

OCEAN SQUARE, SAUNDERSFOOT

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CONTENTS

0.0	FOREWORD	4
1.0	INTRODUCTION	5
1.1	General	5
1.2	Purpose of Ground Investigation.....	5
1.3	Scope of Work	5
2.0	SITE DETAIL	6
2.1	Site Description.....	6
2.2	Published Geology.....	6
2.3	Hydrology.....	7
2.4	Topography.....	7
3.0	FIELDWORK	8
3.1	General	8
3.2	Exploratory Hole Locations	8
3.3	Hand Excavated Pits.....	8
3.4	Machine Excavated Trial Pits.....	9
3.5	In-Situ Testing.....	10
4.0	LABORATORY TESTING.....	11
4.1	General	11
4.2	Geotechnical Laboratory Testing	11
4.3	Geo-Environmental Laboratory Testing	11
5.0	GROUND CONDITIONS ENCOUNTERED	13
5.1	Overview of strata encountered	13
5.2	Detailed Ground Conditions	13
5.3	Groundwater Conditions	13
5.4	Visual & Olfactory Evidence of Soil Contamination.....	13
5.5	Visual & Olfactory Evidence of Groundwater & Surface Water Contamination	13
6.0	GEOTECHNICAL ENGINEERING APPRAISAL.....	14
6.1	General	14
6.2	Engineering Properties of Strata	14
6.3	Earthworks	14
6.4	Foundation Assessment	15
7.0	GEO-ENVIRONMENTAL CONSIDERATIONS	17
7.1	General	17
7.2	Human Health Risk Assessment Criteria	17
7.3	Pre-Intrusive Investigation Conceptual Site Model.....	17
7.4	Recommendations on Contaminated Land	22
7.5	Review of Conceptual Site Model	22
8.0	REFERENCES	24

APPENDICES

APPENDIX I – SITE PLANS	I
APPENDIX II – HAND EXCAVATED PIT LOGS.....	II
APPENDIX III – MACHINE EXCAVATED TRIAL PIT LOGS.....	III
APPENDIX IV – TRL-DCP CBR RESULTS	IV
APPENDIX V – GEOTECHNICAL AND GEOENVIRONMENTAL LABORATORY TEST RESULTS.....	V

0.0 FOREWORD

The following Conditions and Notes on Site Investigation Procedures should be read in conjunction with this report.

0.1 General

Recommendations made and opinions expressed in the report are based on the strata observed in the excavations, together with the results of site and laboratory tests. No responsibility can be held for conditions which have not been revealed by the trial pits or which occur between trial pit holes. Whilst the report may suggest the likely configuration of strata, both between trial pits and below the maximum depth of investigation, this is only indicative and liability cannot be accepted for its accuracy.

Unless specifically stated, no account has been taken of possible subsidence due to mineral extraction below or close to the site.

0.2 Investigation Procedures

Rotary cored boreholes, window sampling and Trial pitting techniques for ground investigation have been employed within the project. All trial pit operations, sampling and logging of soils, rocks and in-situ testing complies with the recommendations of the British Code of Practice BS 5930: 2015 'Site Investigations', British Code of Practice BS 10175: 2011 +A1:2013 'Investigation of Potentially Contaminated Sites' and BS 1377: 1990, 'Methods of Test for Soils for Engineering Purposes'.

0.3 Routine Sampling

Representative bulk, disturbed and environmental samples of the different strata. All samples are returned from site to QGL's laboratory for controlled storage within 24 hours of sampling to await test scheduling/requirements.

0.4 In-Situ Testing, Surveying & Instrumentation

In-situ testing comprised:

- Environmental and Geotechnical laboratory testing
- TRL DCP testing
- Soakaway testing

0.5 Groundwater

Where possible, the depth of entry of any influx of groundwater is recorded during the course of excavation or boring operations. The rate of inflow into the excavation or borehole is monitored during the course of the excavation or during boring procedures. Upon encountering any water strikes, work is temporarily halted and the water levels monitored for a standard twenty-minute period recording the change in water level at the end of the twenty minutes.

Groundwater conditions observed in the excavations are those appertaining to the period of investigation. It should be noted, however, that groundwater levels are subject to diurnal, seasonal and climatic variations and can also be affected by drainage conditions or other causes.

0.6 Retention of Samples

After satisfactory completion of all the scheduled laboratory tests on any sample, the remaining material is discarded. Further to notifying the Engineer/ Client with one week's notice all soil and/or rock samples not tested will be discarded 28 days after submission of the approved final report.

1.0 INTRODUCTION

1.1 General

Upon the instructions of the Client, Saundersfoot Harbour, Quantum Geotechnical Limited (QGL) was commissioned to undertake a Ground Investigation for the proposed development at the Barbecue, Ocean Square, Saundersfoot Harbour.

1.2 Purpose of Ground Investigation

The purpose of the Ground Investigation is to allow a site-specific geotechnical and environmental assessment of existing ground conditions, to aid with the foundation design and identify any other potential geotechnical and environmental issues that may be present within the shallow ground on site. The investigation works / techniques comprised of a series of hand dug and machine excavated trial pits with soakaway testing and TRL probes around the Barbecue building and picnic area adjacent, accompanied with environmental and geotechnical sampling.

1.3 Scope of Work

The general scope of work undertaken in the preparation of this assessment was as follows:

- Conduct an intrusive ground investigation with the aim of identifying the underlying ground conditions targeting the issues that could potentially impact the proposed development.
- Carry out laboratory testing to gain geotechnical and environmental data.
- Provide an interpretative report presenting an analysis of the available information and offering recommendations on site suitability for the proposed development with regards to geotechnical parameters and environmental/human health risks.

General notes on the techniques employed by Quantum Geotechnical are described in the Foreword together with the limitations inherent in carrying out ground investigation work.

2.0 SITE DETAIL

2.1 Site Description

The area under investigation is located approximately 50m west of Saundersfoot Beach and 120m north west of Saundersfoot Harbour along Cambrian Place. The site of the proposed development is situated around the current Barbecue building and adjacent grassed picnic area.

The proposed development site involves extending the current Barbecue building structure outward into the grassed picnic area in the form of a lightweight framed structure.

The approximate National Grid Reference of the site is E: 213642 N: 204820. (see site location plan in Appendix I) with the nearest address being 4 Cambrian Place, Saundersfoot SA69 9ER. The area under investigation is outlined for ease of reference in Figure 1 below;

Figure 1: Site location indicating area under investigation. *Not to Scale* © Ordnance Survey



2.2 Published Geology

A number of geological sources are available from published geological maps, to stratigraphy data and maps available online. The following sections summarise the information gathered from these sources.

2.2.1 Superficial Deposits

The published geological map covering the site, British Geological Survey (BGS) Sheet 228 'Haverfordwest' (drift edition) shows no superficial deposits to be recorded across the site.

2.2.2 Solid Geology

Bedrock beneath the site is shown to be mudstone, siltstone and sandstone of the South Wales Middle Coal Measures Formation of the Carboniferous Period.

2.2.3 Structural Geology

The closest fault to the site is mapped 25m to the south and trends west to east.

2.3 Hydrology

There is a river to the south of the site that flows into Saundersfoot Harbour. The site is also approximately 50m west to the sea front, adjacent to Saundersfoot Bay

2.4 Topography

The site is relatively flat, with the BBQ building itself located to the northern end.

3.0 FIELDWORK

3.1 General

The fieldwork comprising Machine Excavated Trial Pits with soakaway testing, Hand Excavated Pits, DCP by TRL Probes were undertaken on the 8th and 9th of January. Each location under investigation was fully CAT ('Cable Avoidance Tool') scanned prior to breaking ground. Site supervision and attendance by an Engineering Geologist from Quantum was provided on all aspects of the site works. Safe digging practices in accordance with HS(G)47 were employed when breaking and excavating grounds with all traceable services demarcated prior to works commencing.

A summary of the fieldworks is outlined below;

- 4 No. Trial Pits (TP1 - TP4)
- 3 No. DCP TRL probes (TRL1 – TRL3)
- 1 No. Soakaway Test
- 3 No. Hand Excavated Pits (HP1 – HP3)

3.2 Exploratory Hole Locations

The exploratory hole locations were set out by a QGL Engineering Geologist, positioned to establish relevant ground conditions across the proposed development site.

3.3 Hand Excavated Pits

The fieldworks were undertaken on the 8th and 9th of January and comprised of 3No. Hand Pits, excavated using insulated hand digging tools. Termination depths are detailed in Table 1.

Table 1: Termination depth of Trials Pits

Trial Pits/ DCP TRL Probe I.D.	Termination Depth (mbgl)	Comments
HP01	1.20	Terminated due to max depth achieved
HP02	0.65	Terminated due to refusal
HP03	0.90	Terminated due to refusal

The excavation of Hand Pits allows direct sampling of the near surface deposits for identification purposes, as well as assessment of any salient features and Made Ground or disturbed ground. The Hand Pits were logged in accordance with BS5930:2015; BS EN ISO 14688-1:2002 and BS EN ISO 14688-2:2004, and supervised at all times by an Engineering Geologist from QGL. All of the hand pits were backfilled with compacted layers of arisings upon completion with suitable surface reinstatement where required.

A complete set of engineer's Hand Pit logs are presented in Appendix II. No Groundwater was encountered within the hand pits.

The sequence of deposits encountered during the investigation is detailed within the Engineering Geologist's logs presented within Appendix II and summarised in Table 2.

Table 2: Summary of Strata encountered in Trial Pits

Strata Encountered	Elevation at base of strata (mbgl)		
	HP1	HP2	HP3
Topsoil	--	--	0.05
Made Ground	+1.20	+0.65	+0.90

+ - Base of strata not proven

-- Strat note encountered

The ground conditions identified in the Hand Pit undertaken on the northern side of the building comprised a layer of Topsoil. The other two pits solely comprised Made Ground from surface. The base of the Made Ground material was not found due to refusal on obstruction or maximum depth achieved.

