30	35.50	foam	good	92

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
0.80	S	69/150mm (2,7,19,50)
2.60	S	N=10 (1,2,3,2,2,3)
5.55	S	N=6 (1,1,2,1,1,2)
7.50	S	N=4 (1,1,1,1,1,1)
10.50	S	N=3 (0,1,1,0,1,1)
13.00	S	N=56 (5,7,10,12,16,18)
14.10	S	50/75mm (27,33,50)
15.75	S	112/235mm (4,6,14,19,29,50)
17.50	S	N=99 (8,8,12,16,29,42)
18.80	S	N=86 (6,8,12,20,23,31)
24.50	S	50/30mm (8,26,50)

* Seating blows only.

GENERAL NOTES

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, hard strata time in hours

Form	COMBINED HEADER
Version	2.00
Revised	26/06/1997

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHH7
Sheet 1 of 4

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	334780.0 E 185334.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Edeco	Ground Level	7.02 m AOD
Client	Welsh Office	Drillers	A.M/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	28/10/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	13/11/1997
		Core Bit	P.C.D		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring			Blow count to drive UI100	SPT N & depth		Install-ation
MADE GROUND: Dark greyish brown fine sandy clay with much sub-angular gravel of brick, concrete and coal rubble.				B	0.00	- 0.80				
				D	0.80	- 1.00		S69/150mm	0.80 1.10	
		1.35	5.67	D	1.40					
Soft to firm grey occasionally thinly laminated CLAY. (Estuarine Alluvium)				U	1.50	- 1.95	(12)			
---at 1.40m dark grey to greenish brown				D	1.95					
---from 1.95 to 3.05m grey mottled greyish brown				B D	2.60 2.60	- 3.50		S10	2.60 3.05	
---at 3.60m occasionally organic				D U	3.60 3.65	- 4.10	(11)			
---from 4.10m greyish brown with occasional fine to medium gravel size pockets of blackish brown spongy to firm fibrous peat				D	4.10					
		4.40	2.62	U	4.50	- 4.95	(5)			
Spongy to firm blackish brown fibrous PEAT. (Estuarine Alluvium)		4.95	2.07	D	4.95					
Soft dark grey occasionally thinly laminated organic CLAY with occasional fine to medium gravel size pockets of brownish black spongy to firm fibrous peat. (Estuarine Alluvium)				B D	5.55 5.55	- 6.20		S6	5.55 6.00	
---at 6.40m with much blackish brown firm fibrous peat				D U	6.40 6.50	- 6.95	(7)			
				D	6.95					
---from 7.50m very silty				B D	7.50 7.50	- 8.10		S4	7.50 7.95	
				D	8.80					
---at 9.00m stiff				U	9.00	- 9.45	(6)			
				D	9.45					

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHH7
Sheet 2 of 4

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	334780.0 E 185334.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Edeco	Ground Level	7.02 m AOD
Client	Welsh Office	Drillers	A.M/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	28/10/1997
Consultant	Ove Arup and Partners	Core Barrel	P	Date Completed	13/11/1997
		Core Bit	P.C.D		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Soft dark grey occasionally thinly laminated organic CLAY with occasional fine to medium gravel size pockets of brownish black spongy to firm fibrous peat. (Estuarine Alluvium)				D 10.30 B 10.50 - 11.10 D 10.50		S3 10.50 10.95	
---from 10.50m very soft							
---from 11.80m fine sandy				U 11.70 - 12.15 D 11.80	(10)		
		12.20	-5.18	B 12.15 - 12.60			
Grey slightly sandy clayey sub-angular and sub-rounded GRAVEL and COBBLES of sandstone and mudstone. (Fluvial Alluvium)		12.60	-5.58				
Reddish brown mottled greyish green occasionally thinly laminated completely weathered silty MUDSTONE, very weak to weak. (Mercia Mudstone Group)				D 13.00		S56 13.00 13.45	
				W 13.85			
				D 14.10		S50/75mm 14.10 14.33	
---from 14.35 to 15.75m no recovery				14.35 - 15.75 (TCR 0, SCR 0, RQD 0, FI NA)			
		15.75	-8.73			S112/235mm 15.75 16.14	
Reddish brown thinly bedded highly weathered silty MUDSTONE, weak completely fractured. (Mercia Mudstone Group)				15.75 - 16.30 (TCR 82, SCR 18, RQD 0, FI NI, 1, NA)			
---from 16.10 to 16.20m with very closely horizontal discontinuities planar rough tight				16.30 - 16.50 (TCR 45, SCR 0, RQD 0, FI NI, NA)			
				16.50 - 17.50 (TCR 0, SCR 0, RQD 0, FI NA)		S99 17.50 17.95	
---from 17.75m occasionally mottled green				17.50 - 17.80 (TCR 0, SCR 0, RQD 0, FI NA)			
---from 18.15 to 18.27m with very closely spaced horizontal discontinuities planar rough tight				17.80 - 18.80 (TCR 60, SCR 13, RQD 0, FI NI, 1, NI, NA)		S86 18.80 19.25	
---from 19.30m sandy				18.80 - 19.30 (TCR 0, SCR 0, RQD 0, FI NA)			
		19.65	-12.63	19.30 - 20.30 (TCR 100, SCR 34, RQD 14, FI NI, 1)			

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	2.00
Revised	19/12/1996

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHH7
Sheet 3 of 4

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	334780.0 E 185334.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Edeco	Ground Level	7.02 m AOD
Client	Welsh Office	Driller	A.M/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	28/10/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	13/11/1997
		Core bit	P.C.D		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown thinly bedded moderately weathered silty MUDSTONE, moderately weak with medium spaced very thin beds of green slightly to moderately weathered very silty mudstone moderately weak to moderately strong with closely spaced horizontal discontinuities planar rough tight. (Mercia Mudstone Group) ---from 20.30 to 20.90m highly weathered weak completely fractured		21.60	-14.58	20.30 - 21.60	98	41	25	NI 1 NI 7		
Reddish brown thinly to medium sub-horizontally bedded slightly weathered silty MUDSTONE, moderately strong with very closely to closely spaced sub-horizontal discontinuities planar, rough, tight. (Mercia Mudstone Group)		23.00	-15.98	21.60 - 23.00	91	79	36	10		
Reddish brown medium horizontally bedded highly weathered silty MUDSTONE, very weak completely fractured. (Mercia Mudstone Group)		25.10	-18.08	23.00 - 24.50	45	0	0	NI NA	S50/30mm 24.50 24.68	
				24.50 - 25.70	40	4	0	NI		
Reddish brown medium bedded moderately to highly weathered silty MUDSTONE, weak to moderately weak completely fractured. (Mercia Mudstone Group)		25.60	-18.58							
Reddish brown very thinly to thinly horizontal to sub-horizontally bedded slightly weathered silty MUDSTONE, moderately strong with widely spaced very thin to thin beds of green very silty mudstone and closely to medium spaced horizontal to sub-horizontal fractures planar rough tight. (Mercia Mudstone Group) ---from 27.30 to 27.45m moderately to highly weathered moderately weak completely fractured ---from 27.90 to 27.10m completely fractured ---from 28.10 to 28.40m sub-vertical fracture (075°) planar rough tight ---from 29.50 to 29.75m sub-vertical fracture (065°) planar rough tight				25.70 - 26.70	90	80	37	8		
				26.70 - 28.10	96	54	27	14 NI		
				28.10 - 29.50	96	82	41	9		
								2 NI		

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Borehole No.
BHH7

Contract No.	F10895	Method	Cable Percussion & Rotary Coring	Coordinates	334780.0 E 185334.0 N
Project	M4 Relief Road Magor to Castleton Stage 2	Drilling Rig	Pilcon/Edeco	Ground Level	7.02 m AOD
Client	Welsh Office	Driller	A.M/J.M	Orientation	Vertical
		Logged by	C.D/T.R	Date Started	28/10/1997
Consultant	Ove Arup and Partners	Core barrel	P	Date Completed	13/11/1997
		Core bit	P.C.D		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	TCR	SCR	RQD	FI	SPT N & depth	Install-ation
Reddish brown very thinly to thinly horizontal to sub-horizontally bedded slightly weathered silty MUDSTONE, moderately strong with widely spaced very thin to thin beds of green very silty mudstone and closely to medium spaced horizontal to sub-horizontal fractures planar rough tight. (Mercia Mudstone Group)		31.55	-24.53	29.50 - 31.00	91	60	23	2 NI 0 NI 2		
Reddish brown thinly to medium bedded highly weathered silty MUDSTONE, weak completely fractured. (Mercia Mudstone Group) ---from 31.95 to 32.50m with very closely spaced very thin to thin beds of green moderately to highly weathered silty mudstone		33.80	-26.78	31.00 - 32.50	93	75	27	5 NI 5 2 NI		
				32.50 - 34.00	100	21	15	NI 0 0		
Light green medium to thickly horizontal to sub-horizontal bedding fresh to slightly weathered slightly silty dolomitic SANDSTONE, strong with medium spaced thick laminations to very thin beds of reddish brown and green sandy mudstone and medium to widely spaced sub-horizontal fractures planar rough tight. (Mercia Mudstone Group) ---from 35.00m thinly bedded slightly dolomitic silty		35.50	-28.48	34.00 - 35.50	100	97	78	6		

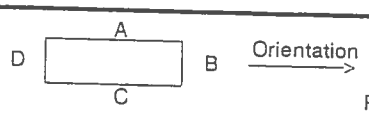
Borehole complete at 35.50 m.

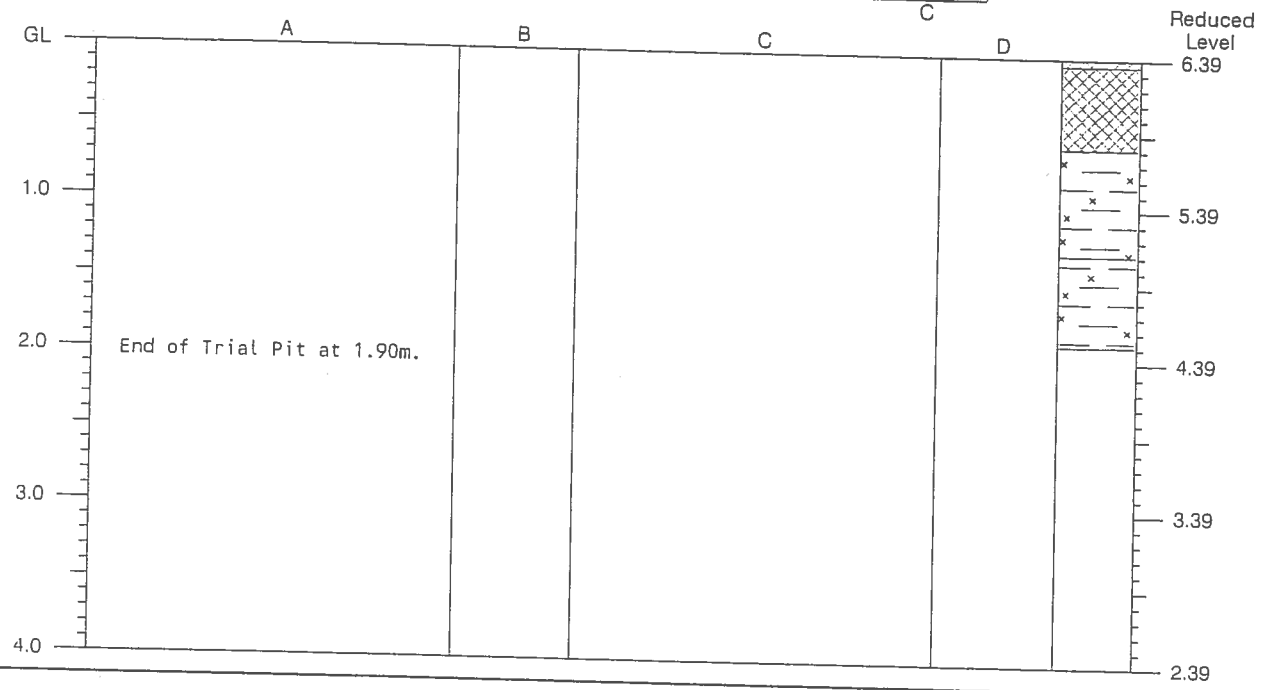
NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	NH COMBINED LOG
Version	1.00
Revised	20/09/96

Dimensions :

Orientation :





Strata

Depth (m)	No.	Description
0.00-0.05	1	Brown very silty clayey TOPSOIL.
0.05-0.60	2	MADE GROUND: Moderately compact brown very sandy sub-angular to sub-rounded fine to coarse gravel and cobbles of slag, ash and brick with occasional boulders (<600mm) of slag.
0.60-1.30	3	Firm to stiff brown slightly mottled grey and orange brown very silty organic CLAY with much root material.
1.30-1.90	4	Firm grey mottled brown very silty CLAY with occasional root material.

Samples and Tests

Depth (m)	Type	Results
0.05-0.60	BTO	
0.60-1.10	BTO	
1.50-1.90	BTO	

Date of Excavation 04/02/00
Equipment JCB 3CX
Stability Stable

Groundwater
No. Struck Behaviour
Not encountered during excavation

Ground Level 6.39 m OD
Coordinates 334598.04 mE
185425.61 mN

Logged by DC
Checked by AF

Remarks

See key sheet
and appendices
for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

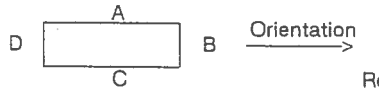
Project
M4 Relief Road - Stage 2. Preliminary
Chemical Investigation
Ove Arup & Partners

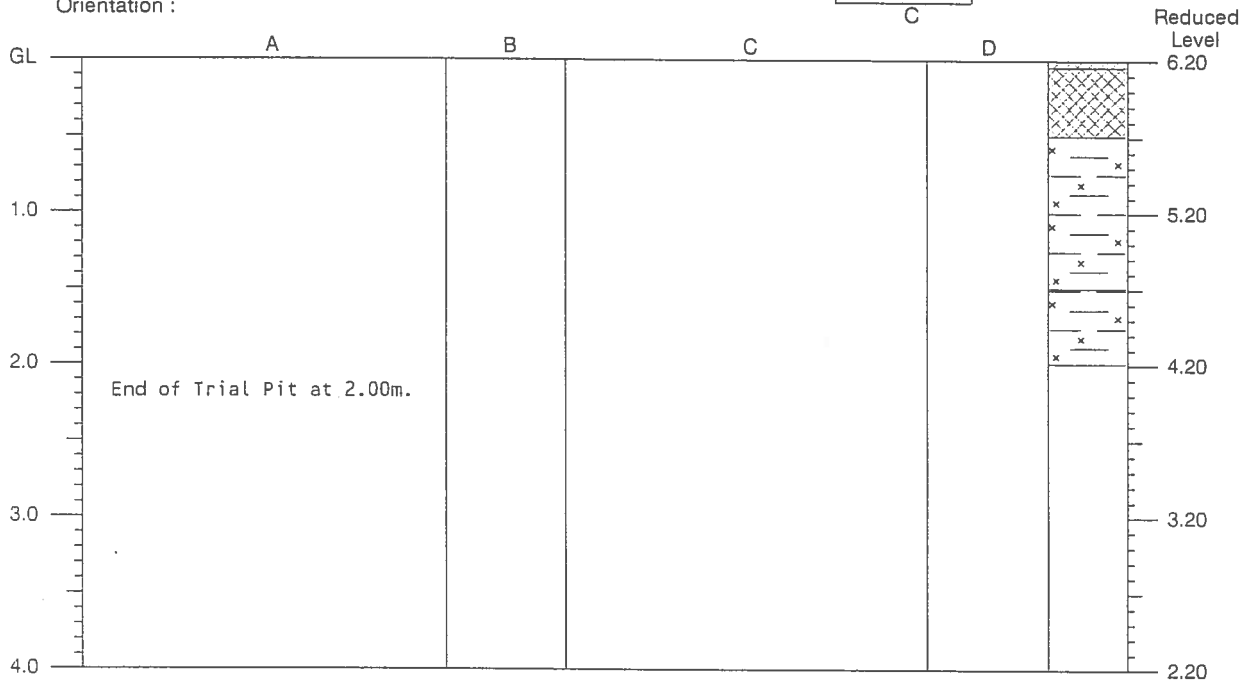
Contract 150006

Trial Pit CH49

Dimensions :

Orientation :





Strata

Depth (m)	No.	Description
0.00-0.05	1	Brown very silty clayey TOPSOIL.
0.05-0.50	2	MADE GROUND: Moderately compact brown very sandy sub-angular to sub-rounded fine to coarse gravel and cobbles of slag, ash and siltstone with occasional boulders (<400mm) of slag.
0.50-1.50	3	Firm brown mottled blue grey very silty slightly organic CLAY with much root material.
1.50-2.00	4	Firm grey mottled brown very silty organic CLAY with occasional root material.

Samples and Tests

Depth (m)	Type	Results
0.05-0.50	BTO	
0.50-1.00	BTO	
1.50-2.00	BTO	

Date of Excavation 04/02/00
Equipment JCB 3CX
Stability Stable

Groundwater

No.	Struck	Behaviour
1	0.50	slight seepage

Ground Level 6.20 m OD
Coordinates 334718.53 mE
185421.00 mN

Logged by DC
Checked by AF

Remarks

See key sheet
and appendices
for explanations.

Form 2/0

Trial Pit Record

Exploration Associates

Project
M4 Relief Road - Stage 2. Preliminary
Chemical Investigation
Ove Arup & Partners

Contract 150006

Trial Pit CH50

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHH06 CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	334690.45 E
Project	New M4 - Second Preliminary Ground Investigation				185422.91 N
		Drilling Rig	Dando	Ground Level	6.52m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	27/11/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	29/11/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
27/11/2007	1730	1.00	1.00	DRY	End of Shift
28/11/2007	0730	1.00	1.00	DRY	Start of Shift
28/11/2007	1730	11.80	11.80	11.20	End of Shift
29/11/2007	0730	11.80	11.80	4.60	Start of Shift
29/11/2007	1730	15.00	13.50	8.60	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
14.30	14.70	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	15.00	200	13.50

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
28/11/2007		5.00	4.70	20	Slow	4.40	NR

GENERAL NOTES

1.Cable Percussive boring complete at 15.00m.
2.50mm standpipe installed, slotted from 10.30m to 12.30m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
2.00	S	N=14 (2,2,3,3,4,4)	1.70	DRY
3.50	S	N=4 (1,0,1,1,1,1)	2.90	DRY
5.50	S	N=3 (1,0,1,0,1,1)	5.20	5.30
7.00	S	N=4 (1,1,1,1,1,1)	6.40	6.10
9.00	S	N=4 (1,0,1,1,1,1)	8.10	7.70
10.50	S	N=3 (1,0,1,0,1,1)	11.80	11.20
12.80	S	50/295mm (6,8,11,12,15,12)	11.80	5.00
14.00	S	50/275mm (7,10,10,12,16,12)	13.50	7.10
14.70	S	50/159mm (9,11,14,16,20)	13.50	8.60

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

Form	ARIAL CP HEADER
Version	3.05
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHH06 CP
Sheet 1 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	334690.45 E
Project	New M4 - Second Preliminary Ground Investigation				185422.91 N
		Drilling Rig	Dando	Ground Level	6.52m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	27/11/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	29/11/2007

Description of Strata	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Grey slightly sandy slightly gravelly clay with low cobble content. Gravel sized fragments are angular fine to coarse of brick, concrete, wood and clinker. Cobble sized fragments are angular of cement and ash.			ES1	0.30				
			B2	0.50 - 1.00				
			ES3	1.00				
			B4	1.00 - 1.50				
	1.30	5.22						
Stiff light grey mottled orangish brown CLAY. (Estuarine Alluvium)			U5	1.50 - 1.95				
			D6	2.00	S14	S	2.00	
			ES7	2.00			2.45	
	2.20	4.32	D8	2.00 - 2.45				
Soft to firm extremely low strength light grey silty CLAY with occasional coarse gravel sized pockets of plastic black pseudofibrous peat. (Estuarine Alluvium)			B9	2.50 - 3.00				
			U10	3.00 - 3.45				
	3.30	3.22						
Soft to very soft light grey silty CLAY with occasional organic material. Organic odour. (Estuarine Alluvium)			D11	3.50	S4	S	3.50	
			D12	3.50 - 3.95			4.03	
			B13	4.00 - 4.50				
			U14	5.00 - 5.45				
			D15	5.00				
			D16	5.50 - 5.95	S3	S	5.50	
							6.03	
	6.00	0.52	B17	6.00 - 6.50				
Plastic black pseudofibrous PEAT with closely spaced gravel sized pockets of soft grey silty clay. (Peat)			U18	6.50 - 6.95				
	7.00	-0.48	D19	7.00	S4	S	7.00	
			D20	7.00 - 7.45			7.45	
Soft light grey silty CLAY with occasional coarse gravel sized pockets of plastic black pseudofibrous peat. (Estuarine Alluvium)								
	8.00	-1.48	D21	8.00				
Very soft extremely low strength light grey silty CLAY with rare fragments of organic material. Organic odour. (Estuarine Alluvium)			U22	8.50 - 8.95				
			D23	9.00	S4	S	9.00	
			D24	9.00 - 9.45			9.53	
			B25	9.50 - 10.00				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHH06 CP
Sheet 2 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	334690.45 E
Project	New M4 - Second Preliminary Ground Investigation				185422.91 N
		Drilling Rig	Dando	Ground Level	6.52m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	27/11/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	29/11/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Very soft extremely low strength light grey silty CLAY with rare fragments of organic material. Organic odour. (Estuarine Alluvium)				D26	10.00 - 10.95				
						S3	S	10.50 11.03	
				B27	11.00 - 11.50				
		11.80	-5.28	D28	11.80				
Very stiff medium strength reddish brown slightly gravelly CLAY. Gravel sized fragments are angular fine (Weathered Mudstone). (Mercia Mudstone Group) ---from 12.00m gravel is angular to rounded fine to coarse of mudstone				U29	12.30 - 12.75				
				D30	12.80	S50/295mm	S	12.80 13.25	
				D31	12.80 - 13.25				
				B32	13.30 - 13.80				
				D33	14.00 - 14.40	S50/275mm	S	14.00 14.43	
				D34	14.70 - 15.00	S50/159mm	S	14.70 15.01	
		15.00	-8.48						
Cable Percussion boring complete at 15.00 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

Hole ID.
STPH01
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	334610.91 E
Project	New M4 - Second Preliminary Ground Investigation				185330.63 N
		Equipment	JCB 3CX	Ground Level	6.39m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	26/11/2007
		Logged by	WA	Date Completed	26/11/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
TOPSOIL.		0.30	6.09	ES1 D2 B3	0.30 0.30 0.30	
MADE GROUND: Dark brown sandy angular to subangular fine to coarse gravel sized fragments of brick and limestone.		0.80	5.59	ES4 D8 B9	0.90 0.90 0.90	
Firm locally soft grey slightly sandy CLAY. (Estuarine Alluvium)				D10	1.90	
---from 2.20m bluish grey		2.40	3.99	B11 D12	2.40 2.40	
Spongy dark brown fibrous PEAT. (Peat)		3.20	3.19	B13 D14	3.30 3.30	
Soft bluish grey slightly sandy CLAY. (Estuarine Alluvium)		4.50	1.89			
Trial pit complete at 4.50 m.						

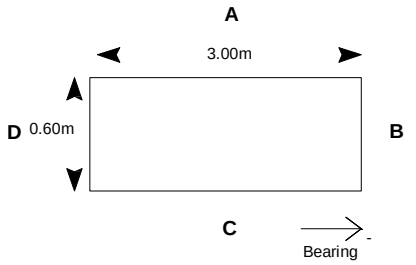
Stability: All faces stable

Shoring: None used

Groundwater: None encountered during excavation

Remarks: 1.Trial pit complete at 4.50m.

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HAND VANE AND HAND PENETROMETER TESTS

Hole ID.
STPH01
Data Sheet

Contract No.	F15056	Method	Machine Excavated	Coordinates	334610.91E
Project	New M4 - Second Preliminary Ground Investigation				185330.63 N
		Equipment	JCB 3CX	Ground Level	6.39m AOD
Client	Transport Wales, Welsh Assembly Government			Orientation	Vertical
		Logged by	WA	Date Started	26/11/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	26/11/2007

Hand Vane				Hand Penetrometer		
Depth	Test No	Peak	Remoulded	Depth	Test No	Result
1.00	01	130.0	130.0			
1.00	02	130.0	130.0			
1.00	03	130.0	130.0			
2.00	04	120.0	100.0			
2.00	05	100.0	90.0			
2.00	06	110.0	110.0			
4.00	07	40.0	0.0			
4.00	08	50.0	10.0			
4.00	09	50.0	20.0			

NOTES: All depths in metres, all diameters in millimetres, test results in kPa.

Form	ARIAL HAND VANE/PEN
Version	3.03
Revised	18/01/2007

Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

Hole ID.
STPH02
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	334673.69 E
Project	New M4 - Second Preliminary Ground Investigation				185342.35 N
		Equipment	JCB 3CX	Ground Level	6.62m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	26/11/2007
		Logged by	WA	Date Completed	26/11/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: topsoil.		0.10	6.52			
MADE GROUND: Grey brown silty slightly sandy slightly ashy angular to subangular fine to coarse gravel sized fragments of brick, concrete and tarmacadam.				ES1 D2 B3	0.30 0.30 0.30	
MADE GROUND: Grey slightly sandy clay. ---from 0.85m to 1.30m concrete slab/footing in face D		0.85	5.77	ES4 D5 B6 ES7 D8 B9	1.00 1.00 1.00 1.30 1.30 1.30	
Firm locally soft bluish grey slightly sandy CLAY. (Estuarine Alluvium)		1.30	5.32	D10 B11	2.30 2.80	
Spongy brown fibrous PEAT. (Peat)		3.00	3.62	D12 B13	3.00 3.00	
Soft bluish grey slightly sandy CLAY. (Estuarine Alluvium)		3.80	2.82	D14 B15	4.00 4.00	
Trial pit complete at 4.50 m.		4.50	2.12			

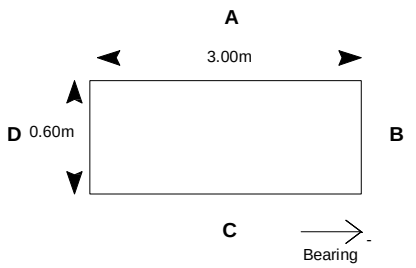
Stability: All faces stable

Shoring: None used

Groundwater: Water strike in face A at 1.00m - moderate

Remarks: 1.Trial pit complete at 4.50m.

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HAND VANE AND HAND PENETROMETER TESTS

Hole ID.
STPH02
Data Sheet

Contract No.	F15056	Method	Machine Excavated	Coordinates	334673.69E
Project	New M4 - Second Preliminary Ground Investigation				185342.35 N
		Equipment	JCB 3CX	Ground Level	6.62m AOD
Client	Transport Wales, Welsh Assembly Government			Orientation	Vertical
		Logged by	WA	Date Started	26/11/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	26/11/2007

Hand Vane				Hand Penetrometer		
Depth	Test No	Peak	Remoulded	Depth	Test No	Result
1.00	01	90.0	40.0			
1.00	02	70.0	40.0			
1.00	03	45.0	0.0			
2.00	04	110.0	90.0			
2.00	05	100.0	100.0			
2.00	06	110.0	110.0			
4.00	07	70.0	10.0			
4.00	08	50.0	0.0			
4.00	09	40.0	10.0			

NOTES: All depths in metres, all diameters in millimetres, test results in kPa.

Form	ARIAL HAND VANE/PEN
Version	3.03
Revised	18/01/2007

Geotechnical Engineering Limited

BOREHOLE LOG

BH504

CLIENT	WELSH GOVERNMENT					Sheet	1 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	3 March 2015	Easting	334644.2			Depth	19.50 m
End Date	9 March 2015	Northing	185244.3	Ground level	6.65mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
03/03/15 0800hrs	1B	0.00 - 0.20						Dark greyish brown and reddish brown clayey very sandy subangular fine to coarse brick and tarmacadam GRAVEL with frequent fragments of organic material (up to 4mm). (MG)			
	2D*	0.00 - 0.20		Vo 0.0							
	3B	0.20 - 0.50									
	4D*	0.20 - 0.50		Vo 0.0							
	5B	0.80 - 1.20									
	6D*	0.80 - 1.20		Vo 0.0							
	7D	1.20 - 1.65	Nil	S 7							
	9D*	1.20 - 1.30							1.20	5.45	
	8X	1.20 - 2.00						Firm dark brownish grey slightly sandy silty CLAY. (TFD)			
03/03/15 1700hrs 1.50m	10UT	2.00 - 2.45	2.00								
04/03/15 0800hrs 0.80m	11D	2.50 - 2.95	2.50	S 8							
	12UT	3.00 - 3.45	2.50								
	13D	3.50 - 3.95	2.50	S 2				3.50 - 5.50m: Very soft.			
	UT	4.00 - 4.45	4.00								
	14D	4.50 - 4.95	4.00	S 1							
	15UT	5.00 - 5.45	5.00								
	16X	5.50 - 7.00	5.00					Soft light grey silty CLAY with rare fragments of organic material (up to 2mm). (TFD)	5.50	1.15	
	17D*	6.00 - 6.10									
								Spongy dark brown mottled black slightly clayey fibrous PEAT. (PEAT)	6.45	0.20	
	18D	7.00 - 7.45	7.00	S 1							
	20D*	7.00 - 7.10									
	19X	7.00 - 8.50						Very soft light grey slightly peaty silty CLAY. (TFDP)	7.15	-0.50	
									7.80	-1.15	
								Continued Next Page	{8.00}		

EQUIPMENT: Comacchio MC205 rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Dynamic sampled (102mm) 1.20-2.00m and 5.50-14.50m. Borehole advanced by reaming casing (140mm) 2.00-5.50m. Waterflush rotary core drilled (116mm) 14.50-19.50m.

CASING: 140mm diam to 12.50m.

BACKFILL: On completion, hole backfilled with bentonite pellets.

REMARKS: Downhole magnetometry for UXO risk mitigation undertaken 0.00-13.00m. No anomalies encountered.

MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
1.00	Nil	No rise	20	Slow ingress.

AGS

CONTRACT	CHECKED
30238	EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH504

CLIENT	WELSH GOVERNMENT					Sheet	2 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	3 March 2015	Easting	334644.2				
End Date	9 March 2015	Northing	185244.3	Ground level	6.65mOD	Depth	19.50 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
04/03/15 1700hrs 4.00m	21D*	8.00 - 8.10						Firm black PEAT with frequent fibrous organic fragments (up to 2mm). (PEAT)	8.30	-1.65	
05/03/15 0835hrs 2.00m	UT	8.50 - 8.95	7.00					Soft locally very soft light grey silty CLAY with frequent organic fragments (up to 3mm) and rare thinly bedded medium and widely spaced beds of clayey peat. (TFDP)			
	22X	9.00 - 10.00									
	23D	10.00 - 10.45	7.00	S 2							
	24X	10.00 - 11.50									
									11.30	-4.65	
								Dark greenish grey slightly gravelly very clayey fine and medium SAND. Gravel is subrounded coarse sandstone. (RTD)	11.70	-5.05	
	25UT	11.50 - 11.95	11.50						11.90	-5.25	
								Dark grey and reddish brown very clayey SAND. (RTD)			
	26X	12.00 - 13.00						Very stiff fissured reddish brown slightly sandy CLAY with rare subangular medium and coarse gravel sized very stiff clay lithorelicts. (MMG) (Grade III/IVa)			
	27D	13.00 - 13.45	11.50	S 37							
	28X	13.00 - 14.50						13.50m: Thin lamination of fine sand.			
	29D	14.50 - 14.95	11.50	S 58							
05/03/15 1700hrs 2.00m	30C	14.50 - 15.00	12.50		80	NA					
06/03/15 0810hrs 3.80m	31C	15.00 - 15.50	11.50		92				15.10	-8.45	
	32C	15.50 - 16.50	11.50		92			Stiff fissured reddish brown sandy gravelly CLAY with frequent light greenish grey reduction spots (up to 3mm). Gravel is subangular and subrounded fine and medium lithorelicts of very stiff clay to extremely weak mudstone. (MMG) (Grade III/IVa)			
									16.50	-9.85	
	33C	16.50 - 17.30	11.50		100			Stiff fissured light greenish grey slightly sandy gravelly CLAY. Gravel is subangular and angular fine to coarse lithorelicts of very stiff clay and extremely weak mudstone. (MMG) (Grade III)			
06/03/15 1715hrs 3.00m									17.10	-10.45	
09/03/15 0800hrs NR	34C	17.30 - 18.20	12.50		94			16.85 - 16.90m: Band (2mm) of greenish grey extremely weak mudstone.			
								Stiff fissured reddish brown slightly sandy gravelly CLAY. Gravel is randomly orientated subangular fine and medium stiff clay and extremely weak mudstone. (MMG)			
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

AGS

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH504

CLIENT	WELSH GOVERNMENT					Sheet	3 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	3 March 2015	Easting	334644.2			Depth	19.50 m
End Date	9 March 2015	Northing	185244.3	Ground level	6.65mOD		

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	35C	18.20	19.10	12.50		100			(Grade IVa)	18.45	-11.80	
09/03/15 1015hrs NR	36C	19.10	19.50	12.50		100			Stiff locally very stiff fissured reddish brown locally sandy gravelly CLAY. Gravel is locally tabular subangular fine to coarse very stiff clay extremely weak mudstone. (MMG) (Grade III)	19.50	-12.85	
		19.50	19.83	12.50	C*86				Borehole completed at 19.50m.			
										{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH505

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	1 of 3
Start Date	10 March 2015	Easting	334764.6	Scale	1 : 50
End Date	12 March 2015	Northing	185354.1 Ground level 6.80mOD	Depth	19.50 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	instru -ment	description	depth (m)	reduced level (m)	legend
10/03/15 0800hrs	1B	0.00 - 0.20					Brown and black silty sandy angular and subangular fine to coarse brick, slag and mudstone GRAVEL. (MG)			
	2D*	0.00 - 0.20		Vo 0.0						
	3B	0.50 - 0.70								
	4D*	0.50 - 0.70		Vo 0.0						
	5B	1.00 - 1.20								
	6D*	1.00 - 1.20		Vo 0.2			1.00 - 1.40m: High mudstone and sandstone cobble content.			
	7X	1.20 - 2.00	Nil					1.40	5.40	
	8D*	1.60 - 1.70					Firm greyish brown mottled orangish brown slightly sandy silty CLAY with rare rootlets (up to 1mm diam). (TFD)			
	9UT	2.00 - 2.45	2.00							
	10D	2.50 - 2.95	2.50	S 8						
	11UT	3.00 - 3.45	2.50				3.00m: Soft.			
	12D	3.50 - 3.95	2.50	S 20						
	13UT	4.00 - 4.45	2.50							
								4.50	2.30	
	14D	4.50 - 4.95	2.50	S 8			Firm bluish grey mottled dark bluish grey silty CLAY. (TFD)			
	15UT	5.00 - 5.45	2.50							
	16D	5.50 - 5.95	2.50	S 9						
								6.00	0.80	
	17X	6.00 - 7.00	4.50				Soft bluish grey CLAY with frequent fragments of organic material (up to 2mm). (TFD)			
								6.40	0.40	
							Spongy dark brown pseudo fibrous PEAT. (PEAT)			
								6.80	0.00	
							Very soft bluish grey silty CLAY with frequent fragments of organic material (up to 2mm). (TFD)			
10/03/15 1700hrs NR	18UT	7.00 - 7.45	4.50							
11/03/15 0820hrs 3.00m	19X	7.50 - 9.00	7.00							
							Continued Next Page	{8.00}		

EQUIPMENT: Comacchio MC205 rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Dynamic sampled (127mm) 1.20-12.50m. Waterflush rotary core drilled (127mm) 12.50-19.50m.

CASING: 127mm diam to 12.00m.

BACKFILL: On completion, a slotted standpipe (50mm) was installed to 19.00m granular response zone 19.00-15.00m and bentonite seal 15.00-14.00m. A second slotted standpipe (35mm) was installed to 14.00m, granular response zone 14.00-12.50m, granular fill 12.50-12.00m, bentonite seal 12.00-0.20m, concrete and raised helmet cover 0.20-0.00m.

REMARKS: Downhole magnetometry for UXO risk mitigation undertaken 0.00-13.00m. No anomalies encountered.

MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	30238	EC

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BOREHOLE LOG

BH505

CLIENT	WELSH GOVERNMENT					Sheet	2 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	10 March 2015	Easting	334764.6			Depth	19.50 m
End Date	12 March 2015	Northing	185354.1	Ground level	6.80mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	instru -ment	description	depth (m)	reduced level (m)	legend
								8.20	-1.40	
							Firm dark brown fibrous PEAT. (PEAT)	8.40	-1.60	
							Soft bluish grey silty CLAY with frequent organic fragments (up to 2mm). (TFD)			
	20D	9.00 - 9.45	7.00	S 3						
	21X	9.50 - 11.00	9.50							
	22UT	11.00 - 11.50	9.50				11.00 - 11.45m: Grey and black with frequent shell fragments.			
	23X	11.50 - 12.50								
								11.85	-5.05	
							Soft greyish brown and reddish brown slightly sandy slightly gravelly silty CLAY with rare shell fragments (up to 3mm). Gravel is subrounded and rounded fine to coarse quartz. (TFD)	12.20	-5.40	
	24D	12.50 - 12.94	12.00	S*53						
	25C	12.50 - 13.50			30		Very dense reddish brown and grey clayey sandy subangular to rounded fine to coarse sandstone, mudstone and quartz GRAVEL. (RTD)	12.90	-6.10	
							Limited recovery. Reddish brown and grey slightly clayey rounded fine and medium sandstone and quartz GRAVEL. Possible loss of fines. (RTD)			
	26C	13.50 - 14.50	12.00		15					
	27D	14.50 - 14.93	12.00	S*55						
11/03/15 1700hrs NR	28C	14.50 - 15.00			30			14.60	-7.80	
	29D	15.00 - 15.39	12.00	S*63			Hard fissured reddish brown gravelly silty CLAY locally tending to extremely weak mudstone. Gravel is angular fine and medium mudstone lithorelicts. Fissures are randomly orientated extremely closely spaced undulating smooth. (MMG) (Grade II/III)			
12/03/15 0830hrs 3.00m	30C	15.00 - 16.50			90					
	31C	16.50 - 18.00	12.00		93					
							Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	30238	EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH505

CLIENT	WELSH GOVERNMENT					Sheet	3 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	10 March 2015	Easting	334764.6				
End Date	12 March 2015	Northing	185354.1	Ground level	6.80mOD	Depth	19.50 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range		instru -ment	description	depth (m)	reduced level (m)	legend
	32C	18.00	19.50	12.00		97			18.50 - 19.20m: Frequent bluish grey reduction spots (up to 5mm).			
12/03/15 1630hrs NR										19.50	-12.70	
									Borehole completed at 19.50m.			
										{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	30238	EC

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A2 Appendix 2

Gas and Groundwater Monitoring Results

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH505	23/03/15 12:30:00	1017	0								0.0	11		15 litres purged, base depth 14.00m. Purging dry with slow recharge. Very silty water.
BH505	23/03/15 12:31:00										0.0			
BH505	23/03/15 12:32:00										0.0			
BH505	23/03/15 12:33:00										0.0			
BH505	23/03/15 12:34:00										0.0			
BH505	23/03/15 12:35:00			0.0	0.0	20.1	0.0	0	0	0.1				
BH505	23/03/15 12:36:00			0.0	0.0	20.0	0.0	0	0	0.1				
BH505	23/03/15 12:37:00			0.0	0.0	20.1	0.0	0	0	0.0				
BH505	23/03/15 12:38:00			0.0	0.0	20.1	0.0	0	0	0.0				
BH505	23/03/15 12:39:00			0.0	0.0	20.1	0.0	0	0	0.0				
BH505	23/03/15 12:40:00			0.0	0.0	20.1	0.0	0	0	0.0				
BH505	23/03/15 12:41:00			0.0	0.0	20.1	0.0	0	0	0.0				
BH505	23/03/15 12:42:00			0.0	0.0	20.0	0.0	0	0	0.0				
BH505	23/03/15 12:43:00			0.0	0.0	20.1	0.0	0	0	0.0				
BH505	23/03/15 12:44:00			0.0	0.0	20.0	0.0	0	0	0.0			1.48	Slow recharge following purging.
BH505	30/03/15 09:01:00										0.4			Only 10 litres purged. Slow recharge. Base depth 14.00m.
BH505	30/03/15 09:02:00										0.8			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH505	30/03/15 09:03:00										0.4			
BH505	30/03/15 09:04:00										0.8			
BH505	30/03/15 09:05:00			0.3	0.0	19.5	0.0	0	0	1.2				
BH505	30/03/15 09:06:00			0.3	0.0	19.4	0.0	0	0	1.1				
BH505	30/03/15 09:07:00			0.3	0.0	19.4	0.0	0	0	1.1				
BH505	30/03/15 09:08:00			0.2	0.0	19.5	0.0	0	0	1.0				
BH505	30/03/15 09:09:00			0.2	0.0	19.5	0.0	0	0	1.0				
BH505	30/03/15 09:10:00			0.2	0.0	19.5	0.0	0	0	0.9				
BH505	30/03/15 09:11:00			0.2	0.0	19.5	0.0	0	0	0.9				
BH505	30/03/15 09:12:00			0.2	0.0	19.5	0.0	0	0	0.8				
BH505	30/03/15 09:13:00			0.2	0.0	19.5	0.0	0	0	0.8				
BH505	30/03/15 09:14:00			0.2	0.0	19.5	0.0	0	0	0.7			2.90	Slow recharge following purging.
BH505	30/03/15 10:30:00	1014	1								0.0	8		
BH505	14/04/15 11:00:00	1030	-0.65								-8.7	13		Only 16 litres purged. Purging dry. Base depth 14.00m.
BH505	14/04/15 11:01:00										-9.0			
BH505	14/04/15 11:02:00										-9.1			
BH505	14/04/15 11:03:00										-9.1			
BH505	14/04/15 11:04:00										-9.1			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT **30238**

CHECKED **EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH505	14/04/15 11:05:00			0.7	0.3	20.0	5.0	0	1	4.4				
BH505	14/04/15 11:06:00			0.6	0.3	20.0	5.0	0	1	4.5				
BH505	14/04/15 11:07:00			0.0	0.1	20.4	2.0	0	0	3.9				
BH505	14/04/15 11:08:00			0.1	0.1	20.4	2.0	0	0	3.6				
BH505	14/04/15 11:09:00			0.1	0.1	20.3	2.0	0	0	3.6				
BH505	14/04/15 11:10:00			0.2	0.1	20.2	3.0	0	0	3.4				
BH505	14/04/15 11:11:00			0.2	0.1	20.1	3.0	0	0	3.2				
BH505	14/04/15 11:12:00			0.2	0.2	20.1	3.0	0	0	3.3				
BH505	14/04/15 11:13:00			0.0	0.2	20.1	3.0	0	0	3.3				
BH505	14/04/15 11:14:00			0.2	0.1	20.1	3.0	0	0	3.2			3.53	Slow recharge following purging.
BH505	08/05/15 12:44:00	1024	0								0.0	15		
BH505	08/05/15 12:45:00										0.0			
BH505	08/05/15 12:46:00										0.0			
BH505	08/05/15 12:47:00										0.0			
BH505	08/05/15 12:48:00										0.0			
BH505	08/05/15 12:49:00			3.6	2.2	18.6	50.6	0	0	0.0				
BH505	08/05/15 12:50:00			3.6	2.2	18.6	50.4	0	0	0.0				
BH505	08/05/15 12:51:00			3.5	2.1	19.7	48.7	0	0	0.0				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT **30238**

CHECKED **EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH505	08/05/15 12:52:00			3.4	2.0	18.8	46.8	0	0	0.0				
BH505	08/05/15 12:53:00			3.2	2.0	18.9	45.3	0	0	0.0				
BH505	08/05/15 12:54:00			3.1	1.9	18.9	43.5	0	0	0.0				
BH505	08/05/15 12:55:00			3.0	1.9	18.9	43.2	0	0	0.0				
BH505	08/05/15 12:56:00			3.0	1.9	18.9	42.6	0	0	0.0				
BH505	08/05/15 12:57:00			2.9	1.8	19.0	41.4	0	0	0.0				
BH505	08/05/15 12:58:00			2.9	1.8	19.0	40.9	0	0	0.0				
BH505	08/05/15 12:59:00												4.02	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT **30238**

CHECKED **EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH505	23/03/15 12:44:00												4.51	86 litres purged, base depth 19.00m.
BH505	30/03/15 09:14:00												3.70	91 litres purged, base depth 19.00m.
BH505	14/04/15 11:14:00												4.73	85 litres purged, base depth 19.00m.
BH505	08/05/15 13:00:00												5.38	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT	CHECKED
30238	**EC**

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		01

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		30/01/2008	09:50	2.45	25/02/2008	14:34	2.48	07/03/2008	14:25	2.60
SBHD03 CP	SPIE	10.00		30/01/2008	11:01	0.47	25/02/2008	14:52	0.43	07/03/2008	14:05	0.56
SBHD05 RC	SPIE	12.00		31/01/2008	09:00	1.02	25/02/2008	15:35	1.05	07/03/2008	13:50	1.77
SBHD06 RC	SP	15.00		30/01/2008	13:00	1.13	21/02/2008	10:30	1.39	07/03/2008	13:30	1.39
SBHD08 RC	SPIE	29.50		30/01/2008	13:50	1.20	25/02/2008	15:58	2.02	07/03/2008	13:35	1.40
SBHE02RD	SPIE	25.00		31/01/2008	09:25	2.18	25/02/2008	16:20	2.09	07/03/2008	13:10	2.48
SBHE04 RC	SPIE	17.20		31/01/2008	09:15	2.31	25/02/2008	16:11	2.51	07/03/2008	13:20	2.59
SBHF01 RC	SPIE	19.00		31/01/2008	09:40	5.69	25/02/2008	16:32	5.72	07/03/2008	12:50	5.43
SBHF02A CP	SPIE	17.00		01/02/2008	14:40	7.61	25/02/2008	17:13	7.57	07/03/2008	12:30	9.00
SBHF03 RC	SPIE	18.00		31/01/2008	10:35	6.97	26/02/2008	08:55	6.77	07/03/2008	12:15	7.22
SBHH01 RC	SPIE	25.00		31/01/2008	11:15	3.45	26/02/2008	09:39	3.42	07/03/2008	11:28	3.65
SBHH02 RC	SPIE	14.90		31/01/2008	11:10	3.42	26/02/2008	09:20	3.88	07/03/2008	11:35	3.64
SBHH05 RC	SPIE	21.50		31/01/2008	11:30	2.22	26/02/2008	10:01	2.13	07/03/2008	11:05	3.10
SBHH06 CP	SP	12.30		30/01/2008	15:30	3.75	21/02/2008	08:00	3.76	07/03/2008	11:10	3.87
SBHH07A RC	SPIE	24.85		30/01/2008	14:50	1.70	26/02/2008	10:40	1.34	07/03/2008	11:00	1.07
SBHJ01 CP	SP	7.50		01/02/2008	12:20	1.34	21/02/2008	11:45	5.98	06/03/2008	12:28	1.82
SBHJ03 CP	SP	5.20		01/02/2008	08:00	0.54	27/02/2008	16:15	0.70	07/03/2008	10:45	0.68
SBHJ04	SP	13.10		01/02/2008	11:55	6.61	22/02/2008	13::55	6.67	06/03/2008	11:46	6.75
SBHJ05	SP	11.50		01/02/2008	11:10	8.91	22/02/2008	09:00	9.07	06/03/2008	11:23	9.16
SBHJ06 CP	SP	4.10		01/02/2008	11:45	1.31	21/02/2008	15:30	1.32	06/03/2008	10:50	1.33
SBHJ07 CP	SP	10.40		01/02/2008	11:43	1.35	21/02/2008	14:40	1.40	06/03/2008	12:05	1.56
SBHJ08A CP	SP	7.40		01/02/2008	11:35	3.49	21/02/2008	13:05	2.31	06/03/2008	10:57	2.67
SBHJ09 CP	SP	2.20		01/02/2008	11:30	0.65	21/02/2008	12:25	0.85	06/03/2008	11:00	0.90
SBHJ10 CP	SP	10.00		01/02/2008	10:40	2.30	21/02/2008	13:45	2.24	06/03/2008	10:40	2.16
SBHK01 CP	SP	6.80		01/02/2008	10:55	0.70	25/02/2008	10:30	1.00	06/03/2008	14:24	1.06
SBHK02 CP	SP	11.20		01/02/2008	10:50	1.34	25/02/2008	11:20	1.33	06/03/2008	14:18	1.47
SBHK03 CP	SP	5.90		01/02/2008	10:45	0.87	25/02/2008	12:00	0.89	06/03/2008	14:15	1.00
SBHK04 CP	SP	12.20		01/02/2008	10:25	1.45	25/02/2008	12:30	1.60	06/03/2008	12:30	1.60
SBHL02 RC	SPIE	15.20		01/02/2008	10:35	2.27	25/02/2008	12:49	2.31	06/03/2008	14:00	2.42
SBHL03 RC	SPIE	15.00		31/01/2008	16:20	0.61	26/02/2008	11:15	0.51	07/03/2008	10:25	0.66
SBHM01 RC	SPIE	21.00		01/01/1900	08:20	-0.26	26/02/2008	11:30	-0.26	07/03/2008	10:17	0.05
SBHM02 RC	SPIE	20.00		01/02/2008	08:25	0.19	26/02/2008	11:41	0.49	07/03/2008	10:14	0.68
SBHN01A RC	SPIE	14.90		01/02/2008	15:20	8.49	27/02/2008	17:15	12.23	07/03/2008	14:45	13.18
SBHN02 RC	SPIE	20.40		31/01/2008	15:55	3.67	26/02/2008	11:57	4.19	07/03/2008	10:05	4.84
SBHN03 RC	SPIE	15.00		31/01/2008	15:45	1.07	26/02/2008	12:03	1.73	07/03/2008	09:55	2.34
SBHN04 RC	SPIE	10.00		31/01/2008	15:30	9.99	26/02/2008	14:42	DRY	07/03/2008	09:45	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		02

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		31/01/2008	14:50	DRY	26/02/2008	14:12	DRY	07/03/2008	09:35	DRY
SBHP02 RC	SPIE	9.80		31/01/2008	13:55	7.20	26/02/2008	13:59	8.09	07/03/2008	09:10	8.25
SBHP03 RC	SPIE	5.00		31/01/2008	13:40	4.09	26/02/2008	13:48	4.76	07/03/2008	09:05	4.78
SBHQ01 RC	SPIE	11.80		31/01/2008	14:20	5.76	26/02/2008	12:46	6.74	07/03/2008	09:30	7.20
SBHQ02 RC	SPIE	6.00		31/01/2008	14:15	4.98	26/02/2008	12:59	5.16	07/03/2008	09:25	5.98
SBHQ03 RC	SPIE	11.00		31/01/2008	13:20	6.04	26/02/2008	13:29	7.22	07/03/2008	08:38	7.59
SBHQ04 RC	SPIE	8.00		31/01/2008	13:05	4.35	26/02/2008	13:36	6.18	07/03/2008	08:55	6.94
SBHQ06 RC	SPIE	7.35		31/01/2008	13:00	3.89	26/02/2008	13:16	4.40	07/03/2008	08:25	4.63
SWSJ08	SP	3.30		01/02/2008	12:30	0.42	21/02/2008	11:45	0.37	06/03/2008	12:35	0.41
SWSJ13	SP	2.50		01/02/2008	12:00	DRY	22/02/2008	13:45	DRY	06/03/2008	11:50	DRY
SWSJ21	SP	6.00		01/02/2008	11:20	3.87	22/02/2008	09:30	5.72	06/03/2008	11:27	6.59
SWSJ23	SP	7.80		01/02/2008	11:22	5.92	22/02/2008	09:55	6.62	06/03/2008	11:30	6.97
SWSJ34	SP	6.00		01/02/2008	11:05	2.52	22/02/2008	10:55	3.33	06/03/2008	11:10	3.08
SWSJ37	SP	5.60		01/02/2008	11:25	0.46	22/02/2008	11:30	0.55	06/03/2008	11:15	0.61
LGBH02	SP	8.88					22/02/2008	14:35	7.50	06/03/2008	11:40	7.52
LGBH03	SP	8.90					22/02/2008	14:21	7.20	06/03/2008	11:44	7.28
LGBH04	SP	10.50					22/02/2008	10:30	8.87	06/03/2008	11:20	9.00
LGBH09	SP	7.00					22/02/2008	12:40	1.13	06/03/2008	10:48	1.56
LGBH10	SP	14.60					27/02/2008	14:30	8.15	06/03/2008	11:12	8.21
LGBH11	SP	11.20					27/02/2008	10:00	7.05	06/03/2008	11:03	7.07
LGBH12	SP	7.05					22/02/2008	13:10	1.40	06/03/2008	10:45	1.40
RBBH07	SP	6.25					27/02/2008	12.15	0.69	06/03/2008	12:20	0.71
RBBH09	SP	7.05					27/02/2008	13:40	1.25	06/03/2008	12:25	1.21
RBBH10	SP	6.85					27/02/2008	13:00	0.68	06/03/2008	12:30	0.82

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		03

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		20/03/2008	16:30	2.57	04/04/2008	08:00	2.59	18/04/2008	07:40	2.66
SBHD03 CP	SPIE	10.00		20/03/2008	16:45	0.58	04/04/2008	08:13	0.53	18/04/2008	08:00	0.60
SBHD05 RC	SPIE	12.00		20/03/2008	16:00	1.08	04/04/2008	09:15	1.22	18/04/2008	08:30	1.32
SBHD06 RC	SP	15.00		20/03/2008	17:55	1.20	04/04/2008	09:30	1.33	18/04/2008	08:40	1.44
SBHD08 RC	SPIE	29.50		19/03/2008	18:30	1.28	04/04/2008	10:00	1.39	18/04/2008	08:52	1.52
SBHE02RD	SPIE	25.00		20/03/2008	16:20	2.23	04/04/2008	08:50	2.46	18/04/2008	09:00	2.54
SBHE04 RC	SPIE	17.20		20/03/2008	15:45	2.20	04/04/2008	09:00	1.80	18/04/2008	08:15	1.80
SBHF01 RC	SPIE	19.00		20/03/2008	15:30	5.50	04/04/2008	08:40	5.55	18/04/2008	13:58	5.58
SBHF02A CP	SPIE	17.00		20/03/2008	15:10	5.60	04/04/2008	10:28	5.70	18/04/2008	13:45	5.77
SBHF03 RC	SPIE	18.00		20/03/2008	14:55	7.20	04/04/2008	10:36	7.38	18/04/2008	13:40	7.42
SBHH01 RC	SPIE	25.00		20/03/2008	14:25	3.60	04/04/2008	15:00	3.60	18/04/2008	13:10	3.62
SBHH02 RC	SPIE	14.90		20/03/2008	14:30	4.27	04/04/2008	15:05	3.64	18/04/2008	13:13	3.70
SBHH05 RC	SPIE	21.50		20/03/2008	17:30	2.17	04/04/2008	15:15	2.78	18/04/2008	11:34	2.90
SBHH06 CP	SP	12.30		17/03/2008	15:20	3.88	04/04/2008	15:20	3.89	17/04/2008	14:15	3.90
SBHH07A RC	SPIE	24.85		20/03/2008	13:55	1.33	04/04/2008	15:28	1.92	18/04/2008	11:43	0.88
SBHJ01 CP	SP	7.50		19/03/2008	14:15	1.81	03/04/2008	16:05	1.90	17/04/2008	12:40	1.80
SBHJ03 CP	SP	5.20		19/03/2008	16:40	0.78	03/04/2008	18:25	0.82	17/04/2008	15:55	0.80
SBHJ04	SP	13.10		17/03/2008	13:35	6.64	03/04/2008	18:10	6.74	17/04/2008	13:08	6.80
SBHJ05	SP	11.50		18/03/2008	13:50	9.02	03/04/2008	17:39	9.10	17/04/2008	13:31	9.11
SBHJ06 CP	SP	4.10		17/03/2008	12:55	1.29	03/04/2008	17:43	1.33	17/04/2008	15:05	1.20
SBHJ07 CP	SP	10.40		17/03/2008	10:25	1.59	03/04/2008	17:47	1.50	17/04/2008	13:58	1.47
SBHJ08A CP	SP	7.40		18/03/2008	10:00	2.50	03/04/2008	17:55	2.50	17/04/2008	15:33	2.50
SBHJ09 CP	SP	2.20		18/03/2008	10:25	0.69	03/04/2008	17:58	0.82	17/04/2008	15:22	0.90
SBHJ10 CP	SP	10.00		17/03/2008	09:15	2.10	03/04/2008	17:50	2.00	17/04/2008	13:55	2.00
SBHK01 CP	SP	6.80		19/03/2008	10:45	0.88	03/04/2008	16:40	1.00	17/04/2008	11:40	0.94
SBHK02 CP	SP	11.20		19/03/2008	11:15	1.46	03/04/2008	16:45	1.48	17/04/2008	11:43	1.46
SBHK03 CP	SP	5.90		19/03/2008	11:45	1.04	03/04/2008	16:48	1.07	17/04/2008	11::46	0.98
SBHK04 CP	SP	12.20		19/03/2008	12:15	1.64	03/04/2008	16:52	1.67	17/04/2008	12:05	1.60
SBHL02 RC	SPIE	15.20		19/03/2008	12:50	2.44	03/04/2008	17:00	2.45	17/04/2008	12:00	2.45
SBHL03 RC	SPIE	15.00		20/03/2008	13:25	0.76	08/04/2008	15:40	0.64	18/04/2008	09:50	0.62
SBHM01 RC	SPIE	21.00		20/03/2008	13:05	-0.21	08/04/2008	15:48	-0.45	18/04/2008	11:55	0.01
SBHM02 RC	SPIE	20.00		20/03/2008	13:10	0.61	08/04/2008	15:52	0.61	18/04/2008	11:50	0.61
SBHN01A RC	SPIE	14.90		20/03/2008	12:55	12.14	08/04/2008	16:05	12.58	18/04/2008	12:48	13.27
SBHN02 RC	SPIE	20.40		20/03/2008	12:45	4.26	08/04/2008	16:12	2.64	18/04/2008	12:45	4.85
SBHN03 RC	SPIE	15.00		20/03/2008	12:30	1.60	08/04/2008	16:17	2.07	18/04/2008	12:35	2.37
SBHN04 RC	SPIE	10.00		20/03/2008	12:10	DRY	08/04/2008	16:28	DRY	18/04/2008	10:55	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		04

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		20/03/2008	12:00	DRY	08/04/2008	16:40	DRY	18/04/2008	10:45	DRY
SBHP02 RC	SPIE	9.80		20/03/2008	11:45	5.59	08/04/2008	16:55	7.98	18/04/2008	10:30	8.20
SBHP03 RC	SPIE	5.00		20/03/2008	11:40	2.80	08/04/2008	16:50	DRY	18/04/2008	10:25	4.93
SBHQ01 RC	SPIE	11.80		20/03/2008	10:40	6.72	08/04/2008	17:13	7.24	18/04/2008	10:10	7.48
SBHQ02 RC	SPIE	6.00		20/03/2008	10:45	4.91	08/04/2008	17:10	DRY	18/04/2008	10:05	DRY
SBHQ03 RC	SPIE	11.00		20/03/2008	10:50	6.76	08/04/2008	17:05	7.69	18/04/2008	10:15	8.00
SBHQ04 RC	SPIE	8.00		20/03/2008	11:30	6.97	08/04/2008	17:02	DRY	18/04/2008	10:40	DRY
SBHQ06 RC	SPIE	7.35		20/03/2008	11:20	4.47	08/04/2008	17:20	6.63	18/04/2008	12:20	4.79
SWSJ08	SP	3.30		19/03/2008	15:10	0.44	03/04/2008	16:00	0.46	17/04/2008	12:35	0.42
SWSJ13	SP	2.50		17/03/2008	13:25	DRY	03/04/2008	18:12	DRY	17/04/2008	13:12	DRY
SWSJ21	SP	6.00		18/03/2008	14:30	4.42	03/04/2008	17:33	5.89	17/04/2008	13:32	6.50
SWSJ23	SP	7.80		18/03/2008	15:05	7.58	03/04/2008	17:35	7.20	17/04/2008	13:35	7.20
SWSJ34	SP	6.00		19/03/2008	08:55	2.36	03/04/2008	17:23	3.26	17/04/2008	13:46	DRY
SWSJ37	SP	5.60		18/03/2008	11:15	0.55	03/04/2008	17:25	0.67	17/04/2008	13:42	0.63
LGBH02	SP	8.88		17/03/2008	12:55	7.48	03/04/2008	18:05	7.46	17/04/2008	13:00	7.48
LGBH03	SP	8.90		17/03/2008	13:15	7.24	03/04/2008	18:08	7.32	17/04/2008	13:03	7.30
LGBH04	SP	10.50		18/03/2008	13:20	8.87	03/04/2008	17:40	8.90	17/04/2008	13:29	8.94
LGBH09	SP	7.00		17/03/2008	11:00	1.08	03/04/2008	17:45	1.15	17/04/2008	15:08	1.05
LGBH10	SP	14.60		18/03/2008	15:20	8.31	03/04/2008	17:27	8.20	17/04/2008	13:40	8.70
LGBH11	SP	11.20		18/03/2008	11:40	6.88	03/04/2008	17:18	7.00	17/04/2008	15:38	7.08
LGBH12	SP	7.05		17/03/2008	10:00	1.30	03/04/2008	17:49	1.47	17/04/2008	15:15	1.36
RBBH07	SP	6.25		19/03/2008	13:25	0.66	03/04/2008	15:50	0.68	17/04/2008	12:30	1.10
RBBH09	SP	7.05		19/03/2008	14:40	1.18	03/04/2008	16:07	1.21	17/04/2008	12:42	1.25
RBBH10	SP	6.85		19/03/2008	13:45	0.70	03/04/2008	16:03	0.75	17/04/2008	12:39	0.78

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

A3 Appendix 3

Soil Laboratory Data

M4CAN
Soil Analysis Results & Screening Assessment
CL-22
30/06/2015

Geological Formation Legend

MG	Made Ground
TFD	Tidal Flat Deposits

Screening Values and Assessment

	Exceeds S4ULs Criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL
N/A = Not applicable

Sample Reference	Units	BHH6	BHH7	BHH7	CH49	CH50	SBHH06 CP	STPH01	STPH02	STPH02	BH504	BH504	BH505	BH505	BH505	CH49	CH50	SBHH06 CP	STPH01	BH504
Location Type		BH	BH	BH	TP	TP	BH	TP	TP	TP	BH	BH	BH	BH	BH	TP	TP	BH	TP	BH
Specimen Depth (m)		0	0	0.8	0.05	0.05	0.3	0.3	0.3	1	0	0.8	0	0.5	1	0.6	0.5	2	0.9	1.2
Sample OD Level (m)		7.3	7.02	6.22	6.34	6.15	6.22	6.09	6.32	5.62	6.65	5.85	6.8	6.3	5.8	5.79	5.7	4.52	5.49	5.45
Sample Type		B	B	D	D	D	ES	ES	ES	ES	ES	ES	ES	ES	ES	D	D	ES	ES	ES
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	TFD	TFD	TFD	TFD	TFD
Cluster Code		1997 GI	1997 GI	1997 GI	2000 GI	2000 GI	2007 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2000 GI	2000 GI	2007 GI	2007 GI	2015 GI
Metals																				
Antimony	mg/kg						3.4	<1.5	2.8	2.6								2.9	3.3	
Arsenic	mg/kg	15.4	17.5	18.1	7.16	11.1	7	<3	<3	8	15	11	8.5	8.2	11	10.7	9.63	8	9	9.2
Barium	mg/kg						410	91	160	84								91	73	
Boron	mg/kg	1.4	0.8	0.9	1.5	0.7					0.92	0.68	0.65	0.68	0.88	1.4	1			1.4
Boron Water Soluble	mg/kg						<3.5	<3.5	<3.5	<3.5								<3.5	<3.5	
Cadmium	mg/kg	2	0.6	0.4	0.64	1.5	0.5	0.5	<0.3	<0.3	0.33	0.24	0.7	0.2	0.22	0.12	0.11	<0.3	0.6	0
Chromium	mg/kg	117.1	76.9	77.6	214	60	48	15	25	33	20	19	25	16	22	35	50	36	44	23
Copper	mg/kg	36.5	42.5	43.3	20	19	24	30	28	17	24	29	34	30	40	14	12	11	43	7.7
Lead	mg/kg	119.4	76.1	72.7	134	180	59	42	21	36	33	45	42	33	36	53	45	23	55	22
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.04	0.02	<0.6	<0.6	<0.6	<0.6	0.22	0.21	0.14	0	0	0.02	0.04	<0.6	<0.6	0
Molybdenum	mg/kg						0.6	2.3	1.3	<0.6								<0.6	1.8	
Nickel	mg/kg	43.3	73	76.5	8	9	20	21	66	27	29	30	23	31	35	29	32	32	37	25
Selenium	mg/kg	1.3	0.5	0.5	1.69	1.33	<3	<3	<3	<3	0.88	1.1	0.47	0.32	0.4	<0.5	0.4	<3	<3	0.44
Zinc	mg/kg	345.4	116.4	116.9	589	520	170	54	95	130	58	55	78	58	62	102	103	110	160	65
Iron	mg/kg				32500	16700														
Cyanide (total)	mg/kg	0.5	0.2	<0.1	4	4	<1	<1	<1	<1	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	<1	<1	<1	<1	< 0.50
Cyanide (free)	mg/kg	<0.1	<0.1	<0.1							< 0.50	< 0.50	< 0.50	< 0.50	< 0.50					< 0.50
Thiocyanate	mg/kg	3.3	1.1	1.1																
Ferro/ferricyanide	mg/kg	<10	<10	<10																
Acid Soluble Sulphate	mg/kg				5090	7330										672	636			
Sulphide	mg/kg	575.6	67.5	27	583	30														
Other																				
Asbestos Presence Screen	None						NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD				NFD	NFD	
Asbestos Identification	%										<0.001	<0.001	<0.001	<0.001						
Loss on Ignition	%						4.7													
Total Organic Carbon	%						2.4		8.7										2.8	
Organic Matter	%																			
pH Value	pH Units	10.5	8.5	8.2	10.5	9.9	7.95	6.92	7.54	7.91	8.5	8.4	9	7.8	7.6	8.2	9.6	8.06	7.4	7.4
Material >2mm	%																			
Organics																				
PAH (Screening)	mg/kg	<0.1	<0.1	<0.1	85	102										<10	15			
TPH FTIR (AR)	mg/kg				63	181														
OIL FTIR	mg/kg				42	74														
Phenols																				
Phenol Index	mg/kg				<0.5	<0.5										<0.5	<0.5			
Phenols Monohydric	mg/kg	<1	<1	<1																
BTEX																				
GRO (C4-C12)	mg/kg						<0.01	<0.01	<0.01	<0.01								<0.01	<0.01	
MTBE	mg/kg						<0.01	<0.01	<0.01	<0.01			<0.001					<0.01	<0.01	
Benzene	mg/kg						<0.01	<0.01	<0.01	<0.01		<0.001	<0.001	<0.001	<0.001			<0.01	<0.01	
Toluene	mg/kg						<0.01	<0.01	<0.01	<0.01		<0.001	<0.001	<0.001	<0.001			<0.01	<0.01	
Ethyl benzene	mg/kg						<0.01	<0.01	<0.01	<0.01		<0.001	<0.001	<0.001	<0.001			<0.01	<0.01	
m & p Xylene	mg/kg						<0.01	<0.01	<0.01	<0.01		<0.001	<0.001	<0.001	<0.001			<0.01	<0.01	
o Xylene	mg/kg						<0.01	<0.01	<0.01	<0.01		<0.001	<0.001	<0.001	<0.001			<0.01	<0.01	
TPH																				
TPH >C6-C8.	mg/kg										<1	<1			<1					<1
TPH >C8-C10.	mg/kg										<1	<1			<1					<1
TPH >C10-C12.	mg/kg										<1	<1			<1					<1
TPH >C12-C16.	mg/kg										<1	<1			<1					<1
TPH >C16-C21.	mg/kg										<1	<1			<1					<1
TPH >C21-C35.	mg/kg										<1	<1			<1					<1
Aliphatics C5-C6	mg/kg						<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1			<0.01	<0.01	<0.1
Aliphatics >C6-C8	mg/kg						<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1			<0.01	<0.01	<0.1
Aliphatics >C8-C10	mg/kg						<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1			<0.01	<0.01	<0.1
Aliphatics >C10-C12	mg/kg						<0.01	<0.01	<0.01	<0.01	<1	<1	<1	<1	<1			<0.01	<0.01	<1
Aliphatics >C12-C16	mg/kg						8.3	3.3	0.19	<0.1	<1	<1	<1	<1	<1			7.6	22	<1
Aliphatics >C16-C21	mg/kg						2	12	0.83	<0.1	<1	<1	<1	<1	<1			1.9	23	<1
Aliphatics >C21-C35	mg/kg						17	42	<0.1	8.2	<1	<1	<1	<1	<1			23	64	<1
Total Aliphatics C5-C35	mg/kg						27	57	1	8.2								33	110	
Aliphatics >C35-44	mg/kg										<1	<1	<1	<1	<1					<1
Aromatics >C5-C7	mg/kg										<0.1	<0.1	<0.1	<0.1	<0.1					<0.1
Aromatics >C6-C7	mg/kg						<0.01	<0.01	<0.01	<0.01								<0.01	<0.01	
Aromatics >C7-C8	mg/kg						<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1			<0.01	<0.01	<0.1
Aromatics >EC8-EC10	mg/kg						<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1			<0.01	<0.01	<0.1
Aromatics >EC10-EC12	mg/kg						<0.01	<0.01	<0.01	<0.01	<1	<1	<1	<1	<1			<0.01	<0.01	<1
Aromatics >EC12-EC16	mg/kg						1.1	0.42	1.4	<0.1	<1	<1	<1	<1	<1			0.37	<0.1	<1
Aromatics >EC16-EC21	mg/kg						3.4	4.1	4	<0.1	<1	<1	<1	<1	<1			0.49	1.1	<1
Aromatics >EC21-EC35	mg/kg						0.037	33	16	39	<1	<1	<1	<1	<1			11	41	<1
Total Aromatics C6-C35	mg/kg						0.042	37	21	39								11	42	
Aromatics >C35-44	mg/kg											<1	<1	<1	<1					
Total Aliphatic TPH	mg/kg											<5	<5	<5	<5					
Total Aromatic TPH	mg/kg											<5	<5	<5	<5					
TPH (Aliphatics and Aromatics C5-C35)	mg/kg						69	94	22	48								44	150	
Total petroleum hydrocarbons	mg/kg											<10	<10	<10	<10					
PAH																				
Acenaphthene	mg/kg						0.19	0.09	0.16	0.027	<0.1	<0.1	<0.1	<0.1	<0.1			0.023	0.1	<0.1
Acenaphthylene	mg/kg						0.027	0.024	0.13	0.01	<0.1	<0.1	<0.1	<0.1	<0.1			0.008	0.041	<0.1
Anthracene	mg/kg						0.49	0.17	0.46	0.016	<0.1	<0.1	<0.1	<0.1	<0.1			0.05	0.1	<0.1
Benz(a)anthracene	mg/kg						0.85	0.35	0.86	0.082	<0.1	<0.1	<0.1	<0.1	<0.1			0.11	0.12	<0.1
Benzo(a)pyrene	mg/kg						0.96	0.32	0.73	0.068	<0.1	<0.1	<0.1	<0.1	<0.1			0.11	0.087	<0.1
Benzo(b)fluoranthene	mg/kg						0.93	0.38	0.68	0.11	<0.1	<0.1	<0.1	<0.1	<0.1			0.09	0.087	<0.1
Benzo(ghi)perylene	mg/kg						0.43	0.18	0.38	0.048	<0.1	<0.1	<0.1	<0.1	<0.1			0.05	0.059	<0.1
Benzo(k)fluoranthene	mg/kg						0.74	0.19	0.38	0.071	<0.1	<0.1	<0.1	<0.1	<0.1			0.094	0.061	<0.1
Chrysene	mg/kg						1	0.39	1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1			0.12	0.11	<0.1
Dibenzo(ah)anthracene	mg/kg						0.15	0.044	0.19	0.026	<0.1	<0.1	<0.1	<0.1	<0.1			0.016	0.014	<0.1
Fluoranthene	mg/kg						2.6	0.83	1.8	0.13	<0.1	<0.1	<0.1	0.22	<0.1			0.29	0.22	<0.1
Fluorene	mg/kg						0.16	0.095	0.34	0.027	<0.1	<0.1	<0.1	<0.1	<0.1			0.017	0.11	<0.1
Indeno(123cd)pyrene	mg/kg						0.39	0.14	0.32	0.041	<0.1	<0.1	<0.1	<0.1	<0.1			0.047	0.04	<0.1
Naphthalene	mg/kg						0.058	0.14	0.64	0.035	<0.1	<0.1	<0.1	<0.1	<0.1			0.02	0.76	<0.1
Phenanthrene	mg/kg						1.1	0.74	1.9	0.11	<0.1	<0.1	<0.1	0.36	<0.1			0.12	0.26	<0.1
Pyrene	mg/kg						2	0.74	1.5	0.11	<0.1	<0.1	<0.1	0.22	<0.1			0.23	0.2	<0.1
PAH 16 Total	mg/kg						12	4.8	12	1	<2	<2	<2	<2	<2			1.4	2.4	<2
VOCs																				
1,1,1,2-Tetrachloroethane	ug/kg												< 2.0							
1,1,1-Trichloroethane	ug/kg												< 1.0							
1,1-Dichloropropene	ug/kg												< 1.0							
1,2,3-Trichloropropane	ug/kg												< 50							
1,1,2-Trichloroethane	ug/kg												< 10							
1,2,3-Trichlorobenzene	ug/kg												< 2.0							
1,1-Dichloroethane	ug/kg												< 1.0							
1,1-Dichloroethene	ug/kg												< 1.0							
1,2-Dichloroethane	ug/kg												< 2.0							
1,2-Dichlorobenzene	ug/kg												< 1.0							
cis-1,2-Dichloroethene	ug/kg												< 1.0							
1,2-Dichloropropane	ug/kg												< 1.0							
1,2-Dibromo-3-Chloropropane	ug/kg												< 50							
cis-1,3-Dichloropropene	ug/kg												< 10							
1,3,5-Trimethylbenzene	ug/kg												< 1.0							
1,2,4-Trichlorobenzene	ug/kg												< 1.0							
1,2-Dibromoethane	ug/kg												< 5.0							
1,2,4-Trimethylbenzene	ug/kg												< 1.0							
1,3-Dichlorobenzene	ug/kg												< 1.0							
1,4-Dichlorobenzene	ug/kg												< 1.0							
1,3-Dichloropropane	ug/kg												< 2.0							
2-Chlorotoluene	ug/kg												< 1.0							
4-Chlorotoluene	ug/kg												< 1.0							
4-Isopropyltoluene	ug/kg												< 1.0							
Benzene	ug/kg												< 1.0							
Bromobenzene	ug/kg												< 1.0							
Bromodichloromethane	ug/kg												< 5.0							
Bromochloromethane	ug/kg												< 5.0							
Bromomethane	ug/kg												< 20							
Tribromomethane	ug/kg												< 1.0							
Chloroethane	ug/kg												< 2.0							
Chloroform	ug/kg												< 1.0							
Chloroethene	ug/kg												< 1.0							
Chloromethane	ug/kg												< 1.0							
Chlorobenzene	ug/kg												< 1.0							
Tetrachloromethane (Carbon Tetra Chloride)	ug/kg												< 1.0							
Dichlorodifluoromethane	ug/kg												< 1.0							
Dibromomethane	ug/kg												< 1.0							
Ethyl benzene	ug/kg												< 1.0							
Dibromochloromethane	ug/kg												< 10							
Hexachlorobutadiene (HCBD)	ug/kg												< 1.0							
Isopropylbenzene	ug/kg												< 1.0							
n-Butylbenzene	ug/kg												< 1.0							
Methyl tert-butyl ether (MTBE)	ug/kg												< 1.0							
m,p xylenes	ug/kg												< 1.0							
O-Xylene	ug/kg												< 1.0							
n-propylbenzene	ug/kg												< 1.0							
trans-1,2-Dichloroethene	ug/kg												< 1.0							
Styrene	ug/kg												< 1.0							
Sec-Butylbenzene	ug/kg												< 1.0							
Tert-Butylbenzene	ug/kg												< 1.0							
trans-1,3-Dichloropropene	ug/kg												< 10							
Tetrachloroethene	ug/kg												< 1.0							
Toluene	ug/kg												< 1.0							
Trichlorofluoromethane	ug/kg												< 1.0							
Trichloroethene	ug/kg												< 1.0							
Ethylbenzene	ug/kg												< 1.0							
Benzene	ug/kg												< 1.0							
m,p xylenes	ug/kg												< 1.0							
O-Xylene	ug/kg												< 1.0							
Toluene	ug/kg												< 1.0							
SVOCs																				
2,4,5-Trichlorophenol	mg/kg												< 0.50							
2,4-Dichlorophenol	mg/kg												< 0.50							
2,4,6-Trichlorophenol	mg/kg												< 0.50							
2,4-Dimethylphenol	mg/kg												< 0.50							
2,6-Dinitrotoluene	mg/kg												< 0.50							
2-Methylnaphthalene	mg/kg												< 0.50							
2,4-Dinitrotoluene	mg/kg												< 0.50							
2-Methylphenol	mg/kg												< 0.50							
2-Chlorophenol	mg/kg												< 0.50							
2-Chloronaphthalene	mg/kg												< 0.50							
2-Methyl-4,6-Dinitrophenol	mg/kg												< 0.50							
4-Chloro-3-Methylphenol	mg/kg												< 0.50							
3-Nitroaniline	mg/kg												< 0.50							
4-Chloroaniline	mg/kg												< 0.50							
2-Nitrophenol	mg/kg												< 0.50							
4-Chlorophenyl Phenyl Ether	mg/kg												< 0.50							
4-Bromophenyl Phenyl Ether	mg/kg												< 0.50							
2-Nitroaniline	mg/kg												< 0.50							
4-Methylphenol	mg/kg												< 0.50							
4-Nitrophenol	mg/kg												< 0.50							
n-nitrosodimethylamine	mg/kg												< 0.50							
4-Nitroaniline	mg/kg												< 0.50							
Azobenzene	mg/kg												< 0.50							
Bis(2-chloroethyl)ether	mg/kg												< 0.50							
Butylbenzylphthalate	mg/kg												< 0.50							
Bis(2-chloroisopropyl)ether	mg/kg												< 0.50							
Bis(2-ethylhexyl)phthalate	mg/kg												< 0.50							
Bis(2-chloroethoxy)methane	mg/kg												< 0.50							
Carbazole	mg/kg												< 0.50							
Diethylphthalate	mg/kg												< 0.50							
Dibenzofuran	mg/kg												< 0.50							
Di-N-Octyl Phthalate	mg/kg												< 0.50							
Di-N-Butyl Phthalate	mg/kg												< 0.50							
Dimethylphthalate	mg/kg												< 0.50							
Hexachlorobenzene (HCB)	mg/kg												< 0.50							
Hexachloroethane	mg/kg												< 0.50							
Hexachlorocyclopentadiene	mg/kg												< 0.50							
Isophorone	mg/kg												< 0.50							
N-Nitroso-Di-N-Propylamine	mg/kg												< 0.50							
Nitrobenzene	mg/kg												< 0.50							
Phenol	mg/kg												< 0.50							
Pentachlorophenol (PCP)	mg/kg												< 0.50							

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	Selected S4ULs Criteria	No. Data Exceeding S4ULs Criteria
Metals						
6	5	3.4	2.6	SBHH06 CP @ 0.3mbGL		1
19	17	18.1	7	BHH7 @ 0.8mbGL	170	0
6	6	410	73	SBHH06 CP @ 0.3mbGL		0
13	13	1.5	0.65	CH49 @ 0.05mbGL	46000	0
6	0	None > LOD	None > LOD			6
19	16	2	0	BHH6 @ 0mbGL	190	0
19	19	214	15	CH49 @ 0.05mbGL	33	10
19	19	43.3	7.7	BHH7 @ 0.8mbGL	44000	0
19	19	180	21	CH50 @ 0.05mbGL	1300	0
19	9	0.22	0	BH504 @ 0mbGL	30	0
6	4	2.3	0.6	STPH01 @ 0.3mbGL		2
19	19	76.5	8	BHH7 @ 0.8mbGL	980	0
19	12	1.69	0.32	CH49 @ 0.05mbGL	1800	0
19	19	589	54	CH49 @ 0.05mbGL	170000	0
2	2	32500	16700	CH49 @ 0.05mbGL		0
19	4	4	0.2	CH49 @ 0.05 / CH50 @ 0.05mbGL		15
9	0	None > LOD	None > LOD			9
3	3	3.3	1.1	BHH6 @ 0mbGL		0
3	0	None > LOD	None > LOD			3
4	4	7330	636	CH50 @ 0.05mbGL		0
5	5	583	27	CH49 @ 0.05mbGL		0
Other						
10	0	None > LOD	None > LOD			10
4	0	None > LOD	None > LOD			4
1	1	4.7	4.7	SBHH06 CP @ 0.3mbGL		0
3	3	8.7	2.4	STPH02 @ 0.3mbGL		0
0	0	None > LOD	None > LOD			0
19	19	10.5	6.92	BHH6 @ 0 / CH49 @ 0.05mbGL	6-9	6
0	0	None > LOD	None > LOD			0
Organics						
7	3	102	15	CH50 @ 0.05mbGL	1.1	3
2	2	181	63	CH50 @ 0.05mbGL	3200	0
2	2	74	42	CH50 @ 0.05mbGL		0
Phenols						
4	0	None > LOD	None > LOD		440	0
3	0	None > LOD	None > LOD		440	0
BTEX						
6	0	None > LOD	None > LOD			6
7	0	None > LOD	None > LOD			7
10	0	None > LOD	None > LOD		27	0
10	0	None > LOD	None > LOD		56000	0
10	0	None > LOD	None > LOD		5700	0
10	0	None > LOD	None > LOD		5900	0
10	0	None > LOD	None > LOD		6600	0
TPH						
4	0	None > LOD	None > LOD		7800	0
4	0	None > LOD	None > LOD		2000	0
4	0	None > LOD	None > LOD		9200	0
4	0	None > LOD	None > LOD		10000	0
4	0	None > LOD	None > LOD		7600	0
4	0	None > LOD	None > LOD		7800	0
12	0	None > LOD	None > LOD		3200	0
12	0	None > LOD	None > LOD		7800	0
12	0	None > LOD	None > LOD		2000	0
12	0	None > LOD	None > LOD		9700	0
12	5	22	0.19	STPH01 @ 0.9mbGL	25000	0
12	5	23	0.83	STPH01 @ 0.9mbGL	450000	0
12	5	64	8.2	STPH01 @ 0.9mbGL	450000	0
6	6	110	1	STPH01 @ 0.9mbGL	2000	0
6	0	None > LOD	None > LOD		450000	0
6	0	None > LOD	None > LOD		26000	0
6	0	None > LOD	None > LOD		26000	0
12	0	None > LOD	None > LOD		56000	0
12	0	None > LOD	None > LOD		3500	0
12	0	None > LOD	None > LOD		9200	0
12	4	1.4	0.37	STPH02 @ 0.3mbGL	10000	0
12	5	4.1	0.49	STPH01 @ 0.3mbGL	7600	0
12	6	41	0.037	STPH01 @ 0.9mbGL	7800	0
6	6	42	0.042	STPH01 @ 0.9mbGL	3500	0
4	0	None > LOD	None > LOD		7800	0
4	0	None > LOD	None > LOD		2000	0
4	0	None > LOD	None > LOD			4
6	6	150	22	STPH01 @ 0.9mbGL	2000	0
4	0	None > LOD	None > LOD		2000	0
PAH						
12	6	0.19	0.023	SBHH06 CP @ 0.3mbGL	29000	0
12	6	0.13	0.008	STPH02 @ 0.3mbGL	29000	0
12	6	0.49	0.016	SBHH06 CP @ 0.3mbGL	150000	0
12	6	0.86	0.082	STPH02 @ 0.3mbGL	49	0
12	6	0.96	0.068	SBHH06 CP @ 0.3mbGL	11	0
12	6	0.93	0.087	SBHH06 CP @ 0.3mbGL	13	0
12	6	0.43	0.048	SBHH06 CP @ 0.3mbGL	1400	0
12	6	0.74	0.061	SBHH06 CP @ 0.3mbGL	370	0
12	6	1	0.1	SBHH06 CP @ 0.3mbGL / STPH02 @ 0.3mbGL	93	0
12	6	0.19	0.014	STPH02 @ 0.3mbGL	1.1	0
12	7	2.6	0.13	SBHH06 CP @ 0.3mbGL	6300	0
12	6	0.34	0.017	STPH02 @ 0.3mbGL	20000	0
12	6	0.39	0.04	SBHH06 CP @ 0.3mbGL	150	0
12	6	0.76	0.02	STPH01 @ 0.9mbGL	190	0
12	7	1.9	0.11	STPH02 @ 0.3mbGL

A4 Appendix 4

Groundwater Laboratory Data

M4CAN
Groundwater Sample Analysis & Screening Assessment
CL-22
30/06/2015

Geological Formation Legend

TFD	Tidal Flat Deposits
GFD	Glaciofluvial Deposits
MM	Mercia Mudstone Group

Monitoring Round	**Units**	**Screening Criteria**		R1	R2	R1		R2		R3	
Location				**SBHH06 CP**	**SBHH06 CP**	**BH505**	**BH505**	**BH505**	**BH505**	**BH505**	**BH505**
Date Sampled				21/02/2008	18/03/2008	23/03/2015		30/03/2015		14/04/2015	
Depth		**EQS**	**DWS**	3.76	12.3	6.1	7.8	6.15	8.4	6.56	8.62
Installation Details				TFD/MM	TFD/MM	GFD	MM	GFD	MM	GFD	MM
Metals & Non-Metal Inorganics											
Hardness Total	mg/l			1300	1300						
Arsenic Dissolved	ug/l	50	10	19	25	9.8	22	48	32	29	15
Boron Dissolved	ug/l	2000	1000			270	530	1200	1100	960	510
Calcium Dissolved	ug/l			140000	140000						
Cadmium Dissolved	ug/l	0.15	5			<0.08	<0.08	0.13	<0.08	0.088	0.082
Chromium Dissolved	ug/l		50	19	17	59	120	210	150	99	44
Copper Dissolved	ug/l	10	2000	3.1	<1.6	23	47	50	45	86	62
Iron Dissolved	ug/l	1000	200	170	220						
Lead Dissolved	ug/l	1.2	10	6.3	0.6	<1	<1	<1	<1	<1	<1
Magnesium Dissolved	ug/l			250000	260000						
Manganese Dissolved	ug/l	30	50	830	510						
Nickel Dissolved	ug/l	4	20	9.9	10	2.8	5.1	8.8	6	8.6	12
Selenium Dissolved	ug/l		10	38	36	14	41	200	97	27	23
Zinc Dissolved	ug/l	75				2.7	5.1	11	5.1	32	13
Cadmium Total	ug/l	0.15	5	1.8	6						
Zinc Total	ug/l	75		580	2400						
Mercury Total	ug/l	0.07	1	<0.01	0.01	1.1	<0.5	2.2	1.4	<0.5	<0.5
Total Alkalinity as CaCO3	mg/l			2100	2900	600	820	1800	1300	2100	2000
BOD	mg/l	5		<1	6						
COD	mg/l			360	1800						
Potassium Dissolved	mg/l			78	96						
Sodium Dissolved	mg/l		200	3800	3500						
Nitrate as NO3	mg/l		50	<0.3	<0.3						
Sulphate (soluble)	mg/l	400	250	1000	510						
Chloride	mg/l	250	250	3700	3900	730	1400	4600	1900	5100	3100
Sulphide	mg/l			<0.5	<0.5						
Ammoniacal Nitrogen as N	mg/l	0.6		23	26	6.6	10	19	14	20	21
Unionised Ammonia ^	mg/l	0.6		0.334	0.909						
Total Ammonium as NH4	mg/l		0.5	29							
Hexavalent Chromium	mg/l		50		<0.03						
Phenols Monohydric	mg/l			<0.01	<0.01						
Total Cyanide	mg/l	0.001	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cyanide Free	mg/l					<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Carbon Dioxide Dissolved	ug/l			81							
pH Value	pH units	6-9	6.5-10	7.9	8.29	7.7	7.6	7.3	7.5	7.7	7.6
Organics											
GRO (C4-C12)	ug/l			<10	<10						
MTBE	ug/l			<10	<10	<1	<1	<1	<1	<1	<1
Benzene	ug/l	10	1	<10	<10	<1	<1	<1	<1	<1	<1
Toluene	ug/l	50		<10	<10	<1	<1	<1	<1	<1	<1
Ethyl benzene	ug/l	20		<10	<10	<1	<1	<1	<1	<1	<1
m & p Xylene	ug/l	30		<10	<10	<1	<1	<1	<1	<1	<1
o Xylene	ug/l	30		<10	<10	<1	<1	<1	<1	<1	<1

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Groundwater Sample Analysis & Screening Assessment
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Screening Values and Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion

Notes
EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc

Monitoring Round / Location / Date Sampled / Depth / Installation Details	Units	Screening Criteria EQS	Screening Criteria DWS	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Installation Details of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
Metals & Non-Metal Inorganics										
Hardness Total	mg/l			2	2	1300	1300	SBHH06 CP @ TFD/MM		
Arsenic Dissolved	ug/l	50	10	8	8	48	9.8	BH505 @ GFD	0	7
Boron Dissolved	ug/l	2000	1000	6	6	1200	270	BH505 @ GFD	0	2
Calcium Dissolved	ug/l			2	2	140000	140000	SBHH06 CP @ TFD/MM		
Cadmium Dissolved	ug/l	0.15	5	6	3	0.13	0.082	BH505 @ GFD	0	0
Chromium Dissolved	ug/l		50	8	8	210	17	BH505 @ GFD		5
Copper Dissolved	ug/l	10	2000	8	7	86	3.1	BH505 @ GFD	6	0
Iron Dissolved	ug/l	1000	200	2	2	220	170	SBHH06 CP @ TFD/MM	0	1
Lead Dissolved	ug/l	1.2	10	8	2	6.3	0.6	SBHH06 CP @ TFD/MM	1	0
Magnesium Dissolved	ug/l			2	2	260000	250000	SBHH06 CP @ TFD/MM		
Manganese Dissolved	ug/l	30	50	2	2	830	510	SBHH06 CP @ TFD/MM	2	2
Nickel Dissolved	ug/l	4	20	8	8	12	2.8	BH505 @ MM	7	0
Selenium Dissolved	ug/l		10	8	8	200	14	BH505 @ GFD		8
Zinc Dissolved	ug/l	75								
Cadmium Total	ug/l	0.15	5	2	2	6	1.8	SBHH06 CP @ TFD/MM	2	1
Zinc Total	ug/l	75		2	2	2400	580	SBHH06 CP @ TFD/MM	2	0
Mercury Total	ug/l	0.07	1	8	4	2.2	0.01	BH505 @ GFD	3	3
Total Alkalinity as CaCO3	mg/l			8	8	2900	600	SBHH06 CP @ TFD/MM		
BOD	mg/l	5		2	1	6	6	SBHH06 CP @ TFD/MM	1	
COD	mg/l			2	2	1800	360	SBHH06 CP @ TFD/MM		
Potassium Dissolved	mg/l			2	2	96	78	SBHH06 CP @ TFD/MM		
Sodium Dissolved	mg/l		200	2	2	3800	3500	SBHH06 CP @ TFD/MM		2
Nitrate as NO3	mg/l		50	2	0	None > LOD	None > LOD			0
Sulphate (soluble)	mg/l	400	250	2	2	1000	510	SBHH06 CP @ TFD/MM	2	2
Chloride	mg/l	250	250	8	8	5100	730	BH505 @ GFD	8	8
Sulphide	mg/l			2	0	None > LOD	None > LOD			
Ammoniacal Nitrogen as N	mg/l	0.6		8	8	26	6.6	SBHH06 CP @ TFD/MM	8	
Unionised Ammonia ^	mg/l	0.6		2	2	0.909	0.334	SBHH06 CP @ TFD/MM	1	
Total Ammonium as NH4	mg/l		0.5	1	1	29	29	SBHH06 CP @ TFD/MM		1
Hexavalent Chromium	mg/l		50	1	0	None > LOD	None > LOD			0
Phenols Monohydric	mg/l			2	0	None > LOD	None > LOD			
Total Cyanide	mg/l	0.001	0.05	8	0	None > LOD	None > LOD		0	0
Cyanide Free	mg/l			6	0	None > LOD	None > LOD			
Carbon Dioxide Dissolved	ug/l			1	1	81	81	SBHH06 CP @ TFD/MM		
pH Value	pH units	6-9	6.5-10	8	8	8.29	7.3	SBHH06 CP @ TFD/MM	0	0
Organics										
GRO (C4-C12)	ug/l			2	0	None > LOD	None > LOD			
MTBE	ug/l			8	0	None > LOD	None > LOD			
Benzene	ug/l	10	1	8	0	None > LOD	None > LOD		0	0
Toluene	ug/l	50		8	0	None > LOD	None > LOD		0	
Ethyl benzene	ug/l	20		8	0	None > LOD	None > LOD		0	
m & p Xylene	ug/l	30		8	0	None > LOD	None > LOD		0	
o Xylene	ug/l	30		8	0	None > LOD	None > LOD		0	

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Geological Formation Legend

TFD	Tidal Flat Deposits
GFD	Glaciofluvial Deposits
MM	Mercia Mudstone Group

Monitoring Round	**Units**	**Screening Criteria**		R1	R2	R1		R2		R3	
Location				**SBHH06 CP**	**SBHH06 CP**	**BH505**	**BH505**	**BH505**	**BH505**	**BH505**	**BH505**
Date Sampled				21/02/2008	18/03/2008	23/03/2015		30/03/2015		14/04/2015	
Depth		**EQS**	**DWS**	3.76	12.3	6.1	7.8	6.15	8.4	6.56	8.62
Installation Details				TFD/MM	TFD/MM	GFD	MM	GFD	MM	GFD	MM
TPH											
Aliphatics C5-C6	ug/l			<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C6-C8	ug/l			<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C8-C10	ug/l			<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C10-C12	ug/l			<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics >C12-C16 Aqueous	ug/l			<10	<10	<0.1	<0.1	<0.1	11	<0.1	<0.1
Aliphatics >C16-C21 Aqueous	ug/l			<10	<10	250	20	<0.1	440	<0.1	<0.1
Aliphatics >C21-C35 Aqueous	ug/l			<10	<10	10000	1000	<0.1	17000	<0.1	<0.1
Total Aliphatics C5-C35 Aqueous	ug/l			<10	<10						
Aliphatics >C35-44	ug/l					720	48	<0.1	1900	<0.1	<0.1
Aromatics >C5-C7	ug/l					<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics C6-C7	ug/l			<10	<10						
Aromatics >C7-C8	ug/l			<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC8-EC10	ug/l			<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC10-EC12	ug/l			<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC12-EC16 Aqueous	ug/l			<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >EC16-EC21 Aqueous	ug/l			<10	<10	230	48	<0.1	31	<0.1	<0.1
Aromatics >EC21-EC35 Aqueous	ug/l			<10	<10	3300	220	<0.1	220	<0.1	<0.1
Total Aromatics C6-C35 Aqueous	ug/l			<10	<10						
Aromatics >C35-44	ug/l					73	<0.1	<0.1	23	<0.1	<0.1
Total Aliphatic TPH	ug/l					11000	1100	<5	20000	<5	<5
Total Aromatic TPH	ug/l					3600	260	<5	270	<5	<5
TPH (Aliphatics and Aromatics C5-C35) Aqueous	ug/l			<10	<10						
Total petroleum hydrocarbons	ug/l					15000	1300	<10	20000	<10	<10
Phenols											
2-Chlorophenol	ug/l	50		<1		<0.5	<0.5				
2 - Methyl-4,6-Dinitrophenol	ug/l					<0.5	<0.5				
2-Methylphenol	ug/l	100		<1		<0.5	<0.5				
2-Nitrophenol	ug/l			<1		<0.5	<0.5				
2,4-Dichlorophenol	ug/l	20		<1		<0.5	<0.5				
2,4-Dimethylphenol	ug/l			<1		<0.5	<0.5				
2,4,5-Trichlorophenol	ug/l			<1		<0.5	<0.5				
2,4,6-Trichlorophenol	ug/l			<1		<0.5	<0.5				
4-Chloro-3-methylphenol	ug/l	40		<1		<0.5	<0.5				
4-Methylphenol	ug/l	100		<1		<0.5	<0.5				
4-Nitrophenol	ug/l			<1		<0.5	<0.5				
Pentachlorophenol	ug/l	0.4		<1		<0.5	<0.5				
Phenol	ug/l	7.7		<1		<0.5	<0.5				
Phenols	mg/l	0.0077				0.74	0.06	0.09	0.5	<0.03	0.08
PAHs											
2-Chloronaphthalene	ug/l			<1		<0.5	<0.5				
2-Methylnaphthalene	ug/l			<1		<0.5	<0.5				
Acenaphthene	ug/l			<1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	ug/l			<1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	ug/l	0.1		<1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	ug/l			<1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	ug/l	0.00017	0.01	<1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	ug/l	0.017	0.1	<1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	ug/l	0.017	0.1	<1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	ug/l	0.0082	0.1	<1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	ug/l		0.1	<1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	ug/l			<1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	ug/l			<1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	ug/l	0.0063		<1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	ug/l			<1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	ug/l	2		<1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	ug/l			<1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	ug/l			<1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total PAHs (USEPA 16)	ug/l					<2	<2	<2	<2	<2	<2

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Screening Values and Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion

Notes
EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc

Monitoring Round / Location / Date Sampled / Depth / Installation Details	Units	Screening Criteria EQS	Screening Criteria DWS	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Installation Details of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
TPH										
Aliphatics C5-C6	ug/l			8	0	None > LOD	None > LOD			
Aliphatics >C6-C8	ug/l			8	0	None > LOD	None > LOD			
Aliphatics >C8-C10	ug/l			8	0	None > LOD	None > LOD			
Aliphatics >C10-C12	ug/l			8	0	None > LOD	None > LOD			
Aliphatics >C12-C16 Aqueous	ug/l			8	1	11	11	BH505 @ MM		
Aliphatics >C16-C21 Aqueous	ug/l			8	3	440	20	BH505 @ MM		
Aliphatics >C21-C35 Aqueous	ug/l			8	3	17000	1000	BH505 @ MM		
Total Aliphatics C5-C35 Aqueous	ug/l			2	0	None > LOD	None > LOD			
Aliphatics >C35-44	ug/l			6	3	1900	48	BH505 @ MM		
Aromatics >C5-C7	ug/l			6	0	None > LOD	None > LOD			
Aromatics C6-C7	ug/l			2	0	None > LOD	None > LOD			
Aromatics >C7-C8	ug/l			8	0	None > LOD	None > LOD			
Aromatics >EC8-EC10	ug/l			8	0	None > LOD	None > LOD			
Aromatics >EC10-EC12	ug/l			8	0	None > LOD	None > LOD			
Aromatics >EC12-EC16 Aqueous	ug/l			8	0	None > LOD	None > LOD			
Aromatics >EC16-EC21 Aqueous	ug/l			8	3	230	31	BH505 @ GFD		
Aromatics >EC21-EC35 Aqueous	ug/l			8	3	3300	220	BH505 @ GFD		
Total Aromatics C6-C35 Aqueous	ug/l			2	0	None > LOD	None > LOD			
Aromatics >C35-44	ug/l			6	2	73	23	BH505 @ GFD		
Total Aliphatic TPH	ug/l			6	3	20000	1100	BH505 @ MM		
Total Aromatic TPH	ug/l			6	3	3600	260	BH505 @ GFD		
TPH (Aliphatics and Aromatics C5-C35) Aqueous	ug/l			2	0	None > LOD	None > LOD			
Total petroleum hydrocarbons	ug/l			6	3	20000	1300	BH505 @ MM		
Phenols										
2-Chlorophenol	ug/l	50		3	0	None > LOD	None > LOD		0	
2 - Methyl-4,6-Dinitrophenol	ug/l			2	0	None > LOD	None > LOD			
2-Methylphenol	ug/l	100		3	0	None > LOD	None > LOD		0	
2-Nitrophenol	ug/l			3	0	None > LOD	None > LOD			
2,4-Dichlorophenol	ug/l	20		3	0	None > LOD	None > LOD		0	
2,4-Dimethylphenol	ug/l			3	0	None > LOD	None > LOD			
2,4,5-Trichlorophenol	ug/l			3	0	None > LOD	None > LOD			
2,4,6-Trichlorophenol	ug/l			3	0	None > LOD	None > LOD			
4-Chloro-3-methylphenol	ug/l	40		3	0	None > LOD	None > LOD		0	
4-Methylphenol	ug/l	100		3	0	None > LOD	None > LOD		0	
4-Nitrophenol	ug/l			3	0	None > LOD	None > LOD			
Pentachlorophenol	ug/l	0.4		3	0	None > LOD	None > LOD		0	
Phenol	ug/l	7.7		3	0	None > LOD	None > LOD		0	
Phenols	mg/l	0.0077		6	5	0.74	0.06	BH505 @ GFD	5	
PAHs										
2-Chloronaphthalene	ug/l			3	0	None > LOD	None > LOD			
2-Methylnaphthalene	ug/l			3	0	None > LOD	None > LOD			
Acenaphthene	ug/l			7	0	None > LOD	None > LOD			
Acenaphthylene	ug/l			7	0	None > LOD	None > LOD			
Anthracene	ug/l	0.1		7	0	None > LOD	None > LOD		0	
Benzo(a)anthracene	ug/l			7	0	None > LOD	None > LOD			
Benzo(a)pyrene	ug/l	0.00017	0.01	7	0	None > LOD	None > LOD		0	0
Benzo(b)fluoranthene	ug/l	0.017	0.1	7	0	None > LOD	None > LOD		0	0
Benzo(k)fluoranthene	ug/l	0.017	0.1	7	0	None > LOD	None > LOD		0	0
Benzo(ghi)perylene	ug/l	0.0082	0.1	7	0	None > LOD	None > LOD		0	0
Indeno(1,2,3-cd)pyrene	ug/l		0.1	7	0	None > LOD	None > LOD			0
Chrysene	ug/l			7	0	None > LOD	None > LOD			
Dibenzo(a,h)anthracene	ug/l			7	0	None > LOD	None > LOD			
Fluoranthene	ug/l	0.0063		7	0	None > LOD	None > LOD		0	
Fluorene	ug/l			7	0	None > LOD	None > LOD			
Naphthalene	ug/l	2		7	0	None > LOD	None > LOD		0	
Phenanthrene	ug/l			7	0	None > LOD	None > LOD			
Pyrene	ug/l			7	0	None > LOD	None > LOD			
Total PAHs (USEPA 16)	ug/l			6	0	None > LOD	None > LOD			

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Geological Formation Legend

TFD	Tidal Flat Deposits
GFD	Glaciofluvial Deposits
MM	Mercia Mudstone Group

Monitoring Round	Units	Screening Criteria		R1	R2	R1		R2		R3	
Location				SBHH06 CP	SBHH06 CP	BH505	BH505	BH505	BH505	BH505	BH505
Date Sampled				21/02/2008	18/03/2008	23/03/2015		30/03/2015		14/04/2015	
Depth		EQS	DWS	3.76	12.3	6.1	7.8	6.15	8.4	6.56	8.62
Installation Details				TFD/MM	TFD/MM	GFD	MM	GFD	MM	GFD	MM
VOCs											
1,1,1,2-Tetrachloroethane	ug/l					<2	<2				
1,1,1-Trichloroethane	ug/l	100				<1	<1				
1,1,2-Trichloroethane	ug/l	400				<10	<10				
1,1-Dichloroethane	ug/l					<1	<1				
1,1-Dichloroethene	ug/l					<1	<1				
1,1-Dichloropropene	ug/l					<1	<1				
1,2,3-Trichlorobenzene	ug/l	0.4				<2	<2				
1,2,3-Trichloropropane	ug/l					<50	<50				
1,2,4-Trichlorobenzene	ug/l	0.4				<1	<1				
1,2,4-Trimethylbenzene	ug/l					<1	<1				
1,2-Dibromo-3-Chloropropane	ug/l					<50	<50				
1,2-Dibromoethane	ug/l					<5	<5				
1,2-Dichlorobenzene	ug/l	20				<1	<1				
1,2-Dichloroethane	ug/l	10	3			<2	<2				
1,2-Dichloropropane	ug/l					<1	<1				
1,3,5-Trimethylbenzene	ug/l					<1	<1				
1,3-Dichloropropane	ug/l					<2	<2				
1,4-Dichlorobenzene	ug/l	20				<1	<1				
2-Chlorotoluene	ug/l					<1	<1				
4-Chlorotoluene	ug/l					<1	<1				
4-Isopropyltoluene	ug/l					<1	<1				
Benzene	ug/l	10	1			<1	<1				
Bromobenzene	ug/l					<1	<1				
Bromochloromethane	ug/l		100			<5	<5				
Bromodichloromethane	ug/l					<5	<5				
Bromomethane	ug/l					<5	<5				
Chlorobenzene	ug/l					<1	<1				
Chloroethane	ug/l					<2	<2				
Chloroethene	ug/l					<1	<1				
Chloroform	ug/l	2.5	100			2.2	<1				
Chloromethane	ug/l					<1	<1				
cis-1,2-Dichloroethene	ug/l					<1	<1				
cis-1,3-Dichloropropene	ug/l					<10	<10				
Dibromochloromethane	ug/l		100			<10	<10				
Dibromomethane	ug/l					<10	<10				
Dichlorodifluoromethane	ug/l					<1	<1				
Ethylbenzene	ug/l	20				<1	<1				
Hexachlorobutadiene (HCBD)	ug/l	0.6				<1	<1				
Isopropylbenzene	ug/l					<1	<1				
m,p xylenes	ug/l	30				<1	<1				
Methyl tert-butyl ether (MTBE)	ug/l					<1	<1				
n-Butylbenzene	ug/l					<1	<1				
n-propylbenzene	ug/l					<1	<1				
O-Xylene	ug/l	30				<1	<1				
Sec-Butylbenzene	ug/l					<1	<1				
Styrene	ug/l	50				<1	<1				
Tert-Butylbenzene	ug/l					<1	<1				
Tetrachloroethene	ug/l	10	10			<1	<1				
Tetrachloromethane (Carbon Tetra Chloride)	ug/l	12	3			<1	<1				
Toluene	ug/l	50				<1	<1				
trans-1,2-Dichloroethene	ug/l					<1	<1				
trans-1,3-Dichloropropene	ug/l					<10	<10				
Tribromomethane	ug/l		100			<1	<1				
Trichloroethene	ug/l	10	10			<1	<1				
Trichlorofluoromethane	ug/l					<1	<1				
Phthalates											
Bis(2-ethylhexyl) phthalate	ug/l	1.3		<2		<0.5	<0.5				
Butylbenzyl phthalate	ug/l	20		<1		<0.5	<0.5				
Di-n-butyl phthalate	ug/l	8		<1		<0.5	<0.5				
Di-n-Octyl phthalate	ug/l	20		<5		<0.5	<0.5				
Diethyl phthalate	ug/l	200		1		<0.5	<0.5				
Dimethyl phthalate	ug/l	800		<1		<0.5	<0.5				

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Screening Values and Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion

Notes
EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc

Monitoring Round / Location / Date Sampled / Depth / Installation Details	Units	Screening Criteria EQS	Screening Criteria DWS	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Installation Details of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
VOCs										
1,1,1,2-Tetrachloroethane	ug/l			2	0	None > LOD	None > LOD			
1,1,1-Trichloroethane	ug/l	100		2	0	None > LOD	None > LOD		0	
1,1,2-Trichloroethane	ug/l	400		2	0	None > LOD	None > LOD		0	
1,1-Dichloroethane	ug/l			2	0	None > LOD	None > LOD			
1,1-Dichloroethene	ug/l			2	0	None > LOD	None > LOD			
1,1-Dichloropropene	ug/l			2	0	None > LOD	None > LOD			
1,2,3-Trichlorobenzene	ug/l	0.4		2	0	None > LOD	None > LOD		0	
1,2,3-Trichloropropane	ug/l			2	0	None > LOD	None > LOD			
1,2,4-Trichlorobenzene	ug/l	0.4		2	0	None > LOD	None > LOD		0	
1,2,4-Trimethylbenzene	ug/l			2	0	None > LOD	None > LOD			
1,2-Dibromo-3-Chloropropane	ug/l			2	0	None > LOD	None > LOD			
1,2-Dibromoethane	ug/l			2	0	None > LOD	None > LOD			
1,2-Dichlorobenzene	ug/l	20		2	0	None > LOD	None > LOD		0	
1,2-Dichloroethane	ug/l	10	3	2	0	None > LOD	None > LOD		0	0
1,2-Dichloropropane	ug/l			2	0	None > LOD	None > LOD			
1,3,5-Trimethylbenzene	ug/l			2	0	None > LOD	None > LOD			
1,3-Dichloropropane	ug/l			2	0	None > LOD	None > LOD			
1,4-Dichlorobenzene	ug/l	20		2	0	None > LOD	None > LOD		0	
2-Chlorotoluene	ug/l			2	0	None > LOD	None > LOD			
4-Chlorotoluene	ug/l			2	0	None > LOD	None > LOD			
4-Isopropyltoluene	ug/l			2	0	None > LOD	None > LOD			
Benzene	ug/l	10	1	2	0	None > LOD	None > LOD		0	0
Bromobenzene	ug/l			2	0	None > LOD	None > LOD			
Bromochloromethane	ug/l		100	2	0	None > LOD	None > LOD			0
Bromodichloromethane	ug/l			2	0	None > LOD	None > LOD			
Bromomethane	ug/l			2	0	None > LOD	None > LOD			
Chlorobenzene	ug/l			2	0	None > LOD	None > LOD			
Chloroethane	ug/l			2	0	None > LOD	None > LOD			
Chloroethene	ug/l			2	0	None > LOD	None > LOD			
Chloroform	ug/l	2.5	100	2	1	2.2	2.2	BH505 @ GFD	0	0
Chloromethane	ug/l			2	0	None > LOD	None > LOD			
cis-1,2-Dichloroethene	ug/l			2	0	None > LOD	None > LOD			
cis-1,3-Dichloropropene	ug/l			2	0	None > LOD	None > LOD			
Dibromochloromethane	ug/l		100	2	0	None > LOD	None > LOD			0
Dibromomethane	ug/l			2	0	None > LOD	None > LOD			
Dichlorodifluoromethane	ug/l			2	0	None > LOD	None > LOD			
Ethylbenzene	ug/l	20		2	0	None > LOD	None > LOD		0	
Hexachlorobutadiene (HCBD)	ug/l	0.6		2	0	None > LOD	None > LOD		0	
Isopropylbenzene	ug/l			2	0	None > LOD	None > LOD			
m,p xylenes	ug/l	30		2	0	None > LOD	None > LOD		0	
Methyl tert-butyl ether (MTBE)	ug/l			2	0	None > LOD	None > LOD			
n-Butylbenzene	ug/l			2	0	None > LOD	None > LOD			
n-propylbenzene	ug/l			2	0	None > LOD	None > LOD			
O-Xylene	ug/l	30		2	0	None > LOD	None > LOD		0	
Sec-Butylbenzene	ug/l			2	0	None > LOD	None > LOD			
Styrene	ug/l	50		2	0	None > LOD	None > LOD		0	
Tert-Butylbenzene	ug/l			2	0	None > LOD	None > LOD			
Tetrachloroethene	ug/l	10	10	2	0	None > LOD	None > LOD		0	0
Tetrachloromethane (Carbon Tetra Chloride)	ug/l	12	3	2	0	None > LOD	None > LOD		0	0
Toluene	ug/l	50		2	0	None > LOD	None > LOD		0	
trans-1,2-Dichloroethene	ug/l			2	0	None > LOD	None > LOD			
trans-1,3-Dichloropropene	ug/l			2	0	None > LOD	None > LOD			
Tribromomethane	ug/l		100	2	0	None > LOD	None > LOD			0
Trichloroethene	ug/l	10	10	2	0	None > LOD	None > LOD		0	0
Trichlorofluoromethane	ug/l			2	0	None > LOD	None > LOD			
Phthalates										
Bis(2-ethylhexyl) phthalate	ug/l	1.3		3	0	None > LOD	None > LOD		0	
Butylbenzyl phthalate	ug/l	20		3	0	None > LOD	None > LOD		0	
Di-n-butyl phthalate	ug/l	8		3	0	None > LOD	None > LOD		0	
Di-n-Octyl phthalate	ug/l	20		3	0	None > LOD	None > LOD		0	
Diethyl phthalate	ug/l	200		3	1	1	1	SBHH06 CP @ TFD/MM	0	
Dimethyl phthalate	ug/l	800		3	0	None > LOD	None > LOD		0	

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Geological Formation Legend

TFD	Tidal Flat Deposits
GFD	Glaciofluvial Deposits
MM	Mercia Mudstone Group

Monitoring Round	**Units**	**Screening Criteria**		R1	R2	R1		R2		R3	
Location				**SBHH06 CP**	**SBHH06 CP**	**BH505**	**BH505**	**BH505**	**BH505**	**BH505**	**BH505**
Date Sampled				21/02/2008	18/03/2008	23/03/2015		30/03/2015		14/04/2015	
Depth		**EQS**	**DWS**	3.76	12.3	6.1	7.8	6.15	8.4	6.56	8.62
Installation Details				TFD/MM	TFD/MM	GFD	MM	GFD	MM	GFD	MM
Other Semi-Volatiles											
1,2-Dichlorobenzene	ug/l	20		<1							
1,2,4-Trichlorobenzene	ug/l	0.4		<1							
1,3-Dichlorobenzene	ug/l	20		<1		<0.5	<0.5				
1,4-Dichlorobenzene	ug/l	20		<1							
2-Nitroaniline	ug/l			<1		<0.5	<0.5				
2,4-Dinitrotoluene	ug/l			<1		<0.5	<0.5				
2,6-Dinitrotoluene	ug/l			<1		<0.5	<0.5				
2-Methylnaphthalene	ug/l					<0.5	<0.5				
3-Nitroaniline	ug/l			<1		<0.5	<0.5				
4-Bromophenylphenylether	ug/l			<1		<0.5	<0.5				
4-Chloroaniline	ug/l			<1		<0.5	<0.5				
4-Chlorophenylphenylether	ug/l			<1		<0.5	<0.5				
4-Nitroaniline	ug/l			<1		<0.5	<0.5				
Azobenzene	ug/l			<1		<0.5	<0.5				
Bis(2-chloroethoxy)methane	ug/l			<1		<0.5	<0.5				
Bis(2-chloroethyl)ether	ug/l			<1		<0.5	<0.5				
Bis(2-chloroisopropyl)ether	ug/l					<0.5	<0.5				
Carbazole	ug/l			<1		<0.5	<0.5				
Dibenzofuran	ug/l			<1		<0.5	<0.5				
Hexachlorobenzene	ug/l	0.05		<1		<0.5	<0.5				
Hexachlorobutadiene	ug/l	0.6		<1							
Hexachlorocyclopentadiene	ug/l			<1		<0.5	<0.5				
Hexachloroethane	ug/l			<1		<0.5	<0.5				
Isophorone	ug/l			<1		<0.5	<0.5				
N-nitrosodi-n-propylamine	ug/l			<1		<0.5	<0.5				
Nitrobenzene	ug/l			<1		<0.5	<0.5				
PCBs											
Pcb-101 2,2',4,5,5' - Pentachlorobiphenyl	ug/l					<0.01	<0.01				
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl						<0.01	<0.01				
Pcb-138 2,2',3,4,4',5' - Hexachlorobiphenyl	ug/l					<0.01	<0.01				
Pcb-153 2,2',4,4',5,5' - Hexachlorobiphenyl						<0.01	<0.01				
Pcb-180 2,2',3,4,4',5,5' - Heptachlorobiphenyl	ug/l					<0.01	<0.01				
Pcb-28 2,4,4' - Trichlororbiphenyl	ug/l					<0.01	<0.01				
Pcb-52 2,2',5,5' - Tetrachlorobiphenyl	ug/l					<0.01	<0.01				

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Screening Values and Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
x	Laboratory detection level higher than screening criterion

Notes
EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc

Monitoring Round / Location / Date Sampled / Depth / Installation Details	Units	Screening Criteria		No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Installation Details of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
		EQS	DWS							
Other Semi-Volatiles										
1,2-Dichlorobenzene	ug/l	20		1	0	None > LOD	None > LOD		0	
1,2,4-Trichlorobenzene	ug/l	0.4		1	0	None > LOD	None > LOD		0	
1,3-Dichlorobenzene	ug/l	20		3	0	None > LOD	None > LOD		0	
1,4-Dichlorobenzene	ug/l	20		1	0	None > LOD	None > LOD		0	
2-Nitroaniline	ug/l			3	0	None > LOD	None > LOD			
2,4-Dinitrotoluene	ug/l			3	0	None > LOD	None > LOD			
2,6-Dinitrotoluene	ug/l			3	0	None > LOD	None > LOD			
2-Methylnaphthalene	ug/l			2	0	None > LOD	None > LOD			
3-Nitroaniline	ug/l			3	0	None > LOD	None > LOD			
4-Bromophenylphenylether	ug/l			3	0	None > LOD	None > LOD			
4-Chloroaniline	ug/l			3	0	None > LOD	None > LOD			
4-Chlorophenylphenylether	ug/l			3	0	None > LOD	None > LOD			
4-Nitroaniline	ug/l			3	0	None > LOD	None > LOD			
Azobenzene	ug/l			3	0	None > LOD	None > LOD			
Bis(2-chloroethoxy)methane	ug/l			3	0	None > LOD	None > LOD			
Bis(2-chloroethyl)ether	ug/l			3	0	None > LOD	None > LOD			
Bis(2-chloroisopropyl)ether	ug/l			2	0	None > LOD	None > LOD			
Carbazole	ug/l			3	0	None > LOD	None > LOD			
Dibenzofuran	ug/l			3	0	None > LOD	None > LOD			
Hexachlorobenzene	ug/l	0.05		3	0	None > LOD	None > LOD		0	
Hexachlorobutadiene	ug/l	0.6		1	0	None > LOD	None > LOD		0	
Hexachlorocyclopentadiene	ug/l			3	0	None > LOD	None > LOD			
Hexachloroethane	ug/l			3	0	None > LOD	None > LOD			
Isophorone	ug/l			3	0	None > LOD	None > LOD			
N-nitrosodi-n-propylamine	ug/l			3	0	None > LOD	None > LOD			
Nitrobenzene	ug/l			3	0	None > LOD	None > LOD			
PCBs										
Pcb-101 2,2',4,5,5' - Pentachlorobiphenyl	ug/l			2	0	None > LOD	None > LOD			
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl				2	0	None > LOD	None > LOD			
Pcb-138 2,2',3,4,4',5' - Hexachlorobiphenyl	ug/l			2	0	None > LOD	None > LOD			
Pcb-153 2,2',4,4',5,5' - Hexachlorobiphenyl				2	0	None > LOD	None > LOD			
Pcb-180 2,2',3,4,4',5,5' - Heptachlorobiphenyl	ug/l			2	0	None > LOD	None > LOD			
Pcb-28 2,4,4' - Trichlororbiphenyl	ug/l			2	0	None > LOD	None > LOD			
Pcb-52 2,2',5,5' - Tetrachlorobiphenyl	ug/l			2	0	None > LOD	None > LOD			

A5 Appendix 5

Surface Water Laboratory Data

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Surface Water Sample Analysis & Screening Assessment
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Notes

EQS calcium carbonate 200-250mg/l for heavy metals: chromium, copper, lead, nickel and zinc
NDP - No determination possible

Screening Values and Assessment

EQS	Environmental Quality Standards
MRV	Minimum Reporting values
	Exceeds EQS
<10	Laboratory detection level higher than screening criterion

Monitoring Round	Units	ening Crit	E1	E2	E3	E4	E1	E2	E3	E4	12.1	12.2	13.1	13.2
Location			R8				R9				Q1			
Date Sampled		EQS	06/12/2007	17/03/2008	23/06/2008	24/09/2008	06/12/2007	17/03/2008	23/06/2008	24/09/2008	01/06/2015	01/06/2015	01/06/2015	01/06/2015
Metals & Non-Metal Inorganics														
Hardness Total	mg/l		175	153	326	294	229	230	266	565				
Calcium Dissolved	mg/l		45	80	81	82	62	64	67	125				
Chromium Dissolved	ug/l		<5	<5	<5	<5	<5	<5	<5	<5				
Copper Dissolved	ug/l	10	<5	<5	<5	<5	<5	5	<5	<5				
Lead Dissolved	ug/l	1.2	<5	<5	25	<5	<5	<5	9	<5				
Magnesium Dissolved	ug/l		11	14	21	19	12	13	20	33				
Nickel Dissolved	ug/l	4	<5	<5	<5	<5	<5	<5	<5	<5				
Cadmium Total	ug/l	0.15	<0.5	<0.5	0.5	<0.5	<0.5	1.1	2.7	<0.5				
Zinc Total	ug/l	75	43	26	19	35	65	45	21	260				
BOD	mg/l	5	0	0	4	12	2	1	0	28	2.5	4.1	<1	8.82
Nitrite as NO2	mg/l										<0.05	<0.05	<0.05	<0.05
Nitrate as NO3	mg/l		1.3	2.21	<0.03	1.329	1.3	3.54	3.1	<0.03	<0.03	<0.3	0.609	<0.3
Nitrate as N	mg/l		<0.3	0.5	<0.3	0.3	<0.3	0.8	0.7	<0.3				
Nitrite as N	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
Nitrogen, Total Oxidised as N	mg/l		<0.3	0.5	<0.3	0.3	<0.3	0.8	0.7	<0.3		<0.1	0.151	<0.1
Sulphate (soluble)	mg/l	400									43.5	36.5	59.2	48.8
Sulphate as SO4	mg/l	400	20	14	43	<5	18	29	68	109				
Phosphate, Ortho as P	mg/l		<0.1	<0.1	2.1	0.5	<0.1	0.2	1.4	0.5				
Phosphorus (tot.unfilt)	mg/l	120									520	630		696
Chloride	mg/l	250	20	14	42	20	21	28	38	51	38.2	30.5	31.5	64
Ammoniacal Nitrogen as N	mg/l	0.6	0.08	0.09	<0.04	0.07	0.05	0.09	0.07	0.31	0.342	0.449	0.416	0.254
pH Value	pH units	6-9	7.6	7.6	7.5	7.2	7.6	7.7	7.8	7.1			7.81	
Dissolved Oxygen	%	60	27.4	40	3.5	18.6	32	78.7	20.7	19.3				
Oxygen, dissovled	mg/l										1.07	6.44	4.76	3.87
Temperature	˚C		10.2	8.89	14.73	11.78	10.26	8.5	15.99	11				
Organics														
MTBE	ug/l										<3	<3		<3
Benzene	ug/l	10									<7	<7		<7
Toluene	ug/l	50									<4	<4		<4
Ethyl benzene	ug/l	20									<5	<5		<5
m & p Xylene	ug/l	30									<8	<8		<8
o Xylene	ug/l	30									<3	<3		<3
TPH														
TPH >C6-C8	ug/l		<10	<10	<10	<10	<10	<10	<10	<40				
TPH >C8-C10	ug/l		<10	<10	<10	<10	<10	<10	<10	<40				
TPH >C10-C16	ug/l		<20	<20	<20	<20	<20	<20	<20	<80				
TPH >C16-C24	ug/l		<20	<20	<20	<20	<20	<20	<20	<80				
TPH >C24-C40	ug/l		<50	<50	<50	<50	61	<50	<50	<200				
TPH >C6-C40	ug/l		<50	<50	<50	<50	61	<50	<50	<200				
Aliphatics C5-C6	ug/l										<10	<10	<10	<10
Aliphatics >C6-C8	ug/l										<10	<10	<10	<10
Aliphatics >C8-C10	ug/l										<10	<10	<10	<10
Aliphatics >C10-C12	ug/l										<10	<10	<10	<10
Aliphatics >C12-C16 Aqueous	ug/l										<10	<10	<10	<10
Aliphatics >C16-C21 Aqueous	ug/l										<10	<10	<10	<10
Aliphatics >C21-C35 Aqueous	ug/l										<10	<10	<10	<10
Total Aliphatics C5-C35 Aqueous	ug/l										<10	<10	<10	<10
Aromatics >C5-C7	ug/l										<10	<10	<10	<10
Aromatics >C7-C8	ug/l										<10	<10	<10	<10
Aromatics >EC8-EC10	ug/l										<10	<10	<10	<10
Aromatics >EC10-EC12	ug/l										<10	<10	<10	<10
Aromatics >EC12-EC16 Aqueous	ug/l										<10	<10	<10	<10
Aromatics >EC16-EC21 Aqueous	ug/l										<10	<10	<10	<10
Aromatics >EC21-EC35 Aqueous	ug/l										<10	<10	<10	<10
PAHs														
Acenaphthene	ug/l										<0.015	<0.015	<0.015	<0.015
Acenaphthylene	ug/l										<0.011	<0.011	<0.011	<0.011
Anthracene	ug/l	0.1									<0.015	<0.015	<0.015	<0.015
Benzo(a)anthracene	ug/l										<0.017	<0.017	<0.017	<0.017
Benzo(a)pyrene	ug/l	0.00017									<0.009	<0.009	<0.009	<0.009
Benzo(b)fluoranthene	ug/l	0.017									<0.023	<0.023	<0.023	<0.023
Benzo(k)fluoranthene	ug/l	0.017									<0.027	<0.027	<0.027	<0.027
Benzo(ghi)perylene	ug/l	0.0082									<0.016	<0.016	<0.016	<0.016
Indeno(1,2,3-cd)pyrene	ug/l										<0.014	<0.014	<0.014	<0.014
Chrysene	ug/l										<0.013	<0.013	<0.013	<0.013
Dibenzo(a,h)anthracene	ug/l										<0.016	<0.016	<0.016	<0.016
Fluoranthene	ug/l	0.0063									<0.017	<0.017	<0.017	<0.017
Fluorene	ug/l										<0.014	<0.014	<0.014	<0.014
Naphthalene	ug/l	2									<0.1	<0.1	<0.1	<0.1
Phenanthrene	ug/l										<0.022	<0.022	<0.022	<0.022
Pyrene	ug/l										<0.015	<0.015	<0.015	<0.015
Total PAHs (USEPA 16)	ug/l										<0.344	<0.344	<0.344	<0.344
VOCs														
Benzene	ug/l	10									<7	<7		<7
Ethylbenzene	ug/l	20									<5	<5		<5
m,p xylenes	ug/l	30									<8	<8		<8
Methyl tert-butyl ether (MTBE)	ug/l										<3	<3		<3
O-Xylene	ug/l	30									<3	<3		<3
Toluene	ug/l	50									<4	<4		<4

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location, Round & Depth of Maximum Concentration	No. Data Exceeding EQS
8	8	565	153	R9 / E4	
8	8	125	45	R9 / E4	
8	0	None > LOD	None > LOD		
8	1	5	5	R9 / E2	0
8	2	25	9	R8 / E3	2
8	8	33	11	R9 / E4	
8	0	None > LOD	None > LOD		0
8	3	2.7	0.5	R9 / E3	3
8	8	260	19	R9 / E4	1
12	11	28	0	R9 / E4	3
4	0	None > LOD	None > LOD		
12	7	3.54	0.609	R9 / E2	
8	4	0.8	0.3	R9 / E2	
8	0	None > LOD	None > LOD		
11	5	0.8	0.151	R9 / E2	
4	4	59.2	36.5	12.1 / Q1	0
8	7	109	14	R9 / E4	0
8	5	2.1	0.2	R8 / E3	
3	3	696	520	13.2 / Q1	3
12	12	64	14	R9 / E4	0
12	11	0.449	0.05	12.1 / Q1	0
9	9	7.81	7.1	R9 / E3	0
8	8	78.7	3.5	R9 / E2	7
4	4	6.44	1.07	12.1 / Q1	
8	8	15.99	8.5	12.1 / Q2	
3	0	None > LOD	None > LOD		
3	0	None > LOD	None > LOD		0
3	0	None > LOD	None > LOD		0
3	0	None > LOD	None > LOD		0
3	0	None > LOD	None > LOD		0
3	0	None > LOD	None > LOD		0
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		0
4	0	None > LOD	None > LOD		0
4	0	None > LOD	None > LOD		0
4	0	None > LOD	None > LOD		0
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		0
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		0
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		
4	0	None > LOD	None > LOD		
3	0	None > LOD	None > LOD		0
3	0	None > LOD	None > LOD		0
3	0	None > LOD	None > LOD		0
3	0	None > LOD	None > LOD		
3	0	None > LOD	None > LOD		0
3	0	None > LOD	None > LOD		0

A6 Appendix 6

Soil Leachate Laboratory Data

M4CAN
Leachate Samples Analysis & Screening Assessment
CL-22
30/06/2015

Geological Formation Legend

MG	Made Ground

Screening Values and Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc

Sample Reference	Units	Screening Criteria		CH49	CH50	SBHH06CP	STPH02	BH504	BH505	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
Location type		EQS	DWS	TP	TP	BH	TP	BH	BH							
Specimen depth				0.05	0.05	0.3	1	0.8	1							
OD Level				6.34	6.15	6.22	5.62	5.85	5.8							
Sample type				D	D	ES	ES	ES	ES							
Geology code				MG	MG	MG	MG	MG	MG							
Cluster code				2000 GI	2000 GI	2007 GI	2007 GI	2015 GI	2015 GI							
2:1 Leachate Results																
Arsenic Dissolved	ug/l	50	10			4	2	2.2	2.1	4	4	4	2	SBHH06CP @ 0.3mbGL	0	0
Boron Dissolved	ug/l	2000	1000			100	250	44	52	4	4	250	44	STPH02 @ 1mbGL	0	0
Barium Dissolved	ug/l					84	16			2	2	84	16	SBHH06CP @ 0.3mbGL		
Cadmium Dissolved	ug/l	0.15	5			<0.4	<0.5	<0.08	<0.08	4	0	None > LOD	None > LOD		0	0
Chromium Dissolved	ug/l		50			<1	<1	<1	<1	4	0	None > LOD	None > LOD			0
Copper Dissolved	ug/l	10	2000			6	12	5.8	2.4	4	4	12	2.4	STPH02 @ 1mbGL	1	0
Iron Dissolved	ug/l	1000	200	30	170					2	2	170	30	CH50 @ 0.05mbGL	0	0
Molybdenum Dissolved	ug/l					9	9			2	2	9	9	SBHH06 @ 0.3 / STPH02 @ 1mbGL		
Nickel Dissolved	ug/l	4	20			<1	6.1	<1	4	4	2	6.1	4	STPH02 @ 1mbGL	1	0
Lead Dissolved	ug/l	1.2	10			1	2.4	1.8	4.7	4	4	4.7	1	BH505 @ 1mbGL	3	0
Mercury dissolved	ug/l	0.07	1					<0.5	<0.5	2	0	None > LOD	None > LOD		0	0
Antimony Dissolved	ug/l		5			<5	22			2	1	22	22	STPH02 @ 1mbGL		1
Selenium Dissolved	ug/l		10			1	2	1.2	<1	4	3	2	1	STPH02 @ 1mbGL		0
Zinc Dissolved	ug/l	75		5	26	<3	<5	2.4	3	6	4	26	2.4	CH50 @ 0.05mbGL	0	
Total Cyanide	mg/l	0.001	0.05			<0.05	<0.05			2	0	None > LOD	None > LOD		0	0
Total Diss Sulphur	mg/l			13.6	12.7					2	2	13.6	12.7	CH49 @ 0.05mbGL		
pH	pH units	6-9	6.5-10	8.4	8.5					2	2	8.5	8.4	CH50 @ 0.05mbGL	0	0
Cyanide	mg/l							< 0.05	< 0.05	2	0	None > LOD	None > LOD			
Cyanide Free	mg/l							< 0.05	< 0.05	2	0	None > LOD	None > LOD			
Phenols																
Phenols	mg/l	0.0077						<0.03	<0.03	2	0	None > LOD	None > LOD		0	
BTEX																
Benzene	ug/l	10	1					<1	<1	2	0	None > LOD	None > LOD		0	0
Toluene	ug/l	50						<1	<1	2	0	None > LOD	None > LOD		0	
Ethylbenzene	ug/l	20						<1	<1	2	0	None > LOD	None > LOD		0	
m,p xylenes	ug/l	30						<1	<1	2	0	None > LOD	None > LOD		0	
O-Xylene	ug/l	30						<1	<1	2	0	None > LOD	None > LOD		0	
TPH																
Aliphatics >C5-C6	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Aliphatics >C6-C8	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Aliphatics >C8-C10	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Aliphatics >C10-C12	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Aliphatics >C12-C16	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Aliphatics >C16-C21	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Aliphatics >C21-C35	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Aliphatics >C35-44	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Aromatics >C5-C7	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Aromatics >C7-C8	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Aromatics >C8-C10	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Aromatics >C10-C12	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Aromatics >C12-C16	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Aromatics >C16-C21	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Aromatics >C21-C35	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Aromatics >C35-44	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Total Aliphatic TPH	ug/l							<5	<5	2	0	None > LOD	None > LOD			
Total Aromatic TPH	ug/l							<5	<5	2	0	None > LOD	None > LOD			
Total petroleum hydrocarbons	ug/l							<10	<10	2	0	None > LOD	None > LOD			
PAH																
Acenaphthene	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Acenaphthylene	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Anthracene	ug/l	0.1						<0.1	<0.1	2	0	None > LOD	None > LOD		0	
Benz(a)anthracene	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Benzo(a)pyrene	ug/l	0.00017	0.01					<0.1	<0.1	2	0	None > LOD	None > LOD		0	0
Benzo(b)fluoranthene	ug/l	0.017	0.1					<0.1	<0.1	2	0	None > LOD	None > LOD		0	0
Benzo(k)fluoranthene	ug/l	0.017	0.1					<0.1	<0.1	2	0	None > LOD	None > LOD		0	0
Chrysene	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Dibenzo(ah)anthracene	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Fluoranthene	ug/l	0.0063						<0.1	<0.1	2	0	None > LOD	None > LOD		0	
Fluorene	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Benzo(ghi)perylene	ug/l	0.0082	0.1					<0.1	<0.1	2	0	None > LOD	None > LOD		0	0
Indeno(123cd)pyrene	ug/l	N/A	0.1					<0.1	<0.1	2	0	None > LOD	None > LOD		0	0
Naphthalene	ug/l	2						<0.1	<0.1	2	0	None > LOD	None > LOD		0	
Phenanthrene	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
Pyrene	ug/l							<0.1	<0.1	2	0	None > LOD	None > LOD			
PAH 16 Total	ug/l							<2	<2	2	0	None > LOD	None > LOD			

A7 Appendix 7

Benzene Pipeline Map

Welsh Government

M4 Corridor around Newport

Land Contamination Assessment Report Annex D
CL-26 Llanwern Steelworks - Volume 1 - Reedbed No. 1 & Metal Recovery Area

M4CaN-DJV-EGT-ZG_GEN-RP_EN-0001

At Issue | March 2016

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1 Introduction

1.1 Background

1.1.1 This report relates to the western part of an area of land potentially affected by contamination (CL-26) known as the 'Llanwern Steelworks'.

1.1.2 Llanwern Steelworks comprises a number of features to include from west to east: Reedbed No.1, Metal Recovery Area, Lagoon 12, Lagoon 25, Lagoon 27 and Lagoon 26. These are shown in Figure 3.

1.1.3 This report, CL-26 Volume 1, encompasses Reedbed No.1 and the Metal Recovery Area, herein referred to as the 'Site'. The remaining areas of CL-26 affected by the Scheme are reported within Volume 2, which includes Lagoons 12, 25, 27 and 26.

1.1.4 The Site is located between chainage 13,900 and 14,900 (see Figure 1), upon the south western part of Llanwern Steelworks (south of the A4810) including, Reedbed No. 1 and the Metal Recovery Area.

1.2 Reporting Context

1.2.1 The Site has been assessed as part of ground investigations and monitoring associated with the wider works for the M4 Corridor around Newport (M4CaN) (hereafter referred to as the 'Scheme'). This report informs the baseline for the environmental impact assessment (EIA) for the Scheme. The EIA is reported in the Environmental Statement (ES) of which this document is an appendix to the chapter on Geology and Soils.

1.2.2 In 2014, a Preliminary Sources Study Report (PSSR) was prepared as an initial land contamination appraisal (Ove Arup & Partners, 2014) as part of Design Manual for Roads and Bridges (DMRB) Stage 2 Assessments for a number of potential route options. This identified a number of individual areas that may have been affected by contamination as a result of historical activities at the Site. In addition, this report draws upon the 2015 Supplementary Ground Investigation report on behalf of the Welsh Government (Geotechnical Engineering, 2015). This report relates to the area defined on Figure 1a (Reedbed No. 1) and Figure 1b (Metal Recovery Area).

1.2.3 The overarching rationale and approach for the assessment of areas of land along the proposed new section of motorway with potential contamination is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES).

1.3 Objectives

1.3.1 The key objectives of this report are set out below.

- Undertake a risk assessment of the Site and determine whether potential risks to human health or controlled waters could exist based upon the Scheme.
- Identify the need for further assessment and investigation in order to refine potential land contamination risks and inform the need for remediation/mitigation.

- To provide information to support the Ground Investigation Report (GIR) and Geotechnical Design Report (GDR) required under DMRB HD22/08 (Highways Agency, 2008).

1.4 Report Structure

1.4.1 The subsequent report structure is as follows.

- Section 2: Site Location and Description – This section summarises the Site description.
- Section 3: The Scheme – This section details the new section of motorway alignment and associated features at the Site.
- Section 4: Site History – This section summarises the history of the Site based on historical maps and historical land photographs.
- Section 5: Environmental Setting – This section summarises the Site description, published geology, hydrology and hydrogeology and any relevant environmental information presented in the 2014 PSSR.
- Section 6: Scope of Investigations – This section describes the previous and supplementary ground investigation data available for the Site.
- Section 7: Ground Conditions - This section describes the main findings of the intrusive site investigation including the ground conditions encountered and any visual or olfactory evidence of contamination identified.
- Section 8: Contamination Assessment – This section describes the findings of the Tier 1 and Tier 2 contamination risk assessment based upon potential contamination sources, potential receptors and potential contamination linkages and presents the human health and controlled waters screening assessments.
- Section 9: Refined Conceptual Site Model – This section presents the Conceptual Site Model (CSM) for the Site and identifies potential contaminant linkages, based upon the findings of the data presented within Sections 2 to 7.
- Section 10: Conclusions and Recommendations – This section provides conclusions concerning the likelihood of land contaminant associated with the Site affecting the Scheme and requirements for remediation/mitigation.
- Section 11: References – This section details the key reference documents referred to within the text.
- Section 12: Glossary – This section details the key terms and acronyms used throughout this report.

2 Site Location and Description

2.1.1 The Llanwern Steelworks area is located approximately 3 km to the east of Newport city centre and is centred on National Grid Reference ST 376 858. It forms part of the still operational steelworks operated by Tata Steel, which are located directly to the north across the A4810 as shown in Figure 1.

2.1.2 The Site is bound to the north by the A4810, to the east by Blackwall Reen and Monks Ditch, to the west by fields and to the south by fields and a large electrical substation. East of Blackwall Reen and Monks Ditch lie the lagoons of Llanwern Steelworks which are discussed in Volume 2 of the Land Contamination Report for CL-26.

2.1.3 The Site comprises areas known as Reedbed No. 1 and the Metal Recovery Area. Figure 5 shows the topography of the Site based upon LiDAR data.

2.1.4 Review of the on site processes has indicated potential contamination sources associated with industrial waste water treatment and waste management/disposal areas associated with the Steelworks within the new section of motorway route corridor, as shown on Figure 1a and Figure 1b. These are discussed further in Section 4.

2.1.5 Table 1 describes the two key Site features.

Table 1: Site Description (within the route corridor)

Area	Description
Reedbed No.1	The area known as Reedbed No.1 measures approximately 600 m by 300 m. It is split into three rectangular areas; two reedbeds in the north orientated approximately north - south and one in the south orientated northeast - southwest. The southern area is further divided into rectangular sections measuring approximately 150 m by 35 m forming the reedbed system. Reedbed No. 1 is surrounded by wetland to the south, east and west, and is largely vegetated, and the A4810 is to the North of Reedbed No. 1. Infilling and vegetation growth within the reedbed has resulted in little difference in ground level between the bed and the top of the Steelwork's bunds that form the edges of the reedbeds. The bunds have been constructed from slag from the Steelworks. The site lies within the northern fringes of a Site of Special Scientific Interest (SSSI). Effluent is understood to filter through the southern area of reedbeds and then flow through the two northern ones prior to being discharged into the estuary via pumping. Following discussions with Tata Steel, Reedbed No 1 is understood to be a backup system to Reedbed No. 2 which is located to the east of the Lagoons areas (CL26 Volume 2). It is also understood that Reedbed No. 1 is rarely used but is important infrastructure to the operation of the Steelworks.

Area	Description
Metal Recovery Area	The Metal Recovery Area is located between Reedbed No.1 and the Lagoons. It is currently an industrial site operated by Tarmac and Civil & Marine for activities including tarmac and slag recycling and asphalt manufacturing. A bunded area, located centrally, is used for surface water collection. A white sheen can be seen on the 2014 aerial photographs, considered to be precipitation of lime leached out from the slag material present below ground level.

2.1.6 A triangular shape zone with ponds is located between these two areas and is considered to be an area of wetland as shown in Figure 1a. This area is not within the footprint of the new section of motorway and no previous ground investigation data are available for this area. It is proposed to redevelop part of this zone into new reedbeds to compensate for the loss of part of Reedbed No. 1 from the permanent land take.

3 The Scheme

3.1.1 The Site is located at approximate chainage 13,900 and 14,900. Refer to Figures 1a & 1b for the site location in relation to the Scheme.

3.1.2 The new section of motorway alignment within the Site would be positioned on an embankment some 2 to 3 metres high. A junction (Glan Llyn junction) is proposed linking the new section of motorway to the A4810 at approximately 14,200 to 14,900 (including slip roads). The link road joining the motorway and the A4810 is currently proposed to pass through the Metal Recovery Area and join the A4810 at an existing roundabout. The junction would be founded on piled embankment whilst the main alignment and link road would initially be surcharged with settlement enhanced by the installation of band drains.

3.1.3 The area impacted by the new section of motorway comprises the south western corner of Reedbed No.1 and the south eastern corner of the Metal Recovery Area of the Site as shown on Figures 1a and 1b.

3.1.4 A Water Treatment Area (WTA) to collect road drainage from the new section of motorway and link road is proposed within the eastern area of the Metal Recovery Area, north of the main alignment and just east of the link road to the A4810. The proposed WTA is anticipated to comprise a lined storage/dilution lagoon to an approximate depth of 1.5 m below current ground level.

3.1.5 As part of the Scheme, a new/replacement maintenance depot (Glan Llyn Depot) is to be constructed in the north western corner of the Metal Recovery Area of the site.

3.1.6 The Scheme design proposes to reconstruct the southern area of Reedbed No. 1 that is within the permanent land take to an approximately equal sized area to the north east (see Figure 3). This is to maintain the functionality of Reedbed No. 1.

4 Site History

4.1.1 The 2014 PSSR historical searches have been based on Ordnance Survey plans, literature reviews, information provided by Natural Resources Wales (NRW) (formerly Environment Agency Wales) and Newport City Council and interpretation of historical aerial photography. This is supplemented by a review of historical maps obtained in 2015 from the Welsh Government. Relevant extracts and historical aerial photography are presented in Appendix 7.

4.1.2 A summary of the Site's history is presented in Table 2.

Table 2: Site History

Date	Use	Source of information
1843 - 1893	Reedbed No. 1 and the Metal Recovery Area comprise of a number of agricultural fields traversed by ditches and reens.	1:10,560 historical mapping
1891 - 1912	No significant change.	1:10,560 Historical mapping
1904 - 1939	No significant change.	1:10,560 historical mapping
1920	No significant change.	1920 OS map
1962	Llanwern Steelworks operation commenced.	2014 PSSR
1964 - 1965	**Spencer Steelworks** has been developed within the Metal Recovery area (northern half), including **slag heaps, slag processing plant, conveyors, tanks and hoppers**. Agricultural fields are shown in the southern half of the Metal Recovery area and Reedbed No.1. A drain forms the eastern, southern and western boundaries of this area. The triangular shape zone in the centre of the Site is shown to be wetland/marsh.	1:10,560 historical mapping
1969	**Bare ground, probable infilling or land raising and stockpiles** identified in the Metal Recovery Area (northern half).	Aerial photography
1970 - 1973	Spencer Steelworks described as '**Slag Processing Plant**'.	1:10,000 historical map
1979	**Expansion of earthworks/slag heaps** in the Metal Recovery Area/Slag Processing Plant. The triangular shape zone in the centre of the wetland between the Reedbed No.1 and the Metal Recovery Area appears to have been split into rectangular sections. This may represent reedbeds associated with the industrial works, prior to the use of Reedbed No.1 however this is not confirmed.	Aerial photography
1981	A track runs along the eastern boundary of Reedbed No.1	Aerial photography
1985	Bare ground/discolouration of vegetation in the central area of the Site, perhaps associated with reedbed activity in this area. A track is present, central to the north.	Aerial photography
1985 - 1996	A pond is identified in the central area of the triangular shape area between Reedbed No.1 and the Metal Recovery Area, adjacent to the northern boundary.	1:10,000 historical mapping

Date	Use	Source of information
	The slag stockpiles are covering much of the Metal Recovery Area. Reedbed No.1 still shown as agricultural fields.	
1991	Bare ground/spoil heaps are identified in the central area of the Site, adjacent to the pond. **Bunds/ditches appear to have been constructed across Reedbed No.1**, splitting the area into sections. **An area of bare ground** is identified within the southernmost reedbed in the south-western corner which indicates that Reedbed No 1 had not yet been constructed in the area. Building infrastructure, broadly similar to the current layout, identified in the south western corner of the Metal Recovery Area.	Aerial Photography
2006	Further **buildings and tanks** in the south-western area of the Metal Recovery Area. Pond water and disturbed ground observed in the central triangular area. No significant changes in Reedbed No. 1, other than the southern tip appears now to be part of the reedbed system.	Aerial photography
2013/2014	Buildings associated with the former Spencer Steelworks in the north-western area of the Metal Recover Area have been **demolished, concrete slabs and foundations remain.**	Aerial Photography

Note: Potential sources of contamination underlined. Those within the temporary and permanent land take are shown in **bold**.

4.1.3 The additional sources of information presented above supplement those used in the 2014 PSSR. Of particular note is that the slag processing works in the Metal Recovery Area have been identified as early as 1964 as opposed to 1981 reported in the PSSR.

4.1.4 The Site was used as bombing decoy site during World War II which is described in detail within the 2014 PSSR (Ove Arup & Partners, 2014) and the Explosive Ordnance Threat Assessment Report (Bactec, 2014). There is thus a risk from unexploded ordnance at the Site which is categorised as a medium risk site however no known incidents of buried unexploded ordnance at the Site have been identified.

5 Environmental Setting

5.1 Geology

5.1.1 British Geological Survey (BGS) records show Tidal Flat Deposits (TFD), comprising layers of sand, gravel and peat underlying the site. The underlying solid geology is that of the Mercia Mudstone Group comprising weathered mottled and often fractured mudstones.

It is anticipated that Made Ground (fill) materials associated with arisings from the Steelworks are present within the areas of Reedbed No.1 and the Metal Recovery Area.

5.2 Hydrology

5.2.1 The Site is situated within a low lying area known as the Gwent Levels, with many surface water reens and ditches traversing through the Site. Blackwall Reen and Monks Ditch flow from north to south beyond the eastern boundary of the Site. Ellen Reen and Middle Reen flow into Blackwall Reen to the south of the Site. These reens and other surface waters are shown on Figure 3. They connect with the Gwent Levels SSSI wider network of reens and ditches, located south and west of the new section of motorway.

5.3 Hydrogeology

5.3.1 NRW records indicate that the clay rich TFD are classified as non-productive strata (negligibly permeable). The Mercia Mudstone Group strata are classified as a Secondary B aquifer (variably permeable).

5.3.2 Groundwater is anticipated to be present between the interface of the bedrock strata and TFD. Further, perched water may be encountered at shallow depth within the Made Ground, above the clay strata or the TFD.

5.4 Environmental Information

5.4.1 This section summarises the information held by NRW relating to the Site and its vicinity.

5.4.2 There are no environmental permits associated with Reedbed No.1 and the Metal Recovery Area. Those located within the vicinity are shown in Table 3.

Table 3: Environmental Permit (off site)

Licence	Year	Release Environment	Substances Released	Comments
Company: Cambrian Stone Ltd Industry: Metal Process: Ferrous metals				East of Metal Recovery Area
AD1925	1998 to 2001	Air	Particulate matter – total sulphur oxides	
Company: Air Products (GB) Ltd and (BR) Ltd Industry: Fuel and Power Process: Gratification and refining etc.				East of Metal Recovery Area
AF7002 and BL2459IC	1998 to 2012	Reuse	Special waste (7000 g)	
		Disposal-incineration	Special waste (100 g)	
		Disposal- landfill	Special waste (59.64 t)	
		Air	Carbon dioxide, carbon monoxide and nitrogen oxides (as NO_2)	
Company: Tata Steelworks UK Limited Industry: Metal Process: Ferrous metals				Main Steelworks works area, to the north, across the A4810.
BS3905IP	2004 to 2012	Air	Particulate matter – total sulphur oxides, carbon monoxide, carbon dioxide, methane, nitrous oxides, VOCs inorganic chlorine compounds, hydrogen chloride	
		Water	Heavy metals, cyanides, nitrogen, phenols, TOC	

5.4.3 Two companies located within 300 m to the north of the site hold industrial pollution licences. These are Koppers UK LTD which had a licence for landfill disposal and air pollution until 2000; and, Multiserv (ASR) LTD which had two air pollution licences until 2002.

5.4.4 Two authorised landfill sites and one under closure have been recorded to the east as detailed in Table 4 below and shown on Figure 3. These three permitted areas are discussed in detail in Volume 2 of Land Contamination Assessment Report CL-26.

Table 4: Authorised Landfills Outside the Site Boundary

Landfill Name and Address	Location	Licence Type [Licence Reference]	Licence Status
Corus Strip Products PPC Llanwern Landfill, South Side of the A4810	Covering the central section of CL-26 including Lagoons 12, 25 and 26 – adjacent and to the east of the Site.	Industrial waste landfill (Factory curtilage)	Modified (under closure)
Tata Steelworks UK Limited, South Side of the A4810 Llanwern Landfill	Covering Lagoon 26 – 950 m east of the Site	Waste Landfilling; >10 T/D with capacity >25,000T excluding inert waste	Effective
Tata Steelworks UK Limited, Llanwern Works	Covering Lagoon 27	Industrial waste landfill (Factory curtilage) [EPR/BS3905IP]	Effective

5.4.5 One historic landfill was recorded to the east of CL-26, as detailed in Table 5 and shown on Figure 3.

Table 5: Historic Landfills within Site Boundary

Landfill Name and Address	Location	Material Type	Date Waste First and Last Received
Llanwern Steelworks Land adjacent to 1-3 Blast Furnacre Corus, Llanwern Works (CL-27 site)	Adjacent to the eastern boundary of CL-26 encompassing Reedbed No.2 – 1.5 km east of the Site	Industrial waste and liquid sludge	Nov 1981 – June 1984

5.4.6 The environmental information held by NRW confirms the various off site land activities and in particular the metal steel works to the north and waste lagoons to the east could represent potential contamination sources that require due consideration in relation to the Scheme.

6 Scope of Investigations

6.1 General

6.1.1 Six previous ground investigations have been undertaken at the Site since 2002 and these have been summarised in the following sections. No data is available for the triangular shape zone between Reedbed No.1 and the Metal Recovery Area.

6.2 Scope of Works

6.2.1 The various intrusive ground investigations undertaken within the Site are summarised in Table 6. A number of boreholes have also been drilled to the south of the Site but within the Scheme land take. These have been considered in order to support understanding of the groundwater quality and gas regime if relevant. The sampling locations are shown on Figures 1a and 1b.

Table 6: Site Investigation Summary

Site Location	Date	Contractor	Boreholes	Window Sampler	Trial Pits	Sampling
Reedbed No. 1	2002	Exploration Associates	RBBH6-10	-	RBTP1-12	Soil & groundwater
	2008	Norwest Holst	SBHJ01 CP	SWSJ01, SWSJ01A, SWSJ01B, SWSJ02, SWSJ03, SWSJ04, SWSJ05, SWSJ06, SWSJ06A, SWSJ06B, SWSJ07, SWSJ08	-	Soil, groundwater & leachate
	2015	Geotechnical Engineering Limited	BH508, BH509	-	-	Soil, groundwater & leachate
Metal Recovery Area	2002	Exploration Associates	CABH1-3	-	MRTP1-5 CATP1-2, 5-10	Soil, groundwater & leachate
	Jan 2005	Exploration Associates	-	-	TP2-6 TP8-13	None recorded
	Aug 2005	Exploration Associates	BH1-5	WS2, WS3, WS4, WS5, WS5A, WS6, WS7, WS8, WS9, WS10	TP1-6	Groundwater
	Jul 2006	Exploration Associates	BH06-09 BH12-21	-	-	Groundwater
	2015	Geotechnical	BH510 (off	-	TP504	Soil,

Site Location	Date	Contractor	Boreholes	Window Sampler	Trial Pits	Sampling
		Engineering Limited	site) BH511, BH512			groundwater & leachate

6.2.2 The construction details of all boreholes installed with monitoring wells on the Site are summarised in Table 7. Boreholes with monitoring wells are shown on Figures 1a and 1b.

Table 7: Summary of Borehole Construction Details

Site Area	Borehole ID	Diameter (mm)	Total Drilled Depth (m)	Top of Slotted Well Casing / Gravel Pack (m bGL)	Base of Slotted Well Casing / Gravel Pack (m bGL)	Targeted Geology
Reedbed No. 1	RBBH6	50	7	0.8	7	Made Ground / TFD (Peat)
	RBBH7	50	7	0.8	7	Made Ground / TFD (Peat)
	RBBH8	50	7	1	7	Made Ground / TFD (Peat)
	RBBH9	50	7	1	7	Made Ground / TFD (Peat)
	RBBH10	50	7	1	7	Made Ground / TFD
	SWSJ08	50	4	0.3	3.3	Made Ground / TFD
	SBHJ01CP	50	14.5	5.8	7.5	TFD (Peat)
	BH509	35		4.3	7.7	TFD
		50	20.5	10.8	13.2	TFD
Metal Recovery Area	CABH1	50	6.0	2.9	6.0	TFD
	CABH2	50	6.0	0.5	3.0	Made Ground
	CABH3	50	6.0	0.8	3.2	Made Ground
	BH1	50	3.3	0.8	3.3	Made Ground / TFD
	BH2	-	2.3	0.5	2.3	Made Ground / TFD
	BH3	50	3.2	1.0	3.2	Made Ground / TFD
	BH4	50	3.5	1	3.5	Made Ground / TFD
	BH5	50	3.2	1	2.6	Made Ground
	BH06	-	2.5	0.5	2.5	Made Ground / TFD
	BH07	-	3.3	0.5	3.0	Made Ground / TFD
	BH08	-	2.5	0.5	2.5	Made Ground / TFD
	BH09	-	2.5	0.5	2.5	Made Ground / TFD
	BH12	-	1.7	0.5	1.7	Made Ground / TFD
	BH13	-	2.5	0.5	1.6	Made Ground
	BH14	-	2.5	0.5	1.8	Made Ground

Site Area	Borehole ID	Diameter (mm)	Total Drilled Depth (m)	Top of Slotted Well Casing / Gravel Pack (m bGL)	Base of Slotted Well Casing / Gravel Pack (m bGL)	Targeted Geology
	BH15	-	1.2	0.5	1.2	Made Ground
	BH16	-	3.5	0.5	3.5	TFD
	BH17	-	2.5	0.5	2.5	Made Ground / TFD
	BH18	-	3.5	0.5	3.5	Made Ground / TFD
	BH19	-	3.0	0.5	3.0	Made Ground / TFD
	BH20	-	3.0	0.5	3.0	Made Ground / TFD
	BH21	-	3.8	0.5	3.8	Made Ground / TFD
	SBHJ03 CP (off site)	50	13.0	3.4	5.2	TFD (Peat)
	BH510 (off site)	35		3	6.0	TFD (Peat)
		50	22.3	9.5	12	TFD / TFD (Peat) / MM
	BH512	35		0.85	2.1	Made Ground
		50	25.2	6.8	11.2	TFD

Notes: TFD = Tidal Flat Deposits. MM = Mercia Mudstone.

6.3 Surface Water Quality Monitoring

6.3.1 Surface water quality monitoring has been undertaken at a number of locations surrounding the Site which are shown in Figure 3 and summarised in Table 8. Sampling has previously been undertaken in 2002, 2004 and 2005 by Enviros Consulting (Enviros, 2006) and between 2007 and 2008 as part of the Titan surface water sampling regime (Titan, 2008) as well as the more recent supplementary Ground Investigation (Geotechnical Engineering, 2015). Sampling has also been undertaken by RPS (2015) as part of the supplementary works commissioned by Welsh Government as part of the Baseline Water Environment Report (Appendix 16.2 of the ES) which presents the baseline water quality monitoring programme of watercourses located near the new section of motorway.

Table 8: Surface water monitoring locations

Surface Water Location ID	Location Description	Comments
EL reen 1	Located 500 m south-west of the Site on Chapel Reen	-
MDSWN	Unknown	-
MDSWS	Located 140 m south of the Site on Monks Ditch	-
R10/ IDB 69-10	Located 280 m south of the site on a drainage ditch	Flow was recorded as slack and slightly turbid.
R11 / IDB 68	Located 540 m south of the site on Ellen Reen	-
R12 / EA 26	Located 400 m south of the site on Blackwall Reen	-

Surface Water Location ID	Location Description	Comments
SW501	Located 580 m west of the site on drainage ditch opposite Julian's Reen.	-
SW502	Located on drainage ditch in the north-west corner of the site on the boundary	-
SW503	Located on drainage ditch in south-west corner of the site on the boundary	-
SW504	Located 60 m north of the site on Monks Ditch	-
14.2	Located approximately 550 m south of the site on Chapel Reen	-
15.3	Located 488 m south of the site on Monks Ditch	-

6.4 Field Testing

6.4.1 Photo Ionisation Detector (PID) monitoring for Volatile Organic Compounds (VOCs) was undertaken on samples from both Reedbed No. 1 and the Metal Recovery Area. The samples monitored and results are presented in Table 9. Locations and depth ranges from which all PID readings are of 0.0ppm have been omitted from the results in Table 9.

Table 9: PID monitoring results

Location	Samples Monitored	Results
Reedbed No. 1	SBHJ01, SWSJ01, SWSJ02, SWSJ04, SWSJ05, SWSJ06, SWSJ06B, SWSJ07, SWSJ08, BH508 and BH509	SWSJ01 0.3 m @ 70.9 ppm SWSJ07 4.0-6.0 m @ 1.9-4.8 ppm BH508 0.0-8.5m @ 0.5-17.5 ppm BH509 0.5-6.5m @ 0.2-1.0 ppm
Metal Recovery Area	SBHJ03 (off site), BH511 and BH512	SBHJ03 3.0-4.0m @ 0.6-0.9 ppm BH511 3.0m @ 0.9 ppm, 4.5m @ 1.0 ppm

6.4.2 Flame Ionisation Detector (FID) monitoring was undertaken on samples from the Metal Recovery Area. The samples monitored and results are presented in Table 10.

Table 10: FID monitoring results

Location	Samples Monitored	Results
Metal Recovery Area	TP1, TP2, TP3, TP4, TP5, TP6 (Aug 2005) WS2, WS3, WS4, WS5, WS6, WS7, WS8, and WS9.	TP1 0.3 m @ 1 ppm, 1.0 m @ 8 ppm TP2 1.7 m @ 8 ppm TP3 0.9 m @ 5ppm, 1.2 m @ 30 ppm TP4 0.6-1.6 m @ 12-20 ppm TP5 0.4-1.3 m @ 2-15 ppm TP6 0.5 m @ 4 ppm, 1.3 m @ 20 ppm WS2 1.5 m @ 27 ppm WS3 0.7-4.0 m @ 2-90 ppm WS6 3.6 m @ 15 ppm WS8 1.7-3.0 m @ 3-49 ppm WS9 1.0-1.5 m @ 12-40 ppm

6.5 Groundwater Monitoring

6.5.1 A summary of the groundwater sampling and monitoring and ground gas monitoring rounds is shown in Table 11.

Table 11: Summary of Monitoring Rounds

Site Area	Location Ref.	Total number of monitoring rounds (date of sampling rounds)	Monitoring details	Notes
Reedbed No. 1	RBBH6	3 no. (2002 – dates unknown)	Groundwater sampling	Monthly groundwater level monitoring understood to have been undertaken from Nov 2003 – Jan 2005 however data is unavailable for review.
	RBBH7	5 no. (3 no. in 2002 – dates unknown, 27th February 2008, 19th March 2008)	Groundwater sampling	Monthly groundwater level monitoring understood to have been undertaken from Nov 2003 – Jan 2005 however data is unavailable for review.
	RBBH8	3 no. (2002 – dates unknown)	Groundwater sampling	-
	RBBH9	5 no. (3 no. in 2002 – dates unknown, 27th February 2008, 19th March 2008)	Groundwater sampling	-
	RBBH10	5 no. (3 no. in 2002 – dates unknown, 27th February 2008, 19th March 2008)	Groundwater sampling	-
	SWSJ08	6 no. (1st February 2008, 21st February 2008, 6th March 2008, 19th March 2008, 3rd April 2008, 17th April 2008)	Groundwater level & sampling	-
	SBHJ01CP	6 no. (1st February 2008, 21st February 2008, 6th March 2008, 19th March 2008, 3rd April 2008, 17th April 2008)	Groundwater level & sampling	-
	BH509 (shallow)	4 no. (4th March 2015, 11th March 2015, 18th March 2015, 6th May 2015)	Groundwater level & sampling, ground gas	-
	BH509	4 no. (4th March 2015, 11th	Groundwater	-

Site Area	Location Ref.	Total number of monitoring rounds (date of sampling rounds)	Monitoring details	Notes
	(deep)	March 2015, 18th March 2015, 6th May 2015)	level & sampling	
Metal Recovery Area	CABH1	5 no. (14th March 2002, unknown date, 17th April 2002, 1st February 2003, 1st June 2004)	Groundwater sampling	Monthly groundwater level monitoring understood to have been undertaken from Nov 2003 – Nov 2004 however data is unavailable for review.
	CABH2	3 no. (14th March 2002, unknown date, 17th April 2002)	Groundwater sampling	-
	CABH3	2 no. (14th March 2002, 17th April 2002)	Groundwater sampling	-
	BH1-5	1 no. (June 2005)	Groundwater sampling	Further monitoring rounds may have been undertaken however no further data is available.
	BH06-09, 12-21	1 no. (June 2006)	Groundwater sampling	Further monitoring rounds may have been undertaken however no further data is available.
	SBHJ03 CP	6 no. (1st February 2008, 27th February 2008, 7th March 2008, 19th March 2008, 3rd April 2008, 17th April 2008)	Groundwater level & sampling	-
	BH510 (shallow)	4 no. (4th March 2015, 12th March 2015, 18th March 2015, 7th May 2015)	Groundwater level, ground gas	-
	BH510 (deep)	4 no. (4th March 2015, 12th March 2015, 18th March 2015, 7th May 2015)	Groundwater level & sampling	-
	BH512 (shallow)	4 no. (21st April 2015, 28th April 2015, 6th May 2015, 14th May 2015)	Groundwater level, ground gas	-
	BH512 (deep)	4 no. (21st April 2015, 28th April 2015, 6th May 2015, 14th May 2015)	Groundwater level & sampling	-

6.6 Laboratory Chemical Testing

6.6.1 A summary of all the laboratory analysis undertaken on soil, groundwater, leachate and surface water from the previous site investigations is shown in Table 12.

Table 12: Summary of Previous Investigation Sampling

Site Area	Site Investigation Date	No. of Soil Samples	No. of Leachate Samples	No. of Water Samples	Suites of Testing
Reedbed No. 1	2002	21	-	21	Metals, pH, phenol, sulphate, chloride, cyanide, ammoniacal N.
	2008	18	9	4	Metals, pH, phenol, sulphate, sulphide, chloride, cyanide, asbestos, ammoniacal N, TPH, PAH, polychlorinated biphenyl (PCBs), BTEX, VOCs and SVOCs
	2015	2	1	6	Metals, pH, phenol, sulphate, sulphide, chloride, cyanide, asbestos, ammoniacal N, TPH, PAH, PCBs, BTEX, VOCs and SVOCs
Metal Recovery Area	2002	45	5	11	Metals, pH, phenol, sulphate, chloride, cyanide, ammoniacal N, phosphorus, fluoride, phenols, TPH, PAH, VOCs
	Jan 2005	-	-	-	None
	Aug 2005	-	-	5	TPH, PAH
	2006	-	-	13	TPH, PAH
	2008	2 soil samples from SBHJ03 CP. Not included within this assessment as not within the Scheme area.	-	2	Metals, pH, alkalinity, hardness, BOD, COD, potassium, sodium, sulphate, chloride, sulphide, ammoniacal N, nitrate, phenol, TPH, PAH, PCBs, BTEX, VOCs and SVOCs
	2015	8	1	12	Metals, pH, phenol, sulphate, sulphide, chloride, cyanide, asbestos, ammoniacal N, TPH, PAH, PCBs, BTEX, VOCs and SVOCs

Soil Analysis

6.6.2 The following sections summarise the laboratory analytical results for soil samples collected during the various intrusive investigation phases. The available data set has been tabulated and is presented in Appendix 3. Supporting laboratory

certificates are available in the relevant original ground investigation reports (see Table 6).

6.6.3 To help inform the conceptual ground model, the analytical data from the Made Ground has been assessed separately from those of the natural soils (Tidal Flat Deposits specifically).

6.6.4 For the purpose of meeting the requirements of Volume 4, Section 1, Part 2 of the DMRB (HD22/08 – Managing Geotechnical Risk – 2008 (Highway Agency, 2008), the historical data used to support the PSSR and the additional 2015 information (Geotechnical Engineering, 2015) have been differentiated in the following sections.

6.6.5 The available information has been summarised in Table 13.

Table 13: Summary of Soil Leaching Analytical Data

Site Area	Formation Unit	Number of Soil Analysis per Analytical Suite - 2015 data / All GI data								
		Metals & Inorganics	Asbestos	PAH	TPH	Phenol	BTEX	VOCs	SVOCs	Polychlorinated Biphenyl
Reedbed No.1	Made Ground	1/26	1/12	1/13	1/12	1/26	1/13	0/12	0/12	0/11
	Natural Soils	1/15	0/7	1/8	1/8	0/14	0/7	0/7	0/7	0/7
Metal Recovery Area	Made Ground	7/33	7/10	7/18	5/18	4/30	2/4	0/2	0/2	4/4
	Natural Soils	1/16	1/1	1/8	1/7	1/16	0/1	0/1	0/1	0/0
	Field Logs Unavailable to Confirm	0/4	0/0	0/1	0/3	0/4	0/0	0/0	0/0	0/0

Soil Leaching Analysis

6.6.6 Similarly to the soils data, the soil leachate results have been considered for the Made Ground and natural soils separately. The available information is presented in Appendix 6 and summarised in Table 14.

Table 14: Summary of Soil Leaching Analytical Data

Site Area	Formation Unit	Number of Soil Leachate Analysis per Analytical Suite - 2015 data / All GI data					
		Metals & Inorganics	PAH	TPH	Phenol	BTEX	Polychlorinated Biphenyl
Reedbed No. 1	Made Ground	1/8	1/1	1/1	1/1	1/1	0/0
	Natural Soils	0/2	0/0	0/0	0/0	0/0	0/0
Metal Recovery Area	Made Ground	1/4	1/1	1/1	1/1	1/1	0/0
	Natural Soils	0/2	0/0	0/0	0/0	0/0	0/0

Groundwater Analysis

6.6.7 The laboratory analytical results for groundwater samples collected during the various intrusive investigation phases have been tabulated in a table format and is presented in Appendix 4. Supporting laboratory certificates available in the relevant original ground investigation reports listed in Table 6.

6.6.8 The available data relates to water samples taken from wells installed within the Made Ground and the groundwater of the Fluvial Glacial Deposits are summarised in Table 15.

Table 15: Summary of Analytical Groundwater Data

Site Area	Groundwater Unit (geological formation)	Number of Groundwater Analysis per Analytical Suite (number of well locations) – 2015 data / All GI data							
		Metals & Inorganics	PAH	TPH	Phenol	BTEX	VOC	SVOC	Polychlorinated Biphenyl
Reed bed No.1	Perched (Made Ground / Tidal Flat Deposits)	0 (0) / 23 (7)	0 (0) / 13 (7)	0 (0) / 13 (7)	0 (0) / 8 (7)	0 (0) / 23 (7)	0 (0) / 10 (7)	0 (0) / 8 (7)	0 (0) / 0(7)
	Perched (Tidal Flat Deposits)	6 (1) / 8(2)	6 (1) / 8 (2)	6 (1) / 8 (2)	6 (1) / 8 (2)	6 (1) / 8 (2)	0 (1) / 2 (2)	0 (1) / 2 (2)	6 (1) / 6 (2)
Metal Recovery Area	Perched (Made Ground)	0 (0) / 3 (4)	0 (0) / 3 (4)	0 (0) / 4 (4)	0 (0) / 3 (4)	0 (0) / 1 (4)	0 (0) / 1 (4)	0 (0) / 0 (4)	0 (0) / 0 (4)
	Perched (Made Ground / Tidal Flat Deposits)	0 (0) / 2 (15)	0 (0) / 12 (15)	0 (0) / 15 (15)	0 (0) / 2 (15)	0 (0) / 2 (15)	0 (0) / 2 (15)	0 (0) / 0 (15)	0 (0) / 0 (15)
	Perched (Tidal Flat Deposits)	6 (2) / 12 (5)	6 (2) / 11 (5)	6 (2) / 10 (5)	6 (2) / 11 (5)	6 (2) / 13 (5)	6 (2) / 13 (5)	3 (1) / 5 (4)	3 (1) / 3 (4)
	Aquifer (Mercia Mudstone)	3 (1) / 3 (1)	3 (1) / 3 (1)	3 (1) / 3 (1)	0 (1) / 0 (1)	3 (1) / 3 (1)	0 (1) / 0 (1)	0 (1) / 0 (1)	0 (1) / 0 (1)

Surface Water Analysis

6.6.9 Table 16 summarises the laboratory analytical results for surface water samples collected during the various intrusive investigation phases. The available data set has been tabulated and is presented in Appendix 5 with the supporting laboratory certificates available in the relevant original ground investigation reports.

Table 16: Summary of Analytical Surface Water Data

Surface Water System	Number of Water Analysis per Analytical Suite (number of locations) – 2015 data / All GI data						
	Metals & Inorganics	Water Quality Parameters	PAH	TPH	BTEX	Phenols	PCBs
Blackwall Reen	0 (0) / 4 (1)	0 (0) / 4 (1)	0 (0) / 0 (0)	0 (0) / 4 (1)	0 (0) / 0 (0)	0 (0) / 0 (0)	0 (0) / 0 (0)
Ellen Reen	0 (0) / 4 (1)	0 (0) / 4 (1)	0 (0) / 0 (0)	0 (0) / 4 (1)	0 (0) / 0 (0)	0 (0) / 0 (0)	0 (0) / 0 (0)
Julian's Reen	3 (1) / 3 (1)	3 (1) / 3 (1)	3 (1) / 3 (1)	3 (1) / 3 (1)	3 (1) / 3 (1)	3 (1) / 3 (1)	3 (1) / 3 (1)
Monks Ditch	4 (2) / 8 (3)	4 (2) / 8 (3)	4 (2) / 6 (3)	4 (2) / 5 (3)	4 (2) / 4 (2)	3 (1) / 7 (2)	3 (1) / 3 (1)
Chapel Reen	1 (1) / 5 (2)	1 (1) / 5 (2)	1 (1) / 1 (1)	1 (1) / 1 (1)	1 (1) / 1 (1)	0 (0) / 4 (1)	0 (0) / 0 (0)
Drainage Ditch S	0 (0) / 4 (1)	0 (0) / 4 (1)	0 (0) / 0 (0)	0 (0) / 4 (1)	0 (0) / 0 (0)	0 (0) / 0 (0)	0 (0) / 0 (0)
Drainage Ditch NW	3 (1) / 3 (1)	3 (1) / 3 (1)	3 (1) / 3 (1)	3 (1) / 3 (1)	3 (1) / 3 (1)	3 (1) / 3 (1)	3 (1) / 3 (1)
Drainage Ditch SW	3 (1) / 3 (1)	3 (1) / 3 (1)	3 (1) / 3 (1)	3 (1) / 3 (1)	3 (1) / 3 (1)	3 (1) / 3 (1)	3 (1) / 3 (1)

6.7 Gap Analysis of Available Data

Reedbed No. 1

6.7.1 Ground investigation data is available from both the northern and southern areas of Reedbed No.1 and is particularly concentrated in the south within the new section of motorway land take area.

6.7.2 No groundwater analytical data is available from the Mercia Mudstone aquifer.

6.7.3 All shallow response zones in this area of the Site are either installed within the Tidal Flat Deposits or cross the boundary between the Made Ground and Tidal Flat Deposits. There are no monitoring well installations within the Made Ground alone and thus the presence and contamination status of perched water within the Made Ground is not known.

6.7.4 Soil gas data is only available from one location (BH509) from within the Tidal Flat Deposits just beyond the southern boundary of Reedbed No. 1. Thus, there is neither soil gas data relating to shallow Made Ground nor data on peat deposits in this area.

Metal Recovery Area

6.7.5 Ground investigation data is concentrated along the western side of the Metal Recovery Area. Previous ground investigations undertaken along the southern boundary, within the footprint of the proposed new section of motorway alignment, are limited.

6.7.6 No ground investigation data is available within the footprint of the proposed link road between A4810 and the Glan Llyn junction and only limited data is available within the proposed Water Treatment Area.

6.7.7 The available data for groundwater within the Mercia Mudstone Secondary B aquifer is limited to one location (BH510) located south of the Site.

6.7.8 No data is available for the central area of the Site, between the eastern boundary of Reedbed No.1 (as defined within the 2014 PSSR) and the Metal Recovery Area, in the area to be used as replacement reedbeds to mitigate the loss of the southern tip of Reedbed No. 1.

7 Ground Conditions

7.1 General

7.1.1 The geological logs for all available exploratory holes excavated on or in close proximity to the Site are provided in Appendix 1. The observed sequence of natural and Made Ground material is consistent with those discussed in the 2014 PSSR report and is summarised in the following sections. Information from the supplementary Ground Investigation (Geotechnical Engineering, 2015) has also been used.

7.1.2 The geological sequence has been discussed for each area of interest, being Reedbed No.1 and the Metal Recovery Area.

7.2 Geology – Reedbed No. 1

Made Ground

7.2.1 The individual rectangular sections within Reedbed No. 1 are contained within bunds of mixed coarse and slurry slag material.

7.2.2 The previous ground investigations advanced boreholes on these bunds in the two north–south orientated sections (RBBH06, RBBH07 and RBBH 08) and on bunds/tracks surrounding the southern, east–west orientated area (RBBH09, RBBH10, SBHJ01, BH508 and BH509). This investigation confirmed the presence of slag gravel within these bunds, up to a maximum thickness of 3.5 m within RBBH07. Within RBBH07, RBBH08, RBBH09 and BH508, this coarse slag material was underlain by Made Ground of slightly gravelly clay with slag, up to 3.2 m in thickness (RBBH09). The base of the bunds which may be inferred from available logs vary widely between 0.8 and 4.67 m AOD.

7.2.3 Within the reedbeds, there is generally 1 to 2.4 m of Made Ground (sediment) identified as brown to black slightly sandy clay with many rootlets. Coarse slag inclusion were identified within SWSJ01 and SWSJ02. Within SWSJ05, the clay Made Ground was underlain by 100 mm of coarse slag.

7.2.4 The original ground level, prior to construction of the reedbed system, may be estimated to be at around 5 to 5.5 m AOD, using nearby exploratory locations from outside Reedbed No.1. Given the base of the Made Ground (bunds and sediment) is generally between 4 to 5.0 m AOD, this would infer no significant excavation of natural materials took place prior to Made Ground accumulation in the reedbed system.

7.2.5 BH509 appears to be located on the peripheral track running along the southern boundary. Made Ground was identified at this location up to 1.20 m bGL (5.25 m AOD), comprising gravel of limestone. No slag was identified at this location.

Superficial Deposits

7.2.6 Unconsolidated superficial deposits were encountered beneath the Made Ground within all boreholes. These comprised Tidal Flat Deposits comprising generally firm

grey/brown, frequently mottled orange brown silty Clay with occasional fragments of organic material, becoming soft or very soft with depth.

7.2.7 The deposits included a 1.5 to 3.2 m thick layer of peat, at between 3.5 and 5.7 m bGL (0.8-2.95 m AOD). This peat seems to be continuous beneath Reedbed No. 1 and extend beyond its footprint. The layer of peat was found to be directly beneath the Made Ground in RBBH07 and RBBH09 along the eastern boundary of Reedbed No. 1.

7.2.8 The coarse Fluvial Glacial Deposits known to be present in the general area were not encountered in any of the boreholes sunk within Reedbed No.1, although their present cannot be ruled out given their discontinuous nature.

Solid Geology

7.2.9 Below the Tidal Flat Deposits the Mercia Mudstone formation was encountered at depths of 13.0 to 14.61 m bGL (-6.55 to -8.2 m AOD). The Mercia Mudstone was typically described as very stiff / hard reddish brown sandy slightly gravelly clay becoming weak to extremely weak mudstone from between -9.65 to -13.80 m AOD.

Geological Sequence Summary

7.2.10 The general geological sequence identified during the previous ground investigations is summarised in Table 17.

Table 17: Summary of Geological Sequence – Reedbed No. 1

Unit	Description	Thickness Range (m)	Depth of Stratum (m AOD)
Made Ground (bunds)	Coarse slag commonly overlying fine material, forming retaining bunds around the reedbed system. Material becoming grey clay with slag gravel with depth	0.9 to 4.7	0.8 to 4.67
Made Ground within bunds (sediment)	Brown/grey/mottled orange occasionally sandy clay with frequent rootlets.	0.3 to 2.4	5.67 to 3.56
Superficial Deposits (Tidal Flat Deposits)	Silty clay, organic in places with one main peat layer (see below)	<12.05	-6.55 to -8.2
Superficial Deposits (Tidal Flat Deposits)	Peat	1.5 to 3.2	0.8 to 2.95
Mercia Mudstone (Mudstone)	Very stiff clay becoming weak Mudstone	>7.5	Unproven

7.3 Geology – Metal Recovery Area

Made Ground

7.3.1 Made Ground containing slag has been identified within all investigation locations across the Metal Recovery Area with the exception of BH16, which is located at the south western corner.

7.3.2 The composition of the Made Ground is variable across the area, however, ash, clinker, concrete and brick are commonly observed within a slag matrix. Observed thicknesses ranges from between 1.2 and 4.9 m (although typically 2.5 m), with a basal level range of between 1.6 to 3.95 m AOD, although datum levels are not available for all sampling locations.

7.3.3 The majority of the Made Ground is coarse (gravel and cobbles) with the exception of a gravelly clay observed within BH12, BH13, BH14 and BH21, between 0.2 and 0.5 m in thickness.

Superficial Deposits

7.3.4 Unconsolidated superficial deposits were encountered beneath the Made Ground in all locations, with the exception of those terminated within the Made Ground. They comprised Tidal Flat Deposits consisting of generally firm to stiff grey clay, occasionally mottled brown and occasionally sandy, becoming soft with depth.

7.3.5 The deposits included a layer of peat which was identified within five locations and between 2.2 and 2.4 m thick within boreholes BH511 and BH512 (4.5 to 6.7 m bGL / 1.6 to 0.3 m AOD). Soft black brown peaty clay was reported within boreholes BH12 BH13 and BH14, directly beneath the Made Ground.

7.3.6 The coarse Glaciofluvial Deposits known to be present in the general area were not encountered in any of the boreholes sunk within the Metal Recovery Area, although their presence cannot be ruled out given their discontinuous nature.

Solid Geology

7.3.7 The Mercia Mudstone Formation was encountered beneath the Tidal Flat Deposits in the south-eastern area of the Site within BH511 and BH512 at depths of 11.9 to 12.6 m bGL (-5.4 to -5.6 m AOD). The elevation of the top formation of the Mercia Mudstone is comparable but slightly lower than seen within Reedbed No.1. The elevation in this location is consistent with the levels seen in Lagoon 12 to the east of the Site.

7.3.8 The Mercia Mudstone was typically described as very firm to very stiff reddish brown slightly gravelly to very gravelly clay, becoming extremely weak mudstone (from -12.10 m AOD within BH512).

Geological Sequence Summary

7.3.9 The general geological sequence identified during the previous ground investigations is summarised in Table 18.

Table 18: Summary of Geological Sequence – Metal Recovery Area

Geological Unit	Description	Thickness Range (m)	Basal depth[(1)] (m AOD)
Made Ground	Variable - mostly coarse gravel comprising slag with occasional ash, clinker, brick concrete and other extraneous materials	1.2 to 4.9	1.6 to 3.95
Superficial Deposits (Tidal Flat Deposits)	Generally firm to stiff, occasionally sandy clay. Organic in places with at least one peat layer (see below)	1.2 to 4.9	1.6 to 3.95
Superficial Deposits (Tidal Flat Deposits)	Peat	2.2 to 2.4 (where proven)	-0.8 to -1.9
Mercia Mudstone (Mudstone)	Very stiff reddish brown clay with lithorelicts of mudstone becoming weak fractured mudstone	>13.3	Not proven

Note: [(1)] survey data based on limited exploratory location coverage.

7.4 Visual and Olfactory Evidence of Contamination

7.4.1 A summary of visual and olfactory evidence of potential contamination encountered during the previous ground investigations is summarised in Table 19.

Table 19: Visual and Olfactory Evidence of Contamination Summary

Site Area	Location ID	Depth (m bGL)	Strata	Evidence of Potential Contamination
Reedbed No.1	RBBH06, RBBH07, RBBH08, RBBH09, RBBH10, SWSJ01 SWSJ02, SWSJ05, SBHJ01, BH508	Various	Made Ground (CS)	Containing slag
	RBBH7	GL-3.5	Made Ground (CS)	Driller reports concrete
	RBBH8	GL-1.6	Made Ground (CS)	Driller reports contamination – no further details known
		1.6-4.1	Made Ground (SS)	Driller reports contamination, becoming less contaminated with depth – no further details known
	BH508	0.4-2.05	Made Ground (SS)	Containing gravel of tarmacadam
Metal Recovery Area	All locations excluding BH16 (outside Metal Recovery Area boundary)	Various	Made Ground (CS)	Containing slag
	CABH2	0.2-2.2	Made Ground	Ash
		2.2-2.9	Made Ground	Strong oily smell
		1.2-2.5	Made Ground (CS)	Brick and iron ore
	MRTP5	GL-2.5	Made	Ash and clinker

Site Area	Location ID	Depth (m bGL)	Strata	Evidence of Potential Contamination
			Ground (CS)	
	CATP1	GL-2.6	Made Ground (CS)	Asphalt boulders in slag. Hydrocarbon odour below 2.5 m
	CATP7	0.4-2.4	Made Ground (CS)	Brick & concrete. Hydrocarbon odour below 2.2 m
	CATP8	0.25-2.1	Made Ground (CS)	Hydrocarbon oil sheen on surface of gravel (beneath 0.15 m thickness of asphalt)
		2.5-2.7	Tidal Flat Deposits	Hydrocarbon oil pockets (<20 mm)
	TP2 (2004)	1.2-base	Made Ground (CS)	Hydrocarbon odour once water struck. Visible brown hydrocarbon floating on surface
	TP3 (2004)	0.2-0.4	Made Ground (CS)	Slag gravel stained black – strong hydrocarbon odour
		0.4-1.3	Made Ground (CS)	Concrete rubble, bricks and furnace bricks. Slightly blackened with hydrocarbon odour.
		1.3-base	Made Ground (CS)	Brown hydrocarbon flowing in from sides of pit once water struck at 1.3 m
	TP4 (2004)	0.3-base	Made Ground (CS)	Slag containing bricks, wood, metal and plastic. Strong hydrocarbon odour. Dark brown hydrocarbon flowing in from sides of pit once water struck at 1.4 m
	TP5 (2004)	1.5-base	Made Ground (CS)	Hydrocarbon odour once water struck. Water yellow and slightly oily (light brown lube oil)
	TP6 (2004)	1.6-base	Made Ground (CS)	Brown hydrocarbon seeping in at sides
	TP8 (2004)	1.7-base	Made Ground (CS)	Strong hydrocarbon odour
	TP9 (2004)	GL-0.3	Made Ground (CS)	Blackened slag gravel and cobbles. Furnace and house bricks
		0.75-0.85	Made Ground (CS)	Slag fused with black tarmac type material
		1.2-base	Made Ground (CS)	Visible hydrocarbon on water at 1.2 m
	TP10 (2004)	0.5-2.1	Made Ground (CS)	Slag blackened in areas. (Location area used historically as a soakaway for steam cleaning process)
	TP11 (2004)	1.3-base	Made Ground (CS)	Slight hydrocarbon sheen on water
	TP12 (2004)	0.5-1.6	Made Ground (CS)	Railway sleepers, concrete rubble and metal. Hydrocarbon odour on water from 1.2 m

Site Area	Location ID	Depth (m bGL)	Strata	Evidence of Potential Contamination
		1.6-base	Made Ground (possible reworked TFD)	Clay blackened with hydrocarbon
	TP13 (2004)	0.2-base	Made Ground (CS)	Blackened slag. Thick black tarry deposit with hydrocarbon odour between 0.35-0.45 m bGL. Walls of the pit seeping with thick light brown oily material and black oily deposit. Strong hydrocarbon odour and water blackened. Compacted concrete slab at base
	TP1 (2005)	0.4-2.1	Made Ground (CS)	Brick. Strong odour of hydrocarbon and free product visible on groundwater
	TP2 (2005)	1.7-base	Made Ground (CS)	Strong odour of hydrocarbon from 1.7 m. Slight sheen on groundwater
	TP3 (2005)	0.5-1	Made Ground (CS)	Strong odour of hydrocarbon
		1-1.4	Made Ground	Dense oily gravel. Much black oil in arisings
	TP4-6 (2005)	GL-base	Made Ground (CS	Concrete and ash and furnace bricks within slag. Slight to strong odour of. Free product on groundwater. Black tarry staining visible on sides of pit in TP4
	BH1	GL-2.8	Made Ground (CS)	Concrete brick and hardcore within slag
	BH2	GL-1.8	Made Ground (CS)	Concrete and ash within slag. Strong odour of hydrocarbon from 1.4 m associated with water strike
	BH3	GL-2.7	Made Ground (CS)	Concrete, brick and metal within slag. Strong odour of hydrocarbon from 1.6 m associated with water strike
	BH4	GL-3.0	Made Ground (CS)	Steelworks and brick within slag
	BH5	GL-2.7	Made Ground (CS)	Strong odour of hydrocarbon from 1.6 m associated with water strike
	WS2-6, WS8-10	GL-base of Made Ground	Made Ground (CS)	Concrete, ash and occasional cement within slag. Slight to strong odour of hydrocarbon associated with water strike in each. Slight oily sheen on arisings in WS3
	WS7	GL-2.6	Made Ground (CS)	Concrete within slag
	BH09	0.3	Made Ground (CS)	Hydrocarbon odour from 0.3 m
	BH17	GL-0.4	Made	Concrete within slag.

Site Area	Location ID	Depth (m bGL)	Strata	Evidence of Potential Contamination
			Ground (CS)	Hydrocarbon odour observed in groundwater.
	BH21	2.2	Made Ground (CS)	Kerosene odour at 2.2 m. Oily sheen on groundwater

Note: CS – Coarse Slag

7.4.2 Hydrocarbon contamination has been observed within the Made Ground and shallow Tidal Flat Deposits at most locations on the western side of the Metal Recovery Area where the new Glan Llyn Depot is being proposed. Hydrocarbon odour and free product was commonly associated with water strikes during the investigations in this area.

7.5 Gas Monitoring

7.5.1 The ground gas monitoring dataset collected during each of the three monitoring rounds of the 2015 investigation is summarised on the field data sheets provided in Appendix 2. The maximum gas concentrations (minimum for oxygen) are presented in Table 20.

