



GEO

Environmental Engineering



PHASE 2: GROUND INVESTIGATION REPORT

PROPOSED RESIDENTIAL DEVELOPMENT OF

LAND OFF GRIFFIN CLOSE, FRIZINGTON

CUMBRIA

FOR:

THOMAS ARMSTRONG CONSTRUCTION LIMITED

GEO Environmental Engineering

DOCUMENT CONTROL SHEET

Report Ref: 2023-5496

Report Date: 03.02.2023

Report Type: PRELIMINARY DRAFT - Ground Investigation Report (GIR) v1

Report Tracking: 03.02.2023 – Preliminary Draft Report v1 Issued for Design Team Review

Prepared By: James Brock *BSc. MSc.* – Geo Environmental Engineer/Associate

Author
Signature:

Checked By: Curtis Evans *B.Sc. (Hons), FGS* – Geo Environmental Engineer/Director

Client Title: Thomas Armstrong Construction Limited

Consultant: ~

CONTENTS

Section		Page
1.0	Introduction	1
2.0	Ground Investigation Report	3
3.0	Ground Investigation Fieldwork	5
4.0	Ground and Groundwater Conditions	6
5.0	Exploratory Hole Testing	8
6.0	Laboratory Testing	10
7.0	Geotechnical Analysis	12
8.0	Generic Quantitative Risk Assessment	13
9.0	Construction Related Excavations and Off-Site Disposal	17
10.0	Discussions and Recommendations	18
Appendix I:	Site Location Plan Exploratory Hole Location Plan Proposed Site Layout Plan	
Appendix II:	Exploratory Hole Logs Ground Gas Monitoring Sheets	
Appendix III:	Laboratory Test Results	
Appendix IV:	GEO Chemical Assessment Sheet	

1.0 Introduction

1.1 Brief

GEO Environmental Engineering Ltd (GEO) were commissioned by the Client, Thomas Armstrong Construction Limited to carry out a ground investigation on land at Griffin Close in Frizington, Cumbria.

The investigation was carried out to determine the ground conditions across the site to aid the design of foundations, roads and drainage, and to assess the risk to human health and environmental receptors from possible contamination and ground gas. The report also includes details of the intrusive coal mining risk assessment.

1.2 Site Location and Description

The site, occupying an area of c.0.51ha is located in the northern part of the Frizington, Cumbria as indicated on the site location plan included in Appendix I. Access to the site is from Griffin Close to the east.

- National Grid Reference: 303358, 517388
- Post Code: CA26 3SH (approximate only)

The site was previously occupied by a care home that has since been demolished. The site is currently undeveloped and covered with grass and occasional block paving. The site is bound by Griffin Close and Greenvale Court to the south east and south west respectively, and by bushes and trees to the north east and north west.

The surrounding land comprises a mixture of housing and agricultural fields.

The site is generally flat and level. A topographical survey has been provided and a copy is included in Appendix 1. The plan indicates elevations of between c.138m and 139m OD.

1.3 Proposed Development

It is understood that the Client plans to develop the site for residential end use. A plan of the site has been provided by the Client and a copy is included in Appendix I. The plan conventional houses with private gardens, soft landscaping, access roads, car parking and other associated infrastructure.

1.4 Other Reports/Studies

GEO completed a Phase 1: Desk Top Study (DTS) Report, details of which are included below:

- Phase 1: Desk Top Study (Preliminary Environmental Risk Assessment), ref: 2022-5436, dated: 17.08.2022.

A brief summary of the findings is included below; however, it is recommended that the DTS is read in conjunction with this report.

Geological data did not indicate any significant made ground on site, however, some made ground was anticipated associated with the former development. Drift deposits are recorded as glacial till (sandy gravelly clay with sand, gravel, cobbles and boulders) overlying solid strata of Pennine Middle Coal Measures (mudstone, siltstone and sandstone with some productive coal seams). The report indicated a potential for shallow mining in the Bannock Coal seam which is indicated to sub-crop across the north east of the site and dip to the south west. Intrusive mining investigations were recommended.

The report also noted that The Coal Authority recorded a mine shaft in the northern part of the site. Two other shafts are recorded to the north of the site. The report recommended intrusive investigations to locate the mine shaft.

Historical records showed the site as undeveloped until 1981 when the care home had been constructed. It is understood that the care home was demolished around c.2012. No potential contamination sources were noted. GEO has not identified a specific reason why the care home was demolished.

The report indicated a high to very high geotechnical risk associated with redevelopment. The main concern was associated with mining, i.e., the potential for shallow unrecorded coal mine workings and the presence of a shaft within the site boundary.

The report indicated a very low risk to human health from potential ground contamination as no significant sources of contamination were identified. A negligible risk was deemed appropriate with regards to controlled waters and a moderate risk was deemed appropriate with regards to possible ground gas (associated with possible shallow mining and on-site mine shafts).

Radon protection measures are not necessary at this time.

The report recommended intrusive investigations to address the concerns and to aid design.

2.0 Ground Investigation Reporting

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-Party 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).

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:

- Land Contamination Risk Management Stages 1 to 4 (LCRM – www.gov.uk) – April 2021.
- BS10175: 2017: Code of Practice for the Investigation of Potentially Contaminated Sites.
- BS5930: 2020: Code of Practice for Site Investigations.
- BS1377: 1990: Methods of test for soils for civil engineering purposes.
- BS8485: 2019: 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.
- CIRIA C758D 2019 - Abandoned Mine Workings Manual.

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 the 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.

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, including warranty providers in order to seek their approval of the findings prior to undertaking any development works.

The Ground Investigation Report and its contents are limited to the boundaries of the site, as indicated on the Plans in Appendix I. Reliance is for the named Client only. 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 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 September and October 2022. The exploratory holes were located across the site to provide general site coverage taking into consideration the locations of buried utilities and surface obstructions. The trenches were located in the northern part of the site in order to locate the mine shaft.

The exploratory hole location plan is provided in Appendix I.

The ground investigation works comprised:

- 5 No. Dynamic (Windowless) Sampling Boreholes (WS01 to WS05) to depths of between c.1.80m and c.5.95m bgl.
- 3 No. Mechanically Excavated Trial Pits (TP01 to TP03) to depths of between c.1.50m and c.3.00m bgl.
- 3 No. Trenches in the northern part to locate the mine shaft.
- 3 No. rotary openholed borings (RBH-A to RBH-C) to depths of between 25.00m and 30.00m bgl.
- In-situ geotechnical testing (Standard Penetration Tests - SPTs).
- Installation of gas and groundwater monitoring wells (WS02, 03 and 04)
 - Gas and groundwater monitoring (6 visits completed).
- Site supervision by a suitably qualified and experienced Geo-Environmental Engineer.
- Laboratory based geotechnical testing.
- Laboratory chemical screening of soil samples

The investigation fieldworks were undertaken in accordance with BS5930:2020, BS1377:1990 and Eurocode 7 (Part I and II).

At each exploratory hole location, 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).

The results of the in-situ SPT tests are presented on the borehole logs included in Appendix II.

The geotechnical and chemical laboratory tests results are provided in Appendix III.

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.

All depths are reported in metres below ground level (m bgl) unless stated otherwise.

4.1.1 Made Ground and Topsoil

Made ground was encountered across the site to depths of between c.0.40m and 6.60m bgl.

The made ground was noted as deepest across the north eastern part (WS02 and RBHA) where it was recorded as topsoil overlying deep clay fill. Borehole WS02 noted a very loosely infilled void between c.3.50m and c.5.00m bgl with coal, clinker and brick. The borehole encountered no resistance through this 'void' with SPT tests recorded zero blow counts, however, recovery was noted as very poor (10%). The nearby rotary borehole noted very soft clay and mudstone with occasional clayey gravel to a depth of c.6.60m and recorded this as possible fill. The reason for such deep made ground is unclear at present and further works are recommended to confirm and delineate the extents of the fill material.

Made ground across the rest of the site, was typically 0.40m to 2.70m deep and comprised topsoil with occasional gravel of clinker, coal, slag and brick, overlying soft and firm sandy clay fill with gravel of clinker, coal, sandstone and brick. Occasional wood fragments, peat, topsoil and black organic silt inclusions were also noted. This was occasionally underlain by gravel of coarse dolomite.

Three trenches were pulled across the area where the mine shaft is shown on The Coal Authority Plan. The trenches were c.1.60m wide and varied between 11.70m and 13.0m in length. The trenches encountered made ground which was typically less than c.1.30m deep, however, a localised pocket of made ground extending to c.2.70m bgl was noted in Trench 02. This comprised firm grey brown gravelly clay with occasional black organic silt (see photos on logs). No direct evidence of a mine shaft was encountered.

In-situ Standard Penetration Tests (SPTs) were completed in the boreholes at depths of between c.1.20m and c.5.00m bgl. Within the made ground, the tests gave 'N' values of between 0 and 23 confirming highly variable and locally very weak ground.

During the investigation, GEO did not identify any visual or olfactory evidence of fuel/oil type contamination (no staining, odour or free product).

4.1.2 Natural Drift Deposits

The natural drift deposits typically comprised firm to stiff or stiff light brown and grey, silty sandy gravelly clay. Borehole WS01 also encountered a band of medium dense slightly clayey gravelly sand between c.1.90m and c.3.00m bgl.

The clay encountered directly beneath the made ground in borehole WS02 at c.5.50m bgl was noted as a very soft. A comment on the log suggests that this could be possible fill material.

The clay in trial pits TP01 and 02 was noted as stiff to very stiff with gravel of angular mudstone. This was noted as possible heavily weathered bedrock.

In-situ Standard Penetration Tests (SPTs) were completed in the boreholes at depths of between c.1.20m and c.5.00m bgl. Within the natural granular drift deposits (sand deposits in borehole WS01), an SPT 'N' value of 16 was recorded indicating medium dense deposit. The tests within the cohesive deposits gave 'N' values of between 8 and 20 which is indicative of clays of medium to high strength.

4.1.3 Solid Geological Deposits (Bedrock)

Solid strata/bedrock was encountered in the rotary boreholes at depths of between c.2.90m and 6.60m bgl. Possible bedrock was also occasionally encountered at the base of the percussive boreholes at depths of between c.2.70 and c.5.50m bgl. The bedrock was described as light grey and reddish brown mudstone with occasional thin, hard siltstone and sandstone bands.

Up to three seams of coal were encountered in the rotary boreholes from depths of between 7.30m and 19.20m bgl. The seams appear to dip to the south west. These varied between 0.20m and 1.40m in thickness. The seams were noted as intact in the boreholes, which could potentially be representative of coal pillars if workings are present.

In-situ Standard Penetration Tests (SPTs) were completed within the suspected weathered bedrock at the base of the percussive boreholes. The tests gave 'N' values of between 50 and 64 indicating very dense deposits.

4.2 Groundwater

The exploratory holes were typically dry during the intrusive ground investigation works. However, significant groundwater ingress was noted in trial pit TP03 at c.1.30m bgl. This was noted as perched water within the made ground and the flow was noted to cease quickly.

The rotary boreholes were drilled with water flush which masked any groundwater ingress.

Groundwater monitoring of installations placed in the boreholes has been carried out on six occasions between September and December 2022. Standing groundwater levels have been recorded between c.0.20m and c.1.00m bgl, although borehole WS01 typically remained dry. Given the ground conditions, it is likely that the water has resulted from surface ingress which has been trapped/perched within the boreholes rather than a continuous groundwater table.

Based on the results of the ground investigation, 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.

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

In-situ Standard Penetration Tests (SPTs) were completed in the boreholes at depths of between c.1.20m and c.5.00m bgl.

Within the made ground, the tests gave 'N' values of between 0 and 23 confirming highly variable and locally very weak ground.

Within the natural granular drift deposits (sand deposits in borehole WS01), an SPT 'N' value of 16 was recorded indicating a medium dense deposit. The tests within the cohesive deposits gave 'N' values of between 8 and 20 which is indicative of clays of medium to high strength.

Tests within the suspected weathered bedrock gave 'N' values of between 50 and 64 indicating very dense deposits.

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

5.2 Ground Gas Monitoring

To assess the on-site potential for hazardous ground gases, the boreholes (WS02, 03 and 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.1.80m and c.4.80m bgl with a 50mm diameter HDPE standpipe. The top section of the well comprised solid pipe surrounded by a bentonite seal and the lower section comprised slotted pipe and a gravel filter. A plastic cap was placed at the base of the well and the rubber bung and gas valve were fitted at the surface. The installation details are presented on the borehole logs in Appendix II.

