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KEYLAND DEVELOPMENTS LTD

LAND AT COOPER BRIDGE, HUDDERSFIELD

PHASE II GEO-ENVIRONMENTAL INVESTIGATION REPORT

SEPTEMBER 2016

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KEYLAND DEVELOPMENTS LTD

LAND AT COOPER BRIDGE, HUDDERSFIELD
PHASE II GEO-ENVIRONMENTAL SITE INVESTIGATION REPORT

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CONTENTS

APPENDICES

DRAWINGS

Drawing No	Title	Scale
SH10234-001	Site Location Plan	1:50,000
SH10243-004	Site Investigation Locations Plan	1:2,000

EXECUTIVE SUMMARY

This report is prepared for redevelopment of the site and in accordance with instructions from KeyLand Developments Ltd. The site is the former Cooper Bridge Waste Water Treatment Works (WWTW). A summary of pertinent information relating to the site along with a qualitative assessment of the potential risk is provided below.

SUMMARY TABLE	
Issue	**Description**
Present and past site use	The site was developed from farmland to a sewage treatment works during the 1920`s. The sewage works was decommissioned in 2008 and remains present on site to date.
Filter Media	The majority of the site is covered by concrete filter beds containing 3m to 3.6m of slag and limestone filter media. Chemical, geotechnical and specific aggregate testing suggests that the filter media is likely to be suitable for processing and use as an aggregate in highway works.
Human Health	The site is not considered to pose a significant risk to construction workers or future occupiers under a commercial / industrial end use scenario.
Groundwater and surface water	There is considered to be a low to moderate risk to ground water and surface water from slightly elevated concentrations of hydrocarbon compounds.
Ground Gas	A preliminary ground gas risk assessment indicates that new buildings are unlikely to require gas protection measures.
Geotechnical	The made ground and underlying alluvium surrounding the filter beds are unlikely to be suitable as a founding medium for most buildings without some form of treatment or specialist foundations. The materials are likely to be suitable for ground improvement treatment such as recompaction and vibro compaction.
Recommended further work	Prior to redevelopment of the site, detailed testing of the filter media is recommended to confirm the nature of the materials. It is assumed that the filter beds are founded on competent materials. However, this should be confirmed by site investigation prior to redevelopment. It is recommended that a further round of groundwater monitoring is conducted to constrain the potential impact from slightly elevated hydrocarbon concentrations. Additionally, it is recommended that surface water samples are collected from adjacent to the site and tested to assess their quality.

The executive summary forms part of the overall report and should not be considered in isolation.

1 INTRODUCTION

Instructions

1.1 This report is prepared in accordance with instructions from KeyLand Developments Ltd dated 13 July 2016. This follows a proposal dated 6 July 2016 by Wardell Armstrong and in accordance with our standard terms of conditions attached at Appendix I.

Site Location

1.2 The site is Cooper Bridge WWTW, Lower Brighouse, West Yorkshire, and is located as shown on Drawing SH10243-001 (1:50,000 scale). A more detailed site plan is shown on Drawing SH10243-004 (1:2,000 scale). The site comprises a decommissioned sewage treatment plant and is bound by Leeds Road and a mill to the north, the River Calder to the north and south east, a railway line to the south west and two residential properties to the west. The site is located approximately 5.5km north east of Huddersfield.

Scope and Objectives

1.3 The purpose of this report is to present the findings of an intrusive site investigation that was carried out to further identify and examine the potential contamination and geotechnical issues identified in a previous Land Quality Statement (Wardell Armstrong report SD08-0128 dated 2008) that may arise in connection with present use or proposed use of the site.

Proposed Site Use

1.4 It is proposed that the site is redeveloped for commercial land use.

2 PREVIOUS INVESTIGATIONS

Introduction

2.1 A previous environmental desk study report has been completed by Wardell Armstrong. The report is entitled, *Phase I Desk Study of Land at Cooper Bridge* and dated December 2008 (ref. SD08-0128). Reference is also made to the Landmark Envirocheck (ref: 25554958) dated 09 June 2008 which was enclosed in this report.

General History

2.2 The site was developed from farmland to be occupied by a sewage works, with a concentration of tanks and filters in the western part of the site by the 1920's. The site was partly active with the filter beds being decommissioned during the 2008 site visit, but was inactive by the 2016 site visit.

Present Site Use

2.3 The site was visited on 04 December 2008 and 19 July 2016. The following points are of note:

- Filter beds cover approximately 4.7 hectares of the site and these were reported to be 4m deep. The filter media within the beds, reported to be slag, has an estimated volume in the order of 190,000m^3.
- The site slopes gently towards the east and the River Calder with a fall of approximately 5m across the site.
- The brick building adjacent to the site entrance was used as a laboratory and store. A prefabricated building to the west of this was marked with a pesticides warning sign. The remaining buildings on site were used as pumping stations.
- Waste management on site appeared to be reasonably controlled with minor stockpiles of stone, timber and concrete rubble.
- Mature trees are present around the perimeter of the site and dense vegetation is present along the banks of the River Calder.
- Sewage treatment works occupy land to the south-east across the River Calder (Heaton Lodge Filter Beds), south (Lower Brighouse WwTW) and south-west (Calder Valley WwTW) of the site.

Preliminary Conceptual Site Model

2.4 A preliminary conceptual site model was presented in the WA Phase I Desk Study report (December 2008) and is presented below as Table I. The table outlines potential sources, pathways and receptors and was based on information provided by statutory sources and a preliminary site investigation. As the Phase I report was largely based on desk study information and no soil testing, a number of uncertainties existed in the conceptual model. These have been updated and a revised conceptual site model is presented in Section 9.

TABLE I: PRELIMINARY CONCEPTUAL SITE MODEL

SOURCE (CONTAMINANT)	PATHWAY	RECEPTOR
No. 1 Chemical storage (various laboratory chemicals)	1. Inhalation. 2. Dermal contact. 3. Ingestion. 4. Surface runoff. 5. Groundwater migration. 6. Direct contact (aggressive attack).	1. Current occupiers. 2. Future occupiers. 3. Construction workers. 4. Groundwater. 5. Surface water. 6. Subsurface building materials and plastic service pipes. 7. Flora and Fauna.
No. 2 Cooling oil in old electrical sub-station. (Hydrocarbons, PCB)	1. Inhalation. 2. Dermal contact. 3. Ingestion. 4. Surface runoff. 5. Groundwater migration. 6. Direct contact (aggressive attack).	1. Current occupiers. 2. Future occupiers. 3. Construction workers. 4. Groundwater. 5. Surface water. 6. Subsurface building materials and plastic service pipes. 7. Flora and Fauna.
No. 3 Sewage treatment works. (hydrocarbons, PCB, metals, pathogens)	1. Inhalation. 2. Dermal contact. 3. Ingestion. 4. Surface runoff. 5. Groundwater migration. 6. Direct contact (aggressive attack).	1. Current occupiers. 2. Future occupiers. 3. Construction workers. 4. Groundwater. 5. Surface water. 6. Subsurface building materials and plastic service pipes. 7. Flora and Fauna.
No. 4 Made ground present across the site.	1. Inhalation. 2. Dermal contact. 3. Ingestion.	1. Current occupiers. 2. Future occupiers. 3. Construction workers.

TABLE I: PRELIMINARY CONCEPTUAL SITE MODEL		
SOURCE (CONTAMINANT)	**PATHWAY**	**RECEPTOR**
(heavy and phytotoxic metals, PAH)	4. Surface runoff. 5. Groundwater migration. 6. Direct contact (aggressive attack).	4. Groundwater. 5. Surface water. 6. Subsurface building materials and plastic service pipes. 7. Flora and Fauna.
No. 5 Historic building material and made ground. (asbestos)	1. Disturbance and inhalation.	1. Current occupiers. 2. Future occupiers. 3. Construction workers.
No. 6 Filter media (slag)	1. Inhalation. 2. Dermal contact. 3. Ingestion. 4. Surface runoff. 5. Groundwater migration.	2. Future occupiers. 3. Construction workers. 4. Groundwater. 5. Surface water. 7. Flora and Fauna.
No. 7 Surrounding industry including agriculture, mills and sewage works. (hydrocarbons, solvents, metals, phenols)	1. Inhalation. 2. Dermal contact. 3. Ingestion. 4. Surface runoff. 5. Groundwater migration. 6. Direct contact (aggressive attack).	1. Current occupiers. 2. Future occupiers. 3. Construction workers. 4. Groundwater. 5. Surface water. 6. Subsurface building materials and plastic service pipes. 7. Flora and Fauna.

3 GEOLOGICAL, HYDROLOGICAL AND HYDROGEOLOGICAL SETTING

Geology

3.1 The assessment of the geology of the site is based on the published geological mapping sheet (Sheet 77, Huddersfield, Solid & Drift Edition, 1:50,000 scale) supplemented by the geological memoir, topographical plans and site visit.

3.2 The site is likely to be underlain by made ground, underlain by superficial deposits comprising alluvium and possible River Terrace Deposits and weathered bedrock of the Lower Coal Measures.

Hydrogeology

3.3 The site is indicated to be underlain by Alluvium, River Terrace Deposits and Coal Measures which are classified as Secondary A Aquifers. The closest groundwater abstraction licence was at 368m west and operated by E Bottomley & Sons Ltd who were licenced to abstract an unknown volume of groundwater for 'Textiles & Leather: Boiler Feed' purposes. The site does not lie within a source protection zone.

Hydrology

Surface Water Features

3.4 The nearest graded surface watercourse is the River Calder, which is adjacent to the eastern site boundary. The closest surface water abstraction licence was at 5m north east of the site operated by John Cotton (Mirfield) Ltd who was licenced to abstract 54,552m^3 of surface water for Textiles and Leather: General Use (Medium Loss) purposes.

Flooding – Planning Purposes

3.5 The majority of the site is within Zone 2 and has a moderate probability of flooding. The chance of flooding each year is between 1.0% (1 in 100) and 0.1% (1 in 1,000). Part of the site adjacent to the River Calder is within Zone 3 and has a high probability of flooding. The chance of flooding each year is 1.0% (1 in 100) or greater.

3.6 Further details are provided in a Flood Risk Assessment report which is being prepared separately by Wardell Armstrong (ref. SH10243-RPT-003).

Mining

3.7 The property is in the likely zone of influence of past workings in one seam of coal at 100m to 120m depth, last worked in 1926. There are no recorded mine entries on or within influencing distance of the site.

4 SITE INVESTIGATION

Introduction

4.1 The current investigation was designed around the preliminary conceptual site model that identified all potential sources, pathways and receptors. This allowed a targeted sampling approach to be undertaken and provide general coverage of the site. Results of the investigation are used to revise the conceptual site model, establish whether linkages identified are plausible and establish the level of risk associated with the site.

4.2 The preliminary conceptual site model is shown as Table I.

4.3 The investigation including sampling techniques was carried out in accordance with BS5930, Code of Practice for Ground Investigations and BS10175:2011 Investigation of potentially contaminated sites – code of practice.

4.4 Locations were positioned to provide complete coverage of the whole site. Site investigation locations are shown on Drawing SH10243-004 (1:2,000 scale).

Scope

4.5 The investigation was designed as a series of tasks that are summarised below in Table II.

TABLE II: SUMMARY OF TASKS

Task	Summary	Date(s)
Preparatory Work	Setting up site investigation contract, including services enquiries, contractor health & safety document and site meeting with contractor/client.	July 2016
Intrusive site investigation	4 cable percussion boreholes to a nominal depth of 10m, 6 hand dug pits to a nominal depth of 1.2m and 15 trial pits within the filter beds to a nominal depth of 3.5m. Installation of monitoring wells for groundwater and gas.	1 – 5 August 2016
Laboratory analysis	Chemical testing in accredited laboratory – 14 soil, 3 leachate and 4 groundwater samples. Geotechnical testing in accredited laboratory – 16 soil and 9 filter medium samples. Microbiological testing in accredited laboratory – 4 soil samples.	4 - 19 August 2016

TABLE II: SUMMARY OF TASKS		
Task	**Summary**	**Date(s)**
Monitoring	Gas and water level monitoring.	8 August - 15 September 2016

4.6 The investigation was completed in accordance with Construction Design and Management (CDM) Regulations 2015 and a site specific Health & Safety plan. Contractors used during this project include; Geotron UK Ltd (drillers and hand dug pits), Thompsons of Prudhoe Ltd (trial pits), ALcontrol Laboratories (geochemical analysis), National Laboratory Service (microbial testing), Professional Soils Laboratory and Celtest Ltd (geotechnical analysis) and Thomas Research Services Ltd (slag expansivity analysis). Drilling was completed using a variety of methods and these are discussed in more detail below.

Cable Percussion Boreholes

4.7 Cable percussion drilling was completed under the part-time supervision of a Wardell Armstrong engineer. Four cable percussion boreholes, BH101 to BH104, were drilled to 6.3m and 10.45m below ground level (bgl). Locations (see Drawing No. SH10243-004) were positioned to provide widespread coverage of the site.

4.8 Cable percussion borehole logs are attached at Appendix II.

Hand-Dug Pit Excavations

4.9 Hand-Dug pit excavations were completed under the full-time supervision of a Wardell Armstrong engineer. Six hand-dug pits, HTP101 to HTP106, were excavated to depths of between 0.2m and 1.2m bgl. Locations (see Drawing No. SH10234-004) were positioned to provide widespread coverage of the site.

4.10 Hand-Dug pit logs are included at Appendix III.

Trial Pit Excavations

4.11 Trial pit excavations were completed under the full-time supervision of a Wardell Armstrong engineer. Fifteen trial pits, TP101 to TP115, were excavated to depths of between 2.5m and 3.6m bgl using a Case CX210C hydraulic excavator. Excavations beyond these depths were not possible due to encountering the base of the filter beds.

Locations (see Drawing No. SH10243-004) were positioned to provide widespread coverage of the filter beds.

4.12 Trial pit logs are included at Appendix IV.

Ground Gas and Groundwater Monitoring Standpipes

4.13 Four gas and groundwater monitoring standpipes were installed by the cable percussion drilling contractor at all borehole locations. The standpipes were completed with 50mm diameter screen and casing between 6.3m and 10.45m bgl, with the screened section extended from the base to 1.00m bgl. A filter pack of 4 - 6mm washed gravel was placed in each well annulus to just above the screened section. Thereafter, the annulus was sealed to the surface with bentonite. Installations were completed with concreted headworks to protect the inner casing and gas valves. All installations were supervised by a Wardell Armstrong engineer on a part-time basis.

4.14 After installation, all water-monitoring wells were developed using a bailer. Development was continued until the water in the wells was visibly clean or until five well volumes of water had been removed.

4.15 Newly installed monitoring boreholes were left for a minimum of 72 hours to allow gas levels to equilibrate. Data for methane, carbon dioxide, oxygen and flow rate was collected using a portable infrared gas analyser. Atmospheric pressure was recorded at the time of monitoring. Soil gases were analysed and assessed following guidance from:

- NHBC Report No. 4, Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present (March, 2007);
- BS 8485, Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (June 2015); and
- CIRIA C665, Assessing Risks Posed by Hazardous Ground Gases to Buildings (2007).

Sampling and Testing

Sampling and Analysis of Soils

4.16 Sixteen disturbed samples of material from beneath the site and from the filter media were collected for geochemical laboratory analysis. In addition, 4 samples from the filter media were collected for microbial analysis. Samples were taken at regular depths, changes in strata and any discrete horizons with a high potential to retain

contaminants and logged in general accordance with BS14686:2002. Samples were obtained using a fresh pair of nitrile gloves.

4.17 Samples scheduled for analysis of organic contaminants were placed in amber bottles with a minimum of headspace. The bottles were immediately sealed with polytetrafluoroethylene (PTFE) lined caps and labelled. The remaining small disturbed samples were placed in polypropylene tubs with a minimum of headspace, sealed with airtight polypropylene 'snap-on' lids and labelled. The labels detailed individual sample number, location, depth and sampler identity.

4.18 Collected samples were stored away from sunlight in temperature controlled conditions and transported by courier to ALcontrol Laboratories and National Laboratory Service. Chain of custody forms were completed for all samples sent to the laboratory. The forms detailed individual bottle identification number and sample location. The forms were signed on release by the Wardell Armstrong field engineer and upon receipt by the laboratory.

4.19 The laboratory analyses scheduled were selected to establish the type, level and distribution of the possible harmful contaminants or common pathogens that may be present on the site given its past and current uses. In order to provide cost effective analysis, solid samples were analysed for a number of substances depending on depth, matrix and a visual assessment of ground conditions. The analysis scheduled is presented in Table III.

Sampling and Chemical Analysis of Groundwater

4.20 Four groundwater samples from groundwater monitoring installations were collected using procedures that ensured the collection and preservation of sample quality. Prior to sampling, each groundwater well was purged until three well volumes of water had been removed. To avoid cross-contamination, all groundwater samples were taken using either in-situ tubing or disposable bailers per well with a bottom pour tap, to minimise the loss of more volatile components.

4.21 Samples were placed in laboratory prepared amber bottles with a minimum of headspace. The bottles were immediately sealed with polytetrafluoroethylene (PTFE) lined caps and labelled. The labels detailed individual sample number, location, depth and sampler identity. The analysis scheduled is presented in Table.

4.22 The results of all analyses are attached at Appendix V.

TABLE III: SUMMARY OF CHEMICAL AND MICROBIOLOGICAL ANALYSIS SCHEDULE			
Substances	**No. Soil Samples**	**No. Leachate Samples**	**No. Groundwater Samples**
A standard suite of industrial pollutants including common metals (arsenic, cadmium, chromium, chromium^{VI}, copper, lead, mercury, nickel, selenium, vanadium and zinc), pH, sulphate, cyanide and phenols.	14	-	4
Alkalinity, Dissolved Organic Carbon (DOC), manganese and calcium.	-	-	4
Toxic metals and pH.	-	2	-
Speciated PAHs (USEPA 16).	14	3	4
Petroleum hydrocarbons (C_5 – C_{44} with aliphatic/aromatic class separation and carbon banding), BTEX, MTBE (TPHCWG).	-	-	4
Total Petroleum Hydrocarbons (banded C_6 – C_{40} (TPH).	8	-	-
Volatile Organic Compounds (VOCs).	-	-	4
Semi-Volatile Organic Compounds (SVOCs).	2	-	4
Poly-chlorinated Biphenyl (PCBs).	-	-	-
Total Organic Carbon (TOC).	16	-	-
Asbestos Screen and Identification.	16	-	-
Ammoniacal Nitrogen.	-	-	4
Redox potential.	-	-	4
Pesticides (Organochlorine and organophosphorus suite)	1		
Microbiological suite (Total Viable Count, E. Coli and Salmonella)	4		

Geotechnical Sampling and Testing

4.23 Sixteen soil and nine filter media samples were taken for geotechnical testing and the testing schedule is summarised below in Table IV. Geotechnical Results are attached at Appendix VII.

TABLE IV: SUMMARY OF GEOTECHNICAL ANALYSIS SCHEDULE				
Geotechnical Test	**Made Ground**	**Superficial Deposits**	**Weathered Bedrock**	**Slag**
Natural Moisture Content.	7	7	2	8
Particle Size Distribution.	7	7	2	8
Atterberg Limits.	2	2	1	1
Slag Expansivity.				8
Aggregate suite ($MgSO_4$, Particle Density and Water Absorption, LA Coefficient, sulphate, sulphides, asbestos).				1

Quality Assurance and Quality Control

4.24 The soil and groundwater samples were collected, transferred to the laboratory under chain of custody and analysed to ensure traceability and reliability of analytical results. Based on the laboratory QA data, the analytical results are considered acceptable for interpretative use.

Limitations of Site Investigation

4.25 It should be noted that the interpretation of the results of the physical site investigation is based on a limited number of investigation points. The locations and numbers of the investigation locations were governed by the physical state of the site and the location of known services at the time of the investigation. Although reasonable inferences have been made during the interpretation, it is possible that variances in the thickness, distribution and physical/chemical characteristics of the strata present will exist.

5 RESULTS OF SITE INVESTIGATION

Ground Conditions

Topsoil

5.1 Topsoil was present in all borehole and hand dug pit locations with the exception of borehole BH101A and hand dug pits HP105 and HP106. The topsoil was between 0.05m and 0.30m thick. Material identified as 'topsoil' does not necessarily conform to the requirements for topsoil as set out within BS 3882:2015.

Made Ground

5.2 Thick deposits of made ground are present within raised filter beds occupying much of the site and beneath the surrounding site area. The filter media is discussed separately below. Made Ground was present in all borehole and hand dug pit locations surrounding the filter beds and varied in thickness from 0.95m in BH101A within the south of the site to 4.7m in BH103 within the north east of the site. The made ground comprised two units, the first being described as a soft, orange brown, sandy to very sandy, gravelly to very gravelly clay. The second unit was described as loose to medium dense, brown/black, locally slightly clayey, gravelly sand. The gravel fraction in both units consisted of a number of constituents including brick, concrete, sandstone, mudstone and wood fragments. Minor ash was only observed in made ground in borehole BH103 and hand dug pit HP102.

5.3 In general, made ground deposits comprised reworked and or disturbed natural deposits corresponding with natural alluvium also found on site. In contrast to this, made ground in the form of subbase was located beneath the hardstanding at BH101A.

5.4 Areas of hardstanding were predominantly surfaced completely with rolled tarmac that was 0.15m thick at borehole BH101A.

5.5 The thickness of the made ground was unproven in borehole BH101 and in the hand dug pits due to drilling refusals caused by obstructions and the thickness of the made ground.

Filter Media

5.6 The filter media varied in thickness from 3.0m to 3.6m. Variability was noted in the depths of the filter media due to difficulties in measurement caused by frequent, minor collapses within the excavation. Additional measurements of depth were

completed using ceramic pipes installed into the filter beds. These indicated that the filter media deepens from 3.0m in the south west to 3.6m in the north east. The filter media was present as two distinctive types; the first being described as loose, orange/grey/brown/black, gravelly cobbles of vesicular slag and the second being described as loose, grey/brown/black, gravelly cobbles of limestone. The filter media was exclusively slag to the north and south (Drawing SH10243-04, filter beds 1, 2, 9, 11, 10 and 12.), exclusively limestone in the central portion (Drawing SH10243-04 filter beds 6, 7 and 8) and a mixture of both lithologies in the remaining filter beds.

5.7 The base of the filter media was defined by ceramic pipes, presumably overlying a concrete base.

Natural Strata

5.8 The natural materials encountered during the intrusive investigation comprised two distinct units. The upper unit consisted of two beds; a loose to dense, brown grey, locally slightly clayey to clayey, locally silty, sandy gravel to sand and gravel and a second bed of very soft to soft, grey brown locally gravelly, sandy clay. The two beds of the upper unit were interpreted as alluvial deposits. The upper unit was underlain in boreholes BH101A and BH104 by a firm to stiff, brown grey, locally sandy and gravelly clay. This is interpreted as the weathering horizon for the underlying coal measures geology. Gravel fractions in all units were fine to coarse, angular to subrounded, sandstone and mudstone.

5.9 Rockhead comprising weak, grey, weathered mudstone was encountered at 7.90m bgl within the south of the site (BH101A) and 4.90m bgl within the north of the site (BH104).

5.10 A summary of the strata beneath the site is shown in Table V.

TABLE V: SUMMARY OF STRATA BENEATH THE SITE

Depth to base of strata (mbgl)			Mean Thickness (m)	Typical Description
Max.	Min.	Mean		
4.70	1.10	3.15	2.93	Made Ground
10.45*	4.90*	8.27*	5.12*	Alluvium
7.90*	4.90*	-	-	Rockhead/Bedrock

* Base of strata not always proven.

Groundwater

5.11 Groundwater was encountered during the intrusive investigation works in boreholes BH101A to BH104. During development and purging the recharge was observed to be instantaneous in all monitoring wells. No visual or olfactory evidence of contamination was observed in the water extracted from the wells.

5.12 Water levels were measured on three occasions between 8 August and 15 September 2016 using a product/water interface probe. No free phase product was detected. Water elevations measured relative to a site datum (m AOD) are shown in Table VI.

TABLE VI: SUMMARY OF GROUNDWATER MONITORING DATA

Borehole ID	Response Zone/Strata	Date and Depth to Water (m AOD)			Trend
		8/8/16	15/8/16	15/9/16	
BH101A	1m-10.15m/ MG-All.-MST	45.57	45.56	45.61	Falling
BH102	1m-10.05m/ MG-All	45.22	45.22	45.25	Steady
BH103	1m-10.45m/ MG-All	46.71	46.67	46.75	Falling
BH104	1m-6.3m/ MG-MST	47.89	47.62	47.68	Falling

Key: MG = Made Ground, All. = Alluvium, MST = Mudstone

5.13 Analysis of monitoring results indicates an inferred groundwater flow direction towards the south east, in the direction of the River Calder.

Ground Gas

5.14 There are several regulatory authorities that require the assessment of ground gas on potentially contaminated sites. The main stakeholders are Building Control, Local Authority Planning and Environmental Health (Contaminated Land Officers). CIRIA have published guidance (C665, 2007) on risk assessment for new buildings and existing structures on ground with potentially hazardous gassing regimes. This guidance indicates that a semi-quantitative risk assessment for ground gas can be completed using Gas Screening Values (GSV) and consideration of the conceptual site model.

5.15 Three gas monitoring rounds have been completed to date over a two month period. One set off readings has been recorded at falling atmospheric pressure.

5.16 A further three rounds are proposed to be completed.

5.17 Gas monitoring results are attached at Appendix VIII.

Observations of contamination

5.18 No significant soil contamination was noted and minor observations recorded during the site investigation are presented on the borehole and trial pit logs (Appendices IV). The minor observations can be summarised as follows:

- Ash was noted at 0.95m bgl to 1.20m bgl in HTP102; and
- Ash was noted at 4.30m bgl to 5.00m bgl in BH103;

General Site Observations

5.19 The site is noted to contain several stands of an invasive plant species tentatively identified as Himalayan Balsam. This is sporadic around the site but is concentrated in particular toward the border of the site and around Nun Brook.

6 GUIDANCE ON CONTAMINATION RISK ASSESSMENT

Introduction

6.1 The following section aims to assess the magnitude and significance of potential risks to human health, surface water, groundwater, ecosystems and buildings from contaminated soil and groundwater. The assessment provides information that is fit for purpose given the regulatory context and completed in accordance with UK best practice. A summary of the risk assessment process is presented below. More detailed information on risk assessments is contained in various reports published by the Environment Agency and DEFRA including:

- Contaminated Land Science Reports (SR2 to 4); and
- Model Procedures for the Management of Land Contamination (CLR 11).

General Soil Contamination Guidance

6.2 The Environment Agency (EA) has a statutory duty to ensure the protection of the environment and the remediation of contaminated land and groundwater. In order to achieve this, the EA employs the principle of risk assessment - the risk of a contaminant source causing harm or pollution via a given pathway to an identified receptor. If one of the source-pathway-receptor linkages is not considered to be present then there is deemed to be no risk. However, if a contaminant source is present and there is a pathway for that contaminant to reach a receptor then there is a potential risk of significant harm to the receptor. Therefore, if the source-pathway-receptor linkages are complete, there is a requirement to undertake a risk assessment related to the receptor of concern, be it human health, surface water, groundwater, buildings or other property or ecological issues.

6.3 The first stage in the assessment of a site is development of a conceptual model. This includes consideration of all possible sources of contamination on the site, the potential receptors and whether there is a plausible pathway between the two. This allows evaluation of whether further more complicated risk assessment for an identified receptor is necessary. A site-specific conceptual model is presented in previous reports and is revised here in Section 9 based on the findings of the site investigations.

Generic Assessment Criteria

6.4 In March 2002 the Environment Agency and the Department of Environment, Food and Rural Affairs (DEFRA) released a package of guidance to assess the health risks

posed by contaminated land as part of the statutory framework for contaminated land. The Contaminated Land Exposure Assessment (CLEA) model is a framework for estimating the likely exposure to contaminants in soil as part of the wider approach of the UK's assessment of risk and suitability for use. The methodology adopted for CLEA builds upon the source-pathway-receptor model for the assessment of risk. Following the CLEA model, generic Soil Guideline Values (SGVs) were developed to act as triggers for intervention in a number of end-use scenarios. The Environment Agency commenced a programme looking at 55 contaminants. The CLEA methodology has been updated and the SGVs were withdrawn from use in August 2008. New SGVs have been published by the EA since March 2009 onwards.

6.5 The CLEA SGVs are derived using specific parameters, which may not be relevant to each site. The CLEA software allows parameters to be changed and site specific assessment criteria (SSAC) can be developed. The CLEA methodology also uses a statistical evaluation of all the data collected in order to give an overall impression of the site and therefore the exposure to a modelled receptor rather then using individual contaminant values, which may vary dramatically across the site. The statistical tests calculate a normalised upper bound value for the site as a whole and also give an indication of whether a particular data value is a statistical outlier (potential hotspot) or whether it is part of the whole population of samples.

6.6 The Soil Guideline Values derived from the CLEA model are intended for use in assessing the risk to long term human users of the site. There is also a requirement to consider the potential for harm from short-term exposure to contaminants at the site, e.g. to construction workers who may be exposed to risk via inhalation of dust or dermal contact with the contaminated material.

6.7 In the absence of SGVs published under the new CLEA methodology, Land Quality Management (LQM) and the Chartered Institute of Environmental Health (CIEH) published their third edition of generic assessment criteria (GAC) for 82 inorganic and organic substances in January 2015 which are termed Suitable 4 Use Levels or S4UL's. In addition, GAC values for 30 separate organic compounds were published in December 2009 by the Environmental Industries Commission (EIC), the Association of Geotechnical and Geoenvironmental Specialists (AGS) and CL:AIRE. These GAC values have been derived in the same vein as SGVs and are intended to be used in the same manner. Additionally, the GAC values have been produced for varying soil organic matter content (i.e. 1%, 2.5% and 6%).

Category 4 Screening Levels (C4SLs)

6.8 Revised Statutory Guidance to support Part 2A of the Environmental Protection Act 1990 was published in April 2012 by DEFRA. This Guidance introduced a new four-category system for classifying land under Part 2A for cases of a Significant Possibility of Significant Harm to human health:

- Category 1 includes land where the level of risk is clearly unacceptable;
- Category 2/3 border defines the point at which land is determined under the legislation;
- Category 3 would include sites that regulators conclude should not be designated as contaminated under Part 2A; and
- Category 4 includes land where the level of risk posed is acceptably low.

6.9 Land is determined as 'contaminated land' under Part 2A if it falls within Categories 1 or 2.

6.10 In March 2014, DEFRA published C4SLs for four generic land-uses comprising residential, commercial, allotments and public open space for six substances – arsenic, benzene, benzo(a)pyrene, cadmium, chromium (VI) and lead.

6.11 The C4SLs have been derived in support of Defra's revised Statutory Guidance for Part 2A of the Environmental Protection Act 1990 but it was anticipated that they could be used under the planning regime as generic screening criteria within a GQRA, albeit describing a higher level of risk than the currently or previously available SGVs.

6.12 In the case of lead where the SGV was removed in 2008 and was not replaced, the C4SL for lead is considered a suitable generic screening value.

Statistical analysis

6.13 Statistical analysis has been completed to identify if the data set for each substance tested contains outliers, has as normal or non-normal distribution and if there is significant evidence that the mean concentration, as defined by the 95% upper confidence level (UCL), is less than the adopted screening value. This process follows the CL:AIRE/CIEH Guidance on Comparing Soil Contamination Data with a Critical Concentration, May 2008. Results from this statistical testing can be used to inform decisions on whether land is suitable for use under the land use planning system without mitigation to break identified pollutant linkages.

General Water Contamination Guidance

6.14 Concentrations of contaminants detected in groundwater have been compared to the UK Drinking Water Standards (UKDWS) encompassing the Water Supply (Water Quality) Regulations 1989 and Water Supply (Water Quality) Regulations 2016 where drinking water is the receptor. Where surface water is the receptor, Water Framework Directive, Environmental Quality Standards (EQS) and The Surface Waters (Abstraction for Drinking Water) (Classification) Regulations 1996 have also been used.

6.15 Where no UKDWS and EQS are available or applicable, reference is made to other appropriate guidance. This includes the World Health Organisation (WHO) Guidelines for Drinking-water Quality (2011) and the United States Environmental Protection Agency (US EPA) Regional Screening Levels (RSL's) for tap water.

Bioavailable EQS

6.16 Bioavailable EQS values for copper, manganese, nickel and zinc have been derived by the regulators as part of the Water Framework Directive requirements. The Metal Bioavailability Assessment Tool (M-BAT) is a UK method which can be used to estimate the bioavailable concentrations of these metals under the conditions found at a site, which can then be compared with the published bioavailable EQS values.

6.17 The M-BAT requires the measured dissolved phase concentration and site parameters including calcium, pH and dissolved organic carbon (DOC). Where the DOC concentration is reported at less than the LOD, the LOD value has been adopted in the M-BAT calculation.

Ground Gas Assessment Guidance

6.18 Guidance within CIRIA 665 "Assessing risks posed by hazardous ground gases to buildings" (2007) is used to calculate a Gas Screening Value (GSV) and generate a Characteristic Situation (CS) for the site. CS1 represents a very low risk and CS6 represents a very high risk from ground gas.

6.19 CIRIA 665 also provides some guidance on gas protection measures for each CS. Design of gas protection is also covered within BS8485:2015 "Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings". Where the end use is residential the NHBC published guidance (traffic light system) can also be used as an alternative provided the construction of the buildings proposed is compliant with their guidance.

7 GENERIC QUANTITATIVE RISK ASSESSMENT

Soil Contamination Results

7.1 Soil samples taken from the site have been tested for potential chemicals of concern appropriate to the former land use. As the proposed redevelopment is for commercial land use, the most appropriate end use for assessment is that of, commercial/industrial or equivalent. Results from the chemical testing have been evaluated with reference to each of the plausible receptors identified in the conceptual model. The results are evaluated differently for each receptor.

Human Health - occupiers

7.2 As the receptor is human health, the most relevant risk assessment model is the CLEA model. The model estimates child and adult exposures to soil contaminants for those potentially living, working and/or playing on contaminated sites over long time periods and has been used to produce the SGVs for the United Kingdom.

7.3 The principal pathways of concern for human health are dermal contact, ingestion, and inhalation. Generally, in the assessment of risk to site users, only samples taken in the top 1m are considered as contact with deeper samples is unlikely. As earthworks are likely at this site samples below 1.0m have also been included.

7.4 The geometric mean soil organic matter content at the site is 1.92%. Therefore GAC values derived using 1% SOM have been selected in this assessment. The pH of the soil ranged from 9.81 in BH104-0.50m to 6.94 in HP106- 0.20m.

Metals

7.5 The mean concentration (95% UCL) for arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, vanadium and zinc were below their respective GAC. Therefore, it may be considered that the concentrations of these substances in soil on site do not present a significant risk to long-term human health.

Volatile Petroleum Hydrocarbons

7.6 Volatile Petroleum Hydrocarbon (VPH) testing represents the short chain-length aliphatic and aromatic petroleum hydrocarbons detected within the carbon band range C5 to C10.

7.7 All samples recorded low concentrations of petroleum hydrocarbons and no visual and olfactory evidence of petroleum hydrocarbons was noted. In addition, the

concentrations of VPH were less than LOD or the adopted GAC. Therefore, the concentrations of VPH are not considered to present a risk to long term human health.

Extractable Petroleum Hydrocarbons

7.8 Extractable Petroleum Hydrocarbon (EPH) testing represent the medium to long chain-length aliphatic and aromatic petroleum hydrocarbons detected within the carbon band range C10 to C44.

7.9 The site investigation identified no visual or olfactory evidence of petroleum hydrocarbons. The maximum concentration of EPH was 519 mg/kg in HDP106. All recorded concentrations were less than the adopted GAC. Therefore, TPH contamination is considered unlikely to present a significant risk to long term human health at the site.

Semi-Volatile Organic Compounds and Polycyclic Aromatic Hydrocarbons

7.10 None of the samples tested contained concentrations of Semi-Volatile Organic Compounds (SVOC) and Polycyclic Aromatic Hydrocarbons (PAH) compounds above the GAC. In addition, no visual or olfactory evidence of PAH or SVOC contamination was recorded during site investigation works. Therefore, PAH and SVOC are unlikely to present a significant risk to long term human health.

Other Substances

7.11 Statistical analysis for monohydric phenol and total cyanide was carried out to identify the 95% confidence limits of the measured mean and to compare the upper 95th percentile with the respective screening criteria.

7.12 The upper bound values (US95) for phenol and cyanide were below their respective screening values. Therefore, it may be considered that the concentrations of these substances in soil on site do not present a significant risk to long-term human health.

7.13 Chemical testing for pesticides has been conducted from samples taken within HDP105, adjacent to an onsite pesticide store. Results from this sample show that all pesticides tested for are less than the limit of detection. Therefore, pesticides are unlikely to pose a significant risk to long term human health.

7.14 Statistical analysis of the laboratory results is attached at Appendix VI.

Asbestos

7.15 Twelve samples were screened for asbestos and no fibres were detected. In addition, no visual evidence of asbestos was recorded during site investigation works. Therefore, asbestos contamination is unlikely to pose a risk to future site occupiers.

Human Health – Construction Workers

7.16 The CLEA Soil Guideline Values only apply to the protection of health for long term chronic exposure. Construction workers are more likely to be at risk from a high single exposure, i.e. an acute dose, which can result in contaminant poisoning. Suggested values for acute lethal doses of arsenic, cadmium, chromium, inorganic mercury, nickel and selenium is outlined in the Environment Agency R&D SGV reports from 2002.

7.17 None of the samples contained concentrations of cadmium, chromium, inorganic mercury, nickel or selenium that are elevated with respects to an acute lethal dose. No acute lethal dose value is given for lead.

Ecology – Future Landscaped Areas

7.18 Ecological Soil Screening Levels (Eco-SSL) have been published by the USEPA for a range of metals. The Eco-SSLs present indicative values for assessing potential risk to plants and other ecological receptors. As no relevant UK guidance exists for assessing risk to ecology, the recorded metal concentrations have been compared on an individual basis to Eco-SSLs.

7.19 The mean concentrations (95% UCL) for Arsenic, Copper, Lead, Nickel and Zinc were above the Eco-SSLs for plants. Therefore, it may be considered that the concentrations of these elements may pose a risk to sensitive plant growth in future garden or landscaped areas without soil treatment or amendment.

Surface Water and Groundwater Contamination Results

Data Sources

7.20 Groundwater samples taken from the site have been tested for potential chemicals of concern appropriate to the former land uses.

7.21 Our assessment of the risk to controlled waters is guided by the following:

- WA groundwater concentrations;
- WA measured soil contamination; and

- Soil samples submitted for leachate preparation.

Controlled Waters Receptors

7.22 The site is situated adjacent to a River Calder and over a Secondary A Aquifer of up to 10m proven thickness. Due to the proximity of the River Calder to the site boundary, concentrations of contaminants detected in groundwater have been compared to Environmental Quality Standard (EQS); where no EQS exists concentrations of these contaminants have been compared to the UKDWS.

7.23 The main pathway by which contaminants are likely to reach the aquifer is through infiltration of rainwater causing vertical movement through the unsaturated zone or by vertical and lateral movement of contaminants within groundwater

Groundwater Contamination Results

Introduction

7.24 In groundwater, the hardness ranged from 133mg/l to 383mg/l, the concentration of calcium ranged from 51.1mg/l to 149mg/l, Dissolved Organic Carbon from <3mg/l to 8mg/l, and pH ranged from 7.38 to 8.41.

Metals

7.25 The recorded concentrations of the majority of metals in groundwater were below their respective LOD or screening values. However, the dissolved concentrations of copper and manganese were elevated with respect to their bioavailable EQS.

7.26 The bioavailable concentrations of copper and manganese within groundwater were calculated using the M-BAT Tool. The bioavailable concentrations of copper were all below the EQS (Table VII) and are not considered to present a significant risk to controlled waters at the site.

7.27 The bioavailable concentration of manganese in one groundwater sample (BH102) was slightly elevated compared to the EQS. The manganese concentrations are not considered to present a significant risk to controlled waters at the site.

TABLE VII: SUMMARY OF METAL CONCENTRATIONS			
Borehole	**Measured Dissolved Concentration**	**M-BAT Bioavailable Concentration**	**EQS (Bioavailable)**
Copper (µg/l)			
BH101	5.2	0.19	1.0
BH102	0.85	0.06	
BH103	2.79	0.28	
BH104	2.72	0.07	
Manganese (µg/l)			
BH101	138	40.83	**123**
BH102	464	**145.90**	
BH103	138	13.08	
BH104	86.8	15.52	

Total Petroleum Hydrocarbons

7.28 There is no EQS value for TPH, so reference is made to the UK Drinking Water Standards (UKDWS) which provides a value for the maximum tolerable concentration of dissolved/emulsified hydrocarbons allowed in drinking water at the tap (0.01mg/l). There are also limits for dissolved or emulsified hydrocarbons given in the Surface Waters (Abstraction for Drinking Water) (Classification) Regulations 1996 of 0.05mg/l, 0.2mg/l or 1mg/l dependent on the degree of treatment required.

7.29 A conservative approach of comparing each speciated TPHCWG fraction with the UKDWS of 0.01mg/l has been performed. The concentration of aromatic and aliphatic petroleum hydrocarbon fractions between C6 and C16 were below the Limit of Detection in all samples.

7.30 The concentration of medium to long chain-length aromatic and aliphatic hydrocarbons (C16-C35) ranged from 0.197mg/l to 0.972mg/l which exceeds the UKDWS of 0.01mg/l. However, these values are all below the DWS surface water abstraction limit of 1mg/l.

7.31 TPH concentrations are shown in Table VIII below.

TABLE VIII: TPH CONCENTRATIONS (µg/l)				
TPH Fraction	BH101	BH102	BH103	BH104
Aliphatics >C5-C6	<10	<10	<10	<10
Aliphatics >C6-C8	<10	<10	<10	<10
Aliphatics >C8-C10	<10	<10	<10	<10
Aliphatics >C10-C12	<10	<10	<10	<10
Aliphatics >C12-C16	<10	<10	<10	<10
Aliphatics >C16-C35	**151**	**45**	**535**	**440**
Aromatics >EC5-EC7	<10	<10	<10	<10
Aromatics >EC7-EC8	<10	<10	<10	<10
Aromatics >EC8-EC10	<10	<10	<10	<10
Aromatics EC10-EC12	<10	<10	<10	<10
Aromatics EC12-EC16	<10	<10	<10	<10
Aromatics EC16-EC21	**41**	**16**	**56**	**38**
Aromatics EC21-EC35	**253**	**91**	**333**	**298**
Total Aliphatics & Aromatics >C5-35	569	197	972	776

Polycyclic Aromatic Hydrocarbons

7.32 For the purposes of this risk assessment, benzo(a)pyrene and dibenz(a,h)anthracene are considered to be the most carcinogenic PAH compound and naphthalene is considered to be the most mobile PAH. These compounds have been used as surrogates to assess the degree of risk posed by PAH compounds in groundwater and surface water.

7.33 The recorded concentrations of benzo(a)pyrene ranged from <0.122µg/l to 5.19µg/l. The concentration of benzo(a)pyrene in BH102, BH103 and BH104 exceeded the maximum allowable EQS of 0.27µg/l and WHO value of 0.7µg/l.

7.34 The recorded concentrations of dibenzo(a,h)anthracene ranged from <0.016µg/l to 0.436µg/l which is below the WHO value of 0.7µg/l for benzo(a)pyrene.