Table 20: Summary of Gas Monitoring Data

Site Area	Location ID	Flow (l/hr)	VOCs (ppm)	CH_4 (%/vol)	Peak LEL (%)	CO_2 (%/vol)	O_2 (%/vol)	CO (ppm)	H_2S (ppm)
		Max.	Max.	Max.	Max.	Max.	Min.	Max.	Max.
Reedbed No.1	BH509 (shallow)	0.4	0.8	4.4	99.9	2.9	15.1	0	0
Metal Recovery (off site)	BH510 (shallow)	0.8	5.3	28.4	> 100%	6.1	11.2	0	0
Metal Recovery area	BH512 (shallow)	0	4.5	0.2	4	0.7	18.7	1	0

7.6 Groundwater Monitoring

Groundwater Encountered During Investigation

7.6.1 Groundwater strikes were encountered during the investigation phases, as detailed on the geological logs provided in Appendix 1. These are summarised in Table 21.

Table 21: Summary of Groundwater Level Data During Investigation

Site Area	Location	Strike Depth m bGL (m AOD)	Geological Formation	Level After 20 Minutes m bGL (m AOD)	Remarks
Reedbed No.1	RBBH6	0.8 (4.09)	Made Ground	No rise	Seepage
	RBBH7	0.8 (4.22)	Made Ground	No rise	Slow inflow
	RBBH8	0.8 (4.10)	Made Ground	0.2 (4.70)	Medium inflow
	RBBH9	1.4 (4.99)	Made Ground	1.1 (4.69)	Medium inflow
	RBBH10	1.1 (4.28)	Made Ground	0.9 (4.48)	Medium inflow
	RBTP1	0.3 (4.28)	Made Ground	-	Fast seepage
	RBTP10	0.1 (5.37)	Made Ground	-	Fast seepage
	RBTP11	0.2 (4.87)	Made Ground	-	Fast seepage
	SBHJ01 CP	13.4 (-6.83)	Mercia Mudstone Group	No rise	Seepage
	SWSJ02,03, 05-08	0.1-0.5 (5.46-6.55)	Made Ground	No rise	Seepage
	SWSJ04	0.4 (5.57)	Tidal Flat Deposits	No rise	Seepage
	BH508	3.0 (2.9)	Tidal Flat Deposits (Peat)	1.8 (4.1)	
		12.5 (-6.6)	Tidal Flat Deposits	7.9 (-2.0)	Fast flow
		14.2 (-8.3)	Mercia Mudstone Group	7.6 (-1.7)	Fast flow
	BH509	2.0 (4.45)	Tidal Flat Deposits	1.3 (5.15)	Medium flow
		14.5 (-8.05)	Mercia Mudstone Group	5.2 (1.25)	Fast flow
Metal Recovery Area	MRTP1	3.0	Made Ground	-	Fast seepage
	MRTP2, MRTP4	2.3	Made Ground	-	Moderate seepage
	MRTP3	1.5	Made Ground	-	Fast seepage
	CATP7	2.2	Made Ground	-	Fast seepage
	CATP8	1.75 (3.90)	Made Ground	-	Fast seepage
	CATP9	0.5 (5.14)	Made Ground	-	Slow seepage

Site Area	Location	Strike Depth m bGL (m AOD)	Geological Formation	Level After 20 Minutes m bGL (m AOD)	Remarks
	CATP10	1.2 (4.18)	Made Ground	-	Fast seepage
	CABH2	1.1 (4.62)	Made Ground	0.8 (4.92)	Moderate inflow
	CABH3	1.3 (4.36)	Made Ground	0.0 (5.66)	
	TP2-6, 8-18 (Jan 2005)	0.85-1.8	Made Ground	-	Free product on water commonly observed
	TP1-6 (Aug 2005)	1.1-2.0	Made Ground	-	Free product on water commonly observed
	BH1-5	1.4-1.7	Made Ground	-	Hydrocarbon odour associated with groundwater
	WS2-10	1.5-1.8	Made Ground	-	Hydrocarbon odour associated with groundwater
	BH06,16 & 20	2.0-3.0	Tidal Flat Deposits	-	
	BH07, 12-15, 17-19, 21	0.9-2.5	Made Ground	-	BH13 Sulphurous odour BH17 Hydrocarbon odour BH21 Sheen on water
	BH510 (off site)	2.0 (3.45)	Tidal Flat Deposits	1.95 (3.4)	
	SBHJ03 CP (off site)	5.2 (0.17)	Tidal Flat Deposits	No rise	Seepage
	BH512	1.7 (4.8)	Made Ground	No rise	Slow flow
		2.0 (4.5)	Made Ground	2.5 (4.0)	

Note: S denotes a shallow installation and D denotes deep installation.

Groundwater was not recorded in any other boreholes or trial pits during the previous investigations.

Groundwater Levels During Monitoring Rounds

7.6.2 The entire groundwater level dataset gathered on Site is provided in Appendix 2 and summarised in Table 22.

Table 22: Summary of Groundwater Level Data During Monitoring

Area	Location	Installation[1] Diameter (mm)	Depth of response zone (m bGL) and Geological Formation	No. Measurements	Min Depth (m bGL)	Max Depth (m bGL)
Reedbed No. 1	RBBH7	50	1 – 7 (Made Ground / PEAT)	5	0.66	1.1
	RBBH8	50	1 – 7 (Made Ground / PEAT)	n/a	n/a	n/a
	RBBH9	50	1 – 7 (Made Ground / TFD / PEAT)	5	1.18	1.25
	RBBH10	50	1 – 7 (Made Ground / TFD / PEAT)	5	0.68	0.82
	SWSJ08	50	0.3 – 3.3 (Made Ground / TFD)	6	0.37	0.46
	SBHJ01CP	50	5.8 – 7.5 (Peat)	6	1.34	5.98
	BH509	35 (S)	4.3 – 7.7 TFD	4	0.74	2.74
		50 (D)	10.8 – 13.2 TFD	4	1.95	3.74
Metal Recovery Area	SBHJ03 CP (off site)	50	3.4 - 5.2 (Peat)	6	0.54	0.82
	BH510 (off site)	35 (S)	3 - 6 Peat	4	0.44	2.28
		50 (D)	9.5 - 12 TFD / MMG	4	0.87	2.7
	BH512	35 (S)	0.85 – 2.1 Made Ground	4	1.3	1.64
		50 (D)	6.8 – 11.2 TFD	4	2.32	3.63

Note: [1] S denotes a shallow installation and D denotes deep installation.

Groundwater Summary

7.6.3 The main groundwater body is within the Mercia Mudstone formation which is confined by the overlying Tidal Flat Deposits. The Tidal Flat Deposits represent an aquitard to vertical groundwater flow based upon groundwater level in the Mercia Mudstone Formation aquifer observations during drilling. Monitoring groundwater level data indicate resting level to be shallow at 0.9 to 2.7 m bGL.

7.6.4 Discontinuous perched groundwaters are seen within the Tidal Flat Deposits, particularly associated with peat horizons. These are considered to represent discrete bodies with little vertical or lateral flow. Resting groundwater levels are similar to those identified in the Mercia Mudstone at 0.54 to 5.98 m bGL.

7.6.5 Water bodies were identified by the previous ground investigations within the peripheral bunds (coarse slag Made Ground) and also within the reedbeds of Reedbed No. 1. These are described as seepages to a medium inflow and are likely to be perched water over the underlying cohesive soils of the Tidal Flat Deposits.

7.6.6 Across the Metal Recovery Area, water bodies were identified by the previous ground investigations within the Made Ground. These are described as moderate to high inflow and are likely to be perched water over the underlying cohesive soils of the Tidal Flat Deposits. Strikes were observed generally between 0.5 and 1.5 m bGL.

8 Contamination Assessment

8.1 Introduction

8.1.1 The following sections provide details of the assessment of land contamination at the Site.

8.1.2 The Conceptual Site Model (CSM) presented within the 2014 PSSR has been reviewed and updated based on data from the Supplementary Ground Investigation (Geotechnical Engineering, 2015) and the current Scheme design . The main alterations to the PSSR model are summarised below.

- New contamination sources identified (perched water body within the Made Ground).
- Additional ground gas source (methane and/or carbon dioxide) considered from Made Ground and TFD including peat.
- Proposed use of band drains to accelerate surcharging of soft soils during construction. These are anticipated to be vertical drains installed in a grid pattern through the Made Ground and underlying Tidal Flat Deposits and to the top of the Mercia Mudstone.
- Piled foundations proposed for the link road junction; and
- Update of the source-pathway-receptor linkages taking account of the above and more detailed assessments.

8.2 Preliminary Risk Assessments

Potential Sources

8.2.1 The Made Ground was identified in the PSSR as a potential source of contamination (slag within the Metal Recovery Area and bunds and sediments in Reedbed No. 1). These sources are confirmed by the new data.

8.2.2 The transient perched water body within the Made Ground is considered to represent a potential contaminant source rather than a receptor.

8.2.3 The Made Ground and organic clays and peat deposits of the TFD may represent a potential source of ground gas. Ground gas flow from the TFD may increase following consolidation associated with the surcharge loading of the embankment.

8.2.4 In addition to the above sources, the quality of surface waters, perched groundwater and the deeper aquifer within the Glaciofluvial Deposits and Mercia Mudstone may influence or impact the quality of the others (for instance the groundwater within the Mercia Mudstone is saline whilst the surface water is not). Surface water, perched groundwater and deeper aquifer are therefore regarded as a possible source of contaminants as well as receptors.

Potential Receptors

8.2.5 The following receptors during the construction and the operational stages of the Scheme have been considered:

Construction

- Construction workers during site development works.
- General public/workers adjacent to construction works.
- Deep groundwater (aquifer) within the Mercia Mudstone.
- Nearby surface waters including the reens and existing surface water ditches bordering the surrounding fields.

Operational

- General public end users, including users of the proposed Glan Llyn Highways Depot.
- General public/workers outside permanent land take (e.g. land tenants of Tata Steel).
- Maintenance workers.
- Deep groundwater (aquifer) within the Mercia Mudstone.
- Nearby surface waters including the reens and existing and/or proposed surface water ditches bordering the surrounding fields.

Potential Pathways

8.2.6 The following pathways during the construction and the operational stages of the Scheme have been considered.

- Dermal contact, ingestion, inhalation pathways of potentially contaminated soils during construction and maintenance works.
- Dermal contact, ingestion, inhalation pathways for general public end users and adjacent general public/workers.
- Contaminated surface water run-off into land drainage surface waters.
- Vertical migration of impacted perched water within the Made Ground and/or leachate from the Made Ground into Tidal Flat Deposits and/or Mercia Mudstone aquifer due to band drain/pile installation.
- Vertical migration of aquifer (Mercia Mudstone) possibly recharging perched groundwater and/or perched water within the Made Ground due to band drain / pile installation.
- Lateral migration of perched water within the Made Ground to land drainage (surface waters).
- Leaching of contaminants from the Made Ground to shallow groundwater then migration to land drainage (surface waters).
- Vertical or lateral migration of ground gas associated with organic materials in Made Ground and natural soils including peat.
- Accumulation of ground gas within confined spaces during construction and operational phases.
- Migration of ground gases along band drains/piles.

8.3 Risk Evaluation

8.3.1 Source-pathway-receptor linkages were considered in the 2014 PSSR using the historical data available up to 2008. With review of the other data described herein, the following risk evaluation has been reconsidered and included the below.

- The new section of motorway is to be constructed at the Site on an embankment which will act as a barrier reducing pathways to future motorway users and maintenance workers from contaminated soils beneath;
- The motorway embankment will be typically 2.5 to 3 m above the original surrounding ground level through the Reedbed No. 1 area. The junction within the south-eastern corner of the Metal Recovery Area is to be some 14 m above the original ground level.
- Tidal Flat Deposits are classified as non-productive and overlie a secondary aquifer associated with the Mercia Mudstone.
- The low permeability Tidal Flat Deposits separate the Made Ground and aquifer.
- Perched groundwater within the Tidal Flat Deposits is not considered a water resource due to its low to negligible vertical hydraulic connectivity with the aquifer beneath.
- There are no nearby abstractions used for potable water.
- Hardstanding on the motorway will limit infiltration.
- The proposed use of band drains could create pathways from any potentially contaminated soils within or under the motorway embankment to the lower aquifer in the Mercia Mudstone. The use of band drains may also allow an increase in the influx of pore water from the Tidal Flat Deposits and aquifer into the Made Ground.
- Leachability of contaminants from the Made Ground.
- Presence of free product within perched groundwaters.
- The proposed drainage system may increase leaching of any contaminants from the Made Ground with an associated increase in the risk for migration into surface waters.
- Motorway users will be within an open environment with no proposed structures or other confined spaces.
- Risk of increased flux of ground gas emission due to induced consolidation of the TFD including peat from the proposed surcharge loading.
- The proposed WTA is to receive surface water from the highway and will be lined to prevent downward infiltration. Discharge of waters are to be controlled under a discharge consent and therefore the WTA is neither considered as a source or receptor in this report.
- The Made Ground is to be entirely encapsulated by the hardstanding of the proposed Glan Llyn Depot minimising the risk of all dermal, ingestion and inhalation of soil dust pathways to future site users and visitors. These pathways are therefore dismissed in the Conceptual Site Model.

8.4 Human Health Risk Assessment

8.4.1 The rationale and approach for the human health (Tier 2) screening assessment is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES). Soil chemical analysis results are presented in Appendix 3. All exceedances to the relevant generic risk assessment criteria are summarised in Tables 23, 24, 25, 26 and 27. For the purposes of this report, Made Ground and natural ground have been considered separately in each Site area.

Reedbed No.1

8.4.2 Exceedances of the soil chemical analysis results within the Reedbed No. 1 to the relevant generic risk assessment criteria are summarised in Tables 23 and 24.

Table 23: Summary of Human Health Soil Screening Exceedances Reedbed No.1 (Made Ground)

Determinant	Units	Range	Screening Criteria	No. Samples Exceeding Screening Criteria (Total Number of Results)	Location of Exceedances
Chromium	mg/kg	5.1 - 640	33	21 (26)	RBBH06, RBBH07 (x2), RBBH08 (x3), RBBH09 (x2), RBBH10, RBTP06, RBTP07, RBTP09, RBTP10, RBTP11, SWSJ01 (x2), SWSJ02, SWSJ03, SWSJ04, SWSJ06B (x2), SWSJ07, SWSJ08 (x2), SBHJ01CP, BH508
pH	pH units	4.93 - 12.8	6-9	14 (26)	RBBH06, RBBH07 (x2), RBBH08 (x3), RBBH09 (x2), RBBH10, SWSJ04, SWSJ07, SWSJ08, SBHJ01CP, BH508
Benzo(b)fluoranthene	mg/kg	<LOD - 42	13	1 (26)	SWSJ06B
Dibenzo(ah)anthracene	mg/kg	<LOD - 3.5	1.1	1 (26)	SWSJ06B

Table 24: Summary of Human Health Soil Screening Exceedances Reedbed No.1 (Natural Ground)

Determinant	Units	Range	Screening Criteria	No. Samples Exceeding Screening Criteria (Total Number of Results)	Location of Exceedances
Chromium	mg/kg	4.7 - 460	33	10 (15)	RBBH05 (x3), RBBH07, RBBH08 (x2), RBBH10, SWSJ02, SWSJ03, SWSJ04, SWSJ05 (x2), SWSJ07, SBHJ01CP, BH508
pH	pH units	7.1 - 11.6	6-9	5 (15)	RBBH07, RBBH08, RBBH10, SBHJ01CP, BH508

8.4.3 The exceedances for pH and chromium identified within the Made Ground cover the predominantly slag material as well as the sediments within the reedbeds.

8.4.4 Elevated alkaline soil conditions have been identified in over half of the samples within the Made Ground, mostly within samples of the coarse slag of the bunds and tracks. Alkaline conditions are also identified within the Tidal Flat Deposits material. Acidic conditions are identified within three of the samples from the sediment within the southern area of Reedbed No. 1.

8.4.5 Although exceedances of chromium are identified throughout the Made Ground (slag material and sediment) and natural soils, the criterion relates to the hexavalent form. Some of the results are considered to be above normal background data range (<95 mg/kg) and therefore may be considered to represent a potential contaminant source. Twelve of the forty one analyses exceed this background with a maximum concentration of up to 640 mg/kg. It is likely that the elevated chromium concentrations are related to the slag used to construct access roads and from the slag particles within the sediment. Further sampling and analysis is needed to determine whether the elevated levels relate to hexavalent chromium, although the latter is not anticipated based on the limited data from the Lagoons areas of Llanwern Steelworks (CL-26, Volume 2).

8.4.6 A single sample of Made Ground (SWSJ06B) was found to have two PAH compounds (benzo(b)fluoranthene and dibenzo(ah)anthracene) marginally in exceedance to the criteria, at 0.1 m bGL. This relates to sediment material within the reedbeds and may represent discrete raised contamination that may require improved delineation. Overall PAH is not considered to pose a significant risk to human health.

8.4.7 All phenols, PCBs and BTEX were at levels below the laboratory limit of detection. VOCs, SVOCs and TPH were identified at low levels and were below the assessment criteria.

8.4.8 No asbestos fibres were detected in the 19 soil samples analysed.

8.4.9 Fifteen samples were collected which targeted the fine Made Ground material within Reedbed No. 1. All samples were taken within the top 1 m and the

majority (87 %) are within the top 0.5 m. Considering the sediment within the reedbeds was encountered to 2.4 mbGL, it would be beneficial for the data set to expand on the vertical coverage of the total thickness. It is possible some stratification of the reedbed sediment and thus contamination levels may have occurred to reflect leaching or sedimentation processes as well as alteration to the Steelworks production processes over the years. No obvious trend with depth from those contaminants in exceedance is being identified in the current data set.

Metal Recovery Area

8.4.10 Exceedances of the soil chemical analysis results within the Metal Recovery Area to the relevant generic risk assessment criteria are summarised in Tables 25, 26 and 27.

Table 25: Summary of Human Health Soil Screening Exceedances – Metal Recovery Area (Made Ground)

Determinant	Units	Range	Screening Criteria	No. Samples Exceeding Screening Criteria (Total Number of Results)	Location of Exceedances
Chromium	mg/kg	36 – 1,800	33	33 (33)	CABH02, CABH03 (x2), CATP01 (x2), CATP02 (x2), CATP05, CATP06 (x2), CATP07 (x2), CATP08, CATP09 (x2), CATP10 (x2), MRTP01 (x2), MRTP02 (x2), MRTP03 (x2), MRTP04 (x2), MRTP05, BH511 (x3), BH512 (x4)
Nickel	mg/kg	2 – 18,000	980	1 (33)	BH512
TPH	mg/kg	<10 – 29,130	2,000	7 (14)	CATP02, CATP06 (x2), CATP07, CATP08, CATP09 (x2)
pH	pH units	9.4 – 12.9	6-9	33 (33)	CABH02, CABH03 (x2), CATP01 (x2), CATP02 (x2), CATP05, CATP06 (x2), CATP07 (x2), CATP08, CATP09 (x2), CATP10 (x2), MRTP01 (x2), MRTP02 (x2), MRTP03 (x2), MRTP04 (x2), MRTP05, BH511 (x3), BH512 (x4)

Table 26: Summary of Human Health Soil Screening Exceedances – Metal Recovery Area (Natural Ground)

Determinant	Units	Range	Screening Criteria	No. Samples Exceeding Screening Criteria (Total Number of Results)	Location of Exceedances
Chromium	mg/kg	3.8 – 55	33	10 (16)	CABH01, CABH02, CABH03 (x2), CATP01, CATP05, CATP07, CATP010, MRTP03, MRTP04
pH	pH units	7.5 – 11.4	6-9	9 (16)	CABH01, CABH02, CABH03 (x2), CATP01, CATP05 (x2), CATP10, MRTP03

Table 27: Summary of Human Health Soil Screening Exceedances – Metal Recovery Area (Unknown strata)

Determinant	Units	Range	Screening Criteria	No. Samples Exceeding Screening Criteria (Total Number of Results)	Location of Exceedances
Chromium	mg/kg	30 – 432	33	3 (4)	CATP03, CATP04 (x2)
pH	pH units	8.9 – 12.9	6-9	3 (4)	CATP03, CATP04 (x2)

8.4.11 Elevated alkaline soil conditions have been identified within all samples taken from the Made Ground. Alkaline conditions are also identified within the Tidal Flat Deposits, with over half of samples exceeding the screening criteria of pH 9.

8.4.12 As per the Reedbed No. 1 area, further sampling and analysis is needed to determine whether the elevated levels of chromium relate to hexavalent chromium, although the latter is not anticipated.

8.4.13 A single sample of Made Ground at BH512 (0.3 to 0.5 m bGL) was found to have a nickel concentration in exceedance of the screening criteria by an order of magnitude. No exceedances were identified in samples taken in the Made Ground at greater depths at this location, or within nearby BH511. Overall nickel is not considered to pose a significant risk to human health across the Site.

8.4.14 Exceedances of TPH were encountered in half of the Made Ground samples analysed. These are specific to the former defragmentation area of the Site where the Glan Llyn Depot is proposed. Due to the un-speciated nature of the analytical data, the most stringent TPH criterion has been used (2,000 mg/kg for aliphatic >C8-C10). Whilst this is considered a conservative approach, the presence of hydrocarbon was widely identified within the exploratory records.

8.4.15 Whilst presence of hydrocarbon is identified within the shallow natural soils, these remain below the screening criteria and are of lower magnitude to concentrations

seen in the Made Ground. This strongly suggests limited penetration of the contaminant into the Tidal Flat Deposits which is thus acting as a barrier to vertical migration to the deep soils and the aquifer.

8.4.16 The absence of speciation prevents detailed identification of the specific hydrocarbon type, although on the basis of the exploratory records, it is anticipated to be a heavy oil or weathered diesel product. In either case, these would be of mid to heavy carbon range, the lesser mobile and volatile types. Speciated TPH of analytical results of groundwater samples (see Section 8.5) have identified predominance in the carbon range C12 to C35 to be present and it is reasonable to assume the hydrocarbon in soils are similar.

8.4.17 Samples taken from trial pits CATP03 and CATP04 have been considered separately as no field logs are available to confirm if these are from Made Ground or from natural strata and from which depth. It is considered from review of the data, and comparison of the Made Ground and natural strata datasets, that the exceedances within the three soil samples described above are likely to represent samples taken from within the Made Ground, between 0.5 and 1.6 m bGL.

8.4.18 No other exceedances of the assessment criteria were identified.

8.4.19 PCBs are at levels below the laboratory limit of detection, although the analysis relates to soil samples within the area of proposed water treatment with no analysis within the proposed Glan Llyn Depot.

8.4.20 Full extent of hydrocarbon contamination has not been confirmed, although its extent is not anticipated to impact the main alignment running south of the Site and across its eastern boundary.

8.4.21 Some VOCs are identified above laboratory limit of detection although no screening criteria are available. These were benzene and toluene related compounds with maximum concentration of 5.14 mg/kg (1.4.4-trimethylbenzene). These are considered to represent a low risk to human health given the low concentrations. Whilst all maximum concentrations relate to CATP08 (also has the highest TPH concentration), it is noted the data set is very limited and includes for three samples only.

8.4.22 No asbestos fibres were detected in the twelve samples analysed.

8.5 Controlled Waters Screening Assessment

8.5.1 The rationale and approach for the controlled waters (Tier 1) screening assessment is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES) and the groundwater chemical results are presented in Appendix 4, surface water chemical results in Appendix 5 and leachate chemical results in Appendix 6 of this CL report. All exceedances to the relevant criteria are summarised in Tables 28 and 29 for soil leachate, Tables 30 and 31 for groundwater and Table 32 for surface waters.

8.5.2 Where an Environmental Quality Standard (EQS) is dependent on water hardness, i.e. heavy metals, the hardness of the surface water receptor would normally be used. The Baseline Water Environment Report (Appendix 16.2 of the ES) indicates surface water to be generally moderately hard with hardness in

a range of 100 to 150 mg/l as calcium carbonate. Therefore EQSs within this water hardness range have been used for screening purposes.

Soil Leachate Results

Reedbed No. 1

8.5.3 Eight soil samples from the Made Ground and two from the Tidal Flat Deposits were subjected to leachate analysis. Soil leachate results from the Tidal Flat Deposits were all below the applied screening criteria. Exceedances of the contaminants summarised in Table 28 were observed within the Made Ground.

Table 28: Controlled Waters Screening Exceedances – Reedbed No. 1 Soil Leachate

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location (formation)	No. Exceeded DWS Screening Criteria (Total Number of Results)	Location (Formation)
Cadmium	µg/l	<0.08 - 1.2	0.15	5	1 (10)	SWSJ01 (Made Ground)	-	-
Copper	µg/l	<1-18	6	2,000	1 (10)	SBHJ01CP (Made Ground)	-	-
Iron	µg/l	<5-3700	1000	200	1 (9)	SWSJ01 (Made Ground)	2 (9)	SWSJ01 (Made Ground)
Nickel	µg/l	<1-11	4	20	3 (10)	SBHJ01CP, SWSJ01 (Made Ground)	-	-
Lead	µg/l	<1-4	1.2	10	2 (10)	SWSJ01, SWSJ07 (Made Ground)	-	-
Selenium	µg/l	<1-18	-	10	-	-	1 (10)	SWSJ01 (Made Ground)
Total Cyanide	µg/l	<0.05-9.4	0.001	0.05	4 (9)	SWSJ01, SWSJ02, SWSJ07 (Made Ground)	4 (9)	SWSJ01, SWSJ02, SWSJ07 (Made Ground)

8.5.4 The leaching analysis of Made Ground indicates that some metals are leachable such that concentrations exceeded EQSs on a limited number of samples. The leachable concentrations exceeding EQSs are generally associated with the sediments within the reedbeds rather than the coarse slag forming the reedbed bunds. Surface water sampling has identified similar concentrations, particularly

for cadmium, copper, lead and nickel which indicates a possible impact to surface water quality and pathway linkages from the Made Ground to surface waters.

8.5.5 Whilst of the 6 no. samples analysed, only one pH test was undertaken which was not above the screening criteria. However, it is possible for leachable alkaline pH to be present in leachate from the Made Ground.

8.5.6 It is considered that exceedance of DWS by selenium is not considered a contaminant source as there are no potable water supplies at or near the Site as the groundwater is saline.

8.5.7 The laboratory detection levels for leaching tests for cadmium, mercury and cyanide, phenols and several PAH are higher than the screening criterion. However it is considered unlikely that these potential contaminants would cause a risk to controlled waters given the low concentrations. Notwithstanding this, future surface water monitoring programmes should include these parameters.

Metal Recovery Area

8.5.8 Four soil samples from the Made Ground and two from the Tidal Flat Deposits were subjected to leachate analysis. The majority of the soil leachate results were all below the screening criteria, with the exception of the contaminants summarised in Table 29 below.

Table 29: Controlled Waters Screening Exceedances – Metal Recovery Area Soil Leachate

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location (Formation)	No. Exceeded DWS Screening Criteria (Total Number of Results)	Location (Formation)
Ammoniacal Nitrogen as N	mg/l	0.2-1.1	0.6	-	1 (5)	CATP10 (TFD)	-	-
Iron	µg/l	<10-220	1000	200	-	-	1 (5)	CATP10 (TFD)
Nickel	µg/l	<1-5	4	20	1 (6)	MRTP02 (Made Ground)	-	-
Lead	µg/l	<1-4	1.2	10	2 (6)	CATP08, MRTP02 (Made Ground)	-	-
Selenium	µg/l	<1-46	-	10	-	-	1 (6)	MRTP02 (Made Ground)

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location (Formation)	No. Exceeded DWS Screening Criteria (Total Number of Results)	Location (Formation)
pH	pH units	8.8-12.9	6-9	6.5-10	3 (6)	MRTP02, MRTP03 (Made Ground) MRTP03 (TFD)	2 (6)	MRTP02, MRTP03 (Made Ground)

Note: TFD – Tidal Flat Deposits

8.5.9 The leachability of contaminants seen in the Metal Recovery area is similar to the one identified in the Reedbed No.1 and therefore similar conclusions may be drawn albeit elevated cadmium, copper and total cyanide above screening criteria were not observed.

8.6 Groundwater Results

Reedbed No. 1

8.6.1 Groundwater analysis results have been assessed for samples collected from the Reedbed No.1 area which includes data from monitoring rounds undertaken in 2002, 2008 and 2015. All groundwater samples were taken from the perched water within the Made Ground and Tidal Flat Deposits at the Site. Samples are predominantly from monitoring well response zones which span the boundary between the Made Ground and Tidal Flat Deposits. Only two boreholes (BH509 and SBHJ01) are installed with response zones which solely target perched groundwater within natural ground.

8.6.2 A summary of the exceedances of the assessment criteria from all available groundwater results relating to the Site is presented in Table 30.

Table 30: Controlled Waters Screening Exceedances – Reedbed No. 1 Groundwater

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS (Total Number of Results)	Location of Exceedances	No. Exceeded DWS (Total Number of Results)	Location of Exceedances
Perched Water: Made Ground/Tidal Flat Deposits								
Cadmium (Dissolved)	µg/l	<1-1	0.15	5	1 (3)	RBBH10	-	-
Copper (Dissolved)	µg/l	1-66	10	2000	8 (25)	RBBH07 (x2), RBBH08 (x4), RBBH09 (x2)	-	-
Iron (Dissolved)	µg/l	<10-860	1000	200	-	-	2 (26)	SWSJ08 (x2)
Lead (Dissolved)	µg/l	<0.4-8	1.2	10	5 (26)	RBBH07 (x3), RBBH08 (x2)	-	-
Manganese (Dissolved)	µg/l	<1-2,100	30	50	3 (11)	RBBH10, SWSJ08 (x2)	2 (11)	SWSJ08 (x2)
Mercury (Dissolved)	µg/l	<0.1-0.4	0.07	1	2 (3)	RBBH07, RBBH10	-	-
Nickel (Dissolved)	µg/l	2-22	4	20	20 (26)	RBBH06, RBBH07 (x6), RBBH08 (x4), RBBH09 (x5), RBBH10 (x2), SWSJ08 (x2)	1 (26)	SWSJ08
Selenium (Dissolved)	µg/l	<1-15	-	10	-	-	4 (26)	RBBH07 (x2), RBBH08, RBBH09
Cadmium (Total)	µg/l	<0.1-9.7	0.15	5	4 (23)	RBBH07 (x2), SWSJ08 (x2)	2 (23)	SWSJ08 (x2)
Zinc (Total)	µg/l	3-950	75	-	6 (23)	RBBH07, RBBH09, RBBH10 (x2), SWSJ08 (x2)	-	-
Mercury (Total)	µg/l	<0.01-0.1	0.07	1	1 (23)	SWSJ08	-	-

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS (Total Number of Results)	Location of Exceedances	No. Exceeded DWS (Total Number of Results)	Location of Exceedances
BOD	mg/l	<1-26	5	-	3 (8)	RBBH07, RBBH09, RBBH10	-	-
Sodium	mg/l	0.4-240	-	200	-	-	2 (16)	SWSJ08 (x2)
Sulphate	mg/l	0.1-1,200	400	250	4 (26)	RBBH07, RBBH10, SWSJ08	7 (26)	RBBH07 (x2), RBBH10 (x3), SWSJ08 (x2)
Chloride	mg/l	0.4-932	250	250	1 (19)	RBBH08	1 (19)	RBBH08
Ammoniacal Nitrogen as N	mg/l	0.4-30.1	0.6	-	22 (23)	RBBH06 (x3), RBBH07 (x5), RBBH08 (x2), RBBH09 (x5), RBBH10 (x5), SWSJ08 (x2)	-	-
Total Ammonium as NH_4	mg/l	1.8	-	0.5	-	-	1 (1)	SWSJ08
Total Cyanide	mg/l	<0.05-0.78	0.001	0.05	6 (23)	RBBH08, RBBH09 (x3), SWSJ08 (x2)	6 (23)	RBBH08, RBBH09 (x3), SWSJ08 (x2)
pH	pH units	7.02-13.1	6-9	6.5-10	23 (26)	RBBH06 (x2), RBBH07 (x6), RBBH08 (x4), RBBH09 (x5), RBBH10 (x6)	22 (26)	RBBH06 (x2), RBBH07 (x6), RBBH08 (x4), RBBH09 (x5, RBBH10 (x5)
4-Methylphenol	µg/l	<1-1,300	100	-	1 (8)	RBBH07	-	-
Phenol	µg/l	<1-36,000	7.7	-	4 (8)	RBBH07 (x2), RBBH09 (x2)	-	-
Anthracene	µg/l	<1-0.3	0.1	-	2 (15)	RBBH07, RBBH08	-	-
Fluoranthene	µg/l	<1-0.156	0.0063	-	2 (15)	RBBH07, RBBH08	-	-

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS (Total Number of Results)	Location of Exceedances	No. Exceeded DWS (Total Number of Results)	Location of Exceedances
Naphthalene	µg/l	<1-2,200	2	-	6 (15)	RBBH07 (x4), RBBH08, RBBH10	-	-
Bis(2-ethylhexyl) phthalate	µg/l	<2-4,200	1.3	-	3 (8)	RBBH07 (x2), SWSJ08	-	-
Benzene	µg/l	<1-4	10	1	-	-	1 (10)	RBBH08
Perched Groundwater: Tidal Flat Deposits								
Arsenic	µg/l	12-77	50	10	2 (8)	BH509 Deep (x2)	8 (8)	SBHJ01 (x2), BH509 Deep (x3), BH509 Shallow (x3)
Boron	µg/l	350-1,300	2000	1000	-	-	1 (6)	BH509 Shallow
Chromium (Dissolved)	µg/l	18-310	-	50	-	-	6 (8)	BH509 Deep (x3), BH509 Shallow (x3)
Copper (Dissolved)	µg/l	2.6-330	10	2000	6 (8)	BH509 Deep (x3), BH509 Shallow (x3)	-	-
Iron (Dissolved)	µg/l	470-5,400	1000	200	1 (2)	SBHJ01	2 (2)	SBHJ01 (x2)
Lead (Dissolved)	µg/l	1.2-6.5	1.2	10	1 (8)	SBHJ01	-	-
Manganese (Dissolved)	µg/l	1,300-1,600	30	50	2 (2)	SBHJ01 (x2)	2 (2)	SBHJ01 (x2)
Mercury (Dissolved)	µg/l	<0.5-0.5	0.07	1	1 (6)	BH509 Deep	-	-
Nickel (Dissolved)	µg/l	5.2-13	4	20	8 (8)	SBHJ01 (x2), BH509 Deep (x3), BH509 Shallow	-	-
Selenium (Dissolved)	µg/l	25-120	-	10	-	-	8 (8)	SBHJ01 (x2), BH509 Deep (x3), BH509 Shallow (x3)

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS (Total Number of Results)	Location of Exceedances	No. Exceeded DWS (Total Number of Results)	Location of Exceedances
Cadmium (Total)	µg/l	5.1-40	0.15	5	2 (2)	SBHJ01 (x2)	2 (2)	SBHJ01 (x2)
Zinc (Total)	µg/l	4.6-4,400	75	-	2 (8)	SBHJ01 (x2)	-	-
BOD	mg/l	5-8	5	-	1 (2)	SBHJ01	-	-
Sodium	mg/l	2,700-2,900	-	200	-	-	2 (2)	SBHJ01 (x2)
Sulphate	mg/l	180-460	400	250	1 (2)	SBHJ01	1 (2)	SBHJ01
Chloride	mg/l	220-6,200	250	250	7 (8)	SBHJ01 (x2), BH509 Deep (x3), BH509 Shallow	7 (8)	SBHJ01 (x2), BH509 (x5)
Ammoniacal Nitrogen as N	mg/l	3.9-33	0.6	-	8 (8)	SBHJ01 (x2), BH509 Deep (x3), BH509 Shallow (x3)	-	-
Total Ammonium as NH_4	mg/l	19	-	0.5	-	-	1 (1)	SBHJ01
Phenols	mg/l	<0.03-0.12	0.0077	-	2 (6)	BH509 Shallow (x2)	-	-

8.6.3 Exceedances of dissolved metals cadmium, copper, lead, manganese, mercury and in particular nickel are observed across the Site. Exceedances of total cadmium, mercury and zinc are also observed where total concentrations have been are compared against EQS values which used dissolved concentrations and this is therefore considered a conservative approach.

8.6.4 Dissolved manganese concentrations within SWSJ08 are seen to exceed the EQS by up to 700 times.

8.6.5 Certain inorganic parameters are seen to exceed screening criteria, including Biological Oxygen Demand (BOD), sulphate, chloride, ammoniacal nitrogen and cyanide.

8.6.6 The majority of samples were found to be alkaline, with values ranging between pH 7.02 and 13.1. Twenty three of twenty six samples exceed the EQS of pH 9 indicating the perched water is alkaline.

8.6.7 Certain PAH compounds (anthracene, fluoranthene and napthalene) and VOCs (bis(2-ethylhexyl) phthalate) are found to exceed the EQS in both the northern and southern areas of the Site, in RBBH07, RBBH08, RBBH10 and SWSJ08.

8.6.8 Phenols are observed to be present within six of the eight samples analysed, particularly within RBBH07 in which a phenol concentration of 36 mg/l is recorded.

8.6.9 Certain laboratory detection limits for mercury, lead, cyanide, some PAHs, VOCs and SVOCs are higher than the screening criterion within the data set.

8.6.10 Samples taken from perched water within the Made Ground and Tidal Flat Deposits gave exceedances of iron, manganese, nickel, selenium, cadmium (total), sodium, sulphate, chloride, cyanide, total ammonium, pH and benzene when considering DWS criteria. These exceedances by themselves are not considered to represent contaminant sources, as there are no potable water supplies at or near the Site, and the groundwater is expected to be saline.

8.6.11 Perched groundwater data is available from two boreholes (SBHJ01 CP and BH509), both located on the bund/track beyond the southern extent of the southern reedbed area. Exceedances of most parameters observed within the Made Ground/Tidal Flat Deposits are also observed from samples taken from perched water within the Tidal Flat Deposits alone. The main difference seen in the water quality is a more neutral pH and a more noticeable high chloride concentration (likely to be associated with saline intrusion) in the Tidal Flat Deposits perched waters.

8.6.12 Samples taken from perched water within Tidal Flat Deposits alone gave exceedances of arsenic, boron, chromium, iron, manganese, selenium, cadmium (total), sodium, sulphate, chloride and total ammonium when considering DWS criteria. These exceedances by themselves are not considered to represent contaminant sources, as there are no potable water supplies at or near the Site, and the groundwater is expected to be saline.

8.6.13 From the eight water samples from the Made Ground/Tidal Flat Deposits, three gave TPH concentrations above the laboratory limit of detection, ranging from 0.6 to 1.1 mg/l (maximum in RBBH08, in 2002). Total aliphatic TPH was identified

above the limit of detection within one sample (maximum of 0.12 mg/l within RBBH07, in 2008).

8.6.14 From the eight water samples from the Tidal Flat Deposits alone, two gave TPH concentrations above the laboratory limit of detection, ranging from 0.16 to 0.34 mg/l (maximum in BH509 shallow, in 2015 round 3).

8.6.15 The data suggests that the perched water in the Made Ground has hydraulic connectivity to the perched water within the Tidal Flat Deposits. A possible linkage between soil and perched water quality within the Made Ground is identified when considering the leachate data.

8.6.16 No groundwater data is available from the Mercia Mudstone aquifer beneath the Site. Linkages between onsite sources and deep groundwater can therefore not be assessed in detail. However the low permeability of the Tidal Flat Deposits is likely to act as an aquitard to downward migration of contaminants.

Metal Recovery Area

8.6.17 The groundwater results for the Metal Recovery Area include a number of rounds of groundwater monitoring undertaken in 2002, 2005, 2008 and 2015. All but one groundwater sample collected were taken from the perched water within the Made Ground and Tidal Flat Deposits at the Site. Samples are predominantly from response zones which span the boundary between the Made Ground and Tidal Flat Deposits. Six boreholes are installed within response zones (CABH02, CABH03, BH13, BH14, BH15 and BH512) which solely target perched water within Made Ground, and five (CABH01, BH16, SBHJ03, BH510 and BH512) target natural ground (Tidal Flat Deposits). One off site borehole (BH510) installation targets the zone between the Tidal Flat Deposits and Mercia Mudstone Group and so the sample collected will be from the aquifer.

8.6.18 The summary of the exceedances of the applied assessment criteria is presented in Table 31.

Table 31: Controlled Waters Screening Exceedances – Metal Recovery Area Groundwater

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS (Total Number of Results)	Location of Exceedances	No. Exceeded DWS (Total Number of Results)	Location of Exceedances
Perched Water: Made Ground								
Nickel (Dissolved)	µg/l	5-9	4	20	3 (3)	CABH02 (x3)	-	-
Selenium (Dissolved)	µg/l	5-19	-	10	-	-	1 (3)	CABH02
Zinc (Total)	µg/l	7-198	75	-	1 (3)	CABH02	-	-
Ammoniacal Nitrogen as N	mg/l	2.1-2.5	0.6	-	3 (3)	CABH02 (x3)	-	-
Phenols	mg/l	0.1-0.2	0.0077	-	3 (3)	CABH02 (x3)	-	-

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS (Total Number of Results)	Location of Exceedances	No. Exceeded DWS (Total Number of Results)	Location of Exceedances
Fluoranthene	µg/l	<0.05-0.056	0.0063	-	1 (3)	BH14	-	-
Naphthalene	µg/l	<0.05-2,909	2	-	1 (4)	CABH02	-	-
pH	pH units	11.8-12.3	6-9	-	3 (3)	CABH02 (x3)		
Perched Water: Made Ground/Tidal Flat Deposits								
Selenium (Dissolved)	µg/l	7-15	-	10	-	-	1 (2)	CABH03
Ammoniacal Nitrogen as N	mg/l	1.5	0.6	-	2 (2)	CABH03 (x2)	-	-
Phenols	mg/l	0.12-0.19	0.0077	-	2 (2)	CABH03 (x2)	-	-
Benzene	µg/l	<5-2	10	1	-	-	1 (2)	CABH03
m&p xylene	µg/l	28-45	30	-	1 (2)	CABH03	-	-
O xylene	µg/l	21-35	30	-	1 (2)	CABH03	-	-
Anthracene	µg/l	0.098-18.865	0.1	-	3 (12)	BH17, BH18, BH20	-	-
Benzo(a) pyrene	µg/l	<0.05-0.129	0.00017	0.01	1 (12)	BH6	1 (12)	BH6
Benzo(b) fluoranthene	µg/l	<0.05-0.145	0.017	0.1	1 (12)	BH6	1 (12)	BH6
Benzo(ghi) perylene	µg/l	<0.05-0.19	0.0082	0.1	1 (12)	BH6	1 (12)	BH6
Benzo(k) fluoranthene	µg/l	<0.05-0.077	0.017	0.1	1 (12)	BH6	-	-
Fluoranthene	µg/l	0.051-33.836	0.0063	-	12 (12)	CABH03, BH4, BH6, BH7, BH8, BH9, BH12, BH17, BH18,	-	-
Indeno(123cd)pyrene	µg/l	<0.05-0.222	-	0.1	-	-	1 (12)	
Naphthalene	µg/l	<0.05-787.015	2	-	8 (12)	CABH03 (x2), BH4, BH7, BH9, BH18, BH20, BH21	-	-
Trichloro-ethene	µg/l	9-11	10	10	1 (2)	CABH03	1 (2)	CABH03
pH	pH units	12.5-12.6	6-9	-	2 (2)	CABH03 (x2)	-	-
Perched groundwater: Tidal Flat Deposits								

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS (Total Number of Results)	Location of Exceedances	No. Exceeded DWS (Total Number of Results)	Location of Exceedances
Arsenic	µg/l	<1 - 22	50	10	0 (12)	-	2 (12)	BH510 (x2)
Boron	µg/l	84-2,300	2000	1000	1 (10)	BH510	4 (10)	CABH01, BH512 Deep, BH512 (x2)
Chromium (Dissolved)	µg/l	5-58	-	50	-	-	2 (12)	CABH01, BH510
Copper (Dissolved)	µg/l	<0.1 - 39	10	2,000	2 (12)	BH510 (x2)	0 (12)	-
Iron (Dissolved)	µg/l	210-7,700	1000	200	2 (6)	SBHJ03 (x2)	6 (6)	CABH01 (x4), SBHJ03 (x2)
Manganese (Dissolved)	µg/l	850-2,750	30	50	6 (6)	CABH01 (x4), SBHJ03 (x2)	6 (6)	CABH01 (x4), SBHJ03 (x2)
Nickel (Dissolved)	µg/l	<1-56	4	20	5 (12)	CABH01 (x3), BH512 Deep, BH510	1 (12)	CABH01
Selenium (Dissolved)	µg/l	4-24	-	10	-	-	3 (12)	CABH01, BH510 (X2)
Cadmium (Total)	µg/l	1.6-18	0.15	5	2 (2)	SBHJ03 (x2)	1 (2)	SBHJ03
Zinc (Total)	µg/l	1.7-1,800	75	-	2 (12)	SBHJ03 (x2)	-	-
BOD	mg/l	56-78	5	-	2 (2)	SBHJ03 (x2)	-	-
Sodium	mg/l	15-1,600	-	200	-	-	4 (5)	CABH01 (x3), SBHJ03
Chloride	mg/l	370-2,270	250	250	9 (9)	CABH01 (x4), SBHJ03 (x2), BH512 Deep (x3)	9 (9)	CABH01 (x4), SBHJ03 (x2), BH512 Deep (x3)
Ammoniacal Nitrogen as N	mg/l	2.9-24.8	0.6	-	8 (8)	CABH01 (x3), SBHJ03 (x2), BH512 Deep (x3)	-	-
Total Ammonium as NH4	mg/l	21	-	0.5	-	-	1 (1)	SBHJ03
Naphthalene	µg/l	<0.01-32	2	-	1 (12)	CABH01	-	-
Groundwater: Mercia Mudstone Group								
Arsenic	µg/l	17 - 43	50	10	0 (3)	-	3 (3)	BH510 (x3)

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS (Total Number of Results)	Location of Exceedances	No. Exceeded DWS (Total Number of Results)	Location of Exceedances
Chromium	µg/l	56 - 120	-	50	-	-	3 (3)	BH510 (x3)
Copper (Dissolved)	µg/l	24 - 150	10	2,000	3 (3)	BH510 (x3)	0 (3)	-
Nickel (Dissolved)	µg/l	4.5 - 13	4	20	3 (3)	BH510 (x3)	0 (3)	-
Selenium (Dissolved)	µg/l	29 - 56	-	10	-	-	3 (3)	BH510 (x3)

8.6.19 The majority of samples are taken from monitoring well response zones which span Made Ground and the Tidal Flat Deposits, however only organic parameters (TPH and PAH) were analysed from the majority of these locations.

8.6.20 Exceedances to EQS criteria of inorganic parameters nickel (dissolved) and zinc (total) are observed within the Made Ground. Ammoniacal nitrogen within both the Made Ground and Made Ground/Tidal Flat Deposits exceeds the EQS criteria.

8.6.21 All samples were found to be alkaline, with values ranging between 11.8 and 12.6 which exceed the EQS of pH 9.

8.6.22 Total phenols were found to be present in all samples analysed above a screening criterion of 0.0077 mg/l. Concentrations have been compared against the screening criterion for phenol which is considered a conservative approach.

8.6.23 EQS exceedances of m&p xylene, o xylene and trichloroethene were identified within the perched groundwater at CABH03 in March 2002. Elevated concentrations of these parameters were observed at this location in the following monitoring round, however, they were marginally below the EQS.

8.6.24 PAH compounds are observed within all locations with the exception of BH13. Exceedances of the EQS is observed for fluoranthene in 13 of 15 samples, naphthalene in 8 of 15 samples and to a lesser extent anthracene, benzo(a)pyrene, benzo(b) fluoranthene, benzo(ghi)perylene and benzo(k)fluoranthene.

8.6.25 Certain laboratory detection levels for mercury, cyanide, some BTEX, PAHs, VOCs and SVOCs are higher than the screening criterion within the data set.

8.6.26 Samples taken from perched water within the Made Ground and Made Ground/Tidal Flat Deposits gave exceedances of the DWS screening criteria for selenium, benzene, trichloroethene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene and Indeno(123cd)pyrene. These exceedances by themselves are not considered to represent a contaminant source as there are no potable water supplies at or near the Site and the groundwater is expected to be saline.

8.6.27 Data is available from three boreholes on Site with monitoring well response zones wholly within the Tidal Flat Deposits. These are CABH01, BH16 and BH512, located in the north-western, south-eastern and south-western corners of

the Site respectively. Data is also available from SBHJ03 CP which is located approximately 60 m beyond the boundary of the Site to the south-east.

8.6.28 EQS exceedances of dissolved manganese, nickel, cadmium are observed as well as, but to lesser extent, boron, copper, iron and zinc. Total concentrations have been compared against dissolved EQS values and this is therefore considered a conservative approach.

8.6.29 BOD, chloride and ammoniacal nitrogen exceed EQS screening criteria in all samples. Elevated chloride concentrations are observed with a maximum of 2,270 mg/l recorded within CABH01. This indicates saline conditions within the perched water in the Tidal Flat Deposits.

8.6.30 Neutral to slightly alkaline pH was recorded ranging between 7.0 and 8.5.

8.6.31 A single exceedance of the EQS for naphthalene, analysed as part of the VOCs suite, was observed within CABH01 in 2003. PAH compounds including naphthalene, phenanthrene and acenaphthene were also identified at low concentrations within BH16 although these remained below screening criteria.

8.6.32 Samples taken from perched water within Tidal Flat Deposits alone gave exceedances of boron, chromium, iron, manganese, nickel, selenium, cadmium (total), sodium, chloride and total ammonium when considering DWS criteria. These DWS exceedances by themselves are not considered to result in unacceptable risks as there are no potable water supplies at or near the Site and the perched water is saline.

8.6.33 From the nineteen water samples from the Made Ground and Made Ground / Tidal Flat Deposits, all had TPH concentrations above the laboratory limit of detection ranging from 0.2 to 156 mg/l (maximum in BH3, in 2005).

8.6.34 From the seven water samples from the Tidal Flat Deposits alone, three had TPH concentrations above the laboratory limit of detection, ranging from 0.5 to 2.2 mg/l. The maximum concentration relates to SBHJ03 in 2008 (round 2) however no TPH was detected at this location in round 1, less than one month before round 2.

8.6.35 The quality of perched water appears different within the Made Ground and Tidal Flat Deposits, with exceedances of a greater number of organic parameters observed within samples associated with the Made Ground, and a greater number of inorganic parameters including metals within the Tidal Flat Deposits. The presence of wide spread organics in the proposed area of Glan Llyn Depot is consistent with the observations made in the exploratory records with presence of hydrocarbon as free product and/or dissolved phase.

8.6.36 Based upon the visual and olfactory evidence from the exploratory records, an area of contamination is present in the western part of the Metal Recovery Area as shown on Figure 4.

8.6.37 The available water data confirms the visual and olfactory evidence with the highest concentration located some 70 m south of the former defrag plant footprint (BH3). It is unclear whether the distribution of the hydrocarbon contamination a single source or from multiple sources. The chromatographs presented within the 2006 analytical data (Enviros, 2006) indicate that the contamination is representative of a mixed fuel and mineral oil fingerprints.

8.6.38 The perched water may be being affected by the leaching of contaminants from Made Ground.

8.6.39 Samples were taken from the Mercia Mudstone aquifer from an offsite borehole (BH510). The groundwater was shown to be impacted by metals including copper, nickel and selenium when compared to EQS criteria. All TPH, PAH and VOCs were below the laboratory limit of detection. The exceedances of organic parameters seen within the perched waters in the Made Ground and perched groundwater of the Tidal Flat Deposits, are not identified in the aquifer. The presence of low permeability clays of the Tidal Flat Deposits are likely to form a barrier to downwards organic migration. However the perched groundwaters within the Tidal Flat Deposits and the deep aquifer appear to have similar qualities when considering metals and inorganics contaminants which may indicate some natural background presence.

Surface Water

8.6.40 Thirty-eight surface water samples were taken and analysed from the reens surrounding the Site including analysis of water quality of drainage ditches within the Site boundary (SW501 and SW503). A summary of the identified exceedances from the screening assessment are shown in Table 32.

8.6.41 The results for all the sample locations are also presented in the Baseline Water Environment Report (Appendix 16.2 of the ES).

Table 32: Summary Surface Water Exceedances

Parameter	Unit	No. Analyses	No. Analyses Above LOD	Min. Conc.[1]	Max. Conc.	Round & Location with Max. Conc.	EQS	No. Exceeding EQS	DWS	No. Exceeding DWS	CCW Trigger Levels	No Exceeding CCW Trigger Levels
Boron	µg/l	24	13	24	1,300	2 / SW502	2,000	0	1,000	3	-	-
Copper	µg/l	24	16	1.5	19	E1 / R10	10	4	2,000	0	-	-
Lead	µg/l l	26	6	0.081	27	E1 / R10	1.2	5	10	1	250	0
Nickel	µg/l l	26	10	1	15	E3 / R12	4	4	20	0	100	0
Cadmium	µg/l	38	15	0.098	1.6	3 / SW501	0.15	11	5	0	5	0
Manganese	µg/l	10	7	4	2640	EL reen 1	30	2	50	0	-	-
Iron	µg/l	12	5	10	940	EL reen 1	1000	0	200	1	-	-
Zinc	µg/l l	24	21	7	360	E4 / R11	75	5	-	-	1,000	0
Sodium	µg/l	2	2	13400	12300	MDSWN	-	-	200	2	-	-
BOD	mg/l	18	12	2	33	E4 / R11	5	8	-	-	18	3
Phosphorus	mg/l	2	2	92.5	245	Q1 / 14.2	120	1	-	-	-	-
Ammoniacal Nitrogen	mg/l	38	34	0.02	2.1	EL reen 1	0.6	4	-	-	1	3
Dissolved Oxygen	%	12	12	0	109.6	E2 / R12	60	3	-	-	-	-
Nitrate as N	mg/l	22	11	0.4	4.4	MDSWN	-	-	50	0	1	9
Nitrate as NO_3	mg/l	14	7	1.3	13.733	E4 / R12	-	-	50	0	1	7
TON	mg/l	14	5	0.9	3.2	E4 / R12	-	-	50	0	2	4
Phosphate	mg/l	24	17	0.06	2.6	E3 / R11	-	-	-	-	1	2
pH	pH units	36	36	7	8.7	1 / SW503	6-9	0	6.5-10	0	6.8-8.5	4

[1]conc. refers to concentration

8.6.42 From the 2008 data, water quality within the drainage ditches and reens flowing south from the Site (Ellen Reen and Middle Reen) are of the poorest quality within the data set (R10, R11 and R12). At those locations, exceedances of the respective EQSs for cadmium, zinc, nickel, copper and lead at multiple locations were observed. These exceedances are not seen in the 2002-2005 data (Enviros Consulting, 2006) indicating a possible deterioration of the quality since 2005 (sample reference EL Reen 1).

8.6.43 The 2008 R10 and R11 locations also recorded Total Petroleum Hydrocarbons concentrations of up to 422 µg/l. At other surface water sampling locations the typical levels have generally remained below the limit of detection at surrounding locations within the Gwent Levels. This may indicate a possible linkage with the presence of hydrocarbon contamination within the Metal Recovery Area. There are no sampling locations for the 2015 period to confirm if elevated organics have persisted.

8.6.44 Water quality at Monks Ditch (locations 15.3 and SW504) from 2015 is of good quality, with only a single exceedance of cadmium (0.16 µg/l at SW504 round 2) recorded above its respective EQS (0.15 µg/l). The 2002-2005 data (Enviros Consulting, 2006) indicated exceedances on a single event of nickel and zinc (MDSWS) which have not been replicated since. The presence of organics was identified in 2002 (MDSWS) with a TPH concentration of 140 µg/l. Whilst the remaining 2002-2005 data did not include TPH analysis, the more recent 2015 information proved concentrations below laboratory limit of detection (<10 µg/l).

8.6.45 Chapel Reen to the south of the Site shows similarly good water quality with only one sampling event recording an exceedance for phosphorous above the EQS. Chapel Reen is separated from the Site by the Blackwall Reen.

8.6.46 Of the 2015 data for the land ditch running along the western boundary of the Reedbed No. 1 (SW502 and SW503), cadmium was encountered just below or marginally above EQS criteria for one of the three rounds at both locations, with the other two below the limit of detection. Thus, this is not considered to represent a contaminant of concern.

8.6.47 Organics were consistently found below the limit of detection. Evidence of pollution by organic contamination from the reedbeds impacting the water quality within the ditch is therefore not identified along the western boundary of the Site.

8.6.48 All surface water analytical results are presented in the Baseline Water Environment Report (Appendix 16.2 of the ES).

8.7 Gas Risk Assessment

8.7.1 The only ground gas data available for the Site relates to two on site boreholes (BH509 and 512) and one off site borehole (BH510). These have monitoring well response zones within the Made Ground (BH512) and peat of the Tidal Flat Deposits (BH509 and BH510). Of the four monitoring rounds available the below observations have been made.

- No monitoring was undertaken during low barometric pressures (<1000 mb) with the lowest conditions being 1006 mb. As such, worst case atmospheric conditions for potential ground gas generation may not have been monitored.

- Gas flow within peat deposits was generally low or absent (up to 0.4 l/hr). Within the Made Ground gas flow was recorded absent.
- Methane has been recorded above the 1 % screening criterion in both boreholes associated with the Tidal Flat Deposits (peat) to a peak of 28.4 % although the concentrations were generally around 4 %. Within the Made Ground, the methane was generally absent with a peak of up to 0.2 %.
- Carbon dioxide within the Tidal Flat Deposits (peat) ranged from absent to 3.5 % with a peak value of 6.1 % (BH510, second round). The majority of the data is below the 5 % screening criterion. Within the Made Ground, carbon dioxide concentrations were generally nil with a peak of 0.7 % recorded during the first round.
- Low levels Volatile Organic Compounds of up to 5.3 ppm have been recorded in both the peat and Made Ground. It is noted that all three available monitoring wells are located outside the zone of hydrocarbon contamination specific of the Metal Recovery Area (see Figure 4).
- Hydrogen sulphide was not detected during the monitoring.
- Carbon monoxide was recorded in BH512 (Made Ground) up to 1 ppm on the third round. Carbon Monoxide was not detected elsewhere.
- Ambient or slightly depleted oxygen levels were recorded in all boreholes. BH510 installed in a peat horizon within the Tidal Flat Deposits had a peak concentration of 11.2 % during round one.

8.7.2 The monitoring data identified the presence of marginally elevated methane concentrations, which are likely to be associated with the organic soils including peat of the Tidal Flat Deposits.

8.7.3 The recorded gas levels and gas flows within the Made Ground and peat deposits are considered to be within the expected gas regime for the ground conditions based on that observed elsewhere along the Scheme (Geotechnical, 2015).

8.7.4 A gas risk assessment for natural soils including the Tidal Flat Deposits has been undertaken and is set out within the Land Contamination Assessment Report (Appendix 11.1 of the ES).

8.7.5 It is noted there is no gas data within the area impacted by hydrocarbon contamination. In this area Volatile Organic Compounds may be expected. However, the heavy carbon range of the hydrocarbons and the age of the contamination (at least 11 years) are factors which may mean only modest levels of VOCs are present. Further VOCs and gas monitoring prior to construction is recommended to confirm the risks and the need for and detailed design of gas protection measures in the proposed buildings at the Glan Llyn Depot.

8.8 Summary

Reedbed No. 1

8.8.1 Made Ground has been shown to have elevated chromium concentrations above background with a maximum of up to 640 mg/kg and is likely to be associated with slag material. This material could represent a potential human health risk to future site workers and remediation may be necessary. Above background

chromium concentrations within the natural soils are also identified on a limited number of samples. Further sampling and analysis of these soils is recommended to determine if the chromium detected is the more toxic hexavalent form and whether remediation is needed.

8.8.2 Elevated alkaline soil conditions have been identified in the majority of the samples, mainly within the Made Ground material but also in some samples of the Tidal Flat Deposits material.

8.8.3 Overall PAH is not considered to pose a significant risk to human health, although marginal exceedances on a single sample of the sediment material were identified.

8.8.4 Made Ground tested at the Site was identified to have leachable contaminants with EQS exceedances of nickel and cyanide. Leachable cadmium, copper, and lead are also identified more sporadically across the Site.

8.8.5 Perched water within the Made Ground has high levels of metals (mainly nickel), inorganics (mainly pH and ammoniacal nitrogen) and organics (TPH and PAHs) exceeding EQS criteria.

8.8.6 The perched groundwater within the Tidal Flat Deposits has elevated levels of metal and inorganics above EQSs. The presence of organic contaminants has also been identified, although elevated levels are noted to be intermittent and inconsistent. The perched water within the Tidal Flat Deposits is noted to be saline.

8.8.7 The water quality within the majority of the adjacent reens and ditches is considered to be of good quality.

8.8.8 The ground gas regime is considered to be in line with the proven ground conditions with low flow high methane conditions within the peat bands of the Tidal Flat Deposits

Metal Recovery Area

8.8.9 Made Ground has been shown to have elevated chromium concentrations above background with a maximum of up to 1,800 mg/kg and is likely to be associated with slag material. This material could represent a potential human health risk to future site workers and remediation may be necessary. Further sampling and analysis of these soils is recommended to determine if the chromium detected is the more toxic hexavalent form and whether remediation is needed.

8.8.10 Elevated alkaline soil conditions have been identified in the majority of the samples, mainly within the Made Ground material but also in some samples of the Tidal Flat Deposits material.

8.8.11 The presence of elevated hydrocarbon contamination (a mixed fuel and mineral oil fingerprints) has been confirmed within the area of the proposed Glan Llyn Depot. The data relates to a 2006 investigation and holds no speciation of hydrocarbons preventing robust, site specific quantitative risk assessment. It is recommended that a supplementary investigation is undertaken to confirm soil and water contamination status. The origin of the hydrocarbon contamination is currently unknown.

8.8.12 Made Ground tested at the Site was identified to have low level leachable contaminants (metals, pH and ammoniacal nitrogen) against EQS criteria.

8.8.13 Perched water within the Made Ground has high levels of metals and pH. Presence of organics (TPH and PAHs) are specific to the Glyn Llyn Depot and support the visual and olfactory evidence of hydrocarbon contamination during the 2005-2006 ground investigation.

8.8.14 The perched groundwater within the Tidal Flat Deposits has elevated levels of metal and inorganics above EQSs. The presence of organic contaminants has also been identified beneath the Glyn Llyn Depot area and off Site (SBHJ03), although elevated levels are noted to be intermittent and inconsistent. The groundwater quality seen in the single monitoring point within the Mercia Mudstone shows similar metal and inorganic concentrations than in the perched body within the Tidal Flat Deposit. The perched groundwater within the Tidal Flat Deposits is saline. Whilst there is no data for the aquifer, saline conditions are also anticipated.

8.8.15 The water quality within the Monks Ditch and Chapel Reen is considered to be of good quality. A number of EQS exceedances in metals and organics were identified in Ellen and Middle Reen. The presence of organics as seen in the 2008 monitoring within both reens may be linked with the hydrocarbon contamination present within the Metal Recovery Area although this cannot be confirmed.

8.8.16 The ground gas regime is considered to be in line with the proven ground conditions with low flow high methane conditions within the peat bands of the Tidal Flat Deposits and low methane and low carbon dioxide within the Made Ground. Whilst no gas data is available within the zone of hydrocarbon contamination of the Metal Recovery Area, the age and type of the contamination are considered unlikely to be generating high levels of VOCs. However further monitoring is recommended to enable risks to be confirmed and to determine the need to incorporate gas protective measures into the proposed Glan Llyn Depot building.

9 Refined Conceptual Site Model

9.1.1 Data from the 2015 Supplementary Ground Investigation has enabled the original CSM presented in the 2014 PSSR to be updated. The assessment is based on the current Scheme during construction and operational phases.

9.1.2 A CSM representing general ground conditions, overall Scheme layout and relevant source-pathway-receptors (each of which having a specific alpha-numerical symbol attached) are presented in Figure 2 and is described in Table 33.

Table 33: Conceptual Site Model

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Onsite: Elevated pH originating from the Made Ground (slag material) and sediments (in Reedbed No. 1). Plus hydrocarbon contaminated soils in part of the Metal Recovery Area	Construction					
	Construction Workers (B)	Direct dermal (1)	Likely	Moderate	Moderate	Construction workers will possibly be exposed to Made Ground materials during site construction works, however exposure duration will be short term only. Prior to construction, a specific risk assessment will be required in line with health and safety legislation. This will enable safe methods of work methodology and appropriate levels of PPE to be put in place. As such all risks will be duly considered and suitably mitigated to protect construction workers. Current data set identify limited exceedances to the selected screening criteria. Current contamination status is not
		Ingestion (3)	Likely	Moderate	Moderate	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of soil dust (2)	Likely	Moderate	Moderate	foreseen to represent abnormal constraints to construction workers health and safety over and above those typical of a brownfield site. Construction works around the proposed motorway junction associated with piling will require construction mats to be in place. This will reduce potential for exposure to contaminated soils and dust; and dermal, ingestion and inhalation pathways will effectively be broken once mats are placed.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of soil gas or vapours (2)	Likely	Low	Low	Limited ground gas data from Made Ground formation. Additional gas monitoring is recommended. Made Ground generally granular and may represent a possible pathway for vertical and lateral migration. No putrescible material identified within the Made Ground. Significant abnormal gas regime not anticipated and low concentration of VOCs and SVOCs recorded. Surcharge of superficial soils may temporarily increase gas flux. Construction to be largely within open space. Any earthworks within confined space would require specific risk assessment, control measures and appropriate PPE. Gap in the data has been identified and further investigations are required to assess any potential gas and confirm the risks.
	Offsite users during construction works (C)	Dermal contact with dust (1)	Low	Low	Very low	During construction there is the possibility of dermal contact and inhalation of soil dust, short term exposure only. Dust suppression measures are recommended during construction works. Receptors limited as surrounding land in this area is not highly populated adjacent to the proposed earthworks.
		Ingestion of dust (3)	Low	Low	Very low	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of soil dust (2)	Low	Low	Very low	
		Inhalation of soil gas or vapours (2)	Unlikely	Low	Very low	No putrescible material identified within the Made Ground. Significant abnormal gas regime not anticipated and low concentration of VOCs and SVOCs recorded. Made Ground generally granular and may represent a possible pathway for vertical and lateral migration. Surcharge of superficial soils may temporarily increase gas flux. Off site migration into confined spaces or into adjacent buildings considered unlikely due to ground conditions and lack of receptors. Gap in the data has been identified and further investigations are required to assess any potential gas and confirm the risks.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Onsite: Elevated pH originating from the Made Ground (slag material) and sediments (in Reedbed No. 1). Plus hydrocarbon contaminated soils in part of the Metal Recovery Area	Groundwater - Aquifer (Da) within the Glaciofluvial Deposits and/or Mercia Mudstone Group	Leaching/migration (4)	Likely	Moderate	Moderate	Displacement of contaminants in soils and perched water in Made Ground is possible during piling. This is subject to selected piling technique and a piling risk assessment will be required. Thick deposit of predominantly soft low permeability Tidal Flat Deposits overlies the aquifer, reducing risk of downward migration. Increased vertical pathways between possible contaminant and receptor with construction of band drains and piles. However, soft clays of the Tidal Flats Deposits likely to 'heal' along pile pathways mitigating this route. The aquifer has elevated metal and inorganic contaminants but the levels appear similar to levels in the perched waters in the TFD and Made Ground and are considered to be at background levels. Perched waters within the Made Ground also include organics which are absent in the aquifer. The perched water and aquifer are saline. Low leaching potential identified from soil materials. Hydrostatic pressures shown to be below or at base of the Made Ground. Possible increase in risk of Made Ground to become saturated during construction. Further investigation is needed in the area of hydrocarbon contamination in the former area of the metal defragmentation plant.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Onsite: Elevated pH originating from the Made Ground (slag material) and sediments (in Reedbed No. 1). Plus hydrocarbon contaminated soils in part of the Metal Recovery Area	Surface water (land drainage) (E)	Saturated flow within perched groundwater (4)	Likely	Moderate	Moderate	Perched (shallow) groundwater is likely to be intercepted by the land drainage. The quality of perched groundwater may become impacted by contamination during the construction works, particularly in the area of excavation (new drains). Increase in water flux and leachate from Made Ground during surcharge loading. Water quality adjacent to Site considered to be of relatively good quality. Further investigation and amendment is needed in the area of hydrocarbon contamination in the area of the former metal defragmentation plant.
		Surface water run-off (5)	Likely	High	High	Surface water run-off may be detrimental to the quality of surface water and thus the construction process may need to adopt surface water control and management. Leachable metals have been identified within the soils in limited samples and hydrocarbon contaminated Made Ground present in the former metal defragmentation plant area. Application of appropriate surface water run-off control measures during the works is considered sufficient to break this potential pollutant linkage. Water quality adjacent to Site considered to be of relatively good quality.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Groundwater - Aquifer	Surface water (land drainage)	Band drain / piles	Likely	High	High	Aquifer quality shown to be impacted by metal and inorganic contaminants. The hydrostatic pressure of the aquifer is near the base of Made Ground and band drains and piles could create potential vertical pathways connecting the aquifer with surface water. However, soft clays of the Tidal Flat Deposits likely to 'heal' along pile pathways mitigating this route. Controls and a piling risk assessment are required to mitigate these risks.
Ground gas from Tidal Flat Deposits, including peat	Construction Workers (B)	Inhalation of soil gas / explosion (2)	Low likelihood	High	Moderate	High methane concentrations associated with peat/organic clays but with low or absent flux. Gas flux likely to increase during surcharge loading for motorway embankment. New pathways could be created with band drains and piles. Construction to be largely within open space. Any earthworks within confined space would require specific risk assessment, control measures and PPE. Low permeability of Tidal Flat Deposits will inhibit lateral migration. Piling and band drain installations could result in explosive risks during operations and risk assessment and gas mitigation measures will be needed. Gap in the data has been identified and further investigations are required to
	Offsite users during construction works (C)	Inhalation of soil gas / explosion (2)	Unlikely	High	Moderate to low	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Onsite Elevated pH originating from the Made Ground (slag material) and sediments (in Reedbed No. 1). Plus hydrocarbon contaminated soils in part of the Metal Recovery Area	Operational					
	Maintenance Workers (B)	Direct dermal (1)	Unlikely	Low	Very low	Made Ground to be largely encapsulated by the embankment or removed and therefore the exposure to contamination will be limited outside the motorway embankment. Areas outside the motorway hardstanding will receive topsoil and/or subsoil cover for planting further reducing pathways. Exposure duration will be short term only. Site specific risk assessment will be required in line with health and safety legislation. This will enable safe working methods and appropriate levels of PPE to be put in place, for instance during future excavations required during maintenance. As such all risks will be duly considered and suitably mitigated. Current data set identifies limited exceedances above the selected generic screening criteria.
		Ingestion (3)	Unlikely	Low	Very low	
		Inhalation of soil dust (2)	Unlikely	Low	Very low	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of soil gas or vapours (2)	Unlikely	Low	Very low	Temporary in increase gas flux due to surcharge of superficial soils would have mostly ceased. Maintenance works to be largely within open space. Any works within confined space would require specific risk assessment, control measures and PPE to meet legislative requirements. Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks associated with the new link road.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Motorway users (A) & Off site users (C)	Dermal contact with dust (1)	Unlikely	Low	Very low	Potential contamination sources in soil are limited to the presence of slag within the Made Ground and the sediments within the lagoon are to be largely encapsulated by the embankment or removed. Areas outside the motorway hardstanding will receive topsoil and/or subsoil cover for planting further reducing pathways. Exposure duration will be short term only for Motorway users. The human health screening criteria is considered conservative when considering exposure and pathway mechanisms to future Site users.
		Ingestion of dust (3)	Unlikely	Low	Very low	
		Inhalation of soil dust (2)	Unlikely	Low	Very low	
		Inhalation of soil gas or vapours (2)	Low likelihood	Moderate	Moderate to low	Limited potential for lateral gas migration given the presence of low permeability Tidal Flat Deposits to shallow depth. Temporary increase in gas flux due to surcharge of superficial soils would have mostly ceased. Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks associated with the link road and also the hydrocarbon contamination in the former metal defragmentation plant area.
Hydrocarbon contamination in part of the	Glan Llyn Depot Workers (A)	Dermal contact (1)	Unlikely	Low	Very low	Made Ground to be entirely encapsulated by the hardstanding removing all dermal, ingestion and inhalation of soil dust pathways.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Metal Recovery Area		Ingestion (3)	Unlikely	Low	Very low	
		Inhalation of soil gas or vapours (2)	Likely	Moderate	Moderate	Made Ground to be entirely encapsulated by the hardstanding removing all dermal, ingestion and inhalation of soil dust pathways. No ground gas data from Made Ground formation. Significant VOCs gas not anticipated given the nature of the hydrocarbon (mid to heavy carbon range). Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks associated.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
On Site: Elevated pH originating from the Made Ground (slag material) and sediments (in Reedbed No. 1). Plus hydrocarbon contaminated soils in part of the Metal Recovery Area	Groundwater - Aquifer (Da)	Leaching/migration (4)	Likely	Moderate	Moderate	Thick deposit of predominantly soft low permeability Tidal Flat Deposits overlies the aquifer, reducing risk of downward migration. Increased vertical pathways between possible contaminant and receptor with construction of band drains and piles. However, soft clays of the Tidal Flat Deposits likely to 'heal' along pile pathways mitigating this route. The aquifer has elevated metal and inorganic contaminants but the levels appear similar to levels in the perched waters in the Made Ground and in the perched groundwaters in the TFD. These are considered to be at background levels. Perched waters within the Made Ground also include organics and, in the former defragmentation plant area, free products which are absent in the aquifer. Made Ground to be entirely encapsulated by the hardstanding removing all dermal, ingestion and inhalation of soil dust pathways. Low leaching potential identified from soil materials. Further investigation is needed in the area of hydrocarbon contamination in the former area of the metal defragmentation plant.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Surface water (land drainage) (E)	Saturated flow within perched groundwater (4)	Likely	Moderate	Moderate	Perched (shallow) groundwater is likely to be intercepted by the land drainage. Contaminants in perched water, especially hydrocarbons in the former metal defragmentation area, could migrate into surrounding surface waters. Temporary increase in water flux due to surcharge of superficial soils would have mostly ceased. Water quality adjacent to Site considered to be of relatively good quality. Further investigation is needed in the area of hydrocarbon contamination in the former area of the metal defragmentation plant.
Groundwater - Aquifer	Surface water (land drainage) (E)	Band drain / piles (4)	Likely	High	High	Aquifer quality shown to be impacted by metal and inorganic contaminants. The hydrostatic pressure of the aquifer is near base of Made Ground and band drains and piles could create potential vertical pathways connecting aquifer with surface water. Controls and a piling risk assessment are required to mitigate these risks.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Peat	Maintenance Workers (B)	Inhalation of soil gas / explosion (2)	Unlikely	High	Moderate to low	Although elevated methane concentrations are known within the natural soils of the Tidal Flat Deposits, the low permeability soils will result in limited gas generation post construction. Risks to maintenance workers are low but entry into any confined spaces will need to adhere to health and safety legislation requirements. Pathways along piles likely to 'heal' with increase in soil contact along pile shaft preventing gas migration. However band drains could still allow localised gas migration. Gap in the data has been identified and further investigations are required to assess any potential gas and confirm the risks.
	Depot Workers (B)	Inhalation of soil gas / explosion (2)	Low likelihood	High	Moderate	Although elevated methane concentrations are known within the natural soils of the Tidal Flat Deposits, the low permeability soils will result in limited gas generation post construction. Pathways along piles likely to 'heal' with increase in soil contact along pile shaft preventing gas migration. Gap in the data has been identified and further investigations are required to assess any potential gas and confirm the risks and the need for gas protection and need for gas protection and control measures to be incorporated into the proposed new buildings at the Glan Llyn Depot.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Motorway users (A) / Off site users (C)	Inhalation of soil gas / explosion (2)	Unlikely	High	Moderate to low	Ground gas data from the peat horizons within the superficial deposits identify concentrations of methane, carbon dioxide and trace VOCs. New pathways to be created with piles and band drains. Limited potential for lateral gas migration given the presence of low permeability Tidal Flat Deposits to shallow depth. Motorway to be built on raised embankment providing a further barrier to migration of gases. Pathways along piles likely to 'heal' with increase in soil contact along pile shaft preventing gas migration. However band drains could still allow localised gas migration. Gap in the data has been identified and further investigations are required to assess any potential gas and confirm the risks.

10 Conclusions and Recommendations

10.1 Conclusions

10.1.1 Ground investigations have been undertaken at the Site to assess risks from land contamination associated with the construction and operation of the Scheme. This has included human health and controlled waters risk assessments. The risk assessment has identified that some residual risks to human health and controlled waters could exist and control measures are required to facilitate the construction and ongoing operation of the Scheme.

10.1.2 Hydrocarbon contamination in soils and perched water has been identified in part of the former Metal Recovery Area including the proposed Glan Llyn Depot. Further ground investigation is required to better establish risks to future site users and controlled waters and determine any remediation required. Additional mitigation measures may also be required for the operational phase such as inclusion of gas barrier beneath the proposed depot buildings.

10.1.3 The laboratory testing results from previous ground investigations confirmed the onsite observations and field testing, and showed that the materials encountered within the new section of motorway alignment are at tolerable levels of risk to human health both during construction and operational phases. Materials are likely to be suitable for reuse subject to compliance of reuse criteria under a Material Management Plan. Within the proposed Glan Llyn Depot, reuse of hydrocarbon impacted soils may require some treatment of soils to enable reuse in the Scheme.

10.1.4 During the construction phase, specific mitigation measures will be required to prevent inhalation pathways of dust to off site and work force receptors, although such measures would be no more than typically expected on a construction site.

10.1.5 Contaminated perched waters in Made Ground, particularly TPH contaminated perched water in the Metal Recovery Area, may be in continuity with land drainage and will require suitable water management strategy to prevent potential impact to surface waters as well as protection against any contaminated run-off during construction. During the operational phase, the motorway hardstanding will significantly limit the infiltration of rainwater through the soils and therefore leaching any soil contaminants in Made Ground into the water will be very limited. A remediation strategy will need to be developed to ensure risks associated with TPH in soils and perched water within the proposed Glyn Llyn Depot are mitigated both during construction and during operational phases of the Scheme.

10.1.6 Surface waters at the boundary of the Site are generally of good quality albeit with possible evidence of impact which may be associated with the Site's historical use. There is insufficient data to verify this currently.

10.1.7 The use of band drain and piles may provide new pathways which may lead to water within the Tidal Flat Deposits and possibly any perched water within the Made Ground to enter the currently confined aquifer within the Glaciofluvial Deposits and Mercia Mudstone. A piling risk assessment will be required prior to construction.

10.1.8 The deep aquifer is identified to have elevated metals and inorganic contaminants which could reduce surface water quality during construction if the band drain/pile allow direct or indirect linkage. Further consideration and a piling risk assessment will be undertaken to mitigate the potential impact of the band drains and sites to allow specific mitigation measures to be implemented.

10.1.9 Post construction, the permanent land take, including the embankment itself, will have topsoil and subsoil cover for landscaping purposes and potential human health pathways to end users and maintenance workers becoming exposed to contaminated soils will be broken. However, topsoil materials will need to be checked for contamination against suitable for reuse criteria.

10.2 Recommendations

10.2.1 Given the identified gap in the data associated with land contamination at the Site, including hydrocarbon contamination associated with the historical slag fragmentation, additional ground investigation works is required. The additional investigation will include the below.

- Trial pits and boreholes to collect soil samples including further delineation of the extent of hydrocarbon contamination at the proposed Glan Llyn Depot along the new link road.
- Installation of groundwater monitoring wells to collect groundwater samples and enable gas monitoring.

10.2.2 Upon review and assessment of the additional ground investigation information, any contamination identified that could cause an unacceptable risk to the identified receptors will require appropriate remedial mitigation measures to be implemented. These measures would be identified within a remedial strategy for the Scheme. The remediation strategy is anticipated to include but is not limited to the below.

- Addressing uncertain human health risk and controlled waters risk identified by the proposed additional ground investigation.
- Safe methods of working to mitigate UXO risks.
- Risk assessment of piles/band drains and associated construction works creating pathways enabling contaminants migration.
- Dealing with unexpected contamination.
- Verification sampling strategy to confirm suitability for soils for retention/reuse.
- Control measures to prevent risks to construction workers and the general public during construction.
- Verification of imported topsoils for suitability of use.

10.2.3 The remediation strategy should include a remediation options appraisal, remediation implementation plan and remediation verification plan. The remediation strategy should be supported by a Scheme wide Material Management Plan prepared in accordance with CL:AIRE Code of Practice (CL:AIRE, 2011).

11 References

Bactec (2014) Explosive Ordnance Threat Assessment in respect of M4 Corridor around Newport for Hyder Consulting (UK) Limited, 5750TA

CL:AIRE (2011) Definition of Waste. Development Industry Code of Practice, Version 2, March 2011, ISBN 978-1-905046-23-2

Environment Agency (2001) Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention. NC/99/73

Environment Agency (2002) Piling into contaminated sites. National Groundwater and Contaminated Land Centre, February 2002

Enviros Consulting (2006), Collation of information for proposed M4 route corridor at Corus Llanwern., July 2006, CO0480043

Geotechnical Engineering Limited (2015), M4 Corridor Around Newport, Factual Report on Ground Investigation, 30238

Highways Agency (2008), Design Manual for Roads and Bridges. Vol. 4. Geotechnics and Drainage. Section 1. Earthworks; Part 2. HD22/08. Managing Geotechnical Risk. April 2008.

Ove Arup & Partners (2014), M4 Corridor Around Newport, Preliminary Sources Study Report, July 2014, 14/9197

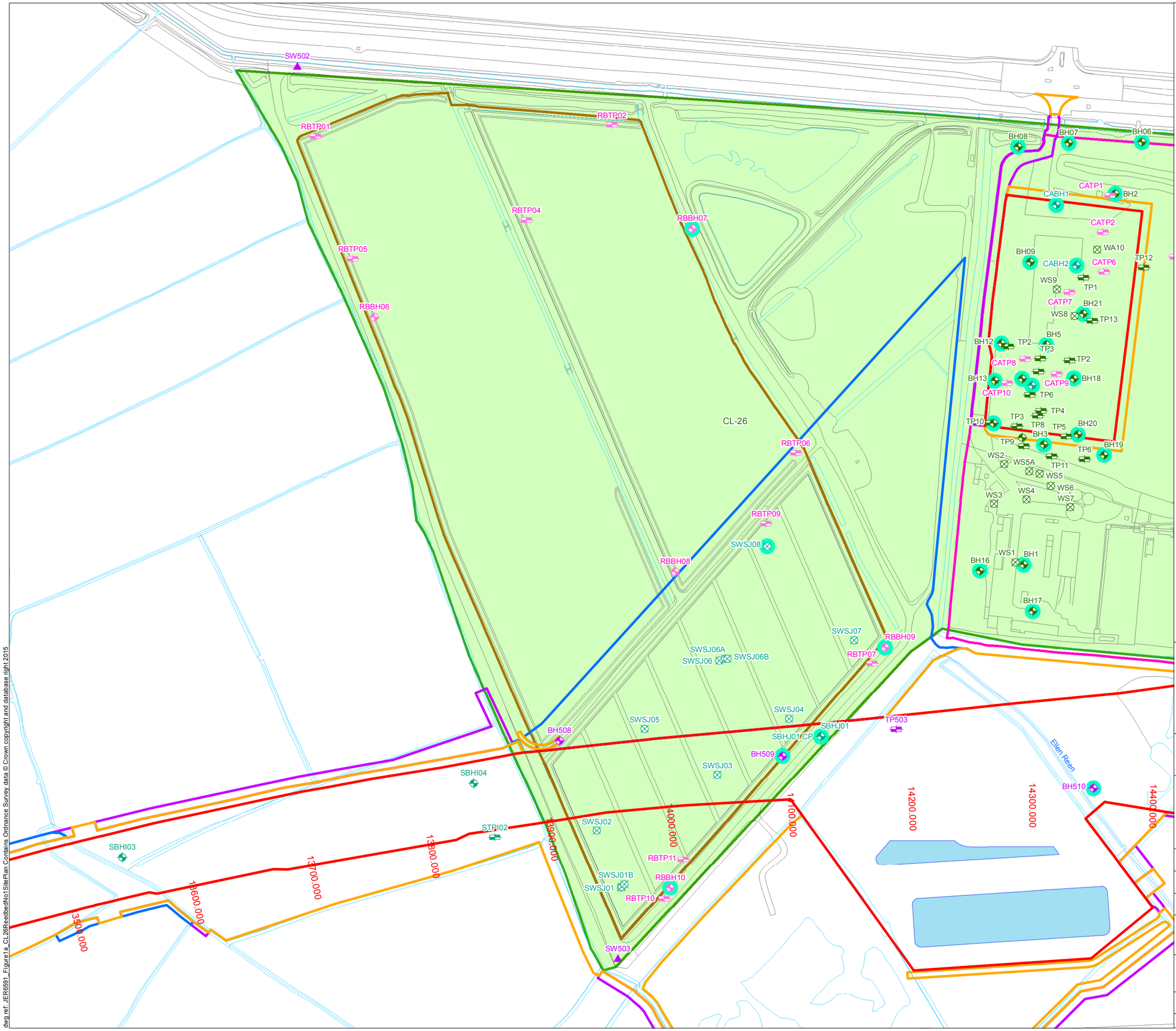
Titan Environmental Surveys Ltd (2008) New M4 Magor to Castleton Baseline Surface Water Quality Final Report for Arup, Report Number HS0442/F1/2

12 Glossary

BF	Blast Furnace
BGS	British Geological Survey
BOD	Biochemical Oxygen Demand
BOS	Basic Oxygen Slag
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CAT	Cable Avoidance Tool
CDM	Construction Design Management
CH4	Methane
CLEA	Contaminated Land Exposure Assessment
CO2	Carbon Dioxide
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CSM	Conceptual Site Model
DMRB	Design Manual for Roads and Bridges
DO	Dissolved Oxygen
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESG	Environmental Scientifics Group
EQS	Environmental Quality Standard
FTIR	Fourier Transform Infrared (spectroscopy)
GAC	Generic Assessment Criteria
GDR	Geotechnical Design Report
GIR	Ground Investigation Report
GRO	Gasoline Range Organics
LEL	Lower Explosive Limit
LOD	Limit of Detection
mAOD	Metres Above Ordnance Datum

mb	Millibars
mbGL	Metres below Ground Level
MTBE	Methyl Tert-butyl Ether
NRW	Natural Resources Wales
ORP	Oxidation Reduction Potential
O2	Oxygen
OS	Ordnance Survey
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCSM	Preliminary Conceptual Site Model
PID	Photo Ionisation Detector
PPE	Personnel Protection Equipment
SGVs	Soil Guideline Values
SSAC	Site Specific Assessment Criteria
SSSI	Site of Special Scientific Interest
SVOCs	Semi-Volatile Organic Compounds
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
TPH CWG	Total Petroleum Hydrocarbon Criteria Working Group
UKAS	United Kingdom Accreditation Service
VOCs	Volatile Organic Compounds
WFD	Water Framework Directive
UXO	Unexploded Ordnance Survey

Figures



Legend

- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Other Permanent Land Take
- Temporary Construction Land
- Easement Only
- Proposed Water Treatment Area (WTA)
- Potential Area of Land Contamination based on 2014 PSSR
- Reedbed No. 1
- Metal Recovery Area

Investigation Locations

2015 (Geotechnical Engineering)

- Borehole
- Trial Pit
- Surface Water Monitoring Location

2007 (Norwest Holst)

- Borehole
- Trial Pit
- Window Sample

2004-2006 (Enviros)

- Borehole
- Trial Pit
- Window Sample

2002 (Exploration Associates)

- Borehole
- Trial Pit
- Monitoring Well Installation

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Welsh Government

Appendix 11.1 Annex D CL-26

Site Plan for CL-26 (Reedbed No. 1)

Figure: 1a	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Scale: A3 @ 1:3,000
0 50 100 m

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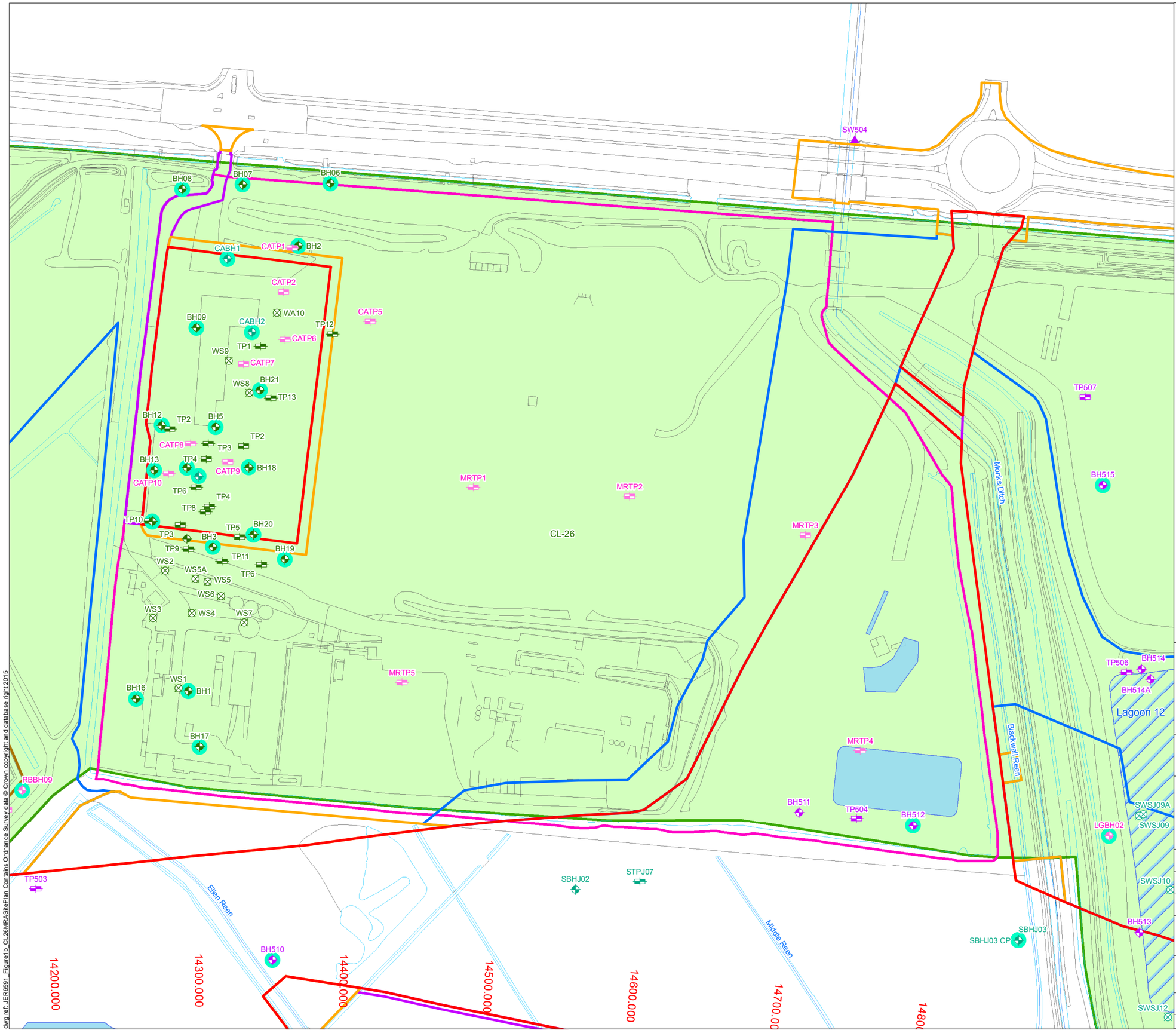

Legend

- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Other Permanent Land Take
- Temporary Construction Land
- Easement Only
- Proposed Water Treatment Area (WTA)
- Potential Area of Land Contamination based on 2014 PSSR
- Reedbed No. 1
- Metal Recovery Area
- Lagoon

Investigation Locations

2015 (Geotechnical Engineering)

- Borehole
- Trial Pit
- Surface Water Monitoring Location

2007 (Norwest Holst)

- Borehole
- Trial Pit
- Window Sample

2004-2006 (Enviros)

- Borehole
- Trial Pit
- Window Sample

2002 (Exploration Associates)

- Borehole
- Trial Pit
- Monitoring Well Installation

Llywodraeth Cymru
Welsh Government

Appendix 11.1 Annex D CL-26

Site Plan for CL-26 (Metal Recovery Area)

Figure: 1b	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Scale: A3 @ 1:2,500
0 40 80m

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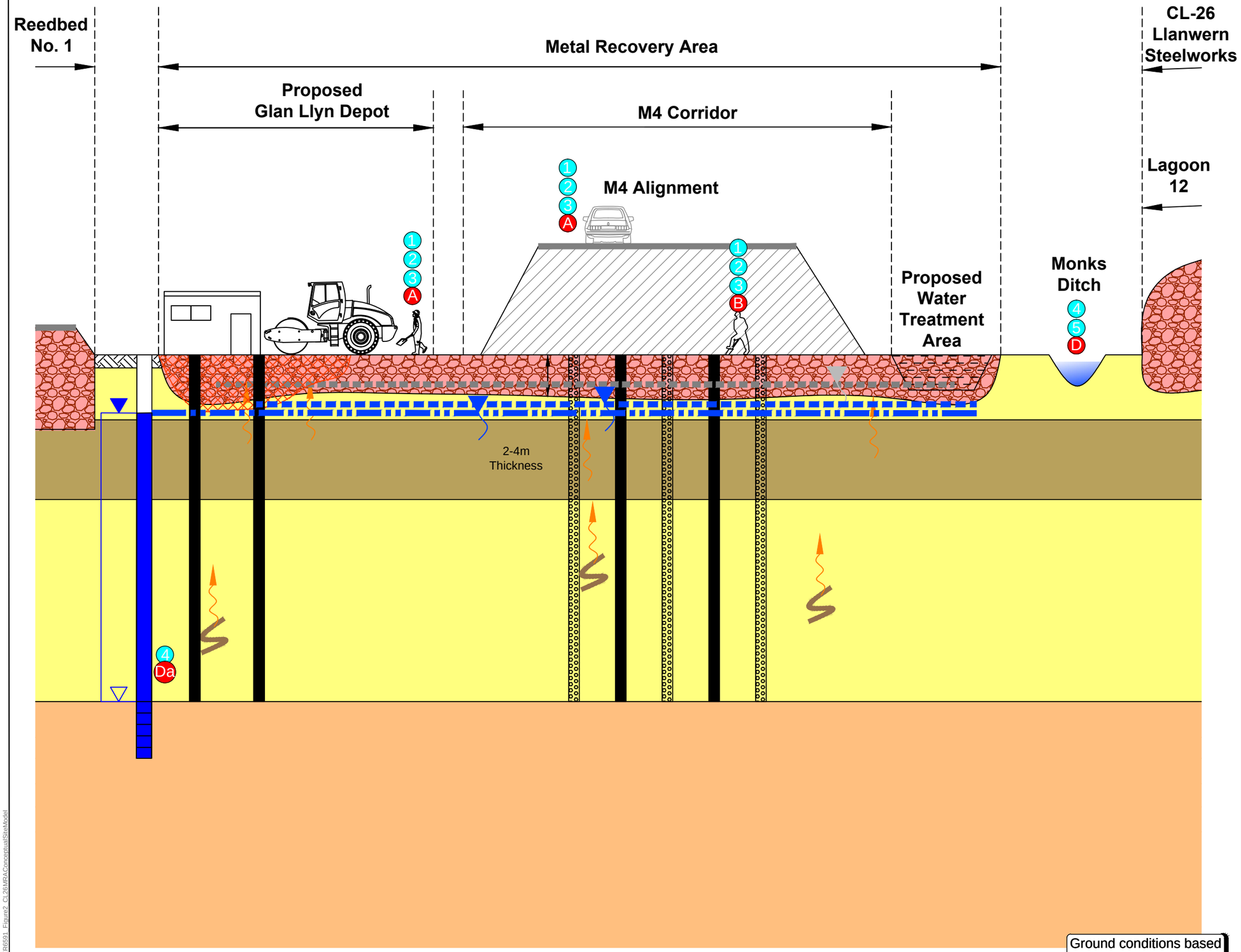
CL- 26 Llanwern Steelworks (Metal Recovery Area)



Ground conditions based on available information

Legend

- Topsoil
- Evidence of Hydrocarbon Contamination
- Made Ground (Slag)
- Tidal Flat Deposits - TFD
- Organic Matter within TFD
- Peat
- Mercia Mudstone - MM
- Proposed Embankment
- Proposed Pile
- Proposed Band Drain
- Perched Water (MG)
- Perched Groundwater (TFD)
- Groundwater (GFD and MM)
- Water Strike
- Rest Water Level
- Gas Migration Pathway

Potential Receptors

- A Humans On-Site (M4/Glan Llyn Depot User)
- B Humans On-Site (Construction/Maintenance)
- C Humans Off-Site (Site Neighbours)
- Da Groundwater (Aquifer)
- Db Groundwater (Perched)
- E Surface Water

Potential Pathways

- 1 Dermal Contact
- 2 Inhalation
- 3 Ingestion
- 4 Leaching / Migration
- 5 Surface Run Off

Potential Sources of Contamination

Possible contamination present on site associated with :

Off-Site

- Reedbed to Llanwern Steelworks surface water process
- Main Llanwern Steelworks
- Lagoons (CL-26)
- Metal Recovery Area (former slag process area)
- Hydrocarbon impacted soils and water in part of Metal Recovery Area
- Ground gas originating from the natural organic peat soils / Made Ground

NOTE
Drawing refined from PSSR Drawing Reference M4-OA-17-00DR-Z-XX-0149 (February 2014)

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Welsh Government

Appendix 11.1 Annex D CL-26

Conceptual Site Model for CL-26 (Metal Recovery Area)

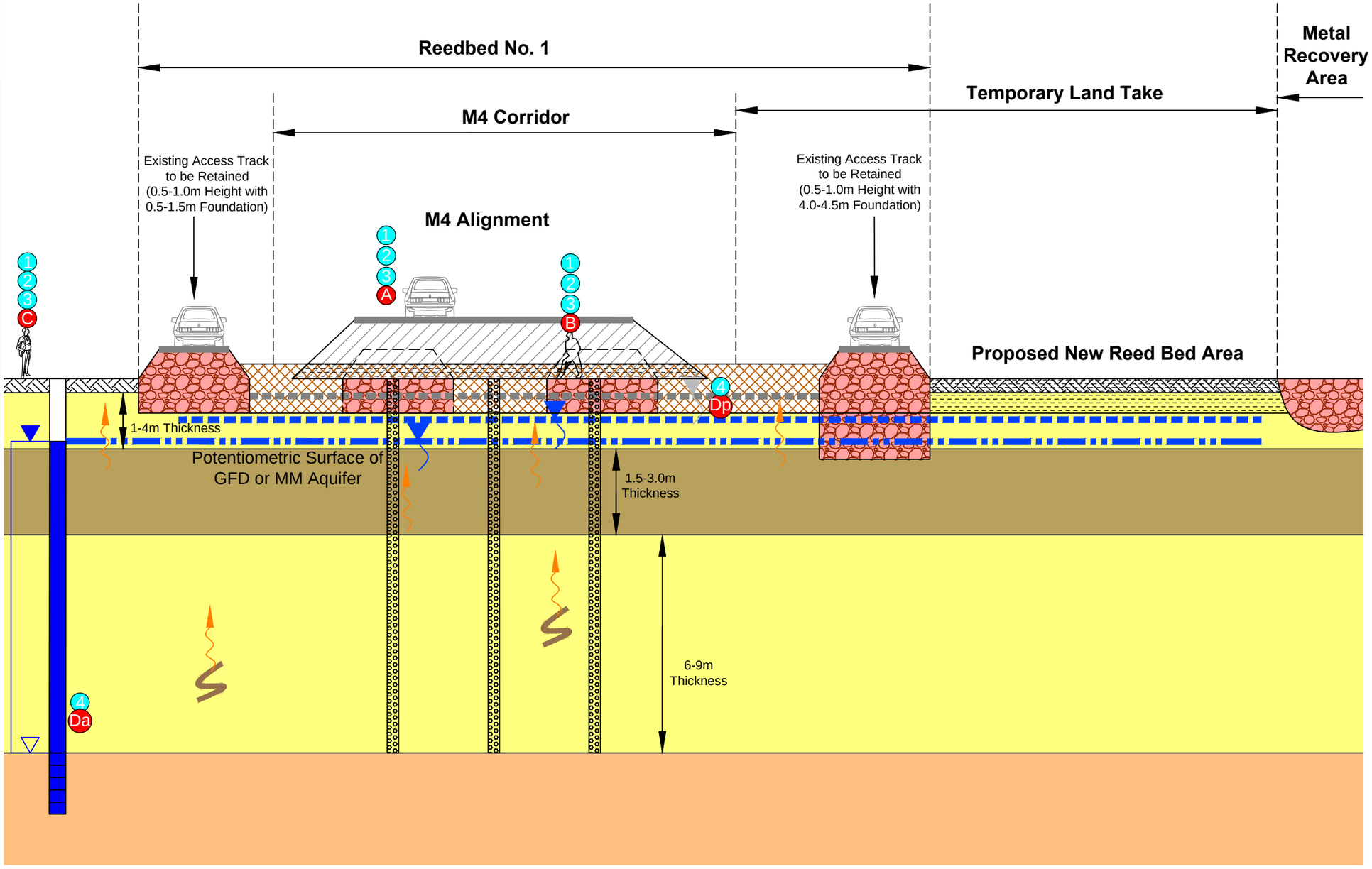
Figure: 2	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Not to Scale

dwg ref:JER6591_Figure2_CL26MRAConceptualSiteModel

dwg ref: JER6591_Figure2_CL26MRAConceptualSiteModel

CL- 26 Llanwern Steelworks (Reedbed No.1)



Ground conditions based on available information

Legend

- Topsoil
- Reedbed (Made Ground: Clay with Roots)
- Made Ground (Slag)
- Tidal Flat Deposits - TFD
- Organic Matter within TFD
- Peat
- Mercia Mudstone - MM
- Proposed Embankment
- Proposed Cutting
- Proposed Band Drain
- Perched Water (MG)
- Perched Groundwater (TFD)
- Groundwater (GFD and MM)
- Water Strike
- Rest Water Level
- Gas Migration Pathway

Potential Receptors

- A Humans On-Site (M4 User)
- B Humans On-Site (Construction/Maintenance)
- C Humans Off-Site (Site Neighbours)
- Da Groundwater (Aquifer)
- Dp Groundwater (Perched)
- E Surface Water

Potential Pathways

- 1 Dermal Contact
- 2 Inhalation
- 3 Ingestion
- 4 Leaching / Migration
- 5 Surface Run Off

Potential Sources of Contamination

Possible contamination present on site associated with :

On-Site

- Reedbed to Llanwern Steelworks surface water process

Off-Site

- Main Llanwern Steelworks
- Lagoons (CL-26)
- Metal Recovery Area (former slag process area)
- Hydrocarbon impacted soils and water in part of Metal Recovery Area
- Ground gas originating from the natural organic peat soils / Made Ground

NOTE
Drawing refined from PSSR Drawing Reference M4-OA-17-00DR-Z-XX-0149 (February 2014)

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Appendix 11.1 Annex D CL-26

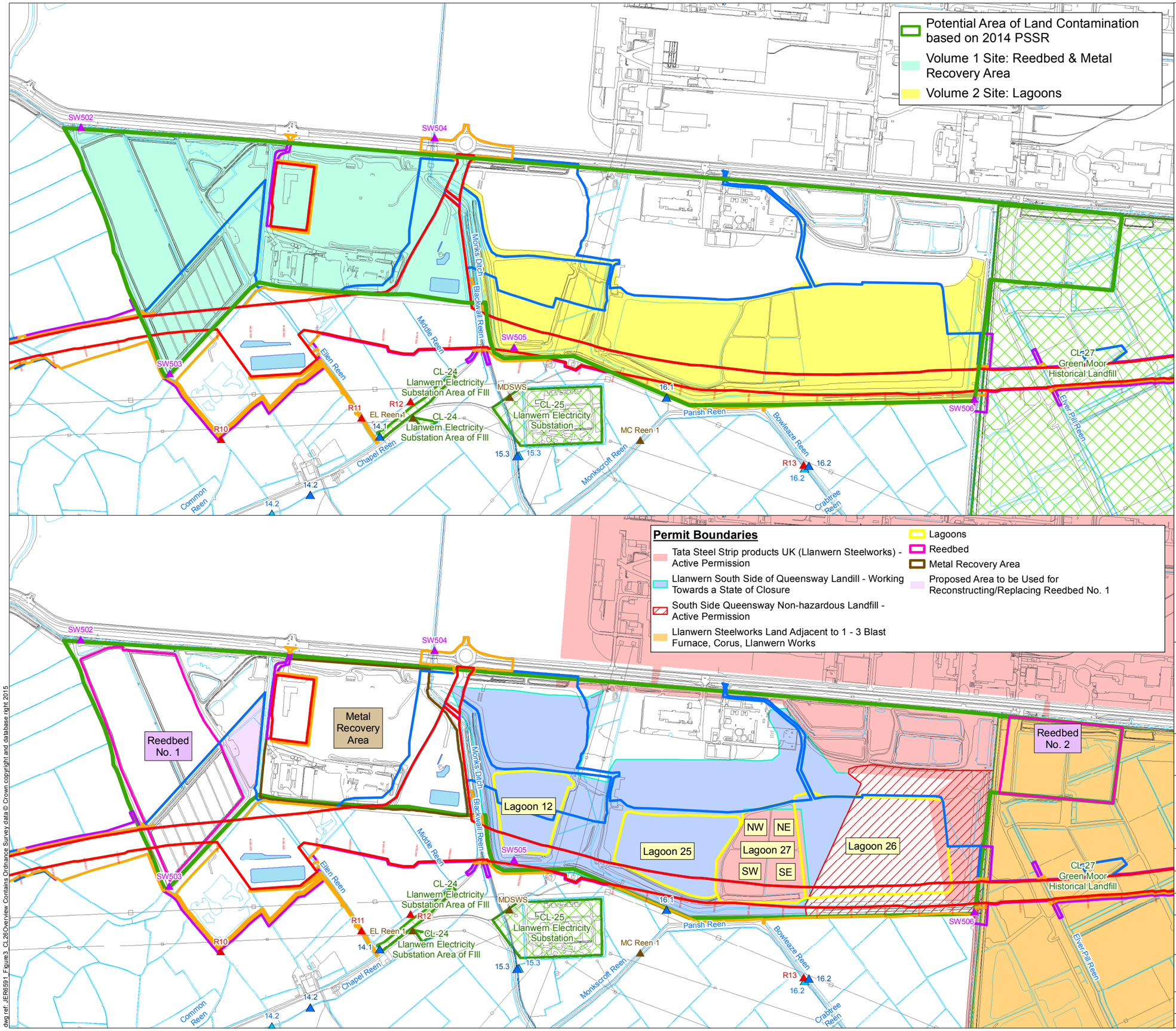
Conceptual Site Model for CL-26 (Reedbed No. 1)

Figure: 2	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Not to Scale

dwg ref:JER6591_Figure2_CL26ReedbedNo1ConceptualSiteModel

dwg ref: JER6591_Figure2_CL26ReedbedNo1ConceptualSiteModel



Legend

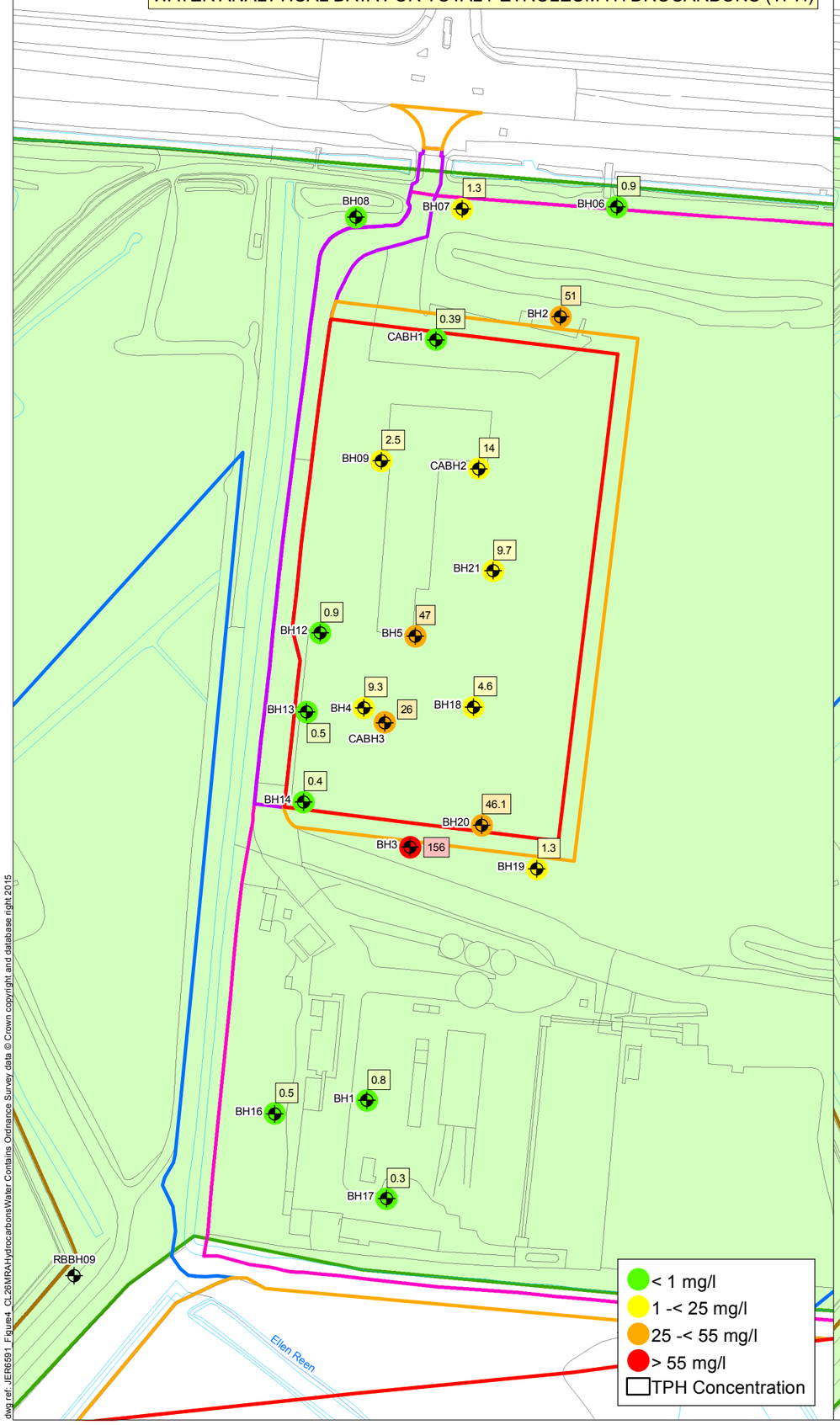
- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Other Permanent Land Take
- Temporary Construction Land
- Easement Only
- Proposed Water Treatment Area (WTA)
- Potential Area of Land Contamination based on 2014 PSSR
- Other Potential Area of Land Contamination

Surface Water Monitoring Locations

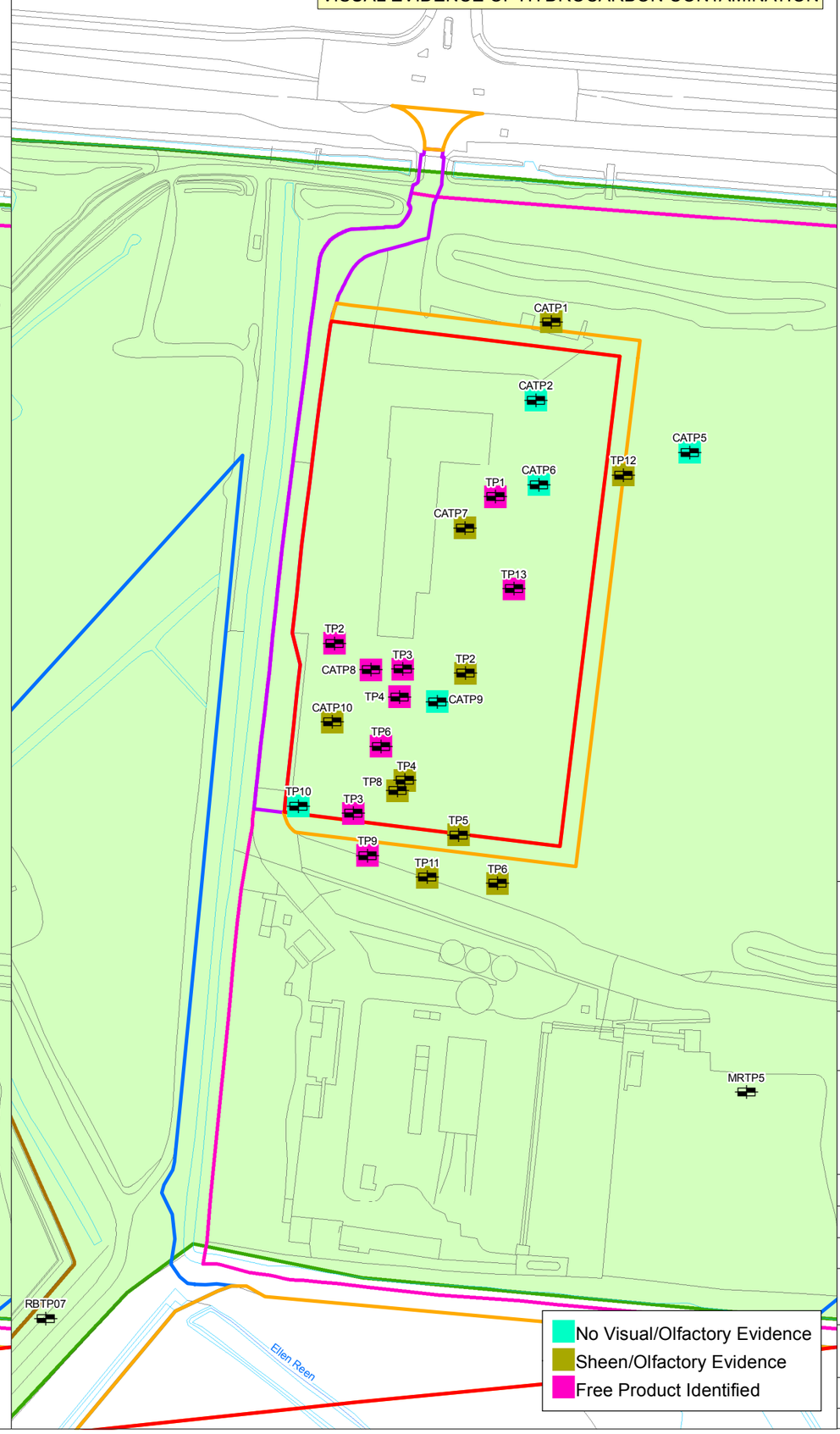
- 2015 (RPS) - Q2
- 2015 (RPS) - Q1
- 2015 (Geotechnical Engineering)
- 2008-2009 (Titan Surveys)
- 2006 (Enviros)

M4
A48
A48(M)
NEWPORT
Llanwern
Wilcrick
Bishton
Underwood
Llanfihangel Rogiet
Magor
Undy
Rhiwderin
Bassaleg
Michaelston-y-Fedw
Duffryn
Coedkernew
Marshfield
Castleton
Tredegar Park
Bedwas
Pontllanfraith
Pontllanfraith
Pontllanfraith

WATER ANALYTICAL DATA FOR TOTAL PETROLEUM HYDROCARBONS (TPH)



VISUAL EVIDENCE OF HYDROCARBON CONTAMINATION



Legend

- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Other Permanent Land Take
- Temporary Construction Land
- Easement Only
- Potential Area of Land Contamination based on 2014 PSSR
- Reedbed No. 1
- Metal Recovery Area
- Monitoring Well Location
- Trial Pit Location

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Appendix 11.1 Annex D CL-26

Hydrocarbon Contamination Distribution for CL-26 (Metal Recovery Area)

Figure: 4	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Scale: A3 @ 1:2,000
0 30 60 m

N

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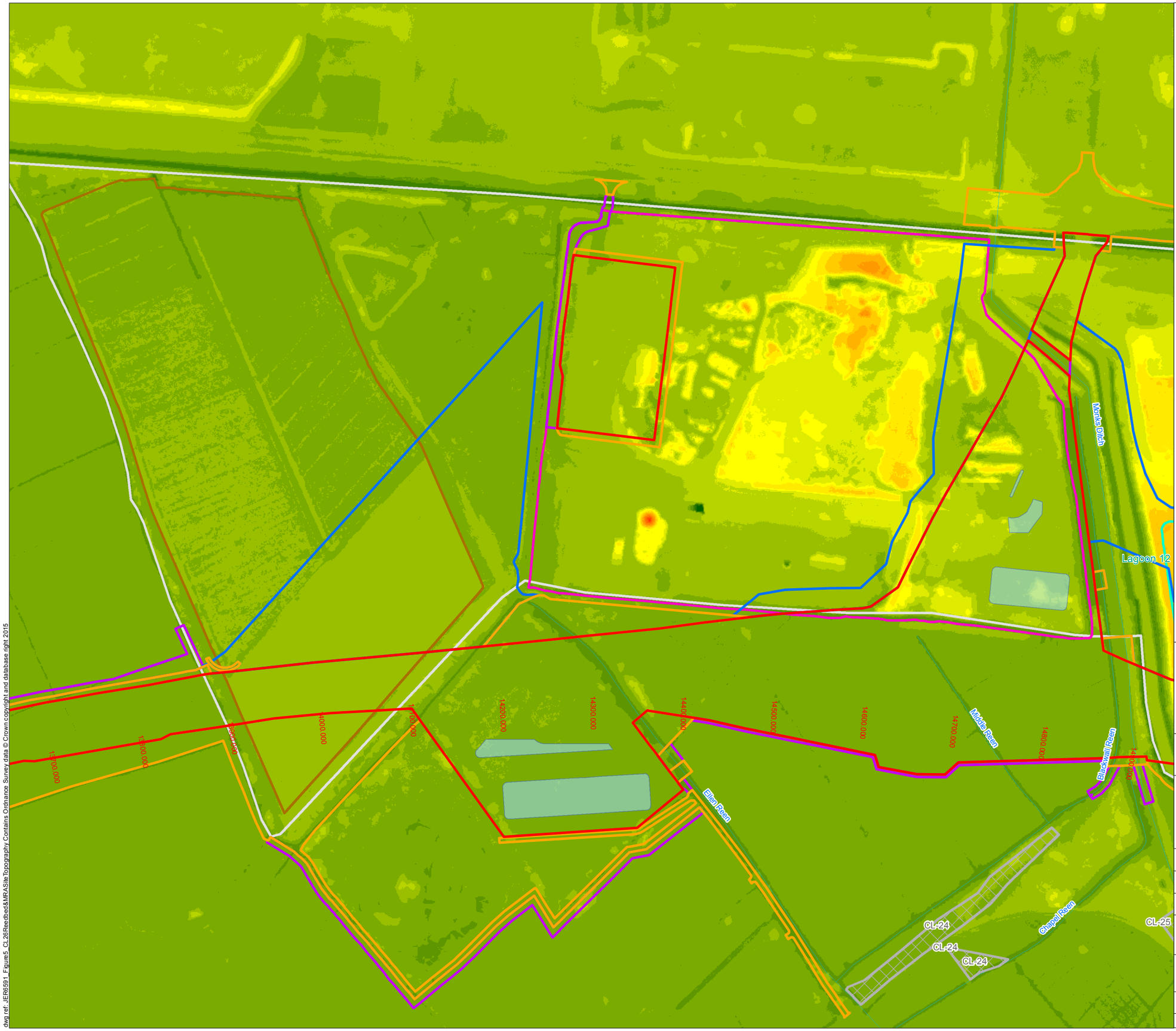
dwg ref: JER6591_Figure4_CL26MRAHydrocarbonsWater

dwg ref: JER6591_Figure4_CL26MRAHydrocarbonsWater Contains Ordnance Survey data © Crown copyright and database right 2015



Legend

- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Other Permanent Land Take
- Temporary Construction Land
- Easement Only
- Proposed Water Treatment Area (WTA)
- Potential Area of Land Contamination based on 2014 PSSR
- Other Potential Area of Land Contamination
- Reedbed No. 1
- Metal Recovery Area
- Lagoon

LiDAR Digital Terrain Model

- 1 -< 2 mAOD
- 2 -< 3 mAOD
- 3 -< 4 mAOD
- 4 -< 5 mAOD
- 5 -< 6 mAOD
- 6 -< 7 mAOD
- 7 -< 8 mAOD
- 8 -< 9 mAOD
- 9 -< 10 mAOD
- 10 -< 11 mAOD
- 11 -< 12 mAOD
- 12 -< 13 mAOD
- 13 -< 14 mAOD
- 14 -< 15 mAOD
- 15 -< 16 mAOD

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Appendix 11.1 Annex D CL-26

Site Topography for CL-26 (Reedbed No. 1 & Metal Recovery Area)

Figure: 5	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Scale: A3 @ 1:4,000
0 100 200 m

N

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dwg ref: JER6591_Figure5_CL26Reedbed&MRASiteTopography

dwg ref: JER6591_Figure5_CL26Reedbed&MRASiteTopography Contains Ordnance Survey data © Crown copyright and database right 2015

Appendices

Appendix 1

Exploratory Records

Borehole Log

Exploration Associates

Drilled by DO Logged by Checked by	Equipment and Methods Cable Percussion 150 mm diameter from 0.00m to 7.00m.	Ground Level + 4.89 m OD National Grid Coordinates E 335772.22 N 186062.34	

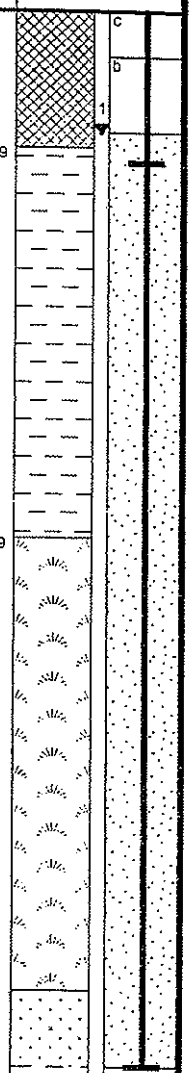
Samples and Tests

Depth	Type & No.	Records	Date Casing	Time Water
			29/01/2002	
0.50	ES1			
0.90	ES2			
3.50	ES3			
6.50	ES4			
			29/01/2002 7.00	
7.00		kRH		

Strata

Description	Depth,Level (Thickness)
Compact slag fill (DRILLERS DESCRIPTION).	(0.90)
	0.90 +3.99
Stiff grey brown mottled CLAY (DRILLERS DESCRIPTION).	(2.60)
	3.50 +1.39
PEAT (DRILLERS DESCRIPTION).	(3.00)
	6.50 --1.61
Soft grey SILT (DRILLERS DESCRIPTION).	(0.50pen)
	7.00 --2.11
EXPLORATORY HOLE ENDS AT 7.00 m.	

Legend



Groundwater

No.	Struck	Behaviour
1	0.80m	Rising to 0.80m after 20 mins. Sealed 1.20. Seepage

Remarks

Chiselling : 0.30m to 0.50m 60minutes
Hole backfill : 0.00m to 0.30m Concrete (c), 0.30m to 0.80m Bentonite (b). Surface protection : Stop Cock Cover
Standpipe installed, 50mm diameter, response zone from 0.80m to 7.00m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole
RBBH6
Sheet 1 of 1

03/05/2002 11:16:26 ESGLog v2.10

Borehole Log

Exploration Associates

Drilled by DO Logged by JN Checked by	Equipment and Methods Cable Percussion 150 mm diameter from 0.00m to 7.00m.	Ground Level + 5.02 m OD National Grid Coordinates E 336043.99 N 186144.72	

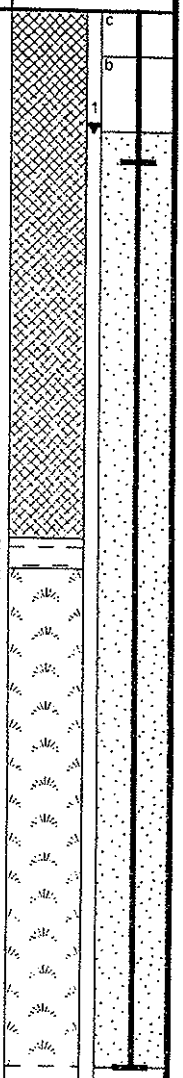
Samples and Tests

Depth	Type & No.	Records	Date Casing Time Water
			29/01/2002
0.50	ES1		
3.50	ES2		
3.70	ES3		
			29/01/2002 0.00

Strata

Description	Depth,Level (Thickness)	
MADE GROUND : Grey brown very sandy GRAVEL. Gravel is angular and subangular fine to coarse of slag. Driller reports concrete.	(3.50)	
MADE GROUND: Soft grey slightly gravelly CLAY. Gravel is angular and fine.	3.50	+1.52
Dark brown spongy pseudofibrous PEAT.	3.70 (3.30pen)	+1.32
EXPLORATORY HOLE ENDS AT 7.00 m.	7.00	-1.98

Legend



Groundwater

No.	Struck	Behaviour
1	0.80m	Rising to 0.80m after 20 mins. Sealed 4.00. Slow inflow

Remarks

Chiselling : 0.50m to 0.75m 60minutes, 1.30m to 1.50m 45minutes
Hole backfill : 0.00m to 0.30m Concrete (c), 0.30m to 0.80m Bentonite (b). Surface protection : Stop Cock Cover
Standpipe installed, 50mm diameter, response zone from 0.80m to 7.00m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project: ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no. 152002
Carried out for Corus plc

Borehole **RBBH7**
Sheet 1 of 1

03/05/2002 11:16:32 ESGLog v2.10

Borehole Log

Exploration Associates

Drilled by DO Logged by JN Checked by	Equipment and Methods Cable Percussion 150 mm diameter from 0.00m to 7.00m.	Ground Level + 4.90 m OD National Grid Coordinates E 335990.18 N 185929.21	

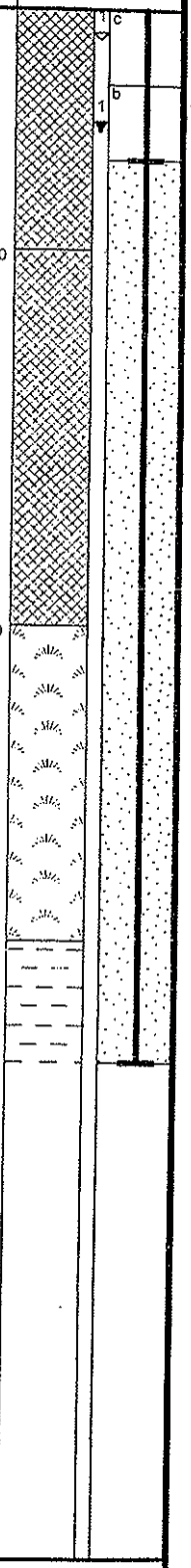
Samples and Tests

Depth	Type & No.	Records	Date Casing	Time Water
			30/01/2002	
0.50	ES1			
1.00	ES2			
1.50	ES3			
4.50	ES4			
6.50	ES5			
7.00		kRH	30/01/2002 7.00	

Strata

Description	Depth,Level (Thickness)
MADE GROUND: Grey brown very sandy GRAVEL. Gravel is angular and subangular fine and medium of slag. Driller reports contamination. At 1.00m: Soft grey slightly gravelly CLAY. Gravel is angular fine of slag.	(1.60)
MADE GROUND: Firm to stiff slightly gravelly CLAY. Gravel is angular and fine. Driller reports contamination - becoming less contaminated with depth.	1.60 +3.30 (2.50)
Black spongy pseudofibrous PEAT.	4.10 +0.80 (2.10)
Soft grey CLAY with bands of black spongy pseudofibrous PEAT.	6.20 -1.30 (0.80pen)
EXPLORATORY HOLE ENDS AT 7.00 m.	7.00 -2.10

Legend



Groundwater

No.	Struck	Behaviour
1	0.80m	Rising to 0.20m after 20 mins. Sealed 2.00. Medium inflow

Remarks

Chiselling : 0.40m to 1.00m 150minutes
Hole backfill : 0.00m to 0.50m Concrete (c), 0.50m to 1.00m Bentonite (b). Surface protection : Stop Cock Cover
Standpipe installed, 50mm diameter, response zone from 1.00m to 7.00m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole
RBBH8
Sheet 1 of 1

03/05/2002 11:16:39 ESGLog v2.10

Borehole Log

Exploration Associates

Drilled by NF Logged by LM Checked by	Equipment and Methods Cable Percussion 150 mm diameter from 0.00m to 7.00m.	Ground Level + 5.79 m OD National Grid Coordinates E 336167.86 N 185870.61	

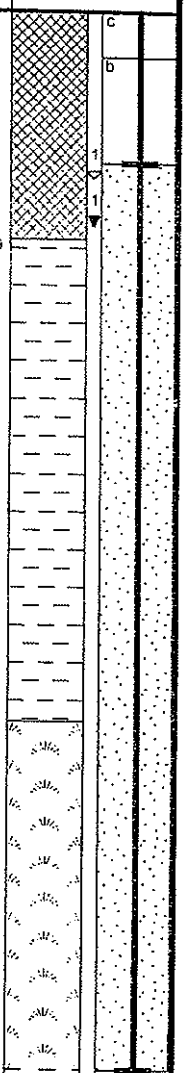
Samples and Tests

Depth	Type & No.	Records	Date Casing	Time Water
			29/01/2002	
1.00	ES1			
2.60	ES2			
7.00		kRH	29/01/2002 7.00	

Strata

Description	Depth,Level (Thickness)	
MADE GROUND: Dark brown to black clayey SAND AND GRAVEL. Gravel is angular to subrounded fine to coarse of slag.	(1.50)	
	1.50	+4.29
Soft to firm grey and brown sandy slightly gravelly CLAY. Gravel is subangular and subrounded fine and medium of slag.	(3.20)	
	4.70	+1.09
PEAT (DRILLERS DESCRIPTION).	(2.30pen)	
EXPLORATORY HOLE ENDS AT 7.00 m.	7.00	-1.21

Legend



Groundwater

No.	Struck	Behaviour
1	1.40m	Rising to 1.10m after 20 mins. Sealed 1.80. Medium inflow

Remarks

Chiselling : 0.50m to 0.80m 60minutes, 1.20m to 1.50m 60minutes
Hole backfill : 0.00m to 0.30m Concrete (c). 0.30m to 1.00m Bentonite (b). Surface protection : Stop Cock Cover
Standpipe installed, 50mm diameter, response zone from 1.00m to 7.00m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole **RBBH9**
Sheet 1 of 1

Borehole Log

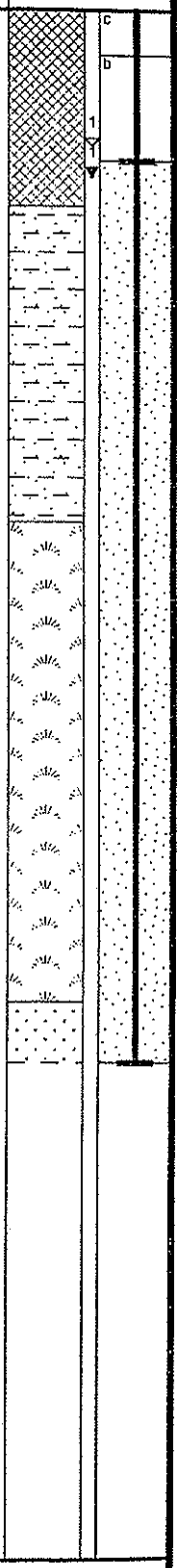
Exploration Associates

Drilled by NF Logged by LM Checked by	Equipment and Methods Cable Percussion 150 mm diameter from 0.00m to 7.00m.	Ground Level + 5.38 m OD National Grid Coordinates E 335984.28 N 185668.31	

Samples and Tests / Strata

Depth	Type & No.	Records	Date Casing	Time Water	Description	Depth,Level (Thickness)
1.00	ES1				MADE GROUND: Dark grey slightly clayey SAND AND GRAVEL. Gravel is subangular and subrounded fine and medium of slag.	(1.30)
						1.30 +4.08
2.30	ES2				Soft dark grey mottled orange brown slightly sandy CLAY.	(2.10)
						3.40 +1.98
					PEAT (DRILLERS DESCRIPTION).	(3.20)
			29/01/2002 7.00		Very soft grey sandy SILT (DRILLERS DESCRIPTION).	6.60 --1.22 (0.40pen)
					EXPLORATORY HOLE ENDS AT 7.00 m.	7.00 --1.62

Legend



Groundwater

No.	Struck	Behaviour
1	1.10m	Rising to 0.90m after 20 mins. Sealed 1.50. Medium inflow

Remarks

Chiselling : 0.70m to 1.00m 60minutes
Hole backfill : 0.00m to 0.30m Concrete (c), 0.30m to 1.00m Bentonite (b). Surface protection : Stop Cock Cover
Standpipe installed, 50mm diameter, response zone from 1.00m to 7.00m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

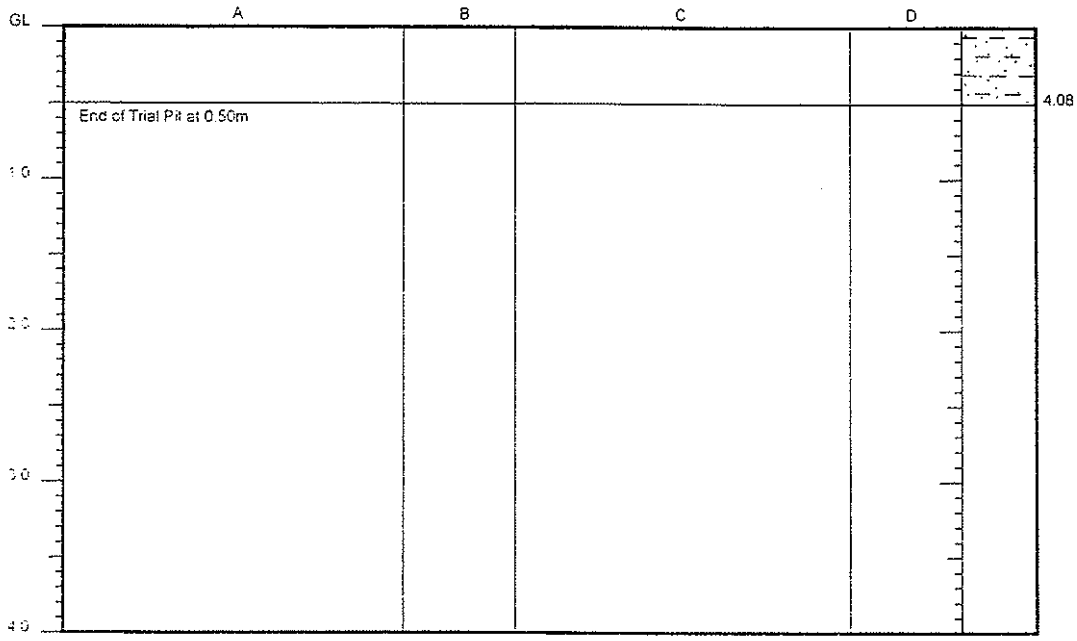
Borehole
RBBH10
Sheet 1 of 1

07/05/2002 11:57:17 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by JL Checked by	**Equipment and Methods** Trial Pit/Trench from 0.00m to 0.50m.Pit dug using Hydraulic wheeled excavator	Ground Level + 4.58 m OD National Grid Coordinates E 335698.68 N 186295.64



Dimensions 0.50m x 0.50m
Excavation date 12/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No	Records	Depth (m)	No	Description
0.50	ES1		0.00-0.50	1	MADEGROUND: Brown mottled grey slightly sandy CLAY with many rootlets

Groundwater
Fast seepage at 0.30m.

Remarks
Trial Pit ended and all samples were obtained.
Stability : Stable, Shoring : None
Hole backfill : 0.00m to 0.50m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no. 152002
Carried out for Corus plc

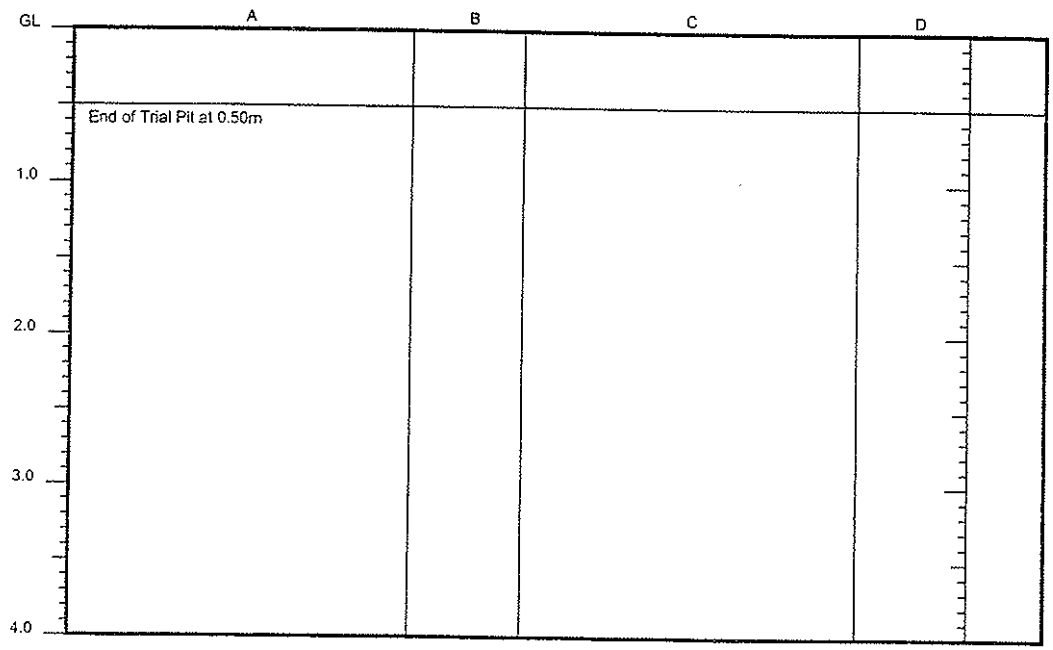
Trial Pit
RBTP1
Sheet 1 of 1

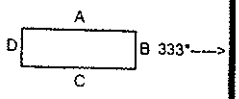
03/05/2002 14:23:26 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by JL Checked by	Equipment and Methods Machine dug Trial Pit from 0.00m to 0.50m using JCB with bucket.	Ground Level National Grid Coordinates





Dimensions 0.80m x 0.80m
Excavation date 12/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
0.50	ES1		0.00-0.50	1	MADE GROUND: Brown black peaty CLAY.

Groundwater
Groundwater at ground level.

Remarks
Stability : Stable, Shoring : None
Hole backfill : 0.00m to 0.50m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

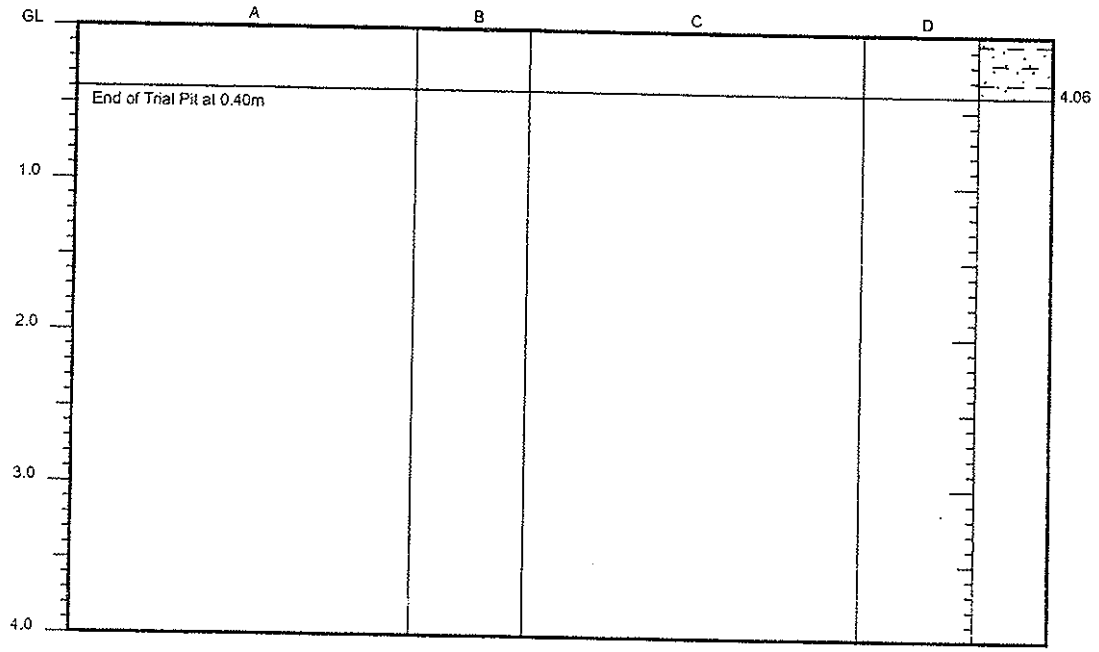
Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

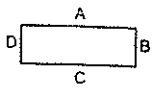
Trial Pit
RBTP2
Sheet 1 of 1

Trial Pit Log

Exploration Associates

Logged by J.L. Checked by	Equipment and Methods Trial Pit/Trench from 0.00m to 0.40m.Pit dug using Hydraulic wheeled excavator	Ground Level + 4.46 m OD National Grid Coordinates E 335868.97 N 186226.97





Excavation date 12/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
0.40	ES1		0.00-0.40	1	MADEGROUND: Soft dark grey slightly sandy CLAY with many rootlets.

Groundwater No. Struck Behaviour	Remarks Stability : Stable, Shoring : None Hole backfill : 0.00m to 0.40m Arisings (a).

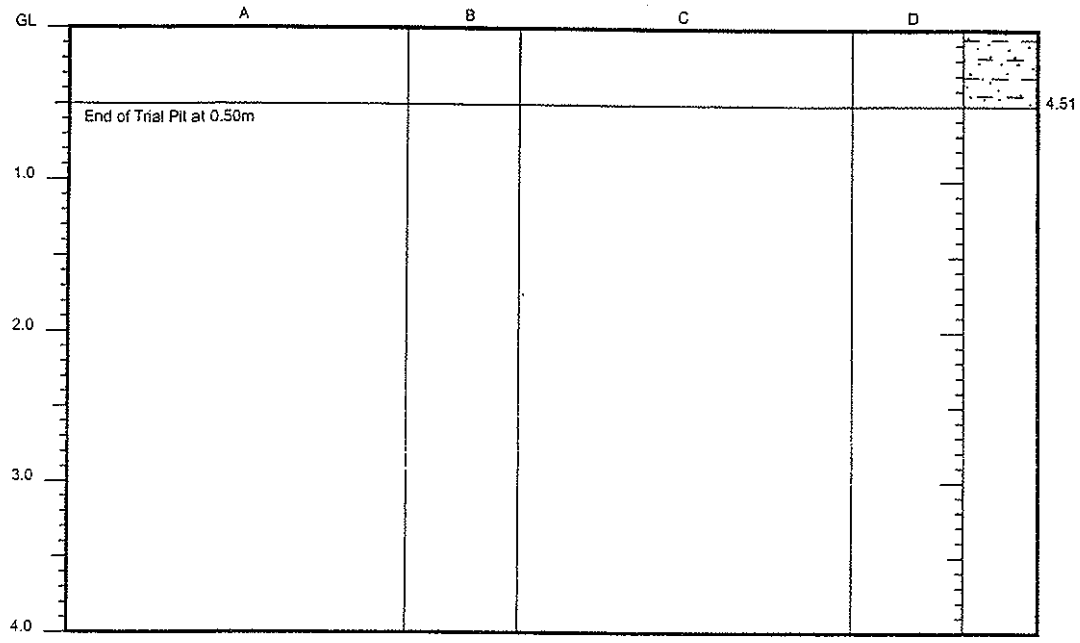
Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres. Scale 1 : 50	Project ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS Project no. 152002 Carried out for Corus plc	Trial Pit RBTP4 Sheet 1 of 1

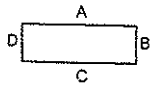
03/05/2002 11:17:08 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by J.L. Checked by	**Equipment and Methods** Trial Pit/Trench from 0.00m to 0.50m.Pit dug using Hydraulic wheeled excavator.	**Ground Level** + 5.01 m OD **National Grid Coordinates** E 335726.66 N 186195.23





Dimensions 0.80m x 0.80m
Excavation date 12/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
0.50	ES1		0.00-0.50	1	MADEGROUND: Brown slightly sandy CLAY with many rootlets

Groundwater
No. Struck Behaviour

Remarks
Stability : Stable, Shoring : None
Hole backfill : 0.00m to 0.50m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

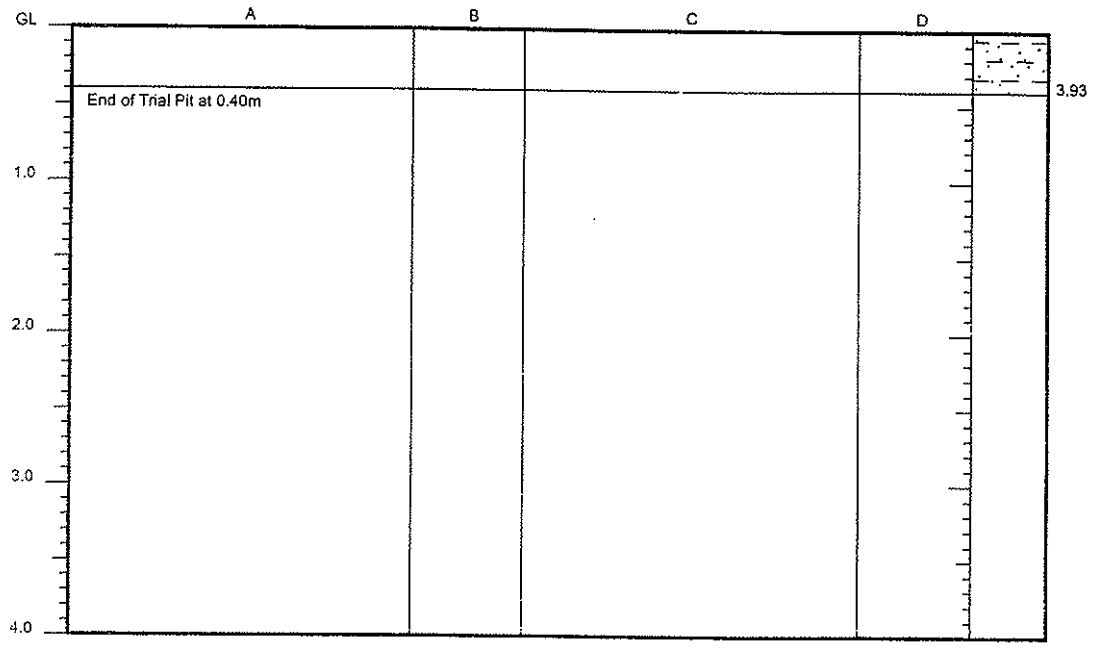
Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

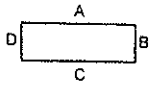
Trial Pit
RBTP5
Sheet 1 of 1

Trial Pit Log

Exploration Associates

Logged by J.L. Checked by	Equipment and Methods Trial Pit/Trench from 0.00m to 0.40m.Pit dug using Hydraulic wheeled excavator.	Ground Level + 4.33 m OD National Grid Coordinates E 336092.35 N 186036.16





Dimensions 1.00m x 1.00m
Excavation date 12/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
0.40	ES1		0.00-0.40	1	MADEGROUND: Slightly sandy CLAY with many rootlets.

Groundwater	Remarks
No. Struck Behaviour	Stability : Stable, Shoring : None Hole backfill : 0.00m to 0.40m Arisings (a).

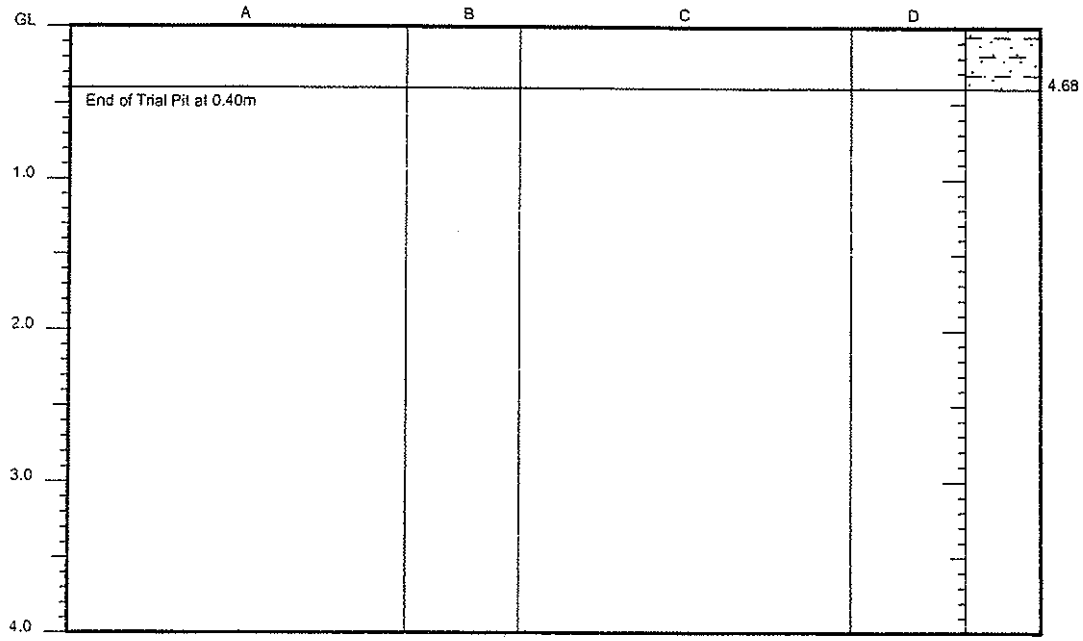
Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres. Scale 1 : 50	Project ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS Project no. 152002 Carried out for Corus plc	Trial Pit **RBTP6** Sheet 1 of 1

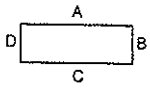
03/05/2002 11:17:15 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by J.L. Checked by	Equipment and Methods Trial Pit/Trench from 0.00m to 0.40m.Pit dug using Hydraulic wheeled excavator	Ground Level + 5.08 m OD National Grid Coordinates E 335943.16 N 186056.60





Dimensions 1.00m x 1.00m
Excavation date 12/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
0.40	ES1		0.00-0.40	1	MADEGROUND: Grey mottled brown slightly sandy CLAY with many rootlets.

Groundwater	Remarks
No. Struck Behaviour	Stability : Stable, Shoring : None Hole backfill : 0.00m to 0.40m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project: ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no. 152002
Carried out for Corus plc

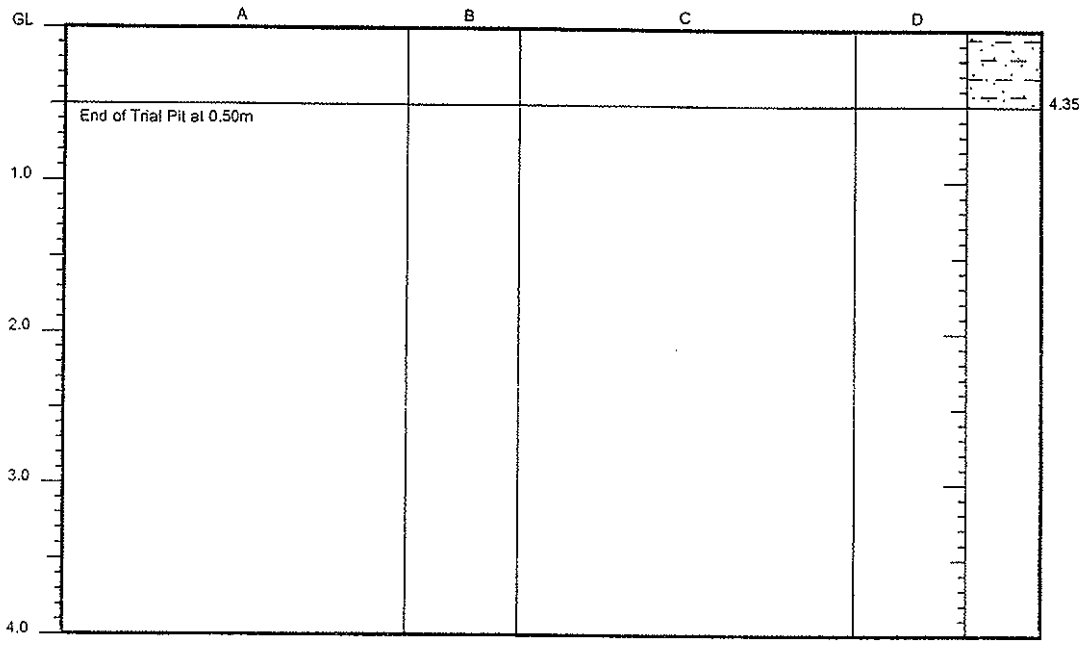
Trial Pit
RBTP7
Sheet 1 of 1

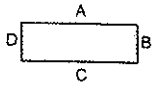
03/05/2002 11:17:20 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by J.L Checked by	**Equipment and Methods** Trial Pit/Trench from 0.00m to 0.50m.Pit dug using Hydraulic wheeled excavator.	Ground Level + 4.85 m OD National Grid Coordinates E 336065.25 N 185980.77





Excavation date 12/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
0.50	ES1		0.00-0.50	1	MADEGROUND: Soft dark grey slightly sandy CLAY with many rootlets.

Groundwater
No. Struck Behaviour

Remarks
Stability : Stable, Shoring : None
Hole backfill : 0.00m to 0.50m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

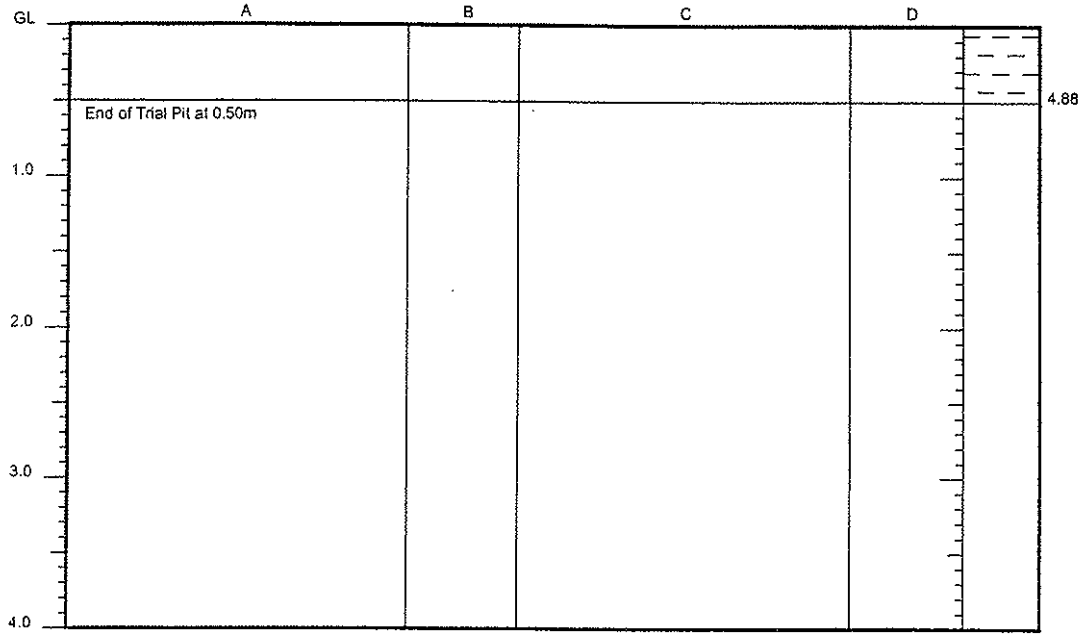
Trial Pit
RBTP9
Sheet 1 of 1

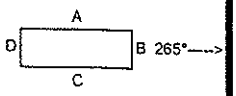
03/05/2002 11:17:24 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by JL Checked by	**Equipment and Methods** Machine dug Trial Pit from 0.00m to 0.50m using JCB with bucket.	**Ground Level** + 5.38 m OD **National Grid Coordinates** E 335984.28 N 185668.31





Dimensions 0.80m x 0.80m
Excavation date 12/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
0.50	ES1		0.00-0.50	1	MADE GROUND: Soft to firm grey CLAY with abundant rootlets.

Groundwater
Fast seepage at 0.10m.

Remarks
Stability : Stable, Shoring : None
Hole backfill : 0.00m to 0.50m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no. 152002
Carried out for Corus plc

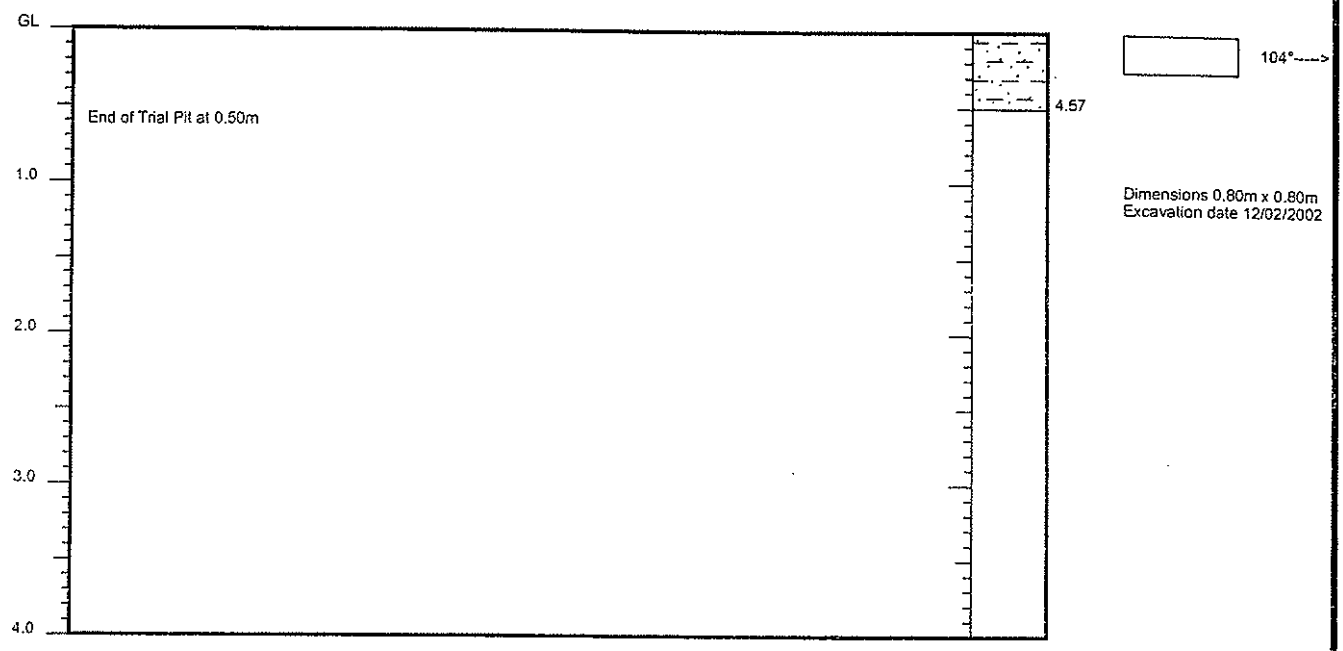
Trial Pit
RBTP10
Sheet 1 of 1

03/05/2002 11:16:53 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by JL Checked by	Equipment and Methods Machine dug Trial Pit from 0.00m to 0.50m using JCB with bucket.	Ground Level + 5.07 m OD National Grid Coordinates E 335997.41 N 185705.59



Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
0.50	ES1		0.00-0.50	1	MADE GROUND: Soft dark grey slightly sandy CLAY with many rootlets.

Groundwater
Fast seepage at 0.20m.

Remarks
Stability : Stable, Shoring : None
Hole backfill : 0.00m to 0.50m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Trial Pit
RBTP11
Sheet 1 of 1

03/05/2002 11:17:01 ESGLog v2.10

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ01 CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	336111.62 E
Project	New M4 - Second Preliminary Ground Investigation				185804.98 N
		Drilling Rig	Dando	Ground Level	6.57m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	PW	Orientation	Vertical
		Logged by	DH	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	14/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
13/12/2007	1730	7.00	6.50	DRY	End of Shift
14/12/2007	0730	7.00	6.50	DRY	Start of Shift
14/12/2007	1730	14.00	13.50	DRY	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
1.20	1.90	2.00	Chiselling
14.10	14.50	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	14.00	200	13.50

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
14/12/2007		13.40	13.40	20	Seepage	13.40	NR

GENERAL NOTES

1. Cable Percussive boring complete at 14.50m.
2. Insitu permeability test carried out from 14.10m to 14.50m.
3. 50mm standpipe installed, slotted from 5.80m to 7.50m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
1.20	C	50/225mm (9,14,18,6,19,7)	1.20	DRY
2.50	S	N=17 (2,3,4,4,4,5)	2.00	DRY
4.50	S	N=10 (2,2,2,2,3,3)	4.00	DRY
6.50	S	N=11 (1,2,2,3,2,4)	6.00	DRY
8.50	S	N=1 (1,0,0,1,0,0)	8.00	DRY
10.50	S	N=2 (1,0,1,0,1,0)	10.00	DRY
12.50	S	N=11 (1,2,2,3,3,3)	12.00	DRY
14.10	S	75/80mm - Abandoned	13.50	3.00
14.50	S	75/20mm - Abandoned	13.50	3.00

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

Form	ARIAL CP HEADER
Version	3.05
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ01 CP
S□ee□1 o□□

Contract No.	F15056	Method	Cable Percussion	Coordinates	336111.62 E
Project	New M4 - Second Preliminary Ground Investigation				185804.98 N
		Drilling Rig	Dando	Ground Level	6.57m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	PW	Orientation	Vertical
		Logged by	DH	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	14/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth			Install-ation
MADE GROUND: Dark greyish brown sandy gravelly clay. Sand sized fragments are fine to coarse. Gravel sized fragments are angular to subangular fine to coarse of mudstone, shale and slag.				ES1	0.30					
				ES2	1.00					
				D3	1.00					
				B4	1.20 - 1.50	C50/225mm	C	1.20	1.58	
Firm to stiff grey mottled orangish brown slightly grtavelly CLAY. Gravel is angular fine to medium of mudstone. (Estuarine Alluvium)		1.90	4.67	D5	2.00	(24)				
				ES6	2.00					
				U7	2.00 - 2.45					
				D8	2.50	S17	S	2.50	2.95	
				D9	2.50 - 2.95					
Soft to firm grey CLAY (Organic odour). (Estuarine Alluvium)		3.00	3.57	ES10	3.00					
				D11	3.50					
				ES12	4.00	(16)				
---from 4.12m soft				U13	4.00 - 4.45					
				D14	4.50	S10	S	4.50	4.95	
				D15	4.50					
				ES16	5.00					
				D17	5.50					
Spongy black fibrous PEAT. (Peat)		5.80	0.77	D18	6.00	(12)				
				U19	6.00 - 6.45					
				D20	6.50	S11	S	6.50	6.95	
				D21	6.50 - 6.95					
Very soft extremely low strength grey silty CLAY. (Esturaine Alluvium) ---from 7.40m to 8.50m with coarse gravel sized pockets of brown fibrous peat		7.40	-0.83	D22	7.50					
				U23	8.00	(5)				
				D24	8.50	S1	S	8.50	9.03	
				D25	8.50					
				D26	9.50					

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ01 CP
S□ee□□o□□

Contract No.	F15056	Method	Cable Percussion	Coordinates	336111.62 E
Project	New M4 - Second Preliminary Ground Investigation				185804.98 N
		Drilling Rig	Dando	Ground Level	6.57m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	PW	Orientation	Vertical
		Logged by	DH	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	14/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Very soft extremely low strength grey silty CLAY. (Esturaine Alluvium)				U27	10.00 - 10.45	(5)			
				D28	10.50	S2	S	10.50	
				D29	10.50			11.03	
				D30	11.50				
				U31	12.00 - 12.45	(12)			
---from 12.00m to 12.24m with very closely spaced white shell fragments and fine to medium gravel sized pockets of brown fibrous peat ---12.43m to 12.45m light brown fine sand. ---from 12.50m becomes firm				D32	12.50	S11	S	12.50	
				D33	12.50			12.95	
Very stiff reddish brown slightly sandy slightly gravelly CLAY. Gravel is angular fine to medium (Weathered Mudstone). (Mercia Mudstone Group)		13.40	-6.83	D34	13.50				
				D35	14.00				
				D36	14.10	S75/80mm - Abandoned	S	14.10	
								14.18	
				D37	14.30				
		14.50	-7.93	D38	14.50	S75/20mm - Abandoned	S	14.50	
Cable Percussion boring complete at 14.50 m.								14.52	

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ01
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	335947.70 E
Project	New M4 - Second Preliminary Ground Investigation				185680.95 N
		Sampling Rig	Hydraulic Hammer	Ground Level	5.82m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	11/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	11/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Dark grey and black angular to subangular medium gravel sized fragments of slag.				D1 ES2 ES3 L4 L6	0.00 - 0.10 0.10 0.30 0.40 - 1.00 0.50 - 1.80	From: 0.00 To: 1.00 Diameter: 100mm Recovery : 100% Blows: 9	
Firm grey mottled orangish brown CLAY with occasional rootlets. (Estuarine Alluvium)		0.95	4.87			From: 1.00 To: 1.80 Diameter: 90mm Recovery : 100% Blows: 10	
Sampling complete at 1.80 m.		1.80	4.02	ES5	1.80		

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 1.80m.
2. Window Sampling terminated at 1.80m due to collapse.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
Revised	13/02/2008

Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ01A
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	335948.36 E
Project	New M4 - Second Preliminary Ground Investigation				185681.66 N
		Sampling Rig	Hydraulic Hammer	Ground Level	5.87m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	11/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	11/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Grey slightly gravelly clay with frequent rootlets (upto 3mm diameter). Gravel sized fragments are angular to subangular medium of slag.				L1	0.00 - 1.00	From: 0.00 To: 1.00 Diameter: 100mm Recovery : 100% Blows: 10	
		0.30	5.57				
MADE GROUND: Dark grey and black angular to subangular medium gravel sized fragments of slag.		0.60	5.27	L2	0.50 - 1.50		
Firm grey mottled orangish brown CLAY with occasional rootlets. (Estuarine Alluvium)						From: 1.00 To: 1.50 Diameter: 90mm Recovery : 40% Blows: 9	
		1.50	4.37				
Sampling complete at 1.50 m.							

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 1.50m.
2. Window Sampling terminated at 1.50m due to collapse.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
Revised	13/02/2008

Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ01B
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	335950.48 E
Project	New M4 - Second Preliminary Ground Investigation				185684.04 N
		Sampling Rig	Hydraulic Hammer	Ground Level	5.88m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	11/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	11/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Grey slightly gravelly clay with frequent rootlets (upto 4mm). Gravel sized fragments are angular to subangular medium of slag.				L1	0.00 - 1.00	From: 0.00 To: 1.00 Diameter: 90mm Recovery : 50% Blows: 10	
		1.00	4.88				
Sampling complete at 1.00 m.							

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 1.00m.
2. Window Sampling terminated at 1.00m due to collapse.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
Revised	13/02/2008

Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ02
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	335927.82 E
Project	New M4 - Second Preliminary Ground Investigation				185727.60 N
		Sampling Rig	Hydraulic Hammer	Ground Level	5.88m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	09/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	09/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Dark brown light brown mottled slightly gravelly clay with frequent rootlets. Gravel sized fragments are angular to subangular medium of slag.				L1	0.00 - 1.00	From: 0.00 To: 1.00 Diameter: 100mm Recovery : 60% Blows: 7	
		0.40	5.48				
MADE GROUND: Grey clayey angular to subangular medium gravel sized fragments of slag.				ES2 L3	1.00 1.00 - 2.00	From: 1.00 To: 2.00 Diameter: 90mm Recovery : 100% Blows: 9	
		1.20	4.68				
Firm grey mottled orangish brown CLAY. (Estuarine Alluvium)							
---from 1.80m becomes soft				ES4 L5	2.00 2.00 - 3.00	From: 2.00 To: 3.00 Diameter: 80mm Recovery : 100% Blows: 10	
---at 2.20m with occasional fine to medium gravel sized pockets of peat							
				ES6	3.00	From: 3.00 To: 3.20 Diameter: 70mm Recovery : 100% Blows: 9	
		3.20	2.68	ES7	3.20		
Sampling complete at 3.20 m.							

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
09/12/2007		0.10	0.10	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 3.20m.
2. Window Sampling terminated at 3.20m due to refusal on peat.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
Revised	13/02/2008

Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ03
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	336026.69 E
Project	New M4 - Second Preliminary Ground Investigation				185773.54 N
		Sampling Rig	Hydraulic Hammer	Ground Level	5.92m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	08/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	08/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Brownish grey clay with frequent rootlets (upto 4mm).				L1	0.00 - 1.00	From: 0.00 To: 1.00 Diameter: 100mm Recovery : 100% Blows: 9	
		0.75	5.17				
MADE GROUND: Grey mottled orangish brown clay with occasional rootlets.		1.00	4.92	ES2 L3	1.00 1.00 - 2.00	From: 1.00 To: 2.00 Diameter: 90mm Recovery : 100% Blows: 8	
MADE GROUND: Grey slightly sandy clay with occasional rootlets. Sand is coarse.		1.40	4.52				
Firm grey mottled orangish brown CLAY. (Estuarine Alluvium)							
		2.00	3.92	ES4 L5	2.00 2.00 - 3.00	From: 2.00 To: 3.00 Diameter: 70mm Recovery : 100% Blows: 6	
Soft greyish brown silty CLAY. (Estuarine Alluvium)							
		2.40	3.52				
Soft grey silty CLAY (Organic odour). (Estuarine Alluvium)							
				ES6	3.00	From: 3.00 To: 3.60 Diameter: 60mm Recovery : 100% Blows: 5	
		3.50	2.42				
Brown pseudofibrous PEAT. (Peat)		3.60	2.32	ES7	3.60		
Sampling complete at 3.60 m.							

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
08/12/2007		0.15	0.15	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 3.60m.
2. Window Sampling terminated at 3.60m due to refusal.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
Revised	13/02/2008

Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ04
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	336085.43 E
Project	New M4 - Second Preliminary Ground Investigation				185819.50 N
		Sampling Rig	Hydraulic Hammer	Ground Level	5.97m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	08/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	08/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Grey locally mottled orangish brown and reddish brown siltyt slightly gravelly clay with frequent rootlets. Gravel sized fragments are angular fine to medium of mudstone.		0.30	5.67	L1	0.00 - 1.00	From: 0.00 To: 1.00 Diameter: 100mm Recovery : 100% Blows: 7	
Firm grey locally mottled orangish brown CLAY with occasional rootlets. (Estuarine Alluvium)		0.50	5.47			From: 0.40 To: 2.10 Diameter: 90mm Recovery : 0% Blows: 5	
Firm grey mottled orangish brown CLAY. (Estuarine Alluvium)				ES2	1.00	From: 0.50 To: 2.00 Diameter: 90mm Recovery : 0% Blows: 7	
Sampling complete at 2.10 m.		2.10	3.87				

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
08/12/2007		0.40	0.40	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 2.10m.
2. Window Sampling terminated at 2.10m due to collapse.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
Revised	13/02/2008

Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ05
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	335966.97 E
Project	New M4 - Second Preliminary Ground Investigation				185811.26 N
		Sampling Rig	Hydraulic Hammer	Ground Level	5.82m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	09/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	09/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Greyish brown clay.		0.10	5.72	L1	0.00 - 1.00	From: 0.00 To: 1.00 Diameter: 100mm Recovery : 100% Blows: 7	
MADE GROUND: Brown clay with frequent rootlets.		0.60	5.22				
MADE GROUND: Dark grey angular to subangular medium gravel of slag.		0.70	5.12				
Soft to firm grey mottled orangish brown CLAY. (Estuarine Alluvium)				ES2 L3	1.00 1.00 - 2.00	From: 1.00 To: 2.00 Diameter: 90mm Recovery : 100% Blows: 8	
Soft grey silty CLAY (Organic odour). (Estuarine Alluvium)		2.00	3.82	ES4 L5	2.00 2.00 - 3.00	From: 2.00 To: 3.00 Diameter: 80mm Recovery : 100% Blows: 8	
				ES6	3.00	From: 3.00 To: 3.30 Diameter: 70mm Recovery : 100% Blows: 12	
PEAT (Driller's description). (Peat)		3.10	2.72				
Sampling complete at 3.30 m.		3.30	2.52	ES7	3.30		

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
09/12/2007		0.10	0.10	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 3.30m.
2. Window Sampling terminated at 3.30m.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
Revised	13/02/2008

Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ06
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	336028.12 E
Project	New M4 - Second Preliminary Ground Investigation				185866.88 N
		Sampling Rig	Hydraulic Hammer	Ground Level	6.03m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	09/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	09/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Brown clay with occasional rootlets (upto 5mm diameter).				L3 ES1 ES2	0.00 - 1.00 0.10 0.30	From: 0.00 To: 1.00 Diameter: 100mm Recovery : 100% Blows: 9	
MADE GROUND: Grey mottled orangish brown clay with occasional rootlets.		0.32	5.71				
Firm greyish blue organic CLAY (Driller's description). (Estuarine Alluvium)		1.00	5.03	ES4	1.00	From: 1.00 To: 1.30 Diameter: 90mm Recovery : 0% Blows: 12	
Stiff grey mottled bluish grey CLAY (Drillers Description). (Estuarine Alluvium)		1.30	4.73			From: 1.30 To: 1.50 Diameter: 60mm Recovery : 0% Blows: 12	
Sampling complete at 1.50 m.		1.50	4.53				

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
09/12/2007		0.15	0.15	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 1.50m.
1. Window Sampling terminated at 1.50m due to refusal.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
Revised	13/02/2008

Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ06B
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	336034.70 E
Project	New M4 - Second Preliminary Ground Investigation				185868.64 N
		Sampling Rig	Hydraulic Hammer	Ground Level	5.96m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	09/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	09/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Grey mottled orangish brown silty clay. ---from 0.40m becomes firm				L1 ES2 ES3	0.00 - 1.00 0.10 0.30	From: 0.00 To: 1.00 Diameter: 100mm Recovery : 80% Blows: 8	
				ES4	1.00	From: 1.00 To: 1.30 Diameter: 90mm Recovery : 0% Blows: 9 From: 1.30 To: 2.00 Diameter: 50mm Recovery : 100% Blows: 9	
Soft brownish grey silty CLAY. (Estuarine Alluvium)		2.00	3.96	ES5 L6	2.00 2.00 - 3.00	From: 2.00 To: 3.00 Diameter: 50mm Recovery : 100% Blows: 9	
Soft brown very silty CLAY. (Estuarine Alluvium)		2.30	3.66				
				ES7 L8	3.00 3.00 - 4.00	From: 3.00 To: 4.00 Diameter: 50mm Recovery : 100% Blows: 7	
Very soft brown silty CLAY. (Estuarine Aluuvium)		3.10	2.86				
Soft to very soft dark grey silty CLAY. (Estuarine Alluvium) ---from 3.20m becomes soft		3.20	2.76				
				ES9	4.00	From: 4.00 To: 4.50 Diameter: 50mm Recovery : 100% Blows: 11	
PEAT (Driller's description). (Peat)		4.20	1.76				
Sampling complete at 4.50 m.		4.50	1.46	ES10	4.50		

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
09/12/2007		0.50	0.50	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 4.50m.
2. Window Sampling terminated at 4.50m due to refusal.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
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Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ06A
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	336032.99 E
Project	New M4 - Second Preliminary Ground Investigation				185868.63 N
		Sampling Rig	Hydraulic Hammer	Ground Level	6.05m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	09/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	09/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Brown clay with occasional rootlets (upto 5mm).						From: 0.00 To: 1.00 Diameter: 90mm Recovery : 100% Blows: 9	
MADE GROUND: Grey mottled orangish brown clay with occasional rootlets.		0.35	5.70				
Firm greyish blue organic CLAY. (Estuarine Alluvium)		1.00	5.05	D1	1.00	From: 1.00 To: 1.30 Diameter: 80mm Recovery : 0% Blows: 12	
Stiff grey mottled bluish grey CLAY. (Estuarine Alluvium)		1.30	4.75			From: 1.30 To: 1.50 Diameter: 60mm Recovery : 100% Blows: 12	
Sampling complete at 1.50 m.		1.50	4.55				

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
09/12/2007		0.15	0.15	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 1.50m.
2. Window Sampling terminated at 1.50m due to refusal.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
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Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ07
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	336138.72 E
Project	New M4 - Second Preliminary Ground Investigation				185883.86 N
		Sampling Rig	Hydraulic Hammer	Ground Level	5.96m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	10/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	10/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Grey mottled orangish brown clay with rare rootlets. ---from GL to 0.20m with frequent rootlets				D1 ES2 ES3 L4	0.00 - 0.10 0.10 0.30 0.40 - 0.70	From: 0.00 To: 1.00 Diameter: 100mm Recovery : 100% Blows: 9	
MADE GROUND: Grey mottled orangish brown clay with occasional fine gravel sized pockets of fine sand. ---from 1.20m becomes soft to firm		1.00	4.96	ES5 L6	1.00 1.00 - 1.80	From: 1.00 To: 2.00 Diameter: 90mm Recovery : 80% Blows: 9	
				ES7 L8	2.00 2.00 - 2.80	From: 2.00 To: 3.00 Diameter: 80mm Recovery : 100% Blows: 8	
Soft grey silty CLAY with occasional fragments of organic material (Organic odour). (Estuarine Alluvium)		2.40	3.56				
				ES9 L10	3.00 3.00 - 3.60	From: 3.00 To: 4.00 Diameter: 70mm Recovery : 100% Blows: 8	
Very soft brownish grey slightly sandy silty CLAY. (Estuarine Alluvium)		4.00	1.96	ES11 L12	4.00 4.00 - 4.50	From: 4.00 To: 4.80 Diameter: 60mm Recovery : 100% Blows: 10	
PEAT (Driller's description). (Peat)		4.50	1.46				
Sampling complete at 4.80 m.		4.80	1.16	ES13	4.80		

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
10/12/2007		0.10	0.10	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 4.80m.
2. Window Sampling terminated at 4.80m due to refusal.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
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Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ08
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	336067.68 E
Project	New M4 - Second Preliminary Ground Investigation				185960.60 N
		Sampling Rig	Hydraulic Hammer	Ground Level	6.75m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	12/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	12/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Grey locally mottled orangish brown slightly sandy clay with frequent rootlets (upto 6mm). Sand is medium to coarse.		0.40	6.35	D1 ES2 ES3 L4	0.00 - 0.10 0.10 0.30 0.40 - 1.00	From: 0.00 To: 1.00 Diameter: 90mm Recovery : 100% Blows: 12	
MADE GROUND: Grey silty clay with occasional rootlets.		1.10	5.65	L5	1.10 - 1.70	From: 1.00 To: 2.00 Diameter: 90mm Recovery : 10% Blows: 13 From: 1.00 To: 2.00 Diameter: 80mm Recovery : 100% Blows: 10	
MADE GROUND: Grey mottled orangish brown clay with occasional fine to medium gravel sized pockets of fine sand. ---from 1.60m becomes soft		2.00	4.75	ES6 L7	2.00 2.00 - 2.70	From: 2.00 To: 3.00 Diameter: 70mm Recovery : 100% Blows: 8	
Soft greyish brown CLAY with occasional coarse gravel sized pockets of brown amorphous peat. (Estuarine Alluvium)		2.20	4.55				
Soft grey silty CLAY. (Estuarine Alluvium)		3.00	3.75	ES8 L9	3.00 3.00 - 3.70	From: 3.00 To: 3.70 Diameter: 70mm Recovery : 100% Blows: 12	
Soft to very soft grey silty CLAY with occasional fine to coarse gravel sized pockets of brown amorphous peat and fragments of organic material. (Estuarine Alluvium)		3.80	2.95	ES10	3.80	From: 3.80 To: 4.00 Diameter: 50mm Recovery : 100% Blows: 10	
PEAT (Driller's description). (Peat)		4.00	2.75				
Sampling complete at 4.00 m.							

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
12/12/2007		0.20	0.20	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 4.00m.
2. Window Sampling terminated at 4.00m.
3. 50mm standpipe installed, slotted from 0.30m to 3.30m.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
Revised	13/02/2008

Geotechnical Engineering Limited

BOREHOLE LOG

BH508

CLIENT	WELSH GOVERNMENT					Sheet	1 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	27 January 2015	Easting	335897.4			Depth	20.50 m
End Date	2 February 2015	Northing	185801.4	Ground level	5.90mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
27/01/15 0800hrs	1B	0.00 - 1.20		Vo 0.50				Brown clayey sandy angular and subangular fine to coarse slag GRAVEL. (MG)	0.40	5.50	
	2D*	0.00 - 0.30									
	3D*	0.50 - 0.60						Very soft dark greyish brown slightly sandy gravelly silty CLAY. Gravel is angular to subangular fine to coarse tarmacadam and slag. (MG)			
	4D*	1.00 - 1.10									
	5D	1.20 - 1.65	1.20	S 3							
	6B	1.20 - 1.65		Vo 1.00				1.20 - 1.65m: Subrounded fine and medium gravel.			
	7D*	1.50 - 1.60							1.60	4.30	
	8UT	1.65 - 2.10	1.50					Very soft dark grey slightly sandy slightly gravelly silty CLAY. Gravel is subangular and subrounded fine to coarse slag, limestone and tarmacadam. (MG)			
	9B	1.65 - 2.25		Vo 0.70							
	10D	2.05 - 2.50	1.50	S 4					2.05	3.85	
	11B	2.05 - 2.50		Vo 5.20				Soft grey mottled brown silty CLAY with rare dark brown staining. (TFD)			
	14B	2.50 - 3.10		Vo 3.10							
	12UT	2.50 - 2.95	2.00								
	13D	2.90 - 3.10									
	15D*	2.50 - 2.60							3.00	2.90	
	16D*	2.60 - 3.00						Spongy black locally tending to brown clayey fibrous PEAT. (PEAT)			
	17D*	3.00 - 4.00									
	18D	3.10 - 3.55	3.00	S 2							
	19B	3.10 - 3.55		Vo 2.60							
	20UT	3.55 - 4.00	3.00								
	21B	3.55 - 4.20		Vo 1.70							
	22D	4.00 - 4.20									
	23D*	4.00 - 5.00									
	24D	4.20 - 4.65	4.00	S 1				4.25 - 4.65m: Frequent fine gravel sized seeds.			
	25B	4.20 - 4.65		Vo 4.30				4.35 - 4.65m: Rare fine and medium gravel sized wood fragments (up to 2mm).			
	26UT	4.65 - 5.10	4.50								
27/01/15 1630hrs 4.70m	27B	4.65 - 5.25		Vo 0.70					4.90	1.00	
	28D*	5.00 - 6.00						Very soft grey mottled dark brown silty peaty CLAY. (TFDP)			
	29D	5.05 - 5.25							5.20	0.70	
28/01/15 0800hrs 3.40m	30D	5.25 - 5.70	5.00	S 2				Very soft grey silty CLAY. (TFD)			
	31B	5.25 - 5.70		Vo 1.00							
	32UT	5.70 - 6.15	5.70								
	33D	6.10 - 6.30									
	34B	5.70 - 7.50		Vo 1.40				6.05 - 6.35m: Rare roots and plant material (up to 2mm).			
	35D*	6.00 - 7.00									
									7.50	-1.60	
	36D	7.50 - 7.95	7.50	S 4				Very soft grey silty amorphous peaty CLAY with frequent decomposed plant material (up to 3mm). (TFDP)			
	37B	7.50 - 8.00		Vo 15.50							
								Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (200mm) 1.20-6.00m and (150mm) 6.00-14.10m. Dynamic sampled (113mm) 14.10-14.50m. Waterflush rotary core drilled (116mm) 14.50-20.50m.

CASING: 200mm diam to 6.00m, 150mm diam to 13.00m and 140mm diam to 14.40m.

BACKFILL: On completion, hole backfilled with bentonite pellets 20.50-0.70m, granular fill 0.70-0.20m and arisings 0.20-0.00m.

REMARKS: Hole advanced by chiselling 14.20-14.40m (1hr). Water added to assist boring throughout borehole (90 litres).

Downhole magnetometry for UXO risk mitigation undertaken 0.00-11.89m. No anomalies encountered.

Bentonite seal for aquifer protection installed during drilling 6.00-5.00m, prior to reduction in casing diameter.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
3.00		1.80	20	

AGS

CONTRACT	CHECKED
30238	EC

Geotechnical Engineering Ltd, Tel. 01452 527743 30238 YODA.GPJ TRIALJH.GPJ GEOTECH.GLB 16/07/2015 16:01:27 TP/RB EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH508

CLIENT	WELSH GOVERNMENT					Sheet	2 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	27 January 2015	Easting	335897.4			Depth	20.50 m
End Date	2 February 2015	Northing	185801.4	Ground level	5.90mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	38UT 39B 40D*	8.00 - 8.45 8.00 - 8.50 8.00 - 8.50	7.50	Vo 17.50				8.00 - 8.50m: Rare wood fragments (up to 5mm) and rare roots (up to 3mm diam).	8.50	-2.60	
	41D 42B	8.50 - 8.95 8.50 - 10.00	8.00	S 1				Very soft grey silty CLAY. (TFD)			
	43UT 44D 45B	10.00 - 10.45 10.45 - 10.65 10.00 - 11.50	10.00								
28/01/15 1630hrs Dry											
29/01/15 0800hrs 7.90m	46D 47B	11.50 - 11.89 11.50 - 12.50	11.50	S*66				11.50 - 11.60m: Black spongy slightly clayey peat.	11.60	-5.70	
								Very stiff black mottled brown and grey slightly sandy slightly gravelly peaty CLAY with frequent plant fragments (up to 7mm). Gravel is subangular to rounded fine and medium sandstone and rare quartz. (TFDP)	12.50	-6.60	
	48D 49B	12.50 - 12.95 12.50 - 13.00	12.50	S 36				Stiff grey slightly sandy slightly gravelly CLAY with frequent wood fragments (up to 30mm). Gravel is subrounded and rounded fine and medium sandstone. (TFD)	13.00	-7.10	
	50D 51B	13.00 - 13.32 13.00 - 14.20	13.00	S*88				Very stiff reddish grey slightly sandy CLAY locally tending to hard brown clayey silt with rare plant fragments (up to 5mm). (TFD)			
29/01/15 1600hrs 7.60m		14.10 - 14.40 14.30 - 14.54	13.00 13.00	C*100 C*167					14.10	-8.20	
02/02/15 1150hrs 1.46m	52X	14.10 - 14.50 14.40 - 14.64	13.00	C*167				Hard fissured reddish brown slightly sandy silty CLAY with rare greenish grey reduction spots (up to 3mm). (MMG. Weathering Grade IVb). (MMG) (Grade IVb)	14.55	-8.65	
	53C	14.50 - 16.00	14.40		97 15 15	NA		14.40 - 14.50m: Hard reddish brown sandy clayey silt.			
						NI NA		Stiff fissured reddish brown slightly sandy slightly gravelly CLAY with frequent greenish grey reduction spots (up to 20mm). Gravel is subangular to rounded fine and medium lithorelicts of very stiff clay to very weak siltstone. (MMG. Weathering Grade III) (MMG) (Grade III)	15.55	-9.65	
	54C	16.00 - 17.50	14.40		100 3 0			14.90 - 15.05m: 80° planar smooth fissure. 15.20 - 15.35m: Tending to claybound mudstone lithorelicts. 15.35 - 15.55m: Extremely weak fractured reddish brown mudstone.			
						NA		Stiff fissured reddish brown slightly gravelly sandy CLAY with rare light greenish grey reduction spots (up to 5mm). Gravel is subangular and subrounded fine to coarse lithorelicts of very stiff clay tending to hard clayey silt to very weak mudstone. Fissures are randomly orientated extremely closely spaced planar smooth. Surfaces frequently stained brownish grey locally with a veneer of clay. (MMG. Weathering Grade III) (MMG) (Grade III)	17.20	-11.30	
	55C	17.50 - 19.00	14.40		100	NA		16.05 - 16.10m: Very weak reddish brown mudstone.	17.60	-11.70	
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
12.50		7.90	20	Fast flow.
14.20		7.60	20	Fast flow.

