GEO Environmental Engineering

PHASE 2: GROUND INVESTIGATION REPORT

PROPOSED COMMERCIAL DEVELOPMENT OF

LAND OFF MILLOM ROAD, MILLOM

CUMBRIA

FOR:

W.MILLIGAN & SONS

GEO Environmental Engineering

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Client Title: W.Milligan & Sons

Consultant: RG Parkins & Partners Ltd

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1.0 Introduction

1.1 Brief

GEO Environmental Engineering Ltd (GEO) were commissioned by the Consultant, RG Parkins & Partners Ltd on behalf of the client, W.Milligan & Sons to carry out a ground investigation on land at Millom Road, Millom, Cumbria.

The investigation was carried out to determine the ground conditions across the site to aid the design of foundations and drainage and to assess the risk to human health and environmental receptors from possible contamination and ground gas.

1.2 Site Location and Description

The site, occupying an area of c.320m^2 is located in the north eastern part of Millom as indicated on the site location plan included in Appendix I. Access to the site is from Millom Road to the south.

- National Grid Reference: 317802, 480278
- Post Code: LA18 4BW

The site is located adjacent to an existing vehicle servicing garage and is used for car parking. The ground is surfaced with gravel and occasional grass and scrub vegetation.

The site is generally flat. A topographical survey has not been provided, however, Ordnance Survey data suggests that the site is at an elevation of <10m OD.

1.3 Proposed Development

It is understood that the Client construct a vehicle body workshop. A plan of the proposed layout has been provided and a copy is included in Appendix I. The plan indicates a portal framed warehouse with car parking and other associated infrastructure. There are no plans to incorporate any soft landscaping.

The Client is also considering the use of a soak-away drainage system if the ground conditions prove suitable.

1.4 Other Reports/Studies

GEO are not aware of any previous reports for the site.

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 on the report 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.

3.0 Ground Investigation Fieldwork

3.1 Intrusive Investigation Fieldworks Summary

The ground investigation works were completed in November 2022.

The exploratory holes were located within the footprint of the proposed building footprint as indicated on the exploratory hole location plan which is included in Appendix I.

The ground investigation works comprised:

- 5 No. Dynamic (Windowless) Sampling Boreholes (BH01 to BH05) to depths of between c.0.40m and c.3.45m bgl.
- Gas and groundwater monitoring (4 visits completed).
- In-situ geotechnical testing (Standard Penetration Tests (SPT).
- Site supervision by a suitably qualified and experienced Geo-Environmental Engineer.
- 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.

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

The 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 within all of the boreholes to depths of between c.0.60m and in excess of c.1.73m bgl. It should be noted that boreholes BH01, 02 , 04 and 05 were terminated within the made ground at depths of between c.0.40m and c.1.73m bgl due to refusal or shallow groundwater. Only borehole BH03 penetrated the made ground into the underlaying drift deposits.

The made ground was predominantly granular and comprised gravel and cobble sized anthropogenic material including slag, concrete, brick, ash, limestone, slate and tile. Occasional inclusions of soft organic peaty deposits were also noted.

Reference to the BGS online database indicates that the site is located within (or very close to) an area of extensive and potentially deep made ground.

During the investigation, no visual or olfactory evidence of fuel/oil type contamination was encountered.

4.1.2 Natural Drift Deposits

Natural drift deposits were only encountered within borehole BH03. The deposits were noted as grey silty fine sand.

SPT tests were completed at 1m intervals between c.1.00m and c.3.00m bgl through the sand deposits. The tests gave values of N15 at c.1m which dropped to N9 and N1 at 2.00m and c.3.00m respectively. The results indicate medium dense deposits which become loose and very loose with depth.

The borehole was terminated at a depth of c.3.45m bgl due to sand blowing up the casing to a depth of c.2.25m bgl.

Reference to the BGS online database indicates that the site is located in an area which is potentially underlain by Raised Marine Deposits (sands and gravels) and Saltmarsh Deposits (clays and silts). The BGS also hold historical borehole data for the existing garage immediately west of the site. The borehole was drilled to depth of c.3.40m bgl in 1972. The borehole recorded compressed silt, soft silty clay and soft sandy silt to a depth of 2.30m bgl. This was underlain by very soft clayey silt to a depth of c.3.40m bgl. The log indicates that the very soft silt had the ‘consistency of toothpaste’.

4.1.3 Solid Geological Deposits (Bedrock)

Solid strata/bedrock was not encountered during the ground investigation.

4.2 Groundwater

Groundwater strikes were encountered din the boreholes during the drilling at depths of between c.0.15m and c.1.55m bgl. This resulted in standing water at depths of between 0.15m and 0.70m bgl.

The groundwater was shallowest in the east of the site (BH04 and BH05). The boreholes in this area were terminated at shallow depth due to the water ingress as it was not possible to hand dig safely.

Groundwater monitoring of installations placed in the boreholes has been carried out on four occasions between December 2022 and February 2023. Standing groundwater levels have been recorded between ground level and c.0.40m bgl. Given the shallow ground water in borehole BH02, it was not possible to complete gas monitoring at this location.

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

SPT tests were completed at 1m intervals between c.1.00m and c.3.00m bgl through the sand deposits. The tests gave values of N15 at c.1m which dropped to N9 and N1 at 2.00m and c.3.00m respectively. The results indicate medium dense deposits which become loose and very loose with depth.

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

5.2 Ground Permeability (Soil Infiltration Tests)

The Consultant requested Falling Head Tests as part of the intrusive ground investigation works, however, due to the shallow groundwater encountered in all of the exploratory hole, the tests were not possible.

5.3 Ground Gas Monitoring

To assess the on-site potential for hazardous ground gases, the boreholes (BH01 to BH03) were installed with ground gas monitoring wells to facilitate a period of ground gas monitoring.

The boreholes were installed to depths of between c.1.00m and c.2.50m 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 the 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 has 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. The monitoring has been completed in general accordance with CIRIA C665 (Table 5.5a and 5.5b) using a GA2000 Ground Gas Analyser with external flow pod.