7.35 The recorded concentrations of naphthalene ranged from <0.1µg/l to 0.6µg/l which are below the maximum allowable EQS of 130µg/l.

Volatile Organic Compounds

7.36 The recorded concentrations of VOC where below their LOD or respective screening values and are not considered to present a significant risk to controlled waters.

Semi-Volatile Organic Compounds

7.37 The recorded concentrations of SVOC were below their LOD or respective screening values and are not considered to present a significant risk to controlled waters.

Non-Aqueous Phase Liquids

7.38 No LNAPL or DNAPL was detected in groundwater boreholes using an interface probe and no odours and/or sheens were noted. Based on the comparison of dissolved phase concentrations to solubility limits in Table IX (below) the recorded concentrations of TPH fractions, with the exception of aromatic hydrocarbon fraction C21-C35, are below their theoretical solubility. However, the recorded concentrations of aromatic hydrocarbon fraction C21-C35 exceed the theoretical solubility limit which indicates that limited LNAPL may be present.

TABLE IX: CONTAMINANT AQUEOUS SOLUBILITY

Contaminant	Maximum Concentrations (mg/l)	Aqueous Solubility (mg/l)	Source
Aliphatic C10-C12	0.01	0.0034	TPHCWG
Aliphatic C12-C16	0.01	$7.6E*10^{-04}$	
Aliphatic C16-C35	0.535	$2.5*10^{-06}$	
Aromatic C10-C12	0.01	24.5	
Aromatic C12-C16	0.01	5.75	
Aromatic C16-C21	0.056	0.653	
Aromatic C21-C35	**0.333**	$6.6E*10^{-03}$	

Ground Gas

7.39 This preliminary ground gas assessment has been undertaken using the Wilson and Card classification for all other development types (CIRIA 665 Situation A). Boreholes from the site are characterised by negligible concentrations of methane (max <0.1%) and low to moderate concentrations of carbon dioxide (max 4.1%) (Table IX). Flow rates for the boreholes where negligible at barometric pressures ranging from 1003mb to 1015mb.

7.40 Using the Wilson and Card classification system (CIRIA 665 Situation A) and based on the monitoring results, a preliminary GSV of 0.0041 l/hr has been calculated. This corresponds to a Characteristic Situation 1.

Ground Gas Protection Measures

7.41 The conceptual site model and preliminary gas monitoring data indicates classification as CS1 and no special ground gas protection measures are required.

7.42 Full gas monitoring results are included at Appendix VIII and a summary of this data is included below in Table X.

TABLE X: SUMMARY OF GROUND GAS MONITORING DATA

Borehole	Response Zone/Strata	No. Tests	CH_4 (%)	CO_2 (%)	Flow (l/hr)	Atmospheric Pressure
BH101	1m-10.15m/ MG-All.-MST	3	0.0	0.5 - 1.4	0.0	1004 - 1016
BH102	1m-10.05m/ MG-All.	3	0.0	0.5 - 2.7	0.0	1003 - 1016
BH103	1m-10.45m/ MG-All.	3	0.0	1.8 - 4.1	0.0	1003 - 1016
BH104	1m-6.3m/ MG-MST	3	0.0	0.7 - 1.9	0.0	1003 - 1015

Building Materials

Concrete

7.43 Chemical attack of concrete is influenced by several factors including the concentration and solubility of the substance, the groundwater table and the pH of the groundwater. Concrete is in particular at risk from acidic groundwater and elevated concentrations of sulphates and chlorides in soil and groundwater. Sulphate reacts with the minerals (e.g. calcium hydroxide) within the cement which causes a breakdown in the structure of the concrete.

7.44 Concentrations of total sulphate were measured in order to indicate the potential for concrete attack. Concentrations on site ranged between 0.046% and 0.266% indicating that there is potential for concrete attack on site.

7.45 Results from sulphate (2:1 extract) for materials on site ranged between 0.025g/l and 0.39g/l. These results indicate that a worst case design sulphate class of DS-1 and Aggressive Chemical for Concrete (ACEC) class of AC-1 may be appropriate for the site. Relevant guidelines are given in BRE Special Digest 1: Concrete in Aggressive Ground.

Water Supply Pipes

7.46 Permeation and accelerated deterioration of pipe material can occur due to chemical reactions between the pipe and contaminants in the ground in which it is laid. This can lead to premature failures resulting in leakage and loss of water quality.

7.47 The Water Supply (Water Quality) Regulations in England and Wales, the Byelaws in Scotland and the Northern Ireland Water Regulations include a requirement to use only suitable materials when laying water pipes and the laying of unprotected water supply pipes through contaminated land is not permitted.

7.48 A table of threshold values for various contaminants has been produced by Water UK and the Home Builders Federation in their report Contaminated Land Assessment Guidance (January 2014). These threshold values allow an assessor to select an appropriate pipe material where the contaminant concentrations are below the threshold values.

7.49 The selection of an appropriate pipe material based on the worst case (maximum) contaminant concentrations at the site is presented below in Table XI. Based on the available chemical test results, it is recommended that barrier pipe or wrapped ductile iron is used for water supply to the site. Further information regarding the selection of materials for water supply pipes is given in the Water UK/Home Builders Federation Contaminated Land Assessment Guidance, January 2014.

TABLE XI: WATER UK PIPE MATERIAL AND THRESHOLD VALUE (mg/kg)						
Contaminant	Max / Range Concentration	PE	Barrier Pipe (PE-AL-PE)	Wrapped Steel	Wrapped Ductile Iron	Copper
SVOC's (excluding PAHs and those substances marked with an*)	1.36mg/kg	2	Pass	Pass	Pass	Pass
EC5-EC10 aliphatic and aromatic hydrocarbons	<10mg/kg	2	Pass	Pass	Pass	Pass
EC10-EC16 aliphatic and aromatic hydrocarbons	<10mg/kg	10	Pass	Pass	Pass	Pass
EC16-EC40 aliphatic and aromatic hydrocarbons	1,136mg/kg	500	Pass	Pass	Pass	Pass
Phenols* (from SVOC analysis)	<0.1mg/kg	2	Pass	Pass	Pass	Pass
Cresols and chlorinated phenols* (from SVOC analysis)	<0.1mg/kg	2	Pass	Pass	Pass	Pass
Ethers*	<0.1mg/kg	0.5	Pass	Pass	Pass	Pass
Nitrobenzene*	<0.1mg/kg	0.5	Pass	Pass	Pass	Pass
Amines	<0.1mg/kg	0.5	Pass	Pass	Pass	Pass
pH	6.94 – 9.81 pH range	Pass	Pass	Fail	Pass	Fail
Preferred Pipe Type		✖	✓	✖	✓	✖

Revised Conceptual Site Model

7.50 In line with Environment Agency guidance CLR11, plausible source, pathway and receptor linkages have been identified for the site. A preliminary conceptual site model was presented in the Phase I Desk Study report. As the Phase I report was largely based on desk study information a number of uncertainties in the conceptual model existed.

7.51 The uncertainties have been revised and an updated CSM is presented below which is based on the findings of the intrusive site investigation works and associated geochemical testing.

Source

7.52 Based on the site investigation results, there is not considered to be a significant risk to human health or controlled waters. Groundwater samples contained slightly elevated concentrations of medium to long chain-length petroleum hydrocarbons, benzo(a)pyrene and manganese. These are not expected to represent a significant risk to controlled waters, but further monitoring is recommended to confirm this finding.

Pathways

7.53 There are no exceedances for human health and these pathways are not considered further. The main pathway by which contaminants are likely to reach the aquifer is through infiltration of rainwater causing vertical movement through the ground. The main pathway by which contaminants are likely to reach the surface water is through lateral migration of groundwater to surface water receptors in hydraulic connectivity.

Receptors

7.54 Groundwater in the aquifer beneath the site is considered to be a sensitive receptor.

7.55 The River Calder adjacent to the site is considered the most sensitive surface water receptor. Additionally, the Nun Brook is present on site toward the north of the main site area.

Summary

7.56 Based on the land use history and identified sources of contamination, a conceptual site model has been developed. This is shown in Table XII and details the potential sources, pathways and receptors and the inter-relationship of these factors.

TABLE XII: CONCEPTUAL SITE MODEL

Source	Pathway	Receptor	Risk
TPH and PAH in groundwater	Infiltration, advection, diffusion and dispersion and lateral migration	Groundwater	Low - Moderate
		Surface Watercourse	Low - Moderate

8 FILTER MEDIA TESTING

Geotechnical, Expansivity and Aggregate Testing

The filter media encountered on site was subjected to a range of aggregate and geotechnical testing parameters including:

- Particle Size Distribution;
- Expansivity;
- Moisture Content;
- Constituent Materials;
- Magnesium Sulphate;
- Water Soluble Sulphate, Acid Soluble Sulphate and Total Sulphate Content;
- Oxidisable Sulphides;
- Particle Density Testing; and
- Los Angeles Coefficient.

Particle Size Distribution

8.1 Particle size distribution tests were performed on eight samples from the filter media. The range in quantities of each soil fraction is shown in Table XIII.

TABLE XIII: PSD Filter Media

Soil Fraction	Total Percentage
Cobbles	0 - 35
Gravel	65 - 100
Sand	0 - 1
Silt/Clay	0 - 1

8.2 The particle size distribution tests indicate that cobbles were only present in one of the eight samples tested. However, observations during the site investigation show that the majority of the filter media is elongate in shape (low sphericity) and therefore may have been classed as a gravel based on the smallest axis. The longest axis of the material was consistently seen to be larger than 63mm which places the material within the cobble size range.

Thermal Expansion Testing

8.3 Thermal expansion or expansivity testing has been conducted at Professional Soils Ltd (PSL), Celtest Ltd and Thomas Research Services Ltd (TRS). Samples of filter media comprised predominantly slag material with some samples containing both slag and limestone and one sample containing predominantly limestone.

8.4 A total of seven samples were tested for expansivity by PSL with results varying between 0.025% and 0.32%. Samples with an expansivity of less than 0.5% are generally regarded as having a low potential for expansion.

8.5 To verify the thermal expansion results a duplicate sample of slag material from TP104 was sent to TRS for detailed mineralogical, chemical and thermal expansion testing. The results indicate that the sample is crystalline blast furnace slag with low sulphur content and no mineralogical evidence for expansive slag types. There was no evidence that the slag had expanded in the past and an accelerated test over 14 days showed a very modest potential for expansion of 0.14%. In terms of comparison the thermal expansion for this sample determined by PSL was 0.18%.

8.6 We consider that all of the test results are consistent, that the slag is crystalline blast furnace slag, that this material has a low to negligible potential for expansion and that it should not be classified as expansive.

Moisture Content

8.7 Eight samples were tested for natural moisture content and the results ranged from 1.7% to 9.6% indicating a consistent moisture content.

Aggregate Testing

8.8 One bulk sample of the filter media (Surface Sample 1, Drawing SH10243-04) was subjected to detailed aggregate testing and the results are summarised below.

Constituent Materials

8.9 The constituent materials are summarised below in Table XIV.

TABLE XIV: Constituent Materials Filter Media	
Material	**Content**
Floating Particles (FL)	0cm^3/kg
Combined clay, soil and other (X)	0%
Concrete, concrete products, mortar and Concrete Masonry Units (Rc)	63%
Unbound Aggregate, Natural Stone, Hydraulically bound aggregate (Ru)	0%
Clay masonry units, calcium silicate masonry units, and aerated non-floating concrete (Rb)	37%
Bituminous materials (Ra)	0%
Glass (Rg)	0%

Magnesium Sulphate

8.10 The mean magnesium sulphate value (MS) recorded from the test was 2%.

Water Soluble Sulphate, Acid Soluble Sulphate, Total Sulphate Content

8.11 The sample recorded results of 510mg/l water soluble sulphate content, 0.45% acid soluble sulphate content, 0.36% total sulphate content and 1.1% total potential sulphate content.

Oxidisable Sulphides

8.12 The oxidisable sulphides recorded from the sample was 0.63%.

Particle Density Testing

8.13 The particle density testing recorded results of 2.31Mg/m^3 for particle density on an oven dried basis, 2.39Mg/m^3 for particle density on a saturated and surface dried basis, 2.51Mg/m^3 for apparent particle density and 3.5% for water absorption (of dry mass) (WA).

Los Angeles Coefficient

8.14 The sample recorded a Los Angeles Coefficient (LA) of 29.

Filter Media Microbial Testing Results

8.15 A total of four samples were collected from towards the base of TP108 to TP111 to maximise the quantity of finer material. Samples were submitted to National Laboratory Service (NLS) for microbial testing including Salmonella and Escherichia coli.

8.16 All samples returned values of Escherichia coli of <1 CFU/gram and no presence of Salmonella. This finding is consistent with decommissioning of the filter beds in 2008 and long term flushing by rain water.

8.17 Based on this testing the filter media is considered unlikely to pose a significant risk to future occupiers or to construction workers. It is therefore considered that microbial activity will not be a constraint to re-use of the material as aggregate.

Filter Media Contamination Results

8.18 Fine grained 'soil' samples taken from the filter beds have been tested for potential chemicals of concern. An assessment of potential risks to human health and the environment is presented below.

Potential Risk to Human Health

8.19 As the receptor is human health, the most relevant risk assessment model is the CLEA model. The principal pathways of concern for human health are dermal contact, ingestion, and inhalation.

8.20 The geometric mean soil organic matter content at the site is 0.56%. Therefore, GAC values derived using 1% SOM have been selected in this assessment. The pH of the soil ranged from 7.77 in TP111 to 8.00 in TP109.

Metals

8.21 The mean concentration (95% UCL) for arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, vanadium and zinc were below their respective GAC. Therefore, it may be considered that the concentrations of these substances in soil on site do not present a significant risk to long-term human health.

Petroleum Hydrocarbons

8.22 Petroleum hydrocarbon testing was not possible on the samples collected due to the limited amount if finer material present within the sample. No visual or olfactory evidence was noted for hydrocarbons within the filter media.

Polycyclic Aromatic Hydrocarbons

8.23 None of the samples tested contained concentrations of Polycyclic Aromatic Hydrocarbons (PAH) compounds above the LOD. In addition, no visual or olfactory evidence of PAH contamination was recorded during site investigation works. Therefore, PAH are unlikely to present a significant risk to long term human health.

Volatile Organic Compounds

8.24 Volatile Organic Compound (VOC) testing was not possible on the samples collected due to the limited amount if finer material present within the sample.

Other Substances

8.25 Statistical analysis for monohydric phenol and total cyanide was carried out to identify the 95% confidence limits of the measured mean and to compare the upper 95th percentile with the respective screening criteria.

8.26 The upper bound values (US95) for phenol and cyanide were below their respective screening values. Therefore, it may be considered that the concentrations of these substances in soil on site do not present a significant risk to long-term human health.

8.27 Statistical analysis of the laboratory results is attached at Appendix VI.

Asbestos

8.28 Five samples were screened for asbestos and no fibres were detected. In addition, no visual evidence of asbestos was recorded during site investigation works. Therefore, asbestos contamination is unlikely to pose a risk to future site occupiers.

Human Health – Construction Workers

8.29 The CLEA Soil Guideline Values only apply to the protection of health for long term chronic exposure. Construction workers are more likely to be at risk from a high single exposure, i.e. an acute dose, which can result in contaminant poisoning. Suggested values for acute lethal doses of arsenic, cadmium, chromium, inorganic mercury, nickel and selenium is outlined in the Environment Agency R&D SGV reports from 2002.

8.30 None of the samples contained concentrations of cadmium, chromium, inorganic mercury, nickel or selenium that are elevated with respects to an acute lethal dose. No acute lethal dose value is given for lead.

Potential Risk to the Environment

8.31 Chemical results for the filter media are shown to be below generic assessment criteria for human health. Additionally, due to the lack of fine material within the filter media, the leachability of the material is expected to be low. Therefore, it is considered that the filler media is unlikely to present a significant risk to the environment.

9 GEOTECHNICAL RESULTS

Introduction

9.1 Site investigation works have identified up to 3.6m of filter media (discussed in Section 8) within raised beds occupying much of the site and up to 4.7m of made ground beneath the surrounding site area. This is underlain by natural alluvium deposits comprising cohesive, sandy gravelly clays and coarse, clayey sandy gravels. The alluvium is underlain by weathered mudstone of the Lower Coal Measures Formation.

9.2 In total, 16 samples of made ground, natural superficial material and weathered rock were collected from various depths and tested for range of geotechnical parameters including:

- Moisture content;
- Particle Size Distribution; and
- Atterberg Limits.

9.3 All tests were performed in an accredited geotechnical laboratory and in accordance with the appropriate British Standard. Five samples of made ground were sent to the laboratory for analysis. The made ground comprised sandy clayey gravel and sandy gravelly clay, interpreted to be reworked natural alluvium.

9.4 Broadly the made ground comprised material which is geotechnically similar and therefore the two types of made ground will be considered together.

Made Ground

Particle Size Distribution Test

9.5 Particle Size Distribution tests were performed on four samples from the made ground. The range in quantities of each soil fraction is shown in Table XV.

TABLE XV: PSD MADE GROUND

Soil Fraction	Total Percentage
Cobbles	0 - 10
Gravel	31 - 63
Sand	15 - 29
Silt/Clay	18 - 45

Moisture Content

9.6 Three samples were tested for natural moisture content and the results varied between 14% and 19% indicating a consistent moisture content.

Natural Deposits - Granular

Particle Size Distribution Test

9.7 Particle Size Distribution tests were performed on six samples from granular natural deposits. The range in quantities of each soil fraction is shown in Table XVI.

TABLE XVI: PSD NATURAL DEPOSITS	
Soil Fraction	**Total Percentage**
Cobbles	0 - 25
Gravel	50 - 66
Sand	18 - 38
Silt/Clay	4 - 17

Moisture Content

9.8 Five samples were tested for natural moisture content and majority of the results varied between 6.5% and 10%. One test recorded a greater moisture content value of 18%. It was noted that this sample represented material from the area of BH102 within clayey, silty sand and gravel which may show variable moisture content due to variations in the fine component.

Natural Deposits - Cohesive

Particle Size Distribution Test

9.9 Particle Size Distribution tests were performed on six samples from cohesive natural deposits. The range in quantities of each soil fraction is shown in Table XVII.

TABLE XVII: PSD NATURAL DEPOSITS	
Soil Fraction	**Total Percentage**
Cobbles	0
Gravel	0 - 26
Sand	13 - 52
Silt/Clay	48 - 77

Moisture Content

9.10 Three samples were tested for natural moisture content and the results varied between 25% and 30% indicating a consistent moisture content.

Atterberg Limits

9.11 Three samples from the cohesive natural deposits were tested for determination of Atterberg limits. Majority of the results from testing of the samples determined low to intermediate plasticity material with a plasticity index (PI) ranging between 15% (BH101A) and 25% (BH104).

Rockhead

9.12 One sample of weathered mudstone, comprising stiff clay, was tested for moisture content and a value of 11% was recorded. This is generally lower than the overlying alluvial deposits.

Standard Penetration Testing

9.13 In addition to laboratory geotechnical testing, in situ standard penetration tests were carried out during the site investigation and the results are summarised in Table XVIII.

9.14 N-values within the made ground are generally low, ranging between 11 and 17 (Table XVIII). As the majority of N-values are low the made ground can be considered to be generally loose to medium dense.

9.15 N–values within the alluvium are generally low, but with significant variability. Values range between 1 and 45 but the majority of values are below 25. This is likely to reflect changes in sand, gravel and clay components and larger gravel or cobble obstructions.

9.16 N-values obtained within underlying weathered mudstone are considerably higher, ranging between 27 and 50.

TABLE XVIII: RESULTS FOR STANDARD PENETRATION TESTS								
Depth (m bgl)	**BH101A**		**BH102**		**BH103**		**BH104**	
	N-value	Geol Unit	N-value	Geol Unit	N-value	Geol Unit	N-value	Geol Unit
1.2	1	A	11	MG	13	MG	12	MG
2.5	1	A			11	MG	15	MG
3							17	MG
4	36	A			11	MG		
5	39	A	39	A			27	MST
5.5					45	A		
6	19	A					50	MST
7			22	A	23	A		
7.5	14	A						
8	37	MST	15	A				
8.5					16	A		
9.5	50	MST	50	A				
10					18	A		

KEY: MG – made ground; A – Alluvium; MST – Mudstone.

10 CONCLUSIONS AND RECOMMENDATIONS

General

10.1 The site history, summarised from the Phase I report dated December 2008, indicates that the site was developed from farmland to be occupied by a sewage works, with a concentration of tanks and filter beds in the western part of the site by the 1920's. The site was decommissioned in 2008.

10.2 A total of four cable percussion boreholes (to a maximum depth of 10.45m), fifteen trial pits (to approximately 3.60m depth) and six hand dug pits (to a maximum depth of 1.2m) were completed as part of this Phase II investigation. Observations from the intrusive work have confirmed the presence of filter beds containing up to 3.6m of filter media covering the majority of the site. Beneath the surrounding area made ground was identified to between 1.1m and 5.0m bgl, underlain by alluvium (sand, gravel and clays) to proven depths of 4.9m bgl and 7.9m bgl. Bedrock of the Lower Coal Measures was encountered in BH101A and BH104 at depths of 7.90m bgl and 4.90m bgl respectively.

Soils Human Health

10.3 Analytical results were analysed using CLEA methodology to assess the risk to human health in a commercial / industrial scenario. The results for all contaminants of concern indicate that these compound are unlikely to pose a significant risk to future occupiers and construction workers.

10.4 No visual evidence of Asbestos has been identified in soils on the site. Additionally, a total of twelve samples were analysed for asbestos fibres in soil and no fibres were detected.

Surface Water and Groundwater

10.5 Slightly elevated concentrations of hydrocarbons have been recorded. The risk to surface and groundwater is considered to be moderate due to the permeable sand and gravel within the alluvium, the sites geographical location and the proximity of the nearest rated surface watercourse, the River Calder which borders the site.

10.6 It is recommended that an additional round of groundwater monitoring is conducted to constrain the potential impact from aromatic, aliphatic and polyaromatic hydrocarbons. Additionally, it is recommended that surface water samples are taken

from the surrounding surface water receptors to allow comparison to contaminants on site.

Buildings and Property

10.7 Results from sulphate (2:1 extract) testing indicate that a design sulphate class of DS-1 and Aggressive Chemical for Concrete (ACEC) class of AC-1 may be appropriate for the site.

10.8 A preliminary ground gas assessment has identified the site as Characteristic Situation 1 and ground gas protection measures are unlikely to be required for new buildings at the site. Ground gas monitoring is currently ongoing and the assessment will be updated on completion of the gas monitoring period.

Filter Media

10.9 Observations indicated that the filter media comprises vesicular slag and limestone that deepens from 3.0m thick in the south west to 3.6m thick in the north east. The filter media was exclusively slag to the north and south, exclusively limestone in the central portion and a mixture of both lithologies in between these areas. The base of the filter media was defined by ceramic pipes, presumably overlying a concrete base.

Contamination Testing

10.10 The results for all contaminants of concern indicate that these compound are unlikely to pose a significant risk to future occupiers and construction workers.

10.11 Microbial testing of the filter media has not identified the presence of E.Coli or Salmonella.

Geotechnical, Expansivity and Aggregate Testing

10.12 Particle size distribution tests show the filter media to be predominantly a coarse gravel material. However, observations on site identified that this material is of low sphericity and classed as cobbles depending in which axis of the material is used for assessment.

10.13 Results from the expansivity testing show that the filter media is unlikely to suffer from significant future expansion. All results indicate that expansion of the filter media is consistently less than 0.5% in the samples tested.

10.14 A suite of tests were completed to determine whether the filter media is likely to be suitable for use as an aggregate. The results of the testing for water soluble sulphate,

total sulphate, Magnesium Sulphate (MS), Los Angeles Coefficient (LA), water absorption (WA) and constituent materials have been compared to the recommended values for aggregates in Clauses 801 and 803 of Volume 1 Specification for Highway Works Series 800. The results demonstrate that the material is likely to be suitable for use as an aggregate in highway works.

Geotechnical and foundation design

10.15 The geology of the site is characterised by significant depths of made ground underlain by variable density clay, sand and gravel which is in turn underlain by weathered mudstone. The weathered mudstone was encountered in two locations, to the south and north of the site, at depths of 7.9m bgl and 4.9m bgl respectively.

10.16 Groundwater levels encountered at the site during monitoring show that the groundwater is approximately 1.3m to 3.8m bgl. This is within the upper levels of the alluvium and made ground.

10.17 The made ground comprises disturbed natural deposits with inclusions of brick, concrete and other construction debris. It is considered that the made ground would be unsuitable as a founding medium for most types of structure unless it were to be excavated and recompacted to form a more uniform engineered fill. Alternatively, the granular nature and shallow thickness of the made ground suggests that it is likely to be suitable for vibro compaction.

10.18 The underlying alluvium is also variable in nature, interpreted to be due to the variation of the clay, sand and gravel components. The alluvium shows variable strength of materials and may not be suitable as a founding stratum depending on the intended usage of the site and anticipated loading. The alluvial materials are likely to be suitable for ground improvement methods such as recompaction and vibro compaction.

10.19 Differential settlement is considered to be a possibility due to the variation in SPT N-values.

10.20 In circumstances where abnormally heavy loading is to be catered for, a piled solution may be appropriate.

APPENDIX I

Standard Terms and Conditions and Limitations to Reports

STANDARD TERMS AND CONDITIONS AND LIMITATIONS TO REPORTS

This Report is provided for the stated purpose and for the sole use of the client in accordance with the Terms and Conditions of Appointment under which the services were performed. The Report is confidential to the client and no other warranty, expressed or implied, is made as to the professional advice included in the Report or any other services provided by Wardell Armstrong LLP. This Report may not be disclosed by the Client nor relied upon by any other party without the prior and express written agreement of Wardell Armstrong LLP.

The conclusions and recommendations contained in this Report are based upon information provided by others including details supplied by the client and/or professional advisors on the assumption that all relevant information from whom it has been requested and/or supplied is accurate. Information so provided and/or supplied has not been verified independently by Wardell Armstrong LLP, unless otherwise stated in the Report.

The methodology adopted and the sources of information used by Wardell Armstrong LLP in providing the services are outlined in this Report. The work described in this Report is based on the conditions and information as stated at the date the Report was completed. The scope of this Report and the services are accordingly limited by these circumstances. The findings outlined in the Report together with any opinions expressed and recommendations made are considered to be valid and appropriate at the time of preparation and for the specific purpose or purposes intended. Whilst a walk over site visit may have been carried out as part of the work this has been limited to observations only and no other physical investigations, sampling and testing work has been carried out as part of this work.

Wardell Armstrong LLP disclaim any undertaking or obligation to advise any person of any change in any matter affecting the Report which may come or be brought to Wardell Armstrong LLP's attention after the date of the Report. Unless otherwise stated in this Report, the assessments made assume that the sites and facilities will continue to be used for their current purpose without significant changes.

Where any site observations have been carried out, these have been restricted to a level of detail required to meet the stated objectives of the services. The results from any site observations made may vary and further confirmatory work should be made after the issuance of this Report. Wardell Armstrong LLP does not guarantee or warrant any estimates or projections contained in this Report.

APPENDIX II

Borehole Logs

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Borehole Log

Borehole No.
BH101
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418159.22 - 420833.17	Hole Type CP
Location: Cooper Bridge		Level: 46.93	Scale 1:50
Client: Keyland Developments Ltd.		Dates: 01/08/2016 - 01/08/2016	Logged By W Reade

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10 - 0.40	B		0.05	46.88		TOPSOIL.
		0.30	D					MADE GROUND: Loose stony soil (fill) with vegetation and large cobbles.
		0.40 - 0.80	B					
		1.00 - 1.20	B					
					1.20	45.73		End of borehole at 1.20 m

Remarks
Drillers' descriptions.
Hole terminated due to suspect service.

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Borehole Log

Borehole No. **BH101A**

Sheet 1 of 2

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418164.44 - 420826.31	Hole Type CP
Location: Cooper Bridge		Level: 46.84	Scale 1:50
Client: Keyland Developments Ltd.		Dates: 01/08/2016 - 01/08/2016	Logged By M Biggins

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.15	46.69		Tarmac.
		0.40	D		0.40	46.44		SUB-BASE (MOT Type 1).
		0.40 - 1.00	B					MADE GROUND: Soft dark brown very sandy very gravelly clay. Gravel of fine-coarse subangular-subrounded sandstone and rare brick.
		1.10	D		1.10	45.74		
		1.20		N=1 (0,0/1,0,0,0)	1.30	45.54		Soft brown sandy gravelly CLAY. Gravel of fine-coarse subangular-subrounded sandstone.
		1.20 - 1.65	SPT					Loose grey silty SAND with occasional gravel of fine-coarse subangular-subrounded sandstone.
		1.20 - 1.70	B					
		2.10	D					
		2.50		N=1 (0,0/1,0,0,0)				
		2.50 - 2.95	SPT					
		3.20	D		3.20	43.64		Wooden obstruction.
		3.60		N=36 (2,4/6,8,12,10)	3.60	43.24		Dense brown grey sandy GRAVEL with occasional large cobbles. Gravel of fine-coarse subangular-subrounded sandstone.
		3.60	D					
		3.60 - 4.05	C					
		4.50	D					
		5.00		N=39 (1,2/5,9,11,14)				
		5.00 - 5.45	C					
		5.00 - 5.50	B					
		6.10		N=19 (1,2/4,4,5,6)	6.00	40.84		Loose-Medium Dense grey brown SAND and GRAVEL with occasional cobbles. Gravel of fine-coarse subangular-subrounded sandstone.
		6.10	D					
		6.10 - 6.55	C					
		7.00	D					
		7.50		N=14 (3,5/4,3,3,4)				
		7.50 - 7.95	C		7.70	39.14		Firm brown grey sandy gravelly CLAY. Gravel of fine-coarse subangular-subrounded sandstone.
		7.70	D		7.90	38.94		Weak grey weathered MUDSTONE.
		7.90		N=37 (5,8/9,9,9,10)				
		7.90	D					
		7.90 - 8.35	SPT					
		7.90 - 8.40	B					
		9.00	D					
		9.70		50 (5,6/11,12,12,15 for 70mm)				
		9.70 - 10.15	SPT					

Continued on next sheet

Remarks

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Borehole Log

Borehole No.
BH101A
Sheet 2 of 2

Project Name:	Cooper Bridge WWTW	Project No. SH10243	Co-ords:	418164.44 - 420826.31	Hole Type CP
Location:	Cooper Bridge		Level:	46.84	Scale 1:50
Client:	Keyland Developments Ltd.		Dates:	01/08/2016 - 01/08/2016	Logged By M Biggins

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					10.15	36.69		End of borehole at 10.15 m

Remarks

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Borehole Log

Borehole No.
BH102
Sheet 1 of 2

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418245.65 - 420913.25	Hole Type CP
Location: Cooper Bridge		Level: 47.40	Scale 1:50
Client: Keyland Developments Ltd.		Dates: 03/08/2016 - 03/08/2016	Logged By M Biggins

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.30	47.10		TOPSOIL.
		0.40 0.40	B D					MADE GROUND: Loose brown slightly clayey gravelly sand. Gravel of brick and concrete.
		1.20 1.20 1.20 - 1.65 1.65 - 2.00	 D SPT B	N=11 (1,2/1,2,4,4)	1.65	45.75		MADE GROUND: Soft grey brown sandy CLAY with rare angular brick fragments.
		2.00 2.00 - 2.45 2.45 - 3.00	D U B		2.50	44.90		Very soft-Soft grey brown sandy CLAY.
		3.50 - 3.95	U					
		4.50 - 4.90	B					
		5.10 5.10 - 5.55	 C	N=39 (2,1/5,9,12,13)	5.00	42.40		Loose-Medium Dense dark grey brown slight clayey silty SAND and GRAVEL with occasional medium-large sized cobbles. Gravel of fine-coarse angular-subrounded sandstone and mudstone.
		6.00 - 6.50	B					
		6.60 6.60 - 7.05	 C	N=22 (2,2/4,5,6,7)				
		7.60 - 8.00	B					
		8.00 8.00 - 8.45	 C	N=15 (4,4/5,4,3,3)				
		9.00 - 9.50	B					
		9.50 9.50 - 10.05	 C	50 (5,5/15,15,20 for 30mm)				

Continued on next sheet

Remarks

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Borehole Log

Borehole No.
BH102
Sheet 2 of 2

Project Name:	Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418245.65 - 420913.25	Hole Type CP
Location:	Cooper Bridge		Level: 47.40	Scale 1:50
Client:	Keyland Developments Ltd.		Dates: 03/08/2016 - 03/08/2016	Logged By M Biggins

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					10.05	37.35		End of borehole at 10.05 m

Remarks

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Borehole Log

Borehole No. **BH103**

Sheet 1 of 2

Project Name:	Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418162.26 - 421081.74
Location:	Cooper Bridge		Level: 49.05
Client:	Keyland Developments Ltd.		Dates: 04/08/2016 - 04/08/2016

Hole Type: CP
Scale: 1:50
Logged By: M Biggins

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.30	48.75		TOPSOIL.
		0.50	B					MADE GROUND: Soft brown sandy gravelly clay. Gravel of fine-coarse angular-subangular mudstone, sandstone and brick.
		1.20		N=13 (3,3/3,4,3,3)				
		1.20	B					
		1.20 - 1.65	C					
		1.80 - 2.20	B					
		2.50		N=11 (2,3/2,3,4,2)				
		2.50 - 2.95	C					
		3.80 - 4.00	B					
		4.00		N=11 (2,3/3,2,2,4)				
		4.00 - 4.45	C					
					4.30	44.75		MADE GROUND: Loose-Medium Dense black gravelly sand. Gravel of brick and ash.
		5.00 - 5.40	B		5.00	44.05		Medium Dense-Dense yellow brown sandy GRAVEL with occasional medium-large sized cobbles. Gravel of fine-coarse subrounded-rounded sandstone.
		5.50		N=45 (2,3/9,12,12,12)				
		5.50 - 5.95	C					
		6.60 - 7.00	B					
		7.10		N=23 (2,3/5,4,6,8)				
		7.10 - 7.55	C					
		8.00 - 8.50	B					
		8.50		N=16 (3,5/5,4,3,4)				
		8.50 - 8.95	C					
		9.50 - 9.80	B					
		10.00		N=18 (6,4/4,5,5,4)				

Continued on next sheet

Remarks

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Borehole Log

Borehole No.
BH103
Sheet 2 of 2

Project Name:	Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418162.26 - 421081.74	Hole Type CP
Location:	Cooper Bridge		Level: 49.05	Scale 1:50
Client:	Keyland Developments Ltd.		Dates: 04/08/2016 - 04/08/2016	Logged By M Biggins

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		10.00 - 10.45	C		10.45	38.60		End of borehole at 10.45 m

Remarks

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Borehole Log

Borehole No.
BH104
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 417858.45 - 420979.07	Hole Type CP
Location: Cooper Bridge		Level: 50.15	Scale 1:50
Client: Keyland Developments Ltd.		Dates: 05/08/2016 - 05/08/2016	Logged By M Biggins

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.10 - 0.50	B		0.10	50.05		TOPSOIL. MADE GROUND: Loose brown slightly clayey gravelly sand. Gravel of fine-coarse subangular sandstone, concrete and brick.
		0.80 - 1.20	B					
		1.20		N=12 (1,1/2,3,3,4)	1.30	48.85		
		1.20 - 1.50	B					MADE GROUND: Soft orange brown very sandy gravelly clay. Gravel of fine-coarse subangular-subrounded sandstone, mudstone, concrete and occasional wood fragments.
		1.20 - 1.65	C					
	▼	2.10		N=15 (1,2/3,4,4,4)				
		2.10 - 2.55	C		2.40	47.75		
		2.50 - 3.00	B					MADE GROUND: Soft-Firm orange grey brown sandy gravelly clay. Gravel of fine subangular-subrounded mudstone.
		3.00		N=17 (1,3/4,5,5,3)				
	▼	3.00 - 3.45	C					
		3.90 - 4.35	U					
		4.00 - 4.50	B		4.00	46.15		Loose-Medium Dense brown clayey very sandy GRAVEL. Gravel of fine-coarse subangular-subrounded sandstone and mudstone.
		5.20		N=27 (2,4/6,7,6,8)	4.90	45.25		Firm to Stiff grey CLAY.
		5.20 - 5.65	SPT					
		5.20 - 5.70	B					
	▽	6.30		50 (25 for 5mm/50 for 0mm)	6.30	43.85		End of borehole at 6.30 m
		6.30	C					

Remarks

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APPENDIX III

Hand Dug Pit Logs

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Trial Pit Log

TrialPit No
HTP101
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418071.74 - 421079.52 Level: 47.34	Date 02/08/2016
Location: Cooper Bridge		Dimensions (m): Depth 1.20	Scale 1:25
Client: Keyland Developments Ltd.			Logged M Biggins

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							TOPSOIL.
	0.30 - 0.50	B		0.30	47.04		MADE GROUND: Loose brown organic gravelly sand. Gravel of fine-medium subangular brick and sandstone.
	0.40	D					
				0.50	46.84		Concrete.
	0.60 - 0.90	B		0.60	46.74		MADE GROUND: Loose-Medium Dense brown sand and gravel. Gravel of sandstone.
	0.80	D					
	0.90 - 1.10	B					
	1.20	D		1.20	46.14		End of Pit at 1.20m

Remarks:

Stability:

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Trial Pit Log

TrialPit No
HTP102
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418163.82 - 421028.35 Level: 47.60	Date 02/08/2016
Location: Cooper Bridge		Dimensions (m): Depth 1.20	Scale 1:25
Client: Keyland Developments Ltd.			Logged M Biggins

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10 - 0.40	B		0.05	47.55		TOPSOIL.
							MADE GROUND: Loose brown organic gravelly sand. Gravel of fine-medium subangular brick and sandstone.
	0.40	D					
				0.70	46.90		Concrete.
	0.95 - 1.20	B		0.95	46.65		MADE GROUND: Loose black gravelly sand. Gravel of ash.
	1.20	D		1.20	46.40		End of Pit at 1.20m

Remarks:

Stability:

AGS

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S35 2PH

Trial Pit Log

TrialPit No
HTP103
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 417913.10 - 421063.70 Level: 49.26	Date 02/08/2016
Location: Cooper Bridge		Dimensions (m): Depth 1.10	Scale 1:25
Client: Keyland Developments Ltd.			Logged M Biggins

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10 - 0.30	B		0.05	49.21		TOPSOIL.
	0.30	D					MADE GROUND: Loose brown organic gravelly sand. Gravel of fine-medium subangular brick and sandstone.
	0.60	D					
	0.60 - 0.90	B					
	0.90 - 1.10	B		0.90	48.36		MADE GROUND: Soft brown sandy gravelly clay. Gravel of fine-medium subangular brick and sandstone.
	1.10	D		1.10	48.16		End of Pit at 1.10m

Remarks: Terminated due to large obstruction.

Stability:

AGS

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Trial Pit Log

TrialPit No
HTP104
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418222.37 - 420894.19 Level: 46.99	Date 02/08/2016
Location: Cooper Bridge		Dimensions (m): Depth 1.20	Scale 1:25
Client: Keyland Developments Ltd.			Logged M Biggins

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10 - 0.40	B		0.05	46.94		TOPSOIL.
	0.30	D					MADE GROUND: Soft light brown sandy gravelly clay. Gravel of fine-medium subangular brick and sandstone.
	0.50 - 0.80	B		0.50	46.49		MADE GROUND: Soft dark brown sandy gravelly clay. Gravel of fine-medium subangular brick and sandstone.
	0.80	D					
	1.00 - 1.20	B		1.00	45.99		MADE GROUND: Soft brown sandy gravelly clay. Gravel of fine-medium subangular brick and sandstone.
	1.20	D		1.20	45.79		End of Pit at 1.20m

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Remarks:

Stability:

AGS

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Trial Pit Log

TrialPit No
HTP105
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418122.48 - 421061.07 Level:	Date 05/08/2016
Location: Cooper Bridge		Dimensions (m): Depth 0.20	Scale 1:25
Client: Keyland Developments Ltd.			Logged M Biggins

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	ES		0.20			MADE GROUND: Loose-Medium Dense brown gravelly organic sand. Gravel of fine-coarse subangular-subrounded sandstone, brick and concrete.
							End of Pit at 0.20m

Remarks: Terminated due to large obstruction.

Stability:

AGS

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Trial Pit Log

TrialPit No
HTP106
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 417950.87 - 420910.55	Date 05/08/2016
Location: Cooper Bridge		Dimensions (m):	Scale 1:25
Client: Keyland Developments Ltd.		Depth 0.20	Logged M Biggins

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	ES		0.20			MADE GROUND: Loose-Medium Dense brown slightly clayey organic gravelly sand. Gravel of fine-medium subangular sandstone.
							End of Pit at 0.20m

Remarks: Terminated due to large obstruction.