AGS

CONTRACT	CHECKED
30238	EC

Geotechnical Engineering Ltd, Tel. 01452 527743 30238 YODA.GPJ TRIALJH.GPJ GEOTECH.GLB 16/07/2015 16:01:28 TP/RB EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH508

CLIENT	WELSH GOVERNMENT					Sheet	3 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	27 January 2015	Easting	335897.4				
End Date	2 February 2015	Northing	185801.4	Ground level	5.90mOD	Depth	20.50 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	56C	19.00 - 20.50	14.40		100 0 0	NI NA		16.60 - 16.75m: Mottled black very sandy clay with medium gravel sized pockets of gypsum crystals (up to 2mm). 16.75 - 17.20m: Slightly sandy.			
								Hard fissured reddish brown and greenish grey slightly sandy clayey SILT with rare gypsum crystals (up to 2mm). Fissures are randomly orientated extremely closely spaced planar smooth. (MMG. Weathering Grade IVa) (MMG) (Grade IVa)	19.15	-13.25	
02/02/15 1519hrs 3.16m						NI		Stiff fissured reddish brown slightly gravelly sandy CLAY with rare greenish grey reduction spots (up to 10mm). Gravel is subangular and subrounded fine and medium lithorelicts of very stiff clay to extremely weak mudstone. (MMG) (Grade III/IVa) 17.90 - 18.10m: Extremely weak reddish brown mudstone. 18.25 - 18.40m: 70° planar rough fissure with clay veneer. 18.70 - 18.90m: Rare fine and medium gravel sized pockets of gypsum crystals (up to 2mm). 19.05 - 19.15m: Extremely weak mudstone. Subhorizontal to 20° fractures intersecting 80° fracture.	19.70	-13.80	
								Stiff fissured reddish brown slightly sandy gravelly clayey SILT locally silty CLAY with rare greenish grey reduction spots (up to 3mm). Gravel is subangular to rounded fine to coarse lithorelicts of hard silt to extremely weak mudstone. (MMG) (Grade III)	20.50	-14.60	
								Extremely weak reddish brown MUDSTONE disintegrated to slightly sandy subrounded and rounded fine to coarse gravel. (MMG) (Grade II/III) 20.20 - 20.25m: Slightly sandy clay.			
								Borehole completed at 20.50m.			
									{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

Geotechnical Engineering Ltd, Tel. 01452 527743 30238 YODA.GPJ TRIALJH.GPJ GEOTECH.GLB 16/07/2015 16:01:28 TP/RB EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH509

CLIENT	WELSH GOVERNMENT					Sheet	1 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	30 January 2015	Easting	336079.9			Depth	20.50 m
End Date	4 February 2015	Northing	185789.0	Ground level	6.45mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
30/01/15 0800hrs	1B	0.00 - 0.50						Dark grey clayey sandy subrounded fine and medium limestone GRAVEL with low subrounded limestone cobble content. (MG)			
	2B	0.50 - 1.20	Nil								
	3D*	0.50 - 1.00		Vo 1							
	4D	1.20 - 1.65	1.20	S 3							
	5B	1.20 - 1.65									
	6D*	1.00 - 1.50		Vo 0.4					1.20	5.25	
								Very soft dark grey slightly gravelly slightly sandy mottled light brown and black organic silty CLAY with frequent plant fragments (up to 3mm). (TFD)			
	7UT	1.65 - 2.10	1.50						1.70	4.75	
	8B	1.65 - 2.00									
	9D*	1.50 - 2.00		Vo 0.3				Very soft dark grey mottled light brown and black gravelly organic silty CLAY with frequent plant fragments (up to 3mm). Gravel is subangular fine to coarse limestone and crystalline. (TFD)			
		2.00 - 2.45	2.00	S 2							
	10B	2.00 - 2.50									
	11D*	2.00 - 2.50		Vo 0.2							
	12UT	2.50 - 2.95	2.50								
	13B	2.50 - 3.20									
	14D*	2.50 - 3.00		Vo 0.4							
	15D	2.65 - 3.15									
	16D*	3.00 - 3.50		Vo 0.5							
	17D	3.20 - 3.65	3.00	S 6							
	18B	3.20 - 3.65									
	19D*	3.50 - 4.00		Vo 0.5							
30/01/15 1630hrs Dry	20UT	3.65 - 4.10	3.50								
	21D	4.05 - 4.15									
	22B	3.65 - 4.20							4.20	2.25	
02/02/15 0800hrs 1.80m	23D	4.20 - 4.65	4.00	S 1				Very soft dark grey mottled black organic silty CLAY with frequent plant fragments (up to 5mm). (TFD)			
	24B	4.20 - 4.65									
	25D*	4.50 - 5.00		V0 0.5							
	26UT	4.65 - 5.10	4.50								
	28B	4.65 - 5.25							5.00	1.45	
								Spongy dark brown and black fibrous PEAT. (PEAT)			
	27D	5.05 - 5.25									
	29D	5.25 - 5.65	4.50	S 4							
	30B	5.25 - 6.00									
	31UT	6.00 - 6.45	6.00								
	32B	6.00 - 6.50									
	33D*	6.00 - 6.50		Vo 0.5					6.50	-0.05	
	34D	6.50 - 6.95	6.50	S 2				Very soft dark grey mottled black organic slightly sandy silty CLAY with frequent plant fragments (up to 5mm). (TFD)			
	35B	6.50 - 8.00									
									8.00 {8.00}	-1.55	

Continued Next Page

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (200mm) 1.20-6.00m and (150mm) 6.00-14.50m. Dynamic sampled (113mm) 14.50-14.80m. Waterflush rotary core drilled (116mm) 14.80-20.50m. CASING: 200mm diam to 6.00m, 150mm diam to 14.50m and 140mm diam to 14.70m.

BACKFILL: On completion borehole backfilled with bentonite 20.50-13.20m. A slotted standpipe (50mm) was installed to 13.00m, granular response zone 13.20-10.80m, bentonite seal 10.80-7.20m. A second slotted standpipe (35mm) was installed to 7.50m, granular response zone 7.70-4.30m, bentonite seal 4.30-0.35, gravel drain 0.35-0.25m, concrete and stopcock cover 0.25-0.00m. REMARKS: Hole advanced by chiselling 14.40-14.50m (1hr). Downhole magnetometry for UXO risk mitigation undertaken 0.00-13.00m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling 6.00-5.00m, prior to reduction in casing diameter. Permeability test undertaken at 8.00-8.50m. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
2.00	1.50	1.30	20	Medium flow.

AGS

CONTRACT	CHECKED
30238	EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH509

CLIENT	WELSH GOVERNMENT					Sheet	2 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	30 January 2015	Easting	336079.9			Depth	20.50 m
End Date	4 February 2015	Northing	185789.0	Ground level	6.45mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	36UT 37D 38B	8.00 - 8.45 8.40 - 8.60 8.00 - 9.50	8.00					Very soft dark grey mottled black slightly sandy silty CLAY with rare subangular fine and medium sandstone gravel. (TFD)			
	39D 40B	9.50 - 9.95 9.50 - 11.00	9.50	S<1				Very soft dark grey sandy gravelly organic CLAY. Gravel is subangular fine and medium sandstone and limestone. (TFD)	9.50	-3.05	
02/02/15 1630hrs 8.70m											
03/02/15 0800hrs 8.80m	41UT 42D 43B	11.00 - 11.45 11.40 - 11.60 11.00 - 12.50	11.00								
	44D 45B	12.50 - 12.95 12.50 - 13.00	12.50	S 27					12.60	-6.15	
	46D 47B	13.00 - 13.45 13.00 - 13.50	13.00	S 50				Stiff dark grey mottled light brown sandy gravelly clayey SILT. Gravel is subangular fine and medium sandstone and limestone. (TFD)	13.00	-6.55	
	48B	13.50 - 13.88 13.50 - 14.50	13.50	C 67				Very stiff reddish brown mottled greenish grey sandy gravelly CLAY with low subrounded sandstone cobble content. Gravel is subangular fine and medium mudstone. (MMG)	14.00	-7.55	
	49X	14.50 - 14.67 14.50 - 14.80	14.50	C*200	100	NA		Reddish brown mottled greenish grey clayey sandy subrounded fine to coarse mudstone and sandstone GRAVEL. (MMG)	14.50	-8.05	
	50C	14.80 - 16.00	14.70					Very stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 5mm). Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. Fissures are subhorizontal up to 20° very closely spaced planar rough. (MMG) (Grade III)			
	51C	16.00 - 17.50	14.70		100 0 0	NI NA NI 200 650		Extremely weak and very weak thinly laminated to very thinly bedded reddish brown MUDSTONE with frequent greenish grey reduction spots (up to 10mm). Fractures are subhorizontal up to 20° and subvertical very closely spaced planar rough. (MMG) (Grade II)	16.10 16.25 16.60	-9.65 -9.80 -10.15	
03/02/15 1735hrs 2.70m								Very stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 5mm). Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° very closely spaced planar rough. (MMG) (Grade III)			
04/02/15 0920hrs 1.60m	52C	17.50 - 19.00	14.70		100 8 8						
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
14.50		5.20	20	Fast flow.

AGS

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Geotechnical Engineering Limited

BOREHOLE LOG

BH509

CLIENT	WELSH GOVERNMENT					Sheet	3 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	30 January 2015	Easting	336079.9				
End Date	4 February 2015	Northing	185789.0	Ground level	6.45mOD	Depth	20.50 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
									Extremely weak and very weak thinly laminated to very thinly bedded reddish brown MUDSTONE with frequent greenish grey reduction spots (up to 10mm). Fractures are subhorizontal up to 20° and subvertical extremely closely to medium spaced planar rough. (MMG) (Grade II)			
	53C	19.00 -	20.50	14.70		100 53 50			16.60 - 16.70m: 70° fracture infilled (up to 2mm) with greenish grey clay. 18.50 - 18.60m: 70° fracture infilled (up to 2mm) with greenish grey clay. 19.80 - 20.00m: 70° fracture stained black and infilled with greenish grey clay up to 2mm.			
04/02/15 1035hrs 3.58m							NA			20.30	-13.85	
									Very stiff fissured reddish brown gravelly CLAY with rare greenish grey reduction spots (up to 5mm). Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° extremely closely spaced planar rough. (MMG) (Grade III)	20.50	-14.05	
									Borehole completed at 20.50m.			
										{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ03 CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	336844.19 E
Project	New M4 - Second Preliminary Ground Investigation				185775.81 N
		Drilling Rig	Dando	Ground Level	5.37m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	PW	Orientation	Vertical
		Logged by	DH	Date Started	17/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	21/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
17/01/2008	1730	5.00	4.50	DRY	End of Shift
18/01/2008	0730	5.00	4.50	DRY	Start of Shift
18/01/2008	1730	11.50	11.50	10.80	End of Shift
21/01/2008	0730	11.50	11.50	5.20	Start of Shift
21/01/2008	1730	13.00	12.00	9.00	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
12.70	13.00	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
150	13.00	150	12.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
18/01/2008		5.20	5.20	20	Seepage	5.00	NS

GENERAL NOTES

1.Cable Percussive boring from GL to 13.00m.
2.50mm standpipe installed, slotted from 3.40m to 5.20m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
1.50	S	N=13 (2,3,3,3,3,4)	1.00	DRY
3.50	S	N=11 (2,2,3,2,2,4)	3.00	DRY
5.50	S	N=2 (1,1,0,1,0,1)	5.00	5.20
7.50	S	N=2 (1,0,1,0,1,0)	7.00	6.80
9.50	S	N=2 (1,1,0,1,0,1)	9.00	8.90
12.50	S	50/180mm (9,14,19,19,12)	12.00	7.00
13.00	S	50/30mm (25,50)	12.00	9.00

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

Form	ARIAL CP HEADER
Version	3.05
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ03 CP
Sheet 1 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	336844.19 E
Project	New M4 - Second Preliminary Ground Investigation				185775.81 N
		Drilling Rig	Dando	Ground Level	5.37m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	PW	Orientation	Vertical
		Logged by	DH	Date Started	17/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	21/01/2008

Description of Strata	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		
TOPSOIL.	0.30	5.07	ES1	0.30				
Firm very low strength grey mottled orangish brown silty slightly sandy CLAY. Sand is coarse. (Estuarine Alluvium)			ES2	1.00	(15)			
			D3	1.00				
			U4	1.00 - 1.45				
			D5	1.50	S13	S	1.50	1.95
			D6	1.50 - 1.95				
			ES7	2.00				
			B8	2.00 - 2.50				
	2.50	2.87	D9	2.50				
Soft to firm grey silty CLAY with closely spaced coarse gravel sized pockets of brown amorphous peat. (Estuarine Alluvium)			ES10	3.00	(14)			
			U11	3.00 - 3.45				
	3.31	2.06						
Spongy black pseudofibrous PEAT. (Peat)			D12	3.50	S11	S	3.50	3.95
			D13	3.50 - 3.95				
			ES14	4.00				
			B15	4.00 - 4.50				
			D16	4.50				
	5.05	0.32	ES17	5.00	(11)			
Very soft grey silty CLAY. (Estuarine Alluvium)			U18	5.00 - 5.45				
---at 5.05m 1no cobble sized fragment of wood.								
---from 5.05m to 6.50m with closely to medium spaced coarse gravel sized pockets of brown fibrous peat			D19	5.50	S2	S	5.50	5.95
			D20	5.50				
			D21	6.50				
---from 6.50m with closely spaced coarse gravel sized pockets of black pseudofibrous peat								
			U22	7.00 - 7.45	(5)			
			D23	7.50	S2	S	7.50	8.03
			D24	7.50				
			D25	8.50				
			U26	9.00 - 9.45	(6)			
			D27	9.50	S2	S	9.50	9.95
			D28	9.50				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ03 CP
Sheet 2 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	336844.19 E
Project	New M4 - Second Preliminary Ground Investigation				185775.81 N
		Drilling Rig	Dando	Ground Level	5.37m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	PW	Orientation	Vertical
		Logged by	DH	Date Started	17/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	21/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Very soft grey silty CLAY. (Estuarine Alluvium)				D29	10.50				
				U30	11.00 - 11.45	(12)			
		11.38	-6.01	D31	11.45				
Firm to stiff reddish brown mottled grey slightly gravelly clay. Gravel is angular fine to medium (Weathered Mudstone). (Mercia Mudstone)				D32 U33	12.00 12.00	(120)			
---from 12.50m very stiff				D34 D35	12.50 12.50	S50/180mm	S	12.50 12.83	
		13.00	-7.63	D36 D37	13.00 13.00	S50/30mm	S	13.00 13.07	
Cable Percussion boring complete at 13.00 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Borehole Log

Exploration Associates

Drilled by GW Logged by DE Checked by	Equipment and Methods Inspection Pit from 0.00m to 0.50m. Cable Percussion 150 mm diameter from 0.50m to 6.00m.	Ground Level + 5.20m OD National Grid Coordinates E 336310.34 N 186243.26	

Samples and Tests / Strata

Depth	Type & No.	Records	Date Casing	Time Water	Description	Depth,Level (Thickness)	Legend
			15/02/2002	:			
0.50	ES1				Soft grey brown slightly sandy gravelly CLAY. Gravel is angular and subangular fine and medium of slag.	(2.50)	a
			15/02/2002 2.50				
			18/02/2002 2.50	0.90		2.50 +2.70	b
3.00	ES2				Soft green grey mottled orange brown CLAY.	(2.60)	
					Brown spongy fibrous PEAT.	5.10 +0.10 (0.90pen)	
			18/02/2002 2.50				
6.00 6.00	ES3	kRH			EXPLORATORY HOLE ENDS AT 6.00 m.	6.00 -0.80	

Groundwater

Remarks
Chiselling : 0.50m to 2.50m 300minutes
Hole backfill : 0.00m to 2.50m Arisings (a), 2.50m to 2.90m Bentonite (b).
Standpipe installed, 50mm diameter, response zone from 2.90m to 6.00m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole
CABH1
Sheet 1 of 1

03/05/2002 11:04:17 ESGLog v2.10

Borehole Log

Exploration Associates

Drilled by	NF	Equipment and Methods Cable Percussion 150 mm diameter from 0.00m to 6.00m.	Ground Level + 5.72 m OD
Logged by	DE		National Grid Coordinates E 336322.12 N 186188.19
Checked by			

Samples and Tests / Strata

Depth	Type & No.	Records	Date Casing	Time Water	Description	Depth,Level (Thickness)
			15/02/2002		MADE GROUND: CONCRETE.	0.20 +5.52
1.00	ES1				Ash and slag (DRILLERS DESCRIPTION).	(2.00)
					Soft grey silty CLAY with strong oily smell (DRILLERS DESCRIPTION).	2.20 +3.52 (0.70)
3.00 3.00	ES2	kRH			Firm green grey CLAY.	2.90 +2.82 (2.00)
			15/02/2002 6.00	dry	PEAT (DRILLERS DESCRIPTION).	4.90 +0.82 (1.10pen)
					EXPLORATORY HOLE ENDS AT 6.00 m.	6.00 -0.28

Legend: c, b, 1, 1, b, a

Groundwater

No.	Struck	Behaviour
1	1.10m	Rising to 0.80m after 20 mins. Sealed 3.80. Moderate inflow

Remarks

Chiselling : 0.00m to 1.00m 90minutes, 1.20m to 1.60m 90minutes
Hole backfill : 0.00m to 0.30m Concrete (c), 0.30m to 0.50m Bentonite (b), 3.00m to 4.00m Bentonite (b), 4.00m to 6.00m Arisings (a). Surface protection : Stop Cock Cover
Standpipe installed, 50mm diameter, response zone from 0.50m to 3.00m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole
CABH2
Sheet 1 of 1

03/05/2002 11:04:21 ESGLog v2.10

Borehole Log

Exploration Associates

Drilled by JR Logged by DE Checked by	Equipment and Methods Inspection Pit from 0.00m to 1.20m. Cable Percussion 150 mm diameter from 1.20m to 6.00m.	Ground Level + 5.66 m OD National Grid Coordinates E 336287.33 N 186098.50	

Samples and Tests / Strata

Depth	Type & No.	Records	Date Casing	Time Water	Description	Depth,Level (Thickness)
			15/02/2002			
0.50	ES1				MADE GROUND: Grey and grey brown locally sandy GRAVEL. Gravel is angular and subangular fine to coarse of slag and shale.	(3.10)
2.80	ES2					
3.20		kRH	15/02/2002 3.50			3.10 +2.56
			18/02/2002 3.50	1.75		
3.50	ES3				Soft green grey mottled orange brown CLAY. Driller reports bands of peat.	(2.90pen)
			18/02/2002 3.50			
6.00	ES4				EXPLORATORY HOLE ENDS AT 6.00 m.	6.00 −0.34

Legend: c, b, 1, g

Groundwater

No.	Struck	Behaviour
1	1.30m	Rising to 0.00m after 20 mins.

Remarks

Chiselling : 0.40m to 1.40m 180minutes, 1.40m to 2.60m 150minutes
Hole backfill : 0.00m to 0.30m Concrete (c), 0.30m to 0.80m Bentonite (b), 3.20m to 6.00m Grout (g). Surface protection : Stop Cock Cover
Standpipe installed, 50mm diameter, response zone from 0.80m to 3.20m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole **CABH3**
Sheet 1 of 1

03/05/2002 11:04:25 ESGLog v2.10

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BOREHOLE LOG

BH511

CLIENT	WELSH GOVERNMENT					Sheet	1 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	24 February 2015	Easting	336694.2				
End Date	2 March 2015	Northing	185862.9	Ground level	7.00mOD	Depth	21.20 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
24/02/15 1330hrs	1D*	0.00 - 0.50		Vo 0.0				Black clayey very sandy angular and subangular fine to coarse slag GRAVEL with medium slag cobble content. (MG)			
	2B	0.50 - 1.00									
24/02/15 1700hrs Dry	3D*	0.50 - 1.00		Vo 0.0							
		1.00 - 1.45	1.00	C 29							
	4B	1.00 - 2.00									
25/02/15 0800hrs Dry	5D*	1.00 - 1.50		Vo 0.0				1.00 - 1.45m: Medium dense.			
		1.50 - 1.80	1.00	C*104							
	6D*	1.50 - 2.00		Vo 0.0				1.50 - 1.80m: Very dense.			
		2.00 - 2.45	2.00	C 31							
	7B	2.00 - 3.00						2.00 - 2.45m: Dense.			
	8D*	2.00 - 2.50		Vo 0.0							
		2.50 - 2.95	2.00	C 22							
	9D*	2.50 - 3.00		Vo 0.0				2.50 - 2.80m: Medium dense.			
	10D	2.80							2.80	4.20	
	11D*	3.00 - 3.50		Vo 0.9				Firm dark grey mottled brown slightly sandy slightly gravelly CLAY. Gravel is angular and subangular fine to coarse slag. (MG)			
	12UT	3.00 - 3.45	2.90								
	13D	3.50									
	14D	3.50 - 3.95	3.00	S 8							
	15B	3.50 - 4.00									
	16D*	3.50 - 4.00		Vo 0.0							
	17UT	4.00 - 4.45	3.90						4.20	2.80	
25/02/15 1700hrs Dry	18D	4.50						Soft dark grey mottled brown silty CLAY. (TFD)			
	19D	4.50 - 4.95	4.50	S 6							
26/02/15 0800hrs 3.00m	20B	4.50 - 5.00									
	21D*	4.50 - 4.70		Vo 1.0							
	22UT	5.00 - 5.45	5.00								
	24D*	5.00 - 5.20		Vo 0.0							
	23D	5.50									
	25D	6.00									
	26D*	6.00 - 6.20		Vo 0.0							
	28D	6.50 - 6.95	6.50	S 8							
	27B	6.50 - 7.00							6.70	0.30	
	29D	6.80						Firm black clayey fibrous PEAT. (PEAT)			
	30D*	7.00 - 7.20		Vo 0.0							
	31D	7.50									
								Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.00m. Cable percussion (200mm) 1.00-4.00m and (150mm) 4.00-15.00m. Dynamic sampled (113mm) 15.00-15.20m (not retained). Waterflush rotary coring (116mm) 15.20-21.20m.

CASING: 200mm to 3.00m and 150mm diam to 14.70m.

BACKFILL: On completion, hole backfilled with bentonite pellets 21.20-0.40m and gravel 0.40-0.00m.

REMARKS: Downhole magnetometry for UXO risk mitigation undertaken 0.00-1.50m. No anomalies encountered.

Hole advanced by chiselling 1.00-2.80m (6.5hrs), 14.50-15.00m (1hr).

Bentonite seal for aquifer protection installed during drilling 4.00-2.50m, prior to reduction in casing diameter. Falling head permeability test undertaken at 9.00m- 9.50m. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks		CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	AGS	30238	EC

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BOREHOLE LOG

BH511

CLIENT	WELSH GOVERNMENT					Sheet	2 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	24 February 2015	Easting	336694.2			Depth	21.20 m
End Date	2 March 2015	Northing	185862.9	Ground level	7.00mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	32UT	8.00 - 8.45	8.00								
	34D*	8.00 - 8.20		Vo 0.0							
	35D	8.40									
	33D	8.50									
									8.90	-1.90	
	36D	9.00						Soft dark grey slightly sandy silty CLAY. (TFD)			
	37D	9.50 - 9.95	9.20	S 7							
	38B	9.50 - 10.00						9.50 - 12.60m: Soft.			
	39D	10.50									
	40UT	11.00 - 11.45	10.90					11.00m: Tending to sandy silt.			
	41D	11.50 - 11.60						11.40 - 11.80m: Black slightly sandy clayey peat.			
	42D	11.50									
	43D	12.00									
	44D	12.50 - 12.95	12.50	S 13							
	45B	12.50 - 13.00							12.60	-5.60	
								Firm reddish brown and dark grey slightly gravelly CLAY. Gravel is subangular and subrounded fine and medium mudstone lithorelicts. (MMG)			
	46D	13.40							13.30	-6.30	
	47D	13.50 - 13.95	13.50	S 27				Stiff reddish brown and light greenish grey slightly gravelly CLAY. Gravel is subangular fine and medium mudstone lithorelicts. (MMG)			
	48B	13.50 - 14.00									
26/02/15 1700hrs 10.00m											
	49D	14.50 - 14.77	14.50	S*123							
27/02/15 0800hrs 11.70m	50B	14.50 - 15.00									
	51D	15.00 - 15.17	14.70	S*161							
02/03/15 1000hrs 13.34m	X	15.00 - 15.20							15.20	-8.20	
	52C	15.20 - 16.70	14.70		100	NA		Very stiff fissured reddish brown very gravelly CLAY. Gravel is subangular and subrounded fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical extremely closely spaced planar smooth. (MMG) (Grade III)			
									16.50	-9.50	
						NA		Stiff fissured reddish brown gravelly CLAY. Gravel is subangular and subrounded fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical extremely closely spaced planar smooth. (MMG) (Grade III)			
	53C	16.70 - 18.20	14.70		100						
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
				Groundwater not encountered prior to use of water flush.

AGS

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH511

CLIENT	WELSH GOVERNMENT					Sheet	3 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	24 February 2015	Easting	336694.2				
End Date	2 March 2015	Northing	185862.9	Ground level	7.00mOD	Depth	21.20 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	54C	18.20	19.70	14.70		100			17.90 - 18.00m: Light greenish grey.			
	55C	19.70	21.20	14.70		100			20.60 - 20.70m: Light greenish grey.			
02/03/15 1305hrs 2.53m										21.20	-14.20	
									Borehole completed at 21.20m.			
										{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	30238	EC

AGS

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BOREHOLE LOG

BH512

CLIENT	WELSH GOVERNMENT					Sheet	1 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	2 March 2015	Easting	336772.2				
End Date	6 March 2015	Northing	185854.1	Ground level	6.50mOD	Depth	25.20 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
02/03/15 0800hrs	1B	0.30	0.50						Medium dense to very dense dark grey subangular fine to coarse slag GRAVEL. (MG)			
	2D*	0.30	0.50		Vo 0.0							
		0.50	0.95	Nil	C 52					0.50	6.00	
	3B	0.50	2.50						Subangular slag COBBLES with much sandy subangular fine to coarse slag gravel. (MG)			
		1.00	1.45	Nil	C 29							
	4D*	1.00	1.50		Vo 0.0							
		1.50	1.95	Nil	C 41							
02/03/15 1700hrs 1.70m	5D*	1.50	2.00		Vo 0.0							
		2.00	2.45	2.00	C 28							
03/03/15 0800hrs 1.70m	6B	2.00	2.50									
	7D*	2.00	2.50		Vo 0.0					2.40	4.10	
	8D	2.50	2.95	2.50	S 8				Soft dark greyish brown sandy gravelly silty CLAY. Gravel is angular fine to coarse slag. (MG)			
	11D	2.50										
	10B	2.50	3.00									
	12D*	2.50	2.70		Vo 0.0					2.95	3.55	
	13UT	3.00	3.45	3.00					Soft dark brown locally mottled grey slightly sandy silty CLAY with frequent subangular fine to coarse slag gravel and rare coarse gravel sized fibrous peat fragments. (MG)			
	14D	3.50										
	15D*	3.00	3.20		Vo 0.0							
	16B	3.50	4.00									
	17D*	3.50	3.70		Vo 0.0							
	18D	3.50	3.95	3.00	S 6							
	19UT	4.00	4.45	3.50								
	21D*	4.00	4.20		Vo 0.0							
	20D	4.50										
	22B	4.50	5.00	4.00	S 3							
	24D	4.50	4.95		Vo 0.0							
	23D*	4.50	4.70							4.90	1.60	
	25UT	5.00	5.44	4.50					Firm black slightly clayey slightly sandy fibrous PEAT with frequent roots (up to 4mm diam) and frequent rootlets (up to 1mm diam). (PEAT)			
	27D*	5.00	5.20		Vo 0.0							
	28D	5.50										
	29D	6.00										
	30D*	6.00	6.20		Vo 0.0							
	31D	6.50	6.95	6.50	S 10							
	32B	6.50	7.00									
	33D*	7.00	7.20							7.30	-0.80	
	34D	7.50							Very soft and soft dark grey very sandy silty CLAY with localised rare fragments of organic material. (TFD)			
									Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-0.50m. Cable percussion (200mm) 0.50-3.00m and (150mm) 3.00-15.00m. Dynamic sampled (113mm) 15.00-15.10m. Waterflush rotary core drilled (116mm) 15.10-25.20m. CASING: 200mm diam to 2.50m and 150mm diam to 14.70m.

BACKFILL: On completion, borehole backfilled with bentonite 25.20-11.20m. A slotted standpipe (50mm) with geo-sock was installed to 11.00m, granular response zone 11.20-6.80m and bentonite seal 6.80-2.10m. A second slotted standpipe (35mm) with geo-sock was installed to 2.00m, granular response zone 2.10-0.85m, bentonite seal 0.85-0.25m, concrete and stopcock cover 0.25-0.00m. REMARKS: Hole advanced by chiselling 0.50-2.40m (2h 30mins) and 14.60-15.00m (1hr). Downhole magnetometry for UXO risk mitigation undertaken 0.00-13.00m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling 3.00-1.50m, prior to reduction in casing diameter.

MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
1.70	Nil	1.70	20	Slow flow.
2.00	2.00	2.50	20	

AGS

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH512

CLIENT	WELSH GOVERNMENT					Sheet	2 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	2 March 2015	Easting	336772.2				
End Date	6 March 2015	Northing	185854.1	Ground level	6.50mOD	Depth	25.20 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	35UT	8.00 - 8.45	7.80								
	37D*	8.00 - 8.20									
	36D	8.50									
	38D	9.00									
	39D	9.50 - 9.95	9.40	S<1							
	40B	9.50 - 10.20									
	41D	10.50									
	42UT	11.00 - 11.45							11.20	-4.70	
								Soft dark grey very sandy silty CLAY with rare subrounded tabular coarse sandstone gravel. (TFD)			
03/03/15 1700hrs Dry	43D	11.50							11.90	-5.40	
	44D	12.00 - 12.45	12.00	S 21				Stiff fissured reddish brown slightly gravelly silty CLAY. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. (MMG)			
04/03/15 0800hrs 7.20m	45B	12.00 - 12.50									
	46D	12.00									
	47D	13.00									
	48D	13.50 - 13.95	13.00	S 46				13.50 - 13.95m: Very stiff.			
	49B	13.50 - 14.00									
04/03/15 1200hrs 10.00m	50D	14.60 - 14.75	14.50	S*140							
	51D	14.60									
06/03/15 0945hrs 3.62m	53D	15.00 - 15.65	14.70	S*246					15.00	-8.50	
	52X	15.00 - 15.10			100	NA		Stiff fissured reddish brown sandy gravelly CLAY. Gravel is angular and subangular tabular fine to coarse lithorelicts of very stiff clay to extremely weak mudstone. Localised relict fissures are subhorizontal to 20° closely spaced. (MMG) (Grade III)			
	54C	15.10 - 16.20	14.70								
	55C	16.20 - 17.70	14.70		100			16.65 - 16.70m: Bluish green reduction spots (up to 3mm).			
									17.20	-10.70	
								Very stiff reddish brown slightly sandy CLAY with rare light greenish grey reduction spots (up to 2mm). (MMG) (Grade IVb)	17.70	-11.20	
	56C	17.70 - 19.20	14.70		100 0						
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

AGS

CONTRACT	CHECKED
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BOREHOLE LOG

BH512

CLIENT	WELSH GOVERNMENT					Sheet	3 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	2 March 2015	Easting	336772.2				
End Date	6 March 2015	Northing	185854.1	Ground level	6.50mOD	Depth	25.20 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
					0			Stiff fissured reddish brown sandy gravelly CLAY with rare greenish grey reduction spots (up to 2mm). Gravel is angular and subangular fine to coarse lithorelicts of very stiff clay to extremely weak mudstone. (MMG) (Grade III)	18.60	-12.10	
						NI		18.00 - 18.20m: Light greenish grey.			
	57C	19.20 - 20.70	14.70		100 0 0			Extremely weak and very weak reddish brown and dark bluish grey MUDSTONE locally tending to claybound angular and subangular fine to coarse gravel sized mudstone lithorelicts. Fractures are randomly orientated extremely closely and very closely spaced planar smooth and rough infilled (up to 5mm) with reddish brown clay. (MMG) (II/III)			
								19.94m: 20° fracture planar rough infilled (up to 2mm) with reddish brown clay.			
								20.35m: 20° fracture planar rough infilled (up to 2mm) with reddish brown clay.			
	58C	20.70 - 22.20	14.70		100 0 0			20.85m: 20° fracture planar rough infilled (up to 2mm) with reddish brown clay.			
								21.35m: 20° fracture planar rough infilled (up to 2mm) with reddish brown clay.			
								21.55m: 20° fracture planar rough infilled (up to 2mm) with reddish brown clay.			
	59C	22.20 - 23.70	14.70		100 0 0			22.10m: 20° fracture planar rough infilled (up to 2mm) with reddish brown clay.			
								22.40 - 22.55m: Light greenish grey.			
								23.10m: 20° fracture planar rough infilled (up to 2mm) with reddish brown clay.			
	60C	23.70 - 25.20	14.70		100	NA			24.10	-17.60	
								Stiff fissured reddish brown sandy gravelly CLAY. Gravel is subhorizontal angular and subangular fine to coarse lithorelicts of very stiff clay to extremely weak mudstone. (MMG) (Grade III)			
06/03/15 1415hrs 3.47m								24.60 - 24.95m: Bluish grey silty clay.	25.20	-18.70	
								Borehole completed at 25.20m.			
									{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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Geotechnical Engineering Limited

TRIAL PIT LOG

TP504

CLIENT	WELSH GOVERNMENT					Sheet	1 of 1
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 25
Start Date	20 February 2015	Easting	336733.7				
End Date	20 February 2015	Northing	185858.9	Ground level	6.60mOD	Depth	1.70 m

water record	sample/test no/type	result	depth (m)	description	depth (m)	level (m)	legend
	1B	Vo 6.8	0.00- 0.10	Dark grey sandy angular and subangular fine to coarse brick, timber and slag GRAVEL with low red brick and slag cobble content. (MG)			
	2D*		0.00- 0.10				
	3B	Vo 30.5	0.60- 0.80				
	4D*		0.60- 0.80				
	5B	Vo 7.2	1.20- 1.40				
	6D*		1.20- 1.40				
Rapid ingress at 1.45m							
1.45m				Trial pit completed at 1.70m.	1.70	4.90	

Notes

Trial pit excavated by JCB 3CX mechanical excavator.
Groundwater encountered at 1.45m.
Trial pit sides remained stable and vertical.
Trial pit dimensions 0.80x2.40x1.70m.
On completion, the trial pit was backfilled with materials arising.
Trial pit terminated at 1.70m due to the strength of the ground.

Sketch of Foundation - Not to scale. All dimensions in metres.

CONTRACT	CHECKED
30238	EC

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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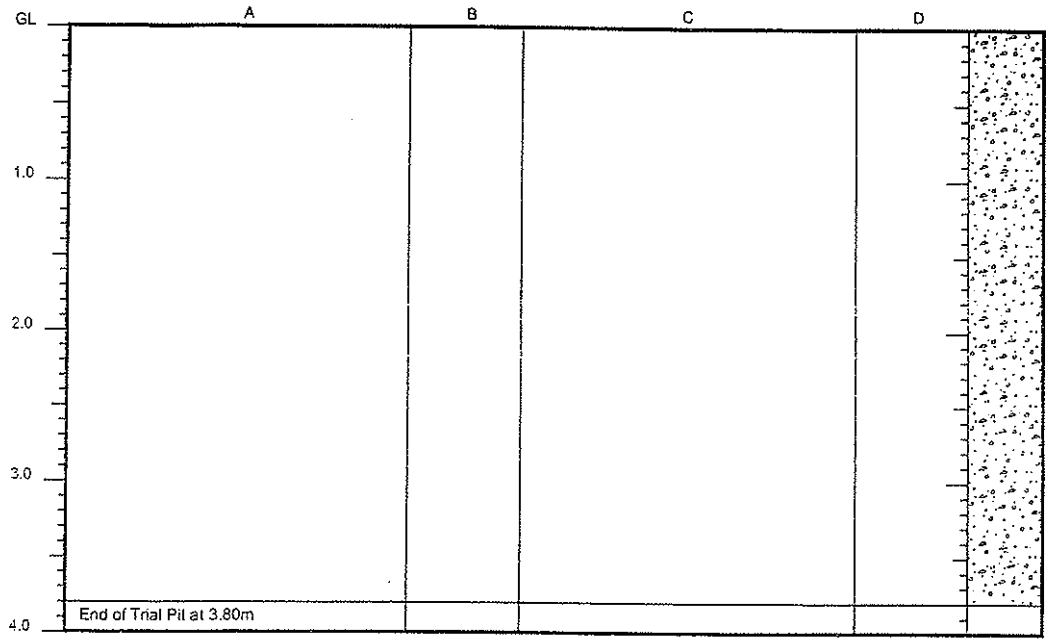
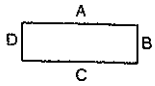
Trial Pit Log

Exploration Associates

Logged by DE Checked by	Equipment and Methods Trial Pit/Trench from 0.00m to 3.80m.Pit dug using Hydraulic wheeled excavator.	Ground Level National Grid Coordinates





Dimensions 4.00m x 2.00m
Excavation date 18/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
0.50 2.00 3.80	ES1 ES2 ES3		0.00-3.80	1	MADE GROUND: Grey sandy GRAVEL with some cobbles. Gravel is fine to coarse.Gravel and cobbles are angular and subangular of slag.

Groundwater
Struck at 3.00m-Fast seepage.

Remarks
Pit terminated at 3.80m due to extensive quantities of groundwater. Unable to remove due to fast inflow.
Stratum 1-lightly compacted.
Machine dug to 3.8m using JCB with bucket and duck with pecker.
Breaking out with pecker 30 mins.
Hole backfill : 0.00m to 3.80m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

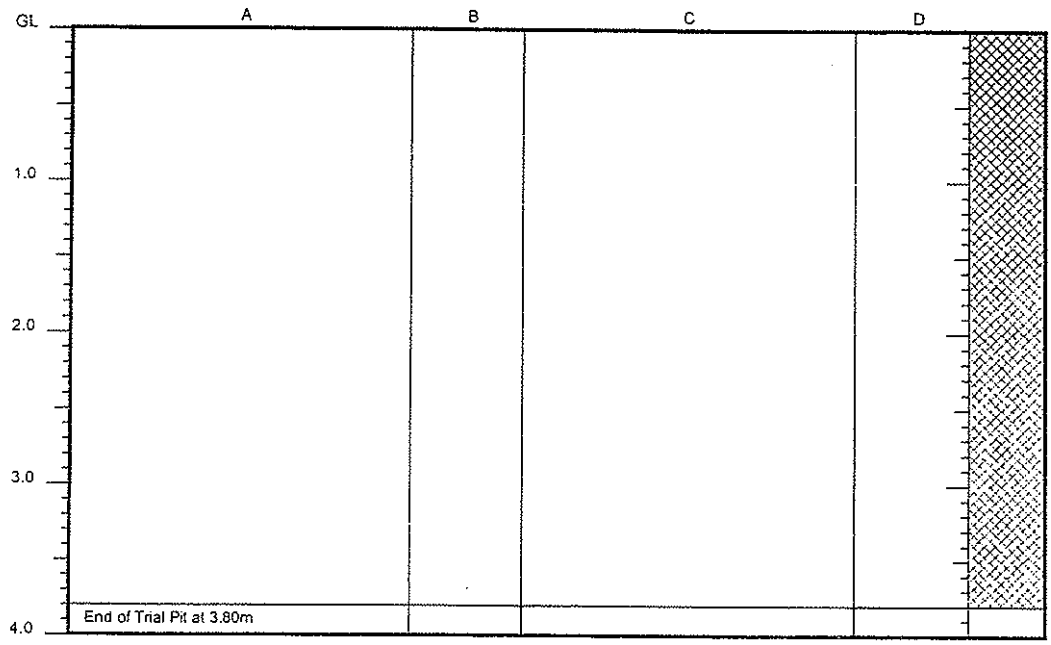
Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

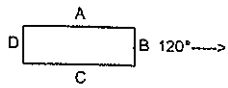
Trial Pit
MRTP1
Sheet 1 of 1

Trial Pit Log

Exploration Associates

Logged by DE Checked by	Equipment and Methods Machine dug Trial Pit from 0.00m to 3.80m using JCB with bucket and Rubber Duck with pecker.	Ground Level National Grid Coordinates





Dimensions 5.10m x 1.90m
Excavation date 19/02/2002

Samples and Tests

Depth (m)	Type & No.	Records
0.50	ES1	
3.80	ES2	

Strata

Depth (m)	No.	Description
0.00-3.80	1	MADE GROUND: Grey sandy GRAVEL with occasional cobbles. Gravel is fine to coarse. Gravel and cobbles are angular and subangular of slag.

Groundwater
Moderate seepage at 2.30m.

Remarks
Stratum 1 - Highly compacted.
Trial Pit terminated at 3.80m due to large quantities of groundwater in pit.
Stability : Stable, Shoring : None
Hole backfill : 0.00m to 3.80m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

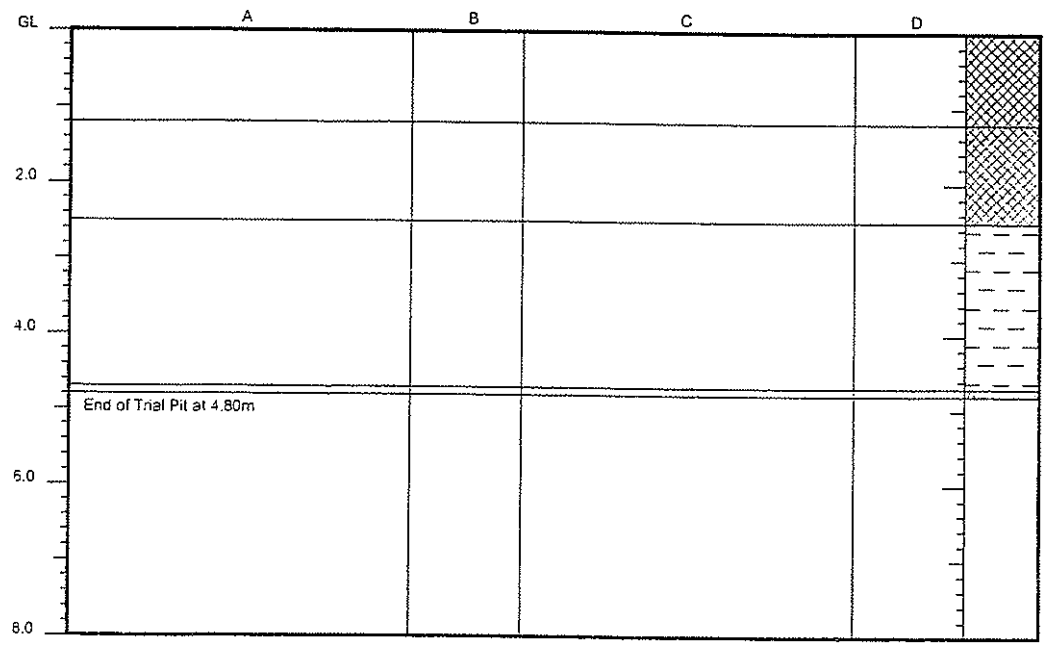
Trial Pit
MRTP2
Sheet 1 of 1

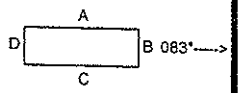
03/05/2002 11:12:21 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by DE Checked by	Equipment and Methods Machine dug Trial Pit from 0.00m to 4.80m using JCB with bucket and Rubber Duck with pecker.	Ground Level National Grid Coordinates





Dimensions 4.60m x 1.80m
Excavation date 19/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
0.50	ES1		0.00-1.20	1	MADE GROUND: Brown sandy GRAVEL with some cobbles. Gravel is fine to coarse. Gravel and cobbles are angular and subangular of slag and brick. Rare fagments of metal wire.
2.00	ES2		1.20-2.50	2	MADE GROUND: Grey slightly sandy GRAVEL with some cobbles. Gravel is fine to coarse. Gravel and cobbles are angular and subangular of slag, brick and iron ore.
3.50	ES3		2.50-4.70	3	Firm grey CLAY with occasional rootlets.
			4.70-4.80	4	Brown spongy fibrous PEAT.

Groundwater
Fast seepage at 1.50m.

Remarks
Stratum 1 and 2 - Highly compacted.
Stability : Stable, Shoring : None
Hole backfill : 0.00m to 4.80m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 100

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

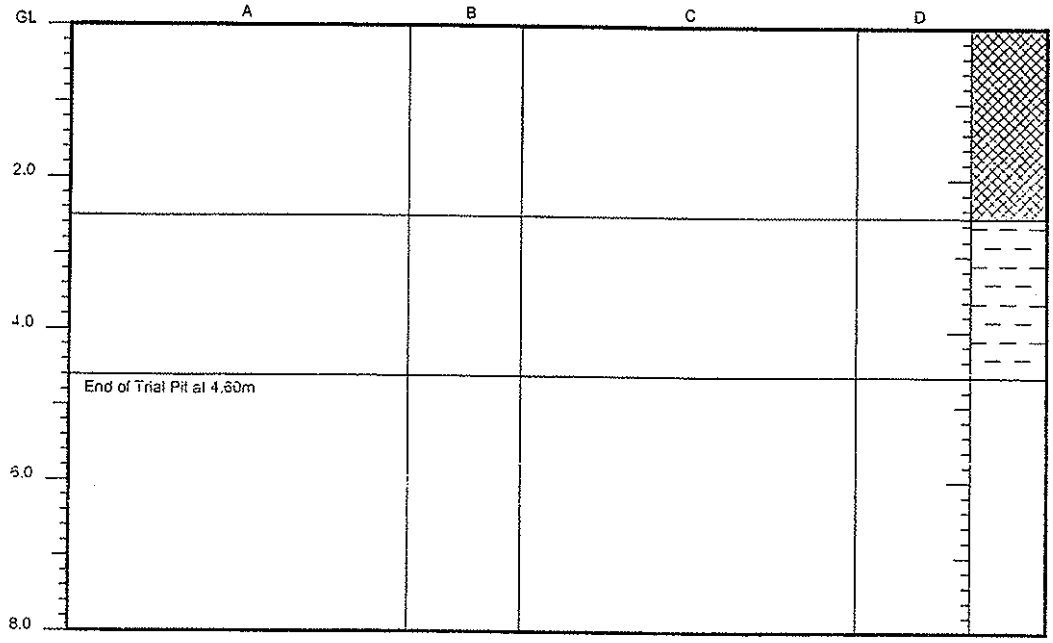
Trial Pit
MRTP3
Sheet 1 of 1

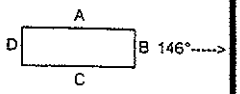
03/05/2002 11:12:25 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by DE Checked by	Equipment and Methods Machine dug Trial Pit from 0.00m to 4.60m using JCB with bucket and Rubber Duck with pecker.	Ground Level National Grid Coordinates





Dimensions 4.70m x 1.50m
Excavation date 19/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
0.50 2.30	ES1 ES2		0.00-2.50	1	MADE GROUND: Black and grey sandy GRAVEL with some cobbles and occasional boulders. Gravel is fine to coarse. Gravel, cobbles and boulders are angular and subangular of brick and slag.
3.50	ES3		2.50-4.60	2	Stiff grey mottled orange brown CLAY.

Groundwater
Moderate seepage at 2.30m.

Remarks
Stratum 1 - Compacted.

Stability : Stable, Shoring : None
Hole backfill : 0.00m to 4.60m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 100

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

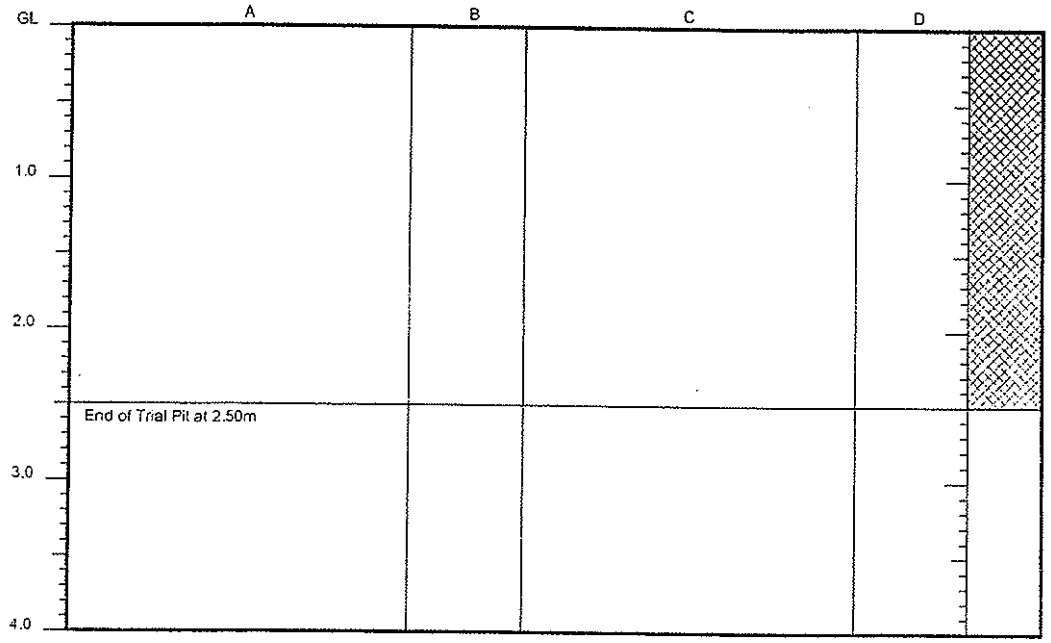
Trial Pit
MRTP4
Sheet 1 of 1

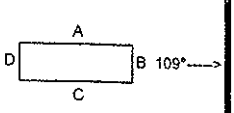
03/05/2002 11:12:29 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by JL Checked by	Equipment and Methods Trial Pit/Trench from 0.00m to 2.50m.Pit dug using Hydraulic wheeled excavator.	Ground Level National Grid Coordinates





Dimensions 3.50m x 1.00m
Excavation date 14/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
0.40	ES1		0.00-2.50	1	MADE GROUND: Brown dark green slightly silty sandy angular to sub rounded fine to coarse GRAVEL of slag ash and clinker.

Groundwater
No groundwater encountered.

Remarks
Stability : Stable, Shoring : None
Hole backfill : 0.00m to 2.50m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

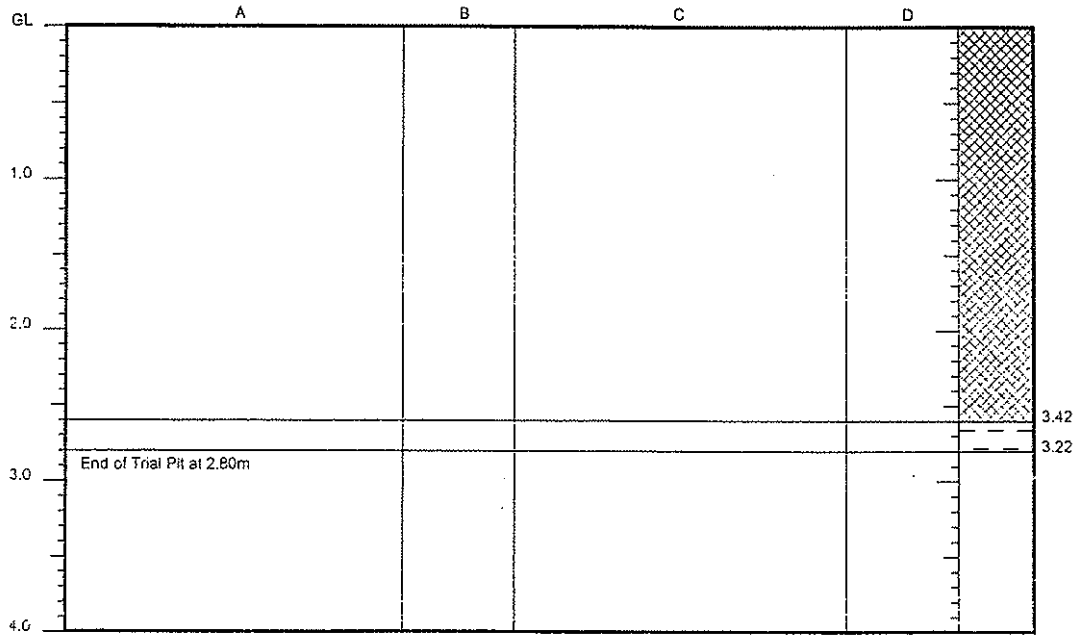
Trial Pit
MRTP5
Sheet 1 of 1

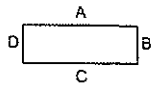
03/05/2002 11:12:33 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by JSN Checked by	**Equipment and Methods** Trial Pit/Trench from 0.00m to 2.80m.Pit dug using Hydraulic wheeled excavator.	**Ground Level** + 6.02 m OD **National Grid Coordinates** E 336349.61 N 186249.72





Dimensions 2.75m x 0.95m
Excavation date 18/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
0.50	ES1		0.00-2.60	1	MADE GROUND: Black very sandy fine to coarse angular of limestone and slag with rare angular cobbles and boulders of slag and asphalt.
0.80-2.80	ES3				
2.50	ES2				Below 2.50m hydrocarbon smell.
			2.60-2.80	2	Firm grey clay with occasional rootlets.

Groundwater
No groundwater encountered.

Remarks
Hole backfill : 0.00m to 2.80m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no. 152002
Carried out for Corus plc

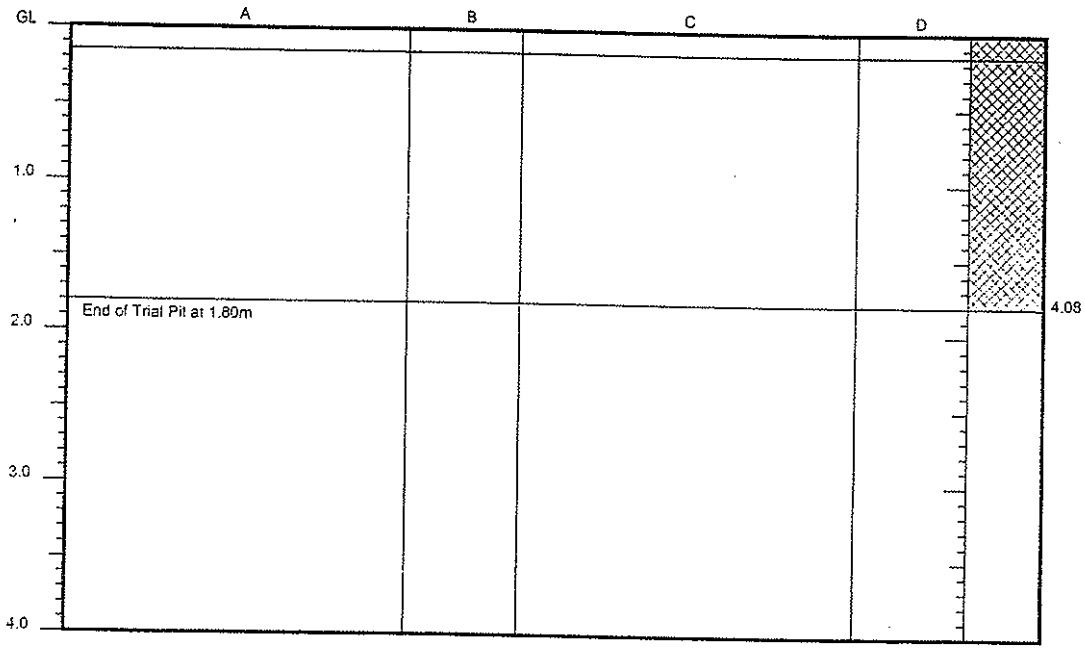
Trial Pit
CATP1
Sheet 1 of 1

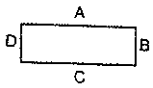
03/05/2002 11:04:28 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by JSN Checked by	Equipment and Methods Trial Pit/Trench from 0.00m to 1.80m.Pit dug using Hydraulic wheeled excavator.	Ground Level + 5.88 m OD National Grid Coordinates E 336346.33 N 186219.69





Dimensions 2.15m x 1.10m
Excavation date 15/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
			0.00-0.15	1	MADE GROUND: Ashphalt.
0.75 1.20	ES1 ES2		0.15-1.80	2	MADE GROUND: Black very sandy fine to coarse angular GRAVEL of limestone and slag with occasional angular cobbles and boulders.

Groundwater
No groundwater encountered.

Remarks
Hole backfill : 0.00m to 1.80m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

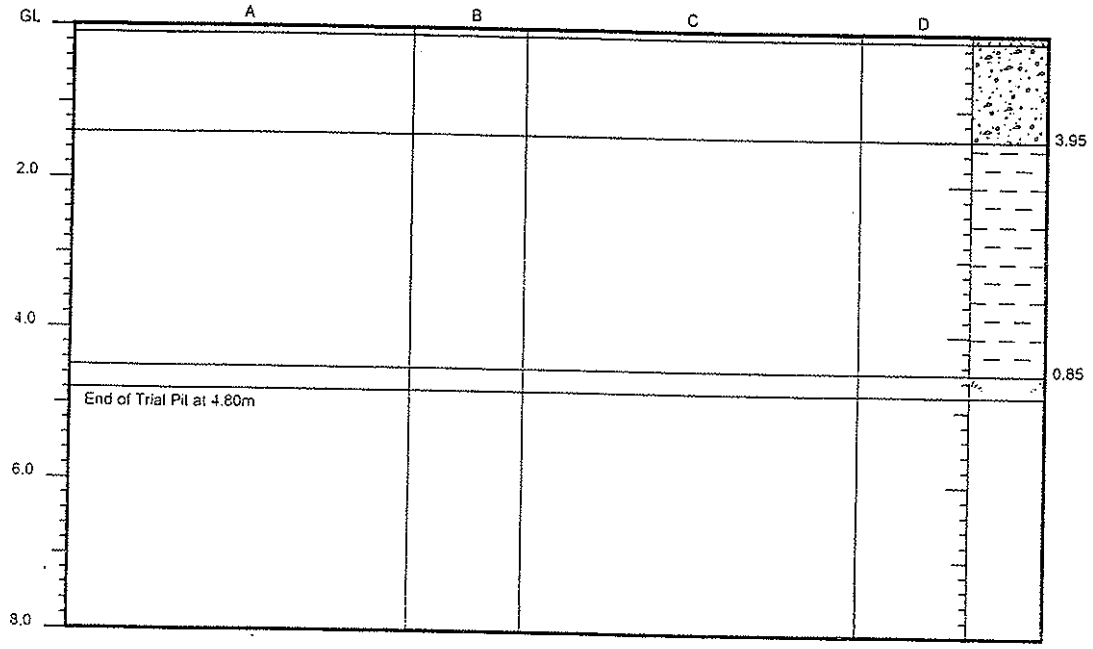
Trial Pit
CATP2
Sheet 1 of 1

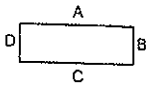
03/05/2002 11:04:34 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by DE Checked by	**Equipment and Methods** Trial Pit/Trench from 0.00m to 2.50m.Pit dug using Hydraulic wheeled excavator.	**Ground Level** + 5.35 m OD **National Grid Coordinates** E 336402.86 N 186196.81





Dimensions 4.60m x 1.60m
Excavation date 18/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
			0.00-0.10	1	MADE GROUND: Tarmac.
0.50 1.30	ES1 ES2		0.10-1.40	2	MADE GROUND: Grey brown sandy GRAVEL with many cobbles. Gravel is fine to coarse. Gravel and cobbles are angular and subangular of slag.
2.50	ES3		1.40-4.50	3	Stiff grey mottled orange/brown CLAY.
			4.50-4.80	4	Dark brown spongy fibrous PEAT.

Groundwater

Remarks
Machine dug to 4.8m using JCB with bucket and duck with pecker.
Stability : Stable, Shoring : None
Hole backfill : 0.00m to 4.80m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 100

Project ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no. 152002
Carried out for Corus plc

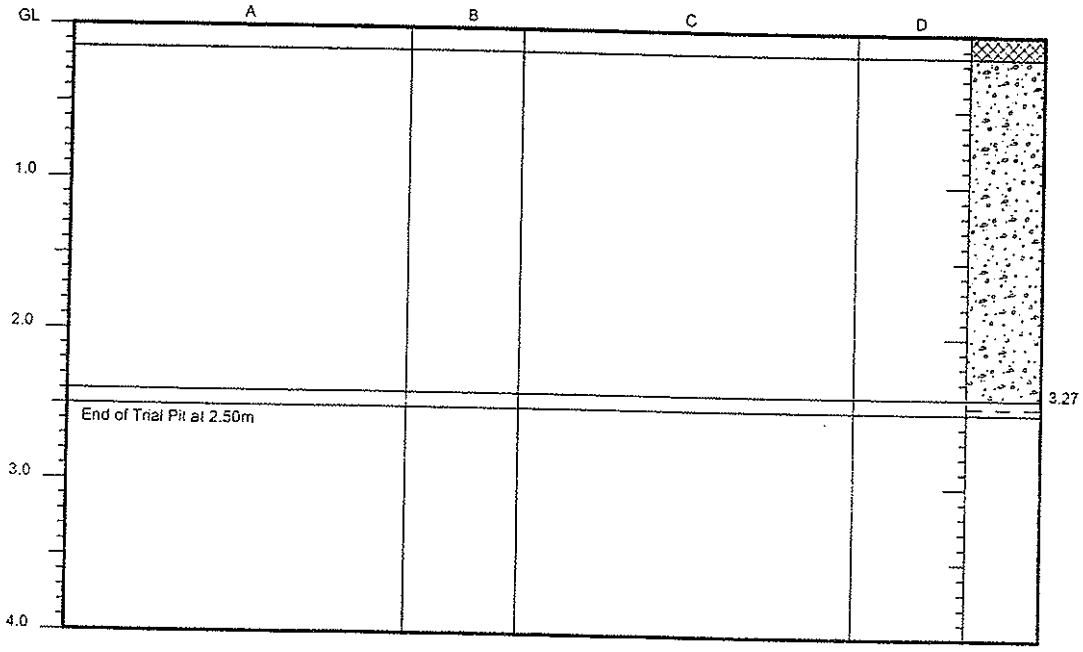
Trial Pit
CATP5
Sheet 1 of 1

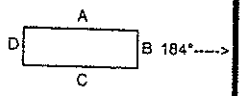
03/05/2002 11:04:43 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by GW Checked by	**Equipment and Methods** Trial Pit/Trench from 0.00m to 2.50m.Pit dug using Hydraulic wheeled excavator.	**Ground Level** + 5.67 m OD **National Grid Coordinates** E 336344.78 N 186192.45





Dimensions 2.50m x 1.20m
Excavation date 18/02/2002

Samples and Tests

Depth (m)	Type & No.	Records
0.75	ES1	
2.04	ES2	
2.50	ES3	

Strata

Depth (m)	No.	Description
0.00-0.15	1	MADE GROUND: Black asphalt.
0.15-2.40	2	MADE GROUND: Black very sandy fine to coarse anguar GRAVEL of slag with occasional angular cobbles and boulders of slag.
2.40-2.50	3	Soft to firm CLAY.

Groundwater
No groundwater encountered.

Remarks
One hour breaking out
Hole backfill : 0.00m to 2.40m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

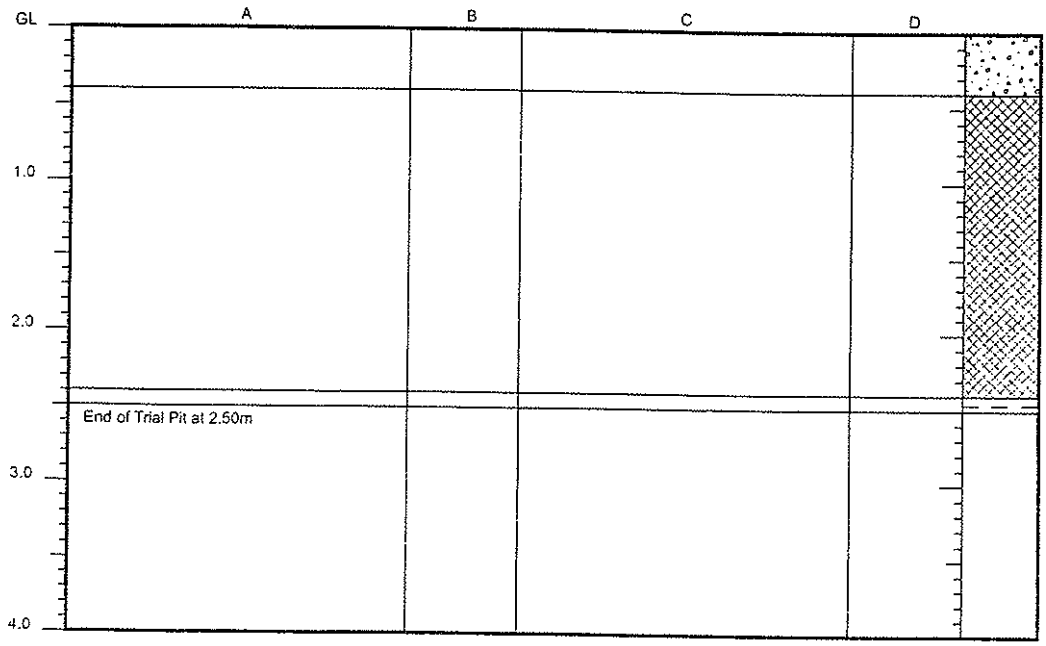
Trial Pit
CATP6
Sheet 1 of 1

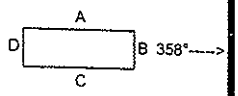
03/05/2002 11:04:46 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by JN Checked by	Equipment and Methods Machine dug Trial Pit from 0.00m to 2.50m using JCB with bucket and pecker.	Ground Level National Grid Coordinates





Dimensions 2.20m x 1.40m
Excavation date 19/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
			0.00-0.40	1	MADE GROUND: Reinforced CONCRETE. At 0.40m: Clear visqueen.
0.75 2.00	ES1 ES2		0.40-2.40	2	MADE GROUND: Dark red brown very sandy GRAVEL. Gravel is angular fine to coarse of slag, brick and concrete. Below 2.20m: Becoming slightly sandy with hydrocarbon oudor.
2.45	ES3		2.40-2.50	3	Soft friable dark blue grey CLAY with frequent rootlets.

Groundwater
Fast seepage at 2.20m.

Remarks
Hydrocarbon oudor from groundwater.
Stability : Stable, Shoring : None
Hole backfill : 0.00m to 2.50m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

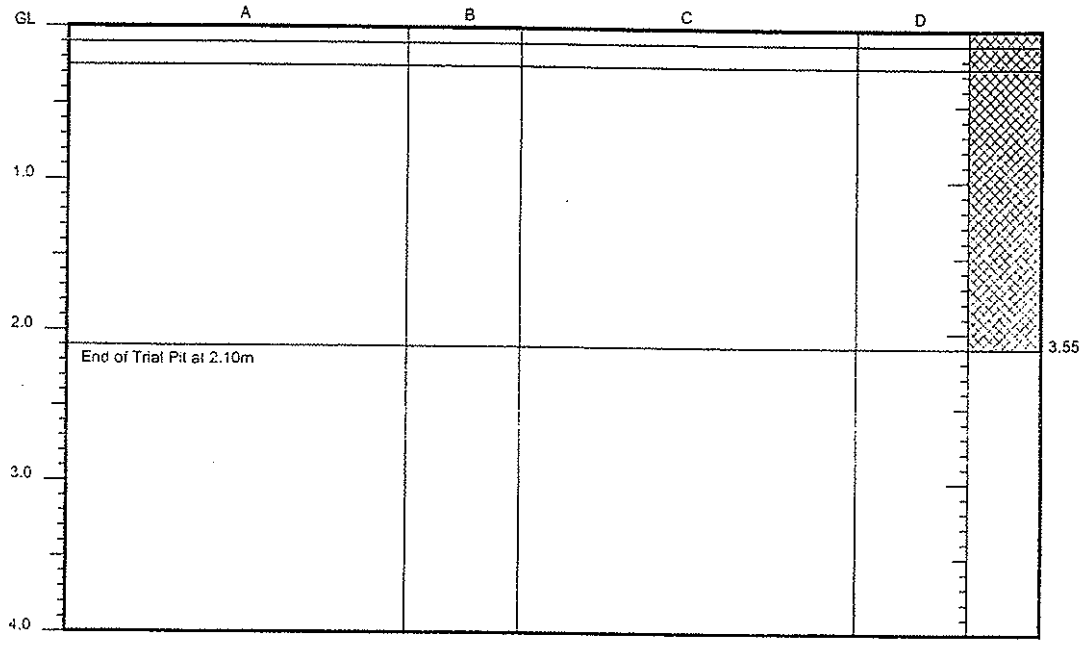
Trial Pit
CATP7
Sheet 1 of 1

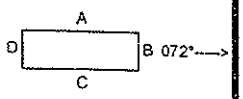
03/05/2002 11:04:49 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by JN Checked by	**Equipment and Methods** Machine dug Trial Pit from 0.00m to 2.10m using JCB with bucket and breaker.	Ground Level + 5.65 m OD National Grid Coordinates E 336285.49 N 186123.84





Dimensions 2.20m x 1.20m
Excavation date 19/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
			0.00-0.10	1	MADE GROUND: Red brown very sandy GRAVEL. Gravel is angular fine to coarse of limestone.
			0.10-0.25	2	MADE GROUND: Dark grey ASPHALT.
1.00 2.10	ES1 ES2		0.25-2.10	3	MADE GROUND: Black very sandy GRAVEL with occasional cobbles and boulders. Gravel is fine to coarse. Gravel, cobbles and boulders are angular of slag. Hydrocarbon oil sheen on surface of gravel.

Groundwater
Fast seepage at 1.75m.

Remarks
Trial Pit terminated on encountering 3 inch wire cable at 2.10m.
Stability : Stable, Shoring : None
Hole backfill : 0.00m to 2.10m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

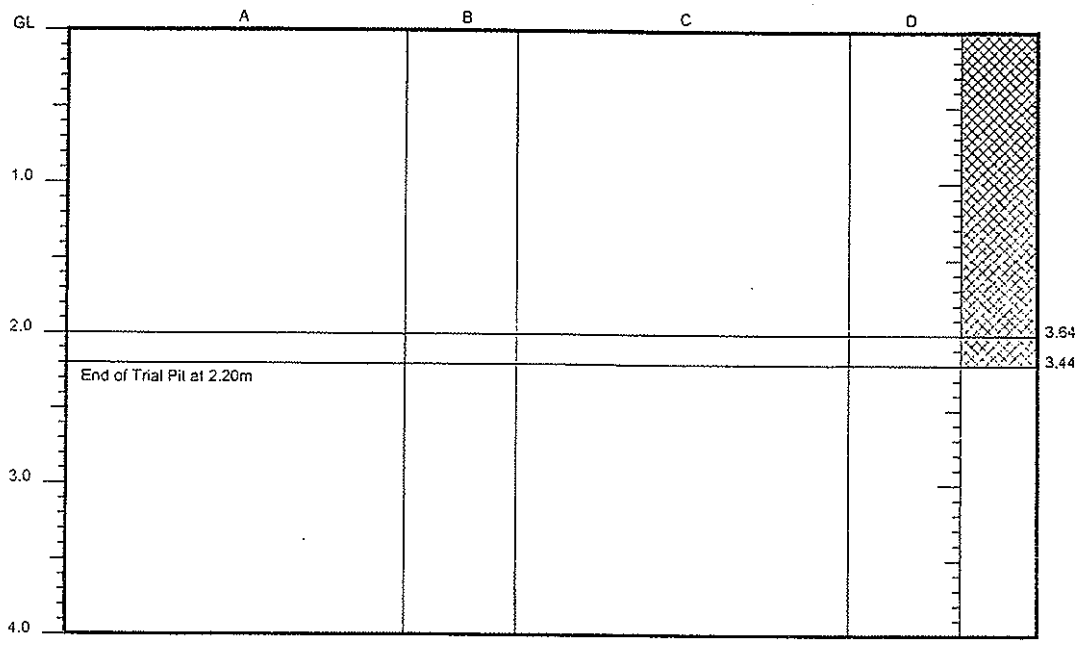
Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

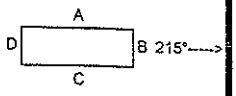
Trial Pit
CATP8
Sheet 1 of 1

Trial Pit Log

Exploration Associates

Logged by JN Checked by	**Equipment and Methods** Machine dug Trial Pit from 0.00m to 2.20m using JCB with bucket and pecker.	**Ground Level** + 5.64 m OD **National Grid Coordinates** E 336295.18 N 186108.83





Dimensions 2.50m x 1.15m
Excavation date 19/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
1.00	ES1		0.00-2.00	1	MADE GROUND: Dark brown very sandy GRAVEL with occasional cobbles and boulders. Gravel is fine to coarse. Gravel, cobbles and boulders are angular and subangular of slag and brick.
2.10	ES2		2.00-2.20	2	MADE GROUND: Light yellow grey GRAVEL. Gravel is angular and subangular fine and medium of unidentifiable stone.

Groundwater
Slow seepage at 0.50m.

Remarks
Trial Pit terminated at 2.20m due to large quantities of groundwater in pit.
Stability : Stable, Shoring : None
Hole backfill : 0.00m to 2.20m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no. 152002
Carried out for Corus plc

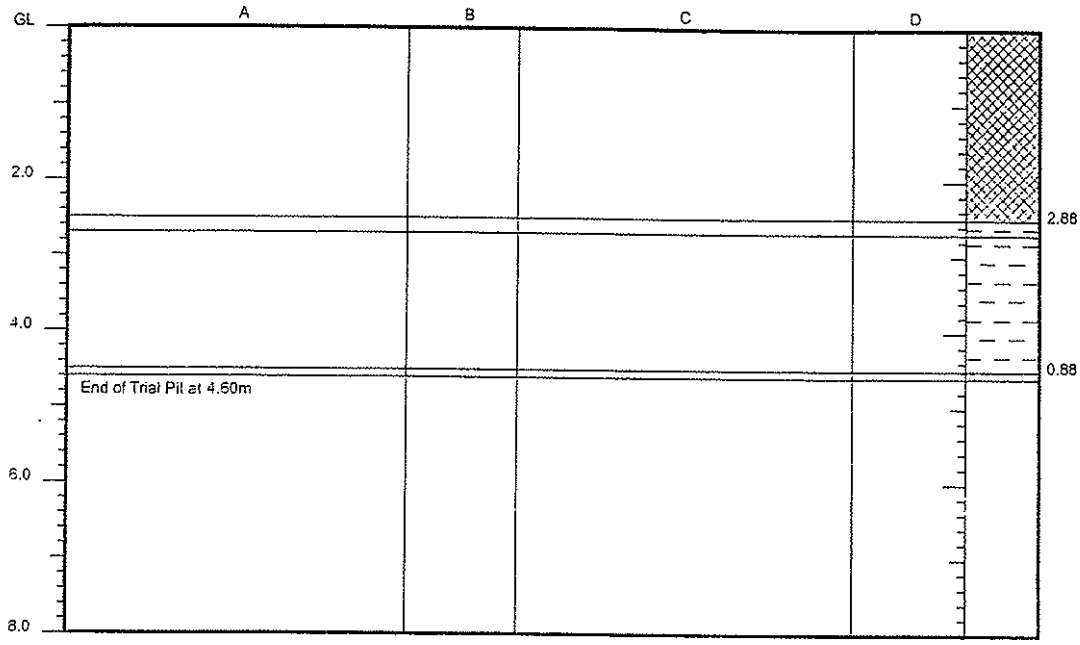
Trial Pit
CATP9
Sheet 1 of 1

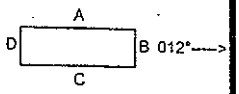
03/05/2002 11:04:56 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by DE Checked by	**Equipment and Methods** Machine dug Trial Pit from 0.00m to 4.60m using JCB with bucket and Rubber Duck with pecker.	Ground Level + 5.38 m OD National Grid Coordinates E 336265.22 N 186098.33





Dimensions 4.30m x 1.50m
Excavation date 19/02/2002

Samples and Tests

Depth (m)	Type & No.	Records
0.50	ES1	
2.40	ES2	
2.60	ES3	
3.50	ES4	

Strata

Depth (m)	No.	Description
0.00-2.50	1	MADE GROUND: Grey and brown slightly sandy GRAVEL with occasional cobbles and boulders. Gravel is fine to coarse. Gravel, cobbles and boulders are angular and subangular of slag and brick.
2.50-2.70	2	Soft black CLAY with abundant rootlets and hydrocarbon oil pockets (<20mm).
2.70-4.50	3	Stiff grey mottled orange brown CLAY.
4.50-4.60	4	Dark brown spongy fibrous PEAT.

Groundwater
Fast seepage at 1.20m.

Remarks
Stratum 1 - Highly compacted.

Stability : Stable, Shoring : None
Hole backfill : 0.00m to 4.60m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 100

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

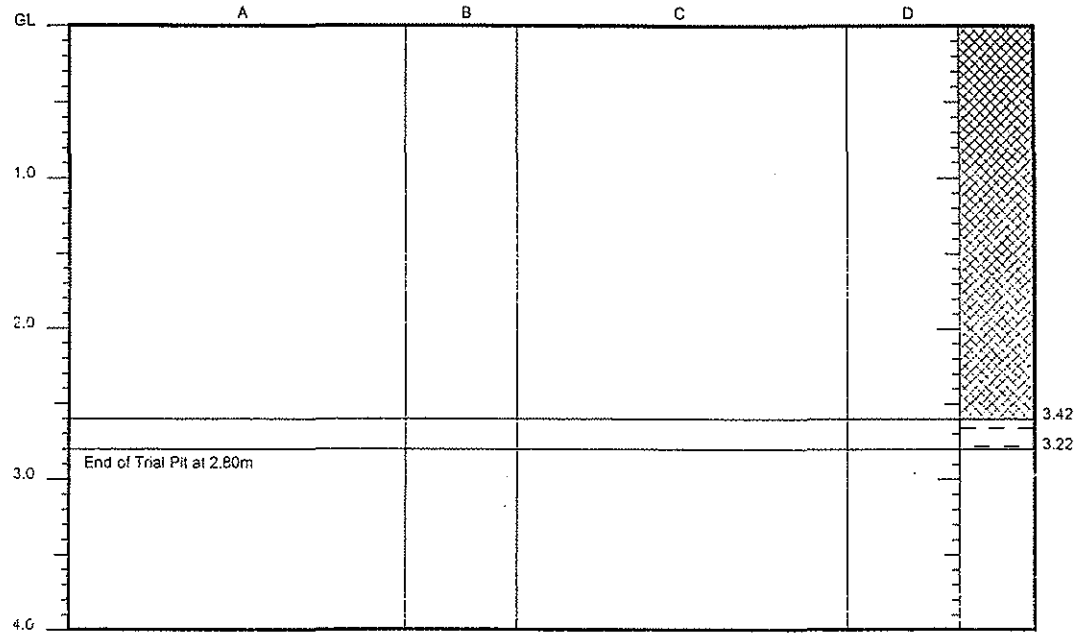
Trial Pit
CATP10
Sheet 1 of 1

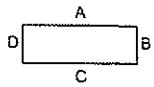
03/05/2002 11:04:31 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by JSN Checked by	**Equipment and Methods** Trial Pit/Trench from 0.00m to 2.80m.Pit dug using Hydraulic wheeled excavator.	**Ground Level** + 6.02 m OD **National Grid Coordinates** E 336349.61 N 186249.72





Dimensions 2.75m x 0.95m
Excavation date 18/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
0.50	ES1		0.00-2.60	1	MADE GROUND: Black very sandy fine to coarse angular of limestone and slag with rare angular cobbles and boulders of slag and asphalt.
0.80-2.80	ES3				
2.50	ES2				Below 2.50m hydrocarbon smell.
			2.60-2.80	2	Firm grey clay with occasional rootlets.

Groundwater
No groundwater encountered.

Remarks
Hole backfill : 0.00m to 2.80m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no. 152002
Carried out for Corus plc

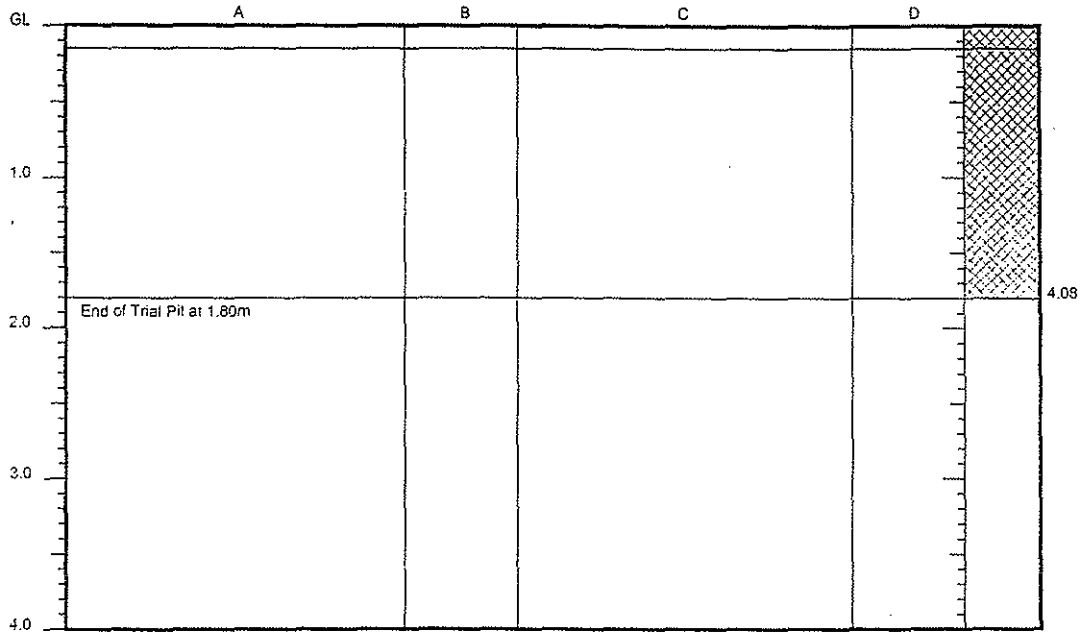
Trial Pit
CATP1
Sheet 1 of 1

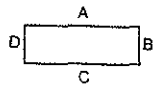
03/05/2002 11:04:28 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by JSN Checked by	Equipment and Methods Trial Pit/Trench from 0.00m to 1.80m.Pit dug using Hydraulic wheeled excavator.	Ground Level + 5.88 m OD National Grid Coordinates E 336346.33 N 186219.69





Dimensions 2.15m x 1.10m
Excavation date 15/02/2002

Samples and Tests

Depth (m)	Type & No.	Records
0.75	ES1	
1.20	ES2	

Strata

Depth (m)	No.	Description
0.00-0.15	1	MADE GROUND: Ashphalt.
0.15-1.80	2	MADE GROUND: Black very sandy fine to coarse angular GRAVEL of limestone and slag with occasional angular cobbles and boulders.

Groundwater
No groundwater encountered.

Remarks
Hole backfill : 0.00m to 1.80m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no. 152002
Carried out for Corus plc

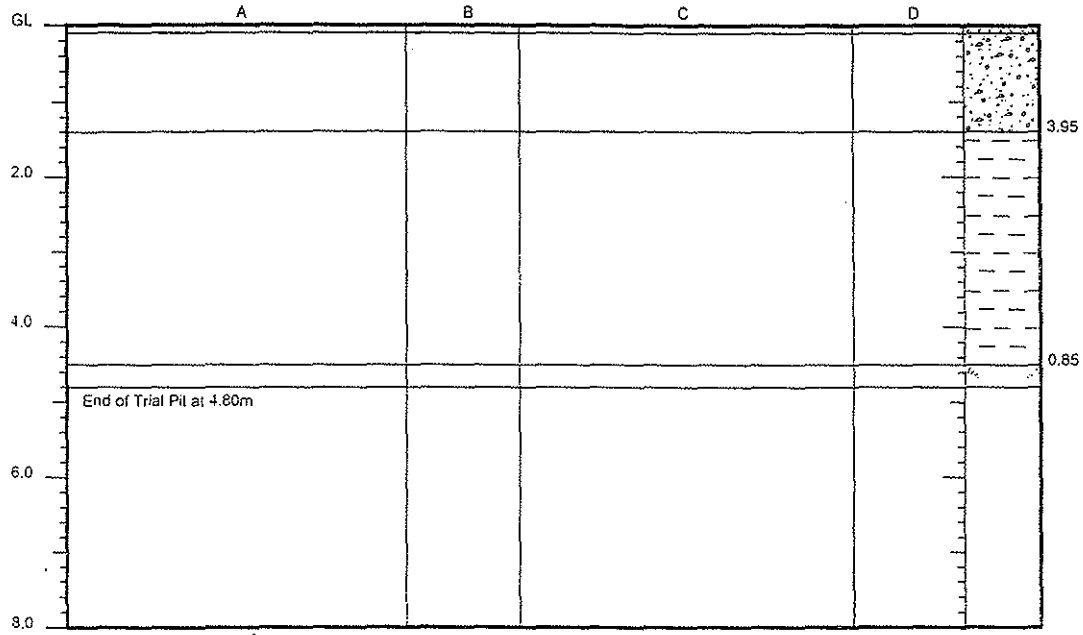
Trial Pit
CATP2
Sheet 1 of 1

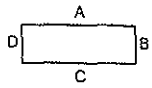
03/05/2002 11:04:34 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by DE Checked by	**Equipment and Methods** Trial Pit/Trench from 0.00m to 2.50m.Pit dug using Hydraulic wheeled excavator.	**Ground Level** + 5.35 m OD **National Grid Coordinates** E 336402.86 N 186196.81





Dimensions 4.60m x 1.60m
Excavation date 18/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
			0.00-0.10	1	MADE GROUND: Tarmac.
0.50 1.30	ES1 ES2		0.10-1.40	2	MADE GROUND: Grey brown sandy GRAVEL with many cobbles. Gravel is fine to coarse. Gravel and cobbles are angular and subangular of slag.
2.50	ES3		1.40-4.50	3	Stiff grey mottled orange/brown CLAY.
			4.50-4.80	4	Dark brown spongy fibrous PEAT.

Groundwater

Remarks
Machine dug to 4.8m using JCB with bucket and duck with pecker.
Stability : Stable, Shoring : None
Hole backfill : 0.00m to 4.80m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 100

Project ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no. 152002
Carried out for Corus plc

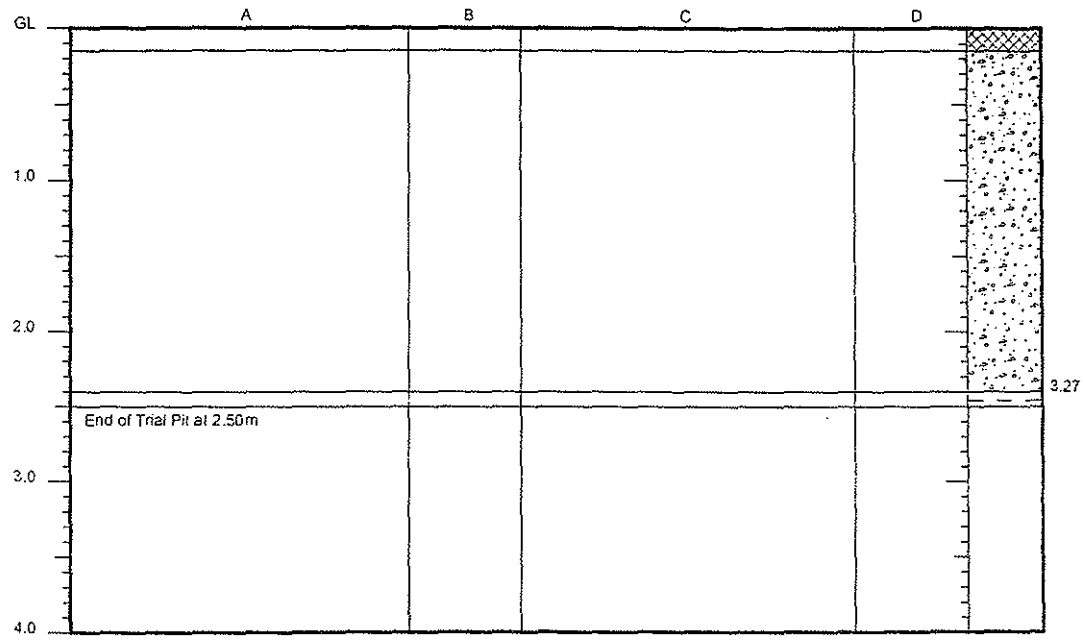
Trial Pit
CATP5
Sheet 1 of 1

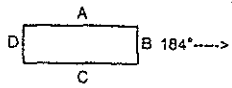
03/05/2002 11:04:43 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by GW Checked by	**Equipment and Methods** Trial Pit/Trench from 0.00m to 2.50m.Pit dug using Hydraulic wheeled excavator.	**Ground Level** + 5.67 m OD **National Grid Coordinates** E 336344.78 N 186192.45





Dimensions 2.50m x 1.20m
Excavation date 18/02/2002

Samples and Tests

Depth (m)	Type & No.	Records
0.75	ES1	
2.04	ES2	
2.50	ES3	

Strata

Depth (m)	No.	Description
0.00-0.15	1	MADE GROUND: Black asphalt.
0.15-2.40	2	MADE GROUND: Black very sandy fine to coarse anguar GRAVEL of slag with occasional angular cobbles and boulders of slag.
2.40-2.50	3	Soft to firm CLAY.

Groundwater
No groundwater encountered.

Remarks
One hour breaking out
Hole backfill : 0.00m to 2.40m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

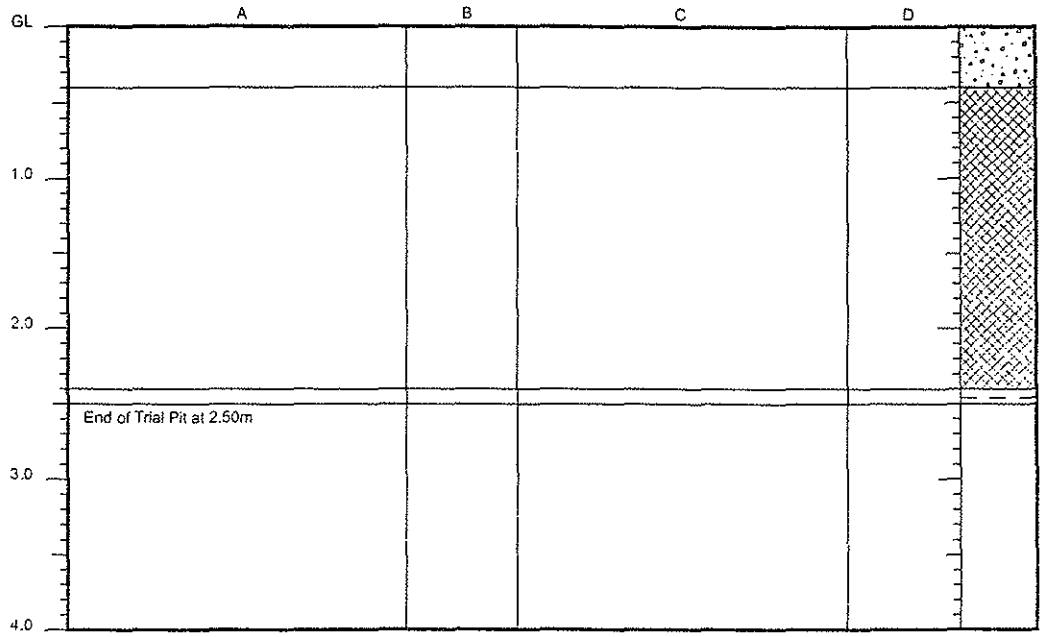
Trial Pit
CATP6
Sheet 1 of 1

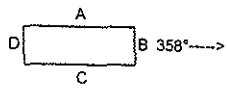
03/05/2002 11:04:46 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by JN Checked by	Equipment and Methods Machine dug Trial Pit from 0.00m to 2.50m using JCB with bucket and pecker.	Ground Level National Grid Coordinates





Dimensions 2.20m x 1.40m
Excavation date 19/02/2002

Samples and Tests

Depth (m)	Type & No.	Records
0.75	ES1	
2.00	ES2	
2.45	ES3	

Strata

Depth (m)	No.	Description
0.00-0.40	1	MADE GROUND: Reinforced CONCRETE. At 0.40m: Clear visqueen.
0.40-2.40	2	MADE GROUND: Dark red brown very sandy GRAVEL. Gravel is angular fine to coarse of slag, brick and concrete. Below 2.20m: Becoming slightly sandy with hydrocarbon oudor.
2.40-2.50	3	Soft friable dark blue grey CLAY with frequent rootlets.

Groundwater
Fast seepage at 2.20m.

Remarks
Hydrocarbon oudor from groundwater.
Stability : Stable, Shoring : None
Hole backfill : 0.00m to 2.50m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

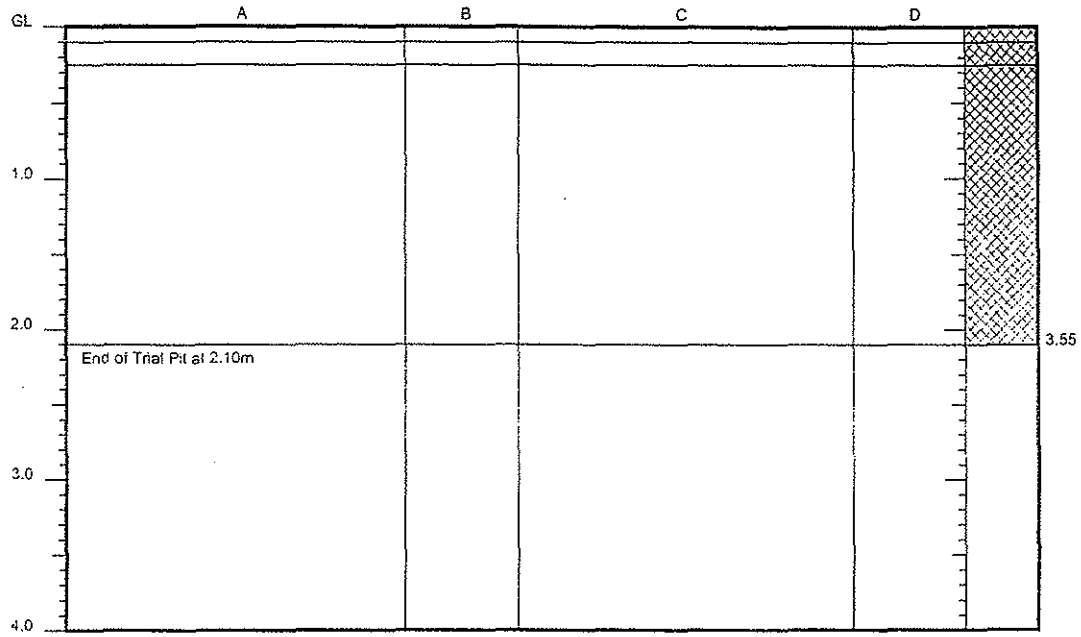
Trial Pit
CATP7
Sheet 1 of 1

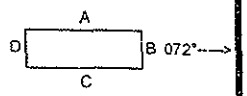
03/05/2002 11:04:49 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by JN Checked by	**Equipment and Methods** Machine dug Trial Pit from 0.00m to 2.10m using JCB with bucket and breaker.	Ground Level + 5.65 m OD National Grid Coordinates E 336285.49 N 186123.84.





Dimensions 2.20m x 1.20m
Excavation date 19/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
			0.00-0.10	1	MADE GROUND: Red brown very sandy GRAVEL. Gravel is angular fine to coarse of limestone.
			0.10-0.25	2	MADE GROUND: Dark grey ASPHALT.
1.00 2.10	ES1 ES2		0.25-2.10	3	MADE GROUND: Black very sandy GRAVEL with occasional cobbles and boulders. Gravel is fine to coarse. Gravel, cobbles and boulders are angular of slag. Hydrocarbon oil sheen on surface of gravel.

Groundwater
Fast seepage at 1.75m.

Remarks
Trial Pit terminated on encountering 3 inch wire cable at 2.10m.
Stability : Stable, Shoring : None
Hole backfill : 0.00m to 2.10m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

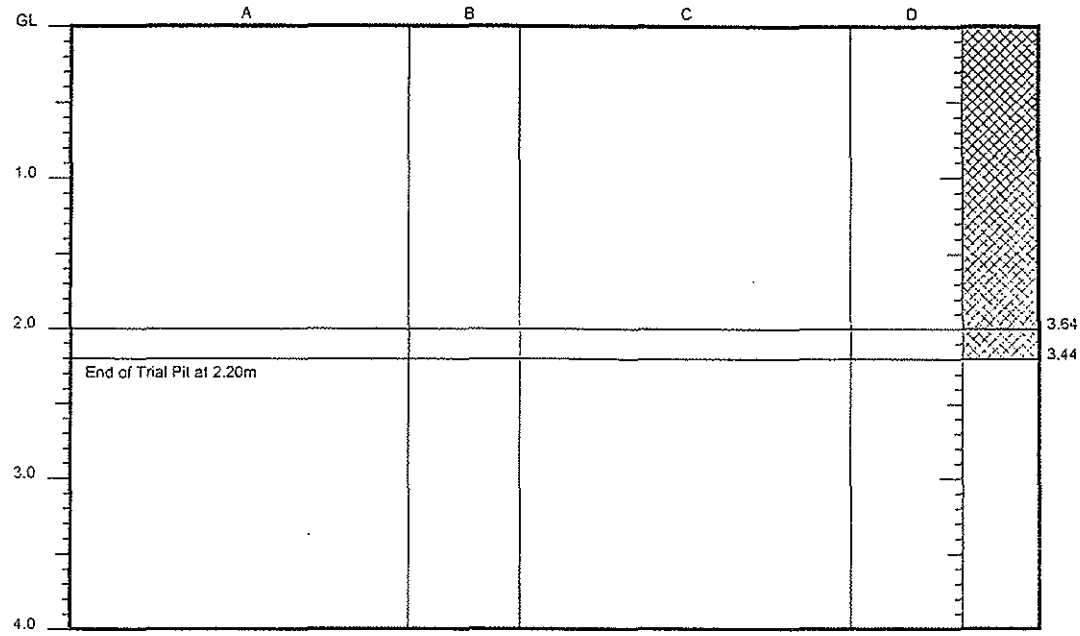
Trial Pit
CATP8
Sheet 1 of 1

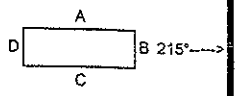
03/05/2002 11:04:52 ESGLog v2.10

Trial Pit Log

Exploration Associates

Logged by JN Checked by	**Equipment and Methods** Machine dug Trial Pit from 0.00m to 2.20m using JCB with bucket and pecker.	**Ground Level** + 5.64 m OD **National Grid Coordinates** E 336295.18 N 186108.83





Dimensions 2.50m x 1.15m
Excavation date 19/02/2002

Samples and Tests			Strata		
Depth (m)	Type & No.	Records	Depth (m)	No.	Description
1.00	ES1		0.00-2.00	1	MADE GROUND: Dark brown very sandy GRAVEL with occasional cobbles and boulders. Gravel is fine to coarse. Gravel, cobbles and boulders are angular and subangular of slag and brick.
2.10	ES2		2.00-2.20	2	MADE GROUND: Light yellow grey GRAVEL. Gravel is angular and subangular fine and medium of unidentifiable stone.

Groundwater
Slow seepage at 0.50m.

Remarks
Trial Pit terminated at 2.20m due to large quantities of groundwater in pit.
Stability : Stable, Shoring : None
Hole backfill : 0.00m to 2.20m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 50

Project ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no. 152002
Carried out for Corus plc

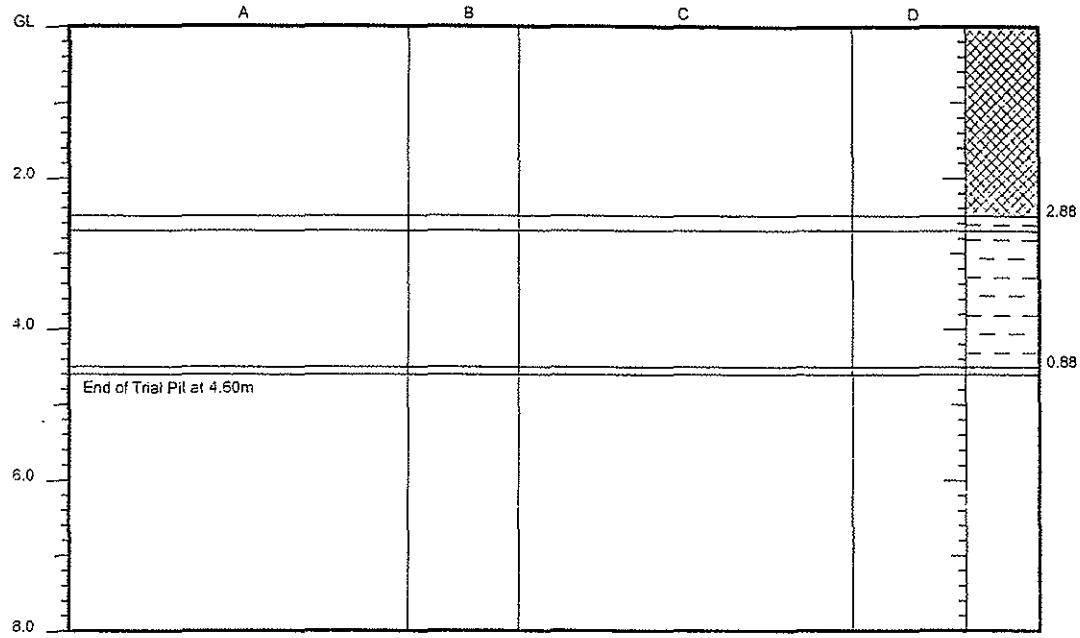
Trial Pit
CATP9
Sheet 1 of 1

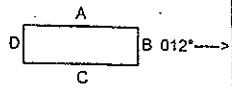
03/05/2002 11:04:56 ESGI.log v2.10

Trial Pit Log

Exploration Associates

Logged by DE Checked by	**Equipment and Methods** Machine dug Trial Pit from 0.00m to 4.60m using JCB with bucket and Rubber Duck with pecker.	Ground Level + 5.38 m OD National Grid Coordinates E 336265.22 N 186098.33





Dimensions 4.30m x 1.50m
Excavation date 19/02/2002

Samples and Tests

Depth (m)	Type & No.	Records
0.50	ES1	
2.40	ES2	
2.60	ES3	
3.50	ES4	

Strata

Depth (m)	No.	Description
0.00-2.50	1	MADE GROUND: Grey and brown slightly sandy GRAVEL with occasional cobbles and boulders. Gravel is fine to coarse. Gravel, cobbles and boulders are angular and subangular of slag and brick.
2.50-2.70	2	Soft black CLAY with abundant rootlets and hydrocarbon oil pockets (<20mm).
2.70-4.50	3	Stiff grey mottled orange brown CLAY.
4.50-4.60	4	Dark brown spongy fibrous PEAT.

Groundwater
Fast seepage at 1.20m.

Remarks
Stratum 1 - Highly compacted.

Stability : Stable, Shoring : None
Hole backfill : 0.00m to 4.60m Arisings (a).

Notes : For explanation of symbols and abbreviations see key sheet. All depths in metres.

Scale 1 : 100

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Trial Pit
CATP10
Sheet 1 of 1

03/05/2002 11:04:31 ESGLog v2.10

ENVIROS

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Trialpit No
TP2
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Oil Contamination at Brambles	CO0480038C	Level: -	09/08/2004
Location: Llanwern Works		Dimensions: -	Scale 1:25
Client: Corus		Depth 1.80m	Logged By KAB

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Groundwater Strike (mbgl)
			MADE GROUND. Light grey slag cobbles in a slag sand and gravel maxtrix.	0.00	
1.20			water cable and electric cable -- pit moved in orientation - continued 10/08/04 MADE GROUND. Compacted grey cobbles and gravels of slag		▼
1.80			Trialpit Complete at 1.80 m		

1.0 2.0 3.0 4.0

Remarks: Water at ~ 1.2m - visible brown hydrocarbon floating on surface. Hydrocarbon odour once water struck

ENVIROS

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Trialpit No **TP3**

Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Oil Contamination at Brambles	CO0480038C	Level: -	09/08/2004
Location: Llanwern Works		Dimensions: -	Scale 1:25
Client: Corus		Depth 1.70m	Logged By KAB

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Groundwater Strike (mbgl)
			MADE GROUND. Brown damp slag sand and gravel in a light brown soil matrix	0.00	
0.20			MADE GROUND. Compacted slag gravel stained black with strong hydrocarbon odour		
0.40			MADE GROUND. Slag sand, gravel and cobbles with frequent concrete rubble, bricks and furnace bricks slightly blackened with hydrocarbon odour		
1.0					
1.30			MADE GROUND. Yellowy grey 2mm granulated slag		▼
1.70			Trialpit Complete at 1.70 m		
2.0					
3.0					
4.0					

Remarks: Water at ~ 1.3m visible brown hydrocarbon flowing in from sides of pit

Howe BASC III (Bd 200) Standard Trialpit Log V1 dated 26th Mar 03

ENVIROS

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Trialpit No
TP4
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Oil Contamination at Brambles	CO0480038C	Level: -	09/08/2004
Location: Llanwern Works		Dimensions: -	Scale 1:25
Client: Corus		Depth 0.00m	Logged By KAB

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Groundwater Strike (mbgl)
			MADE GROUND. Grey/brown sand and gravel of slag in a light brown soil matrix	0.00	
0.30			MADE GROUND. Compacted green grey slag slab		
0.50			MADE GROUND. Grey/brown slag sand, gravel and cobbles with furnace bricks and occasional wooden, metal and plastic materials - strong hydrocarbon odour		

Trialpit Complete at 0.00 m

1.0
2.0
3.0
4.0

Remarks: Water at ~1.4m visible oil layer. Dark brown hydrocarbon flowing in from sides

HOMBASE III (Std 258) Standard Trialpit Log v1 dated 28th Mar 03

ENVIROS

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Trialpit No
TP5
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Oil Contamination at Brambles	CO0480038C	Level: -	09/08/2004

Location: Llanwern Works	Dimensions: -	Scale
	Depth 1.90m	1:25
Client: Corus		Logged By KAB

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Groundwater Strike (mbgl)
			MADE GROUND. Brown sandy slag gravel in a light brown soil matrix	0.00	
0.30			MADE GROUND. Compacted green grey slag slab		
0.80			MADE GROUND. Light brown 5mm granulated slag gravel in a slag sandy matrix		
1.90			Trialpit Complete at 1.90 m		▼

1.0 2.0 3.0 4.0

Remarks: Water strike ~ 1.5m water yellow and slightly oily (light brown lube oil) - Hydrocarbon odour

ENVIROS

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Trialpit No
TP6
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Oil Contamination at Brambles	CO0480038C	Level: -	10/08/2004

Location: Llanwern Works	Dimensions: -	Scale
	Depth 2.00m	1:25
Client: Corus		Logged By KAB

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Groundwater Strike (mbgl)
			MADE GROUND. Slag gravel in a brown slag dust	0.00	
0.20			MADE GROUND. Compacted green grey blast furnace slag		
0.80			MADE GROUND. Grey slag cobbles and boulders		
1.40			MADE GROUND. Yellow grey 1.0mm granulated slag		▼
2.00			Trialpit Complete at 2.00 m		

1.0 2.0 3.0 4.0

Remarks: Water at 1.6m, murky with brown hydrocarbon seeping in at sides

Hole&ASE HT (696 KB) Standard Trialpit Log v1 dated 26th Mar 03

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Trialpit No
TP8
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Oil Contamination at Brambles	CO0480038C	Level: -	10/08/2004

Location: Llanwern Works	Dimensions: -	Scale
	Depth 1.80m	1:25
Client: Corus		Logged By KAB

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Groundwater Strike (mbgl)
			MADGE GROUND. Compacted grey slag cobbles	0.00	
0.70			MADE GROUND. Very hard green grey slag slab		
1.00			MADE GROUND. Slag boulders		
1.20			MADE GROUND. Slag cobbles in a yellow clayey sand.		
1.40			MADE GROUND. Black slag cobbles.		
1.60			MADE GROUND. 10mm granulated slag gravel		▼
1.80			Trialpit Complete at 1.80 m		

1.0 2.0 3.0 4.0

Remarks: Water at ~1.7m. Murky but no visible hydrocarbon strong hydrocarbon smell

HoleBASE III [Bd 296] Standard Trialpit Log V1 dated 26th Mar 03

ENVIROS

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Trialpit No
TP9
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Oil Contamination at Brambles	CO0480038C	Level: -	10/08/2004
Location: Llanwern Works		Dimensions: -	Scale 1:25
Client: Corus		Depth 1.20m	Logged By KAB

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Groundwater Strike (mbgl)
			MADE GROUND. Slightly blackened grey slag gravel and cobbles with furnace and house bricks	0.00	
0.30			MADE GROUND. Green grey compacted slag		
0.60			MADE GROUND. Grey slag cobbles - slight water ingress		
0.75			MADE GROUND. Very hard compacted slag fused with black tar/tarmac type material		
0.85			MADE GROUND. Black/grey slag cobbles in a slag sand and gravel matrix.		
1.20			Trialpit Complete at 1.20 m		▼

1.0 2.0 3.0 4.0

Remarks: Water at ~1.2m - brown with visible hydrocarbon

ENVIROS

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Trialpit No
TP10
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Oil Contamination at Brambles	CO0480038C	Level: -	10/08/2004

Location: Llanwern Works	Dimensions: -	Scale
	Depth 2.30m	1:25
Client: Corus		Logged By KAB

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Groundwater Strike (mbgl)
			MADE GROUND. Slag cobbles in a brown slag dust matrix	0.00	
0.50			MADE GROUND. Slag cobbles in a brown slag dust matrix. Slag blackened in areas.		▼
2.10			Soft damp grey CLAY		
2.30			Trialpit Complete at 2.30 m		

1.0 2.0 3.0 4.0

Remarks: Corner was used as soak away for old steam cleaning process - spills would also soak away here.
Water seepage at 0.5m, standing water at 1.8m

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Trialpit No
TP11
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Oil Contamination at Brambles	CO0480038C	Level: -	10/08/2004
Location: Llanwern Works		Dimensions: -	Scale 1:25
Client: Corus		Depth 1.80m	Logged By KAB

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Groundwater Strike (mbgl)
			MADE GROUND. Slag cobbles and gravels in a light grey slag dust matrix	0.00	
0.20			MADE GROUND. Very hard compacted slag slab		
1.0					
1.30			MADE GROUND. 5mm granulated slag gravel		▼
1.80			Trialpit Complete at 1.80 m		
2.0					
3.0					
4.0					

Remarks: Water at ~1.3 - no visible free oil, slight sheen

HOMES-SE III (Bx 298) Standard Trialpit Log 11 dated 26th Mar 03

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Trialpit No
TP12
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Oil Contamination at Brambles	CO0480038C	Level: -	11/08/2004
Location: Llanwern Works		Dimensions: -	Scale 1:25
Client: Corus		Depth 1.80m	Logged By KAB

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Groundwater Strike (mbgl)
0.05			MADE GROUND. Granulated slag gravel	0.00	
			MADE GROUND. Light brown dust		
0.30			MADE GROUND. Bedded grey friable slag		
0.50			MADE GROUND. Slag cobbles in a light brown slag dust with metalic deposits (rope bar netting etc) railway sleepers and concrete rubble		
1.60			Damp grey CLAY blackened with hydrocarbon possibly reworked		
1.80			Trialpit Complete at 1.80 m		

1.0 2.0 3.0 4.0

Remarks: Water at ~1.2m no visible floating product but hydrocarbon smell.
Upper portion of pit lined with conc on 2 sides

HoleBASE III (Ver 2.06) Standard Trialpit Log v1 dated 28/7/03

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Trialpit No
TP13
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Oil Contamination at Brambles	CO0480038C	Level: -	11/08/2004
Location: Llanwern Works		Dimensions: -	Scale 1:25
Client: Corus		Depth 1.45m	Logged By KAB

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Groundwater Strike (mbgl)
			MADE GROUND. Slag gravels in a brown dust matrix	0.00	
0.20			MADE GROUND. Blackened slag sandy gravel		
0.35			MADE GROUND. Thick black tarry deposit. Hydrocarbon odour		
0.45			MADE GROUND. Cobbles of slag slightly stained black		
1.0					▼
1.40			MADE GROUND. Compacted concrete slab		
1.45			Trialpit Complete at 1.45 m		
2.0					
3.0					
4.0					

Remarks: Walls were seeping with thick light brown oily material and black oily deposit strong hydrocarbon odour water blackened
Water strike at 0.85m

HoleBASE III (3d/2d) Standard Trialpit Log v1 dated 26 Mar 03

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Trialpit No
TP1
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Brambles and Tarmac Site Investigation	CO04800038/TP	Level: -	21/06/2005
Location: Llanwern Steelworks		Dimensions: 2.00m	Scale 1:25
Client: Corus Strip Products		Depth 2.00m, 1.00m	Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Groundwater Strike (mbgl)
0.10			Tarmacadam	0.00	
0.40			Dense light grey fine - coarse angular gravel and sand	0.30	
2.10			Dense fine-coarse angular gravel and cobbles of sand with occasional brick and fragments of brick from 0.6m.	1.00	▼
			Trialpit Complete at 2.00 m		

1.0 2.0 3.0 4.0

Remarks: FID Readings: 0.3m - 1ppm, 1.0m - 8ppm Water strike 1.64m, rapid ingress. Strong odour of hydrocarbon concurrent with groundwater. Free product visible on groundwater

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Trialpit No
TP2
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Brambles and Tarmac Site Investigation	CO04800038/TP	Level: -	21/06/2005
Location: Llanwern Steelworks		Dimensions: 2.00m × 1.00m	Scale 1:25
Client: Corus Strip Products		Depth 2.40m	Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Groundwater Strike (mbgl)
			Tarmacadam	0.00	
0.15			Dense fine - coarse angular gravel and cobbles of slag and slag cement, with much light brown slightly silty sand.		
0.60			Dense grey-green gravel and sand of slag cement. Strong odour of hydrocarbon from 1.7m	1.00	
				1.70	
1.80			Dense fine-medium light grey gravel of stone		▼
2.40			Trialpit Complete at 2.40 m		

Remarks: FID Readings: 1.0m - 0ppm, 1.7m - 8ppm Water strike 2.0m. Rapid ingress. Strong odour of hydrocarbon concurrent with groundwater. Slight sheen on surface of groundwater.

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Trialpit No
TP3
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Brambles and Tarmac Site Investigation	CO04800038/TP	Level: -	20/06/2005

Location: Llanwern Steelworks

Client: Corus Strip Products

Dimensions: 2.00m × 1.00m

Depth 1.40m

Scale 1:25

Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Groundwater Strike (mbgl)
			Reinforced concrete	0.00	
0.30			Dense, light brown slightly silty sand with much fine-coarse subangular gravel of concrete and occasional slag, metal and wire.		
0.50			Dense, dark brown slightly silty sandy fine-coarse angular gravel of slag. Strong odour of hydrocarbon.	0.90	
1.00			Dense oily gravel. Water from 1.1m.	1.20	▼
1.40			Trialpit Complete at 1.40 m		

Remarks: FID Readings: 0.9m - 5ppm, 1.2m - 30ppm Water strike at 1.1m. Much black oil in arisings from this depth. Trial pit completed at 1.4m due to rapid water ingress and obstruction.

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Trialpit No
TP4
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Brambles and Tarmac Site Investigation	CO04800038/TP	Level: -	20/06/2005
Location: Llanwern Steelworks		Dimensions: 2.00m × 1.00m	Scale 1:25
Client: Corus Strip Products		Depth 2.00m	Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Groundwater Strike (mbgl)
			Dense slightly sandy fine-coarse angular gravel and cobbles of concrete and slag	0.00	
0.40			Dark brown - black slightly ashy, silty sandy gravel. Slight odour of hydrocarbon.	0.60	
0.90			Grey-green coarse sand and medium-coarse angular gravel. Strong odour of hydrocarbon		
1.10			Much crushed concrete and sand of concrete in dense dark grey gravel and cobbles of slag. Rapid ingress of water from 1.4m. Strong odour of hydrocarbon.	1.10	▼
				1.60	
2.00			Trialpit Complete at 2.00 m		

1.0 2.0 3.0 4.0

Remarks: FID Readings: 0.6m - 20ppm, 1.10m - 18ppm, 1.6m - 12ppm Trial pit completed at 2m due to rapid water ingress. Much free product visible on groundwater, black tarry staining visible on sides of pit

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Trialpit No
TP5
Sheet 1 of 1

Project Name Brambles and Tarmac Site Investigation	Project No. CO04800038/TP	Co-ords: - Level: -	Date 21/06/2005
Location: Llanwern Steelworks		Dimensions: 2.00m Depth 2.00m 1.00m	Scale 1:25
Client: Corus Strip Products			Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Groundwater Strike (mbgl)
			Concrete	0.00	
0.20			Dense dark grey-brown, slightly silty sandy fine-coarse angular gravel of concrete	0.40	
0.50			Dense grey sandy coarse angular gravel of concrete and slag. Slight odour of hydrocarbon, occasional fragments of furnace brick in arisings.	1.00	
1.25			Dense dark brown - black slightly silty / ashy sandy coarse angular gravel of slag. Slight odour of hydrocarbon. Water strike at 1.6m. Strong odour of hydrocarbon.		▼
2.00			Trialpit Complete at 2.00 m		

Remarks: FID Readings: 0.4m - 4ppm, 1.0m - 2ppm, 13.0m - 15ppm Trial pit completed 2m due to rapid water ingress. Water strike at 1.6m. Strong odour of hydrocarbon and oily sheen on groundwater.

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Trialpit No
TP6
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Brambles and Tarmac Site Investigation	CO04800038/TP	Level: -	21/06/2005

Location: Llanwern Steelworks

Dimensions: 2.00m × 1.00m

Depth 2.50m

Scale 1:25

Client: Corus Strip Products

Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Groundwater Strike (mbgl)
0.60			Dense light grey brown sandy fine-coarse angular gravel of concrete and slag.	0.50	
2.50			Dense dark grey/black gravel and cobbles of slay and concrete and occasional fragments of furnace brick. Rapid seepage from 1.8m and strong odour of hydrocarbon from this depth. Slight oily sheen on groundwater.	1.30	▼
			Trialpit Complete at 2.50 m		

1.0 2.0 3.0 4.0

Remarks: FID Readings: 0.5m - 4ppm, 1.3m - 20ppm Water strike at 1.8m. Strong odour of hydrocarbon and slight oily sheen on groundwater. Trial pit completed at 2m due to rapid water ingress.

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Borehole No	
BH 1	Sheet 1 of 1

Project Name: Brambles & Tarmac Site Investigation	Project No. CO04800038/BH	Co-ords: - Level: -	Hole Type RC
Location: Llanwern Steelworks, Newport		Start Date: 24/06/2005 Finish Date: -	Scale 1:50
Client: Corus Strip Products		Borehole Diameter: 50	Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Well and Backfill Detail	Groundwater (mbgl) Strike	Groundwater (mbgl) Rest
			Made Ground, dense angular gravel and cobbles of slag, concrete, brick and hard core. Wet at 1.7m.	0.00			
2.80			Stiff, light grey clay				
3.30			End of Borehole at 3.30 m				

Remarks: Installed 0.8 m plain and 2.5 m slotted pipe. Water strike at 1.7 m

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Borehole No
BH 2
Sheet 1 of 1

Project Name:	Project No.	Co-ords: -	Hole Type
Brambles & Tarmac Site Investigation	CO04800038/BH	Level: -	RC
Location: Llanwern Steelworks, Newport		Start Date: 27/06/2005 Finish Date: -	Scale 1:50
Client: Corus Strip Products		Borehole Diameter: -	Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Well and Backfill Detail	Groundwater (mbgl) Strike	Groundwater (mbgl) Rest
			Made Ground, dense angular gravel and cobbles of slag, concrete, and much ash. Water and strong odour of hydrocarbon at 1.4 m	0.00			
1.80			Stiff, light grey clay				
2.30			End of Borehole at 3.30 m				

Remarks: Water and strong odour of hydrocarbon at 1.4m. Installed 0.5m plain and 1.8m slotted pipe.

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Borehole No	
BH 3	Sheet 1 of 1

Project Name: Brambles & Tarmac Site Investigation	Project No. CO04800038/BH	Co-ords: - Level: -	Hole Type RC
Location: Llanwern Steelworks, Newport		Start Date: 23/06/2005 Finish Date: -	Scale 1:50
Client: Corus Strip Products		Borehole Diameter: 50	Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Well and Backfill Detail	Groundwater (mbgl) Strike	Groundwater (mbgl) Rest
			Made Ground, dense angular gravel and cobbles of slag, concrete, brick and occasional metal. Strong odour of hydrcarbon from 1.6 m.	0.00			
2.70			Stiff, light grey clay.				
3.20			End of Borehole at 3.20 m				

Remarks: Installed 1 m plain and 2.2 m slotted pipe. Water strike and strong odour of hydrocarbon at 1.6 m.

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Borehole No	
BH 4	Sheet 1 of 1

Project Name:	Project No.	Co-ords: -	Hole Type
Brambles & Tarmac Site Investigation	CO04800038/BH	Level: -	RC
Location: Llanwern Steelworks, Newport		Start Date: 23/06/2005 Finish Date: -	Scale 1:50
Client: Corus Strip Products		Borehole Diameter: 50	Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Well and Backfill Detail	Groundwater (mbgl) Strike	Groundwater (mbgl) Rest
			Made Ground Gravel and occasional cobbles of slag, steel and brick.	0.00			
3.00			Stiff, light grey clay				
3.50			End of Borehole at 3.50 m				

Remarks: Installed 1 m plain and 2.5 m slotted pipe.

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Borehole No
BH 5
Sheet 1 of 1

Project Name: Brambles & Tarmac Site Investigation	Project No. CO04800038/BH	Co-ords: - Level: -	Hole Type RC
Location: Llanwern Steelworks, Newport		Start Date: 23/06/2005 Finish Date: -	Scale 1:50
Client: Corus Strip Products		Borehole Diameter: 50	Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Well and Backfill Detail	Groundwater (mbgl) Strike	Groundwater (mbgl) Rest
			Made Ground: Slag fill (Open Holed)	0.00			
2.60			Stiff light grey clay.				
3.20			End of Borehole at 3.20 m				

Remarks: Backfilled with bentonite to 2.6m. Installed 1m plain and 1.6 m slotted pipe. Water strike and strong odour of hydrocarbon at 1.6m

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Borehole No	
WS10	Sheet 1 of 1

Project Name: Brambles & Tarmac Site Investigation	Project No. CO04800038/BH	Co-ords: - Level: -	Hole Type WS
Location: Llanwern Steelworks, Newport		Start Date: 23/06/2005 Finish Date: -	Scale 1:50
Client: Corus Strip Products		Borehole Diameter: 50	Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Well and Backfill Detail	Groundwater (mbgl) Strike	Groundwater (mbgl) Rest
0.10			Tarmacadam	0.00			
			Dense gravel and occasional cobbles of concrete and slag. Water strike at 1.5m and strong odour of hydrocarbon from this depth.			▼	
2.40			Stiff light grey clay.				
3.70			End of Borehole at 0.00 m				

Remarks: Water strike at 1.5m. Strong odour of hydrocarbon at this depth. Window samples completed at 3.7m and backfilled with bentonite to 1mbgl and arisings to surface

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Borehole No
WS2
Sheet 1 of 1

Project Name: Brambles & Tarmac Site Investigation	Project No. CO04800038/BH	Co-ords: - Level: -	Hole Type WS
Location: Llanwern Steelworks, Newport		Start Date: 20/06/2005 Finish Date: -	Scale 1:50
Client: Corus Strip Products		Borehole Diameter: 50	Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Well and Backfill Detail	Groundwater (mbgl) Strike	Groundwater (mbgl) Rest
			Dense sand and gravel of fine-coarse angular slag and concrete with some ash. Wet at 1.8m, strong odour of hydrocarbon from this depth.	0.50 1.50		▼	▼
2.10			firm-stiff grey clay with occasional organic (plant material)	2.50			
3.50			End of Borehole at 3.50 m				

Remarks: FID Reading : 0.5m - 0ppm, 1.5m - 27ppm, 2.5m - 0ppm Water strike at 1.8m. Strong odour of hydrocarbon and oily sheen on arisings from this depth. Window sample completed at 3.5m and backfilled with bentonite to 1m and arisings to surface.

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Borehole No
WS3
Sheet 1 of 1

Project Name: Brambles & Tarmac Site Investigation	Project No. CO04800038/BH	Co-ords: - Level: -	Hole Type WS
Location: Llanwern Steelworks, Newport		Start Date: 20/06/2005 Finish Date: -	Scale 1:50
Client: Corus Strip Products		Borehole Diameter: 50	Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Well and Backfill Detail	Groundwater (mbgl) Strike	Groundwater (mbgl) Rest
			Dense light grey-brown slightly silty sandy gravel of slag and concrete. Water strike at 1.5m. Strong odour of hydrocarbon from this depth. Slight oily sheen on arisings.	0.70			
				1.70		▼	
1.80			firm-stiff grey clay				
4.00			End of Borehole at 4.00 m	4.00			

Remarks: FID Reading : 0.7m - 2ppm, 1.7m - 90ppm, 4m - 3ppm Water strike at 1.6m. Strong odour of hydrocarbon and oily sheen on arisings from this depth. Window sample completed at 4m and backfilled with bentonite to 1mbgl and arisings to surface

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Borehole No
WS4
Sheet 1 of 1

Project Name: Brambles & Tarmac Site Investigation	Project No. CO04800038/BH	Co-ords: - Level: -	Hole Type WS
Location: Llanwern Steelworks, Newport		Start Date: 22/06/2005 Finish Date: -	Scale 1:50
Client: Corus Strip Products		Borehole Diameter: 50	Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Well and Backfill Detail	Groundwater (mbgl) Strike	Groundwater (mbgl) Rest
			Dense sandy slightly ashy gravel with occasional cobbles of concrete. Water strike at 1.8m and slight odour of hydrocarbon at this depth.	0.00			
				1.20		▼	
				2.00			
				2.40			
2.60			Firm-stiff light grey clay				
4.10			End of Borehole at 4.10 m				

Remarks: FID Reading : 1.2m - 0ppm, 2m - 0ppm, 2.4m - 0ppm Water strike at 1.8m and slight odour of hydrocarbon at this depth. Window sample completed 4.1m and backfilled with bentonite to 1mbgl and arisings to surface

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Borehole No
WS5
Sheet 1 of 1

Project Name: Brambles & Tarmac Site Investigation	Project No. CO04800038/BH	Co-ords: - Level: -	Hole Type WS
Location: Llanwern Steelworks, Newport		Start Date: 21/06/2005 Finish Date: -	Scale 1:50
Client: Corus Strip Products		Borehole Diameter: 50	Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Well and Backfill Detail	Groundwater (mbgl) Strike	Groundwater (mbgl) Rest
			Dense sandy gravel of slag and cement. Water strike at 1.5m and very strong odour of hydrocarbon from this depth.	0.00			
				1.20		▼	
2.10			End of Borehole at 2.10 m				

Remarks: FID Reading : 1.2m - 0ppm Water strike at 1.5m and strong odour of hydrocarbon from this depth. Window sample terminated on obstruction at 2.1m and backfilled with arisings.

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Borehole No
WS5A
Sheet 1 of 1

Project Name: Brambles & Tarmac Site Investigation	Project No. CO04800038/BH	Co-ords: - Level: -	Hole Type WS
Location: Llanwern Steelworks, Newport		Start Date: 21/06/2005 Finish Date: -	Scale 1:50
Client: Corus Strip Products		Borehole Diameter: 50	Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Well and Backfill Detail	Groundwater (mbgl) Strike	Groundwater (mbgl) Rest
			Dense sandy, slightly ashy gravel of slag and cement	0.00		▼	
2.00			Soft-firm light grey clay with occasional organic (plant) material				
3.50			End of Borehole at 3.50 m				

Remarks: Water strike at 1.6m and strong odour of hydrocarbon. Window saomple completed 3.5m and backfilled with bentonite to 1mbgl and arisings to surface.

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Borehole No
WS6
Sheet 1 of 1

Project Name: Brambles & Tarmac Site Investigation	Project No. CO04800038/BH	Co-ords: - Level: -	Hole Type WS
Location: Llanwern Steelworks, Newport		Start Date: 21/06/2005 Finish Date: -	Scale 1:50
Client: Corus Strip Products		Borehole Diameter: 50	Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Well and Backfill Detail	Groundwater (mbgl) Strike	Groundwater (mbgl) Rest
			Dense light grey brown sandy gravel of slag and occasional fragments of concrete and brick. Water strike and strong odour of hydrocarbon from 1.7m.	0.00			
				1.20		▼	
3.20			Firm light grey clay with much organic material.				
				3.60			
4.40			Soft fibrous peat.				
4.70			Firm to stiff light grey clay				
5.10			End of Borehole at 5.10 m				

Remarks: FID Reading : 1.2m - 0ppm, 3.6m - 15ppm Water strike and strong odour of hydrocarbon at 1.7m. Borehole completed at 5.1m and backfilled with bentonite to 1m bgl and with arisings to surface.

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Borehole No
WS7
Sheet 1 of 1

Project Name:	Project No.	Co-ords: -	Hole Type
Brambles & Tarmac Site Investigation	CO04800038/BH	Level: -	WS
Location: Llanwern Steelworks, Newport		Start Date: 22/06/2005	Scale
		Finish Date: -	1:50
Client: Corus Strip Products		Borehole Diameter: 50	Logged By
			MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Well and Backfill Detail	Groundwater (mbgl) Strike	Groundwater (mbgl) Rest
			Dense slightly silty sandy gravel of slag with occasional cobbles of concrete. Water strike at 1.6m.	0.00			
				1.80		▼	
2.60			Stiff light grey clay				
3.80			End of Borehole at 3.80 m				

Remarks: FID Reading : 1.8m - 0ppm Water strike at 1.6m. Window sample completed at 3.8m and backfilled with bentonite to 1m bgl and arisings to surface.

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Borehole No
WS8
Sheet 1 of 1

Project Name: Brambles & Tarmac Site Investigation	Project No. CO04800038/BH	Co-ords: - Level: -	Hole Type WS
Location: Llanwern Steelworks, Newport		Start Date: 22/06/2005 Finish Date: -	Scale 1:50
Client: Corus Strip Products		Borehole Diameter: 50	Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Well and Backfill Detail	Groundwater (mbgl) Strike	Groundwater (mbgl) Rest
			Concrete	0.00			
0.20			Dense slightly ashy sand and gravel of slag and occasional concrete. Water strike at 1.7m. Strong odour of hydrocarbon from this depth.				
				1.20			
				1.70			
2.00			Stiff grey slightly peaty clay				
				3.00			
3.70			End of Borehole at 3.70 m				

Remarks: FID Reading : 1.2m - 0ppm, 1.7m - 49ppm, 3m - 3ppm Water strike at 1.7m. Strong odour of hydrocarbon at this depth. Window samples completed at 3.7m and backfilled with bentonite to 1mbgl and arisings to surface

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Borehole No
WS9
Sheet 1 of 1

Project Name: Brambles & Tarmac Site Investigation	Project No. CO04800038/BH	Co-ords: - Level: -	Hole Type WS
Location: Llanwern Steelworks, Newport		Start Date: 22/06/2005 Finish Date: -	Scale 1:50
Client: Corus Strip Products		Borehole Diameter: 50	Logged By MP

Strata Depth (mbgl)	Level (m AOD)	Legend	Stratum Description	Sample Depth (mbgl)	Well and Backfill Detail	Groundwater (mbgl) Strike	Groundwater (mbgl) Rest
			Reinforced concrete	0.00			
0.30			Dense fine - coarse gravel of slag and concrete.				
				1.00			
				1.50		▼	
2.00			Dense sandy fine - coarse gravel of slag and concrete. Water strike at 1.5m. Strong odour of hydrocarbon at this depth.				
2.30			Firm - stiff grey clay				
3.50			End of Borehole at 3.50 m				

Remarks: FID Readings: 1.0m - 12ppm, 1.5m - 40ppm Water strike at 1.5m. Strong odour of hydrocarbon at this depth. Window sample completed at 3.5m and backfilled with bentonite to 1mbgl and arisings to surface

ENVIROS

Enviros Ltd
Cardiff
CF15 8LW
Tel: 02920 814 200

Borehole No
BH06
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Brambles Process Area	CO0480038		RO
Location: Llanwern Works, Newport		Level: -	Scale 1:50
Client: Corus Strip Products		Dates: 13/03/2006	Logged By MN

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
								Grey brown slightly clayey gravel. Gravel is grey coarse sub-angular to sub-rounded vesiculated low density slag. (MADE GROUND)
	▽				1.80			Soft grey CLAY (ALLUVIUM)
					2.50			End of Borehole at 2.50 m

Type | Results

Remarks: No visual or olfactory evidence of contamination

AGS

Hole BASE III (Bld 296) Standard Borehole Log v2 dated 27th Nov 03

ENVIROS

Enviros Ltd
Cardiff
CF15 8LW
Tel: 02920 814 200

Borehole No
BH07
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Brambles Process Area	CO0480038		RO
Location: Llanwern Works, Newport		Level: -	Scale 1:50
Client: Corus Strip Products		Dates: 08/03/2006	Logged By MN

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.10			Brown clay with rootlets (TOPSOIL)
	▽							Grey brown slightly clayey gravel. Gravel is grey fine to coarse sub-angular to sub-rounded vesiculated low density slag. (MADE GROUND)
					2.80			Soft grey CLAY (ALLUVIUM)
					3.30			End of Borehole at 3.30 m

Type | Results

Remarks: No visual or olfactory evidence of contamination

AGS

HoleBASE III (Bd 399) Standard Borehole Log v2 dated 27th Nov 03

ENVIROS

Enviros Ltd
Cardiff
CF15 8LW
Tel: 02920 814 200

Borehole No
BH08
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Brambles Process Area	CO0480038		RO
Location: Llanwern Works, Newport		Level: -	Scale 1:50
Client: Corus Strip Products		Dates: 08/03/2006	Logged By MN

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.10			Brown clay wth rootlets (TOPSOIL)
								Grey brown slightly clayey gravel. Gravel is grey fine to coarse sub-angular to sub-rounded vesiculated low density slag. (MADE GROUND)
					1.70			Soft grey CLAY (ALLUVIUM)
					2.50			End of Borehole at 2.50 m

Remarks: No visual or olfactory evidence of contamination

AGS

HoleBASE III (Bd 2981 Standard Borehole Log v2 dated 27th Nov 03

ENVIROS	Enviros Ltd Cardiff CF15 8LW Tel: 02920 814 200	Borehole No **BH09** Sheet 1 of 1

Project Name Brambles Process Area	Project No. CO0480038	Co-ords: -	Hole Type RO
Location: Llanwern Works, Newport		Level: -	Scale 1:50
Client: Corus Strip Products		Dates: 13/03/2006	Logged By MN

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
								Light brown slightly sandy clay wih occasional gravel. Gravel is grey fine to medium sub-angular to sub-rounded vesiculated low density slag. (MADE GROUND) Gravel becoming more abundent Slag becoming cobble-sized and tabular. Hole undercutting where slag content increases
					1.80			Soft grey CLAY (ALLUVIUM)
					2.50			End of Borehole at 2.50 m

Type | Results

Remarks: Hydrocarbon odour 0.3m.

AGS

HeleBASE III (Bid 398) Standard Borehole Log v2 dated 27th Nov 03

ENVIROS

Enviros Ltd
Cardiff
CF15 8LW
Tel: 02920 814 200

Borehole No
BH12
Sheet 1 of 1

Project Name Brambles Process Area	Project No. CO0480038	Co-ords: -	Hole Type RO
Location: Llanwern Works, Newport		Level: -	Scale 1:50
Client: Corus Strip Products		Dates: 13/03/2006	Logged By MN

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
								Brown slightly sandy gravelly clay. (MADE GROUND)
					0.50			Grey brown slightly clayey gravel. Gravel is grey coarse sub-angular to sub-rounded vesiculated low density slag. (MADE GROUND)
	▽				1.20			Soft black brown peaty CLAY (MARSH)
					1.70			End of Borehole at 1.70 m
			Type	Results				

Remarks:

AGS

HoleBASE III (Rel 2Ab) Standard Borehole Log v2 dated 27th Nov 03

ENVIROS

Enviros Ltd
Cardiff
CF15 8LW
Tel: 02920 814 200

Borehole No
BH13
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Brambles Process Area	CO0480038		RO
Location: Llanwern Works, Newport		Level: -	Scale 1:50
Client: Corus Strip Products		Dates: 13/03/2006	Logged By MN

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.20			Brown slightly sandy gravelly clay. (MADE GROUND)
	▽							Grey brown slightly clayey gravel. Gravel is grey coarse sub-angular to sub-rounded vesiculated low density slag. (MADE GROUND)
					1.60			Soft black brown peaty CLAY (MARSH)
					2.50			End of Borehole at 2.50 m

Type | Results

Remarks: Backfill to base of Made Gound. Sulphurous odour noted on the groundwater.

AGS

HoleBASE III (Bd 290) Standard Borehole Log v2 dated 27th Nov 03

ENVIROS

Enviros Ltd
Cardiff
CF15 8LW
Tel: 02920 814 200

Borehole No
BH14
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Brambles Process Area	CO0480038		RO
Location: Llanwern Works, Newport		Level: -	Scale 1:50
Client: Corus Strip Products		Dates: 13/03/2006	Logged By MN

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.20			Brown slightly sandy gravelly clay. (MADE GROUND)
								Grey brown slightly clayey gravel. Gravel is grey coarse sub-angular to sub-rounded vesiculated low density slag. (MADE GROUND)
					1.80			Soft black brown peaty CLAY (MARSH)
					2.50			End of Borehole at 2.50 m

Type | Results

Remarks: Backfill to base of Made Gound.

AGS

HoleBASE III (Bd 396) Standard Borehole Log v2 dated 27th Nov 03

ENVIROS

Enviros Ltd
Cardiff
CF15 8LW
Tel: 02920 814 200

Borehole No
BH15
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Brambles Process Area	CO0480038		RO
Location: Llanwern Works, Newport		Level: -	Scale 1:50
Client: Corus Strip Products		Dates: 09/03/2006	Logged By MN

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.30			Grey well sorted medium gravel (MADE GROUND)
	▽				1.20			Grey brown slightly clayey gravel with occasioant cobbles. Gravel is grey coarse sub-angular to sub-rounded vesiculated low density slag (MADE GROUND)
								End of Borehole at 1.20 m

Type | Results

Remarks: Hole terminated at 1.2m

AGS

HoleBASE 81 [Bd 398] Standard Borehole Log v2 dated 27th Nov 03

ENVIROS

Enviros Ltd
Cardiff
CF15 8LW
Tel: 02920 814 200

Borehole No
BH16
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Brambles Process Area	CO0480038		RO
Location: Llanwern Works, Newport		Level: -	Scale 1:50
Client: Corus Strip Products		Dates: 15/03/2006	Logged By MN

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.20			Brown clay wth rootlets (TOPSOIL)
					1.00			Soft grey CLAY (ALLUVIUM)
					3.50			Soft blue CLAY (ALLUVIUM)
								End of Borehole at 3.50 m

Type | Results

Remarks:

AGS

HoleBASE III (Rd 3W) Standard Borehole Log V2 dated 27th Nov 03

ENVIROS

Enviros Ltd
Cardiff
CF15 8LW
Tel: 02920 814 200

Borehole No
BH17
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Brambles Process Area	CO0480038		RO
Location: Llanwern Works, Newport		Level: -	Scale 1:50
Client: Corus Strip Products		Dates: 09/03/2006	Logged By MN

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.30			Brown slightly sandy clayey gravel. Gravel is fine to medium sub angular to rounded concrete and slag (MADE GROUND)
					0.40			Concrete layer (MADE GROUND)
								Grey brown slightly clayey gravel. Gravel is grey coarse sub-angular to sub-rounded vesiculated low density slag. (MADE GROUND)
	▽				2.10			Soft grey CLAY (ALLUVIUM)
					2.50			End of Borehole at 2.50 m

Type | Results

Remarks: Hydrocarbon odour noted in the groundwater however no free product identified

AGS

HoleBASE III (Std 398) Standard Borehole Log v2 dated 27th Nov 03

ENVIROS

Enviros Ltd
Cardiff
CF15 8LW
Tel: 02920 814 200

Borehole No
BH18
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Brambles Process Area	CO0480038		RO
Location: Llanwern Works, Newport		Level: -	Scale 1:50
Client: Corus Strip Products		Dates: 14/03/2006	Logged By MN

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
								Grey brown slightly clayey gravel. Gravel is grey coarse sub-angular to sub-rounded vesiculated low density slag. (MADE GROUND)
					3.00			Soft grey CLAY (ALLUVIUM)
					3.50			End of Borehole at 3.50 m

Remarks:

AGS

HoleBASE SI (Ref 398) Standard Borehole Log V2 dated 27th Nov 03

ENVIROS	Enviros Ltd Cardiff CF15 8LW Tel: 02920 814 200	Borehole No **BH19** Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Brambles Process Area	CO0480038		RO
Location: Llanwern Works, Newport		Level: -	Scale 1:50
Client: Corus Strip Products		Dates: 15/03/2006	Logged By MN

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
								Grey brown slightly clayey gravel. Gravel is grey coarse sub-angular to sub-rounded vesiculated low density slag. (MADE GROUND)
	▽				2.60			Soft grey CLAY (ALLUVIUM)
					3.00			End of Borehole at 3.00 m

Type | Results

Remarks:

AGS

Hole/BASE III (Bd 298) Standard Borehole Log v2 dated 27th Nov 03

ENVIROS

Enviros Ltd
Cardiff
CF15 8LW
Tel: 02920 814 200

Borehole No
BH20
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Brambles Process Area	CO0480038		RO
Location: Llanwern Works, Newport		Level: -	Scale 1:50
Client: Corus Strip Products		Dates: 15/03/2006	Logged By MN

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
								Grey brown slightly clayey gravel. Gravel is grey coarse sub-angular to sub-rounded vesiculated low density slag. (MADE GROUND)
					2.50			Soft grey CLAY (ALLUVIUM)
	▽				3.00			End of Borehole at 3.00 m

Type | Results

Remarks: Slight kerosene odour

AGS

HoleBASE III (Bld 398) Standard Borehole Log v2 dated 27th Nov 03

ENVIROS	Enviros Ltd Cardiff CF15 8LW Tel: 02920 814 200	Borehole No **BH21** Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Brambles Process Area	CO0480038		RO
Location: Llanwern Works, Newport		Level: -	Scale 1:50
Client: Corus Strip Products		Dates: 14/03/2006	Logged By MN

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.20			Brown slightly sandy gravelly clay. (MADE GROUND)
	▽							Grey brown slightly clayey gravel. Gravel is grey coarse sub-angular to sub-rounded vesiculated low density slag (MADE GROUND)
					3.30			Soft grey CLAY (ALLUVIUM)
					3.80			End of Borehole at 3.80 m
			Type	Results				

Remarks: Slight kerosene odour at 2.2m. Sheen on groundwater

AGS

HoleBASE II (Ref 398) Standard Borehole Log v2 dated 27th Nov 03

Appendix 2

Gas and Groundwater Monitoring Data

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		01

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		30/01/2008	09:50	2.45	25/02/2008	14:34	2.48	07/03/2008	14:25	2.60
SBHD03 CP	SPIE	10.00		30/01/2008	11:01	0.47	25/02/2008	14:52	0.43	07/03/2008	14:05	0.56
SBHD05 RC	SPIE	12.00		31/01/2008	09:00	1.02	25/02/2008	15:35	1.05	07/03/2008	13:50	1.77
SBHD06 RC	SP	15.00		30/01/2008	13:00	1.13	21/02/2008	10:30	1.39	07/03/2008	13:30	1.39
SBHD08 RC	SPIE	29.50		30/01/2008	13:50	1.20	25/02/2008	15:58	2.02	07/03/2008	13:35	1.40
SBHE02RD	SPIE	25.00		31/01/2008	09:25	2.18	25/02/2008	16:20	2.09	07/03/2008	13:10	2.48
SBHE04 RC	SPIE	17.20		31/01/2008	09:15	2.31	25/02/2008	16:11	2.51	07/03/2008	13:20	2.59
SBHF01 RC	SPIE	19.00		31/01/2008	09:40	5.69	25/02/2008	16:32	5.72	07/03/2008	12:50	5.43
SBHF02A CP	SPIE	17.00		01/02/2008	14:40	7.61	25/02/2008	17:13	7.57	07/03/2008	12:30	9.00
SBHF03 RC	SPIE	18.00		31/01/2008	10:35	6.97	26/02/2008	08:55	6.77	07/03/2008	12:15	7.22
SBHH01 RC	SPIE	25.00		31/01/2008	11:15	3.45	26/02/2008	09:39	3.42	07/03/2008	11:28	3.65
SBHH02 RC	SPIE	14.90		31/01/2008	11:10	3.42	26/02/2008	09:20	3.88	07/03/2008	11:35	3.64
SBHH05 RC	SPIE	21.50		31/01/2008	11:30	2.22	26/02/2008	10:01	2.13	07/03/2008	11:05	3.10
SBHH06 CP	SP	12.30		30/01/2008	15:30	3.75	21/02/2008	08:00	3.76	07/03/2008	11:10	3.87
SBHH07A RC	SPIE	24.85		30/01/2008	14:50	1.70	26/02/2008	10:40	1.34	07/03/2008	11:00	1.07
SBHJ01 CP	SP	7.50		01/02/2008	12:20	1.34	21/02/2008	11:45	5.98	06/03/2008	12:28	1.82
SBHJ03 CP	SP	5.20		01/02/2008	08:00	0.54	27/02/2008	16:15	0.70	07/03/2008	10:45	0.68
SBHJ04	SP	13.10		01/02/2008	11:55	6.61	22/02/2008	13::55	6.67	06/03/2008	11:46	6.75
SBHJ05	SP	11.50		01/02/2008	11:10	8.91	22/02/2008	09:00	9.07	06/03/2008	11:23	9.16
SBHJ06 CP	SP	4.10		01/02/2008	11:45	1.31	21/02/2008	15:30	1.32	06/03/2008	10:50	1.33
SBHJ07 CP	SP	10.40		01/02/2008	11:43	1.35	21/02/2008	14:40	1.40	06/03/2008	12:05	1.56
SBHJ08A CP	SP	7.40		01/02/2008	11:35	3.49	21/02/2008	13:05	2.31	06/03/2008	10:57	2.67
SBHJ09 CP	SP	2.20		01/02/2008	11:30	0.65	21/02/2008	12:25	0.85	06/03/2008	11:00	0.90
SBHJ10 CP	SP	10.00		01/02/2008	10:40	2.30	21/02/2008	13:45	2.24	06/03/2008	10:40	2.16
SBHK01 CP	SP	6.80		01/02/2008	10:55	0.70	25/02/2008	10:30	1.00	06/03/2008	14:24	1.06
SBHK02 CP	SP	11.20		01/02/2008	10:50	1.34	25/02/2008	11:20	1.33	06/03/2008	14:18	1.47
SBHK03 CP	SP	5.90		01/02/2008	10:45	0.87	25/02/2008	12:00	0.89	06/03/2008	14:15	1.00
SBHK04 CP	SP	12.20		01/02/2008	10:25	1.45	25/02/2008	12:30	1.60	06/03/2008	12:30	1.60
SBHL02 RC	SPIE	15.20		01/02/2008	10:35	2.27	25/02/2008	12:49	2.31	06/03/2008	14:00	2.42
SBHL03 RC	SPIE	15.00		31/01/2008	16:20	0.61	26/02/2008	11:15	0.51	07/03/2008	10:25	0.66
SBHM01 RC	SPIE	21.00		01/01/1900	08:20	-0.26	26/02/2008	11:30	-0.26	07/03/2008	10:17	0.05
SBHM02 RC	SPIE	20.00		01/02/2008	08:25	0.19	26/02/2008	11:41	0.49	07/03/2008	10:14	0.68
SBHN01A RC	SPIE	14.90		01/02/2008	15:20	8.49	27/02/2008	17:15	12.23	07/03/2008	14:45	13.18
SBHN02 RC	SPIE	20.40		31/01/2008	15:55	3.67	26/02/2008	11:57	4.19	07/03/2008	10:05	4.84
SBHN03 RC	SPIE	15.00		31/01/2008	15:45	1.07	26/02/2008	12:03	1.73	07/03/2008	09:55	2.34
SBHN04 RC	SPIE	10.00		31/01/2008	15:30	9.99	26/02/2008	14:42	DRY	07/03/2008	09:45	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		02

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		31/01/2008	14:50	DRY	26/02/2008	14:12	DRY	07/03/2008	09:35	DRY
SBHP02 RC	SPIE	9.80		31/01/2008	13:55	7.20	26/02/2008	13:59	8.09	07/03/2008	09:10	8.25
SBHP03 RC	SPIE	5.00		31/01/2008	13:40	4.09	26/02/2008	13:48	4.76	07/03/2008	09:05	4.78
SBHQ01 RC	SPIE	11.80		31/01/2008	14:20	5.76	26/02/2008	12:46	6.74	07/03/2008	09:30	7.20
SBHQ02 RC	SPIE	6.00		31/01/2008	14:15	4.98	26/02/2008	12:59	5.16	07/03/2008	09:25	5.98
SBHQ03 RC	SPIE	11.00		31/01/2008	13:20	6.04	26/02/2008	13:29	7.22	07/03/2008	08:38	7.59
SBHQ04 RC	SPIE	8.00		31/01/2008	13:05	4.35	26/02/2008	13:36	6.18	07/03/2008	08:55	6.94
SBHQ06 RC	SPIE	7.35		31/01/2008	13:00	3.89	26/02/2008	13:16	4.40	07/03/2008	08:25	4.63
SWSJ08	SP	3.30		01/02/2008	12:30	0.42	21/02/2008	11:45	0.37	06/03/2008	12:35	0.41
SWSJ13	SP	2.50		01/02/2008	12:00	DRY	22/02/2008	13:45	DRY	06/03/2008	11:50	DRY
SWSJ21	SP	6.00		01/02/2008	11:20	3.87	22/02/2008	09:30	5.72	06/03/2008	11:27	6.59
SWSJ23	SP	7.80		01/02/2008	11:22	5.92	22/02/2008	09:55	6.62	06/03/2008	11:30	6.97
SWSJ34	SP	6.00		01/02/2008	11:05	2.52	22/02/2008	10:55	3.33	06/03/2008	11:10	3.08
SWSJ37	SP	5.60		01/02/2008	11:25	0.46	22/02/2008	11:30	0.55	06/03/2008	11:15	0.61
LGBH02	SP	8.88					22/02/2008	14:35	7.50	06/03/2008	11:40	7.52
LGBH03	SP	8.90					22/02/2008	14:21	7.20	06/03/2008	11:44	7.28
LGBH04	SP	10.50					22/02/2008	10:30	8.87	06/03/2008	11:20	9.00
LGBH09	SP	7.00					22/02/2008	12:40	1.13	06/03/2008	10:48	1.56
LGBH10	SP	14.60					27/02/2008	14:30	8.15	06/03/2008	11:12	8.21
LGBH11	SP	11.20					27/02/2008	10:00	7.05	06/03/2008	11:03	7.07
LGBH12	SP	7.05					22/02/2008	13:10	1.40	06/03/2008	10:45	1.40
RBBH07	SP	6.25					27/02/2008	12.15	0.69	06/03/2008	12:20	0.71
RBBH09	SP	7.05					27/02/2008	13:40	1.25	06/03/2008	12:25	1.21
RBBH10	SP	6.85					27/02/2008	13:00	0.68	06/03/2008	12:30	0.82

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		03

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		20/03/2008	16:30	2.57	04/04/2008	08:00	2.59	18/04/2008	07:40	2.66
SBHD03 CP	SPIE	10.00		20/03/2008	16:45	0.58	04/04/2008	08:13	0.53	18/04/2008	08:00	0.60
SBHD05 RC	SPIE	12.00		20/03/2008	16:00	1.08	04/04/2008	09:15	1.22	18/04/2008	08:30	1.32
SBHD06 RC	SP	15.00		20/03/2008	17:55	1.20	04/04/2008	09:30	1.33	18/04/2008	08:40	1.44
SBHD08 RC	SPIE	29.50		19/03/2008	18:30	1.28	04/04/2008	10:00	1.39	18/04/2008	08:52	1.52
SBHE02RD	SPIE	25.00		20/03/2008	16:20	2.23	04/04/2008	08:50	2.46	18/04/2008	09:00	2.54
SBHE04 RC	SPIE	17.20		20/03/2008	15:45	2.20	04/04/2008	09:00	1.80	18/04/2008	08:15	1.80
SBHF01 RC	SPIE	19.00		20/03/2008	15:30	5.50	04/04/2008	08:40	5.55	18/04/2008	13:58	5.58
SBHF02A CP	SPIE	17.00		20/03/2008	15:10	5.60	04/04/2008	10:28	5.70	18/04/2008	13:45	5.77
SBHF03 RC	SPIE	18.00		20/03/2008	14:55	7.20	04/04/2008	10:36	7.38	18/04/2008	13:40	7.42
SBHH01 RC	SPIE	25.00		20/03/2008	14:25	3.60	04/04/2008	15:00	3.60	18/04/2008	13:10	3.62
SBHH02 RC	SPIE	14.90		20/03/2008	14:30	4.27	04/04/2008	15:05	3.64	18/04/2008	13:13	3.70
SBHH05 RC	SPIE	21.50		20/03/2008	17:30	2.17	04/04/2008	15:15	2.78	18/04/2008	11:34	2.90
SBHH06 CP	SP	12.30		17/03/2008	15:20	3.88	04/04/2008	15:20	3.89	17/04/2008	14:15	3.90
SBHH07A RC	SPIE	24.85		20/03/2008	13:55	1.33	04/04/2008	15:28	1.92	18/04/2008	11:43	0.88
SBHJ01 CP	SP	7.50		19/03/2008	14:15	1.81	03/04/2008	16:05	1.90	17/04/2008	12:40	1.80
SBHJ03 CP	SP	5.20		19/03/2008	16:40	0.78	03/04/2008	18:25	0.82	17/04/2008	15:55	0.80
SBHJ04	SP	13.10		17/03/2008	13:35	6.64	03/04/2008	18:10	6.74	17/04/2008	13:08	6.80
SBHJ05	SP	11.50		18/03/2008	13:50	9.02	03/04/2008	17:39	9.10	17/04/2008	13:31	9.11
SBHJ06 CP	SP	4.10		17/03/2008	12:55	1.29	03/04/2008	17:43	1.33	17/04/2008	15:05	1.20
SBHJ07 CP	SP	10.40		17/03/2008	10:25	1.59	03/04/2008	17:47	1.50	17/04/2008	13:58	1.47
SBHJ08A CP	SP	7.40		18/03/2008	10:00	2.50	03/04/2008	17:55	2.50	17/04/2008	15:33	2.50
SBHJ09 CP	SP	2.20		18/03/2008	10:25	0.69	03/04/2008	17:58	0.82	17/04/2008	15:22	0.90
SBHJ10 CP	SP	10.00		17/03/2008	09:15	2.10	03/04/2008	17:50	2.00	17/04/2008	13:55	2.00
SBHK01 CP	SP	6.80		19/03/2008	10:45	0.88	03/04/2008	16:40	1.00	17/04/2008	11:40	0.94
SBHK02 CP	SP	11.20		19/03/2008	11:15	1.46	03/04/2008	16:45	1.48	17/04/2008	11:43	1.46
SBHK03 CP	SP	5.90		19/03/2008	11:45	1.04	03/04/2008	16:48	1.07	17/04/2008	11::46	0.98
SBHK04 CP	SP	12.20		19/03/2008	12:15	1.64	03/04/2008	16:52	1.67	17/04/2008	12:05	1.60
SBHL02 RC	SPIE	15.20		19/03/2008	12:50	2.44	03/04/2008	17:00	2.45	17/04/2008	12:00	2.45
SBHL03 RC	SPIE	15.00		20/03/2008	13:25	0.76	08/04/2008	15:40	0.64	18/04/2008	09:50	0.62
SBHM01 RC	SPIE	21.00		20/03/2008	13:05	-0.21	08/04/2008	15:48	-0.45	18/04/2008	11:55	0.01
SBHM02 RC	SPIE	20.00		20/03/2008	13:10	0.61	08/04/2008	15:52	0.61	18/04/2008	11:50	0.61
SBHN01A RC	SPIE	14.90		20/03/2008	12:55	12.14	08/04/2008	16:05	12.58	18/04/2008	12:48	13.27
SBHN02 RC	SPIE	20.40		20/03/2008	12:45	4.26	08/04/2008	16:12	2.64	18/04/2008	12:45	4.85
SBHN03 RC	SPIE	15.00		20/03/2008	12:30	1.60	08/04/2008	16:17	2.07	18/04/2008	12:35	2.37
SBHN04 RC	SPIE	10.00		20/03/2008	12:10	DRY	08/04/2008	16:28	DRY	18/04/2008	10:55	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		04

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		20/03/2008	12:00	DRY	08/04/2008	16:40	DRY	18/04/2008	10:45	DRY
SBHP02 RC	SPIE	9.80		20/03/2008	11:45	5.59	08/04/2008	16:55	7.98	18/04/2008	10:30	8.20
SBHP03 RC	SPIE	5.00		20/03/2008	11:40	2.80	08/04/2008	16:50	DRY	18/04/2008	10:25	4.93
SBHQ01 RC	SPIE	11.80		20/03/2008	10:40	6.72	08/04/2008	17:13	7.24	18/04/2008	10:10	7.48
SBHQ02 RC	SPIE	6.00		20/03/2008	10:45	4.91	08/04/2008	17:10	DRY	18/04/2008	10:05	DRY
SBHQ03 RC	SPIE	11.00		20/03/2008	10:50	6.76	08/04/2008	17:05	7.69	18/04/2008	10:15	8.00
SBHQ04 RC	SPIE	8.00		20/03/2008	11:30	6.97	08/04/2008	17:02	DRY	18/04/2008	10:40	DRY
SBHQ06 RC	SPIE	7.35		20/03/2008	11:20	4.47	08/04/2008	17:20	6.63	18/04/2008	12:20	4.79
SWSJ08	SP	3.30		19/03/2008	15:10	0.44	03/04/2008	16:00	0.46	17/04/2008	12:35	0.42
SWSJ13	SP	2.50		17/03/2008	13:25	DRY	03/04/2008	18:12	DRY	17/04/2008	13:12	DRY
SWSJ21	SP	6.00		18/03/2008	14:30	4.42	03/04/2008	17:33	5.89	17/04/2008	13:32	6.50
SWSJ23	SP	7.80		18/03/2008	15:05	7.58	03/04/2008	17:35	7.20	17/04/2008	13:35	7.20
SWSJ34	SP	6.00		19/03/2008	08:55	2.36	03/04/2008	17:23	3.26	17/04/2008	13:46	DRY
SWSJ37	SP	5.60		18/03/2008	11:15	0.55	03/04/2008	17:25	0.67	17/04/2008	13:42	0.63
LGBH02	SP	8.88		17/03/2008	12:55	7.48	03/04/2008	18:05	7.46	17/04/2008	13:00	7.48
LGBH03	SP	8.90		17/03/2008	13:15	7.24	03/04/2008	18:08	7.32	17/04/2008	13:03	7.30
LGBH04	SP	10.50		18/03/2008	13:20	8.87	03/04/2008	17:40	8.90	17/04/2008	13:29	8.94
LGBH09	SP	7.00		17/03/2008	11:00	1.08	03/04/2008	17:45	1.15	17/04/2008	15:08	1.05
LGBH10	SP	14.60		18/03/2008	15:20	8.31	03/04/2008	17:27	8.20	17/04/2008	13:40	8.70
LGBH11	SP	11.20		18/03/2008	11:40	6.88	03/04/2008	17:18	7.00	17/04/2008	15:38	7.08
LGBH12	SP	7.05		17/03/2008	10:00	1.30	03/04/2008	17:49	1.47	17/04/2008	15:15	1.36
RBBH07	SP	6.25		19/03/2008	13:25	0.66	03/04/2008	15:50	0.68	17/04/2008	12:30	1.10
RBBH09	SP	7.05		19/03/2008	14:40	1.18	03/04/2008	16:07	1.21	17/04/2008	12:42	1.25
RBBH10	SP	6.85		19/03/2008	13:45	0.70	03/04/2008	16:03	0.75	17/04/2008	12:39	0.78

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		01

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		30/01/2008	09:50	2.45	25/02/2008	14:34	2.48	07/03/2008	14:25	2.60
SBHD03 CP	SPIE	10.00		30/01/2008	11:01	0.47	25/02/2008	14:52	0.43	07/03/2008	14:05	0.56
SBHD05 RC	SPIE	12.00		31/01/2008	09:00	1.02	25/02/2008	15:35	1.05	07/03/2008	13:50	1.77
SBHD06 RC	SP	15.00		30/01/2008	13:00	1.13	21/02/2008	10:30	1.39	07/03/2008	13:30	1.39
SBHD08 RC	SPIE	29.50		30/01/2008	13:50	1.20	25/02/2008	15:58	2.02	07/03/2008	13:35	1.40
SBHE02RD	SPIE	25.00		31/01/2008	09:25	2.18	25/02/2008	16:20	2.09	07/03/2008	13:10	2.48
SBHE04 RC	SPIE	17.20		31/01/2008	09:15	2.31	25/02/2008	16:11	2.51	07/03/2008	13:20	2.59
SBHF01 RC	SPIE	19.00		31/01/2008	09:40	5.69	25/02/2008	16:32	5.72	07/03/2008	12:50	5.43
SBHF02A CP	SPIE	17.00		01/02/2008	14:40	7.61	25/02/2008	17:13	7.57	07/03/2008	12:30	9.00
SBHF03 RC	SPIE	18.00		31/01/2008	10:35	6.97	26/02/2008	08:55	6.77	07/03/2008	12:15	7.22
SBHH01 RC	SPIE	25.00		31/01/2008	11:15	3.45	26/02/2008	09:39	3.42	07/03/2008	11:28	3.65
SBHH02 RC	SPIE	14.90		31/01/2008	11:10	3.42	26/02/2008	09:20	3.88	07/03/2008	11:35	3.64
SBHH05 RC	SPIE	21.50		31/01/2008	11:30	2.22	26/02/2008	10:01	2.13	07/03/2008	11:05	3.10
SBHH06 CP	SP	12.30		30/01/2008	15:30	3.75	21/02/2008	08:00	3.76	07/03/2008	11:10	3.87
SBHH07A RC	SPIE	24.85		30/01/2008	14:50	1.70	26/02/2008	10:40	1.34	07/03/2008	11:00	1.07
SBHJ01 CP	SP	7.50		01/02/2008	12:20	1.34	21/02/2008	11:45	5.98	06/03/2008	12:28	1.82
SBHJ03 CP	SP	5.20		01/02/2008	08:00	0.54	27/02/2008	16:15	0.70	07/03/2008	10:45	0.68
SBHJ04	SP	13.10		01/02/2008	11:55	6.61	22/02/2008	13::55	6.67	06/03/2008	11:46	6.75
SBHJ05	SP	11.50		01/02/2008	11:10	8.91	22/02/2008	09:00	9.07	06/03/2008	11:23	9.16
SBHJ06 CP	SP	4.10		01/02/2008	11:45	1.31	21/02/2008	15:30	1.32	06/03/2008	10:50	1.33
SBHJ07 CP	SP	10.40		01/02/2008	11:43	1.35	21/02/2008	14:40	1.40	06/03/2008	12:05	1.56
SBHJ08A CP	SP	7.40		01/02/2008	11:35	3.49	21/02/2008	13:05	2.31	06/03/2008	10:57	2.67
SBHJ09 CP	SP	2.20		01/02/2008	11:30	0.65	21/02/2008	12:25	0.85	06/03/2008	11:00	0.90
SBHJ10 CP	SP	10.00		01/02/2008	10:40	2.30	21/02/2008	13:45	2.24	06/03/2008	10:40	2.16
SBHK01 CP	SP	6.80		01/02/2008	10:55	0.70	25/02/2008	10:30	1.00	06/03/2008	14:24	1.06
SBHK02 CP	SP	11.20		01/02/2008	10:50	1.34	25/02/2008	11:20	1.33	06/03/2008	14:18	1.47
SBHK03 CP	SP	5.90		01/02/2008	10:45	0.87	25/02/2008	12:00	0.89	06/03/2008	14:15	1.00
SBHK04 CP	SP	12.20		01/02/2008	10:25	1.45	25/02/2008	12:30	1.60	06/03/2008	12:30	1.60
SBHL02 RC	SPIE	15.20		01/02/2008	10:35	2.27	25/02/2008	12:49	2.31	06/03/2008	14:00	2.42
SBHL03 RC	SPIE	15.00		31/01/2008	16:20	0.61	26/02/2008	11:15	0.51	07/03/2008	10:25	0.66
SBHM01 RC	SPIE	21.00		01/01/1900	08:20	-0.26	26/02/2008	11:30	-0.26	07/03/2008	10:17	0.05
SBHM02 RC	SPIE	20.00		01/02/2008	08:25	0.19	26/02/2008	11:41	0.49	07/03/2008	10:14	0.68
SBHN01A RC	SPIE	14.90		01/02/2008	15:20	8.49	27/02/2008	17:15	12.23	07/03/2008	14:45	13.18
SBHN02 RC	SPIE	20.40		31/01/2008	15:55	3.67	26/02/2008	11:57	4.19	07/03/2008	10:05	4.84
SBHN03 RC	SPIE	15.00		31/01/2008	15:45	1.07	26/02/2008	12:03	1.73	07/03/2008	09:55	2.34
SBHN04 RC	SPIE	10.00		31/01/2008	15:30	9.99	26/02/2008	14:42	DRY	07/03/2008	09:45	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		02

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		31/01/2008	14:50	DRY	26/02/2008	14:12	DRY	07/03/2008	09:35	DRY
SBHP02 RC	SPIE	9.80		31/01/2008	13:55	7.20	26/02/2008	13:59	8.09	07/03/2008	09:10	8.25
SBHP03 RC	SPIE	5.00		31/01/2008	13:40	4.09	26/02/2008	13:48	4.76	07/03/2008	09:05	4.78
SBHQ01 RC	SPIE	11.80		31/01/2008	14:20	5.76	26/02/2008	12:46	6.74	07/03/2008	09:30	7.20
SBHQ02 RC	SPIE	6.00		31/01/2008	14:15	4.98	26/02/2008	12:59	5.16	07/03/2008	09:25	5.98
SBHQ03 RC	SPIE	11.00		31/01/2008	13:20	6.04	26/02/2008	13:29	7.22	07/03/2008	08:38	7.59
SBHQ04 RC	SPIE	8.00		31/01/2008	13:05	4.35	26/02/2008	13:36	6.18	07/03/2008	08:55	6.94
SBHQ06 RC	SPIE	7.35		31/01/2008	13:00	3.89	26/02/2008	13:16	4.40	07/03/2008	08:25	4.63
SWSJ08	SP	3.30		01/02/2008	12:30	0.42	21/02/2008	11:45	0.37	06/03/2008	12:35	0.41
SWSJ13	SP	2.50		01/02/2008	12:00	DRY	22/02/2008	13:45	DRY	06/03/2008	11:50	DRY
SWSJ21	SP	6.00		01/02/2008	11:20	3.87	22/02/2008	09:30	5.72	06/03/2008	11:27	6.59
SWSJ23	SP	7.80		01/02/2008	11:22	5.92	22/02/2008	09:55	6.62	06/03/2008	11:30	6.97
SWSJ34	SP	6.00		01/02/2008	11:05	2.52	22/02/2008	10:55	3.33	06/03/2008	11:10	3.08
SWSJ37	SP	5.60		01/02/2008	11:25	0.46	22/02/2008	11:30	0.55	06/03/2008	11:15	0.61
LGBH02	SP	8.88					22/02/2008	14:35	7.50	06/03/2008	11:40	7.52
LGBH03	SP	8.90					22/02/2008	14:21	7.20	06/03/2008	11:44	7.28
LGBH04	SP	10.50					22/02/2008	10:30	8.87	06/03/2008	11:20	9.00
LGBH09	SP	7.00					22/02/2008	12:40	1.13	06/03/2008	10:48	1.56
LGBH10	SP	14.60					27/02/2008	14:30	8.15	06/03/2008	11:12	8.21
LGBH11	SP	11.20					27/02/2008	10:00	7.05	06/03/2008	11:03	7.07
LGBH12	SP	7.05					22/02/2008	13:10	1.40	06/03/2008	10:45	1.40
RBBH07	SP	6.25					27/02/2008	12.15	0.69	06/03/2008	12:20	0.71
RBBH09	SP	7.05					27/02/2008	13:40	1.25	06/03/2008	12:25	1.21
RBBH10	SP	6.85					27/02/2008	13:00	0.68	06/03/2008	12:30	0.82

Recorded by:	S Davis	Checked by:	I Swain	Approved by:	I Swain
Date:	30/01/08-07/03/08	Date:	16/04/2008	Date:	17/04/2008
Form No.	SI GWR	Revision No.	2.03	Issue Date	07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		03

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		20/03/2008	16:30	2.57	04/04/2008	08:00	2.59	18/04/2008	07:40	2.66
SBHD03 CP	SPIE	10.00		20/03/2008	16:45	0.58	04/04/2008	08:13	0.53	18/04/2008	08:00	0.60
SBHD05 RC	SPIE	12.00		20/03/2008	16:00	1.08	04/04/2008	09:15	1.22	18/04/2008	08:30	1.32
SBHD06 RC	SP	15.00		20/03/2008	17:55	1.20	04/04/2008	09:30	1.33	18/04/2008	08:40	1.44
SBHD08 RC	SPIE	29.50		19/03/2008	18:30	1.28	04/04/2008	10:00	1.39	18/04/2008	08:52	1.52
SBHE02RD	SPIE	25.00		20/03/2008	16:20	2.23	04/04/2008	08:50	2.46	18/04/2008	09:00	2.54
SBHE04 RC	SPIE	17.20		20/03/2008	15:45	2.20	04/04/2008	09:00	1.80	18/04/2008	08:15	1.80
SBHF01 RC	SPIE	19.00		20/03/2008	15:30	5.50	04/04/2008	08:40	5.55	18/04/2008	13:58	5.58
SBHF02A CP	SPIE	17.00		20/03/2008	15:10	5.60	04/04/2008	10:28	5.70	18/04/2008	13:45	5.77
SBHF03 RC	SPIE	18.00		20/03/2008	14:55	7.20	04/04/2008	10:36	7.38	18/04/2008	13:40	7.42
SBHH01 RC	SPIE	25.00		20/03/2008	14:25	3.60	04/04/2008	15:00	3.60	18/04/2008	13:10	3.62
SBHH02 RC	SPIE	14.90		20/03/2008	14:30	4.27	04/04/2008	15:05	3.64	18/04/2008	13:13	3.70
SBHH05 RC	SPIE	21.50		20/03/2008	17:30	2.17	04/04/2008	15:15	2.78	18/04/2008	11:34	2.90
SBHH06 CP	SP	12.30		17/03/2008	15:20	3.88	04/04/2008	15:20	3.89	17/04/2008	14:15	3.90
SBHH07A RC	SPIE	24.85		20/03/2008	13:55	1.33	04/04/2008	15:28	1.92	18/04/2008	11:43	0.88
SBHJ01 CP	SP	7.50		19/03/2008	14:15	1.81	03/04/2008	16:05	1.90	17/04/2008	12:40	1.80
SBHJ03 CP	SP	5.20		19/03/2008	16:40	0.78	03/04/2008	18:25	0.82	17/04/2008	15:55	0.80
SBHJ04	SP	13.10		17/03/2008	13:35	6.64	03/04/2008	18:10	6.74	17/04/2008	13:08	6.80
SBHJ05	SP	11.50		18/03/2008	13:50	9.02	03/04/2008	17:39	9.10	17/04/2008	13:31	9.11
SBHJ06 CP	SP	4.10		17/03/2008	12:55	1.29	03/04/2008	17:43	1.33	17/04/2008	15:05	1.20
SBHJ07 CP	SP	10.40		17/03/2008	10:25	1.59	03/04/2008	17:47	1.50	17/04/2008	13:58	1.47
SBHJ08A CP	SP	7.40		18/03/2008	10:00	2.50	03/04/2008	17:55	2.50	17/04/2008	15:33	2.50
SBHJ09 CP	SP	2.20		18/03/2008	10:25	0.69	03/04/2008	17:58	0.82	17/04/2008	15:22	0.90
SBHJ10 CP	SP	10.00		17/03/2008	09:15	2.10	03/04/2008	17:50	2.00	17/04/2008	13:55	2.00
SBHK01 CP	SP	6.80		19/03/2008	10:45	0.88	03/04/2008	16:40	1.00	17/04/2008	11:40	0.94
SBHK02 CP	SP	11.20		19/03/2008	11:15	1.46	03/04/2008	16:45	1.48	17/04/2008	11:43	1.46
SBHK03 CP	SP	5.90		19/03/2008	11:45	1.04	03/04/2008	16:48	1.07	17/04/2008	11::46	0.98
SBHK04 CP	SP	12.20		19/03/2008	12:15	1.64	03/04/2008	16:52	1.67	17/04/2008	12:05	1.60
SBHL02 RC	SPIE	15.20		19/03/2008	12:50	2.44	03/04/2008	17:00	2.45	17/04/2008	12:00	2.45
SBHL03 RC	SPIE	15.00		20/03/2008	13:25	0.76	08/04/2008	15:40	0.64	18/04/2008	09:50	0.62
SBHM01 RC	SPIE	21.00		20/03/2008	13:05	-0.21	08/04/2008	15:48	-0.45	18/04/2008	11:55	0.01
SBHM02 RC	SPIE	20.00		20/03/2008	13:10	0.61	08/04/2008	15:52	0.61	18/04/2008	11:50	0.61
SBHN01A RC	SPIE	14.90		20/03/2008	12:55	12.14	08/04/2008	16:05	12.58	18/04/2008	12:48	13.27
SBHN02 RC	SPIE	20.40		20/03/2008	12:45	4.26	08/04/2008	16:12	2.64	18/04/2008	12:45	4.85
SBHN03 RC	SPIE	15.00		20/03/2008	12:30	1.60	08/04/2008	16:17	2.07	18/04/2008	12:35	2.37
SBHN04 RC	SPIE	10.00		20/03/2008	12:10	DRY	08/04/2008	16:28	DRY	18/04/2008	10:55	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		04

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		20/03/2008	12:00	DRY	08/04/2008	16:40	DRY	18/04/2008	10:45	DRY
SBHP02 RC	SPIE	9.80		20/03/2008	11:45	5.59	08/04/2008	16:55	7.98	18/04/2008	10:30	8.20
SBHP03 RC	SPIE	5.00		20/03/2008	11:40	2.80	08/04/2008	16:50	DRY	18/04/2008	10:25	4.93
SBHQ01 RC	SPIE	11.80		20/03/2008	10:40	6.72	08/04/2008	17:13	7.24	18/04/2008	10:10	7.48
SBHQ02 RC	SPIE	6.00		20/03/2008	10:45	4.91	08/04/2008	17:10	DRY	18/04/2008	10:05	DRY
SBHQ03 RC	SPIE	11.00		20/03/2008	10:50	6.76	08/04/2008	17:05	7.69	18/04/2008	10:15	8.00
SBHQ04 RC	SPIE	8.00		20/03/2008	11:30	6.97	08/04/2008	17:02	DRY	18/04/2008	10:40	DRY
SBHQ06 RC	SPIE	7.35		20/03/2008	11:20	4.47	08/04/2008	17:20	6.63	18/04/2008	12:20	4.79
SWSJ08	SP	3.30		19/03/2008	15:10	0.44	03/04/2008	16:00	0.46	17/04/2008	12:35	0.42
SWSJ13	SP	2.50		17/03/2008	13:25	DRY	03/04/2008	18:12	DRY	17/04/2008	13:12	DRY
SWSJ21	SP	6.00		18/03/2008	14:30	4.42	03/04/2008	17:33	5.89	17/04/2008	13:32	6.50
SWSJ23	SP	7.80		18/03/2008	15:05	7.58	03/04/2008	17:35	7.20	17/04/2008	13:35	7.20
SWSJ34	SP	6.00		19/03/2008	08:55	2.36	03/04/2008	17:23	3.26	17/04/2008	13:46	DRY
SWSJ37	SP	5.60		18/03/2008	11:15	0.55	03/04/2008	17:25	0.67	17/04/2008	13:42	0.63
LGBH02	SP	8.88		17/03/2008	12:55	7.48	03/04/2008	18:05	7.46	17/04/2008	13:00	7.48
LGBH03	SP	8.90		17/03/2008	13:15	7.24	03/04/2008	18:08	7.32	17/04/2008	13:03	7.30
LGBH04	SP	10.50		18/03/2008	13:20	8.87	03/04/2008	17:40	8.90	17/04/2008	13:29	8.94
LGBH09	SP	7.00		17/03/2008	11:00	1.08	03/04/2008	17:45	1.15	17/04/2008	15:08	1.05
LGBH10	SP	14.60		18/03/2008	15:20	8.31	03/04/2008	17:27	8.20	17/04/2008	13:40	8.70
LGBH11	SP	11.20		18/03/2008	11:40	6.88	03/04/2008	17:18	7.00	17/04/2008	15:38	7.08
LGBH12	SP	7.05		17/03/2008	10:00	1.30	03/04/2008	17:49	1.47	17/04/2008	15:15	1.36
RBBH07	SP	6.25		19/03/2008	13:25	0.66	03/04/2008	15:50	0.68	17/04/2008	12:30	1.10
RBBH09	SP	7.05		19/03/2008	14:40	1.18	03/04/2008	16:07	1.21	17/04/2008	12:42	1.25
RBBH10	SP	6.85		19/03/2008	13:45	0.70	03/04/2008	16:03	0.75	17/04/2008	12:39	0.78

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		01

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		30/01/2008	09:50	2.45	25/02/2008	14:34	2.48	07/03/2008	14:25	2.60
SBHD03 CP	SPIE	10.00		30/01/2008	11:01	0.47	25/02/2008	14:52	0.43	07/03/2008	14:05	0.56
SBHD05 RC	SPIE	12.00		31/01/2008	09:00	1.02	25/02/2008	15:35	1.05	07/03/2008	13:50	1.77
SBHD06 RC	SP	15.00		30/01/2008	13:00	1.13	21/02/2008	10:30	1.39	07/03/2008	13:30	1.39
SBHD08 RC	SPIE	29.50		30/01/2008	13:50	1.20	25/02/2008	15:58	2.02	07/03/2008	13:35	1.40
SBHE02RD	SPIE	25.00		31/01/2008	09:25	2.18	25/02/2008	16:20	2.09	07/03/2008	13:10	2.48
SBHE04 RC	SPIE	17.20		31/01/2008	09:15	2.31	25/02/2008	16:11	2.51	07/03/2008	13:20	2.59
SBHF01 RC	SPIE	19.00		31/01/2008	09:40	5.69	25/02/2008	16:32	5.72	07/03/2008	12:50	5.43
SBHF02A CP	SPIE	17.00		01/02/2008	14:40	7.61	25/02/2008	17:13	7.57	07/03/2008	12:30	9.00
SBHF03 RC	SPIE	18.00		31/01/2008	10:35	6.97	26/02/2008	08:55	6.77	07/03/2008	12:15	7.22
SBHH01 RC	SPIE	25.00		31/01/2008	11:15	3.45	26/02/2008	09:39	3.42	07/03/2008	11:28	3.65
SBHH02 RC	SPIE	14.90		31/01/2008	11:10	3.42	26/02/2008	09:20	3.88	07/03/2008	11:35	3.64
SBHH05 RC	SPIE	21.50		31/01/2008	11:30	2.22	26/02/2008	10:01	2.13	07/03/2008	11:05	3.10
SBHH06 CP	SP	12.30		30/01/2008	15:30	3.75	21/02/2008	08:00	3.76	07/03/2008	11:10	3.87
SBHH07A RC	SPIE	24.85		30/01/2008	14:50	1.70	26/02/2008	10:40	1.34	07/03/2008	11:00	1.07
SBHJ01 CP	SP	7.50		01/02/2008	12:20	1.34	21/02/2008	11:45	5.98	06/03/2008	12:28	1.82
SBHJ03 CP	SP	5.20		01/02/2008	08:00	0.54	27/02/2008	16:15	0.70	07/03/2008	10:45	0.68
SBHJ04	SP	13.10		01/02/2008	11:55	6.61	22/02/2008	13::55	6.67	06/03/2008	11:46	6.75
SBHJ05	SP	11.50		01/02/2008	11:10	8.91	22/02/2008	09:00	9.07	06/03/2008	11:23	9.16
SBHJ06 CP	SP	4.10		01/02/2008	11:45	1.31	21/02/2008	15:30	1.32	06/03/2008	10:50	1.33
SBHJ07 CP	SP	10.40		01/02/2008	11:43	1.35	21/02/2008	14:40	1.40	06/03/2008	12:05	1.56
SBHJ08A CP	SP	7.40		01/02/2008	11:35	3.49	21/02/2008	13:05	2.31	06/03/2008	10:57	2.67
SBHJ09 CP	SP	2.20		01/02/2008	11:30	0.65	21/02/2008	12:25	0.85	06/03/2008	11:00	0.90
SBHJ10 CP	SP	10.00		01/02/2008	10:40	2.30	21/02/2008	13:45	2.24	06/03/2008	10:40	2.16
SBHK01 CP	SP	6.80		01/02/2008	10:55	0.70	25/02/2008	10:30	1.00	06/03/2008	14:24	1.06
SBHK02 CP	SP	11.20		01/02/2008	10:50	1.34	25/02/2008	11:20	1.33	06/03/2008	14:18	1.47
SBHK03 CP	SP	5.90		01/02/2008	10:45	0.87	25/02/2008	12:00	0.89	06/03/2008	14:15	1.00
SBHK04 CP	SP	12.20		01/02/2008	10:25	1.45	25/02/2008	12:30	1.60	06/03/2008	12:30	1.60
SBHL02 RC	SPIE	15.20		01/02/2008	10:35	2.27	25/02/2008	12:49	2.31	06/03/2008	14:00	2.42
SBHL03 RC	SPIE	15.00		31/01/2008	16:20	0.61	26/02/2008	11:15	0.51	07/03/2008	10:25	0.66
SBHM01 RC	SPIE	21.00		01/01/1900	08:20	-0.26	26/02/2008	11:30	-0.26	07/03/2008	10:17	0.05
SBHM02 RC	SPIE	20.00		01/02/2008	08:25	0.19	26/02/2008	11:41	0.49	07/03/2008	10:14	0.68
SBHN01A RC	SPIE	14.90		01/02/2008	15:20	8.49	27/02/2008	17:15	12.23	07/03/2008	14:45	13.18
SBHN02 RC	SPIE	20.40		31/01/2008	15:55	3.67	26/02/2008	11:57	4.19	07/03/2008	10:05	4.84
SBHN03 RC	SPIE	15.00		31/01/2008	15:45	1.07	26/02/2008	12:03	1.73	07/03/2008	09:55	2.34
SBHN04 RC	SPIE	10.00		31/01/2008	15:30	9.99	26/02/2008	14:42	DRY	07/03/2008	09:45	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		02

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		31/01/2008	14:50	DRY	26/02/2008	14:12	DRY	07/03/2008	09:35	DRY
SBHP02 RC	SPIE	9.80		31/01/2008	13:55	7.20	26/02/2008	13:59	8.09	07/03/2008	09:10	8.25
SBHP03 RC	SPIE	5.00		31/01/2008	13:40	4.09	26/02/2008	13:48	4.76	07/03/2008	09:05	4.78
SBHQ01 RC	SPIE	11.80		31/01/2008	14:20	5.76	26/02/2008	12:46	6.74	07/03/2008	09:30	7.20
SBHQ02 RC	SPIE	6.00		31/01/2008	14:15	4.98	26/02/2008	12:59	5.16	07/03/2008	09:25	5.98
SBHQ03 RC	SPIE	11.00		31/01/2008	13:20	6.04	26/02/2008	13:29	7.22	07/03/2008	08:38	7.59
SBHQ04 RC	SPIE	8.00		31/01/2008	13:05	4.35	26/02/2008	13:36	6.18	07/03/2008	08:55	6.94
SBHQ06 RC	SPIE	7.35		31/01/2008	13:00	3.89	26/02/2008	13:16	4.40	07/03/2008	08:25	4.63
SWSJ08	SP	3.30		01/02/2008	12:30	0.42	21/02/2008	11:45	0.37	06/03/2008	12:35	0.41
SWSJ13	SP	2.50		01/02/2008	12:00	DRY	22/02/2008	13:45	DRY	06/03/2008	11:50	DRY
SWSJ21	SP	6.00		01/02/2008	11:20	3.87	22/02/2008	09:30	5.72	06/03/2008	11:27	6.59
SWSJ23	SP	7.80		01/02/2008	11:22	5.92	22/02/2008	09:55	6.62	06/03/2008	11:30	6.97
SWSJ34	SP	6.00		01/02/2008	11:05	2.52	22/02/2008	10:55	3.33	06/03/2008	11:10	3.08
SWSJ37	SP	5.60		01/02/2008	11:25	0.46	22/02/2008	11:30	0.55	06/03/2008	11:15	0.61
LGBH02	SP	8.88					22/02/2008	14:35	7.50	06/03/2008	11:40	7.52
LGBH03	SP	8.90					22/02/2008	14:21	7.20	06/03/2008	11:44	7.28
LGBH04	SP	10.50					22/02/2008	10:30	8.87	06/03/2008	11:20	9.00
LGBH09	SP	7.00					22/02/2008	12:40	1.13	06/03/2008	10:48	1.56
LGBH10	SP	14.60					27/02/2008	14:30	8.15	06/03/2008	11:12	8.21
LGBH11	SP	11.20					27/02/2008	10:00	7.05	06/03/2008	11:03	7.07
LGBH12	SP	7.05					22/02/2008	13:10	1.40	06/03/2008	10:45	1.40
RBBH07	SP	6.25					27/02/2008	12.15	0.69	06/03/2008	12:20	0.71
RBBH09	SP	7.05					27/02/2008	13:40	1.25	06/03/2008	12:25	1.21
RBBH10	SP	6.85					27/02/2008	13:00	0.68	06/03/2008	12:30	0.82

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		03

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		20/03/2008	16:30	2.57	04/04/2008	08:00	2.59	18/04/2008	07:40	2.66
SBHD03 CP	SPIE	10.00		20/03/2008	16:45	0.58	04/04/2008	08:13	0.53	18/04/2008	08:00	0.60
SBHD05 RC	SPIE	12.00		20/03/2008	16:00	1.08	04/04/2008	09:15	1.22	18/04/2008	08:30	1.32
SBHD06 RC	SP	15.00		20/03/2008	17:55	1.20	04/04/2008	09:30	1.33	18/04/2008	08:40	1.44
SBHD08 RC	SPIE	29.50		19/03/2008	18:30	1.28	04/04/2008	10:00	1.39	18/04/2008	08:52	1.52
SBHE02RD	SPIE	25.00		20/03/2008	16:20	2.23	04/04/2008	08:50	2.46	18/04/2008	09:00	2.54
SBHE04 RC	SPIE	17.20		20/03/2008	15:45	2.20	04/04/2008	09:00	1.80	18/04/2008	08:15	1.80
SBHF01 RC	SPIE	19.00		20/03/2008	15:30	5.50	04/04/2008	08:40	5.55	18/04/2008	13:58	5.58
SBHF02A CP	SPIE	17.00		20/03/2008	15:10	5.60	04/04/2008	10:28	5.70	18/04/2008	13:45	5.77
SBHF03 RC	SPIE	18.00		20/03/2008	14:55	7.20	04/04/2008	10:36	7.38	18/04/2008	13:40	7.42
SBHH01 RC	SPIE	25.00		20/03/2008	14:25	3.60	04/04/2008	15:00	3.60	18/04/2008	13:10	3.62
SBHH02 RC	SPIE	14.90		20/03/2008	14:30	4.27	04/04/2008	15:05	3.64	18/04/2008	13:13	3.70
SBHH05 RC	SPIE	21.50		20/03/2008	17:30	2.17	04/04/2008	15:15	2.78	18/04/2008	11:34	2.90
SBHH06 CP	SP	12.30		17/03/2008	15:20	3.88	04/04/2008	15:20	3.89	17/04/2008	14:15	3.90
SBHH07A RC	SPIE	24.85		20/03/2008	13:55	1.33	04/04/2008	15:28	1.92	18/04/2008	11:43	0.88
SBHJ01 CP	SP	7.50		19/03/2008	14:15	1.81	03/04/2008	16:05	1.90	17/04/2008	12:40	1.80
SBHJ03 CP	SP	5.20		19/03/2008	16:40	0.78	03/04/2008	18:25	0.82	17/04/2008	15:55	0.80
SBHJ04	SP	13.10		17/03/2008	13:35	6.64	03/04/2008	18:10	6.74	17/04/2008	13:08	6.80
SBHJ05	SP	11.50		18/03/2008	13:50	9.02	03/04/2008	17:39	9.10	17/04/2008	13:31	9.11
SBHJ06 CP	SP	4.10		17/03/2008	12:55	1.29	03/04/2008	17:43	1.33	17/04/2008	15:05	1.20
SBHJ07 CP	SP	10.40		17/03/2008	10:25	1.59	03/04/2008	17:47	1.50	17/04/2008	13:58	1.47
SBHJ08A CP	SP	7.40		18/03/2008	10:00	2.50	03/04/2008	17:55	2.50	17/04/2008	15:33	2.50
SBHJ09 CP	SP	2.20		18/03/2008	10:25	0.69	03/04/2008	17:58	0.82	17/04/2008	15:22	0.90
SBHJ10 CP	SP	10.00		17/03/2008	09:15	2.10	03/04/2008	17:50	2.00	17/04/2008	13:55	2.00
SBHK01 CP	SP	6.80		19/03/2008	10:45	0.88	03/04/2008	16:40	1.00	17/04/2008	11:40	0.94
SBHK02 CP	SP	11.20		19/03/2008	11:15	1.46	03/04/2008	16:45	1.48	17/04/2008	11:43	1.46
SBHK03 CP	SP	5.90		19/03/2008	11:45	1.04	03/04/2008	16:48	1.07	17/04/2008	11::46	0.98
SBHK04 CP	SP	12.20		19/03/2008	12:15	1.64	03/04/2008	16:52	1.67	17/04/2008	12:05	1.60
SBHL02 RC	SPIE	15.20		19/03/2008	12:50	2.44	03/04/2008	17:00	2.45	17/04/2008	12:00	2.45
SBHL03 RC	SPIE	15.00		20/03/2008	13:25	0.76	08/04/2008	15:40	0.64	18/04/2008	09:50	0.62
SBHM01 RC	SPIE	21.00		20/03/2008	13:05	-0.21	08/04/2008	15:48	-0.45	18/04/2008	11:55	0.01
SBHM02 RC	SPIE	20.00		20/03/2008	13:10	0.61	08/04/2008	15:52	0.61	18/04/2008	11:50	0.61
SBHN01A RC	SPIE	14.90		20/03/2008	12:55	12.14	08/04/2008	16:05	12.58	18/04/2008	12:48	13.27
SBHN02 RC	SPIE	20.40		20/03/2008	12:45	4.26	08/04/2008	16:12	2.64	18/04/2008	12:45	4.85
SBHN03 RC	SPIE	15.00		20/03/2008	12:30	1.60	08/04/2008	16:17	2.07	18/04/2008	12:35	2.37
SBHN04 RC	SPIE	10.00		20/03/2008	12:10	DRY	08/04/2008	16:28	DRY	18/04/2008	10:55	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		04