The monitoring and assessment have been completed in accordance with BS8485: 2015: Code of practice for the characterisation and remediation from ground gas affected developments, CIRIA Report C665, November 2015 and the NHBC Document; Guidance on the evaluation of development proposals on site where methane and carbon dioxide are present, March 2015.

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 six occasions between the 21st September and 5th December 2022, in general accordance with CIRIA C665 (Table 5.5a and 5.5b) using a GA2000 Ground Gas Analyser with external 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 8 of this report.

6.0 Laboratory Testing

6.1 Geotechnical Testing

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

- Northumberland County Council Highways Laboratory, Cramlington, Northumberland (NCC).

Samples of the materials recovered from the exploratory holes at depths of between c.1.20m and c.2.50m 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), the following samples were scheduled for laboratory pH and water-soluble sulphate (SO₄) screening:

- 2 No. samples of topsoil (c.0.10 to c.0.15m bgl)
- 7 No. samples of made ground (c.0.10m to c.2.50m bgl)
- 4 No. samples of the natural drift / solid strata deposits (c.1.70m to c.3.00m 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.

The results of the testing are summarised in section 10 and presented in the Chemtech report (ref: 113952) contained 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, the following samples were scheduled for chemical screening:

- 2 No. samples of topsoil (c.0.10m to c.0.15m bgl)
- 6 No. samples of made ground (c.0.00m to 0.50m bgl)
- 2 No. samples of natural strata (c.3.00m bgl)

The samples 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 and the potential for made ground of an unknown source. The samples were screened for the contaminants detailed on the following page:

- **Inorganic Soil Suite (Human Health Risk Assessment):** Metals (Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium and Zinc), Cyanide and Total Organic Carbon.
- **Organic Soil Suite (Human Health Risk Assessment):** Speciated Polycyclic Aromatic Hydrocarbons (PAH – USEPA 16).
- **Other:** Asbestos

The full catalogue of soil screening results and test detection limits can be seen in the Chemtech report (ref: 113952) contained in Appendix III.

No visual or olfactory evidence of organic contamination was identified during the fieldworks. Therefore, the samples were not screened for TPH, BTEX, MTBE, SVOC or VOC.

6.3 Controlled Waters Risk Assessment

The Phase 1: Desk Top Study indicated that the risk to Controlled Waters was considered negligible based on the site's history and the lack of sensitive receptors. During the intrusive site works, no evidence of organic contamination or potentially mobile contaminants was encountered. As such, no further assessment is deemed to be required with respect to controlled waters.

7.0 Geotechnical Analysis

7.1 Testing for Moisture Content, Liquid and Plastic Limits

5 No. samples of the natural clay deposits recovered from the exploratory holes at depths of between c.1.20m and c.2.50m bgl were scheduled for classification tests to determine their moisture content, liquid and plastic limits. The results of the testing are contained in the NCC report (ref: S1438) presented in Appendix III and summarised below.

Natural moisture contents of between 10.5% and 27.9% were observed, with liquid limits of between 36% and 45% and plasticity indices of between 16% and 20% being recorded. The result for borehole BH01 indicates a silt of intermediate plasticity. The tests for the rest of the samples indicate clays of intermediate plasticity and a low 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 be 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), CL:AIRE/DEFRA Category 4 Screening Levels (C4SLs), Land Quality Management (LQM) and 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 purposes 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 End Use* 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.

8.2 Human Health Risk Assessment – Comparison with Guidance Levels

8.2.1 Inorganic Contaminants – Soil

The maximum concentrations for each inorganic analyte have been compared to the published Generic Assessment Criteria (GAC). The GAC have been selected using the following guidance documents:

- LQM/CIEH S4UL 2015 (Residential with Plant Uptake End Use).
- CL:AIRE/DEFRA Cat 4 Screening Levels C4SL (Residential with Plant Uptake End Use).
- Atkins ATRISK Screening Values (Residential with Consumption of Homegrown Produce).

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

Based on the results of the contaminant analysis sheet contained in Appendix IV, none of the inorganic contaminant concentrations exceed the assessment criteria and as such do not pose a risk to human health.

8.2.2 Organic Contaminants – Soil

The maximum concentration values for the organic analytes tested for (i.e. Speciated PAH) have been compared to the published Generic Assessment Criteria which have been selected using the following guidance documents:

- LQM/CIEH S4UL 2015 (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.

Based on the results of the contaminant analysis sheet contained in Appendix IV it can be seen that none of the organic contaminant concentrations exceed the assessment criteria and as such do not pose a risk to human health.

8.2.3 Asbestos Containing Materials (ACM's) – Soil

8 No. samples of the topsoil and made ground have 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.

8.2.4 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:** None.
- **Organic Contamination:** None.
- **Other Contamination:** None.

Based on the Human Health risk assessment above, none of the contaminants have been identified as posing a potential risk to human health with respect to a residential with plant uptake end use.

As such, the materials present on site are unlikely to pose a significant risk to human health. However, as discussed previously, evidence of industrial waste materials including ash, clinker and slag were reported within the topsoil deposits. Therefore, where significant quantities of waste materials are present, the soils are unlikely to be acceptable for re-use within private gardens. It is recommended that an allowance is made for importing suitable clean soils for use in the proposed gardens.

Any imported materials required on site should be screened prior to placement on site to ensure contaminated materials are not being brought to site and that they are suitable for use within a residential setting.

If topsoil is brought on to site, the materials should be as specified in BS 3882:2015 as 'suitable for the intended purpose'. BS3882:2015 relates to nutrient content of topsoil and phytotoxic contamination and does not consider contaminants that pose a risk specifically to human health. Soils should be tested for contaminants that are considered to pose a risk to human health in addition to BS3882:2015 to ensure that they are suitable for their intended use. All materials brought on to site that are to be used as part of soft landscaped areas should be assessed with regards to human health criteria.

8.3 Ground Gas Risk Assessment

As indicated in section 5.5, gas and groundwater monitoring wells have been installed in three boreholes (WS02, 03 and 04) and monitoring has been completed on six occasions.

During the monitoring, atmospheric air pressures varied between 981mb and 1015mb and included rising, steady and falling pressure trends.

A maximum Carbon Dioxide (CO₂) concentration of 4.5%v/v has been recorded and no Methane (CH₄) was detected. The minimum Oxygen (O₂) concentration was 0.8% and the flow was <0.1l/h throughout.

In accordance with CIRIA C665 the maximum recorded CO₂ concentration has been converted to a Gas Screening Value (GSV), summarised as follows.

In this instance, the CO₂ GSV is:

- **CO₂ GSV = (Max CO₂ (%) / 100) x Max Flow (l/hr),**
- **Therefore; (4.5 / 100) x 0.1 = 0.0045 l/hr GSV**

Since no Methane have been detected no GSV has or can be formulated.

Therefore, in accordance with CIRIA C665 Table 8.5, taking into consideration the GSV for CO₂ 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.

However, the exact location of the mine shaft has not been confirmed to date and this is a potential significant source of ground gas, therefore, it would be prudent to allow for the installation of basic gas protection measures at this stage as a precautionary measure regardless of the results. If the location of the shaft is confirmed, it is recommended that all properties within a 50m radius include basic gas protection measures as a precaution. The site will therefore require a Ground Gas Verification Plan and subsequent Verification Report.

At the time of writing, the site was not considered to be at risk of radon gas. Although a UK wide reassessment is understood to be underway, and it is recommended that an up to date radon risk report is procured from the British Geological Survey.

8.4 Determination of pH and Water-Soluble Sulphate

As indicated in Section 6, selected samples of topsoil and natural soil 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 (ref: 113952) contained in Appendix III.

From the results, the following observations can be seen:

- pH values in the soils ranged from 6.8 to 8.4 (slightly acidic to slightly alkali).
- Water Soluble Sulphate (SO₄) levels were recorded as ranging from <10mg/l to 48mg/l.

In accordance with BRE Special Digest 1: 2005 the results recorded equate to a Design Sulphate classification of DS-1 (for brownfield land).

With respect to the pH levels, the results equate to a neutral to slightly alkali chemical environment which is not considered aggressive with respect to concrete. In view of this, an ACEC classification of AC-1 should be adopted (for mobile groundwater on brownfield land).

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 stockpiled separately, and an appropriate waste disposal classification should be determined by the Design Team prior to removal. It may be the case that WAC testing is required to aid the assessment.

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

The ground investigation has encountered variable and locally very deep made ground on site. Across the majority of the site, the made ground was less than 2.70m thick and comprised soft and firm sandy clay fill with gravel of clinker, coal, sandstone and brick. This is likely to be associated with the former care home.

However, localised deep made ground extending to a depth of c.6.6m bgl was encountered in the north eastern part. This was noted as soft and firm clay fill with much organic material and a possible infilled void. It is possible that the fill / void are associated with historical mining on the site and could represent shallow workings, void migration or an infilled shaft. It could also be associated with a former basement beneath the former building although this is considered unlikely. Further works are recommended in this regard to confirm the deep made ground and delineate its extent across the site.

The made ground was generally underlain by firm to stiff and stiff gravelly clay. Geotechnical testing indicates an intermediate plasticity and a low volume change potential.

Bedrock was encountered at depths of between c.2.70m and 6.60m bgl. This comprised mudstone with occasional thin, hard siltstone and sandstone bands and up to three coal seams. The bedrock was often noted as heavily weathered at shallow depths.

The exploratory holes were generally dry apart from TP03 which encountered a localised pocket of perched groundwater at c.1.30m bgl. Perched groundwater was typically recorded at depths of between c.0.20m and c.1.00m bgl during the monitoring. 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.

During the investigation, GEO did not identify any visual or olfactory evidence of fuel/oil type contamination (no staining, odour or free product).

10.2 Coal Mining Risk Assessment

10.2.1 Possible Shallow Unrecorded Workings

The Phase 1: Desk Top Study information records the Bannock Coal seam (up to 2.0m thick) as sub-cropping in the north eastern part of the site with a dip to the south west. The report indicated a significant risk associated with the potential for shallow unrecorded mine workings within this seam. The report also identified a recorded mine shaft in the north western part of the site and recommended works to locate the shaft.

Mudstone bedrock was encountered in the boreholes at depths of between c.2.70m and 6.60m bgl. Up to three seams of coal were encountered in the rotary boreholes from depths of between 7.30m and 19.20m bgl. The seams varied between 0.20m and 1.40m in thickness. The seams appear to dip to the south west in agreement with the geological plan. It is unclear which seam is the Bannock.

The seams were noted as intact with no evidence of mine workings encountered. However, as only three boreholes were sunk, it is possible that the exploratory holes encountered pillars of coal that were often left intact at regular intervals to maintain stability within the mines. Therefore,

consideration should be given to assessing the risk of collapse if any of these seams have been worked elsewhere on site. This is discussed below.

It is generally accepted that there is a risk to the proposed development if the rock cover over a worked coal seam is less than ten times the seam thickness (a ratio of 1:10). There is some debate as to the exact thickness of rock cover required to mitigate the risk of collapse or disturbance at the surface, however, a ratio of 1:15 (15 times seam thickness to rock cover) is generally considered acceptable.

The following table indicates that rock cover thickness and ratio (seam thickness : rock cover) for each of the seams.

	RBH-A		RBH-B		RBH-C	
Seam	Thickness	Rock Cover (ratio)	Thickness (m)	Rock Cover (m)	Thickness (m)	Rock Cover (m)
Seam 1	0.2m	0.7m (1:3.5)	0.5m	11.0 (1:22)	1.1	16.3 (14.8)
Seam 2	1.4m	9.0m (1:6.4)	0.6m	12.0 (1:27)	0.7	25.9 (1:37)
Seam 3	1.2m	12.1m (1:10)	0.8m	24.4 (1:31)	N/A	N/A

Table 1: Coal Seam depths, Rock Cover and Ratios

The risk of collapse is mitigated across the central and southern parts of the site (RBH-B and RBH-C) where the rock cover is sufficient to bridge any collapses (i.e. the ratio is greater than 1:15). However, the ratio between the coal seams and the rock cover is insufficient in the northern part of the site (RBH-A) where the shallow seam is likely to sub-crop (i.e. the ratio is less than 1:10). As such, collapse of workings in this area could migrate to the surface and pose a significant structural risk to the proposed development.

The boreholes sunk in the northern part of the site encountered anomalies that could be associated with shallow workings or a possible mine shaft. This is inconclusive, however, and further would have been recommended in this respect.

Further investigations (boreholes and trial pits) are recommended across the northern part of the site. At this stage, the recommendation would be to allow for remedial measures (pressure grouting).

10.2.2 Possible Mine Shaft on Site

The intrusive ground investigations works did not positively identify any evidence of a mine shaft at the location indicated by The Coal Authority. However, boreholes in the north eastern part of the site encountered anomalies that could be associated with a mine shaft. As such, further works are recommended in this respect.