Stability:

AGS

APPENDIX IV

Trial Pit Logs

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Trial Pit Log

TrialPit No
TP101
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418144.88 - 420936.22 Level: 50.13	Date 02/08/2016
Location: Cooper Bridge		Dimensions (m):	Scale 1:25
Client: Keyland Developments Ltd.		Depth 3.40	Logged MB

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.50	B					MADE GROUND: Loose orange brown black gravelly cobbles. Gravel and cobbles of angular to subangular medium to coarse vesicular slag. Slight iron staining. Occasional very large cobbles. Ceramic pipes (recovered as fragments) at the base.
	3.40 3.40	B ES		3.40	46.73		End of Pit at 3.40m

Remarks:

Stability:

AGS

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Trial Pit Log

TrialPit No
TP102
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418106.99 - 421002.51 Level: 50.18	Date 02/08/2016
Location: Cooper Bridge		Dimensions (m):	Scale 1:25
Client: Keyland Developments Ltd.		Depth 3.60	Logged MB

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							MADE GROUND: Loose grey brown black gravelly cobbles. Cobbles and gravels of angular coarse dark grey limestone and vesicular slag.
	3.60	B		3.60	46.58		End of Pit at 3.60m

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Remarks:

Stability:

AGS

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Trial Pit Log

TrialPit No
TP103
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 417992.07 - 420902.86 Level: 50.26	Date 02/08/2016
Location: Cooper Bridge		Dimensions (m):	Scale 1:25
Client: Keyland Developments Ltd.		Depth 3.20	Logged MB

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	1.00 1.00	B B					MADE GROUND: Loose grey brown black gravelly cobbles. Gravel and cobbles of angular coarse dark grey limestone. Ceramic pipes (recovered as fragments) present at base.
				3.20	47.06		End of Pit at 3.20m

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Remarks:

Stability:

AGS

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Trial Pit Log

TrialPit No
TP104
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 417928.68 - 421045.87 Level: 50.33	Date 02/08/2016
Location: Cooper Bridge		Dimensions (m):	Scale 1:25
Client: Keyland Developments Ltd.		Depth 3.15	Logged MB

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	1.00 1.00	B B					MADE GROUND: Loose orange brown black cobbles. Cobbles of subangular medium to coarse vesicular slag. Ceramic pipes (recovered as fragments) present at base.
	3.15 3.15	D ES		3.15	47.18		End of Pit at 3.15m

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Remarks:

Stability:

AGS

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Trial Pit Log

TrialPit No
TP105
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 417968.64 - 421026.26 Level: 50.27	Date 02/08/2016
Location: Cooper Bridge		Dimensions (m):	Scale 1:25
Client: Keyland Developments Ltd.		Depth 3.00	Logged MB

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							MADE GROUND: Loose orange brown grey black gravelly cobbles. Gravel and cobbles of angular to subangular medium to coarse vesicular slag and dark grey limestone. Ceramic pipes (recovered as fragments) present at base.
				3.00	47.27		End of Pit at 3.00m

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Remarks:

Stability:

AGS

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Trial Pit Log

TrialPit No
TP106
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418035.62 - 421056.75 Level: 50.35	Date 02/08/2016
Location: Cooper Bridge		Dimensions (m):	Scale 1:25
Client: Keyland Developments Ltd.		Depth 3.00	Logged MB

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							MADE GROUND: Loose brown grey black gravelly cobbles. Gravel and cobbles of subangular medium to coarse vesicular slag and dark grey limestone. Ceramic pipes (recovered as fragments) present at base.
	1.50	B					
	3.00	ES		3.00	47.35		End of Pit at 3.00m

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Remarks:

Stability:

AGS

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Trial Pit Log

TrialPit No
TP107
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418051.99 - 420971.72	Date 02/08/2016
Location: Cooper Bridge		Level: 50.26	Scale 1:25
Client: Keyland Developments Ltd.		Dimensions (m): Depth 3.30	Logged MB

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							MADE GROUND: Loose grey brown black gravelly cobbles. Gravel of subangular coarse dark grey limestone. Ceramic pipes (recovered as fragments) present at base.
				3.30	46.96		End of Pit at 3.30m

Remarks:

Stability:

AGS

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Trial Pit Log

TrialPit No
TP108
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 417920.03 - 420990.01	Date 03/08/2016
Location: Cooper Bridge		Level: 50.34	Scale 1:25
Client: Keyland Developments Ltd.		Dimensions (m): Depth 3.00	Logged MB

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
							MADE GROUND: Loose grey brown black gravelly cobbles. Gravel and cobbles of angular coarse vesicular slag and dark grey limestone. Ceramic pipes (recovered as fragments) present at base.
	3.00 3.00 3.00	B D ES		3.00	47.34		End of Pit at 3.00m

Remarks:

Stability:

AGS

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Trial Pit Log

TrialPit No
TP109
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 417964.88 - 420979.39 Level: 50.35	Date 03/08/2016
Location: Cooper Bridge		Dimensions (m): Depth 3.10	Scale 1:25
Client: Keyland Developments Ltd.			Logged MB

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							MADE GROUND: Loose grey black brown gravelly cobbles. Gravel and cobbles of angular to subangular medium to coarse vesicular slag and dark grey limestone. Ceramic pipes (recovered as fragments) present at base.
	2.50	B					
	2.50	B					
	3.10	D		3.10	47.25		
	3.10	ES					End of Pit at 3.10m

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Remarks:

Stability:

AGS

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Trial Pit Log

TrialPit No
TP110
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418011.32 - 420972.57 Level: 50.32	Date 03/08/2016
Location: Cooper Bridge		Dimensions (m): Depth 3.30	Scale 1:25
Client: Keyland Developments Ltd.			Logged MB

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							MADE GROUND: Loose grey brown black gravelly cobbles. Gravel and cobbles of angular to subangular medium to coarse vesicular slag and dark grey limestone. Ceramic pipes (recovered as fragments) present at base.
	3.30 3.30	D ES		3.30	47.02		End of Pit at 3.30m

1
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Remarks:

Stability:

AGS

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Trial Pit Log

TrialPit No
TP111
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418103.41 - 420955.83 Level: 50.23	Date 03/08/2016
Location: Cooper Bridge		Dimensions (m): Depth 3.50	Scale 1:25
Client: Keyland Developments Ltd.			Logged MB

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							MADE GROUND: Loose brown black gravelly cobbles. Gravel and cobbles of subangular fine to coarse vesicular slag. Occasional cobbles of angular dark grey limestone. Ceramic pipes (recovered as fragments) present at base.
	3.50 3.50 3.50	B D ES		3.50	46.72		End of Pit at 3.50m

1
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Remarks:

Stability:

AGS

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Trial Pit Log

TrialPit No
TP112
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418092.87 - 420896.64 Level: 50.11	Date 03/08/2016
Location: Cooper Bridge		Dimensions (m):	Scale 1:25
Client: Keyland Developments Ltd.		Depth 3.10	Logged MB

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							MADE GROUND: Loose orange brown gravelly cobbles. Gravel and cobbles of subangular fine to coarse vesicular slag. Occasional cobbles of angular dark grey limestone. Ceramic pipes (recovered as fragments) present at base.
				3.10	47.01		End of Pit at 3.10m

1
2
3
4
5

Remarks:

Stability:

AGS

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Trial Pit Log

TrialPit No
TP113
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418038.34 - 420904.42 Level: 50.26	Date 03/08/2016
Location: Cooper Bridge		Dimensions (m):	Scale 1:25
Client: Keyland Developments Ltd.		Depth 3.20	Logged MB

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				2.50	47.76		MADE GROUND: Loose orange brown gravelly cobbles. Gravel and cobbles of subangular to angular fine to coarse vesicular slag, dark grey limestone and rare iron nodules.
							End of Pit at 3.20m

1
2
3
4
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Remarks:

Stability:

AGS

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Trial Pit Log

TrialPit No
TP114
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 417935.29 - 420936.28 Level: 50.31	Date 03/08/2016
Location: Cooper Bridge		Dimensions (m):	Scale 1:25
Client: Keyland Developments Ltd.		Depth 3.00	Logged MB

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							MADE GROUND: Loose grey brown black gravelly cobbles. Gravel and cobbles of angular to subangular medium to coarse vesicular slag and dark grey limestone. Ceramic pipes (recovered as fragments) present at base.
				3.00	47.31		End of Pit at 3.00m

1
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Remarks:

Stability:

AGS

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Trial Pit Log

TrialPit No
TP115
Sheet 1 of 1

Project Name: Cooper Bridge WWTW	Project No. SH10243	Co-ords: 418085.78 - 421051.31 Level: 50.27	Date 03/08/2016
Location: Cooper Bridge		Dimensions (m):	Scale 1:25
Client: Keyland Developments Ltd.		Depth 3.60	Logged MB

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							MADE GROUND: Loose grey brown black gravelly cobbles. Gravel and cobbles of angular coarse dark grey limestone. Ceramic pipes (recovered as fragments) present at base.
				3.60	46.67		End of Pit at 3.60m

1
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Remarks:

Stability:

AGS

APPENDIX V

Geochemical Laboratory Results

ALcontrol Laboratories

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: mkt@alcontrol.com
Website: www.alcontrol.com

Wardell Armstrong LLP
Unit 4 Newton Business Centre
Thorncliffe Park
Sheffield
South Yorkshire
S35 2PH

Attention: Matthew Biggins

CERTIFICATE OF ANALYSIS

Date:	16 August 2016
Customer:	H_WARDELL_SHF
Sample Delivery Group (SDG):	160805-79
Your Reference:	SH10243
Location:	Cooper Bridge
Report No:	373711

We received 15 samples on Friday August 05, 2016 and 11 of these samples were scheduled for analysis which was completed on Tuesday August 16, 2016. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:

Redacted

Sonia McWhan

Operations Manager

CERTIFICATE OF ANALYSIS

SDG:	160805-79	**Location:**	Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-160	**Customer:**	Wardell Armstrong LLP	**Report Number:**	373711
Client Reference:	SH10243	**Attention:**	Matthew Biggins	**Superseded Report:**	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
13915095	BH101A ES1		0.80	04/08/2016
13915102	BH102 ES1		0.40	04/08/2016
13915108	BH102 ES2		1.65	04/08/2016
13915035	HP101 ES1		0.30	03/08/2016
13915080	HP102 ES1		0.50	03/08/2016
13915084	HP103 ES1		0.90	03/08/2016
13915089	HP104 ES1		0.80	03/08/2016
13915065	TP108			
13915061	TP110			
13915051	TP101 ES1	ES1	0.00 - 0.00	04/08/2016
13915045	TP103 ES1		0.00 - 0.00	04/08/2016
13915056	TP104 ES1	ES1	0.00 - 0.00	04/08/2016
13915075	TP106 ES1		0.00 - 0.00	04/08/2016
13915040	TP109 ES1		0.00 - 0.00	04/08/2016
13915069	TP111 ES1		0.00 - 0.00	04/08/2016

Only received samples which have had analysis scheduled will be shown on the following pages.

CERTIFICATE OF ANALYSIS

SDG:	160805-79	**Location:**	Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-160	**Customer:**	Wardell Armstrong LLP	**Report Number:**	373711
Client Reference:	SH10243	**Attention:**	Matthew Biggins	**Superseded Report:**	

SOLID

Results Legend

X Test

N No Determination Possible

Lab Sample No(s)	13915095	13915102	13915108	13915035	13915080	13915084	13915089	13915045	13915075	13915040	13915069
Customer Sample Reference	BH101A ES1	BH102 ES1	BH102 ES2	HP101 ES1	HP102 ES1	HP103 ES1	HP104 ES1	TP103 ES1	TP106 ES1	TP109 ES1	TP111 ES1
AGS Reference											
Depth (m)	0.80	0.40	1.65	0.30	0.50	0.90	0.80	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
Container	250g Amber Jar (AL	400g Tub (ALE214)	250g Amber Jar (AL	400g Tub (ALE214)	250g Amber Jar (AL	400g Tub (ALE214)	250g Amber Jar (AL	400g Tub (ALE214)	250g Amber Jar (AL	400g Tub (ALE214)	250g Amber Jar (AL	400g Tub (ALE214)	250g Amber Jar (AL	400g Tub (ALE214)	250g Amber Jar (AL	400g Tub (ALE214)	250g Amber Jar (AL	400g Tub (ALE214)	250g Amber Jar (AL	400g Tub (ALE214)	250g Amber Jar (AL	400g Tub (ALE214)	250g Amber Jar (AL	400g Tub (ALE214)

Anions by Kone (soil)	All	NDPs: 0 Tests: 9	X		X		X		X		X		X						X		X			
Asbestos ID in Solid Samples	All	NDPs: 0 Tests: 11		X		X		X		X		X		X		X		X		X		X		X
CEN Readings	All	NDPs: 2 Tests: 1							X							N		N						
Chromium III	All	NDPs: 0 Tests: 9		X		X		X		X		X		X						X		X		
Cyanide Comp/Free/Total/Thiocyanate	All	NDPs: 0 Tests: 9		X		X		X		X		X		X						X		X		
Dissolved Metals by ICP-MS	All	NDPs: 2 Tests: 0														N		N						
Hexavalent Chromium (s)	All	NDPs: 0 Tests: 9		X		X		X		X		X		X						X		X		
Mercury Dissolved	All	NDPs: 2 Tests: 0														N		N						
Metals in solid samples by OES	All	NDPs: 0 Tests: 9	X		X		X		X		X		X						X		X			
PAH by GCMS	All	NDPs: 0 Tests: 7	X		X		X					X		X						X		X		
PAH Spec MS - Aqueous (W)	All	NDPs: 2 Tests: 1							X							N		N						
pH	All	NDPs: 0 Tests: 9		X		X		X		X		X		X						X		X		
pH Value	All	NDPs: 2 Tests: 0														N		N						
Phenols by HPLC (S)	All	NDPs: 0 Tests: 9		X		X		X		X		X		X						X		X		
Sample description	All	NDPs: 0 Tests: 11	X		X		X		X		X		X		X		X		X		X		X	

CERTIFICATE OF ANALYSIS

SDG:	160805-79	**Location:**	Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-160	**Customer:**	Wardell Armstrong LLP	**Report Number:**	373711
Client Reference:	SH10243	**Attention:**	Matthew Biggins	**Superseded Report:**	

SOLID

Results Legend

X **Test**

N **No Determination Possible**

		Lab Sample No(s)	Customer Sample Reference	AGS Reference	Depth (m)	Container
		13915095	BH101A ES1		0.80	250g Amber Jar (AL)
		13915095	BH101A ES1		0.80	400g Tub (ALE214)
		13915102	BH102 ES1		0.40	250g Amber Jar (AL)
		13915102	BH102 ES1		0.40	400g Tub (ALE214)
		13915108	BH102 ES2		1.65	250g Amber Jar (AL)
		13915108	BH102 ES2		1.65	400g Tub (ALE214)
		13915035	HP101 ES1		0.30	250g Amber Jar (AL)
		13915035	HP101 ES1		0.30	400g Tub (ALE214)
		13915080	HP102 ES1		0.50	250g Amber Jar (AL)
		13915080	HP102 ES1		0.50	400g Tub (ALE214)
		13915084	HP103 ES1		0.90	250g Amber Jar (AL)
		13915084	HP103 ES1		0.90	400g Tub (ALE214)
		13915089	HP104 ES1		0.80	250g Amber Jar (AL)
		13915089	HP104 ES1		0.80	400g Tub (ALE214)
		13915045	TP103 ES1		0.00 - 0.00	250g Amber Jar (AL)
		13915045	TP103 ES1		0.00 - 0.00	400g Tub (ALE214)
		13915075	TP106 ES1		0.00 - 0.00	250g Amber Jar (AL)
		13915075	TP106 ES1		0.00 - 0.00	400g Tub (ALE214)
		13915040	TP109 ES1		0.00 - 0.00	250g Amber Jar (AL)
		13915040	TP109 ES1		0.00 - 0.00	400g Tub (ALE214)
		13915069	TP111 ES1		0.00 - 0.00	250g Amber Jar (AL)
		13915069	TP111 ES1		0.00 - 0.00	400g Tub (ALE214)
Semi Volatile Organic Compounds	All	NDPs: 0 Tests: 2				
Total Organic Carbon	All	NDPs: 0 Tests: 11				
Total Sulphate	All	NDPs: 0 Tests: 9				
TPH c6-40 Value of soil	All	NDPs: 0 Tests: 4				

CERTIFICATE OF ANALYSIS

SDG:	160805-79	**Location:**	Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-160	**Customer:**	Wardell Armstrong LLP	**Report Number:**	373711
Client Reference:	SH10243	**Attention:**	Matthew Biggins	**Superseded Report:**	

Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.1mm	medium	0.1mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm

Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Grain size	Inclusions	Inclusions 2
13915102	BH102 ES1	0.40	Dark Brown	Loamy Sand	0.063 - 2.00 mm	Crushed Brick	Vegetation
13915108	BH102 ES2	1.65	Dark Brown	Sandy Clay Loam	0.063 - 2.00 mm	Vegetation	Stones
13915095	BH101A ES1	0.80	Dark Brown	Loamy Sand	0.063 - 2.00 mm	Vegetation	Stones
13915035	HP101 ES1	0.30	Dark Brown	Silty Clay Loam	0.002 - 0.063 mm	Brick	Vegetation
13915080	HP102 ES1	0.50	Dark Brown	Sandy Loam	0.002 - 0.063 mm	Vegetation	N/A
13915084	HP103 ES1	0.90	Dark Brown	Loamy Sand	0.063 - 2.00 mm	Vegetation	N/A
13915089	HP104 ES1	0.80	Dark Brown	Sandy Loam	0.002 - 0.063 mm	Vegetation	Stones
13915045	TP103 ES1	0.00 - 0.00	Black	Stone/Soil	> 60.00 mm	Stones	N/A
13915075	TP106 ES1	0.00 - 0.00	Dark Brown	Stone/Soil	> 60.00 mm	Stones	Concrete/Aggregate
13915040	TP109 ES1	0.00 - 0.00	Dark Brown	Stone/Soil	2.00 - 60.00 mm	Vegetation	None
13915069	TP111 ES1	0.00 - 0.00	Dark Brown	Loamy Sand	0.063 - 2.00 mm	Concrete/Aggregate	Stones

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally ocurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

CERTIFICATE OF ANALYSIS

SDG:	160805-79	**Location:**	Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-160	**Customer:**	Wardell Armstrong LLP	**Report Number:**	373711
Client Reference:	SH10243	**Attention:**	Matthew Biggins	**Superseded Report:**	

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample R	BH101A ES1	BH102 ES1	BH102 ES2	HP101 ES1	HP102 ES1	HP103 ES1
			Depth (m)	0.80	0.40	1.65	0.30	0.50	0.90
			Sample Type	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid
			Date Sampled	04/08/2016	04/08/2016	04/08/2016	03/08/2016	03/08/2016	03/08/2016
			Sample Time	.	.	.	.	.	.
			Date Received	05/08/2016	05/08/2016	05/08/2016	05/08/2016	05/08/2016	05/08/2016
			SDG Ref	160805-79	160805-79	160805-79	160805-79	160805-79	160805-79
			Lab Sample No.(s)	13915095	13915102	13915108	13915035	13915080	13915084
			AGS Reference						
Moisture Content Ratio (% of as received sample)	%	PM024		14	10	18	5.6	15	11
Phenol	<0.01 mg/kg	TM062 (S)		<0.01 M	<0.01 M	<0.01 M	<0.01 M	<0.01 M	<0.01 M
Cresols	<0.01 mg/kg	TM062 (S)		<0.01 M	0.0333 M	<0.01 M	<0.01 M	<0.01 M	<0.01 M
Xylenols	<0.015 mg/kg	TM062 (S)		<0.015 M	<0.015 M	<0.015 M	<0.015 M	<0.015 M	<0.015 M
Phenols, Total Detected monohydric	<0.035 mg/kg	TM062 (S)		<0.035 M	<0.035 M	<0.035 M	<0.035 M	<0.035 M	<0.035 M
Organic Carbon, Total	<0.2 %	TM132		1.03 M	8.89 M	2.09 M	2.11 M	1.76 M	2.83 M
pH	1 pH Units	TM133		8.55 M	7.35 M	7.84 M	8.28 M	7.33 M	8 M
Chromium, Hexavalent	<0.6 mg/kg	TM151		<0.6 #	1.21 #	<0.6 #	<0.6 #	<0.6 #	<0.6 #
Cyanide, Free	<1 mg/kg	TM153		<1 M	<1 M	<1 M	<1 M	<1 M	<1 M
TPH >C6-C8	<10 mg/kg	TM154				<10	<10	<10	
TPH >C8-C10	<10 mg/kg	TM154				<10	<10	<10	
TPH >C10-C12	<10 mg/kg	TM154				<10	<10	<10	
TPH >C12-C16	<10 mg/kg	TM154				<10	<10	<10	
TPH >C16-C21	<10 mg/kg	TM154				12.7	17.3	31.6	
TPH >C21-C40	<10 mg/kg	TM154				119	174	443	
TPH >C6-C40	<10 mg/kg	TM154				137	195	479	
Chromium, Trivalent	<0.9 mg/kg	TM181		73	404	70.7	84.9	102	53.7
Arsenic	<0.6 mg/kg	TM181		38.3 M	125 M	21.9 M	82.5 M	84.9 M	20 M
Cadmium	<0.02 mg/kg	TM181		0.85 M	2.35 M	1.15 M	1.07 M	1.12 M	1.17 M
Chromium	<0.9 mg/kg	TM181		73 M	405 M	70.7 M	84.9 M	102 M	53.7 M
Copper	<1.4 mg/kg	TM181		52.3 M	120 M	30.1 M	54.7 M	102 M	36.6 M
Lead	<0.7 mg/kg	TM181		122 M	232 M	50.4 M	75.3 M	223 M	73.6 M
Mercury	<0.14 mg/kg	TM181		0.749 M	1.4 M	<0.14 M	0.353 M	1.05 M	<0.14 M
Nickel	<0.2 mg/kg	TM181		20.8 M	26.4 M	29.9 M	37.3 M	34.7 M	24.3 M
Selenium	<1 mg/kg	TM181		<1 #	<10 #	<1 #	<1 #	<1 #	<10 #
Vanadium	<0.2 mg/kg	TM181		24.5 #	28.4 #	22.7 #	42.5 #	36.7 #	31.9 #
Zinc	<1.9 mg/kg	TM181		164 M	243 M	112 M	179 M	281 M	117 M
Sulphate, Total	<48 mg/kg	TM221		918 M	1340 M	458 M	749 M	1430 M	535 M
Water Soluble Sulphate as SO4 2:1 Extract	<0.004 g/l	TM243		0.106 M	0.0246 M	0.0533 M	0.0572 M	0.39 M	0.0535 M

CERTIFICATE OF ANALYSIS

SDG:	160805-79	**Location:**	Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-160	**Customer:**	Wardell Armstrong LLP	**Report Number:**	373711
Client Reference:	SH10243	**Attention:**	Matthew Biggins	**Superseded Report:**	

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample R	HP104 ES1	TP103 ES1	TP106 ES1	TP109 ES1	TP111 ES1
			Depth (m)	0.80	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
			Sample Type	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid
			Date Sampled	03/08/2016	04/08/2016	04/08/2016	04/08/2016	04/08/2016
			Sample Time	.	.	.	.	.
			Date Received	05/08/2016	05/08/2016	05/08/2016	05/08/2016	05/08/2016
			SDG Ref	160805-79	160805-79	160805-79	160805-79	160805-79
			Lab Sample No.(s)	13915089	13915045	13915075	13915040	13915069
			AGS Reference					
Moisture Content Ratio (% of as received sample)	%	PM024		8	0.9	5.1	3.5	12
Phenol	<0.01 mg/kg	TM062 (S)		<0.01 M			0.0207 #	0.0912 M
Cresols	<0.01 mg/kg	TM062 (S)		<0.01 M			<0.01 #	0.0684 M
Xylenols	<0.015 mg/kg	TM062 (S)		<0.015 M			0.0414 #	0.137 M
Phenols, Total Detected monohydric	<0.035 mg/kg	TM062 (S)		<0.035 M			0.0622 #	0.296 M
Organic Carbon, Total	<0.2 %	TM132		4.52 M	0.997 #	0.399 #	0.849 #	0.3 M
pH	1 pH Units	TM133		6.96 M			8 #	7.77 M
Chromium, Hexavalent	<0.6 mg/kg	TM151		<0.6 #			<0.6 #	<0.6 #
Cyanide, Free	<1 mg/kg	TM153		<1 M			<1 #	<1 M
TPH >C6-C8	<10 mg/kg	TM154		<10				
TPH >C8-C10	<10 mg/kg	TM154		<10				
TPH >C10-C12	<10 mg/kg	TM154		<10				
TPH >C12-C16	<10 mg/kg	TM154		<10				
TPH >C16-C21	<10 mg/kg	TM154		16.6				
TPH >C21-C40	<10 mg/kg	TM154		103				
TPH >C6-C40	<10 mg/kg	TM154		128				
Chromium, Trivalent	<0.9 mg/kg	TM181		44.3			36.7	107
Arsenic	<0.6 mg/kg	TM181		32.4 M			21.8 #	101 M
Cadmium	<0.02 mg/kg	TM181		0.718 M			0.427 #	1 M
Chromium	<0.9 mg/kg	TM181		44.3 M			36.7 #	107 M
Copper	<1.4 mg/kg	TM181		79.5 M			23.9 #	57.7 M
Lead	<0.7 mg/kg	TM181		72.2 M			22 #	65.4 M
Mercury	<0.14 mg/kg	TM181		0.228 M			<0.14 #	<0.14 M
Nickel	<0.2 mg/kg	TM181		34.4 M			44.8 #	40.8 M
Selenium	<1 mg/kg	TM181		<1 #			<1 #	<10 #
Vanadium	<0.2 mg/kg	TM181		44.5 #			28.7 #	54.6 #
Zinc	<1.9 mg/kg	TM181		80.2 M			104 #	108 M
Sulphate, Total	<48 mg/kg	TM221		487 M			9940 #	600 M
Water Soluble Sulphate as SO4 2:1 Extract	<0.004 g/l	TM243		0.103 M			0.0457 #	0.073 M

CERTIFICATE OF ANALYSIS

SDG:	160805-79	**Location:**	Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-160	**Customer:**	Wardell Armstrong LLP	**Report Number:**	373711
Client Reference:	SH10243	**Attention:**	Matthew Biggins	**Superseded Report:**	

PAH by GCMS

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample R	BH101A ES1	BH102 ES1	BH102 ES2	HP103 ES1	HP104 ES1	TP109 ES1
			Depth (m)	0.80	0.40	1.65	0.90	0.80	0.00 - 0.00
			Sample Type	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid
			Date Sampled	04/08/2016	04/08/2016	04/08/2016	03/08/2016	03/08/2016	04/08/2016
			Sample Time	.	.	.	.	.	.
			Date Received	05/08/2016	05/08/2016	05/08/2016	05/08/2016	05/08/2016	05/08/2016
			SDG Ref	160805-79	160805-79	160805-79	160805-79	160805-79	160805-79
			Lab Sample No.(s)	13915095	13915102	13915108	13915084	13915089	13915040
			AGS Reference						
Naphthalene	<9 µg/kg	TM218		31.1 M	172 M	53.4 M	67.9 M	210 M	<9 #
Acenaphthylene	<12 µg/kg	TM218		25.3 M	78.7 M	18.2 M	60.5 M	27 M	<12 #
Acenaphthene	<8 µg/kg	TM218		12.7 M	501 M	40.9 M	23.6 M	188 M	<8 #
Fluorene	<10 µg/kg	TM218		13.9 M	383 M	35.3 M	27.2 M	112 M	<10 #
Phenanthrene	<15 µg/kg	TM218		164 M	5900 M	482 M	383 M	1190 M	<15 #
Anthracene	<16 µg/kg	TM218		41.1 M	923 M	99.5 M	113 M	212 M	<16 #
Fluoranthene	<17 µg/kg	TM218		348 M	8330 M	696 M	872 M	1410 M	<17 #
Pyrene	<15 µg/kg	TM218		313 M	6740 M	604 M	820 M	1300 M	<15 #
Benz(a)anthracene	<14 µg/kg	TM218		203 M	3560 M	195 M	489 M	989 M	<14 #
Chrysene	<10 µg/kg	TM218		233 M	3140 M	313 M	462 M	1090 M	<10 #
Benzo(b)fluoranthene	<15 µg/kg	TM218		344 M	4770 M	579 M	831 M	1300 M	<15 #
Benzo(k)fluoranthene	<14 µg/kg	TM218		126 M	1640 M	175 M	303 M	484 M	<14 #
Benzo(a)pyrene	<15 µg/kg	TM218		233 M	3780 M	370 M	584 M	1060 M	<15 #
Indeno(1,2,3-cd)pyrene	<18 µg/kg	TM218		169 M	2120 M	234 M	388 M	430 M	<18 #
Dibenzo(a,h)anthracene	<23 µg/kg	TM218		48.4 M	632 M	72.7 M	114 M	188 M	<23 #
Benzo(g,h,i)perylene	<24 µg/kg	TM218		201 M	2360 M	284 M	477 M	501 M	<24 #
PAH, Total Detected USEPA 16	<118 µg/kg	TM218		2510	45000	4250	6020	10700	<118

CERTIFICATE OF ANALYSIS

SDG:	160805-79	**Location:**	Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-160	**Customer:**	Wardell Armstrong LLP	**Report Number:**	373711
Client Reference:	SH10243	**Attention:**	Matthew Biggins	**Superseded Report:**	

PAH by GCMS

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

	Customer Sample R	LOD/Units	Method
	TP111 ES1		
Depth (m)	0.00 - 0.00		
Sample Type	Soil/Solid		
Date Sampled	04/08/2016		
Sample Time	.		
Date Received	05/08/2016		
SDG Ref	160805-79		
Lab Sample No.(s)	13915069		
AGS Reference			
Component			
Naphthalene	14 M	<9 µg/kg	TM218
Acenaphthylene	<12 M	<12 µg/kg	TM218
Acenaphthene	<8 M	<8 µg/kg	TM218
Fluorene	<10 M	<10 µg/kg	TM218
Phenanthrene	53.5 M	<15 µg/kg	TM218
Anthracene	32.6 M	<16 µg/kg	TM218
Fluoranthene	234 M	<17 µg/kg	TM218
Pyrene	194 M	<15 µg/kg	TM218
Benz(a)anthracene	34.3 M	<14 µg/kg	TM218
Chrysene	87.1 M	<10 µg/kg	TM218
Benzo(b)fluoranthene	165 M	<15 µg/kg	TM218
Benzo(k)fluoranthene	48.6 M	<14 µg/kg	TM218
Benzo(a)pyrene	105 M	<15 µg/kg	TM218
Indeno(1,2,3-cd)pyrene	65.3 M	<18 µg/kg	TM218
Dibenzo(a,h)anthracene	<23 M	<23 µg/kg	TM218
Benzo(g,h,i)perylene	78.2 M	<24 µg/kg	TM218
PAH, Total Detected USEPA 16	1110	<118 µg/kg	TM218

CERTIFICATE OF ANALYSIS

SDG:	160805-79	**Location:**	Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-160	**Customer:**	Wardell Armstrong LLP	**Report Number:**	373711
Client Reference:	SH10243	**Attention:**	Matthew Biggins	**Superseded Report:**	

Semi Volatile Organic Compounds

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample R	HP101 ES1	HP102 ES1				
			Depth (m)	0.30	0.50				
			Sample Type	Soil/Solid	Soil/Solid				
			Date Sampled	03/08/2016	03/08/2016				
			Sample Time	.	.				
			Date Received	05/08/2016	05/08/2016				
			SDG Ref	160805-79	160805-79				
			Lab Sample No.(s)	13915035	13915080				
			AGS Reference						
Phenol	<100 µg/kg	TM157		<100	<100				
Pentachlorophenol	<100 µg/kg	TM157		<100	<100				
n-Nitroso-n-dipropylamine	<100 µg/kg	TM157		<100	<100				
Nitrobenzene	<100 µg/kg	TM157		<100	<100				
Isophorone	<100 µg/kg	TM157		<100	<100				
Hexachloroethane	<100 µg/kg	TM157		<100	<100				
Hexachlorocyclopentadiene	<100 µg/kg	TM157		<100	<100				
Hexachlorobutadiene	<100 µg/kg	TM157		<100	<100				
Hexachlorobenzene	<100 µg/kg	TM157		<100	<100				
n-Dioctyl phthalate	<100 µg/kg	TM157		<100	<100				
Dimethyl phthalate	<100 µg/kg	TM157		<100	<100				
Diethyl phthalate	<100 µg/kg	TM157		<100	<100				
n-Dibutyl phthalate	<100 µg/kg	TM157		<100	<100				
Dibenzofuran	<100 µg/kg	TM157		<100	<100				
Carbazole	<100 µg/kg	TM157		<100	<100				
Butylbenzyl phthalate	<100 µg/kg	TM157		<100	<100				
bis(2-Ethylhexyl) phthalate	<100 µg/kg	TM157		<100	<100				
bis(2-Chloroethoxy)methane	<100 µg/kg	TM157		<100	<100				
bis(2-Chloroethyl)ether	<100 µg/kg	TM157		<100	<100				
Azobenzene	<100 µg/kg	TM157		<100	<100				
4-Nitrophenol	<100 µg/kg	TM157		<100	<100				
4-Nitroaniline	<100 µg/kg	TM157		<100	<100				
4-Methylphenol	<100 µg/kg	TM157		<100	<100				
4-Chlorophenylphenylether	<100 µg/kg	TM157		<100	<100				
4-Chloroaniline	<100 µg/kg	TM157		<100	<100				
4-Chloro-3-methylphenol	<100 µg/kg	TM157		<100	<100				
4-Bromophenylphenylether	<100 µg/kg	TM157		<100	<100				
3-Nitroaniline	<100 µg/kg	TM157		<100	<100				
2-Nitrophenol	<100 µg/kg	TM157		<100	<100				
2-Nitroaniline	<100 µg/kg	TM157		<100	<100				
2-Methylphenol	<100 µg/kg	TM157		<100	<100				
1,2,4-Trichlorobenzene	<100 µg/kg	TM157		<100	<100				

CERTIFICATE OF ANALYSIS

SDG:	160805-79	**Location:**	Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-160	**Customer:**	Wardell Armstrong LLP	**Report Number:**	373711
Client Reference:	SH10243	**Attention:**	Matthew Biggins	**Superseded Report:**	

Semi Volatile Organic Compounds

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample R	HP101 ES1	HP102 ES1				
			Depth (m)	0.30	0.50				
			Sample Type	Soil/Solid	Soil/Solid				
			Date Sampled	03/08/2016	03/08/2016				
			Sample Time	.	.				
			Date Received	05/08/2016	05/08/2016				
			SDG Ref	160805-79	160805-79				
			Lab Sample No.(s)	13915035	13915080				
			AGS Reference						
2-Chlorophenol	<100 µg/kg	TM157		<100	<100				
2,6-Dinitrotoluene	<100 µg/kg	TM157		<100	<100				
2,4-Dinitrotoluene	<100 µg/kg	TM157		<100	<100				
2,4-Dimethylphenol	<100 µg/kg	TM157		<100	<100				
2,4-Dichlorophenol	<100 µg/kg	TM157		<100	<100				
2,4,6-Trichlorophenol	<100 µg/kg	TM157		<100	<100				
2,4,5-Trichlorophenol	<100 µg/kg	TM157		<100	<100				
1,4-Dichlorobenzene	<100 µg/kg	TM157		<100	<100				
1,3-Dichlorobenzene	<100 µg/kg	TM157		<100	<100				
1,2-Dichlorobenzene	<100 µg/kg	TM157		<100	<100				
2-Chloronaphthalene	<100 µg/kg	TM157		<100	<100				
2-Methylnaphthalene	<100 µg/kg	TM157		<100	<100				
Acenaphthylene	<100 µg/kg	TM157		<100	<100				
Acenaphthene	<100 µg/kg	TM157		<100	<100				
Anthracene	<100 µg/kg	TM157		<100	<100				
Benzo(a)anthracene	<100 µg/kg	TM157		360	625				
Benzo(b)fluoranthene	<100 µg/kg	TM157		391	622				
Benzo(k)fluoranthene	<100 µg/kg	TM157		335	549				
Benzo(a)pyrene	<100 µg/kg	TM157		417	649				
Benzo(g,h,i)perylene	<100 µg/kg	TM157		272	391				
Chrysene	<100 µg/kg	TM157		375	651				
Fluoranthene	<100 µg/kg	TM157		607	1360				
Fluorene	<100 µg/kg	TM157		<100	<100				
Indeno(1,2,3-cd)pyrene	<100 µg/kg	TM157		294	457				
Phenanthrene	<100 µg/kg	TM157		236	542				
Pyrene	<100 µg/kg	TM157		546	1110				
Naphthalene	<100 µg/kg	TM157		<100	<100				
Dibenzo(a,h)anthracene	<100 µg/kg	TM157		<100	<100				
Bis(2-chloroisopropyl) ether	<100 µg/kg	TM157		<100	<100				
TIC report	-	TM157		Not Detected	Not Detected				
Total SVOC TIC	<100 µg/kg	TM157		<100	<100				

CERTIFICATE OF ANALYSIS

SDG:	160805-79	**Location:**	Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-160	**Customer:**	Wardell Armstrong LLP	**Report Number:**	373711
Client Reference:	SH10243	**Attention:**	Matthew Biggins	**Superseded Report:**	

Asbestos Identification - Solid Samples

		Date of Analysis	Analysed By	Comments	Amosite (Brown) Asbestos	Chrysotile (White) Asbestos	Crocidolite (Blue) Asbestos	Fibrous Actinolite	Fibrous Anthophyllite	Fibrous Tremolite	Non-Asbestos Fibre
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH101A ES1 0.80 SOLID 04/08/2016 00:00:00 10/08/2016 09:57:39 160805-79 13915095 TM048	15/08/16	Kevin Bowron	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH102 ES1 0.40 SOLID 04/08/2016 00:00:00 10/08/2016 11:54:34 160805-79 13915102 TM048	15/08/16	Simon Postlewhite	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH102 ES2 1.65 SOLID 04/08/2016 00:00:00 10/08/2016 12:04:55 160805-79 13915108 TM048	15/08/16	Simon Postlewhite	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	HP101 ES1 0.30 SOLID 03/08/2016 00:00:00 10/08/2016 10:09:02 160805-79 13915035 TM048	15/08/16	Kevin Bowron	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	HP102 ES1 0.50 SOLID 03/08/2016 00:00:00 10/08/2016 10:34:33 160805-79 13915080 TM048	15/08/16	Kevin Bowron	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected

CERTIFICATE OF ANALYSIS

SDG:	160805-79	**Location:**	Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-160	**Customer:**	Wardell Armstrong LLP	**Report Number:**	373711
Client Reference:	SH10243	**Attention:**	Matthew Biggins	**Superseded Report:**	

		Date of Analysis	Analysed By	Comments	Amosite (Brown) Asbestos	Chrysotile (White) Asbestos	Crocidolite (Blue) Asbestos	Fibrous Actinolite	Fibrous Anthophyllite	Fibrous Tremolite	Non-Asbestos Fibre
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	HP103 ES1 0.90 SOLID 03/08/2016 00:00:00 10/08/2016 10:50:15 160805-79 13915084 TM048	15/08/16	Kevin Bowron	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	HP104 ES1 0.80 SOLID 03/08/2016 00:00:00 10/08/2016 11:00:44 160805-79 13915089 TM048	15/08/16	Simon Postlewhite	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	TP103 ES1 0.00 - 0.00 SOLID 04/08/2016 00:00:00 10/08/2016 10:46:22 160805-79 13915045 TM048	15/08/16	Kevin Bowron	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	TP106 ES1 0.00 - 0.00 SOLID 04/08/2016 00:00:00 10/08/2016 11:12:45 160805-79 13915075 TM048	15/08/16	Kevin Bowron	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	TP109 ES1 0.00 - 0.00 SOLID 04/08/2016 00:00:00 10/08/2016 11:48:09 160805-79 13915040 TM048	15/08/16	Simon Postlewhite	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	TP111 ES1 0.00 - 0.00 SOLID 04/08/2016 00:00:00 10/08/2016 12:54:39 160805-79 13915069 TM048	15/08/16	Simon Postlewhite	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected

CERTIFICATE OF ANALYSIS

SDG:	160805-79	**Location:**	Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-160	**Customer:**	Wardell Armstrong LLP	**Report Number:**	373711
Client Reference:	SH10243	**Attention:**	Matthew Biggins	**Superseded Report:**	

CEN 10:1 SINGLE STAGE LEACHATE TEST

CEN ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Cooper Bridge
Mass Sample taken (kg)	0.096	**Natural Moisture Content (%)**	5.93
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	94.4
Particle Size <4mm	>95%		

Case	
SDG	160805-79
Lab Sample Number(s)	13915035
Sampled Date	03-Aug-2016
Customer Sample Ref.	HP101 ES1
Depth (m)	0.30

Eluate Analysis	**C_2** Conc^n in 10:1 eluate (mg/l)		**A_2** 10:1 conc^n leached (mg/kg)				
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
PAH Spec MS - Aqueous (W)							
Naphthalene by GCMS	<0.0001	<0.0001	<0.001	<0.001	-	-	-
Acenaphthene by GCMS	0.000019	<0.000015	0.00019	<0.00015	-	-	-
Acenaphthylene by GCMS	0.0000116	<0.000011	0.000116	<0.00011	-	-	-
Fluoranthene by GCMS	0.000103	<0.000017	0.00103	<0.00017	-	-	-
Anthracene by GCMS	0.0000249	<0.000015	0.000249	<0.00015	-	-	-
Phenanthrene by GCMS	0.0000602	<0.000022	0.000602	<0.00022	-	-	-
Fluorene by GCMS	<0.000014	<0.000014	<0.00014	<0.00014	-	-	-
Chrysene by GCMS	0.0000577	<0.000013	0.000577	<0.00013	-	-	-
Pyrene by GCMS	0.0000918	<0.000015	0.000918	<0.00015	-	-	-
Benz(a)anthracene by GCMS	0.0000507	<0.000017	0.000507	<0.00017	-	-	-
Benzo(b)fluoranthene by GCMS	0.0000677	<0.000023	0.000677	<0.00023	-	-	-
Benzo(k)fluoranthene by GCMS	0.0000295	<0.000027	0.000295	<0.00027	-	-	-
Benzo(a)pyrene by GCMS	0.0000483	<0.000009	0.000483	<0.00009	-	-	-
Dibenzo(ah)anthracene by GCMS	<0.000016	<0.000016	<0.00016	<0.00016	-	-	-
Benzo(ghi)perylene by GCMS	0.0000504	<0.000016	0.000504	<0.00016	-	-	-
Indeno(123cd)pyrene by GCMS	0.0000479	<0.000014	0.000479	<0.00014	-	-	-
PAH 16 EPA Total by GCMS	0.000662	<0.000344	0.00662	<0.00344	-	-	-

Leach Test Information

Date Prepared	10-Aug-2016
pH (pH Units)	8.59
Conductivity (µS/cm)	110.00
Temperature (ºC)	20.80
Volume Leachant (Litres)	0.895

Mcerts Certification does not apply to leachates

16/08/2016 15:46:14

15:45:59 16/08/2016

CERTIFICATE OF ANALYSIS

SDG:	160805-79	**Location:**	Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-160	**Customer:**	Wardell Armstrong LLP	**Report Number:**	373711
Client Reference:	SH10243	**Attention:**	Matthew Biggins	**Superseded Report:**	

Notification of NDPs (No determination possible)

Date Received : 05/08/2016 12:37:24

Sample No	Customer Sample Ref.	Depth (m)	Test	Comment
13915045	TP103 ES1	0.00 - 0.00	pH Value	Sample unsuitable for analysis
13915045	TP103 ES1	0.00 - 0.00	PAH Spec MS - Aqueous (W)	Sample unsuitable for analysis
13915045	TP103 ES1	0.00 - 0.00	Mercury Dissolved	Sample unsuitable for analysis
13915045	TP103 ES1	0.00 - 0.00	Dissolved Metals by ICP-MS	Sample unsuitable for analysis
13915075	TP106 ES1	0.00 - 0.00	pH Value	Sample used up
13915075	TP106 ES1	0.00 - 0.00	PAH Spec MS - Aqueous (W)	Sample used up
13915075	TP106 ES1	0.00 - 0.00	Mercury Dissolved	Sample used up
13915075	TP106 ES1	0.00 - 0.00	Dissolved Metals by ICP-MS	Sample used up
13915045	TP103 ES1	0.00 - 0.00	CEN 10:1 Leachate (1 Stage)	Sample unsuitable for analysis
13915045	TP103 ES1	0.00 - 0.00	CEN Readings	Sample unsuitable for analysis
13915075	TP106 ES1	0.00 - 0.00	CEN 10:1 Leachate (1 Stage)	Sample used up
13915075	TP106 ES1	0.00 - 0.00	CEN Readings	Sample used up

CERTIFICATE OF ANALYSIS

SDG:	160805-79	**Location:**	Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-160	**Customer:**	Wardell Armstrong LLP	**Report Number:**	373711
Client Reference:	SH10243	**Attention:**	Matthew Biggins	**Superseded Report:**	

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample [1]	Surrogate Corrected
PM001		Preparation of Samples for Metals Analysis		
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material		
PM115		Leaching Procedure for CEN One Stage Leach Test 2:1 & 10:1 1 Step		
TM048	HSG 248, Asbestos: The analysts' guide for sampling, analysis and clearance procedures	Identification of Asbestos in Bulk Material		
TM062 (S)	National Grid Property Holdings Methods for the Collection & Analysis of Samples from National Grid Sites version 1 Sec 3.9	Determination of Phenols in Soils by HPLC		
TM132	In - house Method	ELTRA CS800 Operators Guide		
TM133	BS 1377: Part 3 1990;BS 6068-2.5	Determination of pH in Soil and Water using the GLpH pH Meter		
TM151	Method 3500D, AWWA/APHA, 20th Ed., 1999	Determination of Hexavalent Chromium using Kone analyser		
TM153	Method 4500A,B,C, I, M AWWA/APHA, 20th Ed., 1999	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate using the Skalar SANS+ System Segmented Flow Analyser		
TM154	In - house Method	Determination of Petroleum Hydrocarbons by EZ Flash GC-FID in the Carbon range C6- C40		
TM157	HP 6890 Gas Chromatograph (GC) system and HP 5973 Mass Selective Detector (MSD).	Determination of SVOC in Soils by GC-MS extracted by sonication in DCM/Acetone		
TM178	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS in Waters		
TM181	US EPA Method 6010B	Determination of Routine Metals in Soil by iCap 6500 Duo ICP-OES		
TM218	Microwave extraction – EPA method 3546	Microwave extraction - EPA method 3546		
TM221	Inductively Coupled Plasma - Atomic Emission Spectroscopy. An Atlas of Spectral Information: Winge, Fassel, Peterson and Floyd	Determination of Acid extractable Sulphate in Soils by IRIS Emission Spectrometer		
TM243		Mixed Anions In Soils By Kone		

[1] Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.

