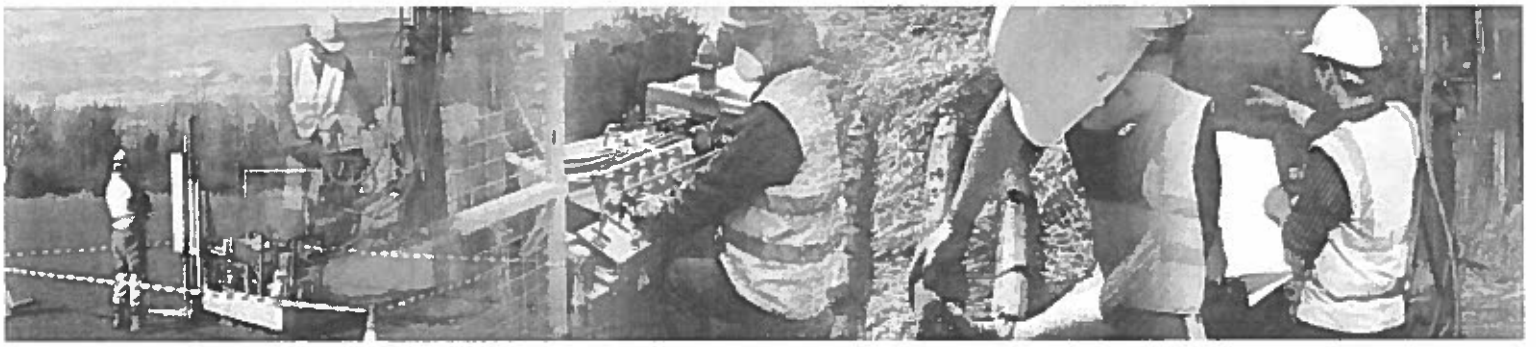
GEO Environmental Engineering



PHASE 2: GROUND INVESTIGATION REPORT

PROPOSED RESIDENTIAL DEVELOPMENT

LAND AT IVY MILL, MAIN STREET

HENSINGHAM, WHITEHAVEN, CA28 8TP

FOR:

GLEESON REGENERATION LTD

DOCUMENT CONTROL SHEET

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1.0 Introduction

1.1 Brief

GEO Environmental Engineering Ltd (GEO) was commissioned by the Client, Gleeson Regeneration Ltd to undertake a ground investigation for land at Ivy Mill which is located on Main Street in Hensingham, Whitehaven, Cumbria, CA28 8TP as indicated on the plan included in Appendix I.

The investigation was completed to aid foundation and road design and assess the risk from potential contamination and ground gas with respect to human health and environmental receptors.

1.2 Site Location and Description

The site, occupying an area of c.0.91ha and is located off Main Street in Hensingham to the southeast of Whitehaven in Cumbria as indicated on the plan included in Appendix I. Access to the site is from Main Street which borders the western / north-western site boundary.

- National Grid Reference: 299048, 517063
- Post Code: CA28 8TP

The site was previously occupied by a factory which manufactured work wear and personal protective equipment. It is understood that the factory was recently demolished. The site currently comprises a mixture of gravel and concrete hardstanding (where the former factory was located) and an area of overgrown vegetation and trees in the east. Piles of crushed concrete are present in the western part of the site. An Electric Sub-Station is still present in the north of the site.

There is a steep slope which rises c.2m-c.3m to the area of overgrown vegetation in the east. Several retaining structures are noted along the northern boundary.

At this stage, no topographical survey data has been provided by the Client.

1.3 Proposed Development

It is understood that the Client plans to redevelop the site for residential end use with residential units, private gardens, car parking, access roads and associated infrastructure.

1.4 Other Reports/Studies

Prior to the completion of the intrusive works, GEO completed the following Phase 1: Desk Top Study (DTS) Report for the site, details of which are included below. It is recommended that the DTS is read in conjunction with this report.

- Phase I: Desk Top Study (Preliminary Environmental Risk Assessment) Executive Summary Report for Land at Ivy Mill, Main Street, Hensingham, Whitehaven, CA28 8TP (ref: 2019-3732, dated June 2019).

2.0 Ground Investigation Report

2.1 Ground Investigation Aims and Objectives

The overall objective of this Ground Investigation is to provide information relating to the geotechnical and environmental properties of the ground and groundwater across the development area in order to facilitate foundation and drainage design and determine any risks to human health or the surrounding environment.

2.2 Guidelines, Codes of Practice and Third Part Accreditations

This report contains information relating to the geotechnical properties of the soils encountered on site to aid foundation and highway design by a Structural Engineer. The report also incorporates a Level 1 Ground Contamination and Ground Gas Risk Assessment for Human Health (Generic Quantitative Risk Assessment – GQRA) as well as a and Controlled Waters Risk Assessment.

The laboratory testing (geotechnical and ground contamination) was completed by UKAS and MCERTS accredited laboratories with details given in Sections 6, with copies of the test reports contained within Appendix III.

This Ground Investigation Report has generally been completed in accordance with the following documents:

- CLR11: Model Procedures for the Management of Land Contamination. DEFRA/EA, 2004.
- BS10175: 2011: Code of Practice for the Investigation of Potentially Contaminated Sites.
- BS5930: 2015: Code of Practice for Site Investigations.
- BS1377: 1990: Methods of test for soils for civil engineering purposes.
- BS8485: 2015: Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.
- BS8576: 2013: Guidance on Ground Gas Investigations.
- CIRIA Report C665: 2015.
- Eurocode 7 – Geotechnical Design (Part 1: General Rules and; Part 2: Ground Investigation and Testing).
- UK Specification for Ground Investigation, 2nd Edition. Site Investigation Steering Group, 2011.
- Effective Site Investigation. Site Investigation Steering Group, 2013.
- SP1010 Development of Category 4 Screening Levels Main Report, 2014.
- The LQM/CIEH S4UL's for Human Health Risk Assessment, 2015.

2.3 Ground Investigation Limitations of Use

Although every effort is made to ensure a full and comprehensive investigation has been completed, it should always be borne in mind that ground conditions have the potential to vary between exploratory hole locations and it is recommended that a prudent developer adopt a "watching brief" during the redevelopment works, to ensure that any potential variations encountered are identified and dealt with in an appropriate manner.

In addition, this Ground Investigation Report and its contents are limited to the boundaries of the site, as indicated on the Plans in Appendix I. No reliance, copying or use of this report (in part or whole) by any Third Party is permitted without prior written approval from Geo Environmental Engineering Ltd, with intellectual copyright remaining the sole property of the author. Reliance on the report and its associated information is strictly in accordance with Geo Environmental Engineering Ltd Terms and Conditions, copies of which are available on request.

2.4 Consideration for Residential End Use

It is understood that the site will be re-developed for residential end use with houses, gardens, car parking, access roads, and other associated infrastructure. Consequently, when considering the intended development, the site is considered suitable for assessment using a Level 1 Generic Quantitative Risk Assessment (GQRA).

A GQRA provides details of potential future risks to Human Health (proposed end users) from any contamination which may be identified on site in made ground or natural soils. For the Human Health Risk Assessment, it is considered that the future residents will be subjected to the greatest exposure periods and consequently the most risk. Therefore, in accordance with current guidance and legislation a CLEA end use classification of *residential* has been considered most appropriate.

3.0 Ground Investigation Fieldwork

3.1 Intrusive Investigation Fieldworks Summary

The ground investigation works were completed during August 2019.

The exploratory holes were located across the site to provide general site coverage, taking cognisance of buried utilities, steep slopes and areas of saturated ground.

The Exploratory Hole Location Plan is provided in Appendix I.

The ground investigation works comprised:

- 4 no. Dynamic (Windowless) Sampling Boreholes (BH's 01 to 04) to depths of between c.1.50m and c.5.00m bgl.
- 10 no. Mechanically Excavated Trial Pits (TP's A to J) to depths of between c.1.10m and c.2.40m bgl.
- 4 no. Gas and Groundwater Monitoring wells installed at all borehole locations to depths of between c.1.00m and c.3.00m bgl.
- Gas and groundwater monitoring (6 No. visits completed).
- In-situ geotechnical testing: Standard Penetration Tests (SPT), Hand Shear Vane Tests (HSV).
- Site supervision by a suitably qualified and experienced Geo-Environmental Engineer.
- Laboratory based geotechnical testing.
- Laboratory chemical screening of soil samples.
- Level 1 Generic Quantitative Risk Assessment (GQRA) to determine potential ground contamination and ground gas risks to the proposed end users.

The investigation fieldworks were undertaken in accordance with BS5930:1999, BS1377:1990 and Eurocode 7 (Part I and II).

At each exploratory hole, the surfacing type, made ground, natural ground and groundwater conditions were observed, with in-situ testing undertaken and samples recovered. Details of the ground conditions are included on the exploratory hole logs which are included in Appendix II together with other relevant ground investigation data (Gas and Groundwater Monitoring results).

All depths included in the report are in metres below ground level (m bgl), unless stated otherwise.

4.0 Ground and Groundwater Conditions

4.1 General

The following section provides a summary of the ground conditions encountered across the site during the investigation. Reference should be made to the exploratory hole logs included in Appendix II for detailed descriptions of the strata and groundwater conditions.

The eastern portion is currently overgrown and has remained undeveloped. However, the western part is covered by demolition rubble with evidence of old floor slabs and areas of hardstanding from the former factory.

4.1.1 Made Ground

3 no. trial pits (TP's A – C) and 2 no. boreholes (BH's 02 – 03) were completed in the eastern part of the site. These identified:

- Unmanaged grass overlying soft brown slightly sandy clay soil with fine roots with occasional anthropogenic materials including glass, brick, re-bar and plastic wrapping to depths of between c.0.10m and c.0.40m bgl.
- Within TP's B and C, the initial topsoil was underlain by variable materials including firm slightly sandy clay with fine roots, a relict topsoil comprising soft to firm slightly sandy clay with fine roots, clayey sandstone gravel as well as possible slag gravel and cobbles exhibiting a strong sulphurous odour. These materials were recorded to depths of between c.0.85m and c.0.90m bgl.
- No visual and / or olfactory evidence of any hydrocarbon type or impacted materials were evident at any of the positions completed across this part of the site.

7 no. trial pits (TP's D – J) and 2 no. boreholes (BH's 01 – 04) were completed in the western part of the site. These identified:

- Not including the trial pits completed in the demolition stockpile (TP's F & G), the majority of this area was covered by demolition type rubble as well as slightly sandy slightly clay to depths of c.0.30m to c.1.25m bgl.
- On the stockpile, TP's F & G identified the crushed demolition rubble to depths of c.2.20m and c.2.40m bgl with possible concrete slabs noted at these depths, with no further excavation possible. On top of the "possible slab" encountered in TPF was a black gravel which exhibited olfactory evidence of hydrocarbons.
- Within TPD, made ground was recorded to a depth of c.0.40m bgl and then identified a relatively thin layer of clay before encountering sandstone. The made ground (gravel) between c.0.23m to c.0.40m bgl was noted to exhibit slight olfactory evidence of hydrocarbons.
- The trial pit (TPD) was extended in length and direction with limited penetration into the sandstone albeit for the made ground (c.9m from the northern boundary) which fell away to c.1.10m bgl where no further excavation was possible. This area will need further works to fully determine the ground conditions at this location.
- Borehole BH04 was positioned to target the historical Above-ground Storage Tank (AST), although no longer present on site. At this location, limited made ground (c.0.30m) was evident with no visual and/or olfactory evidence of hydrocarbons noted.

4.1.2 Natural Drift Deposits

Across the eastern portion of the site, the drift deposits comprised initially firm becoming stiff, occasionally soft, slightly sandy, slightly gravelly clay with occasional cobbles. This was This was proved to a maximum depth of c.5.000m bgl in borehole BH02.

The remainder of the site (western portion), comprised initially firm becoming stiff slightly sandy, slightly gravelly clay with occasional cobbles. This was proved to a maximum depth of c.4.20m bgl in borehole BH01. No drift deposits were identified within TP's D, F and G.

No visual or olfactory evidence of fuel/oil type contamination (no staining, odour or free product) was identified within the drift deposits recovered across the site.

4.1.3 Solid Geological Deposits (Bedrock)

Solid strata (bedrock) was not encountered during the ground investigation.

4.2 Groundwater

During the completion of the trial pits in the east of the site, no groundwater ingresses were recorded with each pit being dry during, and upon completion.

However, across the remainder of the site, water ingresses were recorded in TP's D – G and J at depths of between c.0.40m and c.2.20m bgl. The groundwater was noted within the demolition rubble, former foundation runs and the interface of the made ground and natural clay deposits.

Groundwater monitoring of installations placed in the boreholes has been carried out on four occasions between September and December 2019. The borehole installations recorded standing groundwater at depths of c.0.35m to c.2.58m bgl with periods of being "dry" and "damp at the base".

Given the ground conditions (firm to stiff, occasionally soft sandy gravelly clay), it is likely that the water is perched within the boreholes and has originated from the surface or from minor deposits trapped within any sand lenses rather than a continuous groundwater table.

During recent monitoring visits (October 2019) and following periods of heavy rainfall, the vegetated area in the east of the site was waterlogged with some surface run-off to the lower lying former factory.

It is recommended that allowance be made for some groundwater control measures (i.e. pumping equipment) particularly during wetter periods of the year, as the materials encountered may deteriorate following exposure to surface water.

5.0 Exploratory Hole Testing

In-situ site testing and monitoring was generally undertaken in accordance with BS5930:1999, BS1377:1990 and Eurocode 7 (Part I and II).

5.1 Standard Penetration Tests

5.1.1 Standard Penetration Test Methodology

To determine the relative density and strength of the underlying soils, Standard Penetration Tests (SPT's) were completed within the boreholes. The test uses a "split spoon" sample tube (external diameter of c.50mm, internal diameter of c.35mm and a length of around c.650mm) driven from the base of the borehole as it is progressed, usually at c.1.00m spacing's/intervals.

The sample tube is driven by blows of a slide hammer with a weight of c.63.5kg falling over a c.760mm drop. The sample tube is driven c.150mm into the ground (seating blows) and then the number of blows needed for the tube to penetrate each c.75mm increment up to a depth of c.450mm is recorded.

The number of blows for the final c.300mm of penetration is referred to as the "standard penetration resistance" or "N" value, which are presented on the exploratory hole logs adjacent to each sample depth. Where 50 blows are insufficient to advance the test through a c.75mm interval the amount of penetration after 50 blows is recorded and the test is referred to as a "refusal".

5.1.2 Standard Penetration Test Results

A summary of the Standard Penetration Tests is included below.

Where the standard penetration tests has crossed the horizon between different types of deposits, the result has not been included in the assessment below as the values are not considered representative.