Suitable works may include geophysical surveys, trenching, rotary drilling or a combination of all three.

It is recommended that no development works are progressed until the shaft has been located or works have been completed without locating evidence of a shaft on site. Again, at this stage the recommendation would be to allow for remedial measures, which would require The Coal Authority agreement and may result in sterile zones.

10.3 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 or mass trench fill is likely to be suitable across the central and southern parts of the site where firm to stiff or stiff clay deposits were

encountered beneath the made ground. However, this would be subject to confirmation of the mine shaft location, determination of the shallow mining situation and delineation of the deep made ground which was encountered across the northern part of the site.

Alternative foundation solutions are likely to be required across the northern part of the site where deep made ground was encountered. Consideration may need to be given to a piled solution, although this would be subject to the results of further intrusive ground investigations (i.e., deeper boreholes to the pile specification).

If the mine shaft is confirmed to be present on site, this will need to be suitably treated and capped. It is likely that the shaft and surrounding ground would need to be sterilised with regards to future development. This should be confirmed as part of any future ground investigation works.

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-1 (BRE Special Digest 1: 2005 – (assuming mobile groundwater).

Based on the ground conditions and the results of the DCP tests, conventional road and pavement construction techniques should be suitable across the central and southern parts of the site. However, it is always recommended that the appropriate CBR value is confirmed by way of plate load testing at formation level prior to construction.

10.4 Ground Contamination

10.4.1 Ground Contamination – Human Health

Following the results of the contamination assessment it can be seen that none of the contaminant concentrations exceed the assessment criteria for a residential development with plant uptake and asbestos fibres have not been detected. As such, the soils do not pose a significant risk to human health.

However, evidence of industrial waste materials including ash, clinker and slag were reported within the topsoil deposits. Therefore, where significant quantities of waste materials are present, the soils are unlikely to be acceptable for re-use within private gardens. It is recommended that an allowance is made for importing suitable clean soils for use in the proposed gardens.

Any imported materials required on site should be screened prior to placement on site to ensure contaminated materials are not being brought to site and that they are suitable for use within a residential setting.

If topsoil is brought on to site, the materials should be as specified in BS 3882:2015 as 'suitable for the intended purpose'. BS3882:2015 relates to nutrient content of topsoil and phytotoxic contamination and does not consider contaminants that pose a risk specifically to human health. Soils should be tested for contaminants that are considered to pose a risk to human health in addition to BS3882:2015 to ensure that they are suitable for their intended use. All materials brought on to site that are to be used as part of soft landscaped areas should be assessed with regards to human health criteria.

In view of the above, remediation is not considered necessary in order to develop the site for residential end use.

10.5 Ground Gas

The results of the preliminary ground gas monitoring indicate no methane, low concentrations of carbon dioxide and low flow rates. Therefore, gas protection measures are not required at this stage.

However, the exact location of the mine shaft has not been confirmed to date and this is a potential significant source of ground gas, therefore, it would be prudent to allow for the installation of basic gas protection measures at this stage as a precautionary measure regardless of the results. If the location of the shaft is confirmed, it is recommended that all properties within a 50m radius include basic gas protection measures as a precaution. The site will therefore require a Ground Gas Verification Plan and subsequent Verification Report.

At the time of writing, the site was not considered to be at risk of radon gas. Although a UK wide reassessment is understood to be underway, and it is recommended that an up to date radon risk report is procured from the British Geological Survey.

10.6 Post Investigation Works

Redundant boreholes should be made safe and secure and should not cause a preferential pathway for contaminants and ground gasses.

Where decommissioning is required, the works should be completed in accordance Environment Agency Guidelines: “Guidance on the design and installation of groundwater Monitoring points”, Section 5.5 Decommissioning (Page 59), and “Decommissioning abandoned boreholes and wells”.

10.7 General Comments

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.

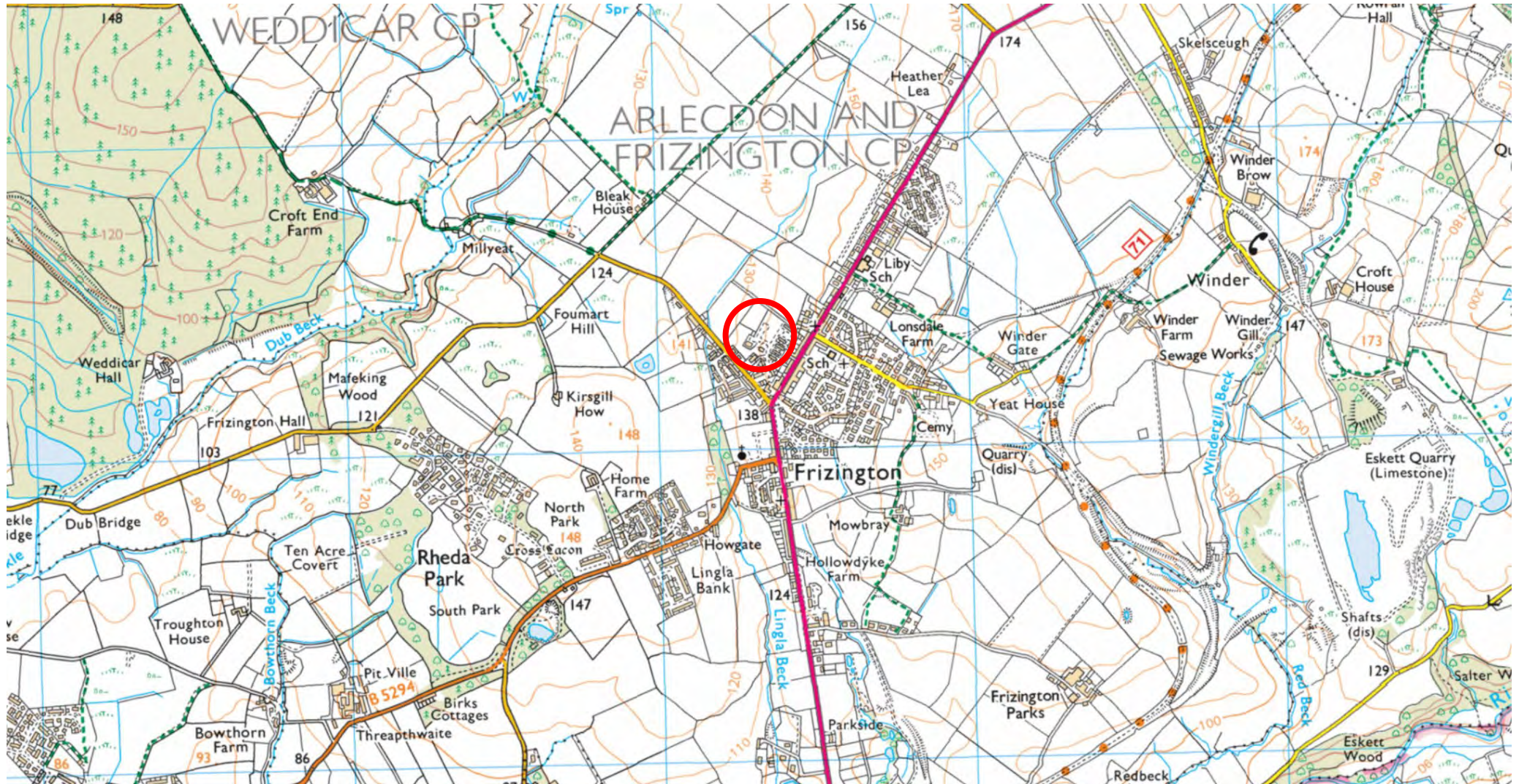
The conclusions and recommendations presented within this report are considered reasonable based on the available information. However, these cannot be guaranteed to gain regulatory approval. Therefore, the report should be passed to the appropriate regulatory authorities and/ or other key stakeholders,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

End of Report

Appendix I

- Site Location Plan
- Exploratory Hole Location Plan
- Proposed Site Layout Plan

GEO2022-5496: Griffin Close, Frizington – Site Location

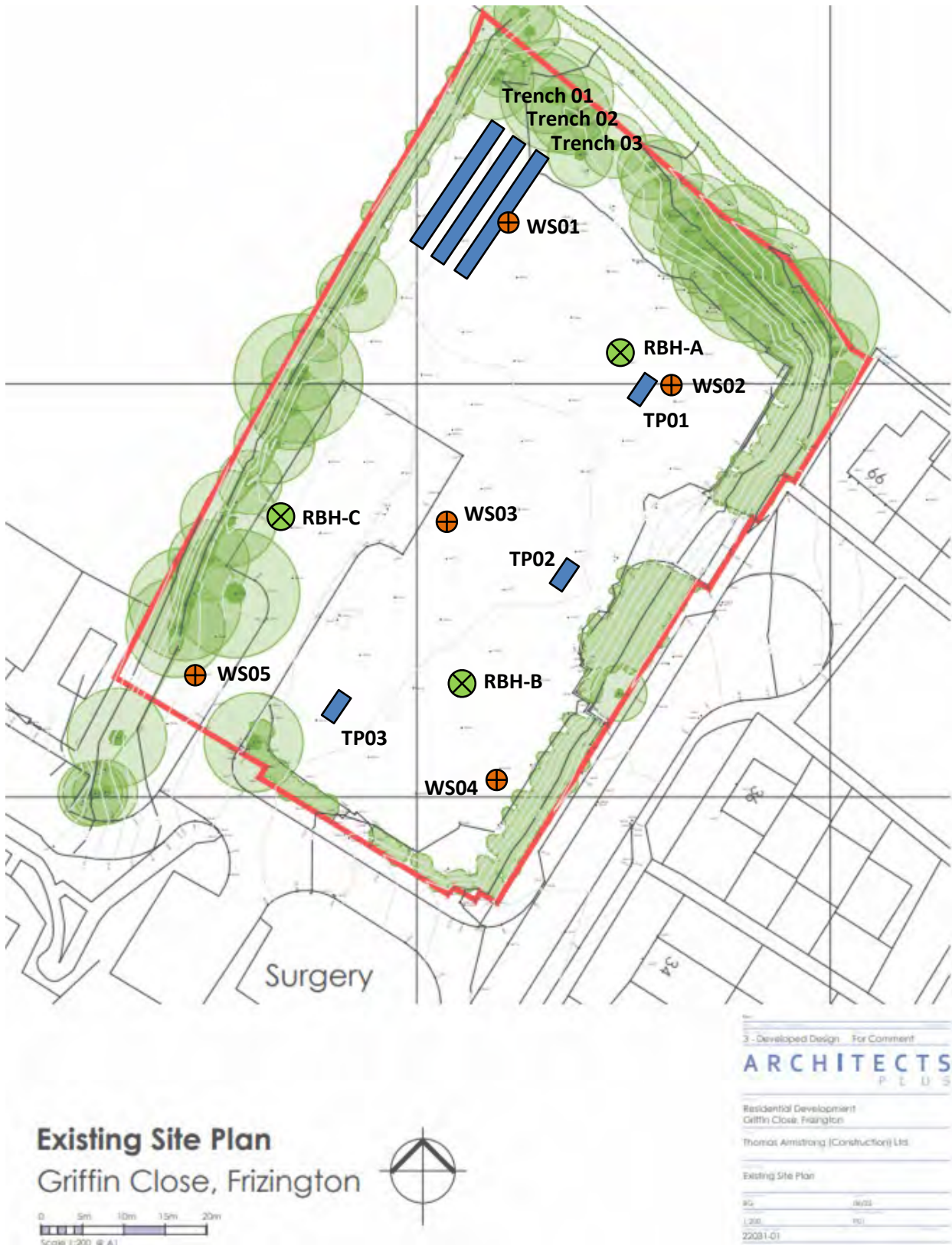


Website: www.geoenvironmentalengineering.com

Email: info@geoenvironmentalengineering.com

Telephone: 07883 440 186

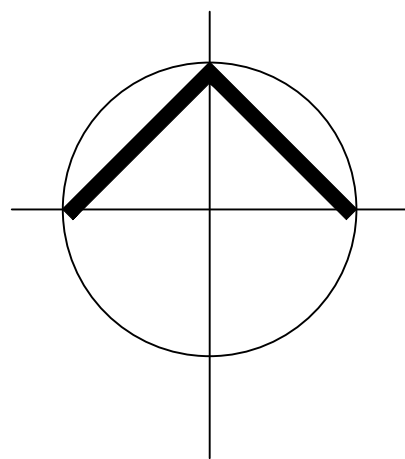
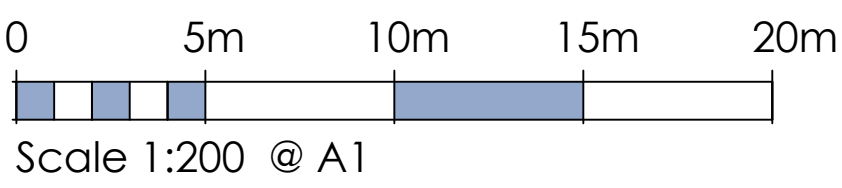
GEO2022-5496: Griffin Close, Frizington - Exploratory Hole Location Plan