A complete set of Engineer's Logs for the hand excavation pits are presented in Appendix II.

3.4 Machine Excavated Trial Pits

4 No. Trial Pits (TP1-TP4) were excavated using an 3-tonne tracked excavator at locations shown on the exploratory hole location plan. The purpose of the pits was to establish existing ground conditions.

This method of investigation allows direct sampling of the near surface deposits for identification purposes, as well as assessment of any salient features and Made Ground or disturbed ground. The Trial Pits were logged in accordance with BS5930:2015; EN ISO 14688-1:2002 and BS EN ISO 14688-2:2004, and supervised at all times by an Engineering Geologist from QGL.

Details of the Trial Pits, including final depths in metres below ground level (mbgl) are provided in Table 3 below:

Table 3: Trial Pit Termination Depth

Exploratory Hole ID	Termination Depth (mbgl)	Termination Strata	Reason for Termination
TP1	1.50	Made Ground	Terminated due to significant instability
TP2	1.70	Made Ground	Terminated due to significant instability
TP3	1.30	Made Ground	Terminated due to significant instability
TP4	1.40	Made Ground	Terminated due to significant instability

A complete set of Engineering Geologist's Machine Excavated Trial Pit Logs are presented within Appendix III.

3.5 In-Situ Testing

3.5.1 TRL DCP Probes

3No. TRL DCP probes were carried out in total, as TRL1, TRL2 and TRL3 undertaken at the specified positions within the existing grassed picnic area adjacent to the Barbecue building. The UK Transport Research Laboratory (TRL) Dynamic Cone Penetrometer (DCP) is an instrument designed for rapid insitu measurement of the structural properties of existing road pavements constructed with unbound materials. Continuous measurements can be made down to a depth of approximately 900mm. Where pavement layers have different strengths, the boundaries can be identified and the thickness of the layer identified. The equipment comprises an 8 kg weight dropping mass through a height of 575 mm, Anvil with driving rod, Penetration rod with 60°, 20 mm dia. Cone and Spanners, Tommy bar.

Correlations between the results of the DCP test and California Bearing Ratio (CBR) can be made. The correlations allow the rapid assessment of in-situ CBR values. The results of the DCP test results can be presented in the form of a continuous CBR vs Depth profile. As shown in the results in Appendix IV

3.5.2 Soakaway Tests

A single Soakaway test was undertaken within selected Trial Pit TP01 to assess the suitability of the strata for use as a drainage solution. The tests were undertaken in accordance with BRE Digest 365 (Revised 2016) and involves filling the trial pit with water and measuring the time elapse whilst the water level drops within the pit. The soakaway could not build a sufficient head of water due to a rapid outflow.

3.5.3 Soil Sampling

Geotechnical bulk and disturbed samples were taken where required within the superficial deposits for strata identification and laboratory testing purposes. In addition, environmental samples were taken for laboratory testing. All samples are returned from site to Quantum's Laboratory for controlled storage within 24 hours of sampling to await test scheduling/ requirements. Sample type and sample depth are all recorded on the Engineering Geologist's Exploratory Hole Logs found within the appropriate Appendix.

4.0 LABORATORY TESTING

4.1 General

The laboratory testing was scheduled by Quantum and comprised geotechnical and geo-chemical testing on selected soil samples obtained during the investigation.

4.2 Geotechnical Laboratory Testing

All the geotechnical soil testing was carried out in accordance with the procedure stipulated in the various sections of BS 1377:1999 Parts 1 – 9 Methods of test for soils for civil engineering purposes. Table 4 details the tests undertaken.

Table 4: Geotechnical Tests Undertaken

Type of Test	No. of Tests
BRE SD1 - Brownfield	2

A full set of geotechnical laboratory test certificates are provided within Appendix V

4.3 Geo-Environmental Laboratory Testing

Geo-Environmental testing was carried out on selected soil samples gained from the ground investigation as shown in Table 5 below. Please note that no groundwater was encountered during the investigation. The purpose of the testing is to gain a holistic view of any raised levels of contaminants that may exist onsite based on the historic, present day and future land use.

Table 5: Geo-Environmental tests undertaken on soil samples

Analytical Parameter (Soil Analysis)	Accreditation Status	No of Tests	Analytical Parameter (Soil Analysis)	Accreditation Status	No of Tests
Asbestos in Soil	ISO 17025	4	Boron (water soluble)	MCERTS	4
General			Cadmium (aqua regia extractable)	MCERTS	4
pH - Automated	MCERTS	6	Chromium (aqua regia extractable)	MCERTS	4
Total Cyanide	MCERTS	4	Copper (aqua regia extractable)	MCERTS	4
Water Sol. Sulphate as SO ₄	MCERTS	5	Lead (aqua regia extractable)	MCERTS	4
Organic Matter	MCERTS	4	Mercury (aqua regia extractable)	MCERTS	4
Chromium III	MCERTS	4	Nickel (aqua regia extractable)	MCERTS	4
Chromium Hexavalent (VI)	MCERTS	4	Selenium (aqua regia extractable)	MCERTS	4
Total Phenols			Vanadium (aqua regia extractable)	MCERTS	4
Total Phenols (monohydric)	MCERTS	4	Zinc (aqua regia extractable)	MCERTS	4
Speciated PAHs			Petroleum Hydrocarbons		
Naphthalene	MCERTS	4	TPH-CWG - Aliphatic >EC5 - EC6	MCERTS	4

Acenaphthylene	MCERTS	4	TPH-CWG - Aliphatic >EC6 - EC8	MCERTS	4
Acenaphthene	MCERTS	4	TPH-CWG - Aliphatic >EC8 - EC10	MCERTS	4
Fluorene	MCERTS	4	TPH-CWG - Aliphatic >EC10 - EC12	MCERTS	4
Phenanthrene	MCERTS	4	TPH-CWG - Aliphatic >EC12 - EC16	MCERTS	4
Anthracene	MCERTS	4	TPH-CWG - Aliphatic >EC16 - EC21	MCERTS	4
Fluoranthene	MCERTS	4	TPH-CWG - Aliphatic >EC21 - EC35	MCERTS	4
Pyrene	MCERTS	4	TPH-CWG - Aliphatic (EC5 - EC35)	MCERTS	4
Benzo(a)anthracene	MCERTS	4	TPH-CWG - Aromatic >EC5 - EC7	MCERTS	4
Chrysene	MCERTS	4	TPH-CWG - Aromatic >EC7 - EC8	MCERTS	4
Benzo(b)fluoranthene	MCERTS	4	TPH-CWG - Aromatic >EC8 - EC10	MCERTS	4
Benzo(k)fluoranthene	MCERTS	4	TPH-CWG - Aromatic >EC10 - EC12	MCERTS	4
Benzo(a)pyrene	MCERTS	4	TPH-CWG - Aromatic >EC12 - EC16	MCERTS	4
Indeno(1,2,3-cd)pyrene	MCERTS	4	TPH-CWG - Aromatic >EC16 - EC21	MCERTS	4
Dibenz(a,h)anthracene	MCERTS	4	TPH-CWG - Aromatic >EC21 - EC35	MCERTS	4
Benzo(ghi)perylene	MCERTS	4			
Total PAH					
Speciated Total EPA-16 PAHs	MCERTS	4			
Heavy Metals / Metalloids					
Arsenic (aqua regia extractable)	MCERTS	4			
Barium (aqua regia extractable)	MCERTS	4			
Beryllium (aqua regia extractable)	MCERTS	4			

5.0 GROUND CONDITIONS ENCOUNTERED

5.1 Overview of strata encountered

The sequence of deposits encountered during the investigation is detailed within the Engineering Geologist's logs presented in Appendix II and III. The following section summarizes the findings within the exploratory holes.

5.2 Detailed Ground Conditions

The general sequence of the ground conditions encountered varied between each trial pit as shown in Table 6 below.

Table 6: Summary of Strata encountered in exploratory holes in the Car Park

General Strata Description	Depth of Strata mbgl						
	TP1	TP2	TP3	TP4	HP1	HP2	HP3
Topsoil	0.10	0.20	0.10	0.20	-	-	-
Made Ground	+1.50	+1.70	+1.30	+1.40	+1.20	+0.60	+0.90

+ Depth of strata not proven

-- Strata not encountered

Made Ground was encountered in all exploratory holes carried out on the site and comprised a range of materials from Mudstone and siltstone cobbles to purplish grey brown sandy gravelly cobble and boulders. Consisting of sandstone, mudstone, slag, brick and flint. The depth of Made Ground was not found on site due to the coarse nature of the material and significant instability of the trial pit sides preventing progress to depth.

5.3 Groundwater Conditions

There were no ground water strikes recorded within the exploratory holes on site.

Please Note: The groundwater conditions observed in these trial pits are those appertaining to the period of the investigation and monitoring. However, it should be noted that groundwater levels are subject to tidal diurnal, seasonal and climatic conditions or may vary due to other causes.

5.4 Visual & Olfactory Evidence of Soil Contamination

Made Ground was identified within the site area which contained slag material as seen in TP4 from 0.30mbgl. This may suggest possible heavy metal contamination in this area.

5.5 Visual & Olfactory Evidence of Groundwater & Surface Water Contamination

There was no evidence of any groundwater contamination or surface water Contamination during the investigation works.

6.0 GEOTECHNICAL ENGINEERING APPRAISAL

6.1 General

The purpose of this Ground Investigation and subsequent reporting is to determine and assess the existing shallow ground conditions on site in preparation for the construction of a new proposed development at the Barbecue, Ocean Square, Saundersfoot Harbour.