- At a depth of c.1.00m, a single test was completed within the drift deposits (clay) with an "N" value of 16 being recorded with this result indicating that the deposits are stiff (medium strength) in nature.
- At a depth of c.2.00m, two tests were wholly completed in the underlying clay deposits with "N" values of 15 up to 23 being recorded. These results indicate that the deposits are stiff (medium and high strength) in nature.
- At a depth of c.3.00m, two tests were completed in the clay deposits with an "N" values of 23 being recorded indicating that the deposits are stiff (high strength) in nature.
- At a depth of 4.00m, two tests were wholly completed in the underlying clay deposits recorded "N" values of 26 and 50 for limited penetration, with the latter likely to have been influenced by the presence of coarse fractions (i.e. gravel and cobbles).

The results of the standard penetration tests are presented on the borehole logs which are included in Appendix II.

5.2 Hand Shear Vane Tests

A Hand Shear Vane was used where possible to determine the indicative shear strength of the cohesive natural deposits recovered from the boreholes and trial pits.

A series of tests were completed at each test location with an average of the results presented on the exploratory hole logs within Appendix II, adjacent to each test depth. The device takes direct readings of shear strength utilising three vane sizes with an upper testing limit of 140kN/m^2, with the maximum vane value read directly from the calibrated scale ring on the head assembly.

The results of the Hand Shear Vane tests completed within the natural appearing (cohesive/fine) drift deposits recorded at varying depths recorded the following;

- Between c.0.90m to c.1.50m, five tests recorded values of between 36kN/m^2 up to 75kN/m^2, indicating soft to stiff deposits. The average of these results is 50kN/m^2 (firm – medium strength).

The results of the hand shear vane tests are presented on the trial pit logs which are included in Appendix II.

5.3 Ground Gas Monitoring

To assess the on-site potential for hazardous ground gases, the boreholes (BH's 01 to 04) were installed with ground gas monitoring wells to facilitate a period of ground gas monitoring.

The boreholes were installed to depths of between c.1.00m and c.3.00m bgl with a 50mm diameter HDPE standpipe with a bentonite seal for the upper section and a gravel surround for the remainder of the pipe, finished with a plastic end cap and rubber gas bung.

The monitoring and assessment has been completed in accordance with BS8485: 2007: Code of practice for the characterisation and remediation from ground gas affected developments, CIRIA Report C665, November 2007 and the NHBC Document; Guidance on the evaluation of development proposals on site where methane and carbon dioxide are present, March 2007.

As it is the intention of the Client to develop the site for Residential end use, the monitoring of ground gas monitoring must comprise at least six site visits over a minimum period of three-months.

The wells have been monitored on 6 No. occasions between the 4th September and 4th December 2019, in general accordance with CIRIA C665 (Table 5.5a and 5.5b) using a GFM436 Ground Gas Analyser with internal flow pod.

The results of monitoring are included on the Ground Gas Monitoring Record Sheets included in Appendix II. The ground gas risk assessment is presented in Section 7 of this report.

6.0 Laboratory Testing

6.1 Geotechnical Testing

Geotechnical testing was completed generally in accordance with BS1377:1990: Part 1 to 4 by the following UKAS and MCERTS accredited laboratory:

- Professional Soil Laboratories (PSL) of Doncaster, Yorkshire.
- Derwentside Environmental Testing Services Limited (DETS) of Consett, County Durham.

9 no. samples of the materials recovered from the exploratory holes at depths of between c.0.60m and c.3.00m bgl were subjected to the following laboratory based geotechnical tests:

- Moisture Content
- Atterberg - Liquid and Plastic Limits

6.2 Chemical Screening

6.2.1 Determination of pH and Water-Soluble Sulphate

In order to determine the correct concrete classification for buried structures (foundations), laboratory testing was undertaken for pH and water-soluble sulphate (SO_4). The tests were completed on 16 no. samples of made ground recovered from the exploratory holes at depths ranging between c.0.10m and c.2.00m bgl as well as 4 no. samples of the natural clay deposits recovered from depths of between c.0.60m to c.1.50m bgl. The testing was completed in general accordance with BS1377:1990: Part 1 to 4 by the following UKAS and MCERTS accredited laboratory:

- Chemtech Environmental Testing of Stanley, County Durham.
- Derwentside Environmental Testing Services Limited (DETS) of Consett, County Durham.

The results of the testing are summarised in Section 10 and presented in the Chemtech report (refs: 80693 and 80748) and DETS report (19-16314) which are included in Appendix III.

6.2.2 Contamination Testing for Human Health

To enable the completion of a Level 1 Generic Quantitative Risk Assessment (GQRA) for Human Health, 15 no. samples of the made ground from across the site at depths of between c.0.10m and c.2.00m bgl were subjected to analysis at the following UKAS and MCERTS accredited laboratory:

- Chemtech Environmental Testing of Stanley, County Durham.

Potential Contaminants of Concern (PCOC's) have been determined for the development area based on the descriptions of the materials encountered within the exploratory holes. The samples were subjected to contamination testing for the determinants detailed below:

- **Inorganic Soil Suite (Human Health Risk Assessment):** Metal (Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium and Zinc), Cyanide, Asbestos and Total Organic Carbon.
- **Organic Soil Suite (Human Health Risk Assessment):** Speciated Polycyclic Aromatic Hydrocarbons (PAH – EPA 16), Speciated Total Petroleum Hydrocarbons (Aromatic / Aliphatic Split), MTBE and BTEX.
- **Other:** Polychlorinated biphenyls (PCB's).

The full catalogue of soil screening results and test detection limits can be seen in the Chemtech report (refs: 80693 and 80748) contained in Appendix III.

6.2.3 Perched Water Testing (Controlled Waters Risk Assessment)

The investigation included contamination screening on water samples recovered from the exploratory holes to determine if any water encountered potentially poses a risk to the environment, specifically controlled waters and adjacent sites. The suite of screening undertaken was completed to reflect the potential contaminants of concern for the site based on the material descriptions and the Phase 1: Desk Top Study completed by GEO. The suite of screening consisted of:

- **Organic Soil Suite (Controlled Waters Risk Assessment):** Suite comprised of Polycyclic Aromatic Hydrocarbons (PAH – USEPA 16) and Speciated Total Petroleum Hydrocarbons (TPH).

The full catalogue of soil screening results and test detection limits can be seen in the Chemtech report (ref: 80693) contained in Appendix III.

7.0 Geotechnical Analysis

7.1 Testing for Moisture Content, Liquid and Plastic Limits

9 no. samples of the natural clay deposits recovered from the exploratory holes at a depth of between c.0.60m and c.3.00m bgl were scheduled for classification tests to determine their moisture content, liquid and plastic limits. The results of the testing are contained in the PSL report (ref: PSL19/2697) presented in Appendix III and summarised below.

Typically, natural moisture contents of 14% and 31% were observed, with liquid limits of between 38% and 50% and plasticity indices of between 20% and 26% being recorded. The results indicate clays of intermediate plasticity and a low to medium volume change potential.

8.0 Generic Quantitative Risk Assessment (GQRA)

8.1 Methodology for Assessing Risks to Human Health

Within the UK, the current framework for assessing potential ground contamination is utilising the Contaminated Land Exposure Assessment (CLEA) model as set out by the Department of the Environment, Farming and Rural Affairs (DEFRA) and comprises of the established pollutant linkage model of *Source – Pathway – Receptor*. For a risk to be present to the proposed end user (*Receptor*) there must be an identified *Source* and a plausible *Pathway*. Where one or more of the links are missing then risk is negated. In order for the land to be classified as contaminated under Part IIa of the Environmental Protection Act (EPA) 1990 all three elements of the pollutant linkage must be present.

A human health risk assessment can completed using the contamination levels recorded in the soils by comparing the values against published Generic Assessment Criteria (GAC), such as CLEA Soil Guideline Values (SGV's), Category 4 Screening Levels (C4SLs), Land Quality Management (LQM)/Chartered Institute of Environmental Health (CIEH) S4UL Values and Atkins ATRISK^{SOIL} Soil Screening Values (SSV's). The guidelines are generally based on three main land uses as outlined below:

- *Residential (with or without plant uptake)*
- *Allotments*
- *Commercial*

Where these land uses are not deemed appropriate, other land use values can be considered with the DEFRA C4SLs, LQM S4UL's values and the ATRISK^{SOIL} SSV's (i.e. parks/playing fields/Public Open Space). Alternatively, it is possible to determine site specific intervention values as part of a Detailed Quantitative Risk Assessment (DQRA).

It is anticipated that the proposed development will incorporate a residential development with private gardens. Therefore, for the purpose of this basic Human Health ground contamination risk assessment, the maximum site recorded values for the soil samples have been compared to GAC for a CLEA end use classification of: *Residential with plant uptake* to determine if a potential risk is present to the proposed end users.

Contaminant Analysis Sheets that include the results of the relevant Human Health Risk Assessment and the Generic Assessment Criteria (GAC) values are presented in Appendix IV.

With respect to controlled waters and the environment (i.e. groundwater, nearby surface water features and adjacent sites) published assessment criteria are available that can be used to determine if groundwater is contaminated or if a risk of contaminating groundwater is present. Where groundwater samples are not available an assessment can be made to determine if the contaminants in the underlying soils are sufficiently mobile (i.e. leachable) therefore potentially posing a risk to controlled waters and the environment. This is determined by-way of soil-leachate screening as opposed to direct-water sampling.

For the purposes of this basic Controlled Waters risk assessment the maximum site recorded values (maximum concentrations) for the water samples have been compared to the most relevant and appropriate assessment criteria to determine if a potential risk is present.

Reference is made to: The River Basin Districts Typology, Standard and Groundwater Threshold Values within the Water Framework Directive (England and Wales) 2010, with additional published values for the Environmental Quality Standard (EQS) for Freshwater or UK Drinking Water Standards taken for Water Supply (Water Quality) Regulations 1989 and 2000 (where considered appropriate). The results of the Controlled Waters Risk Assessment are presented in Appendix IV.

8.2 Pollutant Linkage Model

8.2.1 Sources

Table 8.1 below identifies the sources identified during the Ground Investigation works.

Table 8.1

Sources:
S1 = Generic Made Ground. **POTENTIAL SOURCES IDENTIFIED** – Historical information indicates that the site has been developed since c.1938 when a factory was constructed in the west. An electric sub-station is recorded in the north of the site, present since c.1961. The eastern potion has remained undeveloped. Made ground has been encountered during the intrusive ground investigation, especially across the western parts. Localised evidence of hydrocarbon contamination was noted within the made ground in the western part of the site. The made ground may potentially pose a risk of generic contaminants with a potential for organic contaminants where hydrocarbons have been identified. Potential contaminants of concern (PCOC's) include: Arsenic, Cadmium, Chromium (III and VI), Copper, Lead, Mercury, Nickel, Selenium, Zinc, Cyanide (free), Asbestos Containing Materials (ACM's), Speciated PAH. Speciated Total Petroleum Hydrocarbons (TPH – Aliphatic/Aromatic Split), BTEX, MTBE and PCB's.
S2 = Ground Gas. **POTENTIAL SOURCES IDENTIFIED –** Made ground was identified on site as well as identifying the presence of hydrocarbon impacted materials which may represent a source of hydrocarbon vapours. In addition, there is a lack of current EA, BGS, Local Authority or Historical Landfill Sites recorded within c.250m. Given the above, it Has been deemed prudent to undertake a programme of ground gas monitoring.

8.2.2 Pathways

Table 8.2 below identifies the pathways identified during the Ground Investigation works.

Table 8.2

Pathways:
P1 = Inhalation of indoor / outdoor air (wind-blown particles)
P2 = Dermal/direct contact (limited risk present through areas of soft landscaping)
P3 = Ingestion (limited risk present through areas of soft landscaping)
P4 = Migration through existing services
P5 = Direct contact with building materials
P6 = Surface Run-Off
P7 = Leaching from Soils (risk present where sources are exposed to surface water infiltration)

8.2.3 Receptors

Table 8.3 below determines the receptors identified during the Ground Investigation works.

Table 8.3

Receptors:
R1 = Human Health (Residents)
R2 = Human Health (construction workforce – redevelopment works – not considered in this assessment)
R3 = Groundwater (Secondary A Aquifer)
R4 = Building Materials and Buried Utilities
R5 = Flora and Fauna (soft landscaping)

8.3 Human Health Risk Assessment – Comparison with Guidance Levels

8.3.1 Generic Contaminants – Soil

The maximum concentration values for each inorganic analyte have been compared to the most relevant published Generic Assessment Criteria (GAC) as part of the Maximum Value Test. The GAC have been selected using the following guidance documents:

- LQM CIEH S4UL 2014 (Residential with Plant Uptake End Use).
- Atkins ATRISK Soil Screening Values (Residential with Plant Uptake End Use).

As discussed in Section 8.1, the contaminant concentrations have been assessed against GAC for a residential end use with plant uptake as it is anticipated that the proposed development will incorporate private gardens.

From a review of the chemical assessment sheet contained in Appendix IV it can be seen that slightly elevated levels of Lead have been identified that exceed the relevant assessment criteria for a residential end use.

Consequently, the made ground materials tested on site are currently considered to pose a potential risk to the proposed end users with respect to generic contamination where future hard-standings will not be present and further risk assessment (Detailed Quantitative Risk Assessment – DQRA), remediation or protection measures should be considered to ensure the future suitability of the site for future residential development (see Section 8.2.4 for further details).

Any remedial works will require acceptance by the Local Planning Authority prior to implementation on site.

8.3.2 Organic Contaminants – Soil

The maximum concentration values for the organic analytes tested for (i.e. Speciated PAH) have been compared to the most relevant and appropriate published Generic Assessment Criteria (GAC) as part of the Maximum Value Test. The GAC have been selected using the following guidance documents:

- LQM CIEH S4UL 2014 (Residential with Plant Uptake End Use).
- CL:AIRE GAC (2010) (Residential with Plant Uptake End Use).

Taking in to account the average TOC of the soils on the site, this assessment has been completed utilising a 2.5% SOM.

From a review of the Chemical Assessment Sheet contained in Appendix IV it can be seen that a single slightly elevated concentration of PAH has been identified that exceeds the relevant assessment criteria for a residential end use.

No elevated PCB's, MTBE, BTEX and Speciated TPH's have been identified as part of the screening completed.

Consequently, the made ground materials tested on site are currently considered to pose a potential risk to the proposed end users with respect to organic contamination (particularly where future hard-standings will not be present) and further risk assessment (Detailed Quantitative Risk Assessment – DQRA), remediation or protection measures should be considered to ensure the future suitability of the site for future residential development (see Section 8.2.4 for further details).

Any remedial works will require acceptance by the Local Planning Authority prior to implementation on site.

8.3.3 Asbestos Containing Materials (ACM's) – Soil

15 no. samples of the made ground has been subjected to laboratory microscopic analysis to determine the presence or not of Asbestos Containing Materials (ACM's) in accordance with the methodology within HSG 248.

Of the samples tested, all returned a negative result for ACM's and were recorded as NAD (no asbestos detected), i.e. no asbestos was encountered.

8.3.4 Human Health Risk Assessment – Summary

The following is a summary of the Human Health risk assessment based on a *Residential with Plant Uptake* end use:

- **Generic Contamination:** Lead at TPF (c.1.00m) and TPH (c.0.20m).
- **Organic Contamination:** Dibenz(ah)anthracene at TPJ (c.0.50m).
- **Other Contamination:** None.