Existing Site Plan

Griffin Close, Frizington



Rev	Rev.	Date	Description	Status	Revised by
3	-	-	Developed Design	For Comment	-

ARCHITECTS
PLUS

Project
Residential Development
Griffin Close, Frizington

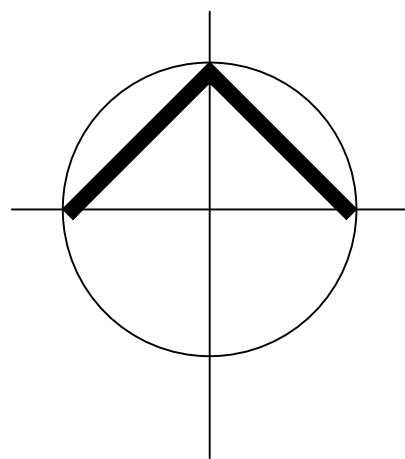
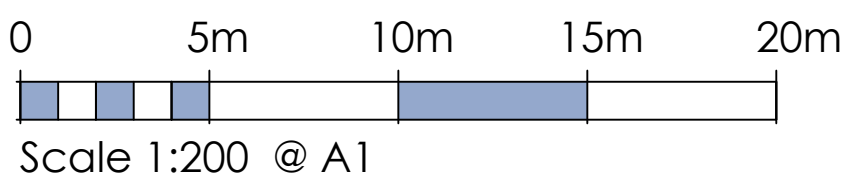
Client
Thomas Armstrong (Construction) Ltd

Drawing	Date
Existing Site Plan	06/22
Drawn by	Scale
BG	A1
Scale	Revision
1:200	P01
Drawing Number	22031-01



Proposed Site Plan

Griffin Close, Frizington



Rev	Rev.	Date	Description	Status	Revised by
	3	06/22	Developed Design	For Comment	

ARCHITECTS
PLUS

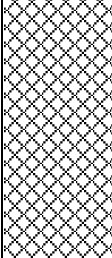
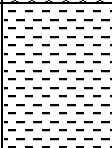
Project
Residential Development
Griffin Close, Frizington
Client
Thomas Armstrong (Construction) Ltd

Drawing	Proposed Site Plan
Drawn by	BG
Date	06/22
Scale @ A1	1:200
Computer file	P01
Drawing Number	22031-02
Revision	

Appendix II

- Exploratory Hole Logs
- Ground Gas Monitoring Sheets

GEO2021-5496: Griffin Close, Frizington – Trench 01

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.20	TOPSOIL: Dark grey brown sandy gravelly LOAM.		
0.20	Varies 0.95 – 1.30	MADE GROUND: Firm reworked brown CLAY with occasional brick and pottery. Occasional organic material.		
Varies 0.95 – 1.30	Varies 1.00 – 1.50	Stiff brown gravelly CLAY.		
		Base of trench varies 1.00m to 1.50m bgl in natural ground. Trench remained open and dry on completion. Trench backfilled with arisings on completion.		

Engineer: J.Brock

Site Works Date: 20.10.2022

Plant: Tracked 360 Excavator

Dimensions: 1.60m wide x 11.7m long

Log Notes:

HSV = Hand Shear Vane (kN/m²)

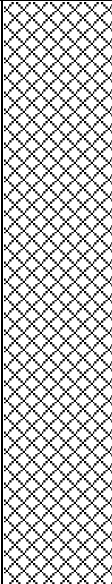
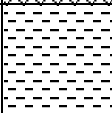
LP = Limited Penetration (HSV/CBR)

B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub



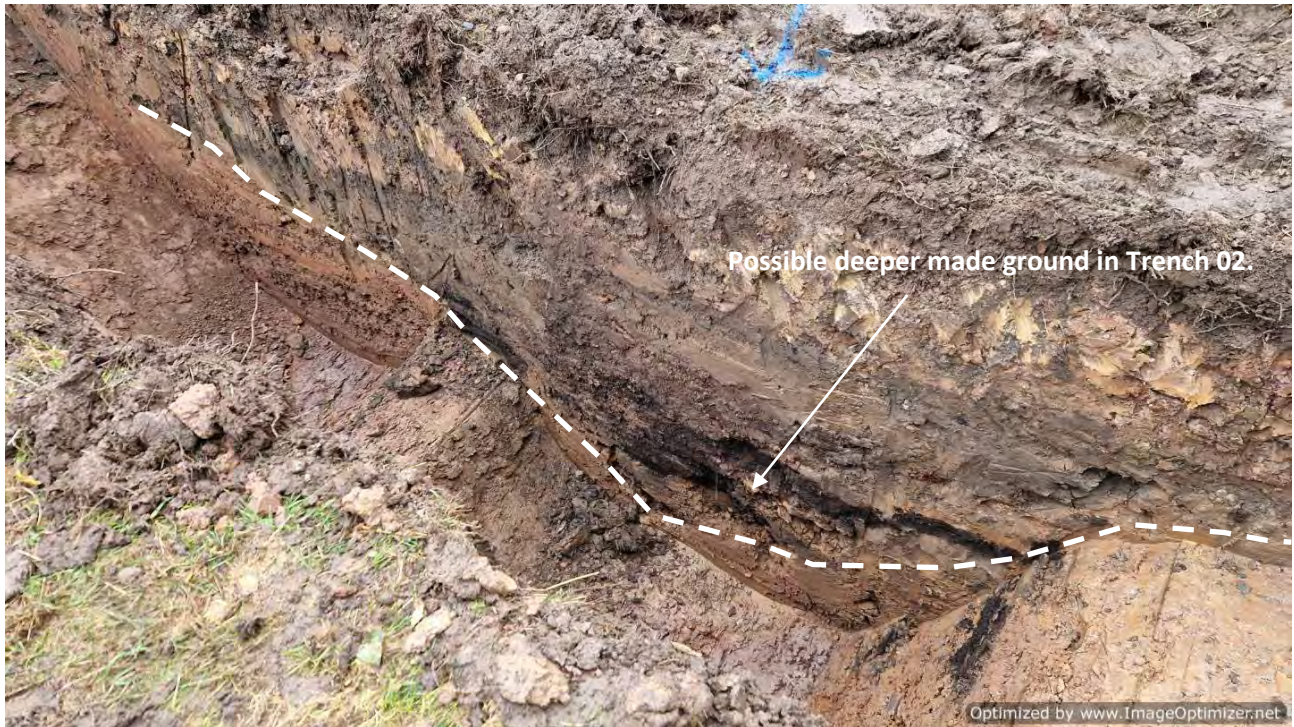
Optimized by www.ImageOptimizer.net

GEO2021-5496: Griffin Close, Frizington – Trench 02

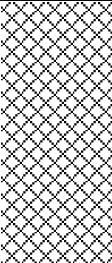
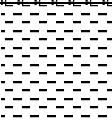
Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.20	TOPSOIL: Dark grey brown sandy gravelly LOAM.		
0.20	Varies 0.70 – 2.70	MADE GROUND: Firm reworked brown CLAY with occasional brick and pottery. Localised area of possible deeper made ground to 2.70m bgl comprising firm grey brown gravelly clay with occasional black organic silt.		
Varies 0.70 – 2.70	Varies 1.00 – 2.80	Stiff brown gravelly CLAY.		
		Base of trench varies 1.00m to 2.80m bgl. Trench remained open and dry on completion. Trench backfilled with arisings on completion.		
Engineer: J.Brock Site Works Date: 20.10.2022 Plant: Tracked 360 Excavator Dimensions: 1.60m wide x 13.0m long		Log Notes: HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub		



GEO2021-5496: Griffin Close, Frizington – Trench 02

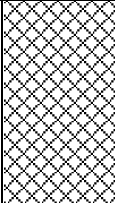
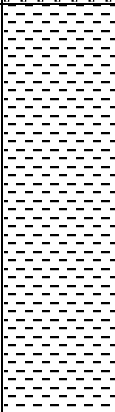


GEO2021-5496: Griffin Close, Frizington – Trench 03

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.20	TOPSOIL: Dark grey brown sandy gravelly LOAM.		
0.20	Varies 0.70 – 1.20	MADE GROUND: Firm reworked brown CLAY with occasional brick, pottery and timber. Localised pockets of brick, timber and concrete.		
Varies 0.70 – 2.70	Varies 1.00 – 1.20	Stiff brown gravelly CLAY. Occasional cobbles.		
		Base of trench varies 1.00m to 1.50m bgl in natural ground. Trench remained open and dry on completion. Trench backfilled with arisings on completion.		
Engineer: J.Brock Site Works Date: 20.10.2022 Plant: Tracked 360 Excavator Dimensions: 1.60m wide x 12.8m long			Log Notes: HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	



GEO2021-5496: Griffin Close, Frizington – TP01

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.24	TOPSOIL: Dark grey brown sandy gravelly LOAM.		
0.24	0.42	MADE GROUND: Firm reworked brown CLAY occasional brick, concrete and plastic pipe.		
0.42	1.10	MADE GROUND: Sift to stiff reworked dark grey gravelly CLAY with much brick, concrete and occasional organic matter.		
1.10	3.00	Firm to stiff grey very gravelly CLAY. Gravel is angular mudstone (possible heavily weathered bedrock).		
		Trial pit terminated at 3.00m bgl. Trench remained open and dry on completion. Trial hole backfilled with arisings on completion.		

Engineer: J.Brock

Site Works Date: 20.10.2022

Plant: Tracked 360 Excavator

Log Notes:

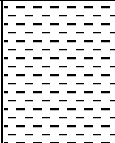
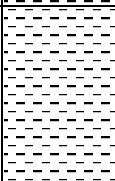
HSV = Hand Shear Vane (kN/m²)

LP = Limited Penetration (HSV/CBR)

B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

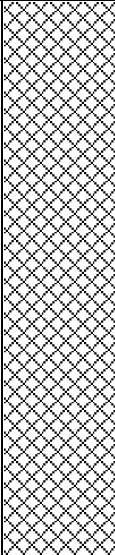
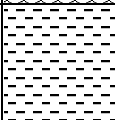


GEO2021-5496: Griffin Close, Frizington – TP02

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.20	TOPSOIL: Dark grey brown sandy gravelly LOAM.		
0.20	0.40	MADE GROUND: Firm reworked brown CLAY occasional brick and concrete.		
0.40	0.90	Stiff brown mottled gravelly CLAY. Becoming very stiff with depth.		
0.90	1.50	Stiff to very stiff grey very gravelly CLAY. Gravel is angular mudstone (possible heavily weathered bedrock). Very slow digging.		
		Trial pit terminated at 1.50m bgl. Trench remained open and dry on completion. Trial hole backfilled with arisings on completion.		
Engineer: J.Brock Site Works Date: 20.10.2022 Plant: Tracked 360 Excavator			Log Notes: HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

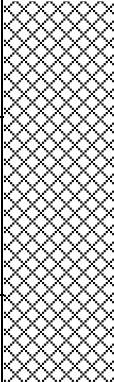
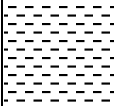
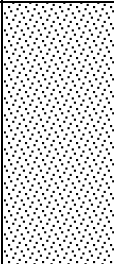


GEO2021-5496: Griffin Close, Frizington – TP03

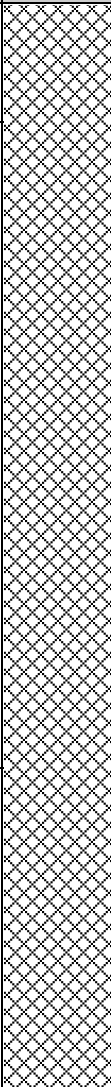
Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.23	TOPSOIL: Dark grey brown sandy gravelly LOAM.		
0.23	2.10	MADE GROUND: Firm reworked brown CLAY with much brick and concrete. 1.30 – Groundwater ingress from 1.30m bgl (perched).		
2.10	2.50	Firm to stiff dark grey very gravelly CLAY. Gravel is angular mudstone with occasional coal.		
		Trial pit terminated at 2.50m bgl. Groundwater ingress (moderate) at 1.30m bgl. Trial hole backfilled with arisings on completion.		
Engineer: J.Brock Site Works Date: 20.10.2022 Plant: Tracked 360 Excavator			Log Notes: HSV = Hand Shear Vane (kN/m ²) LP = Limited Penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	