CERTIFICATE OF ANALYSIS

SDG:	160805-79	**Location:**	Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-160	**Customer:**	Wardell Armstrong LLP	**Report Number:**	373711
Client Reference:	SH10243	**Attention:**	Matthew Biggins	**Superseded Report:**	

Test Completion Dates

Lab Sample No(s)	13915102	13915108	13915095	13915035	13915080	13915084	13915089	13915045	13915075	13915040
Customer Sample Ref.	BH102 ES1	BH102 ES2	BH101A ES1	HP101 ES1	HP102 ES1	HP103 ES1	HP104 ES1	TP103 ES1	TP106 ES1	TP109 ES1
AGS Ref.										
Depth	0.40	1.65	0.80	0.30	0.50	0.90	0.80	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID
Anions by Kone (soil)	15-Aug-2016	15-Aug-2016	15-Aug-2016	12-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016			15-Aug-2016
Asbestos ID in Solid Samples	15-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016
CEN 10:1 Leachate (1 Stage)				10-Aug-2016						
CEN Readings				12-Aug-2016						
Chromium III	15-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016			15-Aug-2016
Cyanide Comp/Free/Total/Thiocyanate	12-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016			12-Aug-2016
Hexavalent Chromium (s)	15-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016			15-Aug-2016
Metals in solid samples by OES	15-Aug-2016	15-Aug-2016	15-Aug-2016	12-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016			15-Aug-2016
PAH by GCMS	15-Aug-2016	15-Aug-2016	12-Aug-2016			15-Aug-2016	12-Aug-2016			15-Aug-2016
PAH Spec MS - Aqueous (W)				15-Aug-2016						
pH	15-Aug-2016	15-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016	15-Aug-2016			15-Aug-2016
Phenols by HPLC (S)	15-Aug-2016	15-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016			12-Aug-2016
Sample description	10-Aug-2016	10-Aug-2016	10-Aug-2016	09-Aug-2016	10-Aug-2016	10-Aug-2016	10-Aug-2016	09-Aug-2016	09-Aug-2016	10-Aug-2016
Semi Volatile Organic Compounds				15-Aug-2016	15-Aug-2016					
Total Organic Carbon	16-Aug-2016	16-Aug-2016	16-Aug-2016	16-Aug-2016	16-Aug-2016	16-Aug-2016	16-Aug-2016	16-Aug-2016	16-Aug-2016	16-Aug-2016
Total Sulphate	12-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016			12-Aug-2016
TPH c6-40 Value of soil		12-Aug-2016		12-Aug-2016	11-Aug-2016		12-Aug-2016			

Lab Sample No(s)	13915069
Customer Sample Ref.	TP111 ES1
AGS Ref.	
Depth	0.00 - 0.00
Type	SOLID
Anions by Kone (soil)	15-Aug-2016
Asbestos ID in Solid Samples	15-Aug-2016
Chromium III	15-Aug-2016
Cyanide Comp/Free/Total/Thiocyanate	12-Aug-2016
Hexavalent Chromium (s)	15-Aug-2016
Metals in solid samples by OES	15-Aug-2016
PAH by GCMS	15-Aug-2016
pH	15-Aug-2016
Phenols by HPLC (S)	15-Aug-2016
Sample description	10-Aug-2016
Total Organic Carbon	16-Aug-2016
Total Sulphate	12-Aug-2016

SDG:	160805-79	**Location:**	Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-160	**Customer:**	Wardell Armstrong LLP	**Report Number:**	373711
Client Reference:	SH10243	**Attention:**	Matthew Biggins	**Superseded Report:**	

Appendix

General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as “Not detected”. If no asbestos fibre types are found all will be reported as “Not detected” and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt . However, the integrity of the data may be compromised.

9. NDP - No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

12. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment . Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect .

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethyphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

21. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill /made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

24. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as “mixed hydrocarbons”. Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

Sample Deviations

1	Container with Headspace provided for volatiles analysis
2	Incorrect container received
3	Deviation from method
4	Holding time exceeded before sample received
5	Samples exceeded holding time before presevation was performed
§	Sampled on date not provided
♦	Sample holding time exceeded in laboratory
@	Sample holding time exceeded due to sampled on date
&	Sample Holding Time exceeded - Late arrival of instructions.

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than : - Trace - Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

ALcontrol Laboratories

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Wardell Armstrong LLP
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Thorncliffe Park
Sheffield
South Yorkshire
S35 2PH

Attention: James Lymer

CERTIFICATE OF ANALYSIS

Date:	26 August 2016
Customer:	H_WARDELL_SHF
Sample Delivery Group (SDG):	160809-47
Your Reference:	SH10243
Location:	Land at Cooper Bridge
Report No:	375185

This report has been revised and directly supersedes 373897 in its entirety.

We received 4 samples on Tuesday August 09, 2016 and 4 of these samples were scheduled for analysis which was completed on Wednesday August 17, 2016. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:

Redacted

Sonia McWhan
Operations Manager

CERTIFICATE OF ANALYSIS

SDG:	160809-47	**Location:**	Land at Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-161	**Customer:**	Wardell Armstrong LLP	**Report Number:**	375185
Client Reference:	SH10243	**Attention:**	James Lymer	**Superseded Report:**	373897

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
13932367	BH101		0.00 - 0.00	08/08/2016
13932373	BH102		0.00 - 0.00	08/08/2016
13932382	BH103		0.00 - 0.00	08/08/2016
13932394	BH104		0.00 - 0.00	08/08/2016

Only received samples which have had analysis scheduled will be shown on the following pages.

CERTIFICATE OF ANALYSIS

SDG:	160809-47	**Location:**	Land at Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-161	**Customer:**	Wardell Armstrong LLP	**Report Number:**	375185
Client Reference:	SH10243	**Attention:**	James Lymer	**Superseded Report:**	373897

LIQUID

Results Legend

X Test

N No Determination Possible

Lab Sample No(s)			13932367	13932373	13932382	13932394
Customer Sample Reference			BH101	BH102	BH103	BH104
AGS Reference						
Depth (m)			0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
Container			0.5 glass bottle	500ml Plastic (ALE208)	Dissolved Metals	Vial (ALE297)
Alkalinity as CaCO3	All	NDPs: 0 Tests: 4		X		X		X		X		X		
Ammonium Low	All	NDPs: 0 Tests: 4		X		X		X		X		X		
Anions by Kone (w)	All	NDPs: 0 Tests: 4		X		X		X		X		X		
Chromium III	All	NDPs: 0 Tests: 4		X		X		X		X		X		
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 4		X		X		X		X		X		
Dissolved Organic/Inorganic Carbon	All	NDPs: 0 Tests: 4		X		X		X		X		X		
EPH CWG (Aliphatic) Aqueous GC (W)	All	NDPs: 0 Tests: 4		X		X		X		X		X		
EPH CWG (Aromatic) Aqueous GC (W)	All	NDPs: 0 Tests: 4		X		X		X		X		X		
GRO by GC-FID (W)	All	NDPs: 0 Tests: 4			X			X			X			X
Low Level Cyanide (W)	All	NDPs: 0 Tests: 4	X			X			X			X		
Low Level Hexavalent Chromium (w)	All	NDPs: 0 Tests: 4		X		X		X		X		X		
Mercury Dissolved	All	NDPs: 0 Tests: 4			X			X			X			X
Metals by iCap-OES Dissolved (W)	All	NDPs: 0 Tests: 4		X		X		X		X		X		
PAH Spec MS - Aqueous (W)	All	NDPs: 0 Tests: 4	X			X			X			X		
pH Value	All	NDPs: 0 Tests: 4		X		X		X		X		X		

CERTIFICATE OF ANALYSIS

SDG:	160809-47	**Location:**	Land at Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-161	**Customer:**	Wardell Armstrong LLP	**Report Number:**	375185
Client Reference:	SH10243	**Attention:**	James Lymer	**Superseded Report:**	373897

LIQUID

Results Legend

X **Test**

N **No Determination Possible**

Lab Sample No(s)	13932367	13932373	13932382	13932394
Customer Sample Reference	BH101	BH102	BH103	BH104
AGS Reference				
Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00

Container	0.5l glass bottle	500ml Plastic (ALE208)	Dissolved Metals	Vial (ALE297)	0.5l glass bottle	500ml Plastic (ALE208)	Dissolved Metals	Vial (ALE297)	0.5l glass bottle	500ml Plastic (ALE208)	Dissolved Metals	Vial (ALE297)	0.5l glass bottle	500ml Plastic (ALE208)	Dissolved Metals	Vial (ALE297)
Phenols by HPLC (W) — All — NDPs: 0 Tests: 4	X				X				X				X			
Redox Potential — All — NDPs: 0 Tests: 4		X				X				X				X		
SVOC MS (W) - Aqueous — All — NDPs: 0 Tests: 4		X				X				X				X		
TPH CWG (W) — All — NDPs: 0 Tests: 4	X				X				X				X			
VOC MS (W) — All — NDPs: 0 Tests: 4				X				X				X				X

CERTIFICATE OF ANALYSIS

SDG:	160809-47	**Location:**	Land at Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-161	**Customer:**	Wardell Armstrong LLP	**Report Number:**	375185
Client Reference:	SH10243	**Attention:**	James Lymer	**Superseded Report:**	373897

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	BH101	BH102	BH103	BH104		
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00		
			Sample Type	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)		
			Date Sampled	08/08/2016	08/08/2016	08/08/2016	08/08/2016		
			Sample Time	.	.	.	.		
			Date Received	09/08/2016	09/08/2016	09/08/2016	09/08/2016		
			SDG Ref	160809-47	160809-47	160809-47	160809-47		
			Lab Sample No.(s)	13932367	13932373	13932382	13932394		
			AGS Reference						
Alkalinity, Total as CaCO3	<2 mg/l	TM043		375 #	245 #	383 #	133 #		
Carbon, Organic (diss.filt)	<3 mg/l	TM090		<6	3.44	8	<3		
Ammoniacal Nitrogen Low as NH4	<0.01 mg/l	TM099		4.48 #	1.94 #	0.444 #	0.238 #		
Redox potential	mV	TM110		127	121	156	104		
Chromium, Trivalent (Low)	<0.003 mg/l	TM152		<0.003	<0.003	<0.003	<0.003		
Arsenic (diss.filt)	<0.51 µg/l	TM152		1 #	15.3 #	1.82 #	1.05 #		
Cadmium (diss.filt)	<0.08 µg/l	TM152		<0.08 #	<0.08 #	<0.08 #	<0.08 #		
Chromium (diss.filt)	<1.2 µg/l	TM152		<1.2 #	<1.2 #	<1.2 #	<1.2 #		
Copper (diss.filt)	<0.85 µg/l	TM152		5.2 #	<0.85 #	2.72 #	2.79 #		
Lead (diss.filt)	<0.1 µg/l	TM152		0.669 #	<0.1 #	0.136 #	0.177 #		
Manganese (diss.filt)	<0.76 µg/l	TM152		138 #	464 #	86.8 #	138 #		
Nickel (diss.filt)	<0.44 µg/l	TM152		3.52 #	1.43 #	3.06 #	3.36 #		
Selenium (diss.filt)	<0.81 µg/l	TM152		<0.81 #	<0.81 #	<0.81 #	<0.81 #		
Zinc (diss.filt)	<1.3 µg/l	TM152		6.34 #	<1.3 #	<1.3 #	8.77 #		
Mercury (diss.filt)	<0.01 µg/l	TM183		<0.01 #	<0.01 #	<0.01 #	<0.01 #		
Sulphate	<2 mg/l	TM184		117 #	58.7 #	117 #	158 #		
Calcium (diss.filt)	<0.012 mg/l	TM228		69 #	35.9 #	149 #	51.1 #		
pH	<1 pH Units	TM256		7.38 #	7.41 #	7.41 #	6.82 #		
Phenol	<0.002 mg/l	TM259		<0.002 2 #	<0.002 2 #	<0.002 2 #	<0.002 2 #		
Cresols	<0.006 mg/l	TM259		<0.006 2 #	<0.006 2 #	<0.006 2 #	<0.006 2 #		
Xylenols	<0.008 mg/l	TM259		<0.008 2 #	<0.008 2 #	<0.008 2 #	<0.008 2 #		
2,3,5-Trimethylphenol	<0.003 mg/l	TM259		<0.003 2 #	<0.003 2 #	<0.003 2 #	<0.003 2 #		
2-Isopropylphenol	<0.006 mg/l	TM259		<0.006 2 #	<0.006 2 #	<0.006 2 #	<0.006 2 #		
Phenols, Total Detected 5 speciated	<0.025 mg/l	TM259		<0.025	<0.025	<0.025	<0.025		
Cyanide, Total (low level)	<5 µg/l	TM279		<5 #	<5 #	<5 #	<5 #		
Cyanide, Free (low level)	<2.5 µg/l	TM279		<2.5 #	<2.5 #	<2.5 #	<2.5 #		
Low Level Hexavalent Chromium	<0.003 mg/l	TM331		<0.003	<0.003	<0.003	<0.003		

CERTIFICATE OF ANALYSIS

SDG:	160809-47	**Location:**	Land at Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-161	**Customer:**	Wardell Armstrong LLP	**Report Number:**	375185
Client Reference:	SH10243	**Attention:**	James Lymer	**Superseded Report:**	373897

PAH Spec MS - Aqueous (W)

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	BH101	BH102	BH103	BH104		
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00		
			Sample Type	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)		
			Date Sampled	08/08/2016	08/08/2016	08/08/2016	08/08/2016		
			Sample Time	.	.	.	.		
			Date Received	09/08/2016	09/08/2016	09/08/2016	09/08/2016		
			SDG Ref	160809-47	160809-47	160809-47	160809-47		
			Lab Sample No.(s)	13932367	13932373	13932382	13932394		
			AGS Reference						
Naphthalene (aq)	<0.1 µg/l	TM178		<0.1 #	<0.1 #	<0.1 #	0.601 #		
Acenaphthene (aq)	<0.015 µg/l	TM178		0.105 #	0.107 #	0.317 #	0.211 #		
Acenaphthylene (aq)	<0.011 µg/l	TM178		0.0275 #	0.0211 #	0.0728 #	0.0654 #		
Fluoranthene (aq)	<0.017 µg/l	TM178		0.301 #	2.69 #	5.07 #	2.15 #		
Anthracene (aq)	<0.015 µg/l	TM178		0.0559 #	0.245 #	0.78 #	0.242 #		
Phenanthrene (aq)	<0.022 µg/l	TM178		0.215 #	1.05 #	2.51 #	1.73 #		
Fluorene (aq)	<0.014 µg/l	TM178		0.0615 #	0.0838 #	0.254 #	0.514 #		
Chrysene (aq)	<0.013 µg/l	TM178		0.123 #	1.32 #	2.74 #	2.07 #		
Pyrene (aq)	<0.015 µg/l	TM178		0.279 #	2.41 #	5 #	1.92 #		
Benzo(a)anthracene (aq)	<0.017 µg/l	TM178		0.143 #	1.28 #	3.24 #	1.84 #		
Benzo(b)fluoranthene (aq)	<0.023 µg/l	TM178		0.202 #	2.5 #	6.2 #	4.14 #		
Benzo(k)fluoranthene (aq)	<0.027 µg/l	TM178		0.0676 #	0.906 #	2.55 #	1.36 #		
Benzo(a)pyrene (aq)	<0.009 µg/l	TM178		0.122 #	1.71 #	5.19 #	2.84 #		
Dibenzo(a,h)anthracene (aq)	<0.016 µg/l	TM178		<0.016 #	0.168 #	0.436 #	0.352 #		
Benzo(g,h,i)perylene (aq)	<0.016 µg/l	TM178		0.0888 #	0.961 #	2.52 #	1.99 #		
Indeno(1,2,3-cd)pyrene (aq)	<0.014 µg/l	TM178		0.0717 #	0.861 #	2.29 #	1.66 #		
PAH, Total Detected USEPA 16 (aq)	<0.344 µg/l	TM178		1.86	16.3	39.2	23.7		

CERTIFICATE OF ANALYSIS

SDG:	160809-47	**Location:**	Land at Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-161	**Customer:**	Wardell Armstrong LLP	**Report Number:**	375185
Client Reference:	SH10243	**Attention:**	James Lymer	**Superseded Report:**	373897

SVOC MS (W) - Aqueous

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+$@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	BH101	BH102	BH103	BH104		
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00		
			Sample Type	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)		
			Date Sampled	08/08/2016	08/08/2016	08/08/2016	08/08/2016		
			Sample Time	.	.	.	.		
			Date Received	09/08/2016	09/08/2016	09/08/2016	09/08/2016		
			SDG Ref	160809-47	160809-47	160809-47	160809-47		
			Lab Sample No.(s)	13932367	13932373	13932382	13932394		
			AGS Reference						
1,2,4-Trichlorobenzene (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
1,2-Dichlorobenzene (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
1,3-Dichlorobenzene (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
1,4-Dichlorobenzene (aq)	<1 µg/l	TM176		<1	<4	<1	<4		
2,4,5-Trichlorophenol (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
2,4,6-Trichlorophenol (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
2,4-Dichlorophenol (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
2,4-Dimethylphenol (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
2,4-Dinitrotoluene (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
2,6-Dinitrotoluene (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
2-Chloronaphthalene (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
2-Chlorophenol (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
2-Methylnaphthalene (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
2-Methylphenol (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
2-Nitroaniline (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
2-Nitrophenol (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
3-Nitroaniline (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
4-Bromophenylphenylether (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
4-Chloro-3-methylphenol (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
4-Chloroaniline (aq)	<1 µg/l	TM176		<1	<4	<1	<4		
4-Chlorophenylphenylether (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
4-Methylphenol (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
4-Nitroaniline (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
4-Nitrophenol (aq)	<1 µg/l	TM176		<1	<4	<1	<4		
Azobenzene (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
bis(2-Chloroethyl)ether (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
bis(2-Chloroethoxy)methane (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
bis(2-Ethylhexyl) phthalate (aq)	<2 µg/l	TM176		<2 #	<8 #	<2 #	<8 #		
Butylbenzyl phthalate (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
Carbazole (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
Dibenzofuran (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
n-Dibutyl phthalate (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		

CERTIFICATE OF ANALYSIS

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Job:	H_WARDELL_SHF-161	**Customer:**	Wardell Armstrong LLP	**Report Number:**	375185
Client Reference:	SH10243	**Attention:**	James Lymer	**Superseded Report:**	373897

SVOC MS (W) - Aqueous

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&•§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	BH101	BH102	BH103	BH104		
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00		
			Sample Type	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)		
			Date Sampled	08/08/2016	08/08/2016	08/08/2016	08/08/2016		
			Sample Time	.	.	.	.		
			Date Received	09/08/2016	09/08/2016	09/08/2016	09/08/2016		
			SDG Ref	160809-47	160809-47	160809-47	160809-47		
			Lab Sample No.(s)	13932367	13932373	13932382	13932394		
			AGS Reference						
Diethyl phthalate (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
Dimethyl phthalate (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
n-Dioctyl phthalate (aq)	<5 µg/l	TM176		<5 #	<20 #	<5 #	<20 #		
Hexachlorobenzene (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
Hexachlorobutadiene (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
Pentachlorophenol (aq)	<1 µg/l	TM176		<1	<4	<1	<4		
Phenol (aq)	<1 µg/l	TM176		<1	<4	<1	<4		
n-Nitroso-n-dipropylamine (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
Hexachloroethane (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
Nitrobenzene (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
Isophorone (aq)	<1 µg/l	TM176		<1 #	<4 #	<1 #	<4 #		
Hexachlorocyclopentadiene (aq)	<1 µg/l	TM176		<1	<4	<1	<4		

CERTIFICATE OF ANALYSIS

SDG:	160809-47	**Location:**	Land at Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-161	**Customer:**	Wardell Armstrong LLP	**Report Number:**	375185
Client Reference:	SH10243	**Attention:**	James Lymer	**Superseded Report:**	373897

TPH CWG (W)

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	BH101	BH102	BH103	BH104		
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00		
			Sample Type	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)		
			Date Sampled	08/08/2016	08/08/2016	08/08/2016	08/08/2016		
			Sample Time	.	.	.	.		
			Date Received	09/08/2016	09/08/2016	09/08/2016	09/08/2016		
			SDG Ref	160809-47	160809-47	160809-47	160809-47		
			Lab Sample No.(s)	13932367	13932373	13932382	13932394		
			AGS Reference						
GRO Surrogate % recovery**	%	TM245		79	88	86	63		
GRO >C5-C12	<50 µg/l	TM245		<50 #	<50 #	<50 #	<50 #		
Methyl tertiary butyl ether (MTBE)	<3 µg/l	TM245		<3 #	<3 #	<3 #	<3 #		
Benzene	<7 µg/l	TM245		<7 #	<7 #	<7 #	<7 #		
Toluene	<4 µg/l	TM245		<4 #	<4 #	<4 #	<4 #		
Ethylbenzene	<5 µg/l	TM245		<5 #	<5 #	<5 #	<5 #		
m,p-Xylene	<8 µg/l	TM245		<8 #	<8 #	<8 #	<8 #		
o-Xylene	<3 µg/l	TM245		<3 #	<3 #	<3 #	<3 #		
Sum of detected Xylenes	<11 µg/l	TM245		<11	<11	<11	<11		
Sum of detected BTEX	<28 µg/l	TM245		<28	<28	<28	<28		
Aliphatics >C5-C6	<10 µg/l	TM245		<10	<10	<10	<10		
Aliphatics >C6-C8	<10 µg/l	TM245		<10	<10	<10	<10		
Aliphatics >C8-C10	<10 µg/l	TM245		<10	<10	<10	<10		
Aliphatics >C10-C12	<10 µg/l	TM245		<10	<10	<10	<10		
Aliphatics >C12-C16 (aq)	<10 µg/l	TM174		<10	<10	<10	<10		
Aliphatics >C16-C21 (aq)	<10 µg/l	TM174		16	<10	15	22		
Aliphatics >C21-C35 (aq)	<10 µg/l	TM174		135	45	425	513		
Total Aliphatics >C12-C35 (aq)	<10 µg/l	TM174		151	45	440	535		
Aromatics >EC5-EC7	<10 µg/l	TM245		<10	<10	<10	<10		
Aromatics >EC7-EC8	<10 µg/l	TM245		<10	<10	<10	<10		
Aromatics >EC8-EC10	<10 µg/l	TM245		<10	<10	<10	<10		
Aromatics >EC10-EC12	<10 µg/l	TM245		<10	<10	<10	<10		
Aromatics >EC12-EC16 (aq)	<10 µg/l	TM174		124	45	<10	26		
Aromatics >EC16-EC21 (aq)	<10 µg/l	TM174		41	16	38	56		
Aromatics >EC21-EC35 (aq)	<10 µg/l	TM174		253	91	298	333		
Total Aromatics >EC12-EC35 (aq)	<10 µg/l	TM174		418	152	336	415		
Total Aliphatics & Aromatics >C5-35 (aq)	<10 µg/l	TM174		569	197	776	972		

CERTIFICATE OF ANALYSIS

SDG:	160809-47	**Location:**	Land at Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-161	**Customer:**	Wardell Armstrong LLP	**Report Number:**	375185
Client Reference:	SH10243	**Attention:**	James Lymer	**Superseded Report:**	373897

VOC MS (W)

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	BH101	BH102	BH103	BH104		
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00		
			Sample Type	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)		
			Date Sampled	08/08/2016	08/08/2016	08/08/2016	08/08/2016		
			Sample Time	.	.	.	.		
			Date Received	09/08/2016	09/08/2016	09/08/2016	09/08/2016		
			SDG Ref	160809-47	160809-47	160809-47	160809-47		
			Lab Sample No.(s)	13932367	13932373	13932382	13932394		
			AGS Reference						
Dibromofluoromethane**	%	TM208		111	115	112	95.9		
Toluene-d8**	%	TM208		98.8	98.8	99.1	88.9		
4-Bromofluorobenzene**	%	TM208		96.6	93.4	97.3	69.8		
Dichlorodifluoromethane	<1 µg/l	TM208		<1	<1	<1	<1		
Chloromethane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Vinyl chloride	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Bromomethane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Chloroethane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Trichlorofluoromethane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,1-Dichloroethene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Carbon disulphide	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Dichloromethane	<3 µg/l	TM208		<3 #	<3 #	<3 #	<3 #		
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
trans-1,2-Dichloroethene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,1-Dichloroethane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
cis-1,2-Dichloroethene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
2,2-Dichloropropane	<1 µg/l	TM208		<1	<1	<1	<1		
Bromochloromethane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Chloroform	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,1,1-Trichloroethane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,1-Dichloropropene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Carbontetrachloride	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,2-Dichloroethane	<1 µg/l	TM208		<1	<1	<1	<1		
Benzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Trichloroethene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,2-Dichloropropane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Dibromomethane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Bromodichloromethane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
cis-1,3-Dichloropropene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Toluene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
trans-1,3-Dichloropropene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,1,2-Trichloroethane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		

CERTIFICATE OF ANALYSIS

SDG:	160809-47	**Location:**	Land at Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-161	**Customer:**	Wardell Armstrong LLP	**Report Number:**	375185
Client Reference:	SH10243	**Attention:**	James Lymer	**Superseded Report:**	373897

VOC MS (W)

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	BH101	BH102	BH103	BH104		
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00		
			Sample Type	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)		
			Date Sampled	08/08/2016	08/08/2016	08/08/2016	08/08/2016		
			Sample Time	.	.	.	.		
			Date Received	09/08/2016	09/08/2016	09/08/2016	09/08/2016		
			SDG Ref	160809-47	160809-47	160809-47	160809-47		
			Lab Sample No.(s)	13932367	13932373	13932382	13932394		
			AGS Reference						
1,3-Dichloropropane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Tetrachloroethene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Dibromochloromethane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,2-Dibromoethane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Chlorobenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,1,1,2-Tetrachloroethane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Ethylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
m,p-Xylene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
o-Xylene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Styrene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Bromoform	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Isopropylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,1,2,2-Tetrachloroethane	<1 µg/l	TM208		<1	<1	<1	<1		
1,2,3-Trichloropropane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Bromobenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Propylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
2-Chlorotoluene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,3,5-Trimethylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
4-Chlorotoluene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
tert-Butylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,2,4-Trimethylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	3.63 #		
sec-Butylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
4-iso-Propyltoluene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,3-Dichlorobenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,4-Dichlorobenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
n-Butylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,2-Dichlorobenzene	<1 µg/l	TM208		<1	<1	<1	<1		
1,2-Dibromo-3-chloropropane	<1 µg/l	TM208		<1	<1	<1	<1		
1,2,4-Trichlorobenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Hexachlorobutadiene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
tert-Amyl methyl ether (TAME)	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Naphthalene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		

CERTIFICATE OF ANALYSIS

SDG:	160809-47	**Location:**	Land at Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-161	**Customer:**	Wardell Armstrong LLP	**Report Number:**	375185
Client Reference:	SH10243	**Attention:**	James Lymer	**Superseded Report:**	373897

VOC MS (W)

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&♦§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	BH101	BH102	BH103	BH104		
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00		
			Sample Type	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)		
			Date Sampled	08/08/2016	08/08/2016	08/08/2016	08/08/2016		
			Sample Time	.	.	.	.		
			Date Received	09/08/2016	09/08/2016	09/08/2016	09/08/2016		
			SDG Ref	160809-47	160809-47	160809-47	160809-47		
			Lab Sample No.(s)	13932367	13932373	13932382	13932394		
			AGS Reference						
1,2,3-Trichlorobenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,3,5-Trichlorobenzene	<1 µg/l	TM208		<1	<1	<1	<1		

CERTIFICATE OF ANALYSIS

SDG:	160809-47	**Location:**	Land at Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-161	**Customer:**	Wardell Armstrong LLP	**Report Number:**	375185
Client Reference:	SH10243	**Attention:**	James Lymer	**Superseded Report:**	373897

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample [1]	Surrogate Corrected
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part109 1984	Determination of alkalinity in aqueous samples		
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)		
TM090	Method 5310, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 415.1 & 9060	Determination of Total Organic Carbon/Total Inorganic Carbon in Water and Waste Water		
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser		
TM110	BS 1377: Part 3 1990	Redox Potential		
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS		
TM174	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Waters by GC-FID		
TM176	EPA 8270D Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Determination of SVOCs in Water by GCMS		
TM178	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS in Waters		
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry		
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers		
TM208	Modified: US EPA Method 8260b & 624	Determination of Volatile Organic Compounds by Headspace / GC-MS in Waters		
TM228	US EPA Method 6010B	Determination of Major Cations in Water by iCap 6500 Duo ICP-OES		
TM245	By GC-FID	Determination of GRO by Headspace in waters		
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter		
TM259	by HPLC	Determination of Phenols in Waters and Leachates by HPLC		
TM279		Determination of Low Level Easily Liberatable (Free) Cyanides and Total Cyanides in Waters using the Skalar SANS+ System Segmented Flow Analyser		
TM331		Low Level Hexavalent Chromium		

[1] Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.

CERTIFICATE OF ANALYSIS

SDG:	160809-47	**Location:**	Land at Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-161	**Customer:**	Wardell Armstrong LLP	**Report Number:**	375185
Client Reference:	SH10243	**Attention:**	James Lymer	**Superseded Report:**	373897

Test Completion Dates

Lab Sample No(s)	13932367	13932373	13932382	13932394
Customer Sample Ref.	BH101	BH102	BH103	BH104
AGS Ref.				
Depth	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
Type	LIQUID	LIQUID	LIQUID	LIQUID
Alkalinity as CaCO3	12-Aug-2016	12-Aug-2016	15-Aug-2016	16-Aug-2016
Ammonium Low	12-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016
Anions by Kone (w)	13-Aug-2016	13-Aug-2016	13-Aug-2016	13-Aug-2016
Chromium III	17-Aug-2016	17-Aug-2016	17-Aug-2016	17-Aug-2016
Dissolved Metals by ICP-MS	17-Aug-2016	17-Aug-2016	17-Aug-2016	17-Aug-2016
Dissolved Organic/Inorganic Carbon	11-Aug-2016	10-Aug-2016	10-Aug-2016	10-Aug-2016
EPH CWG (Aliphatic) Aqueous GC (W)	17-Aug-2016	17-Aug-2016	17-Aug-2016	17-Aug-2016
EPH CWG (Aromatic) Aqueous GC (W)	17-Aug-2016	17-Aug-2016	17-Aug-2016	17-Aug-2016
GRO by GC-FID (W)	16-Aug-2016	17-Aug-2016	17-Aug-2016	17-Aug-2016
Low Level Cyanide (W)	15-Aug-2016	15-Aug-2016	15-Aug-2016	15-Aug-2016
Low Level Hexavalent Chromium (w)	11-Aug-2016	11-Aug-2016	11-Aug-2016	11-Aug-2016
Mercury Dissolved	16-Aug-2016	16-Aug-2016	16-Aug-2016	16-Aug-2016
Metals by iCap-OES Dissolved (W)	12-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016
PAH Spec MS - Aqueous (W)	17-Aug-2016	17-Aug-2016	17-Aug-2016	17-Aug-2016
pH Value	15-Aug-2016	15-Aug-2016	16-Aug-2016	15-Aug-2016
Phenols by HPLC (W)	12-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016
Redox Potential	12-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016
SVOC MS (W) - Aqueous	17-Aug-2016	16-Aug-2016	17-Aug-2016	16-Aug-2016
TPH CWG (W)	17-Aug-2016	17-Aug-2016	17-Aug-2016	17-Aug-2016
VOC MS (W)	16-Aug-2016	16-Aug-2016	16-Aug-2016	16-Aug-2016

SDG:	160809-47	**Location:**	Land at Cooper Bridge	**Order Number:**	SH5293
Job:	H_WARDELL_SHF-161	**Customer:**	Wardell Armstrong LLP	**Report Number:**	375185
Client Reference:	SH10243	**Attention:**	James Lymer	**Superseded Report:**	373897

Appendix

General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as “Not detected”. If no asbestos fibre types are found all will be reported as “Not detected” and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP - No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

12. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethyphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

21. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

24. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as “mixed hydrocarbons”. Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

Sample Deviations

1	Container with Headspace provided for volatiles analysis
2	Incorrect container received
3	Deviation from method
4	Holding time exceeded before sample received
5	Samples exceeded holding time before presevation was performed
§	Sampled on date not provided
♦	Sample holding time exceeded in laboratory
@	Sample holding time exceeded due to sampled on date
&	Sample Holding Time exceeded - Late arrival of instructions.

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than:
- Trace - Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

National Laboratory Service

Analytical Report

Final Report

Report ID - 20097509 - 1

Batch description: Soil Gravel

UKAS TESTING
0754

Reported on:
11-Aug-2016

Michael Kelly
Wardell Armstrong LLP
Unit 5
Newton Business Centre
Thorncliffe Park Estate
Sheffield
S35 2PH

Dear Michael

Please find attached the results for the batch of 4 samples described below.

Samples Registered on:	04-Aug-2016	
Analysis Started on:	04-Aug-2016	@ 11:15 am
Analysis Completed on:	11-Aug-2016	
Results for Batch Number	20097509	
Your Purchase Order Number:	SH5299	

You will be invoiced shortly by our accounts department.

If we can be of further assistance then please do not hesitate to contact us.

Yours sincerely

Redacted

Vici Morgan
Customer Services Team Leader
Tel: (0113) 231 2177
nls@environment-agency.gov.uk

National Laboratory Service

Analytical Report

Final Report

Report ID - 20097509 - 1

Batch description: Soil Gravel

UKAS TESTING 0754

Reported on: 11-Aug-2016

Client: Wardell Armstrong LLP

Project: 13529 Soil Analysis

Quote Description: Soil Analysis

Folder No: 003628415

Sampled on: 3-Aug-16 @ 10:50

Comments: TP108M1. Soil Gravel

Quote No: 13529

Matrix: Soil

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Escherichia coli : Confirmed : Membrane Filtration : Wet W	<1	CFU/gram	DB, DC	1	UKAS	SX	827
Escherichia coli : Presumptive : MF : Wet Wt	<1	CFU/gram	DB, DC	1	UKAS	SX	826
Colony count : 3 Days at 22C : Aerobic : Wet Wt	57000	CFU/gram	DB, DC	1	UKAS	SX	1190
Colony count : 5 Days at 22C : Aerobic : Wet Wt	75000	CFU/gram	DB, DC	1	UKAS	SX	1190
Colony count : 7 Days at 22C : Aerobic : Wet Wt	75000	CFU/gram	DB, DC	1	UKAS	SX	1190
Colony count : 3 Days at 30C : Aerobic : Wet Wt	39000	CFU/gram	DB, DC	1	UKAS	SX	1191
Colony count : 2 Days at 37C : Aerobic : Wet Wt	5900	CFU/gram	DB, DC	1	UKAS	SX	1189
Colony count : 3 Days at 37C : Aerobic : Wet Wt	5900	CFU/gram	DB, DC	1	None	SX	1189
Salmonella : Wet Wt	Absent	Pres/Abs	DB, DC	0	UKAS	SX	291

National Laboratory Service

Analytical Report

Final Report

Report ID - 20097509 - 1

Batch description: Soil Gravel

UKAS TESTING 0754

Reported on: 11-Aug-2016

Client: Wardell Armstrong LLP

Project: 13529 Soil Analysis

Quote Description: Soil Analysis

Folder No: 003628416

Sampled on: 3-Aug-16 @ 10:40

Comments: TP109M1. Soil Gravel

Quote No: 13529

Matrix: Soil

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Escherichia coli : Confirmed : Membrane Filtration : Wet W	<1	CFU/gram	DB, DC	1	UKAS	SX	827
Escherichia coli : Presumptive : MF : Wet Wt	<1	CFU/gram	DB, DC	1	UKAS	SX	826
Colony count : 3 Days at 22C : Aerobic : Wet Wt	245455	CFU/gram	DB, DC	1	UKAS	SX	1190
Colony count : 5 Days at 22C : Aerobic : Wet Wt	320000	CFU/gram	DB, DC	1	UKAS	SX	1190
Colony count : 7 Days at 22C : Aerobic : Wet Wt	340000	CFU/gram	DB, DC	1	UKAS	SX	1190
Colony count : 3 Days at 30C : Aerobic : Wet Wt	220000	CFU/gram	DB, DC	1	UKAS	SX	1191
Colony count : 2 Days at 37C : Aerobic : Wet Wt	46000	CFU/gram	DB, DC	1	UKAS	SX	1189
Colony count : 3 Days at 37C : Aerobic : Wet Wt	48000	CFU/gram	DB, DC	1	None	SX	1189
Salmonella : Wet Wt	Absent	Pres/Abs	DB, DC	0	UKAS	SX	291

National Laboratory Service

Analytical Report

Final Report

Report ID - 20097509 - 1

Batch description: Soil Gravel

UKAS TESTING 0754

Reported on: 11-Aug-2016

Client: Wardell Armstrong LLP

Project: 13529 Soil Analysis

Quote Description: Soil Analysis

Folder No: 003628417

Sampled on: 3-Aug-16 @ 10:30

Comments: TP110M1. Soil Gravel

Quote No: 13529

Matrix: Soil

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Escherichia coli : Confirmed : Membrane Filtration : Wet W	<1	CFU/gram	DB, DC	1	UKAS	SX	827
Escherichia coli : Presumptive : MF : Wet Wt	<1	CFU/gram	DB, DC	1	UKAS	SX	826
Colony count : 3 Days at 22C : Aerobic : Wet Wt	290909	CFU/gram	DB, DC	1	UKAS	SX	1190
Colony count : 5 Days at 22C : Aerobic : Wet Wt	440000	CFU/gram	DB, DC	1	UKAS	SX	1190
Colony count : 7 Days at 22C : Aerobic : Wet Wt	590000	CFU/gram	DB, DC	1	UKAS	SX	1190
Colony count : 3 Days at 30C : Aerobic : Wet Wt	136364	CFU/gram	DB, DC	1	UKAS	SX	1191
Colony count : 2 Days at 37C : Aerobic : Wet Wt	41000	CFU/gram	DB, DC	1	UKAS	SX	1189
Colony count : 3 Days at 37C : Aerobic : Wet Wt	50000	CFU/gram	DB, DC	1	None	SX	1189
Salmonella : Wet Wt	Absent	Pres/Abs	DB, DC	0	UKAS	SX	291

National Laboratory Service

Analytical Report

Final Report

Report ID - 20097509 - 1

Batch description: Soil Gravel

UKAS TESTING 0754

Reported on: 11-Aug-2016

Client: Wardell Armstrong LLP

Project: 13529 Soil Analysis

Quote Description: Soil Analysis

Folder No: 003628418

Sampled on: 3-Aug-16 @ 10:15

Comments: TP111M1. Soil Gravel

Quote No: 13529

Matrix: Soil

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Escherichia coli : Confirmed : Membrane Filtration : Wet W	<1	CFU/gram	DB, DC	1	UKAS	SX	827
Escherichia coli : Presumptive : MF : Wet Wt	<1	CFU/gram	DB, DC	1	UKAS	SX	826
Colony count : 3 Days at 22C : Aerobic : Wet Wt	1430000	CFU/gram	DB, DC	1	UKAS	SX	1190
Colony count : 5 Days at 22C : Aerobic : Wet Wt	1630000	CFU/gram	DB, DC	1	UKAS	SX	1190
Colony count : 7 Days at 22C : Aerobic : Wet Wt	1650000	CFU/gram	DB, DC	1	UKAS	SX	1190
Colony count : 3 Days at 30C : Aerobic : Wet Wt	670000	CFU/gram	DB, DC	1	UKAS	SX	1191
Colony count : 2 Days at 37C : Aerobic : Wet Wt	500000	CFU/gram	DB, DC	1	UKAS	SX	1189
Colony count : 3 Days at 37C : Aerobic : Wet Wt	500000	CFU/gram	DB, DC	1	None	SX	1189
Salmonella : Wet Wt	Absent	Pres/Abs	DB, DC	0	UKAS	SX	291

National Laboratory Service

Analytical Report

Final Report

Report ID - 20097509 - 1

Batch description: Soil Gravel

UKAS TESTING
0754

Reported on:
11-Aug-2016

Method Description Summary for all samples in batch Number 20097509

291	NLS B SAL PA - Qualitative Analysis for Salmonella Spp. (Not S.Typhi) by Membrane Filtration
826	NLS B ECOLI ENV - Enumeration of Escherichia coli by Membrane Filtration (Presumptive)
827	NLS B ECOLI ENV - Enumeration of Escherichia coli by Membrane Filtration (Confirmed)
1189	NLS B PLATE COUNT - Heterptrophic Plate Count by Pour Plate
1190	NLS B PLATE COUNT - Heterptrophic Plate Count by Pour Plate
1191	NLS B PLATE COUNT - Heterptrophic Plate Count by Pour Plate

Redacted

James Trout
Laboratory Site Manager

All reporting limits quoted are those achievable for clean samples of the relevant matrix. No allowance is made for instances when dilutions are necessary owing to the nature of the sample or insufficient volume of the sample being available. In these cases higher reporting limits may be quoted and will be above the MRV.
Minimum Reporting Value (MRV). A minimum concentration selected for reporting purposes (i.e. the less than value), which is higher than the statistically derived method limit of detection.

Solid sample results are determined on a "dried" sample fraction except for parameters where the method description identifies that "as received" sample was used.
Key to Results Flags:

DB Samples received outside specified stability times. It is possible that the results may be compromised.

DC Analysis started outside of specified stability time. It is possible that the results may be compromised.

The analysis start date specified is the date of the first test, dates for other analysis are available on request.

Please note all samples will be retained for 10 working days for aqueous samples and 30 working days for solid samples after reporting unless otherwise agreed with Customer Services
Key to Accreditation: UKAS = Methodology accredited to ISO/IEC 17025:2005, MCertS = Methodology accredited to MCertS Performance Standard for testing of soils, none = Methodology not accredited
Key to Lab ID: LE = Leeds, NM = Nottingham, SX = Starcross, SC = Sub-Contracted outside NLS, FI = Field Data - outside NLS, NLS = Calculated

Any subsequent version of this report denoted with a higher version number will supersede this and any previous versions

END OF TEST REPORT

APPENDIX VI

Statistical Analysis of Geochemical Laboratory Results

STATISTICAL ANALYSIS OF SOIL CONTAMINATION DATA - PLANNING SCENARIO

(Based on CL:AIRE/CIEH Guidance on Comparing Soil Contamination Data with a Critical Concentration, May 2008)

Job Number: **SH10243** Job Name: **Cooper Bridge WWTW**

Assessor: **M Biggins** Date: **25/08/2016**

Proposed Land Use: **Commercial / Industrial** Zone: **Whole Site**

Key Question: Is there significant evidence that the true mean concentration of the contaminant is less than the screening value (critical concentration)?