The main aims of the geotechnical investigation are to provide an assessment of the ground conditions to inform initial design of the foundations and determine chemical conditions in respect of below ground structures and confirm ground water levels within the working area.

6.2 Engineering Properties of Strata

The soils at the site comprised Made Ground of varying content with unknown thicknesses in the grassed picnic area adjacent to the Barbecue building.

The engineering properties each strata is summarised below:

6.2.1 Made Ground

The geotechnical laboratory results undertaken within the Made Ground are summarised in Table 7.

Table 7: Summary of Clay Laboratory Test Results

Clay		Range	No. Tests
Moisture Content	%	9.2 - 10	2
Sulphate as SO ₄	g/l	0.0070 – 0.011	2
pH	NA	8.2 - 8.4	2

6.3 Earthworks

All earthworks shall be carried out according to best practice and in accordance with BS 6031:2009 Code of practice of earthworks. Foundations should be constructed and designed in accordance with BS 8000-0:2014 Workmanship on Construction Sites, BS 8004:2015 Code of practice for foundations and BS EN 1997-1:2004+A1:2013.

6.3.1 Site Preparation

Prior to commencing the earthworks/ groundwork for the development, all live services on and in the vicinity of the site should be accurately located and protected or if required diverted. The ends of existing drains or sewers, which will be made redundant by the development, should be sealed in order to prevent any

residual or persisting seepages from adversely affecting the integrity and or stability of the formations/ foundations. Service conduits and surface voids resulting from the sites preparation works should be filled and well compacted with acceptable granular material (DoT Type 1 or similar approved).

Any exposed formations should be protected from the effects of the weather, site traffic, or water in order to prevent deterioration of this surface. It is recommended that any exposed formations be protected with a minimum thickness of 200mm of suitable granular material or a thin layer of blinding concrete, which should be placed immediately after excavation and exposure.

6.3.2 Excavation Plant

On the basis of the observations made during the exploratory investigation it is considered that excavations throughout the Made Ground can be undertaken using conventional excavation methods and plant.

6.3.3 Stability of Excavation Sides / Slope Stability

The exploratory holes undertaken within the grassed picnic area encountered granular Made Ground material. Due to the predominantly granular nature of the Made Ground deposits significant instability of the trial pit sides was encountered/experienced. Therefore any excavations undertaken are likely to experience instability and any excavations within the Made Ground are likely to require shoring or lateral support or be battered back to a suitable safe angle if left open for a sustained period of time.

6.3.4 Control of Groundwater

Groundwater was not encountered during the investigation in any of the exploratory holes. However it may be present at increased depths across the site. It is then considered unlikely groundwater will be encountered within the shallow excavations undertaken. It is anticipated sump pumping will be adequate for dewatering shallow excavations if groundwater seepage is encountered, or where surface water ingress occurs. Therefore groundwater is not a significant issue for the due to the proposed development, but should be taken into consideration if any work is to be carried out at depth.

6.4 Foundation Assessment

6.4.1 Foundation Recommendations

No precise details are available at present as regards foundation loads of the proposed footprints of the new structures. However we understand that the proposed development in the existing area will comprise a framed, relatively lightweight, structure.

Based on the findings of this ground investigation the Made Ground identified across the site will not provide a suitable founding stratum for conventional strip foundation, given its highly variable and loose nature. Given possible significant magnitudes of differential and total settlements may occur. As a result, a raft foundation should be suitable for the proposed structure.

A raft or pad foundation in conjunction with excavation /replacement ground improvement; i.e. excavation of the existing poor ground to 1.0mbgl and replaced with an engineered fill such as type 1. Alternatively it may be possible to re-use the existing material following selection/screening process, followed by placement in accordance with an appropriate earthworks engineering specification.

A piled/mini piled foundation system with a suspended floor slab is also a possibility. If a piled foundation solution is preferable, it is suggested further investigation is undertaken to establish the thickness of the Made Ground deposits and depth of competent soil or rock.

6.4.2 Foundation Concrete Class Designation

The Aggressive Chemical Environment for Concrete (ACEC) classification for the site has been assessed according to the guidelines within BRE Special Digest 1 (2005). For classification purposes, based on the BRE guidance, the groundwater must be classed as 'mobile' unless proven to be 'static' over a 24hr period.

The pH values of the soil samples taken from across the site ranged from 8.2 – 8.4, slightly alkaline conditions. The levels of water-soluble sulphate (SO₄) content of the tested soil samples varied between 0.011g/l (11mg/l) to 0.0077g/l (7.7mg/l).

Based on the above, the Design Sulphate (DS) class for the site is DS-1, and the Aggressive Chemical Environment for Concrete (ACEC) site classification is AC-1, assuming mobile groundwater conditions. The ACEC testing undertaken focused on the superficial deposits.

6.4.3 Pavement Design

In total 3No. CBR tests carried out across the site performed using a hand held TRL-DCP, undertaken from the surface. Table 8 details the results of the CBR testing.

Table 8: CBR Results

Location	Derived CBR Value (%)
CBR 1	6
CBR2	3
CBR3	7

Given the results of the CBR testing it is recommended a site wide CBR design value of 3% is assumed unless in-situ testing is undertaken within the zone of the proposed hard standing at formation depths to prove otherwise.

7.0 GEO-ENVIRONMENTAL CONSIDERATIONS

7.1 General

The following section assesses the findings of the geo-environmental laboratory results from samples obtained during the ground investigation. The risks to human health and the environment are both considered herein.

7.2 Human Health Risk Assessment Criteria

For the purposes of Quantum Geotechnical Ltd assessments, the most recent and applicable SGVs, GACs, SU4Ls and C4SLs are used based on site end use and development and overall suitability. These are all referenced within the text. SU4Ls take precedence in QGL assessments. Where these are not available or suitable, C4SLs are adopted.

By adopting the CLEA approach to human health risk assessment as defined in CLR11, a human health risk assessment has been undertaken for the proposed development adopting the least sensitive model of Commercial threshold values.

The assessment criteria used in this assessment is that presented by LQM/CIEH in their publication The LQM/CIEH S4ULs for Human Health Risk Assessment (2015). The S4ULs (Suitable for Use Levels) used have been derived in accordance with UK legislation, national as well as Environmental Agency policy and using a modified version of the Environmental Agency CLEA software and available guidance provided to the contaminated land practitioner community for the purpose of deriving Generic Assessment Criteria (GAC).

The LQM/CIEH S4ULs are intended for use in assessing potential risks posed to human health by contaminants in soil and as transparently derived and cautious 'trigger values' above which further assessment or remedial action may be necessary. By using the LQM/CIEH S4ULs, Quantum Geotechnical acknowledges Copyright Land Quality Management Ltd reproduced with permission; Publication Number S4UL3409. All Rights Reserved.

7.3 Pre-Intrusive Investigation Conceptual Site Model

A Pre-intrusive investigation Conceptual Site Model was identified with the Quantum Desk Study Report G40102/DS. The CSM is a representation of the current understanding of the site and its surrounding environment with regards to geology, groundwater, surface waters, and potential contamination on-site and adjacent off-site and any migration pathways.

The potential risks to the proposed development and adjacent land have been assessed by consideration

of the potential pollution linkages. For a risk to exist there must be a source of contamination, a receptor that may be harmed, and a pathway by which the receptor could be exposed to the contaminant. Only when all three factors are present (i.e. source, pathway, and receptor) can a pollution linkage, and consequently an unacceptable risk, exist. The conceptual site model considers all three elements and the potential for pollution linkages that may exist. If no linkage is identified then there is considered to be no or negligible risk.

The information gained from the land use desk study assessment has been collated to identify any potential pathways that may exist between any contamination source and its receptors. The Conceptual Site Model has been developed for the proposed end use. Receptors specific for the proposed end use considered in the assessment are as follows:

- Human Health – end users
- Controlled Waters – ground water and surface waters
- Buildings and Services

The main potential contamination source at the site is the possible Made Ground associated possible historic infilling of the site. Given the historical dock and railway use of the area, the material used for any re-profiling/infilling may be waste generated from the industrial processes. Due to the possible presence of potentially contaminated Made Ground across the site there may be a contamination source present on site. The risk of land contamination on site is considered medium.

Details of the pathways associated with each of the components are highlighted in the following set of tables:

Table 9: Existing Pollutant Linkages *on-site to on-site*

Potential Sources onsite	• POSSIBLE MADE GROUND - Heavy Metals, Total Petroleum Hydrocarbons, Polycyclic Aromatic Hydrocarbons, and Asbestos. • CONTAMINATED SOILS – Plant spillage/leaks	
Potential Pathways on-site to on-site	Receptors onsite	
• Dermal contact with contaminated soils – dermatitis. • Ingestion of soil, water or dust through ground maintenance etc. • Inhalation of dust or land gas emissions from Made Ground and organic soils. • Leaching of contaminated soils into groundwater. • Migration of groundwater across site. • Flooding of Zones 2/3	Future Site End Users including Workers, Construction Workers and Visitors. Groundwater: – Bedrock: ‘Secondary A’ aquifer	
• Chemically aggressive contaminants identified at raised concentrations.	Buildings and services.	