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		20/03/2008	12:00	DRY	08/04/2008	16:40	DRY	18/04/2008	10:45	DRY
SBHP02 RC	SPIE	9.80		20/03/2008	11:45	5.59	08/04/2008	16:55	7.98	18/04/2008	10:30	8.20
SBHP03 RC	SPIE	5.00		20/03/2008	11:40	2.80	08/04/2008	16:50	DRY	18/04/2008	10:25	4.93
SBHQ01 RC	SPIE	11.80		20/03/2008	10:40	6.72	08/04/2008	17:13	7.24	18/04/2008	10:10	7.48
SBHQ02 RC	SPIE	6.00		20/03/2008	10:45	4.91	08/04/2008	17:10	DRY	18/04/2008	10:05	DRY
SBHQ03 RC	SPIE	11.00		20/03/2008	10:50	6.76	08/04/2008	17:05	7.69	18/04/2008	10:15	8.00
SBHQ04 RC	SPIE	8.00		20/03/2008	11:30	6.97	08/04/2008	17:02	DRY	18/04/2008	10:40	DRY
SBHQ06 RC	SPIE	7.35		20/03/2008	11:20	4.47	08/04/2008	17:20	6.63	18/04/2008	12:20	4.79
SWSJ08	SP	3.30		19/03/2008	15:10	0.44	03/04/2008	16:00	0.46	17/04/2008	12:35	0.42
SWSJ13	SP	2.50		17/03/2008	13:25	DRY	03/04/2008	18:12	DRY	17/04/2008	13:12	DRY
SWSJ21	SP	6.00		18/03/2008	14:30	4.42	03/04/2008	17:33	5.89	17/04/2008	13:32	6.50
SWSJ23	SP	7.80		18/03/2008	15:05	7.58	03/04/2008	17:35	7.20	17/04/2008	13:35	7.20
SWSJ34	SP	6.00		19/03/2008	08:55	2.36	03/04/2008	17:23	3.26	17/04/2008	13:46	DRY
SWSJ37	SP	5.60		18/03/2008	11:15	0.55	03/04/2008	17:25	0.67	17/04/2008	13:42	0.63
LGBH02	SP	8.88		17/03/2008	12:55	7.48	03/04/2008	18:05	7.46	17/04/2008	13:00	7.48
LGBH03	SP	8.90		17/03/2008	13:15	7.24	03/04/2008	18:08	7.32	17/04/2008	13:03	7.30
LGBH04	SP	10.50		18/03/2008	13:20	8.87	03/04/2008	17:40	8.90	17/04/2008	13:29	8.94
LGBH09	SP	7.00		17/03/2008	11:00	1.08	03/04/2008	17:45	1.15	17/04/2008	15:08	1.05
LGBH10	SP	14.60		18/03/2008	15:20	8.31	03/04/2008	17:27	8.20	17/04/2008	13:40	8.70
LGBH11	SP	11.20		18/03/2008	11:40	6.88	03/04/2008	17:18	7.00	17/04/2008	15:38	7.08
LGBH12	SP	7.05		17/03/2008	10:00	1.30	03/04/2008	17:49	1.47	17/04/2008	15:15	1.36
RBBH07	SP	6.25		19/03/2008	13:25	0.66	03/04/2008	15:50	0.68	17/04/2008	12:30	1.10
RBBH09	SP	7.05		19/03/2008	14:40	1.18	03/04/2008	16:07	1.21	17/04/2008	12:42	1.25
RBBH10	SP	6.85		19/03/2008	13:45	0.70	03/04/2008	16:03	0.75	17/04/2008	12:39	0.78

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		01

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		30/01/2008	09:50	2.45	25/02/2008	14:34	2.48	07/03/2008	14:25	2.60
SBHD03 CP	SPIE	10.00		30/01/2008	11:01	0.47	25/02/2008	14:52	0.43	07/03/2008	14:05	0.56
SBHD05 RC	SPIE	12.00		31/01/2008	09:00	1.02	25/02/2008	15:35	1.05	07/03/2008	13:50	1.77
SBHD06 RC	SP	15.00		30/01/2008	13:00	1.13	21/02/2008	10:30	1.39	07/03/2008	13:30	1.39
SBHD08 RC	SPIE	29.50		30/01/2008	13:50	1.20	25/02/2008	15:58	2.02	07/03/2008	13:35	1.40
SBHE02RD	SPIE	25.00		31/01/2008	09:25	2.18	25/02/2008	16:20	2.09	07/03/2008	13:10	2.48
SBHE04 RC	SPIE	17.20		31/01/2008	09:15	2.31	25/02/2008	16:11	2.51	07/03/2008	13:20	2.59
SBHF01 RC	SPIE	19.00		31/01/2008	09:40	5.69	25/02/2008	16:32	5.72	07/03/2008	12:50	5.43
SBHF02A CP	SPIE	17.00		01/02/2008	14:40	7.61	25/02/2008	17:13	7.57	07/03/2008	12:30	9.00
SBHF03 RC	SPIE	18.00		31/01/2008	10:35	6.97	26/02/2008	08:55	6.77	07/03/2008	12:15	7.22
SBHH01 RC	SPIE	25.00		31/01/2008	11:15	3.45	26/02/2008	09:39	3.42	07/03/2008	11:28	3.65
SBHH02 RC	SPIE	14.90		31/01/2008	11:10	3.42	26/02/2008	09:20	3.88	07/03/2008	11:35	3.64
SBHH05 RC	SPIE	21.50		31/01/2008	11:30	2.22	26/02/2008	10:01	2.13	07/03/2008	11:05	3.10
SBHH06 CP	SP	12.30		30/01/2008	15:30	3.75	21/02/2008	08:00	3.76	07/03/2008	11:10	3.87
SBHH07A RC	SPIE	24.85		30/01/2008	14:50	1.70	26/02/2008	10:40	1.34	07/03/2008	11:00	1.07
SBHJ01 CP	SP	7.50		01/02/2008	12:20	1.34	21/02/2008	11:45	5.98	06/03/2008	12:28	1.82
SBHJ03 CP	SP	5.20		01/02/2008	08:00	0.54	27/02/2008	16:15	0.70	07/03/2008	10:45	0.68
SBHJ04	SP	13.10		01/02/2008	11:55	6.61	22/02/2008	13::55	6.67	06/03/2008	11:46	6.75
SBHJ05	SP	11.50		01/02/2008	11:10	8.91	22/02/2008	09:00	9.07	06/03/2008	11:23	9.16
SBHJ06 CP	SP	4.10		01/02/2008	11:45	1.31	21/02/2008	15:30	1.32	06/03/2008	10:50	1.33
SBHJ07 CP	SP	10.40		01/02/2008	11:43	1.35	21/02/2008	14:40	1.40	06/03/2008	12:05	1.56
SBHJ08A CP	SP	7.40		01/02/2008	11:35	3.49	21/02/2008	13:05	2.31	06/03/2008	10:57	2.67
SBHJ09 CP	SP	2.20		01/02/2008	11:30	0.65	21/02/2008	12:25	0.85	06/03/2008	11:00	0.90
SBHJ10 CP	SP	10.00		01/02/2008	10:40	2.30	21/02/2008	13:45	2.24	06/03/2008	10:40	2.16
SBHK01 CP	SP	6.80		01/02/2008	10:55	0.70	25/02/2008	10:30	1.00	06/03/2008	14:24	1.06
SBHK02 CP	SP	11.20		01/02/2008	10:50	1.34	25/02/2008	11:20	1.33	06/03/2008	14:18	1.47
SBHK03 CP	SP	5.90		01/02/2008	10:45	0.87	25/02/2008	12:00	0.89	06/03/2008	14:15	1.00
SBHK04 CP	SP	12.20		01/02/2008	10:25	1.45	25/02/2008	12:30	1.60	06/03/2008	12:30	1.60
SBHL02 RC	SPIE	15.20		01/02/2008	10:35	2.27	25/02/2008	12:49	2.31	06/03/2008	14:00	2.42
SBHL03 RC	SPIE	15.00		31/01/2008	16:20	0.61	26/02/2008	11:15	0.51	07/03/2008	10:25	0.66
SBHM01 RC	SPIE	21.00		01/01/1900	08:20	-0.26	26/02/2008	11:30	-0.26	07/03/2008	10:17	0.05
SBHM02 RC	SPIE	20.00		01/02/2008	08:25	0.19	26/02/2008	11:41	0.49	07/03/2008	10:14	0.68
SBHN01A RC	SPIE	14.90		01/02/2008	15:20	8.49	27/02/2008	17:15	12.23	07/03/2008	14:45	13.18
SBHN02 RC	SPIE	20.40		31/01/2008	15:55	3.67	26/02/2008	11:57	4.19	07/03/2008	10:05	4.84
SBHN03 RC	SPIE	15.00		31/01/2008	15:45	1.07	26/02/2008	12:03	1.73	07/03/2008	09:55	2.34
SBHN04 RC	SPIE	10.00		31/01/2008	15:30	9.99	26/02/2008	14:42	DRY	07/03/2008	09:45	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		02

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		31/01/2008	14:50	DRY	26/02/2008	14:12	DRY	07/03/2008	09:35	DRY
SBHP02 RC	SPIE	9.80		31/01/2008	13:55	7.20	26/02/2008	13:59	8.09	07/03/2008	09:10	8.25
SBHP03 RC	SPIE	5.00		31/01/2008	13:40	4.09	26/02/2008	13:48	4.76	07/03/2008	09:05	4.78
SBHQ01 RC	SPIE	11.80		31/01/2008	14:20	5.76	26/02/2008	12:46	6.74	07/03/2008	09:30	7.20
SBHQ02 RC	SPIE	6.00		31/01/2008	14:15	4.98	26/02/2008	12:59	5.16	07/03/2008	09:25	5.98
SBHQ03 RC	SPIE	11.00		31/01/2008	13:20	6.04	26/02/2008	13:29	7.22	07/03/2008	08:38	7.59
SBHQ04 RC	SPIE	8.00		31/01/2008	13:05	4.35	26/02/2008	13:36	6.18	07/03/2008	08:55	6.94
SBHQ06 RC	SPIE	7.35		31/01/2008	13:00	3.89	26/02/2008	13:16	4.40	07/03/2008	08:25	4.63
SWSJ08	SP	3.30		01/02/2008	12:30	0.42	21/02/2008	11:45	0.37	06/03/2008	12:35	0.41
SWSJ13	SP	2.50		01/02/2008	12:00	DRY	22/02/2008	13:45	DRY	06/03/2008	11:50	DRY
SWSJ21	SP	6.00		01/02/2008	11:20	3.87	22/02/2008	09:30	5.72	06/03/2008	11:27	6.59
SWSJ23	SP	7.80		01/02/2008	11:22	5.92	22/02/2008	09:55	6.62	06/03/2008	11:30	6.97
SWSJ34	SP	6.00		01/02/2008	11:05	2.52	22/02/2008	10:55	3.33	06/03/2008	11:10	3.08
SWSJ37	SP	5.60		01/02/2008	11:25	0.46	22/02/2008	11:30	0.55	06/03/2008	11:15	0.61
LGBH02	SP	8.88					22/02/2008	14:35	7.50	06/03/2008	11:40	7.52
LGBH03	SP	8.90					22/02/2008	14:21	7.20	06/03/2008	11:44	7.28
LGBH04	SP	10.50					22/02/2008	10:30	8.87	06/03/2008	11:20	9.00
LGBH09	SP	7.00					22/02/2008	12:40	1.13	06/03/2008	10:48	1.56
LGBH10	SP	14.60					27/02/2008	14:30	8.15	06/03/2008	11:12	8.21
LGBH11	SP	11.20					27/02/2008	10:00	7.05	06/03/2008	11:03	7.07
LGBH12	SP	7.05					22/02/2008	13:10	1.40	06/03/2008	10:45	1.40
RBBH07	SP	6.25					27/02/2008	12.15	0.69	06/03/2008	12:20	0.71
RBBH09	SP	7.05					27/02/2008	13:40	1.25	06/03/2008	12:25	1.21
RBBH10	SP	6.85					27/02/2008	13:00	0.68	06/03/2008	12:30	0.82

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		03

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		20/03/2008	16:30	2.57	04/04/2008	08:00	2.59	18/04/2008	07:40	2.66
SBHD03 CP	SPIE	10.00		20/03/2008	16:45	0.58	04/04/2008	08:13	0.53	18/04/2008	08:00	0.60
SBHD05 RC	SPIE	12.00		20/03/2008	16:00	1.08	04/04/2008	09:15	1.22	18/04/2008	08:30	1.32
SBHD06 RC	SP	15.00		20/03/2008	17:55	1.20	04/04/2008	09:30	1.33	18/04/2008	08:40	1.44
SBHD08 RC	SPIE	29.50		19/03/2008	18:30	1.28	04/04/2008	10:00	1.39	18/04/2008	08:52	1.52
SBHE02RD	SPIE	25.00		20/03/2008	16:20	2.23	04/04/2008	08:50	2.46	18/04/2008	09:00	2.54
SBHE04 RC	SPIE	17.20		20/03/2008	15:45	2.20	04/04/2008	09:00	1.80	18/04/2008	08:15	1.80
SBHF01 RC	SPIE	19.00		20/03/2008	15:30	5.50	04/04/2008	08:40	5.55	18/04/2008	13:58	5.58
SBHF02A CP	SPIE	17.00		20/03/2008	15:10	5.60	04/04/2008	10:28	5.70	18/04/2008	13:45	5.77
SBHF03 RC	SPIE	18.00		20/03/2008	14:55	7.20	04/04/2008	10:36	7.38	18/04/2008	13:40	7.42
SBHH01 RC	SPIE	25.00		20/03/2008	14:25	3.60	04/04/2008	15:00	3.60	18/04/2008	13:10	3.62
SBHH02 RC	SPIE	14.90		20/03/2008	14:30	4.27	04/04/2008	15:05	3.64	18/04/2008	13:13	3.70
SBHH05 RC	SPIE	21.50		20/03/2008	17:30	2.17	04/04/2008	15:15	2.78	18/04/2008	11:34	2.90
SBHH06 CP	SP	12.30		17/03/2008	15:20	3.88	04/04/2008	15:20	3.89	17/04/2008	14:15	3.90
SBHH07A RC	SPIE	24.85		20/03/2008	13:55	1.33	04/04/2008	15:28	1.92	18/04/2008	11:43	0.88
SBHJ01 CP	SP	7.50		19/03/2008	14:15	1.81	03/04/2008	16:05	1.90	17/04/2008	12:40	1.80
SBHJ03 CP	SP	5.20		19/03/2008	16:40	0.78	03/04/2008	18:25	0.82	17/04/2008	15:55	0.80
SBHJ04	SP	13.10		17/03/2008	13:35	6.64	03/04/2008	18:10	6.74	17/04/2008	13:08	6.80
SBHJ05	SP	11.50		18/03/2008	13:50	9.02	03/04/2008	17:39	9.10	17/04/2008	13:31	9.11
SBHJ06 CP	SP	4.10		17/03/2008	12:55	1.29	03/04/2008	17:43	1.33	17/04/2008	15:05	1.20
SBHJ07 CP	SP	10.40		17/03/2008	10:25	1.59	03/04/2008	17:47	1.50	17/04/2008	13:58	1.47
SBHJ08A CP	SP	7.40		18/03/2008	10:00	2.50	03/04/2008	17:55	2.50	17/04/2008	15:33	2.50
SBHJ09 CP	SP	2.20		18/03/2008	10:25	0.69	03/04/2008	17:58	0.82	17/04/2008	15:22	0.90
SBHJ10 CP	SP	10.00		17/03/2008	09:15	2.10	03/04/2008	17:50	2.00	17/04/2008	13:55	2.00
SBHK01 CP	SP	6.80		19/03/2008	10:45	0.88	03/04/2008	16:40	1.00	17/04/2008	11:40	0.94
SBHK02 CP	SP	11.20		19/03/2008	11:15	1.46	03/04/2008	16:45	1.48	17/04/2008	11:43	1.46
SBHK03 CP	SP	5.90		19/03/2008	11:45	1.04	03/04/2008	16:48	1.07	17/04/2008	11::46	0.98
SBHK04 CP	SP	12.20		19/03/2008	12:15	1.64	03/04/2008	16:52	1.67	17/04/2008	12:05	1.60
SBHL02 RC	SPIE	15.20		19/03/2008	12:50	2.44	03/04/2008	17:00	2.45	17/04/2008	12:00	2.45
SBHL03 RC	SPIE	15.00		20/03/2008	13:25	0.76	08/04/2008	15:40	0.64	18/04/2008	09:50	0.62
SBHM01 RC	SPIE	21.00		20/03/2008	13:05	-0.21	08/04/2008	15:48	-0.45	18/04/2008	11:55	0.01
SBHM02 RC	SPIE	20.00		20/03/2008	13:10	0.61	08/04/2008	15:52	0.61	18/04/2008	11:50	0.61
SBHN01A RC	SPIE	14.90		20/03/2008	12:55	12.14	08/04/2008	16:05	12.58	18/04/2008	12:48	13.27
SBHN02 RC	SPIE	20.40		20/03/2008	12:45	4.26	08/04/2008	16:12	2.64	18/04/2008	12:45	4.85
SBHN03 RC	SPIE	15.00		20/03/2008	12:30	1.60	08/04/2008	16:17	2.07	18/04/2008	12:35	2.37
SBHN04 RC	SPIE	10.00		20/03/2008	12:10	DRY	08/04/2008	16:28	DRY	18/04/2008	10:55	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		04

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		20/03/2008	12:00	DRY	08/04/2008	16:40	DRY	18/04/2008	10:45	DRY
SBHP02 RC	SPIE	9.80		20/03/2008	11:45	5.59	08/04/2008	16:55	7.98	18/04/2008	10:30	8.20
SBHP03 RC	SPIE	5.00		20/03/2008	11:40	2.80	08/04/2008	16:50	DRY	18/04/2008	10:25	4.93
SBHQ01 RC	SPIE	11.80		20/03/2008	10:40	6.72	08/04/2008	17:13	7.24	18/04/2008	10:10	7.48
SBHQ02 RC	SPIE	6.00		20/03/2008	10:45	4.91	08/04/2008	17:10	DRY	18/04/2008	10:05	DRY
SBHQ03 RC	SPIE	11.00		20/03/2008	10:50	6.76	08/04/2008	17:05	7.69	18/04/2008	10:15	8.00
SBHQ04 RC	SPIE	8.00		20/03/2008	11:30	6.97	08/04/2008	17:02	DRY	18/04/2008	10:40	DRY
SBHQ06 RC	SPIE	7.35		20/03/2008	11:20	4.47	08/04/2008	17:20	6.63	18/04/2008	12:20	4.79
SWSJ08	SP	3.30		19/03/2008	15:10	0.44	03/04/2008	16:00	0.46	17/04/2008	12:35	0.42
SWSJ13	SP	2.50		17/03/2008	13:25	DRY	03/04/2008	18:12	DRY	17/04/2008	13:12	DRY
SWSJ21	SP	6.00		18/03/2008	14:30	4.42	03/04/2008	17:33	5.89	17/04/2008	13:32	6.50
SWSJ23	SP	7.80		18/03/2008	15:05	7.58	03/04/2008	17:35	7.20	17/04/2008	13:35	7.20
SWSJ34	SP	6.00		19/03/2008	08:55	2.36	03/04/2008	17:23	3.26	17/04/2008	13:46	DRY
SWSJ37	SP	5.60		18/03/2008	11:15	0.55	03/04/2008	17:25	0.67	17/04/2008	13:42	0.63
LGBH02	SP	8.88		17/03/2008	12:55	7.48	03/04/2008	18:05	7.46	17/04/2008	13:00	7.48
LGBH03	SP	8.90		17/03/2008	13:15	7.24	03/04/2008	18:08	7.32	17/04/2008	13:03	7.30
LGBH04	SP	10.50		18/03/2008	13:20	8.87	03/04/2008	17:40	8.90	17/04/2008	13:29	8.94
LGBH09	SP	7.00		17/03/2008	11:00	1.08	03/04/2008	17:45	1.15	17/04/2008	15:08	1.05
LGBH10	SP	14.60		18/03/2008	15:20	8.31	03/04/2008	17:27	8.20	17/04/2008	13:40	8.70
LGBH11	SP	11.20		18/03/2008	11:40	6.88	03/04/2008	17:18	7.00	17/04/2008	15:38	7.08
LGBH12	SP	7.05		17/03/2008	10:00	1.30	03/04/2008	17:49	1.47	17/04/2008	15:15	1.36
RBBH07	SP	6.25		19/03/2008	13:25	0.66	03/04/2008	15:50	0.68	17/04/2008	12:30	1.10
RBBH09	SP	7.05		19/03/2008	14:40	1.18	03/04/2008	16:07	1.21	17/04/2008	12:42	1.25
RBBH10	SP	6.85		19/03/2008	13:45	0.70	03/04/2008	16:03	0.75	17/04/2008	12:39	0.78

Recorded by:	S Davis	Checked by:	I Swain	Approved by:	I Swain
Date:	17/03/08-17/04/08	Date:	21/04/2008	Date:	21/04/2008
Form No.	SI GWR	Revision No.	2.03	Issue Date	07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		01

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		30/01/2008	09:50	2.45	25/02/2008	14:34	2.48	07/03/2008	14:25	2.60
SBHD03 CP	SPIE	10.00		30/01/2008	11:01	0.47	25/02/2008	14:52	0.43	07/03/2008	14:05	0.56
SBHD05 RC	SPIE	12.00		31/01/2008	09:00	1.02	25/02/2008	15:35	1.05	07/03/2008	13:50	1.77
SBHD06 RC	SP	15.00		30/01/2008	13:00	1.13	21/02/2008	10:30	1.39	07/03/2008	13:30	1.39
SBHD08 RC	SPIE	29.50		30/01/2008	13:50	1.20	25/02/2008	15:58	2.02	07/03/2008	13:35	1.40
SBHE02RD	SPIE	25.00		31/01/2008	09:25	2.18	25/02/2008	16:20	2.09	07/03/2008	13:10	2.48
SBHE04 RC	SPIE	17.20		31/01/2008	09:15	2.31	25/02/2008	16:11	2.51	07/03/2008	13:20	2.59
SBHF01 RC	SPIE	19.00		31/01/2008	09:40	5.69	25/02/2008	16:32	5.72	07/03/2008	12:50	5.43
SBHF02A CP	SPIE	17.00		01/02/2008	14:40	7.61	25/02/2008	17:13	7.57	07/03/2008	12:30	9.00
SBHF03 RC	SPIE	18.00		31/01/2008	10:35	6.97	26/02/2008	08:55	6.77	07/03/2008	12:15	7.22
SBHH01 RC	SPIE	25.00		31/01/2008	11:15	3.45	26/02/2008	09:39	3.42	07/03/2008	11:28	3.65
SBHH02 RC	SPIE	14.90		31/01/2008	11:10	3.42	26/02/2008	09:20	3.88	07/03/2008	11:35	3.64
SBHH05 RC	SPIE	21.50		31/01/2008	11:30	2.22	26/02/2008	10:01	2.13	07/03/2008	11:05	3.10
SBHH06 CP	SP	12.30		30/01/2008	15:30	3.75	21/02/2008	08:00	3.76	07/03/2008	11:10	3.87
SBHH07A RC	SPIE	24.85		30/01/2008	14:50	1.70	26/02/2008	10:40	1.34	07/03/2008	11:00	1.07
SBHJ01 CP	SP	7.50		01/02/2008	12:20	1.34	21/02/2008	11:45	5.98	06/03/2008	12:28	1.82
SBHJ03 CP	SP	5.20		01/02/2008	08:00	0.54	27/02/2008	16:15	0.70	07/03/2008	10:45	0.68
SBHJ04	SP	13.10		01/02/2008	11:55	6.61	22/02/2008	13::55	6.67	06/03/2008	11:46	6.75
SBHJ05	SP	11.50		01/02/2008	11:10	8.91	22/02/2008	09:00	9.07	06/03/2008	11:23	9.16
SBHJ06 CP	SP	4.10		01/02/2008	11:45	1.31	21/02/2008	15:30	1.32	06/03/2008	10:50	1.33
SBHJ07 CP	SP	10.40		01/02/2008	11:43	1.35	21/02/2008	14:40	1.40	06/03/2008	12:05	1.56
SBHJ08A CP	SP	7.40		01/02/2008	11:35	3.49	21/02/2008	13:05	2.31	06/03/2008	10:57	2.67
SBHJ09 CP	SP	2.20		01/02/2008	11:30	0.65	21/02/2008	12:25	0.85	06/03/2008	11:00	0.90
SBHJ10 CP	SP	10.00		01/02/2008	10:40	2.30	21/02/2008	13:45	2.24	06/03/2008	10:40	2.16
SBHK01 CP	SP	6.80		01/02/2008	10:55	0.70	25/02/2008	10:30	1.00	06/03/2008	14:24	1.06
SBHK02 CP	SP	11.20		01/02/2008	10:50	1.34	25/02/2008	11:20	1.33	06/03/2008	14:18	1.47
SBHK03 CP	SP	5.90		01/02/2008	10:45	0.87	25/02/2008	12:00	0.89	06/03/2008	14:15	1.00
SBHK04 CP	SP	12.20		01/02/2008	10:25	1.45	25/02/2008	12:30	1.60	06/03/2008	12:30	1.60
SBHL02 RC	SPIE	15.20		01/02/2008	10:35	2.27	25/02/2008	12:49	2.31	06/03/2008	14:00	2.42
SBHL03 RC	SPIE	15.00		31/01/2008	16:20	0.61	26/02/2008	11:15	0.51	07/03/2008	10:25	0.66
SBHM01 RC	SPIE	21.00		01/01/1900	08:20	-0.26	26/02/2008	11:30	-0.26	07/03/2008	10:17	0.05
SBHM02 RC	SPIE	20.00		01/02/2008	08:25	0.19	26/02/2008	11:41	0.49	07/03/2008	10:14	0.68
SBHN01A RC	SPIE	14.90		01/02/2008	15:20	8.49	27/02/2008	17:15	12.23	07/03/2008	14:45	13.18
SBHN02 RC	SPIE	20.40		31/01/2008	15:55	3.67	26/02/2008	11:57	4.19	07/03/2008	10:05	4.84
SBHN03 RC	SPIE	15.00		31/01/2008	15:45	1.07	26/02/2008	12:03	1.73	07/03/2008	09:55	2.34
SBHN04 RC	SPIE	10.00		31/01/2008	15:30	9.99	26/02/2008	14:42	DRY	07/03/2008	09:45	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		02

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		31/01/2008	14:50	DRY	26/02/2008	14:12	DRY	07/03/2008	09:35	DRY
SBHP02 RC	SPIE	9.80		31/01/2008	13:55	7.20	26/02/2008	13:59	8.09	07/03/2008	09:10	8.25
SBHP03 RC	SPIE	5.00		31/01/2008	13:40	4.09	26/02/2008	13:48	4.76	07/03/2008	09:05	4.78
SBHQ01 RC	SPIE	11.80		31/01/2008	14:20	5.76	26/02/2008	12:46	6.74	07/03/2008	09:30	7.20
SBHQ02 RC	SPIE	6.00		31/01/2008	14:15	4.98	26/02/2008	12:59	5.16	07/03/2008	09:25	5.98
SBHQ03 RC	SPIE	11.00		31/01/2008	13:20	6.04	26/02/2008	13:29	7.22	07/03/2008	08:38	7.59
SBHQ04 RC	SPIE	8.00		31/01/2008	13:05	4.35	26/02/2008	13:36	6.18	07/03/2008	08:55	6.94
SBHQ06 RC	SPIE	7.35		31/01/2008	13:00	3.89	26/02/2008	13:16	4.40	07/03/2008	08:25	4.63
SWSJ08	SP	3.30		01/02/2008	12:30	0.42	21/02/2008	11:45	0.37	06/03/2008	12:35	0.41
SWSJ13	SP	2.50		01/02/2008	12:00	DRY	22/02/2008	13:45	DRY	06/03/2008	11:50	DRY
SWSJ21	SP	6.00		01/02/2008	11:20	3.87	22/02/2008	09:30	5.72	06/03/2008	11:27	6.59
SWSJ23	SP	7.80		01/02/2008	11:22	5.92	22/02/2008	09:55	6.62	06/03/2008	11:30	6.97
SWSJ34	SP	6.00		01/02/2008	11:05	2.52	22/02/2008	10:55	3.33	06/03/2008	11:10	3.08
SWSJ37	SP	5.60		01/02/2008	11:25	0.46	22/02/2008	11:30	0.55	06/03/2008	11:15	0.61
LGBH02	SP	8.88					22/02/2008	14:35	7.50	06/03/2008	11:40	7.52
LGBH03	SP	8.90					22/02/2008	14:21	7.20	06/03/2008	11:44	7.28
LGBH04	SP	10.50					22/02/2008	10:30	8.87	06/03/2008	11:20	9.00
LGBH09	SP	7.00					22/02/2008	12:40	1.13	06/03/2008	10:48	1.56
LGBH10	SP	14.60					27/02/2008	14:30	8.15	06/03/2008	11:12	8.21
LGBH11	SP	11.20					27/02/2008	10:00	7.05	06/03/2008	11:03	7.07
LGBH12	SP	7.05					22/02/2008	13:10	1.40	06/03/2008	10:45	1.40
RBBH07	SP	6.25					27/02/2008	12.15	0.69	06/03/2008	12:20	0.71
RBBH09	SP	7.05					27/02/2008	13:40	1.25	06/03/2008	12:25	1.21
RBBH10	SP	6.85					27/02/2008	13:00	0.68	06/03/2008	12:30	0.82

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		03

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		20/03/2008	16:30	2.57	04/04/2008	08:00	2.59	18/04/2008	07:40	2.66
SBHD03 CP	SPIE	10.00		20/03/2008	16:45	0.58	04/04/2008	08:13	0.53	18/04/2008	08:00	0.60
SBHD05 RC	SPIE	12.00		20/03/2008	16:00	1.08	04/04/2008	09:15	1.22	18/04/2008	08:30	1.32
SBHD06 RC	SP	15.00		20/03/2008	17:55	1.20	04/04/2008	09:30	1.33	18/04/2008	08:40	1.44
SBHD08 RC	SPIE	29.50		19/03/2008	18:30	1.28	04/04/2008	10:00	1.39	18/04/2008	08:52	1.52
SBHE02RD	SPIE	25.00		20/03/2008	16:20	2.23	04/04/2008	08:50	2.46	18/04/2008	09:00	2.54
SBHE04 RC	SPIE	17.20		20/03/2008	15:45	2.20	04/04/2008	09:00	1.80	18/04/2008	08:15	1.80
SBHF01 RC	SPIE	19.00		20/03/2008	15:30	5.50	04/04/2008	08:40	5.55	18/04/2008	13:58	5.58
SBHF02A CP	SPIE	17.00		20/03/2008	15:10	5.60	04/04/2008	10:28	5.70	18/04/2008	13:45	5.77
SBHF03 RC	SPIE	18.00		20/03/2008	14:55	7.20	04/04/2008	10:36	7.38	18/04/2008	13:40	7.42
SBHH01 RC	SPIE	25.00		20/03/2008	14:25	3.60	04/04/2008	15:00	3.60	18/04/2008	13:10	3.62
SBHH02 RC	SPIE	14.90		20/03/2008	14:30	4.27	04/04/2008	15:05	3.64	18/04/2008	13:13	3.70
SBHH05 RC	SPIE	21.50		20/03/2008	17:30	2.17	04/04/2008	15:15	2.78	18/04/2008	11:34	2.90
SBHH06 CP	SP	12.30		17/03/2008	15:20	3.88	04/04/2008	15:20	3.89	17/04/2008	14:15	3.90
SBHH07A RC	SPIE	24.85		20/03/2008	13:55	1.33	04/04/2008	15:28	1.92	18/04/2008	11:43	0.88
SBHJ01 CP	SP	7.50		19/03/2008	14:15	1.81	03/04/2008	16:05	1.90	17/04/2008	12:40	1.80
SBHJ03 CP	SP	5.20		19/03/2008	16:40	0.78	03/04/2008	18:25	0.82	17/04/2008	15:55	0.80
SBHJ04	SP	13.10		17/03/2008	13:35	6.64	03/04/2008	18:10	6.74	17/04/2008	13:08	6.80
SBHJ05	SP	11.50		18/03/2008	13:50	9.02	03/04/2008	17:39	9.10	17/04/2008	13:31	9.11
SBHJ06 CP	SP	4.10		17/03/2008	12:55	1.29	03/04/2008	17:43	1.33	17/04/2008	15:05	1.20
SBHJ07 CP	SP	10.40		17/03/2008	10:25	1.59	03/04/2008	17:47	1.50	17/04/2008	13:58	1.47
SBHJ08A CP	SP	7.40		18/03/2008	10:00	2.50	03/04/2008	17:55	2.50	17/04/2008	15:33	2.50
SBHJ09 CP	SP	2.20		18/03/2008	10:25	0.69	03/04/2008	17:58	0.82	17/04/2008	15:22	0.90
SBHJ10 CP	SP	10.00		17/03/2008	09:15	2.10	03/04/2008	17:50	2.00	17/04/2008	13:55	2.00
SBHK01 CP	SP	6.80		19/03/2008	10:45	0.88	03/04/2008	16:40	1.00	17/04/2008	11:40	0.94
SBHK02 CP	SP	11.20		19/03/2008	11:15	1.46	03/04/2008	16:45	1.48	17/04/2008	11:43	1.46
SBHK03 CP	SP	5.90		19/03/2008	11:45	1.04	03/04/2008	16:48	1.07	17/04/2008	11::46	0.98
SBHK04 CP	SP	12.20		19/03/2008	12:15	1.64	03/04/2008	16:52	1.67	17/04/2008	12:05	1.60
SBHL02 RC	SPIE	15.20		19/03/2008	12:50	2.44	03/04/2008	17:00	2.45	17/04/2008	12:00	2.45
SBHL03 RC	SPIE	15.00		20/03/2008	13:25	0.76	08/04/2008	15:40	0.64	18/04/2008	09:50	0.62
SBHM01 RC	SPIE	21.00		20/03/2008	13:05	-0.21	08/04/2008	15:48	-0.45	18/04/2008	11:55	0.01
SBHM02 RC	SPIE	20.00		20/03/2008	13:10	0.61	08/04/2008	15:52	0.61	18/04/2008	11:50	0.61
SBHN01A RC	SPIE	14.90		20/03/2008	12:55	12.14	08/04/2008	16:05	12.58	18/04/2008	12:48	13.27
SBHN02 RC	SPIE	20.40		20/03/2008	12:45	4.26	08/04/2008	16:12	2.64	18/04/2008	12:45	4.85
SBHN03 RC	SPIE	15.00		20/03/2008	12:30	1.60	08/04/2008	16:17	2.07	18/04/2008	12:35	2.37
SBHN04 RC	SPIE	10.00		20/03/2008	12:10	DRY	08/04/2008	16:28	DRY	18/04/2008	10:55	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		04

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		20/03/2008	12:00	DRY	08/04/2008	16:40	DRY	18/04/2008	10:45	DRY
SBHP02 RC	SPIE	9.80		20/03/2008	11:45	5.59	08/04/2008	16:55	7.98	18/04/2008	10:30	8.20
SBHP03 RC	SPIE	5.00		20/03/2008	11:40	2.80	08/04/2008	16:50	DRY	18/04/2008	10:25	4.93
SBHQ01 RC	SPIE	11.80		20/03/2008	10:40	6.72	08/04/2008	17:13	7.24	18/04/2008	10:10	7.48
SBHQ02 RC	SPIE	6.00		20/03/2008	10:45	4.91	08/04/2008	17:10	DRY	18/04/2008	10:05	DRY
SBHQ03 RC	SPIE	11.00		20/03/2008	10:50	6.76	08/04/2008	17:05	7.69	18/04/2008	10:15	8.00
SBHQ04 RC	SPIE	8.00		20/03/2008	11:30	6.97	08/04/2008	17:02	DRY	18/04/2008	10:40	DRY
SBHQ06 RC	SPIE	7.35		20/03/2008	11:20	4.47	08/04/2008	17:20	6.63	18/04/2008	12:20	4.79
SWSJ08	SP	3.30		19/03/2008	15:10	0.44	03/04/2008	16:00	0.46	17/04/2008	12:35	0.42
SWSJ13	SP	2.50		17/03/2008	13:25	DRY	03/04/2008	18:12	DRY	17/04/2008	13:12	DRY
SWSJ21	SP	6.00		18/03/2008	14:30	4.42	03/04/2008	17:33	5.89	17/04/2008	13:32	6.50
SWSJ23	SP	7.80		18/03/2008	15:05	7.58	03/04/2008	17:35	7.20	17/04/2008	13:35	7.20
SWSJ34	SP	6.00		19/03/2008	08:55	2.36	03/04/2008	17:23	3.26	17/04/2008	13:46	DRY
SWSJ37	SP	5.60		18/03/2008	11:15	0.55	03/04/2008	17:25	0.67	17/04/2008	13:42	0.63
LGBH02	SP	8.88		17/03/2008	12:55	7.48	03/04/2008	18:05	7.46	17/04/2008	13:00	7.48
LGBH03	SP	8.90		17/03/2008	13:15	7.24	03/04/2008	18:08	7.32	17/04/2008	13:03	7.30
LGBH04	SP	10.50		18/03/2008	13:20	8.87	03/04/2008	17:40	8.90	17/04/2008	13:29	8.94
LGBH09	SP	7.00		17/03/2008	11:00	1.08	03/04/2008	17:45	1.15	17/04/2008	15:08	1.05
LGBH10	SP	14.60		18/03/2008	15:20	8.31	03/04/2008	17:27	8.20	17/04/2008	13:40	8.70
LGBH11	SP	11.20		18/03/2008	11:40	6.88	03/04/2008	17:18	7.00	17/04/2008	15:38	7.08
LGBH12	SP	7.05		17/03/2008	10:00	1.30	03/04/2008	17:49	1.47	17/04/2008	15:15	1.36
RBBH07	SP	6.25		19/03/2008	13:25	0.66	03/04/2008	15:50	0.68	17/04/2008	12:30	1.10
RBBH09	SP	7.05		19/03/2008	14:40	1.18	03/04/2008	16:07	1.21	17/04/2008	12:42	1.25
RBBH10	SP	6.85		19/03/2008	13:45	0.70	03/04/2008	16:03	0.75	17/04/2008	12:39	0.78

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		01

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		30/01/2008	09:50	2.45	25/02/2008	14:34	2.48	07/03/2008	14:25	2.60
SBHD03 CP	SPIE	10.00		30/01/2008	11:01	0.47	25/02/2008	14:52	0.43	07/03/2008	14:05	0.56
SBHD05 RC	SPIE	12.00		31/01/2008	09:00	1.02	25/02/2008	15:35	1.05	07/03/2008	13:50	1.77
SBHD06 RC	SP	15.00		30/01/2008	13:00	1.13	21/02/2008	10:30	1.39	07/03/2008	13:30	1.39
SBHD08 RC	SPIE	29.50		30/01/2008	13:50	1.20	25/02/2008	15:58	2.02	07/03/2008	13:35	1.40
SBHE02RD	SPIE	25.00		31/01/2008	09:25	2.18	25/02/2008	16:20	2.09	07/03/2008	13:10	2.48
SBHE04 RC	SPIE	17.20		31/01/2008	09:15	2.31	25/02/2008	16:11	2.51	07/03/2008	13:20	2.59
SBHF01 RC	SPIE	19.00		31/01/2008	09:40	5.69	25/02/2008	16:32	5.72	07/03/2008	12:50	5.43
SBHF02A CP	SPIE	17.00		01/02/2008	14:40	7.61	25/02/2008	17:13	7.57	07/03/2008	12:30	9.00
SBHF03 RC	SPIE	18.00		31/01/2008	10:35	6.97	26/02/2008	08:55	6.77	07/03/2008	12:15	7.22
SBHH01 RC	SPIE	25.00		31/01/2008	11:15	3.45	26/02/2008	09:39	3.42	07/03/2008	11:28	3.65
SBHH02 RC	SPIE	14.90		31/01/2008	11:10	3.42	26/02/2008	09:20	3.88	07/03/2008	11:35	3.64
SBHH05 RC	SPIE	21.50		31/01/2008	11:30	2.22	26/02/2008	10:01	2.13	07/03/2008	11:05	3.10
SBHH06 CP	SP	12.30		30/01/2008	15:30	3.75	21/02/2008	08:00	3.76	07/03/2008	11:10	3.87
SBHH07A RC	SPIE	24.85		30/01/2008	14:50	1.70	26/02/2008	10:40	1.34	07/03/2008	11:00	1.07
SBHJ01 CP	SP	7.50		01/02/2008	12:20	1.34	21/02/2008	11:45	5.98	06/03/2008	12:28	1.82
SBHJ03 CP	SP	5.20		01/02/2008	08:00	0.54	27/02/2008	16:15	0.70	07/03/2008	10:45	0.68
SBHJ04	SP	13.10		01/02/2008	11:55	6.61	22/02/2008	13::55	6.67	06/03/2008	11:46	6.75
SBHJ05	SP	11.50		01/02/2008	11:10	8.91	22/02/2008	09:00	9.07	06/03/2008	11:23	9.16
SBHJ06 CP	SP	4.10		01/02/2008	11:45	1.31	21/02/2008	15:30	1.32	06/03/2008	10:50	1.33
SBHJ07 CP	SP	10.40		01/02/2008	11:43	1.35	21/02/2008	14:40	1.40	06/03/2008	12:05	1.56
SBHJ08A CP	SP	7.40		01/02/2008	11:35	3.49	21/02/2008	13:05	2.31	06/03/2008	10:57	2.67
SBHJ09 CP	SP	2.20		01/02/2008	11:30	0.65	21/02/2008	12:25	0.85	06/03/2008	11:00	0.90
SBHJ10 CP	SP	10.00		01/02/2008	10:40	2.30	21/02/2008	13:45	2.24	06/03/2008	10:40	2.16
SBHK01 CP	SP	6.80		01/02/2008	10:55	0.70	25/02/2008	10:30	1.00	06/03/2008	14:24	1.06
SBHK02 CP	SP	11.20		01/02/2008	10:50	1.34	25/02/2008	11:20	1.33	06/03/2008	14:18	1.47
SBHK03 CP	SP	5.90		01/02/2008	10:45	0.87	25/02/2008	12:00	0.89	06/03/2008	14:15	1.00
SBHK04 CP	SP	12.20		01/02/2008	10:25	1.45	25/02/2008	12:30	1.60	06/03/2008	12:30	1.60
SBHL02 RC	SPIE	15.20		01/02/2008	10:35	2.27	25/02/2008	12:49	2.31	06/03/2008	14:00	2.42
SBHL03 RC	SPIE	15.00		31/01/2008	16:20	0.61	26/02/2008	11:15	0.51	07/03/2008	10:25	0.66
SBHM01 RC	SPIE	21.00		01/01/1900	08:20	-0.26	26/02/2008	11:30	-0.26	07/03/2008	10:17	0.05
SBHM02 RC	SPIE	20.00		01/02/2008	08:25	0.19	26/02/2008	11:41	0.49	07/03/2008	10:14	0.68
SBHN01A RC	SPIE	14.90		01/02/2008	15:20	8.49	27/02/2008	17:15	12.23	07/03/2008	14:45	13.18
SBHN02 RC	SPIE	20.40		31/01/2008	15:55	3.67	26/02/2008	11:57	4.19	07/03/2008	10:05	4.84
SBHN03 RC	SPIE	15.00		31/01/2008	15:45	1.07	26/02/2008	12:03	1.73	07/03/2008	09:55	2.34
SBHN04 RC	SPIE	10.00		31/01/2008	15:30	9.99	26/02/2008	14:42	DRY	07/03/2008	09:45	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		02

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		31/01/2008	14:50	DRY	26/02/2008	14:12	DRY	07/03/2008	09:35	DRY
SBHP02 RC	SPIE	9.80		31/01/2008	13:55	7.20	26/02/2008	13:59	8.09	07/03/2008	09:10	8.25
SBHP03 RC	SPIE	5.00		31/01/2008	13:40	4.09	26/02/2008	13:48	4.76	07/03/2008	09:05	4.78
SBHQ01 RC	SPIE	11.80		31/01/2008	14:20	5.76	26/02/2008	12:46	6.74	07/03/2008	09:30	7.20
SBHQ02 RC	SPIE	6.00		31/01/2008	14:15	4.98	26/02/2008	12:59	5.16	07/03/2008	09:25	5.98
SBHQ03 RC	SPIE	11.00		31/01/2008	13:20	6.04	26/02/2008	13:29	7.22	07/03/2008	08:38	7.59
SBHQ04 RC	SPIE	8.00		31/01/2008	13:05	4.35	26/02/2008	13:36	6.18	07/03/2008	08:55	6.94
SBHQ06 RC	SPIE	7.35		31/01/2008	13:00	3.89	26/02/2008	13:16	4.40	07/03/2008	08:25	4.63
SWSJ08	SP	3.30		01/02/2008	12:30	0.42	21/02/2008	11:45	0.37	06/03/2008	12:35	0.41
SWSJ13	SP	2.50		01/02/2008	12:00	DRY	22/02/2008	13:45	DRY	06/03/2008	11:50	DRY
SWSJ21	SP	6.00		01/02/2008	11:20	3.87	22/02/2008	09:30	5.72	06/03/2008	11:27	6.59
SWSJ23	SP	7.80		01/02/2008	11:22	5.92	22/02/2008	09:55	6.62	06/03/2008	11:30	6.97
SWSJ34	SP	6.00		01/02/2008	11:05	2.52	22/02/2008	10:55	3.33	06/03/2008	11:10	3.08
SWSJ37	SP	5.60		01/02/2008	11:25	0.46	22/02/2008	11:30	0.55	06/03/2008	11:15	0.61
LGBH02	SP	8.88					22/02/2008	14:35	7.50	06/03/2008	11:40	7.52
LGBH03	SP	8.90					22/02/2008	14:21	7.20	06/03/2008	11:44	7.28
LGBH04	SP	10.50					22/02/2008	10:30	8.87	06/03/2008	11:20	9.00
LGBH09	SP	7.00					22/02/2008	12:40	1.13	06/03/2008	10:48	1.56
LGBH10	SP	14.60					27/02/2008	14:30	8.15	06/03/2008	11:12	8.21
LGBH11	SP	11.20					27/02/2008	10:00	7.05	06/03/2008	11:03	7.07
LGBH12	SP	7.05					22/02/2008	13:10	1.40	06/03/2008	10:45	1.40
RBBH07	SP	6.25					27/02/2008	12.15	0.69	06/03/2008	12:20	0.71
RBBH09	SP	7.05					27/02/2008	13:40	1.25	06/03/2008	12:25	1.21
RBBH10	SP	6.85					27/02/2008	13:00	0.68	06/03/2008	12:30	0.82

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		03

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		20/03/2008	16:30	2.57	04/04/2008	08:00	2.59	18/04/2008	07:40	2.66
SBHD03 CP	SPIE	10.00		20/03/2008	16:45	0.58	04/04/2008	08:13	0.53	18/04/2008	08:00	0.60
SBHD05 RC	SPIE	12.00		20/03/2008	16:00	1.08	04/04/2008	09:15	1.22	18/04/2008	08:30	1.32
SBHD06 RC	SP	15.00		20/03/2008	17:55	1.20	04/04/2008	09:30	1.33	18/04/2008	08:40	1.44
SBHD08 RC	SPIE	29.50		19/03/2008	18:30	1.28	04/04/2008	10:00	1.39	18/04/2008	08:52	1.52
SBHE02RD	SPIE	25.00		20/03/2008	16:20	2.23	04/04/2008	08:50	2.46	18/04/2008	09:00	2.54
SBHE04 RC	SPIE	17.20		20/03/2008	15:45	2.20	04/04/2008	09:00	1.80	18/04/2008	08:15	1.80
SBHF01 RC	SPIE	19.00		20/03/2008	15:30	5.50	04/04/2008	08:40	5.55	18/04/2008	13:58	5.58
SBHF02A CP	SPIE	17.00		20/03/2008	15:10	5.60	04/04/2008	10:28	5.70	18/04/2008	13:45	5.77
SBHF03 RC	SPIE	18.00		20/03/2008	14:55	7.20	04/04/2008	10:36	7.38	18/04/2008	13:40	7.42
SBHH01 RC	SPIE	25.00		20/03/2008	14:25	3.60	04/04/2008	15:00	3.60	18/04/2008	13:10	3.62
SBHH02 RC	SPIE	14.90		20/03/2008	14:30	4.27	04/04/2008	15:05	3.64	18/04/2008	13:13	3.70
SBHH05 RC	SPIE	21.50		20/03/2008	17:30	2.17	04/04/2008	15:15	2.78	18/04/2008	11:34	2.90
SBHH06 CP	SP	12.30		17/03/2008	15:20	3.88	04/04/2008	15:20	3.89	17/04/2008	14:15	3.90
SBHH07A RC	SPIE	24.85		20/03/2008	13:55	1.33	04/04/2008	15:28	1.92	18/04/2008	11:43	0.88
SBHJ01 CP	SP	7.50		19/03/2008	14:15	1.81	03/04/2008	16:05	1.90	17/04/2008	12:40	1.80
SBHJ03 CP	SP	5.20		19/03/2008	16:40	0.78	03/04/2008	18:25	0.82	17/04/2008	15:55	0.80
SBHJ04	SP	13.10		17/03/2008	13:35	6.64	03/04/2008	18:10	6.74	17/04/2008	13:08	6.80
SBHJ05	SP	11.50		18/03/2008	13:50	9.02	03/04/2008	17:39	9.10	17/04/2008	13:31	9.11
SBHJ06 CP	SP	4.10		17/03/2008	12:55	1.29	03/04/2008	17:43	1.33	17/04/2008	15:05	1.20
SBHJ07 CP	SP	10.40		17/03/2008	10:25	1.59	03/04/2008	17:47	1.50	17/04/2008	13:58	1.47
SBHJ08A CP	SP	7.40		18/03/2008	10:00	2.50	03/04/2008	17:55	2.50	17/04/2008	15:33	2.50
SBHJ09 CP	SP	2.20		18/03/2008	10:25	0.69	03/04/2008	17:58	0.82	17/04/2008	15:22	0.90
SBHJ10 CP	SP	10.00		17/03/2008	09:15	2.10	03/04/2008	17:50	2.00	17/04/2008	13:55	2.00
SBHK01 CP	SP	6.80		19/03/2008	10:45	0.88	03/04/2008	16:40	1.00	17/04/2008	11:40	0.94
SBHK02 CP	SP	11.20		19/03/2008	11:15	1.46	03/04/2008	16:45	1.48	17/04/2008	11:43	1.46
SBHK03 CP	SP	5.90		19/03/2008	11:45	1.04	03/04/2008	16:48	1.07	17/04/2008	11::46	0.98
SBHK04 CP	SP	12.20		19/03/2008	12:15	1.64	03/04/2008	16:52	1.67	17/04/2008	12:05	1.60
SBHL02 RC	SPIE	15.20		19/03/2008	12:50	2.44	03/04/2008	17:00	2.45	17/04/2008	12:00	2.45
SBHL03 RC	SPIE	15.00		20/03/2008	13:25	0.76	08/04/2008	15:40	0.64	18/04/2008	09:50	0.62
SBHM01 RC	SPIE	21.00		20/03/2008	13:05	-0.21	08/04/2008	15:48	-0.45	18/04/2008	11:55	0.01
SBHM02 RC	SPIE	20.00		20/03/2008	13:10	0.61	08/04/2008	15:52	0.61	18/04/2008	11:50	0.61
SBHN01A RC	SPIE	14.90		20/03/2008	12:55	12.14	08/04/2008	16:05	12.58	18/04/2008	12:48	13.27
SBHN02 RC	SPIE	20.40		20/03/2008	12:45	4.26	08/04/2008	16:12	2.64	18/04/2008	12:45	4.85
SBHN03 RC	SPIE	15.00		20/03/2008	12:30	1.60	08/04/2008	16:17	2.07	18/04/2008	12:35	2.37
SBHN04 RC	SPIE	10.00		20/03/2008	12:10	DRY	08/04/2008	16:28	DRY	18/04/2008	10:55	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		04

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		20/03/2008	12:00	DRY	08/04/2008	16:40	DRY	18/04/2008	10:45	DRY
SBHP02 RC	SPIE	9.80		20/03/2008	11:45	5.59	08/04/2008	16:55	7.98	18/04/2008	10:30	8.20
SBHP03 RC	SPIE	5.00		20/03/2008	11:40	2.80	08/04/2008	16:50	DRY	18/04/2008	10:25	4.93
SBHQ01 RC	SPIE	11.80		20/03/2008	10:40	6.72	08/04/2008	17:13	7.24	18/04/2008	10:10	7.48
SBHQ02 RC	SPIE	6.00		20/03/2008	10:45	4.91	08/04/2008	17:10	DRY	18/04/2008	10:05	DRY
SBHQ03 RC	SPIE	11.00		20/03/2008	10:50	6.76	08/04/2008	17:05	7.69	18/04/2008	10:15	8.00
SBHQ04 RC	SPIE	8.00		20/03/2008	11:30	6.97	08/04/2008	17:02	DRY	18/04/2008	10:40	DRY
SBHQ06 RC	SPIE	7.35		20/03/2008	11:20	4.47	08/04/2008	17:20	6.63	18/04/2008	12:20	4.79
SWSJ08	SP	3.30		19/03/2008	15:10	0.44	03/04/2008	16:00	0.46	17/04/2008	12:35	0.42
SWSJ13	SP	2.50		17/03/2008	13:25	DRY	03/04/2008	18:12	DRY	17/04/2008	13:12	DRY
SWSJ21	SP	6.00		18/03/2008	14:30	4.42	03/04/2008	17:33	5.89	17/04/2008	13:32	6.50
SWSJ23	SP	7.80		18/03/2008	15:05	7.58	03/04/2008	17:35	7.20	17/04/2008	13:35	7.20
SWSJ34	SP	6.00		19/03/2008	08:55	2.36	03/04/2008	17:23	3.26	17/04/2008	13:46	DRY
SWSJ37	SP	5.60		18/03/2008	11:15	0.55	03/04/2008	17:25	0.67	17/04/2008	13:42	0.63
LGBH02	SP	8.88		17/03/2008	12:55	7.48	03/04/2008	18:05	7.46	17/04/2008	13:00	7.48
LGBH03	SP	8.90		17/03/2008	13:15	7.24	03/04/2008	18:08	7.32	17/04/2008	13:03	7.30
LGBH04	SP	10.50		18/03/2008	13:20	8.87	03/04/2008	17:40	8.90	17/04/2008	13:29	8.94
LGBH09	SP	7.00		17/03/2008	11:00	1.08	03/04/2008	17:45	1.15	17/04/2008	15:08	1.05
LGBH10	SP	14.60		18/03/2008	15:20	8.31	03/04/2008	17:27	8.20	17/04/2008	13:40	8.70
LGBH11	SP	11.20		18/03/2008	11:40	6.88	03/04/2008	17:18	7.00	17/04/2008	15:38	7.08
LGBH12	SP	7.05		17/03/2008	10:00	1.30	03/04/2008	17:49	1.47	17/04/2008	15:15	1.36
RBBH07	SP	6.25		19/03/2008	13:25	0.66	03/04/2008	15:50	0.68	17/04/2008	12:30	1.10
RBBH09	SP	7.05		19/03/2008	14:40	1.18	03/04/2008	16:07	1.21	17/04/2008	12:42	1.25
RBBH10	SP	6.85		19/03/2008	13:45	0.70	03/04/2008	16:03	0.75	17/04/2008	12:39	0.78

Recorded by:	S Davis	Checked by:	I Swain	Approved by:	I Swain
Date:	17/03/08-17/04/08	Date:	21/04/2008	Date:	21/04/2008
Form No.	SI GWR	Revision No.	2.03	Issue Date	07/01/2008

NORWEST HOLST SOIL ENGINEERING

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH509	04/03/15 11:00:00	1034	0								0.0	7		
BH509	04/03/15 11:01:00										0.0			
BH509	04/03/15 11:02:00										0.0			
BH509	04/03/15 11:03:00										0.0			
BH509	04/03/15 11:04:00										0.0			
BH509	04/03/15 11:05:00			1.8	4.4	15.1	99.9	0	0	0.6				
BH509	04/03/15 11:06:00			1.7	4.2	15.2	96.3	0	0	0.6			0.74	Upsurge at 2min 30sec. Unable to take further readings.
BH509	11/03/15 11:30:00	1028	0								0.0	10		28 litres purged, base depth 7.70m.
BH509	11/03/15 11:31:00										0.0			
BH509	11/03/15 11:32:00										0.0			
BH509	11/03/15 11:33:00										0.0			
BH509	11/03/15 11:34:00										0.0			
BH509	11/03/15 11:35:00			0.2	0.7	19.8	7.6	0	0	0.8				
BH509	11/03/15 11:36:00			0.0	0.0	20.0	1.2	0	0	0.6				
BH509	11/03/15 11:37:00			0.0	0.0	20.0	0.0	0	0	0.5				
BH509	11/03/15 11:38:00			0.0	0.0	20.0	0.0	0	0	0.4				
BH509	11/03/15 11:39:00			0.0	0.0	20.0	0.0	0	0	0.3				
BH509	11/03/15 11:40:00			0.0	0.0	20.1	0.0	0	0	0.3				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH509	11/03/15 11:41:00			0.0	0.0	20.0	0.0	0	0	0.2				
BH509	11/03/15 11:42:00			0.0	0.0	20.1	0.0	0	0	0.2				
BH509	11/03/15 11:43:00			0.0	0.0	20.1	0.0	0	0	0.1				
BH509	11/03/15 11:44:00			0.0	0.0	20.0	0.0	0	0	0.1			1.12	
BH509	18/03/15 09:00:00	1038	0								0.0	6		29 litres purged, base depth 7.70m.
BH509	18/03/15 09:01:00										0.0			
BH509	18/03/15 09:02:00										0.0			
BH509	18/03/15 09:03:00										0.0			
BH509	18/03/15 09:04:00										0.0			
BH509	18/03/15 09:05:00			0.0	0.0	19.8	0.0	0	0	0.2				
BH509	18/03/15 09:06:00			0.0	0.0	19.8	0.0	0	0	0.0				
BH509	18/03/15 09:07:00			0.0	0.0	19.7	0.0	0	0	0.0				
BH509	18/03/15 09:08:00			0.0	0.0	19.7	0.0	0	0	0.0				
BH509	18/03/15 09:09:00			0.0	0.0	19.8	0.0	0	0	0.0				
BH509	18/03/15 09:10:00			0.0	0.0	19.8	0.0	0	0	0.0				
BH509	18/03/15 09:11:00			0.0	0.0	19.8	0.0	0	0	0.0				
BH509	18/03/15 09:12:00			0.0	0.0	19.8	0.0	0	0	0.0				
BH509	18/03/15 09:13:00			0.0	0.0	19.8	0.0	0	0	0.0				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH509	18/03/15 09:14:00			0.0	0.0	19.8	0.0	0	0	0.0			0.86	
BH509	06/05/15 13:04:00	1015	0								0.4	14		
BH509	06/05/15 13:05:00										0.0			
BH509	06/05/15 13:06:00										0.0			
BH509	06/05/15 13:07:00										0.0			
BH509	06/05/15 13:08:00										0.0			
BH509	06/05/15 13:09:00			2.9	3.6	18.2	60.1	0	0	0.0				
BH509	06/05/15 13:10:00			1.0	1.3	19.4	28.5	0	0	0.0				
BH509	06/05/15 13:11:00			0.6	0.8	19.7	14.2	0	0	0.0				
BH509	06/05/15 13:12:00			0.3	0.4	19.9	8.4	0	0	0.0				
BH509	06/05/15 13:13:00			0.1	0.2	19.9	5.6	0	0	0.0				
BH509	06/05/15 13:14:00			0.1	0.2	19.9	3.4	0	0	0.0				
BH509	06/05/15 13:15:00			0.0	0.0	20.0	1.9	0	0	0.0				
BH509	06/05/15 13:16:00			0.0	0.0	20.0	0.8	0	0	0.0				
BH509	06/05/15 13:17:00			0.0	0.0	20.0	0.0	0	0	0.0				
BH509	06/05/15 13:18:00			0.0	0.0	20.0	0.0	0	0	0.0				
BH509	06/05/15 13:19:00												2.37	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH509	04/03/15 11:14:00												1.95	
BH509	11/03/15 11:44:00												2.30	64 litres purged, base depth 13.20m.
BH509	18/03/15 09:14:00												2.11	66 litres purged, base depth 13.20m.
BH509	06/05/15 13:20:00												3.74	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH510	04/03/15 12:30:00	1034	0								0.4	8		
BH510	04/03/15 12:31:00										0.4			
BH510	04/03/15 12:32:00										0.0			
BH510	04/03/15 12:33:00										0.0			
BH510	04/03/15 12:34:00										0.0			
BH510	04/03/15 12:35:00			3.6	3.6	11.2	82.5	0	0	5.3				
BH510	04/03/15 12:36:00			3.5	3.6	11.3	81.6	0	0	5.2				
BH510	04/03/15 12:37:00			3.5	3.5	11.4	81.0	0	0	4.7				
BH510	04/03/15 12:38:00			3.4	3.5	11.5	81.6	0	0	4.2				
BH510	04/03/15 12:39:00			3.4	3.6	11.6	83.0	0	0	3.9				
BH510	04/03/15 12:40:00			3.3	3.8	11.6	88.3	0	0	3.6				
BH510	04/03/15 12:41:00			3.3	4.0	11.7	92.0	0	0	3.2				
BH510	04/03/15 12:42:00			3.2	4.1	11.7	95.5	0	0	3.9				
BH510	04/03/15 12:43:00			3.2	4.2	11.7	97.3	0	0	4.0				
BH510	04/03/15 12:44:00			3.2	4.3	11.7	99.3	0	0	3.8			0.68	
BH510	12/03/15 08:15:00	1026	0								0.0	10		25 litres purged, base depth 6.00m.
BH510	12/03/15 08:16:00										0.0			
BH510	12/03/15 08:17:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH510	12/03/15 08:18:00										0.0			
BH510	12/03/15 08:19:00										0.0			
BH510	12/03/15 08:20:00			0.0	0.0	20.3	0.0	0	0	0.4				
BH510	12/03/15 08:21:00			0.0	0.0	20.3	0.0	0	0	0.3				
BH510	12/03/15 08:22:00			2.0	7.5	17.7	#	0	0	0.0				
BH510	12/03/15 08:23:00			6.1	28.4	17.7	#	0	0	0.0			0.44	Upsurge at 4min 20sec. Unable to obtain further readings.
BH510	18/03/15 10:30:00	1037	0								0.0	5		23 litres purged, base depth 6.00m.
BH510	18/03/15 10:31:00										0.0			
BH510	18/03/15 10:32:00										0.0			
BH510	18/03/15 10:33:00										0.0			
BH510	18/03/15 10:34:00										0.0			
BH510	18/03/15 10:35:00			2.2	4.1	18.5	#	0	0	0.0				
BH510	18/03/15 10:36:00			1.9	4.0	18.7	#	0	0	0.0				
BH510	18/03/15 10:37:00			1.5	3.2	19.0	69.4	0	0	0.0				
BH510	18/03/15 10:38:00			0.3	2.6	19.2	46.2	0	0	0.0				
BH510	18/03/15 10:39:00			0.8	3.4	19.3	50.4	0	0	0.0				
BH510	18/03/15 10:40:00			1.4	2.6	19.1	73.7	0	0	0.0				
BH510	18/03/15 10:41:00			1.8	4.5	18.6	#	0	0	0.0				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH510	18/03/15 10:42:00			1.5	4.2	18.8	97.9	0	0	0.0				
BH510	18/03/15 10:43:00			1.5	5.0	18.7	#	0	0	0.0				
BH510	18/03/15 10:44:00			1.5	5.5	18.6	#	0	0	0.0			0.83	
BH510	07/05/15 09:40:00	1014	1								0.4	17		
BH510	07/05/15 09:41:00										0.8			
BH510	07/05/15 09:42:00										0.4			
BH510	07/05/15 09:43:00										0.4			
BH510	07/05/15 09:44:00										0.4			
BH510	07/05/15 09:45:00			2.4	8.7	18.1	#	0	0	0.0				
BH510	07/05/15 09:46:00			1.6	5.9	18.7	#	0	0	0.0				
BH510	07/05/15 09:47:00			1.4	4.6	19.0	#	0	0	0.0				
BH510	07/05/15 09:48:00			1.1	3.9	19.2	85.9	0	0	0.0				
BH510	07/05/15 09:49:00			0.9	3.2	19.4	72.9	0	0	0.0				
BH510	07/05/15 09:50:00			0.7	2.7	19.5	60.1	0	0	0.0				
BH510	07/05/15 09:51:00			0.6	2.5	19.6	55.0	0	0	0.0				
BH510	07/05/15 09:52:00			0.6	2.2	19.7	48.4	0	0	0.0				
BH510	07/05/15 09:53:00			0.4	2.0	19.7	44.9	0	0	0.0				
BH510	07/05/15 09:54:00			0.3	1.6	19.8	40.2	0	0	0.0				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT **30238**

CHECKED **EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH510	07/05/15 09:55:00												2.28	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH510	04/03/15 12:44:00												0.87	
BH510	12/03/15 08:29:00												1.60	62 litres purged, base depth 12.00m.
BH510	18/03/15 10:44:00												1.22	64 litres purged, base depth 12.00m.
BH510	07/05/15 09:56:00												2.70	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT	CHECKED
30238	**EC**

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GAS AND GROUNDWATER LEVELS

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SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH510	04/03/15 12:30:00	1034	0								0.4	8		
BH510	04/03/15 12:31:00										0.4			
BH510	04/03/15 12:32:00										0.0			
BH510	04/03/15 12:33:00										0.0			
BH510	04/03/15 12:34:00										0.0			
BH510	04/03/15 12:35:00			3.6	3.6	11.2	82.5	0	0	5.3				
BH510	04/03/15 12:36:00			3.5	3.6	11.3	81.6	0	0	5.2				
BH510	04/03/15 12:37:00			3.5	3.5	11.4	81.0	0	0	4.7				
BH510	04/03/15 12:38:00			3.4	3.5	11.5	81.6	0	0	4.2				
BH510	04/03/15 12:39:00			3.4	3.6	11.6	83.0	0	0	3.9				
BH510	04/03/15 12:40:00			3.3	3.8	11.6	88.3	0	0	3.6				
BH510	04/03/15 12:41:00			3.3	4.0	11.7	92.0	0	0	3.2				
BH510	04/03/15 12:42:00			3.2	4.1	11.7	95.5	0	0	3.9				
BH510	04/03/15 12:43:00			3.2	4.2	11.7	97.3	0	0	4.0				
BH510	04/03/15 12:44:00			3.2	4.3	11.7	99.3	0	0	3.8			0.68	
BH510	12/03/15 08:15:00	1026	0								0.0	10		25 litres purged, base depth 6.00m.
BH510	12/03/15 08:16:00										0.0			
BH510	12/03/15 08:17:00										0.0			

remarks
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Shallow install.

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30238	**EC**

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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH510	12/03/15 08:18:00										0.0			
BH510	12/03/15 08:19:00										0.0			
BH510	12/03/15 08:20:00			0.0	0.0	20.3	0.0	0	0	0.4				
BH510	12/03/15 08:21:00			0.0	0.0	20.3	0.0	0	0	0.3				
BH510	12/03/15 08:22:00			2.0	7.5	17.7	#	0	0	0.0				
BH510	12/03/15 08:23:00			6.1	28.4	17.7	#	0	0	0.0			0.44	Upsurge at 4min 20sec. Unable to obtain further readings.
BH510	18/03/15 10:30:00	1037	0								0.0	5		23 litres purged, base depth 6.00m.
BH510	18/03/15 10:31:00										0.0			
BH510	18/03/15 10:32:00										0.0			
BH510	18/03/15 10:33:00										0.0			
BH510	18/03/15 10:34:00										0.0			
BH510	18/03/15 10:35:00			2.2	4.1	18.5	#	0	0	0.0				
BH510	18/03/15 10:36:00			1.9	4.0	18.7	#	0	0	0.0				
BH510	18/03/15 10:37:00			1.5	3.2	19.0	69.4	0	0	0.0				
BH510	18/03/15 10:38:00			0.3	2.6	19.2	46.2	0	0	0.0				
BH510	18/03/15 10:39:00			0.8	3.4	19.3	50.4	0	0	0.0				
BH510	18/03/15 10:40:00			1.4	2.6	19.1	73.7	0	0	0.0				
BH510	18/03/15 10:41:00			1.8	4.5	18.6	#	0	0	0.0				

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Shallow install.

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SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH510	18/03/15 10:42:00			1.5	4.2	18.8	97.9	0	0	0.0				
BH510	18/03/15 10:43:00			1.5	5.0	18.7	#	0	0	0.0				
BH510	18/03/15 10:44:00			1.5	5.5	18.6	#	0	0	0.0			0.83	
BH510	07/05/15 09:40:00	1014	1								0.4	17		
BH510	07/05/15 09:41:00										0.8			
BH510	07/05/15 09:42:00										0.4			
BH510	07/05/15 09:43:00										0.4			
BH510	07/05/15 09:44:00										0.4			
BH510	07/05/15 09:45:00			2.4	8.7	18.1	#	0	0	0.0				
BH510	07/05/15 09:46:00			1.6	5.9	18.7	#	0	0	0.0				
BH510	07/05/15 09:47:00			1.4	4.6	19.0	#	0	0	0.0				
BH510	07/05/15 09:48:00			1.1	3.9	19.2	85.9	0	0	0.0				
BH510	07/05/15 09:49:00			0.9	3.2	19.4	72.9	0	0	0.0				
BH510	07/05/15 09:50:00			0.7	2.7	19.5	60.1	0	0	0.0				
BH510	07/05/15 09:51:00			0.6	2.5	19.6	55.0	0	0	0.0				
BH510	07/05/15 09:52:00			0.6	2.2	19.7	48.4	0	0	0.0				
BH510	07/05/15 09:53:00			0.4	2.0	19.7	44.9	0	0	0.0				
BH510	07/05/15 09:54:00			0.3	1.6	19.8	40.2	0	0	0.0				

remarks
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Shallow install.

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GAS AND GROUNDWATER LEVELS

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SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH510	07/05/15 09:55:00												2.28	

remarks
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Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH510	04/03/15 12:44:00												0.87	
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BH510	07/05/15 09:56:00												2.70	

remarks
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VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

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Appendix 3

Soil Laboratory Data

MMCAN
Soil Analysis Results & Screening Assessment
CL-26 Reedbed No.1
06/07/2015

Geological Formation Legend

MG	Made Ground
Sed	Sediment
TFD	Tidal Flat Deposits
PEAT	Peat

ScreningValuesandAssessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference	Units	BBRH006	BBRH007	BBRH027	BBRH008	BBRH008	BBRH008	BBRH009	BBRH009	BBRH010	BBRH010	BBTP005	BBTP006	BBTP007	BBTP009	BBTP010	BBTP011	SWS101	SWS101	SWS102	SWS103	SWS104	SWS104	SWS106B	SWS108	SWS107	SWS108	SWS108	SBH01CP	BH508	BH508
Specimen Depth (m)		0.5	0.5	3.5	0.5	1	1.8	1	2.6	1	0.5	0.4	0.4	0.4	0.5	0.5	0.5	0.1	0.3	1	1	0	0.1	0.3	0.3	0.3	0.3	1	0.0-0.3
OD Level (m)																		5.72	5.52	4.88	4.92	5.97	5.86	5.66	5.66	5.66	6.65	6.45	5.57	5.9
Sample Type		ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES
Geology Code		MG-slag	MG-slag	MG-slag	MG-slag	MG-slag	MG-slag	MG-slag	MG-slag	MG-slag	MG-sed	MG-sed	MG-sed	MG-sed	MG-sed	MG-sed	MG-sed	MG-slag	MG-slag	MG-sed	MG-sed	MG-sed	MG-sed	MG-sed	MG-sed	MG-sed	MG-sed	MG-slag	MG-slag
Cluster Code		2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2007GI	2007GI	2007GI	2007GI	2007GI	2007GI	2007GI	2007GI	2007GI	2007GI	2007GI	2015GI
Metals																													
Antimony	mg/kg																	3.9	3.7	1.9	<1.5	2.5	<1.5	<1.5	<1.5	7	5.7	24	
Arsenic	mg/kg	<3	<3	5	<3	<3	8	<3	5	3		12	11	<3	9	13	<3	<3	<3	<3	<3	8	20	21	<3	8	25	<3	28
Barium	mg/kg																	480	560	70	48	110	170	150	97	110	100	140	
Boron Water Soluble	mg/kg	2	1	2	1	1	2	1	1	2		1	1	1	<0.5	1	<3.5	<3.5	<3.5	<3.5	90	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	1.7
Cadmium	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	0.7	0.5	<0.3	0.6	0.4	0.6	0.4	0.3	0.7	0.5	1.3	<0.1
Chromium	mg/kg	172	390	312	541	640	150	546	269	55		38	33	37	24	46	8.8	8.1	48	5.1	41	51	47	45	53	57	410	570
Copper	mg/kg	12	13	11	11	10	13	3	12	8		11	14	5	5	19	<6	<6	<6	15	18	14	13	9	16	9	8	13
Lead	mg/kg	61	57	24	54	20	45	13	38	21		44	50	44	25	71	2	2	16	48	40	56	41	39	34	26	170	12
Mercury	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	0.83
Molybdenum	mg/kg																0.8	0.6	<0.6	1.9	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	2.3	
Nickel	mg/kg	8	6	22	13	13	29	4	17	7		34	31	15	15	27	1.3	<0.9	32	5.6	27	23	22	26	26	22	7.3	44
Selenium	mg/kg	1.89	1.45	0.74	1.85	1.06	1.16	1.29	1.31	2.74		0.91	3.01	0.79	1.01	3.42	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<0.2
Zinc	mg/kg	64	86	112	30	76	93	48	57	60		95	114	132	80	167	33	24	120	11	150	170	160	140	180	140	310	92
Beryllium	mg/kg																<0.4	<0.4	<0.4	1	1.6	1.5	1.5	1.3	1.2	0.8	<0.4	
Iron	mg/kg	143000	119000	97400	148000	129000	52800	155000	65900	24500		34600	34900	46200	12200	41600	5100	3300	41000	4600	35000	44000	41000	41000	43000	42000	140000	
Vanadium	mg/kg																7.8	6.1	65	5.8	57	74	69	63	63	56	340	
Other																													
Asbestos Presence Screen	None																NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD
Cyanide (total)	mg/kg	4	<1	<1	1	1	<1	<1	<1	4		<1	20	18	<1	12	2100	470	40	<1	120	<1	13	77	110	23	<1	<0.5
Cyanide (free)	mg/kg																1							<1		<1		<0.5
Complex Cyanide	mg/kg																2100							77		23		
Thiocyanate	mg/kg	1.8	<0.5	4.5	5.4	6.3	3.4	<0.5	1	5.7		1.6	40.4	36	4.9	25.8	7								5		3	
Sulphate (soluble)	g/l	4160	2940	3310													0.13	0.081	0.14	0.065	0.009	0.16	0.12	0.098	0.031	0.052	0.005	
Elemental/Free Sulphur	mg/kg																770	810	<70	<70	<70	<700	<70	<70	<70	<70	<70	
Easily Liberated Sulphide	mg/kg																<15				<15							
Acid Soluble Sulphide	mg/kg																	590	150	<50	<50	<50	<50	<50	<50	<50	110	
Ammoniacal Nitrogen as N	mg/kg	2.2	1.2	1.8	1.1	<0.1	9.4	1.3	5.8	2.1		201	1730	1990	658	1850	<15	<15	71	<15	<15	<15	<15	<15	<15	<15	<15	
Chloride	mg/kg	81.8	135	752													200	440	14	90	20	34	34	18	26	30	28	
Loss on Ignition	%																1		6.3	2.3	4.4	4.4	4.8	10	1.9	2.2	1.5	
Total Organic Carbon	%																0.7		0.6	0.8		4.5		2.9	1	2.8	<0.2	
Organic Matter	%																		0.8		1.9							
pH Value	pH Uni	12.8	12.8	11.9	12.8	12.4	11.6	12.7	12	11.6		8	8.6	8.2	8.5	7.4	7.1	7.15	7.4	8.17	5.48	7.7	7.52	5.02	4.93	6.03	12.71	11.8
Material >2mm	%																		<0.1		<0.1							
Organics																													
PCBs (vs Aroclor 1254)	mg/kg																<0.02	<0.02	<0.02	<0.02	<0.035	<0.2	<0.02	<0.02	<0.02	<0.02	<0.02	
Phenols (total)	mg/kg	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0006		<0.0005	<0.0005	0.0008	<0.0005	<0.0005												
Phenols (monohydric)	mg/kg																<0.15	<0.15	0.25	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
BTEX																													
GRO (C4-C12)	mg/kg																<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
MTBE	mg/kg																<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Benzene	mg/kg																<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001
Toluene	mg/kg																<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001
Ethylbenzene	mg/kg																<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001
m & p Xylene	mg/kg																<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001
o Xylene	mg/kg																<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001
TPH																													
TPH >C6-C8.	mg/kg																												
TPH >C8-C10.	mg/kg																												
TPH >C10-C12.	mg/kg																												
TPH >C12-C16.	mg/kg																												
TPH >C16-C21.	mg/kg																												
TPH >C21-C35.	mg/kg																												
Aliphatics C5-C6	mg/kg																<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1
Aliphatics >C6-C8	mg/kg																<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1
Aliphatics >C8-C10	mg/kg																<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1
Aliphatics >C10-C12	mg/kg																<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<1
Aliphatics >C12-C16	mg/kg																<0.1	<0.1	<0.1	2.1	<0.1	22	10	0.31	<0.1	<0.1	<0.1	<1
Aliphatics >C16-C21	mg/kg																<0.1	<0.1	<0.1	1.4	<0.1	2.2	1.1	1.2	<0.1	<0.1	4.1	<1
Aliphatics >C21-C35	mg/kg																5.1	3.3	1.5	130	15	13	7.1	26	12	9.7	22	2.4
Total Aliphatics C5-C35	mg/kg																5.1	3.3	2.1	150	15	37	18	28	12	9.7	26	
Aliphatics >C35-44	mg/kg																											<1
Aromatics C5-C7	mg/kg																											<0.1
Aromatics C6-C7	mg/kg																<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Aromatics >C7-C8	mg/kg																<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1
Aromatics >C8-EC10	mg/kg																<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1
Aromatics >EC10-EC12	mg/kg																<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<1
Aromatics >EC12-EC16	mg/kg																5.4	1.7	<0.1	1.2	1	3.2	0.47	0.2	<0.1	<0.1	<0.1	<1
Aromatics >EC16-EC21	mg/kg																1.1	1.5	0.52	4.5	0.27	12	0.71	<0.1	0.9	<0.1	0.3	<1
Aromatics >EC21-EC35	mg/kg																46	55	5.6	770	50	470	67	55	48	41	2.6	<1
Total Aromatics C5-C35	mg/kg																53	58	5.6	771	51	480	68	56	49	41	2.9	
Aromatics >C35-44	mg/kg																											<1
TPH (Aliphatics and Aromatics C5-C35)	mg/kg																58	61	7.7	920	66	520	87	84	61	50	29	
Total Aliphatic TPH	mg/kg																											<5
Total Aromatic hydrocarbons	mg/kg																											<5
Total petroleum hydrocarbons	mg/kg																											<10
PAH																													
Acenaphthene	mg/kg																0.02	0.016	<0.014	<0.014	<0.014	0.051	0.019	<0.014	<0.014	<0.014	<0.014	<0.1
Acenaphthylene	mg/kg																0.5	0.32	<0.005	0.065	0.05	1.9	0.18	0.046	0.045	0.016	<0.005	<0.1
Anthracene	mg/kg																0.5	0.41	<0.009	0.078	0.033	1.8	0.13	0.023	0.027	0.011	0.033	<0.1
Benz(a)anthracene	mg/kg																1.9	1.9	<0.012	0.47	0.26	16	1	0.27	0.27	0.078	0.11	<0.1
Benzo(a)pyrene	mg/kg																2.8	2.2	<0.012	0.32	0.22	0.101	1.3	0.25	0.23	0.082	0.068	<0.1
Benzo(b)fluoranthene	mg/kg																4.4	4.3	<0.016	0.45	0.25	42	2.2	0.6	0.44	0.095	0.14	<0.1
Benzo(ghi)perylene	mg/kg																2.7	2	<0.01	0.26	0.19	17	1.1	0.26	0.25	0.084	0.065	<0.1
Benzo(k)fluoranthene	mg/kg																1.5	1.9	<0.025	0.19	0.21	17	1.1	0.26	0.21	0.077	0.049	<0.1
Chrysene	mg/kg																2.4	2.4	<0.01	0.43	0.32	18	1.3	0.29	0.31	0.09	0.14	<0.1
Dibenz(ah)anthracene	mg/kg																0.67	0.42	<0.008	0.1	0.041	3.5	0.25	0.062	0.099	0.017	0.019	<0.1
Fluoranthene	mg/kg																2.1	2	<0.025	0.47	0.24	16	1	0.16	0.22	0.098	0.26	0.17
Fluorene	mg/kg																0.092	0.078	<0.012	0.023	0.026	0.44	0.068	<0.012	<0.012	<0.012	0.019	<0.1
Indeno(123cd)pyrene	mg/kg																2.4	1.8	<0.01	0.22	0.16	14	0.95	0.21	0.18	0.066	0.04	<0.1
Naphthalene	mg/kg																0.12	0.081	<0.01	0.042	0.15	0.4	0.52	0.21	0.18	0.23	0.033	<0.1
Phenanthrene	mg/kg																0.32	0.32	<0.021	0.11	0.12	1.3	0.29	0.054	0.075	0.045	0.19	0.21
Pyrene	mg/kg																1.8	1.6	<0.022	0.44	0.19	13	0.79	0.12	0.18	0.077	0.21	0.13
PAH 16 Total	mg/kg																24	22	<0.025	3.7	2.5	180	12	2.8	2.8	1.1	1.4	<2
SVOCs																													
Phenols																													
2-Chlorophenol	mg/kg																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
2-Methylphenol	mg/kg																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
2-Nitrophenol	mg/kg																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
2,4-Dichlorophenol	mg/kg																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
2,4-Dimethylphenol	mg/kg																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
2,4,5-Trichlorophenol	mg/kg																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
2,4,6-Trichlorophenol	mg/kg																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
4-Chloro-3-methylphenol	mg/kg																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
4-Methylphenol	mg/kg																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
4-Nitrophenol	mg/kg																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Pentachlorophenol	mg/kg																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Phenol	mg/kg																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
PAHs																													
2-Chloronaphthalene	mg/kg																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
2-Methylnaphthalene	mg/kg																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Acenaphthene	mg/kg																<0.1										<0.1	
Acenaphthylene	mg/kg																0.33										<0.1	
Anthracene	mg/kg																0.19										<0.1	
Benzo(a)anthracene	mg/kg																1.8										<0.1	
Benzo(a)pyrene	mg/kg																2.3										<0.1	
Benzo(b)fluoranthene	mg/kg																2.7										<0.1	
Benzo(ghi)perylene	mg/kg																1.8										<0.1	
Benzo(k)fluoranthene	mg/kg																1.9										<0.1	
Chrysene	mg/kg																2.3										<0.1	
Dibenzo(a,h)anthracene	mg/kg																0.38										<0.1	
Fluoranthene	mg/kg																1.8										<0.1	
Fluorene	mg/kg																										<0.1	
Indeno(1,2,3-cd)pyrene	mg/kg																2.6										<0.1	
Naphthalene	mg/kg																										<0.1	
Phenanthrene	mg/kg																0.28										<0.1	
Pyrene	mg/kg																1.6										<0.1	
Phtalates																													
Bis(2-ethylhexyl) phthalate	mg/kg																350	1000	<100	9800	420	680	200	700	460	<100	120	
Butylbenzyl phthalate	mg/kg																<100	<100	<100	<100	<100	<100	<100	200	<100	<100	<100	
Di-n-butyl phthalate	mg/kg																<100	<100	<100	<100	<100	<100	480	<100	<100	<100	<100	
Di-n-Octyl phthalate	mg/kg																<100	<100	<100	<100	<100	<100	<100	250	<100	<100	<100	
Diethyl phthalate	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
Dimethyl phthalate	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
Other Semi-Volatiles																													
1,2-Dichlorobenzene	mg/kg										<0.005						<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
1,2,4-Trichlorobenzene	mg/kg										<0.025						<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
1,3-Dichlorobenzene	mg/kg										<0.05						<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
1,4-Dichlorobenzene	mg/kg										<0.05						<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
2-Nitroaniline	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
2,4-Dinitrotoluene	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
2,6-Dinitrotoluene	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
3-Nitroaniline	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
4-Bromophenylphenylether	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
4-Chloroaniline	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
4-Chlorophenylphenylether	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
4-Nitroaniline	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
Azobenzene	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
Bis(2-chloroethoxy)methane	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
Bis(2-chloroethyl)ether	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
Carbazole	mg/kg																<100	<100	<100	<100	<100	450	<100	<100	<100	<100	<100	
Dibenzofuran	mg/kg																<100	<100	<100	<100	<100	220	<100	<100	<100	<100	<100	
Hexachlorobenzene	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
Hexachlorobutadiene	mg/kg										<0.025						<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
Hexachlorocyclopentadiene	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
Hexachloroethane	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
Isophorone	mg/kg																<100	<100	<100	<100	<100	<100	<100	170	<100	<100	<100	
N-nitrosodi-n-propylamine	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
Nitrobenzene	mg/kg																<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
VOCs																													
Methyl Tertiary Butyl Ether	ug/kg																<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	
Benzene	ug/kg										293						<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	
Toluene	ug/kg										37						<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	
Ethylbenzene	ug/kg										15						<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	
p/m-Xylene	ug/kg										15						<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	
o-Xylene	ug/kg										<5						<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	
Naphthalene	ug/kg										1849						<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	
Hexachlorobutadiene	ug/kg										<25						<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	
1,2,4-Trichlorobenzene	ug/kg										<25						<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	
1,2-Dichlorobenzene	ug/kg										<5						<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	
1,3-Dichlorobenzene	ug/kg										<5						<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	
1,4-Dichlorobenzene	ug/kg										<5						<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	
1,1,1,2-Tetrachloroethane	ug/kg										<5						<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	
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MACAN
Soil Analysis Results & Screening Assessment
CL-26 Metal Recovery
06/07/2015

Geological Formation Legend

MG	Made Ground
PEAT	Peat
TFD	Tidal Flat Deposits

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference	Units	CABH002	CABH003	CABH003	CATP001	CATP001	CATP002	CATP002	CATP005	CATP006	CATP006	CATP007	CATP007	CATP008	CATP009	CATP009	CATP010	CATP010	MRTP001	MRTP001	MRTP002	MRTP002	MRTP003	MRTP003	MRTP004	MRTP004	MRTP005	BH511	BH511	BH511	BH512	BH512	BH512	BH512	CATP003	CATP004	CATP004	CATP004
Specimen Depth (m)		1	0.5	2.8	0.5	2.5	0.75	1.2	0.5	0.75	2	0.75	2	1	1	2.1	0.5	2.4	0.5	3.8	0.5	3.8	0.5	2	0.5	2.3	0.4	0 - 0.5	1 - 1.5	2 - 2.5	0.3 - 0.5	1 - 1.5	2 - 2.5	3.5 - 3.7	1.1	0.5	1.6	2.4
OD Level (m)																												7	6	5	6.2	5.5	4.5	3				
Sample Type	Units	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	TFD	TFD	TFD	TFD
Cluster Code		2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2002	2002	2002	2002
Metals																																						
Arsenic	mg/kg	<3	<3	<3	<3	4	<3	<3	<3	<3	<3	6	<3	<3	<3	<3	<3	<3										43	50	35	41	38	54	23	<3	<3	<3	11
Barium	mg/kg																		<3	<3	<3	<3	<3	<3	<3	<3	4											
Boron	mg/kg	0.8			2.6	2.2	<0.5	0.8	1.2	2.4	<0.5	0.8	2.3	<0.5	<0.5	<0.5																			0.9	0.7	0.6	1.5
Boron Water Soluble	mg/kg		1.3	<0.5													2.7	<0.5	1.4	<0.5	1	0.6	0.5	0.7	1.3	<0.5	0.9	2.7	2.8	1.1	1.8	2.2	2.4	1.5				
Cadmium	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	7	5	5	<1	0.44	0.48	0.19	0.81	0.58	0.31	0.13	<1	<1	<1	<1
Chromium	mg/kg	380	358	225	119	50	67	90	36	66	97	105	41	394	423	172	98	71	126	385	707	621	717	542	922	802	100	1506	1806	1186	870	770	1400	38	32	359	432	30
Copper	mg/kg	19	25	4	14	6	3	9	6	9	3	38	11	12	21	10	37	3	10	6	7	11	31	42	39	21	24	58	67	22	76	74	34	14	21	25	10	10
Lead	mg/kg	67	65	<5	58	10	<5	49	<5	52	5	37	48	22	66	<5	60	<5	9	14	15	16	57	71	69	51	44	25	60	25	16	9	24	11	77	87	34	37
Mercury	mg/kg	<0.5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1	1.3	0.4	1.4	1.1	0.95	0.11	<0.5	<0.5	<0.5	<0.5
Nickel	mg/kg	3	5	<2	4	7	<2	2	<2	3	<2	14	3	<2	5	<2	8	<2	6	4	4	2	15	15	9	5	8	72	76	27	18000	60	26	37	4	6	<2	28
Selenium	mg/kg	2.06	2.26	4.28	4.71	4.35	5.66	5.23	4.95	4.99	4.73	4.4	6.47	2.55	3.21	5.03	3.19	3.47	3.87	2.08	1.62	1.77	1.62	1.94	1.22	1.83	2.99	<0.2	<0.2	<0.2	0.49	0.54	<0.2	<0.2	2.74	8.22	3.11	0.81
Zinc	mg/kg	25	68	7	23	37	10	23	37	29	7	39	23	90	50	7	101	5	33	20	48	21	100	61	93	53	69	81	90	52	130	92	90	110	58	69	37	82
Iron	mg/kg	164000	114000	74100	68700	21900	30400	43000	17100	33600	44300	72900	21000	163000	103000	63100	39700	27100	89900	205000	162000	190000	284000	200000	165000	150000	46100								116000	136000	165000	28600
Manganese	mg/kg	50800			19700	7210	12800	15400	4990	12500	17700	13200	6720	43400	32700	20600	8600	9890																	31300	35200	40200	897
Other																																						
Asbestos Presence Screen	None																											NAD	NAD	NAD	NAD	NAD	NAD	NAD				
Asbestos Fibres	%						<0.001		<0.001			<0.001																									<0.001	
Cyanide (total)	mg/kg	<1	<1	3	<1	<1	<1	<1	<1	<1	<1	2	1	1	<1	4	<1	2	1	<1	<1	<1	7	<1	<1	<1	3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	1	<1	<1
Cyanide (free)	mg/kg																											<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				
Thiocyanate	mg/kg	0.9	<0.5	1.2	1	5.6	6	1.5	3.7	1.9	2.8	2.1	1.4	0.9	3.9	3.9	1.5	4.3	2.2	0.6	<0.5	<0.5	1.7	1.4	<0.5	0.6	7								0.9	0.6	1.2	1.4
Ammoniacal Nitrogen as N	mg/kg	2	1.4	1.4	1.2	14.2	1.4	1.7	2.6	2.2	1.7	2.3	1.6	1.6	4.1	1.2	2.2	1.3	1.2	1.1	1.2	1.2	1.4	1	1	1.2	1.7								5.1	1.1	2.6	46.3
Total Phosphorous	mg/kg	22100			7550	2430	3850	4810	1020	3350	5470	4690	1930	15900	11400	7410																			16300	19900	23600	1990
Acid Soluble Sulphate	mg/kg	5660			1100	6360	11500	12200	15600	16600	11500	9540	13200	6280	13600	15200																			10600	9630	11300	1950
Fluoride	mg/kg								25			6.7																										
Chloride	mg/kg	197	45.6	136	107	652	818	142	492	241	400	309	156	93.1	489	488	176	588	277	71.7	40.1	67.1	36.2	98.8	67.5	126	733								104	51.4	156	379
pH Value	pH Units	12.9	12.6	12.2	12	11.3	12	12.4	11.6	11.8	11.9	12.3	11.4	12.4	12.4	12.4	11.9	12.2	11.7	12.8	12.5	12.6	12.4	12.7	12.7	12.7	11.4	12	12	12.5	12.1	11.8	12.1	9.4	12.7	12.9	12.8	8.9
Organics																																						
PCB 105	mg/kg																													<0.01	<0.01	<0.01		<0.01				
PCB 114	mg/kg																													<0.01	<0.01	<0.01		<0.01				
PCB 123	mg/kg																													<0.01	<0.01	<0.01		<0.01				
PCB 126	mg/kg																													<0.01	<0.01	<0.01		<0.01				
PCB 157	mg/kg																													<0.01	<0.01	<0.01		<0.01				
PCB 167	mg/kg																													<0.01	<0.01	<0.01		<0.01				
PCB 169	mg/kg																													<0.01	<0.01	<0.01		<0.01				
PCB 189	mg/kg																													<0.01	<0.01	<0.01		<0.01				
PCB 77	mg/kg																													<0.01	<0.01	<0.01		<0.01				
PCB 81	mg/kg																													<0.01	<0.01	<0.01		<0.01				
Pcb-118 2,3',4,4',5 - Pentachlorobiph	mg/kg																													<0.01	<0.01	<0.01		<0.01				
Pcb-156 2,3,3',4,4,5 - Hexachlorobiph	mg/kg																													<0.01	<0.01	<0.01		<0.01				
Phenols (total)	ug/kg	<0.5	0.8	1	<0.5	4.5	3	0.9	<0.5	0.5	3.5	<0.5	0.9	2.1	<0.5	0.6	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5			360	<300	<300	<300	<300	<0.5	<0.5	<0.5	<0.5
TPH																																						
TPH >C6-C8.	mg/kg																															0	0	0				
TPH >C8-C10.	mg/kg																															0	0	0				
TPH >C10-C12.	mg/kg																															0	0	0				
TPH >C12-C16.	mg/kg																															27	47	0				
TPH >C16-C21.	mg/kg																															0	0	0				
TPH >C21-C35.	mg/kg																															0	0	0				
Aliphatics C5-C6	mg/kg																											<0.1			<0.1							
Aliphatics >C6-C8	mg/kg																											<0.1			<0.1							
Aliphatics >C8-C10	mg/kg																											<0.1			<0.1							
Aliphatics >C10-C12	mg/kg																											<1			<1							
Aliphatics >C12-C16	mg/kg																											<1			<1							
Aliphatics >C16-C21	mg/kg																											<1			2.8							
Aliphatics >C21-C35	mg/kg																											<1			40							
Aliphatics >C35-A4	mg/kg																											<1			1.5							
Aromatics C5-C7	mg/kg																											<0.1			<0.1							
Aromatics >C7-C8	mg/kg																											<0.1			<0.1							
Aromatics >EC8-EC10	mg/kg																											<0.1			<0.1							
Aromatics >EC10-EC12	mg/kg																											<1			<1							
Aromatics >EC12-EC16	mg/kg																											<1			<1							
Aromatics >EC16-EC21	mg/kg																											<1			2.2							
Aromatics >EC21-EC35	mg/kg																											<1			5.6							
Aromatics >C35-A4	mg/kg																											<1			<1							
Total Aliphatic TPH	mg/kg																											<5			44							
Total Aromatic hydrocarbons	mg/kg																											<5			8.7							
Total petroleum hydrocarbons	mg/kg	1880		146	764	237		19500	837	4180	9510		2670	29130	7970	4900											650	<10		53				88	590		<10
PAH																																						
Acenaphthene	mg/kg					1.2		27	<0.2	<1			11.5			32.6	<2	8.8										0.3	<0.1	<0.1	0.1	<0.1	0.15	<0.1	<0.1		<0.2	
Acenaphthylene	mg/kg					<1		<10	<0.2	<1			0.3			<2	<2	<1										1.1	<0.1	0.36	<0.1	<0.1	0.37	<0.1	<0.1		<0.2	
Anthracene	mg/kg					<1		<10	<0.2	<1			2.7			<2	<2	1										3.3	<0.1	<0.1	0.39	0.21	0.12	0.14	<0.1		<0.2	
Benz[a]anthracene	mg/kg					1.1		<10	<0.2	<1			1.3			<2	<2	<1										4.5	<0.1	<0.1	4.3	2.6	0.72	1.1	<0.1		0.8	
Benzo[a]pyrene	mg/kg					<1		<10	<0.2	<1			0.7			<2	<2	<1										4.2	<0.1	<0.1	2.9	1.4	1.1	1.2	<0.1		1.1	
Benzo[b]fluoranthene	mg/kg					1.2		<10	<0.2	<1			0.9			<2	<2	<1										4.8	<0.1	<0.1	3.5	2.1	1.2	1.3	<0.1		1.2	
Benzo[ghi]perylene	mg/kg					<1		<10	<0.2	<1			0.3			<2	<2	<1										2.4	<0.1	<0.1	7	3.5	2	2.1	<0.1		0.9	
Benzo[k]fluoranthene	mg/kg					1.3		<10	<0.2	<1			1.2			<2	<2	<1										4.4	<0.1	<0.1	4.8	1.6	1.3	1.2	<0.1		0.6	
Chrysene	mg/kg					1.3		<10	<0.2	<1			1.2			<2	<2	<1										4.4	<0.1	<0.1	4.8	1.6	1.3	1.2	<0.1		0.9	
Dibenzo[ah]anthracene	mg/kg					<1		<10	<0.2	<1			<0.2			<2	<2	<1										0.6	<0.1	<0.1	0.65	0.4	0.31	0.32	<0.1		<0.2	
Fluoranthene	mg/kg					3.2		11.5	2.3	1.6			7.6			2.4	<2	2.2										10	<0.1	<0.1	6.8	2.6	2.2	2.2	<0.1		1.3	
Fluorene	mg/kg					<1		20	<0.2	<1			7.9			16.6	<2	4.5										1.4	<0.1	<0.1	0.12	<0.1	<0.1	<0.1	<0.1		<0.2	
Indeno[123cd]pyrene	mg/kg					<1		<10	<0.2	<1			0.3			<2	<2	<1										2.4	<0.1	<0.1	3.1	1.6	0.79	0.69	<0.1		0.8	
Naphthalene	mg/kg					<1	0.687	<10	<0.2	<1			1.8	11.733		32.8	<2	28.6										0.9	<0.1	<0.1	0.42	<0.1	0.12	<0.1	<0.1		<0.2	
Phenanthrene	mg/kg					3.3		21.2	2.1	1.4			10.5			15.7	<2	8.1										9.7	<0.1	<0.1	4.3	1.6	1.4	1.3	<0.1		0.8	
Pyrene	mg/kg					2.2		10.3	<0.2	2.6			8.3			<2	<2	2										8.5	<0.1	<0.1	5.1	2.6	2.1	2.2	<0.1		1.2	
PAH 16 Total	mg/kg					<22.4		<200	<32.4	<18.6			<55.8			<122.1	<32	<64.2											<2	<2	47	21	15	15	<2		<10.8	
BTEX																																						
Methyl Tertiary Butyl Ether	mg/kg																																					
Benzene	mg/kg						<0.005								0.05														<1			<1							
Toluene	mg/kg						<0.005								0.308														<1			<1							
Ethylbenzene	mg/kg						<0.005								0.53														<1			<1							
p/m-Xylene	mg/kg						0.014								2.002														<1			<1							
o-Xylene	mg/kg						0.01								1.623														<1			<1							
Other Semi-Volatiles																																						
1,2-Dichlorobenzene	mg/kg						<0.005								<0.05																							
1,2,4 Trichlorobenzene	mg/kg						<0.025								<0.25																							
1,3-Dichlorobenzene	mg/kg						<0.05								<0.5																							
1,4-Dichlorobenzene	mg/kg						<0.05								<0.5																							
2-Nitroaniline	mg/kg																																					
2,4-Dinitrotoluene	mg/kg																																					
2,6-Dinitrotoluene	mg/kg																																					
3-Nitroaniline	mg/kg																																					
4-Bromophenylphenylether	mg/kg																																					
4-Chloroaniline	mg/kg																																					
4-Chlorophenylphenylether	mg/kg																																					
4-Nitroaniline	mg/kg																																					
Azobenzene	mg/kg																																					
Bis(2-chloroethoxy)methane	mg/kg																																					
Bis(2-chloroethyl)ether	mg/kg																																					
Carbazole	mg/kg																																					
Dibenzofuran	mg/kg																																					
Hexachlorobenzene	mg/kg																																					
Hexachlorobutadiene	mg/kg						<0.025								<0.25																							
Hexachlorocyclopentadiene	mg/kg																																					
Hexachloroethane	mg/kg																																					
Isophorone	mg/kg																																					
N-nitrosodi-n-propylamine	mg/kg																																					
Nitrobenzene	mg/kg																																					
VOCs																																						
1,1,1,2-Tetrachloroethane	ug/kg						<5								<50																							
1,1,1-Trichloroethane	ug/kg						<5								<50																							
1,1,2,2-Tetrachloroethane	ug/kg						<5								<50																							
1,1,2-Trichloroethane	ug/kg						<5								<50																							
1,1-Dichloropropene	ug/kg						<5								<50																							
1,1-Dichloroethane	ug/kg						<5								<50																							
1,2-Dichloroethane	ug/kg						<5								<50																							
1,2,3-Trichlorobenzene	ug/kg						<25								<250																							
1,2,3-Trichloropropane	ug/kg						<5								<50																							
1,2,4-Trimethylbenzene	ug/kg						71								5139																							
1,2-Dibromo-3-chloropropane	ug/kg						<25								<250																							
1,2-Dichloroethane	ug/kg						<5								<50																							
cis-1,2-Dichloroethene	ug/kg						<5								<50																							
1,2-Dibromoethane	ug/kg						<5								<50																							
1,2-Dichloropropane	ug/kg						<5								<50																							
1,3,5-Trimethylbenzene	ug/kg						19								1928																							
cis-1,3-Dichloropropene	ug/kg						<5								<50																							
1,3-Dichloropropane	ug/kg						<5								<50																							
2,2-Dichloropropane	ug/kg						<5								<50																							
2-Chlorotoluene	ug/kg						<5								<50																							
4-Chlorotoluene	ug/kg						<5								<50																							
p-Isopropyltoluene	ug/kg						12								812																							
Bromobenzene	ug/kg						<5								<50																							
Bromochloromethane	ug/kg						<5								<50																							
Bromomethane	ug/kg						<5								<50																							
Bromoform	ug/kg						<5								<50																							
Bromodichloromethane	ug/kg						<5								<50																							
Chlorobenzene	ug/kg						<5								<50																							
Carbon Disulphide	ug/kg																																					
Chloroethane	ug/kg						<5								<50																							
Chloroform	ug/kg						<5								<50																							
Chloromethane	ug/kg						<5								<50																							
Carbontetrachloride	ug/kg						<5								<50																							
Dibromomethane	ug/kg						<5								<50																							
Dichlorodifluoromethane	ug/kg						<5								<50																							
Dibromochloromethane	ug/kg						<5								<50																							
Dichloromethane	ug/kg																																					
Isopropylbenzene	ug/kg						<5								573																							
n-Butylbenzene	ug/kg						<5								<50																							
Propylbenzene	ug/kg						<5								1317																							
sec-Butylbenzene	ug/kg						7								959																							
Styrene	ug/kg						<5								<50																							
trans-1-2-Dichloroethene	ug/kg						<5								<50																							
trans-1-3-Dichloropropene	ug/kg						<5								<50																							
Trichlorofluoromethane	ug/kg						<5								<50																							
tert-Butylbenzene	ug/kg						<5								<50																							
Tetrachloroethene	ug/kg						<5								<50																							
Trichloroethene	ug/kg						<5								265																							

Sample Reference	BH512	CATP003	CATP004	CATP004	CATP004		CABH001	CABH001	CABH002	CABH003	CABH003	CABH003	CATP001	CATP005	CATP005	CATP006	CATP007	CATP010	CATP010	MRTP003	MRTP004	BH512
Specimen Depth (m)	3.5 - 5.2	1.1	0.5	1.6	2.4		3	6	3	3.5	6	7	2.7	1.3	2.5	2.45	2.45	2.6	3.5	3.5	3.5	5 - 5.2
OD Level (m)	1.5																					1.5
Sample Type	ES	ES	ES	ES	ES		ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES
Geology Code	PEAT						TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	TFD	PEAT
Cluster Code	2015 GI	2002	2002	2002	2002		2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002

| | | |

Appendix 4

Groundwater Laboratory Data

WSCAN
Groundwater Analysis Results & Screening Assessment
CL-28 Rwellbed No.1
08/07/2015

Geological Formation Legend

MG	Made Ground
TFD	Tidal Flat Deposits

Screening Values & Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
	Exceeds DWS
*	Laboratory detection level higher than screening criterion

Geological Formation Legend

CS	Coarse sea
RG	Rocky ground
TFD	Tidal Flat Deposits
GFD	Glaciofluvial Deposits
MM	Marcia Mudstone

Notes
EDTA calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc
*Ammonised ammonia = total ammonia/(1+10^10.0251/10.03)

Sample Reference	Units	Screening Criteria		RBEH005	RBEH006	RBEH006	RBEH007	RBEH007	RBEH007	RBEH007	RBEH007	RBEH007	RBEH008	RBEH008	RBEH008	RBEH008	RBEH009	RBEH009	RBEH009	RBEH009	RBEH009	RBEH010	RBEH010	RBEH010	RBEH010	RBEH010	RBEH010	RBEH012	SWS08	SWS08	SR01	SR01	SR01	BH509	BH509	BH509	BH509	BH509	BH509	BH509
Round		EQS	DWS	2002 Round 1	2002 Round 2	2002 Round 2	2002 Round 1	2002 Round 2	2002 Round 3	2004	2008 Round 1	2008 Round 2	2002 Round 1	2002 Round 2	2002 Round 3	2004	2002 Round 1	2002 Round 2	2002 Round 3	2004	2008 Round 1	2002 Round 1	2002 Round 2	2002 Round 3	2004	2008 Round 1	2008 Round 2	2002 Round 1	2008 Round 1	2008 Round 2	2002 Round 1	2008 Round 1	2008 Round 2	Round 1		Round 2		Round 3		
Sample Type				W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	EW	EW	EW	EW	EW	EW	EW	EW	EW	EW	EW	EW	EW
Sample Received Date											29/05/2008	29/05/2008									29/05/2008							29/05/2008	20/05/2008	21/05/2008	20/05/2008	21/05/2008	20/05/2008							
Sampled Date										11/06/2004	27/02/2008	19/03/2008				11/08/2004				11/08/2004	27/02/2008				11/08/2004	27/02/2008	19/03/2008	21/02/2008	19/03/2008	21/02/2008	19/03/2008	21/02/2008	19/03/2008							
Depth																																		04/03/2015		11/03/2015		18/03/2015		
Response Zone (RZ) Details																												5.38	7.5	0.74	1.95	4.47	5.05	0.37	3.5	5.38	7.5	0.74	1.95	4.47	5.05
Installation Details				MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD (peat)	MW/TFD	MW/TFD	TFD/ (Peat)	TFD/ (Peat)	TFD/ Shallow	TFD/ Deep	TFD/ Shallow	TFD/ Deep	TFD/ Shallow	TFD/ Deep	TFD/ Shallow	TFD/ Deep	TFD/ Shallow	TFD/ Deep
Location				UPSTREAM OF CORUS REDEBED																																				
Metals																																								
Arsenic Dissolved	ug/l	50	10	2	3	5	2	2	3	1	<1	1.5	2	2	2	2	2	3	3	<1	1.3	3	2	0	5	6	2.7	6	5.7	12	16	18	37	15	32	77	0	14	32	77
Boron Dissolved	ug/l	2000	1000							<50						50									220							610	350	950	710	830	1300				
Beryllium Dissolved	ug/l										<1	<1								<1	<1					<1	<1	<1	<1	<1	<1	<1								
Cadmium Dissolved	ug/l	0.25	5							<1						<1									3							<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	1	0		
Calcium Dissolved	ug/l			479000			802				71000	73000		552000	538000			863000	844000	790000	810000		290000	168000			210000	240000	470000	440000	110000	96000								
Chromium Dissolved	ug/l		50	8	7	3	<1	<1	<1	<1	<1	<1	<1	<1	<1	3	28	25	2	8	8	<1	2	<1	5	3	<1	6	5	18	23	15	15	25	15	71	0	14	15	71
Copper Dissolved	ug/l	10	2000	6	7	4	1	21	22	1	1.6	4.9	65	15	20	20	8	15	21	10	9.8	1	6	1	2.1	4	8.7	4.1	5	2.6	110	100	16	57	80	14	0	14	57	80
Iron Dissolved	ug/l	1000	200	<10	<10	<10	<10	10	<10	20	<10	5.5	120	120	<10	20	<10	<10	40	66	120	<10	20	20	40	<50	55	170	80	110	110	8.5	7.5	1.2	3.5	7.5	0	14	1.2	3.5
Lead Dissolved	ug/l	1.2	10	<1	<1	<1	<1	4	8	2	0.5	0.4	1	<1	2	4	1	1	<1	<0.5	1	<1	<1	<1	<1	<0.5	<0.4	0.9	1	<1	<1	<1	<1	<1	<1	<1	0	14	<1	<1
Magnesium Dissolved	ug/l			3115			6.1				40	40		<0.03	<0.03			<0.03	<0.03	<40	<40					<80	<80	480	8600	250000	240000									
Manganese Dissolved	ug/l	30	50							<10	<1	2				<10				<1	1					<1	<1	3100	3800	1300	1400									
Mercury Dissolved	ug/l	0.07	1							0.4						<1									0.2							<0.5	<0.5	<0.5	<0.5	0.5	<0.5				
Nickel Dissolved	ug/l	4	20	4	4	10	6	8	6	5	8.1	12	5	6	11	8	6	7	18	9.6	16	3	3	3	2	2.9	4.5	20	12	7.4	5.2	5.9	13	5.8	11	12	8.6				
Selenium Dissolved	ug/l	8	10	4	5	4	6	8	11	4	4	15	7	11	8	4	8	11	5	<1	3	7	10	7	4	6	8	6	11	21	25	52	28	100	120	12	8			
Vanadium Dissolved	ug/l										1	2								1	<1					21	36	2	3	2	12										
Zinc Dissolved	ug/l	25								21						27									20																
Cadmium Total	ug/l	0.25	5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		0.4	0.4	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.4	<0.4	0.3	0.7	0.2	0.2										
Zinc Total	ug/l	7.5		3	5	15		21	15		0.5	0.5	<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	0.2	0.2	<0.1	<0.1	5.1	15	6.2	17	22	4.6				
Mercury Total	ug/l	0.07	1	<1	<1	<1	<1	<0.1	<0.1	<0.1	0.03	0.03	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.03	<0.03	<0.1	<0.1	<0.1		<0.03	0.03	0.07	0.1	<0.03	<0.03										
Non-Metal Inorganics																																								
Hardness Total	mg/l			1130						10	1900	2000								2100	2000					500	520	1300	1300	1200	1100									
Total Alkalinity as CaCO3	mg/l						2120				1700	1900						1980	917	1800	1900		589	1096		320	510	840	630	2100	2900	860	2000	900	2000	2300	1300			
BOD	mg/l	5									<1	20								12	27					<1	34	<1	8	5	5									
COD	mg/l										280	72								260	18					44	150	700	480	140	1700									
Ammonium Dissolved	mg/l			50.7			30				7.8	27		8.45	8.23			13.8	13.8	10	10		30.8	48.5		12	10	1.7	2.6	48	80									
Phosphate	mg/l			<0.1	0.4	0.2	<0.1	0.1	0.4				<0.1	0.4	0.1		<0.1	0.4	0.3			<0.1	0.4	0.1																
Sodium Dissolved	mg/l		200	16.8			14.5				77	57		0.4	0.3			31.1	86.8	25	27		23.1	26.3		25	27	280	240	2300	2700									
Nitrate as NO3	mg/l		50	38.3			6				1.3	0.6		0.4	6.3			31.9	24.2	1.9	1.8		5.4	0.5		0.4	<0.3	0.4	0.7	<0.3	<0.3									
Sulphate (soluble)	mg/l	400	250	27.3	27.3	30.9	75.7	327	76.9	300	8	7	52.3	0.4	47.3	26.4	75.7	70.6	61.9	6	5	349	295	295	247	36	31	160	160	160	160									
Chloride	mg/l	250	250	44			9			126	170	170		0.4	50	39		8	304	34	36		4	29		48	53	110	110	2700	230	4600	1100	4700	1100	4700	1100			
Sulphide	mg/l			<0.5	<0.2	<0.2					<0.5	0.5	<0.2	0.4				<0.5	<0.5	<0.5	<0.5		<0.5	<0.2		<0.5	<0.5	<0.1	<0.1	<0.1										
Ammoniacal Nitrogen as N	mg/l	0.6		4.3	1.6	7.7	7	14	10.6		0.6	0.7	30.1	0.4	29		1.8	3.3	4.6	2.3	2.6	5.6	12.2	18.4		4.2	3.6	0.6	0.1	3.9	20	11	29	11	29	11	12			
Total Cyanide (Free)	mg/l										8.551	8.691							2.458	2.537						4.141	1.542	0.083	0.042	0.088	1.482									
Total Antimony(as as SbN)	mg/l		0.5																																					
Hexavalent Chromium	mg/l		50																															<0.30	<0.03					
Phenols Monohydric	mg/l			<0.05	<0.05	<0.05	0.07	0.12	0.1		0.09	0.12	<0.05	<0.05	0.06		<0.05	<0.05	<0.05	0.04	0.05	<0.05	<0.05	<0.05		0.03	0.02	<0.03	<0.03	<0.03										
Total Cyanide	mg/l	0.001	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	0.45			0.14	0.15	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05	0.15	0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05				
Cyanide (Free)	mg/l																																							
Carbon Dioxide Dissolved	mg/l																																	100		110				
pH Value	pH units	6.5	6.5-10	11.6	12.2	7.8	10.7	12.2	11.1	10.8	12.01	12.01	10.7	12.2	11.7	10.6	12.2	11.6	12.2	12.01	12.01	10.4	12.2	11	8.7	12.12	11.12	7.03	8.04	7.5	8.74	8	7.8	8	7.6	7.8	7.9				
Fluoride		5000	1500	1.3			2.8							0.6	0.8			0.3	0.2				1.4	1.4																
Organics																																								
GRO (C4-C12)	ug/l										<10	<10								<10	<10					<10	<10	<10	<10	<10	<10									
Benzene	ug/l	10	1								<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<1	<1	<1	<1	<1	<1			
Toluene	ug/l	50		<5	<5	<5	<5	<5	<5		<10	<10	<5	<5	<5		<5	<5	<5	<10	<10	<5	<5	22		<10	<10	<10	<10	<10	<10	<1	<1	<1	<1	<1	<1			
Ethylbenzene	ug/l	20									<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<1	<1	<1	<1	<1	<1			
m & p Xylene	ug/l	30									<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<1	<1	<1	<1	<1	<1			
o Xylene	ug/l	30									<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<1	<1	<1	<1	<1	<1			
TPH GC (C10-C37)										<10					1100									760																
Aliphatics >5-C6	ug/l							600			<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Aliphatics >C6-C8	ug/l										<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Aliphatics >C8-C10	ug/l										<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Aliphatics >C10-C12	ug/l										<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Aliphatics >C12-C16 Aqueous	ug/l										<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Aliphatics >C16-C21 Aqueous	ug/l										<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<0.1	<0.1	1.2	<0.1	<0.1	5.3			
Aliphatics >C21-C35 Aqueous	ug/l										<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<0.1	<0.1	140	<0.1	<0.1	250			
Total Aliphatics C5-C35 Aqueous	ug/l										<10	<10								<10	<10					<10	<10	<10	<10	<10	<10									
Aliphatics >C5-A4	ug/l																															<0.1	<0.1	2.6	<0.1	<0.1	20			
Aromatics >C5-C7	ug/l										<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Aromatics >C7-C8	ug/l										<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Aromatics >C8-C10 EC10	ug/l										<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Aromatics >EC10-EC12	ug/l										<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Aromatics >EC12-EC16 Aqueous	ug/l										<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Aromatics >EC16-EC21 Aqueous	ug/l										<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<0.1	<0.1	0.9	<0.1	<0.1	3.7			
Aromatics >EC21-EC35 Aqueous	ug/l										<10	<10								<10	<10					<10	<10	<10	<10	<10	<10	<0.1	<0.1	18	<0.1	<0.1	46			
Total Aromatics C6-C35 Aqueous	ug/l										<10	<10								<10	<10					<10	<10	<10	<10	<10	<10									
Aromatics >C35 - 44																																<0.1	<0.1	2.3	<0.1	<0.1	12			
TPH (Aliphatics and Aromatics) C5-C35 Aqueous	ug/l																																							
Total Aliphatic TPH	ug/l										12	<10								<10	<10					<10	<10	<10	<10	<10	<10	<5	<5	140	<5	<5	270			
Total Aromatic TPH	ug/l																															<5	<5	21	<5	<5	31			
Total petroleum hydrocarbons	ug/l																															<10	<10	160	<10	<10	340			
SVOC by SCAN																																								
Phenols																																								
2-Chlorophenol	ug/l	50									<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
2-Methylphenol	ug/l	100									<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
3-Nitrophenol	ug/l										<1	1900								<1	<1					<1	<1	<1	<1	<1	<1									
2,4-Dichlorophenol	ug/l	20									<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
2,4-Dimethylphenol	ug/l										<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
2,4,5-Trichlorophenol	ug/l										<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
2,4,6-Trichlorophenol	ug/l										<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
4-Chloro-3-methylphenol	ug/l	40									<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
4-Methylphenol	ug/l	100									1	1300								<1	<1					<1	<1	<1	<1	<1	<1									
4-Nitrophenol	ug/l										<1	3000								<1	<1					<1	<1	<1	<1	<1	<1									
Pentachlorophenol	ug/l	0.4									<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
Phenol	ug/l	7.7									51	16000								11	11					6	7	<1	<1	<1	<1									
Phenols Monohydric	mg/l	0.0077																										<0.03	<0.03	<0.03	<0.03									
Phenols	mg/l	0.0077																														0.12	<0.03	0.08	<0.03	<0.03	<0.03			
PAHs																																								
2-Chloronaphthalene	ug/l																			<1	<1					<1	<1	<1	<1	<1	<1									
2-Methylnaphthalene	ug/l										1	2700								<1	<1					<1	<1	<1	<1	<1	<1									
Acenaphthene	ug/l			<2						4	4.371	4	2000	<2	1.128					<1	<1	6				2	1	<1	<1	<1	<1									
Acenaphthylene	ug/l			<2						<2	0.133	<1	<2	<2	0.857					<1	<1	<2				<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Anthracene	ug/l	0.1		<2						<2	0.3	<1	<2	<2	0.286					<1	<1	<2				<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Benzo(a)anthracene	ug/l			<2						<2	<0.01	<1	<2	<2	0.054					<1	<1	<2				<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Benzo(a)pyrene	ug/l	0.00017	0.01	<2						<2	<0.01	<1	<1	<2	<0.01					<1	<1	<2				<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Benzo(b)fluoranthene	ug/l	0.017	0.1	<2						<2	<0.01	<1	<1	<2	<0.01					<1	<1	<2				<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Benzo(k)fluoranthene	ug/l	0.017	0.1	<2						<2	<0.01	<1	<1	<2	<0.01					<1	<1	<2				<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Benzo(ghi)perylene	ug/l	0.0082	0.1	<2						<2	<0.01	<1	<1	<2	<0.01					<1	<1	<2				<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Indeno(1,2,3-cd)pyrene	ug/l		0.1	<2						<2	<0.01	<1	<1	<2	<0.01					<1	<1	<2				<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Chrysene	ug/l			<2						<2	<0.01	<1	<1	<2	0.016					<1	<1	<2				<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Dibenzo(a,h)anthracene	ug/l			<2						<2	<0.01	<1	<1	<2	<0.01					<1	<1	<2				<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Fluoranthene	ug/l	0.0063		<2						<2	0.544	<1	<1	<2	2.428					<1	<1	<2				<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Fluorene	ug/l			<2						<2	0.444	<1	<1	<2	1.428					<1	<1	<2				<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Naphthalene	ug/l	2		<2						45	10.059	23	2000	28	1.19					<1	1	4				<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Phenanthrene	ug/l			<2						<2	0.455	<1	<1	8	2.843					<1	<1	3				<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Pyrene	ug/l			<2						<2	0.079	<1	<1	<2	0.121					<1	<1	<2				<1	<1	<1	<1	<1	<1	<2	<2	<2	<2	<2	<2			
Total PAHs (USEPA 16)				<77						16.446	<32	<66			9.194					<320	<61																			
Phthalates																																								
Bis(2-ethylhexyl)phthalate	ug/l	1.3									2	4200								<2	<2					<2	<2	<2	20	<2	<2									
Butylbenzyl phthalate	ug/l	20									<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
Di n-butyl phthalate	ug/l	8									<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
Di n-Octyl phthalate	ug/l	20									5	5								<5	<5					<5	<5	<5	<5	<5	<5									
Diethyl phthalate	ug/l	100									<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
Dimethyl phthalate	ug/l	800									<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
Other Semi-Volatiles																																								
1,2-Dichlorobenzene	ug/l	20									<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
1,2,4-Trichlorobenzene	ug/l	0.4									<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
1,3-Dichlorobenzene	ug/l	20									<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
1,4-Dichlorobenzene	ug/l	30									<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
2-Nitroaniline	ug/l										<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
2,4-Dinitrotoluene	ug/l										<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									
2,6-Dinitrotoluene	ug/l										<1	<1								<1	<1					<1	<1	<1	<1	<1	<1									

Sample Reference		Screening Criteria		CA8HS01	CA8HS02	CA8HS03	BH5	BH13	BH14	CA8HS03	CA8HS03	BH1	BH2	BH3	BH4	BH6	BH7	BH8	BH9	BH11	BH17	BH18	BH15	BH19	BH20	BH21	CA8HS01	CA8HS01	CA8HS01	CA8HS01	CA8HS05	BH16	BH16	BH16	BH12	BH12	BH12	BH13	BH13	BH13	BH14	BH14	BH14	BH15	BH15	BH15
Round				Round 1	Round 2	Round 3				Round 1	Round 2																Round 1	Round 2	Round 3	Round 4	Round 5				Round 1	Round 2	Round 3	Round 1	Round 2	Round 3	Round 1	Round 2	Round 3	Round 1	Round 2	Round 3
Sample Type				W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W
Sample Received Date										20/04/2002																																				
Sampled Date	Units	EQS	DWS	31/01/2002	11/04/2002	26/06/2005	06/07/2006	06/07/2006	06/07/2006	14/03/2002	17/04/2002	25/06/2005	25/07/2005	26/06/2005	27/07/2006	06/07/2006	06/07/2006	06/07/2006	06/07/2006	06/07/2006	06/07/2006	06/07/2006	06/07/2006	06/07/2006	06/07/2006	06/07/2006	10/05/2002	Apr-02	17/04/2002	31/03/2003	01/06/2004	07/07/2006	27/02/2008	17/03/2008	21/04/2003	26/04/2005	06/05/2015	06/05/2015	06/05/2015	12/05/2005	18/05/2015	06/05/2015	12/05/2005	18/05/2015	06/05/2015
Response Zone (KS) Details				MG	MG	MG	MG	MG	MG	MG / TRG	MG / TRG	MG / TRG	MG / TRG	MG / TRG	MG / TRG	MG / TRG	MG / TRG	MG / TRG	MG / TRG	MG / TRG	MG / TRG	MG / TRG	MG / TRG	MG / TRG	MG / TRG	MG / TRG	TRG(Peak)	TRG(Peak)	TRG(Peak)	TRG(Peak)	TRG(Peak)	TRG	TRG (Peak)	TRG (Peak)	TRG	TRG	TRG	TRG (Peak)	TRG (Peak)	TRG (Peak)	TRG (Peak)	TRG (Peak)	TRG (Peak)	TRG (Peak)	TRG (Peak)	TRG (Peak)	TRG (Peak)
Depth																																	0.75	5.25	6.50	7.12	8.48	0.68	0.87	2.52	7.38	2.82	5.86
Installation Details																																	TTD (Peat)	TTD (Peat)	Deep	Deep	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep
Metals																																														
Arsenic	ug/l	50	10	2	2	1				1	1																2	<1	6		4		8	7.9	4.2	5.6	9.8	6.7	17	22	43	18	27
Beryllium Dissolved	ug/l																																<1	<1	100	180	1400	760	340	4000	600	4400	340	
Boron	ug/l	2000	1000	<50	50	130				<50	<50																84	1100	1000		800				<5.0	<5.0	<5.0	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Cadmium Dissolved	ug/l	0.15	5	<0.1	<0.1	<0.1				<0.1	<0.1																<0.1	<0.1	<0.1		<0.1															
Calcium Dissolved	ug/l									169000	178000																176000	192000	189000						77000	77000	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Chromium Dissolved	ug/l		50	3	<1	<1				2	<1																42	<1	<1		10		10	5	13	16	230	20	50	88	5	100	20	100	20
Copper Dissolved	ug/l	10	2000	<1	<1	<1				<1	<1																3	2	2		<0.1		<1.0	2.5	5.8	2.5	7.3	5	52	23	24	39	100	
Iron Dissolved	ug/l	1000	200	50	165	20				50	<10																400	210	430		400		<50	<50	20	100									
Lead Dissolved	ug/l	1.2	10	<1	<1	<1				<1	<1																<1	<1	<1		<0.1		<0.5	<0.4	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mercury Dissolved	ug/l	0.07	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								
Magnesium Dissolved	ug/l									<30	<30																187000	189000	162000		94000		94000	88000											
Manganese Dissolved	ug/l	30	50	2	2	2				2	2																1100	1100	1100		1100		1.1	1.1											
Nickel Dissolved	ug/l	4	20	5	8	5				5	7																7	8	8		7		2.3	1.2	2.7	1.1	8	2.2	12	<1	4.3	13	13	13
Selenium Dissolved	ug/l		10	10	8	5				15	7																11	10	7		4		8	6	5.3	4.9	6.4	8.4	29	24	39	23	55	
Strontium Dissolved	ug/l																																5	3											
Cadmium Total	ug/l	0.15	5																														18	0.8											
Zinc Total	ug/l	75	5	7	16	18				4	24																15	15	40		16		200	200	3.5	1.7	4.1	1.4	4	7.5	3.8	6	12
Mercury Total	ug/l	0.07	1																														<0.1	<0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	ug/l									6	4																1		1																
Non-Metal Inorganics																																														
Sulphate Total	mg/l																																380	550											
CaCO3 Alkalinity as CaCO3	mg/l									796	788																1760	1610	1660				200	1100	730	1100	1400							
Chloride	mg/l	5																															36	16											
CN	mg/l				240	220																											1000	110											
Potassium Dissolved	mg/l		200							159	139																68.1	65.4	65.5				41	36											
Sodium Dissolved	mg/l		200							15.9	12.5																1400	1900	1100				1400	15											
Nitrate as NO3	mg/l		50							<0.5	0.6																<0.5	<0.5	<0.5		<0.3		<0.3	<0.3											
Total Sits sulphur	mg/l																																1000	110											
Sulphate (soluble)	mg/l	400	250																														67	150											
Chloride	mg/l	250	25							43	38																1700	1700	1700				1700	1700	1700	1700	1700								
Fluoride	mg/l									11.6	7																0.4	<0.3	0.3				<0.5	<0.5											
Phosphate	mg/l			<0.1	<0.1	<0.1				<0.1	<0.1																4.9	1.5	0.9		0.17														
Nitrite	mg/l	5000	1500							1.5	1.5																1.8	1.4	0.9																
Ammoniacal Nitrogen as N	mg/l	0.6		2.2	2.1	2.5				1.5	1.5																24.8	19.3	19.1		26		17	16	2.6	7.6	60								
Unionised ammonia	mg/l																																													
Total Ammonium as NH4	mg/l		0.5																														21												
Total Cyanide	mg/l	0.003	0.05	<0.05	<0.05	<0.05				<0.05	<0.05																<0.05	<0.05	<0.05		<0.05		<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Free Cyanide	mg/l																																<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Complex Cyanide Dissolved	mg/l																																2												
Sulphate	mg/l	6.6	6.5-10	12.3	11.8	11.9				12.5	12.6																7.2	7	7.1		7		7.5	7.77	8.3	8.5	7.6	7.6	8	7.8	7.8	7.6	8.4
Total Sulphur as SO4	mg/l			902	927	1000				1630	1590																116	122	70.2		7.8														
Volume Extractable Material	mg/l			123	221	1400				166	71																<5	10	8		<5														
Conductivity	uS/cm			2640	1750	1640				3850	4220																9090	7860	7930		9100														
Isopropanol	mg/l			1.1	1.6	0.9				1.1	0.5																64	64	48		1.9														
CO2	mg/l			29	31	54				13	13																1760	1610	1660																
Acetate Alkalinity as CaCO3	mg/l																																													
Phenols																																														
Phenols Monohydric	ug/l																																<0.01	<0.01											
Phenols	mg/l	0.0077																									<0.05	<0.05	<0.05						<0.02	<0.03	<0.03								
Phenol Index	ug/l			0.1	0.2	0.2				0.12	0.19																<0.25	<0.25	<0.25		<0.25														
Organics																																														
GRO (C4-C12)																																	<10	<10											
Benzene	ug/l	10	1			<200				2	<1																<1	<1	<1	<1	<1		<100	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	ug/l	10				<200				17	10																<1	<1	<1	<1	<1		<100	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	ug/l	20				<200				13	8																<1	<1	<1	<1	<1		<100	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
m & p Xylene	ug/l	30				<200				45	28																<1	<1	<1	<1	<1		<100	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
o Xylene	ug/l	30				<200				35	21																<1	<1	<1	<1	<1		<100	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Methyl tert-butyl ether (MTBE)																																	<10	<10	<1	<1	<1								
SVOC																																														
Naphthalene	ug/l																																<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
Phenanthrene	ug/l																																<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	ug/l																																<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	ug/l																																<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	ug/l																																<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a) anthracene	ug/l																																<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	ug/l																																<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b) fluoranthene	ug/l																																<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k) fluoranthene	ug/l																																<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i) perylene	ug/l																																<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd) pyrene	ug/l																																<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenz(a,h)anthracene	ug/l																																<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Coronene	ug/l																																<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TPH CWG																																														
Aliphatics >C5-C6	ug/l					<200				<1	<1																<1	<1	<1		<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aliphatics >C6-C8	ug/l					<200				<1	<1																<1	<1	<1		<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aliphatics >C8-C10	ug/l					<200				<1	<1																<1	<1	<1		<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aliphatics >C10-C12	ug/l					<200				<1	<1																<1	<1	<1		<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aliphatics >C12-C16	ug/l					<200				<1	<1																<1	<1	<1		<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aliphatics >C16-C21	ug/l					<200				<1	<1																<1	<1	<1		<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aliphatics >C21-C35	ug/l					<200				<1	<1																<1	<1	<1		<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total Aliphatics C5-C35 Aqueous	ug/l																																<10	500											
Aromatics >C5-C7	ug/l																																<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C7-C8	ug/l																																<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C8-C10	ug/l																																<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C10-C12	ug/l																																<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C12-C16	ug/l																																<10	590	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C16-C21	ug/l																																<10	610	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C21-C35	ug/l																																<10	510	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Aromatics C5-C35 Aqueous	ug/l																																<10	1700											
Aliphatics >C5-35	ug/l																																		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C5-35	ug/l																																<10	1700	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Aromatic TPH	ug/l																																<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
>C8-C10	ug/l						279					13	192	769	145																	<100													
>C10-C12	ug/l						2400					79	2720	8640	1130																	<100													
>C12-C16	ug/l						8700					181	12300	45000	3450																	<100													
>C16-C21	ug/l						11000					290	21000	54500	3230																	<100													
>C21-C35	ug/l						22000					274	2200	44000	2180																	<100													
Total Range Hydrocarbons	ug/l																															10		10											
Total petroleum hydrocarbons	ug/l						14000	47000	100	400		28000	800	51000	156000	5000	1700	900	1300	200	2500	900	300	4600	1300	46100	9700			390	300	500	120	2200	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
PAH																																														
Acenaphthene	ug/l					<20				<2							38.704	0.130	0.498	<0.05	153.236	<0.05	8.100	76.758	0.212	423.001	205.114			<2	0.14	<0.05	0.122	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	ug/l					<20		<0.05	<0.05	<2							2.152	0.095	0.29	<0.05	2.562	<0.05	0.240	0.481	<0.05	<0.05	4.223			<2	0.01	<1	<0.05	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	ug/l	0.1				<20		<0.05	<0.05	<2							<0.05	0.038	<0.05	<0.05	<0.05	<0.05	0.64	1.128	<0.05	18.663	<0.068			<2	<0.01	<0.05	<0.05	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	ug/l					<20		<0.05	<0.05	<2							<0.05	0.086	<0.05	0.083	<0.05	<0.05	<0.05	1.79	0.11	6.338	0.227			<2	<0.01	<0.05	<0.05	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	ug/l	0.00017	0.01			<20		<0.05	<0.05	<2							<0.05	0.127	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.068			<2	<0.01	<0.05	<0.05	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	ug/l	0.017	0.1			<20		<0.05	<0.05	<2							<0.05	0.045	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.068			<2	<0.01	<0.05	<0.05	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	ug/l	0.0082	0.1			<20		<0.05	<0.05	<2							<0.05	0.049	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.068			<2	<0.01	<0.05	<0.05	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	ug/l	0.017	0.1			<20		<0.05	<0.05	<2							<0.05	0.085	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.068			<2	<0.01	<0.05	<0.05	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	ug/l					<20		<0.05	<0.05	<2							0.862	0.267	0.401	0.087	1.201	0.201	2.716	12.016	0.481	31.816	1.3			<2	<0.01	<0.05	<0.05	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenz(a,h)anthracene	ug/l	N/A	0.1			<20		<0.05	<0.05	<2							<0.05	0.022	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.068			<2	<0.01	<0.05	<0.05	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	ug/l	2				1027		<0.05	1.17	8							792.055	0.513	16.54	<0.05	0.212	1.862	11.869	0.844	8.213	363.879				<2	0.84	<0.5	0.555	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	ug/l					53		<0.05	0.168	20							18.596	0.108	1.229	<0.05	37.751	<0.05	2.95	124.297	1.207	329.099	78.513			<2	<0.01	<0.05	0.106	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	ug/l					42		<0.05	0.152	8							0.867	0.246	0.387	0.097	1.681	0.032	0.934	10.237	0.618	20.841	2.605			<2	<0.01	<0.05	<0.05	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total 16 Total	ug/l					<1456		<0.8	<2.358	<329							<984.119	<2.151	<11.776	<0.0914	<836.601	<1.015	<17.976	<868.689	<4.086	<1153.844	<984.669			<32	1.69	<2.2	<1.411	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
VOCs																																														
1,1,1,2-Tetrachloroethane	ug/l					<200				<1	<1																						<1	<1	<1	<1	<1								
1,1,1-Trichloroethane	ug/l	100				<200				<1	<1																				<1	<1	<1	<1	<1	<1	<1								
1,1,2,2-Tetrachloroethane	ug/l					<200				<1	<1																				<1	<1	<1	<1	<1	<1	<1								
1,1,2-Trichloroethane	ug/l	400				<200				<1	<1																				<1	<1	<1	<1	<1	<1	<1								
1,1-Dichloroethane	ug/l					<200				<1	<1																				<1	<1	<1	<1	<1	<1	<1								
1,1-Dichloroethene	ug/l					<200				<1	<1																				<1	<1	<1	<1	<1	<1	<1								
1,2-Dichlorobenzene	ug/l	0.4				<1000				<5	<25																				<1	<1	<1	<1	<1	<1	<1								
1,2,3-Trichlorobenzene	ug/l					<1000				<5	<25																				<1	<1	<1	<1	<1	<1	<1								
1,2,4-Trichlorobenzene	ug/l	0.4				<1000				<5	<25																				<1	<1	<1	<1	<1

Appendix 5

Surface Water Laboratory Data

NMCAN
Surface Water Sample Analysis & Screening Assessment
FLZB
01/07/2015

Monitoring Round / Location	Units	Screening Criteria			E1 / R10	E2 / R10	E3 / R10	24/08/2008	24/08/2008	E1 / R11	E2 / R11	E3 / R11	24/08/2008	24/08/2008	E1 / R12	E2 / R12	E3 / R12	24/08/2008	24/08/2008	1 / SW501	2 / SW501	1 / SW502	2 / SW502	1 / SW503	2 / SW503	1 / SW504	2 / SW504	Q1 / 14.3	Q2 / 15.3	1 / EL-new1	2 / EL-new1	3 / EL-new1	4 / EL-new1	1 / MD5WN	2 / MD5WN	3 / MD5WN	4 / MD5WN	1 / MD5WS	2 / MD5WS	3 / MD5WS	4 / MD5WS
Date Sampled		EQS	DWS	CCW	11/12/2007	18/03/2008	24/06/2008			11/12/2007	18/03/2008	24/06/2008			11/12/2007	17/03/2008	24/06/2008			01/04/2015	15/04/2015	22/04/2015	01/04/2015	15/04/2015	22/04/2015	01/04/2015	15/04/2015	22/04/2015	01/06/2015	15/04/2015	22/04/2015	01/05/2015	03/03/2014	15/06/2004	20/09/2004	06/05/2005	18/04/2002	18/04/2002	15/06/2004	06/05/2005	18/04/2002	18/04/2002	15/06/2004	06/05/2005
Metals & Non-Metal Inorganics																																								
Hardness Total	mg/l				250	266	242	480	224	328	314	447	206	203	270	208																								
Total Alkalinity	mg/l																																	149		143		151	116	
Bicarbonate Alkalinity as CaCO3	mg/l																																	149	143			151	116	
Calcium Dissolved	mg/l	50	10																	5.5	4.2	6.9	4.2	3.4	2	1.4	1.6	<1	1.8	<1	<1	1.88	1.17	<1	1	1	2	<1	<1				
Boron Dissolved	mg/l	2000	1000																	990	76	74	1050	1600	149	1100	910	69	970	990	24	64.6	49.9	60	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Calcium Dissolved	mg/l			100000	76	82	4.2	101	67	101	5.1	110	68	62	5.5	61																		53.7	49.6										
Sodium Dissolved	mg/l		200																															2160	1200										
Potassium Dissolved	mg/l																																	2160	1320										
Cadmium Dissolved	mg/l	0.15	5	5																0.13	<0.08	1.6	0.098	<0.08	<0.08	0.2	<0.08	<0.08	0.16	<0.08	<0.08	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium Dissolved	mg/l		50																	13	1.1	<1	15	2.5	<1	16	1.6	<1	18	<1	<1	2.8	1.41	<1	<1	3	<1	<1	<1	12	<1	<1	<1
Copper Dissolved	mg/l	10	2000		19	<0.85	9	<0.85	12	<0.85	10	<0.85	14	<0.85	11	<0.85	24	<0.85	2.1	3.3	1.5	1.7	1.5	<0.85	<0.85	1.6	<0.85	<0.85	<0.85	1.75	<1	<1	<1	<1	3	<1	2	<1	8	<1	2
Lead Dissolved	mg/l	1.2	10	250	17	<0.02	8	<0.02	10	<0.02	6	<0.02	9	<0.02	<0.02	<0.02																		<0.02	0.081	<1	<1	<1	<1	<1	<1	<1	<1	<1
Magnesium Dissolved	mg/l				15	14	5.1	15	11	13	5.5	16	13	16	5.5	16																										
Nickel Dissolved	mg/l	4	20	100	10	<1	<1	<1	<1	<1	7	<1	<1	<1	15	<1																		1.7	1.17	2	<1	2	1	<1	<1	<1	10	<1	<1
Selenium Dissolved	mg/l		10																	<1	1.6	4.5	2.2	3.1	2.3	1.9	1.6	1.8	<1	<1	<1	0.48	0.829	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc Dissolved	mg/l	75		1000																														7	9	11	<2	8	10	7	<2	11	80	9	<2
Manganese Dissolved	mg/l	123	50																															1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
Iron Dissolved	mg/l	1000	200																															<100	<100	<100	100	100	<100	<100	100	<100	<100	100
Mercury Dissolved	mg/l	0.07	1																															<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum Dissolved	mg/l																																		<1	<1								
Cadmium Total	mg/l	0.15	5	5	0.3	<0.5	0.5	0.5	0.7	0.6	0.8	0.5	0.6	<0.5	<0.5	<0.5																								
Zinc Total	mg/l	75		1000	20	20	14	110	37	37	50	39	41	15	42	7																		7	<5	<5	5	8	<5	5	8	<5	<5	5
COD	mg/l																																	<5	<5			<5	<5					
BOD	mg/l	5		18	21	2	4	17	7	12	27	22	6	<1	6	<1																		4.5	<2.0			1	<2.0					
TOC	mg/l																																	1.6	3.3			1.8	4.2					
Nitrate as N	mg/l		50	1	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	2.4	2.1	0.7	3.1															<0.3	0.4	<0.3	<0.3	4.4	3.3	4.1	4.3			2.4	2.9
Nitrate as NO3	mg/l		50	1	1.3	<0.3	<0.3	<0.3	<0.3	1.2	<0.3	<0.3	10.6	9.3	3.1	13.733															<0.03	9.72										
Nitrite as N	mg/l		0.51277853	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																										
Nitrite as NO2	mg/l		0.5	1																											<0.05	<0.05										
Nitrogen Total Oxidised as N	mg/l		50	1	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	2.4	2.1	0.9	3.2															<0.3	2.23										
Phosphate, Ortho as P	mg/l		0.2	<0.1	<0.1	<0.1	<0.1	0.1	0.2	<0.1	1.6	1.8	<0.1	<0.1	<0.1	<0.1															0.07	0.24	0.14	0.71	0.5	0.1	0.11	0.06	0.5	0.1	0.1	0.05
Phosphate, Ortho as PO4	mg/l	120																													245	92.5										
Sulphate (soluble)	mg/l	400	250	500																											11.8	21.5										
Sulphate as SO4	mg/l	480	250	300	12	16	<5	<5	9	10	<5	9	21	21	25	21															26.6	21.6	6.35	225	32	28.5	27.8	26.9	26.7	25	27.1	26
Toluene Extractable Material	mg/l																														<6	<6	<6	<6	<5	<5	<6	<6	<5	<5	<6	<6
Chloride	mg/l	250	250	300	35	62	17	28	21	17	21	21	37	14	22	16															49	23	28	33	19	26	21	23			21	23
Fluoride	mg/l	5000	1500																																4.4	1.6						
Sulphide	mg/l																																							
Ammoniacal Nitrogen as N	mg/l	0.6		1	0.49	0.43	0.22	1.04	0.26	0.23	0.22	0.52	<0.2	0.05	<0.2	<0.2	0.17	0.7	0.48	0.064	0.11	0.12	0.52	0.034	0.041	0.078	0.13	0.06	0.206	0.237	0.3	0.5	0.17	2.1	0.2	0.2	0.1	<0.03	0.2	0.1	0.06	0.02
Cyanide Total	mg/l	0.001	0.05																												<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cyanide Free	mg/l																<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05														
Thiocyanate as SCN	mg/l																														0.1	<0.1	0.2	0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.2	0.1
Dissolved Oxygen	mg/l				0	4.56	1.87	1.91	6.6	5.67	0.47	3.23	7.61	12.72	0.93	7.6													7.41	14												
Dissolved Oxygen (Saturation)	mg/l	60			0	37.5	17.5	19.2	46.6	47.9	4.9	31	65.5	109.9	6.6	71.5																										
pH (Acidity)	pH units	6.5 - 9	6.5-10	6.8-8.5	7.3	7.7	7.1	7.1	7.3	7.4	7.1	7	7.5	8	7.8	7.8	8.6	7.7	8	8.5	8.3	8.1	8.7	8.5	9	8.6	8.6	8.2			7.4	7.4	7	7.4	7.5	8	7.6	8	7.7	7.8	7.6	8.1
Conductivity	us/cm																														725	480	584	522	439	439	687	479	642	395	483	481
Organics																																								
GRO (C5-C12)	ug/l																<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3										
MTBE	ug/l																<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7										
Benzene	ug/l	10	1														<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4										
Toluene	ug/l	50															<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5										
Ethyl benzene	ug/l	20															<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8										
m & p Xylene	ug/l	30															<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5										
o Xylene	ug/l	30															<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8										
TPH																																								
Aliphatics C5-C6	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10										
Aliphatics >C6-C8	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10										
Aliphatics >C8-C10	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10										
Aliphatics >C10-C12	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10										
Aliphatics >C12-C16 Aqueous	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10										
Aliphatics >C16-C21 Aqueous	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10										
Aliphatics >C21-C35 Aqueous	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10										
Total Aliphatics C5-C35 Aqueous	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10										
Aromatics >C5-C7	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10										
Aromatics >C7-C8	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10										
Aromatics >C8-C10	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10										
Aromatics >C10-C12	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10										
Aromatics >C12-C16 Aqueous	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10										
Aromatics >C16-C21 Aqueous	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10										
Aromatics >C21-C35 Aqueous	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10										
Total Aromatics C12-C35 Aqueous	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10										
Total Aliphatic TPH	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10										
TPH >C5-C6	ug/l				<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80																								
TPH >C6-C8	ug/l				<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80																								
TPH >C8-C10	ug/l				<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80																								
TPH >C10-C12	ug/l				43	<80	<80	<80	<80	<80	115	138	<80	<80	<80	<80																								
TPH >C12-C16	ug/l				255	<200	<200	52	220	206	284	159	<200	<200	<200	<200																								
TPH >C16-C40	ug/l				298	<200	<200	52	220	510	412	159	<200	<200	<200	<200																								
Total petroleum hydrocarbons	ug/l																<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Phenols																																								
2-Chlorophenol	ug/l	50															<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5												
2- Methyl 4,6-Dinitrophenol	ug/l																<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5												
2-Methylphenol	ug/l	100															<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5												
2-Nitrophenol	ug/l																<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5												
2,4-Dichlorophenol	ug/l	20															<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5												
2,4-Dimethylphenol	ug/l																<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5												
2,4,5-Trichlorophenol	ug/l																<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5												
2,4,6-Trichlorophenol	ug/l																<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5												
4-Chloro 3-methylphenol	ug/l	40															<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5												
Pentachlorophenol	ug/l	100															<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5												
Pentachlorophenol	ug/l	0.4															<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5												
Phenol	ug/l	7.7															<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5												
Phenols	ug/l	#N/A															<0.03	0.28	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03												
Phenol Index	mg/l																														<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
PAHs																																								
2-Chloronaphthalene	ug/l																<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5												
2-Methylnaphthalene	ug/l																<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5												
Acenaphthene	ug/l																<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015												
Acenaphthylene	ug/l																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1												
Anthracene	ug/l	0.1															<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015												
Benzo(a)anthracene	ug/l																<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017												
Benzo(a)pyrene	ug/l	0.00017	0.01														<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1												
Benzo(b)fluoranthene	ug/l	0.0017	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												
Benzo(k)fluoranthene	ug/l	0.0017	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												
Benzo(ghi)perylene	ug/l	0.0082	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												
Chrysene(1,2,5-cd)pyrene	ug/l		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												
Chrysene	ug/l																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1												
Dibenzo(a,h)anthracene	ug/l																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1												
Fluoranthene	ug/l	0.0063															<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1												
Fluorene	ug/l																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1												
Naphthalene	ug/l	2															<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1												
Phenanthrene	ug/l																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1												
Pyrene	ug/l																<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1												
Total PAHs (UKPN 16)	ug/l																																							
VOCs																																								
1,1,1,2-Tetrachloroethane	ug/l																<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2												
1,1,1-Trichloroethane	ug/l	100															<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
1,1,2-Trichloroethane	ug/l	400															<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
1,1-Dichloroethane	ug/l																<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5												
1,1-Dichloroethene	ug/l																<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
1,1-Dichloropropene	ug/l																<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5												
1,2,3-Trichlorobenzene	ug/l	0.4															<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2												
1,2,3-Trichloropropane	ug/l																<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50												
1,2,4-Trichlorobenzene	ug/l	0.4															<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
1,2,4-Trimethylbenzene	ug/l																<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3												
1,2-Dibromo-3-Chloropropane	ug/l																<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50												
1,2-Dibromoethane	ug/l																<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5												
1,2-Dichlorobenzene	ug/l	20															<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3												
1,2-Dichloroethane	ug/l	10	3														<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2												
1,2-Dichloropropane	ug/l																<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
1,3,5-Trimethylbenzene	ug/l																<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
1,3-Dichloropropane	ug/l																<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2												
1,3-Dichlorobenzene	ug/l	20															<0.5	<0.5	<0.5	<0.8	<0.9	<0.10	<0.11	<0.12	<0.13	<0.14	<0.15	<0.18												
2-Chlorotoluene	ug/l																<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
4-Chlorotoluene	ug/l																<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
4-Isopropyltoluene	ug/l																<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
Benzene	ug/l	10	1														<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7										
Bromobenzene	ug/l																<1	<1	<1	<1	<1	<1	<1

Appendix 6

Soil Leachate Laboratory Data

M4CAN
Leachate Samples Analysis & Screening Assessment
CL-26 - Leachate - Metal Recovery Area
30/06/2015

Geological Formation Legend

MG	Made Ground
TFD	Tidal Flat Deposits

Screening Values & Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc

Sample Reference	Units	Screening Criteria		CATP008	MRTP002	MRTP003	BH512		MRTP003	CATP010	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
Specimen Depth (m)				1	0.5	0.5	3.5 - 3.7		3.5	3.5							
OD Level (m)							3										
Sample Type							ES										
Geology Code		EQS	MRV	MG	MG	MG	MG		TFD	TFD							
Cluster Code				2002	2002	2002	2015 GI		2002	2002							
2:1 Results																	
Arsenic Dissolved	ug/l	50	10	<1	<1	<1	8.2		8	2	6	3	8.2	2	BH512 @ 3.5 - 3.7mbGL	0	0
Boron Dissolved	ug/l	2000	1000	<50	60	<50	60		<50	90	6	3	90	60	CATP010 @ 3.5mbGL	0	0
Barium Dissolved	ug/l										4	0	None > LOD	None > LOD			
Beryllium Dissolved	ug/l										4	0	None > LOD	None > LOD			
Cadmium Dissolved	ug/l	0.15	5		<0.1	<0.1	<0.08		<0.1		4	0	None > LOD	None > LOD		0	0
Chromium Dissolved	ug/l		50	<1	1	17	6.1		0.1	1	6	5	17	0.1	MRTP003 @ 0.5mbGL		0
Copper Dissolved	ug/l	10	2000	2	10	3	2.1		4	<1	6	5	10	2	MRTP002 @ 0.5mbGL	0	0
Iron Dissolved	ug/l	1000	200	<10	10	110			180	220	5	4	220	10	CATP010 @ 3.5mbGL	0	1
Mercury as Hg Dissolved	ug/l	0.07	1	<0.1	**<0.1**	**<0.1**	**<0.5**		**<0.1**	<0.1	6	0	None > LOD	None > LOD		0	0
Molybdenum Dissolved	ug/l										4	0	None > LOD	None > LOD			
Nickel Dissolved	ug/l	4	20	1	5	1	1.2		1	<1	6	5	5	1	MRTP002 @ 0.5mbGL	1	0
Lead Dissolved	ug/l	1.2	10	2	4	<1	<1		<1	<1	6	2	4	2	MRTP002 @ 0.5mbGL	2	0
Antimony Dissolved	ug/l		5		4						4	1	4	4	MRTP002 @ 0.5mbGL		0
Selenium Dissolved	ug/l		10	1	46	1	4.6		<1	1	6	5	46	1	MRTP002 @ 0.5mbGL		1
Vanadium Dissolved	ug/l										4	0	None > LOD	None > LOD			
Zinc Dissolved	ug/l	75		10	46	20	4		16	18	6	6	46	4	MRTP002 @ 0.5mbGL	0	
Ammoniacal Nitrogen as N	mg/l	0.6		0.3	0.2	0.2			0.6	1.1	5	5	1.1	0.2	CATP010 @ 3.5mbGL	1	
Conductivity uS/m @ 25c	mg/l			1460	8000	1740			135	264	5	5	8000	135	MRTP002 @ 0.5mbGL		
pH	pH units	6-9	6.5-10	12.2	12.9	12.2	9		9.8	8.8	6	6	12.9	8.8	MRTP002 @ 0.5mbGL	0	0
Chloride as Cl	mg/l	250	250	<2	<2	<2			2	8	5	2	8	2	CATP010 @ 3.5mbGL	0	0
Total Sulphur as S04 Dissolved	mg/l			57	24.5	12.2			11.7	56.2	5	5	57	11.7	CATP008 @ 1mbGL		
Thiocyanate as SCN	mg/l			<0.1	<0.1	0.2			<0/1	<0.1	5	1	0.2	0.2	MRTP003 @ 0.5mbGL		
Phosphate as P	mg/l			<0.1	0.1	0.1			0.3	<0.1	5	3	0.3	0.1	MRTP003 @ 3.5mbGL		
Total Cyanide	mg/l	0.001	0.05	<0.05	**<0.05**	**<0.05**	**<0.05**		**<0.05**	<0.05	6	0	None > LOD	None > LOD		0	0
Cyanide Free	mg/l						<0.05				1	0	None > LOD	None > LOD			
Phenols																	
Phenols	mg/l	0.0077					**<0.03**				1	0	None > LOD	None > LOD		0	
BTEX																	
Benzene	ug/l	10	1				<1				1	0	None > LOD	None > LOD		0	0
Toluene	ug/l	50					<1				1	0	None > LOD	None > LOD		0	
Ethylbenzene	ug/l	20					<1				1	0	None > LOD	None > LOD		0	
m,p xylenes	ug/l	30					<1				1	0	None > LOD	None > LOD		0	
O-Xylene	ug/l	30					<1				1	0	None > LOD	None > LOD		0	
TPH																	
Aliphatics >C5-C6	ug/l						<0.1				1	0	None > LOD	None > LOD			
Aliphatics >C6-C8	ug/l						<0.1				1	0	None > LOD	None > LOD			
Aliphatics >C8-C10	ug/l						<0.1				1	0	None > LOD	None > LOD			
Aliphatics >C10-C12	ug/l						<0.1				1	0	None > LOD	None > LOD			
Aliphatics >C12-C16	ug/l						<0.1				1	0	None > LOD	None > LOD			
Aliphatics >C16-C21	ug/l						<0.1				1	0	None > LOD	None > LOD			
Aliphatics >C21-C35	ug/l						<0.1				1	0	None > LOD	None > LOD			
Aliphatics >C35-44	ug/l						<0.1				1	0	None > LOD	None > LOD			
Aromatics >C5-C7	ug/l						<0.1				1	0	None > LOD	None > LOD			
Aromatics >C7-C8	ug/l						<0.1				1	0	None > LOD	None > LOD			
Aromatics >C8-C10	ug/l						<0.1				1	0	None > LOD	None > LOD			
Aromatics >C10-C12	ug/l						<0.1				1	0	None > LOD	None > LOD			
Aromatics >C12-C16	ug/l						<0.1				1	0	None > LOD	None > LOD			
Aromatics >C16-C21	ug/l						<0.1				1	0	None > LOD	None > LOD			
Aromatics >C21-C35	ug/l						<0.1				1	0	None > LOD	None > LOD			
Aromatics >C35-44	ug/l						<0.1				1	0	None > LOD	None > LOD			
Total Aliphatic TPH	ug/l						<5				1	0	None > LOD	None > LOD			
Total Aromatic TPH	ug/l						<5				1	0	None > LOD	None > LOD			
Total petroleum hydrocarbons	ug/l						<10				1	0	None > LOD	None > LOD			
PAH																	
Acenaphthene	ug/l						<0.1				1	0	None > LOD	None > LOD			
Acenaphthylene	ug/l						<0.1				1	0	None > LOD	None > LOD			
Anthracene	ug/l	0.1					<0.1				1	0	None > LOD	None > LOD		0	
Benz(a)anthracene	ug/l						<0.1				1	0	None > LOD	None > LOD			
Benzo(a)pyrene	ug/l	0.00017	0.01				**<0.1**				1	0	None > LOD	None > LOD		0	0
Benzo(b)fluoranthene	ug/l	0.017	0.1				**<0.1**				1	0	None > LOD	None > LOD		0	0
Benzo(ghi)perylene	ug/l	0.0082	0.1				**<0.1**				1	0	None > LOD	None > LOD		0	0
Benzo(k)fluoranthene	ug/l	0.017	0.1				**<0.1**				1	0	None > LOD	None > LOD		0	0
Chrysene	ug/l						<0.1				1	0	None > LOD	None > LOD			
Dibenzo(ah)anthracene	ug/l						<0.1				1	0	None > LOD	None > LOD			
Fluoranthene	ug/l	0.0063					<0.1				1	0	None > LOD	None > LOD		0	
Fluorene	ug/l						<0.1				1	0	None > LOD	None > LOD			
Indeno(123cd)pyrene	ug/l	N/A	0.1				**<0.1**				1	0	None > LOD	None > LOD		0	0
Naphthalene	ug/l	2					<0.1				1	0	None > LOD	None > LOD		0	
Phenanthrene	ug/l						<0.1				1	0	None > LOD	None > LOD			
Pyrene	ug/l						<0.1				1	0	None > LOD	None > LOD			
PAH 16 Total	ug/l						<2				1	0	None > LOD	None > LOD			

M4CAN
Leachate Samples Analysis & Screening Assessment
CL-26 - Leachate - Reedbed No. 1
30/06/2015

Geological Formation Legend

MG	Made Ground
sed	Sediment
TFD	Tidal Flat Deposits

Screening Values & Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc

Sample Reference	Units	Screening Criteria		SBHJ01CP	SWSJ01	SWSJ01	SWSJ02	SWSJ03	SWSJ06B	SWSJ07	BH508		SWSJ04	SWSJ05
Specimen Depth (m)				1	0.1	0.3	1	1	0.1	0.3	0 - 0.3		1	1
OD Level (m)				5.57	5.72	5.52	4.88	4.92	5.86	5.66	5.9		4.97	4.82
Sample Type				D	ES	ES	ES	L	ES	ES	ES		ES	L
Geology Code		EQS	DWS	MG-slag	MG-slag	MG-slag	MG-sed	MG-sed	MG-sed	MG-sed	MG-slag		TFD	TFD
Cluster Code				2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2015 GI		2007 GI	2007 GI
2:1 Results														
Arsenic Dissolved	ug/l	50	10	<1	<1	1	1	1	1	<1	<1		<1	<1
Boron Dissolved	ug/l	2000	1000	<10	56	<10	200	120	110	110	<20		80	80
Barium Dissolved	ug/l			6900	39	25	25	6	54	11			8	14
Beryllium Dissolved	ug/l			<1	2	<1								
Cadmium Dissolved	ug/l	0.15	5	<0.4	1.2	<0.4	<0.4	<0.4	<0.4	<0.4	<0.08		<0.4	<0.4
Chromium Dissolved	ug/l		50	<1	1	<1	<1	<1	<1	2	5.8		<1	<1
Copper Dissolved	ug/l	10	2000	18	1	3	<1	3	5	2	7.6		<1	3
Iron Dissolved	ug/l	1000	200	<5	340	3700	<5	66	<5	160			26	39
Mercury Dissolved	ug/l	0.07	1								<0.5			
Molybdenum Dissolved	ug/l			2	<1	5	1	<1	<1	<1			2	4
Nickel Dissolved	ug/l	4	20	11	5	7	3	4	3	3	<1		2	3
Lead Dissolved	ug/l	1.2	10	1	4	<1	<1	<1	<1	2	<1		<1	<1
Antimony Dissolved	ug/l		5	<5	<5	<5	<5	<5	<5	<5			<5	<5
Selenium Dissolved	ug/l		10	<1	1	18	<1	2	2	<1	<1		<1	<1
Vanadium Dissolved	ug/l			<1	<1	<1	<1	<1	4	1			<1	<1
Zinc Dissolved	ug/l	75		<3	40	<3	4	4	6	11	18		<3	<3
Total Cyanide	mg/l	0.001	0.05	<0.05	0.48	9.4	0.1	<0.05	<0.05	0.29			<0.05	<0.05
Total Diss Sulphur	mg/l													
pH	pH units	6-9	6.5-10								8.6			
Cyanide	mg/l										<0.05			
Cyanide Free	mg/l										<0.05			
Phenols														
Phenols	mg/l	0.0077									<0.03			
BTEX														
Benzene	ug/l	10	1								<1			
Toluene	ug/l	50									<1			
Ethylbenzene	ug/l	20									<1			
m,p xylenes	ug/l	30									<1			
O-Xylene	ug/l	30									<1			
TPH														
Aliphatics >C5-C6	ug/l										<0.1			
Aliphatics >C6-C8	ug/l										<0.1			
Aliphatics >C8-C10	ug/l										<0.1			
Aliphatics >C10-C12	ug/l										<0.1			
Aliphatics >C12-C16	ug/l										<0.1			
Aliphatics >C16-C21	ug/l										<0.1			
Aliphatics >C21-C35	ug/l										<0.1			
Aliphatics >C35-44	ug/l										<0.1			
Aromatics >C5-C7	ug/l										<0.1			
Aromatics >C7-C8	ug/l										<0.1			
Aromatics >C8-C10	ug/l										<0.1			
Aromatics >C10-C12	ug/l										<0.1			
Aromatics >C12-C16	ug/l										<0.1			
Aromatics >C16-C21	ug/l										<0.1			
Aromatics >C21-C35	ug/l										<0.1			
Aromatics >C35-44	ug/l										<0.1			
Total Aliphatic TPH	ug/l										<5			
Total Aromatic TPH	ug/l										<5			
Total petroleum hydrocarbo	ug/l										<10			
PAH														
Acenaphthene	ug/l										<0.1			
Acenaphthylene	ug/l										<0.1			
Anthracene	ug/l	0.1									<0.1			
Benz(a)anthracene	ug/l										<0.1			
Benzo(a)pyrene	ug/l	0.00017	0.01								<0.1			
Benzo(b)fluoranthene	ug/l	0.017	0.1								<0.1			
Benzo(ghi)perylene	ug/l	0.0082	0.1								<0.1			
Benzo(k)fluoranthene	ug/l	0.017	0.1								<0.1			
Chrysene	ug/l										<0.1			
Dibenzo(ah)anthracene	ug/l										<0.1			
Fluoranthene	ug/l	0.0063									<0.1			
Fluorene	ug/l										<0.1			
Indeno(123cd)pyrene	ug/l	N/A	0.1								<0.1			
Naphthalene	ug/l	2									<0.1			
Phenanthrene	ug/l										<0.1			
Pyrene	ug/l										<0.1			
PAH 16 Total	ug/l										<2			

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
10	4	1	1	SWSJ02 @ 1mbGL	0	0
10	7	200	56	SWSJ02 @ 1mbGL	0	0
10	9	6900	6	SBHJ01CP @ 1mbGL		
10	1	2	2	SWSJ01 @ 0.1mbGL		
10	1	1.2	1.2	SWSJ01 @ 0.1mbGL	1	0
10	3	5.8	1	BH508 @ 0 - 0.3mbGL		0
10	8	18	1	SBHJ01CP @ 1mbGL	1	0
9	6	3700	26	SWSJ01 @ 0.3mbGL	1	2
1	0	None > LOD	None > LOD		0	0
10	5	5	1	SWSJ01 @ 0.3mbGL		
10	9	11	2	SBHJ01CP @ 1mbGL	3	0
10	3	4	1	SWSJ01 @ 0.1mbGL	2	0
10	0	None > LOD	None > LOD			0
10	4	18	1	SWSJ01 @ 0.3mbGL		1
10	2	4	1	SWSJ06B @ 0.1mbGL		
10	6	40	4	SWSJ01 @ 0.1mbGL	0	
9	4	9.4	0.1	SWSJ01 @ 0.3mbGL	4	4
0	0	None > LOD	None > LOD			
1	1	8.6	8.6	BH508 @ 0 - 0.3mbGL	0	0
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD		0	0
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD		0	
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			
1	0	None > LOD	None > LOD			

Appendix 7

Relevant Extract from Additional Environmental Data

Plate 01: Extract of 1969 Aerial Photograph.

Plate 02: Extract of 1979 Aerial Photograph.

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591 Checked By: Date: Oct 2015

Plate 03: Extract of 1991 Aerial Photograph.

Plate 04: Extract of 2006 Aerial Photograph.

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591 Checked By: Date: Oct 2015

Plate 05: Extract of 2013/14 Aerial Photograph.

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591 Checked By: Date: Oct 2015

Welsh Government

M4 Corridor around Newport

Land Contamination Assessment Report Annex D
CL-26, Llanwern Steel Works – Volume 2 - Lagoon Areas

M4CaN-DJV-EGT-ZG_GEN-RP-EN-0018

At issue | March 2016

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1 Introduction

1.1 Background

1.1.1 This report relates an area of land occupied by a series of lagoon areas associated with the Llanwern Steel Works and hereinafter referred to as the 'Site'. The site forms part of an area of land potentially affected by contamination identified as CL26 in the 2014 PSSR (Ove Arup and Partners, 2014). The remaining areas of CL-26 affected by the Scheme are reported within Volume 1 which includes the Reed beds and Metal Recovery Area.

1.1.2 The Site is located between chainage 14,900 and 16,800 (See Figure 3), upon the southern part of Llanwern Steel Works (south of the A4810).

1.2 Reporting Context

1.2.1 The Site has been assessed as part of ground investigations and monitoring associated with the wider works for the M4 Corridor around Newport (M4CaN) (hereafter referred to as the 'Scheme') and informs the baseline for the environmental impact assessment (EIA) for the Scheme. The EIA is reported in the Environmental Statement (ES) of which this document is an appendix to the chapter on Geology and Soils.

1.2.2 In 2014, a Preliminary Sources Study Report (2014 PSSR) was prepared as an initial land contamination appraisal (Ove, Arup & Partners, 2014) as part of the Design Manual for Roads and Bridges (DMRB) Stage 2 Assessments for this Scheme. This identified a number of individual areas that may have been affected by contamination as a result of historical activities at the Site. In addition, this report draws upon information available from the 2015 Supplementary Ground Investigation Works undertaken on behalf of the Welsh Government (Geotechnical Engineering, 2015). This report relates to the area as defined on the Site Location Plan Figure 3.

1.2.3 The overarching rationale and approach for the assessment of areas of land along the Scheme with potential contamination is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES).

1.3 Objectives

1.3.1 The key objectives of this report are as the below.

- Undertake a risk assessment of the Site and determine whether potential risks to human health or controlled waters could exist based upon the Scheme
- Identify the need for further assessment and investigation in order to refine potential land contamination risks and inform the need for remediation/mitigation;
- To provide information to support the Ground Investigation Report (GIR) and Geotechnical Design Report (GDR) required under DMRB HD22/08 (Highways Agency, 2008).

1.4 Report Structure

1.4.1 The subsequent report structure is as follows.

- Section 2: Site Location and Description.
- Section 3: The Scheme – This section details the new section of motorway alignment and associated features at the Site;
- Section 4: Site History – This section summarises the history of the Site based on historical maps and historical land photographs.
- Section 5: Environmental Setting – This section summarises the Site description, published geology, hydrology and hydrogeology and relevant environmental information presented in the 2014 PSSR.
- Section 6: Scope of Investigations – This section describes the previous and supplementary ground investigation data available for the Site;
- Section 7: Ground Conditions – This section describes the main findings of the intrusive site investigations including the ground conditions encountered and significant visual or olfactory evidence of contamination identified;
- Section 8: Contamination Assessment – This section describes the findings of the Tier 1 and Tier 2 contamination risk assessment based upon potential contamination sources, potential receptors and potential contaminant linkages and presents the human health and controlled waters assessment.
- Section 9: Refined Conceptual Site Model – This section presents the Conceptual Site Model (CSM) for the Site and identifies contaminant linkages, based upon the findings of the data presented within Sections 2 to 7.
- Section 10: Conclusions and Recommendations - This section provides conclusions concerning the likelihood of land contamination associated with the Site affecting the Scheme and subsequent requirements for remediation / mitigation.
- Section 11: References – This section details the key reference documents referred to within the text; and
- Section 12: Glossary – This section details the key terms and acronyms used throughout the report.

2 Site Location and Description

2.1.1 The Llanwern Steel Works former lagoons area is located approximately 3 km to the east of Newport City centre and is centred on National Grid Reference ST 376 858. It forms part of the still operational Tata Steel Works, which is located directly to the north across the A4810 as shown in Figure 3.

2.1.2 The Site is bound to the north by the A4810, to the east by CL27 Green Moor Lane Landfill, part of land potentially affected by contamination CL26 to the west by Monks Ditch beyond which are the Metal Recovery area of Llanwern Steel Works (Volume 1). The south is bounded by a drainage ditch with fields and an electrical sub-station and agricultural land beyond.

2.1.3 The Site is associated with the active steelworks operated by TATA Steel.

2.1.4 Review of the onsite processes has indicated potential contamination sources associated with these industrial waste management and disposal areas within the proposed route corridor, as shown on Figure 3.

2.1.5 Lagoons 12, 25, 27 and 26 (also known as Llanwern south tips), are located in the southern half of a roughly rectangular area, and is approximately 1500m by 600m. The lagoons lie north of and adjacent to an area designated as an SSSI (Gwent Levels). The lagoons are formed with slag bunds up to approximately 8m high. Lagoon 27 is split into quadrants, referred to here as 27NE, 27NW, 27SE and 27SW.

2.1.6 To the north of the lagoons is an industrial plant site (occupied by BOC) and smaller drainage lagoons. In 2010, Tata Steel was granted an Environmental Permit for non-hazardous waste disposal (Permit No. EPR/GP3331SV) in Lagoon 26, although at the time of writing, the landfill has not yet been constructed. The site also has two other environmental permits associated with waste disposal operations. The permitting regime of the Site is detailed further in Section 5 and the area shown on Figure 3.

2.1.7 It is understood that a number of sludge lagoons were filled with washing from the Basic Oxygen Steelmaking (BOS) processes and blast furnaces (BF). Other materials that may have been disposed at the lagoons include palm oil from the strip mill (specific to Lagoon 27NW).

2.1.8 Site observations from various walkover surveys indicated material to be fine sediment with visual evidence of hydrocarbon in lagoons 27NW and 27NE.

2.1.9 The use and current state of each lagoon is summarised in Table 1 below:

Table 1: Use and Current State of Lagoons

Area	Use / Current state
Lagoon 12	Approximately 200,000 m^3 of BOS/BF slurry contained within slag bunds. Firm ground surface overgrown with rough vegetation and small trees.
Lagoon 25	Approximately 570,000 m^3 of BOS/BF slurry contained within slag bunds. Firm ground surface starting to be become vegetation.
Lagoon 27SW	BOS/BF slurry contained within slag bunds. Firm ground surface.
Lagoon 27SE	Empty lagoon (never used). Eastern slag bund removed. Contains some rough vegetation and small trees.

Area	Use / Current state
Lagoon 27NW	Approximately 2/3 full of oily mill scale/hot mill sludge contained within slag bunds. Surface water with free product.
Lagoon 27NE	Lagoon never used but does contain some surface water with oily sheen. Traces of reens in original ground surface visible at base.
Lagoon 26	Empty lagoon (never used as a lagoon). Slag bunds removed. Figure 4 shows the existing site around elevations based upon LIDAR survey imagery. Surface covered by slag based materials. Area now used by Tarmac for slag weathering.

3 The Scheme

3.1.1 The Site is located within the new section of motorway footprint at approximate chainage 14,900 and 16,400 as shown in Figure 3.

3.1.2 The Scheme consists of the mainline alignment within the Site to be positioned on an embankment some 2 m to 3 m high. A new junction (Glan Llyn junction) is proposed to the west of the Site, linking the new M4 to the A4810 way slip roads. The junction is located within the Metal Recovery Area of Llanwern Steel Works (Volume 1) at approximately 14,900 to 15,100.

3.1.3 The area affected by the Scheme comprises Lagoons 12, 25, 27SE, 27SW and 26, as shown on Figure 3. Lagoons 27 NE and NW are not affected by the Scheme and are to remain unaltered. The engineering design of the construction of the motorway through the Tata Lagoons is as below.

- Excavate and treat lagoon waste and create a material suitable for reuse as a construction material within the motorway embankment subject to compliance with environmental and geotechnical acceptability criteria.
- The existing lagoon bunds will be excavated and reconstructed north of the motorway.
- The dirty and clean ditches will be reconstructed to replicate the existing arrangements.

3.1.4 The boundaries of the existing permit (licence) boundaries will be revised such that the permanent land take that will be owned by Welsh Government will be outside the revised permit boundaries. Land previously within permitted areas will be surrendered.

3.1.5 The proposed lagoon material waste treatment is expected to be cement stabilised. Sampling and leaching trials are currently being undertaken to enable an assessment and definition of acceptability of use criteria. The current design of these works has been agreed with NRW as being acceptable in principle.

3.1.6 The Conceptual Site Model (Figure 2) shows the new section of motorway outline design for the Site.

4 Site History

4.1.1 The 2014 PSSR historical searches have been based on Ordnance Survey plans, literature reviews, information provided by Natural Resources Wales (NRW) (formally Environment Agency Wales) and Newport City Council and interpretation of aerial photography.

4.1.2 This is supplemented by a review of historical maps obtained in 2015 from Welsh Government. Relevant extracts are presented in Appendix 7.

4.1.3 A summary of the Site's history is presented in Table 2 below.

Table 2: Site History

Date	Use	Source of information
1843 - 1893	The site comprises a number of agricultural fields traversed by ditches and reens. A road crosses through the southern area of Lagoons 25 and 27 and along the western boundary. A number of buildings are located within the western boundary of Lagoon 12.	1:10,560 historical map
1891 - 1912	No significant change	1:10,560
1904-1939	No significant change	1:10,560 historical map
1920	No significant change	1920 OS map
1962	Llanwern Steel Works operation commenced.	2014 PSSR
1964 - 1965	A possible residential property 'Moorview' is located within Lagoon 27. BOC plant partially developed to the north.	1,250 historical map
1979	Construction of **Lagoon 12**. Expansion of BOC plant works.	Aerial photography
1979	**Llanwern Landfill** (covering the whole of the Site area)	Environment Agency
1985 - 1991	**Settling ponds** identified in Lagoons 12 and 25. **Construction of bunds** for Lagoons 26 and 27.	Aerial photography 1:10,000 historical map
1991 - 2001	**Earthworks / infilling** activity ongoing in Lagoons 12, 25, 26 and 27	Aerial photography
2006	No significant change. Earthwork activity particularly evident within Lagoon 26	Aerial photography
2014	A number of (central settling ponds) Lagoons 12, 25 and Lagoon 27SW appear vegetated.	Aerial photography

Note : Potential contamination sources are underlined. Those within the temporary and permanent land take are shown in bold.

4.1.4 The sources of information presented above supplement those used in the 2014 PSSR. Relevant extract of the photographs are presented in Appendix 7.

4.1.5 The construction of the lagoons and associated waste disposal are considered to represent the main source of contamination at the Site. There locations are detailed in Figure 1.

4.1.6 Historically the Site was also used as bombing decoy site during World War II which is described in detail within the 2014 PSSR (Ove Arup 2014) and the Explosive Ordnance Threat Assessment Report (Bactec, 2014). There is thus a risk from buried unexploded ordnance at the Site which is categorised as a medium risk site in the Explosive Ordnance Threat Assessment Report.

5 Environmental Setting

5.1 Geology

5.1.1 British Geological Survey (BGS) data indicates that the Site is underlain by Tidal Flat Deposits, comprising layers of sand, gravel and peat. The underlying solid geology is the Mercia Mudstone Group comprising weathered mottled and often fractured mudstones.

5.2 Hydrology

5.2.1 The Site is situated within the low lying area known as the Gwent Levels which has many surface water reens and ditches. The Bowleaze Reen and Parish Reen are located adjacent to the southern boundary of the Site, south of Lagoons 25 and 27. Monks Ditch flows from north to south beyond the western boundary of the Site.

5.2.2 To the South-West, South and East of the Tata Steelworks lagoons area are two ditches known as the “dirty ditch”, which is adjacent to the lagoons, and the “clean ditch” which is immediately to its West, South and East. The “dirty ditch” currently collects any surface run off and any leachate that manages to flow out of the lagoons. The “clean ditch” acts as a final barrier of any water bourne contamination migrating from the lagoons that manages to escape from the “dirty ditch” for instance in an emergency. Both of the ditches flow into Tata steels effluent treatment systems and, once treated waters discharged into the Severn Estuary via Tata’s pipeline in accordance with their authorised discharge consent (APR/BS3905IP). Thus Tata’s lagoon systems are designed such that any surface run off or leachate is prevented from entering the sensitive Gwent Levels.

5.3 Hydrogeology

5.3.1 NRW records indicate that the Tidal Flat Deposits are classified as non-productive strata (negligibly permeable). The Mercia Mudstone Group strata are classified as a Secondary B aquifer (variable permeability).

5.3.2 Groundwater is anticipated to be present between the interface of the Mercia Mudstone Group and Tidal Flat Deposits. Furthermore, perched water may be encountered at shallow depth within any made ground, above the clay strata of the Tidal Flat Deposits.

5.4 Environmental Information

5.4.1 The following section provides an overview of NRW information associated with the Sites.

5.4.2 Three companies located within the Site or its vicinity hold an industrial pollution licence. Details are provided in Table 3.

Table 3: Industrial pollution licences

Licence	Year	Release environment	Substances Released	Comments
Company: Cambrian Stone LTD. **Industry**: Metal. **Process**: Ferrous metals				150 m north of the Site
AD1925	1998 to 2001	Air	Particulate matter – total Sulphur oxides	
Company: Air Products (GB) Ltd and (BR) Ltd **Industry**: Fuel and Power **Process**: Gratification and refining etc				150 m north of the Site
AF7002 and BL2459IC	1998 to 2012	Reuse	Special waste (7000g)	
		Disposal- incineration	Special waste (100g)	
		Disposal- landfill	Special waste (59.64t)	
		Air	Carbon dioxide, carbon monoxide and nitrogen oxides (as NO2)	
Company: Tata Steel UK Limited **Industry**: Metal **Process**: Ferrous metals				Main steel works area, to the north, across the A4810
BS3905IP	2004 - 2012	Air	Particulate matter – total sulphur oxides, carbon monoxide, carbon dioxide, methane, nitrous oxides, VOCs inorganic chlorine compounds, hydrogen chloride	
		Water	Heavy metals, cyanides, nitrogen, phenols, TOC	

- Two companies located within 300 m to the north of the site held industrial pollution licences. These are Koppers UK LTD which held a licence for landfill disposal and air pollution until 2000 and Multiserv (ASR) LTD which held two air pollution licences until 2002.
- No abstraction licences are identified within the Site boundary.
- Three authorised landfill sites including one under closure have been recorded within the Site boundary as detailed in Table 4 below. All three environmental regulated facility boundaries will be impacted by the motorway alignment and a proportion of the land falls within the proposed land take as shown on Figure 4;

Table 4: Authorised Environmental Regulated Facilities Within Site Boundary

Landfill and Address	Location	Licence type	Licence Status
Corus UK Limited PPC, Llanwern South Side of Queensway Landfill	Covering the central section of the site including Lagoons 12, 25 and 26	Industrial waste landfill (Factory curtilage) EPR/HP3899FC	Modified (under closure)
Tata Steel UK Limited, Llanwern Works	Covering Lagoon 27	Industrial waste landfill (Factory curtilage) EPR/BS3905IP	Effective
Tata Steel UK Limited South Side Of Queensway Llanwern Landfill	Covering Lagoon 26	Waste Landfilling; >10 T/D with capacity >25,000T excluding inert waste EPR/GP3331SV (superseding EAWML 30009)	Effective

- One historic landfill was recorded adjacent to the east of the site boundary but also encompassed Reedbed No.2, as detailed in Table 5 and shown on Figure 4.

Table 5: Historic landfills off site boundary

Landfill name and address	Location	Material type	Date waste first and last received
Llanwern Steelworks Land adjacent to 1-3 Blast Furnacre Corus, Llanwern Works (CL-27 site)	Adjacent to the eastern site boundary encompassing Reedbed No.2.	Industrial waste and liquid sludge	Nov 1981 – June 1984

5.4.3 Regulated land taken as part of the Compulsory Purchase Order for this scheme will lead to partial permit surrender for the facilities as Welsh Government will not want to be holders of an Environmental Permit. The partial surrender applications will need to demonstrate that the land does not pose a risk to the environment, that the sites condition has not deteriorated from that at the time of the permit issue in the case of industrial installations, and is not and will not cause a significant risk to the environment. The permit boundaries will be re-drawn as part of the process, removing the permanent land take from the confines of the regulated facility.

5.4.4 The new section of motorway alignment will cross through, Lagoons 12, and 25, which form part of the closed landfill (EPR/GP3331SV). The site is operated, maintained, monitored and controlled in line with the requirements laid out in the accepted site Closure Report "Geotechnology report 664.1/0/0708" and supporting information.

5.4.5 Llanwern Steel Works (EPR/BS3905IP) produces 2,000,000 tonnes of hot rolled coil per year in various sizes and a variety of finishes for the manufacturing sector. The regulated facility consists of hot rolling, cold rolling, pickling and galvanising activities. The process waters from the facility is treated to remove solids and oils, combined with drainage from a lagoon before discharging into the Severn Estuary via a Mid Effluent Outfall.

5.4.6 Lagoon 27 forms part of the on-site treatment facility. Divided into four equal quarters, accepting waste from the hot milll activity. The new section of motorway alignment will pass through the two southerly quarters of the lagoon. The lagoon waste will be excavated to make way for the new section of motorway. The excavated waste will likely require treatment before reuse within the Scheme. The alignment will also pass the southern tip of Reedbed No.2, with the underpass from the A4810 impacted the eastern permitted boundary, please see Figure 4.

5.4.7 South Side of Queensway Non-Haz Landfill (EPR/GP3331SV) is an historic landfill; the current permission operating at the site exceeds EAWML 30009. The Non-Hazardous Landfill is an in-house disposal facility for the Llanwern steel plant. The permit regulates the disposal of a maximum 13,500 tonnes per annum of waste in the fully re-engineered cell, of that 10,000 tonnes Non-Hazardous and 3,500 tonnes of Inert Waste. However it is known the site is not and has not been actively accepting waste. The new section of motorway will pass the southern section of the landfill.

5.4.8 The environmental information confirms the various site usages could represent potential contamination sources that requires due consideration in relation to the Scheme.

5.4.9 The new section of motorway will cross through the lagoons which will partially be excavated. The new section of motorway will also comprise creation of new bunds and drainage channels. The permits operating across the site EPR/HP3899FC, EPR/BS3905IP and EPR/GP3331SV will require a partial surrender application to remove the permanent land take required for the new section of motorway. Surrender applications will be submitted post construction works, demonstrating that the land, following remedial works, no longer poses a risk to the environment. Details of the environmental permit strategy are provided outside this report.

6 Scope of Investigations

6.1 General

6.1.1 Five previous intrusive ground investigations have been undertaken at the Site.

6.2 Scope of Works

6.2.1 The various intrusive ground investigations undertaken within the Site are summarised in Table 6 and Figure 1. Those located outside the lagoon's footprints have been identified within the table.

Table 6: Ground Investigation Summary

Site Location	Date	Contractor	Boreholes	Window Sampler	Trial Pits	Sampling
Lagoon 12	2002	Exploration Associates	LGBH1-3	-	-	Soil & groundwater
	2005/2006	Enviros	BH14a, BH14b	-	-	-
	2008	Norwest Holst	SBHJ04	SWSJ09, SWSJ09A, SWSJ10, SWSJ11, SWSJ12, SWSJ13, SWSJ14, SWSJ15, SWSJ16, SWSJ17, SWSJ17A	-	-
	2015	Geotechnical Engineering Limited	BH513, BH514/514A, BH515 (outside lagoon), BH516	-	TP506	Soil, groundwater & gas
Lagoon 25	2002	Exploration Associates	LGBH4, LGBH5 (outside lagoon), LGBH7, LGBH9 (outside lagoon)	-	-	Soil & groundwater
	2005/2006	Enviros	BH24 (outside lagoon)	-	-	-
	2008	Norwest Holst	SBHJ05	SWSJ18, SWSJ19, SWSJ20, SWSJ21, SWSJ22,	-	-

Site Location	Date	Contractor	Boreholes	Window Sampler	Trial Pits	Sampling
				SWSJ22A, SWSJ22B, SWSJ23, SWSJ24, SWSJ24A, SWSJ25, SWSJ26, SWSJ27, SWSJ28, SWSJ29, SWSJ30		
	2015	Geotechnical Engineering Limited	BH518 (outside lagoon), BH519 (outside lagoon)	WS501	-	-
Lagoon 27SW	2002	Exploration Associates	LGBH10	-	-	Soil & groundwater
	2005/2006	Enviros	BH17 (outside lagoon)	-	-	-
	2008	Norwest Holst	SBHJ06, SBHJ06CP, SBHJ07CP, SBHJ07RC, SBHJ07ARC, SBHJ07BRC	SWSJ31, SWSJ32, SWSJ33, SWSJ34,	-	-
	2015	Geotechnical Engineering Limited	BH520	-	-	-
Lagoon 27SE	2002	Exploration Associates	LGBH12	-	-	Soil & groundwater
	2004/20 05/ 2006	Enviros	BH19 (outside lagoon)	-	TP4 (outside lagoon)	No logs for TP4
	2008	Norwest Holst	-	SWSJ35, SWSJ35A, SWSJ36, SWSJ37, SWSJ38	-	-
	2015	Geotechnical Engineering Limited	BH521 (outside lagoon)		TP508 (outside lagoon)	Soil, groundwater & gas
Lagoon 26	2005	Enviros	BH20 (outside lagoon), BH21, BH23	-	TP1, TP2 (outside lagoon), TP3	No logs for TP1, TP2 and TP3
	2008	Norwest Holst	SBHJ08CP, SBHJ08ACP,	-	STPJ01, STPJ02,	-

Site Location	Date	Contractor	Boreholes	Window Sampler	Trial Pits	Sampling
			SBHJ09CP, SBHJ10CP		STPJ03, STPJ04, STPJ05, STPJ06	
	2015	Geotechnical Engineering Limited	BH522, BH523, BH524, BH525	-	TP509 (outside lagoon)	Soil, groundwater & gas

6.2.2 The construction details of all monitoring wells installed in boreholes on the Site are summarised in Table 7 their locations are shown on figures 1a-1d.