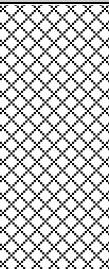
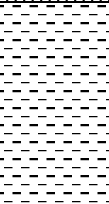
GEO2022-5496: Griffin Close, Frizington. WS01

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / ROP Samples
0.00	0.35	MADE GROUND: Long grass over dark brown silty, sandy TOPSOIL with ash and much fine to coarse angular to sub-angular gravel of clinker, coal, slag and brick. Slag cobbles noted.		0.10 J
0.35	1.25	MADE GROUND: Soft becoming firm purple-grey slightly sandy CLAY FILL with much fine to coarse angular to sub-angular gravel of clinker, coal, sandstone and brick. Occasional peaty and topsoil inclusions noted.		0.50 TJ 1.20 SPT: 1/1/1/1/3/3. N8
1.25	1.45	MADE GROUND: Dark grey-brown peaty, clayey fine to medium SAND with some fine to coarse sub-angular gravel of clinker, concrete, coal and brick. Relic topsoil.		1.30 T
1.45	1.90	Firm dark reddish brown sandy CLAY with much fine to coarse sub-angular gravel of sandstone, limestone and mudstone.		1.50 T
1.90	3.00	Medium dense reddish brown slightly clayey, silty fine to coarse SAND with much fine to coarse angular sandstone gravel.		2.00 SPT: 4/3/3/3/5/5. N16 2.50 T 3.00 SPT: 3/7/7/7/17/22. N53
3.00	3.45	Light grey and reddish-brown MUDSTONE.		
Log Notes: Borehole backfilled with bentonite and arisings. Borehole remained open and dry on completion.			Hand dug before drilling. Cased to 2.00m.	
Site: Griffin Close, Frizington, Cumbria. Engineer: GE Plant: Archway DART tracked window sampling rig.		Log Key: ROP = Rate of penetration (rotary drilling) SPT = Standard Penetration test (result as N value) HSV = Hand Shear Vane (result in kN/m²) CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage) LP = Limited Penetration (HSV/CBR) NP = No penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub		

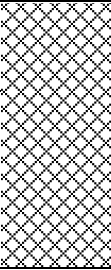
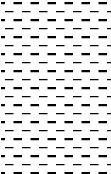
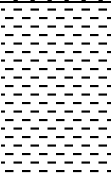
GEO2022-5496: Griffin Close, Frizington. WS02

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / ROP Samples
0.00	0.34	MADE GROUND: Long grass over dark brown silty, clayey TOPSOIL with ash and much fine to coarse angular to sub-angular gravel of clinker, coal, slag and brick. Slag cobbles noted.		0.15 TJ
0.34	3.50	MADE GROUND: Firm reddish-brown and light grey slightly sandy CLAY FILL with much fine to coarse angular to sub-angular gravel and cobbles of mudstone. <		

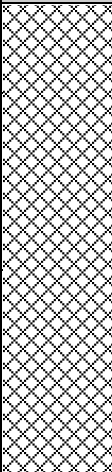
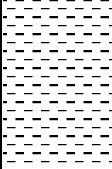
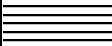
GEO2022-5496: Griffin Close, Frizington. WS03

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / ROP Samples
0.00	0.18	MADE GROUND: Long grass over dark brown silty, sandy TOPSOIL with ash and much fine to coarse angular to sub-angular gravel of clinker, coal, slag and brick.		
0.18	1.20	MADE GROUND: Reddish-brown sandy CLAY FILL with much fine to coarse angular to sub-angular gravel of limestone, slag, concrete, clinker, coal, sandstone and brick. Occasional wood fragments noted.		0.50 TJ 1.20 SPT: 1/2/1/2/4/6. N13
1.20	1.80	Stiff becoming very stiff dark reddish brown sandy CLAY with much fine to coarse sub-angular gravel of sandstone, limestone and mudstone.		1.20 T 1.70 T 1.80 SPT: 25/50mm. 50/0mm. N50/0mm.
Log Notes: Borehole installed 0.80m slotted/1.00m plain pipe/gas bung/steel cover. Borehole remained open and dry on completion.			Hand dug before drilling. Cased to 1.50m.	
Site: Griffin Close, Frizington, Cumbria. Engineer: GE Plant: Archway DART tracked window sampling rig.		Log Key: ROP = Rate of penetration (rotary drilling) SPT = Standard Penetration test (result as N value) HSV = Hand Shear Vane (result in kN/m²) CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage) LP = Limited Penetration (HSV/CBR) NP = No penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub		

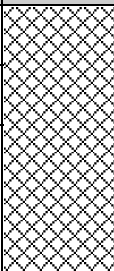
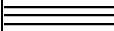
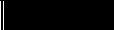
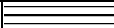
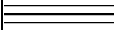
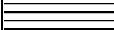
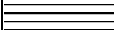
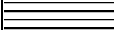
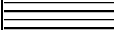
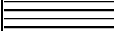
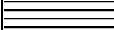
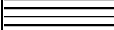
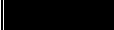
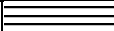
GEO2022-5496: Griffin Close, Frizington. WS04

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / ROP Samples
0.00	0.25	MADE GROUND: Long grass over dark brown silty, sandy TOPSOIL with much fine to coarse angular to sub-angular gravel of clinker, coal and brick.		0.20 J
0.25	1.20	MADE GROUND: Reddish-brown sandy CLAY FILL with much fine to coarse angular to sub-angular gravel of limestone, slag, concrete, clinker, coal, sandstone and brick. Occasional wood fragments noted.		1.20 SPT: 2/2/2/1/2/3. N8
1.20	1.90	Stiff reddish brown sandy CLAY with much fine to coarse sub-angular gravel of sandstone, limestone and mudstone.		1.50 T
1.90	2.10	Black sandy coal GRAVEL. Unnatural appearance.		1.90 J 2.00 SPT: 3/3/4/4/5/7. N20
2.10	2.90	Reddish brown and grey silty, sandy CLAY with much medium to coarse sub-angular mudstone gravel.		2.50 T
2.90	3.45	Light grey silty MUDSTONE.		3.00 SPT: 7/10/12/14/14/16. N56 3.00 T
Log Notes: Borehole installed 2.00m slotted/1.00m plain pipe/gas bung/steel cover. Borehole remained open and dry on completion.			Hand dug before drilling. Cased to 2.50m.	
Site: Griffin Close, Frizington, Cumbria. Engineer: GE Plant: Archway DART tracked window sampling rig.			Log Key: ROP = Rate of penetration (rotary drilling) SPT = Standard Penetration test (result as N value) HSV = Hand Shear Vane (result in kN/m ²) CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage) LP = Limited Penetration (HSV/CBR) NP = No penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

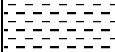
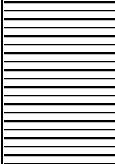
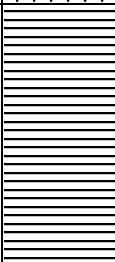
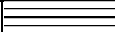
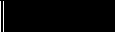
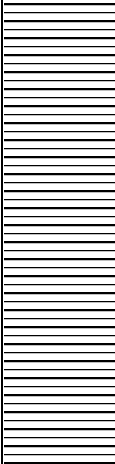
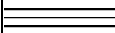
GEO2022-5496: Griffin Close, Frizington. WS05

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / ROP Samples
0.00	0.30	MADE GROUND: Grass over dark grey-brown silty, sandy TOPSOIL with much fine to coarse angular to sub-angular gravel of clinker, coal and brick.		0.10 J
0.30	1.20	MADE GROUND: Reddish-brown sandy CLAY FILL with much fine to coarse angular to sub-angular gravel of limestone, slag, concrete, clinker, coal, sandstone and brick. Occasional wood fragments noted.		0.70 T 1.20 SPT: 3/2/2/5/10/3. N20
1.20	2.00	MADE GROUND: Dense grey sandy concrete cobbles and medium to coarse dolomite GRAVEL.		1.50 T 2.00 SPT: 2/2/3/3/4/4. N14
2.00	2.70	Stiff light brown and grey silty, sandy CLAY with much medium to coarse sub-angular mudstone gravel.		2.50 T 2.50 SPT: 7/11/12/12/14/14. N52
2.70	2.95	Light grey silty MUDSTONE.		
Log Notes: Borehole backfilled with bentonite and arisings. Borehole remained open and dry on completion.			Hand dug before drilling. Cased to 1.50m.	
Site: Griffin Close, Frizington, Cumbria. Engineer: GE Plant: Archway DART tracked window sampling rig.		Log Key: ROP = Rate of penetration (rotary drilling) SPT = Standard Penetration test (result as N value) HSV = Hand Shear Vane (result in kN/m²) CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage) LP = Limited Penetration (HSV/CBR) NP = No penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub		

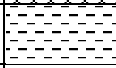
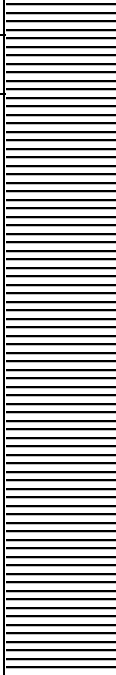
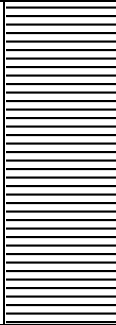
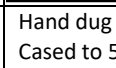
GEO2022-5496: Griffin Close, Frizington. RBH-A

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / ROP Samples
0.00	0.45	MADE GROUND: Dark grey-brown sandy TOPSOIL with some gravel and cobbles.		
0.45	2.50	Reddish brown CLAY with mudstone gravel and cobbles.		1.50-3.00: 30 seconds
2.50	6.60	Very soft CLAY + MUDSTONE with occasional coal gravel. Possible fill material.		3.00-4.50: 20 seconds
				4.50-6.00: 20 seconds
			6.00-7.50: 6 mins	
6.60	7.30	Grey MUDSTONE.		
7.30	7.50	Black COAL (Intact – 0.20m).		7.50-9.00: 6 mins
7.30	15.60	Grey MUDSTONE with occasional thin hard siltstone and sandstone bands.		9.00-10.50: 10 mins
				10.50-12.00: 12 mins
				12.00-13.50: 9 mins
				13.50-15.00: 7 mins
				15.00-16.50: 5 mins
				
15.60	17.00	Black COAL (Intact – 1.40m).		16.50-18.00: 12 mins
17.00	18.70	Grey MUDSTONE.		18.00-19.50: 6 mins
18.70	19.90	Black COAL (Intact – 1.20m).		19.50-21.00: 8 mins
19.90	25.00	Grey light reddish brown MUDSTONE.		21.00-22.50: 5 mins
				22.50-24.00: 6 mins
				24.00-25.50: 5 mins
				
Log Notes: Borehole backfilled with bentonite. No adverse gas detected during or after drilling.			Hand dug before drilling. Cased to 5.00m.	
Site: Griffin Close, Frizington, Cumbria. Engineer: GE Plant: Beretta T25 Tracked rotary rig with water flush		Log Key: ROP = Rate of penetration (rotary drilling) SPT = Standard Penetration test (result as N value) HSV = Hand Shear Vane (result in kN/m²) CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage) LP = Limited Penetration (HSV/CBR) NP = No penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub		

GEO2022-5496: Griffin Close, Frizington. RBH-B

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / ROP Samples
0.00	0.45	MADE GROUND: Turf over dark brown sandy, gravelly TOPSOIL.		
0.45	3.60	Reddish-brown sandy, gravelly CLAY.		1.50-3.00: 4 mins
3.60	6.40	Light grey and reddish-brown MUDSTONE.		3.00-4.50: 5 mins 4.50-6.00: 5 mins 6.00-7.50: 28 mins
6.40	7.80	Hard light brown SANDSTONE.		7.50-9.00: 14 mins
7.80	14.60	Interbedded light grey and reddish- brown MUDSTONE with occasional thin hard siltstone and sandstone bands.		9.00-10.50: 12 mins 10.50-12.00: 5 mins 12.00-13.50: 5 mins 13.50-15.00: 4 mins
14.60	15.10	Black COAL (Intact – 0.50m).		15.00-16.50: 5 mins
15.10	15.60	Grey MUDSTONE.		
15.60	16.20	Black COAL (Intact – 0.60m).		
16.20	28.00	Grey MUDSTONE.		16.50-18.00: 4 mins 18.00-19.50: 13 mins 19.50-21.00: 5 mins 21.00-22.50: 5 mins 22.50-24.00: 5 mins 24.00-25.50: 7 mins 25.50-27.00: 4 mins 27.00-28.50: 5 mins
28.00	28.80	Black COAL (Intact – 0.80m).		28.50-30.00: 8 mins
29.50	30.00	Grey light reddish brown MUDSTONE.		
Log Notes: Borehole backfilled with bentonite. No adverse gas detected during or after drilling.			Hand dug before drilling. Cased to 3.00m.	
Site: Griffin Close, Frizington, Cumbria. Engineer: GE Plant: Beretta T25 Tracked rotary rig with water flush			Log Key: ROP = Rate of penetration (rotary drilling) SPT = Standard Penetration test (result as N value) HSV = Hand Shear Vane (result in kN/m ²) CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage) LP = Limited Penetration (HSV/CBR) NP = No penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub	