Based on the above information, elevated contaminants have been identified in the western portion of the site. The elevated results are thought to have been impacted by the presence of anthropogenic debris within the made ground and historical site activities across this part of the site.

Although some made ground was identified across the eastern portion of the site, no elevated levels have been identified and therefore the materials across this area of the site are not deemed to represent a potential risk to the proposed end users.

Consequently, the site can be effectively split in two with further risk assessment (Detailed Quantitative Risk Assessment – DQRA), remediation or protection measures only required across the western portion of the site to ensure the future suitability of the site for the proposed residential development.

This site will therefore require a Remediation Strategy that should be agreed with the Planning Authority prior to implementation on site. Once the remedial works have been agreed and implemented on site the Planning Authority will require the completion of Validation/Verification works and reporting, to confirm the remedial works have been completed in accordance with the agreed remedial strategy.

8.4 Controlled Waters Risk Assessment – Comparison with Guidance Levels

8.4.1 Organic Contamination – Water

In order to determine the potential risk to controlled waters and adjacent sites, the results of the groundwater analysis have been compared to generic assessment criteria as indicated below:

- UK Drinking Water Standards.
- Environment Quality Standard (EQS) Freshwater Standards

From a review of the Chemical Assessment Sheet contained in Appendix IV it can be seen that several elevated PAH's and TPH's have been identified in the western portion of the site where olfactory evidence of hydrocarbons were recorded.

The presence of the organic impacted groundwater could potentially pose a risk to Controlled Waters. The nearest surface water feature being a small stream / drain located c.217m west. There is also speculation that a culvert passes through the site, although its location is currently unknown.

Although the hydrocarbon impacted water is not considered to be widespread across the site, some localised pockets of hydrocarbon impacted water should be anticipated in the western portion of the site.

Given it was identified that natural clay soils were present below the site it is considered that these deposits will restrict potential contamination movements to surrounding features including streams, drains, fishponds and the underlying Secondary (A) Aquifer. Therefore, no significant future risk is identified.

Likewise, the site is not located within a Source Protection Zone with no groundwater abstractions, surface water abstractions or potable water abstractions recorded within c.2km of the site.

With regards to the main contractor and the build phase, contaminated water will potentially be encountered during the site works (i.e. site strip, utility and foundation excavations, etc.) that could exhibit fuel/oil type odours and sheen, particularly when mixed with contaminated soils during excavation. Appropriate measures should be put in place during any site works to ensure that any potentially contaminated water is contained and disposed of appropriately to reduce risk of cross-contamination.

8.5 Ground Gas Risk Assessment

As indicated in Section 5.2, gas and groundwater monitoring wells have been installed in boreholes BH's 01 to 04 and monitoring has been completed on 6 No. occasions. During the monitoring, atmospheric air pressures varied between 981mb and 1012mb and included both rising and falling pressure trends.

A maximum Carbon Dioxide (CO_2) concentration of 3.6%v/v has been recorded as well as a maximum Methane (CH_4) of 0.1%v/v being detected. The minimum Oxygen (O_2) concentration was 9.9% with low positive flow rates being recorded (maximum being +0.4l/h).

In accordance with CIRIA C665 the maximum recorded CH_4 and CO_2 concentration have been converted to Gas Screening Values (GSV), summarised as follows.

In this instance, the CH_4 and CO_2 GSV are:

- **CO_2 GSV = (Max CO_2 (%) / 100) x Max Flow (l/hr),**
- **Therefore; (3.6 / 100) x 0.4 = 0.0144 l/hr GSV**

- **CH_4 GSV = (Max CH_4 (%) / 100) x Max Flow (l/hr),**

- **Therefore; (0.1 / 100) x 0.4 = 0.0004 l/hr GSV**

Therefore, in accordance with CIRIA C665 Table 8.5, taking into consideration the GSV for CO_2 and the maximum gas concentrations, the site falls into Characteristic Situation 1 (CS1) or the Green Classification when utilising the NHBC Characterisation System. This indicates that gas precautions are not necessary at this stage.

8.6 Determination of pH and Water-Soluble Sulphate

As indicated in Section 6, representative samples of the made ground have been screened to determine their pH and soluble sulphate potential to aid the design of buried concrete. The results of the chemical screening are presented in the Chemtech report (refs: 80693 and 80748) and DETS report (19-16314) contained in Appendix III.

From the results, the following observations can be seen:

- pH values in the soils ranged from 4.6 to 10.7.
- Water Soluble Sulphate (SO_4) levels were recorded as ranging from 16mg/l to 2679mg/l.

The dataset has been assessed in accordance with BRE Special Digest 1: 2005. Since the dataset is in excess of 10 results, the mean of the highest 20% of sulphate test results should be taken as the characteristic value of the site. Therefore, the results recorded equate to a Design Sulphate classification of DS-1.

An elevated concentration of soluble sulphate was encountered in trial pit TPC (2679mg/l) which appears to be associated with the slag. As such, this area could be treated as a localised hot spot and the concrete classification increased accordingly (DS-3, AC-5) or the slag should be removed.

In accordance with BRE Special Digest 1: 2005 the results equate to an Aggressive Chemical Environment for Concrete (ACEC) classification of AC-3z (when assuming mobile groundwater – Brownfield Land) as pH levels are recorded as being below the primary pH threshold level of 6.5.

9.0 Construction Related Excavations and Off-Site Disposal

During the construction works it is likely that materials will be excavated on site (i.e. future foundations and buried utilities, etc.) that will not be able to be accommodated on site during to space and level constraints, ultimately requiring removal off site.

During the construction works different materials should be kept separate, as it may be the case that uncontaminated natural materials can be classified as Inert and transferred to an Inert Landfill site. A separate assessment will be required for any topsoil (naturally occurring organic materials) that may be encountered as they cannot be classified as inert due to their natural organic content.

Where made ground materials or disturbed natural strata is to be removed, the results of the soil testing undertaken within this report can be used as a preliminary assessment and the anticipated waste disposal facility should be provided with a copy of the results for review. It may be the case that the waste facility requires additional contamination screening to aid the characterisation of the made ground for off-site disposal (i.e. Waste Acceptance Criteria – WAC) and it is recommended that this be confirmed by the design team prior to commencing on site.

During the construction phase, it may be the case that WAC screening is required to aid classification for disposal and it is recommended that all materials are classified prior to excavation and disposal off site.

Conversely, if materials are required to be brought to site to raise site levels or as part of a clean cover system then certification and/or soil testing results should be reviewed by a suitably experienced and qualified geo-environmental engineer to ensure that potentially contaminated materials are not being brought to site.

Any material movements may require a Material Management Plan (MMP) in accordance with CL:AIRE.

10.0 Discussion and Recommendations

10.1 Ground and Groundwater Conditions Summary

10.1.1 Eastern Portion of the site

The ground investigation has encountered made ground across the eastern part of the site to depths of between c.0.40m and c.1.25m bgl. Across the east, unmanaged vegetation gave way to soft brown slightly sandy clay soil with fine roots and occasional anthropogenic debris including glass, brick, re-bar and plastic wrapping.

Within TP's B and C, these initial materials were underlain by firm slightly sandy clay with fine roots, soft to firm slightly sandy clay with fine roots which is thought to represent a relict topsoil, clayey sandstone gravel as well as possible slag gravel and cobbles exhibiting a strong sulphurous odour. These materials were recorded to depths of c.0.85m and c.0.90m bgl.

Across this area of the site, there was no visual and/or olfactory evidence of any hydrocarbon contamination.

The natural drift deposits comprised initially firm becoming stiff, occasionally soft slightly sandy slightly gravelly clay with occasional cobbles. No visual or olfactory evidence of fuel/oil type contamination (no staining, odour or free product) was identified within the drift deposits recovered across the site.

10.1.2 Western Portion of the site

The western portion of the site (i.e. the area of the former factory), was predominantly covered by demolition type rubble as well as slightly sandy slightly clay to depths of c.0.30m to c.1.25m bgl.

Where targeted (TP's F & G), the demolition rubble materials were proven to depths of c.2.20m and c.2.40m bgl overlying possible concrete slabs. Within TPF only, a black gravel was encountered which exhibited olfactory evidence of hydrocarbon contamination.

An anomaly was noted within TPD whereby made ground was recorded to c.0.40m bgl and then identified a relatively thin layer of clay before encountering sandstone. The made ground (gravel) between c.0.23m to c.0.40m bgl was noted to exhibit slight olfactory evidence of hydrocarbons. At this location, the trial pit was extended to create a "t" shaped excavation, primarily to determine the extent of the sandstone. Approximately c.9m from the northern boundary, the made ground was noted to fall away to a depth of c.1.10m bgl with no further excavation possible.

The natural drift comprised initially firm becoming stiff slightly sandy slightly gravelly clay with occasional cobbles was recovered to depths of at least c.2.25m bgl. No drift deposits were identified within TP's D, F and G.

No visual or olfactory evidence of fuel/oil type contamination (no staining, odour or free product) was identified within the drift deposits recovered across the site.

10.1.3 Groundwater

Groundwater ingresses were noted on site within TP's D – G and J at depths of between c.0.40m and c.2.20m bgl with these present within the demolition rubble, former foundation run and the interface of the made ground and natural clay deposits.

Groundwater monitoring has recorded SWL at depths of between c.0.35m to c.2.58m bgl it is likely that the water has resulted from ingress from the surface which has been trapped/perched within the boreholes rather than a continuous groundwater table.

Following periods of heavy rainfall, the vegetated area in the east of the site was waterlogged with some surface run-off to the lower lying former factory.

Significant groundwater ingress is not anticipated, however, it is recommended that allowance be made for some groundwater control measures (i.e. pumping equipment) particularly during wetter periods of the year, as the materials encountered may deteriorate following exposure to surface water.

10.2 Future Foundations, Pavements and Buried Structures

It is understood that the proposed development will incorporate residential housing. Based on the results of the ground investigation, conventional strip foundations are considered appropriate with localised deepening where required (i.e. to go through any areas of soft clay and any sand lenses).

Based on the testing results, the foundations should be at least 0.90m deep and should extend through all of the made ground. Foundations should be placed in the firm to stiff and/or stiff sandy gravelly clay (Glacial Till). Localised deepening of the foundations may be required where areas of soft/unsuitable deposits are present.

This foundation appraisal will need to take in to account the thickness of the stockpile and proposed finished levels as the trial pits completed on the stockpile (TP's F and G) did not identify any natural clay deposits.

Assuming foundations are based wholly within the initial firm clay deposits, the foundations can be designed to a maximum allowable bearing pressure not exceeding 75KN/m^2, based on the results of the insitu geotechnical testing.

However, if a greater maximum allowable bearing pressure is required then basing the foundations within the stiff clay identified at depths of between c.0.70m and c.1.80m bgl would be possible where an allowable bearing pressure not exceeding 120KN/m^2 can be achieved.

Given the presence of existing mature trees and hedgerows along the majority of the site boundaries, it is recommended that the foundations are designed in accordance with NHBC Standards (Chapter 4.2, "Building Near Trees").

With respect to buried structures (concrete), the pH levels and soluble sulphate concentrations in the soils equate to a Design Sulphate classification of DS-1 and an ACEC classification of AC-3z (BRE Special Digest 1: 2005 – (assuming mobile groundwater). A localised elevated soluble sulphate concentration of 2679mg/l was encountered in trial pit TPC associated with the slag. As such, it is recommended that the slag is removed or where slag is encountered, the concrete classification should be increased to DS-3, AC-5.

Cumbria County Council (Highways Department) visited site during the fieldworks and stated that they believe a culvert passes through the site. They were not able to confirm where it is located, and utility/historical plans do not record its presence. It is recommended that the Design Team make further enquiries as to the potential culvert, as this will have an impact on redevelopment.

10.3 Ground Contamination

Following the results of the contamination assessment it can be seen that elevated levels of both generic (i.e. Lead) and organic contamination (PAH's) have been recorded within the made ground materials across the western part of the site and are considered as posing a potential risk to the proposed end users, based on a residential end use.

Therefore, the site requires a remediation strategy to determine the most appropriate method of remediating the site. At this stage options include the delineation and excavation of the contaminated made ground across the western portion of the site only, the placement of clean cover within the proposed private gardens and soft landscaping or further detailed quantitative risk assessment (DQRA).

At this stage, when considering the above there are a range of suitable options available to adequately protect the proposed end users which may include one of the following;

- Taking in to account the existing site levels, consideration will need to be made to proposed finished site levels to determine if they can accommodate an increase for clean cover purposes or if off site removal of made ground is necessary. By removing the made ground in all areas of private gardens/soft landscaping would suitably remove the *source* from site and therefore no potential risk will remain to the proposed end users. Any made ground to be placed below any areas of hardstanding including buildings and areas of car parking as an engineered fill is not considered to represent a risk to the proposed end users.

- If the made ground cannot be removed from all areas of soft landscaping across the western portion of the site, then a clean cover system should be employed to protect the end user. This should be a minimum 600mm thick. Due to the type and level of contamination, the cclean cover layer should incorporate a 150mm thick "no dig layer" overlying a geotextile membrane acting as a visible marker layer. This should be capped with clean inert sub-soil and topsoil (minimum 150mm topsoil). Under no circumstances should the made ground currently on site be used as part of any future clean cover system.

By undertaking one of the above options, the *source* or pathway would be suitably removed from the *source-pathway-receptor* pollutant linkage and the risk to the proposed end users would be mitigated.

Although hydrocarbons were encountered in TP's D and F, no risk has been identified from the testing. Therefore, in this instance, the materials do not represent a risk to the proposed end users. However, elevated levels were detected in the water samples collected at these locations and suitable techniques will need to be employed during any future site works to dispose of any hydrocarbon impacted groundwater.

It should be noted that the presence of the hydrocarbon impacted groundwater is not considered to represent a risk to off-site receptors as the site is underlain by natural clay soils which will restrict potential contamination movements to surrounding features including streams, drains, fish ponds and the underlying Secondary (A) Aquifer.

In addition, the site is not located within a Source Protection Zone with no groundwater abstractions, surface water abstractions or potable water abstractions recorded within c.2km of the site.

However, with regards to the main contractor and the build phase, contaminated water will potentially be encountered during the site works (i.e. site strip, demolition, utility and foundation excavations, etc.) that could exhibit fuel/oil type odours and sheen, particularly when mixed with contaminated soils during excavation. Appropriate measures should be put in place during any site works to ensure that any potentially contaminated water is contained and disposed of appropriately to reduce risk of cross-contamination.

Prior to the commencement of any future works, it is recommended that a Remediation Strategy be produced for this site and agreed with the Local Authority. Following completion of the remedial works, a Validation Report will also be required, verifying the works carried out. Any materials imported onto site for use within the clean cover system will need to validated to ensure they are suitable for use. The acceptance criteria for validation will need to be agreed with the Local Authority as part of a remediation statement for this site.

It should be noted that the made ground materials identified may potentially pose a risk to future buried utilities (particularly water supplies) and it may be the case that non-standard supply pipes are required. As a result, consultation should be made with the utility providers for their comments.