As it is the intention of the Client to develop the site for Commercial end use, the monitoring of ground gas monitoring must comprise at least four site visits over a minimum period of four weeks.

The wells have been monitored on four occasions between December 2022 and February 2023. The results of monitoring are included on the Ground Gas Monitoring Record Sheets included in Appendix II. The ground gas risk assessment is presented in Section 7.3 of this report.

A review of the UK Health Security Agency website suggests that the site may be located within a Radon Affected area. It is recommended that a bespoke radon report is ordered for the site to determine if radon protection measures are required.

6.0 Laboratory Testing

6.1 Chemical Screening

6.1.1 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 (SO_4) screening:

- 4 No. samples of made ground (c.0.15m to 0.70m 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 9 and presented in the Chemtech report (ref: 115967) contained in Appendix III.

6.1.2 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:

- 4 No. samples of made ground (c.0.15m to 0.70m bgl).

The samples were subjected to analysis at the following UKAS and MCERTS accredited laboratory:

- Chemtech Environmental Testing of Stanley, County Durham.

The suite of chemical testing was based on the descriptions of the materials encountered within the exploratory holes, the site history and the potential for made ground of an unknown source. The samples were screened for the contaminants detailed below:

- **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: 115967) contained in Appendix III.

No visual or olfactory evidence of contamination was identified during the fieldworks. Therefore, the samples were not screened for petroleum hydrocarbons or volatile organic compounds.

No evidence of contamination was noted within the natural drift deposits; therefore, no samples of the drift were scheduled for chemical screening.

7.0 Generic Quantitative Risk Assessment (GQRA)

7.1 Methodology for Assessing Risks to Human Health

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

A human health risk assessment can completed using the contamination levels recorded in the soils by comparing the values against published Generic Assessment Criteria (GAC), such as CLEA Soil Guideline Values (SGV's), 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*
- *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 comprise a single portal framed building for vehicle servicing. There are no plans for areas of soft landscaping. Therefore, for the purposes of this basic Human Health ground contamination risk assessment, the maximum values for the soil samples have been compared to GAC for a CLEA end use classification of: ***Commercial*** 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.

7.2 Human Health Risk Assessment – Comparison with Guidance Levels

7.2.1 Inorganic Contaminants – Soil

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

- LQM/CIEH S4UL 2015 (Commercial End Use).
- CL:AIRE/DEFRA Cat 4 Screening Levels C4SL (Commercial End Use).
- Atkins ATRISK Screening Values (Commercial End Use).

As discussed in section 8.1, the contaminant concentrations have been assessed against GAC for a Commercial 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.

7.2.2 Organic Contaminants – Soil

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

- LQM/CIEH S4UL 2015 (Commercial End Use).

Taking in to account the average TOC of the soils on the site, this assessment has been completed utilising a 1.0% 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.

7.2.3 Asbestos Containing Materials (ACM's) – Soil

4 No. samples of the 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.

7.2.4 Human Health Risk Assessment – Summary

The following is a summary of the Human Health risk assessment based on *Commercial 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 commercial end use.

7.3 Ground Gas Risk Assessment

As indicated in section 5.5, gas and groundwater monitoring wells have been installed in three boreholes (BH01, 02 and 03) and monitoring has been completed on four occasions.

During the monitoring, atmospheric air pressures varied between 1024mb and 1036mb and included both rising and falling pressure trends.

A maximum Carbon Dioxide (CO_2) concentration of 0.9%v/v has been recorded and a maximum Methane (CH_4) concentration of 6.3%v/v has been recorded. The minimum Oxygen (O_2) concentration was 15.6%. The flow was <0.1l/h throughout.

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

The CO_2 GSV is:

- **CO_2 GSV = (Max CO_2 (%) / 100) x Max Flow (l/hr),**
- **Therefore; (0.9 / 100) x 0.1 = 0.0009 l/hr GSV**

The CH_4 GSV is:

- **CH_4 GSV = (Max CH_4 (%) / 100) x Max Flow (l/hr),**
- **Therefore; (6.3 / 100) x 0.1 = 0.0063 l/hr GSV**

The concentration of methane concentration (6.3%) exceeds the assessment criteria for Characteristic Situation 1 (CS1) which is 1%. Therefore, in accordance with CIRIA C665 Table 8.5, taking into consideration the GSV values and the maximum gas concentrations, the site falls into Characteristic Situation 2 (CS2). This indicates that basic gas precautions are required.

A review of the UK Health Security Agency website suggests that the site may be located within a Radon Affected area. It is recommended that a bespoke radon report is ordered for the site to determine if radon protection measures are required.

7.4 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: 75849) contained in Appendix III.

From the results, the following observations can be seen:

- pH values in the soils ranged from 8.6 to 9.1 (alkali).
- Water Soluble Sulphate (SO_4) levels were recorded as ranging from 63mg/l to 308mg/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).

8.0 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.

9.0 Discussion and Recommendations

9.1 Ground and Groundwater Conditions Summary

Geological maps for the site indicate that it is located within, or very close to an area of extensive and potentially deep made ground which is underlain by Raised Marine and Saltmarsh Deposits. Historical boreholes in the vicinity of the site have encountered poor ground conditions to a depth of at least c.3.45m bgl.

The ground investigation encountered variable and potentially deep made ground comprising much anthropogenic material and occasional organic material overlying natural drift deposits of medium dense silty sand which became very loose with depth. Shallow groundwater was also recorded which prevented two of the boreholes from progressing.

During the investigation, GEO did not identify any visual or olfactory evidence of fuel/oil type contamination.

Due to the shallow groundwater, falling head tests could not be completed and the site is not considered suitable for soakaway drainage. An alternative drainage solution should be sought.

9.2 Future Foundations, Pavements and Buried Structures

It is understood that the proposed development will incorporate a portal framed warehouse. Although loads are not expected to be high, the shallow ground conditions are not considered suitable for the proposed foundations at this stage due to the potential for differential settlement and possible shear failure.