Table 7: Summary of Borehole Construction Details

Site Area	Borehole ID	Diameter (mm)	Total Drilled Depth (m)	Top of Slotted Well Casing / Gravel Pack (m bGL)	Base of Slotted Well Casing / Gravel Pack (m bGL)	Targeted Geology
Lagoon 12	LGBH2	50	9	0.9	9	Made Ground (CS) / TFD
	LGBH3	50	9	0.9	9	Made Ground (CS) / TFD
	SWSJ13	50	2.55	0.5	2.5	Made Ground (SS)
	LGBH1	50	10.5	8.5	10.5	TFD
	SBHJ04CP	50	18.5	12.1	13.1	TFD (Peat)
	BH515	35		0.85	5.2	Made Ground (CS)
		50		9.8	13.2	TFD (Peat)
Lagoon 25	LGBH4	50	12.5	1	11	Made Ground (CS)
	LGBH7	50	12.2	1	12.2	Made Ground (CS)
	LGBH9	50	7	1.5	7	Made Ground / TFD
	SBHJ05	50	20.5	9.5	11.5	Made Ground (slag type not identified)
	SWSJ21	50	6	4	6	Made Ground (SS)
	SWSJ23	50	8.35	5.8	7.8	Made Ground (SS)
	LGBH5	50	7	1.8	7	Made Ground (CS) / TFD

Site Area	Borehole ID	Diameter (mm)	Total Drilled Depth (m)	Top of Slotted Well Casing / Gravel Pack (m bGL)	Base of Slotted Well Casing / Gravel Pack (m bGL)	Targeted Geology
	BH519	35	18.8	0.85	4.2	Made Ground (CS) / TFD
		50		6.8	11.2	TFD
	BH24	Not known	15	11.5	15	Mercia Mudstone
Lagoon 27SW	SWSJ34	50	6.45	3	6	Made Ground (CS)
	LGBH10	50	15	11	15	TFD
	BH17	Not known	11.5	4.2	6.2	TFD (Peat)
	SBHJ06CP	50	14.9	3.1	4.1	TFD (Peat)
	SBHJ07CP	50	13.3	8.4	10.4	TFD / Mercia Mudstone
Lagoon 27SE	BH18	Not known	12	0.5	3	Made Ground (CS)
		Not known	12	5.8	7.2	TFD (Peat)
	SWSJ37	50	6.45	4.1	5.6	TFD
	LGBH12	50	7	6	10	Made Ground / TFD
	BH521	35	19	4.3	6.2	TFD (peat)
		50	19	8.8	11.2	TFD
Lagoon 26	SBHJ09CP	50	13.2	1	2.2	Made Ground
	BH525	35	22.7	0.5	2.8	Made Ground
		50		9.8	11.8	TFD
	SBHJ10CP	50	13	9	10	TFD
	SBHJ08ACP	50	13.7	6.4	7.4	TFD (Peat)

Note: CS: Coarse Slag
SS: Slurry Slag
TFD: Tidal Flat Deposits

6.3 Surface Water Quality Monitoring

6.3.1 Surface water quality monitoring has been undertaken at multiple locations between 2007 and 2015. Surface water samples from locations SW505 and SW506 have been collected from within the Site boundary whilst the remaining locations were sampled on reens surrounding the Site. Sampling locations are shown on Figure 1 and are described further in Table 8.

Table 8: Surface Water Monitoring Locations

Surface water location ID	Sampling Location description	Comments
R13/ ID B63	Located approximately 180m south of Lagoon 27 at Bowleaze Reen	Flow was recorded as slack and slightly turbid.
15.3	Collected from Monks Ditch down gradient of CL26	____
16.2	Sampled from Bowleaze Reen. Reen with south easterly flow direction from CL26.	____
SW504	Located 70m north of the Site on Monks Ditch	____
SW505	Located to the south west of the lagoons on the boundary of the Site	____
SW506	Located on a drainage ditch in the southeast corner of the Site	____
MC Reen1	Located 150 m south of the Site on Monkscroft Reen	____
MDSWS	Located 150 m south of the Site on Monks Ditch	____
MDSWN	Understood to be located on Monks Ditch, north of the Site. Specific location unknown	____

6.4 Field Testing

6.4.1 Photo Ionisation Detector (PID) monitoring was undertaken on samples from the lagoons. The samples monitored and their respective results are presented in Table 9. Locations and depth ranges from which all PID readings are of 0.0ppm have been omitted from the results in Table 9.

Table 9: PID monitoring results

Location	Samples Monitored	Results
Lagoon 12	SBHJ04, SWSJ09, SWSJ09A, SWSJ10 to SWSJ17A, BH513, BH514, BH514A, BH515, BH516, TP506.	SWSJ10 4-4.5m @ 6.2-29.8ppm SWSJ11 1m @ 0.5ppm, 3.2m @ 7.2ppm SWSJ16 2.3m @ 6.3ppm BH513 0-2.55m @ 0.1-0.2ppm, 3-3.5m @ 0.1ppm, 4.5-5m @ 0.1ppm, 7.5-9m @ 0.2ppm, 11-12.5m @ 0.3ppm BH514 1.5-6.0m @ 0.1-0.3ppm BH514A 0-0.5@ 0.9ppm, 2-3.7m @ 0.3-0.7ppm BH515 0.2-1.6m @ 0.5-3.7ppm BH516 0-3.5m @ 0.6-2.0ppm TP506 1-4m @ 1.3-9.1ppm

Location	Samples Monitored	Results
Lagoon 25	SBHJ05, SWSJ18 to SWSJ26, SWSJ28 to SWSJ30, BH518, WS501.	SBHJ05 11.5-14.5m @ 0.6-1.7ppm SWSJ20 4-6m @ 1.2-29.4ppm SWSJ21 3-4m @ 0.4-1.6ppm SWSJ22B 2-3m @ 3-3.7ppm SWSJ23 1--7.9m @ 0.9-25ppm SWSJ24 1-2m @ 0.7-13.8ppm SWSJ25 1-5m @ 2.2-8.2ppm SWSJ28 1-5m @ 1.1-15ppm SWSJ29 4m @ 2.2ppm SWSJ30 5m @ 0.4ppm BH518 3-4.5m @ 0.1-0.9ppm
Lagoon 27SW	SBHJ07, SWSJ31 to SWSJ34.	SWSJ31 2-5m @ 1.2-10.3ppm SWSJ32 3-8m @ 2.8-11.1ppm SWSJ33 1-4m @ 0.8-7.3ppm SWSJ34 4-6m @ 3.8-10.4ppm
Lagoon 27SE	SWSJ35A to 38, BH521, TP508.	SWSJ35 3-6m @ 0.8-6.2ppm SWSJ36 3-5m @ 3.8-17.3ppm SWSJ37 1-6m @ 1.9-13.1ppm SWSJ38 0.3-6m @ 0.1-35.5ppm BH521 1-6.5m @ 0.1-1.7ppm TP508 0.5-3m @ 0.1-0.7ppm
Lagoon 26	SBHJ09 and 10, STPJ02 to 06, BH522, BH523, BH524, BH525, TP509.	SBHJ10 0.3-5m @ 0.9-3.1ppm BH522 0.5-5.2m @ 0.2-0.3ppm BH523 1.5-1.7m @ 0.1ppm BH524 4-4.2m @ 0.7ppm BH525 1-2.2m @ 0.2ppm

6.5 Groundwater Monitoring

6.5.1 A summary of the groundwater sampling, groundwater monitoring and ground gas monitoring rounds is shown in Table 10.

Table 10: Summary of Monitoring Rounds

Site Area	Location Ref.	Total number of monitoring rounds (date of sampling rounds)	Monitoring details	Notes
Lagoon 12	LGBH2	**7 no**. (2 no. in 2002-date unknown, 22nd February 2008, 17th March 2008)	Groundwater level & sampling	——
	LGBH3	**8 no**. (2 no. in 2002-date unknown, 22nd February 2008, 17th March 2008)	Groundwater level & sampling	——
	SWSJ13	**6 no** (No data-dry)	Groundwater level	——
	LGBH1	**2 no**. (2 no. in 2002-date unknown)	Groundwater sampling	——
	SBHJ04CP	**6 no**. (22nd February 2008, 17th March 2008)	Groundwater level & sampling	——
	BH515 (shallow)	**4 no.** (6th March 2015, 13th March 2015, 18th March 2015, 7th May 2015)	Groundwater level, ground Gas	Outside of lagoon to the north
	BH515 (Deep)	**4 no.** (6th March 2015, 13th March 2015, 18th March 2015, 7th May 2015)	Groundwater level & sampling	Outside of Lagoon to the north

Site Area	Location Ref.	Total number of monitoring rounds (date of sampling rounds)	Monitoring details	Notes
Lagoon 25	LGBH4	**7 no**. (2 no. in 2002-date unknown, 22nd February 2008, 18th March 2008)	Groundwater level & sampling	——
	LGBH9	**8 no**. (3 no. in 2002-date unknown, 22nd February 2008, 17th March 2008)	Groundwater level & sampling	——
	LGBH7	**1 no**. (1 no. in 2002-date unknown)	Groundwater sampling	——
	SBHJ05	**6 no**. (22nd February 2008, 18th March 2008)	Groundwater sampling	——
	SWSJ21	**6 no**. (27th February 2008, 18th March 2008)	Groundwater level & sampling	——
	SWSJ23	**6 no**. (February 2008)	Groundwater level & sampling	——
	LGBH5	**3 no**. (3 no. in 2002-date unknown)	Groundwater sampling	——
	BH519 (shallow)	**4 no**. (19th March 2015, 26th March 2015, 2nd April 2015, 7th May 2015)	Groundwater level & sampling, ground gas	——
	BH519 (deep)	**3 4 no**. (19th March 2015, 26th March 2015, 2nd April 2015, 7th May 2015)	Groundwater level & sampling	——
	BH24	**No data**	——	——
Lagoon 27SW	SWSJ34	**6 no**. (27th February 2008, 19th March 2008)	Groundwater level & sampling	——
	LGBH10	**7 no**. (27th February 2002, 7th March 2002, 27th February 2008, 18th March 2008)	Groundwater level & sampling	——
	SBHJ06CP	**6 no**. (21st February 2008, 17th March 2008)	Groundwater level & sampling	——
	SBHJ07CP	**6 no**. (22nd February 2008, 17th March 2008)	Groundwater level & sampling	——
	BH17	**No data**	——	——
Lagoon 27SE	SWSJ37	**6 no**. (22nd February 2008, 19th March 2008)	Groundwater level & sampling	——
	LGBH12	**7 no**. (2 no. in 2002-date unknown, 27th February 2008, 13th March 2008)	Groundwater level & sampling	——
	BH521 (shallow)	**3 no**. (19th March 2015, 26th March 2015, 2nd April 2015, 7th May 2015)	Groundwater level & sampling, ground gas	——
	BH521 (deep)	**3 no**. (19th March 2015, 26th March 2015, 2nd April 2015, 7th May 2015)	Groundwater level & sampling	——
	BH18	**No data**	——	——
Lagoon 26	SBHJ09CP	**6 no.** (21st February 2008, 18th March 2008)	Groundwater level & sampling	——
	BH525 (shallow)	**3 no.** (19th March 2015, 26th March 2015, 2nd April 2015, 7th May 2015)	Groundwater level & sampling, ground gas	Shallow / deep installation details not known for 26th March 2015 sampling round
	BH525 (deep)	**3 no.** (19th March 2015, 26th March 2015, 2nd April 2015, 7th May 2015)	Groundwater level & sampling	Shallow / deep installation details not

Site Area	Location Ref.	Total number of monitoring rounds (date of sampling rounds)	Monitoring details	Notes
				known for 26th March 2015 sampling round
	SBHJ10CP	**6 no.** (22nd February 2008, 17th March 2008)	Groundwater level & sampling	——
	SBHJ08ACP	**6 no.** (22nd February 2008, 18th March 2008)	Groundwater level & sampling	——

6.6 Laboratory Chemical Testing

6.6.1 A summary of all laboratory analysis undertaken on soil, groundwater, leachate and surface water from the previous site investigations is summarised in Tables 11 to 15 below.

Table 11: Summary of previous investigation sampling

Site Area	Site Investigation date	No. of soil samples	No. of leachate samples	No. of water samples	Suites of testing
Lagoon 12	2002	8	0	6	Metals, pH, phenols, ammoniacal nitrogen, chloride, cyanide, PAH, total TPH
	2004/2005/2006	0	0	0	-
	2008	21	2	6	Metals, pH, phenols, sulphate, ammoniacal nitrogen, chloride, cyanide, PAH, BTEX, SVOCs, VOCs, aliphatic and aromatic TPH, asbestos screen
	2015	11	3	3	Metals, pH, phenols, cyanide, PAH, BTEX, aliphatic and aromatic TPH, carbon banded TPH, PCB, asbestos screen
Lagoon 25	2002	15	2	9	Metals, inorganics, phenol, PAH, VOCs
	2004/2005/2006	0	0	0	-
	2008	25	13	7	Metals, pH, phenols, sulphate, ammoniacal nitrogen, chloride, cyanide, PAH, BTEX, SVOCs, VOCs, aliphatic and aromatic TPH, asbestos screen
	2015	9	4	6	Metals, pH, phenols, cyanide, PAH, BTEX, SVOCs, VOCs, aliphatic and aromatic TPH, PCB, asbestos screen
Lagoon 27SW	2002	4	1	2	Metals, pH, phenols, cyanide, inorganics, TPH, PAH, VOCs

Site Area	Site Investigation date	No. of soil samples	No. of leachate samples	No. of water samples	Suites of testing
	2004/2005/2006	0	0	0	-
	2008	16	5	6	Metals, pH, phenols, sulphate, ammoniacal nitrogen, chloride, cyanide, PAH, BTEX, SVOCs, VOCs, aliphatic and aromatic TPH, asbestos screen
	2015	5	1	0	Metals, pH, phenols, cyanide, PAH, BTEX, aliphatic and aromatic TPH, carbon banded TPH, PCB, asbestos screen
Lagoon 27SE	2002	0	0	2	Metals, pH, phenols, cyanide, inorganics, TPH, PAH, VOCs
	2004/2005/2006	0	0	0	-
	2008	11	4	4	Metals, pH, phenols, sulphate, ammoniacal nitrogen, chloride, cyanide, PAH, BTEX, SVOCs, VOCs, aliphatic and aromatic TPH, asbestos screen
	2015	5	1	3	Metals, pH, phenols, cyanide, PAH, BTEX, aliphatic and aromatic TPH, carbon banded TPH, PCB, asbestos screen
Lagoon 26	2002	4	2	0	Metals, pH, phenols, cyanide, inorganics, TPH, PAH, VOCs
	2008	31	9	6	Metals, pH, phenols, sulphate, ammoniacal nitrogen, chloride, cyanide, PAH, BTEX, SVOCs, VOCs, aliphatic and aromatic TPH, asbestos screen
	2015	13	2	6	Metals, pH, phenols, cyanide, PAH, BTEX, aliphatic and aromatic TPH, carbon banded TPH, PCB, asbestos screen

Soil Analysis

6.6.2 The following sections summarise the laboratory analytical results for soil samples collected during the various intrusive investigation phases. The available data set has been tabulated and is presented in Appendix 3. Supporting laboratory certificates available in the relevant previous ground investigation reports (See Table 5).

6.6.3 To help inform the conceptual ground model, the analytical data from the Made Ground has been assessed separately from those of the natural soils (Tidal Flat Deposits specifically).

6.6.4 For the purpose of meeting the requirements of Volume 4, Section 1, Part 2 of the DMRB (HD22/08 – Managing Geotechnical Risk – 2008 (Highway Agency, 2008), the historical data used to support the PSSR and the additional 2015 information (Geotechnical Engineering, 2015) have been differentiated in the following sections.

6.6.5 The available information has been summarised in Table 12.

Table 12: Summary of Analytical Soil Data

Site Area	Formation Unit	Number of Soil Analysis per Analytical Suite - 2015 data / All GI data								
		Metals & Inorganics	Asbestos	PAH	TPH	Phenol	BTEX	VOCs	SVOCs	Polychlorinated Biphenyl
Lagoon 12	Made Ground	11 / 33	8 / 26	7 / 33	10 / 35	8 / 30	2 / 20	0 / 17	0 / 18	3/20
	Natural Soils	0 / 7	0 / 5	0 / 6	0 / 5	0 / 5	0 / 4	0 / 3	0 / 3	0 / 5
Lagoon 25	Made Ground	5 / 37	5 / 28	5 / 28	3 / 26	5 / 36	3 / 26	0 / 23	0 / 23	2 / 13
	Natural Soils	4 / 12	2 / 4	4 / 7	2 / 4	3 / 11	2 / 4	0 / 2	0 / 2	3 / 5
Lagoon 27SW	Made Ground	5 / 18	3 / 14	5 / 16	3 / 14	5 / 18	3 / 14	0 / 9	0 / 9	1 / 12
	Natural Soils	0 / 3	0 / 1	0 / 1	0 / 1	0 / 3	0 / 1	0 / 1	0 / 1	0 / 1
Lagoon 27SE	Made Ground	4 / 8	3 / 5	4 / 8	4 / 8	2 / 4	1 / 3	0 / 4	0 / 4	0 / 4
	Natural Soils	1 / 5	0 / 4	1 / 4	1 / 4	0 / 4	0 / 4	0 / 4	0 / 4	0 /4
Lagoon 26	Made Ground	10/26	10/23	13/26	9/22	6/19	8/20	0/13	0/13	6/18
	Natural Soils	0 / 5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5

Soil Leaching Analysis

6.6.6 Similarly to the soils data, the soil leachate results have been considered for the Made Ground and natural soils separately. The available information is presented in Appendix 6 and summarised in Table 13.

Table 13: Summary of Soil Leaching Analytical Data

Site Area	Formation Unit	Number of Soil Leachate Analysis per Analytical Suite - 2015 data / All GI data					
		Metals & inorganics	PAH	TPH	Phenol	BTEX	Polychlorinated Biphenyl
Lagoon 12	Made Ground	3 / 14	3 / 3	3 / 3	3 / 3	3 / 3	1 / 1
	Natural Soils	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Lagoon 25	Made Ground	1 / 15	1 / 1	1 / 1	1 / 1	1 / 1	0 / 0
	Natural Soils	3 / 4	3 / 3	3 / 3	2 / 2	3 / 3	0 / 0
Lagoon 27SW	Made Ground	1 / 7	1 /1	1 /1	1 /1	1 /1	0 / 0
	Natural Soils	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Lagoon 27SE	Made Ground	1 / 5	1 / 1	0 / 0	1 / 1	1 / 1	0 / 0
	Natural Soils	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Lagoon 26	Made Ground	2 / 11	2 / 2	2 / 0	2 / 0	2 / 0	1 / 1
	Natural Soils	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0

Groundwater Analysis

6.6.7 The following sections summarise the laboratory analytical results for groundwater samples collected during the various intrusive investigation phases. The available data set has been tabulated in a table format and is presented in Appendix 4 with supporting laboratory certificates available in the relevant original ground investigation reports.

6.6.8 The available data relating to water samples taken from wells installed within the Made Ground and the groundwater of the Glaciofluvial Deposits are summarised in Table 14.

Table 14: Summary of Analytical Groundwater Data

Groundwater Unit (geological formation)	Number of Groundwater Analysis per Analytical Suite (number of well locations) –2015 data / All GI data							
	Metals & inorganics	PAH	TPH	Phenol	BTEX	VOCs	SVOCs	Polychlorinated Biphenyl
Perched (Made Ground)	6 (2) / 46 (13)	6 (2) / 33 (13)	6 (2) / 33 (13)	6 (2) / 26 (13)	6 (2) / 34 (13)	3 (2) / 29 (13)	3 (2) / 28 (13)	2 (1) / 2 (1)
Perched (Tidal Flat Deposits)	15 (4) / 28 (7)	16 (4) / 27 (7)	16 (4) / 27 (7)	15 (4) / 27 (7)	16 (4) / 26 (7)	10 (4) / 24 (7)	10 (4) / 25 (7)	6 (2) / 6 (2)
Aquifer (Mercia Mudstone	0 (0) / 2 (1)	0 (0) / 1 (1)	0 (0) / 1 (1)	0 (0) / 1 (1)	0 (0) / 1 (1)	0 (0) / 1 (1)	0 (0) / 1 (1)	0 (0) / 0 (0)

Surface Water Analysis

6.6.9 Table 15 summarises the laboratory analytical results for surface water samples collected during the various intrusive investigation phases. The available data set has been tabulated and is presented in Appendix 5 with the supporting laboratory certificates available in the relevant original ground investigation reports.

Table 15: Summary of Analytical Surface Water Data

Surface Water System	Number of Water Analysis per Analytical Suite (number of locations) – 2015 data / All GI data				
	Metals & inorganics	Water quality parameters	PAH	TPH	BTEX
Drainage Ditches Onsite	6 (2) / 6 (2)	6 (2) / 6 (2)	6 (2) / 6 (2)	6 (2) / 6 (2)	6 (2) / 6 (2)
Bowleaze Reen	1 (1) / 5 (2)	1 (1) / 5 (2)	1 (1) / 1 (2)	1 (1) / 5 (2)	1 (1) / 1 (2)
Monks Ditch	4 (2) / 12 (4)	4 (2) / 12 (4)	4 (2) / 8 (4)	4 (2) / 7 (4)	4 (2) / 4 (4)
Monkscroft Reen	0 (0) / 4 (1)	0 (0) / 4 (1)	0 (0) / 0 (1)	0 (0) / 0 (1)	0 (0) / 0 (1)

6.7 Gap Analysis of Available Data

6.7.1 Groundwater and ground gas data is only available for one borehole within each lagoon (four in total).

6.7.2 The soil sample data set within the Made Ground in Lagoon 12 is limited to samples within the top 1 m. Considering the overall Made Ground thickness is 7.2-9.3 m. It is possible some stratification of the materials in the lagoons and thus distribution of contamination is like to be present reflecting leaching or sedimentation processes as well as alteration to the steel production processes over the years.

6.7.3 Many boreholes terminated at between 2 and 3 m bGL and the base of the slurry in lagoons has not been proven.

6.7.4 It is recommended that additional investigation is undertaken to mitigate the existing data gaps.

7 Ground Conditions

7.1 General

7.1.1 The geological logs for all available exploratory holes excavated on or in close proximity to the Site are provided in Appendices 1a, 1b, 1c, 1d and 1e. The observed sequence of natural and Made Ground material is consistent with those discussed in the 2014 PSSR and is summarised in the following sections. Information from the Supplementary Ground Investigation (Geotechnical Engineering, 2015) has also been used.

7.1.2 The geological sequence is discussed for Lagoons 12, 25, 27SW, 27SE, and 26.

7.2 Geology – Lagoon 12

Made Ground

7.2.1 Lagoon 12 consists of an approximately 6 m high raised bunded lagoon infilled with waste materials reported to comprise Blast Furnace (BF) and/or Basic Oxygen Slag (BOS) slurry. A coarse fraction of the slag was used to construct the peripheral bund in order to contain the slurry material.

7.2.2 The previous ground investigations have confirmed coarse slag (mainly gravel with infrequent cobble) forms an outer bund with fine material (slurry typically described as silt or clay) placed on top of coarse slag within the lagoon itself. The top of the slurry is generally level with the top of the bund. The slurry was found to be of 3 to 4 m in thickness at least before the exploratory refused on top of dense coarse slag. No boreholes have proven the full sequence of slurry within the lagoon during previous ground investigation. It is understood that the slurry may be interbedded with layers of coarse slag.

7.2.3 The thickness of the coarse slag in the bund ranged between 7.2 and 9.3 m, inferring a basal elevation at 1.51 to 3.5 m AOD.

7.2.4 The base of the lagoon is also reported to comprise a layer of coarse slag although this has not been fully proven by the previous ground investigations. Evidence of this is noted in BH514A and various refusals in window sample boreholes drilled in the main lagoon.

7.2.5 The original ground level (pre-lagoon construction) may be estimated to be at around 5 m AOD, using nearby exploratory locations from outside the lagoon. This would infer the base of the lagoon to be 1.9 to 3.7 m AOD. It is unclear whether the construction of the slag bund was undertaken purposely below the original ground level or whether this is simply a result of compaction and consolidation of the superficial deposits beneath.

Superficial Deposits

7.2.6 Unconsolidated superficial deposits were encountered beneath the slag in all locations. These comprised Tidal Flat Deposits consisting of, generally firm bluish grey clays becoming soft or very soft with depths.

7.2.7 The deposits included a main 1.5 m thick layer of peat, at about 0 m AOD. This peat seems to be continuous beneath Lagoon 12 and extends beyond its footprint.

A discrete shallower and thinner layer was found in borehole SBHJ04 at 1.2 m AOD with a recorded thickness of 0.5 m.

7.2.8 Sand and gravel material considered to represent Glaciofluvial Deposits was found to underlie the predominantly fine and cohesive Tidal Flat Deposits at a depth of -4.7 m AOD (i.e. 16 m below the top of the lagoon). These coarse deposits were discontinuous and were present in borehole SBHJ04 only with thickness of 1.4 m. This material was absent in boreholes BH513 and BH516.

Solid Geology

7.2.9 Below the Tidal Flat Deposits or Glaciofluvial Deposits, the Mercia Mudstone Formation was encountered at depth of 11 to 14.6 m bGL (-6.16 to -5.9 m AOD). The Mercia Mudstone was typically described as very stiff reddish brown clay.

Geological Sequence Summary

7.2.10 The general geological sequence identified during the previous ground investigations is summarised in Table 16.

Table 16: Summary of Geological Sequence – Lagoon 12

Unit	Description	Thickness Range (m)	Basal depth (m AOD)
Made Ground (above original ground level)	Coarse slag forming a retaining peripheral bund which contains slag slurry within.	About 7	Assume 5
Made Ground (below original ground level)	Coarse slag forming a retaining peripheral bund which contains slag slurry within.	1.5 to 4.3	1.9 to 3.7
Superficial Deposits (Tidal Flat Deposits)	Silty clay, organic in places with at least one main peat layer (see below)	8.8 to 9.6	-5.9 to -6.9
Superficial Deposits (Tidal Flat Deposits)	Peat layer	1.2-1.5	-1.76 to – 1.3
Superficial Deposits (Glaciofluvial Deposits)	Sand and gravel	Absent to 1.4	-6.16
Mercia Mudstone	Very stiff becoming weak completely fractured mudstone	>10	< -18.3

7.3 Geology – Lagoon 25

Made Ground

7.3.1 Lagoon 25 consists of an approximately 7 to 8 m high raised bunded lagoon infilled with waste materials reported to comprise Blast Furnace (BF) and/or Basic Oxygen Slag (BOS). As for Lagoon 12, the coarse fraction of the slag was used to construct the peripheral bund in order to contain the slurry material.

7.3.2 The thickness of the coarse slag of the bund ranged from 11.5 to over 12.2 m, inferring a basal elevation at 0.45 - 1.74 m AOD.

7.3.3 No intrusive boreholes proved the full sequence of the waste slurry within the lagoon. It is understood that the slurry may be interbedded with layers of coarse slag as per Lagoon 12.

7.3.4 The original ground level pre-lagoon construction is estimated to be at around 5 m AOD, using nearby exploratory locations from outside the lagoon. This would infer the base of the lagoon to be at a similar albeit slightly greater depth to Lagoon 12.

7.3.5 Made Ground consisting of a clay material with slag content was encountered (0.5 to 2.5 m in thickness) outside and immediately beyond to the south of Lagoon 12 within boreholes LGBH5, BH518, BH519, BH24 and LGBH9.

Superficial Deposits

7.3.6 Unconsolidated superficial deposits were encountered beneath the Made Ground in all locations. These comprised Tidal Flat Deposits, generally firm bluish grey clays becoming soft or very soft with depths.

7.3.7 The deposits included a 1.3 m thick layer of peat, at about -0.26 m AOD in borehole SBHJ05, which appears to be in continuity with the one peat band encountered in Lagoon 12. The top of the peat is shown to rise eastwards up to an elevation of 4.85 m AOD centrally (borehole BH519) and at least 4.78 m AOD at the eastern end (borehole BH24) making the stratum near or in direct contact with the overlying slag. The thickness of the peat also increases eastwards up to 4.15 m centrally (BH519). Boreholes further east of BH519 show the peat to continue being directly beneath the Made Ground although of lesser thickness.

7.3.8 The coarse Glaciofluvial Deposits were not encountered in any of the boreholes sunk within Lagoon 25, although there present cannot be ruled out given there predicted discontinuous nature.

Solid Geology

7.3.9 Below the Tidal Flat Deposits the Mercia Mudstone Formation was encountered at depth of 18.9 m bGL beneath the Lagoon 25 and at depths of 10 to 5-12 m bGL outside the lagoon. In terms of elevation, the top of the mudstone was found to be at -6.15 to -5.6 m AOD, which remains consistent with the levels seen in Lagoon 12. The Mercia Mudstone was typically described as very stiff reddish brown clay.

Geological Sequence Summary

7.3.10 The general geological sequence identified during the previous ground investigations is summarised in Table 17.

Table 17: Summary of Geological Sequence – Lagoon 25

Unit	Description	Thickness Range (m)	Basal depth (m AOD)
Made Ground (above original ground level)	Coarse slag forming a retaining peripheral bund which contains slag slurry within.	About 7 to 8	Assume 5
Made Ground	Coarse slag forming a retaining	3.24 to >4.55	<0.45 to 1.74

Unit	Description	Thickness Range (m)	Basal depth (m AOD)
(below original ground level)	peripheral bund which contains slag slurry within.		
Superficial Deposits (Tidal Flat Deposits)	Silty clay, organic in places with at least one main peat layer (see below)	10 to 11.15	-5.9 to -6.9
Superficial Deposits (Tidal Flat Deposits)	Peat Layer (apparent dip)	1.2 to 11	-2 to 1.56
Superficial Deposits (Glaciofluvial Deposits)	Sand and gravel	Absent	Absent
Mercia Mudstone	Very stiff becoming weak completely fractured mudstone	>10	< -13.3

7.4 Geology – Lagoon 27SW

Made Ground

7.4.1 Lagoon 27SW consists of an approximately 5 - 7 m high raised bunded lagoon infilled with waste materials to comprise BF and/or BOS slurry. Similar to Lagoons 12 and 25, the coarse fraction of the slag was used to construct a peripheral bund in order to contain the slurry material.

7.4.2 Based on boreholes LGBH10 and BH520, the thickness of the coarse slag of the bund range between 10.6 m and 12.2 m, inferring a basal elevation at 0.65 to 1.64 m AOD.

7.4.3 No intrusive boreholes proved the full sequence of the slurry within the lagoon. It is understood that the slurry may be interbedded with layers of coarse slag as per Lagoons 12 and 25.

7.4.4 The original ground level pre-lagoon construction is estimated to be at around 5 m AOD, based upon nearby exploratory locations outside the lagoon. This would infer the base of the lagoon to be a similar depth to Lagoons 12 and 25.

7.4.5 Made Ground consisting of a clay material with slag content of over a 0.5 m in thickness was identified outside and immediately beyond to the south of the Lagoon in SHBJ06 and BH17. At SHBJ07, the thickness of Made Ground was found substantially thicker by up to 4 m depth, (basal elevation of 1.79 m AOD). At this location, the Made Ground was described as “with frequent pocket of peat below 2 m”.

Superficial Deposits

7.4.6 Unconsolidated superficial deposits were encountered beneath the Made Ground in all locations. These comprised Tidal Flat Deposits which were encountered as generally firm bluish grey clays becoming soft or very soft with depth.

7.4.7 The peat layer near or directly beneath the Made Ground in Lagoon 25 was also found beneath Lagoon 27SW. This was found to be generally 2 m in thickness with a basal elevation of 0.89 to – 2.76 m AOD. At borehole SBHJ07 the thickness of

the peat layer may be up to 3.86 m when considering the inclusion of peat material within the base of Made Ground.

7.4.8 Similarly to Lagoon 25, the coarse Glaciofluvial Deposits were not encountered in any of the boreholes within Lagoon 27SW, although their presence cannot be ruled out given their discontinuous nature.

Solid Geology

7.4.9 Below the Tidal Flat Deposits the Mercia Mudstone Formation was encountered at depth of 17.5 m bGL beneath the lagoon and at depths of 10.5 to 12.5 m bGL outside the lagoon. The top of the mudstone was found to be at -6.32 to -4.21 m AOD, which remains consistent with the levels seen in Lagoons 12 and 25. The Mercia Mudstone was typically described as very stiff reddish brown clay.

Geological Sequence Summary

7.4.10 The general geological sequence identified during the previous ground investigations is summarised in Table 18

Table 18: Summary of Geological Sequence – Lagoon 27SW

Unit	Description	Thickness Range (m)	Basal depth (m AOD)
Made Ground (above original ground level)	Coarse slag forming a retaining peripheral bund which contains slag slurry within.	About 5 to 7	Assume 5
Made Ground (below original ground level)	Infill described above extend below original ground level	3 to 4	0.65 to 1.64
Superficial Deposits (Tidal Flat Deposits)	Silty clay, organic in places with at least one main peat layer (see below)	6 to 10	-6.32 to -4.21
Superficial Deposits (Tidal Flat Deposits)	Peat Layer	1.2 to 11	0.89 to -1.45
Superficial Deposits (Glaciofluvial Deposits)	Sand and gravel	Absent	-
Mercia Mudstone	Very stiff becoming weak completely fractured mudstone	>3.3	< - 7.51

7.5 Geology – Lagoon 27SE

Made Ground

7.5.1 Similar to Lagoons 12 and 25 and 27SW a bund surrounds Lagoon 27SE. The bunds have been engineered on the northern (shared with Lagoon 27NE) and western (shared with Lagoon 27SW) boundaries. The bund on its southern boundary has not yet been constructed and instead some stockpiles of coarse slag have been awaiting placement. There are no bunds or stockpiled bund material along the eastern boundary of Lagoon 27SE (shared with Lagoon 26).

7.5.2 Lagoon 27SE is reported to be empty and ground level within the partial bund perimeter is found at or close to original ground level.

7.5.3 However, the boreholes within the cell itself proved 0.9 to 1.5 m thick of slurry slag. In SWSJ35 the slurry was underlain by 0.5 m thick of coarse slag. Elsewhere the slurry was found to overly directly the Tidal Flat Deposits. The base of the slurry slag was found to range between 4.05 to 5.05 m AOD.

7.5.4 Outside and immediately to the south of Lagoon 27SE, Made Ground was found to include clay material with slag content to depth of 1.8 to 3 m bGL (3.66 - 4.6 m AOD) in boreholes BH18 and LGBH12 and trial pit TP508. At borehole BH521, a similar material was encountered although this extended to 2.55 m AOD (4.6 m in thickness) which is lower than the basal depth of Made Ground within the cell.

Superficial Deposits

7.5.5 Unconsolidated superficial deposits were encountered beneath the Made Ground in all locations. These comprised Tidal Flat Deposits consisting of, generally firm bluish grey clays becoming soft or very soft with depth.

7.5.6 The peat layer beneath Lagoon 27SW, also seen in Lagoon 27SE, was generally in excess of 1.7 m in thickness.

7.5.7 Similar to Lagoons 25 and 27SW, the coarse Glaciofluvial Deposits were not encountered in any of the boreholes drilled within Lagoon 27SE, although their presence cannot be ruled out given their discontinuous nature.

Solid Geology

7.5.8 Below the Tidal Flat Deposits the Mercia Mudstone Formation was encountered at depth of 10.9-12 m bGL. The top of the Mercia Mudstone was found to be at -6 to -5.14 m AOD, which remain consistent with the levels seen in Lagoons 12, 25 and 27SE. The Mercia Mudstone was typically described as very stiff reddish brown clay.

Geological Sequence Summary

7.5.9 The general geological sequence identified during the previous ground investigation is summarised in Table 19.

Table 19: Summary of Geological Sequence – Lagoon 27SE

Unit	Description	Thickness Range (m)	Basal depth (m AOD)
Made Ground	Slag slurry over discontinuous coarse slag layer	0.9 to 4.6	0.65 to 1.64
Superficial Deposits (Tidal Flat Deposits)	Silty Clay, organic in places with at least one main peat layer (see below)	6 to 10	-6 to -5.14
Superficial Deposits (Tidal Flat Deposits)	Peat layer	1 to >1.7	-0.74 to 0
Superficial Deposits (Glaciofluvial Deposits)	Sand and gravel	Absent	-
Mercia Mudstone	Very stiff becoming weak completely fractured mudstone	>7	< - 13

7.6 Geology – Lagoon 26

Made Ground

7.6.1 Lagoon 26 has no peripheral bund.

7.6.2 Whilst the ground level within the lagoon is similar to the ground level in the surrounding fields. Made Ground has been encountered to depths of 0.3 to 4.6 m bGL (1.29 to 4.7 m AOD). The Made Ground comprises predominantly slag gravel with variable mix of limestone, concrete, brick and to lesser frequency metal and wood.

7.6.3 The variability in the thickness of Made Ground and its basal depth below ground level may indicate irregular settlement or placement of Made Ground materials across the lagoon area.

7.6.4 The limited data outside and to the south of Lagoon 26 (STPJ05, SHJ10, TP509 and BH525) has also identified similar Made Ground material to depth of 0.6 - 2.5 m (3.45 to 5.25 m AOD).

Superficial Deposits

7.6.5 Unconsolidated superficial deposits were encountered beneath the Made Ground in all locations. These comprised Tidal Flat Deposits consisting of generally firm bluish grey clays becoming soft or very soft with depth.

7.6.6 A thin and discontinuous peat band was encountered at typically 5.6 to 7.7 m bGL (-0.5 to -1.75 m AOD) with a thickness of less than 1 m.

7.6.7 Coarse Glaciofluvial Deposits were encountered in one borehole (SBHJ08A) at 10.4 m bGL (-4.5 m AOD) with a thickness of 0.4 m. All other deep boreholes proved the Tidal Flat Deposits overlie the Mercia Mudstone bedrock directly, confirming the discontinuous presence of the Glaciofluvial Deposits.

7.6.8 Borehole BH525 encountered stiff dark reddish brown slightly gravelly clay, identified in the borehole log sheet as River Terrace Deposit. However, this is considered to likely represent the upper formation of the Mercia Mudstone.

Solid Geology

7.6.9 Below the Tidal Flat Deposits and, where present, Glaciofluvial Deposits the Mercia Mudstone formation was encountered at depth of 9.3 - 10.8 m bGL. The top of the Mercia Mudstone was found to be at -4.9 to -3.9 m AOD, which remains consistent with the levels seen in all other lagoons, albeit marginally shallower. The Mercia Mudstone was typically described as very stiff reddish brown clay becoming weak mudstone.

Geological Sequence Summary

7.6.10 The general geological sequence identified during the previous ground investigation is summarised in Table 20.

Table 20: Summary of Geological Sequence – Lagoon 26

Unit	Description	Thickness Range (m)	Basal depth (m AOD)
Made Ground	Coarse slag with mix of limestone, concrete and bricks	0.3 to 4.6	1.29 to 4.7
Superficial Deposits (Tidal Flat Deposits)	Silty clay, organic in places with a discontinuous peat layer (see below)	6 to 9	-3.9 to -4.9
Superficial Deposits (Tidal Flat Deposits)	Peat layer (discontinuous)	0.5 to 1.0	-2.15 to -0.6
Superficial Deposits (Glaciofluvial Deposits)	Sand and gravel (discontinuous)	0.4	-4.91
Mercia Mudstone (Mudstone)	Very stiff becoming weak completely fractured mudstone	>9	< -16.7

7.7 Visual and Olfactory Evidence of Contamination

7.7.1 A summary of visual and olfactory evidence of potential contamination encountered during the previous ground investigations is summarised in Table 21.

Table 21: Visual and Olfactory Evidence of Contamination Summary

Site Area	Location ID	Depth (m bGL)	Strata	Evidence of Potential Contamination
Lagoon 12	All locations	All	Made Ground - Slag slurry and coarse slag	Slag and clinker reported.
	LGBH1	GL-8.5	Made Ground (coarse slag)	Slag containing concrete and clinker.
	LGBH2	GL-7.9	Made Ground (concrete gravel)	Concrete and slag.
	SBHJ08	GL-2.2	Made Ground (coarse slag)	Slag containing ash.
	SWSJ09A	GL-2.6	Made Ground	Containing gravel of brick.
	SWSJ12	4.35-4.55	Made Ground (base of slag slurry within coarse slag layer)	Possible contamination (no further details given in the log).

Site Area	Location ID	Depth (m bGL)	Strata	Evidence of Potential Contamination
	BH513	GL-9.3	Made Ground (coarse slag)	Slag containing brick. Malodorous (no further details given in the log).
	BH514	3.5-4.0	Made Ground (coarse slag)	Iron nodules.
		6.7	Made Ground (coarse slag)	Metal.
	BH515	GL-4.0	Made Ground (coarse slag)	Slag containing brick and fibrous organic material.
	BH516	GL-3.5	Made Ground (coarse slag)	Slag containing tarmacadam and brick.
	TP504	GL-1.7	Made Ground (coarse slag)	Slag containing brick and timber.
	TP506	2.2-3.6	Made Ground (coarse slag)	Slag containing ash, brick, wood, plastic and steel.
Lagoon 25	Many locations		Made Ground	Slag and clinker reported (gravel & boulders).
	LGBH4	GL-11.2	Made Ground (coarse slag)	Slag containing ash and clinker.
	LGBH9	1.6-2.7	Made Ground (coarse slag)	Slag containing ash and clinker.
	SBHJ05	GL-6.0	Made Ground	Ash and clinker.
	SWSJ18	1-3.45	Made Ground (coarse slag)	Slag containing brick.
Lagoon 27SW	All locations	All	Made Ground	Slag and clinker reported (gravel & boulders).
	LGBH10	GL-10.6	Made Ground (coarse slag)	Slag containing ash.
	SBHJ04	GL-6.0	Made Ground	Ash and clinker.

Site Area	Location ID	Depth (m bGL)	Strata	Evidence of Potential Contamination
	BH520	4.9-7.0	Made Ground (coarse slag)	Slag containing fragments of metal.
Lagoon 27SE	All locations	All	Made Ground	Slag and clinker reported (gravel & boulders).
Lagoon 26	All locations	All	Made Ground	Slag reported (gravel & boulders).
	STPJ01	GL-3.0	Made Ground (coarse slag)	Slag containing brick, concrete, tarmac, wood and metal. Slight sulphur odour reported from 0.3 m.
	STPJ02	GL-0.3	Made Ground (coarse slag)	Slag containing brick and concrete.
		0.3-1.2	Made Ground (coarse slag)	Strong hydrocarbon odour at 0.3 m. Wooden sleepers reported from 0.5 to 1.2 m.
	STPJ03	GL-1.2	Made Ground (coarse slag)	Slag containing brick, concrete, wood and metal.
	STPJ04	GL-1.2	Made Ground (coarse slag)	Slag containing brick and concrete.
	STPJ05	GL-0.3	Made Ground (coarse slag)	Slag containing concrete and metal.
	STPJ06	GL-2.6	Made Ground (coarse slag)	Slag containing concrete, brick and metal.
	BH522	GL-2.3	Made Ground (coarse slag)	Slag containing rare fragments of steel.
	BH524	GL-4.0	Made Ground (coarse slag)	Slag containing concrete and brick.
	BH525	1.0-1.3	Made Ground (slag)	Clay containing gravel of brick and slag.

7.7.2 Slag, ash and clinker are observed within the majority of the sampling locations across the Site. Fragments of brick, concrete, tarmacadam and metal are commonly observed within the coarse slag matrix.

7.7.3 Evidence of hydrocarbon contamination was identified during previous ground investigations, described as a strong hydrocarbon odour within STPJ02 (Lagoon 26).

7.7.4 BH513 (within Lagoon 12) was described as malodorous from ground level to 9.3 m bGL.

7.7.5 'Possible contamination' is recorded within the Made Ground at SWSJ12 (Lagoon 12), however no further information is available.

7.7.6 PID readings provided in Table 9 recorded VOC levels to a maximum of 35.5 ppm at SWSJ38 (Lagoon 27SE). This is indicated to be associated with frequent organic material.

7.8 Gas Monitoring

7.8.1 The ground gas monitoring dataset collected during each of the four monitoring rounds of the 2015 investigation (Geotechnical Engineering, 2015) is summarised on the field data sheets provided in Appendix 2. The maximum gas concentrations (minimum for oxygen) are presented in Table 22.

Table 22: Summary of Ground Gas Monitoring

Site Area	Location ID	Flow (l/hr)	VOCs (ppm)	CH4 (%/vol)	Peak LEL (%)	CO2 (%/vol)	O2 (%/vol)	CO (ppm)	H2S (ppm)
		Max.	Max.	Max.	Max.	Max.	Min.	Max.	Max.
Lagoon 12	BH515 (shallow) within coarse slag	0	5.2	3.9 (2.3)	90	0.1	0	935 (935)	200 (200)
Lagoon 25	BH519 (shallow) within peat	0.4	2.1	8.6 (2.4)	>100 %	0	0.6	248 (193)	0
Lagoon 27SE	BH521 (shallow) within peat	0.4	1.6	5	94	0.3	19.3	2	0
Lagoon 26	BH525 (shallow) within Made Ground	1.2	1.2	9.9 (4.6)	>100 %	0	0	4 (3)	0

7.8.2 Figure in brackets in Table 22 indicate stable reading.

7.9 Groundwater Monitoring

Groundwater Encountered During Investigation

7.9.1 Groundwater strikes were encountered during the drilling of boreholes and excavation of trial pits across the Site, as detailed on the geological logs provided in Appendices 1a, 1b, 1c, 1d and 1e. These are summarised in Table 23.

Table 23: Summary of Groundwater Level Data During Investigation

Site Area	Location	Strike Depth m bGL (m AOD)	Geological Formation	Level after 20 minutes depth m bGL (m AOD)	Remarks
Lagoon 12	LGBH2	7.5 (3.31)	Made Ground (coarse slag - bund)	7.5 (3.31)	Water ingress sealed at 8.0 m bGL into the Tidal Flat Deposits
	LGBH3	none reported	-	-	Water recorded at 6.9 m bGL (3.63 m AOD) within the Made Ground (coarse slag – bund) at the beginning of the shift.
	BH14b	9.51 (2.9)	Interface between Made Ground (coarse slag -	No data	——

Site Area	Location	Strike Depth m bGL (m AOD)	Geological Formation	Level after 20 minutes depth m bGL (m AOD)	Remarks
			bund) and Tidal Flat Deposits		
	SBHJ04	None reported	-	-	Water reported to be at 11 m bGL (0.24 m AOD) at start of shift when borehole taken down to 16 m bGL (-4.76 m AOD) on top of the Fluvio Glacial Deposits. Water reported to be at 1.85 m bGL (9.39 m AOD) when borehole taken down to 18.5 m bGL (-7.26 m AOD) into Mercia Mudstone
	BH513 BH513	8.2 (3.0)	Made Ground (coarse slag - bund)	7.74.5 (6.7)	Fast
		17.5 (-6.3)	Tidal Flat Deposits / Mercia Mudstone	4.57.7 (3.5)	Subartesian pressure
	BH516	6.7 (0.5)	Tidal Flat Deposit	5.1 (2.1)	———
Lagoon 25	LGBH4	9.3 (2.88)	Made Ground (coarse slag - bund)	9.1 (3.08)	Water ingress sealed at 11.4 m bGL into the Tidal Flat Deposits
	LGBH7	None reported	-	-	Water reported to be at 9.8 m bGL (2.85 m AOD) when borehole taken down to 12.2 m bGL (0.45 m AOD) within the Made Ground (coarse slag bund).
	SBHJ05	14.8 (-1.56)	Tidal Flat Deposits	Not recorded	———
	SWSJ21	4 (8.97)	Made Ground (slurry slag)	4 (8.97)	Seepage
		6 (6.97)	Made Ground (slurry slag)	6 (6.97)	Seepage
	SWSJ22A	Surface water recorded on logs			
	SWSJ22B	1 (10.99)	Made Ground (slurry slag)	1 (10.99)	Seepage
	SWSJ23	1.5 (10.79)	Made Ground (slurry slag)	1.5 (10.79)	Seepage
	BH24	2.58 (2.8)	Tidal Flat Deposit	Not recorded	———
Lagoon 27SW	LGBH10	7.5 (4.74)	Made Ground (coarse slag - bund)	7.4 (4.75)	———

Site Area	Location	Strike Depth m bGL (m AOD)	Geological Formation	Level after 20 minutes depth m bGL (m AOD)	Remarks
	BH17	1.5 (3.81)	Tidal Flat Deposits	Not recorded	——
	SWSJ31	2.3 (8.04)	Made Ground (slurry slag)	Not recorded	Seepage
	SWSJ32	2.3 (7.97)	Made Ground (slurry slag)	Not recorded	Seepage
	SWSJ33	2.0 (7.17)	Made Ground (slurry slag)	Not recorded	Seepage
	SBHJ07	None reported	-	-	Water reported to be at 2.6 m bGL (3.19 m AOD) when borehole taken down to 3 m bGL (3.19 m AOD) within the Made Ground.
Lagoon 27SE	SWSJ36	2.3 (3.04)	Tidal Flat Deposits	2.3 (3.04)	Seepage
	SWSJ37	3.5 (2.75)	Tidal Flat Deposits	3.5 (2.75)	Seepage
	LGBH12	0.8 (4.3)	Made Ground	0.5 (4.6)	Medium inflow
	TP4	1.4	Made Ground	Not recorded	Visible oil layer
	BH18	2.9	Made Ground	Not recorded	——
		3.0	Made Ground	Not recorded	——
	BH521	6.5 (-0.5)	Tidal Flat Deposits	5.9 (0.1)	——
Lagoon 26	BH20	2.3	Tidal Flat Deposits	Not recorded	——
		2.8	Tidal Flat Deposits	Not recorded	——
	TP1	1.64	Made Ground	Not recorded	Free product visible on groundwater
	TP2	2.0	Made Ground	Not recorded	Rapid ingress. Slight sheen on groundwater.
	TP3	1.1	Made Ground	Not recorded	Rapid ingress.
	SBHJ08A CP	1.3 (4.59)	Made Ground	1.2 (4.69)	Seepage
	SBHJ10 CP	2.5 (3.55)	Tidal Flat Deposits	1.0 (5.5)	Slow
	STPJ01	1.0 (4.95)	Made Ground	Not recorded	Fast on one face.
	STPJ02	0.5 (4.87)	Made Ground	Not recorded	Fast on one face.
	STPJ03	0.5 (5.07)	Made Ground	Not recorded	Fast on one face.
	STPJ03	0.5 (4.93)	Made Ground	Not recorded	Fast on all faces.
	STPJ05	2.6 (3.25)	Tidal Flat Deposits	Not recorded	Seepage on one face.
	STPJ06	0.5 (5.21)	Made Ground	Not recorded	Fast on all faces.
	BH523	1 (5.15)	Made Ground	1 (5.15)	Seepage
		10.5 (-4.35)	Mercia Mudstone Group	9.6 (-3.45)	Medium flow
	BH524	10.5 (-4.8)	Mercia Mudstone Group	10.35 (-4.65)	——
	BH525	1.5 (4.45)	Made Ground	1.3 (4.65)	Medium flow
	TP509	Seepages observed between 1.2 m bGL (Made Ground) and 4.5 m bGL			

Site Area	Location	Strike Depth m bGL (m AOD)	Geological Formation	Level after 20 minutes depth m bGL (m AOD)	Remarks
		(Tidal Flat Deposits)			

7.9.2 Groundwater was not recorded in any other boreholes and trial pits.

Groundwater Level During Monitoring Rounds

7.9.3 The entire groundwater level data set gathered on site is provided in Appendix 2 and summarised in Table 24.

Table 24: Summary of Groundwater Level Data During Monitoring

Site Area	Location	Installation	Depth of response zone (m bGL) and Geological Formation	No. Measurements	Min. Depth m bGL (m AOD)	Max. Depth m bGL (m AOD)	Comments
Lagoon 12	LGBH2	50 mm	0.9-9 m (Made Ground CS / Tidal Flat Deposits)	5	7.46 (3.35)	7.52 (3.29)	-
	LGBH3	50 mm	0.9-9 m (Made Ground CS / Tidal Flat Deposits)	5	7.2 (3.33)	7.32 (3.21)	-
	SBHJ04	50 mm	12.1-13.1 m (Tidal Flat Deposits)	6	6.61 (4.63)	6.8 (4.44)	-
	BH515 (shallow)	35 mm	0.85-5.2 m (Made Ground)	4	Dry		-
	BH515 (deep)	50 mm	9.8-13.0 m (Tidal Flat Deposits)	4	6.22 (4.43)	7.83 (2.82)	-
	LGBH1 and SWSJ13	No data					-
Lagoon 25	LGBH4	50 mm	1-11 m (Made Ground CS)	5	8.87 (3.31)	9.0 (3.18)	-
	SBHJ05	50 mm	9.5-11.5 m (Made Ground CS)	6	8.91 (4.33)	9.16 (4.08)	-
	SWSJ21	50 mm	4-6 (Made Ground SS)	6	3.87 (9.1)	6.5 (6.47)	-
	SWSJ23	50 mm	5.8-7.8 m (Made Ground SS)	6	5.92 (6.37)	7.58 (4.71)	-
	BH519 (shallow)	35 mm	0.85-4.2 (Made Ground / Tidal Flat Deposits)	4	0.74 (5.11)	2.65 (3.2)	-
	BH519 (deep)	50 mm	6.8-11.2 (Tidal Flat Deposits)	4	1.37 (4.48)	3.5 (2.35)	-
Lagoon 27SW	SWSJ34	50 mm	3-6 (Made Ground SS)	6	Dry	2.36 (8.16)	Dry recorded once. Second shallowest is 3.33 m bGL (7.19 m AOD)
	LGBH9	50 mm	1.5-7 m (Made Ground / Tidal Flat Deposits)	5	1.05 (3.91)	1.56 (3.4)	-
	LGBH10	50 mm	11-15 m (Tidal Flat Deposits)	5	8.15 (4.09)	8.7 (3.54)	-

Site Area	Location	Installation	Depth of response zone (m bGL) and Geological Formation	No. Measurements	Min. Depth m bGL (m AOD)	Max. Depth m bGL (m AOD)	Comments
	SBHJ06 CP	50 mm	3.1-4.1 (Tidal Flat Deposits)	6	1.35 (4.83)1.20 (4.98)	1.59 (4.59)1.33 (4.85)	-
	SBHJ07 CP	50 mm	8.4-10.4 (Tidal Flat Deposits / Mercia Mudstone Group)	6	1.35 (4.44)	1.59 (4.2)	-
Lagoon 27SE	SWSJ37	50 mm	4.1-6.45 (Tidal Flat Deposits)	6	0.46 (5.79)	0.67 (5.58)	-
	BH521 (shallow)	35 mm	4.3-6.2 (Tidal Flat Deposits)	4	0.85 (5.15)	2.66 (3.34)	-
	BH521 (deep)	50 mm	8.8-11.2 (Tidal Flat Deposits / Mercia Mudstone Group)	4	1.99 (4.01)	3.57 (2.43)	-
Lagoon 26	SBHJ09 CP	50 mm	1.0-2.2 (Made Ground)	6	0.65 (5.11)	0.9 (4.86)	-
	BH525 (shallow)	35 mm	0.5-2.8 (Made Ground / Tidal Flat Deposits)	4	Dry	1.66 (4.29)	Dry recorded once. Second shallowest is 1.32 m bGL (4.63)
	BH525 (deep)	50 mm	9.8-11.8 (Glaciofluvial Deposits)	4	1.8 (4.15)	3.26 (2.69)	-
	SBHJ10 CP	50 mm	9.0-10.0 (Tidal Flat Deposits)	6	2.0 (4.05)	2.3 (4.2)	-
	SBHJ08A CP	50 mm	6.4-7.4 (Tidal Flat Deposits)	6	2.31 (3.58)	3.59 (2.3)	-

Groundwater Summary – Lagoon 12

7.9.4 The main groundwater body is within the granular Glaciofluvial Deposits (where present) and the Mercia Mudstone which is confined by the overlying Tidal Flat Deposits. This demonstrates that the Tidal Flat Depositsto represent an aquitard to vertical groundwater flow based upon groundwater level observations during drilling. Hydrostatic pressures within the confined aquifer have been noted elsewhere with standing water levels in the Mercia Mudstone 13 to 15 m higher than the level of the groundwater strike. However, very limited information exists on the groundwater level in the Mercia Mudstone at the Site.

7.9.5 Discontinuous perched groundwater is seen within the upper formation of the Tidal Flat Deposits. This "groundwater" is regarded as "pore water" given the low permeability soil and little flow is likely. Data from borehole SBJ04 indicates the presence of subartesian pressures within this body with resting levels rising to within the Made Ground (about 4.5 m AOD).

7.9.6 Perched water bodies which are considered over the underlying cohesive soils of the Tidal Flat Deposits were identified by the intrusive works within the base of the peripheral bund (coarse slag Made Ground). The monitoring data indicates the lower 0.5 m of the Made Ground to be saturated (about 3.3 m AOD). Little variability in the recorded monitoring rounds is noted.

7.9.7 The extent of perched water bodies within the Made Ground is anticipated to be strongly influenced by rainfall events and water levels within the reen and ditch system.

7.9.8 No groundwater levels are available from within the slurry waste.

Groundwater Summary – Lagoon 25

7.9.9 The main groundwater body within the Mercia Mudstone was not encountered in any of the three boreholes that penetrated the aquifer (SBHJ05, BH518 and BH519). However no monitoring wells have been installed and therefore standing levels cannot be confirmed.

7.9.10 Discontinuous perched groundwater is seen within the upper formation of the Tidal Flat Deposits. This "groundwater" is regarded as "pore water" given the low permeability soil and a little flow is likely. When encountered, little or no rise in the levels after 20 minutes is noted, indicating low recharge. The water strikes ranged between -2.5 to 2.8 m AOD. The standing levels of the perched groundwater are not known given the absence of monitoring wells targeting the Tidal Flat Deposits.

7.9.11 Water bodies were identified by the intrusive works within the base of the peripheral bund (coarse slag). It is likely that this water body is perched over the underlying cohesive soils of the Tidal Flat Deposits. The monitoring data indicates the lower 2.5 m of the coarse slag to be saturated (between 3.18 and 4.33 m AOD). Little variability in the recorded levels during monitoring rounds was noted.

7.9.12 The resting groundwater level within the bund is similar to the perched water level seen outside the lagoon within the Made Ground indicating perched water being present generally within the Made Ground.

7.9.13 Higher elevations are typical of the monitoring points within the slurry waste with levels ranging from 4.71 to 9.1 m AOD. The minimum and maximum levels for the same monitoring location within the slurry are also noted to be wide (up to 2.63 m) indicating a possible increased sensitivity to rainfall events.

7.9.14 The extent of perched water bodies within the Made Ground is anticipated to be strongly influenced by rainfall events and water levels within the reen and ditch system.

Groundwater Summary – Lagoon 27SW

7.9.15 The main groundwater body within the Mercia Mudstone was not encountered in any of the three boreholes that penetrated within the formation (SBHJ06, SBHJ07 and BH520). However, no monitoring wells have been installed within the aquifer and therefore standing levels cannot be confirmed.

7.9.16 Whilst no strikes were recorded associated with the perched groundwater of the Tidal Flat Deposits standing water levels between 3.54 to 4.83 m AOD (i.e. near the original ground level) were noted between monitoring.

7.9.17 Water bodies were identified by the intrusive works within the top 2 - 2.5 m of the lagoon waste at an elevation of 7.17 to 8.16 m AOD. The variability in the data set for the same monitoring points indicates a possible increased sensitivity to rainfall events.

7.9.18 The resting groundwater level within the bund is similar to the perched groundwater level associated with the Tidal Flat Deposits indicating a possible hydraulic continuity. However, the Tidal Flat Deposits water is considered to be “pore water” given the low permeability and flow.

Groundwater Summary – Lagoon 27SE

7.9.19 The main groundwater within the Mercia Mudstone was encountered in borehole BH521 with a resting water level range of 1.99 to 3.57 m bGL (2.43 - 4.01 m AOD), which confirms it is confined by the overlying Tidal Flat Deposits.

7.9.20 Monitoring installations within the Tidal Flat Deposits identified a resting water level range between 0.46 and 2.66 m bGL. The strikes in this formation ranged between 2.3 to 6.5 m bGL with little rise after 20 minutes.

7.9.21 Perched water was also recorded within the Made Ground from strikes during trial pitting at depths of 0.8 to 3.0 m bGL.

7.9.22 The resting groundwater level within the Mercia Mudstone, the Tidal Flat Deposits and the Made Ground are reported to be similar.

Groundwater Summary – Lagoon 26

7.9.23 Groundwater within the Mercia Mudstone was encountered in borehole BH525 with a resting level ranging from 1.8 to 3.26 m bGL (2.69 - 4.15 m AOD), which confirms it is confined by the overlying Tidal Flat Deposits. The strikes were recorded to have little rise after 20 minutes indicating a low flow.

7.9.24 Perched “pore” water within the Tidal Flat Deposits was recorded to range from 2.0 to 3.26 m bGL The strikes in this formation ranged between 2.3 and 6.5 m bGL with little rise after 20 minutes.

7.9.25 Perched water within the Made Ground was also recorded at typically 0.5 to 1.3 m bGL.

8 Contamination Assessment

8.1 Introduction

8.1.1 The following sections provide details of the assessment of land contamination at the Site.

8.1.2 The outline Conceptual Site Model (CSM) presented within the 2014 PSSR has been reviewed and updated based on data from the Supplementary Ground Investigation (Geotechnical Engineering, 2015) and current Scheme design. The main alterations to the 2014 PSSR model are summarised as the below.

- Revision of the Site geological ground model.
- New contamination sources identified (perched water body within the Made Ground).
- Additional gas pollutant (methane and/or carbon dioxide) considered from sources in Made Ground and natural soils (including peat).
- The use of band drains to accelerate settlement of the soft Tidal Flat Deposits is not required beneath the lagoons.
- Update of the source/pathway/receptor linkages taking account of the above and more detailed assessments.

8.2 Preliminary Risk Assessments

Potential Sources

8.2.1 A number of potential contaminant sources have been identified at the site.

- The Made Ground was identified in the 2014 PSSR as a potential source of contamination (lagoon waste). This is confirmed by the new data. The slag deposits within the lagoons were encountered 2 to 4 m below surrounding level.
- Made Ground is also found to extend beyond the lagoon footprints.
- The perched water body within the Made Ground is considered to represent a potential contaminant source rather than a receptor.
- The Made Ground and organic soils within the Tidal Flat Deposits may represent potential source of ground gas. The extent of the latter may increase during consolidation associated with the surcharge loading of the embankment.
- Hydrogen sulphide (H_2S) was identified in a single monitoring well (BH515) and this gas appear to have originated from coarse slag.

8.2.2 In addition to the above sources, the quality of surface waters, perched groundwater and the deeper aquifer within the Glaciofluvial Deposits and Mercia Mudstone bodies may influence or impact the quality of the others (for instance the groundwater within the Glaciofluvial Deposits and Mercia Mudstone is saline whilst the surface water is not). Surface water and deeper aquifer are therefore regarded as a source of possible contaminants as well as receptors.

8.2.3 To the north of the Site lies Llanwern Steelworks and its main operational activity also includes other waste deposits in lagoons. This is considered to be up-gradient to the Site from a groundwater flow (Appendix 16.2 of the ES). The steelworks represent a possible off site contamination source.

8.2.4 To the east of the Site (east of Lagoon 26) is the Green Moor Landfill. The land contamination associated with this site has been considered with the CL-27 report (Annex D of Appendix 11.1 of the ES). The landfill is reported to have received industrial waste and liquid sludge between 1981 and 1984 although evidence suggests the areas that may have received waste are very discrete in relation to the permit boundary. Previous ground investigation identified no evidence of waste deposition although slag material has been used to construct the various network of access roads. The Green Moor Landfill may be considered a possible off site contamination source in the shared boundary with Lagoon 26 although groundwater would likely be to the south rather than towards the site.

Potential Receptors

8.2.5 A number of relevant receptors during the construction and the operational stages of the Scheme have been considered:

Construction

- Construction workers during site development works;
- General public/workers adjacent to construction works;
- Main groundwater aquifer within the Glaciofluvial Deposits and/or Mercia Mudstone; and
- Nearby surface waters including the reens and existing surface water ditches bordering the surrounding fields including the Gwent Levels SSSI.

Operational

- General public end users;
- Maintenance workers;
- General public/workers, outside permanent land take;
- Groundwater aquifer within the Glaciofluvial Deposits (where present) and/or Mercia Mudstone; and
- Nearby surface waters including the reens and existing surface water ditches bordering the surrounding fields including the Gwent Levels SSSI.

Potential Pathways

8.2.6 Relevant pathways during the construction and the operational stages of the Scheme have been considered.

- Dermal contact, ingestion and inhalation of potentially contaminated soils, dust and waters by construction workers during construction and maintenance workers during operation.
- Dermal contact, ingestion, inhalation of potentially contaminated dusts, soils and waters by general public end users and adjacent general public/workers.
- Contaminated surface water run-off into surface waters including reens.

- Vertical migration of contaminated perched water within the Made Ground into waters within the Tidal Flat Deposits and/or the Mercia Mudstone aquifer including migration along pile/band drain installations.
- Lateral migration of perched water within the Made Ground to surface waters including reens.
- Leaching of contaminants from the Made Ground into shallow groundwater then further migration into surface waters including reens.
- Vertical or lateral migration of ground gas associated with Made Ground and natural soils including peat causing an explosion during construction.
- Possibility of upward migration of ground gases along piles/band drains and accumulation of ground gases in confined spaces.
- Explosive detonation of buried unexploded ordnance during excavation and piling/band drain installation.

8.3 Risk Evaluation

8.3.1 Relevant source-pathway-receptor linkages were considered in the 2014 PSSR using the historical data available up to 2008. With review of the new data described herein, the following risk evaluation has been reconsidered.

- Proposed hardstanding (carriageway) is to be constructed at the Site which is to cover most of the motorway corridor reducing pathways to motorway users.
- Tidal Flat Deposits are classified as non-productive and overly an underlying secondary Aquifer associated with the mudstone.
- The low permeability Tidal Flat Deposits (of over 10m thickness) separates the Made Ground and Aquifer. Main groundwater body identified of being confined by the Tidal Flat Deposits.
- Perched groundwater within the Tidal Flat Deposits is not considered a water resource receptor due to its anticipated low vertical hydraulic continuity with the aquifer beneath.
- Lagoon wastes to be excavated and treated primarily using cement stabilisation to enable materials to be geotechnically and environmentally suitable for reuse as a construction material (general fill) during construction of the Scheme.
- Proposed hardstanding (carriageway) and use of low permeability cement stabilised lagoon waste is likely to limit infiltration and also severely inhibit or break ingestion, dermal contact and inhalation pathways.
- Contaminants from the soil matrix of the Made Ground may leach and subsequently migrate into shallow water.
- Motorway users will be within open environment with no proposed structures or other confined spaces.

8.4 Human Health Risk Assessment

8.4.1 The rationale and approach for the human health (Tier 2) screening assessment is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES). Soil chemical analysis results and the findings of the generic tier 2 human health

risk assessment are presented in Appendix 3. All exceedances of the relevant generic risk assessment criteria are summarised in Tables 25 to 34. For the purposes of this report Made Ground and natural ground have been considered separately in each lagoon area.

8.4.2 Each of the four lagoons has been considered individually in order to identify any variability within the contamination fingerprint. Analytical data from samples for the material within the lagoons as well as from samples taken outside the lagoons has been considered.

Lagoon 12

Table 25: Summary of Human Health Soil Screening Exceedances - Lagoon 12 (Made Ground)

Determinant	Units	Range	Screening Criteria	No. samples exceeding Screening Criteria (Total number of results)	Location of exceedances
Chromium	mg/kg	60 - 1400	33	33 (33)	LGBH01 (x2), LGBH02, LGBH03, SWSJ09A (x2), SWSJ10 (x2), SWSJ11 (x2), SWSJ12 (x2), SWSJ13 (x2), SWSJ14 (x2), SWSJ15 (x2) SWSJ16 (x2), SWSJ17a (x2), BH514A (x5), BH515 (x2). BH516, TP506 (x3)
Lead	mg/kg	20 - 3200	1,300	20 (33)	SWSJ09A (x2), SWSJ10 (x2), SWSJ11 (x2), SWSJ12 (x2), SWSJ13 (x2), SWSJ14 (x2), SWSJ16 (x2), SWSJ17a (x2), BH514A (x3), BH515
pH	pH units	7.2 - 12.8	6-9	23 (33)	LGBH01 (x2), LGBH02, LGBH03, SWSJ10 (x2), SWSJ11 (x2), SWSJ12, SWSJ13, SWSJ14, SWSJ15 (x2), SWSJ16, SWSJ17a,

Determinant	Units	Range	Screening Criteria	No. samples exceeding Screening Criteria (Total number of results)	Location of exceedances
					BH514A (x2), BH515 (x2). BH516, TP506 (x3)
PAH (benzo(b)fluoranthene)	mg/kg	0.03-14	13	1 (31)	SWSJ14
PAH (dibenzo(ah)anthracene)	mg/kg	<0.2-7	1.1	1 (31)	SWSJ14

Table 26: Summary of Human Health Soil Screening Exceedances - Lagoon 12 (Natural Ground)

Determinant	Units	Range	Screening Criteria	No. samples exceeding Screening Criteria (Total number of results)	Location of exceedances
Chromium	mg/kg	35 - 130	33	6 (6)	LGBH01, LGBH02 (x2), LGBH03, SBHJ04 (x2)
pH	pH units	8.08 - 12.5	6-9	4 (6)	LGBH01, LGBH02 (x2), LGBH03

8.4.3 Elevated alkaline soil conditions have been identified over nearly three quarters of the samples within the Made Ground (both slurry and coarse slag) but also in the Tidal Flat Deposits.

8.4.4 Elevated concentrations of lead are also identified as being widespread in the Made Ground slurry and coarse slag (19 no. exceedances from the 31 no. total Made Ground samples).

8.4.5 Although exceedances of chromium are identified throughout the Made Ground, the criterion relates to the toxic hexavalent form of chromium. The majority of the results are considered to be above normal background data range (<95 mg/kg) and therefore may be considered to represent a contaminant of concern. A maximum concentration is recorded at 1,400 mg/kg. Limited chromium speciation analysis has been undertaken on samples from Lagoons 25 and 26 (see relevant section below) and this confirms the elevated chromium is not hexavalent and instead relates to a lesser toxic form of these samples. The highest speciation test relates to slurry slag (Made Ground) in SWSJ18 (Lagoon 25) with a total chromium concentration of 960 mg/kg and an associated chromium hexavalent of 1.9 mg/kg. The latter is well below the screening criteria of 33 mg/kg. It is therefore considered that the chromium in Made Ground represents a low risk to human health.

8.4.6 A single sample (SWSJ14) was found to have two PAH compounds (benzo(b)fluoranthene and dibenzo(ah)anthracene) marginally in exceedance to the criteria. Overall PAH is considered to pose a low risk to human health and the two slightly elevated concentrations are not considered to require specific remediation.

8.4.7 No other exceedances of the screening criteria have been identified and no asbestos fibres were detected out of the 26 Made Ground and 2 Tidal Flat Deposits samples tested.

8.4.8 The total number of samples collected from Made Ground in Lagoon 12 was 31. Of these the majority (61 %) target soils within the top 1 m and only one sample has targeted soil below 5 m. Considering the overall Made Ground thickness of 7.2-9.3 m in Lagoon 12 further sampling of deep materials is recommended. It is possible some stratification of the slurry and slag is present which may have higher or lower levels of contaminants due to historical processes and alterations to the steel production processes. No obvious trend with depth from contaminants has been identified in the current data set.

Lagoon 25

Table 27: Summary of Human Health Soil Screening Exceedances - Lagoon 25 (Made Ground)

Determinant	Units	Range	Screening Criteria	No. samples exceeding Screening Criteria (Total number of results)	Location of exceedances
Chromium	mg/kg	42 - 1660	33	37 (37)	LGBH04 (x3), LGBH05 (x3), LGBH07 (x2), LGBH09, SWSJ18 (x2), SWSJ19 (x2), SWSJ20 (x2), SWSJ21 (x2), SWSJ22b (x2), SWSJ23 (x2), SWSJ24a (x2), SWSJ26 (x2), SWSJ27 (x2), SWSJ28 (x2), SWSJ29 (x2), SWSJ30, WS501 (x3), BH518, BH519
Lead	mg/kg	15 - 2700	1,300	11 (37)	SWSJ19, SWSJ20, SWSJ21, SWSJ23 (x2), SWSJ24a, SWSJ26, SWSJ27 (x2), SWSJ30, WS501

Determinant	Units	Range	Screening Criteria	No. samples exceeding Screening Criteria (Total number of results)	Location of exceedances
pH	pH units	7.7 - 13	6-9	34 (36)	LGBH04 (x3), LGBH05 (x3), LGBH07 (x2), SWSJ18 (x2), SWSJ19 (x2), SWSJ20 (x2), SWSJ21 (x2), SWSJ22b (x2), SWSJ23 (x2), SWSJ24a (x2), SWSJ26 (x2), SWSJ27 (x2), SWSJ28 (x2), SWSJ29 (x2), WS501 (x3), BH519
Dibenzo[a]anthracene	mg/kg	<0.08 - 5	1.1	1 (30)	SWSJ28

Table 28: Summary of Human Health Soil Screening Exceedances - Lagoon 25 (Natural Ground)

Determinant	Units	Range	Screening Criteria	No. samples exceeding Screening Criteria (Total number of results)	Location of exceedances
Chromium	mg/kg	11 - 460	33	7 (12)	LGBH04, LGBH05, LGBH09, SBHJ05, WS501, BH518, BH519
Lead	mg/kg	3.3 - 1700	1,300	1 (12)	WS501
pH	pH units	7.6 - 12.1	6-9	6 (12)	LGBH04, LGBH05 (x2), LGBH09, , WS501, BH519

8.4.9 The human health risk assessment of the samples analysed from the lagoon sludge and coarse slag material and underlying Tidal Flat Deposits within Lagoon 25 have identified the below.

- Alkaline soil conditions have been identified within Made Ground coarse slag and sludge and the underlying natural strata.
- Elevated concentration of lead above the screening criteria was noted to be widespread in the sludge and coarse slag.
- Chromium is generally above the normal background data range (<95 mg/kg) with maximum concentrations of 1660 mg/kg in the Made Ground and of up to 460 mg/kg within the natural strata. However, it is considered that chromium

represents a low risk to human health for the same reason given in the Lagoon 12 assessment.

- A single sample (SWSJ28) was found to have one PAH compound (dibenzo(ah)anthracene) marginally in exceedance of the screening criteria. Overall PAH is not considered to pose a significant risk to human health and the single elevated PAH concentration is not considered to require specific remedial action.

8.4.10 No other exceedances of the applied assessment criteria have been identified and no asbestos fibres were detected out of the 28 Made Ground and 4 Tidal Flat Deposits samples tested.

8.4.11 The elevated lead concentration on the sample of natural soil that was noted to be above the screening criteria may actually be from made ground as it is unclear on the borehole log (WS501) what material the sample has been collected from.

Lagoon 27SW

Table 29: Summary of Human Health Soil Screening Exceedances - Lagoon 27SW (Made Ground)

Determinant	Units	Range	Screening Criteria	No. samples exceeding Screening Criteria (Total number of results)	Location of exceedances
Chromium	mg/kg	52 - 1500	33	18 (18)	LGBH10 (x2), SBHJ06CP, SBHJ07CP (x2), SWSJ31 (x2), SWSJ32 (x2), SWSJ33 (x2), SWSJ34 (x2), BH520 (x5)
pH	pH units	8.73 - 12.9	6-9	17 (18)	LGBH10 (x2), SBHJ06CP, SBHJ07CP, SWSJ31 (x2), SWSJ32 (x2), SWSJ33 (x2), SWSJ34 (x2), BH520 (x5)
PCBs (Aro)	mg/kg	<0.035 - 1.2	0.24	1 (11)	SBHJ07CP

Table 30: Summary of Human Health Soil Screening Exceedances - Lagoon 27 SW (Natural Ground)

Determinant	Units	Range	Screening Criteria	No. samples exceeding Screening Criteria (Total number of results)	Location of exceedances
Chromium	mg/kg	17 - 90	33	2 (3)	LGBH10, SBHJ06CP
pH	pH units	8.8 - 10.6	6-9	1 (3)	LGHBH10

8.4.12 As per Lagoons 12 and 25, alkaline soil conditions have been identified within Made Ground and the underlying natural strata.

8.4.13 Chromium in made ground is identified above the normal background data range (<95 mg/kg) with a maximum concentration of 1500 mg/kg. However, it is considered that chromium represents a low risk to human health for the same reason as that given in the assessment of Lagoon 12.

8.4.14 A single sample (SBHJ07CP) was found to have PCBs marginally in exceedance to the criteria. This may represent discrete raised contamination that may require improved delineation and sampling. However the tests conducted were for aroclors and therefore will not necessarily comprise entirely of dioxin-like PCBs. The screening criterion is for dioxins, furans and dioxin-like PCBs and therefore the assessment may be considered conservative.

8.4.15 No other exceedances of the screening criteria have been identified and no asbestos fibres were detected out of the 14 Made Ground and 1 Tidal Flat Deposits samples tested.

Lagoon 27SE

Table 31: Summary of Human Health Soil Screening Exceedances - Lagoon 27SE (Made Ground)

Determinant	Units	Range	Screening Criteria	No. samples exceeding Screening Criteria (Total number of results)	Location of exceedances
Arsenic	mg/kg	<3 - 280	170	1 (8)	BH521
Chromium	mg/kg	28 - 3300	33	7 (8)	SWSJ37 (x2), SWSJ35A, SWSJ38, BH521 (x2), TP508
pH	pH units	8 - 12.2	6-9	4 (8)	SWSJ35A, BH521 (x2), TP508

Table 32: Summary of Human Health Soil Screening Exceedances - Lagoon 27SE (Natural Ground)

Determinant	Units	Range	Screening Criteria	No. samples exceeding Screening Criteria (Total number of results)	Location of exceedances
Chromium	mg/kg	8.9 - 47	33	2 (5)	SWSJ36, SWSJ35A

8.4.16 As per Lagoon 12 and 25, alkaline soil conditions have been identified within Made Ground and the underlying natural strata.

8.4.17 Chromium in Made Ground is identified above the normal background data range (<95 mg/kg) with a maximum concentration of 3,300 mg/kg (the highest of the entire data set for the Scheme). However, it is considered that chromium represents a low risk to human health for the same reason as that given in the assessment of Lagoon 12.

8.4.18 An elevated arsenic concentration is identified within the Made Ground at one exploratory hole location (BH521 at 1 to 1.5 m depth).

8.4.19 No other exceedances of the screening criteria have been identified and no asbestos fibres were detected out of the 7 Made Ground and 4 Tidal Flat Deposits samples tested.

Lagoon 26

Table 33: Summary of Human Health Soil Screening Exceedances - Lagoon 26 (Made Ground)

Determinant	Units	Range	Screening Criteria	No. samples exceeding Screening Criteria (Total number of results)	Location of exceedances
Arsenic	mg/kg	<3 - 420	170	2 (26)	BH522 (x2)
Chromium	mg/kg	48 - 2500	33	26 (26)	SBHJ08ACP (x2), STPJ02 (x2), STPJ06 (x2), STPJ04, STPJ01 (x2), SBHJ09CP, STPJ03, BH522 (x2), BH523 (x4), BH524 (x4), SBHJ10CP, STPJ05, BH525, TP509 (x2)
Nickel	mg/kg	<0.9 - 3400	980	2 (26)	BH522 (x2)
pH	pH units	7.95 - 12.84	6-9	22 (26)	SBHJ08ACP (x2), STPJ06

Determinant	Units	Range	Screening Criteria	No. samples exceeding Screening Criteria (Total number of results)	Location of exceedances
					(x2), STPJ04, STPJ01 (x2), SBHJ09CP, STPJ03, BH522 (x2), BH523 (x4), BH524 (x4), SBHJ10CP, STPJ05, BH525
VOC (carbon disulphide)	µg/kg	<7 - 35	11	1 (18)	STPJ02

Table 34: Summary of Human Health Soil Screening Exceedances - Lagoon 26 (Natural Ground)

Determinant	Units	Range	Screening Criteria	No. samples exceeding Screening Criteria (Total number of results)	Location of exceedances
Chromium	mg/kg	40 -110	33	5 (5)	STPJ04, STPJ03, STPJ05, SBHJ09CP, SBHJ10CP

8.4.20 As per the other lagoons, alkaline soil conditions have been identified within Made Ground.

8.4.21 Chromium in Made Ground and natural ground has been identified above the normal background data range (<95 mg/kg) with a maximum concentration of 2,500 mg/kg. However, it is considered that chromium represents a low risk to human health for the same reasons given in the assessment for Lagoon 12.

8.4.22 Elevated arsenic and nickel concentrations in Made Ground at one exploratory hole location (BH522 1.5 - 1.7 m and 2 - 2.2 m depth) were above the screening criteria. A single elevated VOC compound (STPJ02 0.3 m depth) was identified within Lagoon 26 in Made Ground. A TPH concentration of 2,300 mg/kg was also reported for this sample. It is noted that a strong hydrocarbon odour was identified at 0.3 m and frequent wooden sleepers were noted at between 0.5-1.2 mbgl however it is considered unlikely that this will require remediation.

8.4.23 No other exceedances of the applied assessment criteria have been identified and no asbestos fibres were detected out of the 23 Made Ground and 5 Tidal Flat Deposits samples tested.

8.5 Controlled Waters Screening Assessment

8.5.1 The rationale and approach for the controlled waters (Tier 1) screening assessment is detailed in the Land Contamination Assessment Report (Appendix 11.1 of the ES) and the groundwater chemical results are presented in Appendix 4. All exceedances to the relevant generic criteria are summarised in Tables 35 to 41 for leachate, groundwater and surface water respectively.

8.5.2 Where an Environmental Quality Standard (EQS) is dependent on water hardness (i.e. some heavy metals), the hardness of the surface water receptor would normally be used. The Baseline Water Environment Report (Appendix 16.2 of the ES) indicates surface water to be generally moderately hard with hardness in a range of 100 to 150 mg/l as calcium carbonate. Therefore EQSs within this water hardness range have been used for screening purposes.

Soil Leachate Results

Lagoon 12

8.5.3 Fourteen Made Ground samples and one natural soil sample from Lagoon 12 were subjected to leaching analysis. The majority of the soil leachate results were all below the applied screening criteria, with the exception of the contaminants in Table 35.

Table 35: Controlled waters screening exceedances – Lagoon 12 soil leachate

Determinant	Units	Range	EQS	DWS	No. exceeded EQS Screening Criteria (Total number of results)	Location (formation)	No. exceeded DWS Screening Criteria (Total number of results)	Location (formation)
Cadmium	µg/l	<0.08 - 0.2	0.15	5	1 (15)	BH514a (Made Ground)	0 (14)	-
Chromium	µg/l	<1 - 170	-	50	-	-	3 (15)	SWSJ10, SWSJ12 (x2) (All Made Ground)
Copper	µg/l	<1 - 22	10	2,000	1 (15)	SWSJ12 (Made Ground)	0 (15)	-
Lead	µg/l	<1 - 14	1.2	10	2 (15)	SWSJ12 (Made Ground), SBHJ04 (TFD)	1 (15)	SWSJ12 (Made Ground)

Determinant	Units	Range	EQS	DWS	No. exceeded EQS Screening Criteria (Total number of results)	Location (formation)	No. exceeded DWS Screening Criteria (Total number of results)	Location (formation)
pH	pH units	8.6 - 12	6-9	6.5-10	3 (4)	LGBH03, BH515, TP506 (All Made Ground)	3 (4)	LGBH03, BH515, TP506 (All Made Ground)

8.5.4 It is considered that the elevated concentrations of chromium are not considered to be representative of a major contaminant source as there are no potable water abstractions at or near the Site and the aquifer is saline. There is no EQS criterion for this contaminant.

8.5.5 Copper, lead, cadmium and pH exceed the EQS criteria and may pose a risk of nearby surface waters (Bowleaze and Parish Reens, Monks Ditch and other unnamed ditches). These contaminants are not considered to represent widespread contaminants of concern as only one or two samples of the fifteen tested had been identified with exceedances.

8.5.6 Certain laboratory detection levels in samples used in previous ground investigations for cadmium, mercury, cyanide and some PAHs are higher than the screening criteria. This is also the case for the analytical data collected from the other lagoons (discussed below).

Lagoon 25

8.5.7 Fifteen Made Ground samples and four natural soil samples from Lagoon 25 were subjected to leaching analysis. The majority of the soil leachate results were all below the applied screening criteria, with the exception of the contaminants in Table 36.

Table 36: Controlled waters screening exceedances – Lagoon 25 soil leachate

Determinant	Units	Range	EQS	DWS	No. exceeded EQS Screening Criteria (Total number of results)	Location (formation)	No. exceeded DWS Screening Criteria (Total number of results)	Location (formation)
Arsenic	µg/l	<1 - 11	50	10	0 (19)	-	1 (19)	BH519 (TFD)
Chromium	µg/l	<1 - 170	-	50	-	-	2 (19)	SWSJ24a, SWSJ28 (All Made Ground)

Determinant	Units	Range	EQS	DWS	No. exceeded EQS Screening Criteria (Total number of results)	Location (formation)	No. exceeded DWS Screening Criteria (Total number of results)	Location (formation)
Copper	µg/l	<1 - 30	10	2,000	3 (19)	SWSJ18, SWSJ23, SWSJ24a (All Made Ground)	0 (19)	-
Nickel	µg/l	<1 - 26	4	20	10 (19)	LGBH04, LGBH05, SWSJ19, SWSJ20, SWJ21, SWSJ22b, SWSJ23, SWSJ27, SWSJ30 (All Made Ground), SBHJ005 (TFD)	1 (19)	SWSJ27 (Made Ground)
Lead	µg/l	<1 - 600	1.2	10	11 (19)	LGBH04, SWSJ18, SWSJ19, SWSJ20, SWJ21, SWSJ22b, SWSJ23, SWSJ24a, SWSJ26, SWSJ27, SWSJ30, WS501 (All Made Ground)	8 (19)	WSJ18, SWSJ19, SWSJ20, SWJ21, SWSJ22b, SWSJ23, SWSJ26, SWSJ27 (All Made Ground)
Selenium	µg/l	<1 - 18	-	10	-	-	2 (19)	SWSJ27, SWSJ30 (All Made Ground)
pH	pH units	9 - 12.3	6-9	6.5-10	5 (6)	LGBH04 (MG), LGBH05(MG), WS501 (1 x MG, 1 x TFD), BH519 (Peat)	3 (6)	LGBH04, LGBH05, WS501
Ammoniacal Nitrogen as N	mg/l	0.8 - 1.2	0.6	-	2 (2)	LGBH04, LGBH05	-	-

8.5.8 It is considered that the elevated concentrations of chromium, arsenic and selenium are not considered to be representative of a major contaminant source as there are no potable water abstractions at or near the Site and the aquifer in the Mercia Mudstone is saline. Furthermore only one or two of the nineteen samples tested had elevated leachate concentrations above the DWS criteria indicating a relatively limited contaminant source.

8.5.9 Copper, lead, nickel, ammoniacal nitrogen and pH exceeded the EQS criteria and may pose a risk to nearby surface waters (Bowleaze and Parish Reens, Monks Ditch and other unnamed ditches). Nickel, lead and ammoniacal nitrogen are considered to represent widespread contaminants of concern for Lagoon 25 as the majority of the samples have been identified with exceedances for these contaminants.

Lagoon 27SW

8.5.10 Seven Made Ground soil samples from Lagoon 27SW were subjected to leaching analysis. The majority of the soil leachate results were all below the screening criteria, with the exception of the contaminants listed in Table 37.

Table 37: Controlled Waters Screening Exceedances – Lagoon 27SW soil leachate

Determinant	Units	Range	EQS	DWS	No. exceeded EQS Screening Criteria (Total number of results)	Location (Formation)	No. exceeded DWS Screening Criteria (Total number of results)	Location (Formation)
Copper	µg/l	3 - 39	10	2,000	2 (7)	SBHJ07CP, SWSJ32	0 (7)	-
Nickel	µg/l	1.3 - 11	4	20	5 (7)	SBHJ06CP, SBHJ07CP, SWSJ31, SWSJ32, SWSJ34	0 (7)	-
Lead	µg/l	<1 - 54	1.2	10	4 (7)	LGBH10, SWSJ31, SWSJ32, SWSJ34	1 (7)	SWSJ31
pH	pH units	11.6 - 12.7	6-9	6.5-10	3 (3)	LGBH10, SBHJ06CP, BH520	3 (3)	LGBH10, SBHJ06CP, BH520
Ammoniacal Nitrogen as N	mg/l	0.8 - 200	0.6	-	2 (2)	LGBH10, SBHJ06CP	-	-

8.5.11 The leachate of the soils for Lagoon 27SW is similar to those identified for Lagoon 25, in particular the predominance of leachable nickel, lead, pH and ammoniacal nitrogen which may pose a risk to surface waters.

Lagoon 27SE

8.5.12 Five Made Ground and two natural soil samples from Lagoon 27SE were subjected to leaching analysis. The majority of the soil leachate results were all below the screening criteria, with the exception of the contaminants listed in Table 38.

Table 38: Controlled waters screening exceedances – Lagoon 27SE Soil Leachate

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location (Formation)	No. Exceeded DWS Screening Criteria (Total Number of results)	Location (Formation)
Nickel	µg/l	<1 - 6	4	20	1 (7)	LGBH12 (Made Ground)	0 (7)	-
Lead	µg/l	<1 - 26	1.2	10	3 (7)	SWSJ35a, SWSJ38 (Made Ground), SWSJ36	2 (7)	SWSJ35a (Made Ground), SWSJ36 (TFD)
Antimony	µg/l	<5 - 14	-	5	0 (4)	-	1 (4)	SWSJ36 (TFD)
pH	pH units	11.6 - 12	6-9	6.5-10	2 (2)	TP508, LGBH12 (Made Ground)	2 (2)	TP508, LGBH12 (Made Ground)

8.5.13 As per Lagoons 25 and 27SW, leachable lead and pH is predominant within Lagoon 27SE and similarly may pose a risk to surface waters. The leachability of nickel is however more localised and copper is not noted to be as leachable as in other lagoons.

8.5.14 Ammoniacal nitrogen analysis has not been included within the analytical suite available for Lagoon 27SE. The single elevated concentration of antimony is not considered to represent a major contaminant source as there are no nearby water abstractions.

Lagoon 26

8.5.15 Eleven Made Ground soil samples from Lagoon 26 were subjected to leaching analysis. The majority of the soil leachate results were all below the screening criteria, with the exception of the contaminants listed in Table 39.

Table 39: Controlled Waters Screening Exceedances – Lagoon 26 Soil Leachate

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location (Formation)	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location (Formation)
Cadmium	µg/l	<0.08 - 0.24	0.15	5	1 (11)	BH524	0 (11)	-
Copper	µg/l	2 - 89	10	2000	4 (11)	STPJ03, STPJ04, STPJ05, STPJ06	0 (11)	-
Nickel	µg/l	<1 - 16	4	20	6 (11)	SBHJ09CP, STPJ03, STPJ04, STPJ05, STPJ06, SBHJ08ACP	0 (7)	-
Lead	µg/l	<1 - 14	1.2	10	7 (11)	SBHJ09CP, SBHJ10CP, STPJ01, STPJ05, STPJ06, SBHJ08ACP, BH524	2 (11)	SBHJ09CP, STPJ06
pH	pH units	11 - 12	6-9	6.5-10	2 (2)	BH523, BH524	2 (2)	BH523, BH524

8.5.16 The leachate fingerprint of the soils for Lagoon 26 is similar to those identified for Lagoons 25, 27SW and 27SE, and similarly leachable nickel, lead and pH may pose a risk to surface waters.

8.5.17 Ammoniacal nitrogen analysis has not been included within the analytical suite available for Lagoon 26.

Groundwater Results

8.5.18 The groundwater results assessment includes a number of monitoring rounds of groundwater monitoring results from boreholes drilled in 2002, 2008 and 2015. The groundwater samples were predominantly taken from the perched water within the Made Ground or Tidal Flat Deposits at the Site with only two samples locations (BHSBHJ07 in Lagoon 25 and BH525 in Lagoon 26) used for sampling the aquifer of the Mercia Mudstone.

8.5.19 The summary of the exceedances of the screening criteria is presented in Table 40.

Table 40: Groundwater Screening Exceedances - All Lagoons

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location of Exceedances EQS	No. exceeded DWS Screening Criteria (Total number of results)	Location of Exceedances DWS
Perched Water: Made Ground								
Boron	µg/l	86-1,200	2,000	1,000	0 (6)	-	1 (6)	BH519
Copper	µg/l	1 - 62	10	2,000	10 (44)	LGBH02 (x2), LGBH03 (x3), LGBH04 (x2), SWSJ23, BH519, BH525	0 (44)	-
Iron	µg/l	<10 - 6200	1,000	200	1 (3)	LGBH11	4 (38)	SWSJ34, LGBH11, LGBH12 (x2)
Lead	µg/l	<0.5 - 1500	1.2	10	18 (44)	LGBH02 (x4), LGBH03 (x2), LGBH04 (x3), LGBH07, SBHJ05, SWSJ21 (x2), SWSJ23, SBHJ09, SWSJ34 (x2), LGBH12	9 (44)	LGBH02 (x3), LGBH04, SWSJ21 (x2), SWSJ23, SWSJ34 (x2)
Manganese	µg/l	<1 - 2100	30	50	8 (31)	LGBH09 (x4), LGBH11 (x2), LGBH12 (x2)	8 (31)	LGBH09 (x4), LGBH11 (x2), LGBH12 (x2)
Nickel	µg/l	1.9 - 36	4	20	32 (44)	LGBH02 (x4), LGBH03 (x4), LGBH04 (x4), LGBH05 (x2), LGBH07, SBHJ05 (x2), SWSJ21 (x2), SWSJ23, BH519, LGBH09 (x3), SWSJ34 (x2), LGBH11, SBHJ09 (x2), BH525, SBHJ09, LGBH12 (x2)	1 (44)	SWSJ21

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location of Exceedances EQS	No. exceeded DWS Screening Criteria (Total number of results)	Location of Exceedances DWS
Selenium	µg/l	<1 - 19	-	10	-	-	4 (44)	LGBH02, BH519, LGBH09, BH525
Cadmium	µg/l	<0.1 - 480	0.15	5	10 (38)	LGBH04, SBHJ05, SWSJ21 (x2), SWSJ23, SWSJ34 (x2), LGBH11 SBHJ09, LGBH12	5 (38)	LGBH04, SWSJ21, SWSJ23, SWSJ34 (x2)
Zinc	µg/l	3 - 82000	75	-	19 (44)	LGBH02, LGBH03 (x2), LGBH04 (x2), SBHJ05 (x2), SWSJ21 (x2), SWSJ23, LGBH09, SWSJ34 (x2), LGBH11 (x2), SBHJ09 (x2),	-	-
BOD	mg/l	<1 - 220	5	-	16 (21)	LGBH02, LGBH04 (x2), SBHJ05 (x2), SWSJ21, SWSJ23, LGBH09, SWSJ34 (x2), LGBH11 (x2), SBHJ09 (x2), LGBH12 (x2)	-	-
Sodium	mg/l	11 - 2000	-	200	-	-	5 (32)	LGBH09 (x4), SWSJ34, LGBH12
Sulphate (soluble)	mg/l	<3 - 302	400	250	0 (34)	-	1 (38)	LGBH03
Chloride	mg/l	3 - 1500	250	250	8 (38)	LGBH05, BH519 (x3), LGBH09 (x4)	8 (38)	LGBH05, BH519 (x3), LGBH09 (x4)

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location of Exceedances EQS	No. exceeded DWS Screening Criteria (Total number of results)	Location of Exceedances DWS
Ammoniacal Nitrogen	mg/l	0.7 - 15.1	0.6	-	44 (44)	LGBH02 (x4), LGBH03 (x4), LGBH04 (x4), LGBH05 (x3), LGBH07, SBHJ05 (x2), SWSJ21 (x2), SWSJ23, BH519 (x3), LGBH09 (x6), SWSJ34 (x2), LGBH11 (x4), SBHJ09 (x2), BH525 (x3), LGBH12 (x4)	-	-
Total Ammonium	mg/l	1.8 - 7.5	-	0.5	-	-	4 (4)	SBHJ05, SWSJ23, SWSJ34, SBHJ09
pH	pH units	7.1 - 12.74	6-9	6.5-10	27 (44)	LGBH02 (x4), LGBH03 (x4), LGBH04 (x4), LGBH05 (x3), LGBH07, SBHJ05 (x2), SWSJ21 (x2), SWSJ23, SWSJ34 (x2), LGBH11, SBHJ09 (x2), BH525	25 (44)	LGBH02 (x4), LGBH03 (x4), LGBH04 (x4), LGBH05 (x2), LGBH07, SBHJ05 (x2), SWSJ21 (x2), SWSJ23, SWSJ34 (x2), LGBH11, SBHJ09 (x2), BH525
Toluene	µg/l	<1 - 104	50	-	1 (44)	LGBH11	-	-
Phenol	mg/l	<0.001 - 0.3	0.0077[1]	-	11 (29)	LGBH04 (x2), SBHJ05 (x2), SWSJ21, SWSJ23, BH519 (x3), BH525 (x2)	-	-

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location of Exceedances EQS	No. exceeded DWS Screening Criteria (Total number of results)	Location of Exceedances DWS
Fluoranthene	µg/l	<0.002 - 2	0.0063	-	4 (33)	LGBH04, SBHJ05, LGBH11 (x2)	-	-
Napthalene	µg/l	<0.002 - 7	2	-	2 (33)	LGBH04 (x2)	-	-
Bis(2-ethylhexyl)phthalate	µg/l	<0.5 - 4	1.3	-	3 (23)	LGBH04, LGBH11 (x2)	-	-
1,2,3-Trichlorobenzene	µg/l	<1 - 21701	0.4	-	1 (29)	LGBH11	-	-
Perched Water: Tidal Flat Deposits								
Arsenic	µg/l	1 - 38	50	10	0 (27)	-	13 (27)	SBHJ04, BH515, BH519 (x3), LGBH10 (x2), BH521 (x2), SBHJ10 (x2),
Boron	µg/l	290 - 1600	2,000	1,000	0 (11)	-	3 (11)	BH521 (x2), BH515
Chromium	µg/l	1 - 87	-	50	-	-	3 (27)	BH519 (x2), BH521
Copper	µg/l	<1 - 110	10	2,000	5 (27)	BH519 (x2), BH521 (x3),	0 (27)	-
Iron	µg/l	<10 - 5800	1,000	200	6 (16)	SBHJ04 (x2), LGBH10 (x2), SWSJ37, SBHJ10	8 (16)	SBHJ04 (x2), LGBH10 (x2), SBHJ06, SWSJ37 (x2), SBHJ10

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location of Exceedances EQS	No. exceeded DWS Screening Criteria (Total number of results)	Location of Exceedances DWS
Lead	µg/l	<0.4 - 5.2	1.2	10	3 (24)	SBHJ04, SBHJ06, SBHJ08A	0 (24)	-
Mercury	µg/l	<0.5-0.56	0.07	1	1 (5)	BH525	0 (5)	-
Manganese	µg/l	2 - 2300	30	50	10 (12)	SBHJ04 (x2), LGBH10 (x2), SBHJ06 (x2), SWSJ37 (x2), LGBH10 (x2)	10 (12)	SBHJ04 (x2), LGBH10 (x2), SBHJ06 (x2), SWSJ37 (x2), LGBH10 (x2)
Nickel	µg/l	2.6 - 25	4	20	21 (27)	LGBH01(x2), SBHJ04, BH515 (x2), BH519 (x3), LGBH10 (x3), SBHJ06 (x2), SWSJ37, BH521 (x3), SBHJ08a (x2), SBHJ10 (x2)	1 (30)	LGBH01
Selenium	µg/l	<1 - 75	-	10	-	-	16 (327)	LGBH01, SBHJ04 (x2), BH519 (x3), LGBH10, SBHJ06 (x2), BH521 (x3), SBHJ10 (x2), BH515 (x2)
Cadmium	µg/l	<0.1 - 23	0.15	5	5 (11)	SBHJ04, LGBH10, SBHJ06 (x2), SBHJ10	1 (11)	SBHJ04
Zinc	µg/l	5 - 8100	75	-	11 (27)	SBHJ04 (x2), LGBH10 (x2), SBHJ06 (x2), SWSJ37 (x2), SBHJ08a (x2), SBHJ10	-	-
BOD	mg/l	<1 - 73	5	-	7 (12)	SBHJ04 (x2), LGBH10 (x2), SWSJ37, SBHJ08a, SBHJ10	-	-

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location of Exceedances EQS	No. exceeded DWS Screening Criteria (Total number of results)	Location of Exceedances DWS
Sodium	mg/l	48 - 4600	-	200	-	-	10 (12)	SBHJ04 (x2), LGBH10 (x2), SBHJ06 (x2), SWSJ37 (x2), SBHJ10 (x2)
Sulphate (soluble)	mg/l	<3 - 1160	400	250	4 (16)	LGBH01 (x2), SBHJ10 (x2)	4 (16)	LGBH01 (x2), SBHJ10 (x2)
Chloride	mg/l	38 - 4300	250	250	18 (21)	SBHJ04 (x2), BH515 (x2), BH519 (x3), LGBH10 (x2), SBHJ06 (x2), SWSJ37 (x2), BH521 (x3), SBHJ10 (x2)	18 (21)	SBHJ04 (x2), BH515 (x2), BH519 (x3), LGBH10 (x2), SBHJ06 (x2), SWSJ37 (x2), BH521 (x3), SBHJ10 (x2)
Ammoniacal Nitrogen	mg/l	2.4 - 36	0.6	-	25 (25)	LGBH01(x2), SBHJ04 (x2), BH515 (x2), BH519 (x3), LGBH10 (x4), SBHJ06 (x2), SWSJ37 (x2), BH521 (x4), SBHJ08a (x2), SBHJ10 (x2)	-	-
Total Ammonium	mg/l	39	-	0.5	-	-	1 (1)	SBHJ04
pH	pH units	7.3 - 13	6-9	6.5-10	7 (27)	LGBH01(x2), BH519, LGBH10, BH521, SBHJ08a (x2)	5 (27)	LGBH01(x2), LGBH10, SBHJ08a (x2)
Phenol	mg/l	<0.001 - 0.089	0.0077[1]	-	6 (22)	BH515, BH519 (x2), BH521 (x3)	-	-

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location of Exceedances EQS	No. exceeded DWS Screening Criteria (Total number of results)	Location of Exceedances DWS
Bis(2-ethylhexyl)phthalate	µg/l	<0.5 - 4	1.3	-	1 (16)	SWSJ37	-	-
Aquifer: Mercia Mudstone								
Arsenic	µg/l	7 - 18	50	10	0 (2)	-	1 (2)	SBHJ07
Copper	µg/l	2.3 - 110	10	2,000	3 (5)	BH525 (x3)	0 (5)	-
Iron	µg/l	570 - 840	1,000	200	0 (2)	-	2 (2)	SBHJ07 (x2)
Lead	µg/l	<0.5 - 8.2	1.2	10	1 (5)	SBHJ07	0 (5)	-
Manganese	µg/l	630 - 2100	30	50	2 (2)	SBHJ07(x2)	2 (2)	SBHJ07(x2)
Nickel	µg/l	4 – 6.1	4	20	3 (5)	SBHJ07, BH525 (x2)	0 (5)	-
Cadmium	µg/l	<0.4 - 18	0.15	5	1 (2)	SBHJ07	1 (2)	SBHJ07
Zinc	µg/l	58 - 6500	75	-	1 (2)	SBHJ07	-	-
BOD	mg/l	8 - 30	5	-	2 (2)	SBHJ07 (x2)	-	-
Sodium	mg/l	900 - 1400	-	200	-	-	2 (2)	SBHJ07(x2)
Selenium	µg/	7.3-75	-	10	-	-	3 (5)	SBHJ07, BH525 (x2)

Determinant	Units	Range	EQS	DWS	No. Exceeded EQS Screening Criteria (Total Number of Results)	Location of Exceedances EQS	No. exceeded DWS Screening Criteria (Total number of results)	Location of Exceedances DWS
Chloride	mg/l	540 - 3200	250	250	5 (5)	SBHJ07(x2), BH525 (x3)	5 (5)	SBHJ07(x2), BH525 (x3)
Ammoniacal Nitrogen	mg/l	9.3 - 25	0.6	-	5 (5)	SBHJ07(x2), BH525 (x2)	-	-
Total Ammonium	mg/l	12	-	0.5	-	-	1 (1)	SBHJ07

Note: [1] based on phenol criteria

8.5.20 Certain laboratory detection levels for mercury, lead, some PAHs, VOCs and SVOCs are higher than applied screening criteria within the data set.

8.5.21 The main contaminants of concern in perched water in Made Ground which is consistently exceed EQS were nickel, ammoniacal nitrogen and pH. Other frequent EQS exceedances of zinc, lead, BOD and to a lesser extent copper, cadmium, iron, manganese and chloride are identified. The elevated copper, lead, nickel, PH and ammoniacal zinc indicate potential leaching of contaminants in coarse slag and sludges has occurred given similar concentrations were noted in the soil leaching test results.

8.5.22 Elevated chloride concentrations indicate the perched water is saline (brackish) and has similar concentrations to the perched water in the Tidal Flat Deposits. Exceedances of DWS were also noted for boron, iron, lead, nickel, manganese, cadmium, zinc, selenium, sodium, sulphate, PH and total ammonium although it is noted that there are no potable surface or groundwater abstractions in the area.

8.5.23 Certain PAH compounds (fluoranthene and napthalene) and VOCs (bis(2-ethylhexyl)phthalate and 1,2,3-Trichlorobenzene) were found within Lagoon 25 (LGBH04) and outside of Lagoon 27 (LGBH11).

8.5.24 Total phenols were found to be present in a third of the samples analysed. Total phenol concentrations have been compared against the EQS for phenol and this is considered a conservative approach. This same screening approach has also been adopted when considered groundwater quality of the Tidal Flat Deposits and Mercia Mudstone discussed below.

8.5.25 Similar to the perched water within the Made Ground widespread EQS exceedances of nickel, pH and ammoniacal nitrogen were observed in the perched water of the Tidal Flat Deposits, chloride and manganese are also persistent within the perched groundwater. EQS exceedances of iron, BOD, phenols and to lesser extent cadmium, lead, mercury and sulphate are also identified. An exceedance of bis(2-ethylhexyl)phthalate was identified within the perched groundwater at SWSJ37 in Lagoon 27SE. The elevated chloride concentrations indicate saline conditions within the perched groundwater of the Tidal Flat Deposits. Within the perched groundwater of the Tidal Flat Deposits arsenic, selenium, sodium, chloride, total ammonium and to lesser degree boron, chromium, iron, manganese and nickel were identified as exceeding DWS criteria.

8.5.26 Similar to the perched water within the Made Ground and perched waters within the Tidal Flat Deposits, the main contaminants of concerns with widespread EQS exceedances are nickel and ammoniacal nitrogen. Chloride, lead, cadmium, copper, manganese and BOD are also persistent within the groundwater with concentrations often similar to the Made Ground perched water and water in the Tidal Flat Deposits. An exceedance of cadmium and zinc was identified within the groundwater at SBHJ07 on the second round of monitoring. The elevated chloride concentrations indicate saline conditions (brackish) within the groundwater. Only two boreholes (BH525 and SBHJ07) with monitoring wells installed in the Mercia Mudstone aquifer were sampled and thus it is not clear whether the results from these two wells are representative of conditions beneath the Site. Within the aquifer, arsenic, selenium, manganese, iron, sodium, chloride, total ammonium and to lesser degree boron, chromium, cadmium were identified exceeding DWS criteria.

8.5.27 From the 36 water samples from the Made Ground, 13 gave TPH concentrations above the laboratory limit of detection ranging from 0.16 to 27,000 µg/l (maximum at LGBH11 during round 2 in 2008). In the water samples collected from Tidal Flat Deposits and Mercia Mudstone, the six TPH results were found to be above laboratory limit of detection (out of 33 samples) all of which were from the perched water within the Tidal Flat Deposits. TPH concentrations ranged from 0.92 to 1,000 µg/l (maximum at SBHJ08A during round 1 in 2008).

8.5.28 The elevated concentrations of copper, lead, manganese, cadmium, zinc and ammoniacal nitrogen are very similar in the water samples from the Tidal Flat Deposits and the Mercia Mudstone aquifer. However, although the perched water in the Made Ground has similar concentrations of copper, manganese and ammoniacal nitrogen to the perched water in the Tidal Flat Deposits and the groundwater in the Mercia Mudstone, concentrations of pH, lead, nickel and cadmium were notably higher in the Made Ground samples. Furthermore pH, lead, nickel and cadmium are noted to be leachable from lagoon sludge and coarse slag. Elevated organic contaminants have been identified in the perched water of the Made Ground including PAHs, phenols and total TPH whereas organic contamination levels were noticeably lower or absent in the Tidal Flat Deposits. On this basis, it is considered that the groundwater in the Mercia Mudstone does not appear to have been contaminated and the low permeability Tidal Flat Deposits are acting as an aquitard, protecting the lower aquifer. However, there is only limited sample data available for the aquifer and further sampling is recommended.

Surface Water

8.5.29 Twenty Seven surface water samples were taken and analysed from the reens surrounding the Site including analysis of water quality of a drainage ditch (the “dirty ditch”) within the Site boundary (SW505). A summary of the exceedances identified by the screening assessment are shown in Table 41. The results for all the sample locations are also presented in the Baseline Water Environment Report (Appendix 16.2 of the ES).

Table 41: Surface Water Screening Exceedances

Parameter	Unit	No. Analyses	No. Analyses above LOD	Minimum concentration	Maximum Concentration	Location & Round of Maximum Concentration	EQS	No. Analyses Exceeding EQS	DWS	No. Analyses Exceeding DWS	CCW Trigger Level	No. Analyses Exceeding CCW Trigger Level
Copper	µg/l	127	15	<0.85	11	E3 / R13	10	1	2000	0	-	-
Lead	µg/l	18	3	<0.02	9	E3 / R13	1.2	1	10	0	250	0
Nickel	µg/l	18	9	<1	10	2 / MDSWS	4	3	20	0	100	0
Cadmium	µg/l	23	4	<0.08	2.9	2 / SW506	0.15	2	5	0	5	0
Cadmium (total)	µg/l	4	1	<0.5	0.5	E1 / R13	0.15	1	5	0	5	0
BOD	mg/l	6	3	1	7	E3 / R13	5	1	-	-	18	-
Dissolved Oxygen	%	4	4	10	63.2	E2 / R13	60	1	-	-	-	-
Nitrate as NO3	mg/l	6	2	0.368	9.73	Q1 / 15.3	-	-	50	0	1	3
Nitrogen as TON	mg/l	6	2	< 0.3	2.21	Q1 / 15.3	-	-	50	0	2	2
Phosphate	mg/l	4	3	0.3	1.3	E2 / R13	-	-	-	-	1	1
pH	pH Units	25	25	7.2	12	SW505	6-9	3	6.5-10	3	6.8-8.5	8

8.5.30 Water quality within Monks Ditch is generally good with a single exceedance above the EQS for cadmium. There are also single EQS exceedances for nitrate (NO3) and total oxidised nitrogen (TON) and three EQS exceedances for pH. All the surface water data for Monks Ditch has been collected in 2015.

8.5.31 Surface water monitoring location R13 on Bowleaze Reen has recorded poor water quality, with exceedances recorded for copper, lead and nickel above their respective EQS. However, these were all recorded during 3rd round (June 2008). This monitoring round also recorded elevated concentrations of long chain TPH, however during other monitoring rounds TPH has been recorded below the LOD. It is considered the elevated copper, lead, nickel and TPH results during this round is anomalous but further monitoring should be undertaken to verify the baseline conditions.

8.5.32 Monitoring locations SW505 and SW506 are situated on drainage ditches within the Site boundary ("dirty ditch" and "clean ditch" respectively). The pH for all monitoring rounds at SW505 and SW506 exceeds the EQS and also the CCW trigger level (notably SW505 recording pH 12 on all three monitoring occasions).

8.5.33 Based upon the surface water monitoring results it is clear that the water quality of the surface waters (Bowleaze Reen, Monks Ditch and Monkscroft Reen) are of far higher quality than that of the perched water of the Made Ground (lagoons) and Tidal Flat Deposits as well as the aquifer of the Mercia Mudstone. It is therefore arguable that the existing containment measures of the lagoons are functioning well.

8.6 Ground Gas Risk Assessment

8.6.1 The ground gas data available relates to boreholes BH515, BH519, BH521, and BH525 with response zones within the Made Ground (BH515 and BH525), peat of Tidal Flat Deposits (BH521) and the transition zone between the Made Ground and the Tidal Flat Deposits (BH519). Based on the monitoring undertaken the below observations have been made.

- The fourth monitoring round (undertaken on 7th May 2015) was undertaken during low barometric pressure (less than 1000 mb), with the lowest conditions being 995 mb. This monitoring data obtained in the first round of monitoring was thus undertaken during conditions more likely to result in ground gas emission.
- Gas flow was generally recorded as absent or negative, with the exceptions of a peak of 0.4 l/hr during the third monitoring round in BH519 (peat) and a peak of 0.1 l/hr during the third monitoring round in BH521 (Made Ground).
- Methane has been recorded within all of the boreholes generally with concentrations above the screening criteria of 1 % (maximum concentration of 8.6% in monitoring round four BH519).
- Carbon dioxide is generally recorded absent in all boreholes with the exception of a maximum concentration of 0.1 % in monitoring round three in BH515. This is significantly below the screening criteria of 5 %.
- Traces of VOCs of up to 5.2 ppm has been recorded.
- With the exception of BH515, hydrogen sulphide was recorded to be at zero throughout the monitoring. In BH515 hydrogen sulphide was recorded during

all monitoring rounds with a maximum of 200 ppm recorded during monitoring round one.

- Carbon monoxide was identified with concentrations of between 0 and 4 ppm at BH521 and BH525. These concentrations are below screening criteria of 30 ppm. At BH515 higher concentrations of carbon monoxide between 463 - 935 ppm were recorded in each of the monitoring rounds. In BH519 carbon monoxide was below 1ppm during the first round, ranged between 2 and 248ppm during the second round and ranged between 0 and 58ppm during the third.
- Oxygen has been recorded to be at ambient concentrations in BH521 of between 19 and 20.9 %. Low to depleted levels of oxygen were encountered in the remaining three boreholes with concentrations of between 0.6 and 13.4 % in BH519, absent to 2.6% in BH515 and absent to 15% in BH5252.

8.6.2 All available gas monitoring data is presented in Appendix 2.

8.6.3 The available data identifies overall moderate methane concentrations are present in soils and raised carbon monoxide and hydrogen sulphide is also present in apparently localised locations. Ambient or depleted oxygen conditions exist within the Made Ground and peat.

8.6.4 A gas risk assessment on the natural soils of the Tidal Flat Deposits has been undertaken and is set out within the Land Contamination Assessment Report (Appendix 11.1 of the ES).

8.6.5 Further gas monitoring is recommended to verify conditions prior to construction and fully determine risks during construction and operation of the Scheme particularly to establish the localised occurrence of the elevated hydrogen sulphide and carbon monoxide in BH515 and carbon monoxide in BH519. It is noted that BH515 is located off the route alignment. Robust control measures will be needed during construction in to prevent risks to construction workers from hydrogen sulphide.

8.7 Summary

8.7.1 Made Ground and natural soils have been shown to have elevated chromium concentrations. However assessment and analysis indicates these are not of the more toxic hexavalent form of chromium thus are considered to be at tolerable levels to human health.

8.7.2 The Made Ground and to a lesser extent, shallow natural soils have been identified to be alkaline.

8.7.3 The lagoon material (both coarse slag and slurry sludge) is generally identified to have high levels of lead in Lagoon 12 and to lesser degree in Lagoon 25 which may pose a risk to human health. Discrete areas of elevated nickel, arsenic and PAH have also been recorded in some of the lagoons although these are not considered to represent such a widespread degree of contamination compared to lead.

8.7.4 Leachable metals (nickel, lead and to lesser extent copper) together with ammoniacal nitrogen and pH in sludge and slag have been identified to be widespread in most lagoons. This may pose a risk to the nearby surface waters.

Chromium, arsenic, selenium and antimony present sporadic exceedances to DWS within the lagoons but these are not considered to be representative of risk as there are no potable water abstractions at or near the Site and the aquifer is also saline. Leaching tests undertaken in Lagoon 12 have identified considerably lower inorganic concentrations in comparison to other lagoons.

8.7.5 The lagoon slurry (sludge) and coarse slag have leachable inorganic and pH contaminants and perched waters within the lagoons and within Made Ground (coarse slag) have been noted to have similarly elevated levels of metals (particularly lead, nickel and cadmium) and pH. Elevated organic contaminants including TPH, PAHs and phenols were also identified in perched water in Made Ground. Elevated copper, lead, manganese, cadmium, zinc and ammoniacal nitrogen were in perched water in the Tidal Flat Deposits and the Mercia Mudstone were noted to be similar. However the concentrations of pH, lead, nickel and cadmium and other organic contaminants were noted to be much higher in perched water in the Made Ground including lagoons. Thus, it is considered that the Tidal Flat Deposits are acting as a relatively effective aquitard severely limiting contaminants in the lagoons to mitigate the Mercia Mudstone aquifer.

8.7.6 The surface water monitoring results indicate that the surface waters adjacent to the lagoons are generally at good quality. Contaminant levels recorded in perched waters of the Made Ground were not identified in surface waters to the north and south of the Site. Based on the information available, it is considered that the current lagoon containment systems seem to be functioning adequately and are protecting the surface waters.

8.7.7 Overall, the quality status of the perched groundwater and aquifer is consistent to the one seen within the area of Newport associated with historical industrial land use.

8.7.8 Elevated methane levels and depleted oxygen levels with low gas flows have been identified. The results indicated that limited ground gas is being generated in Made Ground and natural soils. Elevated carbon monoxide and hydrogen sulphide has been identified and further monitoring and refinement of risks is required to enable control measures to be implemented prior to construction, particularly to protect construction workers.

9 Refined Conceptual Site Model

9.1.1 The incorporation of data from the 2015 Supplementary Ground Investigation has enabled the original CSM presented in the 2014 PSSR to be updated. The assessment is based on the proposed Scheme during construction and operational phases.

9.1.2 A CSM representing general ground conditions, overall Scheme layout and relevant source/pathway/receptors (each of which having a specific alpha-numerical symbol attached) are presented in Figure 2 and is described in Table 42

9.1.3 The CSM assumes that the construction of the motorway will include the excavation of lagoon wastes and reconstruction of the lagoon bunds to the north of the motorway. Surplus materials not used to reinstate the lagoons will be reused elsewhere on the Scheme provided they meet suitability for reuse criteria. Lagoon sludge materials will be treated and reused as 'general fill' within the core of the motorway embankment provided the treated material satisfies suitable for reuse criteria. Coarse slag will be excavated from beneath the water table and clean material placed in its place.

Table 42: Conceptual Site Model

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
On site Elevated metals and pH originating from Made Ground including lagoon waste and perched water and ground gas.	**Construction Stage**					
	Construction workers (B)	Direct dermal (1)	Likely	Moderate	Moderate	Construction workers could be exposed to Made Ground materials during construction works. However exposure duration will be short term only. Prior to construction, a specific risk assessment will be required in line with CDM and other health and safety legislation. This will enable safe methods of work and appropriate levels of PPE to be put in place. As such all risks will be duly considered and suitably mitigated to protect construction workers. The contamination status is not foreseen to represent abnormal constraints to construction workers health and safety over and above those typical of a brownfield site. A construction mat will be placed over the length and width of the proposed embankment to enable band drain installation as well as general construction. This will break dermal, ingestion and inhalation pathways once placed. Ground gas data from the Made Ground is characterised by moderately elevated methane and depleted oxygen with localised abnormal carbon
		Ingestion (3)	Likely	Moderate	Moderate	
		Inhalation of soil dust (2)	Likely	Moderate	Moderate	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of soil gas or vapours (2)	Likely	Moderate	Moderate	monoxide and hydrogen sulphide concentrations. Any surcharge of superficial soils during construction may temporarily increase gas flux. Construction to be largely within open space. Any earthworks within confined space would require specific risk assessment, control measures and appropriate PPE. A gas risk assessment should be undertaken during piling activities to protect construction workers. Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks.
	General public / site neighbours during construction works (C)	Dermal contact with dust (1)	Low likelihood	Low	Very low	During construction there is the possibility of inhalation/ ingestion of soil dust albeit a short term exposure only. The adaption of conventional construction safety methodologies typical for a brownfield site would be required to mitigate these risks to the general public. Dust suppression measures are recommended during construction works. Limited off site receptors within 50 m to main route alignment. Potential contamination sources extend well beyond land take. Ground gas data from the Made Ground is characterised by moderate methane and depleted oxygen with localized abnormal carbon monoxide and hydrogen sulphide concentrations. Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks.
		Ingestion of dust (3)	Unlikely	Low	Very low	
		Inhalation of soil dust (2)	Low likelihood	Low	Very low	
		Inhalation of soil gas or vapours (2)	Unlikely	Low	Very low	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Surface water including reens of the Gwent Levels SSSI (C)	Saturated flow within perched water and groundwaters (4)	Likely	High	High	Perched water in the Made Ground is likely to have low flow and may be absent seasonally. Leachable organics identified within the soils. Surface waters at the boundary of the Site are generally of good quality. Perched (shallow) groundwater is currently intercepted by the lagoon containment systems ('dirty' and 'clean' ditches). The quality of perched water in the Made Ground and lagoons was shown to have been impacted by contamination and therefore the quality of surface water is likely to deteriorate if new pathways are created during construction. A water management system, temporary drainage and a surface water protection plan will be required during construction to protect surface waters being contaminated by leachate generated from lagoon sludge and coarse slag as well as perched waters
		Contaminated surface water run-off (5)	Likely	High	High	Leachable metals identified within the lagoon waste. Surface water run-off from the construction area may deteriorate the quality of surface water and thus the construction process will need to adopt surface water control and management.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Groundwater - aquifer (Da)	Vertical migration (4)	Unlikely	Moderate	Low	Moderate leaching potential identified from lagoon waste. Perched groundwater quality within the Made Ground and Tidal Flat Deposits shown to have elevated concentrations of metals, inorganic and organic contaminants. Thick mantle of predominantly soft low permeability Tidal Flat Deposits overlying aquifer reducing risk of downward migration. Increased vertical pathways between possible contaminant and receptor with construction of piles/band drains. Aquifer identified to be saline and have elevated concentrations of metals and inorganics and is not considered to represent a key receptor especially as it is not used for potable water supply. Hydrostatic pressures shown to be below or at base of the Made Ground. Possible increase in risk of Made Ground to become saturated.
Groundwater – Aquifer from the Glaciofluvial Deposits and/or Mercia Mudstone identified as saline and has elevated levels of metals and inorganics	Surface water (land drainage)	Band drains and pile installation	Unlikely	High	Moderate to low	Water quality within reens identified as good with no obvious impact from existing contamination sources. Perched water of TFD and aquifer quality shown to be saline and has elevated metal, inorganic and organic contaminants. The hydrostatic pressure of the aquifer is near base of Made Ground and piles or band drains could create potential vertical pathways connecting aquifer with surface water. Controls and a foundation risk assessment are required to mitigate these risks. Band drains are not to be installed beneath the full extent of the lagoons reducing this risk.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
Ground gas from TFD including Peat	Construction workers (B)	Inhalation of soil gas / explosion (2)	Low likelihood	High	Moderate	Limited data on ground gas regime from natural strata and further ground gas monitoring required. Peat likely to be associated with high methane concentration but with low or absent flux. Peat overlain by low permeability cohesive soils. Flux likely to increase during any surcharge loading. New pathways could be created with band drains and piling. Construction to be largely within open space. Any earthworks within confined space and during piling and band drain installation would require specific risk assessment, control measures and PPE.
	Off site users during construction works (C)	Inhalation of soil gas / explosion (2)	Unlikely	High	Moderate to low	Limited data on ground gas regime from natural strata and further ground gas monitoring required. Peat likely to be associated with high methane concentration but with low or absent flux. Peat overlain by low permeability cohesive soils. Flux likely to increase during any surcharge loading. New pathways could be created with band drains and piling. Nearest receptors over 50 m south and limited potential for lateral gas migration given the presence of low permeability.
<u>On site</u> Elevated metals and pH originating from Made Ground including lagoon waste and perched water and ground gas.	**Operational**					
	Maintenance workers (B)	Direct dermal (1)	Unlikely	Low	Very low	Made Ground to be encapsulated by the embankment and landscaping and therefore the exposure to contamination will be effectively mitigated. Existing contamination levels are not foreseen to represent abnormal constraints to maintenance workers health and safety over and above those typical of a brownfield site.
		Ingestion (3)	Unlikely	Unlikely	Very low	
		Inhalation of soil dust (2)	Unlikely	Low	Very low	

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
		Inhalation of soil gas or vapours (2)	Unlikely	Low	Very low	Surcharge of superficial soils completed and gas flux likely to have stabilised. Maintenance works would be largely within open space. Any works within confined space would require specific risk assessment, control measures and PPE to meet legislative requirements. Gap in the data has been identified and further investigations are required to delineate any potential contamination and confirm the risks.
	Future Motorway users (A) and other off site users (C)	Dermal contact with soil dust (1)	Unlikely	Low	Very low	Exposure duration will be short term only for motorway users which are to be elevated above ground level. The human health screening criteria is considered conservative when considering exposure and pathway mechanisms to future site users. Made Ground to be encapsulated by the embankment and landscaping and therefore the exposure to contamination will be effectively mitigated. Limited potential for lateral gas migration given the presence of low permeability Tidal Flat Deposits to shallow depth and thus no viable off site receptors. However, further monitoring is required to verify.
		Ingestion of soil dust (3)	Unlikely	Low	Very low	
		Inhalation of soil dust (2)	Unlikely	Low	Very low	
		Inhalation of soil gas or vapours (2)	Unlikely	Low	Very low	
	Groundwater - Aquifer (Da)	Leaching/migration (4)	Unlikely	Moderate	Low	Lagoon wastes to be treated which will reduce mobilisation of contaminants. Majority of Made Ground to be encapsulated by the embankment, further reducing rainfall infiltration potential for mobilisation of contaminants contained within these materials. Aquifer identified to be saline and have elevated concentrations of metals and inorganics and is not considered to represent a key receptor especially as it is not used for potable water supply.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Surface water including reens of the Gwent Levels SSSI (C)	Saturated flow within perched groundwater (4)	Unlikely	Moderate	Low	Perched water within the TFD and lagoon waste contains elevated metal, inorganic and organic contaminant concentrations and lagoon waste has leachable contaminants. Lagoon wastes to be treated which will reduce mobilisation of most contaminants. Lagoon wastes to be removed from beneath perched water level in TFD. Clean and dirty ditch to be reinstated north of motorway to prevent contaminants entering surface waters as per existing arrangements.
Groundwater – Aquifer from the Glaciofluvial Deposits and/or Mercia Mudstone identified as saline and has elevated metals and inorganics	Surface water (land drainage)	Band drain and piling	Unlikely	High	Moderate to low	Water quality within reens identified as good with no obvious impact from existing contamination sources. Perched groundwater and aquifer quality shown to be saline and has elevated metal, inorganic and organic contaminants. The hydrostatic pressure of the aquifer is near base of Made Ground and band drains and piles could create potential vertical pathways connecting aquifer with surface water. A foundation risk assessment is required to mitigate these risks.
Ground Gas from Made Ground / Peat	Maintenance Workers (B)	Inhalation of soil gas / explosion (2)	Unlikely	High	Moderate to low	Although elevated methane concentrations are known within the natural soils of the Tidal Flat Deposits, the low permeability soils will result in limited gas generation post construction. Risk to maintenance workers is low but entry into any confined spaces will need to adhere to health and safety legislation requirements. Pathways along band drains and piles could still allow localised gas migration. Gap in the data has been identified and further investigations are required to assess any potential gas and confirm the risks.

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk	Comment
	Motorway users (A)	Inhalation of soil gas / explosion (2)	Unlikely	High	Moderate to low	Ground gas data from the peat horizons within the superficial deposits identify concentrations of methane. Limited potential for lateral gas migration given the presence of low permeability Tidal Flat Deposits to shallow depth. Motorway to be built on raised embankment providing a further barrier to migration of gases. Gap in the data has been identified and further investigations are required to assess any potential gas and confirm the risks.
	Off site users (C)	Inhalation of soil gas / explosion (2)	Unlikely	High	Moderate to low	Limited data on ground gas regime from natural strata and further ground gas monitoring required. Peat likely to be associated with high methane concentration but with low or absent flux. Peat overlain by low permeability cohesive soils. Nearest receptors some 50 m south and limited potential for lateral gas migration given the presence of low permeability Tidal Flat Deposits viable pathways not considered realistic.

10 Conclusions and Recommendations

10.1 Conclusions

10.1.1 Ground investigations have been undertaken at the Site to assess risks from land contamination associated with the construction and operation of the Scheme including risks to human health and controlled waters.

10.1.2 Widespread contamination within lagoon wastes associated with the Site's historical use has been identified. The risk assessment has identified that some residual risks to human health and controlled waters exist and control measures are required to facilitate the construction and ongoing operation of the Scheme.

10.1.3 The laboratory testing results from previous ground investigations confirmed the onsite observations and field testing, and showed that the lagoon wastes including sludge and coarse slag encountered within the Site contain widespread alkaline conditions with elevated lead concentrations and discrete arsenic, nickel, VOCs and PCB concentrations which are likely to pose a moderate risk to human health during construction and a low risk during the operational phases..

10.1.4 Given the leachability of some contaminants, lagoon waste materials are unlikely to be suitable for reuse without some soil treatment which satisfies suitably for reuse criteria and implementation of a remediation strategy including adoption of a Material Management Plan. The coarse slag and other contaminated waste materials beneath the perched water table will require removal. However this material may be suitable for reuse on the Scheme subject to compliance with suitability for reuse criteria. Clean material won on site or imported to site will be placed in its place.

10.1.5 During the construction phase, specific mitigation measures will be required to prevent inhalation pathways of dust to off site and workforce receptors, although such measures would be no more than typically expected on a construction site.

10.1.6 Contaminated perched groundwaters especially within slag and sludge wastes will require suitable water management strategy and surface and groundwater protection plans will also be required to prevent potential impact to surface waters from contaminant run-offs during construction.

10.1.7 During the operational phase, the embankment will cover part of the Site which will significantly limit the infiltration of rainwater through the soils and potentially leaching any soil contaminants into the groundwater. However, perched water within the Made Ground could remain beneath the embankment and this will require mitigation to prevent future risks to surface waters.

10.1.8 Surface waters at the boundary of the Site are generally of good quality with limited evidence of contamination.

10.1.9 The use of piles and band drains could create new pathways which may lead to impacted perched water within the Tidal Flat Deposits and within the Made Ground to enter the currently confined aquifer within the Glaciofluvial Deposits and the Mercia Mudstone. However band drains will not be used beneath the full extent of the lagoons and band drains will not be installed through contaminated material, which considerably reduces this risk.

10.1.10 The deep aquifer is identified to be have elevated metals and inorganic contaminants which may reduce surface water quality if the band drains or piling pathways allow direct or indirect linkage during construction. Further consideration and a foundation (piling) risk assessment will be undertaken to mitigate the potential impact of the piles and band drains to allow specific mitigation measures to be implemented. However as stated above band drains will not be used beneath the full extent of the lagoons and band drains will not be installed through contaminated material, which considerably reduces this risk.

10.1.11 Post construction, the embankment itself and topsoil and subsoil used for landscaping along the motorway corridor will break potential human health pathways to end-users and maintenance workers. However, topsoil materials placed at the surface will need to be checked for contamination.

10.1.12 Elevated levels of ground gas above screening criteria have been identified in in some monitoring wells and gas protection and control measure will be required during construction to protect workers. Risks to human health and structures from ground gas during the operational phase are considered low.

10.1.13 An unexploded buried ordnance mitigation strategy will be required.

10.2 Recommendations

10.2.1 Given the identified gap in the data, an additional scope of ground investigation works is required. Upon completion this report shall be reviewed and updated accordingly once the findings of the additional investigation are made available. The additional ground investigation will include the below.

- Installation of boreholes to verify the depths of the lagoons and allow installation of groundwater monitoring wells within the Mercia Mudstone.
- Collection of soil samples from lagoons to assess suitability for treatment including cement stabilisation.
- Collection of soil and groundwater samples for contaminant testing.
- Gas monitoring of new and existing wells.
- Ongoing surface water monitoring and sampling.

10.2.2 Upon review and assessment of the additional ground investigation information any contamination identified that could cause an unacceptable risk to the identified receptors will require appropriate remedial mitigation measures to be implemented. These measures would be identified within a remediation strategy for the Scheme. The remediation strategy is anticipated to include but is not limited to the below.

- Addressing potential human health risk and controlled waters risk identified by the proposed additional ground investigation.
- Design details of the reinstated lagoons to facilitate variations of environmental permits and partial surrender of land within the permanent highway and land to the south.
- Lagoon waste treatment requirements and surface water protection controls during construction.

- Risk assessment of piling and band drains and associated construction works creating pathways enabling contaminants migration.
- Dealing with unexpected contamination.
- Verification sampling strategy to confirm suitability for soils for retention / reuse.
- Control measures to prevent risks to construction workers and the general public during construction.
- Verification of imported topsoils for suitability of use.

10.2.3 The remediation strategy will include a remediation options appraisal, remediation implementation plan and remediation verification plan. The remediation strategy should be supplemented with a Scheme wide Material Management Plan prepared in accordance with CL:AIRE Code of Practice (CL:AIRE, 2011). The remediation strategy should be agreed with NRW prior to implementation.

11 References

Bactec (2014) Explosive Ordnance Threat Assessment in respect of M4 Corridor around Newport for Hyder Consulting (UK) Limited, 5750TA

CL:AIRE (2011) Definition of Waste. Development Industry Code of Practice, Version 2, March 2011, ISBN 978-1-905046-23-2

Environment Agency (2001) Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention. NC/99/73

Environment Agency (2002) Piling into contaminated sites. National Groundwater and Contaminated Land Centre, February 2002

Geotechnical Engineering Limited (2015) M4 Corridor Around Newport, Factual Report on Ground Investigation, 30238

Highways Agency (2008) Design Manual for Roads and Bridges. Vol. 4. Geotechnics and Drainage. Section 1. Earthworks; Part 2. HD22/08. Managing Geotechnical Risk.

Ove Arup & Partners (2014) M4 Corridor Around Newport, Preliminary Sources Study Report, 14/9197

Peter Brett Associates (2004) Docksway Disposal Site, Newport Conceptual Model and Hydrogeological Risk Assessment for Area 1 - Current and Past Tipping Area. 14739/014/1/CBH/DA/RHT /DW, October 2004

Peter Brett Associates (2005) Docksway Disposal Site, Newport Conceptual Model and Hydrogeological Risk Assessment for Area 2 - Landfill Extension. 14739/014/A2/002-CBH/DA/RHT, April 2005

Peter Brett Associates (2013) Docksway Disposal Site, Annual Environmental Review for Area 1 - 2012. 14739/153/R001/Rev 01, February 2013

Peter Brett Associates (2013) Docksway Disposal Site, Annual Environmental Review for Area 2 - 2012. 14739/152/R001/Rev 01, March 2013

Peter Brett Associates (2015) Docksway Disposal Site, Annual Environmental Review for Area 2 - 2014. 14739/3508/R001/Rev 01, February 2015

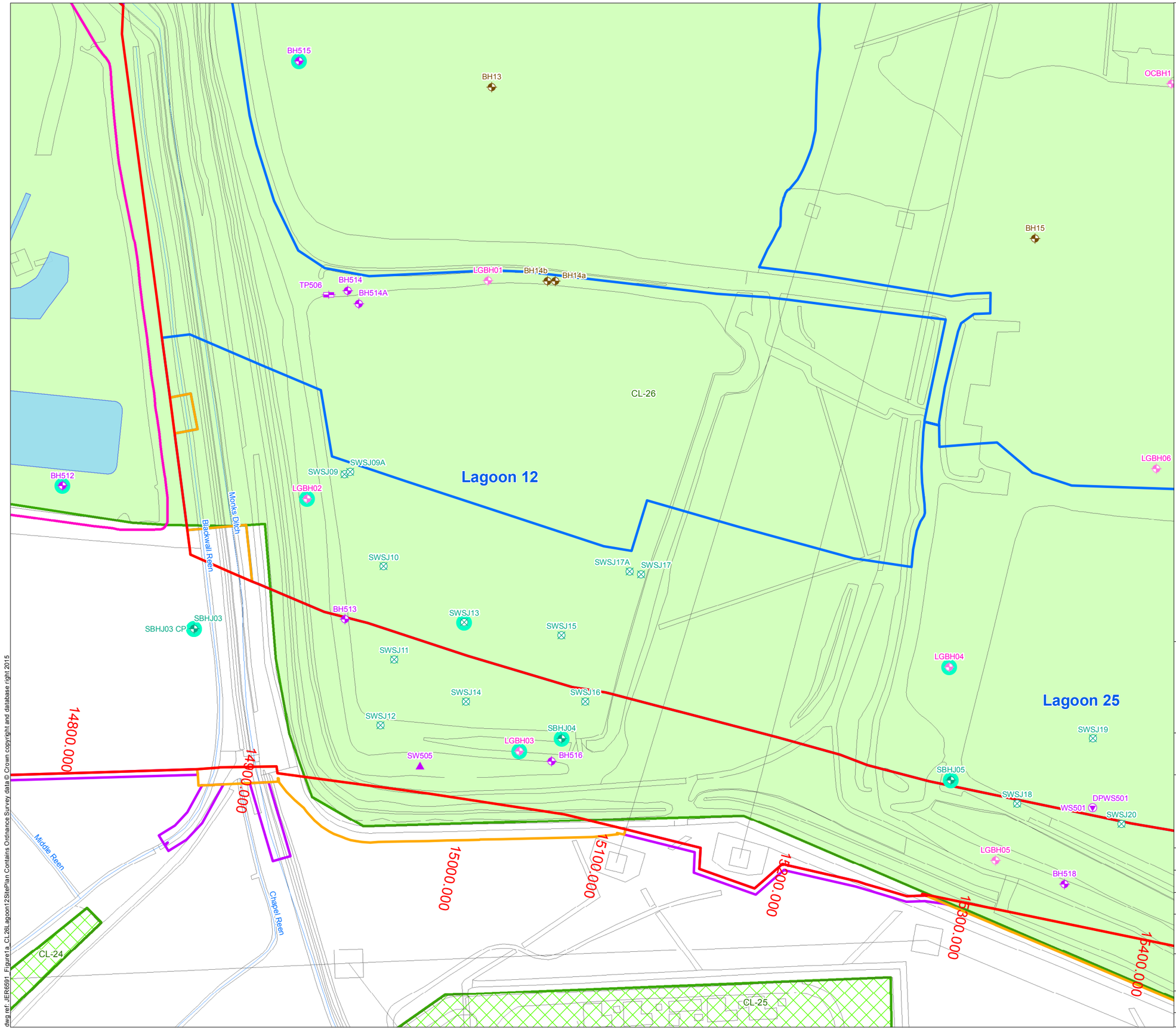
Titan Environmental Surveys Ltd (2008) New M4 Magor to Castleton Baseline Surface Water Quality Final Report for Arup, Report Number HS0442/F1/2

12 Glossary

BF	Blast Furnace
BGS	British Geological Survey
BOD	Biochemical Oxygen Demand
BOS	Basic Oxygen Slag
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CAT	Cable Avoidance Tool
CDM	Construction Design Management
CH_4	Methane
CLEA	Contaminated Land Exposure Assessment
CO_2	Carbon Dioxide
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CSM	Conceptual Site Model
DMRB	Design Manual for Roads and Bridges
DO	Dissolved Oxygen
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESG	Environmental Scientifics Group
EQS	Environmental Quality Standard
FTIR	Fourier Transform Infrared (spectroscopy)
GAC	Generic Assessment Criteria
GDR	Geotechnical Design Report
GIR	Ground Investigation Report
GRO	Gasoline Range Organics
LEL	Lower Explosive Limit
LOD	Limit of Detection
mAOD	Metres Above Ordnance Datum

mb	Millibars
mbGL	Metres below Ground Level
MTBE	Methyl Tert-butyl Ether
NRW	Natural Resources Wales
ORP	Oxidation Reduction Potential
O_2	Oxygen
OS	Ordnance Survey
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCSM	Preliminary Conceptual Site Model
PID	Photo Ionisation Detector
PPE	Personnel Protection Equipment
SGVs	Soil Guideline Values
SSAC	Site Specific Assessment Criteria
SSSI	Site of Special Scientific Interest
SVOCs	Semi-Volatile Organic Compounds
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
TPH CWG	Total Petroleum Hydrocarbon Criteria Working Group
UKAS	United Kingdom Accreditation Service
VOCs	Volatile Organic Compounds
WFD	Water Framework Directive
UXO	Unexploded Ordnance Survey

Figures



Legend

- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Other Permanent Land Take
- Temporary Construction Land
- Easement Only
- Proposed Water Treatment Area (WTA)
- Potential Area of Land Contamination based on 2014 PSSR
- Other Potential Area of Land Contamination
- Metal Recovery Area

Investigation Locations

2015 (Geotechnical Engineering)

- Borehole
- Dynamic Probe (Proposed Borehole)
- Trial Pit
- Surface Water Monitoring Location

2007 (Norwest Holst)

- Borehole
- Window Sample

2006 (Enviros)

- Borehole

2002 (Exploration Associates)

- Borehole
- Monitoring Well Installation

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Welsh Government

Appendix 11.1 Annex D CL-26

Site Plan for CL-26 (Lagoon 12)

Figure: 1a	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Scale: A3 @ 1:2,000

0 30 60 m

N

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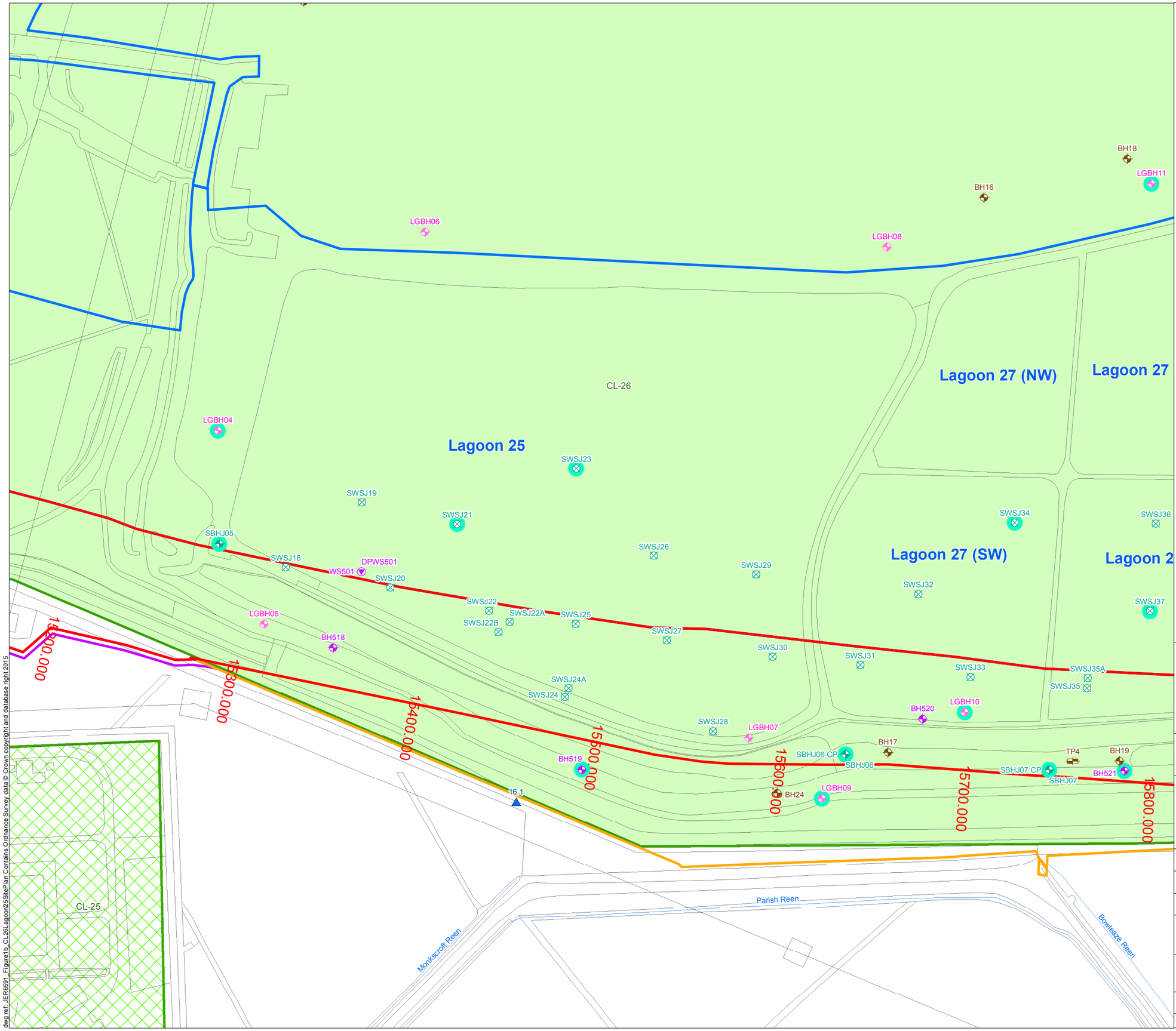
dwg ref: JER6591_Figure1a_CL26Lagoon12SitePlan Contains Ordnance Survey data © Crown copyright and database right 2015



Legend

- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Other Permanent Land Take
- Temporary Construction Land
- Easement Only
- Potential Area of Land Contamination based on 2014 PSSR
- Other Potential Area of Land Contamination

Investigation Locations

2015 (RPS)
- Surface Water Monitoring Location - Q2

2015 (Geotechnical Engineering)
- Borehole
- Dynamic Probe (Proposed Borehole)

2007 (Norwest Holst)
- Borehole
- Window Sample

2006 (Enviros)
- Borehole
- Trial Pit

2002 (Exploration Associates)
- Borehole
- Monitoring Well Installation

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Appendix 11.1 Annex D CL-26

Site Plan for CL-26 (Lagoon 25)

Figure: 1b	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Scale: A3 @ 1:2,000
0 30 60 m

N

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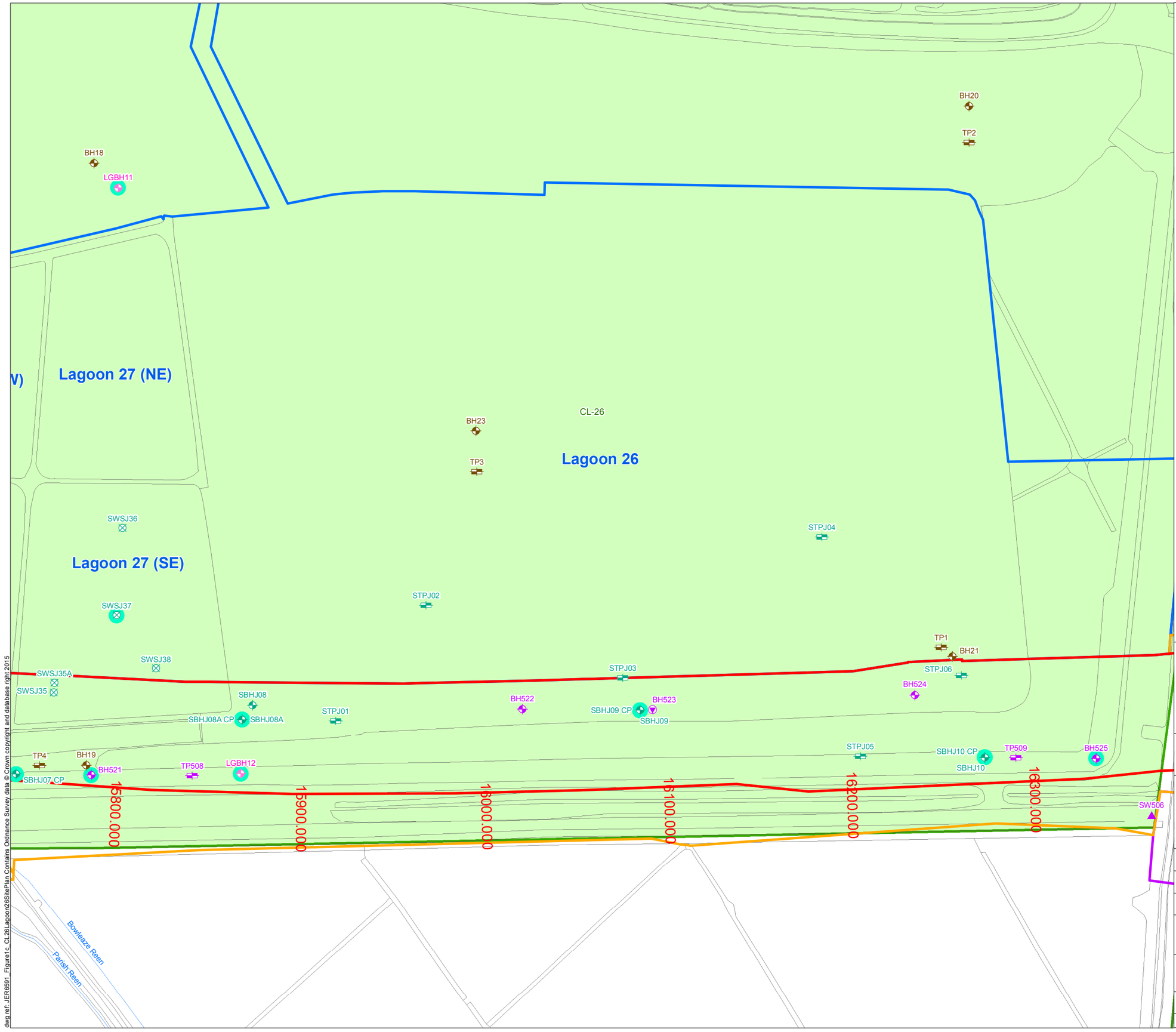
dwg ref: JER6591_Figure1b_CL26Lagoon25SitePlan Contains Ordnance Survey data © Crown copyright and database right 2015



Legend

- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Other Permanent Land Take
- Temporary Construction Land
- Easement Only
- Potential Area of Land Contamination based on 2014 PSSR
- Other Potential Area of Land Contamination

Investigation Locations

2015 (Geotechnical Engineering)

- Borehole
- Dynamic Probe (Proposed Borehole)
- Trial Pit
- Surface Water Monitoring Location

2007 (Norwest Holst)

- Borehole
- Trial Pit
- Window Sample

2006 (Enviros)

- Borehole
- Trial Pit

2002 (Exploration Associates)

- Borehole
- Monitoring Well Installation

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Appendix 11.1 Annex D CL-26

Site Plan for CL-26 (Lagoon 26)

Figure: 1c	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Scale: A3 @ 1:2,000
0 30 60 m

N

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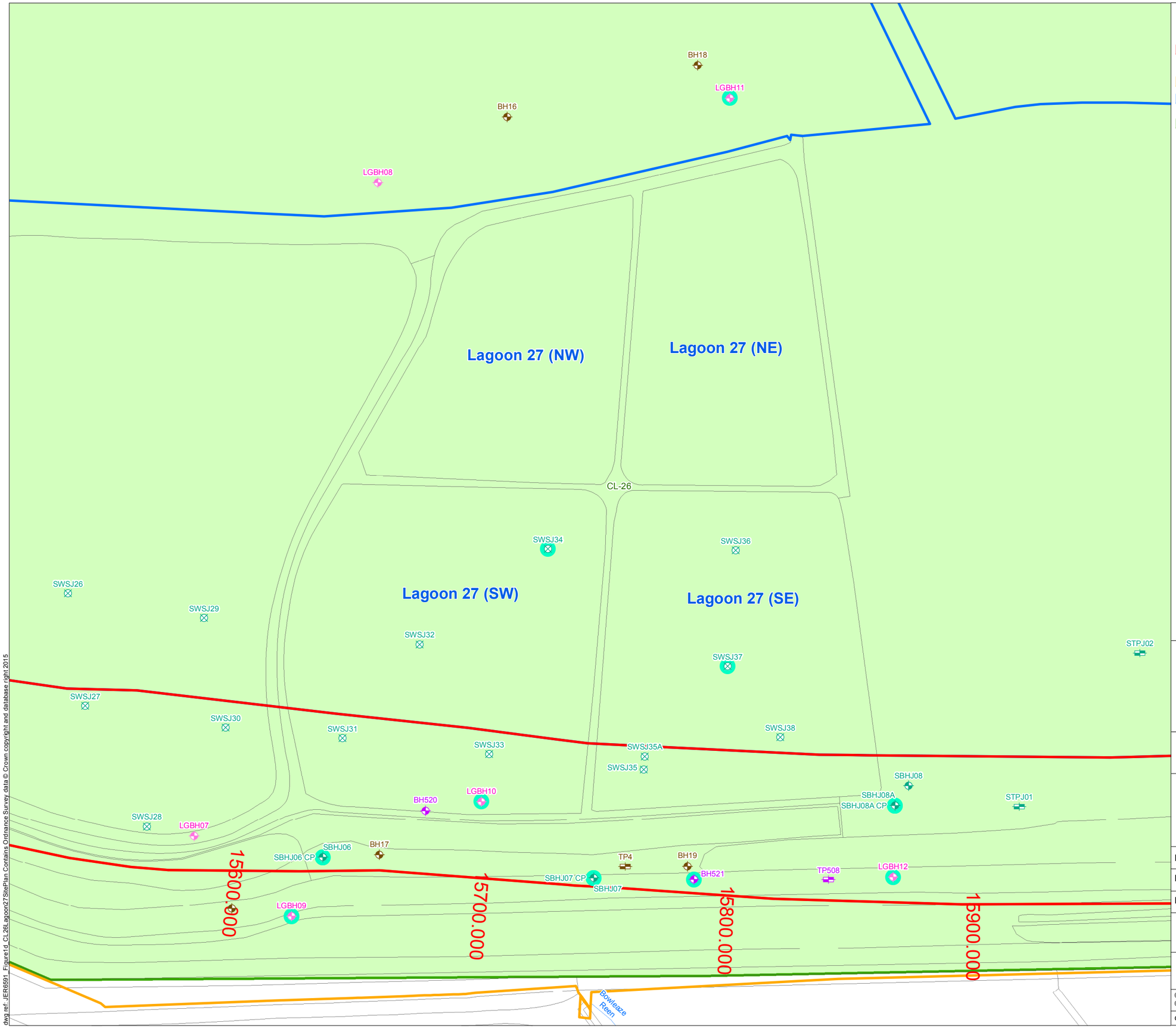
dwg ref: JER6591_Figure1c_CL26Lagoon26SitePlan

dwg ref: JER6591_Figure1c_CL26Lagoon26SitePlan Contains Ordnance Survey data © Crown copyright and database right 2015



Legend

- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Other Permanent Land Take
- Temporary Construction Land
- Potential Area of Land Contamination based on 2014 PSSR

Investigation Locations

2015 (Geotechnical Engineering)
- Borehole
- Trial Pit

2007 (Norwest Holst)
- Borehole
- Trial Pit
- Window Sample

2006 (Enviros)
- Borehole
- Trial Pit

2002 (Exploration Associates)
- Borehole
- Monitoring Well Installation

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Appendix 11.1 Annex D CL-26

Site Plan for CL-26 (Lagoon 27)

Figure: 1d	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Scale: A3 @ 1:1,500

0 25 50 m

N

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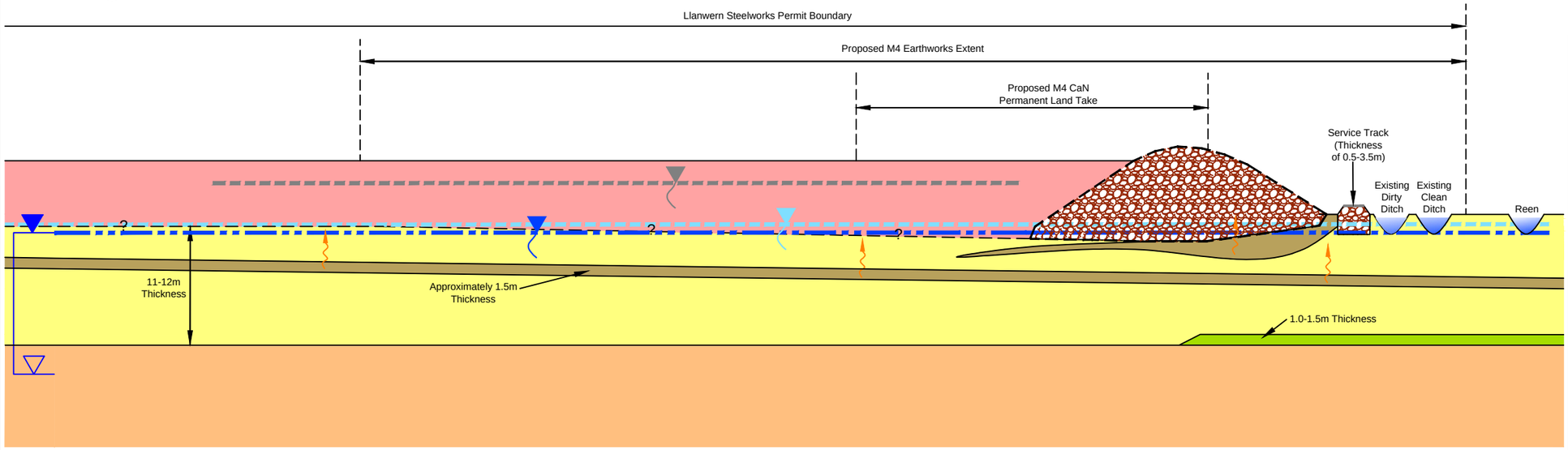
dwg ref: JER6591_Figure1d_CL26Lagoon27SitePlan

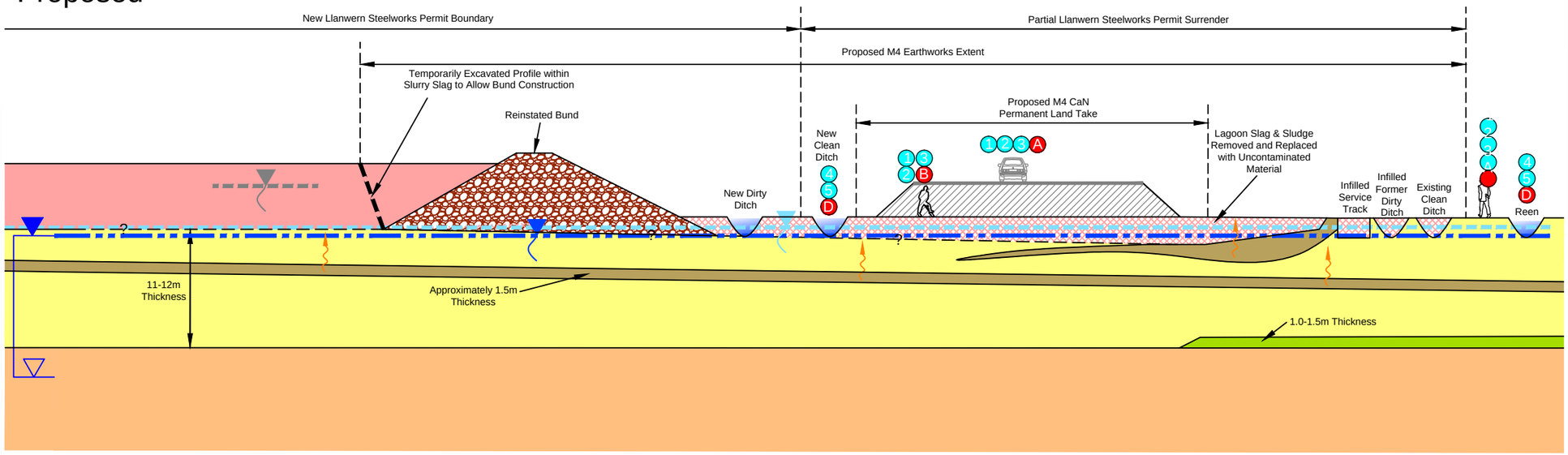
dwg ref: JER6591_Figure1d_CL26Lagoon27SitePlan Contains Ordnance Survey data © Crown copyright and database right 2015

CL- 26 Llanwern Steelworks

Existing



Proposed



Ground conditions based on available information

Legend

- Made Ground (Slurry Slag) - MG
- Coarse Slag (Peripheral Bund)
- Uncontaminated Clean Infill Material
- Tidal Flat Deposits - TFD
- Peat
- Glaciofluvial Deposits - GFD
- Mercia Mudstone (Proven) - MM
- Proposed Motorway (Cement Stabilised Lagoon Slurry)
- ? No Information Available
- Perched Water (MG)
- Perched Groundwater (TFD)
- Groundwater (GFD and MM)
- Water Strike
- Rest Water Level
- Gas Migration Pathway

Potential Receptors

- A Humans On-Site (M4 User)
- B Humans On-Site (Construction/Maintenance)
- C Humans Off-Site (Site Neighbours)
- D2 Groundwater (Aquifer)
- D1 Groundwater (Perched)
- D Surface Water

Potential Pathways

- 1 Dermal Contact
- 2 Inhalation
- 3 Ingestion
- 4 Leaching / Migration
- 5 Surface Run Off

Potential Sources of Contamination

Possible contamination present on site associated with :

On-Site

- Contamination present on site associated with the slag material located in the lagoons
- Cyanide is recorded in a mobile state

Off-Site

- Main Llanwern Steelworks

NOTE
Drawing refined from PSSR Drawing Reference
M4-OA-17-00DR-Z-XX-0145 (April 2014)

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Appendix 11.1 Annex D CL-26

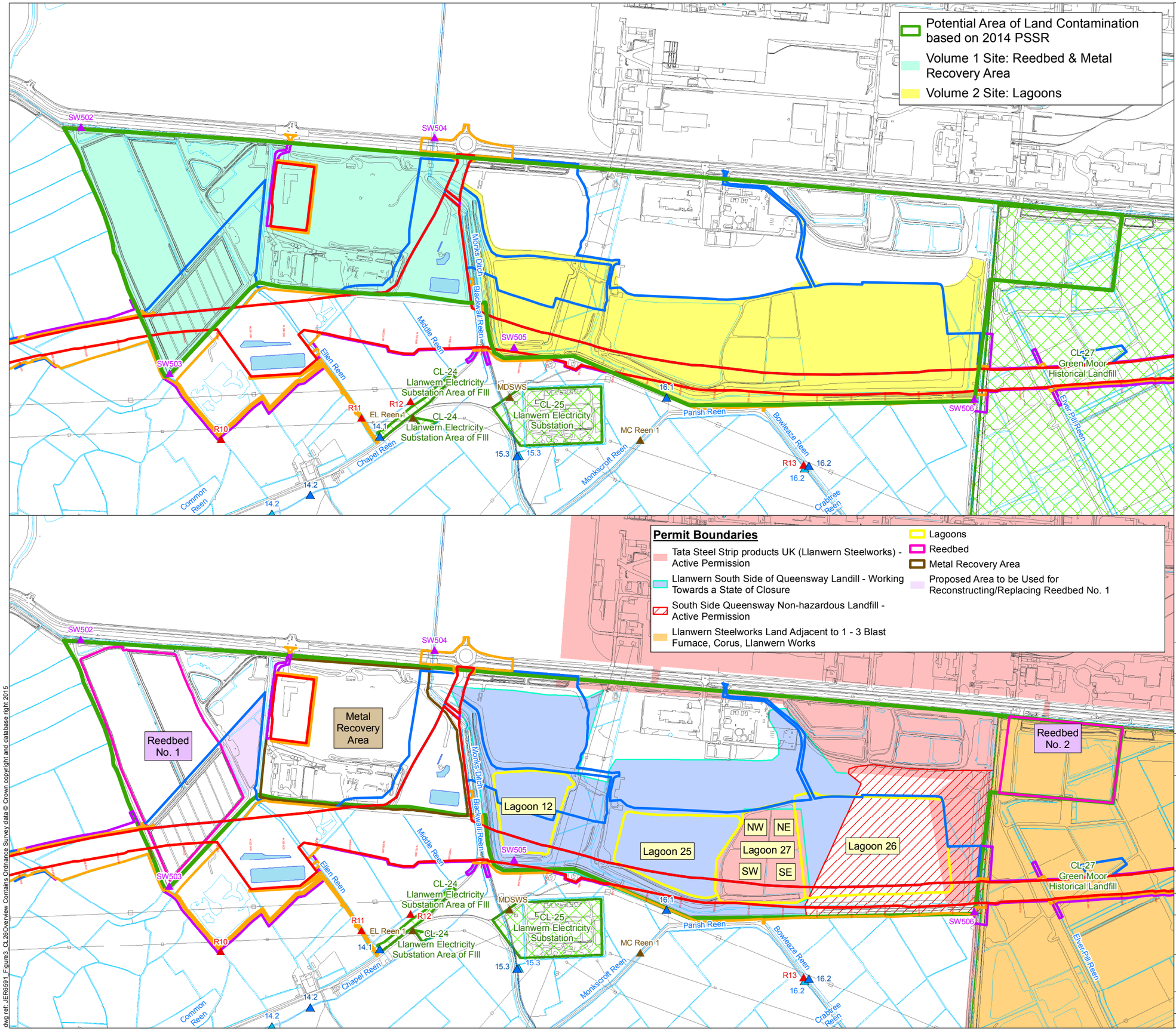
Conceptual Site Model for CL-26 (Lagoons)

Figure: 2	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Not to Scale

dwg ref:JER6591_Figure2_CL26LagoonsConceptualSiteModel

dwg ref: JER6591_Figure2_CL26LagoonsConceptualSiteModel



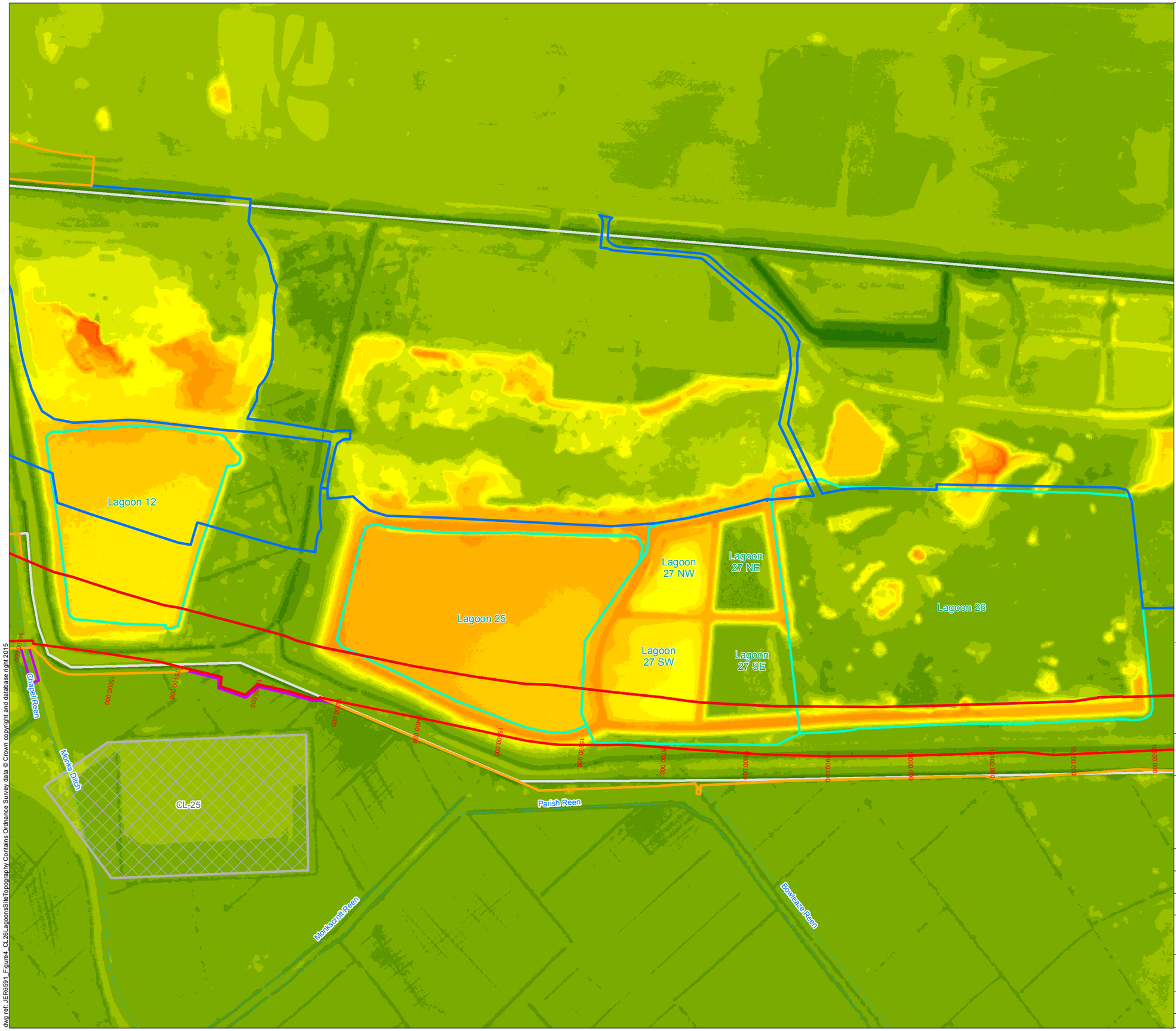
Legend

- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Other Permanent Land Take
- Temporary Construction Land
- Easement Only
- Proposed Water Treatment Area (WTA)
- Potential Area of Land Contamination based on 2014 PSSR
- Other Potential Area of Land Contamination

Surface Water Monitoring Locations

- 2015 (RPS) - Q2
- 2015 (RPS) - Q1
- 2015 (Geotechnical Engineering)
- 2008-2009 (Titan Surveys)
- 2006 (Enviros)

M4
A48
A48(M)
NEWPORT
Llanwern
Wilcrick
Bishton
Underwood
Llanfihangel Rogiet
Magor
Undy
Rhiwderin
Bassaleg
Michaelston-y-Fedw
Duffryn
Coedkernew
Marshfield
Castleton
Tredegar Park
Bedwas
Pontllanfraith
Pontllanfraith
Pontllanfraith



Legend

- Permanent Highway Land within Fenceline (including Water Treatment Areas)
- Other Permanent Land Take
- Temporary Construction Land
- Easement Only
- Potential Area of Land Contamination based on 2014 PSSR
- Other Potential Area of Land Contamination
- Lagoon

LiDAR Digital Terrain Model

- 1 -< 2 mAOD
- 2 -< 3 mAOD
- 3 -< 4 mAOD
- 4 -< 5 mAOD
- 5 -< 6 mAOD
- 6 -< 7 mAOD
- 7 -< 8 mAOD
- 8 -< 9 mAOD
- 9 -< 10 mAOD
- 10 -< 11 mAOD
- 11 -< 12 mAOD
- 12 -< 13 mAOD
- 13 -< 14 mAOD
- 14 -< 15 mAOD
- 15 -< 16 mAOD
- 16 -< 17 mAOD
- 17 -< 18 mAOD

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Appendix 11.1 Annex D CL-26

Site Topography for CL-26 (Lagoons)

Figure: 4	Revision: -
Date: March 2016	Status: At Issue
Drawn: RJJ	Checked: FB

Scale: A3 @ 1:4,500

0 112.5 225 m

N

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dwg ref: JER6591_Figure4_CL26LagoonsSiteTopography Contains Ordnance Survey data © Crown copyright and database right 2015

Appendices

A1 Appendix 1a

Exploratory Records (Lagoon 12)

Borehole Log

Exploration Associates

Drilled by NF Logged by LM Checked by	Equipment and Methods Inspection Pit from 0.00m to 1.20m. Cable Percussion 150 mm diameter from 1.20m to 10.50m.	Ground Level National Grid Coordinates	+ 11.80 m OD E 337005.30 N 185966.22

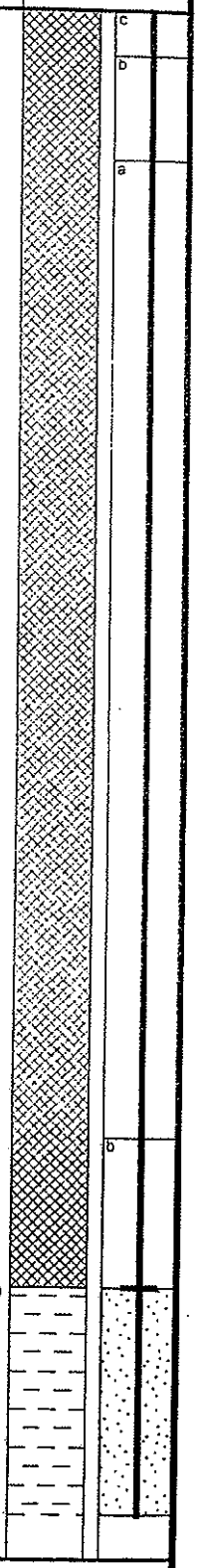
Samples and Tests

Depth	Type & No.	Records	Date Casing Water
			05/02/2002 0.00 dry
1.00	ES1		
			05/02/2002 5.00 dry
			06/02/2002 5.00 dry
7.50	ES2		
9.50	ES3		

Strata

Description	Depth,Level (Thickness)
MADE GROUND: Brown and grey clayey sandy GRAVEL. Gravel is angular and subangular fine to coarse of slag, concrete and clinker.	(8.50)
	8.50 +3.30
Firm grey mottled orange brown and dark brown CLAY.	(2.00)

Legend



Groundwater
Not encountered during drilling.

Remarks
Chiselling : 1.70m to 2.20m 90minutes, 2.90m to 3.50m 120minutes, 4.40m to 5.00m 90minutes, 5.00m to 5.70m 120minules, 6.60m to 7.30m 120minules, 8.00m to 8.50m 150minutes
Hole backfill : 0.00m to 0.30m Concrete (c), 0.30m to 1.00m Bentonite (b), 1.00m to 7.50m Arisings (a), 7.50m to 8.50m Bentonite (b). Surface protection : Stop Cock Cover
Standpipe installed, 50mm diameter, response zone from 8.50m to 10.50m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole
LGBH1
Sheet 1 of 2

Borehole Log

Exploration Associates

Drilled by NF Logged by LM Checked by	Equipment and Methods See sheet 1	Ground Level National Grid Coordinates	+ 11.80 m OD E 337005.30 N 185966.22

Samples and Tests / Strata

Depth	Type & No.	Records	Date Casing	Time Water	Description	Depth,Level (Thickness)	Legend
10.50		kRH	06/02/2002 10.50	dry	As sheet 1	(2.00pen)	
					EXPLORATORY HOLE ENDS AT 10.50 m.	10.50 +1.30	

Groundwater

Remarks

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project: ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no. 152002
Carried out for Corus plc

Borehole
LGBH1
Sheet 2 of 2

03/05/2002 11:10:22 ESGLog v2.10

Borehole Log

Exploration Associates

Drilled by GW Logged by LM Checked by	Equipment and Methods Inspection Pit from 0.00m to 0.50m. Cable Percussion 150 mm diameter from 0.50m to 9.00m.	Ground Level National Grid Coordinates	+ 10.81 m OD E 336915.38 N 185866.11

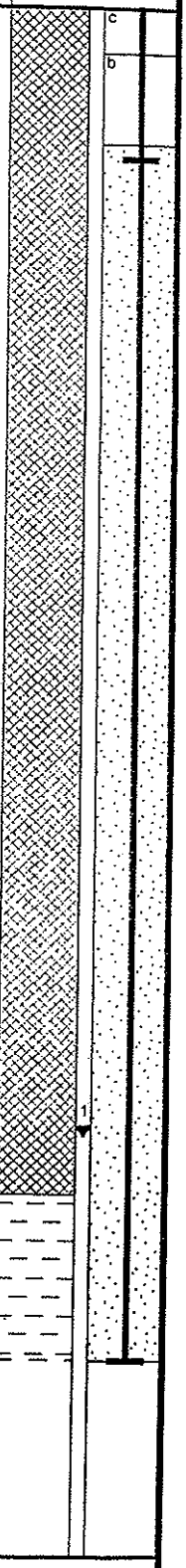
Samples and Tests

Depth	Type & No.	Records	Date Casing	Time Water
			05/02/2002	
0.50	ES1			
			05/02/2002 6.00	dry
			06/02/2002 6.00	dry
8.10	ES2			
			06/02/2002 0.00	
9.00	ES3			

Strata

Description	Depth,Level (Thickness)	
MADE GROUND: Grey brown sandy GRAVEL. Gravel is angular to subrounded fine to coarse of concrete. Driller reports slag.	(7.90)	
Soft to firm grey mottled brown slightly sandy CLAY.	7.90 +2.91 (1.10pen)	
EXPLORATORY HOLE ENDS AT 9.00 m.	9.00 +1.81	

Legend



Groundwater

No. Struck Behaviour

1 7.50m Rising to 7.50m after 20 mins. Sealed 8.00. Slow inflow

Remarks

Chiselling : 0.50m to 6.00m 240minutes, 6.00m to 7.90m 360minutes
Hole backfill : 0.00m to 0.30m Concrete (c), 0.30m to 0.90m Bentonite (b). Surface protection : Stop Cock Cover
Standpipe installed, 50mm diameter, response zone from 0.90m to 9.00m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole
LGBH2
Sheet 1 of 1

Borehole Log

Exploration Associates

Drilled by GW Logged by DE Checked by	Equipment and Methods Cable Percussion 150 mm diameter from 0.00m to 9.00m.	Ground Level + 10.53 m OD National Grid Coordinates E 336994.50 N 185716.52	

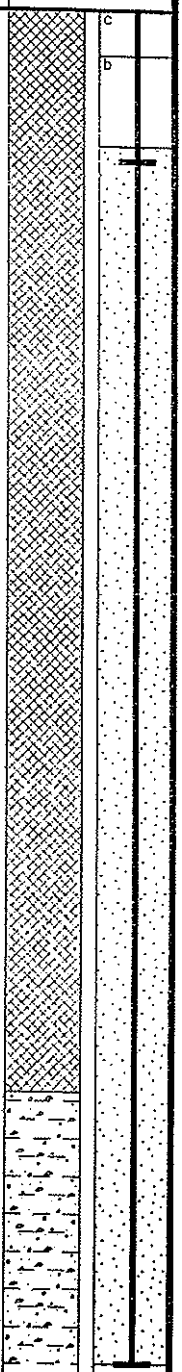
Samples and Tests

Depth	Type & No.	Records	Date Casing	Time Water
			31/01/2002	
0.50	ES1			
			01/02/2002 3.00	dry
			04/02/2002 3.00	dry
			04/02/2002 7.00	dry
			05/02/2002 7.00	6.90
8.00	ES2			
			05/02/2002	
9.00		kRH		

Strata

Description	Depth,Level (Thickness)
MADE GROUND: Dark grey SAND AND GRAVEL. Gravel is subangular to rounded fine to coarse of slag.	(7.20)
	7.20 +3.33
Soft green grey mottled orange brown slightly gravelly CLAY. Gravel is angular fine to coarse of limestone.	(1.80pen)
EXPLORATORY HOLE ENDS AT 9.00 m.	9.00 +1.53

Legend



Groundwater

Remarks
Chiselling : 0.70m to 3.00m 150minutes, 3.00m to 7.00m 270minutes, 7.00m to 7.70m 90minutes
Hole backfill : 0.00m to 0.30m Concrete (c), 0.30m to 0.90m Bentonite (b). Surface protection : Stop Cock Cover
Standpipe installed, 50mm diameter, response zone from 0.90m to 9.00m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no. 152002
Carried out for Corus plc

Borehole
LGBH3
Sheet 1 of 1

03/05/2002 11:11:05 ESGLog v2.10

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
SBHJ04
Header

Contract No.	F15056	Method	Cable Percussion & Rotary	Coordinates	337045.30 E 185715.92 N
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	Dando Tractor/Dando	Ground Level	11.24m AOD
Client	Transport Wales, Welsh Assembly Government	Drillers	MM/PW	Orientation	Vertical
		Logged by	DH	Date Started	18/12/2007
Consultant	Ove Arup & Partners Ltd	Core barrel		Date Completed	09/01/2008
		Core bit	8 Inch Hammer		

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
18/12/2007	1730	7.70	7.70	DRY	End of Shift
08/01/2008	0730	7.70	7.70	DRY	Start of Shift
08/01/2008	1730	16.00	16.00	DRY	End of Shift
09/01/2008	0730	16.00	16.00	11.00	Start of Shift
09/01/2008	1730	18.50	18.20	1.85	End of Hole

CABLE PERCUSSION DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling Hours	Remarks
7.20	7.80	1.50	Chisseling
16.40	17.40	2.50	Slow Progress
18.20	18.50	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	7.70	200	7.70
150	18.50	150	18.20

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

ROTARY DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
0.00	7.70	Air	Good	0*

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm	Casing	Water Depth
8.50	S	N=13 (2,3,3,4,3,3)	8.00	DRY
10.50	S	N=19 (2,3,4,5,5,5)	9.70	DRY
12.50	S	N=22 (3,4,5,7,5,5)	12.00	DRY
14.50	S	N=8 (1,1,2,2,2,2)	14.00	DRY
16.50	C	N=39 (5,9,9,11,10,9)	10.00	12.00
18.00	S	50/210mm (7,14,16,16,18)	17.50	14.00
18.50	S	50/20mm (25,50)	18.20	10.00

* Seating blows only.

GENERAL NOTES

1. Rotary Openhole cemetrix drilling from GL to 7.70m.
2. Insitu permeability testing carried out from 17.40m to 18.50m.
3. Cable Percussive boring from 7.20m to 18.50m.
4. 50mm Standpipe installed slotted from 12.10m to 13.10m.
5. 0.00* indicates openhole drilling.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, hard strata time in hours

Form	ARIAL COMBINED HEADER
Version	3.04
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
SBHJ04
Sheet 1 of 2

Contract No.	F15056	Method	Rotary & Cable Percussion	Coordinates	337045.30 E
Project	New M4 - Second Preliminary Ground Investigation				185715.92 N
		Drilling Rig	Dando Tractor/Dando	Ground Level	11.24m AOD
Client	Transport Wales, Welsh Assembly Government	Drillers	MM/PW	Orientation	Vertical
		Logged by	DH	Date Started	18/12/2007
Consultant	Ove Arup & Partners Ltd	Core Barrel		Date Completed	09/01/2008
		Core Bit	8 Inch Hammer		

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling & coring		Blow Count TCR	SCR	RQD	SPT type, N & depth		Install-ation
MADE GROUND: Steel clinker. (Driller's description)											
		7.00	4.24								
MADE GROUND: Stiff clay. (Driller's description)		7.20	4.04								
MADE GROUND: Clinker fill. (Driller's description)											
		7.80	3.44								
Firm grey silty CLAY. (Driller's description) (Estuarine Alluvium)		8.00	3.24	ES1	8.00		(10)				
				D2	8.00						
				U3	8.00-8.45						
Firm high strength thinly laminated grey silty CLAY with occasional organic fragments. (Estuarine Alluvium)				D4	8.50				S13		
				D5	8.50				8.50	8.95	
---from 8.50m to 10.50m becomes soft to firm											
				ES6	9.00						
				D7	9.50						

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL COMBINED LOG
Version	3.10
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
SBHJ04
Sheet 2 of 2

Contract No.	F15056	Method	Rotary & Cable Percussion	Coordinates	337045.30 E
Project	New M4 - Second Preliminary Ground Investigation				185715.92 N
		Drilling Rig	Dando Tractor/Dando	Ground Level	11.24m AOD
Client	Transport Wales, Welsh Assembly Government	Drillers	MM/PW	Orientation	Vertical
		Logged by	DH	Date Started	18/12/2007
Consultant	Ove Arup & Partners Ltd	Core Barrel		Date Completed	09/01/2008
		Core Bit	8 Inch Hammer		

Description of Strata	Depth Below G.L.	Datum Level	Sampling & coring		Blow Count (TCR / SCR / RQD)	SPT type, N & depth	Install-ation
Firm black pseudofibrous PEAT. (Peat)	10.00	1.24	ES8 U9	10.00 10.00-10.45	(14)		
Firm high strength thinly laminated grey silty CLAY with occasional organic fragments. (Estuarine Alluvium)	10.50	0.74	D10 D11	10.50 10.50		S19 10.50 10.95	
			ES12	11.00			
---from 11.50m becomes speckled brown			D13	11.50			
Firm black pseudofibrous PEAT. (Peat)	11.80	-0.57	ES14 U15	12.00 12.00-12.45	(16)		
			D16 D17	12.50 12.50		S22 12.50 12.95	
Firm grey silty CLAY with occasional coarse gravel sized pockets of brown pseudofibrous peat. (Estuarine Alluvium)	13.00	-1.77	ES18	13.00			
			D19	13.50			
			U20 D21 D22	14.50 14.50 14.50	(5)	S8 14.50 14.95	
			D23	15.50			
Grey clayey slightly sandy subangular to rounded GRAVEL of quartz, mudstone, siltstone and sandstonewith medium cobble content. Sand is coarse. Cobbles are subrounded of sandstone and siltstone. (Fluvial Alluvium) from 16.22m slightly gravelly, gravel is subangular to subrounded fine to medium of mudstone, siltstone and sandstone.	16.00	-4.77	U24	16.00-16.45	(17)		
			D25	16.50		C39 16.50 16.95	
			B26	17.00			
Firm to stiff reddish brown mottled greenish grey slightly gravelly CLAY. Gravel is angular fine to medium (Weathered Mudstone). (Mercia Mudstone Group)	17.40	-6.17	D27 U28	17.50 17.50-17.95	(120)		
---from 18.00m very stiff			D29 D30	18.00 18.00		S50/210mm 18.00 18.36	
---at 18.50m recovered as angular fine to coarse gravel sized fragments	18.50	-7.27	D31 D32	18.50 18.50		S50/20mm 18.50 18.55	
Borehole complete at 18.50 m.							

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
SBHJ05
Header

Contract No.	F15056	Method	Cable Percussion & Rotary	Coordinates	337257.91 E 185693.20 N
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	Dando Tractor/Dando	Ground Level	13.24m AOD
Client	Transport Wales, Welsh Assembly Government	Drillers	MM/PW	Orientation	Vertical
		Logged by	DH	Date Started	17/12/2007
Consultant	Ove Arup & Partners Ltd	Core barrel	Cemetrix	Date Completed	13/01/2008
		Core bit	8 inch Hammer		

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
17/12/2007	1730	10.30	10.30	DRY	End of Shift
11/01/2008	0730	10.30	10.40	DRY	Start of Shift
11/01/2008	1730	10.70	10.70	DRY	End of Shift
12/01/2008	0730	10.70	10.70	DRY	Start of Shift
12/01/2008	1730	14.50	14.50	DRY	End of Shift
13/01/2008	0730	14.50	14.50	DRY	Start of Shift
13/01/2008	1730	20.50	19.50	DRY	End of Hole

CABLE PERCUSSION DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling Hours	Remarks
10.20	10.70	6.00	Chiselling
10.70	11.50	5.00	Chiselling
20.20	20.50	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	10.30	200	10.30
150	20.50	150	19.50

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
13/01/2008		14.80	14.80	NR	Seepage	14.80	NS

ROTARY DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
0.00	10.30	Air	Good	0*

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm	Casing	Water Depth
12.00	S	N=20 (3,4,4,5,5,6)	11.50	DRY
14.00	S	N=25 (4,5,5,6,7,7)	13.50	DRY
16.00	S	N=2 (1,1,0,1,0,1)	15.50	15.80
18.00	S	N=2 (1,0,1,0,1,0)	17.50	17.80
19.50	S	50/200mm (9,13,14,16,20)	19.00	DRY
20.50	S	50/20mm (25,50)	19.50	DRY

* Seating blows only.