Null Hypothesis (H0): The true mean concentration is equal to or greater than the screening value (critical concentration; $\mu \geq Cc$)

Alternative Hypothesis (H1): The true mean concentration is less than the screening value (critical concentration; $\mu < Cc$)

SAMPLE IDENTIFICATION / STATISTICAL TEST		RECORDED CONCENTRATION / STATISICAL RESULT															
		Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Chromium (VI)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Selenium (Se)	Vanadium (V)	Zinc (Zn)	Cyanide (free)	Phenol (total-mono)	Sulphate (total)	Sulphate (2:1)	pH
Location	Depth (mbgl)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	g/l	-
HDP105 ES1	0.20-	70.90	1.02	90.50	0.30	90.50	161.00	0.94	23.80	0.05	28.80	271.00	0.05	0.005	724.00	0.00	7.94
HDP106 ES1	0.20-	96.50	0.98	282.00	0.30	149.00	212.00	4.26	42.40	0.05	34.60	414.00	0.05	0.011	688.00	0.00	6.94
HP101 ES1	0.30-	82.50	1.07	84.90	0.30	54.70	75.30	0.35	37.30	0.05	42.50	179.00	0.05	0.005	749.00	0.06	8.28
BH102 ES1	0.40-	125.00	2.35	405.00	1.21	120.00	232.00	1.40	26.40	0.05	28.40	243.00	0.05	0.005	1340.00	0.02	7.35
BH103 ES1	0.50-	63.30	1.20	79.60	0.30	43.00	71.90	0.07	23.60	0.05	57.90	161.00	0.05	0.005	2660.00	0.16	8.12
BH104 ES1	0.50-	29.20	0.96	41.90	0.30	34.00	51.70	0.07	24.10	0.05	31.80	72.40	0.05	0.005	1610.00	0.05	9.81
HP102 ES1	0.50-	84.90	1.12	102.00	0.30	102.00	223.00	1.05	34.70	0.05	36.70	281.00	0.05	0.005	1430.00	0.39	7.33
BH101A ES1	0.80-	38.30	0.85	73.00	0.30	52.30	122.00	0.75	20.80	0.05	24.50	164.00	0.05	0.005	918.00	0.11	8.55
HP104 ES1	0.80-	32.40	0.72	44.30	0.30	79.50	72.20	0.23	34.40	0.05	44.50	80.20	0.05	0.005	487.00	0.10	6.96
HP103 ES1	0.90-	20.00	1.17	53.70	0.30	36.60	73.60	0.07	24.30	0.05	31.90	117.00	0.05	0.005	535.00	0.05	8.00
BH103 ES2	1.20-	97.40	0.90	116.00	0.30	52.90	77.80	0.46	36.60	0.05	55.70	263.00	0.05	0.005	1870.00	0.29	9.14
BH102 ES2	1.65-	21.90	1.15	70.70	0.30	30.10	50.40	0.07	29.90	0.05	22.70	112.00	0.05	0.005	458.00	0.05	7.84
BH103 ES3	3.80-																
BH104 ES2	4.00-																
Number of samples (N)		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Minimum		20	0.718	41.9	0.3	30.1	50.4	0.07	20.8	0.05	22.7	72.4	0.05	0.005	458	0.002	6.94
Maximum		125	2.35	405.0	1.21	149	232	4.26	42.4	0.05	57.9	414	0.05	0.0113	2660	0	9.81
Standard Deviation		35	0	110	0	38	70	1	7	0	11	101	0	0	676	0	1
Screening Value (Critical Conc.; Cc)		640	190	8600	33	68000	2300	58	980	12000	9000	730000	41	760	n/a	n/a	n/a
Source of Screening Value																	
Outlier Identification																	
Standardised Value (Tn)		1.329	2.717	2.157	3.175	1.674	1.451	1.777	1.621	#DIV/0!	1.670	1.619	#DIV/0!	3.175	1.772	1.240	1.975
Critical Value (Tcrit)		2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285
Is there an Outlier (Tn > Tcrit)		NO	***YES***	NO	***YES***	NO	NO	NO	NO	#DIV/0!	NO	NO	#DIV/0!	***YES***	NO	NO	NO
Outlier location(s) and depth(s)																	
Outlier status																	
Does the Data have a Normal Distribution?																	
Visual Estimate (probablitity plot)		YES	NO	NO	NO	YES	NO	NO	YES	NO	YES	YES	NO	NO	YES	NO	YES
Shapiro-Wilk statistic (W)		0.93	0.67	0.68	0.33	0.90	0.81	0.66	0.91	0.00	0.91	0.93	0.00	0.33	0.88	0.80	0.94
Shapiro-Wilk Test (is W > Sig(0.05))		YES	NO	NO	NO	YES	NO	NO	YES	NO	YES	YES	NO	NO	YES	NO	YES
Mean Concentration (95% UCL)		82	n/a	n/a	n/a	90	n/a	n/a	33	n/a	43	249	n/a	n/a	1473	n/a	8
Is there significant evidence that the mean concentration is less than the screening value ($\mu < Cc$)?		YES	n/a	n/a	n/a	YES	n/a	n/a	YES	n/a	YES	YES	n/a	n/a	YES	n/a	YES
Level of Evidence (p_1, %)		100	n/a	n/a	n/a	100	n/a	n/a	100	n/a	100	100	n/a	n/a	n/a	n/a	n/a
Does the Data have a Non-normal Distribution?																	
Chebychev Theorem.		NO	YES	YES	YES	NO	YES	YES	NO	YES	NO	NO	YES	YES	NO	YES	NO
Mean Concentration (95% UCL)		n/a	1.64	258.39	0.71	n/a	206.20	2.29	n/a	0.05	n/a	n/a	0.05	0.01	n/a	0.26	n/a
Is there significant evidence that the mean concentration is less than the screening value ($\mu < Cc$)?		n/a	YES	YES	YES	n/a	YES	YES	n/a	YES	n/a	n/a	YES	YES	n/a	n/a	n/a
Level of Evidence (p1, %)		n/a	99	99	99	n/a	99	99	n/a	99	n/a	n/a	99	99	n/a	n/a	n/a

NB: 1) values shown in bold exceed the critical concentration (adopted generic screening value); 2) Non-detects have been entered as the limit of dectection for that substance and these values are shown in italics.

STATISTICAL ANALYSIS OF SOIL CONTAMINATION DATA - PLANNING SCENARIO

(Based on CL:AIRE/CIEH Guidance on Comparing Soil Contamination Data with a Critical Concentration, May 2008)

Job Number: **SH10243** Job Name: **Cooper Bridge WWTW**

Assessor: **M Biggins** Date: **12/09/2016**

Proposed Land Use: **Commercial / Industrial** Zone: **Whole Site**

Key Question: Is there significant evidence that the true mean concentration of the contaminant is less than the screening value (critical concentration)?

Null Hypothesis (H0): The true mean concentration is equal to or greater than the screening value (critical concentration; $\mu \geq Cc$)

Alternative Hypothesis (H1): The true mean concentration is less than the screening value (critical concentration; $\mu < Cc$)

SAMPLE IDENTIFICATION / STATISTICAL TEST		RECORDED CONCENTRATION / STATISICAL RESULT															
Location	Depth (mbgl)	Acenaphthene ug/kg	Acenaphthylene ug/kg	Anthracene ug/kg	Benzo(a) anthracene ug/kg	Benzo(a)pyrene ug/kg	Benzo(b) fluoranthene ug/kg	Benzo(ghi) perylene ug/kg	Benzo(k) fluoranthene ug/kg	Chrysene ug/kg	Dibenzo (ah)anthracene ug/kg	Fluoranthene ug/kg	Fluorene ug/kg	Indeno(123cd) pyrene ug/kg	Naphthalene ug/kg	Phenanthrene ug/kg	Pyrene ug/kg
HDP105 ES1	0.20-	1510.00	102.00	1730.00	4020.00	3410.00	4250.00	1790.00	1450.00	3200.00	494.00	9090.00	981.00	1700.00	475.00	7370.00	7310.00
HDP106 ES1	0.20-	20.20	39.50	104.00	455.00	503.00	826.00	367.00	180.00	353.00	96.30	728.00	23.60	299.00	134.00	386.00	642.00
HP101 ES1	0.30-	50.00	50.00	50.00	360.00	417.00	391.00	272.00	335.00	375.00	50.00	607.00	50.00	294.00	50.00	236.00	546.00
BH102 ES1	0.40-	501.00	78.70	923.00	3560.00	3780.00	4770.00	2360.00	1640.00	3140.00	632.00	8330.00	383.00	2120.00	172.00	5900.00	6740.00
BH103 ES1	0.50-	40.40	36.70	153.00	456.00	515.00	689.00	368.00	237.00	394.00	98.40	942.00	43.70	330.00	56.10	523.00	792.00
BH104 ES1	0.50-	119.00	81.00	304.00	1200.00	1370.00	2020.00	923.00	662.00	1440.00	226.00	3680.00	121.00	767.00	71.80	1680.00	3140.00
HP102 ES1	0.50-	50.00	50.00	50.00	625.00	649.00	622.00	391.00	549.00	651.00	50.00	1360.00	50.00	457.00	50.00	542.00	1110.00
BH101A ES1	0.80-	12.70	25.30	41.10	203.00	233.00	344.00	201.00	126.00	233.00	48.40	348.00	13.90	169.00	31.10	164.00	313.00
HP104 ES1	0.80-	188.00	27.00	212.00	989.00	1060.00	1300.00	501.00	484.00	1090.00	188.00	1410.00	112.00	430.00	210.00	1190.00	1300.00
HP103 ES1	0.90-	23.60	60.50	113.00	489.00	584.00	831.00	477.00	303.00	462.00	114.00	872.00	27.20	388.00	67.90	383.00	820.00
BH103 ES2	1.20-	92.50	22.10	234.00	345.00	331.00	446.00	235.00	204.00	380.00	59.10	1020.00	101.00	190.00	89.50	831.00	829.00
BH102 ES2	1.65-	40.90	18.20	99.50	195.00	370.00	579.00	284.00	175.00	313.00	72.70	696.00	35.30	234.00	53.40	482.00	604.00
BH103 ES3	3.80-																
BH104 ES2	4.00-																
Number of samples (N)		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Minimum		12.7	18.2	41.1	195	233	344	201	126	233	48.4	348	13.9	169	31.1	164	313
Maximum		1510	102	1730.0	4020	3780	4770	2360	1640	3200	632	9090	981	2120	475	7370	7310
Standard Deviation		428	27	501	1306	1210	1518	689	504	1073	191	3062	277	631	124	2392	2454
Screening Value (Critical Conc.; Cc)		84000000	83000000	520000000	170000	35000	44000	3900000	1200000	350000	3500	23000000	63000000	500000	190000	22000000	54000000
Source of Screening Value																	
Outlier Identification																	
Standardised Value (Tn)		2.160	1.560	2.045	1.858	1.859	1.838	2.014	1.783	1.761	1.900	1.832	2.164	1.980	2.183	1.897	1.823
Critical Value (Tcrit)		2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285	2.285
Is there an Outlier (Tn > Tcrit)		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Outlier location(s) and depth(s)																	
Outlier status																	
Does the Data have a Normal Distribution?																	
Visual Estimate (probablitity plot)		NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Shapiro-Wilk statistic (W)		0.53	0.92	0.62	0.66	0.69	0.70	0.69	0.75	0.69	0.71	0.66	0.56	0.69	0.69	0.63	0.66
Shapiro-Wilk Test (is W > Sig(0.05))		NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Mean Concentration (95% UCL)		n/a	63.06	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Is there significant evidence that the mean concentration is less than the screening value ($\mu < Cc$)?		n/a	YES	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Level of Evidence (p_1, %)		n/a	100	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Does the Data have a Non-normal Distribution?																	
Chebychev Theorem.		YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Mean Concentration (95% UCL)		759.26	n/a	964.71	2718.58	2624.70	3332.99	1547.48	1162.83	2352.50	417.50	6276.93	510.01	1409.49	277.82	4651.15	5100.28
Is there significant evidence that the mean concentration is less than the screening value ($\mu < Cc$)?		YES	n/a	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Level of Evidence (p1, %)		99	n/a	99	99	99	99	99	99	99	99	99	99	99	99	99	99

NB: 1) values shown in bold exceed the critical concentration (adopted generic screening value); 2) Non-detects have been entered as the limit of dectection for that substance and these values are shown in italics.

APPENDIX VII

Geotechnical Laboratory Results

LABORATORY REPORT

4043

Contract Number: PSL16/3716

Report Date: 01 September 2016

Client's Reference: SH10243

Client Name: Wardell Armstrong
Sir Henry Doulton House
Forge Lane
Etruria
Stoke on Trent
ST1 5BD

For the attention of: Matt Biggins/Mike Kelly

Contract Title: Cooper Bridge

Date Received: 10/8/2016
Date Commenced: 10/8/2016
Date Completed: 1/9/2016

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson (Director)
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SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
BH101A	5	B	1.20	1.70	Greyish brown very sandy CLAY.
BH101A	18	B	7.90	8.40	Dark grey very gravelly sandy CLAY.
BH102	5	B	1.65	2.00	Dark brown slightly gravelly very sandy CLAY.
BH102	8	B	2.45	3.00	Brown slightly gravelly very sandy CLAY.
BH102	12	B	6.00	6.50	Brown very sandy clayey GRAVEL.
BH102	14	B	7.60	8.00	Brown very sandy slightly silty GRAVEL with many cobbles.
BH102	16	B	9.00	9.50	Brown very sandy slightly silty GRAVEL.
TP101		B	0.50		Grey slightly sandy GRAVEL.
TP102		B	4.00		Grey GRAVEL.
TP103		B	1.00		Grey GRAVEL.
TP104		B	1.00		Grey slightly silty GRAVEL.
TP106		B	1.50		Grey GRAVEL.
TP109		B	2.50		Grey GRAVEL.
TP111		B	3.00		Grey GRAVEL.
BH103	4	B	1.80	2.20	MADE GROUND dark brown sandy clayey gravel.
BH103	10	B	6.60	7.00	Brown very sandy slightly silty GRAVEL.
BH103	14	B	9.50	9.80	Brown very sandy slightly silty GRAVEL.
BH104	1	B	0.10	0.50	MADE GROUND dark brown very gravelly sandy clay with occasional cobbles.
BH104	2	B	0.80	1.20	MADE GROUND brown very sandy very clayey gravel with some cobbles.

UKAS TESTING 4043

PSL Professional Soils Laboratory

Checked / Approved		Date	01/09/16	Contract No:
Cooper Bridge				PSL16/3716
				Client Ref:

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
BH104	3	B	1.20	1.50	MADE GROUND brown very gravelly very sandy clay.
BH104	4	B	2.50	3.00	Brown very gravelly very sandy CLAY.
BH104	5	B	4.00	4.50	Brown sandy clayey silty GRAVEL.
BH104	6	B	5.20	5.70	Dark grey gravelly sandy CLAY.

UKAS TESTING 4043

PSL Professional Soils Laboratory

Checked / Approved		Date	01/09/16	Contract No:
Cooper Bridge				PSL16/3716
				Client Ref:

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
BH101A	5	B	1.20	1.70	30			34	19	15	99	Low plasticity CL.
BH101A	18	B	7.90	8.40	11							
BH102	5	B	1.65	2.00	25			42	22	20	92	Intermediate plasticity CI.
BH102	8	B	2.45	3.00	29			39	21	18	99	Intermediate plasticity CI.
BH102	12	B	6.00	6.50	18							
BH102	14	B	7.60	8.00	9.1							
BH102	16	B	9.00	9.50	9.5							
TP101		B	0.50		9.6							
TP102		B	4.00		1.7							
TP103		B	1.00		1.6							
TP104		B	1.00		5.3							
TP106		B	1.50		1.7							
TP109		B	2.50		2.6							
TP111		B	3.00		4.8							
BH103	4	B	1.80	2.20	19							
BH103	10	B	6.60	7.00	6.5							
BH103	14	B	9.50	9.80	10							
BH104	1	B	0.10	0.50	15							
BH104	2	B	0.80	1.20	14							

SYMBOLS : **NP : Non Plastic** *** : Liquid Limit and Plastic Limit Wet Sieved.**

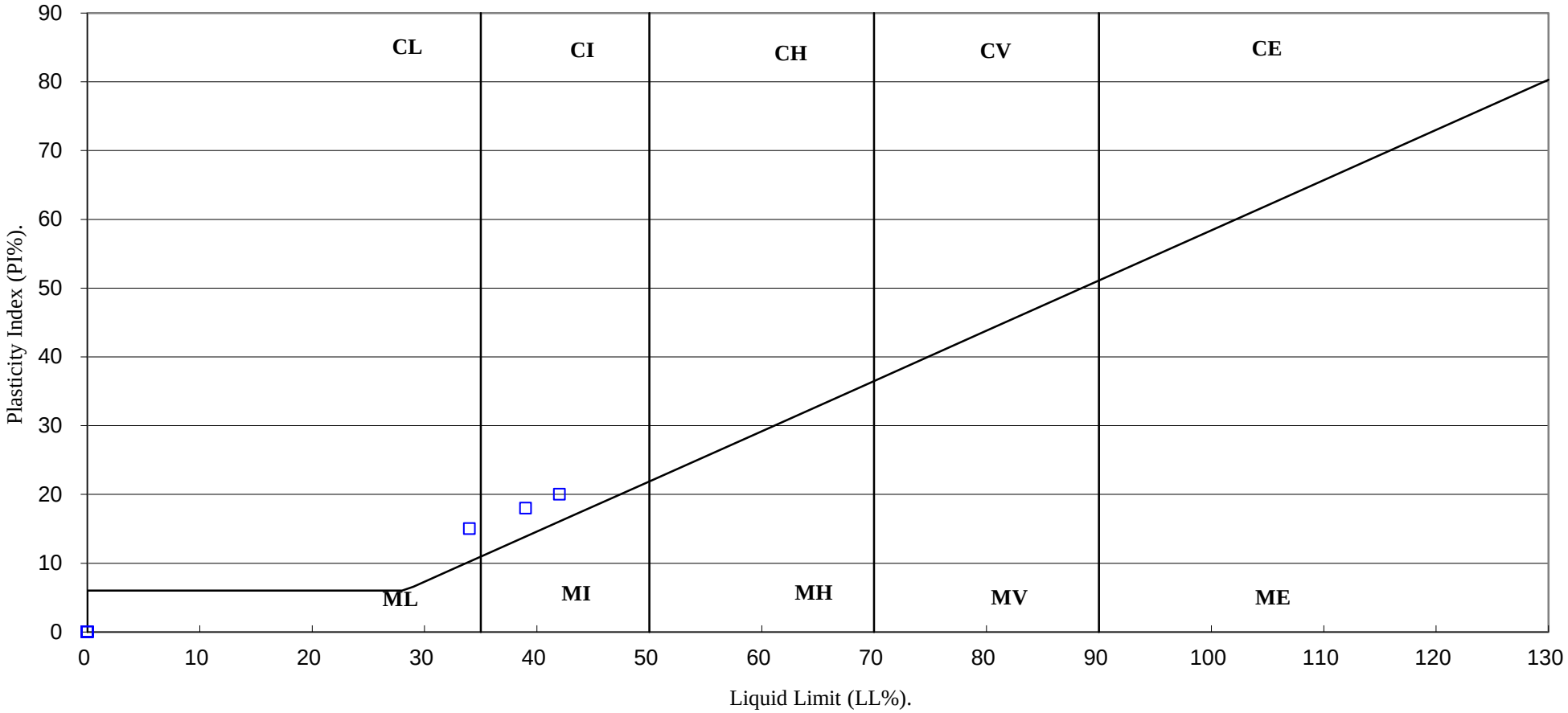
UKAS TESTING 4043

PSL Professional Soils Laboratory

Checked / Approved		Date	01/09/16	Contract No:
Cooper Bridge				PSL16/3716
				Client Ref:

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(BS5930 :2015)



UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked /Approved**		**Date**	**01/09/16**	**Contract No:**
		Cooper Bridge				**PSL16/3716**
						Client Ref:

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
BH104	3	B	1.20	1.50	16							
BH104	4	B	2.50	3.00	17			32	16	16	64	Low plasticity CL.
BH104	5	B	4.00	4.50	16							
BH104	6	B	5.20	5.70	15			47	22	25	84	Intermediate plasticity CI.

SYMBOLS : **NP : Non Plastic** *** : Liquid Limit and Plastic Limit Wet Sieved.**

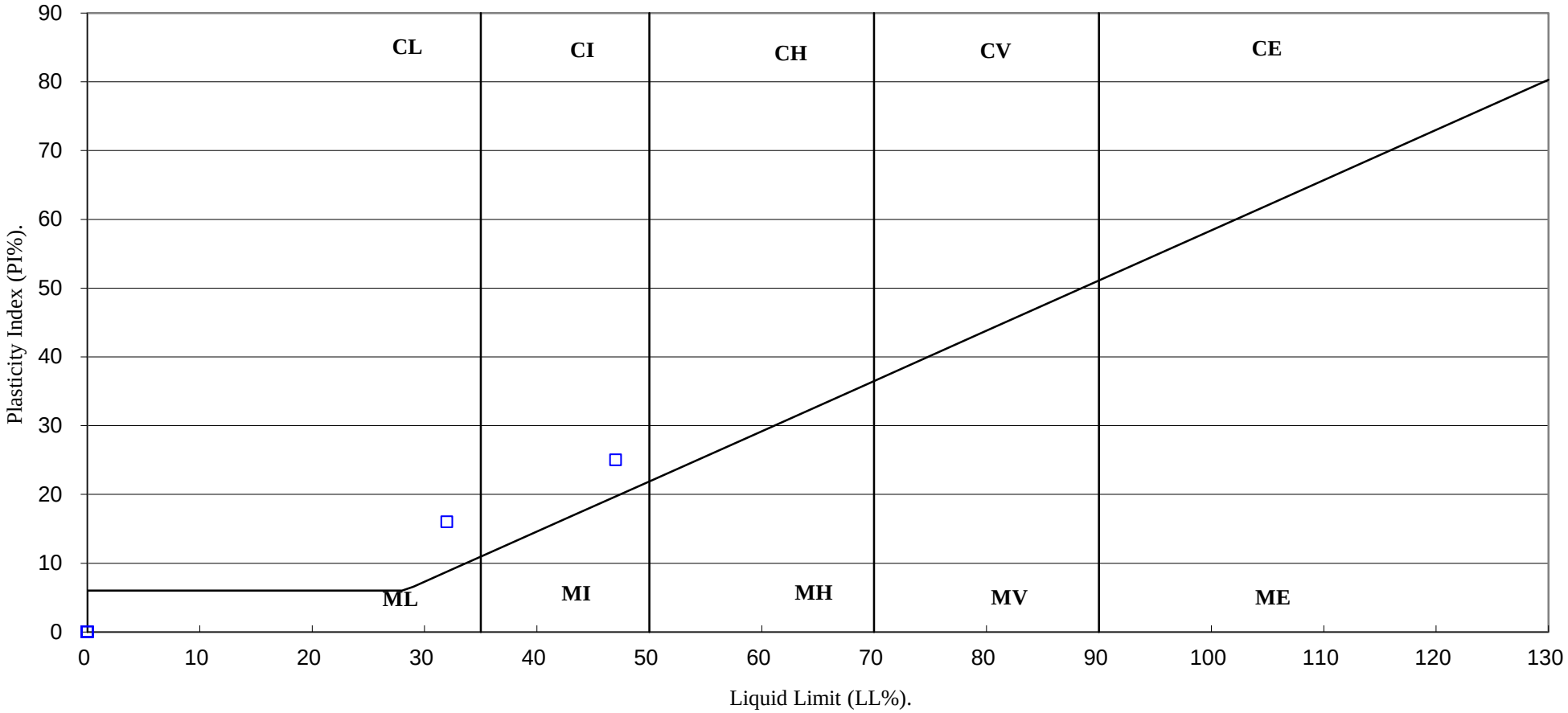
UKAS TESTING 4043

PSL Professional Soils Laboratory

Checked / Approved		Date	01/09/16	Contract No:
Cooper Bridge				PSL16/3716
				Client Ref:

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(BS5930 :2015)



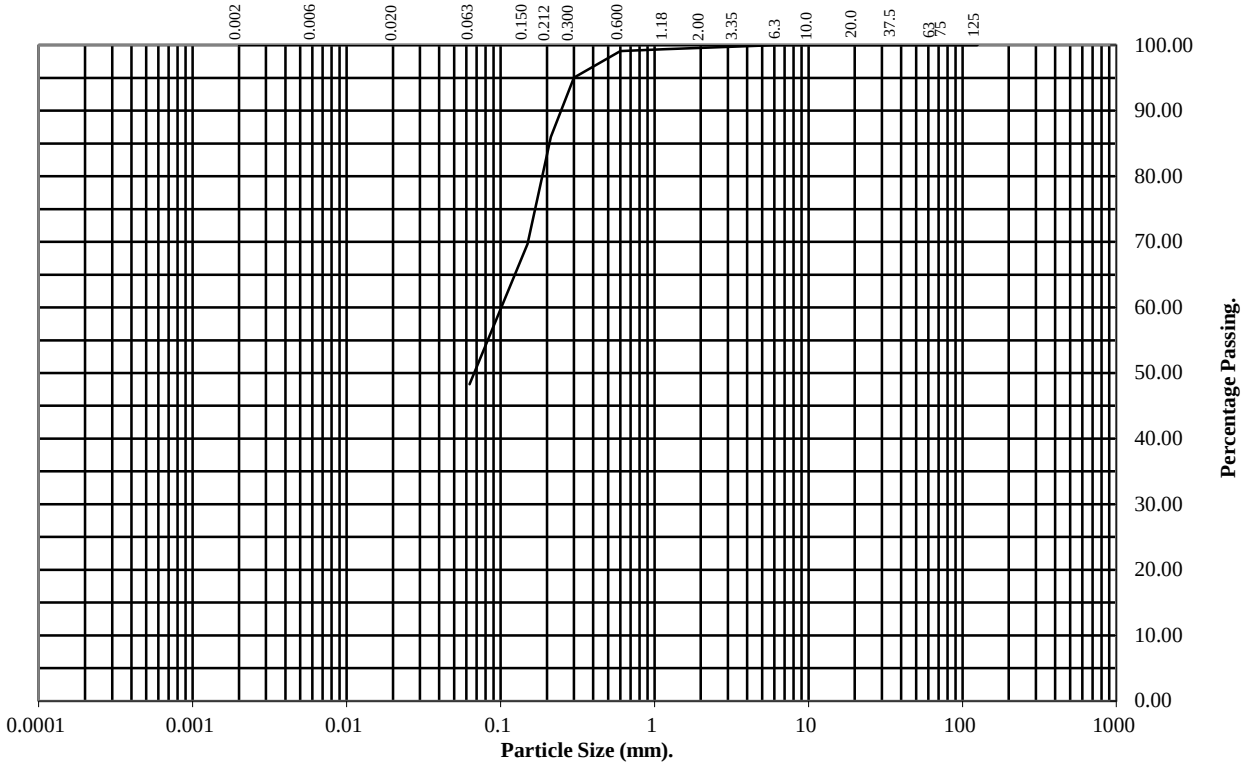
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked /Approved**		**Date**	**01/09/16**	**Contract No:**
		Cooper Bridge				**PSL16/3716**
						Client Ref:

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH101A**	**Top Depth (m):**	**1.20**
Sample Number:	**5**	**Base Depth(m):**	**1.70**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	100
1.18	99
0.6	99
0.3	95
0.212	86
0.15	70
0.063	48

Soil Fraction	Total Percentage
Cobbles	0
Gravel	0
Sand	52
Silt/Clay	48

Remarks:

See summary of soil descriptions.

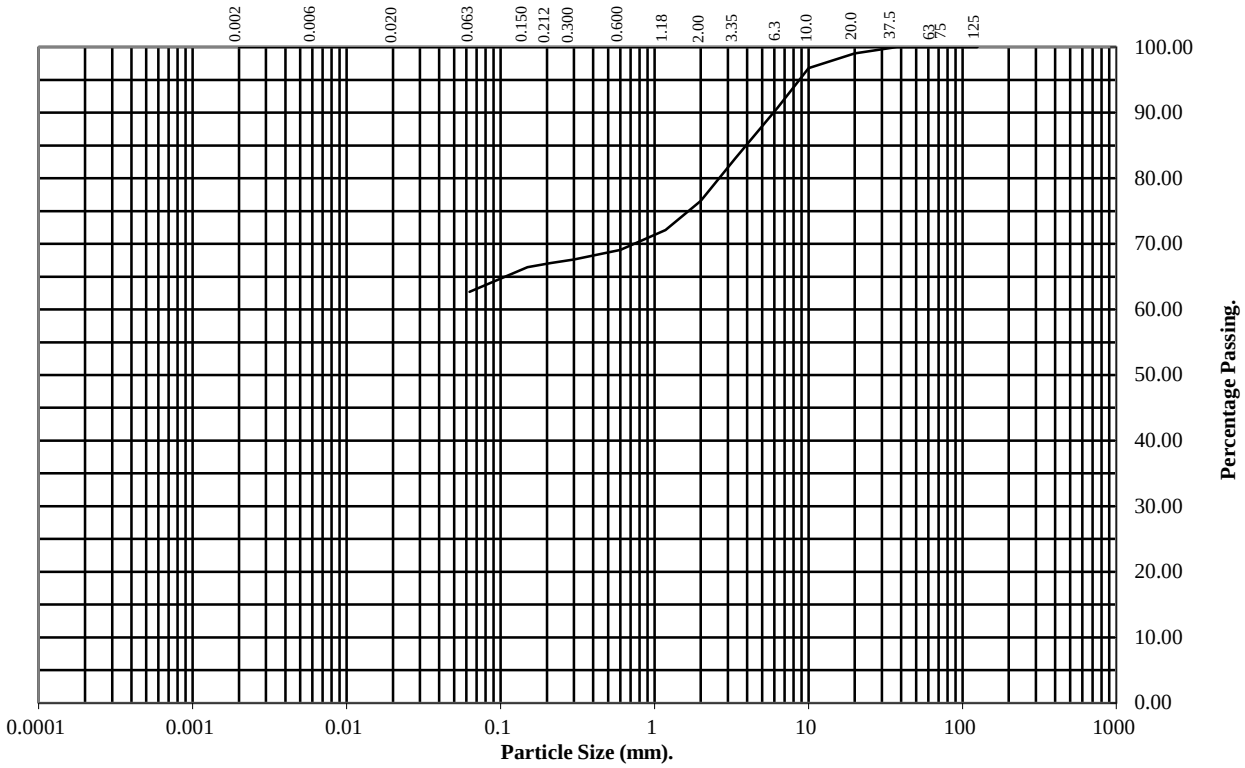
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 31/08/16	**Contract No:** PSL16/3716
		Cooper Bridge			**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH101A**	**Top Depth (m):**	**7.90**
Sample Number:	**18**	**Base Depth(m):**	**8.40**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	99
10	97
6.3	91
3.35	83
2	77
1.18	72
0.6	69
0.3	68
0.212	67
0.15	66
0.063	63

Soil Fraction	Total Percentage
Cobbles	0
Gravel	23
Sand	14
Silt/Clay	63

Remarks:

See summary of soil descriptions.

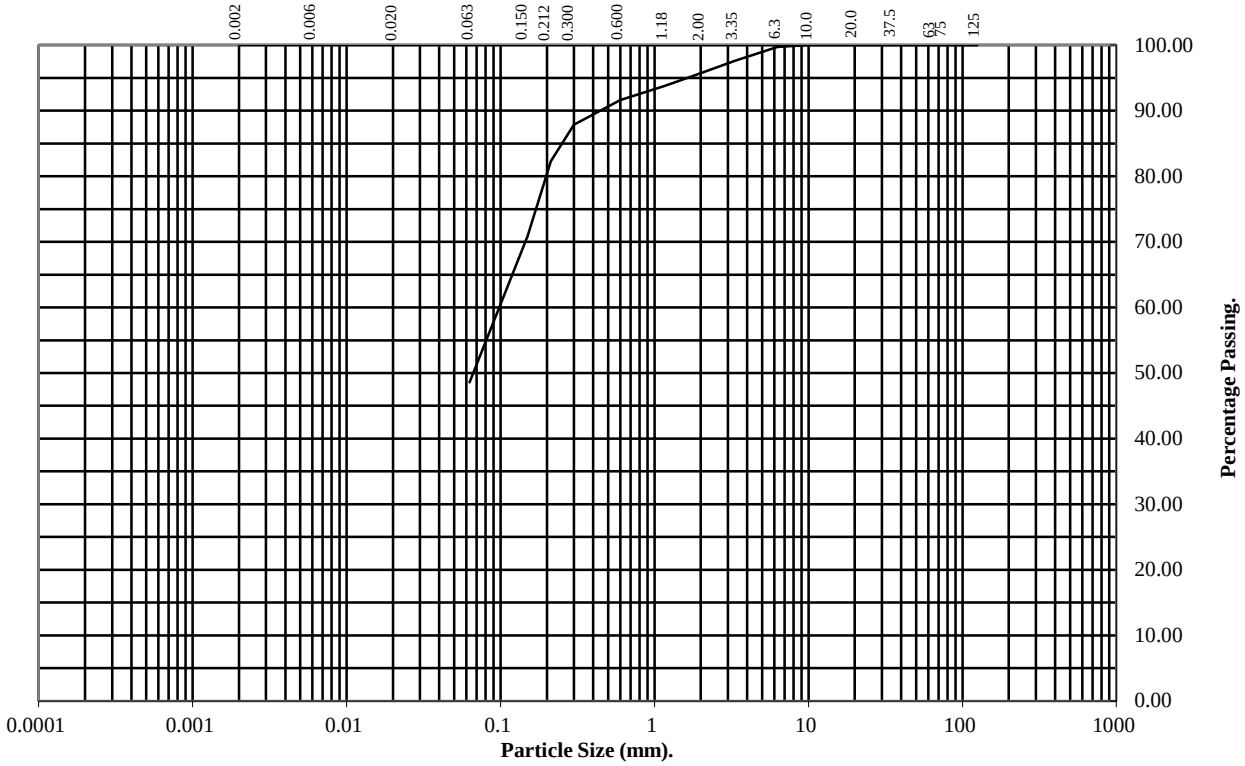
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 31/08/16	**Contract No:** PSL16/3716
		Cooper Bridge			**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH102**	**Top Depth (m):**	**1.65**
Sample Number:	**5**	**Base Depth(m):**	**2.00**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	98
2	96
1.18	94
0.6	92
0.3	88
0.212	82
0.15	71
0.063	49

Soil Fraction	Total Percentage
Cobbles	0
Gravel	4
Sand	47
Silt/Clay	49

Remarks:

See summary of soil descriptions.

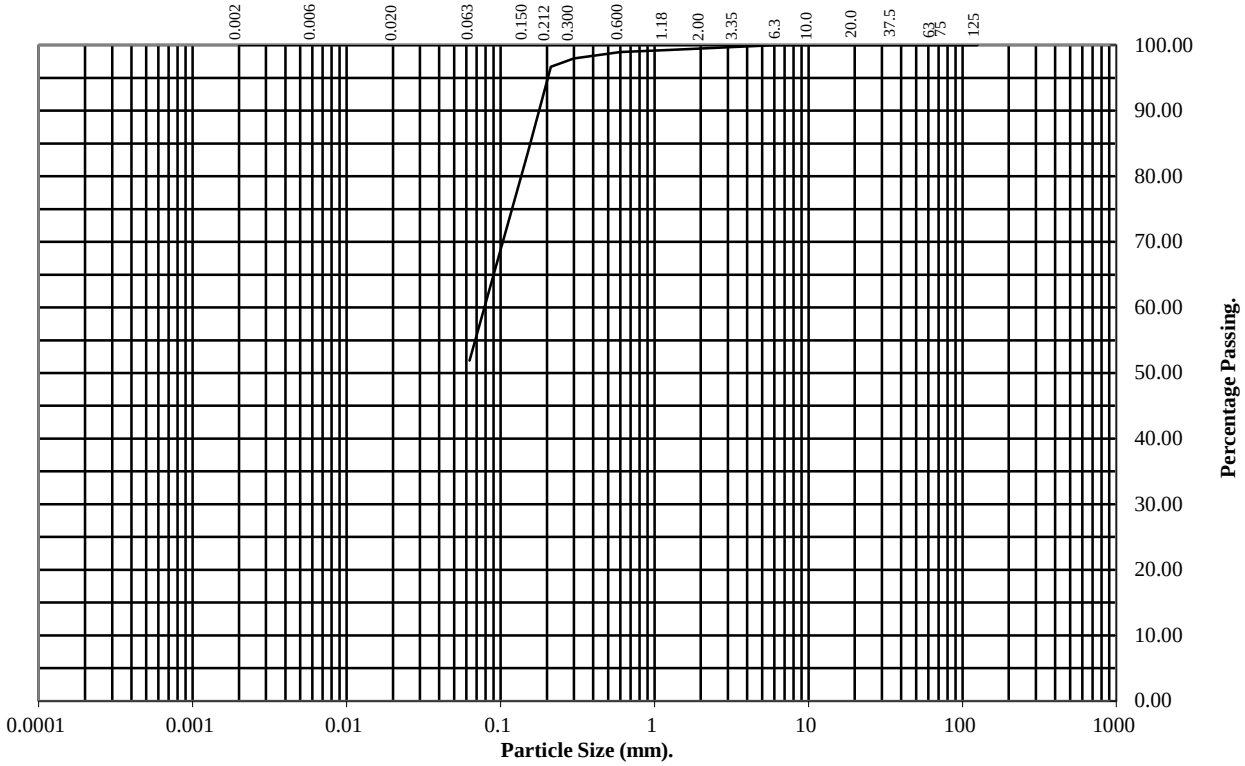
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 31/08/16	**Contract No:** PSL16/3716
		Cooper Bridge			**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH102**	**Top Depth (m):**	**2.45**
Sample Number:	**8**	**Base Depth(m):**	**3.00**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	99
1.18	99
0.6	99
0.3	98
0.212	97
0.15	83
0.063	52

Soil Fraction	Total Percentage
Cobbles	0
Gravel	1
Sand	47
Silt/Clay	52

Remarks:

See summary of soil descriptions.

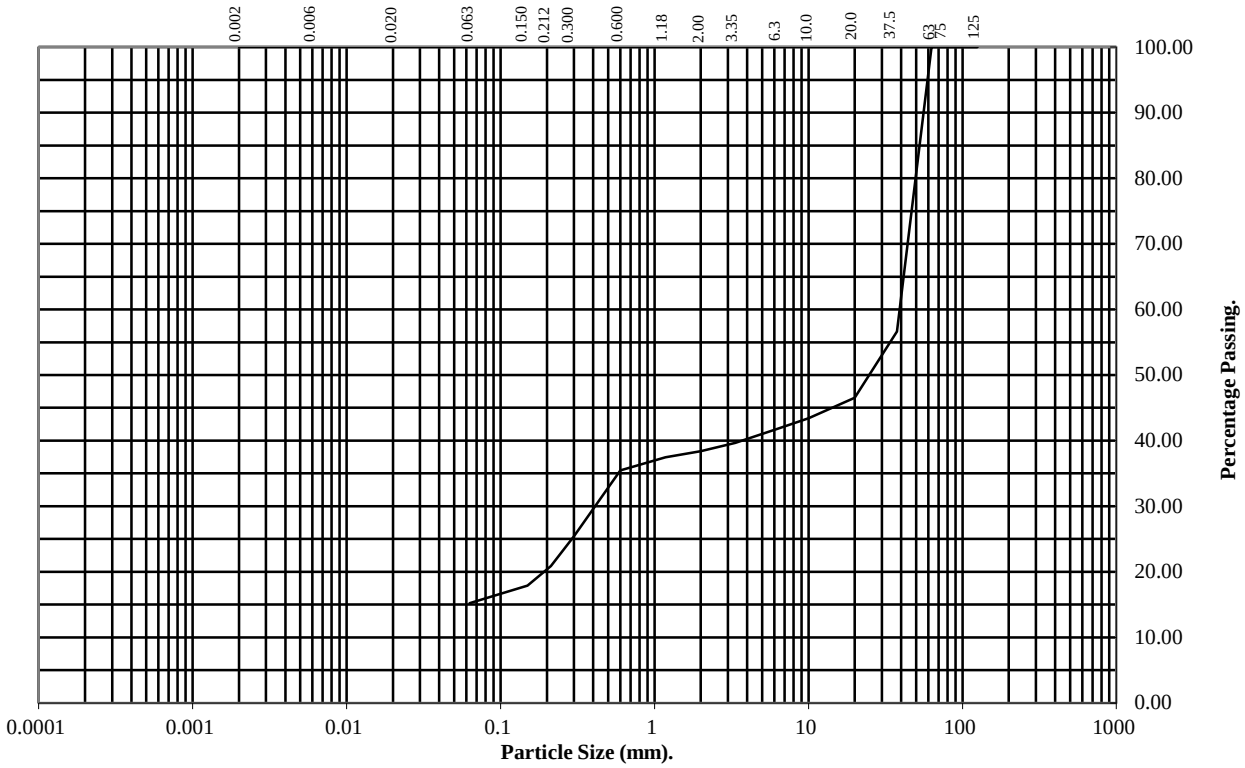
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 31/08/16	**Contract No:** PSL16/3716
		Cooper Bridge			**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH102**	**Top Depth (m):**	**6.00**
Sample Number:	**12**	**Base Depth(m):**	**6.50**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	57
20	47
10	43
6.3	42
3.35	40
2	38
1.18	37
0.6	35
0.3	25
0.212	21
0.15	18
0.063	15

Soil Fraction	Total Percentage
Cobbles	0
Gravel	62
Sand	23
Silt/Clay	15

Remarks:

See summary of soil descriptions.

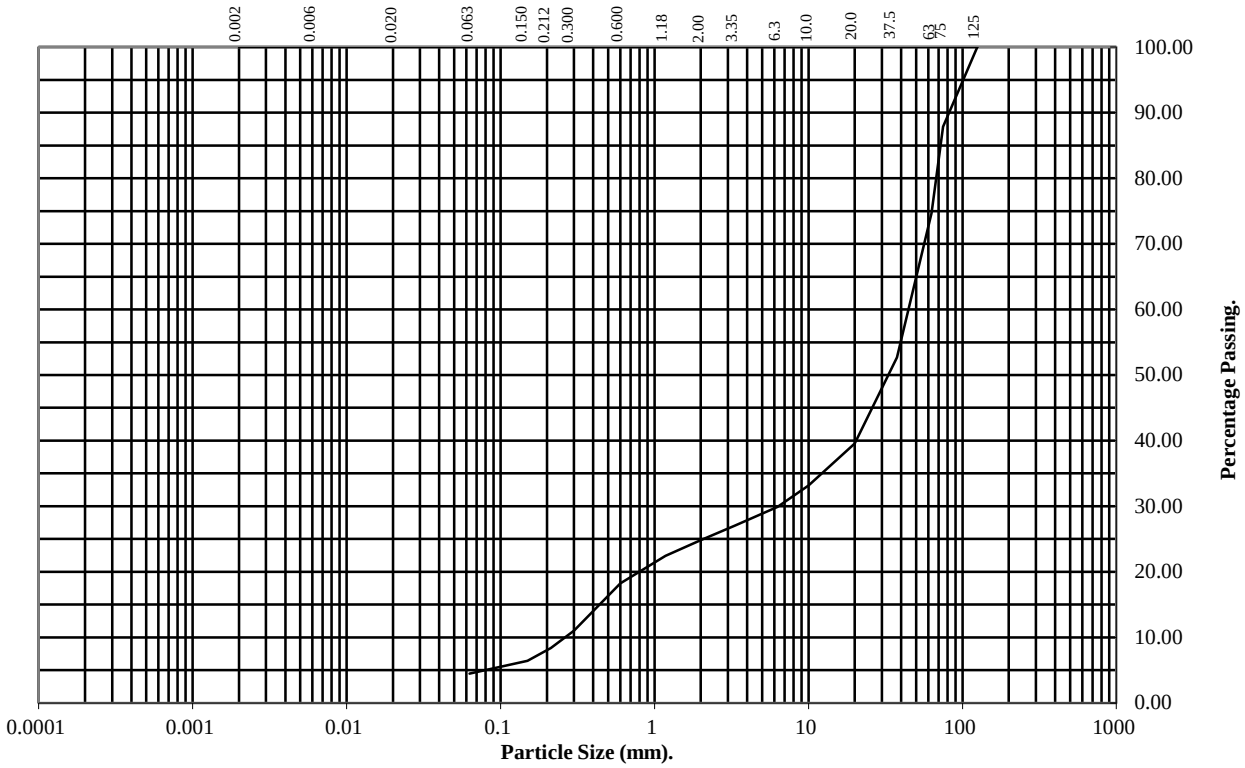
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 31/08/16	**Contract No:** PSL16/3716
		Cooper Bridge			**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH102**	**Top Depth (m):**	**7.60**
Sample Number:	**14**	**Base Depth(m):**	**8.00**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	88
63	75
37.5	53
20	40
10	33
6.3	30
3.35	27
2	25
1.18	22
0.6	18
0.3	11
0.212	8
0.15	6
0.063	4

Soil Fraction	Total Percentage
Cobbles	25
Gravel	50
Sand	21
Silt/Clay	4

Remarks:

See summary of soil descriptions.