Taking in to account the historical development and processes that have occurred on site as well as buildings which remain standing, it may prove to be beneficial to have a watching brief on site during the initial site strip to verify that no unforeseen contamination is present on site, in particular the presence of any hydrocarbon contamination.

Any proposed remediation should be confirmed with the Local Planning Authority by-way of a Remediation Strategy prior to commencing on site.

The made ground materials identified as well as the presence of the hydrocarbons may potentially pose a risk to future buried utilities (particularly water supplies) and it may be the case that non-standard supply pipes are required. As a result, consultation should be made with the utility providers for their comments.

10.4 Ground Gas

The results of the ground gas monitoring indicate low levels of methane and carbon dioxide and low flow rates. Therefore, gas protection measures are not considered necessary at this stage.

Radon protection measures are not considered necessary at this time.

10.5 Potential for Permeable Ground

It is understood that the Client is considering the use of soakaway drainage.

Soak away tests have not been completed, however, based on the ground/groundwater conditions encountered across the site, the potential for permeable ground is negligible to very low. As a result, it is unlikely that soakaways will form an appropriate solution and an alternative should be considered.

10.6 General Comments

During the site works, officials from Cumbria County Council Informed GEO that there is a possible culvert present below the site although the definitive route is currently unknown. Therefore, it is considered prudent that prior to any redevelopment works its location is identified as it may include an easement for development purposes.

Although no relict foundations were identified, a possible slab was identified in TP's F & G below the demolition stockpile and therefore it may be the case that as well as the slab, former foundations may also be present on site.

During the site works it was identified that behind the existing electric sub-station, possible Japanese knotweed may be present. It would be considered prudent to obtain advice from a suitably qualified ecologist to determine if this is in fact the case.

Consideration must be made for variations to occur in the ground conditions between the exploratory hole locations for which GEO holds no responsibility and areas where limited access was available. It is therefore recommended that a "watching brief" and "observational technique" be applied to this site to ensure that if ground conditions appear to vary from those identified within this investigation report then advice should be sought from a suitably qualified and experienced Engineering Geologist, Geotechnical or Geo-Environmental Engineer.

The recommendations and opinions expressed in this report are based on the strata observed within the exploratory holes in addition to the results of the site and laboratory tests commissioned by GEO. Consequently, GEO takes no responsibility for conditions that have not been revealed or which occur between them. GEO takes no responsibility for the accuracy of third party information provided by sub-contract drillers or laboratories.

The conclusions and recommendations presented within this report are considered reasonable based on the available information. However, these cannot be guaranteed to gain regulatory approval. Therefore, the report should be passed to the appropriate regulatory authorities and/ or other key stakeholders in order to seek their approval of the findings prior to undertaking any works on site.

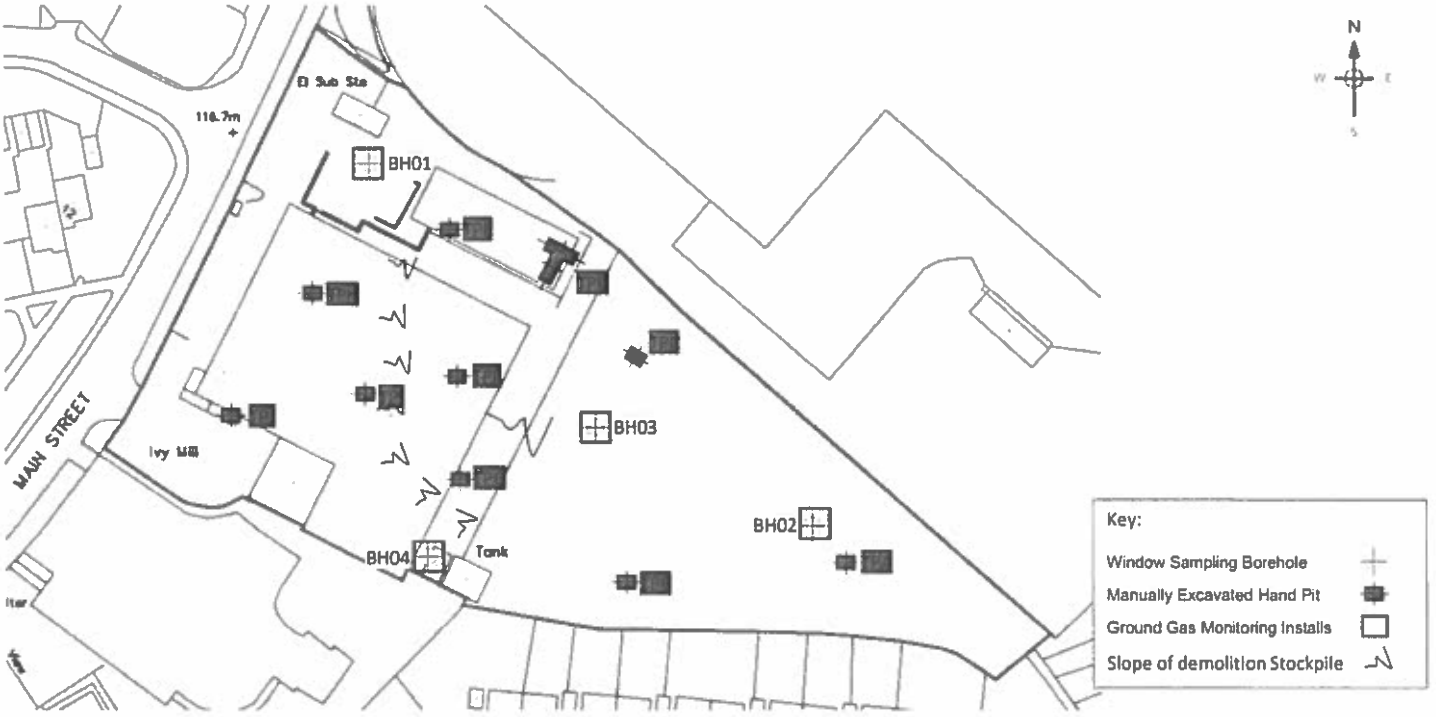
End of Report

Appendix I

- Exploratory Hole Location Plan

GEO
Environmental Engineering

GEO2019-3886: Exploratory Hole Location Plan – Ivy Mill, Hensingham (Approximate Locations – Not to Scale)



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Appendix II

- Exploratory Hole Logs
- Ground Gas and Groundwater Monitoring Record Sheets

GEO
Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. TPA

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.40	MADE GROUND: Unmanaged grass overlying soft brown slightly sandy clay soil with fine roots. Occasional glass pieces were noted. Pottery drain noted at c.0.40m.		0.10 J
0.40	1.00	Firm brown mottled grey slightly sandy slightly gravelly CLAY with occasional sandstone cobbles.		0.90 HSV: 40kN/m² 0.90 B
1.00	2.00	Initially firm becoming stiff dark brown mottled grey slightly sandy slightly gravelly CLAY with occasional cobbles. Noted to be stiff at c.1.50m recovered as gravel size pieces.		1.75 B
		End of trial hole sides noted to be stable. Trial hole remained dry during and upon completion. Dimensions: L (2.50m) x W (0.90m) x D (2.00m)		

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: AH
Site Works Date: 14/08/2019
Plant: Mechanical Excavtor (JCB 3cX)

Log Notes:
HSV = Hand Shear Vane (result in kN/m²)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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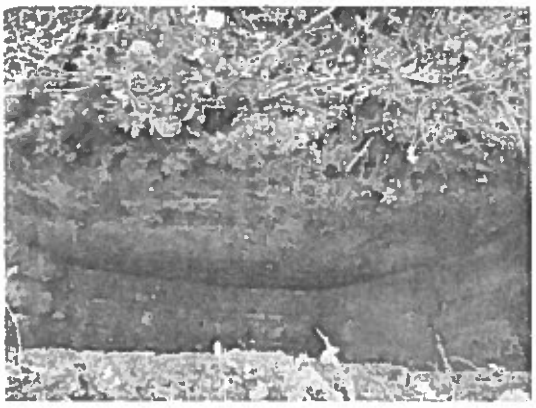
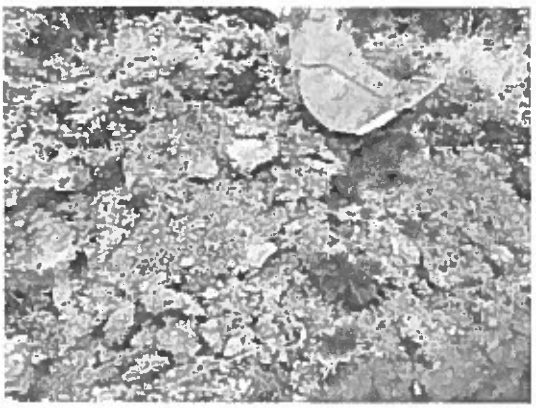
GEO2019-3886: Ivy Mill, Hensingham. TPB

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.10	MADE GROUND: Unmanaged grass overlying soft brown sandy clay soil with fine roots and occasional brick fragments.		0.00 - 0.10 J
0.10	0.50	MADE GROUND: Firm orange brown / grey slightly sandy CLAY. No anthropogenic debris noted.		0.30 J
0.50	0.85	RELICT TOPSOIL: Soft to firm brown slightly sandy CLAY with fine roots.		0.60 J
0.85	1.30	Firm orange brown mottled grey slightly gravelly very sandy CLAY.		1.00 HSV: 36kN/m²
1.30	1.80	Firm occasionally soft brown mottled grey slightly sandy slightly gravelly CLAY with occasional sandstone cobbles.		1.50 B
1.80	2.25	Stiff dark brown mottled grey slightly sandy slightly gravelly CLAY with occasional cobbles. Recovered as gravel size pieces.		2.25 B
		End of trial hole sides noted to be stable. Trial hole remained dry during and upon completion. Dimensions: L (3.00m) x W (0.60m) x D (2.25m)		





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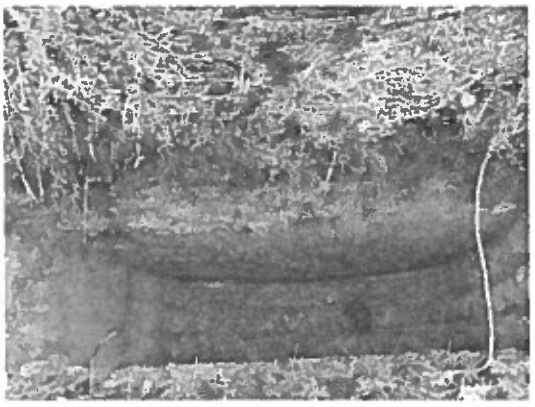
GEO2019-3886: Ivy Mill, Hensingham. TPC

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.35	MADE GROUND: Unmanaged grass overlying soft brown sandy clay soil with fine roots and occasional brick, glass, re-bar and plastic wrapping.		0.25 J
0.35	0.60	MADE GROUND: Red clayey sandstone GRAVEL.		0.40 J
0.60	0.90	MADE GROUND: Possible grey slag gravel and cobbles exhibiting a strong sulphurous odour.		0.60 J
0.90	1.60	Soft to firm light brown mottled grey slightly gravelly sandy CLAY.		1.20 HSV: 48kN/m² 1.20 B
1.60	2.15	Firm to stiff dark brown mottled grey slightly sandy slightly gravelly CLAY with occasional cobbles. At c.1.90m, recovered as gravel size pieces.		1.80 B
		End of trial hole sides noted to be stable. Trial hole remained dry during and upon completion. Dimensions: L (2.60m) x W (0.60m) x D (2.15m)		



Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: AH
Site Works Date: 14/08/2019
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GEO2019-3886: Ivy Mill, Hensingham. TPD

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.23	MADE GROUND: Grey and brown sandy fine to coarse GRAVEL of concrete, brick, sandstone, glass and plastic.		0.20 J
0.23	0.40	MADE GROUND: Grey fine to medium GRAVEL exhibiting slight olfactory evidence of hydrocarbons.		0.30 – 0.40 J
0.40	0.65	Stiff brown slightly gravelly CLAY.		
0.65	1.10	Possible sandstone encountered so extended the trial pit in to a "T" trench. At c.8m from the northern boundary, saturated GRAVEL (possibly demolition rubble) comprising concrete, brick, sandstone) to a depth of c.1.10m where no further excavation was possible.		0.60 W
		End of trial hole sides noted to be stable. The majority of the trial hole remained dry during and upon completion. Saturated gravels (demolition rubble) were noted at end of the trench. Dimensions: L (5.70m & 7.70m) x W (0.80m) x D (0.40m & 1.10m)		

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: AH
Site Works Date: 14/08/2019
Plant: Mechanical Excavtor (JCB 3cX)

Log Notes:
HSV = Hand Shear Vane (result in kN/m²)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub, W = Water

GEO
Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. TPE

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.50 / 1.25	MADE GROUND: Bare ground overlying red / brown sandy fine to coarse GRAVEL & COBBLES of brick, sandstone, concrete and pottery. Deeper made ground (c.1.25m) was noted where it was visible that a former foundation was once present.		0.25 J
0.50 / 1.25	1.50	Firm to stiff dark brown mottled grey slightly sandy slightly gravelly CLAY with occasional cobbles.		1.50 B
		End of trial hole sides noted to be stable. A water ingress was noted at c.1.00m within the infilled former foundation run. Dimensions: L (4.20m) x W (0.65m) x D (1.50m)		

Site: Ivy Lane, Hensingham
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Engineer: AH
Site Works Date: 14/08/2019
Plant: Mechanical Excavtor (JCB 3cX)

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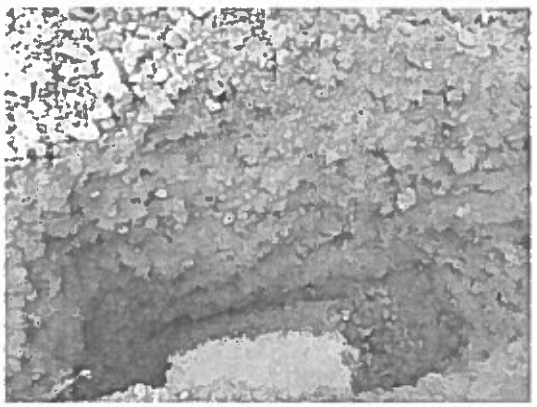
GEO
Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. TPF

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	2.40	MADE GROUND: Bare ground overlying grey / brown sandy fine to coarse GRAVEL & COBBLES of brick, re-bar, concrete within a sandy matrix. Occasional wire, hosing, chipboard and plastic were also recovered.		1.00 J 2.30 W
2.40		At c.2.40m, noted as being hard with no further excavation, possibly a concrete slab. On the top of the "slab" was black GRAVEL which exhibited olfactory evidence of hydrocarbons.		2.40 J
		End of trial hole sides noted to be stable. A water ingress was noted at c.2.00m with a SWL at 2.30m. A visible iridescent sheen as noted on the surface. Dimensions: L (4.00m) x W (1.00m) x D (2.40m)		