Table 10: Existing Pollutant Linkages *on-site to off-site*

Potential Sources onsite	• POSSIBLE MADE GROUND - Heavy Metals, Total Petroleum Hydrocarbons, Polycyclic Aromatic Hydrocarbons, and Asbestos. • CONTAMINATED SOILS – Historic spillage/leaks	
Potential Pathways on-site to off-site		Receptors offsite
• Inhalation of dust or land gas emissions from possible Made Ground and organic soils. • Leaching of contaminated soils into groundwater. • Migration from groundwater to surface waters. • Migration of contaminants through groundwater off-site leading to potential dermal contact, ingestion of soil, water or dust and inhalation of gas emissions. • Flooding of Zones 2/3		Neighbouring site users and occupiers Groundwater: – Bedrock: ‘Secondary A’ aquifer

Table 11: Existing Pollutant Linkages *off-site to on-site*

Potential Sources offsite	• POSSIBLE MADE GROUND - Heavy Metals, Total Petroleum Hydrocarbons, Polycyclic Aromatic Hydrocarbons, and Asbestos. • HISTORIC SITE USES – Docks, Railway and tramway siding and tunnels. • ELECTRICITY SUB STATION	
Potential Pathways off-site to on-site		Receptors onsite
• Inhalation of dust or land gas emissions from Made Ground and organic soils. • Migration of contaminants through groundwater on-site leading to potential dermal contact, ingestion of soil, water or dust and inhalation of gas emissions. • Flooding of Zones 2/3		Future Site End Users including Workers, Construction Workers and Visitors. Groundwater: – Bedrock: ‘Secondary A’ aquifer

The aforementioned CSM will be reviewed later in the report following assessment of the laboratory test results findings and information gathered from the intrusive investigation.

7.3.1 Soil Sample Test Results Comparisons

Heavy Metal and Inorganic Compounds

The results of levels of potential contaminants have been compared to generic assessment criteria as described above, for a ‘Commercial’ end use as being considered the most appropriate threshold for human health. The test certificated are included in Appendix V. The concentrations of heavy metal and inorganic compounds are summarized in the Table 12.

Table 12: Summary of Heavy Metals and Inorganic Soil Test Results

Determinant	Results Range (mg/kg)	LQM/CIEH (2015) GAC (mg/kg) Commercial End Use ⁽¹⁾	Exceedances
	Made Ground		
Arsenic (aqua regia extractable)	14 - 38	640	0
Boron (water soluble)	0.3 – 1.0	240,000	0
Cadmium (aqua regia extractable)	<0.2	190	0
Chromium (aqua regia extractable)	<4.0	8,600	0
Copper (aqua regia extractable)	10 - 64	68,000	0
Lead (aqua regia extractable)	39 - 130	2,300	0
Mercury (aqua regia extractable)	<0.3	1,100	0
Nickel (aqua regia extractable)	23 - 31	980	0
Selenium (aqua regia extractable)	<1.0	12,000	0
Zinc (aqua regia extractable)	40 - 120	730,000	0

Notes:

(1). GAC from LQM/CIEH S4ULs 2015. (2). GAC from LQM/CIEH 2009 & 2015. (3). GAC from DEFRA C4SL. (4). GAC from AtRisk adopting most sensitive end use for acute risk.

Polycyclic Aromatic Hydrocarbons

The results of levels of potential contaminants have been compared to generic assessment criteria as described, for a Commercial end use as being considered the most appropriate threshold for human health relating to handling of soils and for a Soil Organic Matter (SOM) content of 1%. The test certificates are included in Appendix V. The concentrations of speciated Polycyclic Aromatic Hydrocarbon are summarised and compared in the Table 13.

Table 13: Summary of Polycyclic Aromatic Hydrocarbon Soil Test Results

Determinant	Site Results Range (mg/kg)	LQM/CIEH (2015) GAC Commercial (mg/kg)	Exceedances
		1% SOM	
Organic Matter	0.6-4.1		
Naphthalene	<0.05	190	0
Acenaphthylene	<0.05	83,000	0
Acenaphthene	<0.05	84,000	0
Fluorene	<0.05	63,000	0
Phenanthrene	<0.05-0.64	22,000	0
Anthracene	<0.05	520,000	0
Fluoranthene	0.32-1.1	23,000	0
Pyrene	<0.05-0.97	54,000	0
Benzo(a)anthracene	<0.05-0.77	170	0
Chrysene	<0.05-0.57	350	0
Benzo(b)fluoranthene	<0.05-0.65	44	0
Benzo(k)fluoranthene	<0.05-0.38	1,200	0
Benzo(a)pyrene	<0.05-0.64	35	0
Indeno(1,2,3-cd)pyrene	<0.05-0.31	500	0
Dibenz(a,h)anthracene	<0.05	3.5	0
Benzo(ghi)perylene	<0.05-0.34	3,900	0

Notes:

(1). GAC from LQM/CIEH S4ULs 2015.

Total Petroleum Hydrocarbons

The results of levels of potential contaminants have been compared to generic assessment criteria as described, for a Commercial end use as being considered the most appropriate threshold for human health relating to handling of soils and for a Soil Organic Matter (SOM) content of 1%. The test certificates are included in Appendix V. The concentrations of speciated Petroleum Hydrocarbon are summarised and compared in the Table 14.

Table 14: Summary of Petroleum Hydrocarbon Soil Test Results

Determinand	Site Results Range (mg/kg)	LQM/CIEH (2015) GAC ⁽¹⁾ Residential without Plant Uptake (mg/kg)	
		1% SOM	Exceedances
Organic Matter	0.6-4.1		
TPH – Aliphatic EC5-6	<0.001	3,200	0
TPH – Aliphatic >EC6-8	<0.001	7,800	0
TPH – Aliphatic >EC8-10	<0.001	2,000	0
TPH – Aliphatic >EC10-12	<1.0	9,700	0
TPH – Aliphatic >EC12-16	<2.0	59,000	0
TPH – Aliphatic >EC16-21	<8.0	1,600,000	0
TPH – Aliphatic >EC21-35	<8.0	1,600,000	0
TPH – Aromatic >EC5-7	<0.001	26,000	0

TPH – Aromatic >EC7-8	<0.001	56,000	0
TPH – Aromatic >EC8-10	<0.001	3,500	0
TPH – Aromatic >EC10-12	<1.0	16,000	0
TPH – Aromatic >EC12-16	<2.0	36,000	0
TPH – Aromatic >EC16-21	<10	28,000	0
TPH – Aromatic >EC21-35	<10	28,000	0
TPH – Aromatic >EC5-EC35	<10	28,000	0

Notes:

(1). GAC from LQM/CIEH S4ULs 2015. (2). GAC for C16 – C35 only quoted.

Total Phenols

Total Phenols (monohydric) all recorded values of <1.0mg/kg in the Made Ground soil samples.

Asbestos

Asbestos identification undertaken on each of the samples tested recorded 'not-detected'.

7.4 Recommendations on Contaminated Land

7.4.1 Human Health Risks of Site End Users

No samples taken within the Made Ground across the site exceeded values when assessed against the criteria for commercial site end use. Therefore from the exploratory holes, the risk of contamination from potential sources affecting site end users is negligible and a significant risk is unlikely to exist.

7.4.2 Human Health Risks of Workers during Construction

The geo-environmental laboratory test results did not identify raised contaminant concentrations within the Made Ground material on the site, therefore the risk posed to construction operatives from chemical contaminants within the Made Ground/ shallow ground would be negligible.

However, operatives working with, or likely to come into contact with the Made Ground, should still observe particular precautions concerning personal hygiene. They should be issued with the appropriate personal protective equipment and should be instructed in safe working methods.

Instructions should be issued in the recognition of potentially hazardous materials including oily and odorous soil and water and also any discoloured or fibrous substances for example. Operatives should be warned to avoid contact between hands and mouth before washing. The consumption of food must be confined to designated clean areas with suitable welfare including washing facilities should be provided.

7.5 Review of Conceptual Site Model

Based on the Phase I Desk Study and the findings of the Phase II Investigation, no potential source-

pathway-receptor (S-P-R) linkages have been identified within the Made Ground deposits across the site.

With regards to risk to Human Health, a potential source is unlikely to exist on site and therefore the S-P-R linkage will not exist.

In addition, it is believed the proposed development will involve the construction of an impermeable hardstanding across the site and therefore if any unidentified contamination sources are present on site, the hardstanding layer will remove any pathway between source and receptor.

During the construction phase (and any future construction works that involve excavations), if Made Ground deposits are to be exposed, as the Made Ground was highly varied across the site and although considered unlikely, the potential of unidentified contamination exists and therefore a risk may exist to construction workers through dermal contact and neighbouring site users through wind-blown dust migration. Any pathways may be removed by the use of suitable PPE and suitable working methods which should include damping down of the Made Ground if dust creation could potentially occur.

In summary, no significantly elevated potential contaminant concentrations have been identified within the Made Ground samples tested and therefore a potential contamination source has also not been identified. Given the proposed development will involve the construction of hardstanding across the site any potential contamination will also be removed. It is therefore considered unlikely that significant risk to future site users from potential contamination that exists.