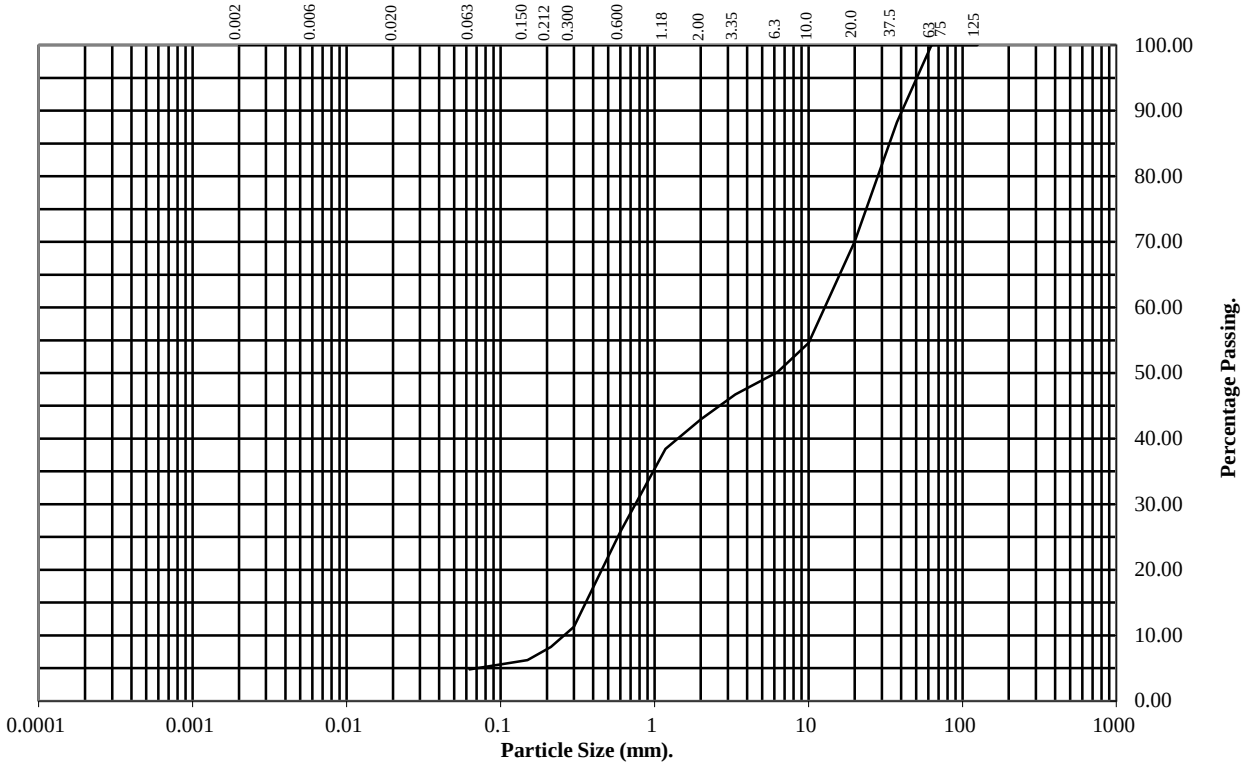
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 31/08/16	**Contract No:** PSL16/3716
		Cooper Bridge			**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH102**	**Top Depth (m):**	**9.00**
Sample Number:	**16**	**Base Depth(m):**	**9.50**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	88
20	70
10	55
6.3	50
3.35	47
2	43
1.18	38
0.6	26
0.3	11
0.212	8
0.15	6
0.063	5

Soil Fraction	Total Percentage
Cobbles	0
Gravel	57
Sand	38
Silt/Clay	5

Remarks:

See summary of soil descriptions.

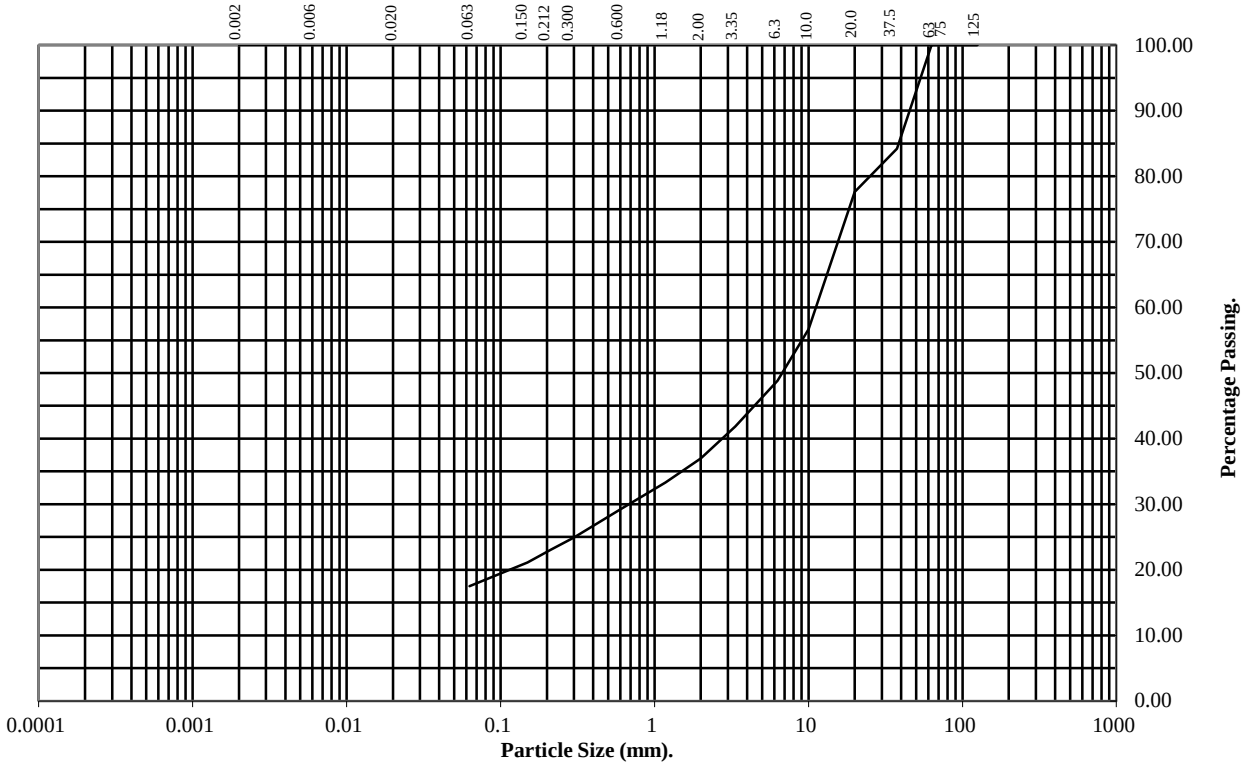
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 31/08/16	**Contract No:** PSL16/3716
		Cooper Bridge			**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH103**	**Top Depth (m):**	**1.80**
Sample Number:	**4**	**Base Depth(m):**	**2.20**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	84
20	78
10	57
6.3	49
3.35	42
2	37
1.18	33
0.6	29
0.3	25
0.212	23
0.15	21
0.063	18

Soil Fraction	Total Percentage
Cobbles	0
Gravel	63
Sand	19
Silt/Clay	18

Remarks:

See summary of soil descriptions.

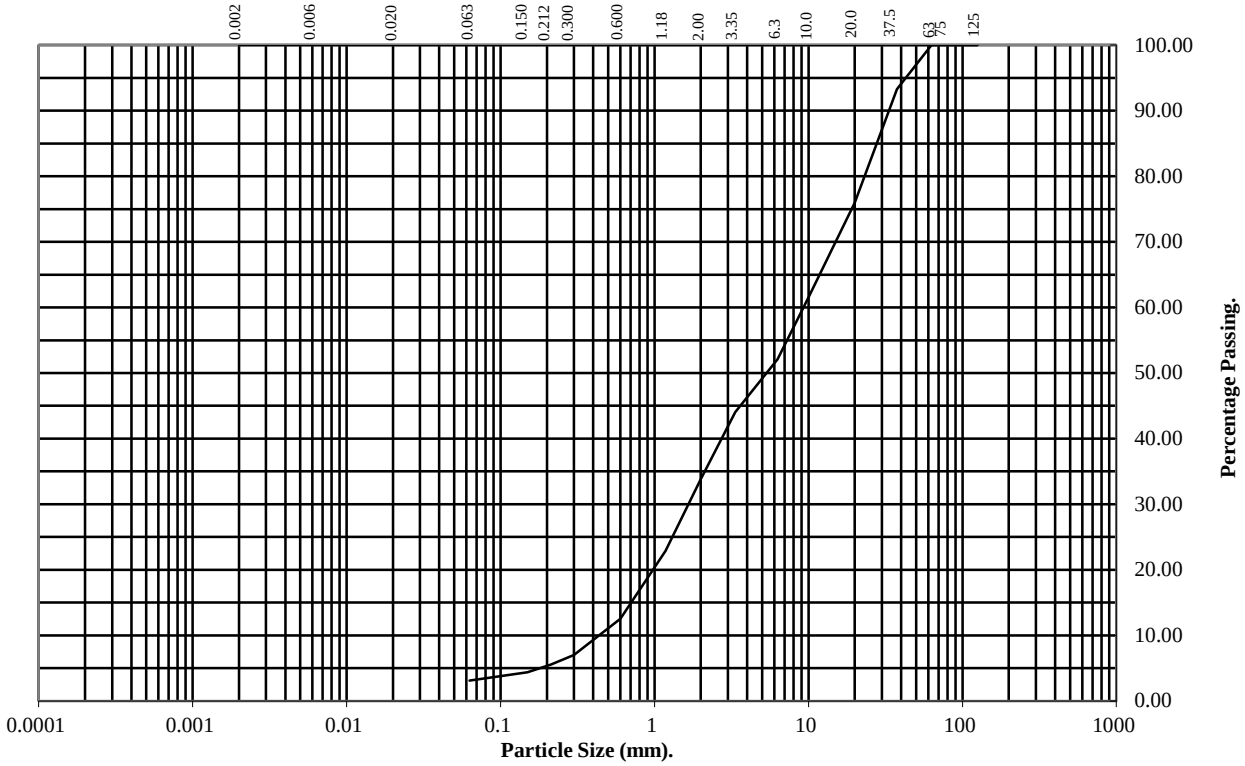
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 01/09/16	**Contract No:** PSL16/3716
		Cooper Bridge			**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH103**	**Top Depth (m):**	**6.60**
Sample Number:	**10**	**Base Depth(m):**	**7.00**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	93
20	76
10	62
6.3	52
3.35	44
2	34
1.18	23
0.6	13
0.3	7
0.212	6
0.15	4
0.063	3

Soil Fraction	Total Percentage
Cobbles	0
Gravel	66
Sand	31
Silt/Clay	3

Remarks:

See summary of soil descriptions.

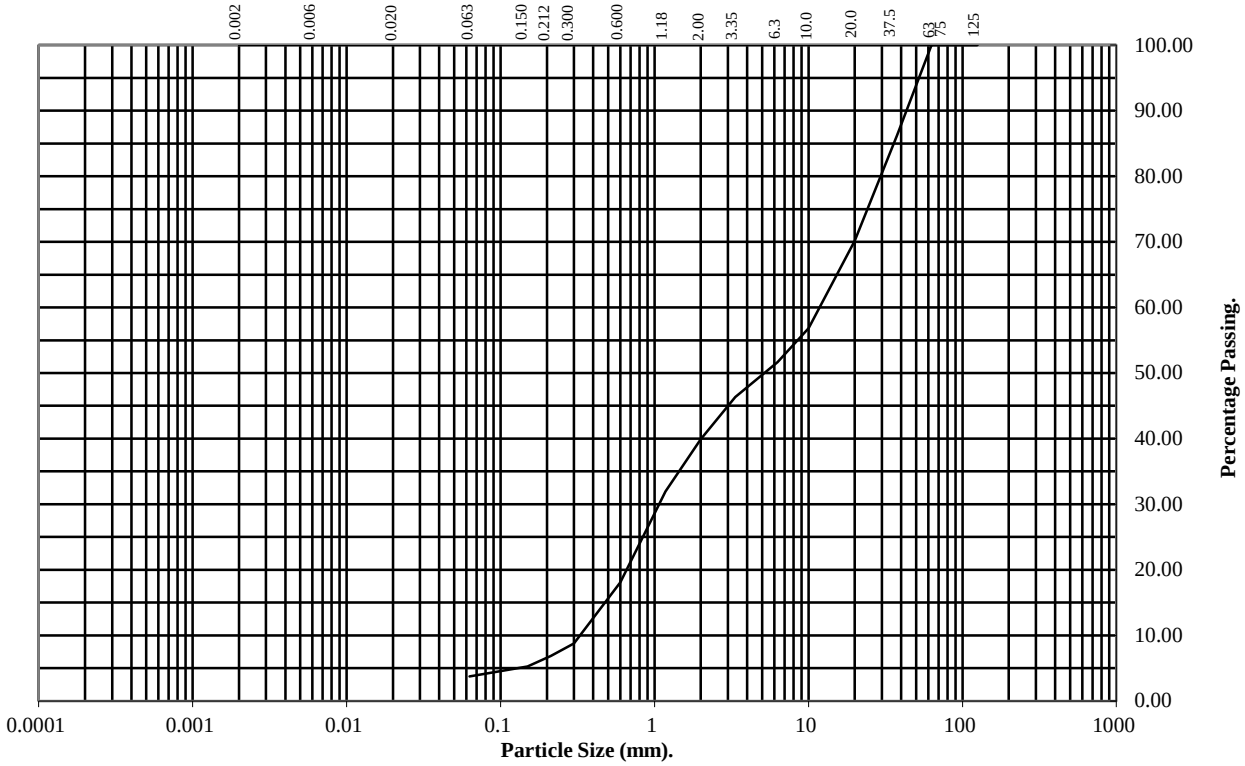
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date** 01/09/16	**Contract No:** PSL16/3716
		Cooper Bridge		**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH103**	**Top Depth (m):**	**9.50**
Sample Number:	**14**	**Base Depth(m):**	**9.80**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	86
20	70
10	57
6.3	52
3.35	46
2	40
1.18	32
0.6	18
0.3	9
0.212	7
0.15	5
0.063	4

Soil Fraction	Total Percentage
Cobbles	0
Gravel	60
Sand	36
Silt/Clay	4

Remarks:

See summary of soil descriptions.

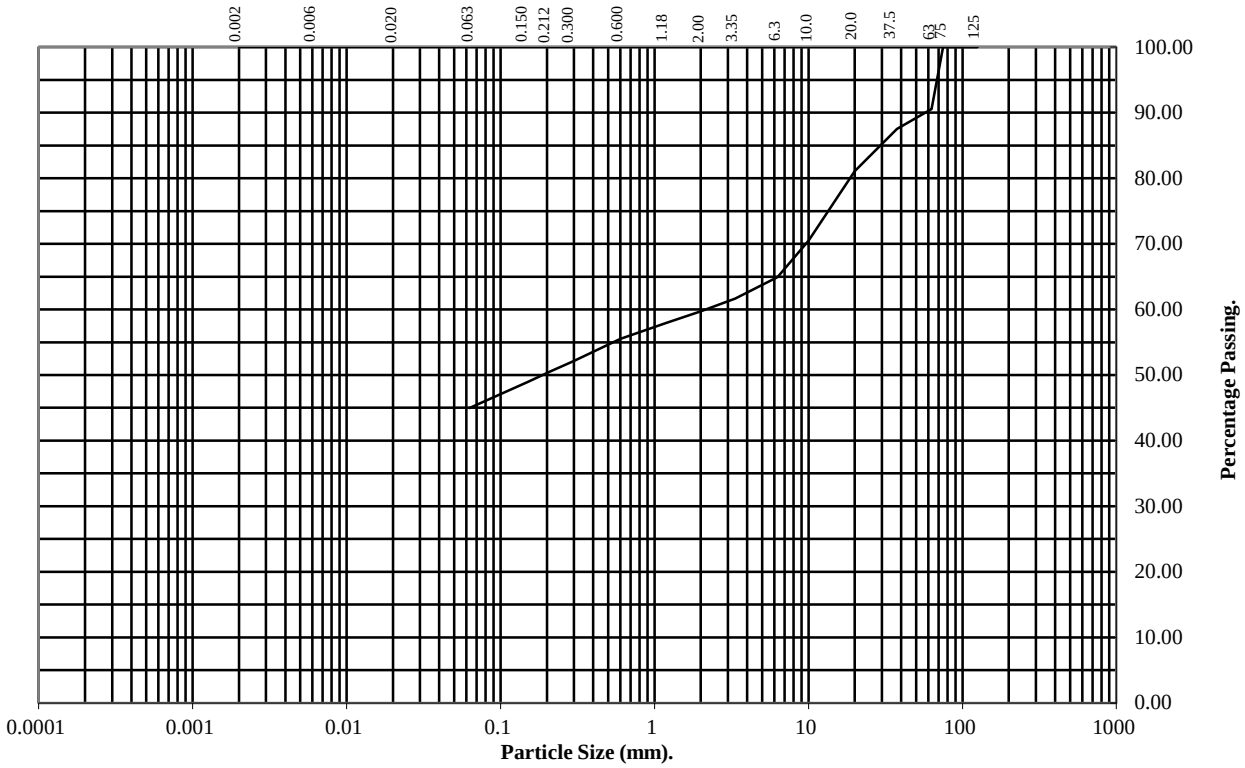
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 01/09/16	**Contract No:** PSL16/3716
		Cooper Bridge			**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH104**	**Top Depth (m):**	**0.10**
Sample Number:	**1**	**Base Depth(m):**	**0.50**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	91
37.5	88
20	81
10	71
6.3	65
3.35	62
2	60
1.18	58
0.6	55
0.3	52
0.212	51
0.15	49
0.063	45

Soil Fraction	Total Percentage
Cobbles	9
Gravel	31
Sand	15
Silt/Clay	45

Remarks:

See summary of soil descriptions.

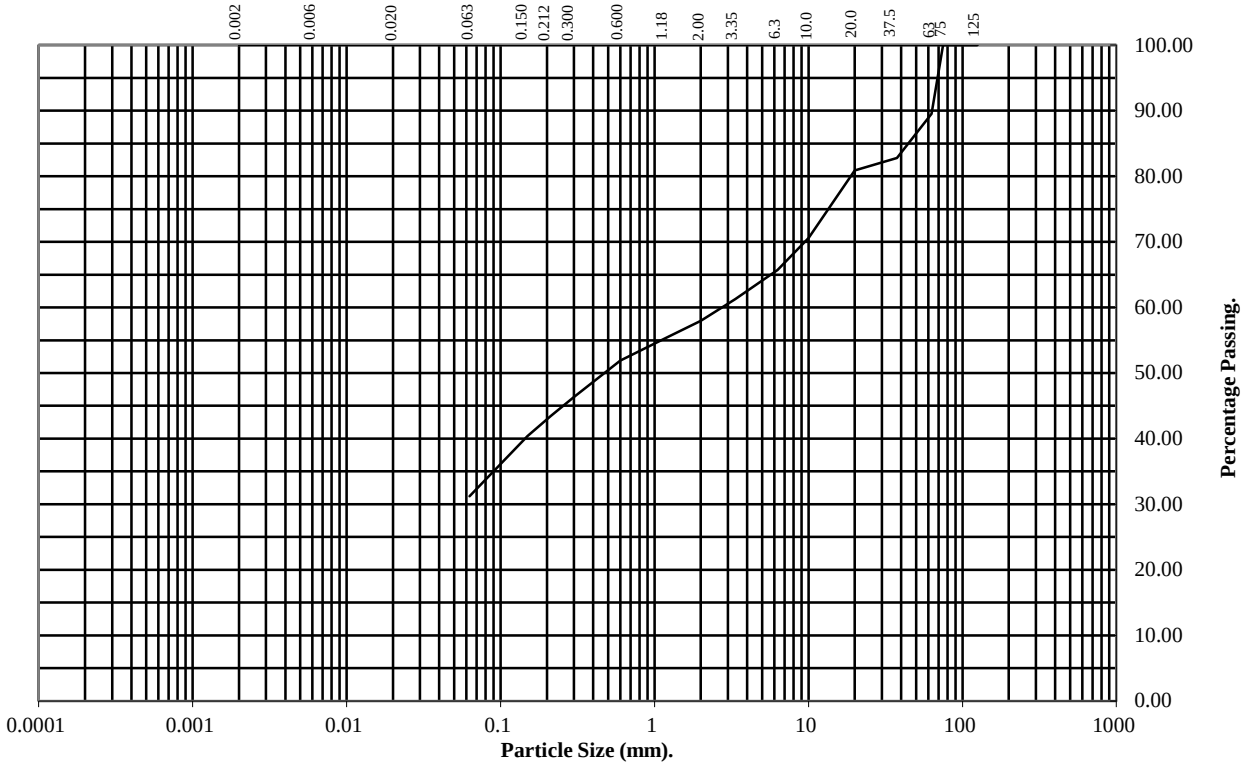
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 01/09/16	**Contract No:** PSL16/3716
		Cooper Bridge			**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH104**	**Top Depth (m):**	**0.80**
Sample Number:	**2**	**Base Depth(m):**	**1.20**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	90
37.5	83
20	81
10	71
6.3	66
3.35	61
2	58
1.18	55
0.6	52
0.3	46
0.212	43
0.15	40
0.063	31

Soil Fraction	Total Percentage
Cobbles	10
Gravel	32
Sand	27
Silt/Clay	31

Remarks:

See summary of soil descriptions.

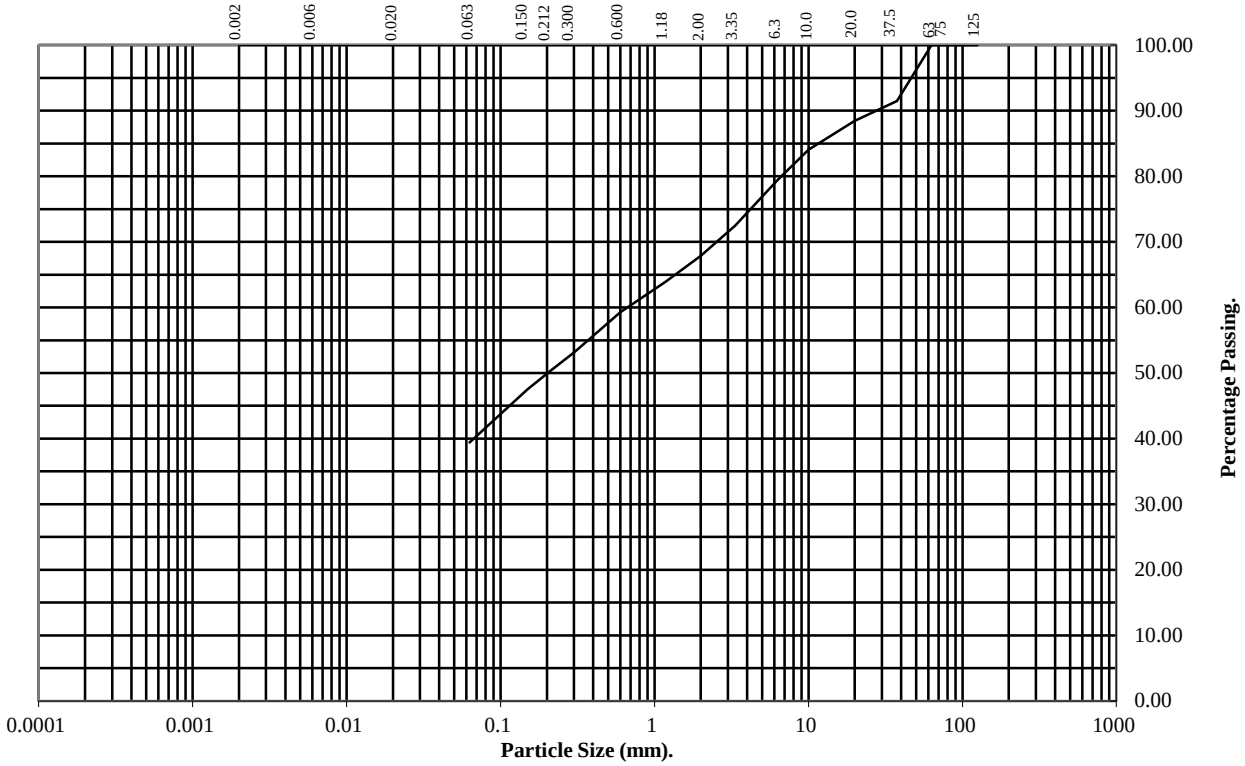
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 01/09/16	**Contract No:** PSL16/3716
		Cooper Bridge			**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH104**	**Top Depth (m):**	**1.20**
Sample Number:	**3**	**Base Depth(m):**	**1.50**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	91
20	88
10	84
6.3	79
3.35	73
2	68
1.18	64
0.6	59
0.3	53
0.212	50
0.15	48
0.063	39

Soil Fraction	Total Percentage
Cobbles	0
Gravel	32
Sand	29
Silt/Clay	39

Remarks:

See summary of soil descriptions.

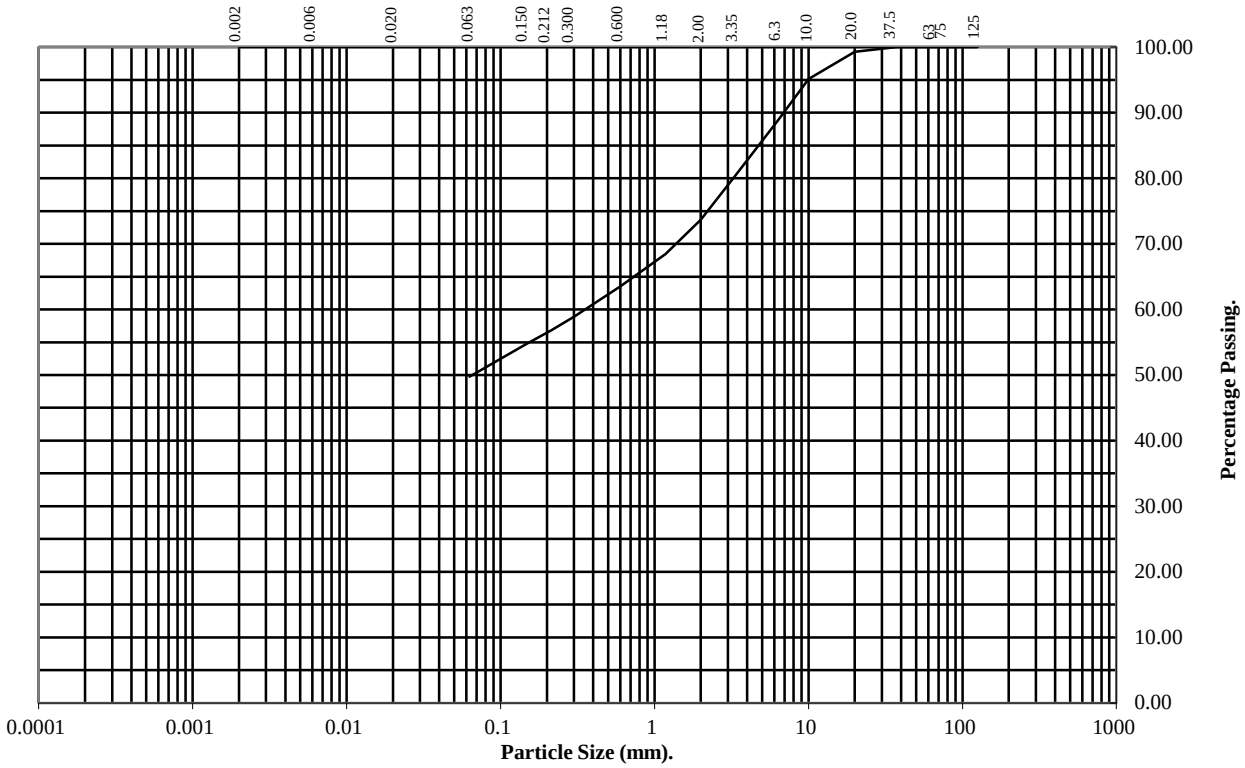
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 01/09/16	**Contract No:** PSL16/3716
		Cooper Bridge			**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH104**	**Top Depth (m):**	**2.50**
Sample Number:	**4**	**Base Depth(m):**	**3.00**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	99
10	95
6.3	89
3.35	80
2	74
1.18	68
0.6	64
0.3	59
0.212	57
0.15	55
0.063	50

Soil Fraction	Total Percentage
Cobbles	0
Gravel	26
Sand	24
Silt/Clay	50

Remarks:

See summary of soil descriptions.

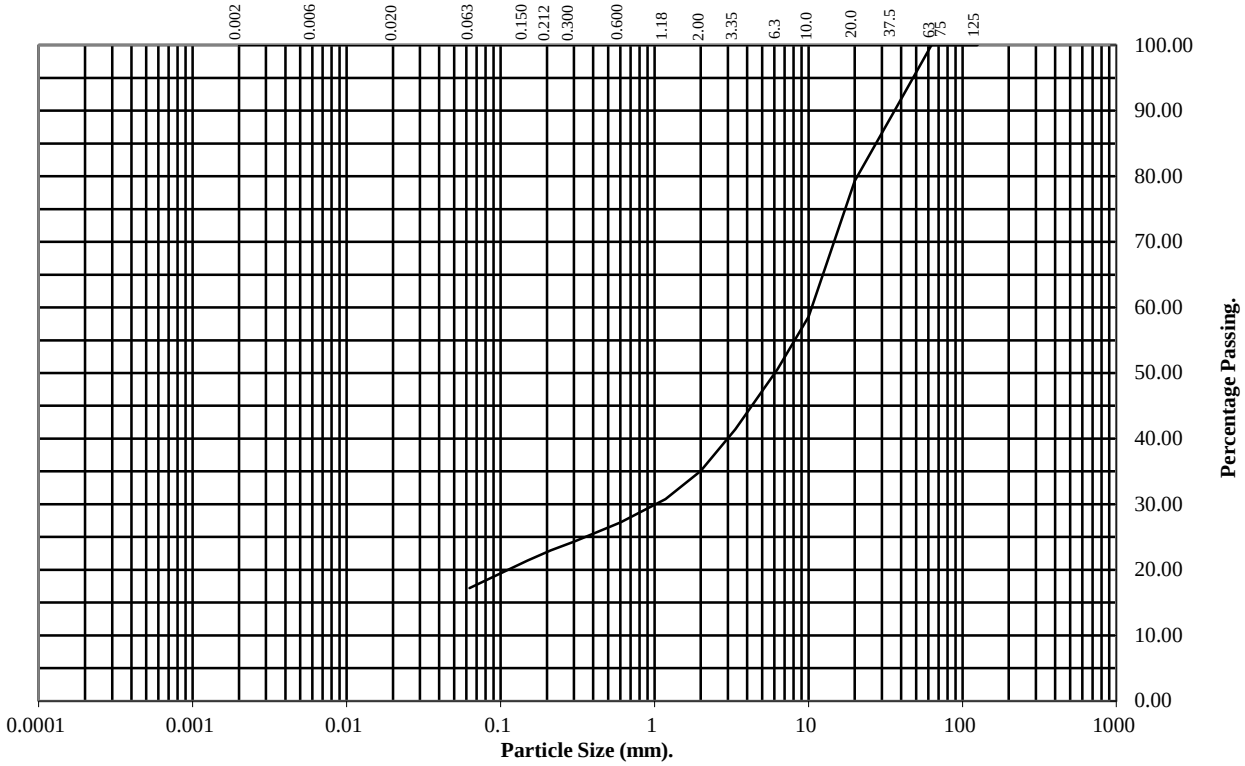
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 01/09/16	**Contract No:** PSL16/3716
		Cooper Bridge			**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH104**	**Top Depth (m):**	**4.00**
Sample Number:	**5**	**Base Depth(m):**	**4.50**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	91
20	79
10	59
6.3	51
3.35	41
2	35
1.18	31
0.6	27
0.3	24
0.212	23
0.15	21
0.063	17

Soil Fraction	Total Percentage
Cobbles	0
Gravel	65
Sand	18
Silt/Clay	17

Remarks:

See summary of soil descriptions.

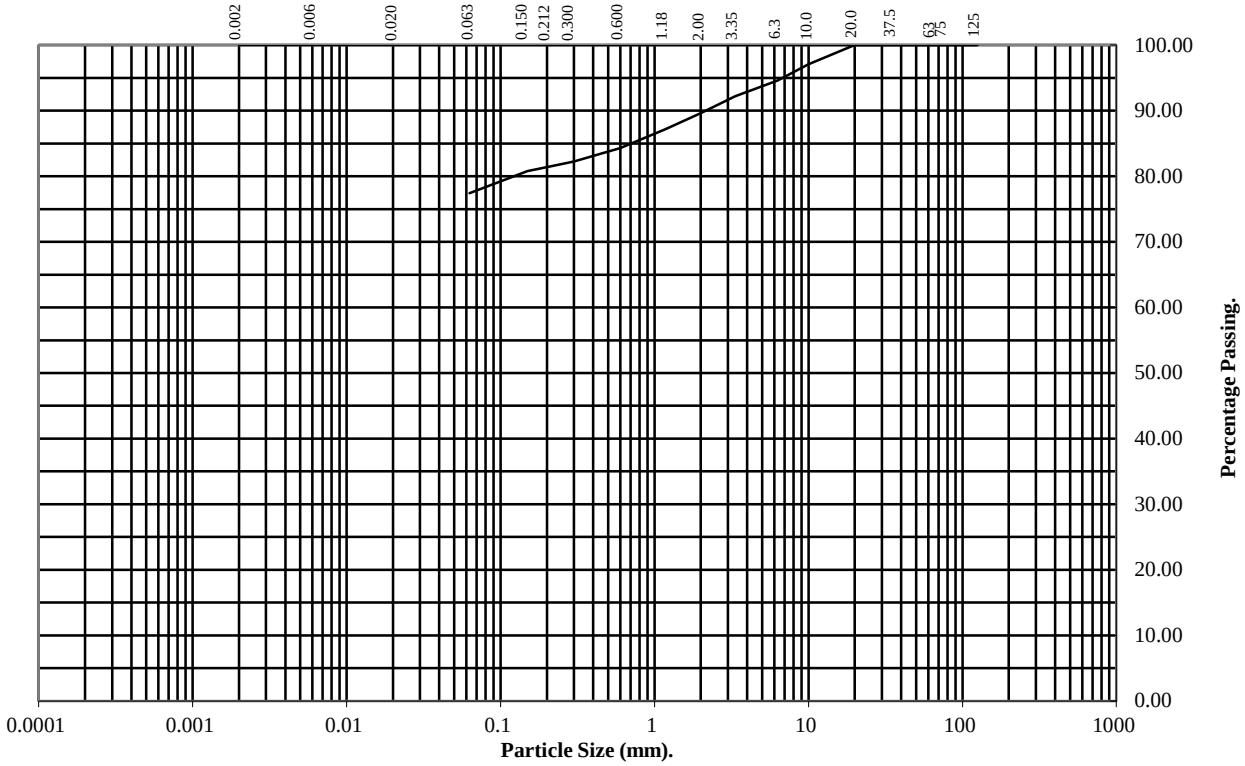
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 01/09/16	**Contract No:** PSL16/3716
		Cooper Bridge			**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH104**	**Top Depth (m):**	**5.20**
Sample Number:	**6**	**Base Depth(m):**	**5.70**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	97
6.3	95
3.35	92
2	90
1.18	87
0.6	84
0.3	82
0.212	82
0.15	81
0.063	77

Soil Fraction	Total Percentage
Cobbles	0
Gravel	10
Sand	13
Silt/Clay	77

Remarks:

See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 01/09/16	**Contract No:** PSL16/3716
		Cooper Bridge			**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

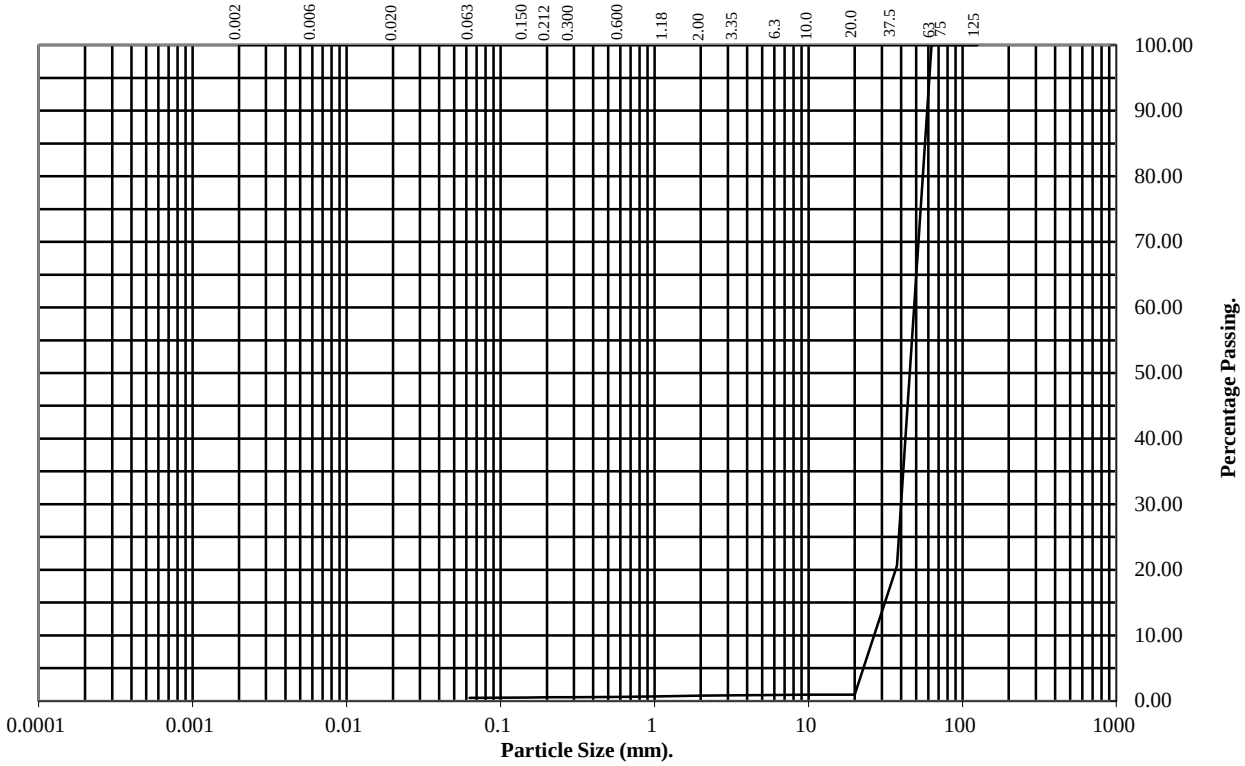
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP101** **Top Depth (m):** **0.50**

Sample Number: **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	21
20	1
10	1
6.3	1
3.35	1
2	1
1.18	1
0.6	1
0.3	1
0.212	1
0.15	1
0.063	0

Soil Fraction	Total Percentage
Cobbles	0
Gravel	99
Sand	1
Silt/Clay	0

Remarks:

See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date** 01/09/16	**Contract No:** PSL16/3716
		Cooper Bridge		**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

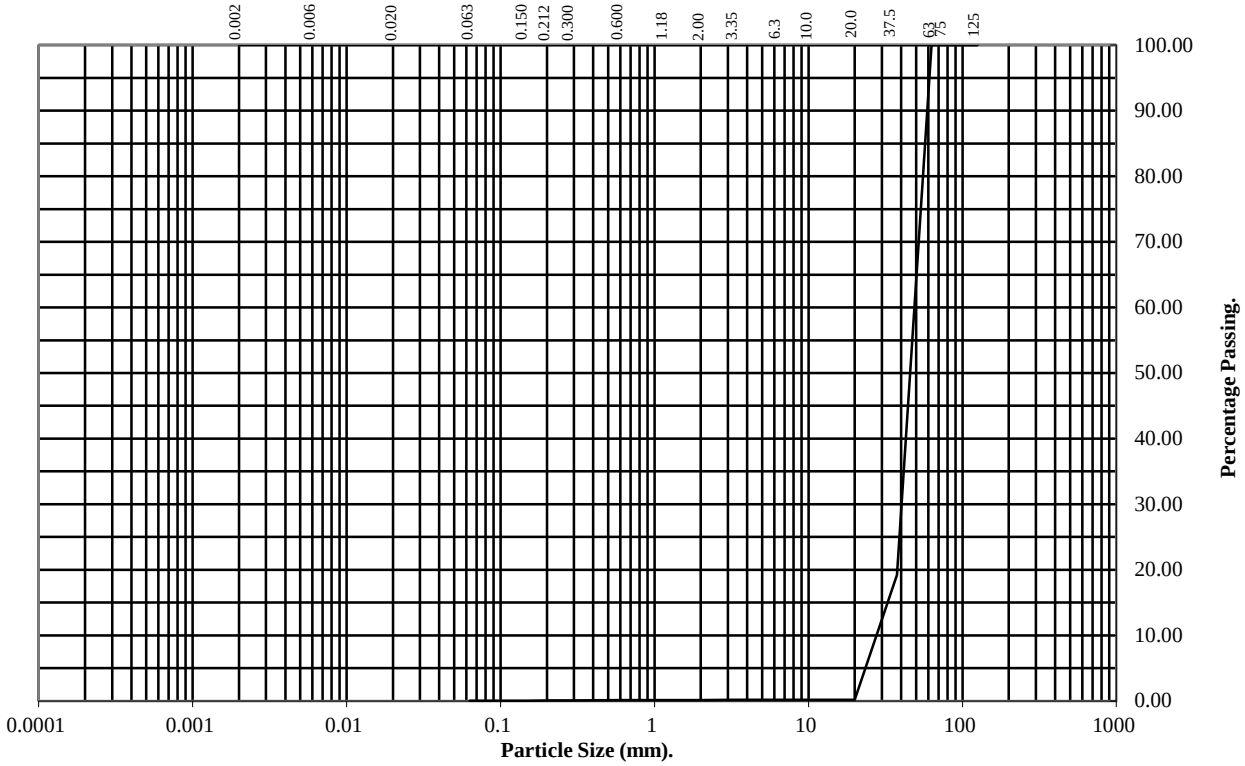
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP102** **Top Depth (m):** **4.00**