GENERAL NOTES

1. Rotary Openhole cemetrix drilling from GL to 10.30m.
2. Cable Percussive boring from 10.20m to 20.50m.
3. 50mm standpipe installed, slotted from 9.50m to 11.50m.
4. 0.00* indicates openhole drilling.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, hard strata time in hours

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
SBHJ05
Sheet 1 of 3

Contract No.	F15056	Method	Rotary & Cable Percussion	Coordinates	337257.91 E
Project	New M4 - Second Preliminary Ground Investigation				185693.20 N
		Drilling Rig	Dando Tractor/Dando	Ground Level	13.24m AOD
Client	Transport Wales, Welsh Assembly Government	Drillers	MM/PW	Orientation	Vertical
		Logged by	DH	Date Started	17/12/2007
Consultant	Ove Arup & Partners Ltd	Core Barrel	Cemetrix	Date Completed	13/01/2008
		Core Bit	8 inch Hammer		

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling & coring	Blow Count (TCR / SCR / RQD)	SPT type, N & depth	Install-ation
MADE GROUND: Ash and steel clinker. (Driller's description)							
		6.00	7.24				
MADE GROUND: Clay and gravel. (Driller's description)							

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Hole ID.
SBHJ05
Sheet 2 of 3

Contract No.	F15056	Method	Rotary & Cable Percussion	Coordinates	337257.91 E
Project	New M4 - Second Preliminary Ground Investigation				185693.20 N
		Drilling Rig	Dando Tractor/Dando	Ground Level	13.24m AOD
Client	Transport Wales, Welsh Assembly Government	Drillers	MM/PW	Orientation	Vertical
		Logged by	DH	Date Started	17/12/2007
Consultant	Ove Arup & Partners Ltd	Core Barrel	Cemetrix	Date Completed	13/01/2008
		Core Bit	8 inch Hammer		

Description of Strata	Depth Below G.L.	Datum Level	Sampling & coring		Blow Count (TCR / SCR / RQD)	SPT type, N & depth	
MADE GROUND: Clay and gravel. (Driller's description)	10.20	3.04					
MADE GROUND: Very compact slag fill with large fragments. (Driller's description)			ES1	11.30			
Brownish grey silty CLAY. (Estuarine Alluvium)	11.50	1.74	ES1 D2 U3	11.50 11.50 11.50-11.95	(21)		
---from 12.00m firm to stiff			D4 D5	12.00 12.00		S20 12.00	12.45
			ES6 B7	12.50 12.50			
			D8	13.00			
Firm brown fibrous PEAT. (Peat)	13.50	-0.26	ES9 U10	13.50 13.50-13.95	(32)		
			D11 D12	14.00 14.00		S25 14.00	14.45
			D13 ES14	14.50 14.50			
Grey slightly silty sandy CLAY with very closely spaced fine to coarse gravel sized pockets of pseudofibrous locally amorphous peat. Sand is fine. (Estuarine Alluvium)	14.80	-1.56					
			D15 ES16 U17	15.50 15.50 15.50	(6)		
			D18 D19	16.00 16.00		S2 16.00	16.45
			ES20	16.50			
			D21 B22	17.00 17.00-17.50			
Grey slightly sandy SILT. Sand is fine to medium	17.50	-4.26	U23	17.50	(5)		
			D24 D25	18.00 18.00		S2 18.00	18.53
Stiff reddish brown mottled grey slightly gravelly clay. Gravel is angular fine to coarse (Weathered Mudstone). (Mercia Mudstone Group)	18.90	-5.66	D26 U27	19.00 19.00	(110)		
---from 19.50m very stiff			D28 D29	19.50 19.50		S50/200mm 19.50	19.85

Install-ation

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Hole ID.
SBHJ05
Sheet 3 of 3

Contract No.	F15056	Method	Rotary & Cable Percussion	Coordinates	337257.91 E
Project	New M4 - Second Preliminary Ground Investigation				185693.20 N
		Drilling Rig	Dando Tractor/Dando	Ground Level	13.24m AOD
Client	Transport Wales, Welsh Assembly Government	Drillers	MM/PW	Orientation	Vertical
		Logged by	DH	Date Started	17/12/2007
Consultant	Ove Arup & Partners Ltd	Core Barrel	Cemetrix	Date Completed	13/01/2008
		Core Bit	8 inch Hammer		

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling & coring		Blow Count TCR	SCR	RQD		SPT type, N & depth	Install-ation
Stiff reddish brown mottled grey slightly gravelly clay. Gravel is angular fine to coarse (Weathered Mudstone). (Mercia Mudstone Group)				D30	20.00						
		20.50	-7.26	D31	20.50					S50/20mm 20.50 20.55	
Borehole complete at 20.50 m.											

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ08A CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	337834.72 E
Project	New M4 - Second Preliminary Ground Investigation				185599.42 N
		Drilling Rig	Dando	Ground Level	5.89m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	20/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	08/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
20/12/2007	1730	6.00	5.70	1.70	End of Shift
07/01/2008	0730	6.00	5.70	1.40	Start of Shift
07/01/2008	1730	10.50	9.20	2.50	End of Shift
08/01/2008	0730	10.50	9.20	1.30	Start of Shift
08/01/2008	1730	13.40	11.50	6.50	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
0.70	0.80	0.50	Chiselling
1.30	2.20	2.50	Chiselling
3.70	3.90	0.50	Chiselling
13.00	13.40	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	13.70	200	11.50

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
20/12/2007		1.30	1.20	20	Seepage	1.20	NR

GENERAL NOTES

1. Cable Percussive boring from GL to 13.70m.
2. Insitu permeability testing carried out from 6.40m to 7.50m.
3. 50mm standpipe installed, slotted from 6.40m to 7.40m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
1.00	S	50/75mm (15,10,50)	1.00	DRY
2.20	S	50/85mm (7,15,34,16)	2.20	1.50
3.00	S	51/225mm (5,10,12,13,26)	2.80	1.30
4.00	S	N=43 (4,6,8,9,13,13)	3.90	1.30
5.50	S	N=15 (2,3,3,4,4,4)	5.70	1.70
7.50	S	N=12 (2,2,3,3,3,3)	6.40	1.70
9.00	S	N=12 (2,3,2,3,3,4)	8.50	2.60
11.50	S	50/190mm (10,12,16,21,13)	10.70	2.20
12.70	S	50/210mm (8,13,15,18,17)	11.50	4.90
13.40	S	50/150mm (9,15,21,29)	11.50	6.50

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ08A CP
Sheet 1 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	337834.72 E
Project	New M4 - Second Preliminary Ground Investigation				185599.42 N
		Drilling Rig	Dando	Ground Level	5.89m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	20/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	08/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Black very sandy gravel. Sand is fine to coarse. Gravel sized fragments are angular to subangular fine to coarse of slag.				ES1	0.30				
				B2	0.50				
				ES3	1.00	S50/75mm	S	1.00	
				D4	1.00 - 1.20			1.17	
				ES5	2.00				
				D6	2.20 - 2.40	S50/85mm	S	2.20	
								2.44	
---from 2.50m Sandy with high cobble content. Cobble sized fragments are subangular of slag.				B7	2.50 - 3.00				
				D8	3.00 - 3.30	S51/225mm	S	3.00	
				ES9	3.00			3.38	
				D11	4.00 - 4.45	S43	S	4.00	
				ES10	4.10			4.45	
		4.60	1.29						
Stiff grey CLAY. (Estuarine Alluvium)									
				D12	4.80				
---from 4.80m to 5.20m slightly gravelly. Gravel is angular fine of mudstone				U14	5.00 - 5.45	(14)			
				ES13	5.10				
				D15	5.50	S15	S	5.50	
				D16	5.50 - 5.95			5.95	
		6.40	-0.51						
Firm black psuedofibrous PEAT. (Peat)				D17	6.50				
				U18	7.00 - 7.45	(24)			
				D19	7.00				
		7.20	-1.31						
Firm medium strength grey silty CLAY with occasional coarse gravel sized pockets of brown fibrous peat. (Estuarine Alluvium)				D20	7.50 - 7.95	S12	S	7.50	
								7.95	
---from 7.50m become soft with occasional coarse gravel sized pockets of black amorphous peat									
				D21	8.50				
				U22	9.00 - 9.45	S12 (16)	S	9.00	
								9.45	
				D23	9.50				
				D24	9.50 - 9.95				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ08A CP
Sheet 2 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	337834.72 E
Project	New M4 - Second Preliminary Ground Investigation				185599.42 N
		Drilling Rig	Dando	Ground Level	5.89m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	20/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	08/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Firm medium strength grey silty CLAY with occasional coarse gravel sized pockets of brown fibrous peat. (Estuarine Alluvium)		10.40	-4.51	D25	10.50				
Grey slightly sandy clayey subrounded to rounded medium to coarse GRAVEL of mudstone and siltstone. (Fluvial Alluvium)		10.80	-4.91	D26 U27	10.90 11.00 - 11.45	(100)			
Very stiff grey slightly gravelly CLAY. Gravel is angular fine of mudstone (Weathered Mudstone). (Mercia Mudstone Group) ---from 10.90m to 11.50m with occasional rootlets ---from 11.50m becomes reddish brown locally mottled greenish grey				D28 D29	11.50 11.50 - 11.90	S50/190mm	S	11.50 11.84	
				D30	12.50				
				D31	12.70 - 13.10	S50/210mm	S	12.70 13.06	
				D32	13.40 - 13.70	S50/150mm	S	13.40 13.70	
Cable Percussion boring complete at 13.70 m.		13.70	-7.81						

NOTES: All depths in metres, all diameters in millimetres.
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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ08 CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	337840.41 E
Project	New M4 - Second Preliminary Ground Investigation				185607.35 N
		Drilling Rig	Dando	Ground Level	6.38m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	18/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	19/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
18/12/2007	1730	0.60	0.50	DRY	End of Shift
19/01/2008	0730	0.60	0.50	DRY	Start of Shift
19/01/2008	1730	1.10	1.10	DRY	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
0.50	0.60	0.50	Chiselling
0.60	1.10	6.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	1.10	200	1.10

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Cable Percussive boring terminated at 1.10m.
2. Borehole grouted upon completion.
3. Refer to SBHJ08A for Redrill

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
		* Seating blows only.		

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ08 CP
Sheet 1 of 1

Contract No.	F15056	Method	Cable Percussion	Coordinates	337840.41 E
Project	New M4 - Second Preliminary Ground Investigation				185607.35 N
		Drilling Rig	Dando	Ground Level	6.38m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	18/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	19/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Slag, stone. (Driller's description)				ES1	0.30			
		0.50	5.88	B2	0.50 - 1.00			
MADE GROUND: Black slightly sandy gravel. Sand sized fragments are fine to coarse. Gravel sized fragments are angular to subangular fine to coarse of slag.				ES3	1.00			
		1.10	5.28					
Cable Percussion boring complete at 1.10 m.								

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ09 CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	338052.21 E
Project	New M4 - Second Preliminary Ground Investigation				185604.66 N
		Drilling Rig	Dando	Ground Level	5.76m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	18/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
13/12/2007	1730	1.00	1.00	0.40	End of Shift
14/12/2007	0730	1.00	1.00	0.40	Start of Shift
14/12/2007	1730	3.50	2.50	2.20	End of Shift
17/12/2007	0730	3.50	2.50	1.30	Start of Shift
17/12/2007	1730	11.50	11.00	10.80	End of Shift
18/12/2007	0730	11.50	11.00	0.70	Start of Shift
18/12/2007	1730	13.20	11.00	6.80	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
1.00	2.20	4.00	Chiselling
12.40	12.80	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	13.20	200	11.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Cable Percussive boring complete at 13.20m.
2. 50mm standpipe installed, slotted from 1.00m to 2.20m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
1.00	S	51/150mm (5,7,11,40)	1.00	0.50
2.00	S	50/75mm (12,50)	1.90	0.70
3.00	S	N=22 (2,4,5,5,6,6)	2.50	2.20
5.00	S	N=10 (1,2,2,2,3,3)	4.10	1.50
7.00	S	N=14 (1,2,3,3,4,4)	6.20	2.60
9.00	S	N=7 (1,2,1,2,2,2)	7.70	6.10
10.50	S	N=53 (6,8,10,14,14,15)	9.80	8.50
12.20	S	50/230mm (7,9,11,14,18,7)	11.00	2.10
12.80	S	50/225mm (9,10,11,16,23)	11.00	6.80

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ09 CP
Sheet 1 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	338052.21 E
Project	New M4 - Second Preliminary Ground Investigation				185604.66 N
		Drilling Rig	Dando	Ground Level	5.76m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	18/12/2007

Description of Strata	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Grey coarse sand sized fragments and angular to subangular fine to coarse gravel sized fragments of ash, limestone and slag. with low cobble content, cobble sized fragments are subangular of slag.			ES1	0.30				
			B2	0.50 - 1.00				
			ES3	1.00	S51/150mm	S	1.00	
			D4	1.00 - 1.30			1.30	
			ES5	2.00	S50/75mm	S	2.00	
			D6	2.00 - 2.10			2.23	
Firm grey mottled orangish brown CLAY with rare rootlets. (Estuarine Alluvium)	2.20	3.56	D7	2.30				
---at 2.30m slightly gravelly. Gravel is angular fine of mudstone			U8	2.50 - 2.95	(24)			
			D9	3.00	S22	S	3.00	
			ES10	3.00			3.45	
			D11	3.00 - 3.45				
Soft to firm indistinctly laminated grey silty CLAY with extremely closely to very closely fine to medium gravel sized pockets of brown amorphous peat. Organic odour. (Estuarine Alluvium)	4.00	1.76	ES12	4.00				
			D13	4.00				
			U14	4.50 - 4.95	(12)			
---from 5.00m becomes firm with partings of silt and fine sand. Occasional medium gravel sized pockets of black clay			D15	5.00	S10	S	5.00	
			ES16	5.00			5.45	
			D17	5.00 - 5.45				
			D18	6.00				
			U19	6.50 - 6.95	(20)			
Firm thinly laminated medium strength grey silty CLAY with laminations of extremely closely spaced black amorphous peat. (Estuarine Alluvium with bands of peat)	6.80	-1.04	D20	7.00	S14	S	7.00	
			D21	7.00 - 7.45			7.45	
			D22	8.00	(12)			
			U23	8.00 - 8.95				
Soft to firm grey silty CLAY with thin laminations of black fibrous peat. (Estuarine Alluvium)	8.90	-3.14	D24	9.00	S7	S	9.00	
			D25	9.00 - 9.45			9.45	
	9.80	-4.04	D26	9.90				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ09 CP
Sheet 2 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	338052.21 E
Project	New M4 - Second Preliminary Ground Investigation				185604.66 N
		Drilling Rig	Dando	Ground Level	5.76m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	18/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Very stiff reddish brown locally mottled greenish grey slightly gravelly CLAY. Gravel is angular fine to medium (Weathered Mudstone). (Mercia Mudstone Group)				U27	10.00 - 10.45	(93)			
				D28	10.50	S53	S	10.50	
				D29	10.50 - 10.95			10.95	
				D30	11.50				
				D31	12.00 - 12.40				
						S50/230mm	S	12.20	
								12.58	
				D32	12.80 - 13.20	S50/225mm	S	12.80	
								13.18	
		13.20	-7.44						
Cable Percussion boring complete at 13.20 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ10 CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	338240.80 E
Project	New M4 - Second Preliminary Ground Investigation				185578.80 N
		Drilling Rig	Dando	Ground Level	6.05m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	PW	Orientation	Vertical
		Logged by	DH	Date Started	09/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	11/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
09/01/2008	1730	6.00	4.80	2.70	End of Shift
10/01/2008	0730	6.00	4.80	1.70	Start of Shift
10/01/2008	1730	11.50	10.50	11.30	End of Shift
11/01/2008	0730	11.50	10.50	7.30	Start of Shift
11/01/2008	1730	13.00	10.50	9.20	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
12.30	12.70	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	1.50	200	1.50
150	13.00	150	10.50

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
09/01/2008		2.50	1.00	20	Slow	2.50	NR

GENERAL NOTES

1. Cable Percussive boring from GL to 13.00m.
2. Insitu permeability testing carried out from 10.50 to 11.50m.
3. 50mm standpipe installed, slotted from 9.00m to 10.00m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
1.50	S	N=15 (2,3,3,4,4,4)	1.00	DRY
3.50	S	N=6 (1,1,2,1,1,2)	2.80	1.50
5.50	S	N=2 (1,0,0,1,0,1)	4.80	2.70
7.50	S	N=5 (1,0,1,1,1,2)	6.80	2.00
9.50	S	N=9 (1,1,2,2,2,3)	8.80	4.80
11.00	S	50/225mm (5,12,15,15,17,3)	10.50	8.90
12.00	S	50/160mm (8,11,19,29,2)	10.50	8.10
12.70	S	50/160mm (7,16,18,23,9)	10.50	9.20

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ10 CP
Sheet 1 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	338240.80 E
Project	New M4 - Second Preliminary Ground Investigation				185578.80 N
		Drilling Rig	Dando	Ground Level	6.05m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	PW	Orientation	Vertical
		Logged by	DH	Date Started	09/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	11/01/2008

Description of Strata	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		
MADE GROUND: Dark brown silty very sandy angular to subangular fine to coarse Gravel sized fragments of sandstone and slag.			ES1	0.30				
			B2	0.50 - 0.80				
	0.80	5.25						
Firm to stiff grey silty CLAY with occasional rootlets (Mild organic odour). (Estuarine Alluvium)			ES3	1.00				
			U4	1.00 - 1.45				
	1.50	4.55	D5	1.50	S15	S	1.50	1.95
Firm orangish brown mottled grey CLAY. (Estuarine Alluvium)			D6	1.50 - 1.95				
			ES7	2.00				
	2.50	3.55	D8	2.50				
Soft very low strength grey silty CLAY. (Estuarine Alluvium) ---from 2.50m to 3.50m become slightly gravelly. Gravel is angular fine to medium of mudstone			ES9	3.00				
			U10	3.00 - 3.45				
			D11	3.50	S6	S	3.50	3.95
			D12	3.50 - 3.95				
			ES13	4.00				
	4.50	1.55	D14	4.50				
Very soft grey silty CLAY with rare rootlets. (Estuarine Alluvium)			ES15	5.00				
			U16	5.00 - 5.45				
			D17	5.50	S2	S	5.50	6.03
			D18	5.50 - 5.95				
			B19	6.30 - 6.80				
			U20	7.00 - 7.45				
			D21	7.50	S5	S	7.50	8.03
			D22	7.50 - 7.95				
	7.70	-1.65						
Very soft dark grey clayey PEAT. (Peat)								
	8.20	-2.15						
Very soft grey silty CLAY with occasional coarse gravel sized pockets of fine sand. (Estuarine Alluvium)			D23	8.50				
			U24	9.00 - 9.45				
---from 9.50m becomes slightly sandy gravelly. Gravel is angular to subangular fine to medium of sandstone			D25	9.50	S9	S	9.50	9.95
			D26	9.50 - 9.95				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ10 CP
Sheet 2 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	338240.80 E
Project	New M4 - Second Preliminary Ground Investigation				185578.80 N
		Drilling Rig	Dando	Ground Level	6.05m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	PW	Orientation	Vertical
		Logged by	DH	Date Started	09/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	11/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Remaining Detail : 9.40m - 9.40m : and mudstone		10.00	-3.95						
stiff to very stiff reddish brown mottled greenish grey slightly gravelly CLAY. Gravel is angular fine to medium of mudstone (Weathered Mudstone). (Mercia Mudstone Group)				D27	10.20				
				U28	10.50 - 10.95				
---from 11.00m very stiff				D29	11.00	G50/225mm	S	11.00	
				D30	11.00 - 11.45			11.38	
				D31	12.00 - 12.30	G50/160mm	S	12.00	
								12.31	
Very weak reddish brown mottled greenish grey MUDSTONE. Recovered as angular fine to coarse gravel sized fragments. (Mercia Mudstone Group)		12.50	-6.45	D32	12.50				
				D33	12.70 - 13.00	G50/160mm	S	12.70	
								13.01	
---from 12.50m recovered as angular fine to coarse gravel sized fragments		13.00	-6.95						
Cable Percussion boring complete at 13.00 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

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WINDOW SAMPLING LOG

Hole ID.
SWSJ09
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	336926.52 E
Project	New M4 - Second Preliminary Ground Investigation				185860.56 N
		Sampling Rig	Hydraulic Hammer	Ground Level	11.02m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	12/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	12/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Black and brown slightly sandy clayey silt.				L1	0.00 - 0.80	From: 0.00 To: 1.00 Diameter: 90mm Recovery : 100% Blows: 1	
				ES2 L3	1.00 1.00 - 1.80	From: 1.00 To: 2.00 Diameter: 90mm Recovery : 100% Blows: 4	
				ES4 L5	2.00 2.00 - 2.40	From: 2.00 To: 2.60 Diameter: 80mm Recovery : 100% Blows: 7	
MADE GROUND: Gravel sized fragments of clinker. (Driller's description)		2.60	8.42				
Sampling complete at 2.61 m.		2.61	8.41				

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 2.61m.
2. Window Sampling terminated at 2.61m due to refusal.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

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WINDOW SAMPLING LOG

Hole ID.
SWSJ09A
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	336929.51 E
Project	New M4 - Second Preliminary Ground Investigation				185861.77 N
		Sampling Rig	Hydraulic Hammer	Ground Level	10.95m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	13/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Black clayey slightly sandy slightly gravelly silt. Gravel sized fragments are angular fine to coarse of brick and sandstone. ---from 0.00m to 0.80m with occasional rootlets				L1	0.00 - 0.80	From: 0.00 To: 1.00 Diameter: 90mm Recovery : 100% Blows: 2	
				ES2 L3	1.00 1.00 - 1.70	From: 1.00 To: 2.00 Diameter: 80mm Recovery : 100% Blows: 3	
				ES4 L5	2.00 2.00 - 2.60	From: 2.00 To: 3.00 Diameter: 70mm Recovery : 100% Blows: 3	
---from 2.30m to 2.34m thin bed thinly laminated silt							
		2.60	8.35				
MADE GROUND: Black slightly sandy silt. (Driller's description)							
				ES6 ES7	3.00 3.00 - 3.70	From: 3.00 To: 3.65 Diameter: 60mm Recovery : 100% Blows: 8	
		3.65	7.30			From: 3.65 To: 3.70 Diameter: 50mm Recovery : 100% Blows: 10	
MADE GROUND: Clinker. (Driller's description)		3.70	7.25				
Sampling complete at 3.70 m.							

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 3.70m.
2. Window Sampling terminated at 3.70m due to refusal.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

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WINDOW SAMPLING LOG

Hole ID.
SWSJ10
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Contract No.	F15056	Method	Window Sampling	Coordinates	336947.85 E
Project	New M4 - Second Preliminary Ground Investigation				185810.03 N
		Sampling Rig	Hydraulic Hammer	Ground Level	10.53m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	18/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	18/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Black clayey slightly sandy silt with occasional rootlets.		0.20	10.33	L1	0.00 - 1.00	From: 0.00 To: 1.00 Diameter: 80mm Recovery : 90% Blows: 1	
MADE GROUND: Black slightly clayey sandy slightly gravelly silt. Gravel sized fragments are subangular fine to medium of slag.				ES2 L3	1.00 1.00 - 1.80	From: 1.00 To: 2.00 Diameter: 70mm Recovery : 100% Blows: 1	
				ES4 L5	2.00 2.00 - 2.75	From: 2.00 To: 2.75 Diameter: 60mm Recovery : 100% Blows: 7	
				ES6 L7	3.00 3.00 - 3.60	From: 2.75 To: 3.75 Diameter: 50mm Recovery : 100% Blows: 8	
---from 3.50m to 3.60m 1 No thin bed slightly gravelly clayey sand. Sand is fine to coarse. Gravel sized fragments are subangular fine to medium of slag				ES8 L9	4.00 4.00 - 4.30	From: 3.75 To: 4.50 Diameter: 50mm Recovery : 100% Blows: 12	
MADE GROUND: Clinker. (Driller's description)		4.30	6.23				
Sampling complete at 4.50 m.		4.50	6.03	ES10	4.50		

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 4.50m.
2. Window Sampling terminated at 4.50m due to refusal.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

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WINDOW SAMPLING LOG

Hole ID.
SWSJ11
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	336953.56 E
Project	New M4 - Second Preliminary Ground Investigation				185759.27 N
		Sampling Rig	Hydraulic Hammer	Ground Level	10.28m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	18/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	18/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Black slightly clayey slightly sandy slightly gravelly silt. Gravel sized fragments are subangular fine to medium of slag ---from GL to 0.15m with occasional rootlets				L1	0.00 - 0.80	From: 0.00 To: 1.00 Diameter: 80mm Recovery : 100% Blows: 1	
				ES2 L3	1.00 1.00 - 1.70	From: 1.00 To: 2.00 Diameter: 70mm Recovery : 100% Blows: 2	
				ES4 L5	2.00 2.00 - 2.70	From: 2.00 To: 3.00 Diameter: 60mm Recovery : 100% Blows: 3	
MADE GROUND: Dark brown slightly sandy clayey silt.		2.70	7.58				
				ES6	3.00	From: 3.00 To: 3.20 Diameter: 50mm Recovery : 100% Blows: 12	
MADE GROUND: Clinker. (Driller's description)		3.10 3.20	7.18 7.08	ES7	3.20		
Sampling complete at 3.20 m.							

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 3.20m.
2. Window Sampling terminated at 3.20m due to refusal.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

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WINDOW SAMPLING LOG

Hole ID.
SWSJ12
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	336946.18 E
Project	New M4 - Second Preliminary Ground Investigation				185723.14 N
		Sampling Rig	Hydraulic Hammer	Ground Level	10.59m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	13/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Black slightly sandy clayey silt (fragmented) with occasional rootlets.				L1	0.00 - 0.80	From: 0.00 To: 1.00 Diameter: 90mm Recovery : 80% Blows: 1	
MADE GROUND: Slightly sandy clayey silt.		0.45	10.14				
				ES2 L3	1.00 1.00 - 1.70	From: 1.00 To: 2.00 Diameter: 80mm Recovery : 100% Blows: 6	
				ES4 L5	2.00 2.00 - 2.20	From: 2.00 To: 2.60 Diameter: 70mm Recovery : 100% Blows: 10	
						From: 2.60 To: 4.00 Diameter: 50mm Recovery : 100% Blows: 7	
				ES6 L7	3.00 3.00 - 4.00		
				ES8 L9 ES10	4.00 4.00 - 4.20 4.20 - 4.55	From: 4.00 To: 4.45 Diameter: 70mm Recovery : 100% Blows: 12	
		4.35	6.24				
MADE GROUND: Gravels (possible contamination). (Driller's description)		4.55	6.04			From: 4.45 To: 4.55 Diameter: 50mm Recovery : 100% Blows: 12	
Sampling complete at 4.55 m.							

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 4.55m.
2. Window Sampling terminated at 4.55m due to refusal.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

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WINDOW SAMPLING LOG

Hole ID.
SWSJ13
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	336991.86 E
Project	New M4 - Second Preliminary Ground Investigation				185779.46 N
		Sampling Rig	Hydraulic Hammer	Ground Level	11.01m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	14/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	14/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Black slightly clayey slightly sandy silt. ---from 0.00m to 0.30m dark brown ---from 0.60m to 0.65m speckled white and with frequent rootlets				L1	0.00 - 0.80	From: 0.00 To: 1.00 Diameter: 90mm Recovery : 95% Blows: 1	
				ES2 L3	1.00 1.00 - 1.80	From: 1.00 To: 2.00 Diameter: 80mm Recovery : 100% Blows: 2	
				ES4 ES5	2.00 2.00 - 2.50	From: 2.00 To: 2.50 Diameter: 70mm Recovery : 100% Blows: 10	
MADE GROUND: Clinker. (Driller's description)		2.50	8.51			From: 2.50 To: 2.55 Diameter: 50mm Recovery : 100% Blows: 10	
Sampling complete at 2.55 m.		2.55	8.46				

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 2.55m.
2. Window Sampling terminated at 2.55m due to refusal.
3. 50mm standpipe installed, slotted from 0.50m to 2.50m.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

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WINDOW SAMPLING LOG

Hole ID.
SWSJ14
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	336992.97 E
Project	New M4 - Second Preliminary Ground Investigation				185736.12 N
		Sampling Rig	Hydraulic Hammer	Ground Level	10.14m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	14/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	14/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Black slightly clayey slightly sandy silt.				L1	0.00 - 0.60	From: 0.00 To: 1.00 Diameter: 90mm Recovery : 80% Blows: 1	
				ES2 L3	1.00 1.00 - 1.75	From: 1.00 To: 2.00 Diameter: 80mm Recovery : 100% Blows: 2	
				ES4 L5	2.00 2.00 - 2.70	From: 2.00 To: 3.00 Diameter: 70mm Recovery : 100% Blows: 6	
---from 2.17m to 2.18m brown		2.30	7.84				
MADE GROUND: Black slightly gravelly slightly sandy clayey silt. Sand is fine to coarse. Gravel sized fragments are subangular to subrounded fine to coarse of sandstone and slag.				ES6	3.00	From: 3.00 To: 3.30 Diameter: 60mm Recovery : 100% Blows: 10	
		3.20	6.94				
MADE GROUND: Clinker. (Driller's description)		3.30	6.84	ES7	3.30	From: 3.30 To: 3.35 Diameter: 50mm Blows: 10	
Sampling complete at 3.30 m.							

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 3.30m.
2. Window Sampling terminated at 3.30m due to refusal.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
Revised	13/02/2008

Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ15
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337045.13 E
Project	New M4 - Second Preliminary Ground Investigation				185772.46 N
		Sampling Rig	Hydraulic Hammer	Ground Level	10.09m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	17/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	17/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Black slightly clayey slightly sandy silt.				L1	0.00 - 0.80	From: 0.00 To: 1.00 Diameter: 90mm Recovery : 90% Blows: 1	
				ES2 L3	1.00 1.00 - 1.60	From: 1.00 To: 2.00 Diameter: 60mm Recovery : 100% Blows: 1	
---from 1.90m to 2.00m sandy				ES4 L5	2.00 2.00 - 2.60	From: 2.00 To: 3.00 Diameter: 60mm Recovery : 100% Blows: 3	
MADE GROUND: Clinker. (Driller's description)		3.00	7.09	ES6	3.00	From: 3.00 To: 3.10 Diameter: 60mm Recovery : 100% Blows: 10	
Sampling complete at 3.10 m.		3.10	6.99	ES7	3.10		

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 3.10m.
2. Window Sampling terminated at 3.50m due to refusal.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
Revised	13/02/2008

Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ16
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337058.17 E
Project	New M4 - Second Preliminary Ground Investigation				185735.97 N
		Sampling Rig	Hydraulic Hammer	Ground Level	10.20m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	17/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	17/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Black slightly clayey slightly sandy silt. ---from GL to 0.15m with occasional rootlets				L1	0.00 - 0.80	From: 0.00 To: 1.00 Diameter: 90mm Recovery : 100% Blows: 1	
				ES2 L3	1.00 1.00 - 1.80	From: 1.00 To: 2.00 Diameter: 90mm Recovery : 100% Blows: 2	
---from 1.45m to 1.80m indistinctly laminated							
				ES4	2.00	From: 2.00 To: 2.30 Diameter: 80mm Recovery : 100% Blows: 8	
MADE GROUND: Clinker. (Driller's description)		2.30	7.90	ES5	2.30	From: 2.30 To: 2.40 Diameter: 50mm Recovery : 100% Blows: 12	
Sampling complete at 2.40 m.		2.40	7.80				

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 2.40m.
2. Window Sampling terminated at 2.40m due to refusal.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
Revised	13/02/2008

Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ17A
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337082.25 E
Project	New M4 - Second Preliminary Ground Investigation				185807.28 N
		Sampling Rig	Hydraulic Hammer	Ground Level	10.74m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	17/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	17/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Black slightly clayey slightly sandy silt. ---from GL to 0.20m occasional rootlets upto 8mm diameter				L1	0.00 - 0.80	From: 0.00 To: 1.00 Diameter: 80mm Recovery : 90% Blows: 6	
				ES2	1.00	From: 1.00 To: 1.50 Diameter: 60mm Recovery : 100% Blows: 4	
		1.50	9.24	ES3	1.50		
Sampling complete at 1.50 m.							

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 1.50m.
2. Window Sampling terminated at 1.50m due to refusal.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

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Version	3.07
Revised	13/02/2008

Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ17
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337088.49 E
Project	New M4 - Second Preliminary Ground Investigation				185805.72 N
		Sampling Rig	Terrier	Ground Level	11.33m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	17/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	17/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth	Progress	Install-ation
MADE GROUND: Clinker. (Driller's description)		0.05	11.28		From: 0.00 To: 0.05 Diameter: 90mm Recovery : 0% Blows: 10	
Sampling complete at 0.05 m.						

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling terminated at 0.05m due to refusal.
2. Window Sampling relocated 5.00m inter lagoon, refer to SWSJ17A.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
Revised	13/02/2008

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ21
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337387.85 E
Project	New M4 - Second Preliminary Ground Investigation				185703.94 N
		Drilling Rig	Terrier	Ground Level	12.97m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	16/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	16/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
16/12/2007		6.00	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
16/12/2007	1350	4.00	4.00	20	Seepage	NR	NR
16/12/2007	1450	6.00	6.00	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 6.00m.
2. Window Sampling complete at 6.00m.
3. 50mm standpipe installed, slotted from 4.00m to 6.00m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
Version	3.03
Revised	19/01/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ21
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337387.85 E
Project	New M4 - Second Preliminary Ground Investigation				185703.94 N
		Drilling Rig	Terrier	Ground Level	12.97m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	16/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	16/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Black slightly clayey slightly sandy silt with occasional rootlets.				L1	0.00 - 0.80			
---from 0.25m becomes sandy		0.40	12.57					
---from 0.35m becomes very sandy		0.45	12.52					
MADE GROUND: Slightly gravelly sandy silt. Gravel sized fragments are subangular fine to medium of sandstone.				ES2	1.00			
MADE GROUND: Black slightly clayey silt.				L3	1.00 - 1.80			
				ES4	2.00			
				L5	2.00 - 2.80			
				ES6	3.00			
				L7	3.00 - 3.80			
				ES8	4.00			
				L9	5.00 - 6.00			
Sampling complete at 6.00 m.		6.00	6.97					

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ23
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337452.87 E
Project	New M4 - Second Preliminary Ground Investigation				185734.27 N
		Drilling Rig	Terrier	Ground Level	12.29m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	13/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	13/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
13/01/2008		8.35	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
13/01/2008		1.50	1.50	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 8.35m.
2. Window Sampling complete a 8.35m.
3. 50mm standpipe installed, slotted from 5.80m to 7.80m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=0 (0,0,0,0,0,0)
2.00	S	N=0 (1,0,0,0,0,0)
3.00	S	N=0 (1,0,0,0,0,0)
4.00	S	N=0 (0,0,0,0,0,0)
5.00	S	N=0 (1,0,0,0,0,0)
6.00	S	N=0 (0,0,0,0,0,0)
7.00	S	N=0 (0,0,0,0,0,0)
7.90	S	72/225mm (18,24,28,27,17)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
Version	3.03
Revised	19/01/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ23
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337452.87 E
Project	New M4 - Second Preliminary Ground Investigation				185734.27 N
		Drilling Rig	Terrier	Ground Level	12.29m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	13/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	13/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Black slightly clayey slightly sandy silt.				L1	0.00 - 0.80				
				ES2 D3 L4	1.00 1.00 - 1.45 1.00 - 1.80	S0	S	1.00 1.60	
				ES5 D6 L7	2.00 2.00 - 2.45 2.00 - 2.80	S0	S	2.00 2.53	
				ES8 D9	3.00 3.00 - 3.45	S0	S	3.00 3.53	
				D10	4.00 - 4.50	S0	S	4.00 4.60	
				D11	5.00 - 5.45	S0	S	5.00 5.53	
MADE GROUND: Black slightly clayey slightly sandy silt.		6.00	6.29	D12 L13	6.00 - 6.45 6.00 - 6.80	S0	S	6.00 6.60	
				ES14 D15 L16	7.00 7.00 - 7.45 7.00 - 7.80	S0	S	7.00 7.60	
MADE GROUND: Clinker. (Driller's description)		7.80	4.49	ES17 D18	7.90 7.90 - 8.35	S72/225mm	S	7.90 8.28	
Sampling complete at 8.35 m.		8.35	3.94						

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ34
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337692.22 E
Project	New M4 - Second Preliminary Ground Investigation				185704.76 N
		Drilling Rig	Terrier	Ground Level	10.52m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	16/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	17/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
16/01/2008	1730	2.00	0.00	NR	End of Shift
17/01/2008	0730	2.00	0.00	NR	Start of Shift
17/01/2008	1730	6.45	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 6.45m.
2. Window Sampling complete at 6.45m.
3. 50mm standpipe installed, slotted from 6.00m to 3.00m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=0 (0,0,0,0,0,0)
2.00	S	N=1 (0,0,0,1,0,0)
3.00	S	N=0 (0,0,0,0,0,0)
4.00	S	N=2 (1,0,1,0,0,1)
5.00	S	N=1 (1,0,0,1,0,0)
6.00	S	N=2 (1,0,1,0,1,0)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
Version	3.03
Revised	19/01/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ34
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337692.22 E
Project	New M4 - Second Preliminary Ground Investigation				185704.76 N
		Drilling Rig	Terrier	Ground Level	10.52m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	16/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	17/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth			Install-ation
MADE GROUND: Black slightly clayey slightly sandy silt.				L1	0.00 - 0.80					
				ES2 D3 L4	1.00 1.00 - 1.45 1.00 - 1.80	S0	S	1.00	1.60	
---from 2.00m sandy				ES5 D6 L7	2.00 2.00 - 2.45 2.00 - 2.80	S1	S	2.00	2.60	
MADE GROUND: Brown slightly sandy clayey silt.		3.00	7.52	ES8 D9 L10	3.00 3.00 - 3.45 3.00 - 3.80	S0	S	3.00	3.60	
				ES11 D12 L13	4.00 4.00 - 4.45 4.00 - 4.80	S2	S	4.00	4.53	
				ES14 D15 L16	5.00 5.00 - 5.45 5.00 - 5.80	S1	S	5.00	5.53	
				ES17 D18	6.00 6.00 - 6.45	S2	S	6.00	6.53	
Sampling complete at 6.45 m.		6.45	4.07							

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ37
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337766.04 E
Project	New M4 - Second Preliminary Ground Investigation				185656.53 N
		Drilling Rig	Terrier	Ground Level	6.25m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	22/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	22/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
22/01/2008		6.45	2.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
100	2.00	100	2.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
22/01/2008		3.50	3.50	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 6.45m.
2. Window Sampling complete at 6.45m.
3. 50mm standpipe installed, slotted from 4.10m to 5.60m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=7 (1,2,2,2,1,2)
2.00	S	N=5 (1,1,1,2,1,1)
3.00	S	N=8 (2,2,2,2,2,2)
4.00	S	N=2 (1,0,1,0,1,0)
5.00	S	N=1 (0,0,0,0,0,1)
6.00	S	N=1 (1,0,0,0,1,0)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
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Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ37
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337766.04 E
Project	New M4 - Second Preliminary Ground Investigation				185656.53 N
		Drilling Rig	Terrier	Ground Level	6.25m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	22/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	22/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Black slightly sandy clayey silt.				ES1	0.30				
				ES2	1.00	S7	S	1.00 1.45	
				D3	1.00 - 1.45				
		1.20	5.05	L4	1.00 - 1.80				
Firm grey mottled orangish brown CLAY with occasional rootlets. (Estuarine Alluvium) ---from 1.65m becomes firm to stiff ---from 1.77m to 1.80m 1 No very thin bed of spongy brown pseudofibrous peat				ES5	2.00	S5	S	2.00 2.45	
				D6	2.00 - 2.45				
		2.20	4.05	L7	2.00 - 2.80				
Soft to firm grey CLAY. (Estuarine Alluvium)				ES8	3.00	S8	S	3.00 3.45	
				D9	3.00 - 3.45				
				L10	3.00 - 3.80				
				ES11	4.00	S2	S	4.00 4.53	
				D12	4.00 - 4.45				
		4.35	1.90						
Stiff and firm brown slightly sandy CLAY with much organic material. Estuarine Alluvium									
		5.00	1.25	ES13	5.00	S1	S	5.00 5.60	
Spongy black pseudofiberous PEAT. (Peat)				D14	5.00 - 5.45				
				L15	5.00 - 5.80				
		6.00	0.25	ES16	6.00	S1	S	6.00 6.53	
Sampling complete at 6.45 m.				D17	6.00 - 6.45				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Geotechnical Engineering Limited

BOREHOLE LOG

BH513

CLIENT	WELSH GOVERNMENT					Sheet	1 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	9 February 2015	Easting	336926.7				
End Date	18 February 2015	Northing	185781.1	Ground level	11.20mOD	Depth	29.50 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
09/02/15 0800hrs	1B	0.00 - 0.50						Dark grey slightly silty sandy angular to subrounded fine to coarse sandstone and slag GRAVEL with a low cobble content. Cobbles are slag rarely brick. Malodourous. (MG)			
	2D*	0.00 - 0.50		Vo 0.2							
	3B	0.50 - 1.20									
	4D*	0.50 - 1.20		Vo 0.2							
		1.20 - 1.65	1.20	C 11							
	5B	1.20 - 1.65						1.20 - 2.10m: Medium dense.			
		1.65 - 2.10	1.50	C 23							
	6B	1.65 - 2.10		Vo 0.1							
		2.10 - 2.55	2.00	C 37					2.10	9.10	
	7B	2.10 - 2.55		Vo 0.2				Dense dark brown and dark grey silty sandy (ashy) angular to subrounded fine to coarse slag and sandstone GRAVEL. Malodourous. Driller notes slag cobbles throughout. (MG)			
		2.55 - 3.00	2.50	C 38							
09/02/15 1700hrs Dry	8B	2.55 - 3.00									
	9D*	2.55 - 3.00		Vo 0.0							
		3.00 - 3.45	3.00	C 50							
10/02/15 0800hrs Dry	10B	3.00 - 3.50									
	11D*	3.00 - 3.50		Vo 0.1							
		3.50 - 3.95	3.50	C 27							
10/02/15 1700hrs Dry	12B	3.50 - 4.00						3.50 - 4.50m: Medium dense.			
	13D*	3.50 - 4.00		Vo 0.0							
		4.00 - 4.45	4.00	C 25							
12/02/15 0800hrs Dry	14B	4.00 - 4.50									
	15D*	4.00 - 4.50		Vo 0.0							
		4.50 - 4.95	4.50	C 37							
	16B	4.50 - 5.00									
	17D*	4.50 - 5.00		Vo 0.1							
		5.00 - 5.45	5.00	C*52							
	18B	5.00 - 6.00						5.00m: Slag cobble.			
	19D*	5.00 - 6.00		Vo 0.0							
		6.00 - 6.45	6.00	C 34							
12/02/15 1700hrs Dry	20B	6.00 - 7.50									
	21D*	6.00 - 7.50		Vo 0.0							
13/02/15 0800hrs Dry											
		7.50 - 7.95	7.50	C 39							
	22B	7.50 - 9.00						7.50 - 9.50m: Low angular sandstone cobble content.			
	23D*	7.50 - 9.00		Vo 0.2							
								Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (200mm) 1.20-9.00m and (150mm) 9.00-19.20m. Waterflush rotary core drilled (116mm) 19.20-29.50m.

CASING: 200mm diam to 9.00m and 150mm diam to 19.00m.

BACKFILL: On completion, hole backfilled (on 19/02/2015) with bentonite pellets 29.50-0.60m and gravel 0.60-0.00m.

REMARKS: Bentonite seal for aquifer protection installed during drilling 7.50-9.00m, prior to reduction in casing diameter. Permeability test undertaken 13.00-13.50m.

CPT at 19.20m undertaken 17/02/2015 prior to rotary follow-on coring.

MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m) casing (m) rose to (m) time to rise (min) remarks

AGS

CONTRACT	CHECKED
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BOREHOLE LOG

BH513

CLIENT	WELSH GOVERNMENT					Sheet	2 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	9 February 2015	Easting	336926.7				
End Date	18 February 2015	Northing	185781.1	Ground level	11.20mOD	Depth	29.50 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
		9.00 - 9.45	9.00	C 21							
	24B	9.00 - 9.50									
	25D*	9.00 - 9.50		Vo 0.0					9.30	1.90	
								Soft dark grey mottled dark brown slightly sandy silty CLAY with frequent wood fragments (up to 3mm) and rootlets (up to 1mm). (TFD)			
	26B	9.50 - 11.00									
	27D*	9.50 - 11.00									
	29D	11.00 - 11.45	11.00	S 11					11.00	0.20	
	28B	11.00 - 12.50						Firm dark brown PEAT with thin lenses and pockets (up to 10mm) of very soft grey clay. (PEAT)			
	30D*	11.00 - 12.50		Vo 0.3							
13/02/15 1700hrs 8.00m									12.50	-1.30	
16/02/15 0800hrs 9.20m	31UT	12.50 - 12.95	12.50					Very soft becoming firm with depth grey and bluish grey slightly sandy silty CLAY with frequent pockets (up to 50mm) of black organic material and decomposed roots (up to 2mm). (TFDP)			
	33B	12.50 - 13.50									
	32D	12.90 - 13.10									
	34B	13.50 - 15.00						13.50 - 13.95m: Tending to dark grey very silty fine and medium sand.			
	35D	13.50 - 13.95	13.50	S 10							
	36UT	15.00 - 15.45	15.00								
	37B	15.00 - 15.50									
	38D	15.50 - 15.95	15.50	S 8							
	39B	15.50 - 16.00									
	40UT	16.00 - 16.40	16.00								
	41B	16.00 - 16.60									
	42D	16.40 - 16.60						16.40 - 16.60m: Slightly gravelly. Gravel is subangular and subrounded fine to coarse sandstone. Rare shell fragments (up to 50mm).	16.60	-5.40	
	43D	16.60 - 17.05	16.50	S 35							
	44B	16.60 - 18.10						Recovered as soft brown and dark grey slightly sandy slightly gravelly CLAY with rare rootlets (up to 2mm). Gravel is subangular and subrounded fine to coarse mudstone and sandstone. (TFD)			
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
8.20	8.20	4.50	20	Fast
17.50	16.50	7.70	20	

AGS

CONTRACT	CHECKED
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BOREHOLE LOG

BH513

CLIENT	WELSH GOVERNMENT					Sheet	3 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	9 February 2015	Easting	336926.7				
End Date	18 February 2015	Northing	185781.1	Ground level	11.20mOD	Depth	29.50 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
16/02/15 1700hrs 8.10m 17/02/15 0800hrs 8.10m 17/02/15 1000hrs 8.00m	45D	18.10	18.55	18.00	S*54				Very stiff reddish brown and bluish grey slightly sandy slightly gravelly silty CLAY. Gravel is subangular fine to coarse mudstone lithorelicts. (MMG)	18.10	-6.90	
	46B	18.10	19.00									
	48D	19.00	19.20							19.00	-7.80	
		19.20	19.37	19.00	C*156		NI		Extremely weak and very weak thinly laminated to thinly bedded reddish brown MUDSTONE. Fractures are subhorizontal to 10° and subvertical extremely closely and very closely spaced planar smooth. (MMG) (Grade II) 19.20 - 19.30m: Light greenish grey.			
18/02/15 1040hrs 16.30m	47C	19.20	20.50			100 10 0						
	49C	20.50	22.00	19.00		100 0 0			21.50 - 21.60m: 80° fracture planar smooth.			
	50C	22.00	23.50	19.00		100 0 0			22.00 - 22.60m: Intersecting subvertical fractures, surfaces stained dark grey.			
							NA		Stiff fissured reddish brown gravelly CLAY. Gravel is angular and subangular fine and medium lithorelicts of very stiff clay to extremely weak mudstone. Localised relict fissures are randomly orientated extremely closely spaced. (MMG) (Grade III)	22.60	-11.40	
	51C	23.50	25.00	19.00		100 5 0	NI		Extremely weak thinly laminated to thinly bedded reddish brown MUDSTONE. Fractures are subhorizontal to 10° and subvertical extremely closely and very closely spaced planar smooth. (MMG) (Grade II)	23.50	-12.30	
							NA			23.80	-12.60	
							NI NI 80		Stiff fissured reddish brown gravelly CLAY. Gravel is angular and subangular fine and medium lithorelicts of very stiff clay to extremely weak mudstone. Localised relict fissures are randomly orientated extremely closely spaced. (MMG) (Grade III)	24.50	-13.30	
	52C	25.00	26.50	19.00		100 0 0			Extremely weak and very weak thinly laminated to thinly bedded reddish brown MUDSTONE. Fractures are subhorizontal to 10° and subvertical extremely closely and very closely spaced planar smooth. (MMG) (Grade II)	25.30	-14.10	
							NA		Stiff fissured reddish brown gravelly CLAY. Gravel is angular and subangular fine and medium lithorelicts of very stiff clay to extremely weak mudstone. Localised relict fissures are randomly orientated extremely closely spaced. (MMG) (Grade III) 25.80 - 25.90m: Light greenish grey.			
	53C	26.50	28.00	19.00		100 0 0			27.50 - 28.20m: Tending to extremely weak mudstone.			
									Continued Next Page	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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BOREHOLE LOG

BH513

CLIENT	WELSH GOVERNMENT					Sheet	4 of 4
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	9 February 2015	Easting	336926.7				
End Date	18 February 2015	Northing	185781.1	Ground level	11.20mOD	Depth	29.50 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	54C	28.00 - 29.50	19.00		100 0 0						
18/02/15 1730hrs 2.70m									29.50	-18.30	
19/02/15 0845hrs 4.40m								Borehole completed at 29.50m.			
									{38.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH514

CLIENT	WELSH GOVERNMENT					Sheet	1 of 1
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	10 February 2015	Easting	336928.2				
End Date	12 February 2015	Northing	185960.8	Ground level	12.00mOD	Depth	6.85 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range		instru -ment	description	depth (m)	reduced level (m)	legend
10/02/15 1500hrs	1B	0.20 - 0.50						Dense to very dense black slightly silty sandy angular to subrounded fine to coarse slag GRAVEL. (MG)			
	2D*	0.20 - 0.50		Vo 0							
	3B	0.50 - 1.00									
10/02/15 1700hrs Dry	4D*	0.50 - 1.00		Vo 0							
		1.00 - 1.45	1.00	C 34							
11/02/15 0800hrs Dry	5B	1.00 - 1.50									
	6D*	1.00 - 1.50		Vo 0							
		1.50 - 1.51	1.50	C**							
	7B	1.50 - 2.00									
	8D*	1.50 - 2.00		Vo 0.3							
		2.00 - 2.45		C 52							
	9B	2.50 - 3.00									
	10D*	2.50 - 3.00		Vo 0.2							
		3.00 - 3.00	3.00	C**							
	11B	3.50 - 4.00									
	12D*	3.50 - 4.00		Vo 0.1				3.50 - 4.00m: Rare rounded fine and medium gravel sized iron nodules.			
		4.00 - 4.00	3.00	C**							
	13B	4.50 - 5.20									
	14D*	4.50 - 5.20						4.50 - 5.20m: Cobble sized pockets of soft greenish grey locally brownish grey clay.			
		5.20 - 5.43	5.20	C*100							
	15D*	5.50 - 6.00		Vo 0.1							
11/02/15 1700hrs Dry	16B	6.00 - 6.30									
12/02/15 0800hrs Dry											
		6.70 - 6.70	6.70	C**				6.70m: Driller notes metal.	6.85	5.15	
12/02/15 1200hrs Dry		6.85 - 6.85	6.85	C**				Borehole completed at 6.85m.			
									{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig.

METHOD: Hand dug inspection pit 0.00-1.00m. Cable percussion (200mm) 1.00-6.85m.

CASING: 200mm diam to 6.85m.

BACKFILL: On completion, hole backfilled with bentonite pellets.

REMARKS: Hole advanced by chiselling 1.50-2.00m (1hr), 3.00-4.50m (2.5hr), 5.60-6.85m (3.5hr). Hole terminated at 6.85m due to encountering metallic obstruction.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
				Groundwater not encountered.

AGS

CONTRACT	CHECKED
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BOREHOLE LOG

BH514A

CLIENT	WELSH GOVERNMENT					Sheet	1 of 1
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	4 March 2015	Easting	336934.3				
End Date	6 March 2015	Northing	185953.7	Ground level	11.90mOD	Depth	7.50 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range		instru -ment	description	depth (m)	reduced level (m)	legend
04/03/15 1500hrs	1D*	0.00 - 0.50		Vo 0.9				Soft to very soft black to dark brown (ashy) gravelly sandy clayey SILT with rare roots (up to 3mm diam). Gravel is subangular fine to coarse slag and mudstone. (MG)			
	2B	0.30 - 0.60									
	4D*	0.50 - 1.00		Vo 0.0							
	3B	0.60 - 1.00									
		1.00 - 1.45	1.00	C 1							
	5B	1.00 - 1.50									
	6D*	1.00 - 1.50		Vo 0.0							
		1.50 - 1.95	1.40	C 1							
04/03/15 1700hrs Dry	7B	1.50 - 2.00									
		2.00 - 2.45	2.00	C 12					2.00	9.90	
05/03/15 0800hrs Dry	8B	2.00 - 2.50						Firm black to dark brown gravelly sandy clayey SILT. Gravel is subangular fine to coarse slag and mudstone. (MG)			
	9D*	2.00 - 2.50		Vo 0.5							
		2.50 - 2.95	2.50	C 13							
	10B	2.50 - 3.00									
	11D*	2.50 - 2.70		Vo 0.7							
		3.00 - 3.45	3.00	C 28							
	12B	3.00 - 3.50						3.00 - 3.40m: Stiff.			
	13D*	3.00 - 3.20		Vo 0.3					3.40	8.50	
		3.50 - 3.80	3.50	C*106				Very dense dark brown sandy subangular fine to coarse slag GRAVEL with high subangular slag cobble content. (MG)			
	14D*	3.50 - 3.70		Vo 0.3							
		4.00 - 4.45	4.00	C 8							
	15B	4.00 - 4.50						4.00 - 4.45m: Loose (?).			
	16D*	4.00 - 4.20		Vo 0.0							
		4.50 - 4.80	4.50	C*106							
	17B	4.50 - 4.80									
	18D*	4.50 - 4.70		Vo 0.0							
		5.00 - 5.45	5.00	C 64							
05/03/15 1700hrs Dry	19D*	5.00 - 5.20		Vo 0.0							
06/05/15 0800hrs Dry		5.50	5.50								
	20B	6.00 - 7.50							6.00	5.90	
	21D*	6.00 - 6.50						Very dense dark brownish grey silty sandy subangular fine to coarse slag GRAVEL. (MG)			
		6.50 - 6.56	6.50	C*246							
06/05/15 1700hrs Dry	22D*	7.00 - 7.50									
		7.50 - 7.70	7.00	C*313					7.50	4.40	
	23D*	7.50						Borehole completed at 7.50m.			
									{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig.

METHOD: Hand dug inspection pit 0.00-1.00m. Cable percussion (200mm) 1.00-5.50m and (150mm) 5.50-7.50m.

CASING: 200mm diam to 5.50m and 150mm diam to 7.00m.

BACKFILL: On completion, hole backfilled with bentonite pellets.

REMARKS: Hole advanced by chiselling 3.60-6.00m (6.5hr) and 6.00-7.50m (8.5hr). Water added to assist boring 6.00-7.50m. Hole terminated at 7.50m due to encountering obstruction.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
				Groundwater not encountered.

AGS

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH515

CLIENT	WELSH GOVERNMENT					Sheet	1 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	5 February 2015	Easting	336901.7			Depth	21.70 m
End Date	9 February 2015	Northing	186086.3	Ground level	10.65mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
05/02/15 0800hrs	1B	0.00 - 0.50						Black slightly sandy subangular to subrounded fine to coarse slag and red brick GRAVEL with low slag cobble content. (MG)			
	2D*	0.20 - 0.30		Vo 0.5							
	3B	0.50 - 1.00									
	4D*	0.50 - 0.60		Vo 3.7							
05/02/15 1600hrs Dry	5D	1.00 - 1.45	Nil	S 4							
	6B	1.00 - 1.50							1.00	9.65	
06/02/15 0800hrs Dry	7D*	1.00 - 1.10		Vo 0.8				Very loose to loose black sandy to very sandy very clayey GRAVEL with a medium brick cobble content. Frequent fragments of fibrous organic material. (MG)			
	8D	1.50 - 1.95	1.50	S 4				1.50m: Tending to very clayey very gravelly sand.			
	9B	1.50 - 2.00									
	10D*	1.50 - 1.60		Vo 1.9							
	11D	2.00 - 2.45	2.00	S 4							
	12B	2.00 - 2.50									
	13D	2.50 - 2.95	2.50	S 10							
	14B	2.50 - 3.00									
	15D*	2.50 - 2.60									
	16D	3.00 - 3.45	3.00	S 8							
	17B	3.00 - 3.50									
	18D*	3.00 - 3.10									
	19D	3.50 - 3.95	3.50	S 8							
	20B	3.50 - 4.00									
	21D	4.00 - 4.45	4.00	S 12					4.00	6.65	
	22B	4.00 - 4.50						Firm black and reddish brown slightly gravelly CLAY. Gravel is subangular fine and medium mudstone. (MG)			
	23D*	4.00 - 4.10									
	24D	4.50 - 4.95	4.50	S 8							
	25B	4.50 - 5.00									
	26D*	4.50 - 5.00									
	27D	5.00 - 5.45	5.00	S 6					5.00	5.65	
	28B	5.00 - 5.50						Soft dark grey and light brown slightly sandy CLAY. (MG)			
	29B	5.50 - 6.00									
		6.00 - 6.00	6.00	C**					6.00	4.65	
	30B	6.00 - 6.50						Driller notes slag boulders recovered as: Dark brown and black sandy very angular to subangular fine to coarse slag GRAVEL. (MG)			
	31D*	5.50 - 6.10									
	32B	6.00 - 6.10									
	33D*	6.50 - 7.00									
06/02/15 1600hrs Dry		6.50 - 7.00									
		7.00 - 7.00	6.00	C**							
09/02/15 0800hrs Dry	34B	7.00 - 7.50									
									7.60	3.05	
	35B	7.50 - 8.00						Firm dark and light brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine to medium sandstone.			
		7.60 - 8.00									
								Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.00m. Cable percussion (200mm) 1.00-9.00m and (150mm) 9.00-16.50m. Waterflush rotary coring (116mm) 16.50-21.70m. CASING: 200mm to 8.00m and 150mm diam to 16.15m.

BACKFILL: On completion, borehole backfilled with bentonite 21.70-13.20m. A slotted standpipe (50mm) was installed to 13.00m, granular response zone 13.20-9.80m, bentonite seal 9.80-5.20m. A second standpipe (35mm) was installed to 5.00m, granular response zone 5.20-0.85m, bentonite seal 0.85-0.25m, concrete and stopcock cover 0.25-0.00m. REMARKS: Hole advanced by chiselling 6.00-7.00m (2hr), and 15.50-16.50m (2hr). Downhole magnetometry for UXO risk mitigation undertaken 0.00-6.00m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling 7.00-9.00m, prior to reduction in casing diameter. Permeability test undertaken at 11.00-12.00m. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
				Groundwater not encountered.

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH515

CLIENT	WELSH GOVERNMENT					Sheet	2 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	5 February 2015	Easting	336901.7				
End Date	9 February 2015	Northing	186086.3	Ground level	10.65mOD	Depth	21.70 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	36UT	8.00 - 8.45						(TFD)			
	37B	8.00 - 8.50									
									9.00	1.65	
	38B	9.00 - 9.50						Spongy black and brown clayey fibrous PEAT. (PEAT)			
	39D	9.50 - 9.95	9.50	S 34							
	40B	10.00 - 10.50									
									11.00	-0.35	
	41D	10.90 - 11.00						Soft dark grey sandy locally very sandy clayey SILT. (TFD)			
	42D	11.00 - 11.45	11.00	S 11							
09/02/15 1600hrs 10.80m	43B	11.50 - 12.00									
10/02/15 0810hrs 6.75m											
	44D	12.50 - 12.95	12.50	S 2							
	45B	13.50 - 14.00									
	46UT	14.00 - 14.45	14.00								
	47B	15.00 - 15.50									
	48D	15.50 - 15.95	15.50	S 38					15.50	-4.85	
	49B	15.50 - 16.00						Stiff fissured reddish brown slightly sandy slightly gravelly CLAY. Gravel is subrounded fine and medium lithorelicts of very stiff clay and extremely weak mudstone. Fissures are subhorizontal extremely closely spaced. (MMG) (Grade III/IVa)			
	50D	16.00 - 16.09	16.00	S**							
10/02/15 1335hrs 6.75m	51B	16.00 - 16.50									
		16.50 - 16.61	16.15	C*250							
11/02/15 0955hrs 11.23m	52C	16.50 - 17.20			100						
	53C	17.20 - 18.70			99						
								17.30m: Single greenish grey reduction spot (30mm).	17.40	-6.75	
								Very stiff reddish brown very gravelly CLAY. Gravel is angular and subangular fine to coarse lithorelicts of very stiff clay and extremely weak mudstone. (MMG) (Grade III)			
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered.	30238	EC

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BOREHOLE LOG

BH515

CLIENT	WELSH GOVERNMENT					Sheet	3 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	5 February 2015	Easting	336901.7				
End Date	9 February 2015	Northing	186086.3	Ground level	10.65mOD	Depth	21.70 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
									17.80 - 17.90m: Mottled greenish grey.	18.30	-7.65	
							NA		Stiff reddish brown slightly sandy slightly gravelly CLAY. Gravel is angular and subangular fine and medium lithorelicts of very stiff clay and extremely weak mudstone. (MMG) (Grade III/IVa)			
	54C	18.70	20.20			95				19.40	-8.75	
									Very stiff fissured reddish brown very gravelly CLAY. Gravel is angular and subangular medium and coarse lithorelicts of very stiff clay and extremely weak mudstone. Fissure are subhorizontal and vertical very closely spaced with bluish grey locally greenish grey staining. (MMG) (Grade III)			
	55C	20.20	21.70			96 20 20				21.00	-10.35	
							300		Weak thinly laminated reddish brown MUDSTONE. (MMG) (Grade I)	21.30	-10.65	
11/02/15 1245hrs 2.55m							NA		Stiff reddish brown slightly sandy slightly gravelly CLAY. Gravel is subangular and subrounded fine and medium lithorelicts of very stiff clay and extremely weak mudstone. (MMG) (Grade IVa)	21.70	-11.05	
									Borehole completed at 21.70m.	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered.	30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

BH516

CLIENT	WELSH GOVERNMENT					Sheet	1 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	5 February 2015	Easting	337039.7				
End Date	10 February 2015	Northing	185703.6	Ground level	7.20mOD	Depth	25.30 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
04/02/15 0800hrs	1B	0.00 - 0.50						Black mottled dark grey sandy subangular fine to coarse tarmacadam, limestone and brick GRAVEL. (MG)			
	2D*	0.00 - 0.50		Vo 2.0							
	3B	0.50 - 1.20									
	4D*	0.50 - 1.20		Vo 0.6							
04/02/15 1700hrs Dry		1.20 - 1.20	1.20	C**							
	5B	1.20 - 1.50						1.20 - 1.50m: Driller notes slag boulders.			
		1.50 - 1.60	1.50	C*714							
05/02/15 0800hrs Dry	6B	1.65 - 2.05		Vo 1.3					1.65	5.55	
	7D*	1.70 - 2.30		Vo 1.4				Dense black mottled dark grey sandy subangular fine to coarse tarmacadam, limestone and brick GRAVEL with low subrounded limestone cobble content. (MG)			
		2.05 - 2.50	2.50	C 42							
	8B	2.05 - 2.50									
	9D*	2.30 - 2.80		Vo 0.7							
		2.50 - 2.95	2.50	C 44							
	10B	2.50 - 3.00									
	11D*	2.80 - 3.00		Vo 1.7							
	12D	3.00 - 3.45	3.00	S 9							
	13B	3.00 - 3.50									
	14D*	3.00 - 3.50		Vo 1.4							
									3.50	3.70	
	15UT	3.50 - 3.95	3.50					Firm dark grey mottled black slightly gravelly organic silty CLAY. Gravel is subangular fine and medium limestone. (TFD)			
	16B	3.50 - 4.10							4.00	3.20	
	17D	4.10 - 4.55	4.10	S 4				Firm dark grey mottled light brown and black organic silty CLAY with rare subangular fine and medium limestone gravel and rare plant fragments (up to 2mm). (TFDP)			
	18B	4.10 - 4.60									
	19UT	4.60 - 5.05	4.60								
	20B	4.60 - 5.20									
	21D	5.00 - 5.20							5.00	2.20	
	22B	5.00 - 5.20						Soft becoming firm light grey mottled light brown and black organic silty CLAY. (TFDP)			
	23D	5.20 - 5.65	5.20	S 6							
	24B	5.20 - 6.70									
05/02/15 1700hrs Dry											
06/02/15 0800hrs Dry	25UT	6.70 - 7.15	6.70								
	27B	6.70 - 7.30									
	26D	7.10 - 7.30									
	28D	7.30 - 7.75	7.30	S 4					7.30	-0.10	
	29B	7.30 - 8.80						Spongy dark brown fibrous PEAT. (PEAT)			
								Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (200mm) 1.20-3.00m and (150mm) 3.00-14.80m. Waterflush rotary core drilled (116mm) 14.80-25.30m.

CASING: 200mm diam to 3.00m and 150mm diam to 14.70m.

BACKFILL: On completion, hole backfilled with bentonite pellets 25.30-0.40m, gravel 0.40-0.10m, and topsoil 0.10-0.00m. REMARKS: Hole advanced by chiselling 1.20-1.30m (1hr), 1.30-1.50m (1hr), 1.50m: no penetration (2hr), 1.70-2.00m (1hr), 2.00-2.50m (1.5hr), 13.60-13.80m (1hr) and 14.40-14.70m (1hr). Water added to assist boring 1.20-1.50m. Downhole magnetometry for UXO risk mitigation undertaken 0.00-1.20m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling 3.00-2.00m, prior to reduction in casing diameter. Permeability test undertaken at 9.00m- 9.50m. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
6.70	6.70	5.10	20	

AGS

CONTRACT	CHECKED
30238	EC

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BOREHOLE LOG

BH516

CLIENT	WELSH GOVERNMENT					Sheet	2 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	5 February 2015	Easting	337039.7				
End Date	10 February 2015	Northing	185703.6	Ground level	7.20mOD	Depth	25.30 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
									8.80	-1.60	
	30UT	8.80 - 9.20	8.80					Very soft dark grey mottled dark brown and black silty CLAY with frequent plant and peat fragments (up to 5mm). (TFDP)			
	31B	9.20 - 10.30									
	32D	9.20 - 9.40									
	33D	10.30 - 10.75	10.30	S 4							
	34B	10.30 - 11.80									
	35UT	11.80 - 12.25	11.80								
		12.20 - 12.65	12.20	C 26					12.20	-5.00	
	36B	12.20 - 13.10						Stiff dark grey gravelly organic silty CLAY. Gravel is subangular fine and medium limestone. (TFD)			
	37D	13.10 - 13.48	13.10	S*67					13.10	-5.90	
06/02/15 1600hrs Dry	38B	13.10 - 13.60						Very stiff reddish brown mottled dark grey gravelly silty CLAY. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. (MMG) (Grade IVa)			
		13.60 - 13.99	13.10	C*64							
09/02/15 0830hrs 4.30m	39B	13.60 - 14.10									
		14.10 - 14.41	13.10	C*96							
	40B	14.10 - 14.70									
09/02/15 1700hrs 4.30m	41X	14.50 - 14.80				NI			14.50	-7.30	
		14.70 - 14.85	13.10	C*200				Very stiff reddish brown locally mottled greenish grey gravelly CLAY locally tending to extremely weak mudstone with rare greenish grey reduction spots (up to 10mm). Gravel is subangular fine to coarse lithorelicts of very stiff clay and extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical very closely spaced planar rough locally stained dark grey. (MMG) (Grade III)			
10/02/15 0835hrs 4.58m	42C	14.80 - 16.30			100						
	43C	16.30 - 17.80			100			16.30 - 16.60m: Recovered as angular fine to coarse mudstone gravel.			
								17.10 - 17.30m: Recovered as angular fine to coarse mudstone gravel.			
	44C	17.80 - 19.30			100						
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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BOREHOLE LOG

BH516

CLIENT	WELSH GOVERNMENT					Sheet	3 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	5 February 2015	Easting	337039.7				
End Date	10 February 2015	Northing	185703.6	Ground level	7.20mOD	Depth	25.30 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
								17.70 - 17.85m: Recovered as angular fine to coarse mudstone gravel.			
	45C	19.30 - 20.80			100			19.30 - 19.60m: Recovered as angular fine to coarse mudstone gravel.			
	46C	20.80 - 22.30			100			20.80 - 22.30m: Rare greenish grey reduction spots (up to 20mm). 21.20 - 21.40m: Mottled greenish grey and reddish brown.			
	47C	22.30 - 23.80			100			22.30 - 23.50m: Recovered as angular fine to coarse mudstone gravel.			
	48C	23.80 - 25.30			100			23.70 - 23.85m: Recovered as angular fine to coarse mudstone gravel. 23.80 - 25.30m: Tending to extremely weak and weak mudstone. 24.05 - 24.20m: Recovered as angular fine to coarse mudstone gravel.			
10/02/15 1445hrs 3.78m									25.30	-18.10	
								Borehole completed at 25.30m.			
									{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

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Geotechnical Engineering Limited

TRIAL PIT LOG

TP504

CLIENT	WELSH GOVERNMENT					Sheet	1 of 1
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 25
Start Date	20 February 2015	Easting	336733.7				
End Date	20 February 2015	Northing	185858.9	Ground level	6.60mOD	Depth	1.70 m

water record	sample/test no/type	result	depth (m)	description	depth (m)	level (m)	legend
	1B	Vo 6.8	0.00- 0.10	Dark grey sandy angular and subangular fine to coarse brick, timber and slag GRAVEL with low red brick and slag cobble content. (MG)			
	2D*		0.00- 0.10				
	3B	Vo 30.5	0.60- 0.80				
	4D*		0.60- 0.80				
	5B	Vo 7.2	1.20- 1.40				
	6D*		1.20- 1.40				
Rapid ingress at 1.45m							
1.45m				Trial pit completed at 1.70m.	1.70	4.90	

Notes

Trial pit excavated by JCB 3CX mechanical excavator.
Groundwater encountered at 1.45m.
Trial pit sides remained stable and vertical.
Trial pit dimensions 0.80x2.40x1.70m.
On completion, the trial pit was backfilled with materials arising.
Trial pit terminated at 1.70m due to the strength of the ground.

Sketch of Foundation - Not to scale. All dimensions in metres.

CONTRACT	CHECKED
30238	EC

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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A2 Appendix 1b

Exploratory Records (Lagoon 25)

Borehole Log

Exploration Associates

Drilled by IH Logged by JL Checked by	Equipment and Methods Cable Percussion 150 mm diameter from 0.00m to 12.50m.	Ground Level + 12.18 m OD National Grid Coordinates E 337265.23 N 185731.72	

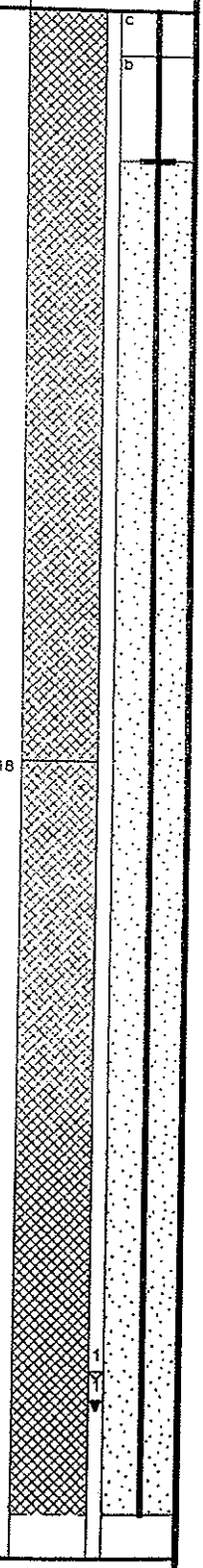
Samples and Tests

Depth	Type & No.	Records	Date Casing Water
			25/01/2002
1.30	ES1		
5.00	ES2		
			25/01/2002 5.50 dry
			28/01/2002 5.50 dry
8.70	ES3		

Strata

Description	Depth,Level (Thickness)
MADE GROUND : Dark grey slightly clayey SAND AND GRAVEL. Gravel is angular to subrounded fine to coarse of ash and clinker. Driller reports slag.	(5.00)
	5.00 +7.18
MADE GROUND: Dark grey slightly clayey SAND AND GRAVEL. Gravel is angular to subrounded fine to coarse of ash and clinker. Driller reports slag.	(6.20)

Legend



Groundwater

No.	Struck	Behaviour
1	9.30m	Rising to 9.10m after 20 mins. Sealed 11.40.

Remarks

Chiselling : 3.80m to 4.10m 30minutes, 6.10m to 6.40m 30minutes, 7.30m to 7.50m 45minutes, 8.00m to 9.30m 90minutes, 9.30m to 10.40m 120minutes
Hole backfill : 0.00m to 0.30m Concrete (c), 0.30m to 1.00m Bentonite (b), 11.00m to 12.50m Arisings (a). Surface protection : Stop Cock Cover
Standpipe installed, 50mm diameter, response zone from 1.00m to 11.00m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole **LGBH4**

03/05/2002 11:11:12 ESGLog v2.10

Borehole Log

Exploration Associates

Drilled by IH Logged by JL Checked by	Equipment and Methods See sheet 1	Ground Level	+ 12.18 m OD
		National Grid Coordinates	E 337265.23 N 185731.72

Samples and Tests

Depth	Type & No.	Records	Date Casing	Time Water
11.00		kRH		
11.50	ES4			
			28/01/2002 11.50	dry

Strata

Description	Depth,Level (Thickness)	Legend
As sheet 1	(6.20)	a
	11.20 +0.98	
Firm to stiff light grey mottled orange brown slightly sandy CLAY with occasional rootlets. Driller reports clay and peat.	(1.30pen)	
EXPLORATORY HOLE ENDS AT 12.50 m.	12.50 -0.32	

Groundwater
No. Struck Behaviour

Remarks

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole
LGBH4
Sheet 2 of 2

03/05/2002 11:11:16 ESGLog v2.10

Borehole Log

Exploration Associates

Drilled by DO Logged by LM Checked by	Equipment and Methods Cable Percussion 150 mm diameter from 0.00m to 7.00m.	Ground Level + 4.60 m OD National Grid Coordinates E 337283.62 N 185650.46	

Samples and Tests

Depth	Type & No.	Records	Date Casing	Time Water
			24/01/2002	
0.50	ES1			
1.50	ES2			
1.60	ES3			
			24/01/2002	dry
			25/01/2002	dry
3.10	ES5			
6.00	ES6			
			25/01/2002	dry
7.00	ES7			
7.00		kRH		

Strata

Description	Depth,Level (Thickness)	Legend
MADE GROUND: Dark brown and grey brown slightly gravelly to gravelly fine to coarse SAND. Driller reports slag.	(1.50)	c, b
MADE GROUND: Soft pale grey CLAY. Driller reports slag.	1.50 +3.10 (0.50)	
Soft grey silt with slag (DRILLERS DESCRIPTION).	2.00 +2.60 (0.50)	
Firm pale grey CLAY.	2.50 +2.10 (0.60)	
PEAT (DRILLERS DESCRIPTION).	3.10 +1.50 (2.90)	
Soft pale grey CLAY.	6.00 -1.40 (1.00pen)	
EXPLORATORY HOLE ENDS AT 7.00 m.	7.00 -2.40	

Groundwater
Not encountered during drilling.

Remarks
Chiselling : 0.70m to 1.00m 75minutes
Hole backfill : 0.00m to 0.30m Concrete (c), 0.30m to 1.80m Bentonite (b). Surface protection : Stop Cock Cover
Standpipe installed, 50mm diameter, response zone from 1.80m to 7.00m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole
LGBH5
Sheet 1 of 1

03/05/2002 11:11:22 ESGLog v2.10

Borehole Log

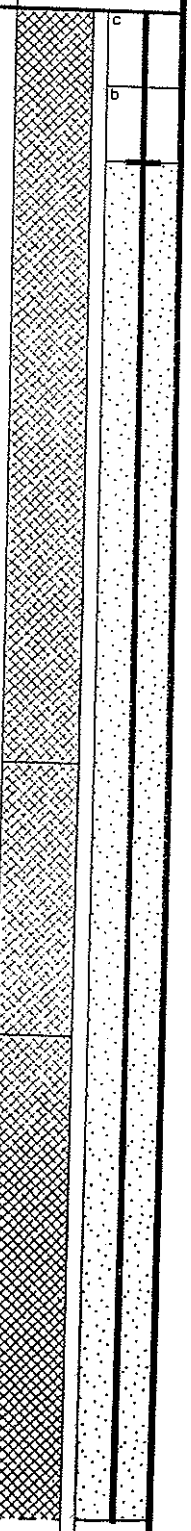
Exploration Associates

Drilled by: GR Logged by JN Checked by	Equipment and Methods Cable Percussion 150 mm diameter from 1.20m to 12.20m.	Ground Level National Grid Coordinates	+ 12.65 m OD E 337548.31 N 185583.01

Samples and Tests / Strata

Depth	Type & No.	Records	Date Casing Time Water	Description	Depth,Level (Thickness)
			30/01/2002		
1.00	ES1			MADE GROUND: Grey brown very sandy GRAVEL. Gravel is angular and subangular fine and medium of slag.	(5.00)
			30/01/2002 5.00 dry		
			31/01/2002 5.00		5.00 +7.65
				Fused steelworks slag (DRILLERS DESCRIPTION).	(1.80)
					6.80 +5.85
			31/01/2002 0.00	MADE GROUND: Grey slightly sandy GRAVEL. Gravel is angular fine and medium of shale. Driller reports slag.	(5.40)
			04/02/2002		

Legend



Groundwater

Remarks

Chiselling : 1.80m to 2.80m 120minutes, 3.40m to 3.60m 30minutes, 4.00m to 4.30m 45minutes, 4.80m to 5.00m 30minutes, 5.90m to 6.10m 30minutes, 6.80m to 9.00m 360minutes, 9.00m to 10.70m 240minutes
Hole backfill : 0.00m to 0.50m Concrete (c), 0.50m to 1.00m Bentonite (b). Surface protection : Stop Cock Cover
Standpipe installed, 50mm diameter, response zone from 1.00m to 12.20m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole
LGBH7
Sheet 1 of 2

03/05/2002 11:11:32 ESGLog v2.10

Borehole Log

Exploration Associates

Drilled by GR Logged by JN Checked by	Equipment and Methods See sheet 1	Ground Level National Grid Coordinates

Samples and Tests					Strata		
Depth	Type & No.	Records	Date Casing	Time Water	Description	Depth,Level (Thickness)	Legend
			04/02/2002				
			05/02/2002 10.70	9.80	As sheet 1	(5.40pen)	
12.00	ES2		05/02/2002				
					EXPLORATORY HOLE ENDS AT 12.20 m.	12.20	

Groundwater

Remarks
Chiselling : 10.70m to 12.20m 240minutes

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project: ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no. 152002
Carried out for Corus plc

Borehole
LGBH7
Sheet 2 of 2

19/04/2002 15:15:28 ESGLog v2.10

Borehole Log

Exploration Associates

Drilled by IH Logged by LM Checked by	Equipment and Methods Cable Percussion 150 mm diameter from 0.00m to 7.00m.	Ground Level + 4.96 m OD National Grid Coordinates E 337621.91 N 185568.04	

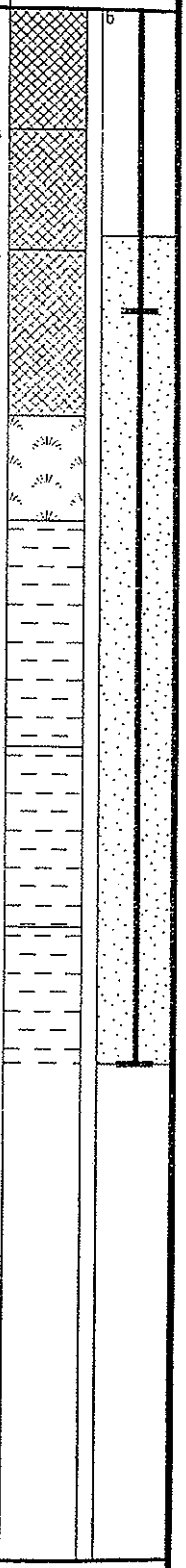
Samples and Tests

Depth	Type & No.	Records	Date Casing Water
			25/01/2002
1.90	ES1		
5.00	ES2		
			25/01/2002 dry
6.80	ES3		

Strata

Description	Depth,Level (Thickness)
Slag (DRILLERS DESCRIPTION).	(0.80)
	0.80 +4.16
Grey clayey SILT with slag (DRILLERS DESCRIPTION).	(0.80)
	1.60 +3.36
MADE GROUND : Soft dark brown grey sandy gravelly CLAY. Gravel is subangular and subrounded fine and medium of ash and clinker. Driller reports some peat.	(1.10)
	2.70 +2.26
PEAT (DRILLERS DESCRIPTION).	(0.70)
	3.40 +1.56
Green grey silty CLAY (DRILLERS DESCRIPTION).	(1.50)
	4.90 +0.06
Soft grey CLAY and black spongy pseudofibrous PEAT.	(1.20)
	6.10 -1.14
Soft grey CLAY.	(0.90pen)
EXPLORATORY HOLE ENDS AT 7.00 m.	7.00 -2.04

Legend



Groundwater
Not encountered during drilling.

Remarks
Chiselling : 0.40m to 0.60m 30minutes
Hole backfill : 0.00m to 1.50m Bentonite (b). Surface protection : <none>
Standpipe installed, 50mm diameter, response zone from 1.50m to 7.00m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole
LGBH9
Sheet 1 of 1

03/05/2002 11:11:45 ESGLog v2.10

BOREHOLE No: BH 24

Client : Corus Ltd.	**Contractor :** Apex Drilling Ltd.	**Hole Coordinates :** E337962.515 N185757.140
Project : SSQ Landfill Llanwern	**Hole Depth (m) :**	**Logged By :** AWJ
Location : See site plan	**Steel Collar Level :**	**Date :** 06.10.05 **Sheet No :** 1 of 2

Depth (m)	Elevation	Geotechnical Description (BS5930:1999)	Strata Type	Well Details	Water Level Below Ground	Samples: Sample Type	Samples: From	Samples: To	Remarks
0	5.38	Ground Surface							
	5.08	**Made Ground** Dense to very dense dark grey silty sandy fine to coarse angular gravel with occasional cobble and rare boulder, comprising of slag							
	4.78	**Estuarine Alluvium** Firm grey CLAY							
1		**Peat** Soft dark brown fibrous woody PEAT							
	2.98	**Estuarine Alluvium** Firm becoming soft grey CLAY			2.58m				
3									
4									
5	0.18	**Triassic Bedrock** Moderately strong grey MUDSTONE/ Stiff Clay							
6									
8									
9									
10									

Drilled By : GJ

Rig Type : Gryphon

Hole Diameter (mm) : 110

Casing Depth (m) : 10.00

Bit Type :

Log Template File : GEOROTARY

Notes

1

2

3

4

5

BOREHOLE No: BH 24

Client : Corus Ltd.	**Contractor :** Apex Drilling Ltd.	**Hole Coordinates :** E337962.515 N185757.140
Project : SSQ Landfill Llanwern	**Hole Depth (m) :**	**Logged By :** AWJ
Location : See site plan	**Steel Collar Level :**	**Date :** 06.10.05 **Sheet No :** 2 of 2

Depth (m)	Elevation	Geotechnical Description (BS5930:1999)	Strata Type	Well Details	Water Level Below Ground	Samples: Sample Type	Samples: From	Samples: To	Remarks
11	-5.62	**Triassic Bedrock** Strong dark reddish brown MARL with many fine to coarse sub-rounded gravels - Conglomerate							
13	-8.32	**Triassic Bedrock** Moderately strong reddish brown MARL							
14									
15	-9.62								
16									
17									
18									
19									
20									

Drilled By : GJ

Rig Type : Gryphon

Hole Diameter (mm) : 110

Casing Depth (m) : 10.00

Bit Type :

Log Template File : GEOROTARY

Notes

1

2

3

4

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
SBHJ05
Header

Contract No.	F15056	Method	Cable Percussion & Rotary	Coordinates	337257.91 E 185693.20 N
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	Dando Tractor/Dando	Ground Level	13.24m AOD
Client	Transport Wales, Welsh Assembly Government	Drillers	MM/PW	Orientation	Vertical
		Logged by	DH	Date Started	17/12/2007
Consultant	Ove Arup & Partners Ltd	Core barrel	Cemetrix	Date Completed	13/01/2008
		Core bit	8 inch Hammer		

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
17/12/2007	1730	10.30	10.30	DRY	End of Shift
11/01/2008	0730	10.30	10.40	DRY	Start of Shift
11/01/2008	1730	10.70	10.70	DRY	End of Shift
12/01/2008	0730	10.70	10.70	DRY	Start of Shift
12/01/2008	1730	14.50	14.50	DRY	End of Shift
13/01/2008	0730	14.50	14.50	DRY	Start of Shift
13/01/2008	1730	20.50	19.50	DRY	End of Hole

CABLE PERCUSSION DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling Hours	Remarks
10.20	10.70	6.00	Chiselling
10.70	11.50	5.00	Chiselling
20.20	20.50	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	10.30	200	10.30
150	20.50	150	19.50

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
13/01/2008		14.80	14.80	NR	Seepage	14.80	NS

ROTARY DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
0.00	10.30	Air	Good	0*

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm	Casing	Water Depth
12.00	S	N=20 (3,4,4,5,5,6)	11.50	DRY
14.00	S	N=25 (4,5,5,6,7,7)	13.50	DRY
16.00	S	N=2 (1,1,0,1,0,1)	15.50	15.80
18.00	S	N=2 (1,0,1,0,1,0)	17.50	17.80
19.50	S	50/200mm (9,13,14,16,20)	19.00	DRY
20.50	S	50/20mm (25,50)	19.50	DRY

* Seating blows only.

GENERAL NOTES

1. Rotary Openhole cemetrix drilling from GL to 10.30m.
2. Cable Percussive boring from 10.20m to 20.50m.
3. 50mm standpipe installed, slotted from 9.50m to 11.50m.
4. 0.00* indicates openhole drilling.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, hard strata time in hours

Form	ARIAL COMBINED HEADER
Version	3.04
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
SBHJ05
Sheet 1 of 3

Contract No.	F15056	Method	Rotary & Cable Percussion	Coordinates	337257.91 E
Project	New M4 - Second Preliminary Ground Investigation				185693.20 N
		Drilling Rig	Dando Tractor/Dando	Ground Level	13.24m AOD
Client	Transport Wales, Welsh Assembly Government	Drillers	MM/PW	Orientation	Vertical
		Logged by	DH	Date Started	17/12/2007
Consultant	Ove Arup & Partners Ltd	Core Barrel	Cemetrix	Date Completed	13/01/2008
		Core Bit	8 inch Hammer		

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling & coring	Blow Count (TCR / SCR / RQD)	SPT type, N & depth	Install-ation
MADE GROUND: Ash and steel clinker. (Driller's description)							
		6.00	7.24				
MADE GROUND: Clay and gravel. (Driller's description)							

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL COMBINED LOG
Version	3.10
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
SBHJ05
Sheet 2 of 3

Contract No.	F15056	Method	Rotary & Cable Percussion	Coordinates	337257.91 E
Project	New M4 - Second Preliminary Ground Investigation				185693.20 N
		Drilling Rig	Dando Tractor/Dando	Ground Level	13.24m AOD
Client	Transport Wales, Welsh Assembly Government	Drillers	MM/PW	Orientation	Vertical
		Logged by	DH	Date Started	17/12/2007
Consultant	Ove Arup & Partners Ltd	Core Barrel	Cemetrix	Date Completed	13/01/2008
		Core Bit	8 inch Hammer		

Description of Strata	Depth Below G.L.	Datum Level	Sampling & coring		Blow Count (TCR / SCR / RQD)	SPT type, N & depth	
MADE GROUND: Clay and gravel. (Driller's description)	10.20	3.04					
MADE GROUND: Very compact slag fill with large fragments. (Driller's description)			ES1	11.30			
Brownish grey silty CLAY. (Estuarine Alluvium)	11.50	1.74	ES1 D2 U3	11.50 11.50 11.50-11.95	(21)		
---from 12.00m firm to stiff			D4 D5	12.00 12.00		S20 12.00	12.45
			ES6 B7	12.50 12.50			
			D8	13.00			
Firm brown fibrous PEAT. (Peat)	13.50	-0.26	ES9 U10	13.50 13.50-13.95	(32)		
			D11 D12	14.00 14.00		S25 14.00	14.45
			D13 ES14	14.50 14.50			
Grey slightly silty sandy CLAY with very closely spaced fine to coarse gravel sized pockets of pseudofibrous locally amorphous peat. Sand is fine. (Estuarine Alluvium)	14.80	-1.56					
			D15 ES16 U17	15.50 15.50 15.50	(6)		
			D18 D19	16.00 16.00		S2 16.00	16.45
			ES20	16.50			
			D21 B22	17.00 17.00-17.50			
Grey slightly sandy SILT. Sand is fine to medium	17.50	-4.26	U23	17.50	(5)		
			D24 D25	18.00 18.00		S2 18.00	18.53
Stiff reddish brown mottled grey slightly gravelly clay. Gravel is angular fine to coarse (Weathered Mudstone). (Mercia Mudstone Group)	18.90	-5.66	D26 U27	19.00 19.00	(110)		
---from 19.50m very stiff			D28 D29	19.50 19.50		S50/200mm 19.50	19.85

Install-ation

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL COMBINED LOG
Version	3.10
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
SBHJ05
Sheet 3 of 3

Contract No.	F15056	Method	Rotary & Cable Percussion	Coordinates	337257.91 E
Project	New M4 - Second Preliminary Ground Investigation				185693.20 N
		Drilling Rig	Dando Tractor/Dando	Ground Level	13.24m AOD
Client	Transport Wales, Welsh Assembly Government	Drillers	MM/PW	Orientation	Vertical
		Logged by	DH	Date Started	17/12/2007
Consultant	Ove Arup & Partners Ltd	Core Barrel	Cemetrix	Date Completed	13/01/2008
		Core Bit	8 inch Hammer		

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling & coring		Blow Count TCR	SCR	RQD		SPT type, N & depth	Install-ation
Stiff reddish brown mottled grey slightly gravelly clay. Gravel is angular fine to coarse (Weathered Mudstone). (Mercia Mudstone Group)				D30	20.00						
		20.50	-7.26	D31	20.50					S50/20mm 20.50 20.55	
Borehole complete at 20.50 m.											

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL COMBINED LOG
Version	3.10
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ20
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337351.15 E
Project	New M4 - Second Preliminary Ground Investigation				185669.24 N
		Sampling Rig	Hydraulic Hammer	Ground Level	12.21m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	18/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	18/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Black slightly clayey slightly sandy silt. ---from 0.30m to 0.50m sandy				L1	0.00 - 0.80	From: 0.00 To: 1.00 Diameter: 90mm Recovery : 100% Blows: 1	
				ES2 L3	1.00 1.00 - 1.80	From: 1.00 To: 2.00 Diameter: 80mm Recovery : 90% Blows: 1	
				ES4 L5	2.00 2.00 - 2.60	From: 2.00 To: 3.00 Diameter: 70mm Recovery : 80% Blows: 1	
				ES6 L7	3.00 3.00 - 3.60	From: 3.00 To: 4.00 Diameter: 70mm Recovery : 80% Blows: 1	
				ES8 L9	4.00 4.00 - 4.50	From: 4.00 To: 5.00 Diameter: 50mm Recovery : 90% Blows: 2	
				ES10 L11	5.00 5.00 - 5.50	From: 5.00 To: 6.00 Diameter: 50mm Recovery : 100% Blows: 2	
		6.00	6.21	ES12	6.00		
Sampling complete at 6.00 m.							

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 6.00m.
2. Window Sampling complete at 6.00m.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
Revised	13/02/2008

Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ25
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337452.48 E
Project	New M4 - Second Preliminary Ground Investigation				185649.26 N
		Sampling Rig	Hydraulic Hammer	Ground Level	11.77m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	19/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	19/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth	Progress	Install-ation
MADE GROUND: Clinker. (Driller's description)					From: 0.00 To: 0.50 Diameter: 80mm Recovery : 100% Blows: 12	
		0.50	11.27			
Sampling complete at 0.50 m.						

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 0.50m.
2. Window Sampling terminated at 0.50m due to refusal.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
Revised	13/02/2008

Norwest Holst Soil Engineering Ltd.

WINDOW SAMPLING LOG

Hole ID.
SWSJ27
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337502.30 E
Project	New M4 - Second Preliminary Ground Investigation				185640.30 N
		Sampling Rig	Hydraulic Hammer	Ground Level	11.30m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	19/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	19/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sample type and depth		Progress	Install-ation
MADE GROUND: Black slightly clayey slightly sandy silt. ---from 0.23m to 0.26m 1 No thin bed of black clayey silty fine sand				L1	0.00 - 0.80	From: 0.00 To: 1.00 Diameter: 90mm Recovery : 100% Blows: 1	
				ES2 L3	1.00 1.00 - 1.70	From: 1.00 To: 2.00 Diameter: 80mm Recovery : 90% Blows: 1	
				ES4 L5	2.00 2.00 - 2.70	From: 2.00 To: 3.00 Diameter: 70mm Recovery : 80% Blows: 2	
				ES6 L7	3.00 3.00 - 3.70	From: 3.00 To: 4.00 Diameter: 60mm Recovery : 100% Blows: 4	
				ES8 L9	4.00 4.00 - 4.60	From: 4.00 To: 5.00 Diameter: 50mm Recovery : 100% Blows: 3	
				ES10 L11	5.00 5.00 - 5.50	From: 5.00 To: 6.00 Diameter: 50mm Recovery : 90% Blows: 3	
Sampling complete at 6.00 m.		6.00	5.30	ES12	6.00		

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 6.00m.
2. Window Sampling complete at 6.00m.

NOTES: All depths in metres, all diameters in millimetres, Water strike rise time in minutes. See legend sheet for key to symbols.

Form	ARIAL WINDOW LOG
Version	3.07
Revised	13/02/2008

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ18
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337294.09 E
Project	New M4 - Second Preliminary Ground Investigation				185680.26 N
		Drilling Rig	Terrier	Ground Level	12.83m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	16/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	16/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
16/12/2007		3.45	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 3.45m.
2. Window Sampling terminated at 3.45m due to continuous collapse.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=21 (2,4,4,5,6,6)
2.00	S	N=24 (2,3,6,6,6,6)
3.00	S	N=26 (5,6,6,7,6,7)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
Version	3.03
Revised	19/01/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ18
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337294.09 E
Project	New M4 - Second Preliminary Ground Investigation				185680.26 N
		Drilling Rig	Terrier	Ground Level	12.83m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	16/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	16/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Indistinctly laminated black slightly sandy clayey silt with rare rootlets.				L1	0.00 - 0.80				
		1.00	11.83	ES2 D3 L4	1.00 1.00 - 1.45 1.00 - 1.80	S21	S	1.00 1.45	
MADE GROUND: Dark brown fine to coarse sand and angular to subangular gravel sized fragments of sandstone, slag and brick.				ES5 D6 L7	2.00 2.00 - 2.45 2.00 - 2.80	S24	S	2.00 2.45	
				ES8 D9	3.00 3.00 - 3.45	S26	S	3.00 3.45	
		3.45	9.38						
Sampling complete at 3.45 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ19
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337335.58 E
Project	New M4 - Second Preliminary Ground Investigation				185715.90 N
		Drilling Rig	Terrier	Ground Level	12.31m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	16/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	16/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
16/12/2007		6.45	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 6.45m.
2. Window Sampling complete at 6.45m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=0 (0,0,0,0,0,0)
2.00	S	N=0 (0,0,0,0,0,0)
3.00	S	N=0 (0,0,0,0,0,0)
4.00	S	N=0 (0,0,0,0,0,0)
5.00	S	N=0 (0,0,0,0,0,0)
6.00	S	N=0 (1,0,0,0,0,0)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
Version	3.03
Revised	19/01/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ19
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337335.58 E
Project	New M4 - Second Preliminary Ground Investigation				185715.90 N
		Drilling Rig	Terrier	Ground Level	12.31m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	16/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	16/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Black clayey silt with frequent rootlets.		0.10	12.21	L1	0.00 - 0.80				
MADE GROUND: Black clayey slightly sandy silt. Sand is fine. ---from 0.75m to 0.80m sand is fine to medium				ES2 D3 L4	1.00 1.00 - 1.45 1.00 - 1.80	S0	S	1.00 1.60	
				ES5 D6 L7	2.00 2.00 - 2.45 2.00 - 3.00	S0	S	2.00 2.60	
				ES8 D9	3.00 3.00 - 3.45	S0	S	3.00 3.60	
						S0	S	4.00 4.60	
				L10	5.00 - 6.00	S0	S	5.00 5.60	
				ES11 D12	6.00 6.00 - 6.45	S0	S	6.00 6.53	
Sampling complete at 6.45 m.		6.45	5.86						

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ21
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337387.85 E
Project	New M4 - Second Preliminary Ground Investigation				185703.94 N
		Drilling Rig	Terrier	Ground Level	12.97m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	16/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	16/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
16/12/2007		6.00	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
16/12/2007	1350	4.00	4.00	20	Seepage	NR	NR
16/12/2007	1450	6.00	6.00	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 6.00m.
2. Window Sampling complete at 6.00m.
3. 50mm standpipe installed, slotted from 4.00m to 6.00m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
Version	3.03
Revised	19/01/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ21
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337387.85 E
Project	New M4 - Second Preliminary Ground Investigation				185703.94 N
		Drilling Rig	Terrier	Ground Level	12.97m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	16/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	16/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Black slightly clayey slightly sandy silt with occasional rootlets.				L1	0.00 - 0.80			
---from 0.25m becomes sandy		0.40	12.57					
---from 0.35m becomes very sandy		0.45	12.52					
MADE GROUND: Slightly gravelly sandy silt. Gravel sized fragments are subangular fine to medium of sandstone.				ES2	1.00			
MADE GROUND: Black slightly clayey silt.				L3	1.00 - 1.80			
				ES4	2.00			
				L5	2.00 - 2.80			
				ES6	3.00			
				L7	3.00 - 3.80			
				ES8	4.00			
				L9	5.00 - 6.00			
Sampling complete at 6.00 m.		6.00	6.97					

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ22
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337405.22 E
Project	New M4 - Second Preliminary Ground Investigation				185656.40 N
		Drilling Rig	Terrier	Ground Level	11.99m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	11/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	11/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
11/01/2008		1.00	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
11/01/2008		1.00	1.00	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 1.00m.
2. Window Sampling terminated at 1.00m due to collapse.
3. Refer to SWSJ22A for reattempt.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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SWSJ22
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Contract No.	F15056	Method	Window Sampling	Coordinates	337405.22 E
Project	New M4 - Second Preliminary Ground Investigation				185656.40 N
		Drilling Rig	Terrier	Ground Level	11.99m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	11/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	11/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Black slightly clayey sandy silt.				L1	0.00 - 0.80			
		1.00	10.99	ES2	1.00			
Sampling complete at 1.00 m.								

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ22A
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337416.40 E
Project	New M4 - Second Preliminary Ground Investigation				185650.28 N
		Drilling Rig	Terrier	Ground Level	11.94m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	11/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	12/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
11/01/2008	0730	1.00	0.00	NR	End of Shift
12/01/2008		5.00	0.00	NR	End of Hole
12/01/2008		1.00	0.00	NR	Start of Shift

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
11/01/2008		0.00	0.00	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 5.00m.
2. Window Sampling terminated at 5.00m due to surface water.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=0 (0,0,0,0,0,0)
2.00	S	N=0 (0,0,0,0,0,0)
3.00	S	N=0 (0,0,0,0,0,0)
4.00	S	N=0 (0,0,0,0,0,0)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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Hole ID.
SWSJ22A
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Contract No.	F15056	Method	Window Sampling	Coordinates	337416.40 E
Project	New M4 - Second Preliminary Ground Investigation				185650.28 N
		Drilling Rig	Terrier	Ground Level	11.94m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	11/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	12/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Black slightly clayey slightly sandy silt.				L1	0.00 - 0.80				
				ES2 D3 L4	1.00 1.00 - 1.45 1.00 - 1.80	S0	S	1.00 1.60	
				ES5 D6	2.00 2.00 - 2.45	S0	S	2.00 2.60	
				D7	3.00 - 3.45	S0	S	3.00 3.60	
				D8	4.00 - 4.45	S0	S	4.00 4.60	
		5.00	6.94						
Sampling complete at 5.00 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ22B
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337410.30 E
Project	New M4 - Second Preliminary Ground Investigation				185644.94 N
		Drilling Rig	Terrier	Ground Level	11.99m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	12/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	12/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
12/01/2008		4.45	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
12/01/2008		1.00	1.00	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 4.45m.
2. Window Sampling terminated at 4.45m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=0 (0,0,0,0,0,0)
2.00	S	N=0 (0,0,0,0,0,0)
3.00	S	N=0 (0,0,0,0,0,0)
4.00	S	N=0 (0,0,0,0,0,0)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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Contract No.	F15056	Method	Window Sampling	Coordinates	337410.30 E
Project	New M4 - Second Preliminary Ground Investigation				185644.94 N
		Drilling Rig	Terrier	Ground Level	11.99m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	12/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	12/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Black slightly clayey slightly sandy silt.				L1	0.00 - 0.80				
				ES2 D3 L4	1.00 1.00 - 1.45 1.00 - 1.80	S0	S	1.00 1.60	
				ES5 D6	2.00 2.00 - 2.45	S0	S	2.00 2.60	
				ES7 D8	3.00 3.00 - 3.45	S0	S	3.00 3.60	
				D9	4.00 - 4.45	S0	S	4.00 4.60	
Sampling complete at 4.45 m.		4.45	7.54						

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ23
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337452.87 E
Project	New M4 - Second Preliminary Ground Investigation				185734.27 N
		Drilling Rig	Terrier	Ground Level	12.29m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	13/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	13/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
13/01/2008		8.35	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
13/01/2008		1.50	1.50	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 8.35m.
2. Window Sampling complete a 8.35m.
3. 50mm standpipe installed, slotted from 5.80m to 7.80m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=0 (0,0,0,0,0,0)
2.00	S	N=0 (1,0,0,0,0,0)
3.00	S	N=0 (1,0,0,0,0,0)
4.00	S	N=0 (0,0,0,0,0,0)
5.00	S	N=0 (1,0,0,0,0,0)
6.00	S	N=0 (0,0,0,0,0,0)
7.00	S	N=0 (0,0,0,0,0,0)
7.90	S	72/225mm (18,24,28,27,17)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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Hole ID.
SWSJ23
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Contract No.	F15056	Method	Window Sampling	Coordinates	337452.87 E
Project	New M4 - Second Preliminary Ground Investigation				185734.27 N
		Drilling Rig	Terrier	Ground Level	12.29m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	13/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	13/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Black slightly clayey slightly sandy silt.				L1	0.00 - 0.80				
				ES2 D3 L4	1.00 1.00 - 1.45 1.00 - 1.80	S0	S	1.00 1.60	
				ES5 D6 L7	2.00 2.00 - 2.45 2.00 - 2.80	S0	S	2.00 2.53	
				ES8 D9	3.00 3.00 - 3.45	S0	S	3.00 3.53	
				D10	4.00 - 4.50	S0	S	4.00 4.60	
				D11	5.00 - 5.45	S0	S	5.00 5.53	
MADE GROUND: Black slightly clayey slightly sandy silt.		6.00	6.29	D12 L13	6.00 - 6.45 6.00 - 6.80	S0	S	6.00 6.60	
				ES14 D15 L16	7.00 7.00 - 7.45 7.00 - 7.80	S0	S	7.00 7.60	
MADE GROUND: Clinker. (Driller's description)		7.80	4.49	ES17 D18	7.90 7.90 - 8.35	S72/225mm	S	7.90 8.28	
Sampling complete at 8.35 m.		8.35	3.94						

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ24
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337446.60 E
Project	New M4 - Second Preliminary Ground Investigation				185609.38 N
		Drilling Rig	Terrier	Ground Level	12.17m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	12/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	12/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
12/01/2008		2.00	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 2.00m.
2. Window Sampling terminated at 2.00m due to collapse.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=46 (1,3,4,12,17,13)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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Hole ID.
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Contract No.	F15056	Method	Window Sampling	Coordinates	337446.60 E
Project	New M4 - Second Preliminary Ground Investigation				185609.38 N
		Drilling Rig	Terrier	Ground Level	12.17m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	12/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	12/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Dark grey medium to coarse sand and angular to subangular fine to medium gravel of slag.		0.20	11.97	L1	0.00 - 0.80				
MADE GROUND: Black slightly sandy clayey silt. ---from 0.57m to 0.62m black clayey sand ---from 0.62m to 0.68m Brown				ES2 D3 L4	1.00 1.00 - 1.45 1.00 - 1.80	S46	S	1.00 1.45	
Sampling complete at 2.00 m.		2.00	10.17	ES5	2.00				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ24A
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337448.56 E
Project	New M4 - Second Preliminary Ground Investigation				185614.04 N
		Drilling Rig	Terrier	Ground Level	12.01m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	12/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	12/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
12/01/2008		5.45	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 5.45m.
2. Window Sampling terminated at 5.45m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=0 (0,0,0,0,0,0)
2.00	S	N=0 (0,0,0,0,0,0)
3.00	S	N=9 (2,3,2,2,3,2)
4.00	S	N=13 (2,2,3,3,3,4)
5.00	S	N=29 (1,2,5,7,8,9)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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Hole ID.
SWSJ24A
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Contract No.	F15056	Method	Window Sampling	Coordinates	337448.56 E
Project	New M4 - Second Preliminary Ground Investigation				185614.04 N
		Drilling Rig	Terrier	Ground Level	12.01m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	12/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	12/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Black slightly sandy silt.				L1	0.00 - 0.80				
---from 0.57m to 0.62m brown									
---from 1.00m with occasional coarse sand sized pockets of black clayey silty fine sand				ES2 D3 L4	1.00 1.00 - 1.45 1.00 - 1.80	S0	S	1.00 1.60	
				ES5 D6	2.00 2.00 - 2.45	S0	S	2.00 2.60	
				D7 L8	3.00 - 3.45 3.00 - 3.70	S9	S	3.00 3.45	
MADE GROUND: Fine to coarse gravel sized fragments of clinker.		3.25 3.40	8.76 8.61						
MADE GROUND: Black slightly sandy clayey silt.		3.80	8.21						
MADE GROUND: Black slightly sandy slightly gravelly clayey silt. Gravel sized fragments are subangular fine to medium of sandstone and clinker.				ES9 D10	4.00 4.00 - 4.45	S13	S	4.00 4.45	
				ES11 D12	5.00 5.00 - 5.45	S29	S	5.00 5.45	
Sampling complete at 5.45 m.		5.45	6.56						

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ26
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337495.14 E
Project	New M4 - Second Preliminary Ground Investigation				185686.59 N
		Drilling Rig	Terrier	Ground Level	11.60m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	15/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	15/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
15/12/2007		4.60	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 4.60m.
2. Window Sampling terminated at 4.60m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=0 (0,0,0,0,0,0)
2.00	S	N=0 (0,0,0,0,0,0)
3.00	S	N=0 (0,0,0,0,0,0)
4.00	S	N=0 (0,1,0,0,0,0)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ26
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337495.14 E
Project	New M4 - Second Preliminary Ground Investigation				185686.59 N
		Drilling Rig	Terrier	Ground Level	11.60m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	15/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	15/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Black clayey slightly sandy silt.				L1	0.00 - 0.80				
---from 0.60m to 0.65m speckled white									
				ES2 D3 L4	1.00 1.00 - 1.45 1.00 - 1.80	S0	S	1.00 1.60	
				ES5 D6 L7	2.00 2.00 - 2.45 2.00 - 3.00	S0	S	2.00 2.60	
				ES8 D9 L10	3.00 3.00 - 3.45 3.00 - 3.80	S0	S	3.00 3.60	
				ES11 D12 L13	4.00 4.00 - 4.45 4.00 - 4.60	S0	S	4.00 4.53	
		4.60	7.00						
Sampling complete at 4.60 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ28
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337527.55 E
Project	New M4 - Second Preliminary Ground Investigation				185590.83 N
		Drilling Rig	Terrier	Ground Level	11.59m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	13/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	13/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
13/01/2008		3.75	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 3.75m.
2. Window Sampling terminated at 3.75m due to refusal.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=0 (0,0,0,0,0,0)
2.00	S	N=0 (0,0,0,0,0,0)
3.00	S	N=34 (2,4,5,6,8,15)
3.50	S	49/100mm - Abandoned

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ28
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Contract No.	F15056	Method	Window Sampling	Coordinates	337527.55 E
Project	New M4 - Second Preliminary Ground Investigation				185590.83 N
		Drilling Rig	Terrier	Ground Level	11.59m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	13/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	13/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth			Install-ation
MADE GROUND: Dark brown slightly clayey slightly sandy silt.				L1	0.00 - 0.80					
---from 0.60m to 0.70m brown										
				ES2	1.00	S0	S	1.00	1.60	
				D3	1.00 - 1.45					
---from 1.20m to 1.23m 1 No very thin bed of black silty clayey fine sand				L4	1.00 - 1.80					
				ES5	2.00	S0	S	2.00	2.60	
				D6	2.00 - 2.45					
				L7	2.00 - 2.80					
		3.00	8.59	ES8	3.00	S34	S	3.00	3.45	
MADE GROUND: Subangular fine to coarse gravel sized fragments of clinker.				D9	3.00 - 3.45					
				ES10	3.50	S49/190mm - Abandoned	S	3.50	3.75	
				D11	3.50 - 3.75					
		3.75	7.84							
Sampling complete at 3.75 m.										

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ29
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337551.09 E
Project	New M4 - Second Preliminary Ground Investigation				185676.38 N
		Drilling Rig	Terrier	Ground Level	11.63m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	15/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	15/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
15/12/2007		6.00	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 6.00m.
2. Window Sampling complete at 6.00m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
Version	3.03
Revised	19/01/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ29
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337551.09 E
Project	New M4 - Second Preliminary Ground Investigation				185676.38 N
		Drilling Rig	Terrier	Ground Level	11.63m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	15/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	15/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Black slightly sandy slightly gravelly silt. Gravel sized fragments are angular to subangular fine to coarse of slag.				L1	0.00 - 0.80			
		0.30	11.33					
MADE GROUND: Black slightly clayey slightly sandy silt.								
				ES2	1.00			
				L3	1.00 - 1.80			
				ES4	2.00			
				L5	2.00 - 2.80			
				ES6	3.00			
				L7	3.00 - 3.80			
				ES8	4.00			
				L9	4.00 - 4.80			
				ES10	5.00			
				L11	5.00 - 5.60			
		6.00	5.63	ES12	6.00			
Sampling complete at 6.00 m.								

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ30
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337559.99 E
Project	New M4 - Second Preliminary Ground Investigation				185631.41 N
		Drilling Rig	Terrier	Ground Level	11.54m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	15/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	15/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
15/12/2007		6.45	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 6.45m.
2. Window Sampling complete at 6.45m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=1 (1,0,0,0,1,0)
2.00	S	N=0 (1,0,0,0,0,0)
3.00	S	N=0 (1,0,0,0,0,0)
4.00	S	N=1 (1,0,0,0,1,0)
5.00	S	N=1 (1,0,0,0,1,0)
6.00	S	N=1 (1,0,0,0,1,0)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
Version	3.03
Revised	19/01/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ30
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337559.99 E
Project	New M4 - Second Preliminary Ground Investigation				185631.41 N
		Drilling Rig	Terrier	Ground Level	11.54m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	15/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	15/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Black slightly gravelly clayey silt. Gravel sized fragments are angular fine to coarse of slag.				L1	0.00 - 0.80				
				ES2	1.00	S1	S	1.00 1.53	
				D3	1.00 - 1.45				
				L4	1.00 - 1.80				
MADE GROUND: Dark brown slightly sandy clayey silt.		1.55	9.99						
				ES5	2.00	S0	S	2.00 2.53	
				D6	2.00 - 2.45				
				L7	2.00 - 2.80				
				ES8	3.00	S0	S	3.00 3.53	
				D9	3.00 - 3.45				
				L10	3.00 - 3.60				
				ES11	4.00	S1	S	4.00 4.53	
				D12	4.00 - 4.45				
				L13	4.00 - 4.60				
				ES14	5.00	S1	S	5.00 5.53	
				D15	5.00 - 5.45				
				L16	5.00 - 5.60				
				ES17	6.00	S1	S	6.00 6.53	
				D18	6.00 - 6.45				
Sampling complete at 6.45 m.		6.45	5.09						

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Geotechnical Engineering Limited

BOREHOLE LOG

BH518

CLIENT	WELSH GOVERNMENT					Sheet	1 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	27 February 2015	Easting	337320.0				
End Date	5 March 2015	Northing	185636.3	Ground level	5.50mOD	Depth	18.50 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
27/02/15 0800hrs	1B	0.20 - 0.50						Soft dark greenish grey slightly gravelly CLAY. Gravel is subangular fine to medium slag. (MG)			
	2D*	0.20 - 0.50		Vo 0.0							
	3B	0.50 - 1.00									
	4D*	0.50 - 0.70		Vo 0.0							
	5D	1.00 - 1.45	1.00	S 6							
	6B	1.00 - 1.50							1.00	4.50	
	7D*	1.00 - 1.20		Vo 0.0				Soft dark greenish grey CLAY. (TFD)			
	8UT	1.50 - 1.95	1.50								
	9D	2.00 - 2.45	2.00	S 6							
	10B	2.00 - 2.50									
	11D*	2.00 - 2.20		Vo 0.0							
27/02/15 1700hrs Nil	12UT	2.50 - 2.95	2.00					2.50m: Tending to firm.			
	13D	2.95 - 3.05									
02/03/15 0800hrs Nil	14D	3.00 - 3.45	3.00	S 8							
	15B	3.00 - 3.50									
	16D*	3.00 - 3.50		Vo 0.1							
	17UT	3.50 - 3.95	3.50								
	18D	3.95 - 4.05							3.85	1.65	
	19D	4.00 - 4.45	4.00	S 7				Soft black fibrous PEAT. (PEAT)			
	20B	4.00 - 4.50									
	21D*	4.00 - 4.50		Vo 0.9							
	22UT	4.50 - 4.95	4.50								
	23D	4.95 - 5.05									
	24D	5.00 - 5.45	5.00	S 5							
	25B	5.00 - 5.50									
	26D*	5.00 - 5.50		Vo 0.0							
	27B	5.50 - 6.00									
	28UT	6.50 - 6.95	6.50					6.50 - 6.95m: Slightly sandy silty clay.			
	29D	6.95 - 7.05									
	30B	7.00 - 7.50									
									7.50	-2.00	
	31B	7.50 - 8.00						Very soft dark greenish grey and black peaty CLAY. (TFDP)			
	32D	8.00 - 8.45	8.00	S 1							
								Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.00m. Cable percussion (200mm) 1.00-2.00m and (150mm) 2.00-12.40m. Waterflush rotary core drilled (116mm) 12.40-18.50m.

CASING: 200mm diam to 2.00m and 150mm diam to 12.40m.

BACKFILL: On completion, hole backfilled with bentonite pellets18.50-0.80m and gravel 0.80-0.00m.

REMARKS: Downhole magnetometry for UXO risk mitigation undertaken 0.00-11.00m. No anomalies encountered.

Bentonite seal for aquifer protection installed during drilling 2.00m, prior to reduction in casing diameter.

Permeability test undertaken at 7.50m- 8.50m.

MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered.	30238	EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH518

CLIENT	WELSH GOVERNMENT					Sheet	2 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	27 February 2015	Easting	337320.0				
End Date	5 March 2015	Northing	185636.3	Ground level	5.50mOD	Depth	18.50 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	33B	8.00 - 8.50									
	34B	8.50 - 9.00						8.50 - 10.50m: Slightly sandy silty clay.			
	35UT	9.50 - 9.95	9.50								
	36B	10.00 - 10.50									
	37B	10.50 - 11.00						Stiff fissured reddish brown slightly gravelly CLAY. Gravel is subangular fine to coarse extremely weak mudstone lithorelicts. Fissures are subhorizontal and subvertical extremely closely spaced. (MMG) (Grade III)	10.50	-5.00	
	38D	11.00 - 11.45	11.00	S 40							
	39B	11.50 - 12.50									
02/03/15 1700hrs 3.95m	40D	12.50 - 12.73	12.30	S*100							
05/03/15 1010hrs 3.31m	41C	12.50 - 14.00			100 0 0	NA		12.70 - 12.80m: Light greenish grey.			
						NI		Extremely weak very thinly bedded reddish brown MUDSTONE. Fractures are subhorizontal to 20° and subvertical extremely closely spaced planar smooth. (MMG) (Grade II)	13.50	-8.00	
	42C	14.00 - 15.50	12.30		100 0 0						
	43C	15.50 - 17.00	12.30		100 0 0			16.70 - 16.80m: Light greenish grey.			
	44C	17.00 - 18.50	12.30		100 0 0						
						NA		Stiff fissured reddish brown slightly gravelly CLAY. Gravel is subangular fine to coarse extremely weak mudstone lithorelicts. Fissures subhorizontal and subvertical	17.40	-11.90	
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered.	30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

BH518

CLIENT	WELSH GOVERNMENT					Sheet	3 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	27 February 2015	Easting	337320.0				
End Date	5 March 2015	Northing	185636.3	Ground level	5.50mOD	Depth	18.50 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
05/03/15 1530hrs 2.23m									extremely closely spaced. (MMG) (Grade III)	18.50	-13.00	
									Borehole completed at 18.50m.	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
				Groundwater not encountered.

AGS

CONTRACT	CHECKED
30238	EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH519

CLIENT	WELSH GOVERNMENT					Sheet	1 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	17 February 2015	Easting	337455.8				
End Date	20 February 2015	Northing	185569.8	Ground level	5.85mOD	Depth	18.80 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
17/02/15 1500hrs	1B	0.20 - 0.50						Dark brown and black slightly sandy angular and subangular fine to coarse slag GRAVEL. (MG)			
	2D*	0.20 - 0.50									
17/02/15 1700hrs Dry	3B	0.50 - 0.80									
	4D*	0.50 - 0.80									
	5D	0.90 - 1.00							0.90	4.95	
18/02/15 0800hrs Dry	6UT	1.00 - 1.45	1.00					Very soft grey slightly sandy silty CLAY. (TFD)	1.00	4.85	
								Black locally grey slightly clayey fibrous PEAT. Organic odour. (PEAT)			
	7D	1.45 - 1.55									
	8B	1.55 - 2.00									
	9D*	1.50 - 2.00									
	10D	2.00 - 2.45	2.00	S 4							
	11B	2.50 - 3.00						2.50 - 3.00m: Amorphous peat.			
	12D*	2.50 - 3.00									
	13D	3.00 - 3.45	3.00	S 6							
	14B	3.50 - 4.00									
	15D*	3.50 - 4.00									
	16D	4.00 - 4.45	4.00	S 4							
	17B	4.50 - 5.00									
	18D	5.00 - 5.45	5.00	S 4					5.15	0.70	
	19B	5.00 - 5.50						Very soft dark grey mottled light grey silty CLAY. (TFD)			
	20D*	5.00 - 5.50									
	21B	5.50 - 6.00									
	UT	6.00 - 6.45	6.00								
	22B	6.50 - 7.00						6.50m: Tending to very silty fine sand.			
	24D	7.00 - 7.45	7.00	S 2							
	23B	7.00 - 7.50									
	25B	7.50 - 8.00									
									8.00 {8.00}	-2.15	

Continued Next Page

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.00m. Cable percussion (150mm) 1.00-13.00m. Dynamic sampled (113mm) 13.00-13.50m. Waterflush rotary core drilled (116mm) 13.50-18.80m. CASING: 200mm diam to 1.00m and 150mm diam to 12.40m.

BACKFILL: On completion, borehole backfilled with bentonite 18.80-11.20m. A slotted standpipe (50mm) with geo-sock was installed to 11.00m, granular response zone 11.20-6.80m, bentonite seal 6.80-4.20m. A second slotted standpipe (35mm) with geo-sock was installed to 4.00m, granular response zone 4.20-0.85m, bentonite seal 0.85-0.25m, concrete and stopcock cover 0.25-0.00m.

REMARKS: Hole advanced by chiselling 12.00-12.90m (1hr), 12.90-13.00m (1hr). Downhole magnetometry for UXO risk mitigation undertaken 0.00-11.00m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling 1.00m, prior to reduction in casing diameter. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks		CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	AGS	30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

BH519

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	2 of 3
Start Date	17 February 2015	Easting	337455.8	Scale	1 : 50
End Date	20 February 2015	Northing	185569.8 Ground level 5.85mOD	Depth	18.80 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	26D 27B	8.00 - 8.45 8.00 - 8.50	8.00	S 1				Very loose grey silty fine SAND with rare fragments (up to 2mm) of black organic material. (TFD)	8.50	-2.65	
18/02/15 1700hrs 5.80m	28B	8.50 - 9.00						Very soft grey silty CLAY with frequent pockets (up to 30mm) of dark brown peat and rare fragments (up to 10mm) of black organic material. Organic odour. (TFDP)			
19/02/15 0815hrs 3.10m											
	29D 30B	9.50 - 9.95 9.50 - 10.00	9.50	S 4					10.00	-4.15	
	31B 32B	10.00 - 10.50 10.50 - 11.00						Grey locally mottled red slightly sandy SILT with frequent pockets (up to 80mm) of spongy dark brown pseudofibrous peat and frequent fragments (up to 30mm) of black organic material. Rare subrounded coarse gravel of grey sandstone. Organic odour. (TFDP) 10.50 - 11.00m: Sandy very silty angular and subangular fine to coarse slag (?) gravel. 11.00 - 12.00m: Locally mottled red.			
	33D 34B	11.00 - 11.45 11.00 - 11.50	11.00	S 52					12.00	-6.15	
								Very stiff reddish brown silty CLAY. (MMG)			
19/02/15 1200hrs 7.35m	35D	12.50 - 12.95	12.40	S 50					13.00	-7.15	
19/02/15 1435hrs 2.70m	36X	13.00 - 13.50	12.40			NA		Very stiff fissured dark reddish brown locally mottled grey gravelly CLAY locally tending to extremely weak highly fractured mudstone with rare light greenish grey reduction spots (up to 30mm). Gravel is angular and subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical extremely closely spaced. (MMG) (Grade III)			
	37C	13.50 - 14.50	12.40		98						
	38C	14.50 - 16.00	12.40		96 6 0						
						90 NA		14.80 - 14.90m: Very weak reddish brown mottled grey mudstone.	15.10	-9.25	
						NI		Extremely weak and very weak highly fractured reddish brown MUDSTONE with frequent grey and greenish grey reduction spots (up to 20mm). Fractures are subhorizontal to 20° and subvertical extremely closely and very closely spaced planar smooth and rough frequently infilled (up to 5mm) with reddish brown clay. (MMG) (Grade II) 15.80 - 16.00m: Frequent pockets (up to 20mm) of light greenish grey clay. 16.50 - 16.60m: Very weak reddish brown calcareous mudstone.			
	39C	16.00 - 17.50	12.40		98 0 0						
19/02/15 1650hrs 2.20m								17.20 - 18.25m: Locally disintegrated to claybound angular fine to coarse gravel sized mudstone lithorelicts.			
20/02/15 0910hrs 2.67m	40C	17.50 - 18.80	12.40		100 5 0	70					
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

BH519

CLIENT	WELSH GOVERNMENT					Sheet	3 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	17 February 2015	Easting	337455.8				
End Date	20 February 2015	Northing	185569.8	Ground level	5.85mOD	Depth	18.80 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
							NI			18.25	-12.40	
20/02/15 1220hrs 2.48m							NA		Very stiff fissured reddish brown gravelly CLAY with frequent light greenish grey reduction spots (up to 20mm). Gravel is subangular fine and medium lithorelicts of very stiff clay and extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical extremely closely spaced. (MMG) (Grade III) 18.70 - 18.80m: Very weak highly fractured reddish brown mottled grey mudstone.	18.80	-12.95	
									Borehole completed at 18.80m.	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

WS501

CLIENT	WELSH GOVERNMENT						
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	1 of 2
Start Date	26 February 2015	Easting	337335.5			Scale	1 : 50
End Date	26 February 2015	Northing	185678.0	Ground level	12.15mOD	Depth	9.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range		instru -ment	description	depth (m)	reduced level (m)	legend
26/02/15 1400hrs	X	0.00 - 1.00	Nil					Grass over very soft black sandy clayey SILT. (MG)	0.20	11.95	
	1D*	0.00 - 0.20		Vo 0.0				Very soft black clayey SILT. (MG)			
	2D*	0.60 - 0.80		Vo 0.0							
	X	1.00 - 2.00	1.00								
	3D*	1.20 - 1.40		Vo 0.0							
	4D*	1.80 - 2.00									
	X	2.00 - 3.00	2.00								
	5D*	2.40 - 2.60									
	X	3.00 - 4.00	3.00								
	6D*	3.00 - 3.20									
	7D*	3.50 - 3.70									
	X	4.00 - 5.00	4.00								
	8D*	4.00 - 4.20									
	9D*	4.50 - 4.70									
	X	5.00 - 6.00	5.00								
	10D*	5.00 - 5.20									
	11D*	5.50 - 5.70									
	X	6.00 - 7.00	6.00								
	12D*	6.00 - 6.20									
	13D*	6.50 - 6.70							7.00	5.15	
	X	7.00 - 8.00	7.00					Soft black slightly sandy slightly gravelly clayey SILT. Gravel is subangular fine to coarse slag. (MG)			
	14D*	7.00 - 7.20									
	15D*	7.50 - 7.70									
								Continued Next Page	{8.00}		

EQUIPMENT: Geotechnical Terrier 2000 rig.

METHOD: Dynamic sampled (98mm) 0.00-8.00m and (84mm) 8.00-9.00m. Samples not retained.

CASING: 113mm diam to 7.00m.

BACKFILL: On completion, hole backfilled with materials arising.

REMARKS: Downhole magnetometry for UXO risk mitigation undertaken 0.00-1.20m. No anomalies encountered.

DPSH(B) test carried out adjacent to borehole in general accordance with BS EN ISO 22476-2:2005 + A1:2011, sacrificial cone used, reported as DPWS501.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered.	30238	EC

Geotechnical Engineering Limited

BOREHOLE LOG

WS501

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	2 of 2
Start Date	26 February 2015	Easting	337335.5	Scale	1 : 50
End Date	26 February 2015	Northing	185678.0 Ground level 12.15mOD	Depth	9.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range		instru -ment	description	depth (m)	reduced level (m)	legend
	X 16D*	8.00 - 9.00 8.00 - 8.20	7.00								
26/02/15 1700hrs Dry	17D*	8.70 - 8.90						Firm brown mottled bluish grey silty CLAY. (TFD)	8.70 9.00	3.45 3.15	
								Borehole completed at 9.00m.	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered.	30238	EC

Geotechnical Engineering Ltd, Tel. 01452 527743 30238 YODA.GPJ TRIALJH.GPJ GEOTECH.GLB 16/07/2015 16:13:36 TP EC

A3 Appendix 1c

Exploratory Records (Lagoon 27SW)

Borehole Log

Exploration Associates

Drilled by IH Logged by LM Checked by	Equipment and Methods Cable Percussion 150 mm diameter from 0.00m to 7.00m.	Ground Level + 4.96 m OD National Grid Coordinates E 337621.91 N 185568.04	

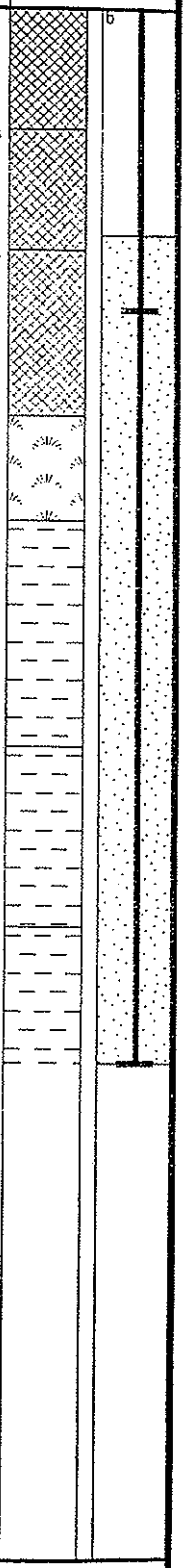
Samples and Tests

Depth	Type & No.	Records	Date Casing Water
			25/01/2002
1.90	ES1		
5.00	ES2		
			25/01/2002 dry
6.80	ES3		

Strata

Description	Depth,Level (Thickness)
Slag (DRILLERS DESCRIPTION).	(0.80)
	0.80 +4.16
Grey clayey SILT with slag (DRILLERS DESCRIPTION).	(0.80)
	1.60 +3.36
MADE GROUND : Soft dark brown grey sandy gravelly CLAY. Gravel is subangular and subrounded fine and medium of ash and clinker. Driller reports some peat.	(1.10)
	2.70 +2.26
PEAT (DRILLERS DESCRIPTION).	(0.70)
	3.40 +1.56
Green grey silty CLAY (DRILLERS DESCRIPTION).	(1.50)
	4.90 +0.06
Soft grey CLAY and black spongy pseudofibrous PEAT.	(1.20)
	6.10 -1.14
Soft grey CLAY.	(0.90pen)
EXPLORATORY HOLE ENDS AT 7.00 m.	7.00 -2.04

Legend



Groundwater
Not encountered during drilling.

Remarks
Chiselling : 0.40m to 0.60m 30minutes
Hole backfill : 0.00m to 1.50m Bentonite (b). Surface protection : <none>
Standpipe installed, 50mm diameter, response zone from 1.50m to 7.00m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole
LGBH9
Sheet 1 of 1

03/05/2002 11:11:45 ESGLog v2.10

Borehole Log

Exploration Associates

Drilled by	GR	Equipment and Methods	Ground Level + 12.24 m OD
Logged by	LM	Cable Percussion 150 mm diameter from 0.00m to 15.00m.	National Grid Coordinates E 337712.92 N 185594.87
Checked by			

Samples and Tests

Depth	Type & No.	Records	Date Casing	Time Water
			25/01/2002	
1.00	ES1			
			25/01/2002 3.50	dry
			28/01/2002 3.50	dry

Strata

Description	Depth,Level (Thickness)
MADE GROUND: Dark grey and brown sandy GRAVEL. Gravel is angular to subrounded fine to coarse of ash and slag.	(10.60)

Legend: c, b, g, 1

Groundwater

No.	Struck	Behaviour
1	7.50m	Rising to 7.40m after 20 mins.

Remarks

Chiselling : 1.00m to 3.50m 315minutes, 3.50m to 4.00m 60minutes, 4.20m to 4.60m 60minutes, 4.80m to 5.20m 60minutes, 6.00m to 6.50m 60minutes, 6.85m to 7.70m 30minutes
Hole backfill : 0.00m to 0.50m Concrete (c), 0.50m to 1.50m Bentonite (b), 1.50m to 10.00m Grout (g), 10.00m to 11.00m Bentonite (b). Surface protection : Stop Cock Cover
Standpipe installed, 50mm diameter, response zone from 11.00m to 15.00m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole **LGBH10**

Sheet 1 of 2

03/05/2002 11:10:27 ESGLog v2.10

Borehole Log

Exploration Associates

Drilled by GR Logged by LM Checked by	Equipment and Methods See sheet 1	Ground Level National Grid Coordinates	+ 12.24 m OD E 337712.92 N 185594.87

Samples and Tests / Strata

Depth	Type & No.	Records	Date Casing	Time Water	Description	Depth,Level (Thickness)	Legend
10.00	ES2				As sheet 1	(10.60)	
						10.60 +1.64	
11.50	ES3				Soft to firm light grey mottled brown slightly sandy CLAY with rare pockets of decaying plant matter.	(4.40pen)	
			28/01/2002 13.50				
			30/01/2002 13.50	11.00			
			30/01/2002				
15.00 15.00	ES4	kRH			EXPLORATORY HOLE ENDS AT 15.00 m.	15.00 -2.76	

Legend: b

Groundwater
No. Struck Behaviour

Remarks

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole
LGBH10
Sheet 2 of 2

03/05/2002 11:10:31 ESGLog v2.10

BOREHOLE No: BH 17

Client : Corus Ltd.	**Contractor :** Apex Drilling Ltd.	**Hole Coordinates :** E337622.996 N185579.20
Project : SSQ Landfill Llanwern	**Logged By :** AWJ	**Ground Level :** 5.310m AOD
Location : See site plan	**Date :** 03-04.10.05	**Hole Depth :** 11.50m **Sheet No :** 1 of 2

Depth (m)	Elevation	Geotechnical Description	Strata Symbol	Well Details (Shallow)	Well Details (Deep)	Samples: Sample Type	Samples: From	Samples: To	Samples: U100 Blows	Standard Penetration Tests: 75 mm	150 mm	225 mm	300 mm	375 mm	450 mm	N-Value / Rec %
0	0.00	Ground Surface														
	-0.50	**Made Ground** Dense dark grey and grey silty sandy fine to coarse angular gravel with many cobbles and occasional boulders, comprising of slag														
1		**Estuarine Alluvium** Firm becoming soft greyish brown becoming grey CLAY														
3	-3.90															
4		**Peat** Firm dark brown fibrous woody PEAT														
5																
6	-6.20															
		Estuarine Alluvium Soft grey CLAY with some fine to coarse sub-rounded gravel														
8																
9																
10																

Rig Type : Dando 150

Drilled By : MM

Hole Diameter (mm) : 200

Casing Depth (m) : 11.50m

Log Template File : GEOSA

Chiselling :

Remarks

1 Hole excavated by backhoe to base of upper clayand re-drilled through

2 Casing reduced to 150mm at 7m with bentonite seal

3 installed within 200mm casing.

4

5

BOREHOLE No: BH 17

Client : Corus Ltd.	**Contractor :** Apex Drilling Ltd.	**Hole Coordinates :** E337622.996 N185579.20
Project : SSQ Landfill Llanwern	**Logged By :** AWJ	**Ground Level :** 5.310m AOD
Location : See site plan	**Date :** 03-04.10.05	**Hole Depth :** 11.50m **Sheet No :** 2 of 2

Depth (m)	Elevation	Geotechnical Description	Strata Symbol	Well Details (Shallow)	Well Details (Deep)	Samples: Sample Type	Samples: From	Samples: To	Samples: U100 Blows	Standard Penetration Tests: 75 mm	150 mm	225 mm	300 mm	375 mm	450 mm	N-Value / Rec %
	-11.00															
11	-11.50	**Triassic Bedrock** Firm reddish brown CLAY with much fine to medium angular gravel, comprising of mudstone lithorelicts														
13																
14																
15																
16																
18																
19																
20																

Rig Type : Dando 150

Drilled By : MM

Hole Diameter (mm) : 200

Casing Depth (m) : 11.50m

Log Template File : GEOSA

Chiselling :

Remarks

1 Hole excavated by backhoe to base of upper clayand re-drilled through

2 Casing reduced to 150mm at 7m with bentonite seal

3 installed within 200mm casing.

4

5

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
SBHJ05
Header

Contract No.	F15056	Method	Cable Percussion & Rotary	Coordinates	337257.91 E 185693.20 N
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	Dando Tractor/Dando	Ground Level	13.24m AOD
Client	Transport Wales, Welsh Assembly Government	Drillers	MM/PW	Orientation	Vertical
		Logged by	DH	Date Started	17/12/2007
Consultant	Ove Arup & Partners Ltd	Core barrel	Cemetrix	Date Completed	13/01/2008
		Core bit	8 inch Hammer		

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
17/12/2007	1730	10.30	10.30	DRY	End of Shift
11/01/2008	0730	10.30	10.40	DRY	Start of Shift
11/01/2008	1730	10.70	10.70	DRY	End of Shift
12/01/2008	0730	10.70	10.70	DRY	Start of Shift
12/01/2008	1730	14.50	14.50	DRY	End of Shift
13/01/2008	0730	14.50	14.50	DRY	Start of Shift
13/01/2008	1730	20.50	19.50	DRY	End of Hole

CABLE PERCUSSION DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling Hours	Remarks
10.20	10.70	6.00	Chiselling
10.70	11.50	5.00	Chiselling
20.20	20.50	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	10.30	200	10.30
150	20.50	150	19.50

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
13/01/2008		14.80	14.80	NR	Seepage	14.80	NS

ROTARY DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
0.00	10.30	Air	Good	0*

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm	Casing	Water Depth
12.00	S	N=20 (3,4,4,5,5,6)	11.50	DRY
14.00	S	N=25 (4,5,5,6,7,7)	13.50	DRY
16.00	S	N=2 (1,1,0,1,0,1)	15.50	15.80
18.00	S	N=2 (1,0,1,0,1,0)	17.50	17.80
19.50	S	50/200mm (9,13,14,16,20)	19.00	DRY
20.50	S	50/20mm (25,50)	19.50	DRY

* Seating blows only.

GENERAL NOTES

1. Rotary Openhole cemetrix drilling from GL to 10.30m.
2. Cable Percussive boring from 10.20m to 20.50m.
3. 50mm standpipe installed, slotted from 9.50m to 11.50m.
4. 0.00* indicates openhole drilling.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, hard strata time in hours

Form	ARIAL COMBINED HEADER
Version	3.04
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
SBHJ05
Sheet 1 of 3

Contract No.	F15056	Method	Rotary & Cable Percussion	Coordinates	337257.91 E
Project	New M4 - Second Preliminary Ground Investigation				185693.20 N
		Drilling Rig	Dando Tractor/Dando	Ground Level	13.24m AOD
Client	Transport Wales, Welsh Assembly Government	Drillers	MM/PW	Orientation	Vertical
		Logged by	DH	Date Started	17/12/2007
Consultant	Ove Arup & Partners Ltd	Core Barrel	Cemetrix	Date Completed	13/01/2008
		Core Bit	8 inch Hammer		

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling & coring	Blow Count (TCR / SCR / RQD)	SPT type, N & depth	Install-ation
MADE GROUND: Ash and steel clinker. (Driller's description)							
		6.00	7.24				
MADE GROUND: Clay and gravel. (Driller's description)							

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL COMBINED LOG
Version	3.10
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
SBHJ05
Sheet 2 of 3

Contract No.	F15056	Method	Rotary & Cable Percussion	Coordinates	337257.91 E
Project	New M4 - Second Preliminary Ground Investigation				185693.20 N
		Drilling Rig	Dando Tractor/Dando	Ground Level	13.24m AOD
Client	Transport Wales, Welsh Assembly Government	Drillers	MM/PW	Orientation	Vertical
		Logged by	DH	Date Started	17/12/2007
Consultant	Ove Arup & Partners Ltd	Core Barrel	Cemetrix	Date Completed	13/01/2008
		Core Bit	8 inch Hammer		

Description of Strata	Depth Below G.L.	Datum Level	Sampling & coring		Blow Count (TCR / SCR / RQD)	SPT type, N & depth	
MADE GROUND: Clay and gravel. (Driller's description)	10.20	3.04					
MADE GROUND: Very compact slag fill with large fragments. (Driller's description)			ES1	11.30			
Brownish grey silty CLAY. (Estuarine Alluvium)	11.50	1.74	ES1 D2 U3	11.50 11.50 11.50-11.95	(21)		
---from 12.00m firm to stiff			D4 D5	12.00 12.00		S20 12.00	12.45
			ES6 B7	12.50 12.50			
			D8	13.00			
Firm brown fibrous PEAT. (Peat)	13.50	-0.26	ES9 U10	13.50 13.50-13.95	(32)		
			D11 D12	14.00 14.00		S25 14.00	14.45
			D13 ES14	14.50 14.50			
Grey slightly silty sandy CLAY with very closely spaced fine to coarse gravel sized pockets of pseudofibrous locally amorphous peat. Sand is fine. (Estuarine Alluvium)	14.80	-1.56					
			D15 ES16 U17	15.50 15.50 15.50	(6)		
			D18 D19	16.00 16.00		S2 16.00	16.45
			ES20	16.50			
			D21 B22	17.00 17.00-17.50			
Grey slightly sandy SILT. Sand is fine to medium	17.50	-4.26	U23	17.50	(5)		
			D24 D25	18.00 18.00		S2 18.00	18.53
Stiff reddish brown mottled grey slightly gravelly clay. Gravel is angular fine to coarse (Weathered Mudstone). (Mercia Mudstone Group)	18.90	-5.66	D26 U27	19.00 19.00	(110)		
---from 19.50m very stiff			D28 D29	19.50 19.50		S50/200mm 19.50	19.85

Install-ation

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL COMBINED LOG
Version	3.10
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
SBHJ05
Sheet 3 of 3

Contract No.	F15056	Method	Rotary & Cable Percussion	Coordinates	337257.91 E
Project	New M4 - Second Preliminary Ground Investigation				185693.20 N
		Drilling Rig	Dando Tractor/Dando	Ground Level	13.24m AOD
Client	Transport Wales, Welsh Assembly Government	Drillers	MM/PW	Orientation	Vertical
		Logged by	DH	Date Started	17/12/2007
Consultant	Ove Arup & Partners Ltd	Core Barrel	Cemetrix	Date Completed	13/01/2008
		Core Bit	8 inch Hammer		

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling & coring		Blow Count TCR	SCR	RQD		SPT type, N & depth	Install-ation
Stiff reddish brown mottled grey slightly gravelly clay. Gravel is angular fine to coarse (Weathered Mudstone). (Mercia Mudstone Group)				D30	20.00						
		20.50	-7.26	D31	20.50					S50/20mm 20.50 20.55	
Borehole complete at 20.50 m.											

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL COMBINED LOG
Version	3.10
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ06 CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	337599.88 E
Project	New M4 - Second Preliminary Ground Investigation				185578.07 N
		Drilling Rig	Dando	Ground Level	6.18m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	15/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	17/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
15/01/2008	1730	4.50	3.50	DRY	End of Shift
16/01/2008	0730	4.50	3.50	4.30	Start of Shift
16/01/2008	1730	12.50	12.00	7.20	End of Shift
17/01/2008	0730	12.50	12.00	3.20	Start of Shift
17/01/2008	1730	14.90	13.00	7.60	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
14.30	14.60	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	1.50	200	1.50
150	14.90	150	13.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Falling head test conducted from 4.00m to 5.00m.
2. Cable Percussive boring from GL to 14.90m.
3. 50mm standpipe installed, slotted from 3.10m to 4.10m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
1.50	S	N=8 (1,1,2,2,2,2)	1.70	DRY
2.70	S	N=7 (1,1,2,2,1,2)	2.00	DRY
4.00	S	N=9 (1,2,2,2,2,3)	3.30	DRY
6.00	S	N=6 (1,2,1,2,1,2)	5.30	1.80
8.00	S	N=6 (1,1,1,1,2,2)	7.30	4.80
10.00	S	N=8 (1,1,2,2,2,2)	9.20	6.20
12.00	S	N=21 (2,3,4,5,6,6)	11.40	7.60
13.10	S	50/150mm (9,12,19,27,4)	12.50	3.50
14.00	S	50/155mm (5,11,12,24,14)	13.00	4.70
14.60	S	50/155mm (10,14,19,26,5)	13.00	7.60

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

Form	ARIAL CP HEADER
Version	3.05
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ06 CP
Sheet 1 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	337599.88 E
Project	New M4 - Second Preliminary Ground Investigation				185578.07 N
		Drilling Rig	Dando	Ground Level	6.18m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	15/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	17/01/2008

Description of Strata	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Slag and stone. (Driller's description)			ES1	0.30				
	0.60	5.58						
Stiff orangish brown grey mottled slightly sandy slightly gravelly CLAY with occasional rootlets. Sand is fine. Gravel is angular fine of mudstone (Estuarine Alluvium)			D2 ES3 U4	0.70 1.00 1.00 - 1.45				
	1.50	4.68	D5 D6	1.50 1.50 - 1.95	S8	S	1.50	1.95
Soft dark grey CLAY. (Estuarine Alluvium)								
	2.00	4.18	ES7 D8 U9	2.00 2.10 2.20 - 2.65	(10)			
Plastic dark brown amorphous PEAT. (Peat)								
	2.46	3.72						
Firm greenish grey silty CLAY with occasional organic fragments. (Organic odour) (Estuarine Alluvium)			D10 D11 ES12	2.70 2.70 - 3.15 3.00	S7	S	2.70	3.15
	3.30	2.88	D13 U14	3.40 3.50 - 3.95	(9)			
Plastic dark brown amorphous PEAT. (Peat)								
	3.70	2.48						
Soft to firm greenish grey silty CLAY with closely spaced medium to coarse gravel sized pockets of light brown fibrous peat (Organic odour). (Estuarine Alluvium)			D15 ES16 D17 B18 ES19	4.00 4.00 4.00 - 4.45 4.50 - 5.00 5.00	S9	S	4.00	4.45
	5.30	0.88	D20 U21	5.40 5.50 - 5.95	(10)			
Plastic brown pseudofibrous PEAT. (Peat)								
---from 6.00m becomes spongy	6.10	0.08	D22 D23	6.00 6.00 - 6.45	S6	S	6.00	6.45
Very soft grey silty CLAY. (Estuarine Alluvium)			D24	7.00				
			U25	7.50 - 7.95	(9)			
---from 8.00m to 8.50m with occasional fine to medium gravel sized shell fragments			D26 D27 B28	8.00 8.00 - 8.45 8.50 - 9.00	S6	S	8.00	8.45
			U29	9.50 - 9.95				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ06 CP
Sheet 2 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	337599.88 E
Project	New M4 - Second Preliminary Ground Investigation				185578.07 N
		Drilling Rig	Dando	Ground Level	6.18m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	15/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	17/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Very soft grey silty CLAY. (Estuarine Alluvium) ---from 10.00m becomes slightly sandy. Sand is fine				D30 D31	10.00 10.00 - 10.45	S8	S	10.00 10.45	
		11.00	-4.82	D32	11.00				
Very soft to soft grey silty CLAY with closely spaced coarse gravel sized pockets of black pseudofibrous peat. (Estuarine Alluvium)				U33	11.50 - 11.95	(70)			
		11.95	-5.77	B34 D35	12.00 12.00 - 12.45	S21	S	12.00 12.45	
Soft brownish grey slightly sandy CLAY with occasional angular cobbles of sandstone. Sand is fine to medium. (Estuarine Alluvium)									
		12.50	-6.32						
Very stiff reddish brown locally mottled greenish grey sandy slightly gravelly CLAY. Gravel is angular fine to medium (Weathered Mudstone). (Mercia Mudstone Group)				U36	12.70 - 13.05				
				D37 D38	13.10 13.10 - 13.55	S50/150mm	S	13.10 13.40	
				D39	13.80				
				D40	14.00 - 14.30	S50/155mm	S	14.00 14.31	
				D41	14.60 - 14.90	S50/155mm	S	14.60 14.91	
		14.90	-8.72						
Cable Percussion boring complete at 14.90 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ07 CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	337711.12 E
Project	New M4 - Second Preliminary Ground Investigation				185569.62 N
		Drilling Rig	Dando	Ground Level	5.79m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	12/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	14/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
12/01/2008	1730	3.00	2.80	DRY	End of Shift
13/01/2008	0730	3.00	2.80	2.60	Start of Shift
13/01/2008	1730	10.00	9.20	5.50	End of Shift
14/01/2008	0730	10.00	9.20	4.10	Start of Shift
14/01/2008	1730	13.00	11.50	9.30	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
0.50	0.70	2.00	Chiselling
12.70	13.00	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	1.70	200	1.70
150	13.30	150	11.50

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Cable Percussive boring from GL to 13.00m.
2. 50mm standpipe installed, slotted from 8.40m to 10.40m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
1.00	S	N=13 (2,2,3,4,3,3)	1.00	0.80
2.00	S	N=7 (1,2,1,2,2,2)	1.90	DRY
4.00	S	N=9 (1,1,2,2,2,3)	3.30	3.30
6.00	S	N=4 (1,0,1,1,1,1)	5.40	4.10
8.00	S	N=3 (1,0,1,0,1,1)	7.30	5.00
10.00	S	N=7 (1,0,0,1,2,4)	9.30	4.20
11.20	S	N=46 (5,7,9,10,13,14)	11.50	6.10
12.30	S	50/235mm (7,11,12,16,18,4)	11.50	8.60
13.00	S	50/190mm (8,13,15,19,16)	11.50	9.30

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

Form	ARIAL CP HEADER
Version	3.05
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ07 CP
Sheet 1 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	337711.12 E
Project	New M4 - Second Preliminary Ground Investigation				185569.62 N
		Drilling Rig	Dando	Ground Level	5.79m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	12/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	14/01/2008

Description of Strata	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Slag, stone. (Driller's description)			ES1	0.30				
	0.50	5.29	B2	0.50 - 1.00				
MADE GROUND: Grey slightly gravelly clay. Gravel sized fragments are angular fine to coarse of slag and sandstone.			ES3	1.00	S13	S	1.00	
			D4	1.00 - 1.45			1.45	
			U5	1.50 - 1.95	(11)			
---from 2.00m with frequent coarse gravel sized pockets of brown pseudofibrous peat			D6	2.00	S7	S	2.00	
			ES7	2.00			2.45	
			D8	2.00 - 2.45				
			ES7	2.20				
			B9	2.50 - 3.00				
			ES10	3.00				
			U11	3.50 - 3.95	(11)			
	4.00	1.79	D12	4.00	S9	S	4.00	
Spongy brownish black pseudofibrous PEAT. (Peat)			ES13	4.00			4.45	
---from 4.20m becomes plastic			D14	4.00 - 4.45				
---from 4.20m to 4.45m with occasional coarse gravel sized pockets of grey silt								
---from 4.45m to 5.70m with occasional pockets of brown pseudofibrous peat			D15	5.00				
			ES16	5.00				
			U17	5.50 - 5.95	(10)			
	5.86	-0.07						
Very soft grey silty CLAY with occasional coarse gravel sized pockets of black pseudofibrous peat and occasional gravel sized organic fragments. (Estuarine Alluvium)			D18	6.00	S4	S	6.00	
			D19	6.00 - 6.45			6.53	
	7.00	-1.21	B20	7.00 - 7.50				
Extremely low strength grey slightly clayey slightly sandy SILT. (Estuarine Alluvium)			U21	7.50 - 7.95				
			D22	8.00	S3	S	8.00	
			D23	8.00 - 8.45			8.53	
---from 9.00m becomes slightly sandy. Sand is fine			D24	9.00				
			U25	9.50 - 9.95	(6)			

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ07 CP
Sheet 2 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	337711.12 E
Project	New M4 - Second Preliminary Ground Investigation				185569.62 N
		Drilling Rig	Dando	Ground Level	5.79m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	12/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	14/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Stiff reddish brown locally mottled greenish grey slightly gravelly clay. Gravel is angular to subangular fine to coarse mudstone (Weathered Mudstone). (Mercia Mudstone Group)		10.00	-4.21	D26	10.00	S7	S	10.00	
				D27	10.00 - 10.45			10.53	
---from 10.00m to 11.20m firm				D28	10.50				
				D30	11.20	S46	S	11.20	
				D31	11.20 - 11.45			11.65	
				D32	12.00				
---from 12.00m very stiff				D33	12.30 - 12.70	S50/235mm	S	12.30	
								12.69	
				D34	13.00 - 13.30	S50/190mm	S	13.00	
								13.34	
		13.30	-7.51						
Cable Percussion boring complete at 13.30 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHJ07 RC
Header

Contract No.	F15056	Method	Rotary Openholing	Coordinates	337708.07 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	Dando Tractor		185608.64 N
		Driller	ME	Ground Level	12.71m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	ME	Orientation	Vertical
		Core barrel	-	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd	Core bit	8 Inch Hammer	Date Completed	13/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
13/12/2007	1100	6.20	6.20	DRY	End of Hole

DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
0.00	6.20	Air	Good	0.00*

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	6.20	200	6.20

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Rotary Openhole cemetrix drilling from GL to 6.20m.
2. Borehole terminated at 6.20m due to obstruction.
3. Refer to SBHJ07A RC for redrill.
4. 0.00* indicates openhole drilling.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes.

Form	ARIAL ROTARY HEADER
Version	3.06
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHJ07 RC
Sheet 1 of 1

Contract No.	F15056	Method	Rotary Openholing	Coordinates	337708.07 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	Dando Tractor		185608.64 N
		Driller	ME	Ground Level	12.71m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	ME	Orientation	Vertical
		Core barrel	-	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd	Core bit	8 Inch Hammer	Date Completed	13/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling	TCR	SCR	RQD		SPT N & depth	Install-ation
IRON/STEEL SLAG. (Driller's description)										
		6.20	6.51							
Rotary drilling complete at 6.20 m.										

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL ROTARY LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHJ07A RC
Header

Contract No.	F15056	Method	Rotary Openholing	Coordinates	337707.69 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	Dando Tractor		185607.02 N
		Driller	ME	Ground Level	12.73m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	ME	Orientation	Vertical
		Core barrel	-	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd	Core bit	8 Inch Hammer	Date Completed	13/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
13/12/2007	1430	6.20	6.20	DRY	End of Hole

DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
0.00	6.20	Air	Good	0.00*

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	6.20	200	6.20

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Rotary Openhole cemetrix drilling from GL to 6.20m.
2. Borehole terminated at 6.20m due to obstruction.
3. Refer to SBHJ07B RC for redrill.
4. 0.00* indicates openhole drilling.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes.

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Version	3.06
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHJ07A RC
Sheet 1 of 1

Contract No.	F15056	Method	Rotary Openholing	Coordinates	337707.69 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	Dando Tractor		185607.02 N
		Driller	ME	Ground Level	12.73m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	ME	Orientation	Vertical
		Core barrel	-	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd	Core bit	8 Inch Hammer	Date Completed	13/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling	TCR	SCR	RQD		SPT N & depth	Install-ation
IRON/STEEL and SLAG. (Driller's description)										
		6.20	6.53							
Rotary drilling complete at 6.20 m.										

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL ROTARY LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHJ07B RC
Header

Contract No.	F15056	Method	Rotary Openholing	Coordinates	337708.26 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	Dando Tractor		185601.09 N
		Driller	ME	Ground Level	12.71m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	ME	Orientation	Vertical
		Core barrel	-	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd	Core bit	8 Inch Hammer	Date Completed	13/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
13/12/2007	1730	6.20	6.20	DRY	End of Hole

DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
0.00	6.20	Air	Good	0.00*

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	6.20	200	6.20

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Rotary Openhole cemetrix drilling from GL to 6.20m.
2. Borehole terminated at 6.20m due to obstruction.
3. Borehole moved to east of bund, see SBHJ07 CP for details.
4. 0.00* indicates openhole drilling.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes.

Form	ARIAL ROTARY HEADER
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - ROTARY

Hole ID.
SBHJ07B RC
Sheet 1 of 1

Contract No.	F15056	Method	Rotary Openholing	Coordinates	337708.26 E
Project	New M4 - Second Preliminary Ground Investigation	Drilling Rig	Dando Tractor		185601.09 N
		Driller	ME	Ground Level	12.71m AOD
Client	Transport Wales, Welsh Assembly Government	Logged by	ME	Orientation	Vertical
		Core barrel	-	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd	Core bit	8 Inch Hammer	Date Completed	13/12/2007

Description of Strata	Legend	Drilled Length	Datum Level	Coring and Sampling	TCR	SCR	RQD		SPT N & depth	Install-ation
IRON/STEEL SLAG. (Driller's description)										
		6.20	6.51							
Rotary drilling complete at 6.20 m.										

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL ROTARY LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ31
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337607.95 E
Project	New M4 - Second Preliminary Ground Investigation				185627.00 N
		Drilling Rig	Terrier	Ground Level	10.34m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	14/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	14/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
14/01/2008		6.45	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
14/01/2008		2.30	2.30	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 6.45m.
2. Window Sampling complete at 6.45m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=0 (0,0,0,0,0,0)
2.00	S	N=0 (0,0,0,0,0,0)
3.00	S	N=0 (1,0,0,0,0,0)
4.00	S	N=0 (1,0,0,0,0,0)
5.00	S	N=8 (2,2,2,2,2,2)
6.00	S	N=6 (1,1,1,2,1,2)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
Version	3.03
Revised	19/01/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ31
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337607.95 E
Project	New M4 - Second Preliminary Ground Investigation				185627.00 N
		Drilling Rig	Terrier	Ground Level	10.34m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	14/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	14/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Black slightly sandy clayey silt.				L1	0.00 - 0.80				
				ES2 D3 L4	1.00 1.00 - 1.45 1.00 - 1.80	S0	S	1.00 1.60	
				ES5 D6 L7	2.00 2.00 - 2.45 2.00 - 2.80	S0	S	2.00 2.60	
				ES8 D9 L10	3.00 3.00 - 3.45 3.00 - 3.70	S0	S	3.00 3.53	
				ES11 D12 L13	4.00 4.00 - 4.45 4.00 - 4.70	S0	S	4.00 4.53	
		4.90	5.44						
MADE GROUND: Grey slightly sandy clayey silt.				ES14 D15	5.00 5.00 - 5.45	S8	S	5.00 5.45	
				D16	6.00 - 6.45	S6	S	6.00 6.45	
		6.45	3.89						
Sampling complete at 6.45 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ32
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337639.54 E
Project	New M4 - Second Preliminary Ground Investigation				185665.63 N
		Drilling Rig	Terrier	Ground Level	10.27m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	15/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	15/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
15/01/2008		8.45	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
15/01/2008		2.30	2.30	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 8.45m.
2. Window Sampling complete at 8.45m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=0 (0,0,0,0,0,0)
2.00	S	N=0 (0,0,0,0,0,0)
3.00	S	N=0 (0,0,0,0,0,0)
4.00	S	N=0 (1,0,0,0,0,0)
5.00	S	N=0 (0,0,0,0,0,0)
6.00	S	N=0 (0,0,0,0,0,0)
7.00	S	N=5 (1,2,1,2,2,0)
8.00	S	N=6 (1,2,2,1,2,1)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
Version	3.03
Revised	19/01/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ32
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337639.54 E
Project	New M4 - Second Preliminary Ground Investigation				185665.63 N
		Drilling Rig	Terrier	Ground Level	10.27m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	15/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	15/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Black slightly clayey slightly sandy clayey silt.				L1	0.00 - 0.80				
				ES2 D3 L4	1.00 1.00 - 1.45 1.00 - 1.80	S0	S	1.00 1.60	
MADE GROUND: Brown slightly sandy clayey silt.		2.00	8.27	ES5 D6 L7	2.00 2.00 - 2.45 2.00 - 2.80	S0	S	2.00 2.60	
				ES8 D9 L10	3.00 3.00 - 3.45 3.00 - 3.80	S0	S	3.00 3.60	
				ES11 D12 L13	4.00 4.00 - 4.45 4.00 - 4.80	S0	S	4.00 4.53	
				ES14 D15	5.00 5.00 - 5.45	S0	S	5.00 5.60	
				ES16 D17 L18	6.00 6.00 - 6.45 6.00 - 6.80	S0	S	6.00 6.60	
				ES19 D20	7.00 7.00 - 7.45	S5	S	7.00 7.45	
				ES21 D22	8.00 8.00 - 8.45	S6	S	8.00 8.45	
Sampling complete at 8.45 m.		8.45	1.82						

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ33
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337668.11 E
Project	New M4 - Second Preliminary Ground Investigation				185620.46 N
		Drilling Rig	Terrier	Ground Level	9.17m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	16/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	16/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
16/01/2008		6.45	NR	0.00	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
16/01/2008		2.00	2.00	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 6.45m.
2. Window Sampling complete at 6.45m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=0 (0,0,0,0,0,0)
2.00	S	N=1 (0,0,0,0,0,1)
3.00	S	N=1 (0,0,1,0,0,0)
4.00	S	N=0 (0,0,0,0,0,0)
5.00	S	N=0 (0,0,0,0,0,0)
6.00	S	N=2 (0,0,0,0,1,1)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
Version	3.03
Revised	19/01/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ33
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337668.11 E
Project	New M4 - Second Preliminary Ground Investigation				185620.46 N
		Drilling Rig	Terrier	Ground Level	9.17m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	16/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	16/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth			Install-ation
MADE GROUND: Dark grey silty very clayey fine sand.				L1	0.00 - 0.80					
---from 0.60m with very closely spaced coarse gravel sized pockets of plastic dark brown amorphous peat		0.80	8.37							
MADE GROUND: Black slightly clayey slightly sandy silt.				ES2 D3	1.00 1.00 - 1.45	S0	S	1.00	1.60	
				ES4 D5 L6	2.00 2.00 - 2.45 2.00 - 2.80	S1	S	2.00	2.60	
				ES7 D8 L9	3.00 3.00 - 3.45 3.00 - 3.70	S1	S	3.00	3.60	
				ES10 D11	4.00 4.00 - 4.45	S0	S	4.00	4.60	
				D12	5.00 - 5.45	S0	S	5.00	5.60	
				D13	6.00 - 6.45	S2	S	6.00	6.60	
Soft grey CLAY. (Estuarine Alluvium)		6.30	2.87							
Sampling complete at 6.45 m.		6.45	2.72							

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ34
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337692.22 E
Project	New M4 - Second Preliminary Ground Investigation				185704.76 N
		Drilling Rig	Terrier	Ground Level	10.52m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	16/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	17/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
16/01/2008	1730	2.00	0.00	NR	End of Shift
17/01/2008	0730	2.00	0.00	NR	Start of Shift
17/01/2008	1730	6.45	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 6.45m.
2. Window Sampling complete at 6.45m.
3. 50mm standpipe installed, slotted from 6.00m to 3.00m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=0 (0,0,0,0,0,0)
2.00	S	N=1 (0,0,0,1,0,0)
3.00	S	N=0 (0,0,0,0,0,0)
4.00	S	N=2 (1,0,1,0,0,1)
5.00	S	N=1 (1,0,0,1,0,0)
6.00	S	N=2 (1,0,1,0,1,0)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
Version	3.03
Revised	19/01/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ34
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337692.22 E
Project	New M4 - Second Preliminary Ground Investigation				185704.76 N
		Drilling Rig	Terrier	Ground Level	10.52m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	16/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	17/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth			Install-ation
MADE GROUND: Black slightly clayey slightly sandy silt.				L1	0.00 - 0.80					
				ES2 D3 L4	1.00 1.00 - 1.45 1.00 - 1.80	S0	S	1.00	1.60	
---from 2.00m sandy				ES5 D6 L7	2.00 2.00 - 2.45 2.00 - 2.80	S1	S	2.00	2.60	
MADE GROUND: Brown slightly sandy clayey silt.		3.00	7.52	ES8 D9 L10	3.00 3.00 - 3.45 3.00 - 3.80	S0	S	3.00	3.60	
				ES11 D12 L13	4.00 4.00 - 4.45 4.00 - 4.80	S2	S	4.00	4.53	
				ES14 D15 L16	5.00 5.00 - 5.45 5.00 - 5.80	S1	S	5.00	5.53	
				ES17 D18	6.00 6.00 - 6.45	S2	S	6.00	6.53	
Sampling complete at 6.45 m.		6.45	4.07							

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Geotechnical Engineering Limited

BOREHOLE LOG

BH520

CLIENT	WELSH GOVERNMENT					Sheet	1 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	12 February 2015	Easting	337642.0			Depth	19.16 m
End Date	24 February 2015	Northing	185597.3	Ground level	12.85mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range		instru -ment	description	depth (m)	reduced level (m)	legend
12/02/15 1500hrs								Dense and very dense black and dark grey mottled green clayey sandy subangular fine to coarse slag and crystalline GRAVEL with low cobble content. (MG)			
	1B	0.20 - 0.50									
	2B	0.50 - 1.00									
	3D*	0.50 - 0.60									
		1.00 - 1.00	1.00	C**							
	4B	1.00 - 1.50									
	5D*	1.00 - 1.10									
	6B	1.50 - 2.00									
12/02/15 1700hrs Dry	7D*	1.50 - 1.60									
		2.00 - 2.45	2.00	C 36							
13/02/15 0800hrs Dry	8B	2.00 - 2.50									
	9D*	2.00 - 2.10									
		2.50 - 2.95	2.50	C 39							
	10B	2.50 - 3.00									
	11D*	2.50 - 2.60									
								3.10 - 3.50m: Driller notes slag boulder.			
									3.50	9.35	
		3.50 - 3.95	3.50	C 39				Dense and very dense black sandy subangular fine to coarse slag and crystalline GRAVEL with low subangular slag cobble content. (MG)			
	12B	4.00 - 4.50									
		4.50 - 4.50	4.50	C**							
	13B	4.50 - 5.00									
		5.00 - 5.45	5.00	C 38				4.90m: Driller notes slag boulder. 4.90 - 7.00m: Driller notes fragments of metal.			
	14B	6.00 - 6.50									
		6.50 - 6.95	5.00	C 34							
13/02/15 1700hrs 4.75m	15B	6.50 - 7.00									
16/02/15 0830hrs 5.90m											
		7.50 - 7.95	7.50	C 32							
								Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.00m. Cable percussion (200mm) 1.00-12.20m. Dynamic sampled (113mm) 12.20-14.50m. Borehole advanced by reaming casing (140mm) 14.50-15.00m to recover vane. Dynamic sampled (113mm) 15.00-18.40m and (98mm) 18.40-18.90m.

CASING: 200mm diam to 11.00m.

BACKFILL: On completion, hole backfilled with bentonite pellets 19.16-0.50m, gravel 0.50-0.20m and arisings 0.20-0.00m.

REMARKS: Hole advanced by chiselling 1.00-1.30m (45mins), 3.10-3.50m (1hr), 4.50-4.90m (1hr), 7.00-7.50m (1hr), 8.50-9.00m (1hr) and 10.00-11.50m (2hr 45mins). Water added to assist boring 2.50-11.00m (23 litres used).

Vane test attempted at 14.80m. Rods parted, test aborted.

MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks		CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	AGS	30238	EC

Geotechnical Engineering Ltd, Tel. 01452 527743 30238 YODA.GPJ TRIALJH.GPJ GEOTECH.GLB 16/07/2015 16:02:26 RM EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH520

CLIENT	WELSH GOVERNMENT					Sheet	2 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	12 February 2015	Easting	337642.0				
End Date	24 February 2015	Northing	185597.3	Ground level	12.85mOD	Depth	19.16 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range		instru -ment	description	depth (m)	reduced level (m)	legend
	16B	8.00 - 8.50									
		9.00 - 9.45	9.00	C 21				9.00m: Medium dense.			
									10.00	2.85	
	17B	10.00 - 10.50						Very dense black sandy subangular fine to coarse slag and crystalline GRAVEL with low subangular slag cobble content and frequent wood fragments (up to 5mm). (MG)			
		10.50 - 10.54	10.50	C*375							
16/02/15 1600hrs 10.60m	18B	10.50 - 11.00									
17/02/15 0830hrs 8.10m											
									11.50	1.35	
	19B	11.50 - 12.20	11.00					Firm dark grey slightly sandy slightly gravelly CLAY with frequent plant and wood fragments (up to 5mm). (MG)			
17/02/15 1200hrs 8.10m											
									12.20	0.65	
23/02/15 1050hrs 9.01m	20P	12.20 - 13.00	11.80					Dark grey locally mottled black slightly sandy peaty CLAY with frequent plant fragments (up to 3mm). (TFDP)			
	21X	12.20 - 13.50			P/S						
	22D*	12.30 - 12.40									
									12.85	0.00	
								Firm dark brown fibrous PEAT. (PEAT)			
	23P	13.50 - 14.00	13.00		P/S						
	24D	14.00 - 14.45	13.00	S 10							
23/02/15 1730hrs 8.84m	25X	14.00 - 14.50									
									14.30	-1.45	
								Firm dark grey mottled black organic clayey SILT. (TFD)			
24/02/15 0845hrs 8.64m	26D*	14.50 - 14.60						14.50 - 15.20m: No recovery.			
	27P	15.20 - 16.00	15.00								
	28X	15.20 - 16.60			P/S						
	29P	16.60 - 17.40	16.60					16.60 - 17.40m: Rare rootlets and shell fragments.			
					P/S						
	30D	17.40 - 17.85	16.60	S 19							
	31X	17.40 - 18.40						17.40 - 17.60m: Tending to mottled black and brown silty clay.	17.50	-4.65	
	32D*	17.40 - 17.50							17.85	-5.00	
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	30238	EC

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Geotechnical Engineering Limited

BOREHOLE LOG

BH520

CLIENT	WELSH GOVERNMENT					Sheet	3 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	12 February 2015	Easting	337642.0				
End Date	24 February 2015	Northing	185597.3	Ground level	12.85mOD	Depth	19.16 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range		instru -ment	description	depth (m)	reduced level (m)	legend
	33X	18.40	18.90	16.60					Stiff fissured reddish brown mottled dark grey silty CLAY. Fissures are randomly orientated closely spaced planar smooth. (MMG) (Grade IVb)			
	34D*	18.40	18.50						Stiff fissured greenish grey gravelly silty CLAY. Gravel is subangular fine and medium lithorelicts of extremely weak siltstone. Fissures are randomly orientated closely spaced planar smooth. (MMG) (Grade III)	18.80	-5.95	
24/02/15 1420hrs 11.53m	35D	18.90	19.16	16.60	S*111					19.16	-6.31	
									Hard fissured reddish brown gravelly CLAY. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone. Fissures are randomly orientated very closely spaced planar smooth. (MMG) (Grade III)			
									Borehole completed at 19.16m.			
										{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	30238	EC

A4 Appendix 1d

Exploratory Records (Lagoon 27SE)

Borehole Log

Exploration Associates

Drilled by IH Logged by CW Checked by	Equipment and Methods Cable Percussion 150 mm diameter from 0.00m to 7.00m.	Ground Level + 5.10 m OD National Grid Coordinates E 337828.21 N 185570.66	

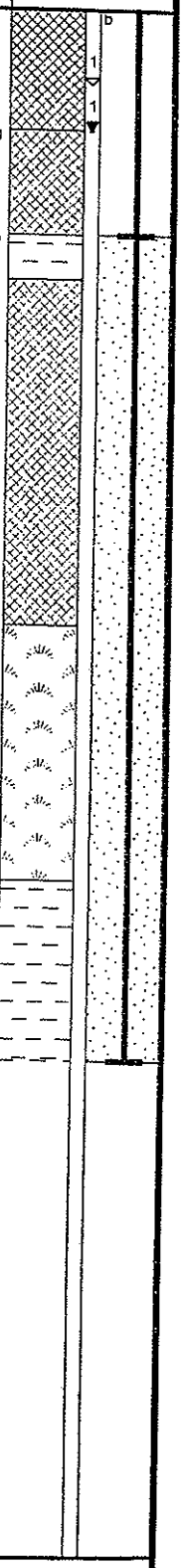
Samples and Tests

Depth	Type & No.	Records	Date Casing	Time Water
			24/01/2002	
0.90	ES1			
2.00	ES2			
4.50	ES3			
6.80 7.00	ES4	kRH	24/01/2002	

Strata

Description	Depth,Level (Thickness)
Slag (DRILLERS DESCRIPTION).	(0.80)
MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY. Gravel is angular and subangular fine and medium of slag.	0.80 +4.30 (0.70)
Grey brown silty CLAY with gravels and peat (DRILLERS DESCRIPTION).	1.50 +3.60 (0.30)
MADE GROUND: Dark brown sandy slightly gravelly CLAY. Gravel is subangular fine and medium of slag and clinker.	1.80 +3.30 (2.30)
Dark brown spongy fibrous PEAT with occasional soft dark grey SILT pockets.	4.10 +1.00 (1.70)
Soft grey CLAY.	5.80 -0.70 (1.20pen)
EXPLORATORY HOLE ENDS AT 7.00 m.	7.00 -1.90

Legend



Groundwater

No.	Struck	Behaviour
1	0.80m	Rising to 0.50m after 20 mins. Sealed 2.60. Medium inflow

Remarks

Chiselling : 0.40m to 0.70m 90minutes
Hole backfill : 0.00m to 1.50m Bentonite (b). Surface protection : <none>
Standpipe installed, 50mm diameter, response zone from 1.50m to 7.00m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole
LGBH12
Sheet 1 of 1

03/05/2002 11:10:50 ESGLog v2.10

BOREHOLE No: BH 18

Client : Corus Ltd.	**Contractor :** Apex Drilling Ltd.	**Hole Coordinates :** E337753.801 N185903.401
Project : Queensway Landfill	**Logged By :** AWJ	**Ground Level :** 6.659m AOD
Location : See site plan	**Date :** 20-21.09.05	**Hole Depth :** 12.00m **Sheet No :** 1 of 2

Depth (m)	Elevation	Geotechnical Description	Strata Symbol	Well Details (Shallow)	Well Details (Deep)	Samples: Sample Type	Samples: From	Samples: To	Samples: U100 Blows	Standard Penetration Tests: 75 mm	150 mm	225 mm	300 mm	375 mm	450 mm	N-Value / Rec %
0	6.66	Ground Surface														
		Made Ground Very dense dark grey and grey silty sandy fine to coarse angular gravel with many cobbles and occasional boulders, comprising of slag														
1																
3	3.66	**Estuarine Alluvium** Firm becoming soft grey CLAY with some small pockets of peat														
4																
5																
6	0.56	**Peat** Firm dark brown fibrous woody PEAT														
	-0.74	**Estuarine Alluvium** Soft grey CLAY														
8																
9																
10																

Rig Type : Dando 150

Drilled By : MM

Hole Diameter (mm) : 200 / 150

Casing Depth (m) : 4m and 12m 200/150mm

Log Template File : GEOSA

Chiselling :

Remarks

1 Hole excavated by backhoe to base of slag and re-drilled through

2 Casing reduced to 150mm at 3m with bentonite seal

3 installed within 200mm casing.

4

5

BOREHOLE No: BH 18

Client : Corus Ltd.	**Contractor :** Apex Drilling Ltd.	**Hole Coordinates :** E337753.801 N185903.401
Project : Queensway Landfill	**Logged By :** AWJ	**Ground Level :** 6.659m AOD
Location : See site plan	**Date :** 20-21.09.05	**Hole Depth :** 12.00m **Sheet No :** 2 of 2

Depth (m)	Elevation	Geotechnical Description	Strata Symbol	Well Details (Shallow)	Well Details (Deep)	Samples: Sample Type	Samples: From	Samples: To	Samples: U100 Blows	Standard Penetration Tests: 75 mm	150 mm	225 mm	300 mm	375 mm	450 mm	N-Value / Rec %
	-4.14															
11		**Estuarine Alluvium** Soft grey CLAY with some fine to coarse sub-rounded gravel														
	-5.14															
	-5.34	**Triassic Bedrock** Firm reddish brown CLAY with much fine to medium angular gravel, comprising of mudstone lithorelicts														
13																
14																
15																
16																
18																
19																
20																

Rig Type : Dando 150

Drilled By : MM

Hole Diameter (mm) : 200 / 150

Casing Depth (m) : 4m and 12m 200/150mm

Log Template File : GEOSA

Chiselling :

Remarks

1 Hole excavated by backhoe to base of slag and re-drilled through

2 Casing reduced to 150mm at 3m with bentonite seal

3 installed within 200mm casing.

4

5

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ35
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337731.68 E
Project	New M4 - Second Preliminary Ground Investigation				185614.13 N
		Drilling Rig	Terrier	Ground Level	5.78m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	21/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	21/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
21/01/2008		1.00	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 1.00m.
2. Window Sampling terminated at 1.00m due to refusal.
3. Refer to SWSJ35A.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
Version	3.03
Revised	19/01/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ35
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337731.68 E
Project	New M4 - Second Preliminary Ground Investigation				185614.13 N
		Drilling Rig	Terrier	Ground Level	5.78m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	21/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	21/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Black slightly clayey slightly sandy silt.				L1	0.00 - 1.00			
MADE GROUND: Brown coarse sand and angular fine to medium gravel of slag.		0.96	4.82					
Sampling complete at 1.00 m.		1.00	4.78					

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ35A
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337732.02 E
Project	New M4 - Second Preliminary Ground Investigation				185619.65 N
		Drilling Rig	Terrier	Ground Level	5.72m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	21/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	21/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
21/01/2008		6.45	NR	0.00	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 6.45m.
2. Window Sampling complete at 6.45m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=5 (1,1,2,1,1,1)
2.00	S	N=3 (1,1,0,1,1,1)
3.00	S	N=2 (1,1,1,0,1,0)
4.00	S	N=4 (1,0,1,1,1,1)
5.00	S	N=2 (1,1,0,1,1,0)
6.00	S	N=2 (1,1,0,1,1,0)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
Version	3.03
Revised	19/01/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ35A
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337732.02 E
Project	New M4 - Second Preliminary Ground Investigation				185619.65 N
		Drilling Rig	Terrier	Ground Level	5.72m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	21/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	21/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Black slightly sandy clayey silt.				L1	0.00 - 0.80				
		0.60	5.12						
MADE GROUND: Black silty fine to coarse gravel sized fragments of clinker.									
				ES2	1.00	S5	S	1.00 1.45	
		1.10	4.62	D3	1.00 - 1.45				
Grey slightly sandy silty CLAY. (Estuarine Alluvium)				L4	1.00 - 1.80				
				ES5	2.00	S3	S	2.00 2.45	
				D6	2.00 - 2.45				
				ES7	3.00	S2	S	3.00 3.45	
				D8	3.00 - 3.45				
				L9	3.00 - 3.80				
				ES10	4.00	S4	S	4.00 4.53	
				D11	4.00 - 4.45				
				L12	4.00 - 4.70				
		4.45	1.27						
Dark brown pseudofibrous PEAT. (Peat)									
				ES13	5.00	S2	S	5.00 5.45	
				D14	5.00 - 5.45				
				L15	5.00 - 5.70				
		5.45	0.27						
Soft grey CLAY. (Estuarine Alluvium)									
		5.70	0.02						
Dark brown pseudofibrous PEAT. (Peat)									
				ES16	6.00	S2	S	6.00 6.45	
				D17	6.00 - 6.45				
		6.45	-0.73						
Sampling complete at 6.45 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ36
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337769.35 E
Project	New M4 - Second Preliminary Ground Investigation				185704.18 N
		Drilling Rig	Terrier	Ground Level	5.34m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	18/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	18/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
18/01/2008		6.45	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
18/01/2008		2.30	2.30	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 6.45m.
2. Window Sampling complete at 6.45m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=3 (1,1,1,1,0,1)
2.00	S	N=4 (1,0,1,1,1,1)
3.00	S	N=4 (1,1,1,1,1,1)
4.00	S	N=4 (1,1,1,1,1,1)
5.00	S	N=4 (1,1,1,1,1,1)
6.00	S	N=3 (1,1,1,1,0,1)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
Version	3.03
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Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ36
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337769.35 E
Project	New M4 - Second Preliminary Ground Investigation				185704.18 N
		Drilling Rig	Terrier	Ground Level	5.34m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	18/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	18/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: black slightly sandy clayey silt.				L1	0.00 - 0.80				
		0.90	4.44						
Firm to stiff medium strength light grey mottled orangish brown silty slightly sandy CLAY with frequent fine to medium gravel sized pockets of brown clay. (Estuarine Alluvium)				ES2 D3 L4	1.00 1.00 - 1.45 1.00 - 1.80	S3	S	1.00 1.45	
				ES5 D6 L7	2.00 2.00 - 2.45 2.00 - 2.80	S4	S	2.00 2.53	
				ES8 D9 L10	3.00 3.00 - 3.45 3.00 - 3.80	S4	S	3.00 3.45	
		3.50	1.84						
Soft grey CLAY with rare fragments of organic material. (Estuarine Alluvium)				ES11 D12	4.00 4.00 - 4.45	S4	S	4.00 4.45	
				ES13 D14	5.00 5.00 - 5.45	S4	S	5.00 5.45	
				D15	6.00 - 6.45	S3	S	6.00 6.45	
		6.45	-1.11						
Sampling complete at 6.45 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ37
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337766.04 E
Project	New M4 - Second Preliminary Ground Investigation				185656.53 N
		Drilling Rig	Terrier	Ground Level	6.25m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	22/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	22/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
22/01/2008		6.45	2.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
100	2.00	100	2.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
22/01/2008		3.50	3.50	20	Seepage	NR	NR

GENERAL NOTES

1. Window Sampling from GL to 6.45m.
2. Window Sampling complete at 6.45m.
3. 50mm standpipe installed, slotted from 4.10m to 5.60m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=7 (1,2,2,2,1,2)
2.00	S	N=5 (1,1,1,2,1,1)
3.00	S	N=8 (2,2,2,2,2,2)
4.00	S	N=2 (1,0,1,0,1,0)
5.00	S	N=1 (0,0,0,0,0,1)
6.00	S	N=1 (1,0,0,0,1,0)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
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Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ37
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337766.04 E
Project	New M4 - Second Preliminary Ground Investigation				185656.53 N
		Drilling Rig	Terrier	Ground Level	6.25m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	22/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	22/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Black slightly sandy clayey silt.				ES1	0.30				
				ES2	1.00	S7	S	1.00 1.45	
				D3	1.00 - 1.45				
		1.20	5.05	L4	1.00 - 1.80				
Firm grey mottled orangish brown CLAY with occasional rootlets. (Estuarine Alluvium) ---from 1.65m becomes firm to stiff ---from 1.77m to 1.80m 1 No very thin bed of spongy brown pseudofibrous peat				ES5	2.00	S5	S	2.00 2.45	
				D6	2.00 - 2.45				
		2.20	4.05	L7	2.00 - 2.80				
Soft to firm grey CLAY. (Estuarine Alluvium)				ES8	3.00	S8	S	3.00 3.45	
				D9	3.00 - 3.45				
				L10	3.00 - 3.80				
				ES11	4.00	S2	S	4.00 4.53	
				D12	4.00 - 4.45				
		4.35	1.90						
Stiff and firm brown slightly sandy CLAY with much organic material. Estuarine Alluvium									
		5.00	1.25	ES13	5.00	S1	S	5.00 5.60	
Spongy black pseudofiberous PEAT. (Peat)				D14	5.00 - 5.45				
				L15	5.00 - 5.80				
		6.00	0.25	ES16	6.00	S1	S	6.00 6.53	
Sampling complete at 6.45 m.				D17	6.00 - 6.45				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ38
Header

Contract No.	F15056	Method	Window Sampling	Coordinates	337787.66 E
Project	New M4 - Second Preliminary Ground Investigation				185627.38 N
		Drilling Rig	Terrier	Ground Level	5.55m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	22/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	22/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
22/01/2008		6.45	0.00	NR	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Window Sampling from GL to 6.45m.
2. Window Sampling complete at 6.45m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm
1.00	S	N=4 (1,2,1,1,1,1)
2.00	S	N=1 (1,2,1,0,0,0)
3.00	S	N=5 (1,2,2,1,1,1)
4.00	S	N=4 (1,2,1,2,1,0)
5.00	S	N=6 (1,2,2,1,2,1)
6.00	S	N=5 (1,2,1,1,2,1)

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

Form	ARIAL HYDRAULIC HEADER
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Norwest Holst Soil Engineering Ltd.

HYDRAULIC SAMPLING PROBE LOG

Hole ID.
SWSJ38
Sheet 1 of 1

Contract No.	F15056	Method	Window Sampling	Coordinates	337787.66 E
Project	New M4 - Second Preliminary Ground Investigation				185627.38 N
		Drilling Rig	Terrier	Ground Level	5.55m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	RK	Orientation	Vertical
		Logged by	DH	Date Started	22/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	22/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Black slightly sandy clayey silt.				L2	0.00 - 0.80				
				ES1	0.30				
---from 0.50m with frequent fragments of organic material. Sand is medium									
				ES3	1.00	S4	S	1.00 1.45	
				D4	1.00 - 1.45				
				L5	1.00 - 1.80				
		1.50	4.05						
Stiff grey mottled orangish brown CLAY. (Estuarine Alluvium)									
---from 2.00m to 3.60m soft to firm				ES6	2.00	S1	S	2.00 2.45	
				D7	2.00 - 2.45				
				L8	2.00 - 2.80				
---from 2.50m firm									
				ES9	3.00	S5	S	3.00 3.45	
				D10	3.00 - 3.45				
				L11	3.00 - 3.80				
				ES12	4.00	S4	S	4.00 4.45	
				D13	4.00 - 4.45				
				L14	4.00 - 4.80				
		4.70	0.85						
Spongy black pseudofibrous PEAT. (Peat)									
				ES15	5.00	S6	S	5.00 5.45	
				D16	5.00 - 5.45				
				L17	5.00 - 5.70				
				ES18	6.00	S5	S	6.00 6.45	
				D19	6.00 - 6.45				
		6.45	-0.90						
Sampling complete at 6.45 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL HYDRAULIC LOG
Version	3.04
Revised	04/04/2005

Geotechnical Engineering Limited

BOREHOLE LOG

BH521

CLIENT	WELSH GOVERNMENT					Sheet	1 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	19 February 2015	Easting	337752.2			Depth	19.00 m
End Date	25 February 2015	Northing	185569.1	Ground level	6.00mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
19/02/15 0800hrs	1D*	0.00 - 0.50		Vo 0.0				Greyish brown sandy angular and subangular fine to coarse slag GRAVEL. Driller notes slag boulders. (MG)			
	2B	0.20 - 0.30									
	3B	0.50 - 1.00									
	4D*	0.50 - 1.00		Vo 0.0							
	5D	1.00 - 1.45	1.00	S 26							
	6B	1.00 - 1.50							1.15	4.85	
	7D*	1.00 - 1.50		Vo 0.7				Very soft dark brownish grey peaty gravelly CLAY with frequent rootlets (up to 1mm diam) and fragments of plant material. Gravel is angular fine to coarse tarmacadam and slag. (MG)			
19/02/15 1700hrs Damp	8B	1.50 - 2.00									
	9D	2.00 - 2.45	2.00	S 5					2.00	4.00	
20/02/15 0800hrs Dry	10B	2.00 - 2.50						Very soft grey mottled black slightly gravelly silty CLAY. Gravel is angular medium and coarse sandstone and slag. (MG)			
	11D*	2.00 - 2.50		Vo 0.3							
	12B	2.50 - 3.00									
	13D*	2.50 - 3.00		Vo 0.2							
	14UT	3.00 - 3.45	3.00								
	16D	3.45 - 3.55		Vo 0.7					3.45	2.55	
	16D*	3.50 - 4.00						Very soft light bluish grey silty CLAY with rare rootlets (up to 2mm diam) and fragments of black organic material. Rare angular fine and medium sandstone gravel. Slight organic odour. (TFD)			
	15B	3.55 - 4.00		Vo 1.7							
	17D*	4.00 - 4.45	4.00	S 4							
	18D	4.00 - 4.50									
	19B	4.00 - 4.50		Vo 0.9					4.30	1.70	
	20D*	4.50 - 5.00						Spongy dark brown fibrous PEAT with frequent roots (up to 3mm diam). Organic odour. (PEAT) 4.50 - 5.00m: Tending to light brownish grey peaty silty clay.			
	21B	4.50 - 5.00									
	22D*	4.50 - 5.00		Vo 0.9							
	23UT	5.00 - 5.45	5.00								
	24D	5.45 - 5.50									
	25B	5.50 - 6.00									
	26D*	5.50 - 6.00		Vo 0.1							
	27D	6.00 - 6.10							6.00	0.00	
	28B	6.00 - 6.50						Very soft grey silty CLAY with rare fragments (up to 20mm) of wood and black organic material and rare thin laminae of grey clay. Organic odour. (TFD)			
	29D*	6.00 - 6.50		Vo 0.2							
	30D	6.50 - 6.95	6.50	S<1							
20/02/15 1300hrs 5.90m	31B	6.50 - 7.00									
23/02/15 0830hrs 5.90m	32B	7.00 - 7.50									
	33B	7.50 - 8.00									

Continued Next Page {8.00}

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.00m. Cable percussion (200mm) 1.00-2.00m and 150mm 2.00-13.00m. Waterflush rotary core drilled (116mm) 13.00-19.00m. CASING: 200mm diam to 2.00m, 150mm diam to 12.95m.

BACKFILL: On completion, borehole backfilled with bentonite pellets 19.00-11.20m and gravel 11.20-11.00m. A slotted standpipe (50mm) with geo-sock was installed to 11.00m, granular response zone 11.20-8.80m and bentonite seal 8.80-6.20m. A second slotted standpipe (35mm) with geo-sock was installed to 6.00m, granular response zone 6.20-4.30m, bentonite seal 4.30-0.35m, gravel 0.35-0.25m, concrete and stopcock cover 0.25-0.00m.

REMARKS: Hole advanced by chiselling 12.00-13.00m (2hr). Downhole magnetometry for UXO risk mitigation undertaken 0.00-12.00m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling 2.00m, prior to reduction in casing diameter. Permeability test undertaken at 6.00-7.00m. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
6.50	5.00	5.90	20	Groundwater not encountered prior to use of water flush.

AGS

CONTRACT	CHECKED
30238	EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH521

CLIENT	WELSH GOVERNMENT					Sheet	2 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	19 February 2015	Easting	337752.2				
End Date	25 February 2015	Northing	185569.1	Ground level	6.00mOD	Depth	19.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	34UT	8.00 - 8.45	8.00								
	35B	8.00 - 8.50									
	36B	8.50 - 9.00									
	37D	9.50 - 9.95	9.50	S 10				Firm brownish yellow, light brown and dark grey slightly sandy slightly gravelly CLAY with low subangular sandstone cobble content. Gravel is subangular fine and medium sandstone and mudstone. (TFD)	9.50	-3.50	
	38B	10.50 - 11.00									
	39D	11.00 - 11.45	11.00	S 13				Firm becoming stiff with depth dark reddish brown slightly sandy slightly gravelly to gravelly CLAY. Gravel is angular and subangular fine and medium mudstone lithorelicts. (MMG)	11.00	-5.00	
23/02/15 1700hrs 7.80m	40B	11.50 - 12.00									
	41D	12.00 - 12.23	12.00	S*100					12.00	-6.00	
24/02/15 0800hrs 7.80m	42B	12.00 - 12.50						Extremely weak reddish brown MUDSTONE with rare light greenish grey reduction spots (up to 10mm) recovered as slightly clayey sandy subangular fine to coarse gravel with a low cobble content. (MMG) (Grade II/III)			
24/02/15 1700hrs 8.00m	43D	12.50 - 12.61	12.50	S*214							
	44D	13.00 - 13.10	12.95	S*375					13.00	-7.00	
25/02/15 1005hrs 8.00m	45C	13.00 - 14.50			100 15 0	NA		Stiff fissured reddish brown mottled bluish grey gravelly CLAY. Gravel is subangular fine to coarse lithorelicts of very stiff clay to extremely weak mudstone. (MMG) (Grade III) 13.75 - 13.80m: Weak reddish brown thinly laminated mudstone. 14.00 - 14.10m: Weak reddish brown thinly laminated mudstone. 14.10 - 14.15m: 30mm band of light bluish grey silty clay.	14.20	-8.20	
	46C	14.50 - 16.00	12.95		100	NA		Stiff fissured reddish brown gravelly CLAY. Gravel is subangular fine to coarse lithorelicts of very stiff clay to extremely weak mudstone. (MMG) (Grade III) 14.25 - 14.40m: Stiff reddish brown mottled light bluish grey silty clay. 15.10 - 15.25m: Stiff light bluish grey silty clay. 15.70 - 16.00m: Tending to extremely weak thinly laminated reddish brown mudstone.			
	47C	16.00 - 17.50	12.95		100						
	48C	17.50 - 19.00	12.95		100						
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
				Groundwater not encountered prior to use of water flush.