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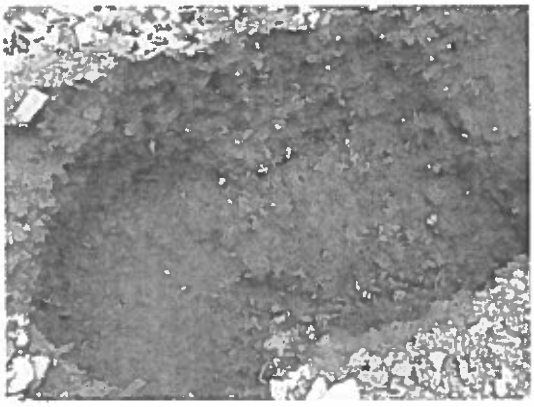
GEO
Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. TPG

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	2.20	MADE GROUND: Bare ground overlying grey / brown sandy fine to coarse GRAVEL & COBBLES of brick, re-bar, concrete within a sandy matrix. Occasional wire, hosing, chipboard and plastic were also recovered.		2.00 J
2.20		At c.2.20m, noted as being hard with no further excavation, possibly a concrete slab.		
		During and upon completion, trial hole sides noted to be unstable. A water ingress was noted at c.2.20m with a similar SWL upon completion. Dimensions: L (3.70m) x W (1.70m) x D (2.20m)		



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Log Notes:
HSV = Hand Shear Vane (result in kN/m²)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO
Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. TPH

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.30	MADE GROUND: Bare ground overlying soft brown / black gravelly SAND and sandy GRAVEL with angular cobbles. No visual or olfactory evidence noted.		0.20 J
0.30	0.70	Firm brown mottled grey slightly sandy slightly gravelly CLAY.		0.60 HSV: 50kN/m² 0.60 B
0.70	2.10	Stiff brown mottled grey slightly sandy slightly gravelly CLAY with occasional cobbles and fine sand partings.		1.50 HSV: 75kN/m² 1.75 B
		End of trial hole sides noted to be stable. Trial hole remained dry during and upon completion. Dimensions: L (3.20m) x W (0.60m) x D (2.10m)		

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: AH
Site Works Date: 14/08/2019
Plant: Mechanical Excavtor (JCB 3cX)

Log Notes:
HSV = Hand Shear Vane (result in kN/m²)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO
Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. TPI

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.30	MADE GROUND: Bare ground overlying soft brown sandy GRAVEL of brick, concrete, glass, rubber pipe with angular cobbles. Noted to be saturated.		0.15 J
0.30	0.70	Firm brown mottled grey slightly sandy slightly gravelly CLAY.		
0.70	2.25	Initially firm becoming stiff dark brown slightly sandy slightly gravelly CLAY with occasional cobbles. Recovered as gravel size pieces.		1.00 B 2.00 B
		End of trial hole sides noted to be stable. Trial hole remained dry during and upon completion. Dimensions: L (3.00m) x W (0.60m) x D (2.25m)		

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: AH
Site Works Date: 14/08/2019
Plant: Mechanical Excavtor (JCB 3cX)

Log Notes:
HSV = Hand Shear Vane (result in kN/m²)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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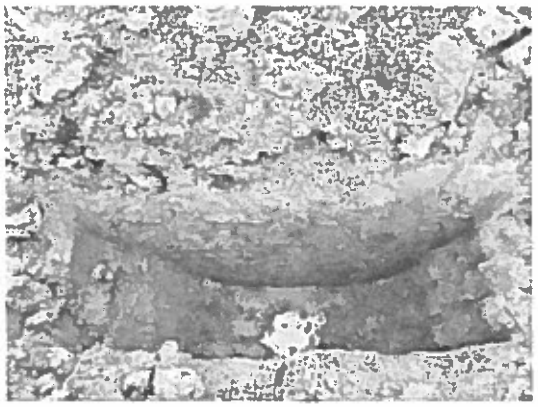
GEO
Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. TPJ

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.40 / 0.60	MADE GROUND: Bare ground overlying mix of saturated brown sandy GRAVEL and firm brown / grey slightly sandy slightly gravelly CLAY with re-bar, brick fragments and whole bricks.		0.50 J
0.40 / 0.60	1.00	Firm brown mottled grey slightly sandy slightly gravelly CLAY.		
1.00	2.00	Initially firm becoming stiff brown / grey slightly sandy slightly gravelly CLAY with occasional cobbles. Recovered as gravel size pieces.		1.00 B 2.00 B
		End of trial hole sides noted to be stable. Water ingress noted at c.0.40m at interface of gravel and clay deposits. Trial hole remained dry during and upon completion. Dimensions: L (3.60m) x W (0.60m) x D (2.00m)		



Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: AH
Site Works Date: 14/08/2019
Plant: Mechanical Excavtor (JCB 3cX)

Log Notes:
HSV = Hand Shear Vane (result in kN/m²)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO
Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. BH01

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	1.40	MADE GROUND: Grey and brown sandy gravelly CLAY with gravel of concrete, brick, sandstone, glass and plastic. Some tarmac noted.		0.10-1.00 J 1.00-1.40 J 1.00-1.45 SPT = N19
1.40	4.20	Firm to stiff brown mottled grey slightly sandy slightly gravelly CLAY with occasional sandstone cobbles.		2.00-3.00 T 2.00-2.45 SPT = N15 3.00-3.45 SPT = N23 3.50-4.00 T 4.00-4.20 SPT = N50LP

End of borehole.
Borehole stable and dry on completion.
Ground gas monitoring well installed to c.2.75m.

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: CRE
Site Works Date: 14/08/2019
Plant: Mini Percussion

Log Key:
SPT = Standard Penetration Test (result as N value)
HSV = Hand Shear Vane (result in kN/m²)
LP = Limited Penetration
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO
Environmental Engineering

GEO2019-3886: Ivy Mill, Hensingham. BH02

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.60	MADE GROUND?: Grass over brown sandy gravelly clayey TOPSOIL with some rootlets. Rare coal fragments noted.		0.00-0.60 J
0.60	1.40	Firm light grey brown sandy gravelly CLAY.		1.00-1.40 JT 1.00-1.45 SPT = N16
1.40	5.00	Firm to stiff dark grey brown sandy gravelly CLAY.		2.00-3.00 T 2.00-2.45 SPT = N23 3.00-4.00 T 3.00-3.45 SPT = N23 4.00-4.45 SPT = N 26

End of borehole.
Borehole stable and dry on completion.
Ground gas monitoring well installed to c.3.00m.

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: CRE
Site Works Date: 14/08/2019
Plant: Mini Percussion

Log Key:
SPT = Standard Penetration Test (result as N value)
HSV = Hand Shear Vane (result in kN/m²)
LP = Limited Penetration
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO
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GEO2019-3886: Ivy Mill, Hensingham. BH03

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.40	MADE GROUND?: Grass over brown sandy gravelly clayey TOPSOIL with some rootlets. Rare coal fragments noted.		0.00-0.40 J
0.40	2.50	Firm light grey brown sandy gravelly CLAY.		

End of borehole.
Borehole stable and dry on completion.
Ground gas monitoring well installed to c.1.20m.

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: CRE
Site Works Date: 14/08/2019
Plant: Mini Percussion

Log Key:
SPT = Standard Penetration Test (result as N value)
HSV = Hand Shear Vane (result in kN/m²)
LP = Limited Penetration
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO
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GEO2019-3886: Ivy Mill, Hensingham. BH04

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.30	MADE GROUND?: Grass over brown sandy gravelly clayey TOPSOIL with some rootlets. Rare coal fragments noted.		0.00-0.30 J
0.30	1.50	Firm light grey brown sandy gravelly CLAY.		0.50-1.00 T
End of borehole. Borehole stable and dry on completion. Ground gas monitoring well installed to c.1.00m.				

Site: Ivy Lane, Hensingham
Client: Gleeson Regeneration Limited
Engineer: CRE
Site Works Date: 14/08/2019
Plant: Mini Percussion

Log Key:
SPT = Standard Penetration Test (result as N value)
HSV = Hand Shear Vane (result in kN/m²)
LP = Limited Penetration
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

Website: www.geoenvironmentalengineering.com
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GEO
Environmental Engineering

Ground Gas & Groundwater Monitoring Record Sheet 01

Site: Ivy Mill, Hensingham

Project No: 2019-3886

Date: 04/09/2019

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	997 F	0.0	0.0	0.5	0.5	19.6	19.6	<0.1	DRY	2.75	-
BH02	997 F	nm	nm	nm	nm	nm	nm	Nm	0.0	3.00	-
BH03	997 F	0.0	0.0	0.7	0.7	19.6	19.6	<0.1	0.35	1.20	-
BH04	997 F	0.0	0.0	0.8	0.4	19.2	19.6	<0.1	Damp at base	1.00	-

Notes:
Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.
F = Falling Atmosphreic Pressure, R = Rising Atmosphreic Pressure, S = Steady Atmospheric Pressure

Monitoring Completed By: JB

Equipment Used: GA2000 Gas Analyser with External Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Dry. Overcast. Temperature 14.0°C.

Notes: BH02 flooded due to standing water. BH02 bailed.

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GEO
Environmental Engineering

Ground Gas & Groundwater Monitoring Record Sheet 02

Site: Ivy Mill, Hensingham

Project No: 2019-3886

Date: 10/09/2019

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	1012 F	0.0	0.0	0.3	0.3	19.8	19.8	<0.1	DRY	2.75	-
BH02	1012 F	0.0	0.0	0.4	0.4	18.3	18.3	<0.1	0.73	3.00	-
BH03	1012 F	0.0	0.0	0.6	0.6	19.5	19.5	<0.1	0.44	1.20	-
BH04	1012 F	0.0	0.0	0.4	0.4	19.6	19.6	<0.1	Damp at base	1.00	-

Notes:
Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.
F = Falling Atmosphreic Pressure, R = Rising Atmosphreic Pressure, S = Steady Atmospheric Pressure

Monitoring Completed By: JB

Equipment Used: GA2000 Gas Analyser with External Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Dry. Overcast. Temperature 15.0°C.

Notes: Boreholes bailed out on the 8th September.

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Ground Gas & Groundwater Monitoring Record Sheet 03

Site: Ivy Mill, Hensingham

Project No: 2019-3886

Date: 16/10/2019

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	0985	0.1	0.1	3.6	2.5	9.9	10.8	+0.4	2.60	2.75	-
BH02	0985	0.1	0.1	0.6	0.5	19.6	19.7	+0.3	0.58	3.00	-
BH03	0985	0.0	0.0	0.4	0.3	18.3	18.4	+0.2	0.45	1.20	-
BH04	0985	0.0	0.0	1.5	0.7	18.9	19.3	+0.3	Damp at base	1.00	-

Notes:
Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.
F = Falling Atmosphreic Pressure, R = Rising Atmosphreic Pressure, S = Steady Atmospheric Pressure

Monitoring Completed By: CRE

Equipment Used: GA2000 Gas Analyser with External Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Overcast, intermittent rain, light winds. Temperature 11.0°C.

Notes:

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GEO Environmental Engineering

Ground Gas & Groundwater Monitoring Record Sheet 04

Site: Ivy Mill, Hensingham

Project No: 2019-3886

Date: 18/10/2019

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	0981	0.0	0.0	1.2	1.4	12.7	13.5	+0.1	2.58	2.75	-
BH02	0981	0.0	0.0	0.9	0.5	19.6	19.6	+0.3	0.58	3.00	-
BH03	0981	0.0	0.0	0.6	0.3	15.2	19.5	+0.3	0.48	1.20	-
BH04	0981	0.0	0.0	1.0	1.0	18.9	18.9	+0.2	Damp at base	1.00	-

Notes:
Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.
F = Falling Atmosphreic Pressure, R = Rising Atmosphreic Pressure, S = Steady Atmospheric Pressure

Monitoring Completed By: CRE

Equipment Used: GA2000 Gas Analyser with External Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Dry with light winds. Temperature 11.0°C.

Notes:

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GEO
Environmental Engineering

Ground Gas & Groundwater Monitoring Record Sheet 05

Site: Ivy Mill, Hensingham

Project No: 2019-3886

Date: 04/11/2019

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	975 R	0.0	0.0	0.6	0.6	18.8	18.8	<0.1	2.54	2.75	-
BH02	975 R	0.0	0.0	1.0	1.0	19.4	19.4	<0.1	0.73	3.00	-
BH03	975 R	0.0	0.0	1.5	1.5	12.8	12.8	<0.1	0.36	1.20	-
BH04	975 R	0.0	0.0	1.2	1.2	18.4	18.4	<0.1	Damp at base	1.00	-

Notes:
Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.
F = Falling Atmosphreic Pressure, R = Rising Atmosphreic Pressure, S = Steady Atmospheric Pressure

Monitoring Completed By: JB

Equipment Used: GA2000 Gas Analyser with External Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Dry with light winds. Temperature 12.0°C.

Notes:

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Telephone: 08456 768 895 / 07883 440 186

GEO
Environmental Engineering

Ground Gas & Groundwater Monitoring Record Sheet 06

Site: Ivy Mill, Hensingham

Project No: 2019-3886

Date: 04/12/2019

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	1011 F	0.0	0.0	0.8	0.7	19.2	19.0	<0.1	2.52	2.75	-
BH02	1011 F	0.0	0.0	1.6	1.4	18.9	19.0	<0.1	0.71	3.00	-
BH03	1011 F	0.0	0.0	1.6	1.6	14.6	15.2	<0.1	0.35	1.20	-
BH04	1011 F	0.0	0.0	1.7	1.8	17.2	17.4	<0.1	Damp at base	1.00	-

Notes:
Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.
F = Falling Atmosphreic Pressure, R = Rising Atmosphreic Pressure, S = Steady Atmospheric Pressure

Monitoring Completed By: JB

Equipment Used: GA2000 Gas Analyser with External Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Dry. Temperature 10.0°C.

Notes:

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Appendix III

- Laboratory Test Results

LABORATORY REPORT

4043

Contract Number: PSL19/5003

Report Date: 27 August 2019

Client's Reference: 2019-3886

Client Name: Geo Environmental Engineering
4 Culgarth Avenue
Cockermouth
Cumbria
CA13 9PL

For the attention of: Andrew Hampson

Contract Title: Ivy Mill, Hemsingham

Date Received: 19/8/2019
Date Commenced: 19/8/2019
Date Completed: 27/8/2019

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 other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson (Director)
A Watkins (Director)
R Berriman (Quality Manager)

L Knight (Senior Technician)
S Eyre (Senior Technician)
R Cowles (Senior Technician)

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awatkins@prosoils.co.uk

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
BH01		B	2.00	3.00	Brown slightly gravelly sandy CLAY.
BH02		B	1.00	1.40	Brown mottled grey sandy CLAY.
TPA		B	0.90		Brown sandy CLAY.
TPB		B	1.50		Brown mottled grey slightly gravelly sandy CLAY.
TPC		B	1.80		Brown mottled grey slightly gravelly sandy CLAY.
TPE		B	1.50		Brown sandy CLAY.
TPH		B	0.60		Brown sandy CLAY.
TPI		B	1.00		Brown slightly gravelly sandy CLAY.
TPJ		B	1.00		Brown sandy CLAY.