It is recommended that the Client/Consultant consider the use of piled foundations to take the loads down to a suitable bearing stratum. Additional deeper boreholes are recommended to inform pile design and costing. It is recommended that the deeper boreholes are drilled using cable percussive techniques.

With respect to buried structures (concrete), the pH values and soluble sulphate concentrations in the soils equate to a Design Sulphate classification of DS-1 and an ACEC classification of AC-1.

Significant groundwater ingress should be anticipated and it is recommended that allowance be made for 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. Care should be taken to avoid pumping fines (sand) as this could underline the ground and destabilise nearby existing structures.

9.3 Ground Contamination

9.3.1 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 commercial development and asbestos fibres have not been detected. As such, the made ground does not pose a risk to human health.

In view of the above, remediation is not considered necessary in order to develop the site for commercial end use. Re-assessment would be required if a change in the end use is considered.

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.

9.4 Ground Gas

The results of the ground gas monitoring indicate elevated concentrations of methane. However, carbon dioxide levels remained low and flow rates were negligible throughout.

Basic gas protection measures in line with CS-2 are considered necessary. It is likely that gas protection measures for the proposed development would comprise a reinforced concrete cast in-situ floor slab with at least 1200g DPM. The site will therefore require a Ground Gas Verification Plan.

Slightly depleted Oxygen (O2) levels have been noted. Whilst these levels are unlikely to pose a risk to above ground structures they may potentially pose a risk to the construction workforce for any below ground works (i.e. installing utilities etc.). Because of this, the information presented in this report should be passed to the Principal Contractor (PC) as a Workforce Health and Safety risk assessment lies out-with the scope of this report.

A review of the UK Health Security Agency website suggests that the site may be located within a Radon Affected area. It is recommended that a bespoke radon report is ordered for the site to determine if radon protection measures are required. Full radon protection measures would require additional protection measures over CS-2.

9.5 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”.

9.6 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.

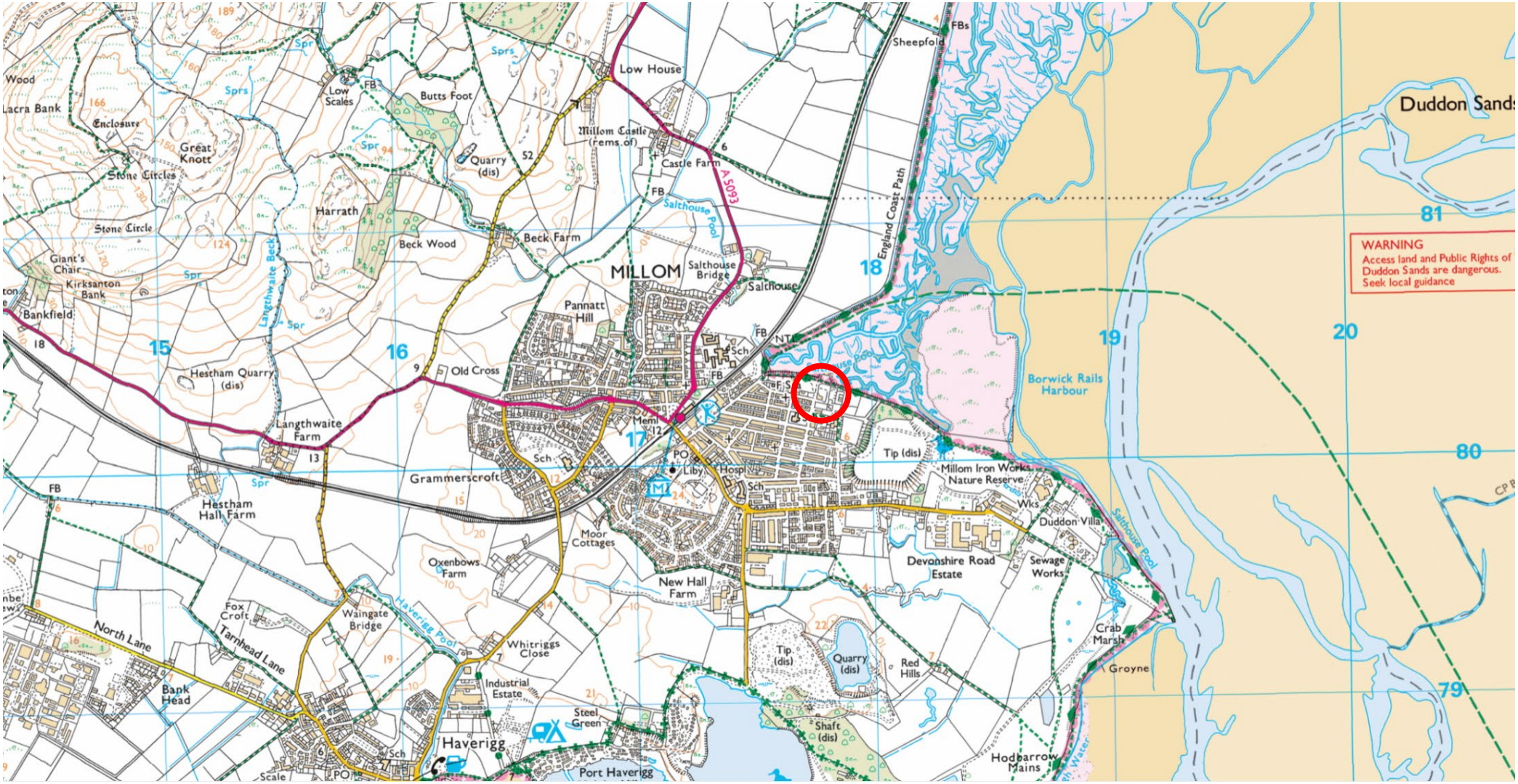
End of Report

Appendix I

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

GEO Environmental Engineering

GEO2022-5585: Millom Road, Millom – Site Location



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GEO Environmental Engineering