AGS

CONTRACT	CHECKED
30238	EC

Geotechnical Engineering Ltd, Tel. 01452 527743 30238 YODA.GPJ TRIALJH.GPJ GEOTECH.GLB 16/07/2015 16:02:31 TP EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH521

CLIENT	WELSH GOVERNMENT					Sheet	3 of 3
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	19 February 2015	Easting	337752.2				
End Date	25 February 2015	Northing	185569.1	Ground level	6.00mOD	Depth	19.00 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
									18.35 - 18.40m: Thin horizontal lamination of gypsum.			
25/02/15 1320hrs 2.62m							NI		Extremely weak thinly laminated MUDSTONE. Fractures are subhorizontal to 20° very closely spaced planar rough with clay veneer. (MMG) (Grade II)	18.80	-12.80	
									Borehole completed at 19.00m.	19.00	-13.00	
										{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush.	30238	EC

Geotechnical Engineering Ltd, Tel. 01452 527743 30238 YODA.GPJ TRIALJH.GPJ GEOTECH.GLB 16/07/2015 16:02:32 TP EC

Geotechnical Engineering Limited

TRIAL PIT LOG

TP508

CLIENT	WELSH GOVERNMENT						
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	1 of 2
Start Date	11 February 2015	Easting	337807.5			Scale	1 : 25
End Date	11 February 2015	Northing	185569.0	Ground level	5.90mOD	Depth	4.30 m

water record	sample/test no/type	result	depth (m)	description	depth (m)	level (m)	legend
				Dark brown sandy angular and subangular fine to coarse slag GRAVEL. (MADE GROUND) (MG)			
	1B		0.50				
	2D*	Vo 0.2	0.50				
				0.75 - 0.90m: Light yellowish brown slag.	0.90	5.00	
				Firm locally stiff dark bluish grey slightly sandy CLAY. (MADE GROUND) (MG)			
	3B	H 56	1.00				
	4D*	Vo 0.7	1.00		1.30	4.60	
				Firm locally stiff light grey mottled light orangish brown slightly sandy CLAY. (TFD)			
	5B	H 71	2.00				
	6D*	Vo 0.4	2.00		2.60	3.30	
				Soft locally very soft light bluish grey sandy CLAY with frequent organic fragments (up to 3mm diam.). (TFD)			
	D*	Vo 0.1	3.00				
	7B	H 25	3.00				
	8D*	Vo 0.2	3.00				

Notes

Trial pit excavated by JCB 3CX mechanical excavator.
Groundwater not encountered.
Trial pit sides remained stable and vertical.
Trial pit dimensions 0.80x2.50x4.30m.
On completion, the trial pit was backfilled with materials arising.
Trial pit terminated at 4.30m due to the strength of the ground.

Sketch of Foundation - Not to scale. All dimensions in metres.

CONTRACT	CHECKED
30238	EC

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

Geotechnical Engineering Ltd, Tel. 01452 527743 30238 YODA.GPJ TRIALJH.GPJ GEOTECH.GLB 16/07/2015 15:53:27 RDL SF/EC

Geotechnical Engineering Limited

TRIAL PIT LOG

TP508

CLIENT	WELSH GOVERNMENT						
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	2 of 2
Start Date	11 February 2015	Easting	337807.5			Scale	1 : 25
End Date	11 February 2015	Northing	185569.0	Ground level	5.90mOD	Depth	4.30 m

water record	sample/test no/type	result	depth (m)	description	depth (m)	level (m)	legend
Dry	9B	H 33	4.00		4.30	1.60	
				Trial pit completed at 4.30m.			

Notes

Trial pit excavated by JCB 3CX mechanical excavator.
Groundwater not encountered.
Trial pit sides remained stable and vertical.
Trial pit dimensions 0.80x2.50x4.30m.
On completion, the trial pit was backfilled with materials arising.
Trial pit terminated at 4.30m due to the strength of the ground.

Sketch of Foundation - Not to scale. All dimensions in metres.

CONTRACT	CHECKED
30238	EC

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

Geotechnical Engineering Ltd, Tel. 01452 527743 30238 YODA.GPJ TRIALJH.GPJ GEOTECH.GLB 16/07/2015 15:53:27 RDL SF/EC

A5 Appendix 1e

Exploratory Records (Lagoon 26)

Borehole Log

Exploration Associates

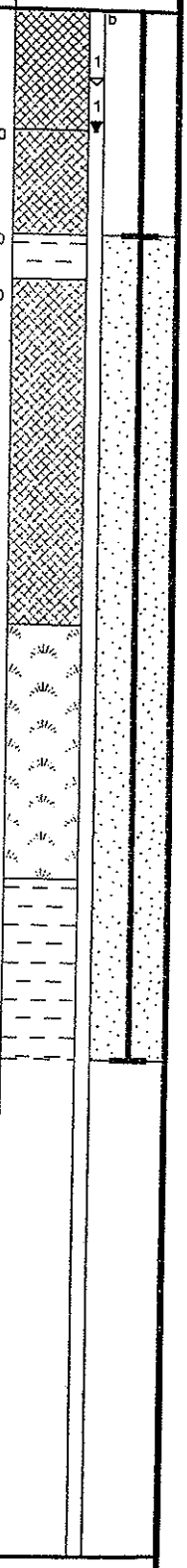
Drilled by	IH	Equipment and Methods	Ground Level + 5.10 m OD
Logged by	CW	Cable Percussion 150 mm diameter from 0.00m to 7.00m.	National Grid Coordinates E 337828.21 N 185570.66
Checked by			

Samples and Tests

Depth	Type & No.	Records	Date Casing	Time Water
			24/01/2002	
0.90	ES1			
2.00	ES2			
4.50	ES3			
6.80	ES4	kRH	24/01/2002	
7.00				

Strata

Description	Depth,Level (Thickness)
Slag (DRILLERS DESCRIPTION).	(0.80)
MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY. Gravel is angular and subangular fine and medium of slag.	0.80 +4.30 (0.70)
Grey brown silty CLAY with gravels and peat (DRILLERS DESCRIPTION).	1.50 +3.60 (0.30)
MADE GROUND: Dark brown sandy slightly gravelly CLAY. Gravel is subangular fine and medium of slag and clinker.	1.80 +3.30 (2.30)
Dark brown spongy fibrous PEAT with occasional soft dark grey SILT pockets.	4.10 +1.00 (1.70)
Soft grey CLAY.	5.80 -0.70 (1.20pen)
EXPLORATORY HOLE ENDS AT 7.00 m.	7.00 -1.90



Groundwater

No.	Struck	Behaviour
1	0.80m	Rising to 0.50m after 20 mins. Sealed 2.60. Medium inflow

Remarks

Chiselling : 0.40m to 0.70m 90minutes
Hole backfill : 0.00m to 1.50m Bentonite (b). Surface protection : <none>
Standpipe installed, 50mm diameter, response zone from 1.50m to 7.00m.

Notes : For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1 : 50

Project	ENVIRONMENTAL INVESTIGATION AT LLANWERN STEELWORKS
Project no.	152002
Carried out for	Corus plc

Borehole **LGBH12**

Sheet 1 of 1

03/05/2002 11:10:50 ESGLog v2.10

BOREHOLE No: BH 20

Client : Corus Ltd.	**Contractor :** Apex Drilling Ltd.	**Hole Coordinates :** E338232.128 N185934.655
Project : Queensway Landfill	**Logged By :** AWJ	**Ground Level :** 4.826m AOD
Location : See site plan	**Date :** 27-29.09.05	**Hole Depth :** 11.3m **Sheet No :** 1 of 2

Depth (m)	Elevation	Geotechnical Description	Strata Symbol	Well Details (Shallow)	Well Details (Deep)	Samples: Sample Type	Samples: From	Samples: To	Samples: U100 Blows	Standard Penetration Tests: 75 mm	150 mm	225 mm	300 mm	375 mm	450 mm	N-Value / Rec %
0	4.83	Ground Surface														
	4.13	**Made Ground** Dense dark grey and grey silty sandy fine to coarse angular gravel with many cobbles and occasional boulders, comprising of slag														
1		**Estuarine Alluvium** Firm becoming soft greyish brown becoming grey CLAY														
3																
4																
5																
6	-1.17	**Peat** Firm dark brown fibrous woody PEAT														
	-2.17	**Estuarine Alluvium** Soft grey CLAY with some fine to coarse sub-rounded gravel														
8																
9	-4.67															
10																

Rig Type : Dando 150

Drilled By : MM

Hole Diameter (mm) : 200 / 150

Casing Depth (m) : 200mm - 7m, 150mm-10.50m

Log Template File : GEOSA

Chiselling :

Remarks

1 Hole excavated by backhoe to base of upper clayand re-drilled through

2 Casing reduced to 150mm at 7m with bentonite seal

3 installed within 200mm casing.

4

5

BOREHOLE No: BH 20

Client : Corus Ltd.	**Contractor :** Apex Drilling Ltd.	**Hole Coordinates :** E338232.128 N185934.655
Project : Queensway Landfill	**Logged By :** AWJ	**Ground Level :** 4.826m AOD
Location : See site plan	**Date :** 27-29.09.05	**Hole Depth :** 11.3m **Sheet No :** 2 of 2

Depth (m)	Elevation	Geotechnical Description	Strata Symbol	Well Details (Shallow)	Well Details (Deep)	Samples: Sample Type	Samples: From	Samples: To	Samples: U100 Blows	Standard Penetration Tests: 75 mm	150 mm	225 mm	300 mm	375 mm	450 mm	N-Value / Rec %
11	-6.47	**Triassic Bedrock** Firm reddish brown CLAY with much fine to medium angular gravel, comprising of mudstone lithorelicts														
13																
14																
15																
16																
18																
19																
20																

Rig Type : Dando 150

Drilled By : MM

Hole Diameter (mm) : 200 / 150

Casing Depth (m) : 200mm - 7m, 150mm-10.50m

Log Template File : GEOSA

Chiselling :

Remarks

1 Hole excavated by backhoe to base of upper clayand re-drilled through

2 Casing reduced to 150mm at 7m with bentonite seal

3 installed within 200mm casing.

4

5

BOREHOLE No: BH 21

Client : Corus Ltd.	**Contractor :** Apex Drilling Ltd.	**Hole Coordinates :** E337304.006 N185989.232
Project : Queensway Landfill	**Logged By :** AWJ	**Ground Level :** 5.255m AOD
Location : See site plan	**Date :** 29-30.09.05	**Hole Depth :** 9.5m **Sheet No :** 1 of 1

Depth (m)	Elevation	Geotechnical Description	Strata Symbol	Well Details (Shallow)	Well Details (Deep)	Samples: Sample Type	Samples: From	Samples: To	Samples: U100 Blows	Standard Penetration Tests: 75 mm	150 mm	225 mm	300 mm	375 mm	450 mm	N-Value / Rec %
	5.25	Ground Surface														
0		**Estuarine Alluvium** Firm becoming soft greyish brown becoming grey CLAY														
1																
3																
4																
5																
6																
	-1.75	**Peat** Firm dark brown fibrous woody PEAT														
8	-2.75	**Estuarine Alluvium** Soft grey CLAY with some fine to coarse sub-rounded gravel														
9	-3.75	**Triassic Bedrock** Firm reddish brown CLAY with much fine to medium angular gravel, comprising of mudstone lithorelicts														
	-4.25															
10																

Rig Type : Dando 150

Drilled By : MM

Hole Diameter (mm) : 200 / 150

Casing Depth (m) : 7m and 9.5m - 200/150mm

Log Template File : GEOSA

Chiselling : None

Remarks

1 Hole excavated by backhoe to base of upper clayand re-drilled through

2 Casing reduced to 150mm at 7m with bentonite seal

3 installed within 200mm casing.

4

5

BOREHOLE No: BH 23

Client : Corus Ltd.	**Contractor :** Apex Drilling Ltd.	**Hole Coordinates :** E337962.515 N185757.140
Project : SSQ Landfill Llanwern	**Hole Depth (m) :**	**Logged By :** AWJ
Location : See site plan	**Steel Collar Level :**	**Date :** 06.10.05 **Sheet No :** 1 of 2

Depth (m)	Elevation	Geotechnical Description (BS5930:1999)	Strata Type	Well Details	Water Level Below Ground	Samples: Sample Type	Samples: From	Samples: To	Remarks
0	6.23	Ground Surface							
1		**Made Ground** Dense to very dense dark grey silty sandy fine to coarse angular gravel with occasional cobble and rare boulder, comprising of slag							
	4.13	**Estuarine Alluvium** Firm grey CLAY			3.23				
3									
4									
5									
6	0.23	**Peat** Soft dark brown fibrous woody PEAT							
	-0.87	**Estuarine Alluvium** Firm becoming soft grey CLAY							
8									
9									
10									

Drilled By : GJ

Rig Type : Gryphon

Hole Diameter (mm) : 110

Casing Depth (m) : 10.00

Bit Type :

Log Template File : GEOROTARY

Notes

1

2

3

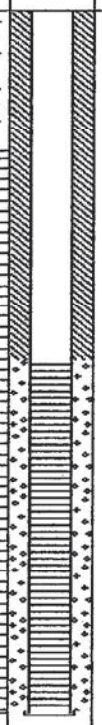
4

5

BOREHOLE No: BH 23

Client : Corus Ltd.	**Contractor :** Apex Drilling Ltd.	**Hole Coordinates :** E337962.515 N185757.140
Project : SSQ Landfill Llanwern	**Hole Depth (m) :**	**Logged By :** AWJ
Location : See site plan	**Steel Collar Level :**	**Date :** 06.10.05 **Sheet No :** 2 of 2

Depth (m)	Elevation	Geotechnical Description (BS5930:1999)	Strata Type	Well Details	Water Level Below Ground	Samples: Sample Type	Samples: From	Samples: To	Remarks
11	-4.97	**Triassic Bedrock** Weak reddish brown MARL							
13									
14									
15									
16	-9.77								
18									
19									
20									



Drilled By : GJ

Rig Type : Gryphon

Hole Diameter (mm) : 110

Casing Depth (m) : 10.00

Bit Type :

Log Template File : GEOROTARY

Notes

1

2

3

4

5

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ06 CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	337599.88 E
Project	New M4 - Second Preliminary Ground Investigation				185578.07 N
		Drilling Rig	Dando	Ground Level	6.18m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	15/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	17/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
15/01/2008	1730	4.50	3.50	DRY	End of Shift
16/01/2008	0730	4.50	3.50	4.30	Start of Shift
16/01/2008	1730	12.50	12.00	7.20	End of Shift
17/01/2008	0730	12.50	12.00	3.20	Start of Shift
17/01/2008	1730	14.90	13.00	7.60	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
14.30	14.60	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	1.50	200	1.50
150	14.90	150	13.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Falling head test conducted from 4.00m to 5.00m.
2. Cable Percussive boring from GL to 14.90m.
3. 50mm standpipe installed, slotted from 3.10m to 4.10m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
1.50	S	N=8 (1,1,2,2,2,2)	1.70	DRY
2.70	S	N=7 (1,1,2,2,1,2)	2.00	DRY
4.00	S	N=9 (1,2,2,2,2,3)	3.30	DRY
6.00	S	N=6 (1,2,1,2,1,2)	5.30	1.80
8.00	S	N=6 (1,1,1,1,2,2)	7.30	4.80
10.00	S	N=8 (1,1,2,2,2,2)	9.20	6.20
12.00	S	N=21 (2,3,4,5,6,6)	11.40	7.60
13.10	S	50/150mm (9,12,19,27,4)	12.50	3.50
14.00	S	50/155mm (5,11,12,24,14)	13.00	4.70
14.60	S	50/155mm (10,14,19,26,5)	13.00	7.60

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

Form	ARIAL CP HEADER
Version	3.05
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ06 CP
Sheet 1 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	337599.88 E
Project	New M4 - Second Preliminary Ground Investigation				185578.07 N
		Drilling Rig	Dando	Ground Level	6.18m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	15/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	17/01/2008

Description of Strata	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Slag and stone. (Driller's description)			ES1	0.30				
	0.60	5.58						
Stiff orangish brown grey mottled slightly sandy slightly gravelly CLAY with occasional rootlets. Sand is fine. Gravel is angular fine of mudstone (Estuarine Alluvium)			D2 ES3 U4	0.70 1.00 1.00 - 1.45				
	1.50	4.68	D5 D6	1.50 1.50 - 1.95	S8	S	1.50	1.95
Soft dark grey CLAY. (Estuarine Alluvium)								
	2.00	4.18	ES7 D8 U9	2.00 2.10 2.20 - 2.65	(10)			
Plastic dark brown amorphous PEAT. (Peat)								
	2.46	3.72						
Firm greenish grey silty CLAY with occasional organic fragments. (Organic odour) (Estuarine Alluvium)			D10 D11 ES12	2.70 2.70 - 3.15 3.00	S7	S	2.70	3.15
	3.30	2.88	D13 U14	3.40 3.50 - 3.95	(9)			
Plastic dark brown amorphous PEAT. (Peat)								
	3.70	2.48						
Soft to firm greenish grey silty CLAY with closely spaced medium to coarse gravel sized pockets of light brown fibrous peat (Organic odour). (Estuarine Alluvium)			D15 ES16 D17 B18 ES19	4.00 4.00 4.00 - 4.45 4.50 - 5.00 5.00	S9	S	4.00	4.45
	5.30	0.88	D20 U21	5.40 5.50 - 5.95	(10)			
Plastic brown pseudofibrous PEAT. (Peat)								
---from 6.00m becomes spongy	6.10	0.08	D22 D23	6.00 6.00 - 6.45	S6	S	6.00	6.45
Very soft grey silty CLAY. (Estuarine Alluvium)			D24	7.00				
			U25	7.50 - 7.95	(9)			
---from 8.00m to 8.50m with occasional fine to medium gravel sized shell fragments			D26 D27 B28	8.00 8.00 - 8.45 8.50 - 9.00	S6	S	8.00	8.45
			U29	9.50 - 9.95				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ06 CP
Sheet 2 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	337599.88 E
Project	New M4 - Second Preliminary Ground Investigation				185578.07 N
		Drilling Rig	Dando	Ground Level	6.18m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	15/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	17/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Very soft grey silty CLAY. (Estuarine Alluvium) ---from 10.00m becomes slightly sandy. Sand is fine				D30 D31	10.00 10.00 - 10.45	S8	S	10.00 10.45	
		11.00	-4.82	D32	11.00				
Very soft to soft grey silty CLAY with closely spaced coarse gravel sized pockets of black pseudofibrous peat. (Estuarine Alluvium)				U33	11.50 - 11.95	(70)			
		11.95	-5.77	B34 D35	12.00 12.00 - 12.45	S21	S	12.00 12.45	
Soft brownish grey slightly sandy CLAY with occasional angular cobbles of sandstone. Sand is fine to medium. (Estuarine Alluvium)									
		12.50	-6.32						
Very stiff reddish brown locally mottled greenish grey sandy slightly gravelly CLAY. Gravel is angular fine to medium (Weathered Mudstone). (Mercia Mudstone Group)				U36	12.70 - 13.05				
				D37 D38	13.10 13.10 - 13.55	S50/150mm	S	13.10 13.40	
				D39	13.80				
				D40	14.00 - 14.30	S50/155mm	S	14.00 14.31	
				D41	14.60 - 14.90	S50/155mm	S	14.60 14.91	
		14.90	-8.72						
Cable Percussion boring complete at 14.90 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ08A CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	337834.72 E
Project	New M4 - Second Preliminary Ground Investigation				185599.42 N
		Drilling Rig	Dando	Ground Level	5.89m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	20/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	08/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
20/12/2007	1730	6.00	5.70	1.70	End of Shift
07/01/2008	0730	6.00	5.70	1.40	Start of Shift
07/01/2008	1730	10.50	9.20	2.50	End of Shift
08/01/2008	0730	10.50	9.20	1.30	Start of Shift
08/01/2008	1730	13.40	11.50	6.50	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
0.70	0.80	0.50	Chiselling
1.30	2.20	2.50	Chiselling
3.70	3.90	0.50	Chiselling
13.00	13.40	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	13.70	200	11.50

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
20/12/2007		1.30	1.20	20	Seepage	1.20	NR

GENERAL NOTES

1. Cable Percussive boring from GL to 13.70m.
2. Insitu permeability testing carried out from 6.40m to 7.50m.
3. 50mm standpipe installed, slotted from 6.40m to 7.40m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
1.00	S	50/75mm (15,10,50)	1.00	DRY
2.20	S	50/85mm (7,15,34,16)	2.20	1.50
3.00	S	51/225mm (5,10,12,13,26)	2.80	1.30
4.00	S	N=43 (4,6,8,9,13,13)	3.90	1.30
5.50	S	N=15 (2,3,3,4,4,4)	5.70	1.70
7.50	S	N=12 (2,2,3,3,3,3)	6.40	1.70
9.00	S	N=12 (2,3,2,3,3,4)	8.50	2.60
11.50	S	50/190mm (10,12,16,21,13)	10.70	2.20
12.70	S	50/210mm (8,13,15,18,17)	11.50	4.90
13.40	S	50/150mm (9,15,21,29)	11.50	6.50

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

Form	ARIAL CP HEADER
Version	3.05
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ08A CP
Sheet 1 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	337834.72 E
Project	New M4 - Second Preliminary Ground Investigation				185599.42 N
		Drilling Rig	Dando	Ground Level	5.89m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	20/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	08/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Black very sandy gravel. Sand is fine to coarse. Gravel sized fragments are angular to subangular fine to coarse of slag.				ES1	0.30				
				B2	0.50				
				ES3	1.00	S50/75mm	S	1.00	
				D4	1.00 - 1.20			1.17	
				ES5	2.00				
				D6	2.20 - 2.40	S50/85mm	S	2.20	
								2.44	
---from 2.50m Sandy with high cobble content. Cobble sized fragments are subangular of slag.				B7	2.50 - 3.00				
				D8	3.00 - 3.30	S51/225mm	S	3.00	
				ES9	3.00			3.38	
				D11	4.00 - 4.45	S43	S	4.00	
				ES10	4.10			4.45	
		4.60	1.29						
Stiff grey CLAY. (Estuarine Alluvium)									
				D12	4.80				
---from 4.80m to 5.20m slightly gravelly. Gravel is angular fine of mudstone				U14	5.00 - 5.45	(14)			
				ES13	5.10				
				D15	5.50	S15	S	5.50	
				D16	5.50 - 5.95			5.95	
		6.40	-0.51						
Firm black psuedofibrous PEAT. (Peat)				D17	6.50				
				U18	7.00 - 7.45	(24)			
				D19	7.00				
		7.20	-1.31						
Firm medium strength grey silty CLAY with occasional coarse gravel sized pockets of brown fibrous peat. (Estuarine Alluvium)				D20	7.50 - 7.95	S12	S	7.50	
								7.95	
---from 7.50m become soft with occasional coarse gravel sized pockets of black amorphous peat									
				D21	8.50				
				U22	9.00 - 9.45	S12 (16)	S	9.00	
								9.45	
				D23	9.50				
				D24	9.50 - 9.95				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ08A CP
Sheet 2 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	337834.72 E
Project	New M4 - Second Preliminary Ground Investigation				185599.42 N
		Drilling Rig	Dando	Ground Level	5.89m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	20/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	08/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Firm medium strength grey silty CLAY with occasional coarse gravel sized pockets of brown fibrous peat. (Estuarine Alluvium)		10.40	-4.51	D25	10.50				
Grey slightly sandy clayey subrounded to rounded medium to coarse GRAVEL of mudstone and siltstone. (Fluvial Alluvium)		10.80	-4.91	D26 U27	10.90 11.00 - 11.45	(100)			
Very stiff grey slightly gravelly CLAY. Gravel is angular fine of mudstone (Weathered Mudstone). (Mercia Mudstone Group) ---from 10.90m to 11.50m with occasional rootlets ---from 11.50m becomes reddish brown locally mottled greenish grey				D28 D29	11.50 11.50 - 11.90	S50/190mm	S	11.50 11.84	
				D30	12.50				
				D31	12.70 - 13.10	S50/210mm	S	12.70 13.06	
				D32	13.40 - 13.70	S50/150mm	S	13.40 13.70	
Cable Percussion boring complete at 13.70 m.		13.70	-7.81						

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ09 CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	338052.21 E
Project	New M4 - Second Preliminary Ground Investigation				185604.66 N
		Drilling Rig	Dando	Ground Level	5.76m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	18/12/2007

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
13/12/2007	1730	1.00	1.00	0.40	End of Shift
14/12/2007	0730	1.00	1.00	0.40	Start of Shift
14/12/2007	1730	3.50	2.50	2.20	End of Shift
17/12/2007	0730	3.50	2.50	1.30	Start of Shift
17/12/2007	1730	11.50	11.00	10.80	End of Shift
18/12/2007	0730	11.50	11.00	0.70	Start of Shift
18/12/2007	1730	13.20	11.00	6.80	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
1.00	2.20	4.00	Chiselling
12.40	12.80	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	13.20	200	11.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Cable Percussive boring complete at 13.20m.
2. 50mm standpipe installed, slotted from 1.00m to 2.20m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
1.00	S	51/150mm (5,7,11,40)	1.00	0.50
2.00	S	50/75mm (12,50)	1.90	0.70
3.00	S	N=22 (2,4,5,5,6,6)	2.50	2.20
5.00	S	N=10 (1,2,2,2,3,3)	4.10	1.50
7.00	S	N=14 (1,2,3,3,4,4)	6.20	2.60
9.00	S	N=7 (1,2,1,2,2,2)	7.70	6.10
10.50	S	N=53 (6,8,10,14,14,15)	9.80	8.50
12.20	S	50/230mm (7,9,11,14,18,7)	11.00	2.10
12.80	S	50/225mm (9,10,11,16,23)	11.00	6.80

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

Form	ARIAL CP HEADER
Version	3.05
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ09 CP
Sheet 1 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	338052.21 E
Project	New M4 - Second Preliminary Ground Investigation				185604.66 N
		Drilling Rig	Dando	Ground Level	5.76m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	18/12/2007

Description of Strata	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
MADE GROUND: Grey coarse sand sized fragments and angular to subangular fine to coarse gravel sized fragments of ash, limestone and slag. with low cobble content, cobble sized fragments are subangular of slag.			ES1	0.30				
			B2	0.50 - 1.00				
			ES3	1.00	S51/150mm	S	1.00	
			D4	1.00 - 1.30			1.30	
			ES5	2.00	S50/75mm	S	2.00	
			D6	2.00 - 2.10			2.23	
Firm grey mottled orangish brown CLAY with rare rootlets. (Estuarine Alluvium)	2.20	3.56	D7	2.30				
---at 2.30m slightly gravelly. Gravel is angular fine of mudstone			U8	2.50 - 2.95	(24)			
			D9	3.00	S22	S	3.00	
			ES10	3.00			3.45	
			D11	3.00 - 3.45				
Soft to firm indistinctly laminated grey silty CLAY with extremely closely to very closely fine to medium gravel sized pockets of brown amorphous peat. Organic odour. (Estuarine Alluvium)	4.00	1.76	ES12	4.00				
			D13	4.00				
			U14	4.50 - 4.95	(12)			
---from 5.00m becomes firm with partings of silt and fine sand. Occasional medium gravel sized pockets of black clay			D15	5.00	S10	S	5.00	
			ES16	5.00			5.45	
			D17	5.00 - 5.45				
			D18	6.00				
			U19	6.50 - 6.95	(20)			
Firm thinly laminated medium strength grey silty CLAY with laminations of extremely closely spaced black amorphous peat. (Estuarine Alluvium with bands of peat)	6.80	-1.04	D20	7.00	S14	S	7.00	
			D21	7.00 - 7.45			7.45	
			D22	8.00	(12)			
			U23	8.00 - 8.95				
Soft to firm grey silty CLAY with thin laminations of black fibrous peat. (Estuarine Alluvium)	8.90	-3.14	D24	9.00	S7	S	9.00	
			D25	9.00 - 9.45			9.45	
	9.80	-4.04	D26	9.90				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	3.09
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ09 CP
Sheet 2 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	338052.21 E
Project	New M4 - Second Preliminary Ground Investigation				185604.66 N
		Drilling Rig	Dando	Ground Level	5.76m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	AL	Orientation	Vertical
		Logged by	DH	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	18/12/2007

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Very stiff reddish brown locally mottled greenish grey slightly gravelly CLAY. Gravel is angular fine to medium (Weathered Mudstone). (Mercia Mudstone Group)				U27	10.00 - 10.45	(93)			
				D28	10.50	S53	S	10.50	
				D29	10.50 - 10.95			10.95	
				D30	11.50				
				D31	12.00 - 12.40				
						S50/230mm	S	12.20	
								12.58	
				D32	12.80 - 13.20	S50/225mm	S	12.80	
								13.18	
		13.20	-7.44						
Cable Percussion boring complete at 13.20 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ10 CP
Header

Contract No.	F15056	Method	Cable Percussion	Coordinates	338240.80 E
Project	New M4 - Second Preliminary Ground Investigation				185578.80 N
		Drilling Rig	Dando	Ground Level	6.05m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	PW	Orientation	Vertical
		Logged by	DH	Date Started	09/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	11/01/2008

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
09/01/2008	1730	6.00	4.80	2.70	End of Shift
10/01/2008	0730	6.00	4.80	1.70	Start of Shift
10/01/2008	1730	11.50	10.50	11.30	End of Shift
11/01/2008	0730	11.50	10.50	7.30	Start of Shift
11/01/2008	1730	13.00	10.50	9.20	End of Hole

BORING DETAILS

Hard Strata from depth	Hard Strata to depth	Chiselling hours	Remarks
12.30	12.70	1.00	Chiselling

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
200	1.50	200	1.50
150	13.00	150	10.50

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
09/01/2008		2.50	1.00	20	Slow	2.50	NR

GENERAL NOTES

1. Cable Percussive boring from GL to 13.00m.
2. Insitu permeability testing carried out from 10.50 to 11.50m.
3. 50mm standpipe installed, slotted from 9.00m to 10.00m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration	Casing	Water Depth
1.50	S	N=15 (2,3,3,4,4,4)	1.00	DRY
3.50	S	N=6 (1,1,2,1,1,2)	2.80	1.50
5.50	S	N=2 (1,0,0,1,0,1)	4.80	2.70
7.50	S	N=5 (1,0,1,1,1,2)	6.80	2.00
9.50	S	N=9 (1,1,2,2,2,3)	8.80	4.80
11.00	S	50/225mm (5,12,15,15,17,3)	10.50	8.90
12.00	S	50/160mm (8,11,19,29,2)	10.50	8.10
12.70	S	50/160mm (7,16,18,23,9)	10.50	9.20

* Seating blows only.

NOTES: All depths in metres, all diameters in millimetres, water strike rise time in minutes, chiselling time in hours.

Form	ARIAL CP HEADER
Version	3.05
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ10 CP
Sheet 1 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	338240.80 E
Project	New M4 - Second Preliminary Ground Investigation				185578.80 N
		Drilling Rig	Dando	Ground Level	6.05m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	PW	Orientation	Vertical
		Logged by	DH	Date Started	09/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	11/01/2008

Description of Strata	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		
MADE GROUND: Dark brown silty very sandy angular to subangular fine to coarse Gravel sized fragments of sandstone and slag.			ES1	0.30				
			B2	0.50 - 0.80				
	0.80	5.25						
Firm to stiff grey silty CLAY with occasional rootlets (Mild organic odour). (Estuarine Alluvium)			ES3	1.00				
			U4	1.00 - 1.45				
	1.50	4.55	D5	1.50	S15	S	1.50	1.95
Firm orangish brown mottled grey CLAY. (Estuarine Alluvium)			D6	1.50 - 1.95				
			ES7	2.00				
	2.50	3.55	D8	2.50				
Soft very low strength grey silty CLAY. (Estuarine Alluvium) ---from 2.50m to 3.50m become slightly gravelly. Gravel is angular fine to medium of mudstone			ES9	3.00				
			U10	3.00 - 3.45				
			D11	3.50	S6	S	3.50	3.95
			D12	3.50 - 3.95				
			ES13	4.00				
	4.50	1.55	D14	4.50				
Very soft grey silty CLAY with rare rootlets. (Estuarine Alluvium)			ES15	5.00				
			U16	5.00 - 5.45				
			D17	5.50	S2	S	5.50	6.03
			D18	5.50 - 5.95				
			B19	6.30 - 6.80				
			U20	7.00 - 7.45				
			D21	7.50	S5	S	7.50	8.03
			D22	7.50 - 7.95				
	7.70	-1.65						
Very soft dark grey clayey PEAT. (Peat)								
	8.20	-2.15						
Very soft grey silty CLAY with occasional coarse gravel sized pockets of fine sand. (Estuarine Alluvium)			D23	8.50				
			U24	9.00 - 9.45				
---from 9.50m becomes slightly sandy gravelly. Gravel is angular to subangular fine to medium of sandstone			D25	9.50	S9	S	9.50	9.95
			D26	9.50 - 9.95				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
SBHJ10 CP
Sheet 2 of 2

Contract No.	F15056	Method	Cable Percussion	Coordinates	338240.80 E
Project	New M4 - Second Preliminary Ground Investigation				185578.80 N
		Drilling Rig	Dando	Ground Level	6.05m AOD
Client	Transport Wales, Welsh Assembly Government	Driller	PW	Orientation	Vertical
		Logged by	DH	Date Started	09/01/2008
Consultant	Ove Arup & Partners Ltd			Date Completed	11/01/2008

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		SPT N & (U blows)	SPT type & depth		Install-ation
Remaining Detail : 9.40m - 9.40m : and mudstone		10.00	-3.95						
stiff to very stiff reddish brown mottled greenish grey slightly gravelly CLAY. Gravel is angular fine to medium of mudstone (Weathered Mudstone). (Mercia Mudstone Group)				D27	10.20				
				U28	10.50 - 10.95				
---from 11.00m very stiff				D29	11.00	G50/225mm	S	11.00	
				D30	11.00 - 11.45			11.38	
				D31	12.00 - 12.30	G50/160mm	S	12.00	
								12.31	
Very weak reddish brown mottled greenish grey MUDSTONE. Recovered as angular fine to coarse gravel sized fragments. (Mercia Mudstone Group)		12.50	-6.45	D32	12.50				
				D33	12.70 - 13.00	G50/160mm	S	12.70	
								13.01	
---from 12.50m recovered as angular fine to coarse gravel sized fragments		13.00	-6.95						
Cable Percussion boring complete at 13.00 m.									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
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Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

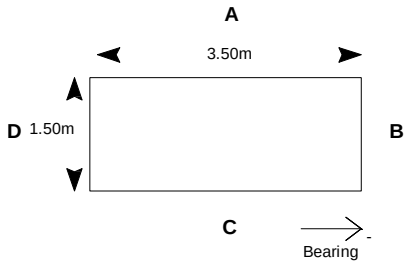
Hole ID.
STPJ01
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	337885.82 E
Project	New M4 - Second Preliminary Ground Investigation				185598.97 N
		Equipment	JCB 3CX	Ground Level	5.95m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	13/12/2007
		Logged by	JB	Date Completed	13/12/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: Grey angular to subangular cobble and boulder sized fragments of slag, brick and concrete.		0.30	5.65	ES1	0.30	
MADE GROUND: Greyish brown sandy gravelly angular to subangular cobble sized fragments of slag, concrete, brick, tarmac, wood and metal. Gravel sized fragments are angular to subangular fine to coarse of slag, wood, metal, mudstone and sandstone. ---from 0.30m slight sulphur odour. ---from 0.50m low boulder content, boulder sized fragments are angular of slag ---at 1.10m yellowish grey on face A				D2 B3 W4 ES5 D6 ES7 B8	0.50 0.50 - 1.00 0.80 1.00 2.00 2.00 2.00 - 2.50	
Firm locally stiff grey mottled orangish brown slightly sandy CLAY. With frequent organic material. Estuarine Alluvium)		3.00	2.95	ES9 D10 B11	3.00 3.00 3.00 - 3.50	
Soft to firm grey slightly silty CLAY with occasional organic material. (Estuarine Alluvium)		3.80	2.15	ES12 D13 B14	4.00 4.00 4.00 - 4.50	
Trial pit complete at 4.50 m.		4.50	1.45			

Stability	Slight collapse from 1.00m on all faces
Shoring	None used
Groundwater	Water strike at 1.00m on face A - fast
Remarks	1.Trial pit complete at 4.50m

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HAND VANE AND HAND PENETROMETER TESTS

Hole ID.
STPJ01
Data Sheet

Contract No.	F15056	Method	Machine Excavated	Coordinates	337885.82E
Project	New M4 - Second Preliminary Ground Investigation				185598.97 N
		Equipment	JCB 3CX	Ground Level	5.95m AOD
Client	Transport Wales, Welsh Assembly Government			Orientation	Vertical
		Logged by	JB	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	13/12/2007

Hand Vane				Hand Penetrometer		
Depth	Test No	Peak	Remoulded	Depth	Test No	Result
3.00	01	90.0	30.0			
3.00	02	90.0	20.0			
3.00	03	60.0	20.0			
4.00	04	70.0	30.0			
4.00	05	50.0	20.0			
4.00	06	50.0	20.0			

NOTES: All depths in metres, all diameters in millimetres, test results in kPa.

Form	ARIAL HAND VANE/PEN
Version	3.03
Revised	18/01/2007

Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

Hole ID.
STPJ02
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	337935.30 E
Project	New M4 - Second Preliminary Ground Investigation				185662.19 N
		Equipment	JCB 3CX	Ground Level	5.37m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	13/12/2007
		Logged by	JB	Date Completed	13/12/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: Grey slightly sandy ashy angular to subangular gravel sized fragnments of slag, concrete, brick, limestone and mudstone.		0.30	5.07	ES1	0.30	
MADE GROUND: Grey mottled brown locally red silty slightly sandy clay. ---at 0.30m strong hydrocarbon odour ---from 0.50m to 1.20m with frequent wooden sleepers and low boulder content, boulder sized fragments are subangular of slag		1.20	4.17	D2 B3 ES4 W5 D6	0.60 0.60 - 1.00 1.00 1.00 1.40	
Firm grey mottled orangish brown slightly sandy CLAY. With frequent organic material (Estuarine Alluvium) ---from 2.00m soft		2.80	2.57	ES7 B8	2.00 2.00 - 2.50	
Soft grey silty CLAY. (Estuarine Alluvium) ---from 4.00m occasional coarse gravel sized pockets of dark bown fibrous peat		4.50	0.87	ES9 D10 B11 ES12 D13	3.00 3.00 3.00 - 3.50 4.00 4.00	
Trial pit complete at 4.50 m.						

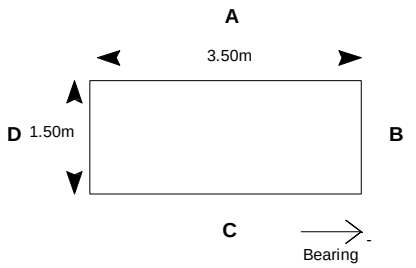
Stability: All faces stable

Shoring: None used

Groundwater: Water strike at 0.50m on face D - fast

Remarks: 1.Trial pit complete at 4.50m

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HAND VANE AND HAND PENETROMETER TESTS

Hole ID.
STPJ02
Data Sheet

Contract No.	F15056	Method	Machine Excavated	Coordinates	337935.30E
Project	New M4 - Second Preliminary Ground Investigation				185662.19 N
		Equipment	JCB 3CX	Ground Level	5.37m AOD
Client	Transport Wales, Welsh Assembly Government			Orientation	Vertical
		Logged by	JB	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	13/12/2007

Hand Vane				Hand Penetrometer		
Depth	Test No	Peak	Remoulded	Depth	Test No	Result
1.00	01	65.0	15.0			
1.00	02	60.0	20.0			
1.00	03	50.0	15.0			
2.00	04	45.0	15.0			
2.00	05	50.0	10.0			
2.00	06	50.0	20.0			
3.00	07	15.0	5.0			
3.00	08	20.0	10.0			
3.00	09	20.0	5.0			
4.00	10	15.0	5.0			
4.00	11	20.0	5.0			
4.00	12	20.0	5.0			

NOTES: All depths in metres, all diameters in millimetres, test results in kPa.

Form	ARIAL HAND VANE/PEN
Version	3.03
Revised	18/01/2007

Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

Hole ID.
STPJ03
Sheet 1 of 1

Contract No.	F15056	Method	Machine excavated	Coordinates	338042.86 E
Project	New M4 - Second Preliminary Ground Investigation				185622.56 N
		Equipment	JCB 3CX	Ground Level	5.57m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	13/12/2007
		Logged by	JB	Date Completed	13/12/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: Greyish brown slightly sandy angular to subangular fine to coarse gravel sized fragments of limestone, slag, brick, concrete, wood and metal. With occasional coarse gravel sized pockets of greyish brown clay. ---from 0.30m with high cobble content, cobble sized fragments are subangular of slag				ES1 W2 D3 B4	0.40 0.50 0.60 0.60 - 1.00	
		1.20	4.37	ES5	1.20	
Firm locally stiff grey mottled orangish brown silty slightly sandy locally sandy CLAY. With frequent organic material. (Estuarine Alluvium) ---from 2.00m soft to firm				D6 ES7 D8 B9	1.40 2.00 2.00 2.00 - 2.50	
		2.80	2.77			
Soft locally firm grey silty CLAY with occasional organic material. (Estuarine Alluvium) ---from 0.30m with occasional lenses of grey coarse sand				ES10 D11 B12 ES13 D14	3.00 3.00 3.50 - 4.00 4.00 4.00	
		4.50	1.07			
Trial pit complete at 4.50 m.						

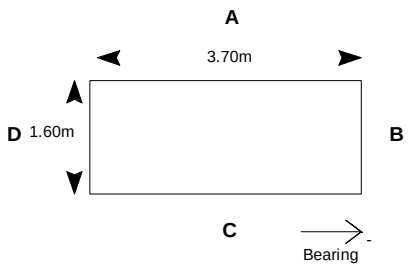
Stability: All faces stable

Shoring: None used

Groundwater: Water strike on all faces at 0.50m - fast

Remarks: 1.Trial pit complete at 4.50m

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HAND VANE AND HAND PENETROMETER TESTS

Hole ID.
STPJ03
Data Sheet

Contract No.	F15056	Method	Machine excavated	Coordinates	338042.86E
Project	New M4 - Second Preliminary Ground Investigation				185622.56 N
		Equipment	JCB 3CX	Ground Level	5.57m AOD
Client	Transport Wales, Welsh Assembly Government			Orientation	Vertical
		Logged by	JB	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	13/12/2007

Hand Vane				Hand Penetrometer		
Depth	Test No	Peak	Remoulded	Depth	Test No	Result
1.00	01	40.0	15.0			
1.00	02	40.0	20.0			
1.00	03	50.0	20.0			
2.00	04	30.0	10.0			
2.00	05	30.0	10.0			
2.00	06	40.0	15.0			
3.00	07	20.0	5.0			
3.00	08	20.0	5.0			
3.00	09	25.0	0.0			
4.00	10	20.0	5.0			
4.00	11	30.0	5.0			
4.00	12	25.0	5.0			

NOTES: All depths in metres, all diameters in millimetres, test results in kPa.

Form	ARIAL HAND VANE/PEN
Version	3.03
Revised	18/01/2007

Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

Hole ID.
STPJ04
Sheet 1 of 1

Contract No.	F15056	Method	Machine excavated	Coordinates	338151.61 E
Project	New M4 - Second Preliminary Ground Investigation				185699.26 N
		Equipment	JCB 3CX	Ground Level	5.43m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	13/12/2007
		Logged by	JB	Date Completed	13/12/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: Greyish brown sandy angular to subangular coarse gravel sized fragments of limestone, slag, brick and concrete with high cobble content, cobble sized fragments are subangular of slag, concrete and brick.				ES1 W2 D3 B4 ES5	0.30 0.30 0.50 0.50 - 1.00 1.00	
		1.20	4.23			
Firm locally stiff grey mottled orangish brown slightly sandy CLAY. With abundant organic material. (Estuarine Alluvium) ---at 1.20m thin layer of plant matter ---from 1.50m occasional organic material				D6 ES7 B8	1.50 1.50 2.00 - 2.50	
		2.40	3.03			
Soft locally firm grey silty CLAY with occasional organic material. (Estuarine Alluvium) ---from 3.00m occasional lenses of coarse sand				ES9 D10 ES11 D12 B13 ES14	2.50 2.50 3.50 3.50 3.50 - 4.00 4.00	
		4.50	0.93			
Trial pit complete at 4.50 m.						

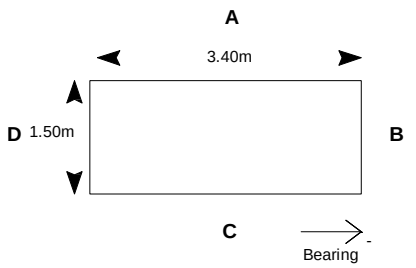
Stability: All faces stable

Shoring: None used

Groundwater: Water strike at 0.30m on all faces - fast

Remarks: 1.Trial pit complete at 4.50m

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HAND VANE AND HAND PENETROMETER TESTS

Hole ID.
STPJ04
Data Sheet

Contract No.	F15056	Method	Machine excavated	Coordinates	338151.61E
Project	New M4 - Second Preliminary Ground Investigation				185699.26 N
		Equipment	JCB 3CX	Ground Level	5.43m AOD
Client	Transport Wales, Welsh Assembly Government			Orientation	Vertical
		Logged by	JB	Date Started	13/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	13/12/2007

Hand Vane				Hand Penetrometer		
Depth	Test No	Peak	Remoulded	Depth	Test No	Result
2.00	01	80.0	20.0			
2.00	02	75.0	20.0			
2.00	03	90.0	25.0			
3.00	04	25.0	5.0			
3.00	05	30.0	10.0			
3.00	06	35.0	10.0			
4.00	07	25.0	5.0			
4.00	08	30.0	5.0			
4.00	09	30.0	5.0			

NOTES: All depths in metres, all diameters in millimetres, test results in kPa.

Form	ARIAL HAND VANE/PEN
Version	3.03
Revised	18/01/2007

Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

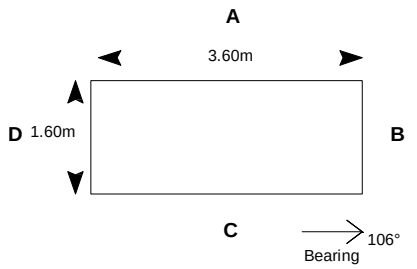
Hole ID.
STPJ05
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	338172.76 E
Project	New M4 - Second Preliminary Ground Investigation				185579.54 N
		Equipment	JCB 3CX	Ground Level	5.85m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	14/12/2007
		Logged by	JB	Date Completed	14/12/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: Grey sandy angular to subangular gravel sized fragments of slag, limestone, metal and concrete with high cobble content, cobble sized fragments are angular of slag.		0.30	5.55	ES1	0.30	
MADE GROUND: Brownish grey mottled orangish brown slightly sandy clay with low cobble content and rootlets. Cobble sized fragments are angular of slag.		0.60	5.25	D2 B3	0.60 0.60 - 1.00	
Firm grey and orangish brown silty slightly sandy locally sandy CLAY with occasional organic matter. (Estuarine Alluvium)				ES4 D5 ES6 B7	1.00 2.00 2.00 2.50 - 3.00	
Soft to firm slightly silty grey CLAY with occasional organic matter. (Estuarine Alluvium) ---from 3.20m soft locally very soft silty		2.80	3.05	ES8 D9 ES10 D11 B12	3.00 3.00 4.00 4.00 4.00 - 4.50	
Trial pit complete at 4.50 m.		4.50	1.35			

Stability	Collapse from 2.00m on face D
Shoring	None used
Groundwater	Water strike at 2.60m face A - seepage
Remarks	1.Trial pit complete at 4.50m.

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HAND VANE AND HAND PENETROMETER TESTS

Hole ID.
STPJ05
Data Sheet

Contract No.	F15056	Method	Machine Excavated	Coordinates	338172.76E
Project	New M4 - Second Preliminary Ground Investigation				185579.54 N
		Equipment	JCB 3CX	Ground Level	5.85m AOD
Client	Transport Wales, Welsh Assembly Government			Orientation	Vertical
		Logged by	JB	Date Started	14/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	14/12/2007

Hand Vane				Hand Penetrometer		
Depth	Test No	Peak	Remoulded	Depth	Test No	Result
1.00	01	60.0	20.0			
1.00	02	50.0	15.0			
1.00	03	60.0	15.0			
2.00	04	40.0	15.0			
2.00	05	40.0	20.0			
2.00	06	45.0	15.0			
3.00	07	30.0	5.0			
3.00	08	25.0	5.0			
3.00	09	25.0	5.0			
4.00	10	30.0	10.0			
4.00	11	25.0	0.0			
4.00	12	30.0	5.0			

NOTES: All depths in metres, all diameters in millimetres, test results in kPa.

Form	ARIAL HAND VANE/PEN
Version	3.03
Revised	18/01/2007

Norwest Holst Soil Engineering Ltd.

TRIAL PIT LOG

Hole ID.
STPJ06
Sheet 1 of 1

Contract No.	F15056	Method	Machine Excavated	Coordinates	338227.89 E
Project	New M4 - Second Preliminary Ground Investigation				185623.61 N
		Equipment	JCB 3CX	Ground Level	5.71m AOD
Client	Transport Wales, Welsh Assembly Government			Date Started	14/12/2007
		Logged by	JB	Date Completed	14/12/2007
Consultant	Ove Arup & Partners Ltd				

Description of Strata	Legend	Depth Below G.L.	Datum Level	Sampling		Remarks
MADE GROUND: Greyish brown sandy angular to subangular fine to coarse gravel sized fragments of slag, concrete, brick and metal. With high cobble content, cobble sized fragments are angular to subangular of slag and concrete.				ES1	0.30	
				D2	0.50	
				W3	0.50	
				B4	0.50 - 1.00	
				ES5	1.00	
				D6	1.50	
				ES7	2.00	
				B8	2.00 - 2.50	
		2.60	3.11	D9	2.60	
Firm greenish grey mottled brown slightly sandy CLAY with occasional organic material. (Estuarine Alluvium)				ES10	3.00	
				B11	3.50 - 4.00	
		3.80	1.91			
Soft grey silty CLAY with occasional organic material. (Estuarine Alluvium)				ES12	4.00	
				D13	4.00	
		4.50	1.21			
Trial pit complete at 4.50 m.						

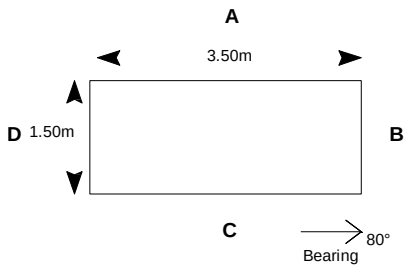
Stability: All faces stable

Shoring: None used

Groundwater: Water strike at 0.50m on all faces - fast

Remarks: 1.Trial pit complete at 4.50m.

Sketch Plan of Trial Pit



NOTES: All depths in metres, all soil strengths in kPa.
See legend sheet for key to symbols and abbreviations.
All bearings given relate to magnetic North

Form	ARIAL TP LOG
Version	3.06
Revised	17/12/2007

Norwest Holst Soil Engineering Ltd.

HAND VANE AND HAND PENETROMETER TESTS

Hole ID.
STPJ06
Data Sheet

Contract No.	F15056	Method	Machine Excavated	Coordinates	338227.89E
Project	New M4 - Second Preliminary Ground Investigation				185623.61 N
		Equipment	JCB 3CX	Ground Level	5.71m AOD
Client	Transport Wales, Welsh Assembly Government			Orientation	Vertical
		Logged by	JB	Date Started	14/12/2007
Consultant	Ove Arup & Partners Ltd			Date Completed	14/12/2007

Hand Vane				Hand Penetrometer		
Depth	Test No	Peak	Remoulded	Depth	Test No	Result
3.00	01	90.0	30.0			
3.00	02	70.0	20.0			
3.00	03	80.0	25.0			
4.00	04	30.0	10.0			
4.00	05	30.0	10.0			
4.00	06	30.0	10.0			

NOTES: All depths in metres, all diameters in millimetres, test results in kPa.

Form	ARIAL HAND VANE/PEN
Version	3.03
Revised	18/01/2007

Geotechnical Engineering Limited

BOREHOLE LOG

BH522

CLIENT	WELSH GOVERNMENT					Sheet	1 of 2
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	20 February 2015	Easting	337987.9				
End Date	26 February 2015	Northing	185605.2	Ground level	5.30mOD	Depth	17.60 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
20/02/15 1500hrs									Dark grey and black subangular fine to coarse slag and limestone GRAVEL with a low subangular slag cobble content and rare fragments of steel. (MG)			
		0.50	0.95	Nil	C 29				0.50 - 2.30m: Medium dense and dense.			
	1B	0.50	2.00									
	2D*	0.50	0.70		Vo 0.2							
		1.00	1.45	1.00	C 24							
	3D*	1.00	1.20		Vo 0.2							
		1.50	1.95	1.50	C 33							
20/02/15 1700hrs 0.50m	4D*	1.50	1.70		Vo 0.2							
		2.00	2.45	2.00	C 26							
	5B	2.00	2.50									
23/02/15 0800hrs 0.50m	6D*	2.00	2.20		Vo 0.2				2.00 - 2.50m: Clayey.			
	7D	2.30								2.30	3.00	
									Very soft grey mottled orangish brown silty CLAY with frequent thin laminae of grey fine sand. (TFD)			
	8UT	2.50	2.95	2.40						2.70	2.60	
	10D*	2.50	2.70		Vo 0.2				Very soft and soft grey silty CLAY with rare fragments (up to 10mm) of black organic material and rare rootlets (up to 50mm x 2mm diam). Organic odour. (TFD)			
	9D	2.95	3.00									
	11D	3.00	3.45	3.00	S 8							
	12B	3.00	3.50									
	13D*	3.00	3.20		Vo 0.2							
	14UT	3.50	3.95	3.00								
	16D*	3.50	3.70		Vo 0.2							
	15D	3.95	4.00									
	16D	4.00	4.45	3.50	S 8							
	17B	4.00	4.50									
	18D*	4.00	4.20		Vo 0.2							
	19UT	4.50	4.95	4.00								
	21D*	4.50	4.70									
	20D	4.95	5.00									
	22D	5.00	5.45	4.90	S 6							
	23B	5.00	5.50									
	24D*	5.00	5.20		Vo 0.3							
										5.60	-0.30	
	25B	5.60	5.90						Spongy black and dark brown fibrous PEAT with frequent plant fragments (up to 60mm). Organic odour. (PEAT)			
	26D	5.70								5.90	-0.60	
	27D	6.00										
	28D*	6.00	6.20						Grey slightly sandy SILT with rare fragments (up to 5mm) of black organic material and rare shell fragments (up to 3mm). Slight organic odour. (TFD)			
	29UT	6.50	6.95	6.00								
	30D	6.95	7.00									
	31D*	7.00	7.20									
									7.30m: Driller notes silty sand.			
	32D	7.50										
	33D	8.20	8.60	8.00	S 4							
									Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-0.50m. Cable percussion (200mm) 0.50-3.00m and (150mm) 3.00-11.90m. Waterflush rotary core drilled (116mm) 11.90-17.60m.

CASING: 200mm diam to 2.50m and 150mm diam to 11.50m.

BACKFILL: On completion, hole backfilled with bentonite pellets 17.60-0.60m and gravel 0.60-0.00m.

REMARKS: Hole advanced by chiselling 0.50-2.30m (4hr) and 11.50-11.90m (1hr).

Downhole magnetometry for UXO risk mitigation undertaken 0.00-10.00m. No anomalies encountered.

Bentonite seal for aquifer protection installed during drilling 2.00-3.00m, prior to reduction in casing diameter. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
0.20	Nil	0.20	20	Slow
5.90		5.50	20	Medium.

AGS

CONTRACT	CHECKED
30238	EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH522

CLIENT	WELSH GOVERNMENT					Sheet	2 of 2
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	20 February 2015	Easting	337987.9				
End Date	26 February 2015	Northing	185605.2	Ground level	5.30mOD	Depth	17.60 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	34B	8.00	8.70						8.00 - 8.60m: Slightly gravelly. Gravel is subrounded fine to coarse sandstone.			
	35D*	8.00	8.20		Vo 0.0							
	36D	8.70							8.60 - 9.30m: With very thin beds and pockets of spongy dark brown fibrous peat.			
										9.30	-4.00	
	37D	9.40							Stiff fissured reddish brown slightly sandy slightly gravelly CLAY with rare light bluish grey reduction spots (up to 2mm). Gravel is angular fine and medium lithorelicts of very stiff clay. (MMG) (MMG)			
23/02/15 1700hrs Dry	38UT	9.50	9.80	9.00								
	39B	9.50	10.00									
	40D	10.00	10.45	10.00	S 48							
24/02/15 0800hrs 9.80m	41B	10.00	10.50									
										11.00	-5.70	
	42B	11.00	11.50						Stiff reddish brown gravelly CLAY with rare low subangular mudstone cobble content. Gravel is subangular fine to coarse mudstone lithorelicts. (MMG) (MMG)			
24/02/15 1200hrs 8.10m		11.50	11.70	10.00	C*278							
		11.90	12.01	10.00	C*417					11.90	-6.60	
26/02/15 1020hrs 5.28m	43C	11.90	13.10	11.50		100	NA		Stiff fissured reddish brown gravelly CLAY. Gravel is randomly orientated angular and subangular fine and medium lithorelicts of very stiff clay. (MMG) (Grade III)			
	44C	13.10	14.60	11.50		100			13.10 - 13.20m: Stiff greenish grey silty clay.			
										14.20	-8.90	
									Stiff indistinctly fissured greenish grey silty CLAY. (MMG) (Grade IVb)			
	45C	14.60	16.10	11.50		100 38 0				14.70	-9.40	
									Stiff fissured reddish brown silty CLAY with rare subangular fine and medium gravel sized mudstone lithorelicts. (MMG) (Grade IVa)	15.10	-9.80	
							NI		Extremely weak and very weak thinly laminated to very thinly bedded reddish brown MUDSTONE. Fractures are subhorizontal and 20° extremely closely and very closely spaced planar rough with a clay veneer. (MMG) (Grade I/II)	15.90	-10.60	
							NA					
	46C	16.10	17.60	11.50		100			Very stiff fissured reddish brown gravelly CLAY. Gravel is subangular fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal extremely closely and very closely spaced planar smooth. (MMG) (Grade III)			
26/02/15 1305hrs 2.21m										17.60	-12.30	
									Borehole completed at 17.60m.	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	AGS	CONTRACT	CHECKED
						30238	EC

Geotechnical Engineering Ltd, Tel. 01452 527743 30238 YODA.GPJ TRIALJH.GPJ GEOTECH.GLB 16/07/2015 16:02:37 TP EC

Geotechnical Engineering Limited

BOREHOLE LOG

BH523

CLIENT	WELSH GOVERNMENT					Sheet	1 of 2
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	27 February 2015	Easting	338059.0			Depth	17.00 m
End Date	6 March 2015	Northing	185604.9	Ground level	6.15mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
27/02/15 1100hrs								Dense and very dense dark greyish black subangular and subrounded fine to coarse slag GRAVEL with a high subangular slag cobble content. (MG)			
		0.50 - 0.95	0.50	C 50							
	1B	0.50 - 0.90									
	2D*	0.50 - 0.70		Vo 0.0							
		1.00 - 1.45	1.00	C 47							
	3B	1.00 - 1.40									
	4D*	1.00 - 1.20		Vo 0.0							
		1.50 - 1.95	1.50	C 35							
	5B	1.50 - 1.90									
	6D*	1.50 - 1.70		Vo 0.1							
		2.00 - 2.45	2.00	C 65							
	7B	2.00 - 2.40							2.00	4.15	
	8D*	2.00 - 2.20		Vo 0.0				Dense dark grey and black subangular and subrounded fine to coarse slag GRAVEL with low slag cobble content. (MG)			
		2.50 - 2.95	2.50	C 37							
	9B	2.50 - 2.90									
	10D*	2.50 - 2.70		Vo 0.0							
		3.00 - 3.45	3.00	C 33							
	12D*	3.00 - 3.20		Vo 0.0							
	11B	3.10 - 3.40							3.20	2.95	
								Soft brownish grey slightly sandy gravelly silty CLAY. Gravel is subangular fine to coarse slag. (MG)			
27/02/15 1700hrs NR	13D*	3.50 - 3.70		Vo 0.0					3.80	2.35	
	14D	4.00 - 4.45	4.00	S 15				Firm light grey slightly sandy slightly gravelly silty CLAY. Gravel is subangular and subrounded fine to coarse slag. (MG)			
03/03/15 0800hrs NR	15B	4.00 - 4.40									
	16D*	4.00 - 4.40							4.40	1.75	
								Firm brownish grey silty CLAY. (TFD)			
	17UT	4.50 - 4.95	4.50								
	20D*	4.50 - 4.70									
	18D	4.95 - 5.00									
	21D*	4.95 - 5.00									
	19D	5.00 - 5.45	5.00	S 10							
	22B	5.00 - 5.50									
	23D*	6.00 - 6.20									
	24UT	6.50 - 6.95	6.50								
									6.95	-0.80	
								Firm black fibrous slightly clayey PEAT with frequent rootlets (up to 1mm diam). (PEAT)			
	25D	6.95 - 7.00									
	26D*	7.00 - 7.20									
	27B	7.50 - 7.90									
									7.90	-1.75	
								Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-0.50m. Cable percussion (200mm) 0.50-4.00m and (150mm) 4.00-11.80m. Waterflush rotary core drilled (116mm) 11.80-17.00m.

CASING: 200mm diam to 4.00m, 150mm diam to 11.70m and 140mm diam to 11.70m.

BACKFILL: On completion, borehole backfilled with bentonite 17.00-0.00m.

REMARKS: Hole advanced by chiselling 0.60-0.90m (45mins) and 2.20-2.50m (1hr 15mins). Driller notes reduced flush returns 13.20-17.00 (40-55% returned). Downhole magnetometry for UXO risk mitigation undertaken 0.00-11.00m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling 3.00-4.00m, prior to reduction in casing diameter. MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
1.00	1.00	1.00	20	Seepage.

AGS

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BOREHOLE LOG

BH523

CLIENT	WELSH GOVERNMENT					Sheet	2 of 2
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	27 February 2015	Easting	338059.0			Depth	17.00 m
End Date	6 March 2015	Northing	185604.9	Ground level	6.15mOD		

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	28UT 30D* 29D 31B	8.00 - 8.45 8.00 - 8.20 8.45 - 8.50 8.50 - 9.00	8.00					Firm brownish grey mottled black silty CLAY with frequent lenses of black organic material. (TFD)			
	32D 33B	9.50 - 9.95 9.50 - 10.00	9.50	S 14					10.30	-4.15	
	34UT	10.50 - 10.95	10.50					Firm fissured reddish brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine and medium lithorelicts of stiff clay and extremely weak mudstone. (MMG)			
	35D	10.95 - 11.00									
03/03/15 1700hrs NR	36B	11.30 - 11.70									
		11.80 - 12.25	11.70	C 68					11.80	-5.65	
05/03/15 1330hrs 1.10m	37C	11.80 - 13.20			100	NA		Very stiff fissured reddish brown sandy gravelly CLAY with subangular fine to coarse lithorelicts of extremely weak and weak mudstone. (MMG) (Grade III) 11.80 - 11.95m: Drilling disturbed. Sandstone cobble. Locally bluish grey. 11.85 - 11.95m: Bluish grey sandy clay. 12.25 - 12.60m: Bluish grey.			
									13.20	-7.05	
	38C	13.20 - 14.70	11.70		100 0 0	NI NA		Highly fractured black and light brown SANDSTONE and MUDSTONE recovered non intact. (MMG)	13.40	-7.25	
05/03/15 1600hrs 3.20m								Very stiff fissured reddish brown gravelly CLAY. Gravel is subangular and subrounded fine to coarse lithorelicts of extremely weak and very weak mudstone. Fractures are subhorizontal to 20° and subvertical very closely and closely spaced undulating rough with clay veneer. (MMG) (Grade III)			
06/03/15 1000hrs 4.10m	39C	14.70 - 16.20	14.70		100			15.45 - 16.05m: Mottled light bluish grey.			
									16.05	-9.90	
06/03/15 1330hrs 0.42m	40C	16.20 - 17.00	14.70		100			Stiff fissured reddish brown slightly sandy gravelly CLAY. Gravel is subangular and subrounded fine and medium lithorelicts of very stiff clay and extremely weak mudstone. (MMG) (Grade III)			
									17.00	-10.85	
								Borehole completed at 17.00m.			
									{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
10.50	10.50	9.60	20	Medium flow.

AGS

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BOREHOLE LOG

BH524

CLIENT	WELSH GOVERNMENT					Sheet	1 of 2
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	23 February 2015	Easting	338202.4				
End Date	25 February 2015	Northing	185612.9	Ground level	5.70mOD	Depth	17.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
23/02/15 1500hrs								Dense and very dense dark grey sandy subangular fine to coarse slag, concrete, brick and limestone GRAVEL. Driller notes slag cobbles and boulders. (MG)			
		0.50 - 0.90	0.50	C*61							
	1B	0.50 - 0.90									
24/02/15 0800hrs Dry	2D*	0.50 - 0.70		Vo 0.0							
		1.00 - 1.45	0.50	C 39							
	3B	1.00 - 1.40									
	4D*	1.00 - 1.20		Vo 0.0							
		1.50 - 1.95	1.00	C 33							
	5B	1.50 - 1.90									
	6D*	1.50 - 1.70		Vo 0.0							
		2.00 - 2.38	2.00	C*67							
	7B	2.00 - 2.40									
	8D*	2.00 - 2.20		Vo 0.0							
		2.50 - 2.95	2.50	C 40							
	9B	2.50 - 2.90									
	10D*	2.50 - 2.70		Vo 0.0							
		3.00 - 3.45	3.00	C 38							
	11B	3.00 - 3.40									
	12D*	3.00 - 3.20		Vo 0.0							
		3.50 - 3.95	3.50	C 27							
	13B	3.50 - 3.90									
	14D*	3.50 - 3.70		Vo 0.0				3.50m: Medium dense.			
	15D	4.00 - 4.45	4.00	S 13							
	16B	4.00 - 4.40							4.00	1.70	
	17D*	4.00 - 4.20		Vo 0.7				Soft dark grey silty CLAY with rare slag gravel. (MG)			
	20D*	4.50 - 4.70							4.50	1.20	
24/02/15 1700hrs Dry	18UT	4.50 - 4.95						Soft locally firm grey mottled light brown silty CLAY with rare fragments (up to 5mm) of black organic material. Slight organic odour. (TFD)			
	19D	4.95 - 5.00									
25/02/15 0800hrs Dry	21D	5.00 - 5.45	5.00	S 11							
	22B	5.00 - 5.50									
	23D*	5.00 - 5.10		Vo 0.0							
	24D*	5.60 - 5.70		Vo 0.0							
	26UT	6.50 - 6.95	6.50								
	25D*	6.50 - 6.60									
	27D	6.95 - 7.00							6.95	-1.25	
	28B	7.00 - 7.50						Soft grey and light greyish brown silty CLAY with very thin and thin beds of firm dark brown and black fibrous peat. Frequent rootlets and fragments (up to 60mm x 2mm diam) of plant material. Slight organic odour. (TFDP)			
	29D*	7.50 - 7.60		Vo 0.0							
								Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-0.50m. Cable percussion (200mm) 0.50-11.00m. Waterflush rotary core drilled (116mm) 11.00-17.00m.

CASING: 200mm diam to 11.00m.

BACKFILL: On completion, hole backfilled with bentonite pellets.

REMARKS: Hole advanced by chiselling 1.20-1.50m (1hr15mins), 2.30-2.50m (1hr15mins) and 2.80-3.00m (1hr).

Downhole magnetometry for UXO risk mitigation undertaken 0.00-11.00m. No anomalies encountered.

Bentonite seal for aquifer protection installed during drilling 3.50m, prior to reduction in casing diameter.

MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

AGS

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BOREHOLE LOG

BH524

CLIENT	WELSH GOVERNMENT					Sheet	2 of 2
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 50
Start Date	23 February 2015	Easting	338202.4				
End Date	25 February 2015	Northing	185612.9	Ground level	5.70mOD	Depth	17.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	30UT	8.00 - 8.45	8.00								
	31D	8.45 - 8.50									
	32B	8.50 - 9.00									
	33D	9.50 - 9.95	9.50	S 27					9.60	-3.90	
	34B	10.00 - 10.50						Stiff dark reddish brown slightly gravelly CLAY. Gravel is angular and subangular fine and medium mudstone lithorelicts rarely subrounded and rounded fine to coarse sandstone. (MMG)	11.00	-5.30	
25/02/15 1700hrs 10.35m	35UT	11.00 - 11.45	11.00		89	NA		Stiff fissured reddish brown slightly gravelly CLAY. Gravel is subangular fine to coarse lithorelicts of very stiff clay to extremely weak mudstone. Localised relict fissures are randomly orientated extremely closely spaced. (MMG) (Grade III)			
	38C	11.00 - 12.50									
26/02/15 1230hrs 3.22m	36D	11.45 - 11.50									
	37D	11.50 - 11.88	11.00	S*68							
	39C	12.50 - 14.00	11.00		100			13.30 - 13.45m: Light greenish grey.	13.60	-7.90	
						NI		Extremely weak highly fractured dark reddish brown MUDSTONE locally tending to claybound mudstone lithorelicts. Fractures are subhorizontal to 20° and 70° to subvertical extremely and very closely spaced planar and undulating smooth. (MMG) (Grade II/III)			
	40C	14.00 - 15.50	11.00		100 34 0						
	41C	15.50 - 17.00	11.00		100 7 0			15.40 - 15.60m: Extremely weak light greenish grey siltstone.			
27/02/15 1530hrs 2.56m								16.20 - 16.65m: Very stiff light greenish grey slightly sandy silty clay with frequent fine and medium gravel sized siltstone lithorelicts.	17.00	-11.30	
								Borehole completed at 17.00m.	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks
10.50	10.50	10.35	20	

AGS

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BOREHOLE LOG

BH525

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	1 of 3
Start Date	24 February 2015	Easting	338301.6	Scale	1 : 50
End Date	26 February 2015	Northing	185578.3 Ground level 5.95mOD	Depth	22.70 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
24/02/15 0800hrs									Large slag BOULDERS (Driller's description). (MG)			
	1D	1.00	1.45	1.00	S 5							
	2B	1.00	1.50							1.00	4.95	
	3D*	1.00	1.20		Vo 0.2				Soft dark grey slightly gravelly silty CLAY. Gravel is angular and subangular fine to coarse brick, slag and limestone. (MG)	1.30	4.65	
	4D	1.50	1.95	1.50	S 8							
	5B	1.50	2.00									
	6D*	1.50	1.70		Vo 0.2				Stiff yellowish brown and grey slightly gravelly silty sandy CLAY. Gravel is angular and subangular fine to coarse slag and limestone. (MG)			
	7B	2.00	2.50									
	8D*	2.00	2.20		Vo 0.2							
		2.50			V 36					2.50	3.45	
24/02/15 1630hrs 1.50m	9UT	2.50	2.95	2.50					Very soft dark grey slightly sandy silty CLAY. (TFD) 2.54m: Low strength.			
	11D*	2.75	3.00		Vo 0.0							
25/02/15 0800hrs	10D	2.95	3.05									
	12D	3.00	3.45	3.00	S<1							
	13B	3.00	3.50									
	14D*	3.00	3.50		Vo 0.0							
	15B	3.50	4.00									
	16D*	3.50	4.00		Vo 0.0							
		3.95			V 36							
	17P	4.00	5.00	4.00		P/S			3.95m: Low strength.			
	18B	5.00	5.50									
		5.55			V 10							
	19P	5.50	6.50	5.50		P/S			5.55m: Extremely to very low strength.			
	20B	6.50	7.00									
		7.10			V 12							
	21P	7.00	7.60	7.00		P/S			7.10m: Very low strength.			
25/02/15 1700hrs NR										7.60	-1.65	
26/02/15 0800hrs									Very soft grey silty CLAY interbedded with firm dark brown fibrous PEAT. (PEAT)			
									Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig and Geotechnical Pioneer rig. METHOD: Cable percussion (200mm) 0.00-2.00m and (150mm) 2.00-12.20m. Waterflush rotary core drilled (116mm) 12.20-22.70m. CASING: 200mm diam to 2.00m, 150mm diam to 12.20m.

BACKFILL: On completion, borehole backfilled with bentonite pellets 22.70-11.80m. A slotted standpipe (50mm) with geo-sock was installed to 11.60m, granular response zone 11.80-9.80m and bentonite seal 9.80-2.80m. A second slotted standpipe (35mm) with geo-sock was installed to 2.60m, granular response zone 2.80-0.50m, bentonite seal 0.50-0.25m, concrete and stopcock cover 0.25-0.00m.

REMARKS: Hole advanced by chiselling 0.00-1.00m (1hr10mins) and 10.90-12.20m (2hr). Downhole magnetometry for UXO risk mitigation undertaken 0.00-11.00m. No anomalies encountered. Bentonite seal for aquifer protection installed during drilling 1.00-2.00m, prior to reduction in casing diameter. Permeability test undertaken at 7.00m- 8.00m.

MMG = Mercia Mudstone Group. Weathering zone after Chandler RJ and Forster CIRIA C570; Engineering in Mercia Mudstone (2001).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
1.50	1.50	1.30	20	Medium flow.

AGS

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BOREHOLE LOG

BH525

CLIENT	WELSH GOVERNMENT				
SITE	M4 CORRIDOR AROUND NEWPORT			Sheet	2 of 3
Start Date	24 February 2015	Easting	338301.6	Scale	1 : 50
End Date	26 February 2015	Northing	185578.3 Ground level 5.95mOD	Depth	22.70 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	22D	8.00 - 8.45	8.00	S 15							
	23B	8.50 - 9.00									
	24UT	9.50 - 9.95	9.50								
	25D	9.95 - 10.05							10.10	-4.15	
	26D	10.10 - 10.20						Stiff dark reddish brown slightly gravelly CLAY. Gravel is subangular and subrounded fine and medium sandstone and siltstone. (RTD)			
	27B	10.50 - 11.00									
	28D	11.00 - 11.45	11.00	S 39							
	29B	11.50 - 12.20									
26/02/15 1620hrs 5.90m	30D	12.20 - 12.43	12.10	S*113							
27/02/15 0915hrs 7.87m	31C	12.20 - 12.50			97	NA					
	32C	12.50 - 13.70	12.10		100			12.90 - 13.05m: Light greenish grey.			
	33C	13.70 - 15.20	12.10		100	NA		13.60 - 13.70m: Light greenish grey.	13.70	-7.75	
								Very stiff fissured dark reddish brown very gravelly CLAY. Gravel is subangular and subrounded fine and medium lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 20° and subvertical extremely closely spaced. (MMG) (Grade III)	14.80	-8.85	
	34C	15.20 - 16.70	12.10		100 19 0	NI 40 80		Stiff fissured reddish brown gravelly CLAY. Gravel is angular and subangular fine and medium lithorelicts of extremely weak mudstone and very stiff clay. Fissures are subhorizontal to 20° very closely spaced planar smooth. (MMG) (Grade III)	15.60	-9.65	
								15.55 - 15.70m: 70° to subvertical planar smooth.			
								Weak thinly laminated reddish brown MUDSTONE with rare light greenish grey reduction spots (up to 20mm). Fractures are subhorizontal to 20° and subvertical very closely and closely spaced planar smooth. (MMG) (Grade I/II)			
	35C	16.70 - 18.20	12.10		93 5 0			15.60 - 16.20m: Light greenish grey. 15.70 - 15.80m: Tending to light greenish grey clay. 16.20 - 16.30m: Tending to reddish brown clay. 16.70 - 17.10m: Tending to light greenish grey clay. 17.30 - 17.40m: Tending to reddish brown clay. 17.50 - 17.60m: Tending to reddish brown clay. 17.60 - 18.20m: Subvertical fracture.			
								Continued Next Page	{18.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks

AGS

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BOREHOLE LOG

BH525

CLIENT	WELSH GOVERNMENT						
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	3 of 3
Start Date	24 February 2015	Easting	338301.6			Scale	1 : 50
End Date	26 February 2015	Northing	185578.3	Ground level	5.95mOD	Depth	22.70 m

progress date/time water depth	sample no & type	depth (m) from	to	casing depth (m)	test type & value	samp. /core range	I_f	instru -ment	description	depth (m)	reduced level (m)	legend
	36C	18.20	19.70	12.10		100 62 37				18.60	-12.65	
							80 120 400		Very weak and weak thinly laminated reddish brown MUDSTONE with rare light greenish grey reduction spots (up to 20mm). Fractures are subhorizontal to 20° and subvertical closely and medium spaced planar smooth. (MMG) (Grade I/II) 19.20 - 19.25m: 20° fracture with a veneer of reddish brown clay.			
	37C	19.70	21.20	12.10		100 100 61						
	38C	21.20	22.70	12.10		100 90 57			21.25 - 21.80m: 80° to vertical fracture undulating smooth. 22.00 - 22.40m: Tending to reddish brown clay. 22.40m: Calcite crystals (up to 20mm).			
27/02/15 1420hrs 2.60m										22.70	-16.75	
									Borehole completed at 22.70m.	{28.00}		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
					30238	EC

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TRIAL PIT LOG

TP509

CLIENT	WELSH GOVERNMENT						
SITE	M4 CORRIDOR AROUND NEWPORT					Sheet	1 of 2
Start Date	11 February 2015	Easting	338257.7			Scale	1 : 25
End Date	11 February 2015	Northing	185578.9	Ground level	6.15mOD	Depth	4.50 m

water record	sample/test no/type	result	depth (m)	description	depth (m)	level (m)	legend
				Dark greyish brown slightly clayey sandy angular and subangular fine to coarse slag GRAVEL. (MG)	0.20	5.95	
				Dark brown sandy angular and subangular fine to coarse slag GRAVEL. (MG)			
	1D*		0.50				
	2D*	Vo 0.2	0.60				
	3B		1.00				
	4D*	Vo 0.7	1.00	1.10 - 1.40m: Locally tending to soft dark bluish grey slightly sandy clay with rare medium gravel sized wood fragments.			
1.20m: Seepage	5B		1.10		1.40	4.75	
	6D*		1.10	Firm light grey mottled light orangish brown sandy CLAY. (TFD)			
		H37	1.30				
	7B	H 76	2.00				
	8D*	Vo 0.4	2.00				
	9D*		2.50		2.70	3.45	
				Soft locally very soft light bluish grey sandy CLAY with frequent organic fragments (up to 3mm). (TFD)			
	10B	H 23	3.00				
	11D*	Vo 0.1	3.00				

Notes

Trial pit excavated by JCB 3CX mechanical excavator.
Groundwater seepages noted between 1.20m and 4.50m.
Trial pit sides remained stable and vertical.
Trial pit dimensions 0.80x2.60x4.50m.
On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.

CONTRACT	CHECKED
30238	EC

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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TRIAL PIT LOG

TP509

CLIENT	WELSH GOVERNMENT					Sheet	2 of 2
SITE	M4 CORRIDOR AROUND NEWPORT					Scale	1 : 25
Start Date	11 February 2015	Easting	338257.7			Depth	4.50 m
End Date	11 February 2015	Northing	185578.9	Ground level	6.15mOD		

water record	sample/test no/type	result	depth (m)	description	depth (m)	level (m)	legend
	12B	H 20	4.00				
	13D*	Vo 0.2	4.00				
					4.50	1.65	
4.45m				Trial pit completed at 4.50m.			

Notes

Trial pit excavated by JCB 3CX mechanical excavator.
Groundwater seepages noted between 1.20m and 4.50m.
Trial pit sides remained stable and vertical.
Trial pit dimensions 0.80x2.60x4.50m.
On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.

CONTRACT	CHECKED
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EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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A6 Appendix 2

Gas and Groundwater Monitoring Results

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		01

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		30/01/2008	09:50	2.45	25/02/2008	14:34	2.48	07/03/2008	14:25	2.60
SBHD03 CP	SPIE	10.00		30/01/2008	11:01	0.47	25/02/2008	14:52	0.43	07/03/2008	14:05	0.56
SBHD05 RC	SPIE	12.00		31/01/2008	09:00	1.02	25/02/2008	15:35	1.05	07/03/2008	13:50	1.77
SBHD06 RC	SP	15.00		30/01/2008	13:00	1.13	21/02/2008	10:30	1.39	07/03/2008	13:30	1.39
SBHD08 RC	SPIE	29.50		30/01/2008	13:50	1.20	25/02/2008	15:58	2.02	07/03/2008	13:35	1.40
SBHE02RD	SPIE	25.00		31/01/2008	09:25	2.18	25/02/2008	16:20	2.09	07/03/2008	13:10	2.48
SBHE04 RC	SPIE	17.20		31/01/2008	09:15	2.31	25/02/2008	16:11	2.51	07/03/2008	13:20	2.59
SBHF01 RC	SPIE	19.00		31/01/2008	09:40	5.69	25/02/2008	16:32	5.72	07/03/2008	12:50	5.43
SBHF02A CP	SPIE	17.00		01/02/2008	14:40	7.61	25/02/2008	17:13	7.57	07/03/2008	12:30	9.00
SBHF03 RC	SPIE	18.00		31/01/2008	10:35	6.97	26/02/2008	08:55	6.77	07/03/2008	12:15	7.22
SBHH01 RC	SPIE	25.00		31/01/2008	11:15	3.45	26/02/2008	09:39	3.42	07/03/2008	11:28	3.65
SBHH02 RC	SPIE	14.90		31/01/2008	11:10	3.42	26/02/2008	09:20	3.88	07/03/2008	11:35	3.64
SBHH05 RC	SPIE	21.50		31/01/2008	11:30	2.22	26/02/2008	10:01	2.13	07/03/2008	11:05	3.10
SBHH06 CP	SP	12.30		30/01/2008	15:30	3.75	21/02/2008	08:00	3.76	07/03/2008	11:10	3.87
SBHH07A RC	SPIE	24.85		30/01/2008	14:50	1.70	26/02/2008	10:40	1.34	07/03/2008	11:00	1.07
SBHJ01 CP	SP	7.50		01/02/2008	12:20	1.34	21/02/2008	11:45	5.98	06/03/2008	12:28	1.82
SBHJ03 CP	SP	5.20		01/02/2008	08:00	0.54	27/02/2008	16:15	0.70	07/03/2008	10:45	0.68
SBHJ04	SP	13.10		01/02/2008	11:55	6.61	22/02/2008	13::55	6.67	06/03/2008	11:46	6.75
SBHJ05	SP	11.50		01/02/2008	11:10	8.91	22/02/2008	09:00	9.07	06/03/2008	11:23	9.16
SBHJ06 CP	SP	4.10		01/02/2008	11:45	1.31	21/02/2008	15:30	1.32	06/03/2008	10:50	1.33
SBHJ07 CP	SP	10.40		01/02/2008	11:43	1.35	21/02/2008	14:40	1.40	06/03/2008	12:05	1.56
SBHJ08A CP	SP	7.40		01/02/2008	11:35	3.49	21/02/2008	13:05	2.31	06/03/2008	10:57	2.67
SBHJ09 CP	SP	2.20		01/02/2008	11:30	0.65	21/02/2008	12:25	0.85	06/03/2008	11:00	0.90
SBHJ10 CP	SP	10.00		01/02/2008	10:40	2.30	21/02/2008	13:45	2.24	06/03/2008	10:40	2.16
SBHK01 CP	SP	6.80		01/02/2008	10:55	0.70	25/02/2008	10:30	1.00	06/03/2008	14:24	1.06
SBHK02 CP	SP	11.20		01/02/2008	10:50	1.34	25/02/2008	11:20	1.33	06/03/2008	14:18	1.47
SBHK03 CP	SP	5.90		01/02/2008	10:45	0.87	25/02/2008	12:00	0.89	06/03/2008	14:15	1.00
SBHK04 CP	SP	12.20		01/02/2008	10:25	1.45	25/02/2008	12:30	1.60	06/03/2008	12:30	1.60
SBHL02 RC	SPIE	15.20		01/02/2008	10:35	2.27	25/02/2008	12:49	2.31	06/03/2008	14:00	2.42
SBHL03 RC	SPIE	15.00		31/01/2008	16:20	0.61	26/02/2008	11:15	0.51	07/03/2008	10:25	0.66
SBHM01 RC	SPIE	21.00		01/01/1900	08:20	-0.26	26/02/2008	11:30	-0.26	07/03/2008	10:17	0.05
SBHM02 RC	SPIE	20.00		01/02/2008	08:25	0.19	26/02/2008	11:41	0.49	07/03/2008	10:14	0.68
SBHN01A RC	SPIE	14.90		01/02/2008	15:20	8.49	27/02/2008	17:15	12.23	07/03/2008	14:45	13.18
SBHN02 RC	SPIE	20.40		31/01/2008	15:55	3.67	26/02/2008	11:57	4.19	07/03/2008	10:05	4.84
SBHN03 RC	SPIE	15.00		31/01/2008	15:45	1.07	26/02/2008	12:03	1.73	07/03/2008	09:55	2.34
SBHN04 RC	SPIE	10.00		31/01/2008	15:30	9.99	26/02/2008	14:42	DRY	07/03/2008	09:45	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		02

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		31/01/2008	14:50	DRY	26/02/2008	14:12	DRY	07/03/2008	09:35	DRY
SBHP02 RC	SPIE	9.80		31/01/2008	13:55	7.20	26/02/2008	13:59	8.09	07/03/2008	09:10	8.25
SBHP03 RC	SPIE	5.00		31/01/2008	13:40	4.09	26/02/2008	13:48	4.76	07/03/2008	09:05	4.78
SBHQ01 RC	SPIE	11.80		31/01/2008	14:20	5.76	26/02/2008	12:46	6.74	07/03/2008	09:30	7.20
SBHQ02 RC	SPIE	6.00		31/01/2008	14:15	4.98	26/02/2008	12:59	5.16	07/03/2008	09:25	5.98
SBHQ03 RC	SPIE	11.00		31/01/2008	13:20	6.04	26/02/2008	13:29	7.22	07/03/2008	08:38	7.59
SBHQ04 RC	SPIE	8.00		31/01/2008	13:05	4.35	26/02/2008	13:36	6.18	07/03/2008	08:55	6.94
SBHQ06 RC	SPIE	7.35		31/01/2008	13:00	3.89	26/02/2008	13:16	4.40	07/03/2008	08:25	4.63
SWSJ08	SP	3.30		01/02/2008	12:30	0.42	21/02/2008	11:45	0.37	06/03/2008	12:35	0.41
SWSJ13	SP	2.50		01/02/2008	12:00	DRY	22/02/2008	13:45	DRY	06/03/2008	11:50	DRY
SWSJ21	SP	6.00		01/02/2008	11:20	3.87	22/02/2008	09:30	5.72	06/03/2008	11:27	6.59
SWSJ23	SP	7.80		01/02/2008	11:22	5.92	22/02/2008	09:55	6.62	06/03/2008	11:30	6.97
SWSJ34	SP	6.00		01/02/2008	11:05	2.52	22/02/2008	10:55	3.33	06/03/2008	11:10	3.08
SWSJ37	SP	5.60		01/02/2008	11:25	0.46	22/02/2008	11:30	0.55	06/03/2008	11:15	0.61
LGBH02	SP	8.88					22/02/2008	14:35	7.50	06/03/2008	11:40	7.52
LGBH03	SP	8.90					22/02/2008	14:21	7.20	06/03/2008	11:44	7.28
LGBH04	SP	10.50					22/02/2008	10:30	8.87	06/03/2008	11:20	9.00
LGBH09	SP	7.00					22/02/2008	12:40	1.13	06/03/2008	10:48	1.56
LGBH10	SP	14.60					27/02/2008	14:30	8.15	06/03/2008	11:12	8.21
LGBH11	SP	11.20					27/02/2008	10:00	7.05	06/03/2008	11:03	7.07
LGBH12	SP	7.05					22/02/2008	13:10	1.40	06/03/2008	10:45	1.40
RBBH07	SP	6.25					27/02/2008	12.15	0.69	06/03/2008	12:20	0.71
RBBH09	SP	7.05					27/02/2008	13:40	1.25	06/03/2008	12:25	1.21
RBBH10	SP	6.85					27/02/2008	13:00	0.68	06/03/2008	12:30	0.82

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		03

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		20/03/2008	16:30	2.57	04/04/2008	08:00	2.59	18/04/2008	07:40	2.66
SBHD03 CP	SPIE	10.00		20/03/2008	16:45	0.58	04/04/2008	08:13	0.53	18/04/2008	08:00	0.60
SBHD05 RC	SPIE	12.00		20/03/2008	16:00	1.08	04/04/2008	09:15	1.22	18/04/2008	08:30	1.32
SBHD06 RC	SP	15.00		20/03/2008	17:55	1.20	04/04/2008	09:30	1.33	18/04/2008	08:40	1.44
SBHD08 RC	SPIE	29.50		19/03/2008	18:30	1.28	04/04/2008	10:00	1.39	18/04/2008	08:52	1.52
SBHE02RD	SPIE	25.00		20/03/2008	16:20	2.23	04/04/2008	08:50	2.46	18/04/2008	09:00	2.54
SBHE04 RC	SPIE	17.20		20/03/2008	15:45	2.20	04/04/2008	09:00	1.80	18/04/2008	08:15	1.80
SBHF01 RC	SPIE	19.00		20/03/2008	15:30	5.50	04/04/2008	08:40	5.55	18/04/2008	13:58	5.58
SBHF02A CP	SPIE	17.00		20/03/2008	15:10	5.60	04/04/2008	10:28	5.70	18/04/2008	13:45	5.77
SBHF03 RC	SPIE	18.00		20/03/2008	14:55	7.20	04/04/2008	10:36	7.38	18/04/2008	13:40	7.42
SBHH01 RC	SPIE	25.00		20/03/2008	14:25	3.60	04/04/2008	15:00	3.60	18/04/2008	13:10	3.62
SBHH02 RC	SPIE	14.90		20/03/2008	14:30	4.27	04/04/2008	15:05	3.64	18/04/2008	13:13	3.70
SBHH05 RC	SPIE	21.50		20/03/2008	17:30	2.17	04/04/2008	15:15	2.78	18/04/2008	11:34	2.90
SBHH06 CP	SP	12.30		17/03/2008	15:20	3.88	04/04/2008	15:20	3.89	17/04/2008	14:15	3.90
SBHH07A RC	SPIE	24.85		20/03/2008	13:55	1.33	04/04/2008	15:28	1.92	18/04/2008	11:43	0.88
SBHJ01 CP	SP	7.50		19/03/2008	14:15	1.81	03/04/2008	16:05	1.90	17/04/2008	12:40	1.80
SBHJ03 CP	SP	5.20		19/03/2008	16:40	0.78	03/04/2008	18:25	0.82	17/04/2008	15:55	0.80
SBHJ04	SP	13.10		17/03/2008	13:35	6.64	03/04/2008	18:10	6.74	17/04/2008	13:08	6.80
SBHJ05	SP	11.50		18/03/2008	13:50	9.02	03/04/2008	17:39	9.10	17/04/2008	13:31	9.11
SBHJ06 CP	SP	4.10		17/03/2008	12:55	1.29	03/04/2008	17:43	1.33	17/04/2008	15:05	1.20
SBHJ07 CP	SP	10.40		17/03/2008	10:25	1.59	03/04/2008	17:47	1.50	17/04/2008	13:58	1.47
SBHJ08A CP	SP	7.40		18/03/2008	10:00	2.50	03/04/2008	17:55	2.50	17/04/2008	15:33	2.50
SBHJ09 CP	SP	2.20		18/03/2008	10:25	0.69	03/04/2008	17:58	0.82	17/04/2008	15:22	0.90
SBHJ10 CP	SP	10.00		17/03/2008	09:15	2.10	03/04/2008	17:50	2.00	17/04/2008	13:55	2.00
SBHK01 CP	SP	6.80		19/03/2008	10:45	0.88	03/04/2008	16:40	1.00	17/04/2008	11:40	0.94
SBHK02 CP	SP	11.20		19/03/2008	11:15	1.46	03/04/2008	16:45	1.48	17/04/2008	11:43	1.46
SBHK03 CP	SP	5.90		19/03/2008	11:45	1.04	03/04/2008	16:48	1.07	17/04/2008	11::46	0.98
SBHK04 CP	SP	12.20		19/03/2008	12:15	1.64	03/04/2008	16:52	1.67	17/04/2008	12:05	1.60
SBHL02 RC	SPIE	15.20		19/03/2008	12:50	2.44	03/04/2008	17:00	2.45	17/04/2008	12:00	2.45
SBHL03 RC	SPIE	15.00		20/03/2008	13:25	0.76	08/04/2008	15:40	0.64	18/04/2008	09:50	0.62
SBHM01 RC	SPIE	21.00		20/03/2008	13:05	-0.21	08/04/2008	15:48	-0.45	18/04/2008	11:55	0.01
SBHM02 RC	SPIE	20.00		20/03/2008	13:10	0.61	08/04/2008	15:52	0.61	18/04/2008	11:50	0.61
SBHN01A RC	SPIE	14.90		20/03/2008	12:55	12.14	08/04/2008	16:05	12.58	18/04/2008	12:48	13.27
SBHN02 RC	SPIE	20.40		20/03/2008	12:45	4.26	08/04/2008	16:12	2.64	18/04/2008	12:45	4.85
SBHN03 RC	SPIE	15.00		20/03/2008	12:30	1.60	08/04/2008	16:17	2.07	18/04/2008	12:35	2.37
SBHN04 RC	SPIE	10.00		20/03/2008	12:10	DRY	08/04/2008	16:28	DRY	18/04/2008	10:55	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		04

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		20/03/2008	12:00	DRY	08/04/2008	16:40	DRY	18/04/2008	10:45	DRY
SBHP02 RC	SPIE	9.80		20/03/2008	11:45	5.59	08/04/2008	16:55	7.98	18/04/2008	10:30	8.20
SBHP03 RC	SPIE	5.00		20/03/2008	11:40	2.80	08/04/2008	16:50	DRY	18/04/2008	10:25	4.93
SBHQ01 RC	SPIE	11.80		20/03/2008	10:40	6.72	08/04/2008	17:13	7.24	18/04/2008	10:10	7.48
SBHQ02 RC	SPIE	6.00		20/03/2008	10:45	4.91	08/04/2008	17:10	DRY	18/04/2008	10:05	DRY
SBHQ03 RC	SPIE	11.00		20/03/2008	10:50	6.76	08/04/2008	17:05	7.69	18/04/2008	10:15	8.00
SBHQ04 RC	SPIE	8.00		20/03/2008	11:30	6.97	08/04/2008	17:02	DRY	18/04/2008	10:40	DRY
SBHQ06 RC	SPIE	7.35		20/03/2008	11:20	4.47	08/04/2008	17:20	6.63	18/04/2008	12:20	4.79
SWSJ08	SP	3.30		19/03/2008	15:10	0.44	03/04/2008	16:00	0.46	17/04/2008	12:35	0.42
SWSJ13	SP	2.50		17/03/2008	13:25	DRY	03/04/2008	18:12	DRY	17/04/2008	13:12	DRY
SWSJ21	SP	6.00		18/03/2008	14:30	4.42	03/04/2008	17:33	5.89	17/04/2008	13:32	6.50
SWSJ23	SP	7.80		18/03/2008	15:05	7.58	03/04/2008	17:35	7.20	17/04/2008	13:35	7.20
SWSJ34	SP	6.00		19/03/2008	08:55	2.36	03/04/2008	17:23	3.26	17/04/2008	13:46	DRY
SWSJ37	SP	5.60		18/03/2008	11:15	0.55	03/04/2008	17:25	0.67	17/04/2008	13:42	0.63
LGBH02	SP	8.88		17/03/2008	12:55	7.48	03/04/2008	18:05	7.46	17/04/2008	13:00	7.48
LGBH03	SP	8.90		17/03/2008	13:15	7.24	03/04/2008	18:08	7.32	17/04/2008	13:03	7.30
LGBH04	SP	10.50		18/03/2008	13:20	8.87	03/04/2008	17:40	8.90	17/04/2008	13:29	8.94
LGBH09	SP	7.00		17/03/2008	11:00	1.08	03/04/2008	17:45	1.15	17/04/2008	15:08	1.05
LGBH10	SP	14.60		18/03/2008	15:20	8.31	03/04/2008	17:27	8.20	17/04/2008	13:40	8.70
LGBH11	SP	11.20		18/03/2008	11:40	6.88	03/04/2008	17:18	7.00	17/04/2008	15:38	7.08
LGBH12	SP	7.05		17/03/2008	10:00	1.30	03/04/2008	17:49	1.47	17/04/2008	15:15	1.36
RBBH07	SP	6.25		19/03/2008	13:25	0.66	03/04/2008	15:50	0.68	17/04/2008	12:30	1.10
RBBH09	SP	7.05		19/03/2008	14:40	1.18	03/04/2008	16:07	1.21	17/04/2008	12:42	1.25
RBBH10	SP	6.85		19/03/2008	13:45	0.70	03/04/2008	16:03	0.75	17/04/2008	12:39	0.78

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		01

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		30/01/2008	09:50	2.45	25/02/2008	14:34	2.48	07/03/2008	14:25	2.60
SBHD03 CP	SPIE	10.00		30/01/2008	11:01	0.47	25/02/2008	14:52	0.43	07/03/2008	14:05	0.56
SBHD05 RC	SPIE	12.00		31/01/2008	09:00	1.02	25/02/2008	15:35	1.05	07/03/2008	13:50	1.77
SBHD06 RC	SP	15.00		30/01/2008	13:00	1.13	21/02/2008	10:30	1.39	07/03/2008	13:30	1.39
SBHD08 RC	SPIE	29.50		30/01/2008	13:50	1.20	25/02/2008	15:58	2.02	07/03/2008	13:35	1.40
SBHE02RD	SPIE	25.00		31/01/2008	09:25	2.18	25/02/2008	16:20	2.09	07/03/2008	13:10	2.48
SBHE04 RC	SPIE	17.20		31/01/2008	09:15	2.31	25/02/2008	16:11	2.51	07/03/2008	13:20	2.59
SBHF01 RC	SPIE	19.00		31/01/2008	09:40	5.69	25/02/2008	16:32	5.72	07/03/2008	12:50	5.43
SBHF02A CP	SPIE	17.00		01/02/2008	14:40	7.61	25/02/2008	17:13	7.57	07/03/2008	12:30	9.00
SBHF03 RC	SPIE	18.00		31/01/2008	10:35	6.97	26/02/2008	08:55	6.77	07/03/2008	12:15	7.22
SBHH01 RC	SPIE	25.00		31/01/2008	11:15	3.45	26/02/2008	09:39	3.42	07/03/2008	11:28	3.65
SBHH02 RC	SPIE	14.90		31/01/2008	11:10	3.42	26/02/2008	09:20	3.88	07/03/2008	11:35	3.64
SBHH05 RC	SPIE	21.50		31/01/2008	11:30	2.22	26/02/2008	10:01	2.13	07/03/2008	11:05	3.10
SBHH06 CP	SP	12.30		30/01/2008	15:30	3.75	21/02/2008	08:00	3.76	07/03/2008	11:10	3.87
SBHH07A RC	SPIE	24.85		30/01/2008	14:50	1.70	26/02/2008	10:40	1.34	07/03/2008	11:00	1.07
SBHJ01 CP	SP	7.50		01/02/2008	12:20	1.34	21/02/2008	11:45	5.98	06/03/2008	12:28	1.82
SBHJ03 CP	SP	5.20		01/02/2008	08:00	0.54	27/02/2008	16:15	0.70	07/03/2008	10:45	0.68
SBHJ04	SP	13.10		01/02/2008	11:55	6.61	22/02/2008	13::55	6.67	06/03/2008	11:46	6.75
SBHJ05	SP	11.50		01/02/2008	11:10	8.91	22/02/2008	09:00	9.07	06/03/2008	11:23	9.16
SBHJ06 CP	SP	4.10		01/02/2008	11:45	1.31	21/02/2008	15:30	1.32	06/03/2008	10:50	1.33
SBHJ07 CP	SP	10.40		01/02/2008	11:43	1.35	21/02/2008	14:40	1.40	06/03/2008	12:05	1.56
SBHJ08A CP	SP	7.40		01/02/2008	11:35	3.49	21/02/2008	13:05	2.31	06/03/2008	10:57	2.67
SBHJ09 CP	SP	2.20		01/02/2008	11:30	0.65	21/02/2008	12:25	0.85	06/03/2008	11:00	0.90
SBHJ10 CP	SP	10.00		01/02/2008	10:40	2.30	21/02/2008	13:45	2.24	06/03/2008	10:40	2.16
SBHK01 CP	SP	6.80		01/02/2008	10:55	0.70	25/02/2008	10:30	1.00	06/03/2008	14:24	1.06
SBHK02 CP	SP	11.20		01/02/2008	10:50	1.34	25/02/2008	11:20	1.33	06/03/2008	14:18	1.47
SBHK03 CP	SP	5.90		01/02/2008	10:45	0.87	25/02/2008	12:00	0.89	06/03/2008	14:15	1.00
SBHK04 CP	SP	12.20		01/02/2008	10:25	1.45	25/02/2008	12:30	1.60	06/03/2008	12:30	1.60
SBHL02 RC	SPIE	15.20		01/02/2008	10:35	2.27	25/02/2008	12:49	2.31	06/03/2008	14:00	2.42
SBHL03 RC	SPIE	15.00		31/01/2008	16:20	0.61	26/02/2008	11:15	0.51	07/03/2008	10:25	0.66
SBHM01 RC	SPIE	21.00		01/01/1900	08:20	-0.26	26/02/2008	11:30	-0.26	07/03/2008	10:17	0.05
SBHM02 RC	SPIE	20.00		01/02/2008	08:25	0.19	26/02/2008	11:41	0.49	07/03/2008	10:14	0.68
SBHN01A RC	SPIE	14.90		01/02/2008	15:20	8.49	27/02/2008	17:15	12.23	07/03/2008	14:45	13.18
SBHN02 RC	SPIE	20.40		31/01/2008	15:55	3.67	26/02/2008	11:57	4.19	07/03/2008	10:05	4.84
SBHN03 RC	SPIE	15.00		31/01/2008	15:45	1.07	26/02/2008	12:03	1.73	07/03/2008	09:55	2.34
SBHN04 RC	SPIE	10.00		31/01/2008	15:30	9.99	26/02/2008	14:42	DRY	07/03/2008	09:45	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		02

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		31/01/2008	14:50	DRY	26/02/2008	14:12	DRY	07/03/2008	09:35	DRY
SBHP02 RC	SPIE	9.80		31/01/2008	13:55	7.20	26/02/2008	13:59	8.09	07/03/2008	09:10	8.25
SBHP03 RC	SPIE	5.00		31/01/2008	13:40	4.09	26/02/2008	13:48	4.76	07/03/2008	09:05	4.78
SBHQ01 RC	SPIE	11.80		31/01/2008	14:20	5.76	26/02/2008	12:46	6.74	07/03/2008	09:30	7.20
SBHQ02 RC	SPIE	6.00		31/01/2008	14:15	4.98	26/02/2008	12:59	5.16	07/03/2008	09:25	5.98
SBHQ03 RC	SPIE	11.00		31/01/2008	13:20	6.04	26/02/2008	13:29	7.22	07/03/2008	08:38	7.59
SBHQ04 RC	SPIE	8.00		31/01/2008	13:05	4.35	26/02/2008	13:36	6.18	07/03/2008	08:55	6.94
SBHQ06 RC	SPIE	7.35		31/01/2008	13:00	3.89	26/02/2008	13:16	4.40	07/03/2008	08:25	4.63
SWSJ08	SP	3.30		01/02/2008	12:30	0.42	21/02/2008	11:45	0.37	06/03/2008	12:35	0.41
SWSJ13	SP	2.50		01/02/2008	12:00	DRY	22/02/2008	13:45	DRY	06/03/2008	11:50	DRY
SWSJ21	SP	6.00		01/02/2008	11:20	3.87	22/02/2008	09:30	5.72	06/03/2008	11:27	6.59
SWSJ23	SP	7.80		01/02/2008	11:22	5.92	22/02/2008	09:55	6.62	06/03/2008	11:30	6.97
SWSJ34	SP	6.00		01/02/2008	11:05	2.52	22/02/2008	10:55	3.33	06/03/2008	11:10	3.08
SWSJ37	SP	5.60		01/02/2008	11:25	0.46	22/02/2008	11:30	0.55	06/03/2008	11:15	0.61
LGBH02	SP	8.88					22/02/2008	14:35	7.50	06/03/2008	11:40	7.52
LGBH03	SP	8.90					22/02/2008	14:21	7.20	06/03/2008	11:44	7.28
LGBH04	SP	10.50					22/02/2008	10:30	8.87	06/03/2008	11:20	9.00
LGBH09	SP	7.00					22/02/2008	12:40	1.13	06/03/2008	10:48	1.56
LGBH10	SP	14.60					27/02/2008	14:30	8.15	06/03/2008	11:12	8.21
LGBH11	SP	11.20					27/02/2008	10:00	7.05	06/03/2008	11:03	7.07
LGBH12	SP	7.05					22/02/2008	13:10	1.40	06/03/2008	10:45	1.40
RBBH07	SP	6.25					27/02/2008	12.15	0.69	06/03/2008	12:20	0.71
RBBH09	SP	7.05					27/02/2008	13:40	1.25	06/03/2008	12:25	1.21
RBBH10	SP	6.85					27/02/2008	13:00	0.68	06/03/2008	12:30	0.82

Recorded by:	S Davis	Checked by:	I Swain	Approved by:	I Swain
Date:	30/01/08-07/03/08	Date:	16/04/2008	Date:	17/04/2008
Form No.	SI GWR	Revision No.	2.03	Issue Date	07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		03

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		20/03/2008	16:30	2.57	04/04/2008	08:00	2.59	18/04/2008	07:40	2.66
SBHD03 CP	SPIE	10.00		20/03/2008	16:45	0.58	04/04/2008	08:13	0.53	18/04/2008	08:00	0.60
SBHD05 RC	SPIE	12.00		20/03/2008	16:00	1.08	04/04/2008	09:15	1.22	18/04/2008	08:30	1.32
SBHD06 RC	SP	15.00		20/03/2008	17:55	1.20	04/04/2008	09:30	1.33	18/04/2008	08:40	1.44
SBHD08 RC	SPIE	29.50		19/03/2008	18:30	1.28	04/04/2008	10:00	1.39	18/04/2008	08:52	1.52
SBHE02RD	SPIE	25.00		20/03/2008	16:20	2.23	04/04/2008	08:50	2.46	18/04/2008	09:00	2.54
SBHE04 RC	SPIE	17.20		20/03/2008	15:45	2.20	04/04/2008	09:00	1.80	18/04/2008	08:15	1.80
SBHF01 RC	SPIE	19.00		20/03/2008	15:30	5.50	04/04/2008	08:40	5.55	18/04/2008	13:58	5.58
SBHF02A CP	SPIE	17.00		20/03/2008	15:10	5.60	04/04/2008	10:28	5.70	18/04/2008	13:45	5.77
SBHF03 RC	SPIE	18.00		20/03/2008	14:55	7.20	04/04/2008	10:36	7.38	18/04/2008	13:40	7.42
SBHH01 RC	SPIE	25.00		20/03/2008	14:25	3.60	04/04/2008	15:00	3.60	18/04/2008	13:10	3.62
SBHH02 RC	SPIE	14.90		20/03/2008	14:30	4.27	04/04/2008	15:05	3.64	18/04/2008	13:13	3.70
SBHH05 RC	SPIE	21.50		20/03/2008	17:30	2.17	04/04/2008	15:15	2.78	18/04/2008	11:34	2.90
SBHH06 CP	SP	12.30		17/03/2008	15:20	3.88	04/04/2008	15:20	3.89	17/04/2008	14:15	3.90
SBHH07A RC	SPIE	24.85		20/03/2008	13:55	1.33	04/04/2008	15:28	1.92	18/04/2008	11:43	0.88
SBHJ01 CP	SP	7.50		19/03/2008	14:15	1.81	03/04/2008	16:05	1.90	17/04/2008	12:40	1.80
SBHJ03 CP	SP	5.20		19/03/2008	16:40	0.78	03/04/2008	18:25	0.82	17/04/2008	15:55	0.80
SBHJ04	SP	13.10		17/03/2008	13:35	6.64	03/04/2008	18:10	6.74	17/04/2008	13:08	6.80
SBHJ05	SP	11.50		18/03/2008	13:50	9.02	03/04/2008	17:39	9.10	17/04/2008	13:31	9.11
SBHJ06 CP	SP	4.10		17/03/2008	12:55	1.29	03/04/2008	17:43	1.33	17/04/2008	15:05	1.20
SBHJ07 CP	SP	10.40		17/03/2008	10:25	1.59	03/04/2008	17:47	1.50	17/04/2008	13:58	1.47
SBHJ08A CP	SP	7.40		18/03/2008	10:00	2.50	03/04/2008	17:55	2.50	17/04/2008	15:33	2.50
SBHJ09 CP	SP	2.20		18/03/2008	10:25	0.69	03/04/2008	17:58	0.82	17/04/2008	15:22	0.90
SBHJ10 CP	SP	10.00		17/03/2008	09:15	2.10	03/04/2008	17:50	2.00	17/04/2008	13:55	2.00
SBHK01 CP	SP	6.80		19/03/2008	10:45	0.88	03/04/2008	16:40	1.00	17/04/2008	11:40	0.94
SBHK02 CP	SP	11.20		19/03/2008	11:15	1.46	03/04/2008	16:45	1.48	17/04/2008	11:43	1.46
SBHK03 CP	SP	5.90		19/03/2008	11:45	1.04	03/04/2008	16:48	1.07	17/04/2008	11::46	0.98
SBHK04 CP	SP	12.20		19/03/2008	12:15	1.64	03/04/2008	16:52	1.67	17/04/2008	12:05	1.60
SBHL02 RC	SPIE	15.20		19/03/2008	12:50	2.44	03/04/2008	17:00	2.45	17/04/2008	12:00	2.45
SBHL03 RC	SPIE	15.00		20/03/2008	13:25	0.76	08/04/2008	15:40	0.64	18/04/2008	09:50	0.62
SBHM01 RC	SPIE	21.00		20/03/2008	13:05	-0.21	08/04/2008	15:48	-0.45	18/04/2008	11:55	0.01
SBHM02 RC	SPIE	20.00		20/03/2008	13:10	0.61	08/04/2008	15:52	0.61	18/04/2008	11:50	0.61
SBHN01A RC	SPIE	14.90		20/03/2008	12:55	12.14	08/04/2008	16:05	12.58	18/04/2008	12:48	13.27
SBHN02 RC	SPIE	20.40		20/03/2008	12:45	4.26	08/04/2008	16:12	2.64	18/04/2008	12:45	4.85
SBHN03 RC	SPIE	15.00		20/03/2008	12:30	1.60	08/04/2008	16:17	2.07	18/04/2008	12:35	2.37
SBHN04 RC	SPIE	10.00		20/03/2008	12:10	DRY	08/04/2008	16:28	DRY	18/04/2008	10:55	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		04

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		20/03/2008	12:00	DRY	08/04/2008	16:40	DRY	18/04/2008	10:45	DRY
SBHP02 RC	SPIE	9.80		20/03/2008	11:45	5.59	08/04/2008	16:55	7.98	18/04/2008	10:30	8.20
SBHP03 RC	SPIE	5.00		20/03/2008	11:40	2.80	08/04/2008	16:50	DRY	18/04/2008	10:25	4.93
SBHQ01 RC	SPIE	11.80		20/03/2008	10:40	6.72	08/04/2008	17:13	7.24	18/04/2008	10:10	7.48
SBHQ02 RC	SPIE	6.00		20/03/2008	10:45	4.91	08/04/2008	17:10	DRY	18/04/2008	10:05	DRY
SBHQ03 RC	SPIE	11.00		20/03/2008	10:50	6.76	08/04/2008	17:05	7.69	18/04/2008	10:15	8.00
SBHQ04 RC	SPIE	8.00		20/03/2008	11:30	6.97	08/04/2008	17:02	DRY	18/04/2008	10:40	DRY
SBHQ06 RC	SPIE	7.35		20/03/2008	11:20	4.47	08/04/2008	17:20	6.63	18/04/2008	12:20	4.79
SWSJ08	SP	3.30		19/03/2008	15:10	0.44	03/04/2008	16:00	0.46	17/04/2008	12:35	0.42
SWSJ13	SP	2.50		17/03/2008	13:25	DRY	03/04/2008	18:12	DRY	17/04/2008	13:12	DRY
SWSJ21	SP	6.00		18/03/2008	14:30	4.42	03/04/2008	17:33	5.89	17/04/2008	13:32	6.50
SWSJ23	SP	7.80		18/03/2008	15:05	7.58	03/04/2008	17:35	7.20	17/04/2008	13:35	7.20
SWSJ34	SP	6.00		19/03/2008	08:55	2.36	03/04/2008	17:23	3.26	17/04/2008	13:46	DRY
SWSJ37	SP	5.60		18/03/2008	11:15	0.55	03/04/2008	17:25	0.67	17/04/2008	13:42	0.63
LGBH02	SP	8.88		17/03/2008	12:55	7.48	03/04/2008	18:05	7.46	17/04/2008	13:00	7.48
LGBH03	SP	8.90		17/03/2008	13:15	7.24	03/04/2008	18:08	7.32	17/04/2008	13:03	7.30
LGBH04	SP	10.50		18/03/2008	13:20	8.87	03/04/2008	17:40	8.90	17/04/2008	13:29	8.94
LGBH09	SP	7.00		17/03/2008	11:00	1.08	03/04/2008	17:45	1.15	17/04/2008	15:08	1.05
LGBH10	SP	14.60		18/03/2008	15:20	8.31	03/04/2008	17:27	8.20	17/04/2008	13:40	8.70
LGBH11	SP	11.20		18/03/2008	11:40	6.88	03/04/2008	17:18	7.00	17/04/2008	15:38	7.08
LGBH12	SP	7.05		17/03/2008	10:00	1.30	03/04/2008	17:49	1.47	17/04/2008	15:15	1.36
RBBH07	SP	6.25		19/03/2008	13:25	0.66	03/04/2008	15:50	0.68	17/04/2008	12:30	1.10
RBBH09	SP	7.05		19/03/2008	14:40	1.18	03/04/2008	16:07	1.21	17/04/2008	12:42	1.25
RBBH10	SP	6.85		19/03/2008	13:45	0.70	03/04/2008	16:03	0.75	17/04/2008	12:39	0.78

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		01

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		30/01/2008	09:50	2.45	25/02/2008	14:34	2.48	07/03/2008	14:25	2.60
SBHD03 CP	SPIE	10.00		30/01/2008	11:01	0.47	25/02/2008	14:52	0.43	07/03/2008	14:05	0.56
SBHD05 RC	SPIE	12.00		31/01/2008	09:00	1.02	25/02/2008	15:35	1.05	07/03/2008	13:50	1.77
SBHD06 RC	SP	15.00		30/01/2008	13:00	1.13	21/02/2008	10:30	1.39	07/03/2008	13:30	1.39
SBHD08 RC	SPIE	29.50		30/01/2008	13:50	1.20	25/02/2008	15:58	2.02	07/03/2008	13:35	1.40
SBHE02RD	SPIE	25.00		31/01/2008	09:25	2.18	25/02/2008	16:20	2.09	07/03/2008	13:10	2.48
SBHE04 RC	SPIE	17.20		31/01/2008	09:15	2.31	25/02/2008	16:11	2.51	07/03/2008	13:20	2.59
SBHF01 RC	SPIE	19.00		31/01/2008	09:40	5.69	25/02/2008	16:32	5.72	07/03/2008	12:50	5.43
SBHF02A CP	SPIE	17.00		01/02/2008	14:40	7.61	25/02/2008	17:13	7.57	07/03/2008	12:30	9.00
SBHF03 RC	SPIE	18.00		31/01/2008	10:35	6.97	26/02/2008	08:55	6.77	07/03/2008	12:15	7.22
SBHH01 RC	SPIE	25.00		31/01/2008	11:15	3.45	26/02/2008	09:39	3.42	07/03/2008	11:28	3.65
SBHH02 RC	SPIE	14.90		31/01/2008	11:10	3.42	26/02/2008	09:20	3.88	07/03/2008	11:35	3.64
SBHH05 RC	SPIE	21.50		31/01/2008	11:30	2.22	26/02/2008	10:01	2.13	07/03/2008	11:05	3.10
SBHH06 CP	SP	12.30		30/01/2008	15:30	3.75	21/02/2008	08:00	3.76	07/03/2008	11:10	3.87
SBHH07A RC	SPIE	24.85		30/01/2008	14:50	1.70	26/02/2008	10:40	1.34	07/03/2008	11:00	1.07
SBHJ01 CP	SP	7.50		01/02/2008	12:20	1.34	21/02/2008	11:45	5.98	06/03/2008	12:28	1.82
SBHJ03 CP	SP	5.20		01/02/2008	08:00	0.54	27/02/2008	16:15	0.70	07/03/2008	10:45	0.68
SBHJ04	SP	13.10		01/02/2008	11:55	6.61	22/02/2008	13::55	6.67	06/03/2008	11:46	6.75
SBHJ05	SP	11.50		01/02/2008	11:10	8.91	22/02/2008	09:00	9.07	06/03/2008	11:23	9.16
SBHJ06 CP	SP	4.10		01/02/2008	11:45	1.31	21/02/2008	15:30	1.32	06/03/2008	10:50	1.33
SBHJ07 CP	SP	10.40		01/02/2008	11:43	1.35	21/02/2008	14:40	1.40	06/03/2008	12:05	1.56
SBHJ08A CP	SP	7.40		01/02/2008	11:35	3.49	21/02/2008	13:05	2.31	06/03/2008	10:57	2.67
SBHJ09 CP	SP	2.20		01/02/2008	11:30	0.65	21/02/2008	12:25	0.85	06/03/2008	11:00	0.90
SBHJ10 CP	SP	10.00		01/02/2008	10:40	2.30	21/02/2008	13:45	2.24	06/03/2008	10:40	2.16
SBHK01 CP	SP	6.80		01/02/2008	10:55	0.70	25/02/2008	10:30	1.00	06/03/2008	14:24	1.06
SBHK02 CP	SP	11.20		01/02/2008	10:50	1.34	25/02/2008	11:20	1.33	06/03/2008	14:18	1.47
SBHK03 CP	SP	5.90		01/02/2008	10:45	0.87	25/02/2008	12:00	0.89	06/03/2008	14:15	1.00
SBHK04 CP	SP	12.20		01/02/2008	10:25	1.45	25/02/2008	12:30	1.60	06/03/2008	12:30	1.60
SBHL02 RC	SPIE	15.20		01/02/2008	10:35	2.27	25/02/2008	12:49	2.31	06/03/2008	14:00	2.42
SBHL03 RC	SPIE	15.00		31/01/2008	16:20	0.61	26/02/2008	11:15	0.51	07/03/2008	10:25	0.66
SBHM01 RC	SPIE	21.00		01/01/1900	08:20	-0.26	26/02/2008	11:30	-0.26	07/03/2008	10:17	0.05
SBHM02 RC	SPIE	20.00		01/02/2008	08:25	0.19	26/02/2008	11:41	0.49	07/03/2008	10:14	0.68
SBHN01A RC	SPIE	14.90		01/02/2008	15:20	8.49	27/02/2008	17:15	12.23	07/03/2008	14:45	13.18
SBHN02 RC	SPIE	20.40		31/01/2008	15:55	3.67	26/02/2008	11:57	4.19	07/03/2008	10:05	4.84
SBHN03 RC	SPIE	15.00		31/01/2008	15:45	1.07	26/02/2008	12:03	1.73	07/03/2008	09:55	2.34
SBHN04 RC	SPIE	10.00		31/01/2008	15:30	9.99	26/02/2008	14:42	DRY	07/03/2008	09:45	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		02

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		31/01/2008	14:50	DRY	26/02/2008	14:12	DRY	07/03/2008	09:35	DRY
SBHP02 RC	SPIE	9.80		31/01/2008	13:55	7.20	26/02/2008	13:59	8.09	07/03/2008	09:10	8.25
SBHP03 RC	SPIE	5.00		31/01/2008	13:40	4.09	26/02/2008	13:48	4.76	07/03/2008	09:05	4.78
SBHQ01 RC	SPIE	11.80		31/01/2008	14:20	5.76	26/02/2008	12:46	6.74	07/03/2008	09:30	7.20
SBHQ02 RC	SPIE	6.00		31/01/2008	14:15	4.98	26/02/2008	12:59	5.16	07/03/2008	09:25	5.98
SBHQ03 RC	SPIE	11.00		31/01/2008	13:20	6.04	26/02/2008	13:29	7.22	07/03/2008	08:38	7.59
SBHQ04 RC	SPIE	8.00		31/01/2008	13:05	4.35	26/02/2008	13:36	6.18	07/03/2008	08:55	6.94
SBHQ06 RC	SPIE	7.35		31/01/2008	13:00	3.89	26/02/2008	13:16	4.40	07/03/2008	08:25	4.63
SWSJ08	SP	3.30		01/02/2008	12:30	0.42	21/02/2008	11:45	0.37	06/03/2008	12:35	0.41
SWSJ13	SP	2.50		01/02/2008	12:00	DRY	22/02/2008	13:45	DRY	06/03/2008	11:50	DRY
SWSJ21	SP	6.00		01/02/2008	11:20	3.87	22/02/2008	09:30	5.72	06/03/2008	11:27	6.59
SWSJ23	SP	7.80		01/02/2008	11:22	5.92	22/02/2008	09:55	6.62	06/03/2008	11:30	6.97
SWSJ34	SP	6.00		01/02/2008	11:05	2.52	22/02/2008	10:55	3.33	06/03/2008	11:10	3.08
SWSJ37	SP	5.60		01/02/2008	11:25	0.46	22/02/2008	11:30	0.55	06/03/2008	11:15	0.61
LGBH02	SP	8.88					22/02/2008	14:35	7.50	06/03/2008	11:40	7.52
LGBH03	SP	8.90					22/02/2008	14:21	7.20	06/03/2008	11:44	7.28
LGBH04	SP	10.50					22/02/2008	10:30	8.87	06/03/2008	11:20	9.00
LGBH09	SP	7.00					22/02/2008	12:40	1.13	06/03/2008	10:48	1.56
LGBH10	SP	14.60					27/02/2008	14:30	8.15	06/03/2008	11:12	8.21
LGBH11	SP	11.20					27/02/2008	10:00	7.05	06/03/2008	11:03	7.07
LGBH12	SP	7.05					22/02/2008	13:10	1.40	06/03/2008	10:45	1.40
RBBH07	SP	6.25					27/02/2008	12.15	0.69	06/03/2008	12:20	0.71
RBBH09	SP	7.05					27/02/2008	13:40	1.25	06/03/2008	12:25	1.21
RBBH10	SP	6.85					27/02/2008	13:00	0.68	06/03/2008	12:30	0.82

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		03

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		20/03/2008	16:30	2.57	04/04/2008	08:00	2.59	18/04/2008	07:40	2.66
SBHD03 CP	SPIE	10.00		20/03/2008	16:45	0.58	04/04/2008	08:13	0.53	18/04/2008	08:00	0.60
SBHD05 RC	SPIE	12.00		20/03/2008	16:00	1.08	04/04/2008	09:15	1.22	18/04/2008	08:30	1.32
SBHD06 RC	SP	15.00		20/03/2008	17:55	1.20	04/04/2008	09:30	1.33	18/04/2008	08:40	1.44
SBHD08 RC	SPIE	29.50		19/03/2008	18:30	1.28	04/04/2008	10:00	1.39	18/04/2008	08:52	1.52
SBHE02RD	SPIE	25.00		20/03/2008	16:20	2.23	04/04/2008	08:50	2.46	18/04/2008	09:00	2.54
SBHE04 RC	SPIE	17.20		20/03/2008	15:45	2.20	04/04/2008	09:00	1.80	18/04/2008	08:15	1.80
SBHF01 RC	SPIE	19.00		20/03/2008	15:30	5.50	04/04/2008	08:40	5.55	18/04/2008	13:58	5.58
SBHF02A CP	SPIE	17.00		20/03/2008	15:10	5.60	04/04/2008	10:28	5.70	18/04/2008	13:45	5.77
SBHF03 RC	SPIE	18.00		20/03/2008	14:55	7.20	04/04/2008	10:36	7.38	18/04/2008	13:40	7.42
SBHH01 RC	SPIE	25.00		20/03/2008	14:25	3.60	04/04/2008	15:00	3.60	18/04/2008	13:10	3.62
SBHH02 RC	SPIE	14.90		20/03/2008	14:30	4.27	04/04/2008	15:05	3.64	18/04/2008	13:13	3.70
SBHH05 RC	SPIE	21.50		20/03/2008	17:30	2.17	04/04/2008	15:15	2.78	18/04/2008	11:34	2.90
SBHH06 CP	SP	12.30		17/03/2008	15:20	3.88	04/04/2008	15:20	3.89	17/04/2008	14:15	3.90
SBHH07A RC	SPIE	24.85		20/03/2008	13:55	1.33	04/04/2008	15:28	1.92	18/04/2008	11:43	0.88
SBHJ01 CP	SP	7.50		19/03/2008	14:15	1.81	03/04/2008	16:05	1.90	17/04/2008	12:40	1.80
SBHJ03 CP	SP	5.20		19/03/2008	16:40	0.78	03/04/2008	18:25	0.82	17/04/2008	15:55	0.80
SBHJ04	SP	13.10		17/03/2008	13:35	6.64	03/04/2008	18:10	6.74	17/04/2008	13:08	6.80
SBHJ05	SP	11.50		18/03/2008	13:50	9.02	03/04/2008	17:39	9.10	17/04/2008	13:31	9.11
SBHJ06 CP	SP	4.10		17/03/2008	12:55	1.29	03/04/2008	17:43	1.33	17/04/2008	15:05	1.20
SBHJ07 CP	SP	10.40		17/03/2008	10:25	1.59	03/04/2008	17:47	1.50	17/04/2008	13:58	1.47
SBHJ08A CP	SP	7.40		18/03/2008	10:00	2.50	03/04/2008	17:55	2.50	17/04/2008	15:33	2.50
SBHJ09 CP	SP	2.20		18/03/2008	10:25	0.69	03/04/2008	17:58	0.82	17/04/2008	15:22	0.90
SBHJ10 CP	SP	10.00		17/03/2008	09:15	2.10	03/04/2008	17:50	2.00	17/04/2008	13:55	2.00
SBHK01 CP	SP	6.80		19/03/2008	10:45	0.88	03/04/2008	16:40	1.00	17/04/2008	11:40	0.94
SBHK02 CP	SP	11.20		19/03/2008	11:15	1.46	03/04/2008	16:45	1.48	17/04/2008	11:43	1.46
SBHK03 CP	SP	5.90		19/03/2008	11:45	1.04	03/04/2008	16:48	1.07	17/04/2008	11::46	0.98
SBHK04 CP	SP	12.20		19/03/2008	12:15	1.64	03/04/2008	16:52	1.67	17/04/2008	12:05	1.60
SBHL02 RC	SPIE	15.20		19/03/2008	12:50	2.44	03/04/2008	17:00	2.45	17/04/2008	12:00	2.45
SBHL03 RC	SPIE	15.00		20/03/2008	13:25	0.76	08/04/2008	15:40	0.64	18/04/2008	09:50	0.62
SBHM01 RC	SPIE	21.00		20/03/2008	13:05	-0.21	08/04/2008	15:48	-0.45	18/04/2008	11:55	0.01
SBHM02 RC	SPIE	20.00		20/03/2008	13:10	0.61	08/04/2008	15:52	0.61	18/04/2008	11:50	0.61
SBHN01A RC	SPIE	14.90		20/03/2008	12:55	12.14	08/04/2008	16:05	12.58	18/04/2008	12:48	13.27
SBHN02 RC	SPIE	20.40		20/03/2008	12:45	4.26	08/04/2008	16:12	2.64	18/04/2008	12:45	4.85
SBHN03 RC	SPIE	15.00		20/03/2008	12:30	1.60	08/04/2008	16:17	2.07	18/04/2008	12:35	2.37
SBHN04 RC	SPIE	10.00		20/03/2008	12:10	DRY	08/04/2008	16:28	DRY	18/04/2008	10:55	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		04

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		20/03/2008	12:00	DRY	08/04/2008	16:40	DRY	18/04/2008	10:45	DRY
SBHP02 RC	SPIE	9.80		20/03/2008	11:45	5.59	08/04/2008	16:55	7.98	18/04/2008	10:30	8.20
SBHP03 RC	SPIE	5.00		20/03/2008	11:40	2.80	08/04/2008	16:50	DRY	18/04/2008	10:25	4.93
SBHQ01 RC	SPIE	11.80		20/03/2008	10:40	6.72	08/04/2008	17:13	7.24	18/04/2008	10:10	7.48
SBHQ02 RC	SPIE	6.00		20/03/2008	10:45	4.91	08/04/2008	17:10	DRY	18/04/2008	10:05	DRY
SBHQ03 RC	SPIE	11.00		20/03/2008	10:50	6.76	08/04/2008	17:05	7.69	18/04/2008	10:15	8.00
SBHQ04 RC	SPIE	8.00		20/03/2008	11:30	6.97	08/04/2008	17:02	DRY	18/04/2008	10:40	DRY
SBHQ06 RC	SPIE	7.35		20/03/2008	11:20	4.47	08/04/2008	17:20	6.63	18/04/2008	12:20	4.79
SWSJ08	SP	3.30		19/03/2008	15:10	0.44	03/04/2008	16:00	0.46	17/04/2008	12:35	0.42
SWSJ13	SP	2.50		17/03/2008	13:25	DRY	03/04/2008	18:12	DRY	17/04/2008	13:12	DRY
SWSJ21	SP	6.00		18/03/2008	14:30	4.42	03/04/2008	17:33	5.89	17/04/2008	13:32	6.50
SWSJ23	SP	7.80		18/03/2008	15:05	7.58	03/04/2008	17:35	7.20	17/04/2008	13:35	7.20
SWSJ34	SP	6.00		19/03/2008	08:55	2.36	03/04/2008	17:23	3.26	17/04/2008	13:46	DRY
SWSJ37	SP	5.60		18/03/2008	11:15	0.55	03/04/2008	17:25	0.67	17/04/2008	13:42	0.63
LGBH02	SP	8.88		17/03/2008	12:55	7.48	03/04/2008	18:05	7.46	17/04/2008	13:00	7.48
LGBH03	SP	8.90		17/03/2008	13:15	7.24	03/04/2008	18:08	7.32	17/04/2008	13:03	7.30
LGBH04	SP	10.50		18/03/2008	13:20	8.87	03/04/2008	17:40	8.90	17/04/2008	13:29	8.94
LGBH09	SP	7.00		17/03/2008	11:00	1.08	03/04/2008	17:45	1.15	17/04/2008	15:08	1.05
LGBH10	SP	14.60		18/03/2008	15:20	8.31	03/04/2008	17:27	8.20	17/04/2008	13:40	8.70
LGBH11	SP	11.20		18/03/2008	11:40	6.88	03/04/2008	17:18	7.00	17/04/2008	15:38	7.08
LGBH12	SP	7.05		17/03/2008	10:00	1.30	03/04/2008	17:49	1.47	17/04/2008	15:15	1.36
RBBH07	SP	6.25		19/03/2008	13:25	0.66	03/04/2008	15:50	0.68	17/04/2008	12:30	1.10
RBBH09	SP	7.05		19/03/2008	14:40	1.18	03/04/2008	16:07	1.21	17/04/2008	12:42	1.25
RBBH10	SP	6.85		19/03/2008	13:45	0.70	03/04/2008	16:03	0.75	17/04/2008	12:39	0.78

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		01

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		30/01/2008	09:50	2.45	25/02/2008	14:34	2.48	07/03/2008	14:25	2.60
SBHD03 CP	SPIE	10.00		30/01/2008	11:01	0.47	25/02/2008	14:52	0.43	07/03/2008	14:05	0.56
SBHD05 RC	SPIE	12.00		31/01/2008	09:00	1.02	25/02/2008	15:35	1.05	07/03/2008	13:50	1.77
SBHD06 RC	SP	15.00		30/01/2008	13:00	1.13	21/02/2008	10:30	1.39	07/03/2008	13:30	1.39
SBHD08 RC	SPIE	29.50		30/01/2008	13:50	1.20	25/02/2008	15:58	2.02	07/03/2008	13:35	1.40
SBHE02RD	SPIE	25.00		31/01/2008	09:25	2.18	25/02/2008	16:20	2.09	07/03/2008	13:10	2.48
SBHE04 RC	SPIE	17.20		31/01/2008	09:15	2.31	25/02/2008	16:11	2.51	07/03/2008	13:20	2.59
SBHF01 RC	SPIE	19.00		31/01/2008	09:40	5.69	25/02/2008	16:32	5.72	07/03/2008	12:50	5.43
SBHF02A CP	SPIE	17.00		01/02/2008	14:40	7.61	25/02/2008	17:13	7.57	07/03/2008	12:30	9.00
SBHF03 RC	SPIE	18.00		31/01/2008	10:35	6.97	26/02/2008	08:55	6.77	07/03/2008	12:15	7.22
SBHH01 RC	SPIE	25.00		31/01/2008	11:15	3.45	26/02/2008	09:39	3.42	07/03/2008	11:28	3.65
SBHH02 RC	SPIE	14.90		31/01/2008	11:10	3.42	26/02/2008	09:20	3.88	07/03/2008	11:35	3.64
SBHH05 RC	SPIE	21.50		31/01/2008	11:30	2.22	26/02/2008	10:01	2.13	07/03/2008	11:05	3.10
SBHH06 CP	SP	12.30		30/01/2008	15:30	3.75	21/02/2008	08:00	3.76	07/03/2008	11:10	3.87
SBHH07A RC	SPIE	24.85		30/01/2008	14:50	1.70	26/02/2008	10:40	1.34	07/03/2008	11:00	1.07
SBHJ01 CP	SP	7.50		01/02/2008	12:20	1.34	21/02/2008	11:45	5.98	06/03/2008	12:28	1.82
SBHJ03 CP	SP	5.20		01/02/2008	08:00	0.54	27/02/2008	16:15	0.70	07/03/2008	10:45	0.68
SBHJ04	SP	13.10		01/02/2008	11:55	6.61	22/02/2008	13::55	6.67	06/03/2008	11:46	6.75
SBHJ05	SP	11.50		01/02/2008	11:10	8.91	22/02/2008	09:00	9.07	06/03/2008	11:23	9.16
SBHJ06 CP	SP	4.10		01/02/2008	11:45	1.31	21/02/2008	15:30	1.32	06/03/2008	10:50	1.33
SBHJ07 CP	SP	10.40		01/02/2008	11:43	1.35	21/02/2008	14:40	1.40	06/03/2008	12:05	1.56
SBHJ08A CP	SP	7.40		01/02/2008	11:35	3.49	21/02/2008	13:05	2.31	06/03/2008	10:57	2.67
SBHJ09 CP	SP	2.20		01/02/2008	11:30	0.65	21/02/2008	12:25	0.85	06/03/2008	11:00	0.90
SBHJ10 CP	SP	10.00		01/02/2008	10:40	2.30	21/02/2008	13:45	2.24	06/03/2008	10:40	2.16
SBHK01 CP	SP	6.80		01/02/2008	10:55	0.70	25/02/2008	10:30	1.00	06/03/2008	14:24	1.06
SBHK02 CP	SP	11.20		01/02/2008	10:50	1.34	25/02/2008	11:20	1.33	06/03/2008	14:18	1.47
SBHK03 CP	SP	5.90		01/02/2008	10:45	0.87	25/02/2008	12:00	0.89	06/03/2008	14:15	1.00
SBHK04 CP	SP	12.20		01/02/2008	10:25	1.45	25/02/2008	12:30	1.60	06/03/2008	12:30	1.60
SBHL02 RC	SPIE	15.20		01/02/2008	10:35	2.27	25/02/2008	12:49	2.31	06/03/2008	14:00	2.42
SBHL03 RC	SPIE	15.00		31/01/2008	16:20	0.61	26/02/2008	11:15	0.51	07/03/2008	10:25	0.66
SBHM01 RC	SPIE	21.00		01/01/1900	08:20	-0.26	26/02/2008	11:30	-0.26	07/03/2008	10:17	0.05
SBHM02 RC	SPIE	20.00		01/02/2008	08:25	0.19	26/02/2008	11:41	0.49	07/03/2008	10:14	0.68
SBHN01A RC	SPIE	14.90		01/02/2008	15:20	8.49	27/02/2008	17:15	12.23	07/03/2008	14:45	13.18
SBHN02 RC	SPIE	20.40		31/01/2008	15:55	3.67	26/02/2008	11:57	4.19	07/03/2008	10:05	4.84
SBHN03 RC	SPIE	15.00		31/01/2008	15:45	1.07	26/02/2008	12:03	1.73	07/03/2008	09:55	2.34
SBHN04 RC	SPIE	10.00		31/01/2008	15:30	9.99	26/02/2008	14:42	DRY	07/03/2008	09:45	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		02

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		31/01/2008	14:50	DRY	26/02/2008	14:12	DRY	07/03/2008	09:35	DRY
SBHP02 RC	SPIE	9.80		31/01/2008	13:55	7.20	26/02/2008	13:59	8.09	07/03/2008	09:10	8.25
SBHP03 RC	SPIE	5.00		31/01/2008	13:40	4.09	26/02/2008	13:48	4.76	07/03/2008	09:05	4.78
SBHQ01 RC	SPIE	11.80		31/01/2008	14:20	5.76	26/02/2008	12:46	6.74	07/03/2008	09:30	7.20
SBHQ02 RC	SPIE	6.00		31/01/2008	14:15	4.98	26/02/2008	12:59	5.16	07/03/2008	09:25	5.98
SBHQ03 RC	SPIE	11.00		31/01/2008	13:20	6.04	26/02/2008	13:29	7.22	07/03/2008	08:38	7.59
SBHQ04 RC	SPIE	8.00		31/01/2008	13:05	4.35	26/02/2008	13:36	6.18	07/03/2008	08:55	6.94
SBHQ06 RC	SPIE	7.35		31/01/2008	13:00	3.89	26/02/2008	13:16	4.40	07/03/2008	08:25	4.63
SWSJ08	SP	3.30		01/02/2008	12:30	0.42	21/02/2008	11:45	0.37	06/03/2008	12:35	0.41
SWSJ13	SP	2.50		01/02/2008	12:00	DRY	22/02/2008	13:45	DRY	06/03/2008	11:50	DRY
SWSJ21	SP	6.00		01/02/2008	11:20	3.87	22/02/2008	09:30	5.72	06/03/2008	11:27	6.59
SWSJ23	SP	7.80		01/02/2008	11:22	5.92	22/02/2008	09:55	6.62	06/03/2008	11:30	6.97
SWSJ34	SP	6.00		01/02/2008	11:05	2.52	22/02/2008	10:55	3.33	06/03/2008	11:10	3.08
SWSJ37	SP	5.60		01/02/2008	11:25	0.46	22/02/2008	11:30	0.55	06/03/2008	11:15	0.61
LGBH02	SP	8.88					22/02/2008	14:35	7.50	06/03/2008	11:40	7.52
LGBH03	SP	8.90					22/02/2008	14:21	7.20	06/03/2008	11:44	7.28
LGBH04	SP	10.50					22/02/2008	10:30	8.87	06/03/2008	11:20	9.00
LGBH09	SP	7.00					22/02/2008	12:40	1.13	06/03/2008	10:48	1.56
LGBH10	SP	14.60					27/02/2008	14:30	8.15	06/03/2008	11:12	8.21
LGBH11	SP	11.20					27/02/2008	10:00	7.05	06/03/2008	11:03	7.07
LGBH12	SP	7.05					22/02/2008	13:10	1.40	06/03/2008	10:45	1.40
RBBH07	SP	6.25					27/02/2008	12.15	0.69	06/03/2008	12:20	0.71
RBBH09	SP	7.05					27/02/2008	13:40	1.25	06/03/2008	12:25	1.21
RBBH10	SP	6.85					27/02/2008	13:00	0.68	06/03/2008	12:30	0.82

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		03

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		20/03/2008	16:30	2.57	04/04/2008	08:00	2.59	18/04/2008	07:40	2.66
SBHD03 CP	SPIE	10.00		20/03/2008	16:45	0.58	04/04/2008	08:13	0.53	18/04/2008	08:00	0.60
SBHD05 RC	SPIE	12.00		20/03/2008	16:00	1.08	04/04/2008	09:15	1.22	18/04/2008	08:30	1.32
SBHD06 RC	SP	15.00		20/03/2008	17:55	1.20	04/04/2008	09:30	1.33	18/04/2008	08:40	1.44
SBHD08 RC	SPIE	29.50		19/03/2008	18:30	1.28	04/04/2008	10:00	1.39	18/04/2008	08:52	1.52
SBHE02RD	SPIE	25.00		20/03/2008	16:20	2.23	04/04/2008	08:50	2.46	18/04/2008	09:00	2.54
SBHE04 RC	SPIE	17.20		20/03/2008	15:45	2.20	04/04/2008	09:00	1.80	18/04/2008	08:15	1.80
SBHF01 RC	SPIE	19.00		20/03/2008	15:30	5.50	04/04/2008	08:40	5.55	18/04/2008	13:58	5.58
SBHF02A CP	SPIE	17.00		20/03/2008	15:10	5.60	04/04/2008	10:28	5.70	18/04/2008	13:45	5.77
SBHF03 RC	SPIE	18.00		20/03/2008	14:55	7.20	04/04/2008	10:36	7.38	18/04/2008	13:40	7.42
SBHH01 RC	SPIE	25.00		20/03/2008	14:25	3.60	04/04/2008	15:00	3.60	18/04/2008	13:10	3.62
SBHH02 RC	SPIE	14.90		20/03/2008	14:30	4.27	04/04/2008	15:05	3.64	18/04/2008	13:13	3.70
SBHH05 RC	SPIE	21.50		20/03/2008	17:30	2.17	04/04/2008	15:15	2.78	18/04/2008	11:34	2.90
SBHH06 CP	SP	12.30		17/03/2008	15:20	3.88	04/04/2008	15:20	3.89	17/04/2008	14:15	3.90
SBHH07A RC	SPIE	24.85		20/03/2008	13:55	1.33	04/04/2008	15:28	1.92	18/04/2008	11:43	0.88
SBHJ01 CP	SP	7.50		19/03/2008	14:15	1.81	03/04/2008	16:05	1.90	17/04/2008	12:40	1.80
SBHJ03 CP	SP	5.20		19/03/2008	16:40	0.78	03/04/2008	18:25	0.82	17/04/2008	15:55	0.80
SBHJ04	SP	13.10		17/03/2008	13:35	6.64	03/04/2008	18:10	6.74	17/04/2008	13:08	6.80
SBHJ05	SP	11.50		18/03/2008	13:50	9.02	03/04/2008	17:39	9.10	17/04/2008	13:31	9.11
SBHJ06 CP	SP	4.10		17/03/2008	12:55	1.29	03/04/2008	17:43	1.33	17/04/2008	15:05	1.20
SBHJ07 CP	SP	10.40		17/03/2008	10:25	1.59	03/04/2008	17:47	1.50	17/04/2008	13:58	1.47
SBHJ08A CP	SP	7.40		18/03/2008	10:00	2.50	03/04/2008	17:55	2.50	17/04/2008	15:33	2.50
SBHJ09 CP	SP	2.20		18/03/2008	10:25	0.69	03/04/2008	17:58	0.82	17/04/2008	15:22	0.90
SBHJ10 CP	SP	10.00		17/03/2008	09:15	2.10	03/04/2008	17:50	2.00	17/04/2008	13:55	2.00
SBHK01 CP	SP	6.80		19/03/2008	10:45	0.88	03/04/2008	16:40	1.00	17/04/2008	11:40	0.94
SBHK02 CP	SP	11.20		19/03/2008	11:15	1.46	03/04/2008	16:45	1.48	17/04/2008	11:43	1.46
SBHK03 CP	SP	5.90		19/03/2008	11:45	1.04	03/04/2008	16:48	1.07	17/04/2008	11::46	0.98
SBHK04 CP	SP	12.20		19/03/2008	12:15	1.64	03/04/2008	16:52	1.67	17/04/2008	12:05	1.60
SBHL02 RC	SPIE	15.20		19/03/2008	12:50	2.44	03/04/2008	17:00	2.45	17/04/2008	12:00	2.45
SBHL03 RC	SPIE	15.00		20/03/2008	13:25	0.76	08/04/2008	15:40	0.64	18/04/2008	09:50	0.62
SBHM01 RC	SPIE	21.00		20/03/2008	13:05	-0.21	08/04/2008	15:48	-0.45	18/04/2008	11:55	0.01
SBHM02 RC	SPIE	20.00		20/03/2008	13:10	0.61	08/04/2008	15:52	0.61	18/04/2008	11:50	0.61
SBHN01A RC	SPIE	14.90		20/03/2008	12:55	12.14	08/04/2008	16:05	12.58	18/04/2008	12:48	13.27
SBHN02 RC	SPIE	20.40		20/03/2008	12:45	4.26	08/04/2008	16:12	2.64	18/04/2008	12:45	4.85
SBHN03 RC	SPIE	15.00		20/03/2008	12:30	1.60	08/04/2008	16:17	2.07	18/04/2008	12:35	2.37
SBHN04 RC	SPIE	10.00		20/03/2008	12:10	DRY	08/04/2008	16:28	DRY	18/04/2008	10:55	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		04

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		20/03/2008	12:00	DRY	08/04/2008	16:40	DRY	18/04/2008	10:45	DRY
SBHP02 RC	SPIE	9.80		20/03/2008	11:45	5.59	08/04/2008	16:55	7.98	18/04/2008	10:30	8.20
SBHP03 RC	SPIE	5.00		20/03/2008	11:40	2.80	08/04/2008	16:50	DRY	18/04/2008	10:25	4.93
SBHQ01 RC	SPIE	11.80		20/03/2008	10:40	6.72	08/04/2008	17:13	7.24	18/04/2008	10:10	7.48
SBHQ02 RC	SPIE	6.00		20/03/2008	10:45	4.91	08/04/2008	17:10	DRY	18/04/2008	10:05	DRY
SBHQ03 RC	SPIE	11.00		20/03/2008	10:50	6.76	08/04/2008	17:05	7.69	18/04/2008	10:15	8.00
SBHQ04 RC	SPIE	8.00		20/03/2008	11:30	6.97	08/04/2008	17:02	DRY	18/04/2008	10:40	DRY
SBHQ06 RC	SPIE	7.35		20/03/2008	11:20	4.47	08/04/2008	17:20	6.63	18/04/2008	12:20	4.79
SWSJ08	SP	3.30		19/03/2008	15:10	0.44	03/04/2008	16:00	0.46	17/04/2008	12:35	0.42
SWSJ13	SP	2.50		17/03/2008	13:25	DRY	03/04/2008	18:12	DRY	17/04/2008	13:12	DRY
SWSJ21	SP	6.00		18/03/2008	14:30	4.42	03/04/2008	17:33	5.89	17/04/2008	13:32	6.50
SWSJ23	SP	7.80		18/03/2008	15:05	7.58	03/04/2008	17:35	7.20	17/04/2008	13:35	7.20
SWSJ34	SP	6.00		19/03/2008	08:55	2.36	03/04/2008	17:23	3.26	17/04/2008	13:46	DRY
SWSJ37	SP	5.60		18/03/2008	11:15	0.55	03/04/2008	17:25	0.67	17/04/2008	13:42	0.63
LGBH02	SP	8.88		17/03/2008	12:55	7.48	03/04/2008	18:05	7.46	17/04/2008	13:00	7.48
LGBH03	SP	8.90		17/03/2008	13:15	7.24	03/04/2008	18:08	7.32	17/04/2008	13:03	7.30
LGBH04	SP	10.50		18/03/2008	13:20	8.87	03/04/2008	17:40	8.90	17/04/2008	13:29	8.94
LGBH09	SP	7.00		17/03/2008	11:00	1.08	03/04/2008	17:45	1.15	17/04/2008	15:08	1.05
LGBH10	SP	14.60		18/03/2008	15:20	8.31	03/04/2008	17:27	8.20	17/04/2008	13:40	8.70
LGBH11	SP	11.20		18/03/2008	11:40	6.88	03/04/2008	17:18	7.00	17/04/2008	15:38	7.08
LGBH12	SP	7.05		17/03/2008	10:00	1.30	03/04/2008	17:49	1.47	17/04/2008	15:15	1.36
RBBH07	SP	6.25		19/03/2008	13:25	0.66	03/04/2008	15:50	0.68	17/04/2008	12:30	1.10
RBBH09	SP	7.05		19/03/2008	14:40	1.18	03/04/2008	16:07	1.21	17/04/2008	12:42	1.25
RBBH10	SP	6.85		19/03/2008	13:45	0.70	03/04/2008	16:03	0.75	17/04/2008	12:39	0.78

Recorded by:	S Davis	Checked by:	I Swain	Approved by:	I Swain
Date:	17/03/08-17/04/08	Date:	21/04/2008	Date:	21/04/2008
Form No.	SI GWR	Revision No.	2.03	Issue Date	07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		01

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		30/01/2008	09:50	2.45	25/02/2008	14:34	2.48	07/03/2008	14:25	2.60
SBHD03 CP	SPIE	10.00		30/01/2008	11:01	0.47	25/02/2008	14:52	0.43	07/03/2008	14:05	0.56
SBHD05 RC	SPIE	12.00		31/01/2008	09:00	1.02	25/02/2008	15:35	1.05	07/03/2008	13:50	1.77
SBHD06 RC	SP	15.00		30/01/2008	13:00	1.13	21/02/2008	10:30	1.39	07/03/2008	13:30	1.39
SBHD08 RC	SPIE	29.50		30/01/2008	13:50	1.20	25/02/2008	15:58	2.02	07/03/2008	13:35	1.40
SBHE02RD	SPIE	25.00		31/01/2008	09:25	2.18	25/02/2008	16:20	2.09	07/03/2008	13:10	2.48
SBHE04 RC	SPIE	17.20		31/01/2008	09:15	2.31	25/02/2008	16:11	2.51	07/03/2008	13:20	2.59
SBHF01 RC	SPIE	19.00		31/01/2008	09:40	5.69	25/02/2008	16:32	5.72	07/03/2008	12:50	5.43
SBHF02A CP	SPIE	17.00		01/02/2008	14:40	7.61	25/02/2008	17:13	7.57	07/03/2008	12:30	9.00
SBHF03 RC	SPIE	18.00		31/01/2008	10:35	6.97	26/02/2008	08:55	6.77	07/03/2008	12:15	7.22
SBHH01 RC	SPIE	25.00		31/01/2008	11:15	3.45	26/02/2008	09:39	3.42	07/03/2008	11:28	3.65
SBHH02 RC	SPIE	14.90		31/01/2008	11:10	3.42	26/02/2008	09:20	3.88	07/03/2008	11:35	3.64
SBHH05 RC	SPIE	21.50		31/01/2008	11:30	2.22	26/02/2008	10:01	2.13	07/03/2008	11:05	3.10
SBHH06 CP	SP	12.30		30/01/2008	15:30	3.75	21/02/2008	08:00	3.76	07/03/2008	11:10	3.87
SBHH07A RC	SPIE	24.85		30/01/2008	14:50	1.70	26/02/2008	10:40	1.34	07/03/2008	11:00	1.07
SBHJ01 CP	SP	7.50		01/02/2008	12:20	1.34	21/02/2008	11:45	5.98	06/03/2008	12:28	1.82
SBHJ03 CP	SP	5.20		01/02/2008	08:00	0.54	27/02/2008	16:15	0.70	07/03/2008	10:45	0.68
SBHJ04	SP	13.10		01/02/2008	11:55	6.61	22/02/2008	13::55	6.67	06/03/2008	11:46	6.75
SBHJ05	SP	11.50		01/02/2008	11:10	8.91	22/02/2008	09:00	9.07	06/03/2008	11:23	9.16
SBHJ06 CP	SP	4.10		01/02/2008	11:45	1.31	21/02/2008	15:30	1.32	06/03/2008	10:50	1.33
SBHJ07 CP	SP	10.40		01/02/2008	11:43	1.35	21/02/2008	14:40	1.40	06/03/2008	12:05	1.56
SBHJ08A CP	SP	7.40		01/02/2008	11:35	3.49	21/02/2008	13:05	2.31	06/03/2008	10:57	2.67
SBHJ09 CP	SP	2.20		01/02/2008	11:30	0.65	21/02/2008	12:25	0.85	06/03/2008	11:00	0.90
SBHJ10 CP	SP	10.00		01/02/2008	10:40	2.30	21/02/2008	13:45	2.24	06/03/2008	10:40	2.16
SBHK01 CP	SP	6.80		01/02/2008	10:55	0.70	25/02/2008	10:30	1.00	06/03/2008	14:24	1.06
SBHK02 CP	SP	11.20		01/02/2008	10:50	1.34	25/02/2008	11:20	1.33	06/03/2008	14:18	1.47
SBHK03 CP	SP	5.90		01/02/2008	10:45	0.87	25/02/2008	12:00	0.89	06/03/2008	14:15	1.00
SBHK04 CP	SP	12.20		01/02/2008	10:25	1.45	25/02/2008	12:30	1.60	06/03/2008	12:30	1.60
SBHL02 RC	SPIE	15.20		01/02/2008	10:35	2.27	25/02/2008	12:49	2.31	06/03/2008	14:00	2.42
SBHL03 RC	SPIE	15.00		31/01/2008	16:20	0.61	26/02/2008	11:15	0.51	07/03/2008	10:25	0.66
SBHM01 RC	SPIE	21.00		01/01/1900	08:20	-0.26	26/02/2008	11:30	-0.26	07/03/2008	10:17	0.05
SBHM02 RC	SPIE	20.00		01/02/2008	08:25	0.19	26/02/2008	11:41	0.49	07/03/2008	10:14	0.68
SBHN01A RC	SPIE	14.90		01/02/2008	15:20	8.49	27/02/2008	17:15	12.23	07/03/2008	14:45	13.18
SBHN02 RC	SPIE	20.40		31/01/2008	15:55	3.67	26/02/2008	11:57	4.19	07/03/2008	10:05	4.84
SBHN03 RC	SPIE	15.00		31/01/2008	15:45	1.07	26/02/2008	12:03	1.73	07/03/2008	09:55	2.34
SBHN04 RC	SPIE	10.00		31/01/2008	15:30	9.99	26/02/2008	14:42	DRY	07/03/2008	09:45	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		02

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		31/01/2008	14:50	DRY	26/02/2008	14:12	DRY	07/03/2008	09:35	DRY
SBHP02 RC	SPIE	9.80		31/01/2008	13:55	7.20	26/02/2008	13:59	8.09	07/03/2008	09:10	8.25
SBHP03 RC	SPIE	5.00		31/01/2008	13:40	4.09	26/02/2008	13:48	4.76	07/03/2008	09:05	4.78
SBHQ01 RC	SPIE	11.80		31/01/2008	14:20	5.76	26/02/2008	12:46	6.74	07/03/2008	09:30	7.20
SBHQ02 RC	SPIE	6.00		31/01/2008	14:15	4.98	26/02/2008	12:59	5.16	07/03/2008	09:25	5.98
SBHQ03 RC	SPIE	11.00		31/01/2008	13:20	6.04	26/02/2008	13:29	7.22	07/03/2008	08:38	7.59
SBHQ04 RC	SPIE	8.00		31/01/2008	13:05	4.35	26/02/2008	13:36	6.18	07/03/2008	08:55	6.94
SBHQ06 RC	SPIE	7.35		31/01/2008	13:00	3.89	26/02/2008	13:16	4.40	07/03/2008	08:25	4.63
SWSJ08	SP	3.30		01/02/2008	12:30	0.42	21/02/2008	11:45	0.37	06/03/2008	12:35	0.41
SWSJ13	SP	2.50		01/02/2008	12:00	DRY	22/02/2008	13:45	DRY	06/03/2008	11:50	DRY
SWSJ21	SP	6.00		01/02/2008	11:20	3.87	22/02/2008	09:30	5.72	06/03/2008	11:27	6.59
SWSJ23	SP	7.80		01/02/2008	11:22	5.92	22/02/2008	09:55	6.62	06/03/2008	11:30	6.97
SWSJ34	SP	6.00		01/02/2008	11:05	2.52	22/02/2008	10:55	3.33	06/03/2008	11:10	3.08
SWSJ37	SP	5.60		01/02/2008	11:25	0.46	22/02/2008	11:30	0.55	06/03/2008	11:15	0.61
LGBH02	SP	8.88					22/02/2008	14:35	7.50	06/03/2008	11:40	7.52
LGBH03	SP	8.90					22/02/2008	14:21	7.20	06/03/2008	11:44	7.28
LGBH04	SP	10.50					22/02/2008	10:30	8.87	06/03/2008	11:20	9.00
LGBH09	SP	7.00					22/02/2008	12:40	1.13	06/03/2008	10:48	1.56
LGBH10	SP	14.60					27/02/2008	14:30	8.15	06/03/2008	11:12	8.21
LGBH11	SP	11.20					27/02/2008	10:00	7.05	06/03/2008	11:03	7.07
LGBH12	SP	7.05					22/02/2008	13:10	1.40	06/03/2008	10:45	1.40
RBBH07	SP	6.25					27/02/2008	12.15	0.69	06/03/2008	12:20	0.71
RBBH09	SP	7.05					27/02/2008	13:40	1.25	06/03/2008	12:25	1.21
RBBH10	SP	6.85					27/02/2008	13:00	0.68	06/03/2008	12:30	0.82

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 30/01/08-07/03/08	Date: 16/04/2008	Date: 17/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		03

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS SBHM01 RC installation extends 0.50m above ground level. - symbol indicates water level is above GL

All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHC01 RC	SPIE	8.05		20/03/2008	16:30	2.57	04/04/2008	08:00	2.59	18/04/2008	07:40	2.66
SBHD03 CP	SPIE	10.00		20/03/2008	16:45	0.58	04/04/2008	08:13	0.53	18/04/2008	08:00	0.60
SBHD05 RC	SPIE	12.00		20/03/2008	16:00	1.08	04/04/2008	09:15	1.22	18/04/2008	08:30	1.32
SBHD06 RC	SP	15.00		20/03/2008	17:55	1.20	04/04/2008	09:30	1.33	18/04/2008	08:40	1.44
SBHD08 RC	SPIE	29.50		19/03/2008	18:30	1.28	04/04/2008	10:00	1.39	18/04/2008	08:52	1.52
SBHE02RD	SPIE	25.00		20/03/2008	16:20	2.23	04/04/2008	08:50	2.46	18/04/2008	09:00	2.54
SBHE04 RC	SPIE	17.20		20/03/2008	15:45	2.20	04/04/2008	09:00	1.80	18/04/2008	08:15	1.80
SBHF01 RC	SPIE	19.00		20/03/2008	15:30	5.50	04/04/2008	08:40	5.55	18/04/2008	13:58	5.58
SBHF02A CP	SPIE	17.00		20/03/2008	15:10	5.60	04/04/2008	10:28	5.70	18/04/2008	13:45	5.77
SBHF03 RC	SPIE	18.00		20/03/2008	14:55	7.20	04/04/2008	10:36	7.38	18/04/2008	13:40	7.42
SBHH01 RC	SPIE	25.00		20/03/2008	14:25	3.60	04/04/2008	15:00	3.60	18/04/2008	13:10	3.62
SBHH02 RC	SPIE	14.90		20/03/2008	14:30	4.27	04/04/2008	15:05	3.64	18/04/2008	13:13	3.70
SBHH05 RC	SPIE	21.50		20/03/2008	17:30	2.17	04/04/2008	15:15	2.78	18/04/2008	11:34	2.90
SBHH06 CP	SP	12.30		17/03/2008	15:20	3.88	04/04/2008	15:20	3.89	17/04/2008	14:15	3.90
SBHH07A RC	SPIE	24.85		20/03/2008	13:55	1.33	04/04/2008	15:28	1.92	18/04/2008	11:43	0.88
SBHJ01 CP	SP	7.50		19/03/2008	14:15	1.81	03/04/2008	16:05	1.90	17/04/2008	12:40	1.80
SBHJ03 CP	SP	5.20		19/03/2008	16:40	0.78	03/04/2008	18:25	0.82	17/04/2008	15:55	0.80
SBHJ04	SP	13.10		17/03/2008	13:35	6.64	03/04/2008	18:10	6.74	17/04/2008	13:08	6.80
SBHJ05	SP	11.50		18/03/2008	13:50	9.02	03/04/2008	17:39	9.10	17/04/2008	13:31	9.11
SBHJ06 CP	SP	4.10		17/03/2008	12:55	1.29	03/04/2008	17:43	1.33	17/04/2008	15:05	1.20
SBHJ07 CP	SP	10.40		17/03/2008	10:25	1.59	03/04/2008	17:47	1.50	17/04/2008	13:58	1.47
SBHJ08A CP	SP	7.40		18/03/2008	10:00	2.50	03/04/2008	17:55	2.50	17/04/2008	15:33	2.50
SBHJ09 CP	SP	2.20		18/03/2008	10:25	0.69	03/04/2008	17:58	0.82	17/04/2008	15:22	0.90
SBHJ10 CP	SP	10.00		17/03/2008	09:15	2.10	03/04/2008	17:50	2.00	17/04/2008	13:55	2.00
SBHK01 CP	SP	6.80		19/03/2008	10:45	0.88	03/04/2008	16:40	1.00	17/04/2008	11:40	0.94
SBHK02 CP	SP	11.20		19/03/2008	11:15	1.46	03/04/2008	16:45	1.48	17/04/2008	11:43	1.46
SBHK03 CP	SP	5.90		19/03/2008	11:45	1.04	03/04/2008	16:48	1.07	17/04/2008	11::46	0.98
SBHK04 CP	SP	12.20		19/03/2008	12:15	1.64	03/04/2008	16:52	1.67	17/04/2008	12:05	1.60
SBHL02 RC	SPIE	15.20		19/03/2008	12:50	2.44	03/04/2008	17:00	2.45	17/04/2008	12:00	2.45
SBHL03 RC	SPIE	15.00		20/03/2008	13:25	0.76	08/04/2008	15:40	0.64	18/04/2008	09:50	0.62
SBHM01 RC	SPIE	21.00		20/03/2008	13:05	-0.21	08/04/2008	15:48	-0.45	18/04/2008	11:55	0.01
SBHM02 RC	SPIE	20.00		20/03/2008	13:10	0.61	08/04/2008	15:52	0.61	18/04/2008	11:50	0.61
SBHN01A RC	SPIE	14.90		20/03/2008	12:55	12.14	08/04/2008	16:05	12.58	18/04/2008	12:48	13.27
SBHN02 RC	SPIE	20.40		20/03/2008	12:45	4.26	08/04/2008	16:12	2.64	18/04/2008	12:45	4.85
SBHN03 RC	SPIE	15.00		20/03/2008	12:30	1.60	08/04/2008	16:17	2.07	18/04/2008	12:35	2.37
SBHN04 RC	SPIE	10.00		20/03/2008	12:10	DRY	08/04/2008	16:28	DRY	18/04/2008	10:55	DRY

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Project Name	New M4 Preliminary Ground Investigation	**Groundwater Readings For Installations**	
Project No.	F15056		
Engineer	Ove Arup & Partners Ltd		Fig no.
Client	Transport Wales, Welsh Assembly Government		04

NOTES: SPIE=Piezometer, SP=Standpipe
For multiple installations, use different Installation IDs.
For piezometers installation depth = tip depth. For standpipes = base of pipe

COMMENTS
Unable to locate LGBH05 and RBBH08. LGBH06 was blocked
All groundwater levels are recorded from ground level

Exploratory Hole ID	Installation Details			Recorded Water Level								
	Type	Depth m	ID	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m	Date dd/mm/yyyy	Time hh:mm	Reading m
SBHP01 RC	SPIE	8.00		20/03/2008	12:00	DRY	08/04/2008	16:40	DRY	18/04/2008	10:45	DRY
SBHP02 RC	SPIE	9.80		20/03/2008	11:45	5.59	08/04/2008	16:55	7.98	18/04/2008	10:30	8.20
SBHP03 RC	SPIE	5.00		20/03/2008	11:40	2.80	08/04/2008	16:50	DRY	18/04/2008	10:25	4.93
SBHQ01 RC	SPIE	11.80		20/03/2008	10:40	6.72	08/04/2008	17:13	7.24	18/04/2008	10:10	7.48
SBHQ02 RC	SPIE	6.00		20/03/2008	10:45	4.91	08/04/2008	17:10	DRY	18/04/2008	10:05	DRY
SBHQ03 RC	SPIE	11.00		20/03/2008	10:50	6.76	08/04/2008	17:05	7.69	18/04/2008	10:15	8.00
SBHQ04 RC	SPIE	8.00		20/03/2008	11:30	6.97	08/04/2008	17:02	DRY	18/04/2008	10:40	DRY
SBHQ06 RC	SPIE	7.35		20/03/2008	11:20	4.47	08/04/2008	17:20	6.63	18/04/2008	12:20	4.79
SWSJ08	SP	3.30		19/03/2008	15:10	0.44	03/04/2008	16:00	0.46	17/04/2008	12:35	0.42
SWSJ13	SP	2.50		17/03/2008	13:25	DRY	03/04/2008	18:12	DRY	17/04/2008	13:12	DRY
SWSJ21	SP	6.00		18/03/2008	14:30	4.42	03/04/2008	17:33	5.89	17/04/2008	13:32	6.50
SWSJ23	SP	7.80		18/03/2008	15:05	7.58	03/04/2008	17:35	7.20	17/04/2008	13:35	7.20
SWSJ34	SP	6.00		19/03/2008	08:55	2.36	03/04/2008	17:23	3.26	17/04/2008	13:46	DRY
SWSJ37	SP	5.60		18/03/2008	11:15	0.55	03/04/2008	17:25	0.67	17/04/2008	13:42	0.63
LGBH02	SP	8.88		17/03/2008	12:55	7.48	03/04/2008	18:05	7.46	17/04/2008	13:00	7.48
LGBH03	SP	8.90		17/03/2008	13:15	7.24	03/04/2008	18:08	7.32	17/04/2008	13:03	7.30
LGBH04	SP	10.50		18/03/2008	13:20	8.87	03/04/2008	17:40	8.90	17/04/2008	13:29	8.94
LGBH09	SP	7.00		17/03/2008	11:00	1.08	03/04/2008	17:45	1.15	17/04/2008	15:08	1.05
LGBH10	SP	14.60		18/03/2008	15:20	8.31	03/04/2008	17:27	8.20	17/04/2008	13:40	8.70
LGBH11	SP	11.20		18/03/2008	11:40	6.88	03/04/2008	17:18	7.00	17/04/2008	15:38	7.08
LGBH12	SP	7.05		17/03/2008	10:00	1.30	03/04/2008	17:49	1.47	17/04/2008	15:15	1.36
RBBH07	SP	6.25		19/03/2008	13:25	0.66	03/04/2008	15:50	0.68	17/04/2008	12:30	1.10
RBBH09	SP	7.05		19/03/2008	14:40	1.18	03/04/2008	16:07	1.21	17/04/2008	12:42	1.25
RBBH10	SP	6.85		19/03/2008	13:45	0.70	03/04/2008	16:03	0.75	17/04/2008	12:39	0.78

Recorded by: S Davis	Checked by: I Swain	Approved by: I Swain
Date: 17/03/08-17/04/08	Date: 21/04/2008	Date: 21/04/2008
Form No. SI GWR	Revision No. 2.03	Issue Date 07/01/2008

NORWEST HOLST SOIL ENGINEERING

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH519	19/03/15 08:30:00	1037	-2								-0.4	5		14 litres purged, base depth 4.00m.
BH519	19/03/15 08:31:00										-0.4			
BH519	19/03/15 08:32:00										-0.4			
BH519	19/03/15 08:33:00										-0.4			
BH519	19/03/15 08:34:00										-0.4			
BH519	19/03/15 08:35:00			0.0	0.1	18.8	3.8	0	0	1.3				
BH519	19/03/15 08:36:00			0.0	0.6	18.6	41.9	0	0	0.7				
BH519	19/03/15 08:37:00			0.0	4.1	17.4	#	0	0	0.9				Upsurge at 3min 10sec. Unable to obtain further readings.
BH519	19/03/15 08:38:00													
BH519	19/03/15 08:39:00													
BH519	19/03/15 08:40:00													
BH519	19/03/15 08:41:00													
BH519	19/03/15 08:42:00													
BH519	19/03/15 08:43:00													
BH519	19/03/15 08:44:00												0.74	
BH519	26/03/15 09:00:00	1005	4								0.0	11		10 litres purged, base depth 4.00m.
BH519	26/03/15 09:01:00										0.0			
BH519	26/03/15 09:02:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH519	26/03/15 09:03:00										0.0			
BH519	26/03/15 09:04:00										0.0			
BH519	26/03/15 09:05:00			0.0	3.0	17.7	50.0	0	1	1.7				
BH519	26/03/15 09:06:00			0.0	1.6	19.1	29.0	0	1	2.0				
BH519	26/03/15 09:07:00			0.0	1.2	19.6	21.0	0	1	2.1				
BH519	26/03/15 09:08:00			0.0	0.6	20.2	11.0	0	0	2.0				
BH519	26/03/15 09:09:00			0.0	0.5	20.4	8.0	0	0	2.1				
BH519	26/03/15 09:10:00			0.0	0.4	20.5	7.0	0	0	2.0				
BH519	26/03/15 09:11:00			0.0	0.3	20.5	6.0	0	0	1.7				
BH519	26/03/15 09:12:00			0.0	0.3	20.6	6.0	0	0	1.4				
BH519	26/03/15 09:13:00			0.0	0.3	20.6	5.0	0	0	1.4				
BH519	26/03/15 09:14:00			0.0	0.3	20.7	5.0	0	0	1.4			1.35	
BH519	02/04/15 08:30:00	1026	-1.01								0.0	7		12 litres purged, base depth 4.00m.
BH519	02/04/15 08:31:00										0.4			
BH519	02/04/15 08:32:00										0.4			
BH519	02/04/15 08:33:00										0.4			
BH519	02/04/15 08:34:00										0.4			
BH519	02/04/15 08:35:00			0.0	4.5	13.4	88.0	0	2	1.9				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH519	02/04/15 08:36:00			0.0	4.0	14.1	78.0	0	2	1.4				
BH519	02/04/15 08:37:00			0.0	4.5	10.1	98.0	0	12	0.9				
BH519	02/04/15 08:38:00			0.0	5.4	7.2	#	0	42	0.7				
BH519	02/04/15 08:39:00			0.0	5.7	5.3	#	0	182	0.6				
BH519	02/04/15 08:40:00			0.0	5.1	6.9	97.0	0	246	0.5				
BH519	02/04/15 08:41:00			0.0	4.1	9.8	77.0	0	248	0.4				
BH519	02/04/15 08:42:00			0.0	3.2	11.6	68.0	0	245	0.5				
BH519	02/04/15 08:43:00			0.0	3.1	12.1	56.0	0	229	0.7				
BH519	02/04/15 08:44:00			0.0	2.4	13.9	45.0	0	193	0.5			1.27	
BH519	07/05/15 12:12:00	996	0								0.0	17		
BH519	07/05/15 12:13:00										0.0			
BH519	07/05/15 12:14:00										0.0			
BH519	07/05/15 12:15:00										0.0			
BH519	07/05/15 12:16:00										0.0			
BH519	07/05/15 12:17:00			0.0	6.7	4.7	#	0	0	1.2				
BH519	07/05/15 12:18:00			0.0	7.7	2.3	#	0	0	1.1				
BH519	07/05/15 12:19:00			0.0	8.4	0.7	#	0	0	1.2				
BH519	07/05/15 12:20:00			0.0	8.6	0.6	#	0	10	1.4				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH519	07/05/15 12:21:00			0.0	8.4	1.3	#	0	34	1.4				
BH519	07/05/15 12:22:00			0.0	7.7	3.2	#	0	53	1.4				
BH519	07/05/15 12:23:00			0.0	6.4	6.8	#	0	58	1.5				
BH519	07/05/15 12:24:00			0.0	4.7	10.4	97.3	0	44	1.3				
BH519	07/05/15 12:25:00			0.0	3.5	12.9	74.3	0	35	1.3				
BH519	07/05/15 12:26:00			0.0	2.5	14.6	54.3	0	24	1.2				
BH519	07/05/15 12:27:00												2.65	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH519	19/03/15 08:44:00												1.37	57 litres purged, base depth 11.00m.
BH519	26/03/15 09:14:00												1.65	56 litres purged, base depth 11.00m.
BH519	02/04/15 08:44:00												1.82	55 litres purged, base depth 11.00m.
BH519	07/05/15 12:28:00												3.50	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH525	19/03/15 12:00:00	1037	2								0.4	9		5 litres purged, base depth 2.60m.
BH525	19/03/15 12:01:00										0.4			
BH525	19/03/15 12:02:00										0.0			
BH525	19/03/15 12:03:00										0.0			
BH525	19/03/15 12:04:00										0.0			
BH525	19/03/15 12:05:00			0.0	3.2	19.1	63.4	0	0	0.2				
BH525	19/03/15 12:06:00			0.0	2.4	19.2	55.7	0	0	0.0				
BH525	19/03/15 12:07:00			0.0	2.4	19.0	54.1	0	0	0.0				
BH525	19/03/15 12:08:00			0.0	2.2	18.9	51.3	0	0	0.0				
BH525	19/03/15 12:09:00			0.0	2.1	18.8	48.8	0	0	0.0				
BH525	19/03/15 12:10:00			0.0	2.0	18.7	46.1	0	0	0.0				
BH525	19/03/15 12:11:00			0.0	1.9	18.6	42.7	0	0	0.0				
BH525	19/03/15 12:12:00			0.0	1.6	18.4	37.0	0	0	0.0				
BH525	19/03/15 12:13:00			0.0	1.5	18.4	36.2	0	0	0.0				
BH525	19/03/15 12:14:00			0.0	1.5	18.2	33.6	0	0	0.0			1.32	
BH525	26/03/15 12:30:00	1008	-0.32								0.0	12		4 litres purged, base depth 2.60m.
BH525	26/03/15 12:31:00										0.0			
BH525	26/03/15 12:32:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH525	26/03/15 12:33:00										0.0			
BH525	26/03/15 12:34:00										0.0			
BH525	26/03/15 12:35:00			0.0	9.9	15.0	#	0	2	0.0				
BH525	26/03/15 12:36:00			0.0	7.5	13.2	#	0	3	0.0				
BH525	26/03/15 12:37:00			0.0	5.8	11.7	#	0	3	0.0				
BH525	26/03/15 12:38:00			0.0	5.2	10.1	#	0	3	0.0				
BH525	26/03/15 12:39:00			0.0	5.0	9.1	99.0	0	3	0.0				
BH525	26/03/15 12:40:00			0.0	4.8	8.7	96.0	0	3	0.0				
BH525	26/03/15 12:41:00			0.0	4.7	8.5	93.0	0	4	0.0				
BH525	26/03/15 12:42:00			0.0	4.7	8.2	93.0	0	4	0.0				
BH525	26/03/15 12:43:00			0.0	4.6	8.0	92.0	0	4	0.0				
BH525	26/03/15 12:44:00			0.0	4.6	8.0	90.0	0	3	0.0			1.64	
BH525	02/04/15 12:00:00	1027	-0.92								0.0	9		4 litres purged, base depth 2.60m.
BH525	02/04/15 12:01:00										0.0			
BH525	02/04/15 12:02:00										0.0			
BH525	02/04/15 12:03:00										0.0			
BH525	02/04/15 12:04:00										0.0			
BH525	02/04/15 12:05:00			0.0	4.4	5.1	87.0	0	1	0.3				

remarks
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VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

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Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH525	02/04/15 12:06:00			0.0	4.3	4.1	86.0	0	2	0.5				
BH525	02/04/15 12:07:00			0.0	4.3	3.6	84.0	0	1	0.2				
BH525	02/04/15 12:08:00			0.0	4.2	3.2	83.0	0	2	0.2				
BH525	02/04/15 12:09:00			0.0	4.1	3.2	81.0	0	2	0.0				
BH525	02/04/15 12:10:00			0.0	3.9	3.4	77.0	0	2	0.0				
BH525	02/04/15 12:11:00			0.0	3.8	3.8	74.0	0	2	0.0				
BH525	02/04/15 12:12:00			0.0	3.6	4.3	70.0	0	2	0.0				
BH525	02/04/15 12:13:00			0.0	3.4	4.9	67.0	0	2	0.0				
BH525	02/04/15 12:14:00			0.0	3.3	5.6	64.0	0	2	0.0			1.66	
BH525	07/05/15 14:39:00	995	1								0.4	17		
BH525	07/05/15 14:40:00										1.2			
BH525	07/05/15 14:41:00										0.0			
BH525	07/05/15 14:42:00										0.0			
BH525	07/05/15 14:43:00										0.0			
BH525	07/05/15 14:44:00			0.0	3.6	0.3	81.4	0	0	1.2				
BH525	07/05/15 14:45:00			0.0	3.7	0.1	85.2	0	0	1.2				
BH525	07/05/15 14:46:00			0.0	3.7	0.0	86.6	0	0	1.1				
BH525	07/05/15 14:47:00			0.0	3.7	0.3	83.8	0	0	1.1				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT **30238**

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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH525	07/05/15 14:48:00			0.0	3.6	0.7	82.1	0	0	1.1				
BH525	07/05/15 14:49:00			0.0	3.5	1.2	80.0	0	0	1.0				
BH525	07/05/15 14:50:00			0.0	3.3	2.2	75.9	0	0	1.0				
BH525	07/05/15 14:51:00			0.0	3.0	3.5	69.3	0	0	1.0				
BH525	07/05/15 14:52:00			0.0	2.7	4.7	62.7	0	0	1.0				
BH525	07/05/15 14:53:00			0.0	2.6	5.6	58.9	0	0	1.0				
BH525	07/05/15 14:54:00												Dry	

remarks
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Shallow install.

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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH525	19/03/15 12:14:00												1.80	58 litres purged, base depth 11.60m.
BH525	26/03/15 12:44:00												2.02	57 litres purged, base depth 11.60m.
BH525	02/04/15 12:14:00												1.80	58 litres purged, base depth 11.60m.
BH525	07/05/15 14:55:00												3.26	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH521	19/03/15 10:30:00	1038	1								0.4	6		23 litres purged, base depth 6.00m.
BH521	19/03/15 10:31:00										0.0			
BH521	19/03/15 10:32:00										0.0			
BH521	19/03/15 10:33:00										0.0			
BH521	19/03/15 10:34:00										0.0			
BH521	19/03/15 10:35:00			0.0	0.0	19.5	0.0	0	0	1.0				
BH521	19/03/15 10:36:00			0.0	0.0	19.6	0.0	0	0	0.8				
BH521	19/03/15 10:37:00			0.0	0.0	19.7	0.0	0	0	0.7				
BH521	19/03/15 10:38:00			0.0	0.0	19.7	0.0	0	0	0.6				
BH521	19/03/15 10:39:00			0.0	0.0	19.8	0.0	0	0	0.5				
BH521	19/03/15 10:40:00			0.0	0.0	19.8	0.0	0	0	0.4				
BH521	19/03/15 10:41:00			0.0	0.0	19.9	0.0	0	0	0.4				
BH521	19/03/15 10:42:00			0.0	0.0	19.9	0.0	0	0	0.3				
BH521	19/03/15 10:43:00			0.0	0.0	19.9	0.0	0	0	0.3				
BH521	19/03/15 10:44:00			0.0	0.0	19.9	0.0	0	0	0.3			0.85	
BH521	26/03/15 11:00:00	1007	0								0.0	11		17 litres purged, base depth 6.00m.
BH521	26/03/15 11:01:00										0.0			
BH521	26/03/15 11:02:00										0.0			

remarks
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Shallow install.

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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH521	26/03/15 11:03:00										0.0			
BH521	26/03/15 11:04:00										0.0			
BH521	26/03/15 11:05:00			0.0	2.8	19.7	49.0	0	1	0.2				
BH521	26/03/15 11:06:00			0.0	1.4	20.2	27.0	0	0	0.5				
BH521	26/03/15 11:07:00			0.0	1.2	20.3	24.0	0	1	0.5				
BH521	26/03/15 11:08:00			0.0	1.1	20.4	21.0	0	0	0.6				
BH521	26/03/15 11:09:00			0.0	0.9	20.5	17.0	0	0	0.7				
BH521	26/03/15 11:10:00			0.0	0.8	20.5	15.0	0	0	0.7				
BH521	26/03/15 11:11:00			0.0	0.6	20.6	12.0	0	0	0.8				
BH521	26/03/15 11:12:00			0.0	0.6	20.6	10.0	0	0	0.9				
BH521	26/03/15 11:13:00			0.0	0.4	20.7	8.0	0	0	1.0				
BH521	26/03/15 11:14:00			0.0	0.4	20.7	6.0	0	0	1.1			1.26	
BH521	02/04/15 10:30:00	1027	-1.02								0.1	8		16 litres purged, base depth 6.00m.
BH521	02/04/15 10:31:00										0.0			
BH521	02/04/15 10:32:00										-0.3			
BH521	02/04/15 10:33:00										-0.5			
BH521	02/04/15 10:34:00										-1.2			
BH521	02/04/15 10:35:00			0.3	5.0	19.0	94.0	0	2	0.1				

remarks
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Shallow install.

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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH521	02/04/15 10:36:00			0.3	3.9	19.3	78.0	0	2	0.0				
BH521	02/04/15 10:37:00			0.3	3.5	19.6	66.0	0	2	0.0				
BH521	02/04/15 10:38:00			0.2	2.8	19.8	46.0	0	2	0.2				
BH521	02/04/15 10:39:00			0.1	1.8	20.2	33.0	0	1	0.5				
BH521	02/04/15 10:40:00			0.0	0.1	20.9	1.0	0	1	1.6				
BH521	02/04/15 10:41:00			0.0	0.1	20.9	1.0	0	1	1.5				
BH521	02/04/15 10:42:00			0.0	0.1	20.9	1.0	0	0	1.3				
BH521	02/04/15 10:43:00			0.0	0.1	20.9	1.0	0	0	1.2				
BH521	02/04/15 10:44:00			0.0	0.1	20.9	1.0	0	0	1.1			1.34	
BH521	07/05/15 13:44:00	997	0								0.0	17		
BH521	07/05/15 13:45:00										0.0			
BH521	07/05/15 13:46:00										0.0			
BH521	07/05/15 13:47:00										0.0			
BH521	07/05/15 13:48:00										0.0			
BH521	07/05/15 13:49:00			0.0	0.3	19.8	2.4	0	0	0.2				
BH521	07/05/15 13:50:00			0.0	0.0	20.1	0.0	0	0	0.0				
BH521	07/05/15 13:51:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH521	07/05/15 13:52:00			0.0	0.0	20.3	0.0	0	0	0.0				

remarks
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VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT **30238**

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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH521	07/05/15 13:53:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH521	07/05/15 13:54:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH521	07/05/15 13:55:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH521	07/05/15 13:56:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH521	07/05/15 13:57:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH521	07/05/15 13:58:00			0.0	0.0	20.3	0.0	0	0	0.0				
BH521	07/05/15 13:59:00												2.66	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

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GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH521	19/03/15 10:44:00												2.93	36 litres purged, base depth 11.00m.
BH521	26/03/15 11:14:00												2.95	36 litres purged, base depth 11.00m.
BH521	02/04/15 10:44:00												1.99	42 litres purged, base depth 11.00m.
BH521	07/05/15 14:00:00												3.57	

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Deep install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH515	18/03/15 12:36:00			0.0	1.2	0.2	28.4	120	582	1.4				
BH515	18/03/15 12:37:00			0.0	1.1	0.1	26.1	140	591	1.5				
BH515	18/03/15 12:38:00			0.0	1.1	0.1	25.4	140	609	1.5				
BH515	18/03/15 12:39:00			0.1	1.1	0.0	25.0	150	620	1.6				
BH515	18/03/15 12:40:00			0.1	1.1	0.0	24.8	150	619	1.6				
BH515	18/03/15 12:41:00			0.0	1.1	0.0	25.2	150	618	1.6				
BH515	18/03/15 12:42:00			0.0	1.0	0.0	24.6	140	623	1.6				
BH515	18/03/15 12:43:00			0.0	1.0	0.0	25.0	140	630	1.7				
BH515	18/03/15 12:44:00			0.0	1.0	0.0	24.5	150	652	1.7			Dry	
BH515	07/05/15 10:49:00	997	0								0.0	17		
BH515	07/05/15 10:50:00										0.0			
BH515	07/05/15 10:51:00										0.0			
BH515	07/05/15 10:52:00										0.0			
BH515	07/05/15 10:53:00										0.0			
BH515	07/05/15 10:54:00			0.0	3.9	2.6	90.0	100	550	0.3				
BH515	07/05/15 10:55:00			0.0	3.8	0.7	84.0	100	592	0.4				
BH515	07/05/15 10:56:00			0.0	3.3	0.0	71.0	130	581	0.6				
BH515	07/05/15 10:57:00			0.0	2.8	0.0	64.0	140	570	0.7				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	**EC**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH515	13/03/15 08:33:00										0.0			
BH515	13/03/15 08:34:00										0.0			
BH515	13/03/15 08:35:00			0.0	1.2	0.3	27.5	60	483	2.9				
BH515	13/03/15 08:36:00			0.0	1.1	0.0	26.6	90	538	2.6				
BH515	13/03/15 08:37:00			0.0	1.1	0.0	26.4	100	531	2.5				
BH515	13/03/15 08:38:00			0.0	1.1	0.0	26.0	100	504	2.4				
BH515	13/03/15 08:39:00			0.0	1.1	0.0	26.0	100	463	2.4				
BH515	13/03/15 08:40:00			0.0	1.1	0.0	26.0	100	474	2.3				
BH515	13/03/15 08:41:00			0.0	1.1	0.0	26.0	100	611	2.3				
BH515	13/03/15 08:42:00			0.0	1.1	0.0	25.6	100	630	2.3				
BH515	13/03/15 08:43:00			0.0	1.1	0.0	25.4	100	629	2.3				
BH515	13/03/15 08:44:00			0.0	1.1	0.0	25.6	100	625	2.3			Dry	
BH515	18/03/15 12:30:00	1034	0								0.0	8		0 litres purged, base depth 5.20m. Dry.
BH515	18/03/15 12:31:00										0.0			
BH515	18/03/15 12:32:00										0.0			
BH515	18/03/15 12:33:00										0.0			
BH515	18/03/15 12:34:00										0.0			
BH515	18/03/15 12:35:00			0.0	1.2	0.5	36.5	90	543	1.3				

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
30238	EC

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: WELSH GOVERNMENT

SITE: M4 CORRIDOR AROUND NEWPORT

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H_2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH515	06/03/15 13:00:00	1033	0								0.0	12		0 litres purged, base depth 5.20m. Dry.
BH515	06/03/15 13:01:00										0.0			
BH515	06/03/15 13:02:00										0.0			
BH515	06/03/15 13:03:00										0.0			
BH515	06/03/15 13:04:00										0.0			
BH515	06/03/15 13:05:00			0.0	1.1	0.3	26.4	100	624	4.2				
BH515	06/03/15 13:06:00			0.0	1.1	0.1	25.4	150	741	4.4				
BH515	06/03/15 13:07:00			0.0	1.1	0.1	25.2	180	758	4.5				
BH515	06/03/15 13:08:00			0.0	1.1	0.1	25.4	180	748	4.7				
BH515	06/03/15 13:09:00			0.0	1.1	0.0	25.2	180	737	5.2				
BH515	06/03/15 13:10:00			0.0	1.0	0.0	25.0	190	723	5.2				
BH515	06/03/15 13:11:00			0.0	1.0	0.0	26.0	190	729	4.9				
BH515	06/03/15 13:12:00			0.0	1.0	0.0	25.0	190	805	4.9				
BH515	06/03/15 13:13:00			0.0	1.0	0.0	24.4	200	892	4.6				
BH515	06/03/15 13:14:00			0.0	1.0	0.0	24.4	200	935	4.6			Dry	
BH515	13/03/15 08:30:00	1024	0								0.0	4		0 litres purged, base depth 5.20m. Dry.
BH515	13/03/15 08:31:00										0.0			
BH515	13/03/15 08:32:00										0.0			

remarks
# denotes result exceeding capacity of gas monitoring equipment
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.
Shallow install.