UKAS 4043	PSL Professional Soils Laboratory	Ivy Mill, Hensingham	Contract No: PSL19/5003
			Client Ref: 2019-3886

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/m³ Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
BH01		B	2.00	3.00	14			38	18	20	98	Intermediate plasticity Cl.
BH02		B	1.00	1.40	31			50	24	26	100	Intermediate plasticity Cl.
TPA		B	0.90		24			48	23	25	100	Intermediate plasticity Cl.
TPB		B	1.50		22			44	21	23	97	Intermediate plasticity Cl.
TPC		B	1.80		18			42	20	22	97	Intermediate plasticity Cl.
TPE		B	1.50		14			38	18	20	100	Intermediate plasticity Cl.
TPH		B	0.60		24			46	22	24	100	Intermediate plasticity Cl.
TPI		B	1.00		15			41	19	22	98	Intermediate plasticity Cl.
TPJ		B	1.00		16			40	19	21	100	Intermediate plasticity Cl.

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

UKAS TESTING 4043

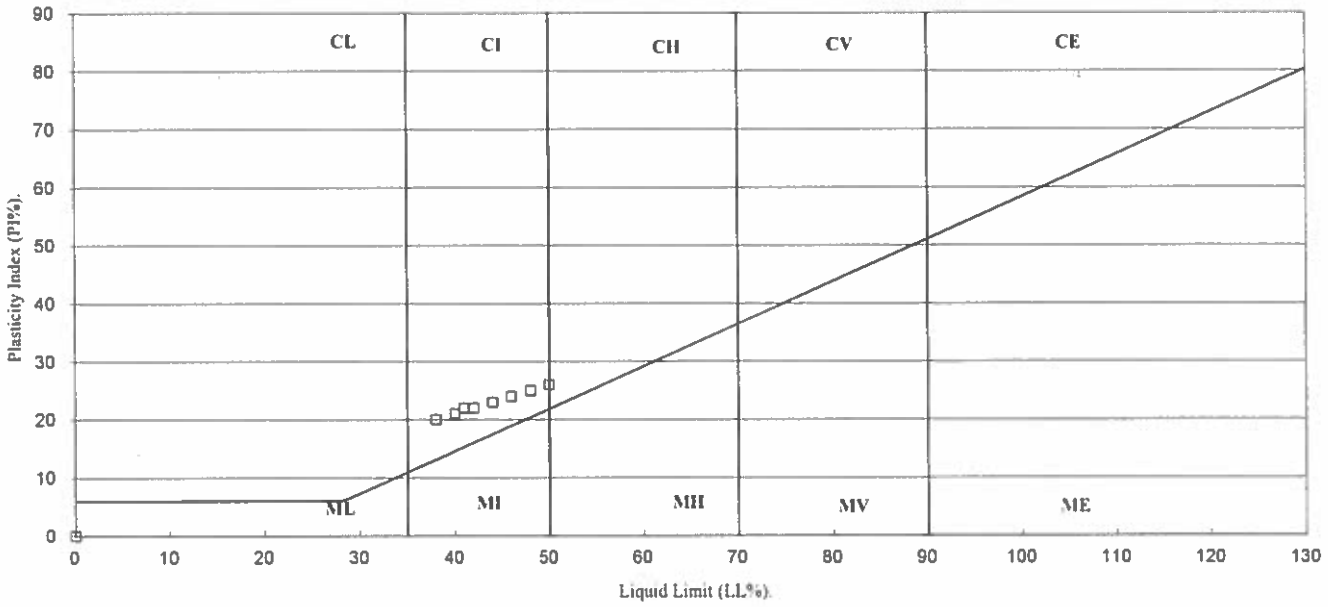
PSL Professional Soils Laboratory

Ivy Mill, Hensingham

Contract No: PSL19/5003

Client Ref: 2019-3886

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



UKAS 4043 PSL Professional Soils Laboratory	Ivy Mill, Hensingham	Contract No: PSL19/5003 Client Ref: 2019-3886

Certificate of Analysis

Certificate Number 19-16314

30-Aug-19

Client Professional Soils Laboratory Ltd
5/7 Hexthorpe Road
Hexthorpe
DN4 0AR

Our Reference 19-16314

Client Reference PSL19/5003

Order No (not supplied)

Contract Title Ivy Mill, Hensingham

Description 4 Soil samples.

Date Received 22-Aug-19

Date Started 22-Aug-19

Date Completed 30-Aug-19

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. 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 except in full, without the prior written approval of the laboratory.

Approved By

Adam Fenwick
Contracts Manager

UKAS TESTING
2139

Summary of Chemical Analysis
Soil Samples

Our Ref 19-16314
Client Ref PSL19/5003
Contract Title Ivy Mill, Hensingham

			Lab No	1551464	1551465	1551466	1551467
			Sample ID	TPA	TPE	TPH	TPI
			Depth	0.90	1.50	0.60	1.00
			Other ID				
			Sample Type	B	B	B	B
			Sampling Date	19/08/19	19/08/19	19/08/19	19/08/19
			Sampling Time	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Inorganics							
pH	DETSC 2008#		pH	7.1	8.1	6.9	8.8
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	27	24	62	19

Information in Support of the Analytical Results

Our Ref 19-16314
Client Ref PSL19/5003
Contract Ivy Mill, Hensingham

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1551464	TPA 0.90 SOIL	19/08/19	PT 1L		
1551465	TPE 1.50 SOIL	19/08/19	PT 1L		
1551466	TPH 0.60 SOIL	19/08/19	PT 1L		
1551467	TPI 1.00 SOIL	19/08/19	PT 1L		

Key: P-Plastic T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

2531

ANALYTICAL TEST REPORT

Contract no: 80693

Contract name: Ivy Mill, Hensingham

Client reference: 2019-3886

Clients name: Geo Environmental Engineering

Clients address: 4 Culgarth Avenue
Cockermouth
Cumbria
CA13 9PL

Samples received: 19 August 2019

Analysis started: 20 August 2019

Analysis completed: 28 August 2019

Report issued: 28 August 2019

Notes:

Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, without prior written approval.
Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.
BTEX compounds are identified by retention time only and may include interference from co-eluting compounds.

Key:

U UKAS accredited test
M MCERTS & UKAS accredited test
$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing
NAD No Asbestos Detected

Approved by: K Campbell

Karan Campbell
Director

Chemtech Environmental Limited

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

All results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.
Analytical results are inclusive of stones.

Lab ref	Sample id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
80693-1	BH01	0.10-1.00	Clay With Gravel	-	-	17.2
80693-2	BH03	0.00-0.40	Clay With Gravel	-	-	22.9
80693-3	BH04	0.00-0.30	Sandy Clay With Gravel	-	-	12.6
80693-4	BH04	0.50-1.00	Clay ith Gravel & Roots	-	-	16.7
80693-5	TPA	0.10	Clay With Gravel	-	-	26.0
80693-6	TPB	0.60	Sand With Gravel	-	-	27.5
80693-7	TPC	0.60	Sand With Gravel & Roadcore	-	-	8.7
80693-8	TPC	1.20	Clay With Gravel	-	-	18.1
80693-9	TPD	0.30-0.40	Sand With Gravel	-	-	6.0
80693-10	TPF	1.00	Clay Sand With Gravel	-	-	13.2
80693-11	TPF	2.40	Sand With Gravel	-	-	16.8
80693-12	TPG	2.00	Sand With Gravel	-	-	10.9
80693-13	TPH	0.20	Clay Sand With Gravel	-	-	17.9
80693-14	TPI	0.15	Sand With Gravel	-	-	14.9
80693-15	TPJ	0.50	Sandy Clay With Gravel	-	-	14.4

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SOILS

Lab number			80693-1	80693-2	80693-3	80693-4	80693-5	80693-6
Sample Id			BH01	BH03	BH04	BH04	TPA	TPB
Depth (m)			0.10-1.00	0.00-0.40	0.00-0.30	0.50-1.00	0.10	0.60
Date sampled			14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019
Test	**Method**	**Units**						
Arsenic (total)	CE127 M	mg/kg As	11	13	13	8.1	21	21
Cadmium (total)	CE127 M	mg/kg Cd	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Chromium (total)	CE127 M	mg/kg Cr	50	47	55	47	53	68
Chromium (III)	-	mg/kg CrIII	50	47	55	47	53	68
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE127 M	mg/kg Cu	23	18	25	20	28	31
Lead (total)	CE127 M	mg/kg Pb	18	42	38	15	65	82
Mercury (total)	CE127 M	mg/kg Hg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel (total)	CE127 M	mg/kg Ni	25	19	44	18	25	31
Selenium (total)	CE127 M	mg/kg Se	1.2	1.2	0.7	1.0	1.2	1.3
Zinc (total)	CE127 M	mg/kg Zn	34	26	43	18	57	55
pH	CE004 M	units	7.4	7.1	7.1	7.4	6.6	7.2
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	592	50	195	134	35	21
Cyanide (total)	CE077	mg/kg CN	<1	<1	<1	<1	<1	<1
Total Organic Carbon (TOC)	CE072 M	% w/w C	1.8	2.4	2.8	1.3	4.2	2.8
PAH								
Naphthalene	CE087 M	mg/kg	0.03	0.03	0.10	<0.02	<0.02	<0.02
Acenaphthylene	CE087 M	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthene	CE087 M	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Fluorene	CE087 U	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	CE087 M	mg/kg	0.24	0.10	0.16	0.02	0.09	0.15
Anthracene	CE087 U	mg/kg	0.06	<0.02	<0.02	<0.02	<0.02	0.02
Fluoranthene	CE087 M	mg/kg	0.35	0.07	0.10	0.02	0.07	0.20
Pyrene	CE087 M	mg/kg	0.31	0.06	0.08	0.02	0.06	0.17
Benzo(a)anthracene	CE087 U	mg/kg	0.20	0.04	0.06	<0.02	0.04	0.10
Chrysene	CE087 M	mg/kg	0.19	0.04	0.06	<0.03	0.04	0.11
Benzo(b)fluoranthene	CE087 M	mg/kg	0.26	0.05	0.08	0.02	0.06	0.14
Benzo(k)fluoranthene	CE087 M	mg/kg	0.09	<0.03	<0.03	<0.03	<0.03	0.06
Benzo(a)pyrene	CE087 U	mg/kg	0.17	0.03	0.04	<0.02	0.03	0.09
Indeno(123cd)pyrene	CE087 M	mg/kg	0.16	0.03	0.05	<0.02	0.03	0.08
Dibenz(ah)anthracene	CE087 M	mg/kg	0.04	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(ghi)perylene	CE087 M	mg/kg	0.14	0.03	0.04	<0.02	0.03	0.07
PAH (total of USEPA 16)	CE087	mg/kg	2.24	0.49	0.76	<0.34	0.46	1.18
BTEX & TPH								
MTBE	CE057 U	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzene	CE057 U	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Toluene	CE057 U	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ethylbenzene	CE057 U	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
m & p-Xylene	CE057 U	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
o-Xylene	CE057 U	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
VPH Aromatic (>EC5-EC7)	CE067	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

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SOILS

Lab number			80693-1	80693-2	80693-3	80693-4	80693-5	80693-6
Sample id			BH01	BH03	BH04	BH04	TPA	TPB
Depth (m)			0.10-1.00	0.00-0.40	0.00-0.30	0.50-1.00	0.10	0.60
Date sampled			14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019
Test	**Method**	**Units**						
VPH Aromatic (>EC7-EC8)	CE067	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
VPH Aromatic (>EC8-EC10)	CE067	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
EPH Aromatic (>EC10-EC12)	CE068	mg/kg	<1	<1	<1	<1	<1	<1
EPH Aromatic (>EC12-EC16)	CE068	mg/kg	<1	<1	<1	<1	<1	<1
EPH Aromatic (>EC16-EC21)	CE068	mg/kg	2	<1	<1	<1	<1	<1
EPH Aromatic (>EC21-EC35)	CE068	mg/kg	2	<1	<1	<1	<1	<1
EPH Aromatic (>EC35-EC44)	CE068	mg/kg	<1	<1	<1	<1	<1	<1
VPH Aliphatic (>C5-C6)	CE067	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
VPH Aliphatic (>C6-C8)	CE067	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
VPH Aliphatic (>C8-C10)	CE067	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
EPH Aliphatic (>C10-C12)	CE068	mg/kg	<4	<4	<4	<4	<4	<4
EPH Aliphatic (>C12-C16)	CE068	mg/kg	7	<4	<4	<4	<4	<4
EPH Aliphatic (>C16-C35)	CE068	mg/kg	40	19	20	<4	24	31
EPH Aliphatic (>C35-C44)	CE068	mg/kg	20	14	<10	<10	15	14
PCB								
PCB Congener 28	CE137 M	mg/kg	<0.004	-	-	-	-	-
PCB Congener 52	CE137 M	mg/kg	<0.004	-	-	-	-	-
PCB Congener 101	CE137 M	mg/kg	<0.008	-	-	-	-	-
PCB Congener 118	CE137 M	mg/kg	<0.006	-	-	-	-	-
PCB Congener 138	CE137 M	mg/kg	<0.006	-	-	-	-	-
PCB Congener 153	CE137 M	mg/kg	<0.009	-	-	-	-	-
PCB Congener 180	CE137 M	mg/kg	<0.008	-	-	-	-	-
PCB (total of ICES 7)	CE137 M	mg/kg	<0.045	-	-	-	-	-
Subcontracted analysis								
Asbestos (qualitative)	$	-	NAD	NAD	NAD	NAD	NAD	NAD

* Higher LOD reported due to sample interference.