GEO2022-5496: Griffin Close, Frizington. RBH-C

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / ROP Samples
0.00	0.22	MADE GROUND: TARMACADAM.		
0.22	1.10	MADE GROUND: Reddish grey limestone GRAVEL.		
1.10	2.90	Grey and dark brown sandy, gravelly CLAY.		1.50-3.00: 3 mins
2.90	3.60	Light grey MUDSTONE.		3.00-4.50: 4 mins
3.60	4.50	Soft reddish brown and grey MUDSTONE. Poor flush. Possible fill material?		
4.50	19.20	Interbedded light grey and reddish- brown MUDSTONE with occasional thin hard siltstone and sandstone bands.		4.50-6.00: 6 mins
				6.00-7.50: 5 mins
				7.50-9.00: 5 mins
				9.00-10.50: 11 mins
				10.50-12.00: 10 mins
				12.00-13.50: 19 mins
				13.50-15.00: 10 mins
				15.00-16.50: 8 mins
			16.50-18.00: 12 mins	
			18.00-19.50: 6 mins	
19.20	20.30	Black COAL (Intact – 1.10m).		19.50-21.00: 4 mins
20.30	28.80	Grey MUDSTONE.		21.00-22.50: 5 mins
				22.50-24.00: 8 mins
				24.00-25.50: 10 mins#]
				25.50-27.00: 9 mins
				27.00-28.50: 6 mins
				28.50-30.00: 5 mins
28.80	29.50	Black COAL (Intact – 0.70m).		
29.50	30.00	Grey light reddish brown MUDSTONE.		
Log Notes: Borehole backfilled with bentonite. No adverse gas detected during or after drilling.			Hand dug before drilling. Cased to 5.00m.	
Site: Griffin Close, Frizington, Cumbria. Engineer: GE Plant: Beretta T25 Tracked rotary rig with water flush		Log Key: ROP = Rate of penetration (rotary drilling) SPT = Standard Penetration test (result as N value) HSV = Hand Shear Vane (result in kN/m²) CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage) LP = Limited Penetration (HSV/CBR) NP = No penetration (HSV/CBR) B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub		

Ground Gas & Groundwater Monitoring Record Sheet 01

Site: Griffin Close, Frizington

Project No: 2022-5496

Date: 21.09.22

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?
BH02	1014 R	0	0	3.7	3.4	6.7	7.1	0.2	DRY	-	-
BH03	1014 R	0	0	0.2	0.2	20.8	21.0	0.4	1.00	-	-
BH04	1014 R	0	0	0.2	0.2	20.4	20.5	0.2	0.55	-	-

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 Atmospheric Pressure, R = Rising Atmospheric Pressure, S = Steady Atmospheric Pressure

Nm – Not Monitored

Monitoring Completed By: SG

Equipment Used: GFM436 Gas Analyser with Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Dry

Temperature 16.0°C

Notes:

Website: www.geoenvironmentalengineering.com

Email: info@geoenvironmentalengineering.com

Telephone: 07883 440 186

Ground Gas & Groundwater Monitoring Record Sheet 02

Site: Griffin Close, Frizington

Project No: 2022-5496

Date: 28.09.2022

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?
BH02	986 F	0	0	2.6	2.6	3.4	3.5	<0.1	DRY	-	-
BH03	986 F	0	0	0.3	0.3	20.1	20.2	<0.1	0.60	-	-
BH04	986 F	0	0	1.0	0.9	19.4	19.6	<0.1	0.30	-	-

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 Atmospheric Pressure, R = Rising Atmospheric Pressure, S = Steady Atmospheric Pressure
 Nm – Not Monitored

Monitoring Completed By: SG

Equipment Used: GFM436 Gas Analyser with Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Dry

Temperature 15.0°C

Notes:

Website: www.geoenvironmentalengineering.com

Email: info@geoenvironmentalengineering.com

Telephone: 07883 440 186

Ground Gas & Groundwater Monitoring Record Sheet 03

Site: Griffin Close, Frizington

Project No: 2022-5496

Date: 11.10.2022

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?
BH02	1008 F	0	0	2.8	2.6	3.2	3.6	<0.1	DRY	-	-
BH03	1008 F	0	0	0.2	0.2	20.2	20.2	<0.1	0.70	-	-
BH04	1008 F	0	0	1.2	1.2	18.8	19.1	<0.1	0.36	-	-

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 Atmospheric Pressure, R = Rising Atmospheric Pressure, S = Steady Atmospheric Pressure
 Nm – Not Monitored

Monitoring Completed By: SG

Equipment Used: GFM436 Gas Analyser with Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Dry

Temperature 14.0°C

Notes:

Website: www.geoenvironmentalengineering.com

Email: info@geoenvironmentalengineering.com

Telephone: 07883 440 186

Ground Gas & Groundwater Monitoring Record Sheet 04

Site: Griffin Close, Frizington

Project No: 2022-5496

Date: 28.10.2022

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?
BH02	986 R	0	0	4.4	4.2	15.0	18.0	<0.1	DRY	-	-
BH03	986 R	0	0	1.8	1.7	17.3	17.5	<0.1	0.60	-	-
BH04	986 R	0	0	4.4	4.2	0.8	1.8	<0.1	nm	-	-

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 Atmospheric Pressure, R = Rising Atmospheric Pressure, S = Steady Atmospheric Pressure

Nm – Not Monitored

Monitoring Completed By: SG

Equipment Used: GFM436 Gas Analyser with Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Dry

Temperature 14.0°C

Notes: BH04 – Bung Stuck

Website: www.geoenvironmentalengineering.com

Email: info@geoenvironmentalengineering.com

Telephone: 07883 440 186

Ground Gas & Groundwater Monitoring Record Sheet 05

Site: Griffin Close, Frizington

Project No: 2022-5496

Date: 03.11.2022

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?
BH02	981 S	0	0	2.5	2.3	2.8	3.5	<0.1	DRY	-	-
BH03	981 S	0	0	0.4	0.4	19.9	20.2	<0.1	0.53	-	-
BH04	981 S	0	0	1.8	1.8	19.1	19.3	<0.1	0.20	-	-

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 Atmospheric Pressure, R = Rising Atmospheric Pressure, S = Steady Atmospheric Pressure
 Nm – Not Monitored

Monitoring Completed By: SG

Equipment Used: GFM436 Gas Analyser with Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Dry

Temperature 15.0°C

Notes:

Website: www.geoenvironmentalengineering.com

Email: info@geoenvironmentalengineering.com

Telephone: 07883 440 186

Ground Gas & Groundwater Monitoring Record Sheet 06

Site: Griffin Close, Frizington

Project No: 2022-5496

Date: 05.12.2022

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?
BH02	1015 F	0	0	0.3	4.5	21.3	2.7	<0.1	4.5	-	-
BH03	1015 F	0	0	0.4	2.8	22.1	15.7	<0.1	0.7	-	-
BH04	1015 F	0	0	1.0	2.0	20.8	20.3	<0.1	0.5	-	-

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 Atmospheric Pressure, R = Rising Atmospheric Pressure, S = Steady Atmospheric Pressure
 Nm – Not Monitored

Monitoring Completed By: TE

Equipment Used: GFM436 Gas Analyser with Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Overcast

Temperature 4.0°C

Notes:

Website: www.geoenvironmentalengineering.com

Email: info@geoenvironmentalengineering.com

Telephone: 07883 440 186

Appendix III

- Laboratory Test Results



ANALYTICAL TEST REPORT

Contract no: 113952

Contract name: Land at Griffin Close, Frizington

Client reference: GEO2022-5496

Clients name: Geo Environmental Engineering

Clients address: 4 Culgarth Avenue
Cockermouth
Cumbria
CA13 9PL

Samples received: 26 September 2022

Analysis started: 26 September 2022

Analysis completed: 04 October 2022

Report issued: 04 October 2022

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:

Abbie Neasham-Bourn
Senior Reporting Administrator

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.

Lab ref	Sample id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
113952-1	WS01	0.10	Sand with Gravel & Roots	-	-	14.6
113952-2	WS01	0.50	Clay	-	-	17.9
113952-3	WS01	2.50	Clayey Sand with Gravel	-	-	13.1
113952-4	WS02	0.15	Sand Clay with Gravel & Roots	-	-	16.6
113952-5	WS02	1.00	Clay	-	-	12.0
113952-6	WS03	2.50	Clay	-	-	13.9
113952-7	WS03	0.50	Sandy Clay with Gravel & Roots	-	-	7.2
113952-8	WS04	1.70	Clay with Gravel	-	-	9.5
113952-9	WS04	3.00	Clay with Gravel	-	-	12.5
113952-10	WS05	0.10	Clay with Gravel	-	-	12.5
113952-11	WS05	0.70	Sandy Loam with Gravel & Roots	-	-	11.3
113952-12	WS05	1.50	Clayey Sand with Gravel & Roots	-	-	12.1
113952-13	WS05	3.00	Sand with Gravel	-	-	6.5

Chemtech Environmental Limited

SOILS

Lab number			113952-1	113952-2	113952-3	113952-4	113952-5	113952-6
Sample id			WS01	WS01	WS01	WS02	WS02	WS03
Depth (m)			0.10	0.50	2.50	0.15	1.00	2.50
Date sampled			23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022
Test	Method	Units						
Arsenic (total)	CE127 ^M	mg/kg As	9.9	16	-	16	2.6	5.6
Cadmium (total)	CE127 ^M	mg/kg Cd	<0.2	<0.2	-	<0.2	<0.2	<0.2
Chromium (total)	CE127 ^M	mg/kg Cr	103	68	-	63	40	34
Chromium (III)	CE208	mg/kg CrIII	103	68	-	63	40	34
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	-	<1	<1	<1
Copper (total)	CE127 ^M	mg/kg Cu	74	35	-	31	4.9	786
Lead (total)	CE127 ^M	mg/kg Pb	61	56	-	42	8.4	7.4
Mercury (total)	CE127 ^M	mg/kg Hg	<0.5	<0.5	-	<0.5	<0.5	<0.5
Nickel (total)	CE127 ^M	mg/kg Ni	29	37	-	37	48	78
Selenium (total)	CE127 ^M	mg/kg Se	0.7	1.6	-	1.3	1.6	4.6
Zinc (total)	CE127 ^M	mg/kg Zn	73	58	-	75	49	58
pH	CE004 ^M	units	7.4	6.8	7.2	7.9	7.2	7.0
Sulphate (2:1 water soluble)	CE061 ^U	mg/l SO ₄	13	19	<10	14	27	30
Cyanide (total)	CE077	mg/kg CN	<1	<1	-	<1	<1	<1
Total Organic Carbon (TOC)	CE197	% w/w C	2.0	1.9	-	2.0	0.5	1.9
PAH								
Naphthalene	CE087 ^M	mg/kg	0.04	<0.02	-	<0.02	<0.02	<0.02
Acenaphthylene	CE087 ^M	mg/kg	<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
Fluorene	CE087 ^U	mg/kg	<0.02	<0.02	-	<0.02	<0.02	<0.02
Phenanthrene	CE087 ^M	mg/kg	0.13	0.04	-	0.21	<0.02	0.04
Anthracene	CE087 ^U	mg/kg	0.03	<0.02	-	0.05	<0.02	<0.02
Fluoranthene	CE087 ^M	mg/kg	0.48	0.08	-	0.50	<0.02	<0.02
Pyrene	CE087 ^M	mg/kg	0.45	0.07	-	0.42	<0.02	<0.02
Benzo(a)anthracene	CE087 ^U	mg/kg	0.34	0.04	-	0.28	<0.02	<0.02
Chrysene	CE087 ^M	mg/kg	0.35	0.06	-	0.31	<0.03	<0.03
Benzo(b)fluoranthene	CE087 ^M	mg/kg	0.39	0.04	-	0.37	<0.02	<0.02
Benzo(k)fluoranthene	CE087 ^M	mg/kg	0.14	<0.03	-	0.12	<0.03	<0.03
Benzo(a)pyrene	CE087 ^U	mg/kg	0.29	0.02	-	0.26	<0.02	<0.02
Indeno(123cd)pyrene	CE087 ^M	mg/kg	0.24	<0.02	-	0.26	<0.02	<0.02
Dibenz(ah)anthracene	CE087 ^M	mg/kg	0.03	<0.02	-	0.04	<0.02	<0.02
Benzo(ghi)perylene	CE087 ^M	mg/kg	0.16	<0.02	-	0.18	<0.02	<0.02
PAH (total of USEPA 16)	CE087	mg/kg	3.08	0.35	-	3.01	<0.34	<0.34
Subcontracted analysis								
Asbestos (qualitative)	\$	-	NAD	NAD	-	NAD	NAD	NAD

