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JWS Development

# Stubbins House, Stubbins Lane

*Phase 2 Geo-Environmental Investigation and Assessment Report*

***G3472***

March 2021

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Document Control Sheet

# Stubbins House, Stubbins Lane

*Phase 2 Geo-Environmental Investigation and Assessment Report*

| Job | Date | Issue | Copy |
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| *G3472* | *March 2021* | *0* | |

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## 1.0 PREFACE

The site is located at Stubbins House, Stubbins Lane, Claughton-On-Brock, Preston. PR3 0PL. (NGR 350668E, 442683N). Site occupies an area of approximately 0.07 hectares.

PSA Design were commissioned by *JWS Development* to provide a Phase 2 Geo-Environmental Investigation & Assessment of the site. It is understood that consideration is being given to the redevelopment of the site as a *mixed use residential and commercial* development. A development layout plan has been provided, which is included in this report as Drawing No. 9009/L06/A.

PSA Design's investigation has incorporated selective information originally included within the following report:

- Worms Eye - Preliminary Risk Assessment (Desk Study) report – Stubbins House, Stubbins Lane, Claughton-On-Brock, Preston, PR3 0PL [Stubbins Lane/PR3 0PL, dated 1 December 2017]

A summary of salient geo-environmental issues is provided in the table below:

| Issue | Remarks |
|---|---|
| Former uses | Former uses of site have been part of a wider farm site. Several buildings and probable garages have previously been on site |
| Hazardous Gas | There are no landfill sites or filled features within 250 metres of the site.<br>It is considered that there is no risk to the development from landfill or ground gases. A qualitative assessment within the Wormseye PRA confirmed that risks from ground gas are very low/negligible and gas monitoring is not required at the site. |
| Mining & Quarrying | The Coal Authority Interactive Mapping shows:<br>- Site is not in a High Risk Area. - No nearby coal seams. - No nearby mine entries. |
| Ground Conditions | Concrete/Made Ground Topsoil over GLACIAL DEPOSITS ('Firm brown/grey sandy silty CLAYS) which were underlain by 'silty sands' in all locations. 'Grey/brown fine gravel' was encountered from depth 3.5 m to the base of the Borehole No WS3 (4.45 m). No groundwater was encountered within the boreholes drilled across the site. |
| Contamination | Several potential pollution sources, but following the ground investigation, chemical testing results showed locally elevated PAH compounds (benzo(b)fluoranthene and dibenzo(ah)anthracene within WS1 which pose a risk to human health (end users) and widespread phytotoxic contamination. Concrete specification of DS-1 AC-2z. Standard water supply pipes are suitable. |
| Anticipated Foundation Solutions | Simple strip foundations are expected to be suitable for the buildings of both properties. All formations must be checked on site to confirm that the design bearing capacity is extent before foundations are installed. Should areas of poor ground be encountered, the excavations may require extending until suitable strata is found, and the design engineer's instruction must be sought. As suitable bearing materials has generally been found within the top 600mm of ground, it will be feasible to construct ground floor slabs as ground bearing. All fill materials, however; must be removed to facilitate this, and levels brought back up with suitably compacted sub-base materials. The foundation designer must consider the potential effects of the existing trees, in respect of determination of formation levels for foundations. Formation levels must be designed to comply with LABC requirements and NHBC Ch.4.2 guidance. |
| Remediation Measures | Remediation Strategy is required.<br>1. Excavation and removal of contaminated soils from garden/landscaped areas.<br>2. Waste disposal assessment of material arisings<br>3. Cover system design.<br>Validation of any imported/site won cover system materials for proposed garden areas. |
| Geotechnical Issues | 1. Trees effect on clay heave.<br>2. Potential unidentified areas of poor ground<br>3. Obstructions within near surface made ground deposits. |

## 2.0 INTRODUCTION

### 2.1 *Terms of Reference*

2.1.1 PSA Design were commissioned by JWS Development to carry out a Phase 2 Geo-Environmental Investigation and Assessment of the proposed new mixed use residential and commercial development at Stubbins House, Stubbins Lane. The investigation was designed to assess the ground conditions within the site and risk to local receptors, in particular for the proposed residential development.

2.1.2 This report presents up-to-date ground data for the site.

2.1.3 The agreed scope of works included:

- Borehole investigation across the site;
- Chemical & geotechnical testing of materials;
- Assessment of ground and groundwater conditions, including additional information regarding potential contaminants;
- Assessment of anticipated foundation and engineering issues associated with redevelopment for a *residential and commercial* end-use.

### 2.2 *Proposed Development*

2.2.1 It is understood that consideration is being given to the redevelopment of the site as a mixed used residential and commercial development. This will include the conversion of the existing stone barn into two houses, with car parking and gardens to the rear (southwest).

2.2.2 A development layout plan has been provided, which is included in this report as Drawing No. 9009/L06/A.

## 3.0 SITE DESCRIPTION

### 3.1 *General*

3.1.1 The site location is shown on Drawing Number G3472/G/01. Site details are summarised in the Table below. Current site layout plan shown in Drawing Number G3472/G/02. The site is situated in a rural location.

| Detail | Remarks |
|---|---|
| Location | SE of Stubbins Lane in Claughton-On-Brock (Dwg G3472/G/01). |
| Address | Stubbins House, Stubbins Lane, Claughton-On-Brock, Preston. PR3 0PL |
| NGR | 350668E, 442683N |
| Area | 0.07ha |
| Known services | Not provided |

### *3.2 Site Features*

3.2.1 The site was inspected on 22/11/17 by a Worms Eye Engineer and the salient features are presented below.

3.2.2 The site is an approximately rectangular shaped plot, about 29 by 24 metres, located to the southeast of Stubbins Lane in Claughton-On-Brock.

3.2.3 The site is part of a farm and comprises agricultural buildings, currently being used mainly for livestock. The site was generally level with a grass surface to the west of the building, and concrete surface to the north and east. In the south the surrounding area was unsurfaced. Surrounding the site was mainly farmland and farm buildings.

3.2.4 The buildings on site comprise a stone built two storey barn with a corrugated steel roof (north-east) with an attached single storey block work lean-to with a corrugated steel roof, a Timber/metal/asbestos dilapidated shed (north of the site and a corrugated steel and timber shed, with diesel tank inside (south-east).

3.2.5 Further buildings off-site include a large high barn of corrugated steel, with diesel tank inside (south), open front barn/stable timber and steel (south-east) and Large modern barns (east).

3.2.6 A barn immediately south of the site had a diesel/oil tank inside. One barn stored hay and another had different oils/lubricants and tools. The area slopes down gently to the northwest.

3.2.7 Existing salient features are shown in Drawing Number G3472/G/02.

### *3.3 Site Operations*

3.3.1 Current site is part of a wider agricultural farm. Several buildings and probable garages have previously been on site. This is not expected to be a source of high levels of contaminants. However, low levels of ground contamination, exceeding stringent residential threshold is possible.

## 4.0 HISTORICAL SITE INFORMATION

4.1 In order to investigate the development history and previous land uses at the site and immediate surrounding land, site centred extracts from Ordnance Survey (OS) plans dating back to 1849 were examined by Worms Eye. The table below provides a summary of the salient points relating to the history of the site with respect to the proposed end use. It is not the intention of this report to describe in detail all the changes that have occurred on or adjacent to the site.

| Date(s) | Site | Surrounding Land |
|---|---|---|
| 1846–1847<br>1:10,560 | Undeveloped field. | Poor and unclear mapping.<br>Possible farm house immediately northwest.<br>Preston and Lancaster Canal 215 metres east.<br>Mostly undeveloped fields |
| 1893<br>1:2,500 | Building on east of site. | Fish pond 245 metres east.<br>Ponds 210 metres, 230 metres and 245 metres southeast.<br>Building 5 metres northeast clearly shown.<br>Stream 25 metres southwest |
| 1912<br>1:2,500 | Little or no change. | One pond to southeast, not present, presumed silted up.<br>Unknown building, probably stables, immediately southeast. |
| 1932<br>1:2,500 | Little or no change. | Pond to southeast not present. |
| 1966<br>1:2,500 | Building on site extended to southwest.<br>Probable garages on site, southwest of building. | Site surrounded by a few small buildings and garages to northeast and 15 metres east. |
| 1994<br>1:2,500 | Garages no longer present.<br>Building on north and south of site | No relevant change. |
| 2017<br>1:10,000 | Site as present. | No relevant change |

## 5.0 GROUND INVESTIGATION

### *5.1 Introduction*

The proposed ground investigation was designed to assess both the ground contamination risks and also to aid foundation design, for the proposed new mixed use residential and commercial development at Stubbins House, Stubbins Lane

### 5.2 *Previous Ground Investigations*

5.2.1 No previous ground investigations have been carried out within the site to the knowledge of PSA Design.

### *5.3 PSA Design Ground Investigation*

*5.3.1* PSA Design conducted the following work:

- Intrusive investigation of ground conditions beneath the site, to include boreholes, sampling and in-situ testing
- Assessment of groundwater underlying site
- Chemical and geotechnical analysis of soils beneath the site, where appropriate.