Sample Number: **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	19
20	0
10	0
6.3	0
3.35	0
2	0
1.18	0
0.6	0
0.3	0
0.212	0
0.15	0
0.063	0

Soil Fraction	Total Percentage
Cobbles	0
Gravel	100
Sand	0
Silt/Clay	0

Remarks:

See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date** 01/09/16	**Contract No:** PSL16/3716
		Cooper Bridge		**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

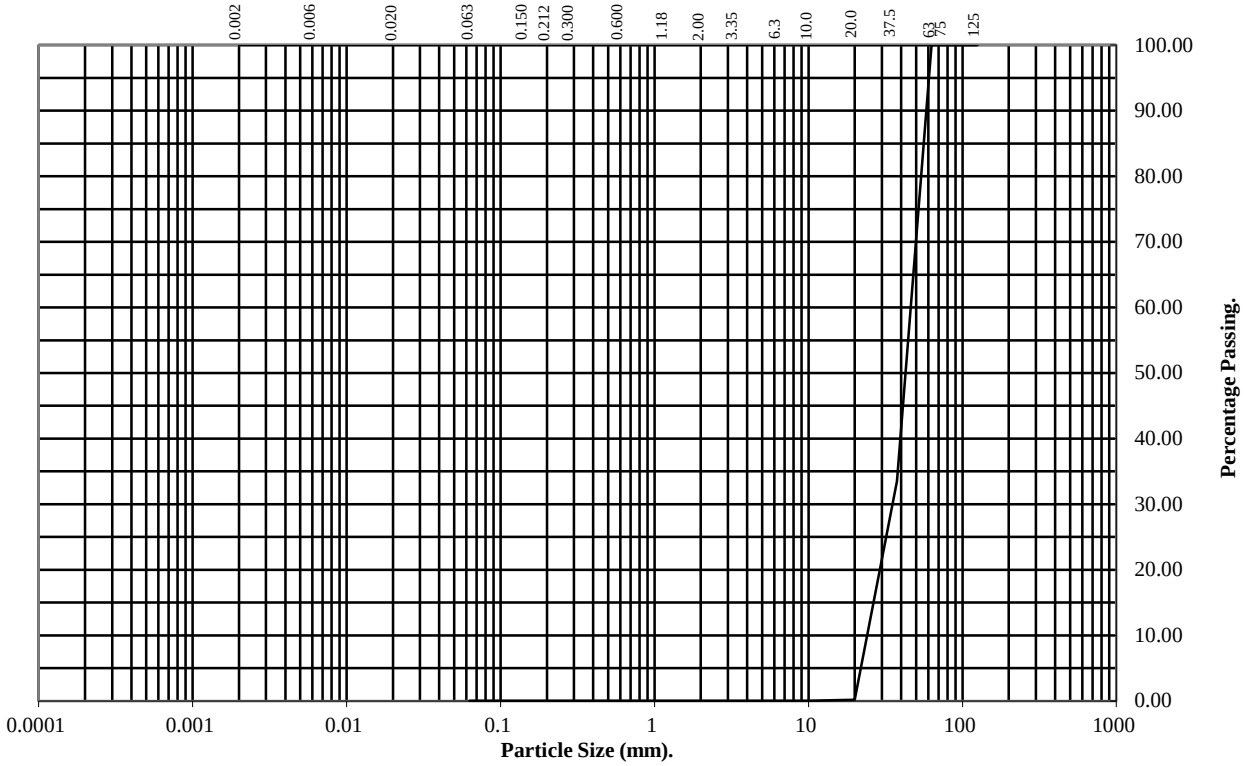
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP103** **Top Depth (m):** **1.00**

Sample Number: **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	34
20	0
10	0
6.3	0
3.35	0
2	0
1.18	0
0.6	0
0.3	0
0.212	0
0.15	0
0.063	0

Soil Fraction	Total Percentage
Cobbles	0
Gravel	100
Sand	0
Silt/Clay	0

Remarks:

See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date**	**01/09/16**	**Contract No:**
		Cooper Bridge				**PSL16/3716**
						Client Ref:

PARTICLE SIZE DISTRIBUTION TEST

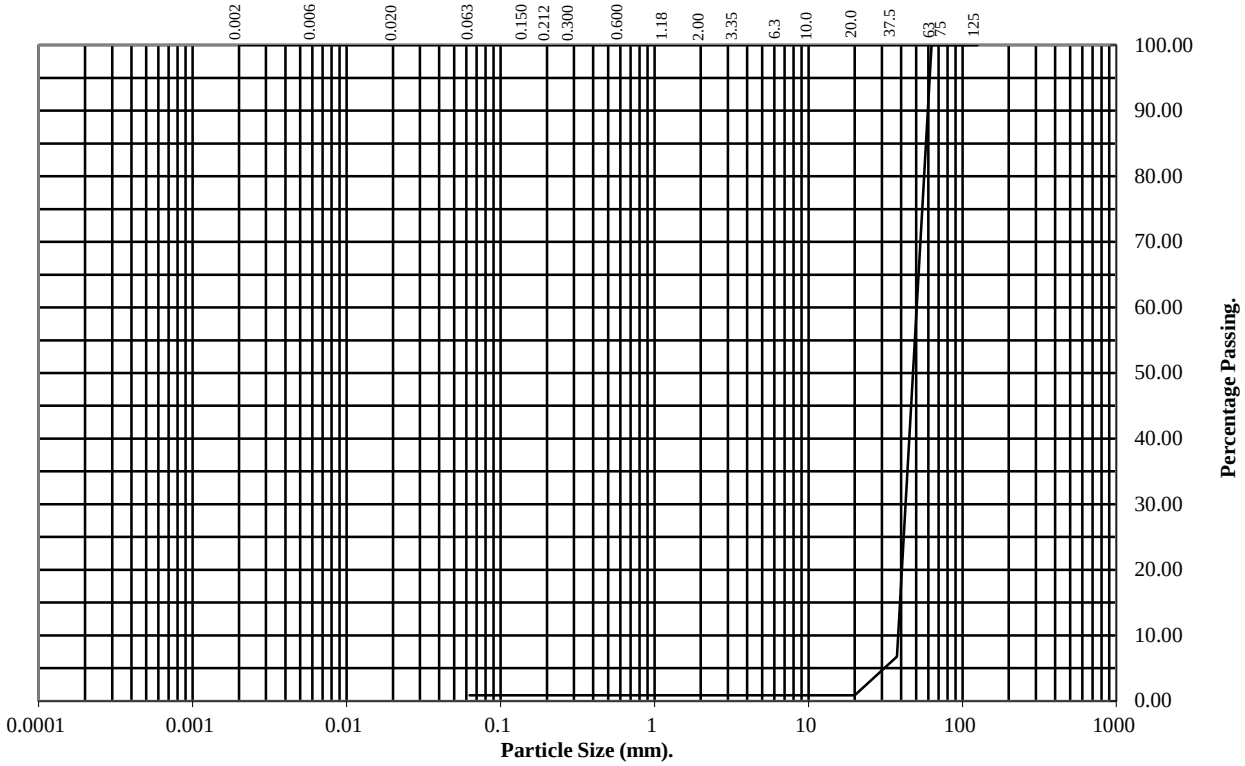
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP104** **Top Depth (m):** **1.00**

Sample Number: **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	7
20	1
10	1
6.3	1
3.35	1
2	1
1.18	1
0.6	1
0.3	1
0.212	1
0.15	1
0.063	1

Soil Fraction	Total Percentage
Cobbles	0
Gravel	99
Sand	0
Silt/Clay	1

Remarks:

See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date** 01/09/16	**Contract No:** PSL16/3716
		Cooper Bridge		**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

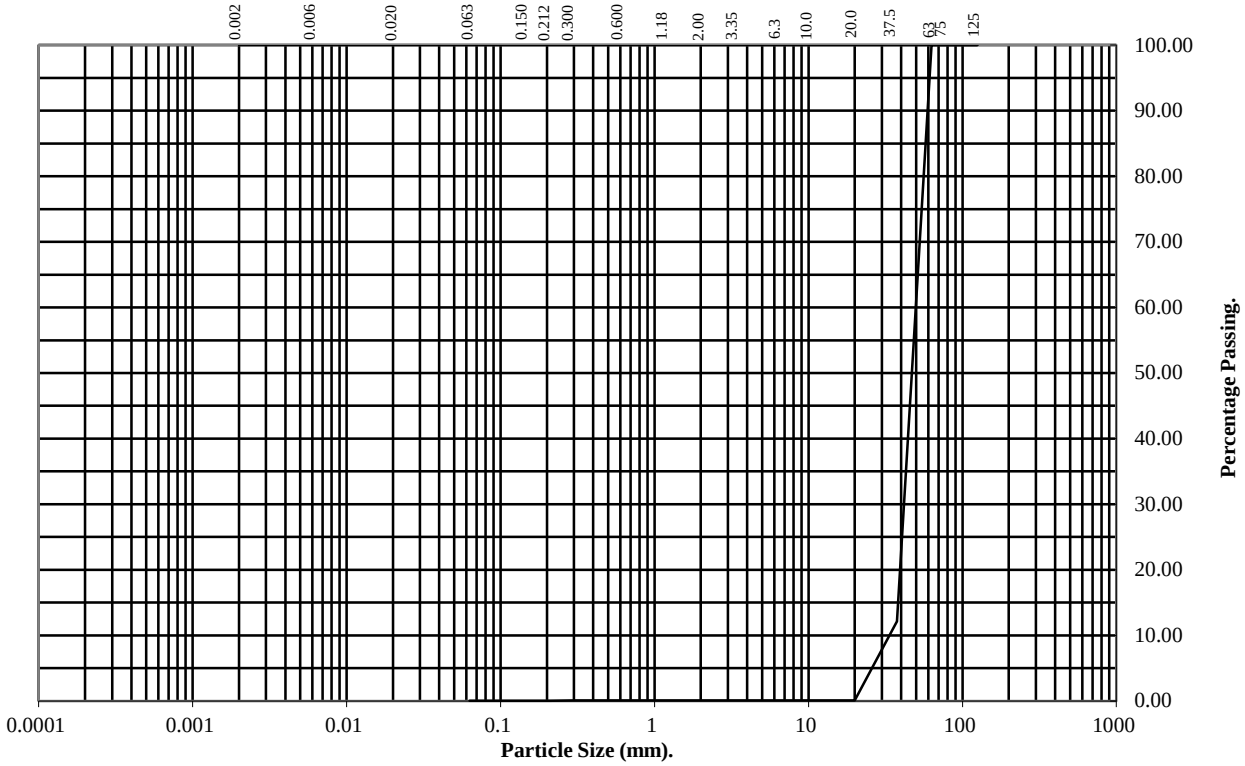
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP106** **Top Depth (m):** **1.50**

Sample Number: **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	12
20	0
10	0
6.3	0
3.35	0
2	0
1.18	0
0.6	0
0.3	0
0.212	0
0.15	0
0.063	0

Soil Fraction	Total Percentage
Cobbles	0
Gravel	100
Sand	0
Silt/Clay	0

Remarks:

See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date**	**01/09/16**	**Contract No:**
		Cooper Bridge				**PSL16/3716**
						Client Ref:

PARTICLE SIZE DISTRIBUTION TEST

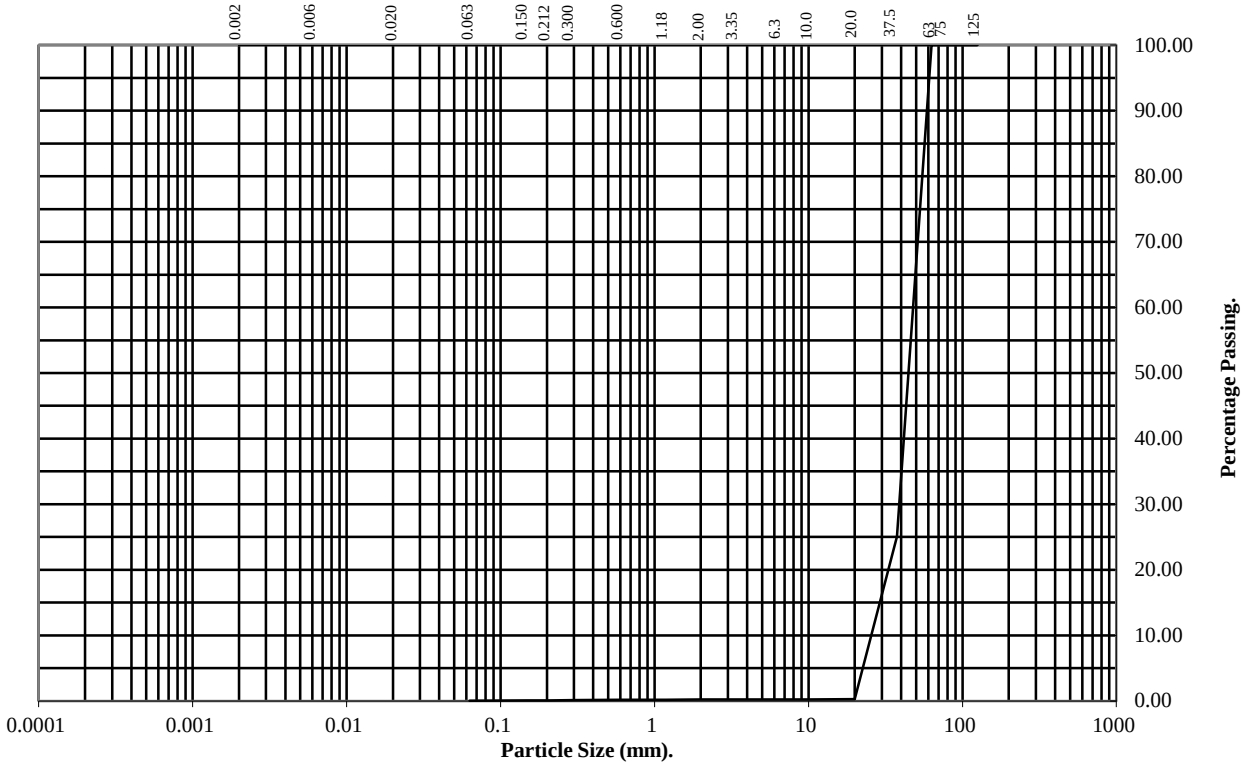
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP109** **Top Depth (m):** **2.50**

Sample Number: **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	25
20	0
10	0
6.3	0
3.35	0
2	0
1.18	0
0.6	0
0.3	0
0.212	0
0.15	0
0.063	0

Soil Fraction	Total Percentage
Cobbles	0
Gravel	100
Sand	0
Silt/Clay	0

Remarks:

See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date**	**01/09/16**	**Contract No:**
		Cooper Bridge			**PSL16/3716**
					Client Ref:

PARTICLE SIZE DISTRIBUTION TEST

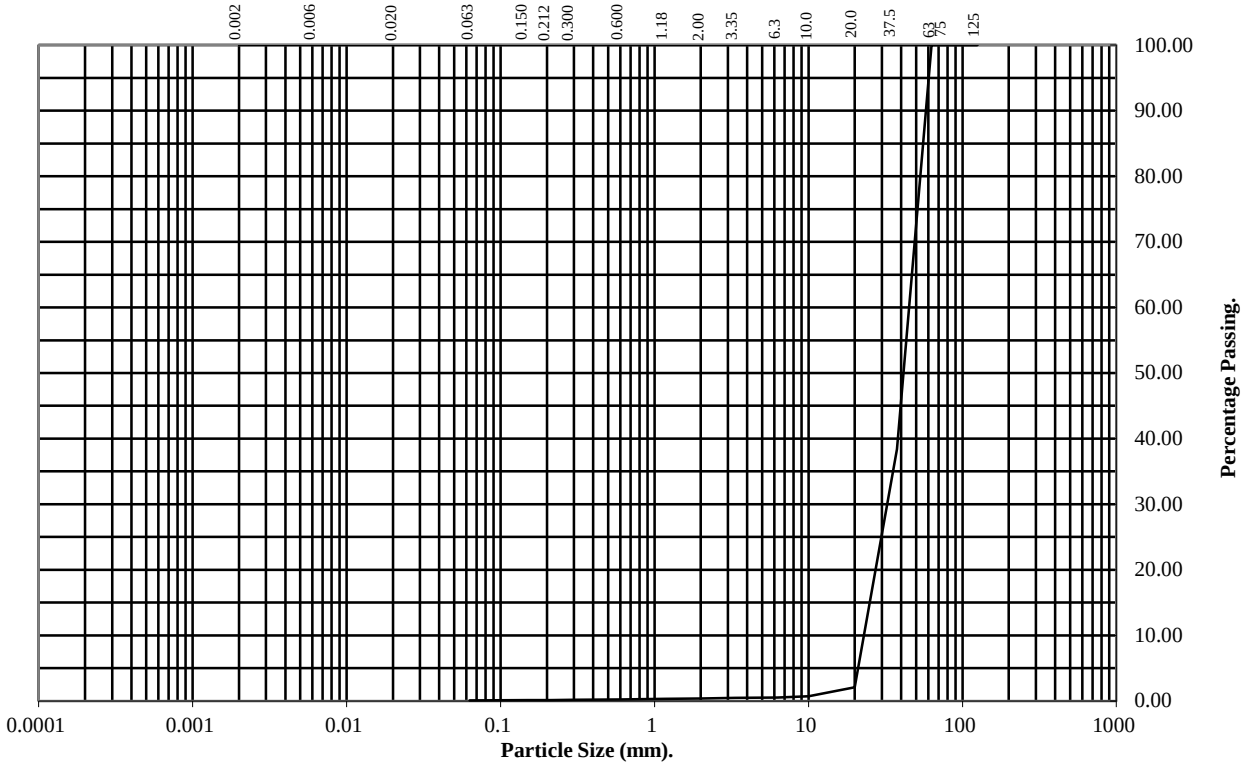
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP111** **Top Depth (m):** **3.00**

Sample Number: **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	38
20	2
10	1
6.3	1
3.35	0
2	0
1.18	0
0.6	0
0.3	0
0.212	0
0.15	0
0.063	0

Soil Fraction	Total Percentage
Cobbles	0
Gravel	100
Sand	0
Silt/Clay	0

Remarks:

See summary of soil descriptions.

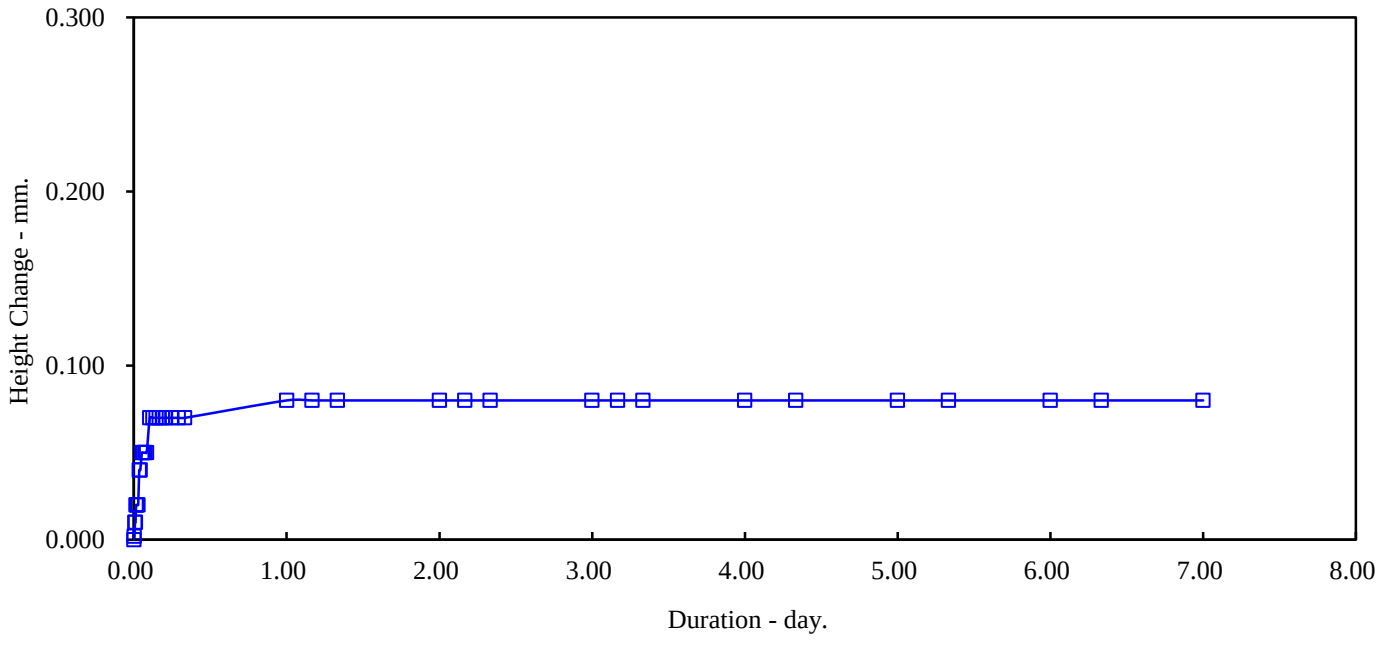
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date** 01/09/16	**Contract No:** PSL16/3716
		Cooper Bridge		**Client Ref:**

EMERY EXPANSION TEST.

Road and Transport Association of Canada 1974.

Hole Number / Depth (m):	TP101 / 0.50	Description.:	Dark grey gravel of slag.
INITIAL CONDITIONS.		**FINAL CONDITIONS.**	
Initial Height - mm:	126.80	Final Height - mm:	126.88
Initial Diameter - mm:	152.00	Final Mass - g:	5097.00
Initial Mass - g:	5029.00	Final Volume - cm3:	2302.34
Initial Volume - cm3:	2301.00	Dry Mass - g:	4587.00
Dry Mass - g:	4587.00	Final Moisture Content - %:	11.1
Initial Moisture Content - %:	9.6	Final Bulk Density - Mg/m3:	2.21
Initial Bulk Density - Mg/m3:	2.19	Final Dry Density - Mg/m3:	1.99
Initial Dry Density - Mg/m3:	1.99	Test Temperature oC:	82

Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm	Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm	Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm
0	0	0.00	210	7	0.07	5760	8	0.08
5	1	0.00	240	7	0.07	6240	8	0.08
10	1	0.01	270	7	0.07	7200	8	0.08
15	1	0.01	300	7	0.07	7680	8	0.08
20	2	0.02	360	7	0.07	8640	8	0.08
25	2	0.02	420	7	0.07	9120	8	0.08
30	2	0.02	480	7	0.07	10080	8	0.08
40	2	0.02	1440	8	0.08			
50	4	0.04	1680	8	0.08			
60	4	0.04	1920	8	0.08			
75	5	0.05	2880	8	0.08			
90	5	0.05	3120	8	0.08			
105	5	0.05	3360	8	0.08			
120	5	0.05	4320	8	0.08			
150	7	0.07	4560	8	0.08			
180	7	0.07	4800	8	0.08			



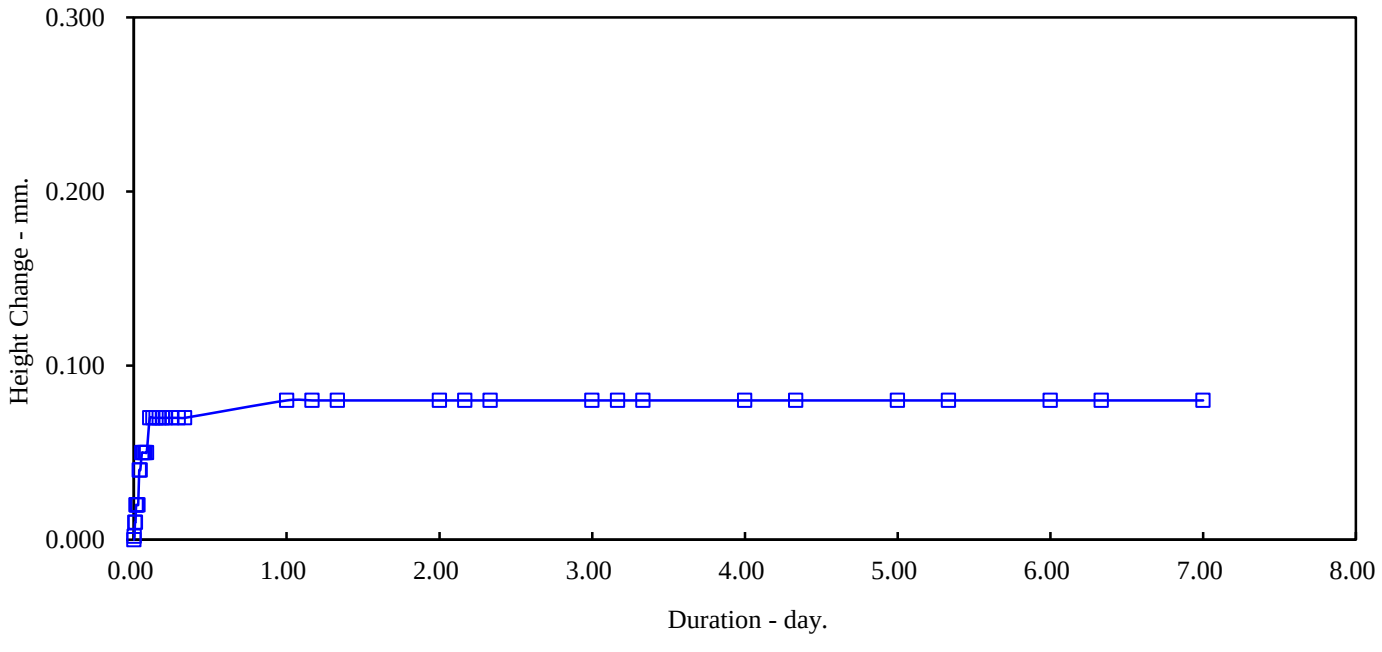
	Compiled	Date	Checked	Date	Approved	Date
PSL Professional Soils Laboratory		01/09/2016		01/09/2016		01/09/2016
	Cooper Bridge				Contract No: PSL15/3716	
					Figure.	

EMERY EXPANSION TEST.

Road and Transport Association of Canada 1974.

Hole Number / Depth (m):	TP102 / 4.00	Description.:	Dark grey gravel of slag.
INITIAL CONDITIONS.		**FINAL CONDITIONS.**	
Initial Height - mm:	127.17	Final Height - mm:	127.25
Initial Diameter - mm:	151.87	Final Mass - g:	4679.00
Initial Mass - g:	4610.00	Final Volume - cm3:	2305.11
Initial Volume - cm3:	2304.00	Dry Mass - g:	4532.00
Dry Mass - g:	4532.00	Final Moisture Content - %:	3.2
Initial Moisture Content - %:	1.7	Final Bulk Density - Mg/m3:	2.03
Initial Bulk Density - Mg/m3:	2.00	Final Dry Density - Mg/m3:	1.97
Initial Dry Density - Mg/m3:	1.97	Test Temperature oC:	82

Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm	Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm	Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm
0	0	0.00	210	7	0.07	5760	8	0.08
5	1	0.00	240	7	0.07	6240	8	0.08
10	1	0.01	270	7	0.07	7200	8	0.08
15	1	0.01	300	7	0.07	7680	8	0.08
20	2	0.02	360	7	0.07	8640	8	0.08
25	2	0.02	420	7	0.07	9120	8	0.08
30	2	0.02	480	7	0.07	10080	8	0.08
40	2	0.02	1440	8	0.08			
50	4	0.04	1680	8	0.08			
60	4	0.04	1920	8	0.08			
75	5	0.05	2880	8	0.08			
90	5	0.05	3120	8	0.08			
105	5	0.05	3360	8	0.08			
120	5	0.05	4320	8	0.08			
150	7	0.07	4560	8	0.08			
180	7	0.07	4800	8	0.08			



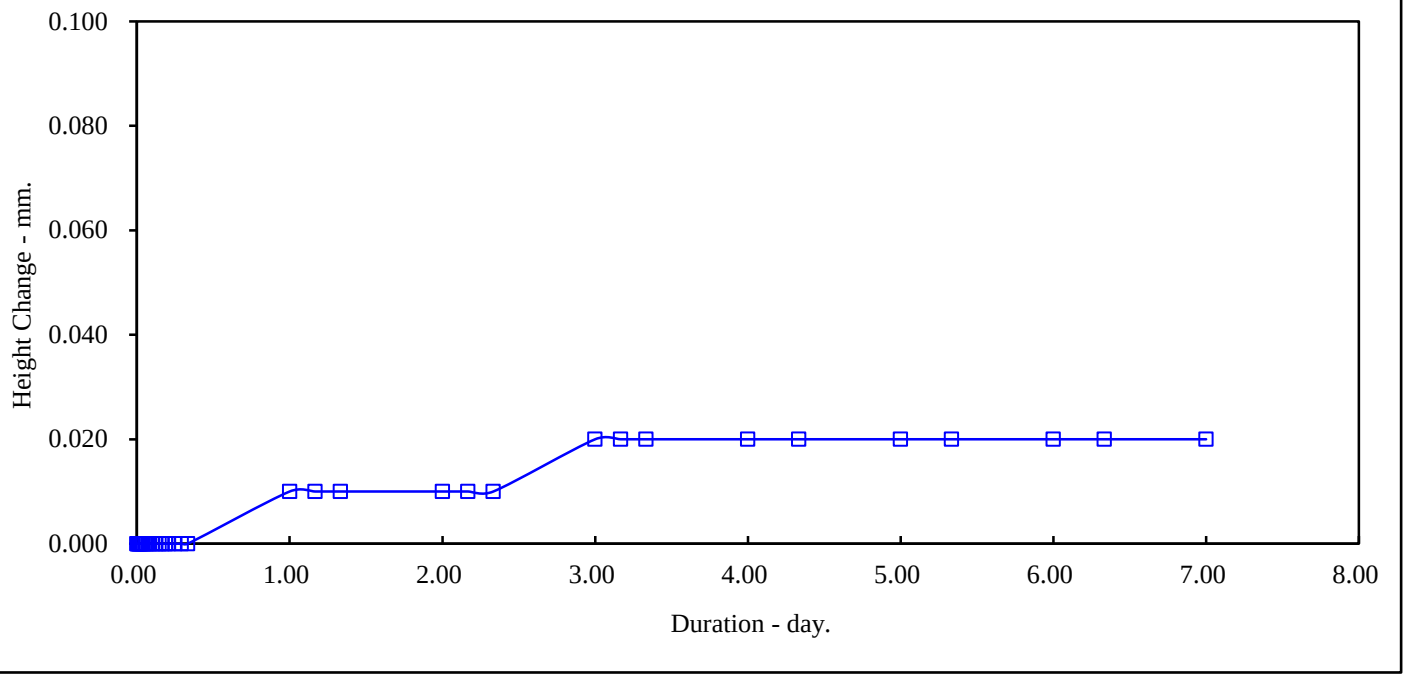
	Compiled	Date	Checked	Date	Approved	Date
PSL Professional Soils Laboratory		01/09/2016		01/09/2016		01/09/2016
	Cooper Bridge				Contract No: PSL15/3716	
					Figure.	

EMERY EXPANSION TEST.

Road and Transport Association of Canada 1974.

Hole Number / Depth (m):	TP103 / 1.00	Description.:	Dark grey gravel of slag.
INITIAL CONDITIONS.		**FINAL CONDITIONS.**	
Initial Height - mm:	127.27	Final Height - mm:	127.29
Initial Diameter - mm:	152.14	Final Mass - g:	4651.00
Initial Mass - g:	4546.00	Final Volume - cm3:	2314.04
Initial Volume - cm3:	2314.00	Dry Mass - g:	4476.00
Dry Mass - g:	4476.00	Final Moisture Content - %:	3.9
Initial Moisture Content - %:	1.6	Final Bulk Density - Mg/m3:	2.01
Initial Bulk Density - Mg/m3:	1.96	Final Dry Density - Mg/m3:	1.93
Initial Dry Density - Mg/m3:	1.93	Test Temperature oC:	82

Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm	Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm	Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm
0	0	0.00	210	0	0.00	5760	2	0.02
5	0	0.00	240	0	0.00	6240	2	0.02
10	0	0.00	270	0	0.00	7200	2	0.02
15	0	0.00	300	0	0.00	7680	2	0.02
20	0	0.00	360	0	0.00	8640	2	0.02
25	0	0.00	420	0	0.00	9120	2	0.02
30	0	0.00	480	0	0.00	10080	2	0.02
40	0	0.00	1440	1	0.01			
50	0	0.00	1680	1	0.01			
60	0	0.00	1920	1	0.01			
75	0	0.00	2880	1	0.01			
90	0	0.00	3120	1	0.01			
105	0	0.00	3360	1	0.01			
120	0	0.00	4320	2	0.02			
150	0	0.00	4560	2	0.02			
180	0	0.00	4800	2	0.02			



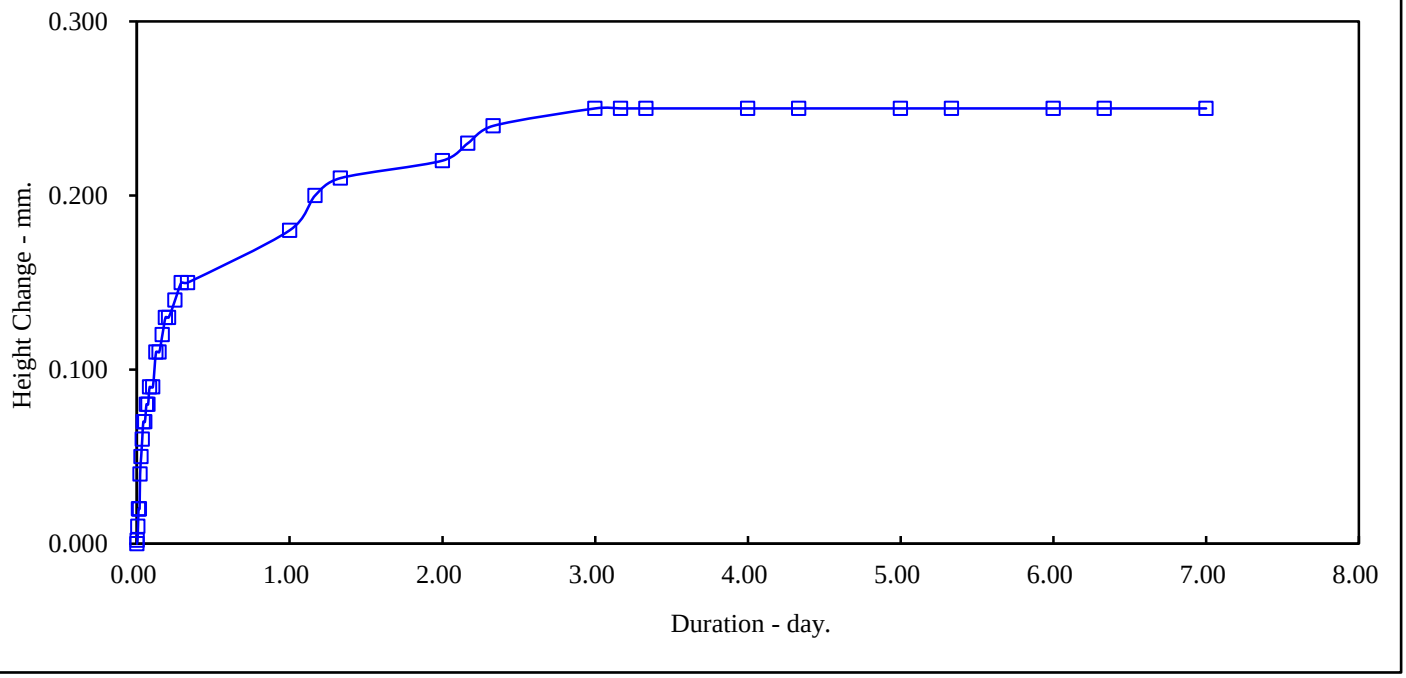
	Compiled	Date	Checked	Date	Approved	Date
PSL Professional Soils Laboratory		01/09/2016		01/09/2016		01/09/2016
	Cooper Bridge				Contract No: PSL15/3716	
					Figure.	

EMERY EXPANSION TEST.

Road and Transport Association of Canada 1974.

Hole Number / Depth (m):	TP104 / 1.00	Description.:	Dark grey gravel of slag.
INITIAL CONDITIONS.		**FINAL CONDITIONS.**	
Initial Height - mm:	126.90	Final Height - mm:	127.15
Initial Diameter - mm:	151.00	Final Mass - g:	4710.00
Initial Mass - g:	4601.00	Final Volume - cm3:	2276.98
Initial Volume - cm3:	2273.00	Dry Mass - g:	4371.00
Dry Mass - g:	4371.00	Final Moisture Content - %:	7.7
Initial Moisture Content - %:	5.3	Final Bulk Density - Mg/m3:	2.07
Initial Bulk Density - Mg/m3:	2.02	Final Dry Density - Mg/m3:	1.92
Initial Dry Density - Mg/m3:	1.92	Test Temperature oC:	82

Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm	Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm	Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm
0	0	0.00	210	11	0.11	5760	25	0.25
5	1	0.00	240	12	0.12	6240	25	0.25
10	1	0.01	270	13	0.13	7200	25	0.25
15	2	0.02	300	13	0.13	7680	25	0.25
20	2	0.02	360	14	0.14	8640	25	0.25
25	2	0.02	420	15	0.15	9120	25	0.25
30	4	0.04	480	15	0.15	10080	25	0.25
40	5	0.05	1440	18	0.18			
50	6	0.06	1680	20	0.20			
60	7	0.07	1920	21	0.21			
75	7	0.07	2880	22	0.22			
90	8	0.08	3120	23	0.23			
105	8	0.08	3360	24	0.24			
120	9	0.09	4320	25	0.25			
150	9	0.09	4560	25	0.25			
180	11	0.11	4800	25	0.25			



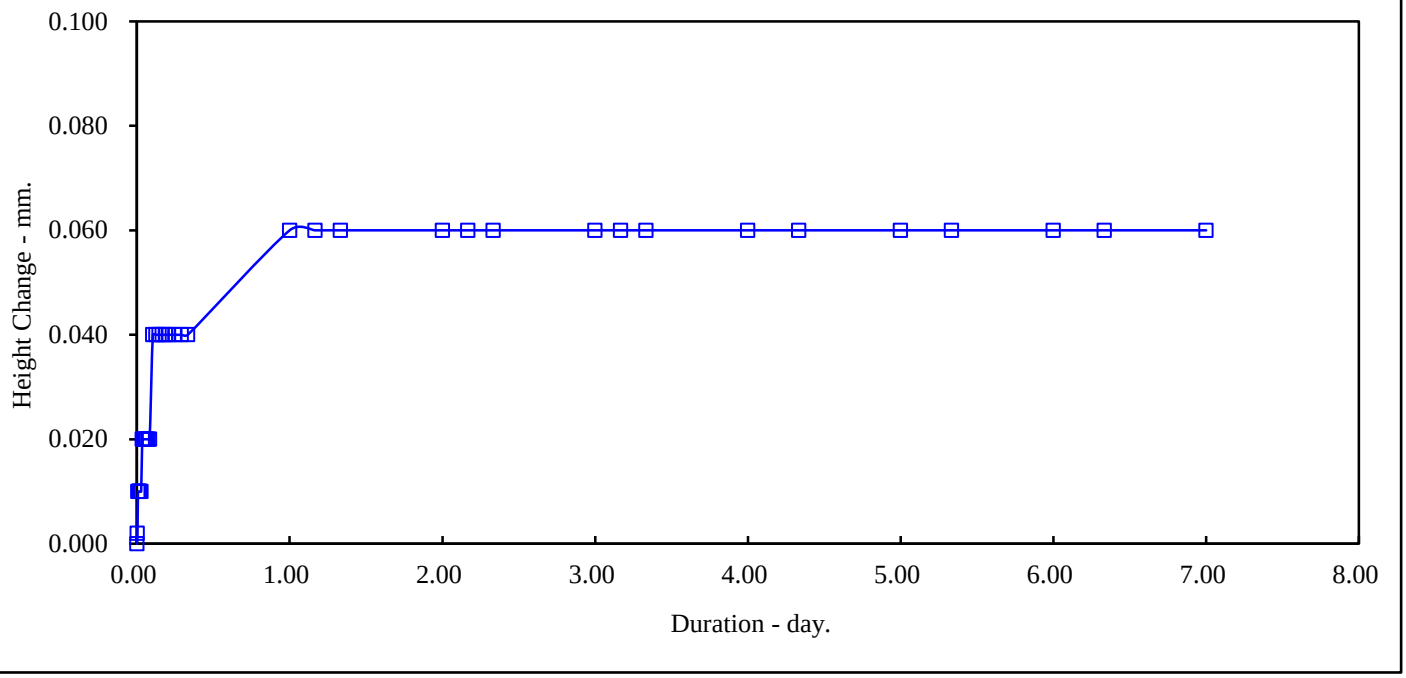
	Compiled	Date	Checked	Date	Approved	Date
PSL Professional Soils Laboratory		01/09/2016		01/09/2016		01/09/2016
	Cooper Bridge				Contract No: PSL15/3716	
					Figure.	

EMERY EXPANSION TEST.

Road and Transport Association of Canada 1974.