8.0 REFERENCES

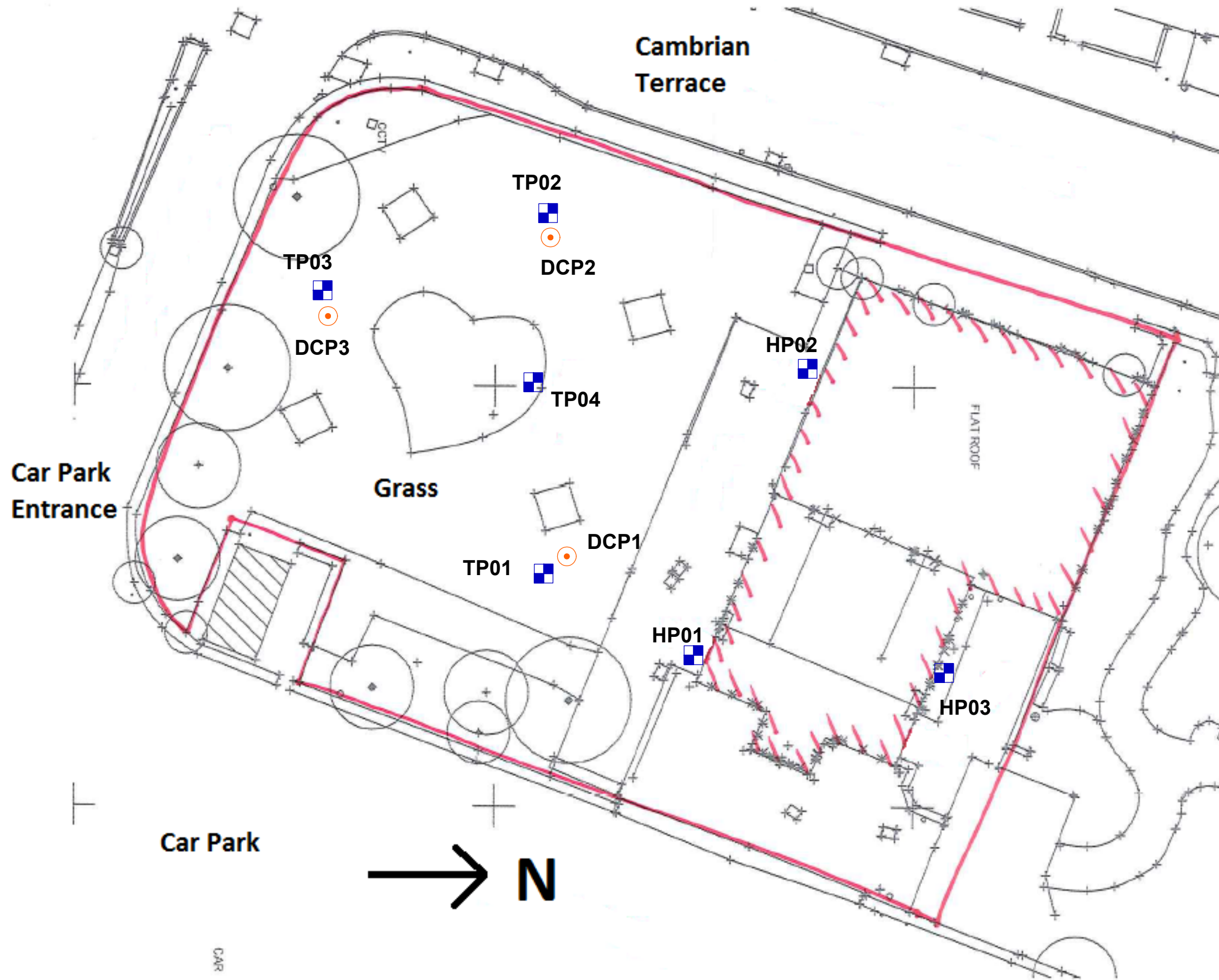
British Geological Survey:

- British Geological Survey Sheet 228 Haverfordwest: 1:50,000 scale, Bedrock and Superficial edition
- BGS Lexicon of Named Rock Units (www.bgs.ac.uk/lexicon)
- BGS Geology of Britain Viewer (www.bgs.ac.uk)

Specialist Publications:-

- British Code of Practice BS 5930:2015 '*Code of Practice for Site Investigations*'
- British Code of Practice BS 1377:1990 '*Methods of test for soils for civil engineering purposes*'.
- British Code of Practice BS EN ISO 14688-1:2002+A2:2013 Geotechnical investigation and testing. Identification and classification of soil. Identification and description
- British Code of Practice BS EN ISO 14688-2:2004+A2:2013 Geotechnical investigation and testing. Identification and classification of soil. Principles for a classification.
- British Code of Practice BS EN ISO 14689-1:2003 Ground Investigation and Testing – Identification and classification of rock
- Health and Safety Executive Guidance Note EH40/90
- *CIRIA Report 143* 'The Standard Penetration Test (SPT): Methods and Use', 1995.
- BRE (2005) Special Digest 1:2005, 3rd Edition, Concrete in aggressive ground. BRE, Garston.
- BS 6031:2009 Code of Practice for Earthworks.
- BS 8004:2015 Code of Practice for Foundations.
- BS 8000-0:2014 Workmanship on Construction Sites.
- BS EN 1997-1:2004+A1:2013 Eurocode 7: Geotechnical Design - Part 1: General Rules
- Foundation design and construction / M.J Tomlinson; with contributions by R. Boorman – 7th Edition 2001

APPENDIX I – SITE PLANS

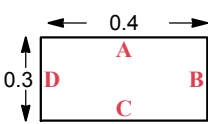


APPENDIX II – HAND EXCAVATION PIT LOGS

Contract : Ocean Square, Saundersfoot Client : Saundersfoot Harbour							Trial Pit No. HP01	
Dates : 8/1/18 - 8/1/18 Location :				Job Number : G40102 Engineer :		Ground Level : Coordinates:		

m B.G.L.	Samples		Tests		Strata			WATER
	Depth	Type No.	Depth	Test Results	Depth (Thickness)	Description	Legend	
					0.03	Concrete floor slab		(0.03)
					0.03	MADE GROUND: Weak brown CONCRETE		0.03
					0.05	MADE GROUND: ASPHALT		(0.05)
					0.08	MADE GROUND: Dark grey slightly sandy GRAVEL. Gravel fine to coarse, subangular to angular, limestone (SUBBASE)		0.08
					0.04			(0.04)
					0.12	MADE GROUND: Soft dark grey to brown slightly sandy gravelly CLAY. Gravel is fine to coarse, rounded to angular, brick, concrete, slag, mudstone, ceramics and sandstone. @0.70-1.20 sandy gravelly clay		0.12
					0.18			(0.18)
					0.30			0.30
	0.50 -	ES1						
					0.90			(0.90)
1	1.00 -	ES2						
					1.20	Hand Pit terminated at 1.20mbgl maximum depth reached		1.20

PLAN



Groundwater: No Groundwater Encountered

Stability: Stable

Shoring: N/A

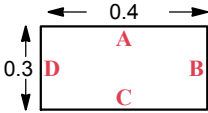
Remarks :

Equipment Used: Various insulated hand digging tools

	Ty Berwig, Bynea, Llanelli SA14 9ST Tel: 01554744880 Fax: 01554776750 email: www.quantum-geotech.co.uk	Operator: KJ	Logged By: J Phillips	Sheet No. 1 Of 2	m Per Page 3	All measurements in metres unless otherwise stated	
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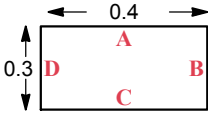
Contract : Ocean Square, Saundersfoot Client : Saundersfoot Harbour		Trial Pit No. HP01
Dates : 8/1/18 - 8/1/18 Location :	Job Number : G40102 Engineer :	Ground Level : Coordinates:



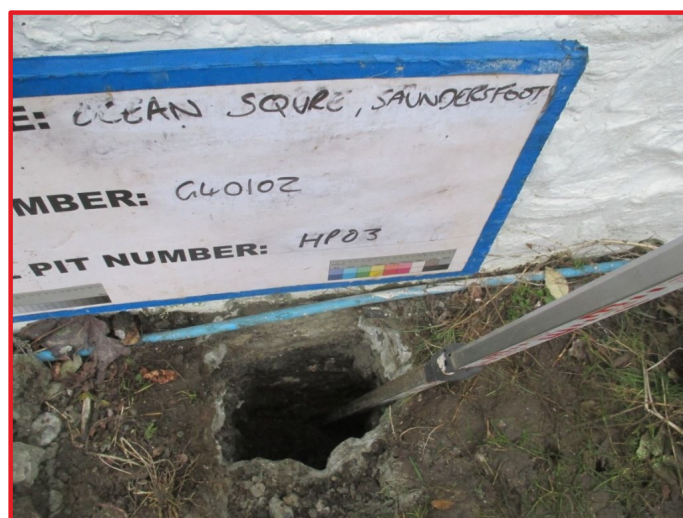
Contract : Ocean Square, Saundersfoot Client : Saundersfoot Harbour							Trial Pit No. HP02		
Dates : 9/1/18 - 9/1/18 Location :			Job Number : G40102 Engineer :			Ground Level : Coordinates:			
m B.G.L.	Samples		Tests		Strata				WATER
	Depth	Type No.	Depth	Test Results	Depth (Thickness)	Description	Legend	Depth (Thickness)	
	0.30 - 0.30 - 0.40	ES1 B2			0.03	Concrete floor slab		(0.03)	
					0.03	MADE GROUND: Weak brown CONCRETE to strong grey		0.03	
					0.12	CONCRETE		(0.12)	
					0.15	MADE GROUND: Dark grey slightly sandy GRAVEL. Gravel		0.15	
					0.08	fine to coarse, subangular to angular, limestone (SUBBASE)		(0.08)	
					0.23	MADE GROUND: Soft dark grey to brown slightly sandy		0.23	
						gravelly CLAY rare cobble content. Gravel is fine to coarse, rounded to angular, brick, concrete, slag, mudstone, ceramics and sandstone. Cobbles sub-rounded mudstone.		(0.42)	
					0.42				
					0.65	Hand Pit terminated at 0.65mbgl foundations exposed		0.65	
PLAN 			Groundwater: No Groundwater Encountered Stability: Stable Shoring: N/A			Remarks :			
Equipment Used: Various insulated hand digging tools									
			Ty Berwig, Bynea, Llanelli SA14 9ST Tel: 01554744880 Fax: 01554776750 email: www.quantum-geotech.co.uk			Operator: KJ		Logged By: J Phillips	
Sheet No. 1 Of 2		m Per Page 3		All measurements in metres unless otherwise stated					

Contract : Ocean Square, Saundersfoot Client : Saundersfoot Harbour		Trial Pit No. HP02
Dates : 9/1/18 - 9/1/18 Location :	Job Number : G40102 Engineer :	Ground Level : Coordinates:

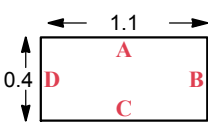


Contract : Ocean Square, Saundersfoot Client : Saundersfoot Harbour							Trial Pit No. HP03								
Dates : 9/1/18 - 9/1/18 Location :				Job Number : G40102 Engineer :		Ground Level : Coordinates:									
m B.G.L.	Samples		Tests		Strata				WATER						
	Depth	Type No.	Depth	Test Results	Depth (Thickness)	Description	Legend	Depth (Thickness)							
	0.40 -	ES1			0.05	TOPSOIL: Brown sandy slightly gravelly CLAY. Gravel fine to medium, sub-rounded to angular, brick, concrete and mudstone.		(0.05)							
			0.05		0.05										
			0.25		MADE GROUND: Strong grey CONCRETE	(0.25)									
			0.30		MADE GROUND: Soft black and brown slightly sandy gravelly CLAY. Gravel is fine to coarse, sub-rounded to angular, sandstone, mudstone, brick, concrete, creamics and slag.	0.30									
			0.35			(0.35)									
			0.65		MADE GROUND: Grey and brown slightly clayey gravelly COBBLES. Gravel is fine to coarse, sub-rounded to sub-angular, mudstone. Cobbles of sub-angular, mudstone.		0.65								
			0.25				(0.25)								
			0.90		Hand Pit terminated at 0.90mbgl due to refusal			0.90							
PLAN 			Groundwater: No Groundwater Encountered Stability: Stable Shoring: N/A			Remarks :									
Equipment Used: Various insulated hand digging tools															
 Ty Berwig, Bynea, Llanelli SA14 9ST Tel: 01554744880 Fax: 01554776750 email: www.quantum-geotech.co.uk				Operator: KJ		Logged By: J Phillips		Sheet No. 1 Of 2		m Per Page 3		All measurements in metres unless otherwise stated			

Contract : Ocean Square, Saundersfoot Client : Saundersfoot Harbour		Trial Pit No. HP03
Dates : 9/1/18 - 9/1/18 Location :	Job Number : G40102 Engineer :	Ground Level : Coordinates:



APPENDIX III – MACHINE EXCAVATED TRIAL PIT LOGS

Contract : Ocean Square, Saundersfoot Client : Saundersfoot Harbour							Trial Pit No. TP01		
Dates : 8/1/18 - 8/1/18 Location :			Job Number : G40102 Engineer :			Ground Level : Coordinates:			
m B.G.L.	Samples		Tests		Strata			WATER	
	Depth	Type No.	Depth	Test Results	Depth (Thickness)	Description	Legend		Depth (Thickness)
1	0.20 -	ES1			0.10	TOPSOIL: Brown sandy slightly gravelly CLAY. Gravel fine to coarse, sub-rounded to angular, brick mudstone and sandstone. MADE GROUND: Soft black to dark brown sandy gravelly CLAY. Gravel is fine to coarse, rounded to sub-angular, mudstone, sandstone, brick, glass and concrete. MADE GROUND: Brown gravelly SAND with occasional cobble content. Sand is coarse. Gravel is fine to coarse, rounded to angular, brick, sandstone and mudstone. Cobbles of sub-rounded sandstone and mudstone.		(0.10)	
					0.10			0.10	
					0.20			(0.20)	
	0.60 - 0.60 - 0.80 0.60 -	ES2 B3 D6			0.30			0.30	
					0.50			(0.50)	
					0.80			0.80	
	1.20 - 1.20 - 1.40	ES4 B5			0.70			(0.70)	
				1.50	1.50				
					Trial Pit terminated at 1.50mbgl due to collapsing sides				
PLAN 			Groundwater: No Groundwater Encountered Stability: Unstable collapsing sides Shoring: N/A			Remarks : Soakaway attempted within trial pit. Failed due to rapid out flow, unable to fill pit.			
Equipment Used: 3T Tracked Mini Excavator									
			Ty Berwig, Bynea, Llanelli SA14 9ST Tel: 01554744880 Fax: 01554776750 email: www.quantum-geotech.co.uk			Operator: KJ		Logged By: J Phillips	
Sheet No. 1 Of 2		m Per Page 3		All measurements in metres unless otherwise stated					

Contract : Ocean Square, Saundersfoot Client : Saundersfoot Harbour		Trial Pit No. TP01
Dates : 8/1/18 - 8/1/18 Location :	Job Number : G40102 Engineer :	Ground Level : Coordinates:



Contract : Ocean Square, Saundersfoot Client : Saundersfoot Harbour							Trial Pit No. TP02	
Dates : 8/1/18 - 8/1/18 Location :			Job Number : G40102 Engineer :			Ground Level : Coordinates:		

m B.G.L.	Samples		Tests		Strata			WATER
	Depth	Type No.	Depth	Test Results	Depth (Thickness)	Description	Legend	
1	0.40 - 0.40 - 0.60 0.40 -	ES1 B2 D6			0.10	TOPSOIL: Brown sandy slightly gravelly CLAY. Gravel fine to coarse, sub-rounded to angular, brick mudstone and sandstone. MADE GROUND: Light yellowish brown slightly clayey gravelly SAND with frequent cobble content and rare boulder content. Gravel is fine to coarse, rounded to sub-angular, flint, limestone, mudstone, slate and sandstone. Cobbles of sub-rounded mudstone and sandstone. Boulders of sub-rounded sandstone. @1.30mbgl, 0.40cm lense of black to brown gravelly Clay. Gravel is fine to coarse, sub-rounded to angular, brick, sandstone and slag. MADE GROUND: Brown gravelly SAND with occasional cobble content. Gravel is fine to coare, rounded to angular, sandstone and mudstone. Cobbles of sub-rounded sandstone and mudstone.		0.10
					0.10			
					0.10			
					0.20			
					0.20			
	1.00 -	ES3			1.50			(1.50)
	1.40 - 1.40 - 1.60	ES4 B5						
					1.70	Trial Pit terminated at 1.70mbgl due to collapsing sides		1.70

PLAN

Groundwater: No Groundwater Encountered

 Stability: Unstable collapsing sides

 Shoring: N/A

Remarks :

Equipment Used: 3T Tracked Mini Excavator

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Contract : Ocean Square, Saundersfoot

Client : Saundersfoot Harbour

Trial Pit No.

TP02

Dates : 8/1/18 - 8/1/18

Job Number : G40102

Ground Level :

Location :

Engineer :

Coordinates:



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Operator:
KJ

Logged By:
J Phillips

Sheet No.
2 Of 2

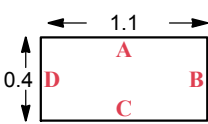
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All measurements in
metres unless
otherwise stated



Contract : Ocean Square, Saundersfoot Client : Saundersfoot Harbour							Trial Pit No. TP03	
Dates : 8/1/18 - 8/1/18 Location :			Job Number : G40102 Engineer :			Ground Level : Coordinates:		

m B.G.L.	Samples		Tests		Strata			WATER
	Depth	Type No.	Depth	Test Results	Depth (Thickness)	Description	Legend	
1	0.20 -	ES1			0.10	TOPSOIL: Brown sandy slightly gravelly CLAY. Gravel fine to coarse, sub-rounded to angular, brick, mudstone and sandstone. MADE GROUND: Soft black to dark brown sandy gravelly CLAY. Gravel is fine to coarse, rounded to sub-angular, mudstone, sandstone, brick and concrete. MADE GROUND: Grey and brown gravelly COBBLES. Gravel is fine to coarse, sub-rounded to angular, mudstone. Cobbles of sub-rounded to sub-angular, mudstone and sandstone.		(0.10)
					0.10			0.10
					0.20			(0.20)
					0.30			0.30
	0.80 - 1.00	B2	1.00		(1.00)			
				1.30	Trial Pit terminated at 1.30mbgl due to collapsing sides			1.30

PLAN


Groundwater: No Groundwater Encountered

 Stability: Unstable collapsing sides

 Shoring: N/A

Remarks :

Equipment Used: 3T Tracked Mini Excavator

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Contract : Ocean Square, Saundersfoot

Client : Saundersfoot Harbour

Trial Pit No.

TP03

Dates : 8/1/18 - 8/1/18

Job Number : G40102

Ground Level :

Location :

Engineer :

Coordinates:



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Operator:
KJ

Logged By:
J Phillips

Sheet No.
2 Of 2

m Per
Page

All measurements in
metres unless
otherwise stated



Contract : Ocean Square, Saundersfoot Client : Saundersfoot Harbour							Trial Pit No. TP04	
Dates : 8/1/18 - 8/1/18 Location :			Job Number : G40102 Engineer :			Ground Level : Coordinates:		

m B.G.L.	Samples		Tests		Strata			WATER
	Depth	Type No.	Depth	Test Results	Depth (Thickness)	Description	Legend	
1	0.50 -	ES1 B2 D3			0.10	TOPSOIL: Brown sandy slightly gravelly CLAY. Gravel fine to coarse, sub-rounded to angular, brick, mudstone and sandstone.		(0.10)
					0.10	MADE GROUND: Soft black to dark brown sandy gravelly CLAY. Gravel is fine to coarse, rounded to sub-angular, mudstone, sandstone and brick.		0.10
					0.10			(0.10)
					0.20	MADE GROUND: Brown SAND and GRAVEL. Sand is coarse. Gravel is fine to coarse, rounded to angular, sandstone and mudstone.		0.20
					0.10			(0.10)
					0.30	MADE GROUND: Purplish grey brown sandy gravelly COBBLES with occasional boulder content. Gravel is fine to coarse, rounded to angular, mudstone, sandstone, slag, brick and flint. Cobbles of sub-rounded to sub-angular, sandstone, mudstone and slag. Boulders of sub-rounded sandstone.		0.30
				1.10			(1.10)	
					1.40	Trial Pit terminated at 1.40mbgl due to collapsing sides		1.40

PLAN

Groundwater: No Groundwater Encountered

 Stability: Unstable collapsing sides

 Shoring: N/A

Remarks :

Equipment Used: 3T Tracked Mini Excavator

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Contract : Ocean Square, Saundersfoot

Client : Saundersfoot Harbour

Trial Pit No.