*5.3.2 Summary*

A ground investigation was undertaken to assess the ground conditions at the site in preparation for the proposed re-development as a residential development with associated infrastructure. The investigation consisted of a borehole drilling exercise, followed by chemical and geotechnical testing of representative samples. General ground conditions consisted locally of concrete in WS1 overlying Granular Made Ground Topsoil over GLACIAL DEPOSITS (‘Firm brown/grey sandy silty CLAYS). This was underlain by ‘silty sands’ in all locations. ‘Grey/brown fine gravel’ was encountered from depth 3.5 m to the base of the Borehole No WS3 (4.45 m). No groundwater was encountered within the boreholes drilled across the site.

### *5.4 Fieldwork*

*5.4.1 Objectives*

5.4.1.1 To determine the general nature of the soils underlying the site, including the thickness and type of any made ground.

5.4.1.2 To assess the density and strength of natural soils on the site to enable pavement and foundation recommendations to be made.

5.4.1.3 To recover soil samples for both chemical and geotechnical analysis.

*5.4.2 Scope of Works*

5.4.2.1 Fieldwork was carried out in one phase, drilling (19th February 2021). The fieldwork was supervised by PSA Design. The exploratory holes are listed in the following table.

| Technique | Date | Exploratory Holes | Final Depth(s) & Location | Remarks |
|---|---|---|---|---|
| | | *Logs in Appendix A* | *Ground Investigation Plan (Dwg G3472/G/03)* | *Lab Testing in Appendix B+C.* |
| Window Sample *Vertical* Boreholes | 19/2/21 | WS1 | 4.45mbgl [N area-north of existing barn] | General ground conditions, sampling for lab testing, in-situ testing. |
| | | WS3 | 4.45mbgl [South-Eastern area-south of livestock barn, adjacent to tank immediately south-east of the site] | General ground conditions, sampling for lab testing, in-situ testing. |
| | | WS4 | 4.45mbgl[SE of Centre - SW of existing barn] | General ground conditions, sampling for lab testing, in-situ testing. |
| | | WS5 | 5.45mbgl [NW of Centre-landscaped area] | General ground conditions, sampling for lab testing, in-situ testing. |
| | | WS6 | 5.45mbgl [SW of Centre-landscaped area] | General ground conditions, sampling for lab testing, in-situ testing. |

5.4.2.2 The exploratory logs are presented in Appendix A. The records provide descriptions, in general accordance with BS 5930 (2015) and Eurocode EN ISO 14688, of the materials encountered and details of the samples taken, together with observations made during drilling.

5.4.2.3 A total of 5No. boreholes (WS1 and WS3 to WS6) were sunk across the site to depths of between 4.45-5.45 mbgl, using a window sampler rig. In-situ SPT tests were carried out every 1 m. Detailed logs are presented in Appendix A.

*5.4.3 Soil Descriptions, In-situ Testing and Sampling*

5.4.3.1 The soils encountered during this investigation have been logged in general accordance with BS5930:1999 “Code of Practice for Site Investigation” and EN ISO 14688.

5.4.3.2 Geotechnical in-situ testing of the materials encountered was undertaken using a Standard Penetration Testing tool.

5.4.3.3 During drilling representative samples were taken at regular intervals, to assist in the identification of soils and allow chemical testing to be programmed.

*5.4.4 Exploratory Hole Locations*

5.4.4.1 Exploratory hole locations were selected by PSA Design to provide a representative view of strata beneath the site and are shown on Drawing G3472/G/03.

## *5.5 Ground Conditions*

### *5.5.1 Geological Summary*

The ground conditions encountered within the exploratory holes at the site have been compiled and reviewed. They can be described in terms of the given lithologies (based on published geological data) and are discussed in the subsequent paragraphs. The lithologies encountered during this investigation are summarised in the following table;

| Lithology | Depth (m) to base below current ground levels [present in hole] | Thickness (m) |
|---|---|---|
| Made Ground (Concrete) | 0.1 [WS1] | 0.1 |
| Made Ground (Made Ground-Topsoil) | 0.20-0.40 [WS1, 3-6] | 0.20-0.40 |
| Firm to Stiff brown/grey sandy silty clays [Glacial Till] | 1.3-2.9 [WS1, 3-6] | 1.1-2.6 |
| Fine to coarse locally silty sands [Glacial Till] | 3.5-5.45 [WS1, 3-6] | 1.7->3.15 |
| Grey/brown fine gravel [Glacial Till] | 4.45 [WS3] | >0.95 |
| Groundwater Entries | None | |

### *5.5.2 Made Ground*

5.5.2.1 Made ground was encountered in all of the 5No. exploratory boreholes, during the course of the ground investigation.

5.5.2.2 The site investigation encountered concrete in the location of Boreohle No WS1 to a depth of 0.1 m. All remaining locations were overlain by 'Dark grey/brown fine to coarse slightly clayey organic sand with occasional fine to medium brick fragments' to depths varying from 0.2 m (Borehole No WS4) to 0.4 m (Borehole No WS5). This material was also encountered below the concrete to a depth of 0.4 m. Cobble inclusions were encountered within this strata in Trial Pit No 1.

### 5.5.3 *Natural Soils*

*5.5.3.1* 'Firm to stiff brown/grey sandy silty clays' was encountered below the made ground in all locations to depths varying from 1.3 m (Borehole No WS4) to depths of 2.9 m (Borehole No WS6). This was underlain by 'locally silty sands' in all locations. 'Grey/brown fine gravel' was encountered from depth 3.5 m to the base of the Borehole No WS3 (4.45 m).

### *5.5.4 Groundwater*

*5.5.4.1* Groundwater strikes were not encountered in any of the boreholes.

## 6.0 GEOTECHNICAL TESTING & EARTHWORKS ASSESSMENT

### *6.1 Introduction*

Selective strata was investigated to gain geotechnical parameters of the ground conditions using the in-situ testing techniques of standard penetration tests (SPT's), in accordance with BS 1377:1990. Furthermore, sulphate and chemical testing was carried out to aid concrete design.

### *6.2 In-situ Testing*

6.2.1 Standard Penetration Tests (SPT's) were carried out during the PSA Design ground investigation, in all of the WS boreholes starting at a depth of 1.0 m and repeated at 1 m levels from 2 m onwards. The SPT results are summarised in the table below.

| Depth of Test (m) | SPT Readings (N) | | | | |
|---|---|---|---|---|---|
| | WS-1 | WS-3 | WS-4 | WS-5 | WS-6 |
| 1.0 – 1.45 | 9 | 9 | 14 | 13 | 15 |
| 2.0 – 2.45 | 10 | 8 | 12 | 15 | 16 |
| 3.0 – 3.45 | 13 | 13 | 14 | 11 | 8 |
| 4.0 – 4.45 | 12 | 29 | 23 | 10 | 13 |
| 5.0 – 5.45 | - | - | - | 18 | 18 |

### *6.3 Earthworks*

6.3.1 Proposed development levels for the site have yet to be determined, however it is expected that, the likely final levels will be similar to the existing levels.

6.3.2 Re-use of excavated materials should be based on approved material acceptability criteria, following detailed pavement design. Any major earthworks activity within the site needs to take into account the properties of the fill deposits, in particular the major constituents, ie particle size of fill materials. The made ground topsoil is contaminated with PAH compounds with respect to human health and also contains widespread phytotoxic contamination and will need excavating and removing from landscaped/garden areas of the site. Earthworks design will need to mitigate the risks of these materials by site procedures and programming to reduce the probability of exposure occurring.

6.3.3 The construction method statement should take account of compaction requirements of the appropriate highways specification for the various formation materials. The imported fill being placed and compacted within suitable layers and the correct specification as set out in the latest Specification for Highway Works (Volume 1) [Manual of Contract Documents for Highway Works (MCDHW)], Series 600 (Earthworks).