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SOILS

Lab number			80693-7	80693-8	80693-9	80693-10	80693-11	80693-12
Sample id			TPC	TPC	TPD	TPF	TPF	TPG
Depth (m)			0.60	1.20	0.30-0.40	1.00	2.40	2.00
Date sampled			14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019
Test	**Method**	**Units**						
Arsenic (total)	CE127 M	mg/kg As	6.6	-	5.0	9.3	-	5.9
Cadmium (total)	CE127 M	mg/kg Cd	<0.2	-	0.3	0.4	-	0.2
Chromium (total)	CE127 M	mg/kg Cr	18	-	15	39	-	35
Chromium (III)	-	mg/kg CrIII	18	-	15	39	-	35
Chromium (VI)	CE146	mg/kg CrVI	<1	-	<1	<1	-	<1
Copper (total)	CE127 M	mg/kg Cu	6.1	-	5.0	19	-	11
Lead (total)	CE127 M	mg/kg Pb	13	-	9.8	239	-	51
Mercury (total)	CE127 M	mg/kg Hg	<0.5	-	<0.5	<0.5	-	<0.5
Nickel (total)	CE127 M	mg/kg Ni	6.5	-	7.5	20	-	14
Selenium (total)	CE127 M	mg/kg Se	3.7	-	1.9	0.8	-	0.5
Zinc (total)	CE127 M	mg/kg Zn	9.3	-	<5	161	-	68
pH	CE004 M	units	10.7	7.8	9.1	10.0	-	9.9
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	2679	114	84	478	-	49
Cyanide (total)	CE077	mg/kg CN	<1	-	<1	<1	-	<1
Total Organic Carbon (TOC)	CE072 M	% w/w C	<0.1	-	1.0	1.2	-	0.7
PAH								
Naphthalene	CE087 M	mg/kg	0.05	-	0.12	0.07*	0.06	0.04
Acenaphthylene	CE087 M	mg/kg	<0.02	-	<0.02	0.04*	<0.02	<0.02
Acenaphthene	CE087 M	mg/kg	<0.02	-	<0.02	0.18*	<0.02	0.04
Fluorene	CE087 U	mg/kg	<0.02	-	0.27	0.15*	0.12	0.04
Phenanthrene	CE087 M	mg/kg	0.12	-	0.64	1.52*	0.43	0.53
Anthracene	CE087 U	mg/kg	<0.02	-	0.24	0.86*	0.55	0.21
Fluoranthene	CE087 M	mg/kg	0.07	-	<0.02	3.88*	0.66	1.56
Pyrene	CE087 M	mg/kg	0.06	-	0.13	3.47*	1.01	1.46
Benzo(a)anthracene	CE087 U	mg/kg	0.04	-	0.04	1.75*	0.28	0.78
Chrysene	CE087 M	mg/kg	0.05	-	0.06	1.70*	0.26	0.74
Benzo(b)fluoranthene	CE087 M	mg/kg	0.04	-	0.04	1.91*	0.32	0.98
Benzo(k)fluoranthene	CE087 M	mg/kg	<0.03	-	<0.03	0.82*	0.16	0.38
Benzo(a)pyrene	CE087 U	mg/kg	0.02	-	0.02	1.29*	0.20	0.64
Indeno(123cd)pyrene	CE087 M	mg/kg	0.02	-	<0.02	1.13*	0.20	0.55
Dibenz(ah)anthracene	CE087 M	mg/kg	<0.02	-	<0.02	0.24*	0.05	0.10
Benzo(ghi)perylene	CE087 M	mg/kg	<0.02	-	<0.02	0.94*	0.18	0.45
PAH (total of USEPA 16)	CE087	mg/kg	0.49	-	1.57	20.0*	4.48	8.50
BTEX & TPH								
MTBE	CE057 U	mg/kg	<0.02	-	<0.02	<0.02	<0.02	<0.02
Benzene	CE057 U	mg/kg	<0.01	-	<0.01	<0.01	<0.01	<0.01
Toluene	CE057 U	mg/kg	<0.01	-	<0.01	<0.01	<0.01	<0.01
Ethylbenzene	CE057 U	mg/kg	<0.01	-	0.03	<0.01	<0.01	<0.01
m & p-Xylene	CE057 U	mg/kg	<0.02	-	<0.02	<0.02	<0.02	<0.02
o-Xylene	CE057 U	mg/kg	<0.01	-	0.01	<0.01	<0.01	<0.01
VPH Aromatic (>EC5-EC7)	CE067	mg/kg	<0.01	-	<0.01	<0.01	<0.01	<0.01

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SOILS

Lab number			80693-7	80693-8	80693-9	80693-10	80693-11	80693-12
Sample id			TPC	TPC	TPD	TPF	TPF	TPG
Depth (m)			0.60	1.20	0.30-0.40	1.00	2.40	2.00
Date sampled			14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019	14/08/2019
Test	**Method**	**Units**						
VPH Aromatic (>EC7-EC8)	CE067	mg/kg	<0.01	-	<0.01	<0.01	<0.01	<0.01
VPH Aromatic (>EC8-EC10)	CE067	mg/kg	0.02	-	<0.01	<0.01	0.01	<0.01
EPH Aromatic (>EC10-EC12)	CE068	mg/kg	<1	-	<1	<1	<1	<1
EPH Aromatic (>EC12-EC16)	CE068	mg/kg	<1	-	<1	<1	<1	<1
EPH Aromatic (>EC16-EC21)	CE068	mg/kg	<1	-	2	12	4	5
EPH Aromatic (>EC21-EC35)	CE068	mg/kg	<1	-	<1	11	2	5
EPH Aromatic (>EC35-EC44)	CE068	mg/kg	<1	-	<1	1	<1	<1
VPH Aliphatic (>C5-C6)	CE067	mg/kg	<0.1	-	<0.1	<0.1	<0.1	<0.1
VPH Aliphatic (>C6-C8)	CE067	mg/kg	<0.1	-	0.1	<0.1	<0.1	<0.1
VPH Aliphatic (>C8-C10)	CE067	mg/kg	<0.1	-	3.2	<0.1	0.5	<0.1
EPH Aliphatic (>C10-C12)	CE068	mg/kg	<4	-	100	<4	135	<4
EPH Aliphatic (>C12-C16)	CE068	mg/kg	6	-	471	12	1614	9
EPH Aliphatic (>C16-C35)	CE068	mg/kg	106	-	857	564	6113	200
EPH Aliphatic (>C35-C44)	CE068	mg/kg	24	-	16	215	2322	105
PCB								
PCB Congener 28	CE137 [M]	mg/kg	-	-	-	-	-	-
PCB Congener 52	CE137 [M]	mg/kg	-	-	-	-	-	-
PCB Congener 101	CE137 [M]	mg/kg	-	-	-	-	-	-
PCB Congener 118	CE137 [M]	mg/kg	-	-	-	-	-	-
PCB Congener 138	CE137 [M]	mg/kg	-	-	-	-	-	-
PCB Congener 153	CE137 [M]	mg/kg	-	-	-	-	-	-
PCB Congener 180	CE137 [M]	mg/kg	-	-	-	-	-	-
PCB (total of ICES 7)	CE137 [M]	mg/kg	-	-	-	-	-	-
Subcontracted analysis								
Asbestos (qualitative)	[$]	-	NAD	-	NAD	NAD	-	NAD

* Higher LOD reported due to sample interference.

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SOILS

Lab number			80693-13	80693-14	80693-15
Sample id			TPH	TPI	TPJ
Depth (m)			0.20	0.15	0.50
Date sampled			14/08/2019	14/08/2019	14/08/2019
Test	**Method**	**Units**			
Arsenic (total)	CE127 M	mg/kg As	11	9.2	9.6
Cadmium (total)	CE127 M	mg/kg Cd	0.7	0.4	0.3
Chromium (total)	CE127 M	mg/kg Cr	54	38	38
Chromium (III)	-	mg/kg CrIII	54	38	38
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	<1
Copper (total)	CE127 M	mg/kg Cu	35	24	21
Lead (total)	CE127 M	mg/kg Pb	341	113	89
Mercury (total)	CE127 M	mg/kg Hg	<0.5	<0.5	<0.5
Nickel (total)	CE127 M	mg/kg Ni	33	21	19
Selenium (total)	CE127 M	mg/kg Se	1.4	0.7	0.9
Zinc (total)	CE127 M	mg/kg Zn	220	136	95
pH	CE004 M	units	9.5	10.1	8.4
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	519	347	189
Cyanide (total)	CE077	mg/kg CN	<1	<1	<1
Total Organic Carbon (TOC)	CE072 M	% w/w C	4.2	1.3	2.6
PAH					
Naphthalene	CE087 M	mg/kg	0.10	0.07	0.08
Acenaphthylene	CE087 M	mg/kg	<0.02	0.03	0.04
Acenaphthene	CE087 M	mg/kg	<0.02	0.29	0.36
Fluorene	CE087 U	mg/kg	<0.02	0.32	0.33
Phenanthrene	CE087 M	mg/kg	0.49	3.90	3.74
Anthracene	CE087 U	mg/kg	0.12	1.08	1.25
Fluoranthene	CE087 M	mg/kg	1.01	5.53	6.18
Pyrene	CE087 M	mg/kg	0.89	4.31	4.72
Benzo(a)anthracene	CE087 U	mg/kg	0.52	2.19	2.66
Chrysene	CE087 M	mg/kg	0.50	1.87	2.26
Benzo(b)fluoranthene	CE087 M	mg/kg	0.65	2.29	2.98
Benzo(k)fluoranthene	CE087 M	mg/kg	0.26	0.98	1.37
Benzo(a)pyrene	CE087 U	mg/kg	0.47	1.77	2.10
Indeno(123cd)pyrene	CE087 M	mg/kg	0.39	1.33	1.84
Dibenz(ah)anthracene	CE087 M	mg/kg	0.07	0.23	0.37
Benzo(ghi)perylene	CE087 M	mg/kg	0.34	1.09	1.51
PAH (total of USEPA 16)	CE087	mg/kg	5.82	27.3	31.8
BTEX & TPH					
MTBE	CE057 U	mg/kg	<0.02	<0.02	<0.02
Benzene	CE057 U	mg/kg	<0.01	<0.01	<0.01
Toluene	CE057 U	mg/kg	<0.01	<0.01	<0.01
Ethylbenzene	CE057 U	mg/kg	<0.01	<0.01	<0.01
m & p-Xylene	CE057 U	mg/kg	<0.02	<0.02	<0.02
o-Xylene	CE057 U	mg/kg	<0.01	<0.01	<0.01
VPH Aromatic (>EC5-EC7)	CE067	mg/kg	<0.01	<0.01	<0.01

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SOILS

Lab number			80693-13	80693-14	80693-15
Sample Id			TPH	TPI	TPJ
Depth (m)			0.20	0.15	0.50
Date sampled			14/08/2019	14/08/2019	14/08/2019
Test	**Method**	**Units**			
VPH Aromatic (>EC7-EC8)	CE067	mg/kg	<0.01	<0.01	<0.01
VPH Aromatic (>EC8-EC10)	CE067	mg/kg	<0.01	<0.01	<0.01
EPH Aromatic (>EC10-EC12)	CE068	mg/kg	<1	<1	<1
EPH Aromatic (>EC12-EC16)	CE068	mg/kg	<1	<1	<1
EPH Aromatic (>EC16-EC21)	CE068	mg/kg	4	16	17
EPH Aromatic (>EC21-EC35)	CE068	mg/kg	4	12	15
EPH Aromatic (>EC35-EC44)	CE068	mg/kg	<1	2	3
VPH Aliphatic (>C5-C6)	CE067	mg/kg	<0.1	<0.1	<0.1
VPH Aliphatic (>C6-C8)	CE067	mg/kg	<0.1	<0.1	<0.1
VPH Aliphatic (>C8-C10)	CE067	mg/kg	<0.1	<0.1	<0.1
EPH Aliphatic (>C10-C12)	CE068	mg/kg	<4	<4	<4
EPH Aliphatic (>C12-C16)	CE068	mg/kg	5	11	8
EPH Aliphatic (>C16-C35)	CE068	mg/kg	103	301	420
EPH Aliphatic (>C35-C44)	CE068	mg/kg	28	126	177
PCB					
PCB Congener 28	CE137 M	mg/kg	-	-	-
PCB Congener 52	CE137 M	mg/kg	-	-	-
PCB Congener 101	CE137 M	mg/kg	-	-	-
PCB Congener 118	CE137 M	mg/kg	-	-	-
PCB Congener 138	CE137 M	mg/kg	-	-	-
PCB Congener 153	CE137 M	mg/kg	-	-	-
PCB Congener 180	CE137 M	mg/kg	-	-	-
PCB (total of ICES 7)	CE137 M	mg/kg	-	-	-
Subcontracted analysis					
Asbestos (qualitative)	$	-	NAD	NAD	NAD

* Higher LOD reported due to sample interference.

Chemtech Environmental Limited

WATERS

Lab number			80693-16	80693-17
Sample id			TPD	TPF
Depth (m)			0.60	2.30
Date sampled			14/08/2019	14/08/2019
Time sampled			-	-
Test	**Method**	**Units**		
PAH				
Naphthalene	CE051	µg/l	<0.1	<0.1
Acenaphthylene	CE051	µg/l	<0.1	<0.1
Acenaphthene	CE051	µg/l	<0.1	<0.1
Fluorene	CE051	µg/l	<0.1	<0.1
Phenanthrene	CE051	µg/l	<0.1	<0.1
Anthracene	CE051	µg/l	<0.1	<0.1
Fluoranthene	CE051	µg/l	0.5	0.9
Pyrene	CE051	µg/l	0.3	0.9
Benzo(a)anthracene	CE051	µg/l	<0.1	<0.1
Chrysene	CE051	µg/l	<0.1	<0.1
Benzo(b)fluoranthene	CE051	µg/l	<0.1	<0.1
Benzo(k)fluoranthene	CE051	µg/l	<0.1	0.2
Benzo(a)pyrene	CE051	µg/l	<0.1	<0.1
Indeno(123cd)pyrene	CE051	µg/l	<0.1	<0.1
Dibenz(ah)anthracene	CE051	µg/l	<0.1	<0.1
Benzo(ghi)perylene	CE051	µg/l	<0.1	<0.1
PAH (total of USEPA 16)	CE051	µg/l	<1.6	1.9
TPH				
VPH Aromatic (>EC5-EC7)	CE175	µg/l	<1	<1
VPH Aromatic (>EC7-EC8)	CE175	µg/l	<1	<1
VPH Aromatic (>EC8-EC10)	CE175	µg/l	<1	<1
EPH Aromatic (>EC10-EC12)	CE161	µg/l	<1	<1
EPH Aromatic (>EC12-EC16)	CE161	µg/l	<1	<1
EPH Aromatic (>EC16-EC21)	CE161	µg/l	1	4
EPH Aromatic (>EC21-EC35)	CE161	µg/l	<1	5
EPH Aromatic (>EC35-EC44)	CE161	µg/l	<1	<1
VPH Aliphatic (>C5-C6)	CE175	µg/l	<1	<1
VPH Aliphatic (>C6-C8)	CE175	µg/l	<1	<1
VPH Aliphatic (>C8-C10)	CE175	µg/l	<1	<1
EPH Aliphatic (>C10-C12)	CE161	µg/l	<1	3
EPH Aliphatic (>C12-C16)	CE161	µg/l	4	56
EPH Aliphatic (>C16-C35)	CE161	µg/l	36	389
EPH Aliphatic (>C35-C44)	CE161	µg/l	<1	16