TP04

Dates : 8/1/18 - 8/1/18

Job Number : G40102

Ground Level :

Location :

Engineer :

Coordinates:



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Operator:
KJ

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J Phillips

Sheet No.
2 Of 2

m Per
Page

All measurements in
metres unless
otherwise stated

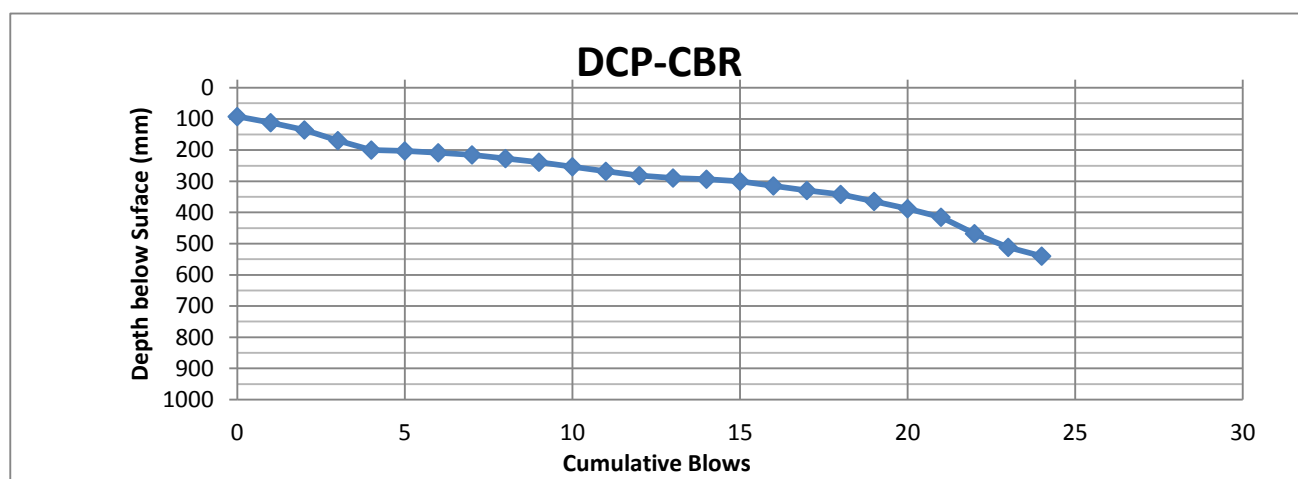


APPENDIX IV – TRL-DCP CBR RESULTS

Determination of Equivalent CBR using TRL Dynamic Cone Penetrometer DCP
CBR Relationship based on Kleyn & Van Heerden (60° Cone) - TRL, DMRB HD 29/08 & TP 12

Client Name:	Saundersfoot Harbour		
Client Address:	Saundersfoot Harbour Office, The Harbour, Saundersfoot. SA69 9HE		
Contract Name:	Ocean Square	Contract No.:	G40102

Site Reference:	1	Lab. Reference:	1	Date Tested:	08.01.18
Sample Location:	TRL 1			Date Received:	08.01.18
Material Description:					
Supplier:	In-Situ		Source:	In-Situ	
Depth Start of Test (mm)	92mm b.g.l.		Tested By:	JP	



CBR Relationship - TRL Equation $\log_{10}(\text{CBR}) = 2.48 - 1.057 \cdot \log_{10}(\text{Penetration Rate})$

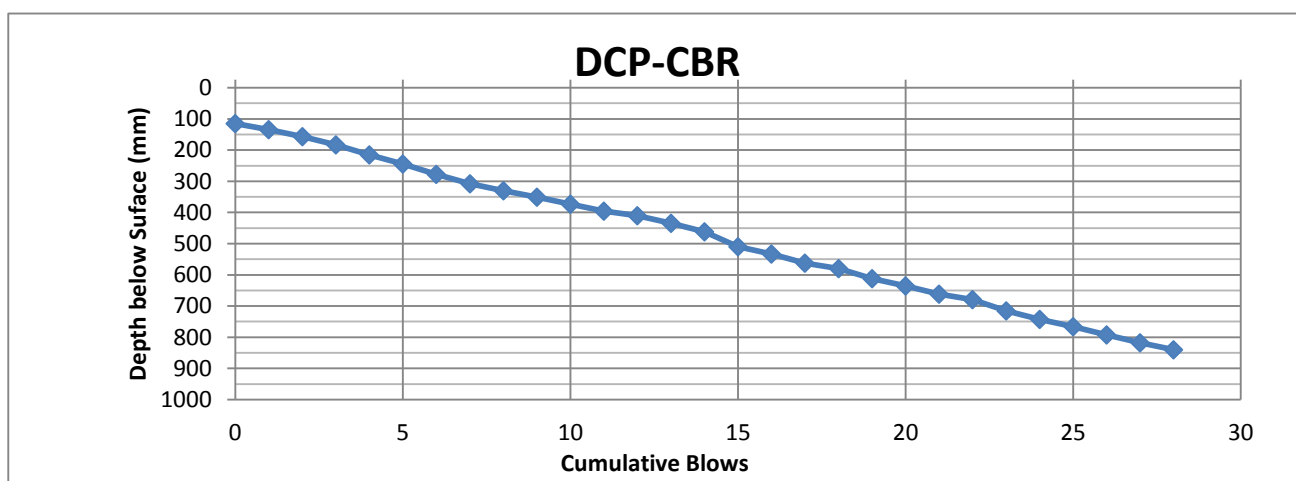
Layer No.	Number of Blows		Penetration (mm)		Rate of Penetration (mm/blow)	Equivalent CBR (%)	Remarks
	Start	Finish	Start	Finish			
1	0	4	92	200	27.00	9	
2	4	21	200	415	12.65	21	
3	21	24	415	540	41.67	6	Terminated due to an obstruction sending off vertical

Signed: **G.Morris**
 Position: Laboratory Manager
 Dated: 26 January 2018

Determination of Equivalent CBR using TRL Dynamic Cone Penetrometer DCP
CBR Relationship based on Kleyn & Van Heerden (60° Cone) - TRL, DMRB HD 29/08 & TP 12

Client Name:	Saundersfoot Harbour		
Client Address:	Saundersfoot Harbour Office, The Harbour, Saundersfoot. SA69 9HE		
Contract Name:	Ocean Square	Contract No.:	G40102

Site Reference:	1	Lab. Reference:	2	Date Tested:	08.01.18
Sample Location:	TRL 2			Date Received:	08.01.18
Material Description:					
Supplier:	In-Situ		Source:	In-Situ	
Depth Start of Test (mm)	115mm b.g.l.		Tested By:	JP	



CBR Relationship - TRL Equation $\log_{10}(\text{CBR}) = 2.48 - 1.057 * \log_{10}(\text{Penetration Rate})$

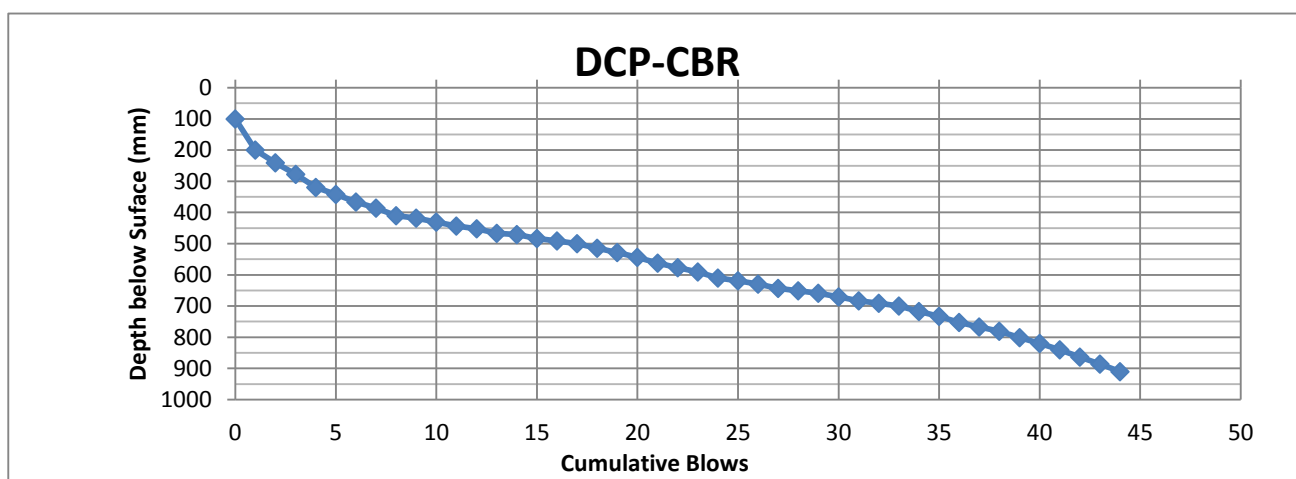
Layer No.	Number of Blows		Penetration (mm)		Rate of Penetration (mm/blow)	Equivalent CBR (%)	Remarks
	Start	Finish	Start	Finish			
1	0	13	115	435	24.62	10	
2	13	15	435	510	37.50	7	
3	15	28	510	840	25.38	10	

Signed: **G.Morris**
 Position: Laboratory Manager
 Dated: 26 January 2018

Determination of Equivalent CBR using TRL Dynamic Cone Penetrometer DCP
CBR Relationship based on Kleyn & Van Heerden (60° Cone) - TRL, DMRB HD 29/08 & TP 12