### *6.4 Excavations & Groundwater*

6.4.1 Excavations at the site should be feasible using an appropriate scale of hydraulic plant.

6.4.2 The close proximity of the proposed building foundations and pavement redevelopment to the neighbouring properties must be taken into account with any excavation works. Allowance may be required for temporary support, whilst excavation works occur for the proposed buildings.

6.4.3 No groundwater was observed during the ground investigation, but it should be taken into account that surface water and localised perched water may be present during site works. All excavations will require adequate lateral support to ensure their stability and a suitably designed de-watering system. Reference should be made to best practice techniques as set out in CIRIA Document C532 “Control of Water Pollution from Construction Sites” (2001).

6.4.4 Excavations should not be left open for any long period of time, as the formation layer is likely to become compromised with the water affecting the quality and strength of the clay formation.

### *6.5 Sulphate and PH*

6.5.1 The concentration of acid soluble sulphate ($SO_4$) was determined on samples of the natural soils. The results have been assessed in accordance with BRE Special Digest SD1; Concrete in Aggressive Ground, 2005.

6.5.2 Results of the 4No. samples are detailed in Appendix B. The sulphate values ranged from <0.01-0.04 g/L. The upper limit for total sulphate in Design Sulphate Class 1 (DS - 1) is 0.5 g/l. The results would suggest that the materials tested lie within the Class DS-1 limit.

6.5.3 The pH values for tested samples showed acidic/neutral conditions within the underlying soils, 5.24-7.07. The site would be classified as *brownfield* with *mobile groundwater* conditions.

6.5.4 Therefore, the ‘Aggressive Chemical Environment for Concrete’ (ASEC) class for the site is considered to be *AC-2z* and design/mix of buried concrete should be undertaken in accordance with these classifications.

### *6.6 Laboratory Testing*

6.6.1 On completion of the fieldwork samples were selected for testing. The laboratory testing was scheduled by PSA Design and carried out by *Structural Soils Labs,* a UKAS accredited laboratory.

6.6.2 Geotechnical testing was targeted at the near surface strata identified within the ground investigation, which was the glacial till clay observed throughout the site underlying the made ground topsoil at varying depths. This clay may be affected by trees in the south-east of the site.

6.6.3 1No. soil samples was obtained from the site and was tested and analysed for the following suite of geotechnical parameters:

- Moisture content
- Plastic limit
- Liquid Limit

6.6.4 A complete record of the strata encountered is given on the exploratory hole records presented in Appendix A.

6.6.5 Geotechnical test results are presented in Appendix C.
Geotechnical testing on the glacial till was carried out on a sample recovered from WS-1 (1.0 m). Atterberg testing was undertaken in the laboratory conditions to determine the plasticity index of the clay. The modified plasticity index for each sample was calculated in accordance with NHBC guidance and summarised in the Table below..

| Plastic Limit Test Results | | | | | |
|---|---|---|---|---|---|
| **Location** | **Depth (m)** | **Plasticity Index (P.I.)** | **Retained 425 Sieve** | **Passing 425 Sieve** | **Modified P.I. (%)** |
| WS-1 | 1.0 | **16** | 13 | 87 | **13.9** |

6.6.6 The plasticity result indicates that the soils can be categorised as low volume change potential. Foundation formation depths should therefore be taken as low volume change potential, requiring a footing depth of 0.75m below existing or proposed ground level, whichever is the lower, in areas where clay soils are present. Clay heave potential must be considered as part of the foundation design and must be appraised in accordance with NHBC Ch.4.2 requirements.

## 7.0 SOIL CONTAMINATION RESULTS & ANALYSIS

### *7.1 Introduction*

The 2021 ground investigation by PSA Design was conducted to develop an understanding of the extent of the ground conditions and groundwater quality and extent. The PSA Design investigation encountered soil results, in general, below trigger values for the residential end-use, apart from the presence of PAH compounds within the south-east of the site. Moreover, widespread phytotoxic concentrations of zinc were encountered across the made ground topsoil at the site. Chemical testing results are presented within Appendix B.

### *7.2 Chemical Analysis*

7.2.1 In view of the site history, selected soil samples were taken during the ground investigation and were analysed for a screening suite. On the basis of the Conceptual Environmental Risk Model, it has been considered that a range of potential contaminants could exist in soils at the site, as follows:

- Elements which could pose a risk to human health and/or controlled water: arsenic, cadmium, chromium, hexavalent chromium, lead, mercury, nickel, selenium;
- Potentially phyto-toxic elements: boron, copper & zinc;
- Inorganic chemicals which could pose a risk to human health, buildings and/or controlled water: cyanide, nitrate, sulphate & sulphide;
- Other inorganic contaminants: pH conditions;
- Organic contaminants: Polynuclear Aromatic Hydrocarbons (PAH's with split of 16 priority EPA PAH's);
- Hydrocarbons (speciated and total);
- VOC & SVOC's;
- TOC;
- Asbestos identification.

7.2.2 Samples from the ground investigation were chemically tested at Envirolab Laboratories Ltd, a UKAS accredited laboratory.

7.2.3 Chemical testing was targeted at all the various surface strata identified within the ground investigation that would be deemed a potential threat to human health with natural materials tested also. This could be broken down into the following:

- Made Ground

7.2.4 Sample selection criteria for chemical testing included good coverage of the made ground covering the site area. The sampling was in accordance with BS 10175:2011, Investigation of potentially contaminated sites - Code of Practice.

7.2.5 4No. soil samples obtained from the site, were tested in total with 4No. analysed for the following suite of chemical determinands:

- Arsenic, cadmium, chromium, hexavalent chromium, lead, mercury, nickel, selenium
- Boron (water soluble), copper, zinc

- Cyanide (total)
- Sulphide (acid soluble)
- Phenol (total)

7.2.6 4No. samples of the sub-surface made ground were analysed for the following suite of determinands:

- Sulphate
- pH conditions

7.2.7 4No. samples of the sub-surface made ground were analysed for the following suite of determinands:

- Total PAH's (speciated)

7.2.8 4No. samples of the sub-surface made ground were analysed for the following suite of determinands:

- Aliphatic & Aromatic Hydrocarbons (speciated)

7.2.9 4No. samples of the sub-surface made ground were analysed for the following suite of determinands:

- Aliphatic & Aromatic Hydrocarbons (total)

7.2.10 1No. sample of the sub-surface made ground was analysed for the following suite of determinands:

- VOC
- SVOC

7.2.11 4No. samples of the various sub-surface made ground was analysed for the following suite of determinands:

- Asbestos id.

7.2.12 4No. samples of the sub-surface made ground were analysed for the following suite of determinands:

- Soil Organic Matter

7.2.13 The analytical results of the chemical testing undertaken are presented in full in Appendix B.

### *7.3 Current Guidance on Interpretation of Analytical Data*

7.3.1 The UK approach to contaminated land is based upon the principles of risk assessment. This in turn is founded upon the use of so called source→pathway→receptor/target principles in order to establish the presence, or potential presence, of a pollutant linkage.

7.3.2 PSA Design adopts a tiered approach to risk assessment that is consistent with UK guidance. The initial step (tier 1) is the comparison of site data with published guidance levels (assessment criteria) or remedial targets.

7.3.3 Sources published guidance levels (assessment criteria) or remedial targets used within this report are as follows:

- LQM/CIEH (2015) *Suitable 4 Use Levels for Human Health Risk Assessment*
- EIC/AGS/CL:AIRE (2009) *Soil Generic Assessment Criteria for Human Health Risk Assessment*
- BRE (2005) *Concrete in Aggressive Ground* BRE Special Digest SD1
- ICRCL (1987) *Guidance on the Assessment and Redevelopment of Contaminated Land Note 59/83* (Landscaped/buildings), DoE
- CIRIA C733 (2014) *Asbestos in soil and made ground: a guide to understanding and managing risks.*
  Note: . For contaminants of concern where generic assessment criteria are not available, in house assessment criteria have been derived using fully justified physical, chemical and toxicological parameters for each contaminants of concern input into the CLEA model.

7.3.4 The potential risk to building material is considered through reference to relevant BRE Digests, with particular emphasis on BRE Special Digest SD1, 2005: “Concrete in Aggressive Ground”.