Chemtech Environmental Limited

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE127	Arsenic (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg As
CE127	Cadmium (total)	Aqua regia digest, ICP-MS	Dry	M	0.2	mg/kg Cd
CE127	Chromium (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cr
-	Chromium (III)	Calculation: Cr (total) - Cr (VI)	Dry		1	mg/kg CrIII
CE146	Chromium (VI)	Acid extraction, Colorimetry	Dry		1	mg/kg CrVI
CE127	Copper (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cu
CE127	Lead (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Pb
CE127	Mercury (total)	Aqua regia digest, ICP-MS	Dry	M	0.5	mg/kg Hg
CE127	Nickel (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Ni
CE127	Selenium (total)	Aqua regia digest, ICP-MS	Dry	M	0.3	mg/kg Se
CE127	Zinc (total)	Aqua regia digest, ICP-MS	Dry	M	5	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	As received	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	M	10	mg/l SO_4
CE077	Cyanide (total)	Extraction, Continuous Flow Colorimetry	As received		1	mg/kg CN
CE072	Total Organic Carbon (TOC)	Removal of IC by acidification, Carbon Analyser	Dry	M	0.1	% w/w C
CE087	Naphthalene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Acenaphthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Benzo(b)fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(k)fluoranthene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Indeno(123cd)pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Dibenz(ah)anthracene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(ghi)perylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS	As received		0.34	mg/kg
CE057	MTBE	Headspace GC-FID	As received	U	0.02	mg/kg
CE057	Benzene	Headspace GC-FID	As received	U	0.01	mg/kg
CE057	Toluene	Headspace GC-FID	As received	U	0.01	mg/kg
CE057	Ethylbenzene	Headspace GC-FID	As received	U	0.01	mg/kg
CE057	m & p-Xylene	Headspace GC-FID	As received	U	0.02	mg/kg
CE057	o-Xylene	Headspace GC-FID	As received	U	0.01	mg/kg
CE067	VPH Aromatic (>EC5-EC7)	Headspace GC-FID	As received		0.01	mg/kg
CE067	VPH Aromatic (>EC7-EC8)	Headspace GC-FID	As received		0.01	mg/kg
CE067	VPH Aromatic (>EC8-EC10)	Headspace GC-FID	As received		0.01	mg/kg
CE068	EPH Aromatic (>EC10-EC12)	Solvent extraction, GC-FID	As received		1	mg/kg
CE068	EPH Aromatic (>EC12-EC16)	Solvent extraction, GC-FID	As received		1	mg/kg
CE068	EPH Aromatic (>EC16-EC21)	Solvent extraction, GC-FID	As received		1	mg/kg

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE068	EPH Aromatic (>EC21-EC35)	Solvent extraction, GC-FID	As received		1	mg/kg
CE068	EPH Aromatic (>EC35-EC44)	Solvent extraction, GC-FID	As received		1	mg/kg
CE067	VPH Aliphatic (>C5-C6)	Headspace GC-FID	As received		0.1	mg/kg
CE067	VPH Aliphatic (>C6-C8)	Headspace GC-FID	As received		0.1	mg/kg
CE067	VPH Aliphatic (>C8-C10)	Headspace GC-FID	As received		0.1	mg/kg
CE068	EPH Aliphatic (>C10-C12)	Solvent extraction, GC-FID	As received		4	mg/kg
CE068	EPH Aliphatic (>C12-C16)	Solvent extraction, GC-FID	As received		4	mg/kg
CE068	EPH Aliphatic (>C16-C35)	Solvent extraction, GC-FID	As received		4	mg/kg
CE068	EPH Aliphatic (>C35-C44)	Solvent extraction, GC-FID	As received		10	mg/kg
CE137	PCB Congener 28	Solvent extraction, GC-MS	As received	M	0.004	mg/kg
CE137	PCB Congener 52	Solvent extraction, GC-MS	As received	M	0.004	mg/kg
CE137	PCB Congener 101	Solvent extraction, GC-MS	As received	M	0.008	mg/kg
CE137	PCB Congener 118	Solvent extraction, GC-MS	As received	M	0.006	mg/kg
CE137	PCB Congener 138	Solvent extraction, GC-MS	As received	M	0.006	mg/kg
CE137	PCB Congener 153	Solvent extraction, GC-MS	As received	M	0.009	mg/kg
CE137	PCB Congener 180	Solvent extraction, GC-MS	As received	M	0.008	mg/kg
CE137	PCB (total of ICES 7)	Solvent extraction, GC-MS	As received	M	0.045	mg/kg
$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

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METHOD DETAILS

METHOD	WATERS	METHOD SUMMARY	STATUS	LOD	UNITS
CE051	Naphthalene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Acenaphthylene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Acenaphthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Fluorene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Phenanthrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Anthracene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Fluoranthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Pyrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(a)anthracene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Chrysene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(b)fluoranthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(k)fluoranthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(a)pyrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Indeno(123cd)pyrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Dibenz(ah)anthracene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(ghi)perylene	Solvent extraction, GC-MS		0.1	µg/l
CE051	PAH (total of USEPA 16)	Solvent extraction, GC-MS		1.6	µg/l
CE175	VPH Aromatic (>EC5-EC7)	Headspace GC-FID		1	µg/l
CE175	VPH Aromatic (>EC7-EC8)	Headspace GC-FID		1	µg/l
CE175	VPH Aromatic (>EC8-EC10)	Headspace GC-FID		1	µg/l
CE161	EPH Aromatic (>EC10-EC12)	Solvent extraction, GC-FID		1	µg/l
CE161	EPH Aromatic (>EC12-EC16)	Solvent extraction, GC-FID		1	µg/l
CE161	EPH Aromatic (>EC16-EC21)	Solvent extraction, GC-FID		1	µg/l
CE161	EPH Aromatic (>EC21-EC35)	Solvent extraction, GC-FID		1	µg/l
CE161	EPH Aromatic (>EC35-EC44)	Solvent extraction, GC-FID		1	µg/l
CE175	VPH Aliphatic (>C5-C6)	Headspace GC-FID		1	µg/l
CE175	VPH Aliphatic (>C6-C8)	Headspace GC-FID		1	µg/l
CE175	VPH Aliphatic (>C8-C10)	Headspace GC-FID		1	µg/l
CE161	EPH Aliphatic (>C10-C12)	Solvent extraction, GC-FID		1	µg/l
CE161	EPH Aliphatic (>C12-C16)	Solvent extraction, GC-FID		1	µg/l
CE161	EPH Aliphatic (>C16-C35)	Solvent extraction, GC-FID		1	µg/l
CE161	EPH Aliphatic (>C35-C44)	Solvent extraction, GC-FID		1	µg/l

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DEVIATING SAMPLE INFORMATION

Comments
Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.
For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.
Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
80693-1	BH01	0.10-1.00	N	
80693-2	BH03	0.00-0.40	N	
80693-3	BH04	0.00-0.30	N	
80693-4	BH04	0.50-1.00	N	
80693-5	TPA	0.10	N	
80693-6	TPB	0.60	N	
80693-7	TPC	0.60	N	
80693-8	TPC	1.20	N	
80693-9	TPD	0.30-0.40	N	
80693-10	TPF	1.00	N	
80693-11	TPF	2.40	N	
80693-12	TPG	2.00	N	
80693-13	TPH	0.20	N	
80693-14	TPI	0.15	N	
80693-15	TPJ	0.50	N	
80693-16	TPD	0.60	N	
80693-17	TPF	2.30	N	

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ANALYTICAL TEST REPORT

Contract no: 80748

Contract name: Ivy Mill, Hensingham

Client reference: 2019-3886

Clients name: Geo Environmental Engineering

Clients address: 4 Culgarth Avenue
Cockermouth
Cumbria
CA13 9PL

Samples received: 22 August 2019

Analysis started: 22 August 2019

Analysis completed: 30 August 2019

Report issued: 30 August 2019

Notes:
Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, without prior written approval.
Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key:
U UKAS accredited test
M MCERTS & UKAS accredited test
$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing
NAD No Asbestos Detected

Approved by: K Campbell
Karan Campbell
Director

Chemtech Environmental Limited

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

All results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.
Analytical results are inclusive of stones.

Lab ref	Sample Id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
80748-1	BH01	1.00-1.40	Sandy Clay With Gravel	-	-	11.6
80748-2	BH02	0.00-0.60	Sandy Clay With Gravel	-	-	19.5

Chemtech Environmental Limited

SOILS

Lab number			80748-1	80748-2
Sample id			BH01	BH02
Depth (m)			1.00-1.40	0.00-0.60
Date sampled			14/08/2019	14/08/2019
Test	**Method**	**Units**		
Arsenic (total)	CE127 M	mg/kg As	15	14
Cadmium (total)	CE127 M	mg/kg Cd	<0.2	<0.2
Chromium (total)	CE127 M	mg/kg Cr	53	50
Chromium (III)	-	mg/kg CrIII	53	50
Chromium (VI)	CE146	mg/kg CrVI	<1	<1
Copper (total)	CE127 M	mg/kg Cu	25	29
Lead (total)	CE127 M	mg/kg Pb	18	28
Mercury (total)	CE127 M	mg/kg Hg	<0.5	<0.5
Nickel (total)	CE127 M	mg/kg Ni	34	39
Selenium (total)	CE127 M	mg/kg Se	1.2	1.3
Zinc (total)	CE127 M	mg/kg Zn	49	47
pH	CE004 M	units	7.0	4.6
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	57	16
Cyanide (total)	CE077	mg/kg CN	<1	<1
Total Organic Carbon (TOC)	CE072 M	% w/w C	1.6	2.3
PAH				
Naphthalene	CE087 M	mg/kg	<0.02	0.09
Acenaphthylene	CE087 M	mg/kg	<0.02	<0.02
Acenaphthene	CE087 M	mg/kg	<0.02	<0.02
Fluorene	CE087 U	mg/kg	<0.02	<0.02
Phenanthrene	CE087 M	mg/kg	0.09	0.39
Anthracene	CE087 U	mg/kg	0.04	0.08
Fluoranthene	CE087 M	mg/kg	<0.02	0.10
Pyrene	CE087 M	mg/kg	<0.02	0.09
Benzo(a)anthracene	CE087 U	mg/kg	<0.02	0.04
Chrysene	CE087 M	mg/kg	<0.03	0.04
Benzo(b)fluoranthene	CE087 M	mg/kg	<0.02	0.02
Benzo(k)fluoranthene	CE087 M	mg/kg	<0.03	<0.03
Benzo(a)pyrene	CE087 U	mg/kg	<0.02	<0.02
Indeno(123cd)pyrene	CE087 M	mg/kg	<0.02	<0.02
Dibenz(ah)anthracene	CE087 M	mg/kg	<0.02	<0.02
Benzo(ghi)perylene	CE087 M	mg/kg	<0.02	<0.02
PAH (total of USEPA 16)	CE087	mg/kg	<0.34	0.85
Subcontracted analysis				
Asbestos (qualitative)	$	-	NAD	NAD

Chemtech Environmental Limited

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE127	Arsenic (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg As
CE127	Cadmium (total)	Aqua regia digest, ICP-MS	Dry	M	0.2	mg/kg Cd
CE127	Chromium (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cr
-	Chromium (III)	Calculation: Cr (total) - Cr (VI)	Dry		1	mg/kg CrIII
CE146	Chromium (VI)	Acid extraction, Colorimetry	Dry		1	mg/kg CrVI
CE127	Copper (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cu
CE127	Lead (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Pb
CE127	Mercury (total)	Aqua regia digest, ICP-MS	Dry	M	0.5	mg/kg Hg
CE127	Nickel (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Ni
CE127	Selenium (total)	Aqua regia digest, ICP-MS	Dry	M	0.3	mg/kg Se
CE127	Zinc (total)	Aqua regia digest, ICP-MS	Dry	M	5	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	As received	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	M	10	mg/l SO_4
CE077	Cyanide (total)	Extraction, Continuous Flow Colorimetry	As received		1	mg/kg CN
CE072	Total Organic Carbon (TOC)	Removal of IC by acidification, Carbon Analyser	Dry	M	0.1	% w/w C
CE087	Naphthalene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Acenaphthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Benzo(b)fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(k)fluoranthene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Indeno(123cd)pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Dibenz(ah)anthracene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(ghi)perylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS	As received		0.34	mg/kg
$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

Chemtech Environmental Limited

DEVIATING SAMPLE INFORMATION

Comments
Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.
For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.
Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
80748-1	BH01	1.00-1.40	N	
80748-2	BH02	0.00-0.60	N	

Appendix IV

- GEO Chemical Assessment Sheet

GEO Environmental Engineering Limited

Level 1 Generic Quantitative Risk Assessment - Human Health (Soils) - Maximum Value Test (MxVT)

[illegible]

GEO Environmental Engineering Limited
LEACHATES - Controlled Waters Generic Quantitative Risk Assessment (GQRA) – Maximum Value Test (MxVT)

Lab number			80693-16	80693-17	CT Concentration	CM Exceeds CT?	CT Ref:
Sample Id			TPD	TPF			
Depth (m)			0.60	2.30			
Date sampled			14/08/2019	14/08/2019			
Time sampled			-	-			
Test	**Method**	**Units**					
PAH							
Naphthalene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Acenaphthylene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Acenaphthene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Fluorene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Phenanthrene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Anthracene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Fluoranthene	CE051	µg/l	0.5	0.9	0.1	Yes	UK DWS
Pyrene	CE051	µg/l	0.3	0.9	0.1	Yes	UK DWS
Benzo(a)anthracene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Chrysene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Benzo(b)fluoranthene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Benzo(k)fluoranthene	CE051	µg/l	<0.1	0.2	0.1	Yes	UK DWS
Benzo(a)pyrene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Indeno(123cd)pyrene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Dibenz(ah)anthracene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
Benzo(ghi)perylene	CE051	µg/l	<0.1	<0.1	0.1	No	UK DWS
PAH (total of USEPA 16)	CE051	µg/l	<1.6	1.9	-	-	-
TPH							
VPH Aromatic (>EC5-EC7)	CE175	µg/l	<1	<1	10	No	UK DWS
VPH Aromatic (>EC7-EC8)	CE175	µg/l	<1	<1	10	No	UK DWS
VPH Aromatic (>EC8-EC10)	CE175	µg/l	<1	<1	10	No	UK DWS
EPH Aromatic (>EC10-EC12)	CE161	µg/l	<1	<1	10	No	UK DWS
EPH Aromatic (>EC12-EC16)	CE161	µg/l	<1	<1	10	No	UK DWS
EPH Aromatic (>EC16-EC21)	CE161	µg/l	1	4	10	No	UK DWS
EPH Aromatic (>EC21-EC35)	CE161	µg/l	<1	5	10	No	UK DWS
EPH Aromatic (>EC35-EC44)	CE161	µg/l	<1	<1	10	No	UK DWS
VPH Aliphatic (>C5-C6)	CE175	µg/l	<1	<1	10	No	UK DWS
VPH Aliphatic (>C6-C8)	CE175	µg/l	<1	<1	10	No	UK DWS
VPH Aliphatic (>C8-C10)	CE175	µg/l	<1	<1	10	No	UK DWS
EPH Aliphatic (>C10-C12)	CE161	µg/l	<1	3	10	No	UK DWS
EPH Aliphatic (>C12-C16)	CE161	µg/l	4	56	10	Yes	UK DWS
EPH Aliphatic (>C16-C35)	CE161	µg/l	36	389	10	Yes	UK DWS
EPH Aliphatic (>C35-C44)	CE161	µg/l	<1	16	10	Yes	UK DWS

Notes:
CT = Target Concentration
CM = Maximum Concentration
CM exceeds CT
UK DWS = UK Drinking Water Standard
EQS Fresh = Environmental Quality Standard Freshwater Standard
LDL = Laboratory Detection Limit
BRE = Building Research Establishment Special Digest 1:2005

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