Chemtech Environmental Limited

SOILS

Lab number			113952-7	113952-8	113952-9	113952-10	113952-11	113952-12
Sample id			WS03	WS04	WS04	WS05	WS05	WS05
Depth (m)			0.50	1.70	3.00	0.10	0.70	1.50
Date sampled			23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022
Test	Method	Units						
Arsenic (total)	CE127 ^M	mg/kg As	7.0	-	12	-	17	14
Cadmium (total)	CE127 ^M	mg/kg Cd	0.3	-	<0.2	-	<0.2	<0.2
Chromium (total)	CE127 ^M	mg/kg Cr	39	-	73	-	59	55
Chromium (III)	CE208	mg/kg CrIII	39	-	73	-	59	55
Chromium (VI)	CE146	mg/kg CrVI	<1	-	<1	-	<1	<1
Copper (total)	CE127 ^M	mg/kg Cu	57	-	17	-	35	28
Lead (total)	CE127 ^M	mg/kg Pb	15	-	11	-	81	60
Mercury (total)	CE127 ^M	mg/kg Hg	<0.5	-	<0.5	-	<0.5	<0.5
Nickel (total)	CE127 ^M	mg/kg Ni	22	-	34	-	36	29
Selenium (total)	CE127 ^M	mg/kg Se	1.1	-	1.5	-	1.2	1.3
Zinc (total)	CE127 ^M	mg/kg Zn	24	-	28	-	62	42
pH	CE004 ^M	units	7.7	8.4	8.2	8.4	6.8	7.9
Sulphate (2:1 water soluble)	CE061 ^U	mg/l SO ₄	48	<10	18	11	71	16
Cyanide (total)	CE077	mg/kg CN	<1	-	<1	-	<1	<1
Total Organic Carbon (TOC)	CE197	% w/w C	0.9	-	0.6	-	5.5	1.9
PAH								
Naphthalene	CE087 ^M	mg/kg	0.02	-	0.03	-	0.03	<0.02
Acenaphthylene	CE087 ^M	mg/kg	<0.02	-	<0.02	-	<0.02	<0.02
Acenaphthene	CE087 ^M	mg/kg	<0.02	-	<0.02	-	<0.02	<0.02
Fluorene	CE087 ^U	mg/kg	<0.02	-	<0.02	-	<0.02	<0.02
Phenanthrene	CE087 ^M	mg/kg	0.28	-	0.04	-	0.28	0.03
Anthracene	CE087 ^U	mg/kg	0.05	-	<0.02	-	0.04	<0.02
Fluoranthene	CE087 ^M	mg/kg	0.52	-	<0.02	-	0.27	0.03
Pyrene	CE087 ^M	mg/kg	0.39	-	<0.02	-	0.22	0.03
Benzo(a)anthracene	CE087 ^U	mg/kg	0.21	-	<0.02	-	0.15	<0.02
Chrysene	CE087 ^M	mg/kg	0.22	-	<0.03	-	0.18	0.03
Benzo(b)fluoranthene	CE087 ^M	mg/kg	0.20	-	<0.02	-	0.20	0.03
Benzo(k)fluoranthene	CE087 ^M	mg/kg	0.07	-	<0.03	-	0.05	<0.03
Benzo(a)pyrene	CE087 ^U	mg/kg	0.14	-	<0.02	-	0.12	<0.02
Indeno(123cd)pyrene	CE087 ^M	mg/kg	0.11	-	<0.02	-	0.11	<0.02
Dibenz(ah)anthracene	CE087 ^M	mg/kg	<0.02	-	<0.02	-	<0.02	<0.02
Benzo(ghi)perylene	CE087 ^M	mg/kg	0.07	-	<0.02	-	0.08	<0.02
PAH (total of USEPA 16)	CE087	mg/kg	2.30	-	<0.34	-	1.74	<0.34
Subcontracted analysis								
Asbestos (qualitative)	\$	-	NAD	-	NAD	-	NAD	NAD

Chemtech Environmental Limited

SOILS

Lab number			113952-13
Sample id			WS05
Depth (m)			3.00
Date sampled			23/09/2022
Test	Method	Units	
Arsenic (total)	CE127 ^M	mg/kg As	9.2
Cadmium (total)	CE127 ^M	mg/kg Cd	0.4
Chromium (total)	CE127 ^M	mg/kg Cr	46
Chromium (III)	CE208	mg/kg CrIII	46
Chromium (VI)	CE146	mg/kg CrVI	<1
Copper (total)	CE127 ^M	mg/kg Cu	31
Lead (total)	CE127 ^M	mg/kg Pb	20
Mercury (total)	CE127 ^M	mg/kg Hg	<0.5
Nickel (total)	CE127 ^M	mg/kg Ni	24
Selenium (total)	CE127 ^M	mg/kg Se	1.0
Zinc (total)	CE127 ^M	mg/kg Zn	48
pH	CE004 ^M	units	8.0
Sulphate (2:1 water soluble)	CE061 ^U	mg/l SO ₄	20
Cyanide (total)	CE077	mg/kg CN	<1
Total Organic Carbon (TOC)	CE197	% w/w C	0.7
PAH			
Naphthalene	CE087 ^M	mg/kg	<0.02
Acenaphthylene	CE087 ^M	mg/kg	<0.02
Acenaphthene	CE087 ^M	mg/kg	<0.02
Fluorene	CE087 ^U	mg/kg	<0.02
Phenanthrene	CE087 ^M	mg/kg	0.08
Anthracene	CE087 ^U	mg/kg	<0.02
Fluoranthene	CE087 ^M	mg/kg	0.11
Pyrene	CE087 ^M	mg/kg	0.11
Benzo(a)anthracene	CE087 ^U	mg/kg	0.06
Chrysene	CE087 ^M	mg/kg	0.07
Benzo(b)fluoranthene	CE087 ^M	mg/kg	0.06
Benzo(k)fluoranthene	CE087 ^M	mg/kg	<0.03
Benzo(a)pyrene	CE087 ^U	mg/kg	0.04
Indeno(123cd)pyrene	CE087 ^M	mg/kg	0.03
Dibenz(ah)anthracene	CE087 ^M	mg/kg	<0.02
Benzo(ghi)perylene	CE087 ^M	mg/kg	0.02
PAH (total of USEPA 16)	CE087	mg/kg	0.60
Subcontracted analysis			
Asbestos (qualitative)	\$	-	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
CE208	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	U	10	mg/l SO ₄
CE077	Cyanide (total)	Extraction, Continuous Flow Colorimetry	As received		1	mg/kg CN
CE197	Total Organic Carbon (TOC)	Carbon Analyser	Dry		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)
113952-1	WS01	0.10	N	
113952-2	WS01	0.50	N	
113952-3	WS01	2.50	N	
113952-4	WS02	0.15	N	
113952-5	WS02	1.00	N	
113952-6	WS03	2.50	N	
113952-7	WS03	0.50	N	
113952-8	WS04	1.70	N	
113952-9	WS04	3.00	N	
113952-10	WS05	0.10	N	
113952-11	WS05	0.70	N	
113952-12	WS05	1.50	N	
113952-13	WS05	3.00	Y	PAH (IC)

Chemtech Environmental Limited

ADDITIONAL INFORMATION

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 4 weeks from initial receipt unless otherwise instructed.

For soils and solids, all results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.

For soils and solids, analytical results are inclusive of stones, where applicable.



Highways Laboratory
Bassington Drive • Cramlington • Northumberland • NE23 8AJ
Tel (01670) 737575 • Email highwayslaboratory@northumberland.gov.uk

CLASSIFICATION OF SOILS

Tests according to B.S. 1377 : 1990

Client: **Geo Environmental Engineering LTD**

Engineer: **Jame Brock**

Project: **Land at Griffin close, Frizlington**

Location: **WS01 @ 1.50m**

Material Type: **Reddie Brown very sandy CLAY with very occasional gravel.**

Sample Specification: **Sampled by Site Staff/Client**

Source: **Site**

Date Sampled: **09/09/2022** Date Received: **27/09/2022** Sampled By: **Clients Staff**

	<u>Test Results</u>	<u>Specification</u>
--	---------------------	----------------------

Water Content (%):	27.9	BS EN ISO 17892-1;2014
--------------------	-------------	------------------------

The liquid and Plastic Limits are prepared in accordance with BS1377: Part 2: Clause 4.2.4 due to the nature of most materials in the surrounding area (Sandy CLAY with gravel cobbles and boulders)

Liquid Limit (%):	41	Part 2 Clause 4.4 (One point method)
Plastic Limit (%):	25	Part 2 Clause 5.3
Plasticity Index (%):	16	Part 2 Clause 5.4
Passing 425mic (%):	58	
Soil Classification:	MI	

Results reported herein relate only to the material supplied or sampled by the laboratory. This report shall not be reproduced except in full without prior written consent. Sampling certificate Uncertainty available on request where applicable. All testing carried out at NCC Laboratory

Remarks: **30.64g was retained on the 20mm test sieve, this was removed prior to testing.**

Certificate of sampling received: ☐

Signed: _____

[✓] M. Newton, Laboratory Manager

[] P. Fletcher, Senior Technician

Start of Test Date: **27/09/2022**

End of Test Date: **30/09/2022**

Report Date: **30/09/2022**



Highways Laboratory
Bassington Drive • Cramlington • Northumberland • NE23 8AJ
Tel (01670) 737575 • Email highwayslaboratory@northumberland.gov.uk

CLASSIFICATION OF SOILS

Tests according to B.S. 1377 : 1990

Client: **Geo Environmental Engineering LTD**Engineer: **Jame Brock**Project: **Land at Griffin close, Frizlington**Location: **WS03 @ 1.20m**Material Type: **Red, Brown slightly sandy CLAY.**Sample Specification: **Sampled by Site Staff/Client**Source: **Site**Date Sampled: **09/09/2022**Date Received: **27/09/2022**Sampled By: **Clients Staff**

	<u>Test Results</u>	<u>Specification</u>
--	---------------------	----------------------

Water Content (%):	12.0	BS EN ISO 17892-1;2014
--------------------	-------------	------------------------

The liquid and Plastic Limits are prepared in accordance with BS1377: Part 2: Clause 4.2.4 due to the nature of most materials in the surrounding area (Sandy CLAY with gravel cobbles and boulders)

Liquid Limit (%):	36	Part 2 Clause 4.4 (One point method)
Plastic Limit (%):	18	Part 2 Clause 5.3
Plasticity Index (%):	18	Part 2 Clause 5.4
Passing 425mic (%):	60	
Soil Classification:	CI	

Results reported herein relate only to the material supplied or sampled by the laboratory. This report shall not be reproduced except in full without prior written consent. Sampling certificate Uncertainty available on request where applicable. All testing carried out at NCC Laboratory

Remarks: **21.76g was retained on the 20mm test sieve, this was removed prior to testing.**Certificate of sampling received: ☐

Signed: _____

[✓] M. Newton, Laboratory Manager

[] P. Fletcher, Senior Technician

Start of Test Date: **27/09/2022**End of Test Date: **30/09/2022**Report Date: **30/09/2022**



Highways Laboratory
Bassington Drive • Cramlington • Northumberland • NE23 8AJ
Tel (01670) 737575 • Email highwayslaboratory@northumberland.gov.uk

CLASSIFICATION OF SOILS

Tests according to B.S. 1377 : 1990

Client: **Geo Environmental Engineering LTD**
Engineer: **Jame Brock**
Project: **Land at Griffin close, Frizlington**
Location: **WS04 @ 1.50m**
Material Type: **Red, Grey silty CLAY.**

Sample Specification: Sampled by Site Staff/Client

Source:

Date Sampled: **09/09/2022**Date Received: **27/09/2022**Sampled By: **Clients Staff**

	<u>Test Results</u>	<u>Specification</u>
--	---------------------	----------------------

Water Content (%):	12.2	BS EN ISO 17892-1;2014
--------------------	-------------	------------------------