GEO2022-5585: Millom Road, Millom – Exploratory Hole Location Plan

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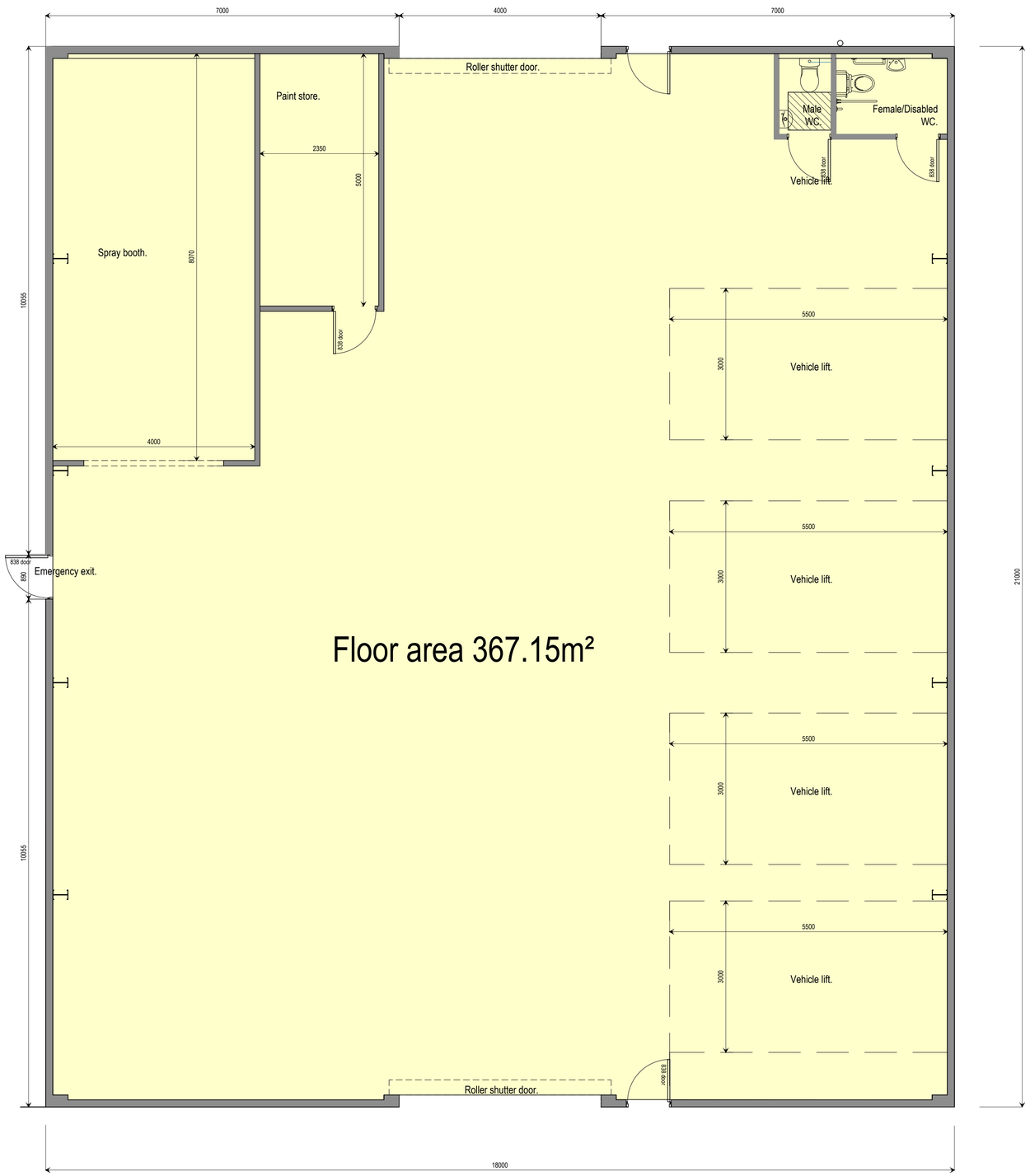
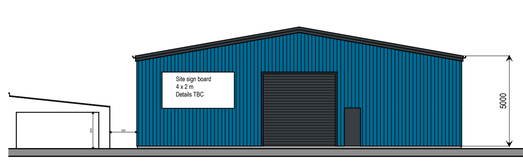
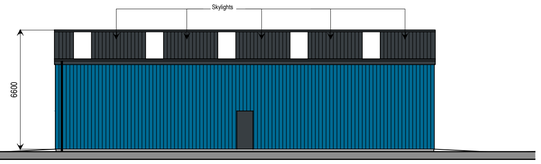


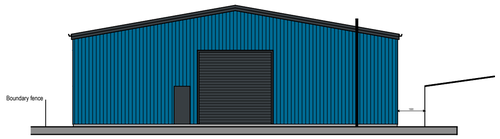
Proposed floor plan



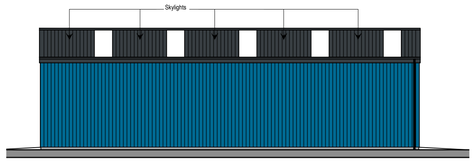
Proposed front elevation



Proposed West elevation



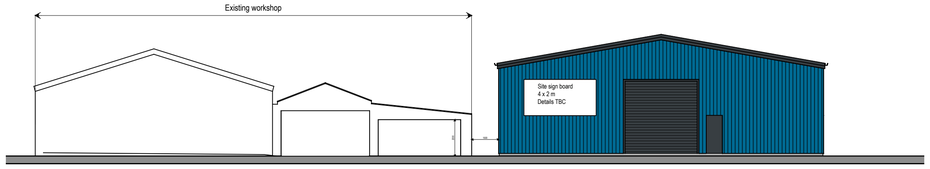
Proposed rear elevation



Proposed east elevation

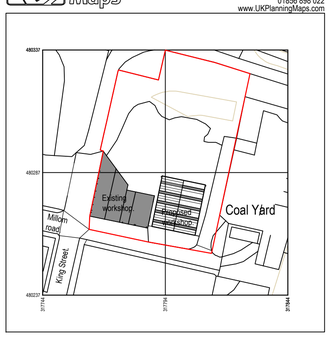
Materials.