7.3.5 Tier 1 groundwater risk assessments are undertaken by comparing leachate concentrations with the appropriate water quality standard. Depending upon the specific characteristics of the site, the appropriate standard may be one of the following:

- Water Supply (Water Quality) Regulations, 1989
- Water Framework Directive, 2003
- River Basin Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions, 2010
- Environmental Quality Standards (for freshwater)
- The surface Waters (abstraction for drinking water) Regulations
- World Health Organisation – Guidelines for Drinking Water Quality, 2005
- Environment Agency: Basic Surface Water Discharges, 2011
- Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites (10/WM/03/21) [UK Water industry Research], 2011
- United Utilities Water guidance for the selection of water pipes in land potentially affected by contamination, July 2011

7.3.6 Copper, nickel and zinc are toxic to plants. The effects of copper, nickel and zinc are often regarded as additive. The assessment criteria used for copper, nickel and zinc in this report, are ‘pseudo total concentrations’ are derived from BS3882:2007.

7.3.7 Should any Tier 1 criteria-in terms of human health, environment and groundwater be exceeded, then two courses of action are available. The first is to ‘break’ the pollutant linkage by recommending an appropriate level of remedial action – removal of contaminated material for example. The alternative approach is to carry out a detailed risk assessment in order to determine whether contamination risks actually exist.

### *7.4 Contamination Results*

7.4.1 The analytical results certificates are presented in Appendix B. Contaminant concentrations have been compared to a range of generic assessment criteria that have been prepared to allow the assessment of contamination relative to uncontaminated and/or background levels.

7.4.2 The preliminary screening process has been compared with the relevant C4SLs and GAC's for a *residential* end land use, as the most suitable equivalent for the proposed development.

7.4.3 The *residential* development will be covered in a mixture of associated hard standing and soft landscaping.

7.4.4 Elevated concentrations of benzo(a)fluoranthene and dibenzo(ah)anthracene were encountered within Borehole No WS1 (0.2 m). None of the samples tested proved positive for the presence of asbestos. A tabulated summary analysing the chemical test results with respect to human health criteria is presented in Appendix D.

7.4.5 The results of the chemical testing of soils show values for the underlying materials of the site that are elevated above values deemed appropriate for the most sensitive residential end use.

7.4.6 To conclude, from a soil risk perspective, the chemical test results for the samples tested by PSA Design show that, there are elevated levels of contaminants for the proposed residential development and as such a moderate risk from soil contamination in this refined environmental model for the site. As such, remediation measures due to soil contamination risk are required for the site. This will need to take the form of a remediation strategy to assess the risks to the garden and landscaping areas, end users and to development workers.

7.4.7 By comparing the chemical test results (Appendix B) to the concentrations in the above table, it can be seen that there are elevation concentrations of zinc *(WS1 – 0.2 m, WS4 – 0.1 m & WS3 (0.2 m)* within three samples of made ground topsoil recovered from the site.

| Phytotoxic Contaminant | pH Range | | |
|---|---|---|---|
| | <6.0 | 6.0 to 7.0 | >7.0 |
| Copper (nitric acid extractable) | <100 | <135 | <200 |
| Nickel (nitric acid extractable) | <60 | <75 | <110 |
| Zinc (nitric acid extractable) | <200 | <200 | <300 |

## 8.0 FOUNDATION ASSESSMENT

### *8.1 Introduction*

8.1.1 The site is covered by made ground, comprising:- organic sands organic materials and brick fragments. The made ground thickness is reasonably consistent, varying between

0.2m to 0.4m. Underlying the made ground is firm to stiff slightly silty Clay generally overlying a layer of silty sand as recorded in the logs. The horizon between the clay layer varies at a depth of between 1.7m (Borehole No WS1) and 2.6m (Borehole No WS5). The silty sand extends to the base of Borehole No WS1, however; in Borehole No WS3 & WS4 a layer of fine to coarse sand extends to the base of the holes. To WS-5 there is a layer of course gravel under the silty clay. Beneath the clays in Borehole No WS6 at a depth of 2.9m is a layer of fine to coarse sand, which extends to the base of the borehole. Bedrock is not believed to have been encountered within any of the boreholes. Boreholes were drilled to a depth to a depth of between 4.45m and 5.55m. Ground water was not encountered in any of the boreholes.

8.1.2 Standard Penetration Tests (SPT's) were carried out during the PSA Design ground investigation, in all of the WS boreholes starting at a depth of 1.0 m and repeated at 1 m levels from 2 m onwards. The SPT results are summarised in the table below.

| Depth of Test (m) | SPT Readings (N) | | | | |
|---|---|---|---|---|---|
| | WS-1 | WS-3 | WS-4 | WS-5 | WS-6 |
| 1.0 – 1.45 | 9 | 9 | 14 | 13 | 15 |
| 2.0 – 2.45 | 10 | 8 | 12 | 15 | 16 |
| 3.0 – 3.45 | 13 | 13 | 14 | 11 | 8 |
| 4.0 – 4.45 | 12 | 29 | 23 | 10 | 13 |
| 5.0 – 5.45 | - | - | - | 18 | 18 |

8.1.3 Geotechnical testing on the glacial till was carried out on a sample recovered from Borehole No WS1 (1.0 m). Atterberg testing was undertaken in the laboratory conditions to determine the plasticity index of the clay. The modified plasticity index for each sample was calculated in accordance with NHBC guidance and summarised in the Table below.

| Plastic Limit Test Results | | | | | |
|---|---|---|---|---|---|
| Location | Depth (m) | Plasticity Index (P.I.) | Retained 425 Sieve | Passing 425 Sieve | Modified P.I. (%) |
| WS-1 | 1.0 | **16** | 13 | 87 | **13.9** |

8.1.4 The plasticity result indicates that the soils can be categorised as low volume change potential. Foundation formation depths should therefore be taken as low volume change potential, requiring a footing depth of 0.75m below existing or proposed ground level, whichever is the lower, in areas where clay soils are present. Clay heave potential must be considered as part of the foundation design and must be appraised in accordance with NHBC Ch.4.2 requirements.

### *8.2 Foundation Construction*

8.2.1 The underlying clays have generally been found to be firm, with a minimum SPT resistance of 8 blows., Based on SPT values and ground water ingress, a bearing capacity of 75kN/m2 can be presumed at likely formation level below existing ground. The varied nature of the soils at likely formation level could lead to some minor disproportionate settlements, to alleviate this potential it is recommended that the foundations are reinforced.

8.2.2 We understand that the proposed domestic properties will be of no greater than two storey height, suggesting a likely foundation load of approximately 50-60kN/m. Based upon this presumption, simple strip foundations are expected to be suitable for the buildings of both properties.

8.2.3 All formations must be checked on site to confirm that the design bearing capacity is extant before foundations are installed. Should areas of poor ground be encountered, the excavations may require extending until suitable strata is found, and the design engineer's instruction must be sought.

8.2.4 As suitable bearing materials has generally been found within the top 600mm of ground, it will be feasible to construct ground floor slabs as ground bearing. All fill materials, however; must be removed to facilitate this, and levels brought back up with suitably compacted sub-base materials.

8.2.5 The dwelling locations to the site are largely free of existing trees within the site, however; if trees exist within the site, particularly near to the proposed buildings; this may have impact on foundation depths. The foundation designer must consider the potential effects of the existing trees, in respect of determination of formation levels for foundations. Formation levels must be designed to comply with LABC requirements and NHBC Ch.4.2 guidance.

8.2.6 All foundation designs must be reviewed and designed by a suitably qualified design engineer. The above advice is based upon the ground condition information obtained during the survey. The design engineer must satisfy themselves that the information meets with their design requirements.