The liquid and Plastic Limits are prepared in accordance with BS1377: Part 2: Clause 4.2.4 due to the nature of most materials in the surrounding area (Sandy CLAY with gravel cobbles and boulders)

Liquid Limit (%):	37	Part 2 Clause 4.4 (One point method)
Plastic Limit (%):	21	Part 2 Clause 5.3
Plasticity Index (%):	16	Part 2 Clause 5.4
Passing 425mic (%):	99	
Soil Classification:	CI	

Results reported herein relate only to the material supplied or sampled by the laboratory. This report shall not be reproduced except in full without prior written consent. Sampling certificate Uncertainty available on request where applicable. All testing carried out at NCC Laboratory

Remarks: **None**Certificate of sampling received: ☐

Signed: _____

[✓] M. Newton, Laboratory Manager

[] P. Fletcher, Senior Technician

Start of Test Date: **27/09/2022**End of Test Date: **30/09/2022**Report Date: **30/09/2022**



Highways Laboratory
Bassington Drive • Cramlington • Northumberland • NE23 8AJ
Tel (01670) 737575 • Email highwayslaboratory@northumberland.gov.uk

CLASSIFICATION OF SOILS

Tests according to B.S. 1377 : 1990

Client: **Geo Environmental Engineering LTD**Engineer: **Jame Brock**Project: **Land at Griffin close, Frizlington**Location: **WS04 @ 2.50m**Material Type: **Red, Grey silty CLAY.**Sample Specification: **Sampled by Site Staff/Client**Source: **Site**Date Sampled: **09/09/2022**Date Received: **27/09/2022**Sampled By: **Clients Staff**

	<u>Test Results</u>	<u>Specification</u>
--	---------------------	----------------------

Water Content (%):	10.5	BS EN ISO 17892-1;2014
--------------------	-------------	------------------------

The liquid and Plastic Limits are prepared in accordance with BS1377: Part 2: Clause 4.2.4 due to the nature of most materials in the surrounding area (Sandy CLAY with gravel cobbles and boulders)

Liquid Limit (%):	40	Part 2 Clause 4.4 (One point method)
-------------------	-----------	--------------------------------------

Plastic Limit (%):	22	Part 2 Clause 5.3
--------------------	-----------	-------------------

Plasticity Index (%):	18	Part 2 Clause 5.4
-----------------------	-----------	-------------------

Passing 425mic (%):	100	
---------------------	------------	--

Soil Classification:	CI	
----------------------	-----------	--

Results reported herein relate only to the material supplied or sampled by the laboratory. This report shall not be reproduced except in full without prior written consent. Sampling certificate Uncertainty available on request where applicable. All testing carried out at NCC Laboratory

Remarks: **None**Certificate of sampling received: ☐

Signed: _____

[✓] M. Newton, Laboratory Manager

[] P. Fletcher, Senior Technician

Start of Test Date: **27/09/2022**End of Test Date: **30/09/2022**Report Date: **30/09/2022**



Highways Laboratory
Bassington Drive • Cramlington • Northumberland • NE23 8AJ
Tel (01670) 737575 • Email highwayslaboratory@northumberland.gov.uk

CLASSIFICATION OF SOILS

Tests according to B.S. 1377 : 1990

Client: **Geo Environmental Engineering LTD**Engineer: **Jame Brock**Project: **Land at Griffin close, Frizlington**Location: **WS05 @ 2.50m**Material Type: **Brown, Orange, Grey mottled sandy CLAY with very occasional gravel.**Sample Specification: **Sampled by Site Staff/Client**Source: **Site**Date Sampled: **09/09/2022**Date Received: **27/09/2022**Sampled By: **Clients Staff**

	<u>Test Results</u>	<u>Specification</u>
--	---------------------	----------------------

Water Content (%):	20.4	BS EN ISO 17892-1;2014
--------------------	-------------	------------------------

The liquid and Plastic Limits are prepared in accordance with BS1377: Part 2: Clause 4.2.4 due to the nature of most materials in the surrounding area (Sandy CLAY with gravel cobbles and boulders)

Liquid Limit (%):	45	Part 2 Clause 4.4 (One point method)
-------------------	-----------	--------------------------------------

Plastic Limit (%):	25	Part 2 Clause 5.3
--------------------	-----------	-------------------

Plasticity Index (%):	20	Part 2 Clause 5.4
-----------------------	-----------	-------------------

Passing 425mic (%):	68	
---------------------	-----------	--

Soil Classification:	CI	
----------------------	-----------	--

Results reported herein relate only to the material supplied or sampled by the laboratory. This report shall not be reproduced except in full without prior written consent. Sampling certificate Uncertainty available on request where applicable. All testing carried out at NCC Laboratory

Remarks: **None**Certificate of sampling received: ☐

Signed: _____

[✓] M. Newton, Laboratory Manager

[] P. Fletcher, Senior Technician

Start of Test Date: **27/09/2022**End of Test Date: **30/09/2022**Report Date: **30/09/2022**

Appendix IV

- GEO Chemical Assessment Sheet

Geo Environmental Engineering Ltd

Chemical Assessment Sheet - Soils

Lab number Sample id Depth (m) Date sampled			113952-1	113952-2	113952-3	113952-4	113952-5	113952-6	113952-7	113952-8	113952-9	113952-10	113952-11	113952-12	113952-13	Generic Assessment Criteria Residential With Plant Uptake 2.5% SOM				
			WS01	WS01	WS01	WS02	WS02	WS03	WS03	WS04	WS04	WS05	WS05	WS05	WS05	GAC	GAC Exceeded?	GAC Ref:		
			0.10	0.50	2.50	0.15	1.00	2.50	0.50	1.70	3.00	0.10	0.70	1.50	3.00					
23/09/2022			23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022						
Test	Method	Units	TOPSOIL	MG	SAND	TOPSOIL	MG	MG	MG	CLAY	MUDSTONE	MG	MG	MG	MUDSTONE					
Arsenic (total)	CE127 ^M	mg/kg As	9.9	16	-	16	2.6	5.6	7.0	-	12	-	17	14	9.2	37	No	LQM S4UL		
Cadmium (total)	CE127 ^M	mg/kg Cd	<0.2	<0.2	-	<0.2	<0.2	<0.2	0.3	-	<0.2	-	<0.2	<0.2	0.4	11	No	LQM S4UL		
Chromium (III)	CE208	mg/kg CrIII	103	68	-	63	40	34	39	-	73	-	59	55	46	910	No	LQM S4UL		
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	-	<1	<1	<1	<1	-	<1	-	<1	<1	<1	6	No	LQM S4UL		
Copper (total)	CE127 ^M	mg/kg Cu	74	35	-	31	4.9	786	57	-	17	-	35	28	31	2400	No	LQM S4UL		
Lead (total)	CE127 ^M	mg/kg Pb	61	56	-	42	8.4	7.4	15	-	11	-	81	60	20	200	No	CL:AIRE C4SL		
Mercury (total)	CE127 ^M	mg/kg Hg	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	<0.5	<0.5	40	No	LQM S4UL		
Nickel (total)	CE127 ^M	mg/kg Ni	29	37	-	37	48	78	22	-	34	-	36	29	24	130	No	LQM S4UL		
Selenium (total)	CE127 ^M	mg/kg Se	0.7	1.6	-	1.3	1.6	4.6	1.1	-	1.5	-	1.2	1.3	1.0	250	No	LQM S4UL		
Zinc (total)	CE127 ^M	mg/kg Zn	73	58	-	75	49	58	24	-	28	-	62	42	48	3700	No	LQM S4UL		
pH	CE004 ^M	units	7.4	6.8	7.2	7.9	7.2	7.0	7.7	8.4	8.2	8.4	6.8	7.9	8.0	<6.5	No	BRE		
Sulphate (2:1 water soluble)	CE061 ^U	mg/l SO ₄	13	19	<10	14	27	30	48	<10	18	11	71	16	20	>500	No	BRE		
Cyanide (total)	CE077	mg/kg CN	<1	<1	-	<1	<1	<1	<1	-	<1	-	<1	<1	<1	34	No	ATRISK SSV		
Total Organic Carbon (TOC)	CE197	% w/w C	2.0	1.9	-	2.0	0.5	1.9	0.9	-	0.6	-	5.5	1.9	0.7	-	-	-		
PAH																				
Naphthalene	CE087 ^M	mg/kg	0.04	<0.02	-	<0.02	<0.02	<0.02	0.02	-	0.03	-	0.03	<0.02	<0.02	5.6	No	LQM S4UL		
Acenaphthylene	CE087 ^M	mg/kg	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	-	<0.02	-	<0.02	<0.02	<0.02	420	No	LQM S4UL		
Acenaphthene	CE087 ^M	mg/kg	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	-	<0.02	-	<0.02	<0.02	<0.02	510	No	LQM S4UL		
Fluorene	CE087 ^U	mg/kg	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	-	<0.02	-	<0.02	<0.02	<0.02	400	No	LQM S4UL		
Phenanthrene	CE087 ^M	mg/kg	0.13	0.04	-	0.21	<0.02	0.04	0.28	-	0.04	-	0.28	0.03	0.08	220	No	LQM S4UL		
Anthracene	CE087 ^U	mg/kg	0.03	<0.02	-	0.05	<0.02	<0.02	0.05	-	<0.02	-	0.04	<0.02	<0.02	5400	No	LQM S4UL		
Fluoranthene	CE087 ^M	mg/kg	0.48	0.08	-	0.50	<0.02	<0.02	0.52	-	<0.02	-	0.27	0.03	0.11	560	No	LQM S4UL		
Pyrene	CE087 ^M	mg/kg	0.45	0.07	-	0.42	<0.02	<0.02	0.39	-	<0.02	-	0.22	0.03	0.11	1200	No	LQM S4UL		
Benzo(a)anthracene	CE087 ^U	mg/kg	0.34	0.04	-	0.28	<0.02	<0.02	0.21	-	<0.02	-	0.15	<0.02	0.06	11	No	LQM S4UL		
Chrysene	CE087 ^M	mg/kg	0.35	0.06	-	0.31	<0.03	<0.03	0.22	-	<0.03	-	0.18	0.03	0.07	22	No	LQM S4UL		
Benzo(b)fluoranthene	CE087 ^M	mg/kg	0.39	0.04	-	0.37	<0.02	<0.02	0.20	-	<0.02	-	0.20	0.03	0.06	3.3	No	LQM S4UL		
Benzo(k)fluoranthene	CE087 ^M	mg/kg	0.14	<0.03	-	0.12	<0.03	<0.03	0.07	-	<0.03	-	0.05	<0.03	<0.03	93	No	LQM S4UL		
Benzo(a)pyrene	CE087 ^U	mg/kg	0.29	0.02	-	0.26	<0.02	<0.02	0.14	-	<0.02	-	0.12	<0.02	0.04	2.7	No	LQM S4UL		
Indeno(123cd)pyrene	CE087 ^M	mg/kg	0.24	<0.02	-	0.26	<0.02	<0.02	0.11	-	<0.02	-	0.11	<0.02	0.03	36	No	LQM S4UL		
Dibenz(ah)anthracene	CE087 ^M	mg/kg	0.03	<0.02	-	0.04	<0.02	<0.02	<0.02	-	<0.02	-	<0.02	<0.02	<0.02	0.28	No	LQM S4UL		
Benzo(ghi)perylene	CE087 ^M	mg/kg	0.16	<0.02	-	0.18	<0.02	<0.02	0.07	-	<0.02	-	0.08	<0.02	0.02	340	No	LQM S4UL		
PAH (total of USEPA 16)	CE087	mg/kg	3.08	0.35	-	3.01	<0.34	<0.34	2.30	-	<0.34	-	1.74	<0.34	0.60	-	-	-		
Subcontracted analysis																				
Asbestos (qualitative)	\$	-	NAD	NAD	-	NAD	NAD	NAD	NAD	-	NAD	-	NAD	NAD	NAD	Present	No	Presence		

Notes:
GAC = Generic Assessment Criteria
YES = GAC Exceeded
CLEA SGV = Clea Soil Guideline Value (Residential with Plant Uptake End Use based on 2.5% SOM)
LQM S4UL = LQM/CIEH 'Suitable 4 Use Levels' S4ULs (Residential with Plant Uptake End Use based on 2.5% SOM)
CL:AIRE C4SL = Category 4 Screening Levels (Residential with Plant Uptake End Use based on 2.5% SOM)
ATRISK SSV = Atkins Soil Screening Values (Residential with Consumption of Home Grown Produce at 1% SOM)



GEO Environmental Engineering Ltd

Geotechnical and Environmental
Consultants
&
Drilling Experts

Intellectual Copyright 2023
(GEO Standard Terms and Conditions Apply)