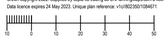
Roof. Profiled metal sheets colour Anthracite.RAL 7016
Walls. Profiled metal sheets colour Solent Blue.RAL CLASSIC 240 40 40
Doors. Coated steel colour Anthracite.RAL 7016
Fascias,gutters and downpipes. Coated steel colour Anthracite.RAL 7016



Millom Road street scene.

UK Planning Maps
01856 898 022
www.UKPlanningMaps.com





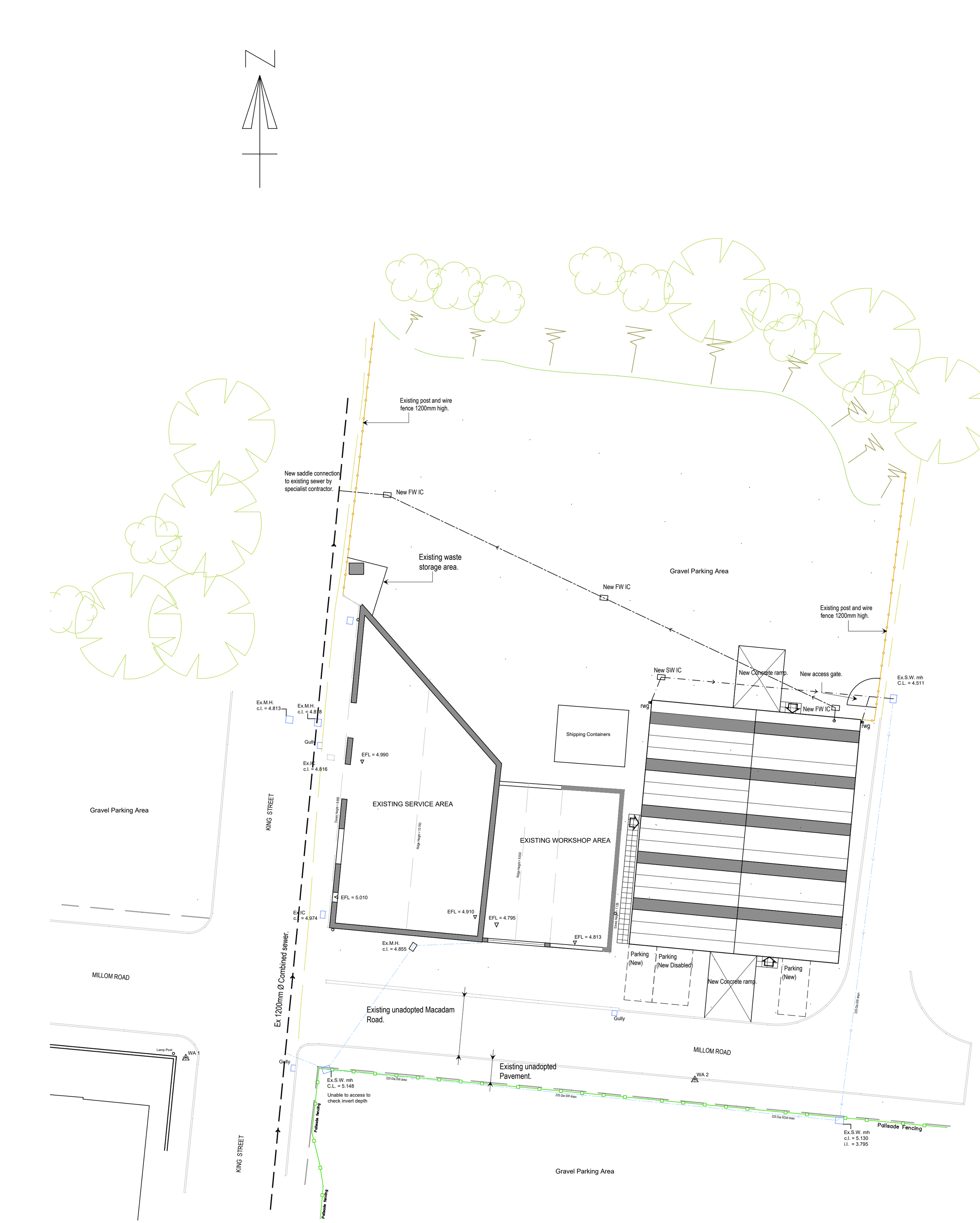
Location plan 1:1250 scale
Total site area = 3847m²
Site boundary shown

FOR PLANNING PURPOSES ONLY.

Rev.B.Internal alterations.Sept 2022.
Rev.A.Building flipped back to front.Sept 2022.

Proposed Vehicle body workshop at Millom Road,Millom.Cumbria.LA18 4BW.
For Mr.J.Milligan.
General arrangement drawing.

Scales 1:50,1:1250 @A1
June 2022.
Dwg No.MIL.JM.01(B).



CONCRETE FLAGGED PATHS - 450 x 450 x 35mm concrete flags on 25mm sand/cement bedding on min. 100mm compacted stone base.
DRAINAGE All pipes for private (not adopted) drainage to be uPVC, with 100mm deep bedding + fill to top of pipe in 10mm granular material, and backfilled with selected fill free from stones larger than 40mm. Concrete bed and surround to pipes required where cover is less than 900mm under roads and drives.
INSPECTION CHAMBERS to be 320mm dia. (max depth 600mm) or 460mm dia. (max depth 1200mm) or 460mm dia with max 350mm dia. cover to restrict access (depth greater than 1200mm).
INSPECTION CHAMBERS & COVERS are designed to be appropriate for their location and traffic load - these should be re-assessed if drainage design is changed on site.

NOTES:- Finished floor level of the proposed building to be determined from the result of the Flood Risk Assessment.
All new drainage,falls,pipe sizes and invert and cover levels to be determined by the result of the Drainage Strategy.