Client Name:	Saundersfoot Harbour		
Client Address:	Saundersfoot Harbour Office, The Harbour, Saundersfoot. SA69 9HE		
Contract Name:	Ocean Square	Contract No.:	G40102

Site Reference:	1	Lab. Reference:	3	Date Tested:	08.01.18
Sample Location:	TRL 3			Date Received:	08.01.18
Material Description:					
Supplier:	In-Situ		Source:	In-Situ	
Depth Start of Test (mm)	100mm b.g.l.		Tested By:	JP	



CBR Relationship - TRL Equation $\log_{10}(\text{CBR}) = 2.48 - 1.057 * \log_{10}(\text{Penetration Rate})$

Layer No.	Number of Blows		Penetration (mm)		Rate of Penetration (mm/blow)	Equivalent CBR (%)	Remarks
	Start	Finish	Start	Finish			
1	0	8	115	435	40.00	6	
2	8	40	435	510	2.34	123	
3	40	44	510	840	82.50	3	

Signed: **G.Morris**
 Position: Laboratory Manager
 Dated: 26 January 2018

APPENDIX V – GEOTECHNICAL AND GEOENVIRONMENTAL LABORATORY TEST RESULTS

**James Phillips**

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Analytical Report Number : 18-72670

Project / Site name:	Ocean Square, Saundersfoot	Samples received on:	12/01/2018
Your job number:	G40102	Samples instructed on:	12/01/2018
Your order number:		Analysis completed by:	22/01/2018
Report Issue Number:	1	Report issued on:	22/01/2018
Samples Analysed:	6 soil samples		

Signed:

Jordan Hill
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :	soils	- 4 weeks from reporting
	leachates	- 2 weeks from reporting
	waters	- 2 weeks from reporting
	asbestos	- 6 months from reporting

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Analytical Report Number: 18-72670

Project / Site name: Ocean Square, Saundersfoot

Lab Sample Number				887487	887488	887489	887490	887491
Sample Reference				TP01	TP01	TP02	TP02	TP04
Sample Number				1	2	1	6	1
Depth (m)				0.20	0.60	0.40	0.40	0.50
Date Sampled				08/01/2018	08/01/2018	08/01/2018	08/01/2018	08/01/2018
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	39	25	39	20	< 0.1
Moisture Content	%	N/A	NONE	11	11	9.1	10	14
Total mass of sample received	kg	0.001	NONE	2.0	2.0	2.0	0.81	2.0

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	-	Not-detected
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.3	8.1	8.4	8.4	8.1
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	-	< 1
Total Sulphate as SO ₄	mg/kg	50	MCERTS	660	1200	290	-	820
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.010	0.012	0.010	0.0070	0.015
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-	-	-	7.0	-
Sulphide	mg/kg	1	MCERTS	< 1.0	5.1	< 1.0	-	48
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	-	-	-	2.1	-
Organic Matter	%	0.1	MCERTS	4.1	1.1	0.6	-	4.5
Total Organic Carbon (TOC)	%	0.1	MCERTS	2.4	0.6	0.3	-	2.6
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	-	-	-	< 2.0	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.64	< 0.05	< 0.05	-	0.26
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	1.1	< 0.05	< 0.05	-	0.53
Pyrene	mg/kg	0.05	MCERTS	0.97	< 0.05	< 0.05	-	0.45
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.77	< 0.05	< 0.05	-	0.44
Chrysene	mg/kg	0.05	MCERTS	0.57	< 0.05	< 0.05	-	0.36
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	0.65	< 0.05	< 0.05	-	0.52
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.38	< 0.05	< 0.05	-	0.20
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.64	< 0.05	< 0.05	-	0.37
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.31	< 0.05	< 0.05	-	0.19
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.34	< 0.05	< 0.05	-	0.23

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	6.40	< 0.80	< 0.80	-	3.55
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	23	14	31	-	38
Boron (water soluble)	mg/kg	0.2	MCERTS	1.0	0.5	0.3	-	0.9
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	-	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	-	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	19	17	19	-	14
Copper (aqua regia extractable)	mg/kg	1	MCERTS	51	25	10	-	64
Lead (aqua regia extractable)	mg/kg	1	MCERTS	130	43	39	-	110
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	-	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	30	31	29	-	23
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	120	52	40	-	71
Magnesium (water soluble)	mg/kg	5	NONE	-	-	-	6.1	-
Magnesium (leachate equivalent)	mg/l	2.5	NONE	-	-	-	3.1	-

Analytical Report Number: 18-72670

Project / Site name: Ocean Square, Saundersfoot

Lab Sample Number	887487	887488	887489	887490	887491
Sample Reference	TP01	TP01	TP02	TP02	TP04
Sample Number	1	2	1	6	1
Depth (m)	0.20	0.60	0.40	0.40	0.50
Date Sampled	08/01/2018	08/01/2018	08/01/2018	08/01/2018	08/01/2018
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		

Monoaromatics

Benzene	ug/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	< 1.0
Toluene	ug/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	< 1.0
Ethylbenzene	ug/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	< 1.0
p & m-xylene	ug/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	< 1.0
o-xylene	ug/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	ug/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	< 1.0

Petroleum Hydrocarbons

TPH C10 - C40	mg/kg	10	MCERTS	< 10	< 10	< 10	-	< 10
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	-	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	-	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	-	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	-	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	-	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	-	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	< 10	< 10	-	< 10
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	-	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	-	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	-	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	-	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10	< 10	< 10	-	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	< 10	< 10	< 10	-	< 10
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	< 10	< 10	-	< 10



Analytical Report Number: 18-72670

Project / Site name: Ocean Square, Saundersfoot

Lab Sample Number				887492				
Sample Reference				TP04				
Sample Number				3				
Depth (m)				0.50				
Date Sampled				08/01/2018				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1				
Moisture Content	%	N/A	NONE	9.2				
Total mass of sample received	kg	0.001	NONE	1.6				

Asbestos in Soil	Type	N/A	ISO 17025	-				
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.2				
Total Cyanide	mg/kg	1	MCERTS	-				
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-				
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.011				
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	11.3				
Sulphide	mg/kg	1	MCERTS	-				
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	2.9				
Organic Matter	%	0.1	MCERTS	-				
Total Organic Carbon (TOC)	%	0.1	MCERTS	-				
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	< 2.0				

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-				
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	-				
Acenaphthylene	mg/kg	0.05	MCERTS	-				
Acenaphthene	mg/kg	0.05	MCERTS	-				
Fluorene	mg/kg	0.05	MCERTS	-				
Phenanthrene	mg/kg	0.05	MCERTS	-				
Anthracene	mg/kg	0.05	MCERTS	-				
Fluoranthene	mg/kg	0.05	MCERTS	-				
Pyrene	mg/kg	0.05	MCERTS	-				
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-				
Chrysene	mg/kg	0.05	MCERTS	-				
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-				
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-				
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-				
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-				
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-				
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-				

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-				
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-				
Boron (water soluble)	mg/kg	0.2	MCERTS	-				
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-				
Chromium (hexavalent)	mg/kg	4	MCERTS	-				
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-				
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-				
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-				
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-				
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-				
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-				
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-				

Magnesium (water soluble)	mg/kg	5	NONE	7.3				
Magnesium (leachate equivalent)	mg/l	2.5	NONE	3.7				

Iss No 18-72670-1 Ocean Square, Saundersfoot G40102

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 18-72670

Project / Site name: Ocean Square, Saundersfoot

Lab Sample Number				887492				
Sample Reference				TP04				
Sample Number				3				
Depth (m)				0.50				
Date Sampled				08/01/2018				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		

Monoaromatics

Benzene	ug/kg	1	MCERTS	-				
Toluene	ug/kg	1	MCERTS	-				
Ethylbenzene	ug/kg	1	MCERTS	-				
p & m-xylene	ug/kg	1	MCERTS	-				
o-xylene	ug/kg	1	MCERTS	-				
MTBE (Methyl Tertiary Butyl Ether)	ug/kg	1	MCERTS	-				

Petroleum Hydrocarbons

TPH C10 - C40	mg/kg	10	MCERTS	-				
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	-				
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-				
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-				
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-				
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-				
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-				
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-				
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-				
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	-				
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-				
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-				
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-				
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-				
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-				
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-				
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-				



Analytical Report Number : 18-72670

Project / Site name: Ocean Square, Saundersfoot

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
887487	TP01	1	0.20	Brown loam and sand with gravel and stones.
887488	TP01	2	0.60	Brown sand with gravel and stones.
887489	TP02	1	0.40	Light brown sandy clay with gravel and stones.
887490	TP02	6	0.40	Light brown sandy clay with gravel and stones.
887491	TP04	1	0.50	Brown loam and clay with gravel and clinker
887492	TP04	3	0.50	Brown loam and clay with gravel and clinker

Analytical Report Number : 18-72670

Project / Site name: Ocean Square, Saundersfoot

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Chloride, water soluble, in soil	Determination of Chloride colorimetrically by discrete analyser.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests. 2:1 extraction.	L082-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Magnesium, water soluble, in soil	Determination of water soluble magnesium by extraction with water followed by ICP-OES.	In-house method based on TRL 447	L038-PL	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L009-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS

Analytical Report Number : 18-72670

Project / Site name: Ocean Square, Saundersfoot

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L009-PL	D	MCERTS
Total sulphate (as SO ₄ in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding.	L076-PL	W	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method	L088/76-PL	W	MCERTS
Water Soluble Nitrate (2:1) as N in soil	Determination of nitrate by reaction with sodium salicylate and colorimetry.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08, 2:1 extraction.	L078-PL	W	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.