# 9.0 HAZARD ASSESSMENT

## *9.1 Sources*

9.1.1 The agricultural activities undertaken on or adjacent to the site that may act as potential historical or current sources of environmental hazard are shown in the Table below.

| Type of Issue | SOURCE-Specific Issue | HAZARD-Remarks |
|---|---|---|
| Potential on-site contamination sources HISTORICAL | 1. Historic infill from historic buildings and garages.<br>2. Storage of equipment/vehicles | 1. Potential source of soil and groundwater contamination (metalloids, hydrocarbons, PAH, organics, & asbestos). |
| Potential on-site contamination sources CURRENT | 1. Asbestos cement building materials.<br>2. Storage of equipment/vehicles | 1. Asbestos represents human health risk (inhalation). |
| Potential off-site contamination sources CURRENT | 1. Above Ground Storage Tanks in lean to south and nearby barn to south (likely diesel) | 1. Potential source of soil and groundwater contamination (Speciated TPH-CWG, BTEX, MTBE, SVOC and VOC compounds). |
| Potential geotechnical hazards | 1. Tree/vegetation along boundary.<br>2. Potential relict foundations and other buried structures post site clearance. | 1. Trees may affect foundation depth through clay heave and/or root barrier specification, dependent upon ground conditions.<br>2. Obstructions for foundation construction. |

## *9.2 Pathways and Receptors*

*9.2.1* *Three* pollutant receptors have been identified for the site, and are listed in the table below, together with the pathways through which they may be linked to pollutant sources.

| Receptor | Pathways |
|---|---|
| **HUMAN HEALTH**<br>Re-development Workers<br>End users-residents | Inhalation (dust and vapours), ingestion, direct contact |
| **FAUNA & FLORA**<br>Landscaping | Root uptake |
| **BUILT ENVIRONMENT**<br>Buildings and services | Direct contact with contaminated soil and groundwater |

## 9.3 *Conceptual Model and Qualitative Risk Assessment*

9.3.1 A preliminary conceptual model of pollutant linkages is given in the table below, together with a qualitative risk assessment for each linkage. The risk assessment uses the method of risk evaluation set out in CIRIA 552 'Contaminated Land Risk Assessment' and YALPAG (Yorkshire and Lincolnshire Pollution Advisory Group) (2017) “Development on Land Affected by Contamination”. The scale of risk is determined from a matrix that combines the *consequence* of a hazard with the *likelihood* of the event happening.

| Source | Pathway | Receptor | Consequence | Probability | Risk Classification | Remediation |
|---|---|---|---|---|---|---|
| On-site sources of ground contamination arising from:<br>-historic infill associated with historic buildings/garages,<br>-historic and current storage storage of vehicles/equipment including metalloids, asbestos, PAHs, + hydrocarbons.<br><br>Off-Site sources of ground contamination arising from leakage from off-site fuel tanks which may have the potential to impact upon the re-development site including speciated Total Petroleum hydrocarbons, SVOC and VOC compounds. | Inhalation (dust & vapours), ingestion, skin contact | Re-development workers | medium | low | **Low/moderate risk** | *PPC required during ground-works.* |
| | | End users- residents | medium | low | **Moderate risk** | ***Results from the ground investigation chemical testing have shown that there is a presence of elevated PAH compounds within WS1 which could potentially be widespread. Likely options are cover system and/or dig out and replace.*** |
| | Root Uptake | Landscaping Vegetation | minor | likely | **Moderate risk** | *Made Ground topsoil unsuitable for re-use due to elevated concentrations of phytotoxic zinc (WS1 – 0.2 m, WS4 – 0.1 m & WS3 (0.2 m)* |
| | Direct Contact | Buildings and Services | medium | low | **Moderate risk** | ***Concrete specification is DS-1 AC-2z*** |

| Source | Pathway | Receptor | Consequence | Probability | Risk Classification | Remediation Measures |
|---|---|---|---|---|---|---|
| On site sources of ground contamination from *asbestos* building materials. | Inhalation, ingestion, skin contact | Re-development workers | medium | likely | **Moderate risk** | *Asbestos survey to be carried out on existing building prior to re-furbishment and actions to be taken following report recommendations.* |
| | | End users | medium | unlikely | **Moderate/Low risk** | |

*9.3.2* *Risks to Human Health, Flora, Building and Services from on-site and off-site ground contamination (infilled ground, storage of equipment/machinery, off-site fuel tanks in close proximity to site)*

The risk classification for *four* pollutant linkages relating to potential sources of contamination in the underlying ground and groundwater from on-site contamination sources from historic/current agricultural activities and potentially infilled ground varied between *low/moderate* risk to *moderate* risk. Investigation, if not already undertaken, is normally required in cases where the risk is classified as *moderate* or higher, and some remedial works may be required.

One *low/moderate* risks were identified re-development workers. The risks for this element can be reduced by suitable remediatory measures such as suitable PPE for construction workers.

Three *moderate risks* were identified to human health of end users, flora and buildings/services.

Following investigation and testing of the made ground topsoil the risks to future end users from on-site and off-site current/historical ground contamination would appear to be *moderate.* Elevated concentrations of two PAH compounds were encountered within WS1 (Benzo(b)fluoranthene, Dibenzo(ah)anthracene). Likely remedial options include a cover system and/or dig out and replace. Options of remediation measures should be developed in a remediation strategy.

Phytotoxic concetrations of zinc were also encountered within three of the four samples tested. The cover system and/or dig out and replace outlined above to protect the human health (end users) will address the aforementioned contamination.

The work force should undergo a site safety briefing to identify the site as ‘brownfield’ and potentially contaminated. The concrete classification for the site is DS-1 AC-2z.

*9.3.3* *On-site contamination from hazardous building materials ie asbestos*
The potential hazards from building materials have been linked with the human health receptor, which includes construction workers and end-users. The risk classification is based on there being a potential source of asbestos.

The risk classification for construction workers is considered to be *moderate* risk. This is based on a *severe* assessment of consequence (chronic damage) in combination with a *low* classification of probability. The risk for end-users is assumed to be slightly less (*low*) because clearance of these materials from the site in preparation for redevelopment is likely to remove the most significant potential source. The walkover survey did encounter asbestos cement panels within the roof and cladding materials. It is assumed that an initial asbestos survey will be carried out for the buildings to be re-furbished. Should any material be found, it would be expected that the asbestos removal will be carried out by a

specialist demolition company and as such various checks and procedures will be carried out to ensure that all traces of asbestos material are removed from site.

*9.3.4* *Uncertainties*

There remains the possibility that some historical occupation of the site has not been identified, which could lead to unforeseen ground contamination.

# 10.0 CONCLUSIONS/RECOMMENDATIONS

## *10.1 General*

A summary of the data collated in the ground investigation and assessment in terms of the various revisions to the original risk assessments in terms of contamination and geotechnical issues for the site and remediation recommendations are set out below in the summary table:

| Issue | Remarks |
|---|---|
| Former uses | Former uses of site have been part of a wider farm site. Several buildings and probable garages have previously been on site |
| Hazardous Gas | There are no landfill sites or filled features within 250 metres of the site.<br>It is considered that there is no risk to the development from landfill or ground gases. A qualitative assessment within the Worms Eye PRA confirmed that risks from ground gas are very low/negligible and gas monitoring is not required at the site. |
| Mining & Quarrying | The Coal Authority Interactive Mapping shows:<br>- Site is not in a High Risk Area.<br>- No nearby coal seams.<br>- No nearby mine entries. |
| Ground Conditions | Concrete/Made Ground Topsoil over GLACIAL DEPOSITS ('Firm brown/grey sandy silty CLAYS) which were underlain by 'silty sands' in all locations. 'Grey/brown fine gravel' was encountered from depth 3.5 m to the base of the Borehole No WS3 (4.45 m). No groundwater was encountered within the boreholes drilled across the site. |
| Contamination | Several potential pollution sources, but following the ground investigation, chemical testing results showed locally elevated PAH compounds (benzo(b)fluoranthene and dibenzo(ah)anthracene within WS1 which pose a risk to human health (end users) and widespread phytotoxic contamination. Concrete specification of DS-1 AC-2z. Standard water supply pipes are suitable. |
| Anticipated Foundation Solutions | Simple strip foundations are expected to be suitable for the buildings of both properties. All formations must be checked on site to confirm that the design bearing capacity is extent before foundations are installed. Should areas of poor ground be encountered, the excavations may require extending until suitable strata is found, and the design engineer's instruction must be sought.<br><br>As suitable bearing materials has generally been found within the top 600mm of ground, it will be feasible to construct ground floor slabs as ground bearing. All fill materials, however; must be removed to facilitate this, and levels brought back up with suitably compacted sub-base materials. The foundation designer must consider the potential effects of the existing trees, in respect of determination of form action levels for foundations. Formation levels must be designed to comply with LABC requirements and NHBC Ch.4.2 guidance. |
| Remediation Measures | Remediation Strategy is required.<br>1. Earthworks suitability assessment of made ground deposits for re-use.<br>2. Excavation and removal of contaminated soils from garden/landscaped areas.<br>3. Waste disposal assessment of material arisings<br>4. Cover system design.<br>Validation of any imported/site won cover system materials for proposed garden areas. |
| Geotechnical Issues | 1. Trees effect on clay heave.<br>2. Potential unidentified areas of poor ground<br>3. Obstructions within near surface made ground deposits. |

## 11.0 REPORT LIMITATIONS

11.1 PSA Design believes that providing information with regard to limitations is essential to assist the *client* identify and therefore manage its risks. The ground is a product of continuing natural and artificial processes and, as a result, may exhibit a variety of characteristics which may vary from place to place, and with time. The risks associated with these variations may be mitigated by appropriate investigations, but cannot be eliminated.