FOR PLANNING PURPOSES ONLY.

Rev.C.Foul drainage updated.Sept.2022
Rev.B.Plan based on topo survey.New unit moved back 1.0m.
Drainage updated.Sept.2022

Proposed Vehicle body workshop at Millom Road,Millom.Cumbria.LA18 4BW.
For Mr.J.Milligan.
Site layout plan.

Scales 1:200 @A2
June 2022.
Dwg No.MIL.JM.02(C).

Appendix II

- Exploratory Hole Logs
- Ground Gas Monitoring Sheets

GEO Environmental Engineering

GEO2022-5585: Millom Road, Millom - BH01 (Rear left Corner).

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.30	MADE GROUND: Grey and dark brown sandy fine to coarse GRAVEL of slag, concrete and brick with many slag cobbles.		0.15 T&J
0.30	1.73	MADE GROUND: Loose becoming very dense dark grey ash-clinker FILL with much fine to coarse gravel of slag, concrete, occasional slate, limestone, brick and tile. Some softer organic peaty inclusions around 0.95m.		1.00 T&J 1.10 SPT: 1/1/1/2/5/6. N14 1.50 T&J 1.65 SPT: N50/30mm
		End of borehole due to sample tube and SPT refusal. Water strike at 0.70m and SWL at 0.55m after 20 minutes. Borehole installed: GL to 0.45m plain pipe 0.45m to 1.45m slotted pipe		Hand dug before drilling. Cased to 1.50m.

Engineer: GE
Site Works Date: 17/11/2022
Plant: Archway DART Superheavy

Log Notes:
SPT = Standard Penetration test (blows per 300mm n300)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

GEO2022-5585: Millom Road, Millom - BH02 (Central).

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.35	MADE GROUND: Grey sandy fine to coarse GRAVEL of slag, concrete and brick with occasional slag and brick cobbles.		0.20 TJ
0.35	1.30	MADE GROUND: Very dense dark grey ash-clinker FILL with much fine to coarse gravel of slag, concrete, occasional slate, limestone, brick and tile.		0.70 TJ 1.10 SPT: N50/70mm
		End of borehole due to sample tube and SPT refusal. Water strike and SWL at 0.55m after 20 minutes. Borehole installed: GL to 0.50m plain pipe 0.50m to 1.0m slotted pipe		Hand dug before drilling. Cased to 1.20m.

Engineer: GE
Site Works Date: 17/11/2022
Plant: Archway DART Superheavy

Log Notes:
SPT = Standard Penetration test (blows per 300mm n300)
HSV = Hand Shear Vane (result in kN/m^2)
LP = Limited Penetration (HSV/CBR)
NP = No penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

GEO2022-5585: Millom Road, Millom. BH03 (Front Left).

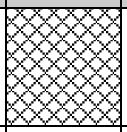
Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.35	MADE GROUND: Grey sandy fine to coarse GRAVEL of slag, concrete and brick with occasional slag and brick cobbles.		0.30 TJ
0.35	0.45	MADE GROUND: CONCRETE.		
0.45	0.60	MADE GROUND: Cemented brick. Possible old foundation.		
0.60	3.45	Medium dense becoming very loose grey silty fine SAND.		0.60 TJ 1.00 T 1.10 SPT: 3/3/4/4/3/4. N15 2.00 T 2.00 SPT: 1/1/2/2/2/3. N9 3.00 T 3.00 SPT: 1/1/1/0/0/0. N1
		End of borehole due to sand blowing up casing to 2.25m. Water strike at 0.60m and 1.55m. SWL at 0.75m after 20 minutes. Borehole installed: GL to 0.50m plain pipe 0.5m to 2.5m slotted with geosock.		Hand dug before drilling. Cased to 2.50m. Sand blowing up casing to 2.25m.

Engineer: GE
Site Works Date: 17/11/2022
Plant: Archway DART Superheavy

Log Notes:
SPT = Standard Penetration test (blows per 300mm n300)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

GEO2022-5585: Millom Road, Millom - BH04 (Rear Right).

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.40	MADE GROUND: Grey slightly sandy fine to coarse GRAVEL and COBBLES of slag, concrete and brick.		0.20 TJ
		End of borehole due to high water table - unable to excavate. Water strike and SWL at 0.20m. Borehole backfilled with arisings on completion.		Hand dug.

Engineer: GE
Site Works Date: 17/11/2022
Plant: Archway DART Superheavy

Log Notes:
SPT = Standard Penetration test (blows per 300mm n300)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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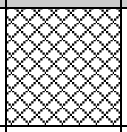
Telephone: 07883 440 186

GEO Environmental Engineering

GEO2022-5585: Millom Road, Millom - BH05 (Front Right).

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.45	MADE GROUND: Dark grey slightly sandy fine to medium GRAVEL of tarmac, slag, brick, clinker and coal.		0.25 TJ
		End of borehole due to high water table - unable to excavate. Water strike and SWL at 0.15m. Borehole backfilled with arisings on completion.		Hand dug.

Engineer: GE
Site Works Date: 17/11/2022
Plant: Archway DART Superheavy

Log Notes:
SPT = Standard Penetration test (blows per 300mm n300)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

Ground Gas & Groundwater Monitoring Record Sheet 01

Site: Millom Road, Millom

Project No: 2022-5585

Date: 06.12.2022

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?
BH01	1024 R	0.1	0.1	0.1	0.0	21.6	22.3	<0.1	0.40	1.50	
BH02	1024 R	nm	nm	nm	nm	nm	nm	nm	0.00	1.00	
BH03	1024 R	0.0	0.0	0.2	0.9	22.6	20.4	<0.1	0.40	2.50	

Notes:
Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.
F = Falling Atmosphreic Pressure, R = Rising Atmosphreic Pressure, S = Steady Atmospheric Pressure
Nm – Not Monitored

Monitoring Completed By: TE

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

Weather Conditions: Sunny and Dry

Temperature 3.0°C

Notes: BH02 Flooded. Unable to monitor.