Hole Number / Depth (m):	TP106 / 1.50	Description.:	Dark grey gravel of slag.
INITIAL CONDITIONS.		**FINAL CONDITIONS.**	
Initial Height - mm:	127.00	Final Height - mm:	127.06
Initial Diameter - mm:	152.00	Final Mass - g:	4687.00
Initial Mass - g:	4473.00	Final Volume - cm3:	2305.61
Initial Volume - cm3:	2305.00	Dry Mass - g:	4397.00
Dry Mass - g:	4397.00	Final Moisture Content - %:	6.6
Initial Moisture Content - %:	1.7	Final Bulk Density - Mg/m3:	2.03
Initial Bulk Density - Mg/m3:	1.94	Final Dry Density - Mg/m3:	1.91
Initial Dry Density - Mg/m3:	1.91	Test Temperature oC:	82

Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm	Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm	Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm
0	0	0.00	210	4	0.04	5760	6	0.06
5	1	0.00	240	4	0.04	6240	6	0.06
10	1	0.01	270	4	0.04	7200	6	0.06
15	1	0.01	300	4	0.04	7680	6	0.06
20	1	0.01	360	4	0.04	8640	6	0.06
25	1	0.01	420	4	0.04	9120	6	0.06
30	1	0.01	480	4	0.04	10080	6	0.06
40	1	0.01	1440	6	0.06			
50	2	0.02	1680	6	0.06			
60	2	0.02	1920	6	0.06			
75	2	0.02	2880	6	0.06			
90	2	0.02	3120	6	0.06			
105	2	0.02	3360	6	0.06			
120	2	0.02	4320	6	0.06			
150	4	0.04	4560	6	0.06			
180	4	0.04	4800	6	0.06			



PSL
Professional Soils Laboratory

Compiled	Date	Checked	Date	Approved	Date
	01/09/2016		01/09/2016		01/09/2016

Cooper Bridge

Contract No: PSL15/3716

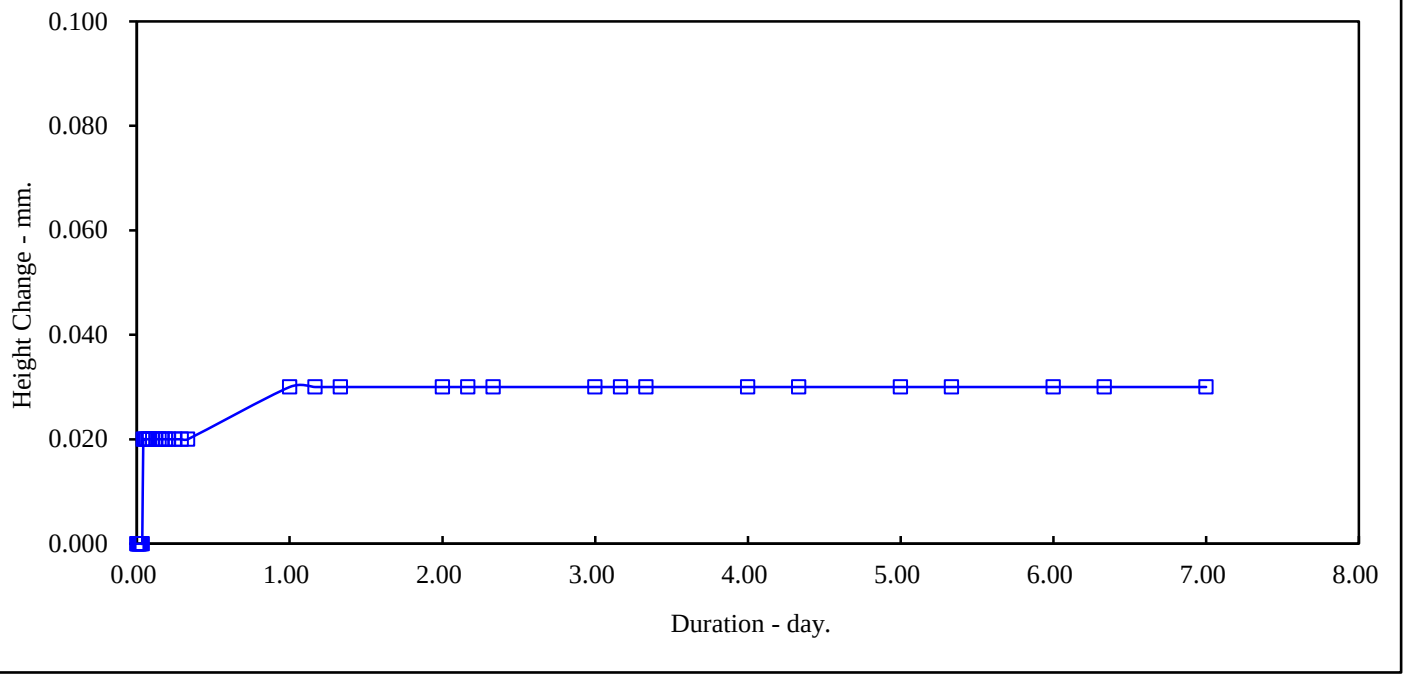
Figure.

EMERY EXPANSION TEST.

Road and Transport Association of Canada 1974.

Hole Number / Depth (m):	TP109 / 2.50	Description.:	Dark grey gravel of slag.
INITIAL CONDITIONS.		**FINAL CONDITIONS.**	
Initial Height - mm:	126.90	Final Height - mm:	126.93
Initial Diameter - mm:	151.90	Final Mass - g:	4687.00
Initial Mass - g:	4490.00	Final Volume - cm3:	2300.22
Initial Volume - cm3:	2280.00	Dry Mass - g:	4377.00
Dry Mass - g:	4377.00	Final Moisture Content - %:	5.3
Initial Moisture Content - %:	2.6	Final Bulk Density - Mg/m3:	2.04
Initial Bulk Density - Mg/m3:	1.97	Final Dry Density - Mg/m3:	1.94
Initial Dry Density - Mg/m3:	1.92	Test Temperature oC:	82

Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm	Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm	Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm
0	0	0.00	210	2	0.02	5760	3	0.03
5	0	0.00	240	2	0.02	6240	3	0.03
10	0	0.00	270	2	0.02	7200	3	0.03
15	0	0.00	300	2	0.02	7680	3	0.03
20	0	0.00	360	2	0.02	8640	3	0.03
25	0	0.00	420	2	0.02	9120	3	0.03
30	0	0.00	480	2	0.02	10080	3	0.03
40	0	0.00	1440	3	0.03			
50	0	0.00	1680	3	0.03			
60	2	0.02	1920	3	0.03			
75	2	0.02	2880	3	0.03			
90	2	0.02	3120	3	0.03			
105	2	0.02	3360	3	0.03			
120	2	0.02	4320	3	0.03			
150	2	0.02	4560	3	0.03			
180	2	0.02	4800	3	0.03			



PSL
Professional Soils Laboratory

Compiled	Date	Checked	Date	Approved	Date
	01/09/2016		01/09/2016		01/09/2016

Cooper Bridge

Contract No: PSL15/3716

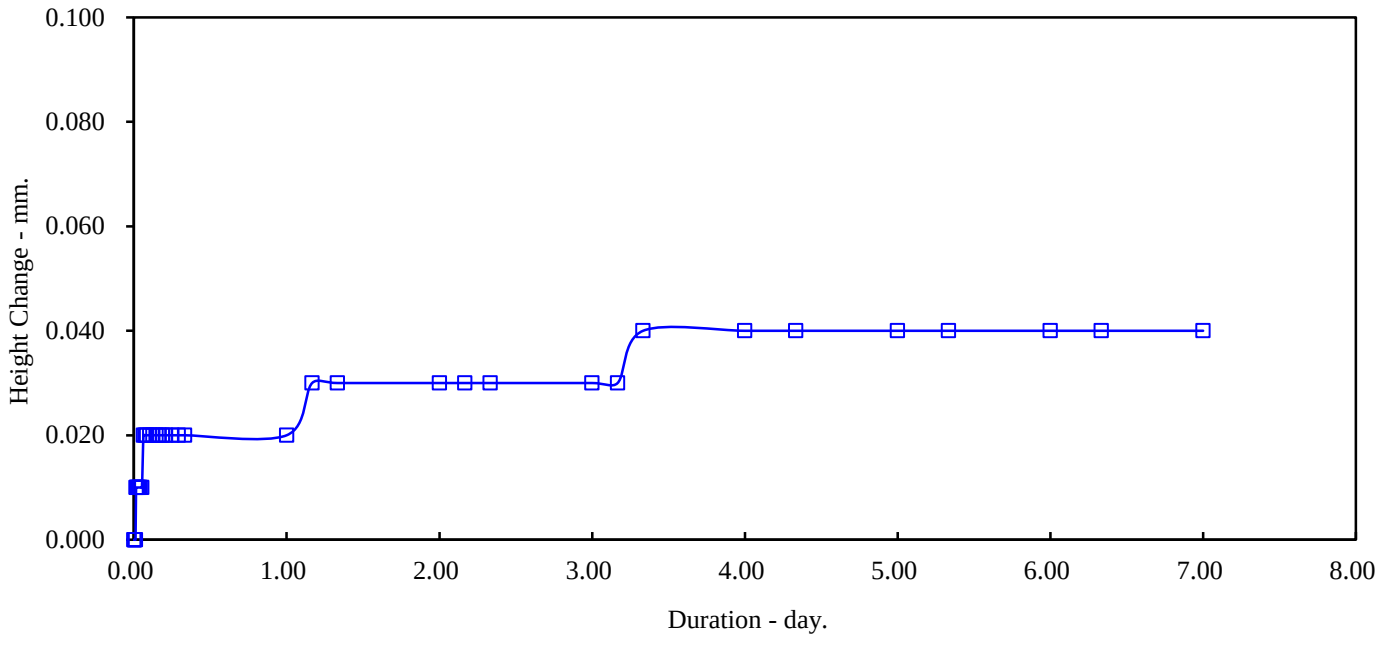
Figure.

EMERY EXPANSION TEST.

Road and Transport Association of Canada 1974.

Hole Number / Depth (m):	TP111 / 3.00	Description.:	Dark grey gravel of slag.
INITIAL CONDITIONS.		**FINAL CONDITIONS.**	
Initial Height - mm:	127.00	Final Height - mm:	127.04
Initial Diameter - mm:	151.80	Final Mass - g:	4817.00
Initial Mass - g:	4723.00	Final Volume - cm3:	2299.18
Initial Volume - cm3:	2299.00	Dry Mass - g:	4508.00
Dry Mass - g:	4508.00	Final Moisture Content - %:	6.8
Initial Moisture Content - %:	4.8	Final Bulk Density - Mg/m3:	2.10
Initial Bulk Density - Mg/m3:	2.05	Final Dry Density - Mg/m3:	1.96
Initial Dry Density - Mg/m3:	1.96	Test Temperature oC:	82

Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm	Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm	Elapsed Time Min	Dial Gauge Reading Div	Change In Height mm
0	0	0.00	210	2	0.02	5760	4	0.04
5	0	0.00	240	2	0.02	6240	4	0.04
10	0	0.00	270	2	0.02	7200	4	0.04
15	0	0.00	300	2	0.02	7680	4	0.04
20	1	0.01	360	2	0.02	8640	4	0.04
25	1	0.01	420	2	0.02	9120	4	0.04
30	1	0.01	480	2	0.02	10080	4	0.04
40	1	0.01	1440	2	0.02			
50	1	0.01	1680	3	0.03			
60	1	0.01	1920	3	0.03			
75	1	0.01	2880	3	0.03			
90	2	0.02	3120	3	0.03			
105	2	0.02	3360	3	0.03			
120	2	0.02	4320	3	0.03			
150	2	0.02	4560	3	0.03			
180	2	0.02	4800	4	0.04			



PSL
Professional Soils Laboratory

Compiled	Date	Checked	Date	Approved	Date
	01/09/2016		01/09/2016		01/09/2016

Cooper Bridge

Contract No: PSL15/3716

Figure.

TRS Report

Report Ref: DC6H/CB/WAL/TRS/08/16/RP1
Date Issued: 29 August 2016
TRS Sample Refs: DC6H01
Order No: SH5304

EXAMINATION OF A SINGLE BULK SAMPLE FROM A WASTE WATER FILTER BED, COOPER BRIDGE FOR WARDELL ARMSTRONG LLP

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A Limited Company registered in England. Company Registration No: 2518421

EXAMINATION OF A SINGLE BULK SAMPLE FROM A WASTE WATER FILTER BED, COOPER BRIDGE FOR WARDELL ARMSTRONG LLP

1. BACKGROUND

A single bulk sample was received from the site on 11th August 2016. The sample is believed to have been taken from material used in filter beds. The sample was weighed and allocated a unique TRS reference, the details of which are recorded below:-

TRS Ref	Site Ref	Mass/kg
DC6H01	TP104 B1(D)	18.9

The purpose of the exercise was to identify any products from iron and steel making operations, and to assess whether there was any risk of potential for volumetric instability from these materials.

2. SAMPLE PREPARATION & PROGRAMME OF ANALYSIS

The sample was primary crushed to reduce particle size down to <50mm, a portion then being selected and dried at low temperature to constant weight. The dried material was subjected to a regime of stage crushing and quartering to further reduce particle size down to <5mm. A portion of this <5mm material was made up into a resin bound block, one face of which was ground flat and polished using diamond pastes. A further portion of the <5mm material was milled to a fine powder. Portions were extracted throughout the preparation procedure to provide the necessary test specimens for the tests and analyses in the programme.

A petrological examination was made of the polished block using reflected light microscopy, the complete findings of which are recorded in appendix A. The following tests and analyses were also carried out on the sample:-

- Water soluble sulphate (table 1)
- Acid soluble sulphate (table 1)
- Total sulphur (table 1)
- Thermal analysis (DTA & TGA) (table 2)
- TRS accelerated expansion test (table 3)

3. DISCUSSION OF RESULTS

3.1 Petrology

A petrological examination was made of the sample using reflected light microscopy. The complete findings of this examination are recorded in appendix A.

The sample consisted almost entirely of little altered, crystalline blast furnace slag. No basic steel slag or basic refractory material was seen (this is good news as when present, these products can have significant potential for expansion).

The mineralogy of the slag was dominated by melilite, along with more minor amounts of dicalcium silicate, wollastonite, calcium titanium silicate, calcium & iron/manganese sulphide and metallic iron.

There was little secondary alteration, the secondary phases being mainly confined to pore infill by calcite. The secondary products were mostly finely granular and were difficult to identify specifically under the microscope. Old weathered blast furnace slag may contain pockets of potentially expansive material (see sections 3.2 to 3.4 & appendix B).

3.2 Sulphur Species

The following range of analyses were performed on the sample. The results are recorded in table 1:-

- Water soluble sulphate
- Acid soluble sulphate
- Total sulphur

Total sulphur was recorded at 0.32 percent. This value would be regarded as fairly modest for this type of slag. Acid soluble sulphate was 0.16 percent, with a corresponding water soluble sulphate of 0.05 g/l. As before, these values are relatively low, but should be taken into consideration if concrete were to come into contact with the material.

3.3 Thermal Analysis

Simultaneous differential thermal analysis (DTA) and thermo-gravimetric analysis (TGA) was performed on the sample. The results are recorded in table two.

No ettringite or gypsum was recorded in the sample. Ettringite is a product of past expansion in the blast furnace slag.

No calcium or magnesium hydroxides were seen in the sample. These products are associated with the presence of basic steel slag and/or basic refractory material, neither of which were identified in this sample.

Calcite was identified at 0.1 percent. This material is an indicator as to the lightly weathered state of the slag.

3.4 TRS Accelerated Expansion Test

The TRS accelerated expansion test was performed on the sample. The results are recorded in table three. The sample was subjected to the test for a period of 14 days. Note that the test measures potential for future expansion, and is not a measure of expansion that may have taken place in the past.

A final expansion (14 day result) was recorded of 0.14 percent. This result then shows a slight potential for future expansion.

4. CONCLUSIONS

The following conclusions can be drawn:-

- The sample comprised almost entirely of little altered, crystalline blast furnace slag.
- There was no evidence that the blast furnace slag had expanded in the past.
- Expansion testing recorded a modest potential for future expansion (0.14 percent).
- Sulphate levels in the blast furnace slag were low, but should be taken into account when specifying concrete that may come into contact with the slag.
- No basic steel slag or basic refractory material was seen in this sample. This is good news, as when present these products can be potentially very expansive.

Note
These conclusions apply only to the sample tested and may not represent the bulk of the material on the site from which it was taken.

Redacted

Ian D Thomas BSc(Hons) **29 August 2016**

Thomas Research Services Ltd

TABLE 1 **SULPHUR SPECIES ANALYSES**

TRS Ref	Site Ref	Water Sol. SO_3 (g/l)	Acid Sol. SO_3 (%)	Total S (%)
DC6H01	Cooper Bridge	0.05	0.16	0.32

TABLE 2 **RESULTS FROM THERMAL ANALYSIS**

TRS Ref	Site Ref	Mass % by Thermal Analysis						
		L.O.I.	Ettringite	Gypsum	Calcite	$Ca(OH)_2$	$Mg(OH)_2$	Others
DC6H01	Cooper Bridge	1.21	0.0	0.0	0.1	0.0	0.0	-

TABLE 3 **TRS ACCELERATED EXPANSION TEST**

TRS Ref	Site Ref	7 day (%)	14 day (%)
DC6H01	Cooper Bridge	0.14	0.14

APPENDIX A

PETROLOGICAL REPORT ON SAMPLE DC6H 01

A petrological examination has been carried out of one sample, DC6H 01.

A polished block was prepared using particulate material, crushed to a nominal size of -5 mm. Representative material was made up into a resin-bonded block. One face of this was ground flat and polished using diamond pastes and the surface was etched with water, 10% $MgSO_4$ solution and 0.1%N HCl in order to help with the phase identification.

The detailed results are given in the accompanying Table.

The sample consists almost entirely of blast furnace slag.

No basic steel slag or basic refractory material was seen.

The blast furnace slag is largely crystalline. It consists mostly of melilite (Ca,Mg,Al silicate) crystals set in an extremely fine grained (crystals less than 0.005mm in size) matrix of glass or other silicates including some dicalcium silicate (larnite (ß-Ca_2SiO_4) or bredigite (Ca_2SiO_4 with some Mg in solid solution)) and wollastonite ($CaSiO_3$) and calcium titanium silicate. Small amounts of calcium and iron/manganese sulphide (CaS and (Fe,Mn)S) are present as small crystallites and dendrites. There are also very small amounts of metallic iron occurring as tiny globules.

The slag is little weathered. There is some pore infill particularly by calcite ($CaCO_3$). Other finely granular secondary phases interstitial to the larger slag particles are difficult to identify specifically under the microscope but are probably hydrated silicates and sulpho-aluminates and possibly clay.

There are a few particles consisting mainly of rust derived from iron prills included in the slag and a minor amount of quartz.

TRS SAMPLE DC6H 01

	1
BLAST FURNACE SLAG	
Amount	***L***
Phases present:-	
Melilite	L
Merwinite	-
Larnite & bredigite	vs
Matrix & other silicates	s
Ca & Fe,Mn sulphides	vs
Metal, rust, scale etc.	vs
Quartz inclusions	vs
Glassy slag	s
Alteration products	s
Calcite	s
Gypsum	-
BASIC STEEL SLAG	
Amount	***-***
BASIC REFRACTORIES	
Amount	***-***
OTHER CONSTITUENTS	
Quartz, sandstone, etc.	vs
Metal, rust, scale, etc.	s
Cementitious material	vs

L = very large, l = large, m = medium, s = small and vs = very small amounts

GENERAL EXPLANATION

L = very large, l = large, m = medium, s = small and vs = very small amounts.

Blast furnace slag. When present this consists mainly of melilite (Ca,Mg,Al silicate ranging in composition between $Ca_2Al_2SiO_7$ and $Ca_2MgSi_2O_7$). Other common phases are merwinite ($Ca_3MgSi_2O_8$), larnite (ß-Ca_2SiO_4) and bredigite (Ca_2SiO_4 with some Mg in solid solution). The matrix often consists of some of the above phases, especially melilite, but may also contain other phases such as wollastonite ($CaSiO_3$), anorthite ($CaAl_2Si_2O_8$) and pyroxene ($(CaMg)SiO_3$). Spinel ($MgAl_2O_4$) may be present. Sulphides and metal usually occur and are mostly finely dispersed, but the metal sometimes occurs as prills and may contain some graphite and Ti carbo-nitride (TiCN). Material reported as ceramic in appearance is very finely crystalline. The alteration products often include calcite and gypsum but are mostly silicate and/or sulpho-aluminate hydrates that are difficult to identify specifically under the microscope.

Basic steel slag. When present this consists mainly of dicalcium silicate, mostly the ß-form (larnite) but sometimes the alpha form. Phosphoric slags may contain nagelschmidtite (Ca_2SiO_4 with $Ca_3P_2O_8$ in solid solution). Other silicate often present in small amounts, unetched by dilute HCl, is probably melilite. RO, R_3O_4 and RF phases are typically present and are mainly FeO and Fe_3O_4 with some Mg, Mn, Ca, etc. in solid solution and complex Ca alumino-ferrites. There may also be some Fe_2O_3 and spinel ($(Mg,Fe)Al_2O_4$). The slag typically carries minor amounts of periclase (MgO with some Fe in solid solution) and lime phase (CaO with some Fe, Mn & Mg in solid solution). Other possible minor constituents include fluorite (CaF_2) and apatite (Ca fluoro-phosphate), the last present in phosphoric slags. The alteration products are, again, difficult to identify specifically but are probably, mainly, hydrated silicates. Portlandite ($Ca(OH)_2$) may be present.

Basic refractory material. When present, this is mainly magnesian and consists of granular periclase (MgO) with interstitial silicates. Sometimes samples contain chrome-magnesia material with chromite present in addition to the other phases. Hot face material (from close to the furnace) may also occur. The periclase and interstitial silicates show secondary alteration similar to that of the basic steel slag. Brucite ($Mg(OH)_2$ is likely.

Acid steel slag. When present this consists mainly of fayalite ($(Fe,Mn)_2SiO_4$), Fe,Mn oxides and cristobalite (high temperature SiO_2).

Other slags. The 'intermediate slag' (probably primary flush slags from steel furnaces) has a variable phase assemblage, being mainly formed of silicates, particularly dicalcium silicate, melilite, merwinite and a complex olivine phase together with spinel and wustite (FeO). Sometimes it contains significant amounts of periclase, well embedded in the slag. The 'ferrous slag' (probably from foundry operations) has similar silicates but much more substantial content of iron oxides, usually wustite. It is often associated with scale (iron oxides formed on the surface of steel during reheating/cooling). When present, the 'cindery slag' consists of various silicates and silicate glass with Fe oxides, hercynite ($FeAl_2O_4$) and, sometimes, corundum (Al_2O_3). It is usually derived from heating furnaces and is often associated with burnt shale. When present, the 'siliceous clinker' is similar but devoid of iron oxides.

Other constituents The alumino-silicate brick includes a range of refractory firebrick, common brick and alumina-rich refractories. The 'quartz, sandstone, etc.' may include used silica refractory material consisting of quartz and its high temperature forms. Sometimes there is a distinct granular texture and it is derived from silcrete, a kind of chert. Cementitious material may bond the finer particles together. It is similar to the other alteration products consisting mostly of complex hydrates difficult to identify under the microscope Sometimes some is used Portland cement recognised by the relict textures of the clinker and the embedded quartz sand.

APPENDIX B

MECHANISMS OF VOLUMETRIC INSTABILITY IN IRON AND STEEL INDUSTRY SLAGS

Volumetric change with time can occur in some types of iron and steel industry slags. These mechanisms are briefly described in this section.

Blast Furnace Slags

Fresh-make air-cooled, i.e. crystalline, blast furnace slags are almost always volumetrically stable after cooling. The two mechanisms for volumetric instability listed in BS1047:1983 – "Air Cooled Blast furnace Slag for use in Construction" are:-

a) Beta to gamma inversion of dicalcium silicate.

b) Iron unsoundness.

a) Research by G H Thomas on this phase transformation has shown the transformation to be athermal rather than isothermal. In practical terms this means that inversion, and the expansion associated with it, can only occur during the cooling cycle. In fully cooled material there would appear to be no further risk of instability from this mechanism.

b) Iron unsoundness is a very rare form of instability frequently associated with operating problems in the blast furnace. TRS know of only one instance in over 40 years. The mechanism, which is a hydrolysis reaction, is immediately triggered off by the presence of water. Once water has initiated the reaction, the mechanism proceeds to completion. It is impossible to arrest the process once started; at least by methods operating in normal ambient conditions.

It follows that the risk of late expansion from either of these mechanisms in blast furnace slag is remote.

c) Sulphoaluminate Type Activity

Some years ago, G. H. Thomas discovered a third mechanism that may give rise to volumetric instability. The process is possible only in some old blast furnace slag altered by weathering. When the sulphide sulphur in the blast furnace slags is oxidised during weathering to sulphate, under some circumstances reactions can take place within the slag to produce an 'ettringite' type product. The process is somewhat analogous to sulphatic attack on concrete and has a similar result - expansion of the mass and associated disruption.

For the mechanism to have any significance, the slag needs to have residual potential for this reaction. Evidence of past activity does not necessarily indicate further reaction is possible.

The TRS accelerated expansion test is, we believe, uniquely capable of identifying such slags, as well as instability attributable to free CaO and free MgO in steel slag & etc.

Basic Steel Slags

Basic steel slags commonly contain significant quantities of free CaO and free MgO. These free oxides are well known for the massive expansion associated with their hydration. In practical terms, it is impossible to forecast when hydration will take place, but it can be up to decades after the material was cooled – or placed. The reasons are complex, but include the varying density of the oxides, due to the variation in temperatures at which the products have been held in the furnace. Other factors influencing rate of hydration include:-

- the protection of slags by a reaction product at the oxide interface with the slag.

- the presence of the oxides as lime or magnesia rich solid solutions instead of the pure oxide.

The result is potential future volumetric instability but at an unforeseeable date. Periclase, i.e. free MgO, is relatively much slower than free CaO to hydrate.

Scrap High Magnesia Refractories

These are particularly undesirable components in fill as they commonly result in high concentrations of free MgO. The problems associated with these concentrations are similar to those where periclase is found in basic steel slag.

Wardell Armstrong LLP
Sir Henry Doulton House
Forge Lane
Etruria
Stoke on Trent
ST1 5BD

Date: 13 September 2016
Test Report Ref: STR 477588

Order No: SH5349

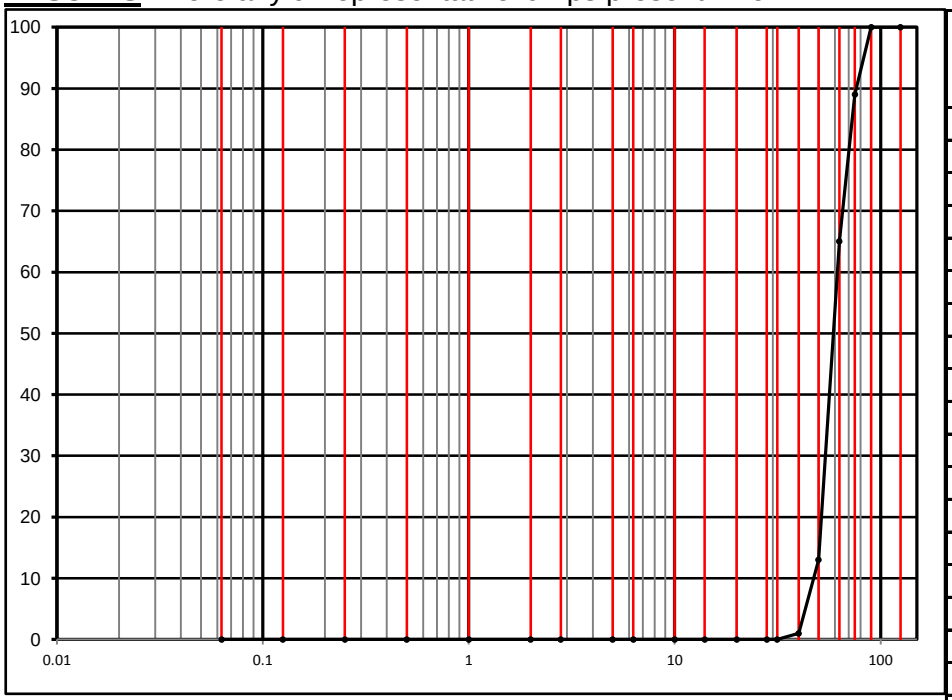
LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Particle Size Distribution (PSD) of a aggregate sample- washing and sieving method in accordance with **BS EN 933-1: 2012.**

SAMPLE DETAILS:

Certificate of sampling received	**No**	Name of Source:	**Unknown**
Laboratory Ref. No:	**S59777**	Method of Sampling:	**Unknown**
Client Ref. No:	**Recycled - 100mm Down**	Sampled By:	**Client**
Date and Time of Sampling:	**Unknown**		
Date of Receipt at Lab:	**11/08/2016**		
Date of Start of Test:	**30/08/2016**		
Sampling Location:	**Unknown**		
Material Description	**Recycled Granular - 100mm Down**		

RESULTS: Were any unrepresentative lumps present? No



BS TEST SIEVE SIZE	PERCENTAGE BY MASS PASSING	SPECIFICATION LIMITS
125.0 mm	100	
90.0 mm	100	
75.0 mm	89	
63.0 mm	65	
50.0 mm	13	
40.0 mm	1	
31.5 mm	0	
28.0 mm	0	
20.0 mm	0	
14.0 mm	0	
10.0 mm	0	
6.3 mm	0	
5.0 mm	0	
2.8 mm	0	
2.0 mm	0	
1.0 mm	0	
0.500 mm	0	
0.250 mm	0	
0.125 mm	0	
0.063 mm	0	

Comments

Certificate Prepared by:- Redacted
Job Coordinator

Approved by: Redacted
Eric Goulden
Technical Manager

Wardell Armstrong LLP
Sir Henry Doulton House
Forge Lane
Etruria
Stoke on Trent
ST1 5BD

Date: 13 September 2016
Test Report Ref: STR 477589

Order No: SH5349

Contract: Coopers Bridge

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S59777**
Client Ref. No:	**Recycled Granular - 100mm Down**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**11/08/2016**
Date of Start of Test:	**30/08/2016**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Recycled Granular - 100mm Down**
Target Specification:	

RESULTS:

Water Content (%) = 1.9

Comments
None

Certificate Prepared by:- Redacted
Joseph Parry
Job Coordinator

Approved by: - Redacted
Eric Goulden
Technical Manager

Wardell Armstrong LLP
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Forge Lane
Etruria
Stoke on Trent
ST1 5BD

Date: 05 September 2016
Test Report Ref: STR 477590

Contract: Coopers Bridge

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Constituent Materials in Recycled Aggregate and Recycled Concrete Aggregate in accordance with **Specification For Highway Works: Volume 1: Series 700: Clause (BS EN 933-11 : 2009)**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S59777**
Client Ref. No:	**Recycled Granular - 100mm Down**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**11/08/2016**
Date of Start of Test:	**30/08/2016**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Recycled Granular - 100mm Down**
Target Specification:	**N/A**

RESULTS:

Floating Particles (FL)	**0 cm³/kg**
Combined clay, soil and other (X)	**0 %**
Concrete, concrete products, mortar and Concrete Masonary Units (Rc)	**63 %**
Unbound Aggregate, Natural Stone and Hydraulically bound aggregate (Ru)	**0 %**
Clay masonary units, calcium silicate masonary units and aerated non-floating concrete (Rb)	**37 %**
Bituminous materials (Ra)	**0 %**
Glass (Rg)	**0 %**

Comments

Certificate Prepared by:- Redacted
Joseph Parry
Job Coordinator

Approved by: Redacted
Eric Goulden
Technical Manager

Wardell Armstrong LLP
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Forge Lane
Etruria
Stoke on Trent
ST1 5BD

Date: 09 September 2016
Test Report Ref: STR 477591

Contract: Coopers Bridge

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Magnesium Sulfate Value of aggregate sample within the size range 10mm to 14mm in accordance with **BS EN 1367-2 : 2009**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S59777**
Client Ref. No:	**Recycled Granular - 100mm Down**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**11/08/2016**
Date of Start of Test:	**09/09/2016**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Recycled Granular - 100mm Down**
Target Specification:	**N/A**

RESULTS:

Magnesium Sulfate Value Portion 1 (MS_1) = 1.9
Magnesium Sulfate Value Portion 2 (MS_2) = 1.5

Mean Magnesium Sulfate Value (MS) = 2

Comments
Proportion by mass of laboratory sample used for the test portion = 5% (nearest 5%)

Certificate Prepared by:- Redacted
Joseph Parry
Job Coordinator

Approved by: Redacted
Eric Goulden
Technical Manager

Wardell Armstrong LLP
Sir Henry Doulton House
Forge Lane
Etruria
Stoke on Trent
ST1 5BD

Date: 02 September 2016
Test Report Ref: STR 477592

Contract: Coopers Bridge

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Particle Density and water absorption for aggregate sample between 4 mm and 31.5mm, in accordance with **BS EN 1097-6: 2013 Clause 8**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S59777**
Client Ref. No:	**Recycled Granular - 100mm Down**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**11/08/2016**
Date of Start of Test:	**31/08/2016**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Recycled Granular - 100mm Down**
Target Specification:	**N/A**

RESULTS:

Particle density on an oven-dried basis =	**2.31 Mg/m³**
Particle density on a saturated and surface-dried basis =	**2.39 Mg/m³**
Apparent Particle density =	**2.51 Mg/m³**
Water absorption (of dry mass) =	**3.5 %**

Comments
None

Certificate Prepared by:- Redacted
Joseph Parry
Job Coordinator

Approved by: Redacted
Eric Goulden
Technical Manager

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Date: 02 September 2016
Test Report Ref: STR 477593

Contract: Coopers Bridge

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Fragmentation of Aggregate - Los Angeles Test Method in accordance with **BS EN 1097-2: 2010**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S59777**
Client Ref. No:	**Recycled Granular - 100mm Down**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**11/08/2016**
Date of Start of Test:	**31/08/2016**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Recycled Granular - 100mm Down**
Target Specification:	**N/A**

RESULTS:

Size fraction from which the test portion was obtained: **14mm to 12.5mm**
12.5mm to 10.0mm

Los Angeles Coefficient (LA) = **29**

Comments
None

Certificate Prepared by:- Redacted
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Date: 25 August 2016
Test Report Ref: STR 477595

Contract: Coopers Bridge

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Water Soluble Sulphur Content of a sample in accordance with
BS 1377 : 1990 : ICP-AES Method 2 (TRL Report 447 Method 1)

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S59777**
Client Ref. :	**Recycled Granular - 100mm Down**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**11/08/2016**
Date of Start of Test:	**16/08/2016**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Recycled Granular - 100mm Down**
Target Specification:	**N/A**

RESULTS:

Water Soluble Sulphate Content (mg/l) : 510.00 (SO_4)

Comments

The work was carried out by our accredited, competent, sub contracted laboratory.

Certificate Prepared by:- Redacted
Joseph Parry
Job Coordinator

Approved by: - Redacted
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Technical Manager

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Date: 25 August 2016
Test Report Ref: STR 477596

Contract: Coopers Bridge

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Acid Soluble Sulphur Content of a sample in accordance with **TRL Report 447 and BS 1377 : 1990 : ICP-AES Method 4 (Test No.2)**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S59777**
Client Ref. :	**Recycled Granular - 100mm Down**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**11/08/2016**
Date of Start of Test:	**16/08/2016**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Recycled Granular - 100mm Down**
Target Specification:	**N/A**

RESULTS:

Acid Soluble Sulphate Content (%) = 0.45 **(SO_4)**

Comments
The work was carried out by our accredited, competent, sub contracted laboratory.

Certificate Prepared by:- Redacted
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Job Coordinator

Approved by: - Redacted
Eric Goulden
Technical Manager

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

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Date: 25 August 2016
Test Report Ref: STR 477597

Contract: Coopers Bridge

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Total Sulphur Content of a sample in accordance **BS 1377 : 1990 : ICP-AES Method 17 (TRL Report 447 Test No.4)**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S59777**
Client Ref. :	**Recycled Granular - 100mm Down**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**11/08/2016**
Date of Start of Test:	**16/08/2016**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Recycled Granular - 100mm Down**
Target Specification:	**N/A**

RESULTS:

Total Sulphur Content (%) = 0.36
Total Potential Sulphate Content (%) = 1.10 (SO_4)

Comments
The work was carried out by our accredited, competent, sub contracted laboratory.

Certificate Prepared by:- Redacted
Joseph Parry
Job Coordinator

Approved by: - Redacted
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Technical Manager

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Date: 25 August 2016
Test Report Ref: STR 477598

Contract: Coopers Bridge

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Oxidisable sulphides (OS) content of an Sample by calculation of **TRL Report 447 Test No. 2 and Test No. 4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S59777**
Client Ref. :	**Recycled Granular - 100mm Down**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**11/08/2016**
Date of Start of Test:	**16/08/2016**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Recycled Granular - 100mm Down**
Target Specification:	**<0.5 % SO_4 - If deposited within 500mm of Cementitious Materials** **<0.06 % SO_4 - If deposited within 500mm of Metallic Structural Elements**

RESULTS:

Oxidisable Sulphides (OS) (%) = 0.63 SO_4

Comments
The work was carried out by our accredited, competent, sub contracted laboratory.

Certificate Prepared by:- Redacted
Joseph Parry
Job Coordinator

Approved by: Redacted
Eric Goulden
Technical Manager

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ST1 5BD

Date: 25 August 2016
Test Report Ref: STR 477600

Contract: Coopers Bridge

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Presence of Asbestos in accordance with DIHM ASB/01

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S59777**
Client Ref. No:	**Recycled Granular - 100mm Down**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**11/08/2016**
Date of Start of Test:	**16/08/2016**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Recycled Granular - 100mm Down**
Target Specification:	**N/A**

RESULTS:

Sample Ref.	Asbestos Presence	Asbestos Type	Comments
100mm Down	**NAD**	**N/A**	**No Asbestos Detected**

Comments

The work was carried out by our accredited, competent, sub contracted laboratory.

Certificate Prepared by:- Redacted

Joseph Parry
Job Coordinator

Approved by: Redacted

Eric Goulden
Technical Manager

Wardell Armstrong LLP
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Stoke on Trent
ST1 5BD

Date: 25th August 2016
Test Report Ref. STR: 477599

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the potential presence of Bitumen and/or Coal Tar of a sample

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S59777**
Client Ref. No:	**Recycled Granular - 100mm Down**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**11/08/2016**
Date of Start of Test.:	**16/8/2016**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Recycled Granular - 100mm Down**
Target Specification:	**N/A**

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The work was carried out by our accredited, competent, sub contracted laboratory.

RESULTS

Redacted

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) N Dumbarton
Assistant Laboratory Manager

Test	Unit	Results
Petroleum Hydrocarbons		
EPH (C10-C40)	mg/kg	< 10
PAHs		
Naphthalene	mg/kg	< 0.1
Acenaphthylene	mg/kg	< 0.1
Acenaphthene	mg/kg	< 0.1
Fluorene	mg/kg	< 0.1
Phenanthrene	mg/kg	< 0.1
Anthracene	mg/kg	< 0.1
Fluoranthene	mg/kg	< 0.1
Pyrene	mg/kg	< 0.1
Benzo(a)anthracene	mg/kg	< 0.1
Chrysene	mg/kg	< 0.1
Benzo(b)fluoranthene	mg/kg	< 0.1
Benzo(k)fluoranthene	mg/kg	< 0.1
Benzo(a)pyrene	mg/kg	< 0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	< 0.1
Dibenzo(a,h)anthracene	mg/kg	< 0.1
Benzo(g,h,i)perylene	mg/kg	< 0.1
PAH Total	mg/kg	< 1.6

APPENDIX VIII

Gas Monitoring Results

RECORD OF MEASUREMENTS FOR GAS MONITORING BOREHOLES

Client Name: KeyLand Developments Ltd

Site Name: Land at Cooper Bridge WWTWs

Date of Sampling: 08/08/2016

Job Number: SH10243

Borehole Ref.	CH_4 % by Volume		CO_2 % by Volume		O_2 % by Volume		Flow Rate l/hr		Sample Type	Barometric Pressure (mb)	Relative Pressure (mb)	Depth to Water (m bTOC)	Depth to Base (mbTOC)
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady					
BH101	0.0	0.0	0.5	0.5	15.9	15.9	0.0	0.0	Acc.	1008	-	1.27	9.3
BH102	0.0	0.0	2.7	2.7	16.0	16.0	0.0	0.0	Acc.	1008	-	2.32	9.8
BH103	0.0	0.0	2.2	2.2	16.2	16.2	0.0	0.0	Acc.	1009	-	3.81	9.8
BH104	0.0	0.0	0.7	0.7	18.6	18.6	0.0	0.0	Acc.	1008	-	1.47	6.8

Atmospheric Pressure: As indicated

Pressure Trend: Rising

Weather: Showers, overcast, warm

Instrument Used: GFM 436

Sample Type: As indicated

Operator:

Notes:	Water level and base was taken from the top of casing. BH101 is a flush cover. BH102 – casing is ~0.34m above ground level BH103 – casing is ~0.37m above ground level BH104 – casing is ~0.31m above ground level

RECORD OF MEASUREMENTS FOR GAS MONITORING BOREHOLES

Client Name: KeyLand Developments Ltd

Date of Sampling: 15/08/2016

Site Name: Land at Cooper Bridge WWTWs

Job Number: SH10243

Borehole Ref.	CH_4 % by Volume		CO_2 % by Volume		O_2 % by Volume		Flow Rate l/hr		Sample Type	Barometric Pressure (mb)	Relative Pressure (mb)	Depth to Water (m bTOC)	Depth to Base (mbTOC)
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady					
BH101	0.0	0.0	0.7	0.7	15.7	15.7	0.0	0.0	Acc.	1016	-	1.28	9.3
BH102	0.0	0.0	0.5	0.5	20.4	20.4	0.0	0.0	Acc.	1016	-	2.32	9.8
BH103	0.0	0.0	1.8	1.8	14.7	14.7	0.0	0.0	Acc.	1016	-	3.85	9.8
BH104	0.0	0.0	1.6	1.6	18.5	18.5	0.0	0.0	Acc.	1015	-	1.74	6.8

Atmospheric Pressure: As indicated

Instrument Used: GFM 436

Pressure Trend: Steady

Sample Type: As indicated

Weather: Dry, sunny and hot

Operator:

Notes:	Water level and base was taken from the top of casing. BH101 is a flush cover. BH102 – casing is ~0.34m above ground level BH103 – casing is ~0.37m above ground level BH104 – casing is ~0.31m above ground level

RECORD OF MEASUREMENTS FOR GAS MONITORING BOREHOLES

Client Name: KeyLand Developments Ltd

Date of Sampling: 15/09/2016

Site Name: Land at Cooper Bridge WWTWs

Job Number: SH10243

Borehole Ref.	CH_4 % by Volume		CO_2 % by Volume		O_2 % by Volume		Flow Rate l/hr		Sample Type	Barometric Pressure (mb)	Diff. Pressure (mb)	Depth to Water (m bTOC)	Depth to Base (mbTOC)
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady					
BH101	**0.0**	0.0	**1.4**	1.4	**3.4**	3.4	**0.0**	0.0	Acc.	1004	0	1.235	9.41
BH102	**0.0**	0.0	**2.2**	2.2	**18.8**	18.8	**0.0**	0.0	Acc.	1003	0	2.290	9.65
BH103	**0.0**	0.0	**4.1**	4.1	**8.0**	8.0	**0.0**	0.0	Acc.	1003	0	3.770	9.63
BH104	**0.0**	0.0	**1.9**	1.9	**18.7**	18.7	**0.0**	0.0	Acc.	1003	0	1.685	6.78

Atmospheric Pressure: As indicated

Instrument Used: GFM 436

Pressure Trend: Falling

Sample Type: As indicated

Weather: Foggy, mild

Operator: M Kelly

Notes:	

D R A W I N G S

DO NOT SCALE FROM THIS DRAWING A4

CLIENT	DRG No.	SCALE	DATE
KEYLAND DEVELOPMENTS LTD	SH10243/01	1:50,000	JULY 2008

PROJECT	DRAWN BY	CHECKED BY	APPROVED BY
LAND AT COOPER BRIDGE, LOWER BRIGHOUSE	DP	GPW	GPW

DRAWING TITLE

SITE LOCATION PLAN

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DO NOT SCALE FROM THIS DRAWING | A3

REFERENCE

SITE BOUNDARY

YORKSHIRE WATER RETAINED LAND

LIGHT CABLE PERCUSSIVE BOREHOLES (MAX. 10M BGL) INSTALLED AS MONITORING WELLS — BH102

LIGHT CABLE PERCUSSIVE BOREHOLES (MAX. 10M BGL) — HP102

TRIAL PIT — TP101

SURFACE SAMPLE — SS1

FILTER BED REFERENCE NUMBER — (1)

SERVICES:

BT

ELECTRICITY

GAS

WATER

REVISION	DETAILS	DATE	DRAWN	CHK'D	APP'D
A	First issue.	26/09/16	DP	MB	GW

CLIENT

KEYLAND DEVELOPMENTS LTD

PROJECT

LAND AT COOPER BRIDGE, HUDDERSFIELD

DRAWING TITLE

SITE INVESTIGATION LOCATIONS PLAN

DRG No	SCALE	DATE
SH10243-004	1:2000 @ A3	10/08/16

DRAWN BY	CHECKED BY	APPROVED BY
DP	MB	

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EDINBURGH TEL 0131 555 3311
TAUNTON TEL 01823 703100

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