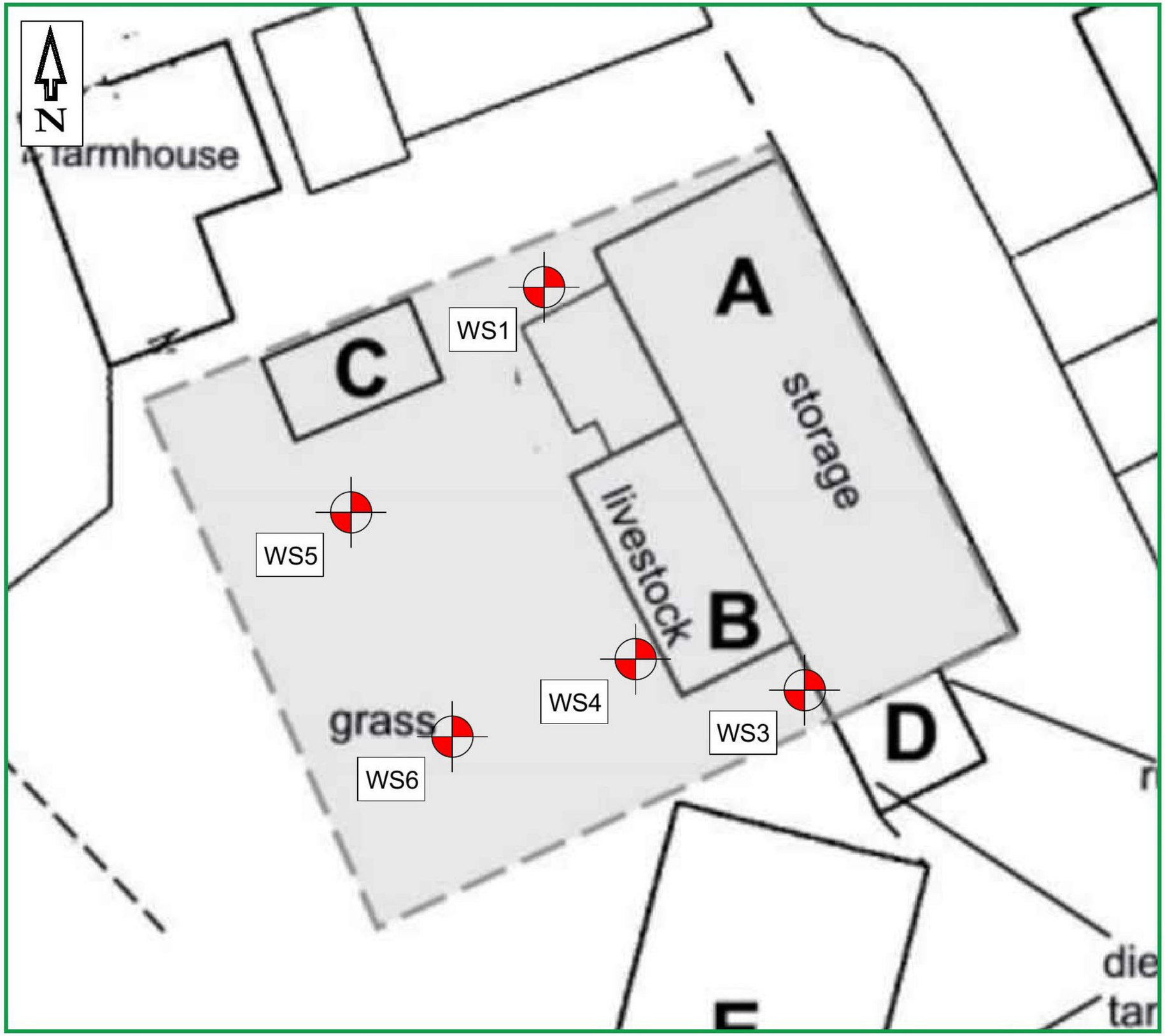
11.2 This report contains interpretations of information which has been gathered from published sources and observations. Such information is only relevant to the ground at the published sources and observations. The information from these is interpreted here in good faith and is believed to be accurate. PSA Design cannot guarantee the authenticity of data obtained from external sources.

11.3 An interpretation or recommendation based on this information and given in this report is based on our judgment and experience of this information and not on any greater knowledge that might be implied.

11.4 The interpretations and recommendations contained herein represent our opinions which are provided for the sole use of our client in accordance with a specific brief. As such these do not necessarily address all aspects of ground behaviour at the site. Should these interpretations be used by any third party to assess ground conditions then verification should be made by reference to the appropriate factual information.

11.5 The remit of the scope of works for this particular site was in regard to a shallow borehole investigation of the soils underlying the site. The aspect of shallow mine workings risk was not covered in the brief for PSA Design and as such this report does not cover this element. The design engineer should be aware that the site is at risk from shallow mine workings and advice should be taken from a mining specialist in relation to this particular site.

# DRAWINGS




## LEGEND

SITE BOUNDARY

WINDOW SAMPLE BOREHOLE

| REV | DESCRIPTION | DATE | BY |
|---|---|---|---|
| | | | |
| | | | |

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CLIENT.
JWS Development

JOB TITLE.
STUBBINS HOUSE, STUBBINS LANE, PRESTON

DRAWING TITLE.
SITE INVESTIGATION PLAN

| SCALE @ A3. | DRAWN BY. | APPROVED BY. | DATE. |
|---|---|---|---|
| NTS | D.E. | M.B. | 17/03/21 |

| DRAWING No. | REV. |
|---|---|
| G3472/G/03 | - |


## LEGEND

SITE BOUNDARY

| REV | DESCRIPTION | DATE | BY |
|---|---|---|---|
| | | | |
| | | | |

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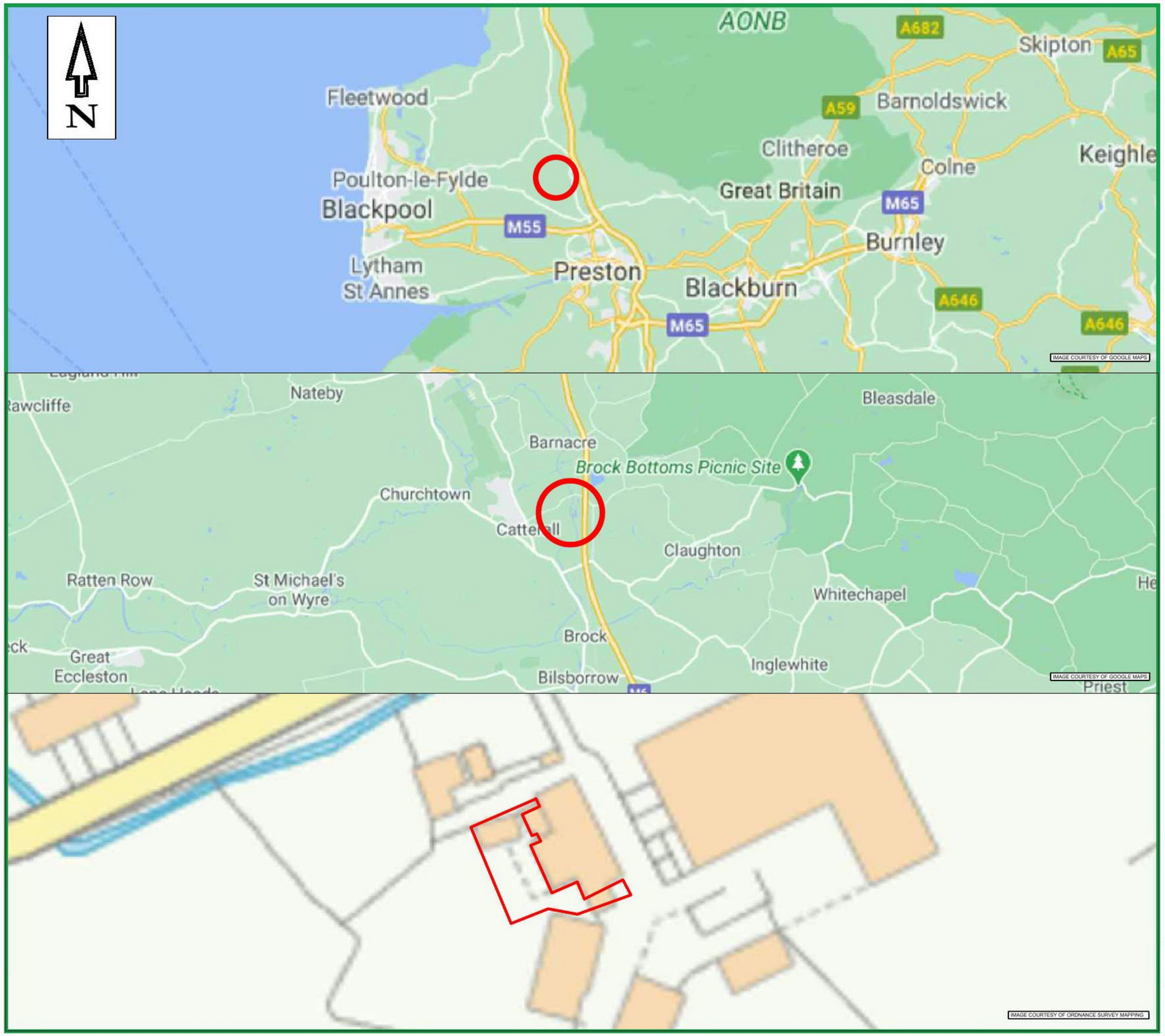
JOB TITLE.
STUBBINS HOUSE, STUBBINS LANE, PRESTON