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GEO Environmental Engineering

Ground Gas & Groundwater Monitoring Record Sheet 02

Site: Millom Road, Millom

Project No: 2022-5585

Date: 26.01.2023

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	1036 R	0.0	4.0	0.0	0.0	20.1	15.6	<0.1	0.40	1.50	
BH02	1036 R	nm	nm	nm	nm	nm	nm	nm	0.00	1.00	
BH03	1036 R	0.0	0.0	0.2	0.6	20.4	19.2	<0.1	0.30	2.50	

Notes:
Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.
F = Falling Atmosphreic Pressure, R = Rising Atmosphreic Pressure, S = Steady Atmospheric Pressure
Nm – Not Monitored

Monitoring Completed By: TE

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

Weather Conditions: Dry, Overcast

Temperature 6.0°C

Notes: BH02 Flooded. Unable to monitor.

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GEO Environmental Engineering

Ground Gas & Groundwater Monitoring Record Sheet 03

Site: Millom Road, Millom

Project No: 2022-5585

Date: 13.02.2023

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	1033 F	0.0	0.0	0.2	0.8	21.2	19.0	<0.1	0.30	1.50	
BH02	nm	nm	nm	nm	nm	nm	nm	nm	0.00	1.00	
BH03	1033 F	0.5	6.3	0.0	0.0	20.1	17.5	<0.1	0.50	2.50	

Notes:
Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.
F = Falling Atmosphreic Pressure, R = Rising Atmosphreic Pressure, S = Steady Atmospheric Pressure
Nm – Not Monitored

Monitoring Completed By: TE

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

Weather Conditions: Dry, Sunny

Temperature 9.0°C

Notes: BH02 Flooded. Unable to monitor.

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GEO Environmental Engineering

Ground Gas & Groundwater Monitoring Record Sheet 04

Site: Millom Road, Millom

Project No: 2022-5585

Date: 23.02.2023

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	1025 F	0.0	0.0	0.2	0.3	21.0	20.3	<0.1	0.30	1.50	-
BH02	Nm	nm	nm	nm	nm	nm	nm	nm	0.00	1.00	-
BH03	1025 F	0.5	1.7	0.0	0.0	21.3	20.8	<0.1	0.50	2.50	-

Notes:
Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.
F = Falling Atmosphreic Pressure, R = Rising Atmosphreic Pressure, S = Steady Atmospheric Pressure
Nm – Not Monitored

Monitoring Completed By: TE

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

Weather Conditions: Dry with some clouds

Temperature 11.0^{o}C

Notes: BH02 Flooded. Unable to monitor.

Website: www.geoenvironmentalengineering.com
Email: info@geoenvironmentalengineering.com
Telephone: 08456 768 895 / 07883 440 186

Appendix III

- Laboratory Test Results

ANALYTICAL TEST REPORT

Contract no: 115967

Contract name: Millom Road, Millom

Client reference: GEO2022-5585

Clients name: Geo Environmental Engineering

Clients address: 4 Culgarth Avenue
Cockermouth
Cumbria
CA13 9PL

Samples received: 18 November 2022

Analysis started: 18 November 2022

Analysis completed: 25 November 2022

Report issued: 25 November 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: [redacted]

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
115967-1	BH01	0.15	Sandy Loamy Clay with Gravel	-	-	14.6
115967-2	BH02	0.70	Sandy Loamy Clay with Gravel	-	-	33.4
115967-3	BH03	0.30	Sandy Loamy Clay with Gravel & Roots	-	-	10.3
115967-4	BH05	0.25	Sandy Loamy Clay with Gravel	-	-	6.3

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SOILS

Lab number			115967-1	115967-2	115967-3	115967-4
Sample id			BH01	BH02	BH03	BH05
Depth (m)			0.15	0.70	0.30	0.25
Date sampled			17/11/2022	17/11/2022	17/11/2022	17/11/2022
Test	**Method**	**Units**				
Arsenic (total)	CE127 M	mg/kg As	13	48	9.7	10
Cadmium (total)	CE127 M	mg/kg Cd	1.2	0.8	0.4	<0.2
Chromium (total)	CE127 M	mg/kg Cr	28	38	27	40
Chromium (III)	CE208	mg/kg CrIII	28	38	27	40
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	<1	<1
Copper (total)	CE127 M	mg/kg Cu	24	250	39	18
Lead (total)	CE127 M	mg/kg Pb	230	251	90	19
Mercury (total)	CE127 M	mg/kg Hg	<0.5	<0.5	<0.5	<0.5
Nickel (total)	CE127 M	mg/kg Ni	17	48	21	39
Selenium (total)	CE127 M	mg/kg Se	3.0	2.9	1.1	2.2
Zinc (total)	CE127 M	mg/kg Zn	224	308	128	63
pH	CE004 M	units	8.8	8.6	9.1	8.8
Sulphate (2:1 water soluble)	CE061 U	mg/l SO_4	432	160	134	73
Cyanide (total)	CE077	mg/kg CN	1.0	16	1.3	<1
Total Organic Carbon (TOC)	CE197	% w/w C	1.3	14.7	1.3	2.0
PAH						
Naphthalene	CE087 M	mg/kg	0.09	0.06	0.07	2.18
Acenaphthylene	CE087 M	mg/kg	0.15	0.06	0.08	0.63
Acenaphthene	CE087 M	mg/kg	0.03	0.05	0.03	8.42
Fluorene	CE087 U	mg/kg	0.10	0.11	0.07	9.73
Phenanthrene	CE087 M	mg/kg	1.71	1.47	0.74	63.75
Anthracene	CE087 U	mg/kg	0.39	0.37	0.27	14.39
Fluoranthene	CE087 M	mg/kg	4.18	2.75	2.10	71.12
Pyrene	CE087 M	mg/kg	3.45	2.23	1.81	52.14
Benzo(a)anthracene	CE087 U	mg/kg	2.24	1.36	1.27	26.44
Chrysene	CE087 M	mg/kg	2.26	1.31	1.22	23.55
Benzo(b)fluoranthene	CE087 M	mg/kg	2.54	1.38	1.57	24.58
Benzo(k)fluoranthene	CE087 M	mg/kg	1.05	0.51	0.67	10.32
Benzo(a)pyrene	CE087 U	mg/kg	1.95	1.12	1.21	20.84
Indeno(123cd)pyrene	CE087 M	mg/kg	1.50	0.72	1.09	13.48
Dibenz(ah)anthracene	CE087 M	mg/kg	0.33	0.14	0.21	3.11
Benzo(ghi)perylene	CE087 M	mg/kg	1.14	0.55	0.95	10.08
PAH (total of USEPA 16)	CE087	mg/kg	23.1	14.2	13.4	355
Subcontracted analysis						
Asbestos (qualitative)	$	-	NAD	NAD	NAD	NAD