CONTRACT	CHECKED
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A7 Appendix 3

Soil Laboratory Data

M4CAN
Soil Analysis Results & Screening Assessment
CL-26 Lagoon 26
05/10/2015

Geological Formation Legend

TFD	Tidal Flat Deposits
MMG	Mercia Mudstone Group
MG	Made Ground
PEAT	Peat

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference	Units	SBHJ08ACP	SBHJ08ACP	STPJ02	STPJ06	STPJ04	STPJ01	SBHJ09CP	STPJ02	STPJ06	STPJ01	STPJ03	BH522	BH522	BH523	BH523	BH523	BH523	BH524	BH524	BH524	BH524	SBHJ10CP	STPJ05	STPJ04	STPJ03	SBHJ09CP	STPJ05	SBHJ10CP	BH525	TP509	TP509
Specimen Depth (m)		2	4.1	0.3	0.3	1	2	1	1	1	0.3	0.4	1.5 - 1.7	2 - 2.2	0.5 - 0.7	1 - 1.2	2 - 2.2	3 - 3.2	0.5 - 0.7	1.5 - 1.7	2.5 - 2.7	3.5 - 3.7	0.3	0.3	1.5	1.2	5	1	1	1	0.6	1.1
OD Level (m)		3.89	1.79	5.07	5.41	4.43	3.95	4.76	4.37	4.71	5.65	5.17	3.8	3.3	5.65	5.15	4.15	3.15	5.2	4.2	3.2	2.2	5.75	5.55	3.93	4.37	0.76	4.85	5.05			
Sample Type		ES	ES	ES	ES	ES	ES	ES	W	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	D	ES	D	ES	U			
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	TFD	TFD	TFD	TFD	TFD	MG	MG	MG
Cluster Code		2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI
Metals																																
Antimony	mg/kg	45	31	2.8	32	27	30	38	3.3	26	25	11											27	28	4.5	2.8	3.3	2.2	5.4			
Arsenic	mg/kg	<3	<3	<3	<3	<3	<3	<3	5	<3	<3	<3	420	380	43	35	39	13	33	22	22	14	<3	<3	<3	<3	24	<3	<3	30	15	16
Barium	mg/kg	21	210	1100	89	110	150	120	150	79	180	150											140	83	52	64	28	33	77			
Boron Water Soluble	mg/kg	<3.5	5.5	7.8	<3.5	<3.5	8.6	<3.5	4	5.5	4.6	<3.5	1.5	1.3	0.9	<0.4	4.8	1.2	1.9	1.9	1.6	1.6	4.8	<3.5	<3.5	<3.5	3.5	<3.5	<3.5	3	1.4	3.2
Cadmium	mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.31	0.27	0.24	0.28	0.31	0.11	0.53	0.27	0.24	0.16	<0.3	<0.3	<0.3	<0.3	0.4	<0.3	<0.3	0.55	0.14	0.32
Chromium	mg/kg	760	530	66	670	430	630	790	48	500	700	280	2500	2100	2100	1400	1500	430	1300	770	900	650	480	590	76	44	68	40	110	780	520	71
Copper	mg/kg	<6	<6	<6	9	<6	<6	<6	9	10	<6	9	26	19	14	20	22	13	29	24	18	12	<6	<6	9	9	9	<6	<6	14	10	13
Lead	mg/kg	22	51	2	24	14	29	20	28	46	25	44	7.5	4.1	1.1	6.2	9.1	10	17	17	15	12	12	25	24	25	28	14	20	33	18	50
Mercury	mg/kg	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	0.79	0.79	1.5	1.2	1.1	0.41	0.29	0.26	0.25	0.21	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	0.82	0.21	<0.1
Molybdenum	mg/kg	<0.6	<0.6	0.7	5.1	1.1	4.8	4.1	<0.6	4.8	<0.6	1.2											<0.6	0.8	<0.6	<0.6	0.7	<0.6	<0.6			
Nickel	mg/kg	<0.9	<0.9	<0.9	<0.9	<0.9	5.4	<0.9	37	4.8	<0.9	17	3400	3000	41	41	27	32	34	42	34	27	39	4.8	32	34	39	25	23	49	130	39
Selenium	mg/kg	<3	<3	<3	<3	<3	8	<3	<3	<3	<3	<3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<3	<3	<3	<3	<3	<3	<3	<0.2	<0.2	0.41
Zinc	mg/kg	32	100	30	56	69	79	87	130	130	140	220	48	54	50	47	45	73	130	140	150	99	84	260	120	130	340	97	100	230	120	130
Beryllium	mg/kg	<0.4	0.8	1.3	<0.4	<0.4	<0.4	<0.4	1	<0.4	<0.4	<0.4											<0.4	<0.4	0.5	1	<0.4	<0.4	<0.4			
Iron	mg/kg	120000	100000	19000	130000	110000	110000	120000	43000	120000	110000	64000											89000	100000	45000	40000	32000	29000	39000			
Vanadium	mg/kg	420	350	57	530	340	410	410	57	430	430	160											280	370	71	51	55	41	91			
Hexavalent Chromium	mg/kg		<0.3																													
Non-Metal Inorganics																																
Cyanide (total)	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	<1	<1	<0.5	<0.5	<0.5
Cyanide (free)	mg/kg												<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5								<0.5	<0.5	<0.5
Sulphate (soluble)	g/l	0.006	0.003	0.2	<0.003	<0.003	<0.003	<0.003	0.16	<0.003	<0.003	0.054											<0.003	<0.003	0.053	0.014	0.089	0.077	0.084			
Elemental/Free Sulphur	mg/kg	<70	<70	<700	<70	<70	<70	<70	730	<70	<70	<70											<70	<70	<70	<70	79	<70	<70			
Acid Soluble Sulphide	mg/kg	66	63	470	<50	<50	57	110	<50	<50	<50	<50												100	<50	<50	91	<50	57			
Ammoniacal Nitrogen as N	mg/kg	<15	<15	24	<15	21	<15	<15	27	<15	<15	<15											<15	<15	<15	<15	56	<15	32			
Chloride	mg/kg	24	36	340	6	14	18	10	170	12	12	86											8	12	68	52	400	40	16			
Other																																
Asbestos Presence Screen	None	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NAD	NAD	NAD	NAD	NAD		NAD	NAD	NAD		NFD	NFD	NFD	NFD	NFD	NFD	NFD		NAD	NAD
Loss on Ignition	%		1.2	5.3		4	1.4	1.7		1.9		2											1	2			3.6					
Total Organic Carbon	%		2	3		0.3	<0.2	<0.2		0.3		1.8	0.36	<0.2	0.89					7.6	0.3	0.27	0.8	0.4	0.5		0.9	0.3				
Organic Matter	%																															
pH Value	pH Units	12.5	12.52	8.17	12.82	10.19	12.53	12.63	7.95	12.84	12.39	10.69	12.7	12.7	12.2	12.4	12.5	12.2	12.5	12.2	12.6	12.7	12.03	12.65	8.37	7.78	8.39	8.44	8.75	11.7	8.5	8.4
Material >2mm	%																															
Calorific Value	MJ/kg												<0.1		<0.1				<0.1	0.17		0.61										
Organics																																
PCBs (vs Aroclor 1254)	mg/kg	<0.02	<0.02	<0.4	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.021	<0.02											<0.1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.035			
PCB 105	mg/kg												<0.01	<0.01	<0.01	<0.01					<0.01											
PCB 114	mg/kg												<0.01	<0.01	<0.01	<0.01					<0.01											
PCB 123	mg/kg												<0.01	<0.01	<0.01	<0.01					<0.01											
PCB 126	mg/kg												<0.01	<0.01	<0.01	<0.01					<0.01											
PCB 157	mg/kg												<0.01	<0.01	<0.01	<0.01					<0.01											
PCB 167	mg/kg												<0.01	<0.01	<0.01	<0.01					<0.01											
PCB 169	mg/kg												<0.01	<0.01	<0.01	<0.01					<0.01											
PCB 189	mg/kg												<0.01	<0.01	<0.01	<0.01					<0.01											
PCB 77	mg/kg												<0.01	<0.01	<0.01	<0.01					<0.01											
PCB 81	mg/kg												<0.01	<0.01	<0.01	<0.01					<0.01											
Pcb-118 2,3',4,4',5 - Pentachlorobiphe	mg/kg												<0.01	<0.01	<0.01	<0.01					<0.01											
Pcb-156 2,3,3,4,4,5 - Hexachlorobiphe	mg/kg												<0.01	<0.01	<0.01	<0.01					<0.01											
Phenols (total)	mg/kg	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15				<0.3	<0.3		<0.3		<0.3		<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.2		<0.3	<0.3
BTEX																																
GRO (C4-C12)	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01											<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
MTBE	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01											<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Benzene	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Toluene	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Ethyl benzene	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
m & p Xylene	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
o Xylene	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
TPH																																
TPH >C6-C8.	mg/kg																		<1		<1									<1		
TPH >C8-C10.	mg/kg																		<1		<1									<1		
TPH >C10-C12.	mg/kg																		<1		<1									<1		
TPH >C12-C16.	mg/kg																		<1		<1									<1		
TPH >C16-C21.	mg/kg																		7.7		<1									<1		
TPH >C21-C35.	mg/kg																		37		<1									13		
Aliphatics C5-C6	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001		<0.0001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Aliphatics >C6-C8	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001		<0.0001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Aliphatics >C8-C10	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001		<0.0001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Aliphatics >C10-C12	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Aliphatics >C12-C16	mg/kg	0.53	12	190	<0.1	<0.1	0.12	<0.1	14	0.34	0.14	1.3	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	4.5	<0.1	<0.1	<0.1	0.63	1.3	2.8			
Aliphatics >C16-C21	mg/kg	4.6	60	270	<0.1	1.6	2.3	0.95	29	6.5	1.7	2.8	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	15	2.3	<0.1	<0.1	3.8	1.3	4.8			
Aliphatics >C21-C35	mg/kg	41	460	810	14	23	55	17	47	62	52	12	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	75	44	1.1	1.6	66	1	30			
Total Aliphatics C5-C35	mg/kg	46	530	1300	14	25	57	18	91	69	54	16											94	47	1.1	1.6	70	3.7	38			
Aliphatics >C35-44	mg/kg												<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.01	<0.01								
Aromatics >C5-7	mg/kg												<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001		<0.0001	<0.01	<0.01								
Aromatics C6-C7	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01											<0.01	<0.01	<0.01	<0.01	<0.01					
Aromatics >C7-C8	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001		<0.0001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Aromatics >EC8-EC10	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001		<0.0001	2.3	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01			
Aromatics >EC10-EC12	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	3.7	0.19	<0.01	<0.01	<0.01	<0.01	<0.01			
Aromatics >EC12-EC16	mg/kg	0.86	4.9	130	<0.1	<0.1	<0.1	<0.1	11	<0.1	<0.1	0.65	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	28	5.5	<0.1	<0.1	0.38	<0.01	<0.01			
Aromatics >EC16-EC21	mg/kg	0.63	21	270	<0.1	0.17	<0.1	<0.1	24	0.39	<0.1	0.33	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001			<0.1	<0.1	0.81	0.63	4.8			
Aromatics >EC21-EC35	mg/kg	8.4	170	1100	<0.1	5	<0.1	<0.1	88	3.1	<0.1	41	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001			3.8	8	21	0.49	15			
Total Aromatics C6-C35	mg/kg	9.9	190	1500	<0.1	5.2	<0.1	<0.1	120	3.5	<0.1	42											34	5.7	3.8	8	22	3.2	300			
Aromatics >C35-44	mg/kg												<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001						4.3	320			
TPH (Aliphatics and Aromatics C5-C35)	mg/kg	56	720	2800	14	30	57	18	210	73	54	59											130	52	4.9	9.6	92	8	360			
Total Aliphatic TPH	mg/kg												<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005										
Total Aromatic hydrocarbons	mg/kg												<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005										
Total petroleum hydrocarbons	mg/kg												<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01		<0.01										
PAH																																
Acenaphthene	mg/kg	<0.014	0.041	2.1	<0.014	<0.014	<0.014	<0.014	0.23	<0.014	<0.014	0.037	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.097	0.02	<0.014	<0.014	0.029	0.042	<0.014	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.007	0.013	<0.05	0.026	0.008	<0.005	0.01	<0.005	<0.005	0.018	0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.025	0.012	<0.005	<0.005	0.007	<0.005	0.007	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.009	0.033	0.71	<0.009	0.012	0.02	<0.009	0.83	0.021	<0.009	0.013	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.25	0.043	<0.009	<0.009	0.035	0.009	0.015	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	0.025	0.12	0.62	0.053	0.083	0.07	0.063	0.11	0.09	0.071	0.25	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.9	0.23	0.02	0.14	0.17	0.037	0.071	<0.1	<0.1	<0.1
Benzo(a)pyrene	mg/kg	0.015	0.078	0.29	0.033	0.085	0.044	0.13	0.034	0.059	0.059	0.39	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	0.2	<0.012	0.25	0.16	0.021	0.13	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	mg/kg	<0.016	0.18	0.32	0.072	0.13	0.059	0.14	0.062	0.11	0.11	0.47	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.9	0.32	<0.016	0.27	0.18	0.021	0.16	<0.1	<0.1	<0.1
Benzo(ghi)perylene	mg/kg	0.016	0.084	<0.1	0.057	0.086	0.038	0.087	<0.01	0.062	0.075	0.26	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	2	0.14	0.012	0.16	0.13	0.014	0.21	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	mg/kg	<0.025	0.085	<0.25	0.042	0.066	0.028	0.072	<0.025	0.047	0.051	0.19	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1	0.13	<0.025	0.14	0.081	<0.025	0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	0.027	0.16	0.81	0.081	0.13	0.084	0.048	0.099	0.11	0.085	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	2.3	0.25	0.017	0.1	0.17	0.028	0.055	<0.1	<0.1	<0.1
Dibenzo(ah)anthracene	mg/kg	<0.008	0.023	<0.08	<0.008	0.026	0.012	0.021	<0.008	0.021	0.013	0.061	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.55	0.044	<0.008	0.036	0.034	<0.008	0.096	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.029	0.24	5.5	0.067	0.076	0.094	0.026	0.72	0.15	0.09	0.1	<0.1	<0.1	<0.1	0.00016	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	0.35	<0.025	<0.025	0.36	0.052	0.082	<0.1	0.14	<0.1
Fluorene	mg/kg	<0.012	0.03	1.7	<0.012	<0.012	<0.012	<0.012	0.21	<0.012	<0.012	0.033	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.06	0.018	<0.012	0.013	0.035	0.052	<0.012	<0.1	<0.1	<0.1
Indeno(123cd)pyrene	mg/kg	<0.011	0.054	<0.11	0.034	0.056	0.023	0.068	<0.011	0.045	0.041	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.2	0.1	<0.011	0.14	0.11	0.012	0.16	<0.1	<0.1	<0.1
Naphthalene	mg/kg	0.012	0.045	<0.1	0.014	0.035	0.021	0.02	0.041	0.026	0.011	0.21	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.11	0.056	0.045	0.086	0.033	0.051	0.039	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.034	0.21	5.4	0.053	0.077	0.13	0.036	0.86	0.14	0.063	0.066	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1	0.18	0.026	0.027	0.22	0.11	0.067	0.19	0.13	<0.1
Pyrene	mg/kg	0.027	0.22	4	0.057	0.12	0.094	<0.022	0.47	0.13	0.083	0.086	<0.1	<0.1	<0.1	0.00015	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	3.1	0.3	<0.022	<0.022	0.28	0.042	0.069	0.32	<0.1	<0.1
PAH 16 Total	mg/kg	0.19	1.6	22	0.59	0.98	0.72	0.72	3.7	1	0.77	2.6	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	19	2.4	0.12	1.4	2	0.49	1.3	<2	<2	<2
SVOCs																																
Phenols																																
2-Chlorophenol	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
2-Methylphenol	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
2-Nitrophenol	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			

Sample Reference	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	Selected S4ULs Criteria	No. Data Exceeding S4ULs Criteria
Antimony	18	18	45	2.2	SBHJ08ACP @ 2mbGL		
Arsenic	31	15	420	5	BH522 @ 1.5 - 1.7mbGL	170	2
Barium	18	18	1100	21	STPJ02 @ 0.3mbGL		
Boron Water Soluble	31	20	8.6	0.9	STPJ01 @ 2mbGL		
Cadmium	31	14	0.55	0.11	BH525 @ 1mbGL	190	0
Chromium	31	31

M4CAN
Soil Analysis Results & Screening Assessment
CL-26 Lagoon 26
05/10/2015

Geological Formation Legend

TFD	Tidal Flat Deposits
MMG	Mercia Mudstone Group
MG	Made Ground
PEAT	Peat

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference	Units	SBHJ08ACP	SBHJ08ACP	STPJ02	STPJ06	STPJ04	STPJ01	SBHJ09CP	STPJ02	STPJ06	STPJ01	STPJ03	BH522	BH522	BH523	BH523	BH523	BH523	BH524	BH524	BH524	BH524	SBHJ10CP	STPJ05	STPJ04	STPJ03	SBHJ09CP	STPJ05	SBHJ10CP	BH525	TP509	TP509	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	Selected S4ULs Criteria	No. Data Exceeding S4ULs Criteria
Specimen Depth (m)		2	4.1	0.3	0.3	1	2	1	1	1	0.3	0.4	1.5 - 1.7	2 - 2.2	0.5 - 0.7	1 - 1.2	2 - 2.2	3 - 3.2	0.5 - 0.7	1.5 - 1.7	2.5 - 2.7	3.5 - 3.7	0.3	0.3	1.5	1.2	5	1	1	1	0.6	1.1							
OD Level (m)		3.89	1.79	5.07	5.41	4.43	3.95	4.76	4.37	4.71	5.65	5.17	3.8	3.3	5.65	5.15	4.15	3.15	5.2	4.2	3.2	2.2	5.75	5.55	3.93	4.37	0.76	4.85	5.05										
Sample Type		ES	ES	ES	ES	ES	ES	ES	W	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	D	ES	D	ES	U										
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	TFD	TFD	TFD	TFD	TFD	MG	MG	MG							
Cluster Code		2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI							
2,4-Dichlorophenol	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
2,4-Dimethylphenol	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
2,4,5-Trichlorophenol	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
2,4,6-Trichlorophenol	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
4-Chloro-3-methylphenol	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
4-Methylphenol	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
4-Nitrophenol	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
Pentachlorophenol	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
Phenol	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD		440	0
PAHs																																							
2-Chloronaphthalene	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
2-Methylnaphthalene	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
Acenaphthene	mg/kg			<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					13	0	None > LOD	None > LOD		29000	0
Acenaphthylene	mg/kg			<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					13	0	None > LOD	None > LOD		29000	0
Anthracene	mg/kg			<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					13	0	None > LOD	None > LOD		150000	0
Benzo(a)anthracene	mg/kg			<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					13	0	None > LOD	None > LOD		49	0
Benzo(a)pyrene	mg/kg			<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					13	0	None > LOD	None > LOD		11	0
Benzo(b)fluoranthene	mg/kg			<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					13	0	None > LOD	None > LOD		13	0
Benzo(ghi)perylene	mg/kg			<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					13	0	None > LOD	None > LOD		1400	0
Benzo(k)fluoranthene	mg/kg			<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					13	0	None > LOD	None > LOD		370	0
Chrysene	mg/kg			<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					13	0	None > LOD	None > LOD		93	0
Dibenzo(a,h)anthracene	mg/kg			<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					13	0	None > LOD	None > LOD			
Fluoranthene	mg/kg			2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1												<0.1	<0.1	<0.1	<0.1	<0.1					13	1	2	2	STPJ02 @ 0.3mbGL	6300	0
Fluorene	mg/kg			<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					13	0	None > LOD	None > LOD		20000	0
Indeno(1,2,3-cd)pyrene	mg/kg			<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					13	0	None > LOD	None > LOD			
Naphthalene	mg/kg			<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					13	0	None > LOD	None > LOD		190	0
Phenanthrene	mg/kg			1.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1												<0.1	<0.1	<0.1	<0.1	<0.1					13	1	1.4	1.4	STPJ02 @ 0.3mbGL	6200	0
Pyrene	mg/kg			2	<0.1	0.12	<0.1	<0.1	<0.1	<0.1		<0.1												<0.1	<0.1	<0.1	<0.1	<0.1					13	2	2	0.12	STPJ02 @ 0.3mbGL	15000	0
Pthalates																																							
Bis(2-ethylhexyl) phthalate	mg/kg	0.14	<0.1	<1	<0.1	<0.1	<0.1	0.45	0.16	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	0.23	<0.1	1.5				18	5	1.5	0.14	SBHJ10CP @ 1mbGL		
Butylbenzyl phthalate	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
Di-n-butyl phthalate	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
Di-n-Octyl phthalate	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
Diethyl phthalate	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
Dimethyl phthalate	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
Other Semi-Volatiles																																							
1,2-Dichlorobenzene	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
1,2,4-Trichlorobenzene	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD		220	0
1,3-Dichlorobenzene	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
1,4-Dichlorobenzene	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
2-Nitroaniline	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
2,4-Dinitrotoluene	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
2,6-Dinitrotoluene	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
3-Nitroaniline	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
4-Bromophenylphenylether	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
4-Chloroaniline	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
4-Chlorophenylphenylether	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
4-Nitroaniline	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
Azobenzene	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
Bis(2-chloroethoxy)methane	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
Bis(2-chloroethyl)ether	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
Carbazole	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
Dibenzofuran	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
Hexachlorobenzene	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD		30	0
Hexachlorobutadiene	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD		31	0
Hexachlorocyclopentadiene	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
Hexachloroethane	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
Isophorone	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
N-nitrosodi-n-propylamine	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
Nitrobenzene	mg/kg	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				18	0	None > LOD	None > LOD			
VOCs																																							
Methyl Tertiary Butyl Ether	ug/kg	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11											<11	<11	<11	<11	<11	<11	<11				18	0	None > LOD	None > LOD			
Benzene	ug/kg	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9											<9	<9	<9	<9	<9	<9	<9				18	0	None > LOD	None > LOD		27000	0
Toluene	ug/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5											<5	<5	<5	<5	<5	<5	<5				18	0	None > LOD	None > LOD		56000000	0
Ethylbenzene	ug/kg	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4											<4	<4	<4	<4	<4	<4	<4				18	0	None > LOD	None > LOD		5700000	0
p/m-Xylene	ug/kg	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14											<14	<14	<14	<14	<14	<14	<14				18	0	None > LOD	None > LOD			
o-Xylene	ug/kg	<10	<10	68	<10	<10	<10	<10	<10	<10	<10	<10											<10	<10	<10	<10	<10	<10	<10				18	1	68	68	STPJ02 @ 0.3mbGL	6600000	0
Naphthalene	ug/kg	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13											<13	<13	<13	<13	<13	<13	<13				18	0	None > LOD	None > LOD		190000	0
Hexachlorobutadiene	ug/kg	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12											<12	<12	<12	<12	<12	<12	<12				18	0	None > LOD	None > LOD		31000	0
1,2,4-Trichlorobenzene	ug/kg	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6											<6	<6	<6	<6	<6	<6	<6				18	0	None > LOD	None > LOD		220000	0
1,2-Dichlorobenzene	ug/kg	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12											<12	<12	<12	<12	<12	<12	<12				18	0	None > LOD	None > LOD			
1,3-Dichlorobenzene	ug/kg	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6											<6	<6	<6	<6	<6	<6	<6				18	0	None > LOD	None > LOD			
1,4-Dichlorobenzene	ug/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5											<5	<5	<5	<5	<5	<5	<5				18	0	None > LOD	None > LOD			
1,1,1,2-Tetrachloroethane	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10											<10	<10	<10	<10	<10	<10	<10				18	0	None > LOD	None > LOD			
1,1,1-Trichloroethane	ug/kg	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7											<7	<7	<7	<7	<7	<7	<7				18	0	None > LOD	None > LOD			
1,1,2,2-Tetrachloroethane	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10											<10	<10	<10	<10	<10	<10	<10				18	0	None > LOD	None > LOD			
1,1,2-Trichloroethane	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10											<10	<10	<10	<10	<10	<10	<10				18	0	None > LOD	None > LOD			
1,1-Dichloropropene	ug/kg	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11											<11	<11	<11	<11	<11	<11	<11				18	0	None > LOD	None > LOD			
1,1-Dichloroethane	ug/kg	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8											<8	<8	<8	<8	<8	<8	<8				18	0	None > LOD	None > LOD			
1,1-Dichloroethene	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10											<10	<10	<10	<10	<10	<10	<10				18	0	None > LOD	None > LOD			
1,2,3-Trichlorobenzene	ug/kg	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11											<11	<11	<11	<11	<11	<11	<11				18	0	None > LOD	None > LOD		102000	0
1,2,3-Trichloropropane	ug/kg	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17											<17	<17	<17	<17	<17	<17	<17				18	0	None > LOD	None > LOD			
1,2,4-Trimethylbenzene	ug/kg	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9											<9	<9	<9	<9	<9	<9	<9				18	0	None > LOD	None > LOD			
1,2-Dibromo-3-chloropropane	ug/kg	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14											<14	<14	<14	<14	<14	<14	<14				18	0	None > LOD	None > LOD			
1,2-Dichloroethane	ug/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5											<5	<5	<5	<5	<5	<5	<5				18	0	None > LOD	None > LOD			
cis-1-2-Dichloroethene	ug/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5											<5	<5	<5	<5	<5	<5	<5				18	0	None > LOD	None > LOD			
1,2-Dibromoethane	ug/kg	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12											<12	<12	<12	<12	<12	<12	<12				18	0	None > LOD	None > LOD			
1,2-Dichloropropane	ug/kg	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12											<12	<12	<12	<12	<12	<12	<12				18	0	None > LOD	None > LOD			
1,3,5-Trimethylbenzene	ug/kg	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8											<8	<8	<8	<8	<8	<8	<8				18	0	None > LOD	None > LOD			
cis-1-3-Dichloropropene	ug/kg	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14											<14	<14	<14	<14	<14	<14	<14				18	0	None > LOD	None > LOD			
1,3-Dichloropropane	ug/kg	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7											<7	<7	<7	<7	<7	<7	<7				18	0	None > LOD	None > LOD			
2,2-Dichloropropane	ug/kg	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12											<12	<12	<12	<12	<12	<12	<12				18	0	None > LOD	None > LOD			
2-Chlorotoluene	ug/kg	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9											<9	<9	<9	<9	<9	<9	<9				18	0	None > LOD	None > LOD			
4-Chlorotoluene	ug/kg	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12											<12	<12	<12	<12	<12	<12	<12				18	0	None > LOD	None > LOD			
4-Isopropyltoluene	ug/kg	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11											<11	<11	<11	<11	<11	<11	<11				18	0	None > LOD	None > LOD			
Bromobenzene	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10											<10	<10	<10	<10	<10	<10	<10				18	0	None > LOD	None > LOD			
Bromochloromethane	ug/kg	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14											<14	<14	<14	<14	<14	<14	<14				18	0	None > LOD	None > LOD			
Bromoform	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10											<10	<10	<10	<10	<10	<10	<10				18	0	None > LOD	None > LOD			
Bromomethane	ug/kg	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13											<13	<13	<13	<13	<13	<13	<13				18	0	None > LOD	None > LOD			
Bromodichloromethane	ug/kg	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7											<7	<7	<7	<7	<7	<7	<7				18	0	None > LOD	None > LOD			
Chlorobenzene	ug/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5											<5	<5	<5	<5	<5	<5	<5				18	0	None > LOD	None > LOD		56000	0
Carbon Disulphide	ug/kg	<7	<7	35	<7	<7	<7	<7

M4CAN
Soil Analysis Results & Screening Assessment
CL-26 Lagoon 26
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Geological Formation Legend

TFD	Tidal Flat Deposits
MMG	Mercia Mudstone Group
MG	Made Ground
PEAT	Peat

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference	**Units**	**SBHJ08ACP**	**SBHJ08ACP**	**STPJ02**	**STPJ06**	**STPJ04**	**STPJ01**	**SBHJ09CP**	**STPJ02**	**STPJ06**	**STPJ01**	**STPJ03**	**BH522**	**BH522**	**BH523**	**BH523**	**BH523**	**BH523**	**BH524**	**BH524**	**BH524**	**BH524**	**SBHJ10CP**	**STPJ05**	**STPJ04**	**STPJ03**	**SBHJ09CP**	**STPJ05**	**SBHJ10CP**	**BH525**	**TP509**	**TP509**
Specimen Depth (m)		2	4.1	0.3	0.3	1	2	1	1	1	0.3	0.4	1.5 - 1.7	2 - 2.2	0.5 - 0.7	1 - 1.2	2 - 2.2	3 - 3.2	0.5 - 0.7	1.5 - 1.7	2.5 - 2.7	3.5 - 3.7	0.3	0.3	1.5	1.2	5	1	1	1	0.6	1.1
OD Level (m)		3.89	1.79	5.07	5.41	4.43	3.95	4.76	4.37	4.71	5.65	5.17	3.8	3.3	5.65	5.15	4.15	3.15	5.2	4.2	3.2	2.2	5.75	5.55	3.93	4.37	0.76	4.85	5.05			
Sample Type	**Units**	ES	ES	ES	ES	ES	ES	ES	W	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	D	ES	D	ES	U			
Geology Code		MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	TFD	TFD	TFD	TFD	TFD	MG	MG	MG
Cluster Code		2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI
Isopropylbenzene	ug/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5											<5	<5	<5	<5	<5	<5	<5			
n-Butylbenzene	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10											<10	<10	<10	<10	<10	<10	<10			
Propylbenzene	ug/kg	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11											<11	<11	<11	<11	<11	<11	<11			
sec-Butylbenzene	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10											<10	<10	<10	<10	<10	<10	<10			
Styrene	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10											<10	<10	<10	<10	<10	<10	<10			
trans-1-2-Dichloroethene	ug/kg	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11											<11	<11	<11	<11	<11	<11	<11			
trans-1-3-Dichloropropene	ug/kg	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14											<14	<14	<14	<14	<14	<14	<14			
Trichlorofluoromethane	ug/kg	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6											<6	<6	<6	<6	<6	<6	<6			
tert-Butylbenzene	ug/kg	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12											<12	<12	<12	<12	<12	<12	<12			
Tetrachloroethene	ug/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5											<5	<5	<5	<5	<5	<5	<5			
Trichloroethene	ug/kg	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9											<9	<9	<9	<9	<9	<9	<9			
Vinyl Chloride	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10											<10	<10	<10	<10	<10	<10	<10			

No. Analyses	**No. Analyses Above LOD**	**Maximum**	**Minimum**	**Location & Depth of Maximum Concentration**	**Selected S4ULs Criteria**	**No. Data Exceeding S4ULs Criteria**
18	0	None > LOD	None > LOD			
18	0	None > LOD	None > LOD			
18	0	None > LOD	None > LOD			
18	0	None > LOD	None > LOD			
18	0	None > LOD	None > LOD			
18	0	None > LOD	None > LOD			
18	0	None > LOD	None > LOD			
18	0	None > LOD	None > LOD			
18	0	None > LOD	None > LOD			
18	0	None > LOD	None > LOD		19000	0
18	0	None > LOD	None > LOD		1200	0
18	0	None > LOD	None > LOD		59	0

MACAN
Soil Analysis Results & Screening Assessment
CL-26 Lagoon 12
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Geological Formation Legend

MG-SS	Made Ground (slurry slag)
MG-CS	Made Ground (coarse slag)
TFD	Tidal Flat Deposits

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference		LGBH001	LGBH001	LGBH002	LGBH003	SW1/0/A	SW1/0/A	SW1/0	SW1/10	SW1/11	SW1/11	SW1/12	SW1/12	SW1/13	SW1/13	SW1/14	SW1/14	SW1/15	SW1/15	SW1/16	SW1/16	SW1/17A	SW1/17A	BH114A	BH114A	BH114A	BH114A	BH114A	BH115	BH115	BH115	TP506	TP506	TP506	LGBH001	LGBH002	LGBH002	LGBH003	SB#104	SB#104
Sample Depth (m)		1	7.5	0.5	0.5	1	9.95	7.95	6.53	6.03	9.28	7.28	8.59	6.39	10.01	9.01	9.14	8.14	9.09	8.09	8.2	7.9	9.74	9.24	11.9	10.9	9.9	8.4	7.4	7.2	10.6	10.4	11.35	10.35	8.85	1	8.1	9	8	9.5	9
OD Level (m)																																							3.24	2.24
Sample Type	Units					1	ES	ES	ES	ES	ES	ES	ES	ES	ES	1	1	2	1	1	2	2.3	1	1.5	0 - 0.5	1 - 1.5	2 - 2.5	3.5 - 3.7	4.5 - 4.7	0 - 0.5	0.5	2.5	0.5 - 0.6	1.5 - 1.6	3 - 3.5	9.5	8.1	9	8	8	9
Geology Code		MG-CS	MG-CS	MG-CS	MG-CS	MG -SS	MG -SS	MG -SS	MG -SS	MG -CS	MG -CS	MG -SS	MG -CS	MG -SS	MG -SS	MG -SS	MG -SS	MG -SS	MG -SS	MG -SS	MG -SS	MG -CS	MG -SS	MG -SS	MG -SS	MG -SS	MG -SS	MG -CS	MG -CS	MG -CS	MG -CS	MG -CS	MG -CS	MG -CS	TFD	TFD	TFD	TFD	TFD	TFD
Cluster Code		2002	2002	2002	2002	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2002	2002	2002	2002	2007 GI	2007 GI
Metals & Inorganics																																								
Antimony	mg/kg					54	38	27	18	29	23	12	27	38	45	34	40	25	23	36	23	26	28																2.6	2.5
Arsenic	mg/kg	<3	<3	<3	<3	<3	23	5	30	11	4	<3	<3	10	20	9	21	15	27	<3	<3	<3	<3	54	51	62	51	33	17	32	22	22	40	24	5	7	5	8	<3	<3
Barium	mg/kg					310	180	170	370	150	170	110	92	150	110	170	91	200	140	130	220	150	96																47	44
Boron Water Soluble	mg/kg	<0.5	<0.5	4.3	<0.5	5.7	<3.5	8.9	4.2	12	<3.5	<3.5	4.8	5.8	<3.5	<3.5	<3.5	3.6	<3.5	<3.5	7	<3.5	<3.5	0.86	0.83	1	2.7	2.5	2.9	2.3	2.4	3.7	2.1	2.5	1	1	2	1.6	<3.5	4.8
Cadmium	mg/kg	<1	<1	<1	1	42	18	23	7.8	15	12	13	8	19	48	24	33	8.3	10	29	15	26	13	21	25	32	3.4	0.55	1.4	2	20	0.7	0.14	0.43	<1	<1	<1	<1	<0.3	<0.3
Chromium	mg/kg	474	316	60	339	180	110	100	50	140	120	120	230	170	140	120	140	140	170	120	330	130	180	210	190	170	1400	1300	670	880	170	610	1300	780	129	63	130	55	59	35
Copper	mg/kg	17	10	4	29	39	67	87	76	41	76	99	68	77	150	71	95	31	38	64	54	130	79	81	47	46	46	23	42	63	94	19	20	22	23	9	10	12	9	8
Lead	mg/kg	68	29	48	33	2900	2400	1900	1600	1400	2600	2200	1800	1800	3300	1900	2100	1200	660	2100	1900	3100	1900	2100	2200	2700	430	20	250	270	3200	69	25	37	130	18	36	39	16	21
Mercury	mg/kg	<0.5	<0.5	0.9	<0.5	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	0.53	0.48	0.62	1.3	1.2	0.46	0.38	0.22	0.39	0.62	0.36	<0.5	<0.5	<0.5	<0.5	<0.6	<0.6
Molybdenum	mg/kg					5	3	<0.6	<0.6	<0.6	<0.6	5.5	5.7	9.2	9	5	8.1	<0.6	<0.6	1	1.9	<0.6	0.7																	<0.6	<0.6
Nickel	mg/kg	4	5	<2	18	11	13	25	37	28	35	45	31	47	45	35	45	37	48	16	16	29	31	69	50	49	44	41	34	120	50	24	25	24	25	20	31	26	20	25
Selenium	mg/kg	2.48	2.37	3.79	2.5	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	2.6	2.3	2.4	<0.2	0.21	0.43	<0.2	1.8	<0.2	<0.2	<0.2	1.14	0.9	1.1	0.96	<3	<3
Zinc	mg/kg	166	90	47	76	9900	13000	20000	4300	25000	6500	14000	780	24000	3000	36000	33000	6100	7000	30000	6300	19000	11000	1800	11000	10000	1400	100	520	1100	8000	360	130	95	269	62	56	63	84	100
Beryllium	mg/kg					<0.4	<0.4	0.5	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4																<0.4	0.5
Iron	mg/kg	99000	87700	16600	184000	290000	280000	280000	250000	350000	320000	300000	200000	330000	300000	320000	290000	330000	300000	300000	300000	210000	300000	320000											65700	34800	41900	58600	31000	30000
Vanadium	mg/kg					55	61	59	76	46	79	72	410	52	48	34	46	89	55	55	290	67	60																65	46
Cyanide (total)	mg/kg	<1	<1	<1	2	<1	<1	10	1	<1	12	<1	7	<1	<1	<1	<1	<1	<1	<1	10	4	<1	<0.5	<0.5	0.6	<0.5	<0.5	5.4	0.6	61	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	<1
Cyanide (free)	mg/kg											<1										<1		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	4.1	<0.5	<0.5	<0.5						
Complex Cyanide	mg/kg											<1										4																		
Thiocyanate	mg/kg	1.2	1.9	2.4	0.6							<1										<1													1.6	<0.5	0.7	0.6		
Sulphate (soluble)	g/l					0.22	1.1	0.2	0.18	0.89	0.24	0.29	0.074	0.066	0.13	0.024	0.17	0.054	0.15	0.24	0.23	0.2	0.021																0.034	0.12
Elemental/Free Sulphur	mg/kg					<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70																<70	<70
Acid Soluble Sulphide	mg/kg					<50	1100	160	140	400	180	170	220	200	<50	220	270	94	200	230	200	340	710																	
Ammoniacal Nitrogen as N	mg/kg	2	1.8	2.2	2.8	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15												9.2	7	8.2	7	<15	57
Chloride	mg/kg	155	286	362	69.8	8	420	46	560	32	8	26	14	6	7	2	4	44	26	6	20	6	8												112	32.9	63.9	53.2	130	440
Other																																								
Asbestos Presence Screen	None					NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NAD	NAD	NAD				NAD	NAD	NAD	NAD	NAD					NFD	NFD
Loss on Ignition	%					3.6			0.9		<0.3	2.5	2.5	4.1	24				39		1.7	0.4																	2.2	
Total Organic Carbon	%					8.1			2.1		6.4	7.8	14	7	4.4	4.4			2.5		4.5	3.7																	0.7	
Organic Matter	%													4.8			5	5.7																						
pH Value	pH Units	12.8	12.4	11.7	12.1	8.27	8.58	10.44	10.11	10.47	9.7	8.93	9.21	9.19	8.39	9.02	8.44	9.41	9.18	8.39	9.41	9.68	8.85	7.2	8.6	8.4	11.9	12.3	12.3	12.1	11.1	12.7	12.7	12.7	12.5	11	11.8	10.8	8.08	8.36
Material<10mm	%							<0.1						<0.1	9.4		<0.1																							
Organics																																								
PCBs (vs Aroclor 1254)	mg/kg					<0.02	<0.02	<0.1	<0.02	<0.02	<0.02	<0.1	<0.02	<0.02	0.065	<0.1	<0.2	<0.02	<0.02	0.023	0.19	0.035	<0.02																0.039	<0.035
PCB 105	mg/kg																																<0.01							
PCB 114	mg/kg																																<0.01							
PCB 123	mg/kg																																<0.01							
PCB 126	mg/kg																																<0.01							
PCB 157	mg/kg																																<0.01							
PCB 167	mg/kg																																<0.01							
PCB 169	mg/kg																																<0.01							
PCB 189	mg/kg																																<0.01							
PCB 77	mg/kg																																<0.01							
PCB 81	mg/kg																																<0.01							
PCb-118 2,3',4,4',5 - Pentachlorobiphenyl	mg/kg																																<0.01							
PCb-156 2,3,3',4,4,5 - Hexachlorobiphenyl	mg/kg																																<0.01							
Phenols (total)	mg/kg	<0.0005	<0.0005	<0.0005	<0.0005	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.3	<0.3	<0.3				<0.3	<0.3	<0.3	<0.3	<0.3	<0.0005	<0.0005	<0.0005	<0.0005	<0.15	<0.15
BTEX																																								
GRO (C4-C12)	mg/kg					<0.01	0.071	0.091	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	3.6	<0.01	<0.01																<0.01	<0.01
MTBE	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01																<0.01	<0.01
Benzene	mg/kg					<0.01	0.071	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005		<0.005													<0.01	<0.01
Toluene	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005		<0.005													<0.01	<0.01
Ethyl benzene	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.017	<0.01	<0.01	<0.005		<0.005													<0.01	<0.01
m & p Xylene	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.1	<0.01	<0.01	<0.005		<0.005													<0.01	<0.01
o Xylene	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.071	<0.01	<0.01	<0.005		<0.005													<0.01	<0.01
TPH																																								
TPH >C6-C8	mg/kg																								<1		<1	<1		<1	<1	<1	<1	<1						
TPH >C8-C10	mg/kg																								<1		<1	<1		<1	<1	<1	<1	<1						
TPH >C10-C12	mg/kg																								<1		<1	<1		<1	<1	<1	<1	<1						
TPH >C12-C16	mg/kg																								<1		3.1	2.2		7.9	<1	3.1	2.2	3.1						
TPH >C16-C21	mg/kg																								<1		<1	<1		12	6.2	10	7.4	11						
TPH >C21-C35	mg/kg																								<1		<1	<1		8.1	<1	44	40	150						
Aliphatics C5-C6	mg/kg					<0.01	<0.01	0.076	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1		<0.1													<0.01	<0.01
Aliphatics >C6-C8	mg/kg					<0.01	<0.01	0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1		<0.1													<0.01	<0.01
Aliphatics >C8-C10	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.7	<0.01	<0.01	<0.1		<0.1													<0.01	<0.01
Aliphatics >C10-C12	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.68	<0.01	<0.01	<1		<1													<0.01	<0.01
Aliphatics >C12-C16	mg/kg					4.1	24	9.6	4.2	7	6.3	2.9	1.9	8.1	1.8	5.1	3.7	2.2	1	3.12	0.15	<0.1	<0.1	<1		<1													0.55	<0.1
Aliphatics >C16-C21	mg/kg					100	670	300	130	55	58	93	39	56	35	130	140	26	16	35	60	11	<0.1	<1		<1													5.8	<0.1
Aliphatics >C21-C35	mg/kg					250	840	270	110	120	62	200	35	160	170	150	120	72	39	120	180	26	<0.1	<1		<1													270	14
Total Aliphatics C5-C35	mg/kg					360	1500	580	250	180	130	290	76	225	200	280	270	100	56	150	240	37	<0.1																280	14
Aliphatics >C35-44	mg/kg																							<1		<1														
Aromatics C5-C7	mg/kg																							<0.1		<0.1														
Aromatics C6-C7	mg/kg					<0.01	0.071	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01																<0.01	<0.01
Aromatics >C7-C8	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1		<0.1													<0.01	<0.01
Aromatics >8C8-8C10	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.2	<0.01	<0.01	<0.1		<0.1													<0.01	<0.01
Aromatics >10C10-EC12	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1	<0.01	<0.01	<1		<1													<0.01	<0.01
Aromatics >EC12-EC16	mg/kg					2.3	5.3	8.3	7.1	9.9	2.6	2	0.98	1.9	3.9	1.6	1.7	6.6	<0.1	1.1	<0.1	<0.1	<0.1	<1		<1													<0.1	<0.1
Aromatics >EC16-EC21	mg/kg					20	130	24	7	18	18	14	8.7	17	23	33	30	4.7	3.1	6.9	1.4	<0.1	<0.1	<1		6.3													<0.1	<0.1
Aromatics >EC21-EC35	mg/kg					95	400	110	36	71	45	64	8.5	47	100	82	100	32	8.6	51	11	7.7	<0.1	<1		8.9													5.7	9.7
Total Aromatics C6-C35	mg/kg					120	540	140	50	98	65	80	18	66	130	120	330	43	12	59	15	7.7	<0.1																5.7	9.7
Aromatics >C35-44	mg/kg																							<1		<1														
TPH (Aliphatics and Aromatics C5-C35)	mg/kg					480	2100	730	300	280	190	370	94	290	330	400	600	140	68	210	250	45	<0.1																280	24
Total Aliphatic TPH	mg/kg																							<5		<5														
Total Aromatic hydrocarbons	mg/kg																							<5		15														
Total petroleum hydrocarbons	mg/kg																							<10		15														
PAH																																								
Acenaphthene	mg/kg	5.2		<0.2	0.22	0.25	0.05	0.025	0.037	0.076	0.044	0.086	0.091	0.09	0.063	0.12	<0.014	0.038	0.016	0.023	<0.014	<0.014	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.33					<0.014	<0.014
Acenaphthylene	mg/kg	<0.2		<0.2	0.69	0.086	0.013	0.006	0.008	0.006	0.062	0.016	0.017	0.013	0.021	0.16	0.006	<0.005	0.012	0.014	<0.005	<0.005	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.26	<0.1					<0.005	<0.005
Anthracene	mg/kg	0.8		<0.2	2	1.6	0.28	0.047	0.2	0.092	0.18	0.11	0.31	0.59	0.38	3.4	0.091	0.13	0.24	0.19	0.042	0.014	<0.1	0.49	0.4	<0.1	<0.1	<0.1	<0.1	0.8	<0.1	<0.1	0.59						<0.009	<0.009
Benzo(a)anthracene	mg/kg	3.1			3.7	4.3	0.91	0.5	0.77	0.94	1.1	0.21	0.75	1.6	0.63	0.81	3.7	0.39	0.19	0.52	0.87	0.24	0.097	<0.1	1.6	1.5	<0.1	0.85	<0.1	<0.1	<0.1	0.4	1.8						<0.008	<0.008
Benzo(a)pyrene	mg/kg	3.1	0.7	1	1.8	0.32	0.1	0.2	<0.012	0.26	0.045	0.25	0.37	0.12	11	0.14	0.033	0.42	0.24	0.037	0.03	<0.012	<0.012	<0.1	<0.1	<0.1	<0.1	<0.1	1.3	<0.1	<0.1	<0.1	0.55	2.3					<0.012	<0.012
Benzo(b)fluoranthene	mg/kg	4.5		0.9	3.4	3.3	0.59	0.27	0.6	0.01	0.8	0.1	0.98	0.61	14	0.44	0.1	0.6	0.82	0.18	0.081	<0.1	<0.1	<0.1	0.81	<0.1	<0.1	1.9	<0.1	<0.1	<0.1	<0.1	0.68	3.1					0.016	<0.016
Benzo(ghi)perylene	mg/kg	1.8		0.6	0.15	1.5	0.3	0.083	0.21	<0.01	0.23	<0.01	0.3	0.72	0.032	27	0.14	0.041	0.53	0.28	0.087	0.062	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.47	1.9					0.013	<0.01
Benzo(k)fluoranthene	mg/kg	2.2		0.7	1.7	1.2	0.5	0.15	0.23	0.029	0.42	0.056	0.28	0.3	0.2	5	0.18	0.058	0.48	0.42	0.11	0.043	<0.1	0.15	<0.1	<0.1	<0.1	0.4	<0.1	<0.1	<0.1	<0.1	0.21	1					<0.025	<0.025
Chrysene	mg/kg	9.9		0.8	7.4	5.4	1.4	0.74	1.1	0.3	1.7	0.78	1.7	1.1	1.8	7.1	0.54	0.34	0.97	1.4	0.5	0.17	<0.1	0.87	0.82	<0.1	<0.1	0.7	<0.1	<0.1	<0.1	<0.1	0.86	2.8					0.018	0.011
Dibenzo(ah)anthracene	mg/kg	0.5		<0.2	0.057	0.51	0.11	0.028	0.087	<0.008	0.11	<0.008	0.065	0.24	0.013	7	0.058	0.018	0.1	0.14	0.018	0.015	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.18					<0.008	<0.008
Fluoranthene	mg/kg	5.4		0.9	5.4	9.4	2.6	1.3	2.2	2.2	1.4	2.8	0.98	1.8	1.5	2.1	8.5	0.49	0.51	0.79	2.3	0.47	0.18	<0.1	0.94	0.74	<0.1	<0.1	2.7	<0.1	1.5	0.28	1	3.8					<0.026	<0.025
Fluorene	mg/kg	3.9		<0.2	1.2	0.79	0.061	0.013	0.044	0.024	0.043	0.036	0.084	0.15	0.083	0.29	0.017	0.047	0.044	0.035	<0.012	<0.012	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.18					<0.012	<0.012
Indeno123cdpyrene	mg/kg	1.8		0.6	0.11	1	0.18	0.058	0.13	<0.011	0.18	<0.011	0.2	0.41	0.018	22	0.1	0.022	0.26	0.19	0.045	0.025	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.48	1.5					<0.011	<0.011
Naphthalene	mg/kg	0.9		<0.2	4.8	0.6	0.22	0.081	0.15	0.21	0.87	<0.1	0.18	0.24	0.24	0.51	0.05	0.11	0.13	0.11	0.035	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.29					<0.01	<0.01
Phenanthrene	mg/kg	6.9		0.4	8.3	4	0.84	0.18	1.1	0.55	0.81	1.4	1.8	2.5	2.5	14	0.34	0.89	0.68	0.74	0.23	0.058	<0.1	1.8	1.7	<0.1	<0.1	1.3	<0.1	2.3	<0.1	<0.1	0.74	3					0.027	<0.021
Pyrene	mg/kg	4.9		0.9	7.2	7.7	2.1	0.95	1.5	1.1	2.1	0.58	1.9	1	1.6	5.1	0.65	0.48	0.71	1.8	0.49	0.17	<0.1	1	0.78	<0.1	<0.1	2.6	<0.1	1.3	0.38	0.97	3.7					0.023	<0.022
PAH 16 Total	mg/kg					47	43

MACAN
Soil Analysis Results & Screening Assessment
CL-26 Lagoon 12
05/10/2015

Geological Formation Legend

MG-SS	Made Ground (slurry slag)
MG-CS	Made Ground (coarse slag)
TFD	Tidal Flat Deposits

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference		LGBH001	LGBH001	LGBH002	LGBH003	SW1/09A	SW1/09A	SW1/10	SW1/10	SW1/11	SW1/11	SW1/12	SW1/12	SW1/13	SW1/13	SW1/14	SW1/14	SW1/15	SW1/15	SW1/16	SW1/16	SW1/17A	SW1/17A	BH514A	BH514A	BH514A	BH514A	BH514A	BH515	BH515	BH515	TP506	TP506	TP506	LGBH001	LGBH002	LGBH002	LGBH003	SBH04	SBH04
Specimen Depth (m)		1	7.5	0.5	0.5	1	3	4	4.5	1	3	2	4.2	1	2	1	2	1	2	2	2.3	1	1.5	0 - 0.5	1 - 1.5	2 - 2.5	3.5 - 3.7	4.5 - 4.7	0 - 0.5	0.5	2.5	0.5 - 0.6	1.5 - 1.6	3 - 3.5	9.5	8.1	9	8	8	9
OD Level (m)						9.95	7.95	6.53	6.03	9.28	7.28	8.59	6.39	10.01	9.01	9.14	8.14	9.09	8.09	8.2	7.9	9.74	9.24	11.9	10.9	9.9	8.4	7.4	7.2	10.6	10.4	11.35	10.35	8.85					3.24	2.24
Sample Type	Units					1	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	1	1	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES					ES	ES
Geology Code		MG-CS	MG-CS	MG-CS	MG-CS	MG -SS	MG -SS	MG -SS	MG -SS	MG -SS	MG -SS	MG - CS	MG - CS	MG -SS	MG -SS	MG -SS	MG -SS	MG -SS	MG -SS	MG -SS	MG - CS	MG -SS	MG -SS	MG -SS	MG -SS	MG -SS	MG - CS	MG - CS	MG - CS	MG - CS	MG - CS	MG - CS	MG - CS	MG - CS	TFD	TFD	TFD	TFD	TFD	TFD
Cluster Code		2002	2002	2002	2002	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2002	2002	2002	2002	2007 GI	2007 GI
1,1,1-Trichloroethane	ug/kg					<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7																<7	<7
1,1,2,2-Tetrachloroethane	ug/kg					<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10																<10	<10
1,1,2-Trichloroethane	ug/kg					<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10																<10	<10
1,1-Dichlorapropene	ug/kg					<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11																<11	<11
1,1-Dichloroethane	ug/kg					<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8																<8	<8
1,1-Dichloroethene	ug/kg					<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10																<10	<10
1,2,3-Trichlorobenzene	ug/kg					<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11																<11	<11
1,2,3-Trichloropropane	ug/kg					<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17																<17	<17
1,2,4-Trimethylbenzene	ug/kg					<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	170	<9	<9																<9	<9
1,2-Dibromo-3-chloropropane	ug/kg					<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14																<14	<14
1,2-Dichloroethane	ug/kg					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5																<5	<5
cis-1-2-Dichloroethene	ug/kg					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5																<5	<5
1,2-Dibromoethane	ug/kg					<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12																<12	<12
1,2-Dichloropropane	ug/kg					<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12																<12	<12
1,3,5-Trimethylbenzene	ug/kg					<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	73	<8	<8																<8	<8
cis-1-3-Dichloropropene	ug/kg					<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14																<14	<14
1,3-Dichloropropane	ug/kg					<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7																<7	<7
2,2-Dichloropropane	ug/kg					<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12																<12	<12
2-Chlorotoluene	ug/kg					<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9																<9	<9
4-Chlorotoluene	ug/kg					<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12																<12	<12
4-Isopropyltoluene	ug/kg					<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11																<11	<11
Bromobenzene	ug/kg					<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10																<10	<10
Bromochloromethane	ug/kg					<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14																<14	<14
Bromoform	ug/kg					<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10																<10	<10
Bromomethane	ug/kg					<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13																<13	<13
Bromodichloromethane	ug/kg					<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7																<7	<7
Chlorobenzene	ug/kg					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5																<5	<5
Carbon Disulphide	ug/kg					<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7																<7	<7
Chloroethane	ug/kg					<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14																<14	<14
Chloroform	ug/kg					<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8																<8	<8
Chloromethane	ug/kg					<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7																<7	<7
Carbontetrachloride	ug/kg					<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14																<14	<14
Carbontetrachloride	ug/kg					<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14																<14	<14
Dibromomethane	ug/kg					<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9																<9	<9
Dichlorodifluoromethane	ug/kg					<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4																<4	<4
Dibromochloromethane	ug/kg					<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13																<13	<13
Dichloromethane	ug/kg					<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10																<10	<10
Isopropylbenzene	ug/kg					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	29	<5	<5																<5	<5
n-Butylbenzene	ug/kg					<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10																<10	<10
Propylbenzene	ug/kg					<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	28	<11	<11																<11	<11
sec-Butylbenzene	ug/kg					<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	26	<10	<10																<10	<10
Styrene	ug/kg					<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10																<10	<10
trans-1-2-Dichloroethene	ug/kg					<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11																<11	<11
trans-1-3-Dichloropropene	ug/kg					<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14																<14	<14
Trichlorofluoromethane	ug/kg					<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6																<6	<6
tert-Butylbenzene	ug/kg					<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	88	<12	<12																<12	<12
Tetrachloroethene	ug/kg					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5																<5	<5
Trichloroethene	ug/kg					<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9																<9	<9
Vinyl Chloride	ug/kg					<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10																<10	<10

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	Selected S4ULs Criteria	No. Data Exceeding S4ULs Criteria
19	0	None > LOD	None > LOD			
19	0	None > LOD	None > LOD			
19	0	None > LOD	None > LOD			
19	0	None > LOD	None > LOD			
19	0	None > LOD	None > LOD			
19	0	None > LOD	None > LOD			
19	0	None > LOD	None > LOD		102000	0
19	0	None > LOD	None > LOD			
19	1	170	170	SW1/16 @ 2.3mbGL		
19	0	None > LOD	None > LOD			
19	0	None > LOD	None > LOD			
19	0	None > LOD	None > LOD			
19	0	None > LOD	None > LOD			
19	0	None > LOD	None > LOD			
19	1	73	73	SW1/16 @ 2.3mbGL		
19	0	None > LOD	None > LOD			
19	0	None > LOD	None > LOD			
19	0	None > LOD	None > LOD			
19	0	None > LOD	None > LOD			
19	0	None > LOD	None > LOD			
19	0	None > LOD	None > LOD

MACAN
Soil Analysis Results & Screening Assessment
CL-26 Lagoon 25
05/10/2015

Geological Formation Legend

TFD	Tidal Flat Deposits
MG	Made Ground
MG-SS	Made Ground (slurry slag)
MG-CS	Made Ground (coarse slag)
MG-G	Made Ground (general)

Screening Values and Assessment

	Exceeds S4ULs criteria
X	laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference		LGB4H04	LGB4H04	LGB4H04	LGB4H05	LGB4H05	LGB4H05	LGB4H07	LGB4H07	LGB4H09	SW5/18	SW5/18	SW5/19	SW5/19	SW5/20	SW5/20	SW5/21	SW5/21	SW5/22B	SW5/22B	SW5/23	SW5/23	SW5/24A	SW5/24A	SW5/26	SW5/26	SW5/27	SW5/27	SW5/28	SW5/28	SW5/29	SW5/29	SW5/30	WS501	WS501	WS501	BHS18	BHS19	LGB4H04	LGB4H05	LGB4H05	LGB4H05	LGB4H05	LGB4H09	SBH05	SBH05	WS501	BHS18	BHS19	BHS19
Specimen Depth (m)		1.3	5	8.7	0.5	1.6	1.6	1	12	0.9	2	3	1	6	5	6	2	4	1	3	7	7.9	4	5	1	4	1	6	1	2	4	6	3	0-0.2	0.6-0.8	4.5-4.7	0.5-0.7	0.2-0.5	11.5	2.5	3.1	6	7	6.8	11.5	14.5	8.7-8.9	2-2.2	1.55-2	2.5-3
OD Level (m)		10.83	9.83	11.31	6.31	7.21	7.21	6.21	10.97	8.97	10.99	8.99	5.29	4.39	8.01	7.01	10.6	7.6	8.3	5.3	10.59	9.59	7.63	5.63	8.54	12.15	11.55	7.65	5	5.65														1.74	-1.26	3.45	3.5	4.3	3.35
Sample Type	Units	ES	ES	ES	D	ES	ES	ES	ES	D	ES	ES	D	D	D	ES	ES	ES	ES	D	ES	D	D	D	ES	ES	ES	L	ES	ES	L	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES
Geology Code		MG-CS	MG-CS	MG-CS	MG-CS	MG-G	MG-G	MG-CS	MG-CS	MG-SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG	MG	MG	MG	MG	TFD	TFD	TFD (peat)	TFD	TFD	TFD	TFD	PEAT	TFD	TFD	PEAT	PEAT
Cluster Code		2002	2002	2002	2002	2002	2002	2002	2002	2002	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2007 G1	2015 G1	2015 G1	2015 G1	2015 G1	2015 G1	2002	2002	2002	2002	2002	2002	2007 G1	2007 G1	2015 G1	2015 G1	2015 G1	2015 G1
Metals																																																			
Antimony	mg/kg										34	20	23	34	29	24	30	35	22	30	34	27	31	26	24	32	41	38	21	28	37	20												6.9	<1.5						
Arsenic	mg/kg	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	14	22	27	28	<3	24	<3	<3	<3	<3	18	<3	<3	<3	<3	<3	22	20	29	13	35	7	4	3	11	12	8	14	<3	41	14	2.3	<1
Barium	mg/kg										90	170	92	83	110	110	100	72	230	160	140	180	220	220	74	86	66	79	160	140	110	110	100											120	31						
Boron Water Soluble	mg/kg	<0.5	<0.5	1.2	1.9	1.7	3.5	0.8	1.4	<0.5	<1.5	<1.5	6.3	<1.5	<1.5	4.6	11	<1.5	3.9	<1.5	<1.5	4.3	8.5	5.8	4.4	<1.5	<1.5	5.8	<1.5	<1.5	7.4	<1.5	<0.4	1.5	0.56	2.4	2.2	0.8	1.7	25	1.8	2	1.6	<1.5	41	4.8	3.1	4	12
Cadmium	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.3	1.1	19	17	25	17	7.2	13	14	16	9.3	20	7.5	20	16	30	19	30	25	23	24	25	38	6.2	11	21	0.37	0.14	<1	<1	<1	<1	<1	<1	<0.3	<0.1	13	<0.1	<0.1	<0.1
Chromium	mg/kg	911	853	1660	850	410	438	1350	1290	663	960	550	82	50	120	87	80	110	160	120	130	120	620	170	99	80	100	94	110	110	87	53	150	51	91	92	42	1400	60	300	25	31	32	41	68	11	460	34	230	15
Copper	mg/kg	15	23	20	17	8	12	32	26	11	<6	18	62	110	99	58	46	84	110	85	86	79	16	84	51	64	98	90	47	79	63	46	150	11	47	78	24	22	8	10	5	14	16	15	6	<6	89	6.6	4.1	1.6
Lead	mg/kg	28	170	82	60	19	39	64	65	54	15	150	1400	1300	1700	1100	900	1400	950	1600	2000	420	2100	920	1600	2200	2000	1100	1200	1300	1200	1300	690	2700	170	940	1500	18	18	22	36	16	19	36	29	8	1700	12	5.2	3.3
Mercury	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	0.7	0.9	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	0.7	0.6	<0.6	<0.6	<0.6	0.21	0.33	1	0.12	0.19	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.6	<0.6	0.65	<0.1	<0.1	<0.1
Molybdenum	mg/kg										0.8	<0.6	2.4	4.5	<0.6	<0.6	<0.6	1.6	3.9	2.7	1.1	8.8	3.9	3.1	3.9	1.3	1.7	1.9	2.5	0.7	0.7	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6							<0.6	<0.6				
Nickel	mg/kg	6	11	3	8	14	18	12	8	7	<0.9	<0.9	46	31	15	<0.9	12	37	12	<0.9	4.2	12	<0.9	11	34	25	23	36	7.9	<0.9	5.7	1.9	46	40	36	30	33	25	19	12	29	33	27	30	1.9	49	21	5.3	1.8
Selenium	mg/kg	2.27	2.44	1.83	1.13	0.98	1.07	1.1	1.05	1.53	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<0.2	0.82	1.3	0.53	<0.2	<0.50	0.6	0.72	0.96	<0.50	0.72	<3	<3	<0.2	<0.2	0.52	0.57
Zinc	mg/kg	99	653	366	63	70	66	41	33	45	46	870	18000	38000	12000	45000	23000	15000	11000	11000	13000	9200	3400	7700	23000	33000	39000	35000	7200	9800	25000	29000	1200	15000	26000	86	150	86	58	46	85	100	77	280	42	9300	58	29	29
Beryllium	mg/kg										<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4																	
Iron	mg/kg	170000	183000	179000	211000	66300	66000	192000	238000	137000	110000	94000	240000	320000	330000	320000	290000	340000	400000	310000	320000	280000	110000	260000	270000	300000	320000	320000	260000	270000	310000	270000	330000						37300	59600	18400	29000	29800	25000	45000	5800				
Vanadium	mg/kg										710	440	28	30	41	38	38	39	42	36	44	31	590	130	30	27	31	29	29	28	35	28												65	6.7					
Hexavalent Chromium	mg/kg										1.9																										<0.5														
Non-Metal Inorganics																																																			
Cyanide (total)	mg/kg	4	3	<1	<1	1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	5	86	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	2	<1	<1	<1	<1	6.1	<0.5	<0.5	<0.5
Cyanide (free)	mg/kg																																	<0.5	<0.5	<0.5	<0.5	<0.5										<0.5	<0.5	<0.5
Sulphate (soluble)	g/l										0.011	<0.003	0.19	0.17	0.11	0.13	0.34	0.2	0.28	0.15	0.2	0.15	0.004	0.23	0.5	0.55	0.17	0.16	1.5	0.11	0.28	0.27										0.022	NDP						
Elemental/Free Sulphur	mg/kg										<70	<70	97	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70												<70	<70					
Easily Liberated Sulphide	mg/kg															1100	730	440	1100	<15	<15									190	42												<15	<15					
Acid Soluble Sulphide	mg/kg										75	110	1600	620	1800	<50	1400	1200						110	1500	1200	3200					440																		
Ammoniacal Nitrogen as N	mg/kg	1.3	1.3	1.6	0.8	2.9	4.8	1.1	1	4.1	<15	24	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15						8.6	13.1	24.2	84.5	60.7	39.4	<15	62				
Chloride	mg/kg	68.1	63.1	49	26.8	233	219	57.1	47.6		14	20	460	370	190	240	270	590	170	660	280	390	34	150	540	720	280	390	22	74	560	810	400						77.2	344	5090	1390	1540	1260	56	NDP				
Other																																																			
Asbestos Presence Screen	None										NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NAD	NAD	NAD	NAD	NAD								NFD	NFD		NAD	NAD	
Loss on Ignition	%											1.7	4.3			8.3		12	4.8		<0.3	<0.3		3.8	5.9			10		<0.3	4.1														3.2	91				
Total Organic Carbon	%											0.7	19			1.6		2.9	3.3		1.1	5.1		8.6	11			4		3.5	4.6		31												0.5	32	2.4				
Organic Matter	%																		8.5		7.3							6.7																							
pH Value	pH Units	12.6	12.5	12.9	13	11.9	12.1	12.9	12.9		12.51	12.06	10.4	9.4	10.49	10.3	9.8	10.87	12.28	12	11.9	11.51	11.69	11.38	11.73	9.98	11.55	11.74	10.22	10.92	10.86	10.87	8.71	9.2	12.1	9.1	7.7	12.8	10	12.1	7.6	9.4	8.9	10.3	8.21	7.8	10.8	8.3	10	8.1
Material >2mm	%																		<0.1		<0.1							<0.1		<0.1																					
Calorific Value	MJ/kg																																	8.1																	
Organics																																																			
PCBs (vs Aroclor 1254)	mg/kg										<0.02	0.038	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.035	<0.035	<0.035	<0.035	<0.035	0.22	<0.02	<0.02	<0.02	<0.02	<0.035	<0.035	<0.02	<0.02	<0.02				<0.01	<0.01							<0.035	<0.035				
PCB 105	mg/kg																																				<0.01	<0.01									<0.01	<0.01	<0.01		
PCB 114	mg/kg																																				<0.01	<0.01									<0.01	<0.01	<0.01		
PCB 123	mg/kg																																				<0.01	<0.01									<0.01	<0.01	<0.01		
PCB 126	mg/kg																																				<0.01	<0.01									<0.01	<0.01	<0.01		
PCB 157	mg/kg																																				<0.01	<0.01									<0.01	<0.01	<0.01		
PCB 167	mg/kg																																				<0.01	<0.01									<0.01	<0.01	<0.01		
PCB 169	mg/kg																																				<0.01	<0.01									<0.01	<0.01	<0.01		
PCB 189	mg/kg																																				<0.01	<0.01									<0.01	<0.01	<0.01		
PCB 77	mg/kg																																				<0.01	<0.01									<0.01	<0.01	<0.01		
PCB 81	mg/kg																																				<0.01	<0.01									<0.01	<0.01	<0.01		
PCb-118 2,3',4,4',5 - Pentachlorobiphenyl	mg/kg																																				<0.01	<0.01									<0.01	<0.01	<0.01		
PCb-156 2,3,3,4,4,5 - Hexachlorobiphenyl	mg/kg																																					<0.01									<0.01	<0.01	<0.01		
Phenols (total)	mg/kg	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.2	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.3	<0.3	<0.3	<0.3	<0.3	<0.0005	<0.0005	0.0007	0.0008	<0.0005	<0.0005	<0.15	<0.15	<0.3	<0.3	<0.3	
BTEX																																																			
GRO (C4-C12)	mg/kg										<0.01	<0.01	<0.01	0.025	0.065	0.12	<0.01	<0.01	<0.01	0.031	0.042	0.64	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.016												<0.01	<0.01				
MTBE	mg/kg										<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01												<0.01	<0.02				
Benzene	mg/kg										<0.01	<0.01	<0.01	<0.01	0.019	0.045	<0.01	<0.01	0.031	<0.01	0.16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	0.016	<0.01	<0.001	<0.001	<0.001									<0.01	<0.02	<0.001		<0.001		
Toluene	mg/kg										<0.01	<0.01	<0.01	<0.01	0.016	0.032	<0.01	<0.01	<0.01	<0.01	0.053	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001									<0.01	<0.02	<0.001		<0.001		
Ethyl benzene	mg/kg										<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001									<0.01	<0.02	<0.001		<0.001		
m & p Xylene	mg/kg										<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.053	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001									<0.01	<0.02	<0.001		<0.001		
o Xylene	mg/kg										<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.054	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001									<0.01	<0.02	<0.001		<0.001		
TPH																																																			
Aliphatics C5-C6	mg/kg										<0.01	<0.01	<0.01	0.025	0.03	0.044	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1									<0.01	<0.01	<0.1		<0.1		
Aliphatics >C6-C8	mg/kg										<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1									<0.01	<0.02	<0.1		<0.1		
Aliphatics >C8-C10	mg/kg										<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.12	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001									<0.01	<0.02	<0.001		<0.1		
Aliphatics >C10-C12	mg/kg										<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.012	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001									<0.01	<0.02	<0.001		<1		
Aliphatics >C12-C16	mg/kg										<0.1	0.56	10	6.9	0.92	<0.1	0.33	4.1	1.2	6.9	8.4	4.4	9.6	1.6	0.33	1.6	<0.1	7.3	<0.02	5.4	3.4	9.6	0.83	22	<0.001	<0.001	<0.001									0.25	<0.02	0.25		<0.1		
Aliphatics >C16-C21	mg/kg										<0.1	7.9	16	25	34	28	14	14	32	36	26	86	22	110	14	24	100	<0.02	17	41	40	54	47	<0.001	<0.001	<0.001									1	<0.02	<0.001		<1		
Aliphatics >C21-C35	mg/kg										19	89	35	32	21	48	30	15	83	65	35	140	71	240	43	44	93	<0.02	66	55	67	76	84	<0.001	<0.001	<0.001									3.1	<0.02	<0.001		<1		
Total Aliphatics C5-C35	mg/kg										19	97	61	58	56	76	48	31	120	110	65	230	95	350	59	68	200	150	88	99	120	130	150											2.6	160			<1		
Aliphatics >C35-C44	mg/kg																																	<1	<1	<1											<1		<0.1		
Aromatics C5-C7	mg/kg																																	<0.1	<0.1	<0.1											<0.1		<0.1		
Aromatics C6-C7	mg/kg										<0.01	<0.01	<0.01	<0.01	0.019	0.045	<0.01	<0.01	<0.01	0.031	<0.01	0.16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1									<0.01	<0.01			<0.1		
Aromatics >C7-C8	mg/kg										<0.01	<0.01	<0.01	<0.01	0.016	0.032	<0.01	<0.01	<0.01	<0.01	0.053	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1									<0.01	<0.01	<0.1		<1		
Aromatics >C8->C10	mg/kg										<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.29	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1									<0.01	<0.01	<0.1		<1		
Aromatics >10-C12	mg/kg										<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.019	0.011	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<1	<1	<1									<0.01	<0.01	<1		<1		
Aromatics >12-C16	mg/kg										<0.1	<0.1	9.4	0.63	<0.1	0.21	3.9	1.4	4.5	3.2	0.94	3.1	0.47	2.7	2	1.1	4.6	3.9	1.1	6.1	5.9	7.6	<1	<1	<1									<0.1	6.2	<1		8		
Aromatics >16-C21	mg/kg										<0.1	0.48	17	6.6	4	10	5.1	5.4	32	14	7.1	63	4	21	4.7	12	13	8.5	14	8.9	21	18	21	<1	<1	<1									<0.1	63	<1		5		
Aromatics >21-C35	mg/kg										<0.1	8.3	29	32	10	67	3.4	14	64	19	30	180	19	84	5.4	32	25	27	27	8.5	41	43	20	<1	<1	<1									2	530	<1		<5		
Total Aromatics C5-C35	mg/kg										<0.1	8.8	55	39	14	78	12	20	100	36	38	250	24	110	12	45	43	40	45	14	69	67	49											2	560			<5		
Aromatics >C35-C44	mg/kg																																	<1	<1	<1														
TPH (Aliphatics and Aromatics C5-C35)	mg/kg										19	110	120	97	70	150	60	51	220	150	100	470	120	460	71	110	250	190	130	110	180	200	200											4.6	720			<10		
Total Aliphatic	mg/kg																																	<5	<5	<5											<5			
Total Aromatics	mg/kg																																	<5	<5	<5											<5			
Total Petroleum Hydrocarbons	mg/kg																																	<10	<10	<10											<10			
PAH																																																			
Acenaphthene	mg/kg	<0.2	<0.2								<0.014	<0.014	0.21	0.032	<0.014	0.026	0.19	0.058	0.15	0.1	<0.014	0.06	0.016	0.033	0.11	0.061	0.063	0.045	4.4	0.025	0.27	0.13	0.48	<0.1	0.3	<0.1	<0.1	<0.1							<0.014	<0.14	0.11	<0.1	<0.1	<0.1				
Acenaphthylene	mg/kg	<0.2	<0.2								<0.01	0.011	0.086	0.016	<0.005	0.006	0.019	0.01	0.029	0.03	<0.005	0.035	0.007	0.014	0.026	0.012	0.024	0.011	0.061	0.063	0.045	0.011	0.015	<0.1	0.46	0.25	<0.1	<0.1							<0.005	<0.06	0.43	<0.1	<0.1	<0.1				
Anthracene	mg/kg	<0.2	0.3								<0.009	0.017	0.52	0.37	0.11	0.23	0.12	0.13	0.65	0.3	0.073	1.1	0.1	0.25	0.27	0.25	0.4	0.28	3.8	0.16	0.41	0.47	0.35	<0.1	0.31	0.18	<0.1	<0.1							<0.009	<0.09	0.2	<0.1	<0.1	<0.1				
Benzo(a)anthracene	mg/kg	0.2	1.5								0.054	0.11	0.054	0.72	0.89	1.6	<0.012	0.33	1.2	0.46	0.22	1.8	0.35	0.94	0.059	0.71	0.87	0.85	4.5	0.29	0.72	1.4	0.61

MACAN
Soil Analysis Results & Screening Assessment
CL-26 Lagoon 25
05/10/2015

Geological Formation Legend

TFD	Tidal Flat Deposits
MG	Made Ground
MG-SS	Made Ground (slurry slag)
MG-CS	Made Ground (coarse slag)
MG-G	Made Ground (general)

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference		LGBH004	LGBH004	LGBH004	LGBH005	LGBH005	LGBH005	LGBH007	LGBH007	LGBH009	SWS118	SWS118	SWS119	SWS119	SWS120	SWS120	SWS121	SWS121	SWS122B	SWS122B	SWS123	SWS123	SWS124A	SWS124A	SWS126	SWS126	SWS127	SWS127	SWS128	SWS128	SWS129	SWS129	SWS130	WS501	WS501	WS501	BHS18	BHS18	BHS19	LGBH004	LGBH005	LGBH005	LGBH005	LGBH005	LGBH009	SBH05	SBH05	WS501	BHS18	BHS19	BHS19
Specimen Depth (m)		1.3	5	8.7	0.5	1.6	1.6	1	12	0.9	2	3	1	6	5	6	2	4	3	6	7	7.9	4	5	1	4	4	6	1	2	4	6	3	0 - 0.2	0.6 - 0.8	4.5 - 4.7	0.5 - 0.7	0.2 - 0.5	11.5	2.5	3.1	6	7	7	6.8	11.5	14.5	8.7 - 8.9	2 - 2.2	1.55 - 2	2.5 - 3
OD Level (m)											10.83	9.83	11.31	6.31	7.21	6.21	10.97	8.97	10.99	8.99	5.29	4.39	8.01	7.01	10.6	7.6	8.3	5.3	10.59	9.59	7.63	5.63	8.54	12.15	11.55	7.65	5	5.65								1.74	-1.26	3.45	3.5	4.3	3.35
Sample Type	Units										ES	ES	ES	D	ES	ES	ES	ES	D	ES	D	D	D	ES	ES	ES	L	ES	ES	L	ES	ES	ES	ES	ES	ES	ES	ES							ES	ES	ES	ES	ES	ES
Geology Code		MG-CS	MG-CS	MG-CS	MG-CS	MG-G	MG-G	MG-CS	MG-CS	MG-SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG	MG	MG	MG	MG	MG	TFD	TFD	TFD (peat)	TFD	TFD	TFD	TFD	PEAT	TFD	TFD	PEAT	PEAT
Cluster Code		2002	2002	2002	2002	2002	2002	2002	2002	2002	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2002	2002	2002	2002	2002	2002	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI	2015 GI
VOCs																																																			
Methyl Tertiary Butyl Ether	ug/kg										<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11												<11	<11				
Benzene	ug/kg										<9	<9	<9	<9	<9	16	<9	<9	<9	<9	<9	16	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9												<9	<9				
Toluene	ug/kg										<5	<5	<5	<5	<5	15	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5												<5	<5				
Ethylbenzene	ug/kg										<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	11	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4												<4	<4				
p/m Xylene	ug/kg										<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	84	<14	<14	<14	<14	28	<14	30	<14	<14	<14	<14												<14	<14				
o-Xylene	ug/kg										<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	140	<10	<10	<10	<10	37	<10	26	<10	<10	<10	<10												<10	<10				
Naphthalene	ug/kg										<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13												<13	<13				
Hexachlorobutadiene	ug/kg										<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12												<12	<12				
1,2,4-Trichlorobenzene	ug/kg										<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6												<6	<6				
1,2-Dichlorobenzene	ug/kg										<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12												<12	<12				
1,3-Dichlorobenzene	ug/kg										<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6												<6	<6				
1,4-Dichlorobenzene	ug/kg										<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5												<5	<5				
1,1,1,2-Tetrachloroethane	ug/kg										<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												<10	<10				
1,1,1-Trichloroethane	ug/kg										<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7												<7	<7				
1,1,2,2-Tetrachloroethane	ug/kg										<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												<10	<10				
1,1,2-Trichloroethane	ug/kg										<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												<10	<10				
1,1-Dichloropropene	ug/kg										<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11												<11	<11				
1,1-Dichloroethane	ug/kg										<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8												<8	<8				
1,1-Dichloroethene	ug/kg										<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												<10	<10				
1,2,3-Trichlorobenzene	ug/kg										<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11												<11	<11		102000	0
1,2,3-Trichloropropane	ug/kg										<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17	<17												<17	<17				
1,2,4-Trimethylbenzene	ug/kg										<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	300	<9	<9	<9	<9	<9	93	<9	39	<9	<9	<9												<9	<9				
1,2-Dibromo-3-chloropropane	ug/kg										<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14												<14	<14				
1,2-Dichloroethane	ug/kg										<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5												<5	<5				
cis-1,2-Dichloroethene	ug/kg										<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5												<5	<5				
1,2-Dibromoethane	ug/kg										<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12												<12	<12				
1,2-Dichloropropane	ug/kg										<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12												<12	<12				
1,3,5-Trimethylbenzene	ug/kg										<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	150	<8	<8	<8	<8	<8	60	<8	<8	<8	<8	<8												<8	<8				
trans-1,3-Dichloropropene	ug/kg										<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14												<14	<14				
1,3-Dichloropropane	ug/kg										<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7												<7	<7				
2,2-Dichloropropane	ug/kg										<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12												<12	<12				
2-Chlorotoluene	ug/kg										<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9												<9	<9				
4-Chlorotoluene	ug/kg										<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12												<12	<12				
4-Isopropyltoluene	ug/kg										<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11												<11	<11				
Bromobenzene	ug/kg										<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												<10	<10				
Bromochloromethane	ug/kg										<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14												<14	<14				
Bromoform	ug/kg										<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												<10	<10				
Bromomethane	ug/kg										<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13												<13	<13				
Bromodichloromethane	ug/kg										<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7												<7	<7				
Chlorobenzene	ug/kg										<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5												<5	<5		56000	0
Carbon Disulphide	ug/kg										<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7												<7	<7		11000	0
Chloroethane	ug/kg										<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14												<14	<14				
Chloroform	ug/kg										<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8												<8	<8		99000	0
Chloromethane	ug/kg										<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7												<7	<7				
Carbontetrachloride	ug/kg										<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14												<14	<14				
Carbontetrachloride	ug/kg										<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14												<14	<14				
Dibromomethane	ug/kg										<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9												<9	<9				
Dichlorodifluoromethane	ug/kg										<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4												<4	<4				
Dibromochloromethane	ug/kg										<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13	<13												<13	<13				
Dichloromethane	ug/kg										<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												<10	<10				
Isopropylbenzene	ug/kg										<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	77	<5	<5	<5	<5	<5	21	<5	<5	<5	<5	<5												<5	<5				
n-Butylbenzene	ug/kg										<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												<10	<10				
Propylbenzene	ug/kg										<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	38	<11	<11	<11	<11	20	<11	<11	<11	<11	<11	<11												<11	<11				
sec-Butylbenzene	ug/kg										<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	34	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												<10	<10				
Styrene	ug/kg										<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												<10	<10				
trans-1-2-Dichloroethene	ug/kg										<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11												<11	<11				
trans-1-3-dichloropropene	ug/kg										<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14												<14	<14				
Trichlorofluoromethane	ug/kg										<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6												<6	<6				
Tert Butylbenzene	ug/kg										<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	140	<12	<12	<12	<12	<12	50	<12	21	<12	<12	<12												<12	<12				
Tetrachloroethene	ug/kg										<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5												<5	<5		19000	0
Trichloroethene	ug/kg										<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9												<9	<9		1200	0
Vinyl Chloride	ug/kg										<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												<10	<10		59	0

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	Selected S4ULs Criteria	No. Data Exceeding S4ULs Criteria
25	0	None > LOD	None > LOD			
25	2	16	16	SWS120 @ 6mbGL	27000	0
24	1	15	15	SWS120 @ 6mbGL	56000000	0
25	1	11	11	SWS123 @ 7.9mbGL	5700000	0
25	3	84	28	SWS123 @ 7.9mbGL		
25	3	140	26	SWS123 @ 7.9mbGL	6600000	0
25	0	None > LOD	None > LOD		190000	0
25	0	None > LOD	None > LOD		31000	0
25	0	None > LOD	None > LOD		220000	0
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD		102000	0
25	0	None > LOD	None > LOD			
25	3	300	39	SWS123 @ 7.9mbGL		
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	2	150	60	SWS123 @ 7.9mbGL		
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD		56000	0
25	0	None > LOD	None > LOD		11000	0
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD		99000	0
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	0	None > LOD	None > LOD			
25	2	77	21	SWS123 @ 7.9mbGL		
25	0	None > LOD	None > LOD			
25	2	38	20	SWS123 @ 7.9mbGL		
24	1	34	34	SWS123 @ 7.9mbGL		
24	0	None > LOD	None > LOD			
24	0	None > LOD	None > LOD			
24	0	None > LOD	None > LOD			
24	0	None > LOD	None > LOD			
24	3	140	21	SWS123 @ 7.9mbGL		
24	0	None > LOD	None > LOD		19000	0
24	0	None > LOD	None > LOD		1200	0
24	0	None > LOD	None > LOD		59	0

M4CAN
Soil Analysis Results & Screening Assessment
CL-26 Lagoon 27SW
05/10/2015

Geological Formation Legend

TFD	Tidal Flat Deposits
MG-SS	Made Ground (slurry slag)
MG-CS	Made Ground (coarse slag)
MG-G	Made Ground (general)

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference	Units	LGBH010	LGBH010	SBHJ06CP	SBHJ07CP	SBHJ07CP	SWSJ31	SWSJ31	SWSJ32	SWSJ32	SWSJ33	SWSJ33	SWSJ34	SWSJ34	BH520	BH520	BH520	BH520	BH520	LGBH010	LGBH010	SBHJ06CP	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	Selected S4ULs Criteria	No. Data Exceeding S4ULs Criteria
Specimen Depth (m)		1	10	0.3	0.3	2	2	5	6	8	1	3	2	4	0.5	2	4.5	8	10.5	11.5	15	1							
OD Level (m)				5.88	5.49	3.79	8.34	5.34	4.27	2.27	8.17	6.17	8.52	6.52	12.35	10.85	8.35	4.85	2.35			5.18							
Sample Type				ES	ES	D	ES	D	ES	ES	D	L	L	L	ES	ES	ES	ES	ES			ES							
Geology Code		MG - CS	MG - CS	MG - G	MG - G	MG - G	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - CS	MG - CS	MG - CS	MG - CS	MG - CS	TFD	TFD	TFD							
Cluster Code		2002 GI	2002 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2002 GI	2002 GI	2007 GI							
Metals																													
Antimony	mg/kg			23	26	3	29	25	23	7.7	32	30	26	30								5.2	12	12	32	3	SWSJ33 @ 1mbGL		
Arsenic	mg/kg	<3	<3	<3	<3	4	9	8	9	15	<3	<3	8	13	26	28	35	22	24	6	5	<3	21	14	35	4	BH520 @ 4.5mbGL	170	0
Barium	mg/kg			130	140	66	150	150	210	89	130	120	140	140								100	12	12	210	66	SWSJ32 @ 6mbGL		
Boron Water Soluble	mg/kg	3	1.7	<3.5	<3.5	<3.5	4	6.7	4.5	5.6	<3.5	6.3	<3.5	6.5	2.8	3	2.4	3.6	3.1	1.9	1	<3.5	21	15	6.7	1	SWSJ31 @ 5mbGL		
Cadmium	mg/kg	<1	<1	<0.3	<0.3	<0.3	21	8.8	11	1.6	17	22	6	14	3.3	0.78	7.5	0.81	1.2	<1	<1	<0.3	21	13	22	0.78	SWSJ33 @ 3mbGL	190	0
Chromium	mg/kg	541	1230	550	660	76	150	120	180	52	150	160	150	160	830	930	660	980	1500	60	17	90	21	21	1500	17	BH520 @ 10.5mbGL	33	20
Copper	mg/kg	2	6	<6	<6	8	72	31	66	13	41	59	54	71	20	15	25	27	32	11	8	23	21	19	72	2	SWSJ31 @ 2mbGL	44000	0
Lead	mg/kg	20	14	36	38	19	690	270	350	60	560	830	580	710	42	27	30	52	78	33	10	110	21	21	830	10	SWSJ33 @ 3mbGL	1300	0
Mercury	mg/kg	<0.5	<0.5	<0.6	<0.6	<0.6	<0.6	<0.6	0.7	<0.6	<0.6	<0.6	0.7	0.6	0.51	0.48	1	0.6	0.59	<0.5	<0.5	<0.6	21	8	1	0.48	BH520 @ 4.5mbGL	30	0
Molybdenum	mg/kg			<0.6	<0.6	<0.6	<0.6	0.6	<0.6	<0.6	<0.6	<0.6	1.1	<0.6								<0.6	12	2	1.1	0.6	SWSJ34 @ 2mbGL		
Nickel	mg/kg	5	<2	<0.9	<0.9	27	19	2.1	8.5	25	39	26	18	16	35	36	35	28	35	25	16	16	21	18	39	2.1	SWSJ33 @ 1mbGL	980	0
Selenium	mg/kg	1.63	1.91	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3						0.66	<0.50	<3	16	3	1.91	0.66	LGBH010 @ 10mbGL	1800	0
Zinc	mg/kg	61	45	65	95	99	10000	11000	10000	2500	31000	30000	11000	10000	99	110	120	800	1700	92	47	370	21	21	31000	45	SWSJ33 @ 1mbGL	170000	0
Beryllium	mg/kg			<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.9	<0.4	<0.4	<0.4	<0.4								<0.4	12	1	0.9	0.9	SWSJ32 @ 8mbGL	12	0
Iron	mg/kg	202000	216000	110000	110000	37000	300000	300000	<4	85000	350000	320000	320000	300000						34900	20600	37000	16	15	350000	20600	SWSJ33 @ 1mbGL		
Vanadium	mg/kg			360	400	70	29	32	43	44	35	45	26	25								71	12	12	400	25	SBHJ07CP @ 0.3mbGL	5000	0
Cyanide (total)	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	21	0	None > LOD	None > LOD			
Sulphate (soluble)	g/l			<0.003	0.007	0.031	0.084	0.016	0.022	0.13	0.008	0.17	0.096	0.19								0.068	12	11	0.19	0.007	SWSJ34 @ 4mbGL		
Elemental/Free Sulphur	mg/kg			<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70								<70	12	0	None > LOD	None > LOD			
Easily Liberated Sulphide	mg/kg			<15	310	<15	73	180	120	160	270	200	36	50								<15	12	9	310	36	SBHJ07CP @ 0.3mbGL		
Ammoniacal Nitrogen as N	mg/kg	1.3	1.3	<15	21	23	<15	34	33	55	<15	24	52	<15						15.3	26.4	<15	16	11	55	1.3	SWSJ32 @ 8mbGL		
Chloride	mg/kg	31.3	32	4	14	80	130	88	78	280	18	NDP	390	380						239	793	650	16	15	793	4	LGBH010 @ 15mbGL		
Other																													
Asbestos Presence Screen	None			NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NAD		NAD		NAD			NFD	15	0	None > LOD	None > LOD			
Asbestos Identification	%				1.1	2.1									0		0		0				5	5	2.1	0	SBHJ07CP @ 2mbGL		
Loss on Ignition	%			1.4	0.3	1.8		4.4	<0.3		<0.3			<0.3								2.5	8	5	4.4	0.3	SWSJ31 @ 5mbGL		
Total Organic Carbon	%			0.2				0.5	0.6		<0.2			0.2	0.67							0.6	7	6	0.67	0.2	BH520 @ 0.5mbGL		
Organic Matter	%								4.6				6										2	2	6	4.6	SWSJ34 @ 2mbGL		
pH Value	pH Units	12.7	12.8	12.05	11.67	8.73	11.65	12.41	12.46	12.42	10.18	11.87	10.31	10.41	12.8	12.9	12.9	12.7	12.7	10.6	8.8	8.83	21	21	12.9	8.73	BH520 @ 2mbGL	6-9	18
Material >2mm	%								<0.1				<0.1										2	0	None > LOD	None > LOD			
Calorific Value	MJ/kg														<0.1		<0.1		<0.1				3	0	None > LOD	None > LOD			
Organics																													
PCBs (vs Aroclor 1254)	mg/kg			<0.035	1.2	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035								<0.035	12	1	1.2	1.2	SBHJ07CP @ 0.3mbGL	0.24	1
PCB 105	mg/kg																		<0.01				1	0	None > LOD	None > LOD		0.24	0
PCB 114	mg/kg																		<0.01				1	0	None > LOD	None > LOD		0.24	0
PCB 123	mg/kg																		<0.01				1	0	None > LOD	None > LOD		0.24	0
PCB 126	mg/kg																		<0.01				1	0	None > LOD	None > LOD		0.24	0
PCB 157	mg/kg																		<0.01				1	0	None > LOD	None > LOD		0.24	0
PCB 167	mg/kg																		<0.01				1	0	None > LOD	None > LOD		0.24	0
PCB 169	mg/kg																		<0.01				1	0	None > LOD	None > LOD		0.24	0
PCB 189	mg/kg																		<0.01				1	0	None > LOD	None > LOD		0.24	0
PCB 77	mg/kg																		<0.01				1	0	None > LOD	None > LOD		0.24	0
PCB 81	mg/kg																		<0.01				1	0	None > LOD	None > LOD		0.24	0
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl	mg/kg																		<0.01				1	0	None > LOD	None > LOD		0.24	0
Pcb-156 2,3,3,4,4,5 - Hexachlorobiphenyl	mg/kg																		<0.01				1	0	None > LOD	None > LOD		0.24	0
Phenols (total)	mg/kg	<0.0005	<0.0005	<0.15	<0.15	<0.15	<1.5	<1.5	<1.5	0.51	<1.5	<1.5	<1.5	<1.5	<0.3	<0.3	<0.3	<0.3	<0.3	<0.0005	0.0005	<0.15	21	2	0.51	0.0005	SWSJ32 @ 8mbGL	440	0
BTEX																													
GRO (C4-C12)	mg/kg			<0.01	<0.01	<0.01	<0.01	<0.01	0.67	<0.01	<0.01	0.1	<0.01	0.078								<0.01	12	3	0.67	0.078	SWSJ32 @ 6mbGL		
MTBE	mg/kg			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01								<0.01	12	0	None > LOD	None > LOD			
Benzene	mg/kg			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001		<0.001				<0.01	15	0	None > LOD	None > LOD		27	0
Toluene	mg/kg			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001		<0.001				<0.01	15	0	None > LOD	None > LOD		56000	0
Ethyl benzene	mg/kg			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001		<0.001				<0.01	15	0	None > LOD	None > LOD		5700	0
m & p Xylene	mg/kg			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001		<0.001				<0.01	15	0	None > LOD	None > LOD		5900	0
o Xylene	mg/kg			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001		<0.001				<0.01	15	0	None > LOD	None > LOD		6600	0
TPH																													
Aliphatics C5-C6	mg/kg			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.056	<0.01	0.078	<0.1	<0.1		<0.1				<0.01	15	2	0.078	0.056	SWSJ34 @ 4mbGL	3200	0
Aliphatics >C6-C8	mg/kg			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.046	<0.01	<0.01	<0.1	<0.1		<0.1				<0.01	15	1	0.046	0.046	SWSJ33 @ 3mbGL	7800	0
Aliphatics >C8-C10	mg/kg			<0.01	<0.01	<0.01	<0.01	<0.01	0.19	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1		<0.1				<0.01	15	1	0.19	0.19	SWSJ32 @ 6mbGL	2000	0
Aliphatics >C10-C12	mg/kg			<0.01	<0.01	<0.01	<0.01	<0.01	0.081	<0.01	<0.01	<0.01	<0.01	<0.01	<1	<1		<1				<0.01	15	1	0.081	0.081	SWSJ32 @ 6mbGL	9700	0
Aliphatics >C12-C16	mg/kg			0.83	<0.1	<0.1	0.57	10	6.5	4	<0.1	<0.1	1.5	0.43	<1	<1		42				0.38	15	9	42	0.38	BH520 @ 8mbGL	25000	0
Aliphatics >C16-C21	mg/kg			1.7	12	20	2.6	190	110	63	<0.1	<0.1	25	9	1.5	1.5		330				1.7	15	13	330	1.5	BH520 @ 8mbGL	450000	0
Aliphatics >C21-C35	mg/kg			1.6	120	150	0.56	720	410	320	<0.1	<0.1	85	26	16	13		1800				37	15	13	1800	0.56	BH520 @ 8mbGL	450000	0
Total Aliphatics C5-C35	mg/kg			4.2	130	170	3.7	930	520	390	<0.1	0.1	110	35								39	12	11	930	0.1	SWSJ31 @ 5mbGL	2000	0
Aliphatics >C35-C44	mg/kg														<1	<1		170					3	1	170	170	BH520 @ 8mbGL	450000	0
Aromatics C5-C7	mg/kg														<0.1	<0.1		<0.1					3	0	None > LOD	None > LOD		26000	0
Aromatics C6-C7	mg/kg			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01								<0.01	12	0	None > LOD	None > LOD		7800	0
Aromatics >C7-C8	mg/kg			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1		<0.1				<0.01	15	0	None > LOD	None > LOD		56000	0
Aromatics >EC8-EC10	mg/kg			<0.01	<0.01	<0.01	<0.01	<0.01	0.28	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1		<0.1				<0.01	15	1	0.28	0.28	SWSJ32 @ 6mbGL	3500	0
Aromatics >EC10-EC12	mg/kg			<0.01	<0.01	<0.01	<0.01	<0.01	0.12	<0.01	<0.01	<0.01	<0.01	<0.01	<1	<1		<1				<0.01	15	1	0.12	0.12	SWSJ32 @ 6mbGL	9200	0
Aromatics >EC12-EC16	mg/kg			<0.1	<0.1	<0.1	<0.1	2.8	1.1	<0.1	<0.1	<0.1	0.42	<0.1	<1	<1		17				1	15	5	17	0.42	BH520 @ 8mbGL	10000	0
Aromatics >EC16-EC21	mg/kg			<0.1	0.17	<0.1	<0.1	21	7.9	1.7	<0.1	<0.1	5.1	0.88	1.2	1.2		32				0.96	15	10	32	0.17	BH520 @ 8mbGL	7600	0
Aromatics >EC21-EC35	mg/kg			3.4	47	40	<0.1	110	56	66	<0.1	<0.1	47	4.6	5.6	5.5		92				9.7	15	12	110	3.4	SWSJ31 @ 5mbGL	7800	0
Total Aromatics C6-C35	mg/kg			3.4	47	40	<0.1	140	66	68	<0.1	<0.1	53	5.5								12	12	9	140	3.4	SWSJ31 @ 5mbGL	3500	0
Aromatics >C35-C44	mg/kg														<1	<1		<1					3	0	None > LOD	None > LOD		7800	0
TPH (Aliphatics and Aromatics C5-C35)	mg/kg			7.5	180	210	3.7	1100	590	460	<0.1	0.1	160	41								51	12	11	1100	0.1	SWSJ31 @ 5mbGL	2000	0
Total Aliphatic TPH	mg/kg														17	15		2300					3	3	2300	15	BH520 @ 8mbGL	2000	1
Total Aromatic hydrocarbons	mg/kg														6.8	6.6		140					3	3	140	6.6	BH520 @ 8mbGL	3500	0
Total Petroleum Hydrocarbons	mg/kg														24	21		2400					3	3	2400	21	BH520 @ 8mbGL	2000	1
PAH																													
Acenaphthene	mg/kg			0.043	<0.014	<0.014	<0.014	0.018	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.1	<0.1	<0.1	<0.1	<0.014			0.16	17	3	0.16	0.018	SBHJ06CP @ 1mbGL	29000	0
Acenaphthylene	mg/kg			0.006	0.012	0.007	<0.005	0.023	0.011	0.007	<0.005	<0.005	<0.005	<0.005	<0.1	<0.1	<0.1	<0.1	<0.005			0.054	17	7	0.054	0.006	SBHJ06CP @ 1mbGL	29000	0
Anthracene	mg/kg			0.019	0.028	<0.009	<0.009	0.056	0.04	0.02	0.01	<0.009	<0.009	<0.009	<0.1	<0.1	<0.1	<0.1	<0.009			0.12	17	7	0.12	0.01	SBHJ06CP @ 1mbGL	150000	0
Benzo(a)anthracene	mg/kg			0.052	0.13	0.023	0.036	0.31	0.088	0.077	0.045	0.023	0.025	0.015	<0.1	<0.1	<0.1	<0.1	<0.1			0.24	17	12	0.31	0.015	SWSJ31 @ 5mbGL	49	0
Benzo(a)pyrene	mg/kg			0.063	0.11	<0.012	<0.012	0.13	0.04	0.03	0.04	<0.012	<0.012	<0.012	<0.1	<0.1	<0.1	<0.1	<0.013			0.25	17	7	0.25	0.03	SBHJ06CP @ 1mbGL	11	0
Benzo(b)fluoranthene	mg/kg			0.083	0.14	<0.016	0.024	0.19	0.098	0.095	0.052	<0.016	0.016	<0.016	<0.1	<0.1	<0.1	<0.1	<0.1			0.3	17	9	0.3	0.016	SBHJ06CP @ 1mbGL	13	0
Benzo(ghi)perylene	mg/kg			0.098	0.098	<0.01	0.015	0.096	0.045	0.038	0.043	0.018	0.014	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1			0.23	17	10	0.23	0.014	SBHJ06CP @ 1mbGL	1400	0
Benzo(k)fluoranthene	mg/kg			0.03	0.081	<0.025	<0.025	0.12	0.056	0.044	0.03	<0.025	<0.025	<0.025	<0.1	<0.1	<0.1	<0.1	<0.026			0.12	17	7	0.12	0.03	SWSJ31 @ 5mbGL	370	0
Chrysene	mg/kg			0.056	0.12	0.026	0.021	0.35	0.2	0.11	0.041	0.012	0.034	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1			0.28	17	11	0.35	0.012	SWSJ31 @ 5mbGL	93	0
Dibenzo(ah)anthracene	mg/kg			0.009	0.014	<0.008	<0.008	0.035	0.014	0.013	<0.008	<0.008	<0.008	<0.008	<0.1	<0.1	<0.1	<0.1	<0.009			0.033	17	6	0.035	0.009	SWSJ31 @ 5mbGL	1.1	0
Fluoranthene	mg/kg			0.076	0.19	0.053	0.047	0.59	0.42	0.2	0.058	0.026	0.025	<0.025	0.15	0.17	<0.1	<0.1	0.61			0.49	17	14	0.61	0.025	BH520 @ 10.5mbGL	6300	0
Fluorene	mg/kg			0.031	<0.012	<0.012	<0.012	0.027	0.028	0.023	<0.012	<0.012	<0.012	<0.012	<0.1	<0.1	<0.1	<0.1	<0.012			0.14	17	5	0.14	0.023	SBHJ06CP @ 1mbGL	20000	0
Indeno(123cd)pyrene	mg/kg			0.051	0.075	<0.011	<0.011	0.058	0.028	0.025	0.036	<0.011	<0.011	<0.011	<0.1	<0.1	<0.1	<0.1	<0.011			0.21	17	7	0.21	0.025	SBHJ06CP @ 1mbGL	150	0
Naphthalene	mg/kg			0.12	0.057	0.012	<0.01	0.017	0.029	0.032	<0.01	0.027	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1			0.085	17	8	0.12	0.012	SBHJ06CP @ 0.3mbGL	190	0
Phenanthrene	mg/kg			0.096	0.12	0.031	0.033	0.21	0.24	0.1	0.041	0.027	0.041	<0.021	<0.1	<0.1	<0.1	<0.1	<0.1			0.58	17	11	0.58	0.027	SBHJ06CP @ 1mbGL	6200	0
Pyrene	mg/kg			0.072	0.16	0.042	0.05	0.66	0.37	0.22	0.061	0.031	0.032	<0.022	0.21	0.19	<0.1	<0.1	0.5			0.49	17	14	0.66	0.031	SWSJ31 @ 5mbGL	15000	0
PAH 16 Total	mg/kg			0.9	1.3	0.19	0.23	2.9	1.7	1	0.46	0.16	0.19	<0.025	<2	<2	<2	<2	<2			3.8	17	11	3.8	0.16	SBHJ06CP @ 1mbGL		
SVOCs																													
Phenols																													
2-Chlorophenol	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	12	0	None > LOD	None > LOD			
2-Methylphenol	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	12	0	None > LOD	None > LOD			
2-Nitrophenol	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	12	0	None > LOD	None > LOD			
2,4-Dichlorophenol	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	12	0	None > LOD	None > LOD			
2,4-Dimethylphenol	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	12	0	None > LOD	None > LOD			
2,4,5-Trichlorophenol	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	12	0	None > LOD	None > LOD			
2,4,6-Trichlorophenol	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	12	0	None > LOD	None > LOD			
4-Chloro-3-methylphenol	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	12	0	None > LOD	None > LOD			

M4CAN
Soil Analysis Results & Screening Assessment
CL-26 Lagoon 27SW
05/10/2015

Geological Formation Legend

TFD	Tidal Flat Deposits
MG-SS	Made Ground (slurry slag)
MG-CS	Made Ground (coarse slag)
MG-G	Made Ground (general)

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference	Units	LGBH010	LGBH010	SBHJ06CP	SBHJ07CP	SBHJ07CP	SWSJ31	SWSJ31	SWSJ32	SWSJ32	SWSJ33	SWSJ33	SWSJ34	SWSJ34	BH520	BH520	BH520	BH520	BH520	LGBH010	LGBH010	SBHJ06CP
Specimen Depth (m)		1	10	0.3	0.3	2	2	5	6	8	1	3	2	4	0.5	2	4.5	8	10.5	11.5	15	1
OD Level (m)				5.88	5.49	3.79	8.34	5.34	4.27	2.27	8.17	6.17	8.52	6.52	12.35	10.85	8.35	4.85	2.35			5.18
Sample Type				ES	ES	D	ES	D	ES	ES	D	L	L	L	ES	ES	ES	ES	ES			ES
Geology Code		MG - CS	MG - CS	MG - G	MG - G	MG - G	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - SS	MG - CS	MG - CS	MG - CS	MG - CS	MG - CS	TFD	TFD	TFD
Cluster Code		2002 GI	2002 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI	2002 GI	2002 GI	2007 GI
4-Methylphenol	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
4-Nitrophenol	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
Pentachlorophenol	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
Phenol	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
PAHs																						
2-Chloronaphthalene	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
2-Methylnaphthalene	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
Bis(2-ethylhexyl) phthalate	mg/kg			<0.1			0.27	0.58	0.39	2.2	<0.1	<0.1	<0.1	<0.1								0.64
Butylbenzyl phthalate	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
Di-n-butyl phthalate	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
Di-n-Octyl phthalate	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
Diethyl phthalate	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
Dimethyl phthalate	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
Other Semi-Volatiles																						
1,2-Dichlorobenzene	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
1,2,4-Trichlorobenzene	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
1,3-Dichlorobenzene	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
1,4-Dichlorobenzene	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
2-Nitroaniline	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
2,4-Dinitrotoluene	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
2,6-Dinitrotoluene	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
3-Nitroaniline	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
4-Bromophenylphenylether	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
4-Chloroaniline	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
4-Chlorophenylphenylether	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
4-Nitroaniline	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
Azobenzene	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
Bis(2-chloroethoxy)methane	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
Bis(2-chloroethyl)ether	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
Carbazole	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
Dibenzofuran	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
Hexachlorobenzene	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
Hexachlorobutadiene	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
Hexachlorocyclopentadiene	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
Hexachloroethane	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
Isophorone	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
N-nitrosodi-n-propylamine	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
Nitrobenzene	mg/kg			<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1								<0.1
VOCs																						
Methyl Tertiary Butyl Ether	ug/kg			<11			<11	<11	<11	<11	<11	<11	<11	<11								<11
Benzene	ug/kg			<9			<9	<9	<9	<9	<9	<9	<9	<9								<9
Toluene	ug/kg			<5			<5	<5	<5	<5	<5	<5	<5	<5								<5
Ethylbenzene	ug/kg			<4			<4	<4	<4	<4	<4	<4	<4	<4								<4
p/m-Xylene	ug/kg			<14			<14	<14	<14	26	<14	<14	<14	<14								<14
o-Xylene	ug/kg			<10			<10	<10	18	20	<10	<10	<10	<10								<10
Naphthalene	ug/kg			<13			<13	<13	<13	<13	<13	<13	<13	<13								<13
Hexachlorobutadiene	ug/kg			<12			<12	<12	<12	<12	<12	<12	<12	<12								<12
1.2.4-Trichlorobenzene	ug/kg			<6			<6	<6	<6	<6	<6	<6	<6	<6								<6
1.2-Dichlorobenzene	ug/kg			<12			<12	<12	<12	<12	<12	<12	<12	<12								<12
1.3-Dichlorobenzene	ug/kg			<6			<6	<6	<6	<6	<6	<6	<6	<6								<6
1.4-Dichlorobenzene	ug/kg			<5			<5	<5	<5	<5	<5	<5	<5	<5								<5
1.1.1.2-Tetrachloroethane	ug/kg			<10			<10	<10	<10	<10	<10	<10	<10	<10								<10
1.1.1-Trichloroethane	ug/kg			<7			<7	<7	<7	<7	<7	<7	<7	<7								<7
1.1.2.2-Tetrachloroethane	ug/kg			<10			<10	<10	<10	<10	<10	<10	<10	<10								<10
1.1.2-Trichloroethane	ug/kg			<10			<10	<10	<10	<10	<10	<10	<10	<10								<10
1.1-Dichloropropene	ug/kg			<11			<11	<11	<11	<11	<11	<11	<11	<11								<11
1.1-Dichloroethane	ug/kg			<8			<8	<8	<8	<8	<8	<8	<8	<8								<8
1.1-Dichloroethene	ug/kg			<10			<10	<10	<10	<10	<10	<10	<10	<10								<10
1.2.3-Trichlorobenzene	ug/kg			<11			<11	<11	<11	<11	<11	<11	<11	<11								<11
1.2.3-Trichloropropane	ug/kg			<17			<17	<17	<17	<17	<17	<17	<17	<17								<17
1.2.4-Trimethylbenzene	ug/kg			<9			<9	<9	52	41	<9	<9	<9	<9								<9
1.2-Dibromo-3-chloropropane	ug/kg			<14			<14	<14	<14	<14	<14	<14	<14	<14								<14
1.2-Dichloroethane	ug/kg			<5			<5	<5	<5	<5	<5	<5	<5	<5								<5
cis-1-2-Dichloroethene	ug/kg			<5			<5	<5	<5	<5	<5	<5	<5	<5								<5
1.2-Dibromoethane	ug/kg			<12			<12	<12	<12	<12	<12	<12	<12	<12								<12
1.2-Dichloropropane	ug/kg			<12			<12	<12	<12	<12	<12	<12	<12	<12								<12
1.3.5-Trimethylbenzene	ug/kg			<8			<8	<8	23	21	<8	<8	<8	<8								<8
cis-1-3-Dichloropropene	ug/kg			<14			<14	<14	<14	<14	<14	<14	<14	<14								<14
1.3-Dichloropropane	ug/kg			<7			<7	<7	<7	<7	<7	<7	<7	<7								<7
2.2-Dichloropropane	ug/kg			<12			<12	<12	<12	<12	<12	<12	<12	<12								<12
2-Chlorotoluene	ug/kg			<9			<9	<9	<9	<9	<9	<9	<9	<9								<9
4-Chlorotoluene	ug/kg			<12			<12	<12	<12	<12	<12	<12	<12	<12								<12
4-Isopropyltoluene	ug/kg			<11			<11	<11	<11	<11	<11	<11	<11	<11								<11
Bromobenzene	ug/kg			<10			<10	<10	<10	<10	<10	<10	<10	<10								<10
Bromochloromethane	ug/kg			<14			<14	<14	<14	<14	<14	<14	<14	<14								<14
Bromoform	ug/kg			<10			<10	<10	<10	<10	<10	<10	<10	<10								<10
Bromomethane	ug/kg			<13			<13	<13	<13	<13	<13	<13	<13	<13								<13
Bromodichloromethane	ug/kg			<7			<7	<7	<7	<7	<7	<7	<7	<7								<7
Chlorobenzene	ug/kg			<5			<5	<5	<5	<5	<5	<5	<5	<5								<5
Carbon Disulphide	ug/kg			<7			<7	<7	<7	<7	<7	<7	<7	<7								<7
Chloroethane	ug/kg			<14			<14	<14	<14	<14	<14	<14	<14	<14								<14
Chloroform	ug/kg			<8			<8	<8	<8	<8	<8	<8	<8	<8								<8
Chloromethane	ug/kg			<7			<7	<7	<7	<7	<7	<7	<7	<7								<7
Carbontetrachloride	ug/kg			<14			<14	<14	<14	<14	<14	<14	<14	<14								<14
Carbontetrachloride	ug/kg			<14			<14	<14	<14	<14	<14	<14	<14	<14								<14
Dibromomethane	ug/kg			<9			<9	<9	<9	<9	<9	<9	<9	<9								<9
Dichlorodifluoromethane	ug/kg			<4			<4	<4	<4	<4	<4	<4	<4	<4								<4
Dibromochloromethane	ug/kg			<13			<13	<13	<13	<13	<13	<13	<13	<13								<13
Dichloromethane	ug/kg			<10			<10	<10	<10	<10	<10	<10	<10	<10								<10
Isopropylbenzene	ug/kg			<5			<5	<5	11	9	<5	<5	<5	<5								<5
n-Butylbenzene	ug/kg			<10			<10	<10	<10	<10	<10	<10	<10	<10								<10
Propylbenzene	ug/kg			<11			<11	<11	<11	<11	<11	<11	<11	<11								<11
sec-Butylbenzene	ug/kg			<10			<10	<10	<10	<10	<10	<10	<10	<10								<10
Styrene	ug/kg			<10			<10	<10	<10	<10	<10	<10	<10	<10								<10
trans-1-2-Dichloroethene	ug/kg			<11			<11	<11	<11	<11	<11	<11	<11	<11								<11
trans-1-3-Dichloropropene	ug/kg			<14			<14	<14	<14	<14	<14	<14	<14	<14								<14
Trichlorofluoromethane	ug/kg			<6			<6	<6	<6	<6	<6	<6	<6	<6								<6
tert-Butylbenzene	ug/kg			<12			<12	<12	23	20	<12	<12	<12	<12								<12
Tetrachloroethene	ug/kg			<5			<5	<5	<5	<5	<5	<5	<5	<5								<5
Trichloroethene	ug/kg			<9			<9	<9	<9	<9	<9	<9	<9	<9								<9
Vinyl Chloride	ug/kg			<10			<10	<10	<10	<10	<10	<10	<10	<10								<10

Sample Reference	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	Selected S4ULs Criteria	No. Data Exceeding S4ULs Criteria
4-Methylphenol	12	0	None > LOD	None > LOD			
4-Nitrophenol	12	0	None > LOD	None > LOD			
Pentachlorophenol	12	0	None > LOD	None > LOD			
Phenol	12	0	None > LOD	None > LOD		440	0
PAHs							
2-Chloronaphthalene	10	0	None > LOD	None > LOD			
2-Methylnaphthalene	10	0	None > LOD	None > LOD			
Bis(2-ethylhexyl) phthalate	10	5	2.2	0.27	SWSJ32 @ 8mbGL		
Butylbenzyl phthalate	10	0	None > LOD	None > LOD			
Di-n-butyl phthalate	10	0	None > LOD	None > LOD			
Di-n-Octyl phthalate	10	0	None > LOD	None > LOD			
Diethyl phthalate	10	0	None > LOD	None > LOD			
Dimethyl phthalate	10	0	None > LOD	None > LOD			
Other Semi-Volatiles							
1,2-Dichlorobenzene	10	0	None > LOD	None > LOD			
1,2,4-Trichlorobenzene	10	0	None > LOD	None > LOD		220	0
1,3-Dichlorobenzene	10	0	None > LOD	None > LOD			
1,4-Dichlorobenzene	10	0	None > LOD	None > LOD			
2-Nitroaniline	10	0	None > LOD	None > LOD			
2,4-Dinitrotoluene	10	0	None > LOD	None > LOD			
2,6-Dinitrotoluene	10	0	None > LOD	None > LOD			
3-Nitroaniline	10	0	None > LOD	None > LOD			
4-Bromophenylphenylether	10	0	None > LOD	None > LOD			
4-Chloroaniline	10	0	None > LOD	None > LOD			
4-Chlorophenylphenylether	10	0	None > LOD	None > LOD			
4-Nitroaniline	10	0	None > LOD	None > LOD			
Azobenzene	10	0	None > LOD	None > LOD			
Bis(2-chloroethoxy)methane	10	0	None > LOD	None > LOD			
Bis(2-chloroethyl)ether	10	0	None > LOD	None > LOD			
Carbazole	10	0	None > LOD	None > LOD			
Dibenzofuran	10	0	None > LOD	None > LOD			
Hexachlorobenzene	10	0	None > LOD	None > LOD		30	0
Hexachlorobutadiene	10	0	None > LOD	None > LOD		31	0
Hexachlorocyclopentadiene	10	0	None > LOD	None > LOD			
Hexachloroethane	10	0	None > LOD	None > LOD			
Isophorone	10	0	None > LOD	None > LOD			
N-nitrosodi-n-propylamine	10	0	None > LOD	None > LOD			
Nitrobenzene	10	0	None > LOD	None > LOD			
VOCs							
Methyl Tertiary Butyl Ether	10	0	None > LOD	None > LOD			
Benzene	10	0	None > LOD	None > LOD		27000	0
Toluene	10	0	None > LOD	None > LOD		56000000	0
Ethylbenzene	10	0	None > LOD	None > LOD		5700000	0
p/m-Xylene	10	1	26	26	SWSJ32 @ 8mbGL		
o-Xylene	10	2	20	18	SWSJ32 @ 8mbGL	6600000	0
Naphthalene	10	0	None > LOD	None > LOD		190000	0
Hexachlorobutadiene	10	0	None > LOD	None > LOD		31000	0
1.2.4-Trichlorobenzene	10	0	None > LOD	None > LOD		220000	0
1.2-Dichlorobenzene	10	0	None > LOD	None > LOD			
1.3-Dichlorobenzene	10	0	None > LOD	None > LOD			
1.4-Dichlorobenzene	10	0	None > LOD	None > LOD			
1.1.1.2-Tetrachloroethane	10	0	None > LOD	None > LOD			
1.1.1-Trichloroethane	10	0	None > LOD	None > LOD			
1.1.2.2-Tetrachloroethane	10	0	None > LOD	None > LOD			
1.1.2-Trichloroethane	10	0	None > LOD	None > LOD			
1.1-Dichloropropene	10	0	None > LOD	None > LOD			
1.1-Dichloroethane	10	0	None > LOD	None > LOD			
1.1-Dichloroethene	10	0	None > LOD	None > LOD			
1.2.3-Trichlorobenzene	10	0	None > LOD	None > LOD		102000	0
1.2.3-Trichloropropane	10	0	None > LOD	None > LOD			
1.2.4-Trimethylbenzene	10	2	52	41	SWSJ32 @ 6mbGL		
1.2-Dibromo-3-chloropropane	10	0	None > LOD	None > LOD			
1.2-Dichloroethane	10	0	None > LOD	None > LOD			
cis-1-2-Dichloroethene	10	0	None > LOD	None > LOD			
1.2-Dibromoethane	10	0	None > LOD	None > LOD			
1.2-Dichloropropane	10	0	None > LOD	None > LOD			
1.3.5-Trimethylbenzene	10	2	23	21	SWSJ32 @ 6mbGL		
cis-1-3-Dichloropropene	10	0	None > LOD	None > LOD			
1.3-Dichloropropane	10	0	None > LOD	None > LOD			
2.2-Dichloropropane	10	0	None > LOD	None > LOD			
2-Chlorotoluene	10	0	None > LOD	None > LOD			
4-Chlorotoluene	10	0	None > LOD	None > LOD			
4-Isopropyltoluene	10	0	None > LOD	None > LOD			
Bromobenzene	10	0	None > LOD	None > LOD			
Bromochloromethane	10	0	None > LOD	None > LOD			
Bromoform	10	0	None > LOD	None > LOD			
Bromomethane	10	0	None > LOD	None > LOD			
Bromodichloromethane	10	0	None > LOD	None > LOD			
Chlorobenzene	10	0	None > LOD	None > LOD		56000	0
Carbon Disulphide	10	0	None > LOD	None > LOD		11000	0
Chloroethane	10	0	None > LOD	None > LOD			
Chloroform	10	0	None > LOD	None > LOD		99000	0
Chloromethane	10	0	None > LOD	None > LOD			
Carbontetrachloride	10	0	None > LOD	None > LOD			
Carbontetrachloride	10	0	None > LOD	None > LOD			
Dibromomethane	10	0	None > LOD	None > LOD			
Dichlorodifluoromethane	10	0	None > LOD	None > LOD			
Dibromochloromethane	10	0	None > LOD	None > LOD			
Dichloromethane	10	0	None > LOD	None > LOD			
Isopropylbenzene	10	2	11	9	SWSJ32 @ 6mbGL		
n-Butylbenzene	10	0	None > LOD	None > LOD			
Propylbenzene	10	0	None > LOD	None > LOD			
sec-Butylbenzene	10	0	None > LOD	None > LOD			
Styrene	10	0	None > LOD	None > LOD			
trans-1-2-Dichloroethene	10	0	None > LOD	None > LOD			
trans-1-3-Dichloropropene	10	0	None > LOD	None > LOD			
Trichlorofluoromethane	10	0	None > LOD	None > LOD			
tert-Butylbenzene	10	2	23	20	SWSJ32 @ 6mbGL		
Tetrachloroethene	10	0	None > LOD	None > LOD		19000	0
Trichloroethene	10	0	None > LOD	None > LOD		1200	0
Vinyl Chloride	10	0	None > LOD	None > LOD		59	0

M4CAN
Soil Analysis Results & Screening Assessment
CL-26 Lagoon 27SE
05/10/2015

Geological Formation Legend

MG	Made Ground
PEAT	Peat
TFD	Tidal Flat Deposits

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference	Units	SWSJ37	SWSJ35A	SWSJ38	SWSJ37	SWSJ38	SWSJ36	SWSJ36	SWSJ35A	BH521	BH521	TP508	TP508	TP508
Specimen Depth (m)		1	1	0.3	0.3	5	4	1	2	0 - 0.5	1 - 1.5	0.5 - 0.6	1 - 1.1	2 - 2.1
OD Level (m)		5.25	4.72	5.25	5.95	0.55	1.34	4.34	3.72	6	5	5.4	4.9	3.9
Sample Type		D	L	ES	ES	D	D	ES	D	ES	ES	ES	ES	ES
Geology Code		MG	MG	MG	MG	PEAT	TFD	TFD	TFD	MG	MG	MG	MG	TFD
Cluster Code		2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI
Metals														
Antimony	mg/kg	15	25	30	29	<1.5	<1.5	3.3	3.4					
Arsenic	mg/kg	<3	<3	<3	<3	<3	<3	5	7	34	280	8.1	12	14
Barium	mg/kg	150	110	170	170	29	48	95	69					
Boron Water Soluble	mg/kg	<3.5	63	<3.5	<3.5	81	91	<3.5	<3.5	1.7	5.7	2.4	1.8	1.6
Cadmium	mg/kg	3.1	26	12	16	<0.3	<0.3	<0.3	0.3	0.23	0.25	<0.1	0.14	0.15
Chromium	mg/kg	100	110	170	150	8.9	13	47	47	940	3300	28	150	21
Copper	mg/kg	<6	<6	14	87	46	<6	<6	<6	5.5	19	5.8	18	39
Lead	mg/kg	410	390	890	740	19	17	43	31	5.5	8	22	61	170
Mercury	mg/kg	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	0.92	0.55	<0.1	0.16	0.39
Molybdenum	mg/kg	1.1	<0.6	1.7	1.7	<0.6	0.7	<0.6	<0.6					
Nickel	mg/kg	31	19	42	37	6	8.3	35	33	39	93	26	56	23
Selenium	mg/kg	<3	<3	<3	<3	<3	<3	<3	<3	<0.2	<0.2	<0.2	<0.2	<0.2
Zinc	mg/kg	20000	23000	43000	48000	670	380	470	570	100	110	62	120	180
Beryllium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	1.4	1.2					
Iron	mg/kg	240000	300000	380000	320000	19000	22000	40000	44000					
Vanadium	mg/kg	41	26	37	37	7.5	17	58	58					
Non-Metal Inorganics														
Cyanide (total)	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5
Sulphate (soluble)	g/l	0.047	0.048	0.06	0.012	NDP	0.36	0.078	0.016					
Elemental/Free Sulphur	mg/kg	<70	<70	<70	<70	240	<70	<70	<70					
Easily Liberated Sulphide	mg/kg	150	64	280	130	<15	<15	<15	<15					
Acid Soluble Sulphide	mg/kg													
Ammoniacal Nitrogen as N	mg/kg	39	<15	27	<15	120	88	31	29					
Chloride	mg/kg	38	1500	28	20	NDP	730	110	110					
Other														
Asbestos Presence Screen	None	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NFD	NAD		NAD	NAD	
Loss on Ignition	%		<0.3	<0.3	<0.3	<0.3	75	5.1						
Total Organic Carbon	%		0.4	0.7	0.5	42	34	1.8		0.47		0.74		
Organic Matter	%		2.7			16.9								
pH Value	pH Units	8.07	10.9	8.69	8.5	7.37	7.57	7.75	8.24	12.2	11.4	11.7	8	8.3
Material >2mm	%		71.7			39.8								
Organics														
PCBs (vs Aroclor 1254)	mg/kg	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035					
Phenols (total)	mg/kg	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15			<0.3	<0.3	
BTEX														
GRO (C4-C12)	mg/kg	0.11	<0.01	0.24	<0.01	5	<0.01	<0.01	<0.01					
MTBE	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01					
Benzene	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.001				
Toluene	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.001				
Ethyl benzene	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.001				
m & p Xylene	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.001				
o Xylene	mg/kg	<0.01	<0.01	<0.01	<0.01	0.27	<0.01	<0.01	<0.01	<0.001				
TPH														
Aliphatics C5-C6	mg/kg	<0.01	<0.01	0.24	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1				
Aliphatics >C6-C8	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1				
Aliphatics >C8-C10	mg/kg	0.038	<0.01	<0.01	<0.01	0.97	<0.01	<0.01	<0.01	<0.1				
Aliphatics >C10-C12	mg/kg	<0.01	<0.01	<0.01	<0.01	0.91	<0.01	<0.01	<0.01	<1				
Aliphatics >C12-C16	mg/kg	<0.1	39	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1				
Aliphatics >C16-C21	mg/kg	<0.1	49	<0.1	<0.1	12	<0.1	<0.1	<0.1	<1				
Aliphatics >C21-C35	mg/kg	<0.1	430	<0.1	9.6	140	140	<0.1	<0.1	<1				
Total Aliphatics C5-C35	mg/kg	<0.1	520	0.24	9.6	160	140	<0.1	<0.1	<1				
Aromatics C6-C7	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1				
Aromatics >C7-C8	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1				
Aromatics >EC8-EC10	mg/kg	0.056	<0.01	<0.01	<0.01	1.7	<0.01	<0.01	<0.01	<0.1				
Aromatics >EC10-EC12	mg/kg	0.012	<0.01	<0.01	<0.01	1.4	<0.01	<0.01	<0.01	<1				
Aromatics >EC12-EC16	mg/kg	<0.1	0.51	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1				
Aromatics >EC16-EC21	mg/kg	<0.1	0.82	<0.1	0.72	<0.1	<0.1	<0.1	<0.1	<1				
Aromatics >EC21-EC35	mg/kg	26	66	<0.1	11	540	1000	22	24	<1				
Total Aromatics C6-C35	mg/kg	26	68	<0.1	12	540	1000	22	24	<1				
TPH (Aliphatics and Aromatics C5-C35)	mg/kg	26	580	0.24	21	700	1200	22	24	<10				
PAH														
Acenaphthene	mg/kg	0.45	0.032	<0.014	<0.014	0.66	0.021	<0.014	<0.014	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.012	0.02	<0.005	0.01	0.024	0.018	<0.005	<0.005	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	0.033	0.066	<0.009	0.019	0.043	0.013	<0.009	<0.009	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	0.08	0.21	0.024	0.1	0.039	0.033	0.04	0.031	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	mg/kg	0.063	0.23	<0.012	0.099	0.024	0.022	0.022	<0.012	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	mg/kg	0.096	0.47	<0.016	0.14	0.027	0.028	0.031	<0.016	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	mg/kg	0.04	0.17	<0.01	0.086	<0.01	<0.01	0.02	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	mg/kg	0.035	0.14	<0.025	0.094	<0.025	<0.025	<0.025	<0.025	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	0.086	0.31	0.015	0.12	0.036	0.022	0.033	0.013	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(ah)anthracene	mg/kg	<0.008	0.041	<0.008	0.02	<0.008	<0.008	<0.008	<0.008	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.17	0.42	<0.025	0.15	0.084	0.028	0.045	<0.025	<0.1	<0.1	0.46	<0.1	<0.1
Fluorene	mg/kg	0.23	0.017	<0.012	<0.012	0.34	0.021	<0.012	<0.012	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(123cd)pyrene	mg/kg	0.036	0.18	<0.011	0.063	<0.011	<0.011	0.017	<0.011	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	mg/kg	4.2	0.028	<0.01	<0.01	7	0.097	0.013	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.24	0.18	0.023	0.064	0.27	0.048	0.041	<0.021	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	0.13	0.37	0.028	0.16	0.063	0.023	0.039	<0.022	<0.1	<0.1	0.64	<0.1	<0.1
PAH 16 Total	mg/kg	5.9	2.9	0.09	1.1	8.6	0.37	0.3	0.044	<2	<2	<2	<2	<2
SVOCs														
Phenols														
2-Chlorophenol	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	Selected S4ULs Criteria	No. Data Exceeding S4ULs Criteria
8	6	30	3.3	SWSJ38 @ 0.3mbGL		
13	7	280	5	BH521 @ 1 - 1.5mbGL	170	1
8	8	170	29	SWSJ38 @ 0.3mbGL		
13	8	91	1.6	SWSJ36 @ 4mbGL		
13	9	26	0.14	SWSJ35A @ 1mbGL	190	0
13	13	3300	8.9	BH521 @ 1 - 1.5mbGL	33	9
13	8	87	5.5	SWSJ37 @ 0.3mbGL	44000	0
13	13	890	5.5	SWSJ38 @ 0.3mbGL	1300	0
13	4	0.92	0.16	BH521 @ 0 - 0.5mbGL	30	0
8	4	1.7	0.7	SWSJ38 @ 0.3mbGL		
13	13	93	6	BH521 @ 1 - 1.5mbGL	980	0
13	0	None > LOD	None > LOD		1800	0
13	13	48000	62	SWSJ37 @ 0.3mbGL	170000	0
8	2	1.4	1.2	SWSJ36 @ 1mbGL	12	0
8	8	380000	19000	SWSJ38 @ 0.3mbGL		
8	8	58	7.5	SWSJ36 @ 1mbGL	5000	0
13	0	None > LOD	None > LOD			
8	7	0.36	0.012	SWSJ36 @ 4mbGL		
8	1	240	240	SWSJ38 @ 5mbGL		
8	4	280	64	SWSJ38 @ 0.3mbGL		
0	0	None > LOD	None > LOD			
8	6	120	27	SWSJ38 @ 5mbGL		
8	7	1500	20	SWSJ35A @ 1mbGL		
11	0	None > LOD	None > LOD			
6	2	75	5.1	SWSJ36 @ 4mbGL		
8	8	42	0.4	SWSJ38 @ 5mbGL		
2	2	16.9	2.7	SWSJ38 @ 5mbGL		
13	13	12.2	7.37	BH521 @ 0 - 0.5mbGL	6-9	4
2	2	71.7	39.8	SWSJ35A @ 1mbGL		
8	0	None > LOD	None > LOD		0.24	0
10	0	None > LOD	None > LOD		440	0
8	3	5	0.11	SWSJ38 @ 5mbGL		
8	0	None > LOD	None > LOD			
9	0	None > LOD	None > LOD		27	0
9	0	None > LOD	None > LOD		56000	0
9	0	None > LOD	None > LOD		5700	0
9	0	None > LOD	None > LOD		5900	0
9	1	0.27	0.27	SWSJ38 @ 5mbGL	6600	0
9	1	0.24	0.24	SWSJ38 @ 0.3mbGL	3200	0
9	0	None > LOD	None > LOD		7800	0
9	2	0.97	0.038	SWSJ38 @ 5mbGL	2000	0
9	1	0.91	0.91	SWSJ38 @ 5mbGL	9700	0
9	1	39	39	SWSJ35A @ 1mbGL	25000	0
9	2	49	12	SWSJ35A @ 1mbGL	450000	0
9	4	430	9.6	SWSJ35A @ 1mbGL	450000	0
9	5	520	0.24	SWSJ35A @ 1mbGL	2000	0
9	0	None > LOD	None > LOD		7800	0
9	0	None > LOD	None > LOD		56000	0
9	2	1.7	0.056	SWSJ38 @ 5mbGL	3500	0
9	2	1.4	0.012	SWSJ38 @ 5mbGL	9200	0
9	1	0.51	0.51	SWSJ35A @ 1mbGL	10000	0
9	2	0.82	0.72	SWSJ35A @ 1mbGL	7600	0
9	7	1000	11	SWSJ36 @ 4mbGL	7800	0
9	7	1000	12	SWSJ36 @ 4mbGL	3500	0
9	8	1200	0.24	SWSJ36 @ 4mbGL	2000	0
13	4	0.66	0.021	SWSJ38 @ 5mbGL	29000	0
13	5	0.024	0.01	SWSJ38 @ 5mbGL	29000	0
13	5	0.066	0.013	SWSJ35A @ 1mbGL	150000	0
13	8	0.21	0.024	SWSJ35A @ 1mbGL	49	0
13	6	0.23	0.022	SWSJ35A @ 1mbGL	11	0
13	6	0.47	0.027	SWSJ35A @ 1mbGL	13	0
13	4	0.17	0.02	SWSJ35A @ 1mbGL	1400	0
13	3	0.14	0.035	SWSJ35A @ 1mbGL	370	0
13	8	0.31	0.013	SWSJ35A @ 1mbGL	93	0
13	2	0.041	0.02	SWSJ35A @ 1mbGL	1.1	0
13	7	0.46	0.028	TP508 @ 0.5 - 0.6mbGL	6300	0
13	4	0.34	0.017	SWSJ38 @ 5mbGL	20000	0
13	4	0.18	0.017	SWSJ35A @ 1mbGL	150	0
13	5	7	0.013	SWSJ38 @ 5mbGL	190	0
13	7	0.27	0.023	SWSJ38 @ 5mbGL	6200	0
13	8	0.64	0.023	TP508 @ 0.5 - 0.6mbGL	15000	0
13	8	8.6	0.044	SWSJ38 @ 5mbGL		
8	0	None > LOD	None > LOD			

M4CAN
Soil Analysis Results & Screening Assessment
CL-26 Lagoon 27SE
05/10/2015

Geological Formation Legend

MG	Made Ground
PEAT	Peat
TFD	Tidal Flat Deposits

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference	Units	SWSJ37	SWSJ35A	SWSJ38	SWSJ37	SWSJ38	SWSJ36	SWSJ36	SWSJ35A	BH521	BH521	TP508	TP508	TP508
Specimen Depth (m)		1	1	0.3	0.3	5	4	1	2	0 - 0.5	1 - 1.5	0.5 - 0.6	1 - 1.1	2 - 2.1
OD Level (m)		5.25	4.72	5.25	5.95	0.55	1.34	4.34	3.72	6	5	5.4	4.9	3.9
Sample Type		D	L	ES	ES	D	D	ES	D	ES	ES	ES	ES	ES
Geology Code		MG	MG	MG	MG	PEAT	TFD	TFD	TFD	MG	MG	MG	MG	TFD
Cluster Code		2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI
2-Methylphenol	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
2-Nitrophenol	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
2,4-Dichlorophenol	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
2,4-Dimethylphenol	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
2,4,5-Trichlorophenol	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
2,4,6-Trichlorophenol	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
4-Chloro-3-methylphenol	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
4-Methylphenol	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
4-Nitrophenol	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Pentachlorophenol	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Phenol	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
PAHs														
2-Chloronaphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
2-Methylnaphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Bis(2-ethylhexyl) phthalate	mg/kg	<0.1	<0.1	<0.1	0.28	2.1	0.47	<0.1	0.96					
Butylbenzyl phthalate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Di-n-butyl phthalate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Di-n-Octyl phthalate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Diethyl phthalate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Dimethyl phthalate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Other Semi-Volatiles														
1,2-Dichlorobenzene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
1,2,4-Trichlorobenzene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
1,3-Dichlorobenzene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
1,4-Dichlorobenzene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
2-Nitroaniline	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
2,4-Dinitrotoluene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
2,6-Dinitrotoluene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
3-Nitroaniline	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
4-Bromophenylphenylether	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
4-Chloroaniline	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
4-Chlorophenylphenylether	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
4-Nitroaniline	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Azobenzene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Bis(2-chloroethoxy)methane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Bis(2-chloroethyl)ether	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Carbazole	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Dibenzofuran	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Hexachlorobenzene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Hexachlorobutadiene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Hexachlorocyclopentadiene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Hexachloroethane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Isophorone	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
N-nitrosodi-n-propylamine	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
Nitrobenzene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					
VOCs														
Methyl Tertiary Butyl Ether	ug/kg	<11	<11	<11	<11	<11	<11	<11	<11					
Benzene	ug/kg	<9	<9	<9	<9	<9	<9	<9	<9					
Toluene	ug/kg	<5	<5	14	<5	35	<5	<5	<5					
Ethylbenzene	ug/kg	7	<4	<4	<4	120	<4	<4	<4					
p/m-Xylene	ug/kg	31	<14	<14	<14	180	<14	<14	<14					
o-Xylene	ug/kg	38	<10	<10	<10	680	<10	<10	<10					
Naphthalene	ug/kg	<13	<13	<13	<13	<13	<13	<13	<13					
Hexachlorobutadiene	ug/kg	<12	<12	<12	<12	<12	<12	<12	<12					
1.2.4-Trichlorobenzene	ug/kg	<6	<6	<6	<6	<6	<6	<6	<6					
1.2-Dichlorobenzene	ug/kg	<12	<12	<12	<12	<12	<12	<12	<12					
1.3-Dichlorobenzene	ug/kg	<6	<6	<6	<6	<6	<6	<6	<6					
1.4-Dichlorobenzene	ug/kg	<5	<5	<5	<5	<5	<5	<5	<5					
1.1.1.2-Tetrachloroethane	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10					
1.1.1-Trichloroethane	ug/kg	<7	<7	<7	<7	<7	<7	<7	<7					
1.1.2.2-Tetrachloroethane	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10					
1.1.2-Trichloroethane	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10					
1.1-Dichloropropene	ug/kg	<11	<11	<11	<11	<11	<11	<11	<11					
1.1-Dichloroethane	ug/kg	<8	<8	<8	<8	<8	<8	<8	<8					
1.1-Dichloroethene	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10					
1.2.3-Trichlorobenzene	ug/kg	<11	<11	<11	<11	<11	<11	<11	<11					
1.2.3-Trichloropropane	ug/kg	<17	<17	<17	<17	<17	<17	<17	<17					
1.2.4-Trimethylbenzene	ug/kg	74	<9	<9	<9	400	<9	<9	<9					
1.2-Dibromo-3-chloropropane	ug/kg	<14	<14	<14	<14	<14	<14	<14	<14					
1.2-Dichloroethane	ug/kg	<5	<5	<5	<5	<5	<5	<5	<5					
cis-1-2-Dichloroethene	ug/kg	<5	<5	<5	<5	<5	<5	<5	<5					
1.2-Dibromoethane	ug/kg	<12	<12	<12	<12	<12	<12	<12	<12					
1.2-Dichloropropane	ug/kg	<12	<12	<12	<12	<12	<12	<12	<12					
1.3.5-Trimethylbenzene	ug/kg	33	<8	<8	<8	640	<8	<8	<8					
cis-1-3-Dichloropropene	ug/kg	<14	<14	<14	<14	<14	<14	<14	<14					
1.3-Dichloropropane	ug/kg	<7	<7	<7	<7	<7	<7	<7	<7					
2.2-Dichloropropane	ug/kg	<12	<12	<12	<12	<12	<12	<12	<12					
2-Chlorotoluene	ug/kg	<9	<9	<9	<9	<9	<9	<9	<9					
4-Chlorotoluene	ug/kg	<12	<12	<12	<12	<12	<12	<12	<12					
4-Isopropyltoluene	ug/kg	<11	<11	<11	<11	<11	<11	<11	<11					
Bromobenzene	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10					
Bromochloromethane	ug/kg	<14	<14	<14	<14	<14	<14	<14	<14					
Bromoform	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10					

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	Selected S4ULs Criteria	No. Data Exceeding S4ULs Criteria
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD		440	0
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	4	2.1	0.28	SWSJ38 @ 5mbGL		
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD		220	0
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD		30	0
8	0	None > LOD	None > LOD		31	0
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD		27000	0
8	2	35	14	SWSJ38 @ 5mbGL	56000000	0
8	2	120	7	SWSJ38 @ 5mbGL	5700000	0
8	2	180	31	SWSJ38 @ 5mbGL		
8	2	680	38	SWSJ38 @ 5mbGL	6600000	0
8	0	None > LOD	None > LOD		190000	0
8	0	None > LOD	None > LOD		31000	0
8	0	None > LOD	None > LOD		220000	0
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD		102000	0
8	0	None > LOD	None > LOD			
8	2	400	74	SWSJ38 @ 5mbGL		
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	2	640	33	SWSJ38 @ 5mbGL		
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			

M4CAN
Soil Analysis Results & Screening Assessment
CL-26 Lagoon 27SE
05/10/2015

Geological Formation Legend

MG	Made Ground
PEAT	Peat
TFD	Tidal Flat Deposits

Screening Values and Assessment

	Exceeds S4ULs criteria
X	Laboratory detection level higher than screening criterion

Notes

NFD = No Fibres Detected
NAD = No Asbestos Detected
Chromium VI criteria used
Elemental Mercury criteria used
Screening criterion for lead is C4SL in the absence of a S4UL

Sample Reference	Units	SWSJ37	SWSJ35A	SWSJ38	SWSJ37	SWSJ38	SWSJ36	SWSJ36	SWSJ35A	BH521	BH521	TP508	TP508	TP508
Specimen Depth (m)		1	1	0.3	0.3	5	4	1	2	0 - 0.5	1 - 1.5	0.5 - 0.6	1 - 1.1	2 - 2.1
OD Level (m)		5.25	4.72	5.25	5.95	0.55	1.34	4.34	3.72	6	5	5.4	4.9	3.9
Sample Type		D	L	ES	ES	D	D	ES	D	ES	ES	ES	ES	ES
Geology Code		MG	MG	MG	MG	PEAT	TFD	TFD	TFD	MG	MG	MG	MG	TFD
Cluster Code		2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI	2015 GI	2015 GI	2015 GI
Bromomethane	ug/kg	<13	<13	<13	<13	<13	<13	<13	<13					
Bromodichloromethane	ug/kg	<7	<7	<7	<7	<7	<7	<7	<7					
Chlorobenzene	ug/kg	<5	<5	<5	<5	<5	<5	<5	<5					
Carbon Disulphide	ug/kg	<7	<7	<7	<7	<7	<7	<7	<7					
Chloroethane	ug/kg	<14	<14	<14	<14	<14	<14	<14	<14					
Chloroform	ug/kg	<8	<8	<8	<8	<8	<8	<8	<8					
Chloromethane	ug/kg	<7	<7	<7	<7	<7	<7	<7	<7					
Carbontetrachloride	ug/kg	<14	<14	<14	<14	<14	<14	<14	<14					
Carbontetrachloride	ug/kg	<14	<14	<14	<14	<14	<14	<14	<14					
Dibromomethane	ug/kg	<9	<9	<9	<9	<9	<9	<9	<9					
Dichlorodifluoromethane	ug/kg	<4	<4	<4	<4	<4	<4	<4	<4					
Dibromochloromethane	ug/kg	<13	<13	<13	<13	<13	<13	<13	<13					
Dichloromethane	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10					
Isopropylbenzene	ug/kg	16	<5	<5	<5	200	<5	<5	<5					
n-Butylbenzene	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10					
Propylbenzene	ug/kg	<11	<11	<11	<11	240	<11	<11	<11					
sec-Butylbenzene	ug/kg	<10	<10	<10	<10	100	<10	<10	<10					
Styrene	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10					
trans-1-2-Dichloroethene	ug/kg	<11	<11	<11	<11	<11	<11	<11	<11					
trans-1-3-Dichloropropene	ug/kg	<14	<14	<14	<14	<14	<14	<14	<14					
Trichlorofluoromethane	ug/kg	<6	<6	<6	<6	<6	<6	<6	<6					
tert-Butylbenzene	ug/kg	28	<12	<12	<12	500	<12	<12	<12					
Tetrachloroethene	ug/kg	<5	<5	<5	<5	<5	<5	<5	<5					
Trichloroethene	ug/kg	<9	<9	<9	<9	<9	<9	<9	<9					
Vinyl Chloride	ug/kg	<10	<10	<10	<10	<10	<10	<10	<10					

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	Selected S4ULs Criteria	No. Data Exceeding S4ULs Criteria
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD		56000	0
8	0	None > LOD	None > LOD		11000	0
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD		99000	0
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	2	200	16	SWSJ38 @ 5mbGL		
8	0	None > LOD	None > LOD			
8	1	240	240	SWSJ38 @ 5mbGL		
8	1	100	100	SWSJ38 @ 5mbGL		
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	0	None > LOD	None > LOD			
8	2	500	28	SWSJ38 @ 5mbGL		
8	0	None > LOD	None > LOD		19000	0
8	0	None > LOD	None > LOD		1200	0
8	0	None > LOD	None > LOD		59	0

A8 Appendix 4

Groundwater Laboratory Data

M4CAN
Groundwater Analysis Results & Screening Assessment
CL-26 All Lagoons
08/07/2015

Geological Formation Legends

MG-SS
MG-CS
MG-G
TDF
MM

Screening Values & Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc

Sample Reference	Units	Screening Criteria		SBHJ07	SBHJ07	BH525	BH525	BH525	No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Installation Details of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
Round				Round 1	Round 2										
Sampled Date				22/02/2008	17/03/2008										
Depth						3.92	3.47	1.98							
Response Zone (RZ) Details		EQS	DWS	TFD/MM	TFD/MM	TFD / GFD	TFD / GFD	TFD / GFD							
Installation Details				8.4 - 10.4	8.4 - 10.4	9.8 - 11.8	9.8 - 11.8	9.8 - 11.8							
Location				Lagoon 27 SW		Lagoon 26									
Metals															
Arsenic Dissolved	ug/l	50	10	7	18	25	21	10	5	5	25	7	BH525 @ 3.92	0	3
Beryllium Dissolved	ug/l			<1	<1				2	0	None > LOD	None > LOD			
Boron	ug/l	2000	1000			290	1100	440	3	3	1100	290	BH525 @ 3.47	0	1
Cadmium Dissolved	ug/l	0.15	5			<0.08	<0.08	<0.08	3	0	None > LOD	None > LOD		0	0
Calcium Dissolved	ug/l			190000	120000				2	2	190000	120000	SBHJ07 @		
Chromium Dissolved	ug/l		50	<1	26	100	130	32	5	4	130	26	BH525 @ 3.47		2
Copper Dissolved	ug/l	10	2000	2.3	2.5	110	25	11	5	5	110	2.3	BH525 @ 3.92	3	0
Iron Dissolved	ug/l	1000	200	840	570				2	2	840	570	SBHJ07 @	0	2
Lead Dissolved	ug/l	1.2	10	8.2	<0.5	<1	<1	<1	5	1	8.2	8.2	SBHJ07 @	1	0
Mercury Dissolved	ug/l	0.07	1			<1	<1	0.56	3	1	0.56	0.56	BH525 @ 1.98	1	0
Magnesium Dissolved	ug/l			130000	160000				2	2	160000	130000	SBHJ07 @		
Manganese Dissolved	ug/l	30	50	2100	630				2	2	2100	630	SBHJ07 @	2	2
Nickel Dissolved	ug/l	4	20	4	5.5	3.6	6.1	5.7	5	5	6.1	3.6	BH525 @ 3.47	3	0
Selenium Dissolved	ug/l		10	8	9	38	75	20	5	5	75	8	BH525 @ 3.47		3
Vanadium Dissolved	ug/l			4	10				2	2	10	4	SBHJ07 @		
Zinc Dissolved	ug/l	75				6	4.9	5.6	3	3	6	4.9	BH525 @ 3.92	0	
Cadmium Total	ug/l	0.15	5	<0.4	18				2	1	18	18	SBHJ07 @	1	1
Zinc Total	ug/l	75		58	6500				2	2	6500	58	SBHJ07 @	1	0
Mercury Total	ug/l	0.07	1	<0.01	0.01				2	1	0.01	0.01	SBHJ07 @	0	0
Non-Metal Inorganics															
Hardness Total	mg/l			890	810				2	2	890	810	SBHJ07 @		
Total Alkalinity as CaCO3	mg/l			1200	810	750	990	1300	5	5	1300	750	BH525 @ 1.98		
BOD	mg/l	5		8	30				2	2	30	8	SBHJ07 @	2	
COD	mg/l			140	3200				2	2	3200	140	SBHJ07 @		
Potassium Dissolved	mg/l			33	63				2	2	63	33	SBHJ07 @		
Sodium Dissolved	mg/l		200	900	1400				2	2	1400	900	SBHJ07 @		2
Nitrate as NO3	mg/l		50	<0.3	<0.3				2	0	None > LOD	None > LOD			0
Sulphate (soluble)	mg/l	400	250	170	110				2	2	170	110	SBHJ07 @	0	0
Chloride	mg/l	250	250	540	1300	2200	3000	3200	5	5	3200	540	BH525 @ 1.98	5	5
Sulphide	mg/l			<0.5	<0.5				2	0	None > LOD	None > LOD			
Phosphate									0	0	None > LOD	None > LOD			
Fluoride		5000	1500						0	0	None > LOD	None > LOD		0	0
Ammoniacal Nitrogen as N	mg/l	0.6		9.3	16	17	23	25	5	5	25	9.3	BH525 @ 1.98	5	
unionised ammonia	mg/l			0.101	0.298				2	2	0.298	0.101	SBHJ07 @		
Total Ammonium as NH4	mg/l		0.5	12					1	1	12	12	SBHJ07 @		1
Hexavalent Chromium	mg/l		50						0	0	None > LOD	None > LOD			0
Phenols Monohydric	mg/l			<0.01	<0.01				2	0	None > LOD	None > LOD			
Thiocyanate	mg/l								0	0	None > LOD	None > LOD			
Total Cyanide	mg/l	0.001	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	0	None > LOD	None > LOD		0	0
Free Cyanide	mg/l					<0.05	<0.05	<0.05	3	0	None > LOD	None > LOD			
Free Cyanide Low	mg/l								0	0	None > LOD	None > LOD			
Complex Cyanide	mg/l								0	0	None > LOD	None > LOD			
Complex Cyanide Low	mg/l								0	0	None > LOD	None > LOD			
Carbon Dioxide Dissolved	ug/l			59					1	1	59	59	SBHJ07 @		
pH Value	pH units	6-9	6.5-10	7.77	8.01	7.7	7.7	8.6	5	5	8.6	7.7	BH525 @ 1.98	0	0
Organics															
GRO (C4-C12)	ug/l			<10	<10				2	0	None > LOD	None > LOD			
MTBE	ug/l			<10	<10				2	0	None > LOD	None > LOD			
Benzene	ug/l	10	1	<10	<10	<1	<1	<1	5	0	None > LOD	None > LOD		0	0
Toluene	ug/l	50		<10	<10	<1	<1	<1	5	0	None > LOD	None > LOD		0	
Ethyl benzene	ug/l	20		<10	<10	<1	<1	<1	5	0	None > LOD	None > LOD		0	
m & p Xylene	ug/l	30		<10	<10	<1	<1	<1	5	0	None > LOD	None > LOD		0	
o Xylene	ug/l	30		<10	<10	<1	<1	<1	5	0	None > LOD	None > LOD		0	
Aliphatics C5-C6	ug/l			<10	<10	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Aliphatics >C6-C8	ug/l			<10	<10	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Aliphatics >C8-C10	ug/l			<10	<10	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Aliphatics >C10-C12	ug/l			<10	<10	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Aliphatics >C12-C16 Aqueous	ug/l			<10	<10	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Aliphatics >C16-C21 Aqueous	ug/l			<10	<10	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Aliphatics >C21-C35 Aqueous	ug/l			56	<10	<0.1	<0.1	<0.1	5	1	56	56	SBHJ07 @		
Total Aliphatics C5-C35 Aqueous	ug/l			56	<10				2	1	56	56	SBHJ07 @		
Aliphatics >C35-44	ug/l					<0.1	<0.1	<0.1	3	0	None > LOD	None > LOD			
Aromatics C5-C7	ug/l					<0.1	<0.1	<0.1	3	0	None > LOD	None > LOD			
Aromatics C6-C7	ug/l			<10	<10				2	0	None > LOD	None > LOD			
Aromatics >C7-C8	ug/l			<10	<10	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Aromatics >EC8-EC10	ug/l			<10	<10	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Aromatics >EC10-EC12	ug/l			<10	<10	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Aromatics >EC12-EC16 Aqueous	ug/l			<10	<10	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Aromatics >EC16-EC21 Aqueous	ug/l			<10	<10	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Aromatics >EC21-EC35 Aqueous	ug/l			<10	<10	<0.1	<0.1	<0.1	5	0	None > LOD	None > LOD			
Total Aromatics C6-C35 Aqueous	ug/l			<10	<10				2	0	None > LOD	None > LOD			
Aromatics >C35-44	ug/l					<0.1	<0.1	<0.1	3	0	None > LOD	None > LOD			
TPH GC (C10-C37)									0	0	None > LOD	None > LOD			
TPH (Aliphatics and Aromatics C5-C35)	ug/l			56	<10				2	1	56	56	SBHJ07 @		
Total Aliphatic	ug/l					<5	<5	<5	3	0	None > LOD	None > LOD			
Total Aromatic	ug/l					<5	<5	<5	3	0	None > LOD	None > LOD			
Total Petroleum Hydrocarbons	ug/l					<10	<10	<10	3	0	None > LOD	None > LOD			
SVOC by GCMS															
Phenols															
2-Chlorophenol	ug/l	50		<1					1	0	None > LOD	None > LOD		0	
2-Methylphenol	ug/l	100		<1					1	0	None > LOD	None > LOD		0	
2-Nitrophenol	ug/l			<1					1	0	None > LOD	None > LOD			
2,4-Dichlorophenol	ug/l	20		<1					1	0	None > LOD	None > LOD		0	
2,4-Dimethylphenol	ug/l			<1					1	0	None > LOD	None > LOD			
2,4,5-Trichlorophenol	ug/l			<1					1	0	None > LOD	None > LOD			
2,4,6-Trichlorophenol	ug/l			<1					1	0	None > LOD	None > LOD			
4-Chloro-3-methylphenol	ug/l	40		<1					1	0	None > LOD	None > LOD		0	
4-Methylphenol	ug/l	100		<1					1	0	None > LOD	None > LOD		0	
4-Nitrophenol	ug/l			<1					1	0	None > LOD	None > LOD			
Pentachlorophenol	ug/l	0.4		<1					1	0	None > LOD	None > LOD		0	
Phenol	ug/l	7.7		<1					1	0	None > LOD	None > LOD		0	
Phenols	mg/l	0.0077				<0.03	<0.03	<0.03	3	0	None > LOD	None > LOD		0	
PAHs															
2-Chloronaphthalene	ug/l			<1					1	0	None > LOD	None > LOD			
2-Methylnaphthalene	ug/l			<1					1	0	None > LOD	None > LOD			
Acenaphthene	ug/l			<1		<0.1	<0.1	<0.1	4	0	None > LOD	None > LOD			
Acenaphthylene	ug/l			<1		<0.1	<0.1	<0.1	4	0	None > LOD	None > LOD			
Anthracene	ug/l	0.1		<1		<0.1	<0.1	<0.1	4	0	None > LOD	None > LOD		0	
Benzo(a)anthracene	ug/l			<1		<0.1	<0.1	<0.1	4	0	None > LOD	None > LOD			
Benzo(a)pyrene	ug/l	0.00017	0.01	<1		<0.1	<0.1	<0.1	4	0	None > LOD	None > LOD		0	0
Benzo(b)fluoranthene	ug/l	0.017	0.1	<1		<0.1	<0.1	<0.1	4	0	None > LOD	None > LOD		0	0
Benzo(k)fluoranthene	ug/l	0.017	0.1	<1		<0.1	<0.1	<0.1	4	0	None > LOD	None > LOD		0	0
Benzo(ghi)perylene	ug/l	0.0082	0.1	<1		<0.1	<0.1	<0.1	4	0	None > LOD	None > LOD		0	0
Indeno(1,2,3-cd)pyrene	ug/l		0.1	<1		<0.1	<0.1	<0.1	4	0	None > LOD	None > LOD			0
Chrysene	ug/l			<1		<0.1	<0.1	<0.1	4	0	None > LOD	None > LOD			
Dibenzo(a,h)anthracene	ug/l			<1		<0.1	<0.1	<0.1	4	0	None > LOD	None > LOD			
Fluoranthene	ug/l	0.0063		<1		<0.1	<0.1	<0.1	4	0	None > LOD	None > LOD		0	
Fluorene	ug/l			<1		<0.1	<0.1	<0.1	4	0	None > LOD	None > LOD			
Naphthalene	ug/l	2		<1		<0.1	<0.1	<0.1	4	0	None > LOD	None > LOD		0	
Phenanthrene	ug/l			<1		<0.1	<0.1	<0.1	4	0	None > LOD	None > LOD			
Pyrene	ug/l			<1		<0.1	<0.1	<0.1	4	0	None > LOD	None > LOD			
Total PAHs (USEPA 16)	ug/l					<2	<2	<2	3	0	None > LOD	None > LOD			
Phthalates															
Bis(2-ethylhexyl) phthalate	ug/l	1.3		<2					1	0	None > LOD	None > LOD		0	
Butylbenzyl phthalate	ug/l	20		<1					1	0	None > LOD	None > LOD		0	
Di-n-butyl phthalate	ug/l	8		<1					1	0	None > LOD	None > LOD		0	
Di-n-Octyl phthalate	ug/l	20		<5					1	0	None > LOD	None > LOD		0	
Diethyl phthalate	ug/l	200		<1					1	0	None > LOD	None > LOD		0	
Dimethyl phthalate	ug/l	800		<1					1	0	None > LOD	None > LOD		0	
Other Semi-Volatiles															
1,2-Dichlorobenzene	ug/l	20		<1					1	0	None > LOD	None > LOD		0	
1,2,4-Trichlorobenzene	ug/l	0.4		<1					1	0	None > LOD	None > LOD		0	

1,3-Dichlorobenzene	ug/l	20		<1					1	0	None > LOD	None > LOD		0	
1,4-Dichlorobenzene	ug/l	20		<1					1	0	None > LOD	None > LOD		0	
2-Nitroaniline	ug/l			<1					1	0	None > LOD	None > LOD			
2,4-Dinitrotoluene	ug/l			<1					1	0	None > LOD	None > LOD			
2,6-Dinitrotoluene	ug/l			<1					1	0	None > LOD	None > LOD			
3-Nitroaniline	ug/l			<1					1	0	None > LOD	None > LOD			
4-Bromophenylphenylether	ug/l			<1					1	0	None > LOD	None > LOD			
4-Chloroaniline	ug/l			<1					1	0	None > LOD	None > LOD			
4-Chlorophenylphenylether	ug/l			<1					1	0	None > LOD	None > LOD			
4-Nitroaniline	ug/l			<1					1	0	None > LOD	None > LOD			
Azobenzene	ug/l			<1					1	0	None > LOD	None > LOD			
Bis(2-chloroethoxy)methane	ug/l			<1					1	0	None > LOD	None > LOD			
Bis(2-chloroethyl)ether	ug/l			<1					1	0	None > LOD	None > LOD			
Bis(2-chloroisopropyl)ether	ug/l								0	0	None > LOD	None > LOD			
Carbazole	ug/l			<1					1	0	None > LOD	None > LOD			
Dibenzofuran	ug/l			<1					1	0	None > LOD	None > LOD			
Hexachlorobenzene	ug/l	0.05		<1					1	0	None > LOD	None > LOD		0	
Hexachlorobutadiene	ug/l	0.6		<1					1	0	None > LOD	None > LOD		0	
Hexachlorocyclopentadiene	ug/l			<1					1	0	None > LOD	None > LOD			
Hexachloroethane	ug/l			<1					1	0	None > LOD	None > LOD			
Isophorone	ug/l			<1					1	0	None > LOD	None > LOD			
n-nitrosodimethylamine	ug/l								0	0	None > LOD	None > LOD			
N-nitrosodi-n-propylamine	ug/l			<1					1	0	None > LOD	None > LOD			
Nitrobenzene	ug/l			<1					1	0	None > LOD	None > LOD			
VOCs															
Dichlorodifluoromethane	ug/l			<1					1	0	None > LOD	None > LOD			
Chloromethane	ug/l			<1					1	0	None > LOD	None > LOD			
Vinyl Chloride	ug/l	0	0.5	<1					1	0	None > LOD	None > LOD		0	0
Bromomethane	ug/l			<1					1	0	None > LOD	None > LOD			
Chloroethane	ug/l			<1					1	0	None > LOD	None > LOD			
Trichlorofluoromethane	ug/l			<1					1	0	None > LOD	None > LOD			
trans-1-2-Dichloroethene	ug/l			<1					1	0	None > LOD	None > LOD			
Dichloromethane	ug/l	20		<1					1	0	None > LOD	None > LOD		0	
Carbon Disulphide	ug/l			<1					1	0	None > LOD	None > LOD			
1.1-Dichloroethene	ug/l			<1					1	0	None > LOD	None > LOD			
1.1-Dichloroethane	ug/l			<1					1	0	None > LOD	None > LOD			
Methyl Tertiary Butyl Ether	ug/l			<1					1	0	None > LOD	None > LOD			
cis-1-2-Dichloroethene	ug/l			<1					1	0	None > LOD	None > LOD			
Bromochloromethane	ug/l		100	<1					1	0	None > LOD	None > LOD			0
Chloroform	ug/l	2.5	100	<1					1	0	None > LOD	None > LOD		0	0
2.2-Dichloropropane	ug/l			<1					1	0	None > LOD	None > LOD			
1.2-Dichloroethane	ug/l	10	3	<1					1	0	None > LOD	None > LOD		0	0
1.1.1-Trichloroethane	ug/l	100		<1					1	0	None > LOD	None > LOD		0	
1.1-Dichloropropene	ug/l			<1					1	0	None > LOD	None > LOD			
Benzene	ug/l	10	1	<1					1	0	None > LOD	None > LOD		0	0
Carbontetrachloride	ug/l	12	3	<1					1	0	None > LOD	None > LOD		0	0
Dibromomethane	ug/l			<1					1	0	None > LOD	None > LOD			
1.2-Dichloropropane	ug/l			<1					1	0	None > LOD	None > LOD			
Bromodichloromethane	ug/l			<1					1	0	None > LOD	None > LOD			
Trichloroethene	ug/l	10	10	<1					1	0	None > LOD	None > LOD		0	0
cis-1-3-Dichloropropene	ug/l			<1					1	0	None > LOD	None > LOD			
trans-1-3-Dichloropropene	ug/l			<1					1	0	None > LOD	None > LOD			
1.1.2-Trichloroethane	ug/l	400		<1					1	0	None > LOD	None > LOD		0	
Toluene	ug/l	50		<1					1	0	None > LOD	None > LOD		0	
1.3-Dichloropropane	ug/l			<1					1	0	None > LOD	None > LOD			
Dibromochloromethane	ug/l		100	<1					1	0	None > LOD	None > LOD			0
1.2-Dibromoethane	ug/l			<1					1	0	None > LOD	None > LOD			
Tetrachloroethene	ug/l	10	10	<1					1	0	None > LOD	None > LOD		0	0
1.1.1.2-Tetrachloroethane	ug/l			<1					1	0	None > LOD	None > LOD			
Chlorobenzene	ug/l			<1					1	0	None > LOD	None > LOD			
Ethylbenzene	ug/l	20		<1					1	0	None > LOD	None > LOD		0	
p/m-Xylene	ug/l	30		<1					1	0	None > LOD	None > LOD		0	
Bromoform	ug/l			<1					1	0	None > LOD	None > LOD			
Styrene	ug/l	50		<1					1	0	None > LOD	None > LOD		0	
1.1.2.2-Tetrachloroethane	ug/l			<1					1	0	None > LOD	None > LOD			
o-Xylene	ug/l	30		<1					1	0	None > LOD	None > LOD		0	
1.2.3-Trichloropropane	ug/l			<1					1	0	None > LOD	None > LOD			
Isopropylbenzene	ug/l			<1					1	0	None > LOD	None > LOD			
Bromobenzene	ug/l			<1					1	0	None > LOD	None > LOD			
2-Chlorotoluene	ug/l			<1					1	0	None > LOD	None > LOD			
Propylbenzene	ug/l			<1					1	0	None > LOD	None > LOD			
4-Chlorotoluene	ug/l			<1					1	0	None > LOD	None > LOD			
1.2.4-Trimethylbenzene	ug/l			<1					1	0	None > LOD	None > LOD			
4-Isopropyltoluene	ug/l			<1					1	0	None > LOD	None > LOD			
1.3.5-Trimethylbenzene	ug/l			<1					1	0	None > LOD	None > LOD			
1.2-Dichlorobenzene	ug/l	20		<1					1	0	None > LOD	None > LOD		0	
1.4-Dichlorobenzene	ug/l	20		<1					1	0	None > LOD	None > LOD		0	
sec-Butylbenzene	ug/l			<1					1	0	None > LOD	None > LOD			
tert-Butylbenzene	ug/l			<1					1	0	None > LOD	None > LOD			
1.3-Dichlorobenzene	ug/l	20		<1					1	0	None > LOD	None > LOD		0	
n-Butylbenzene	ug/l			<1					1	0	None > LOD	None > LOD			
1.2-Dibromo-3-chloropropane	ug/l			<1					1	0	None > LOD	None > LOD			
1.2.4-Trichlorobenzene	ug/l	0.4		<1					1	0	None > LOD	None > LOD		0	
Naphthalene	ug/l	2		<1					1	0	None > LOD	None > LOD		0	
1.2.3-Trichlorobenzene	ug/l	0.4		<1					1	0	None > LOD	None > LOD		0	
Hexachlorobutadiene	ug/l	0.6		<1					1	0	None > LOD	None > LOD		0	
Chloroethene	ug/l								0	0	None > LOD	None > LOD			
Tribromomethane	ug/l		100						0	0	None > LOD	None > LOD			0
PCBs															
Pcb-101 2,2',4,5,5' - Pentachlorobiphenyl	ug/l								0	0	None > LOD	None > LOD			
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl	ug/l								0	0	None > LOD	None > LOD			
Pcb-138 2,2',3,4,4',5' - Hexachlorobiphenyl	ug/l								0	0	None > LOD	None > LOD			
Pcb-153 2,2',4,4',5,5' - Hexachlorobiphenyl	ug/l								0	0	None > LOD	None > LOD			
Pcb-180 2,2',3,4,4',5,5' - Heptachlorobiphenyl	ug/l								0	0	None > LOD	None > LOD			
Pcb-28 2,4,4' - Trichlororbiphenyl	ug/l								0	0	None > LOD	None > LOD			
Pcb-52 2,2',5,5' - Tetrachlorobiphenyl	ug/l								0	0	None > LOD	None > LOD			

A9 Appendix 5

Surface Water Laboratory Data

MACAW
Surface Water Sample Analysis & Screening Assessment
CL20 - Lagoons
15/07/2015

Screening Values and Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Exceeds EQS
CCW	Exceeds CCW
LOD	Laboratory
BOL/ITA	Exceeds CCW

Notes:
EQS calcium carbonate 100-150mg/l for heavy metals: chromium, copper, lead, nickel and zinc
NDP - No determination possible

Monitoring Round / Location		Screening Criteria			E1 / R13	E2 / R13	E3 / R13	E4 / R13	1 / SW504	2 / SW504	3 / SW504	1 / SW505	2 / SW505	3 / SW505	1 / SW506	2 / SW506	3 / SW506	Q1 / 15.3	Q1 / 16.2	1 / MCWave1	2 / MCWave1	3 / MCWave1	4 / MCWave1	1 / MDSWN	2 / MDSWN	3 / MDSWN	4 / MDSWN	1 / MDSWS	2 / MDSWS	3 / MDSWS	4 / MDSWS
Date Sampled	Units	EQS	DWS	CCW	07/12/2007	17/03/2008	24/06/2008	24/09/2008	01/04/2015	15/04/2015	22/04/2015	01/04/2015	15/04/2015	22/04/2015	01/04/2015	15/04/2015	22/04/2015	01/05/2015	01/06/2015	01/01/2009	31/05/2009	20/09/2009	06/05/2009	30/04/2009	30/04/2009	15/06/2009	06/05/2009	30/04/2009	30/04/2009	15/06/2009	06/05/2009
Metals & Non-Metal Inorganics																															
Hardness Total	mg/l				241	205	266	221																							
Total Alkalinity	mg/l																							139		143		151	116		
Bicarbonate Alkalinity as CaCO3	mg/l																							149	141			151	116		
Ceramic Dissolved	ug/l	50	10						1.8	<1	<1	1.6	2	1.1	1.5	4.6	1.5	1.17	1.55	<1	2	<1	2	<5	<5	<5	<5	<5	<5	<5	<5
Boron Dissolved	ug/l	2000	1000						970	990	24	150	210	45	710	930	120	49.9	38.3	80	80	<50	70	<50	<50	<50	<50	<50	<50	<50	<50
Calcium Dissolved	mg/l			300000	60	83	3.9	60																117	49.6						
Iron Dissolved	ug/l																							1100	1600						
Potassium Dissolved	mg/l																							2.6	2.6						
Cadmium Dissolved	ug/l	0.15	5	5					0.16	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.9	0.097	<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
Chromium Dissolved	ug/l		50						18	<1	<1	15	10	<1	9.3	6.2	<1	1.41	1.29	2	<1	2	13	<1	<1	3.2	<1	<1	<1	<1	13
Copper Dissolved	ug/l	10	2000		<0.85	5	11	<0.85	1.4	<0.85	<0.85	3.5	2.8	3.6	1.4	1.6	1.6	1.75	<0.85	<1	<1	<1	2	<1	3	<1	2	<1	4	<1	2
Lead Dissolved	ug/l	1.2	10	250	<0.02	<0.02	9	<0.02										0.081	0.045	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Magnesium Dissolved	mg/l				12	16	1.5	14																15.3	15.3						
Nickel Dissolved	ug/l	4	20	100	<1	<1	5	<1										1.17	1.06	5	1	1	1	<1	3	<1	<1	10	<1	<1	<1
Selenium Dissolved	ug/l		10						<1	<1	<1	2	2.5	2.5	<1	4.9	1.6	1.639	0.691	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc Dissolved	ug/l	75		1000																5	11	21	<2	6	10	7	<5	15	35	8	<5
Manganese Dissolved	ug/l	30	50																	2	110	144	7	10	8	10	8	10	8	10	8
Iron Dissolved	ug/l	1000	200																	<10	<10	<10	<10	300	410	<10	30	300	1110	<10	30
Mercury Dissolved	ug/l	0.07	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
Molybdenum Dissolved	ug/l																							<0.1	<0.1						
Sodium Total	mg/l	0.15	5	5	0.5	<0.5	<0.5	<0.5																							
Zinc Total	ug/l	75		1000	20	24	27	23																							
COD	mg/l																							<5	<5			<5	<5		
BOD	mg/l	5		18	3	<1	7	2										<1	<1					4.1	<2.0			1	<2.0		
TOC	mg/l																							1.6	1.3			1.8	4.2		
Nitrate as N	mg/l		50	1	<0.3	0.5	<0.3	<0.3												<0.3	<0.3	120	<0.3	4.4	3.3	4.1	4.3			2.4	2.8
Nitrate as NO3	mg/l		50	1	1.3	2.23	<0.3	<0.3										0.72	0.368												
Nitrite as N	mg/l		(0.15)(17/811)	1	<0.1	<0.1	<0.1	<0.1																							
Nitrite as NO2	mg/l		0.5	1														<0.05	<0.05												
Nitrogen, Total Oxidised as N	mg/l		50	2	<0.3	0.5	<0.3	<0.3										2.21	<0.3												
Phosphate, Ortho as P	mg/l				<0.1	1.3	0.3	0.3												0.04	0.11	0.05	0.03	0.5	0.1	0.11	0.06	0.5	0.1	0.1	0.05
Phosphorus (tot.unfil.)	ug/l	120																92.5	97.6												
Sulphate (soluble)	mg/l	400	250	300														21.3	16.4												
Sulphate as SO4	mg/l	400	250	300	8	<5	8	36												31.7	11.8	11.9	10.7	15	15.1	21.8	18.3	19.1	21	21.1	16
Sulphate Extractable Material	mg/l																			<8	<8	<8	<8	<8	<8	<8	<8	<5	<5	<5	<5
Chloride	mg/l	250	250	300	21	18	31	19										24.6	24.9	47	52	29	55	19	26	21	23			21	21
Fluoride	mg/l																							0.4	0.9						
Sulphide	mg/l																							<0.1	<0.1						
Ammoniacal Nitrogen as N	mg/l	0.6		1	0.09	0.11	0.04	0.1	0.078	0.13	0.06	0.44	0.49	0.56	0.044	0.044	0.075	0.227	<0.2	0.14	0.16	0.16	0.11	<0.05	<0.05	0.1	<0.05	0.1	<0.05	<0.05	<0.05
Cyanide Free	mg/l								<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05							<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cyanide Total	mg/l																			<0.05	<0.05	<0.05	<0.05								
Thiocyanate as SCN	mg/l																			<0.1	5.1	<0.1	0.2	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.2	0.1
Dissolved Oxygen	mg/l				6.47	7.33	0.91	5.76										14	12.6												
Dissolved Oxygen (Saturation)	%	60			57.2	61.2	10	57																							
pH Value	pH units	6-9	6.5-10	6.8-8.5	7.7	7.7	7.3	7.3	8.0	8.6	8.2	12	12	10	8.7	8.9	8.6			7.7	7.2	7.5	7.9	7.9	8	7.6	8	7.7	7.8	7.6	8.1
Conductivity	us/cm																			649	502	498	582	499	439	487	479	442	396	483	481
Organics																															
C/ND (C5-C12)	ug/l																	<50	<50												
C/HD	ug/l								<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3												
Benzene	ug/l	10	1	1	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7												
Toluene	ug/l	50			<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4												
Ethyl benzene	ug/l	20			<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5												
m & p Xylene	ug/l	30			<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8												
o Xylene	ug/l	30			<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3												
TPH																															
Aliphatics C5-C6	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Aliphatics >C6-C8	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Aliphatics >C8-C10	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Aliphatics >C10-C12	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Aliphatics >C12-C16 Aqueous	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Aliphatics >C16-C21 Aqueous	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Aliphatics >C21-C35 Aqueous	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Total Aliphatics C12-C35 Aqueous	ug/l																	<10	<10												
Aromatics >C5-C7	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Aromatics >C7-C8	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Aromatics >C8-C10	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Aromatics >C10-C12	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Aromatics >C12-C16 Aqueous	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Aromatics >C16-C21 Aqueous	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Aromatics >C21-C35 Aqueous	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Total Aromatics C12-C35 Aqueous	ug/l																	<10	<10												
Total Aliphatic TPH	ug/l								0	0	0	0	0	0	0	0	0														
TPH >C6-C8	ug/l				<40	<40	<40	<40																							
TPH >C8-C10	ug/l				<40	<40	<40	<40																							
TPH >C10-C40	ug/l				<80	<80	<80	<80																							
TPH >C6-C40	ug/l				<40	<40	78	<40																							
TPH >C10-C40	ug/l				<200	<200	197	<200																							
Total petroleum hydrocarbons	ug/l				<200	<200	275	<200																							
Phenols																															
2-Chlorophenol	ug/l	50							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5														
2 , Methyl-4,6-Dinitrophenol	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5														
3-Methylphenol	ug/l	100							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5														
2-Nitrophenol	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5														
4,6-Dichlorophenol	ug/l	20							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5														
2,4-Dimethylphenol	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5														
2,4,5-Trichlorophenol	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5														
2,4,6-Trichlorophenol	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5														
4-Chloro-3-methylphenol	ug/l	40							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5														
3-Methylphenol	ug/l	100							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5														
Pentachlorophenol	ug/l	0.4							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5														
Phenol	ug/l	7.7							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5														
Phenols	ug/l	0.0077							<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03														
Phenol Index	mg/l	0.0077																		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
PAHs																															
2-Chloronaphthalene	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5														
2-Methylnaphthalene	ug/l								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5														
Acenaphthene	ug/l								<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015					<2	<2			<2	<2		
Acenaphthylene	ug/l								<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					<2	<2			<2	<2		
Anthracene	ug/l	0.1							<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015					<2	<2			<2	<2		
Benzo(a)anthracene	ug/l								<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.1	<0.1					<2	<2			<2	<2		
Benzo(a)pyrene	ug/l	0.00017	0.01						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					<2	<2			<2	<2		
Benzo(b)fluoranthene	ug/l	0.017	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.022	<0.022					<2	<2			<2	<2		
Benzo(k)fluoranthene	ug/l	0.017	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.027	<0.027					<2	<2			<2	<2		
Benzo(ghi)perylene	ug/l	0.0082	0.1						<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016					<2	<2			<2	<2		
Indeno(1,2,3-cd)pyrene	ug/l		0.1						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.014	<0.014					<2	<2			<2	<2		
Chrysene	ug/l								<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.016	<0.016					<2	<2			<2	<2		
Dibenzo(a,h)anthracene	ug/l								<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.014	<0.014					<2	<2			<2	<2		
Fluoranthene	ug/l	0.0063							<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.017	<0.017					<2	<2			<2	<2		
Fluorene	ug/l								<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.014	<0.014					<2	<2			<2	<2		
Naphthalene	ug/l	2							<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<1					<2	<2			<2	<2		
Phenanthrene	ug/l								<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.022	<0.022					<2	<2			<2	<2		
Pyrene	ug/l								<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.015	<0.015					<2	<2			<2	<2		
Total PAHs (USEPA 16)	ug/l																	<0.344	<0.344					<2	<2			<2	<2		
VOCs																															
1,1,1,2-Tetrachloroethane	ug/l								<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2												
1,1,1-Trichloroethane	ug/l	100							<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
1,1,2-Trichloroethane	ug/l	400							<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
1,1-Dichloroethane	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
1,1-Dichloroethene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
1,2-Dichloropropane	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
1,2,3-Trichlorobenzene	ug/l	0.4							<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2												
1,2,3-Trichloropropane	ug/l								<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50												
1,2,4-Trichlorobenzene	ug/l	0.4							<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
1,2,4-Trimethylbenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
1,2-Dibromo-3-Chloropropane	ug/l								<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50												
1,2-Dibromoethane	ug/l								<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5												
1,2-Dichlorobenzene	ug/l	20							<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
1,2-Dichloroethane	ug/l	10	3						<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2												
1,2-Dichloropropane	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
1,3,5-Trimethylbenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
1,3-Dichloropropane	ug/l								<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2												
1,4-Dichlorobenzene	ug/l	20							<0.14	<0.15	<0.18	<0.17	<0.18	<0.19	<0.20	<0.23	<0.22	<0.22	<0.22												
2-Chlorotoluene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
4-Chlorotoluene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
Benzene	ug/l	10	1						<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7										
Bromobenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
Bromochloromethane	ug/l		100						<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5												
Bromochloroethane	ug/l								<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5												
Bromomethane	ug/l								<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5												
Chlorobenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
Chloroethane	ug/l								<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2												
Chloroethene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
Chloroform	ug/l	2.5	100						<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
Chloromethane	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
cis-1,2-Dichloroethene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
cis-1,3-Dichloropropene	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Dichlorodifluoromethane	ug/l		100						<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Dibromomethane	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Dichloromethane/methane	ug/l								5	10	11	12	13	14	15	16	17	15	9												
Ethylbenzene	ug/l	20							<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5										
Hexachlorobutadiene (HCBD)	ug/l	0.6							<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
Isopropylbenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
m,p xylenes	ug/l	30							<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8												
Methyl tert-butyl ether (MTBE)	ug/l								<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3										
n-Butylbenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
n-propylbenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
O-Xylene	ug/l	30							<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3										
sec-Butylbenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
Styrene	ug/l	50							<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
Tert-butylbenzene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
Tetrachloroethene	ug/l	10	10						<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
Tetrachloromethane (Carbon Tetra Chloride)	ug/l	12	3						<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
Toluene	ug/l	50							<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4										
trans-1,2-Dichloroethene	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
trans-1,3-Dichloropropene	ug/l								<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10												
Tribromomethane	ug/l		100						<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
Trichloroethene	ug/l	10	10						<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
Trichlorofluoromethane	ug/l								<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1												
Phthalates																															
Bis(2-ethylhexyl) phthalate	ug/l	1.3							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	

A10 Appendix 6

Soil Leachate Laboratory Data

M4CAN
Leachate Samples Analysis & Screening Assessment
CL-26 - Leachate - Lagoon 26
05/10/2015

Geological Formation Legend

MG - G	Made Ground (General)
MG-CS	Made Ground (coarse slag)

Screening Values & Assessment

EQS	Environmental Quality Standards
DWS	Drinking Water Standard
	Exceeds EQS
X	Exceeds DWS
X	Laboratory detection level higher than screening criterion

Notes

EQS calcium carbonate 100 - 150mg/l for heavy metals: chromium, copper, lead, nickel and zinc

Sample Reference	Units	Screening Criteria		SBHJ09CP	SBHJ10CP	STPJ01	STPJ02	STPJ03	STPJ04	STPJ05	STPJ06	SBHJ08ACP	BH523	BH524
Specimen Depth (m)				1	0.3	2	0.3	0.4	1	0.3	1	4.1	1 - 1.2	2.5 - 2.7
OD Level (m)				4.76	5.75	3.95	5.07	5.17	4.43	5.55	4.71	1.79	5.15	3.2
Sample Type		EQS	MRV	D	ES	B	ES	ES	ES	ES	ES	ES	ES	ES
Geology Code				MG-G	MG	MG-G	MG-G	MG-G	MG-G	MG-G	MG-G	MG-CS	MG-G / MG-CS	MG-G / MG-CS
Cluster Code				2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2007 GI	2015 GI	2015 GI
2:1 Results														
Arsenic Dissolved	ug/l	50	10	<1	<1	<1	10	<1	8	<1	<1	<1	<1	<1
Ammoniacal Nitrogen as N	ug/l	0.6												
Boron Dissolved	ug/l	2000	1000	<10	40	<10	240	<10	<10	<10	<10	<10	<20	35
Barium Dissolved	ug/l			1100	600	860	91	960	12	700	570	950		
Beryllium Dissolved	ug/l			<1	<1	<1	<1	<1	<1	<1	<1	<1		
Cadmium Dissolved	ug/l	0.15	5	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.08	0.24
Chromium Dissolved	ug/l		50	<1	5	4	<1	3	5	49	2	<1	<1	9.8
Copper Dissolved	ug/l	10	2000	4	3	10	2	37	89	11	21	5	7.2	9.4
Iron Dissolved	ug/l	1000	200	<5	6	100	17	9	<5	<5	96	<5		
Molybdenum Dissolved	ug/l			1	<1	2	29	3	8	<1	2	<1		
Mercury as Hg Dissolved	ug/l	0.07	1										<0.5	<0.5
Nickel Dissolved	ug/l	4	20	9	4	4	<1	7	16	10	7	10	2.2	1.4
Lead Dissolved	ug/l	1.2	10	14	2	8	<1	<1	<1	7	12	5	<1	1.3
Antimony Dissolved	ug/l		5	<5	<5	<5	<5	<5	<5	<5	<5	<5		
Selenium Dissolved	ug/l		10	<1	<1	<1	9	<1	9	<1	<1	<1	<1	2.1
Vanadium Dissolved	ug/l			2	<1	<1	46	5	13	<1	<1	<1		
Conductivity uS/m @ 25C	mg/l													
pH units	pH units	6-9	6.5-10										12	11
Chloride as Cl	mg/l	250	250											
Thiocyanate as SCN	mg/l													
Phosphate as P	mg/l													
Total Sulphur as SO4 Dissolved	mg/l													
Zinc Dissolved	mg/l	75		<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.0037	0.0023
Total Cyanide	mg/l	0.001	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cyanide Free	mg/l												<0.05	<0.05
Phenols														
Phenols	mg/l	0.0077											<0.03	<0.03
BTEX														
Benzene	ug/l	10	1										<1	<1
Toluene	ug/l	50											<1	<1
Ethylbenzene	ug/l	20											<1	<1
m,p xylenes	ug/l	30											<1	<1
O-Xylene	ug/l	30											<1	<1
TPH														
Aliphatics >C5-C6	ug/l												<0.1	<0.1
Aliphatics >C6-C8	ug/l												<0.1	<0.1
Aliphatics >C8-C10	ug/l												<0.1	<0.1
Aliphatics >C10-C12	ug/l												<0.1	<0.1
Aliphatics >C12-C16	ug/l												<0.1	<0.1
Aliphatics >C16-C21	ug/l												<0.1	<0.1
Aliphatics >C21-C35	ug/l												<0.1	<0.1
Aliphatics >C35-44	ug/l												<0.1	<0.1
Aromatics >C5-C7	ug/l												<0.1	<0.1
Aromatics >C7-C8	ug/l												<0.1	<0.1
Aromatics >C8-C10	ug/l												<0.1	<0.1
Aromatics >C10-C12	ug/l												<0.1	<0.1
Aromatics >C12-C16	ug/l												<0.1	<0.1
Aromatics >C16-C21	ug/l												<0.1	<0.1
Aromatics >C21-C35	ug/l												<0.1	<0.1
Aromatics >C35-44	ug/l												<0.1	<0.1
Total Aliphatic TPH	ug/l												<5	<5
Total Aromatic TPH	ug/l												<5	<5
Total petroleum hydrocarbons	ug/l												<10	<10
PAH														
Acenaphthene	ug/l												<0.1	<0.1
Acenaphthylene	ug/l												<0.1	<0.1
Anthracene	ug/l	0.1											<0.1	<0.1
Benz(a)anthracene	ug/l												<0.1	<0.1
Benzo(a)pyrene	ug/l	0.00017	0.01										<0.1	<0.1
Benzo(b)fluoranthene	ug/l	0.017	0.1										<0.1	<0.1
Benzo(ghi)perylene	ug/l	0.0082	0.1										<0.1	<0.1
Benzo(k)fluoranthene	ug/l	0.017	0.1										<0.1	<0.1
Chrysene	ug/l												<0.1	<0.1
Dibenzo(ah)anthracene	ug/l												<0.1	<0.1
Fluoranthene	ug/l	0.0063											<0.1	<0.1
Fluorene	ug/l												<0.1	<0.1
Indeno(123cd)pyrene	ug/l	N/A	0.1										<0.1	<0.1
Naphthalene	ug/l	2											<0.1	<0.1
Phenanthrene	ug/l												<0.1	<0.1
Pyrene	ug/l												<0.1	<0.1
PAH 16 Total	ug/l												<2	<2
PCBs														
Pcb-101 2,2',4,5,5' - Pentachlorobiphenyl	ug/l												<0.01	
Pcb-118 2,3',4,4',5 - Pentachlorobiphenyl	ug/l												<0.01	
Pcb-138 2,2',3,4,4',5' - Hexachlorobiphenyl	ug/l												<0.01	
Pcb-153 2,2',4,4',5,5' - Hexachlorobiphenyl	ug/l												<0.01	
Pcb-180 2,2',3,4,4',5,5' - Heptachlorobiphenyl	ug/l												<0.01	
Pcb-28 2,4,4' - Trichlororbiphenyl	ug/l												<0.01	
Pcb-52 2,2',5,5' - Tetrachlorobiphenyl	ug/l												<0.01	

No. Analyses	No. Analyses Above LOD	Maximum	Minimum	Location & Depth of Maximum Concentration	No. Data Exceeding EQS	No. Data Exceeding DWS
11	2	10	8	STPJ02 @ 0.3mbGL	0	0
0	0	None > LOD	None > LOD		0	
11	3	240	35	STPJ02 @ 0.3mbGL	0	0
11	9	1100	12	SBHJ09CP @ 1mbGL		
11	0	None > LOD	None > LOD			
11	1	0.24	0.24	BH524 @ 2.5 - 2.7mbGL	1	0
11	7	49	2	STPJ05 @ 0.3mbGL		0
11	11	89	2	STPJ04 @ 1mbGL	4	0
9	5	100	6	STPJ01 @ 2mbGL	0	0
11	6	29	1	STPJ02 @ 0.3mbGL		
2	0	None > LOD	None > LOD		0	0
11	10	16	1.4	STPJ04 @ 1mbGL	6	0
11	7	14	1.3	SBHJ09CP @ 1mbGL	7	2
11	0	None > LOD	None > LOD			0
11	3	9	2.1	STPJ02 @ 0.3mbGL		0
11	4	46	2	STPJ02 @ 0.3mbGL		
0	0	None > LOD	None > LOD			
2	2	12	11	BH523 @ 1 - 1.2mbGL	2	2
0	0	None > LOD	None > LOD		0	0
0	0	None > LOD	None > LOD			
0	0	None > LOD	None > LOD			
0	0	None > LOD	None > LOD			
11	2	0.0037	0.0023	BH523 @ 1 - 1.2mbGL	0	
11	0	None > LOD	None > LOD		0	0
2	0	None > LOD	None > LOD			
2	0	None > LOD	None > LOD		0	
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A11 Appendix 7

Relevant Extract from Additional Environmental Data

Plate 01: Extract of 1969 Aerial Photograph.

Plate 02: Extract of 1979 Aerial Photograph.

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591 Checked By: Date: Oct 2015

Plate 03: Extract of 1991 Aerial Photograph.

Plate 04: Extract of 2006 Aerial Photograph.

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591 Checked By: Date: Oct 2015

Plate 05: Extract of 2013/14 Aerial Photograph.

Client:	Welsh Government
Project:	M4CaN
Job Ref:	JER6591 Checked By: Date: Oct 2015