DRAWING TITLE.
SITE LAYOUT PLAN

| SCALE @ A3. | DRAWN BY. | APPROVED BY. | DATE. |
|---|---|---|---|
| NTS | D.E. | M.B. | 17/03/21 |

| DRAWING No. | REV. |
|---|---|
| G3472/G/02 | - |




## LEGEND

SITE BOUNDARY

| REV | DESCRIPTION | DATE | BY |
|---|---|---|---|
| | | | |
| | | | |

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JWS Development

JOB TITLE.
STUBBINS HOUSE, STUBBINS LANE, PRESTON

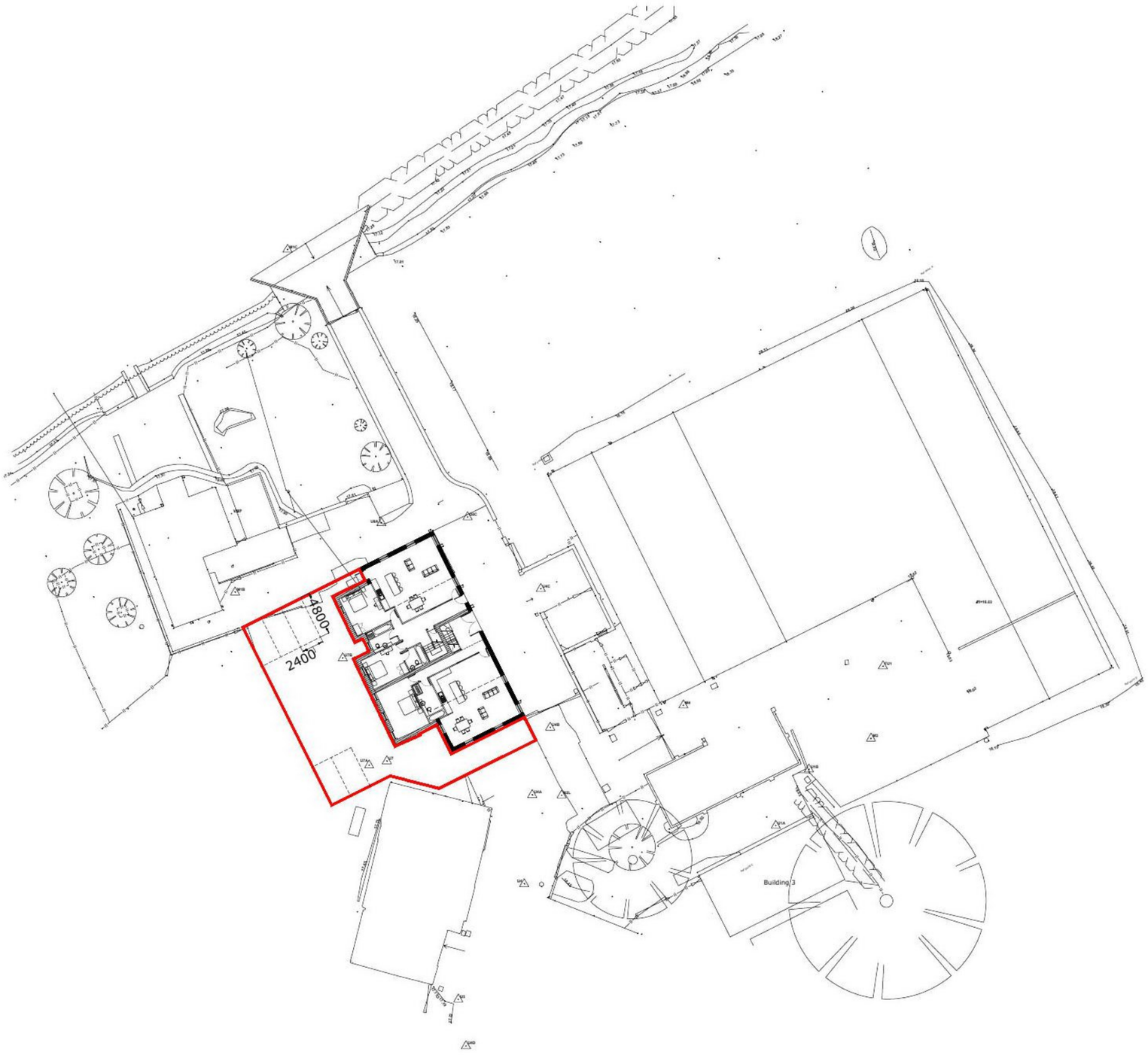
DRAWING TITLE.
SITE LOCATION PLAN

| SCALE @ A3. | DRAWN BY. | APPROVED BY. | DATE. |
|---|---|---|---|
| NTS | D.E. | M.B. | 17/03/21 |

| DRAWING No. | REV. |
|---|---|
| G3472/G/01 | - |

**Health & Safety Notes**

1. Contractor must ensure that all work on site is carried out in a safe & satisfactory manner, in accordance with Health & Safety At Work Act 1974, COSHH Regulations 2002 & requirements of C.D.M




| Rev. | Description | Date |
|---|---|---|
| A | Parking areas and spaces revised | 03.11.2017 |
| P1 | First Issue | 18.09.2017 |

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Client
**Mr & Mrs Thompson**

Project
**Mixed Use Residential And Employment Scheme**

Drawing Title
**Proposed Site Plan**

| Drawn by | Checked by | Date |
|---|---|---|
| JP | ND | 18.09.2017 |

| Status | Scale @ A3 |
|---|---|
| PRELIMINARY | 1:500 |

| Job no. | Dwg.no. | Rev. |
|---|---|---|
| 9009 | L06 | A |

# APPENDICES

# APPENDIX A BOREHOLE LOGS

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# Exploratory Logs

**PROJECT NUMBER** 21833
**PROJECT NAME** Land at Stubbins Lane, Preston
**CLIENT** Cassidy + Ashton

**DATE** 19th February 2021
**DRILLING METHOD** Window Sample Borehole
**BOREHOLE NO** WS1
**SHEET** 1/5

**COMPLETION** | **CASING** uPVC | **SCREEN** uPVC Factory Slotted

**COMMENTS** Borehole Dry.

| Depth (m) | Depth (m) | Samples/ Test | Field Records | Water | Graphic Log | Material Description | Additional Observations | Elevation (m) |
|---|---|---|---|---|---|---|---|---|
| 0 | 0.2 | D=0.2 m | | | | Concrete | | 0 |
| | 0.4 | D=0.4 m | | | | Dark grey/dark brown fine to coarse slightly clayey organic sand with occasional fine brick fragments and occasional rounded sandstone cobbles (Made Ground) | | |
| 0.5 | | | | | | | | 0.5 |
| | | | | | | Firm to stiff grey/brown silty clay | | |
| 1 | 1 - 1.45<br>1 - 1.5 | SPT (C) N=9<br>B=1.0 m-1.5 m | 1,2/2,2,2,2,3 | | | | | 1 |
| 1.5 | 1.7 | D=1.7 m | | | | | | 1.5 |
| | | | | | | Grey fine to medium silty sand | | |
| 2 | 2 - 2.45 | SPT (C) N=10 | 2,3/2,3,2,3 | | | | | 2 |
| 2.5 | 2.6 | D=2.6 m | | | | | | 2.5 |
| 3 | 3 - 3.45 | SPT (C) N=13 | 3,3/3,3,4,3 | | | | | 3 |
| 3.5 | | | | | | | | 3.5 |
| 4 | 4 - 4.45 | SPT (C) N=12 | 2,3/3,3,3,3 | | | | | 4 |
| 4.5 | | | | | | Termination Depth at: 4.45 m | | 4.5 |
| 5 | | | | | | | | 5 |
| 5.5 | | | | | | | | 5.5 |
| 6 | | | | | | | | 6 |
| 6.5 | | | | | | | | 6.5 |