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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)
115967-1	BH01	0.15	N	
115967-2	BH02	0.70	N	
115967-3	BH03	0.30	N	
115967-4	BH05	0.25	N	

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.

Appendix IV

- GEO Chemical Assessment Sheet

Geo Environmental Engineering Ltd

Chemical Assessment Sheet - Soils

Lab number			115967-1	115967-2	115967-3	115967-4	Generic Assessment Criteria Industrial & Commercial 1.0% SOM		
Sample id			BH01	BH02	BH03	BH05			
Depth (m)			0.15	0.70	0.30	0.25	GAC	GAC Exceeded?	GAC Ref:
Date sampled			17/11/2022	17/11/2022	17/11/2022	17/11/2022			
Test	**Method**	**Units**							
Arsenic (total)	CE127 M	mg/kg As	13	48	9.7	10	640	No	S4UL
Cadmium (total)	CE127 M	mg/kg Cd	1.2	0.8	0.4	<0.2	190	No	LQM S4UL
Chromium (total)	CE127 M	mg/kg Cr	28	38	27	40	8600	No	LQM S4UL
Chromium (III)	CE208	mg/kg CrIII	28	38	27	40	8600	No	LQM S4UL
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	<1	<1	33	No	LQM S4UL
Copper (total)	CE127 M	mg/kg Cu	24	250	39	18	68000	No	LQM S4UL
Lead (total)	CE127 M	mg/kg Pb	230	251	90	19	2300	No	C4SL
Mercury (total)	CE127 M	mg/kg Hg	<0.5	<0.5	<0.5	<0.5	1100	No	LQM S4UL
Nickel (total)	CE127 M	mg/kg Ni	17	48	21	39	980	No	LQM S4UL
Selenium (total)	CE127 M	mg/kg Se	3.0	2.9	1.1	2.2	12000	No	LQM S4UL
Zinc (total)	CE127 M	mg/kg Zn	224	308	128	63	730000	No	LQM S4UL
pH	CE004 M	units	8.8	8.6	9.1	8.8	N/A	N/A	N/A
Sulphate (2:1 water soluble)	CE061 U	mg/l SO_4	432	160	134	73	N/A	N/A	N/A
Cyanide (total)	CE077	mg/kg CN	1.0	16	1.3	<1	34	No	ATRISK SSV
Total Organic Carbon (TOC)	CE197	% w/w C	1.3	14.7	1.3	2.0	N/A	N/A	N/A
PAH									
Naphthalene	CE087 M	mg/kg	0.09	0.06	0.07	2.18	190	No	LQM S4UL
Acenaphthylene	CE087 M	mg/kg	0.15	0.06	0.08	0.63	83000	No	LQM S4UL
Acenaphthene	CE087 M	mg/kg	0.03	0.05	0.03	8.42	84000	No	LQM S4UL
Fluorene	CE087 U	mg/kg	0.10	0.11	0.07	9.73	63000	No	LQM S4UL
Phenanthrene	CE087 M	mg/kg	1.71	1.47	0.74	63.75	22000	No	LQM S4UL
Anthracene	CE087 U	mg/kg	0.39	0.37	0.27	14.39	520000	No	LQM S4UL
Fluoranthene	CE087 M	mg/kg	4.18	2.75	2.10	71.12	23000	No	LQM S4UL
Pyrene	CE087 M	mg/kg	3.45	2.23	1.81	52.14	54000	No	LQM S4UL
Benzo(a)anthracene	CE087 U	mg/kg	2.24	1.36	1.27	26.44	170	No	LQM S4UL
Chrysene	CE087 M	mg/kg	2.26	1.31	1.22	23.55	350	No	LQM S4UL
Benzo(b)fluoranthene	CE087 M	mg/kg	2.54	1.38	1.57	24.58	44.0	No	LQM S4UL
Benzo(k)fluoranthene	CE087 M	mg/kg	1.05	0.51	0.67	10.32	1200	No	LQM S4UL
Benzo(a)pyrene	CE087 U	mg/kg	1.95	1.12	1.21	20.84	35.0	No	LQM S4UL
Indeno(123cd)pyrene	CE087 M	mg/kg	1.50	0.72	1.09	13.48	500	No	LQM S4UL
Dibenz(ah)anthracene	CE087 M	mg/kg	0.33	0.14	0.21	3.11	3.50	No	LQM S4UL
Benzo(ghi)perylene	CE087 M	mg/kg	1.14	0.55	0.95	10.08	3900	No	LQM S4UL
PAH (total of USEPA 16)	CE087	mg/kg	23.1	14.2	13.4	355	-	-	-
Subcontracted analysis									
Asbestos (qualitative)	$	-	NAD	NAD	NAD	NAD	Present	No	Presence

Notes:
GAC = Generic Assessment Criteria
YES = GAC Exceeded
LQM S4UL = LQM/CIEH 'Suitable 4 Use Levels' S4ULs (Commercial End Use based on 1.0% SOM)
CL:AIRE GAC (2010) = EIC/AGS/CL:AIRE GAC 2010 (Commercial End Use based on 1.0% SOM)
ATRISK SSV = Atkins Soil Screening Values (Commercial End Use based on 1.0% SOM)

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