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# Exploratory Logs

**PROJECT NUMBER** 21833
**PROJECT NAME** Land at Stubbins Lane, Preston
**CLIENT** Cassidy + Ashton

**DATE** 19th February 2021
**DRILLING METHOD** Window Sample Borehole
**BOREHOLE NO** WS3
**SHEET** 2/5

**COMPLETION** | **CASING** uPVC | **SCREEN** uPVC Factory Slotted

**COMMENTS** Borehole Dry.

| Depth (m) | Depth (m) | Samples/ Test | Field Records | Water | Graphic Log | Material Description | Additional Observations | Elevation (m) |
|---|---|---|---|---|---|---|---|---|
| 0.5 | 0.2 | D=0.2 m | | | | Dark grey/dark brown fine to coarse slightly clayey organic sand with occasional fine brick fragments and occasional rounded sandstone cobbles (Made Ground) | | 0.5 |
| | 0.3 | D=0.3 m | | | | | | |
| | 0.9 | D=0.9 m | | | | Firm grey brown clay with sand bands | | |
| 1 | 1 - 1.45 | SPT (C) N=9 | 3,3/2,3,2,2 | | | Firm to stiff brown silty very sandy clay | | 1 |
| 1.5 | 1.8 | D=1.8 m | | | | | | 1.5 |
| 2 | 2 - 2.45 | SPT (C) N=8 | 2,2/2,2,2,2 | | | Fine to medium brown clayey very silty sand with silt bands | | 2 |
| 2.5 | | | | | | | | 2.5 |
| 3 | 3 - 3.45 | SPT (C) N=13 | 2,3/3,3,3,4 | | | | | 3 |
| 3.5 | | | | | | Grey/brown fine gravel | | 3.5 |
| 4 | 4 - 4.45 | SPT (C) N=29 | 3,6/7,7,8,7 | | | | | 4 |
| 4.5 | | | | | | Termination Depth at: 4.45 m | | 4.5 |
| 5 | | | | | | | | 5 |
| 5.5 | | | | | | | | 5.5 |
| 6 | | | | | | | | 6 |
| 6.5 | | | | | | | | 6.5 |

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# Exploratory Logs

**PROJECT NUMBER** 21833
**PROJECT NAME** Land at Stubbins Lane, Preston
**CLIENT** Cassidy + Ashton

**DATE** 19th February 2021
**DRILLING METHOD** Window Sample Borehole
**BOREHOLE NO** WS4
**SHEET** 3/5

**COMPLETION** | **CASING** uPVC | **SCREEN** uPVC Factory Slotted

**COMMENTS** Borehole Dry.

| Depth (m) | Depth (m) | Samples/ Test | Field Records | Water | Graphic Log | Material Description | Additional Observations | Elevation (m) |
|---|---|---|---|---|---|---|---|---|
| 0.5 | 0.1<br>0.2 | D=0.1 m<br>D=0.2 m | | | | Dark grey/dark brown fine to coarse slightly clayey organic sand with occasional fine brick fragments and occasional rounded sandstone cobbles (Made Ground) | | 0.5 |
| 1 | 1 - 1.45<br>1.3 | SPT (C) N=14<br>D=1.3 m | 1,2/3,4,3,4 | | | Stiff brown sandy clay | | 1 |
| 1.5 | | | | | | Brown fine to coarse silty sand | | 1.5 |
| 2 | 2 - 2.45<br>2.1 | SPT (C) N=12<br>D=2.1 m | 2,2/3,3,3,3 | | | | | 2 |
| 2.5 | | | | | | Brown fine to medium sand | | 2.5 |
| 3 | 3 - 3.45<br>3.1 | SPT (C) N=14<br>D=3.1 m | 2,2/3,3,4,4 | | | | | 3 |
| 3.5 | | | | | | | | 3.5 |
| 4 | 4 - 4.45 | SPT (C) N=23 | 4,4/5,6,6,6 | | | | | 4 |
| 4.5 | | | | | | Termination Depth at: 4.45 m | | 4.5 |
| 5 | | | | | | | | 5 |
| 5.5 | | | | | | | | 5.5 |
| 6 | | | | | | | | 6 |
| 6.5 | | | | | | | | 6.5 |

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# Exploratory Logs

**PROJECT NUMBER** 21833
**PROJECT NAME** Land at Stubbins Lane, Preston
**CLIENT** Cassidy + Ashton

**DATE** 19th February 2021
**DRILLING METHOD** Window Sample Borehole
**BOREHOLE NO** WS5
**SHEET** 4/5

**COMPLETION** | **CASING** uPVC | **SCREEN** uPVC Factory Slotted

**COMMENTS** Borehole Dry.

| Depth (m) | Depth (m) | Samples/ Test | Field Records | Water | Graphic Log | Material Description | Additional Observations | Elevation (m) |
|---|---|---|---|---|---|---|---|---|
| 0 | 0.2 | D=0.2 m | | | | Dark grey/dark brown fine to coarse slightly clayey organic sand with occasional fine brick fragments and occasional rounded sandstone cobbles (Made Ground) | | 0 |
| | 0.4 | D=0.4 m | | | | | | |
| 0.5 | | | | | | Stiff brown sandy clay | | 0.5 |
| 1 | 1 - 1.45 | SPT (C) N=13 | 3,3/3,3,3,4 | | | | | 1 |
| 1.5 | 1.5 - 2.0 | B=1.5 m -2.0 m | | | | | | 1.5 |
| 2 | 2 - 2.45 | SPT (C) N=15 | 2,3/4,3,4,4 | | | | | 2 |
| 2.5 | 2.6 | D=2.6 m | | | | Brown fine to coarse silty sand with silt bands | | 2.5 |
| 3 | 3 - 3.45 | SPT (C) N=11 | 2,2/2,3,3,3 | | | | | 3 |
| 3.5 | | | | | | | | 3.5 |
| 4 | 4 - 4.45 | SPT (C) N=10 | 2,2/2,3,2,3 | | | | | 4 |
| 4.5 | | | | | | | | 4.5 |
| 5 | 5 - 5.45 | SPT (C) N=18 | 2,3/4,4,5,5 | | | Brown fine to coarse sand | | 5 |
| 5.5 | | | | | | Termination Depth at: 5.45 m | | 5.5 |
| 6 | | | | | | | | 6 |
| 6.5 | | | | | | | | 6.5 |

# Exploratory Logs

**PROJECT NUMBER** 21833
**PROJECT NAME** Land at Stubbins Lane, Preston
**CLIENT** Cassidy + Ashton

**DATE** 19th February 2021
**DRILLING METHOD** Window Sample Borehole
**BOREHOLE NO** WS6
**SHEET** 5/5

**COMPLETION** | **CASING** uPVC | **SCREEN** uPVC Factory Slotted

**COMMENTS** Borehole Dry.

| Depth (m) | Depth (m) | Samples/ Test | Field Records | Water | Graphic Log | Material Description | Additional Observations | Elevation (m) |
|---|---|---|---|---|---|---|---|---|
| 0 | 0.2 | D=0.2 m | | | | Dark grey/dark brown fine to coarse slightly clayey organic sand with occasional fine brick fragments and occasional rounded sandstone cobbles (Made Ground) | | 0 |
| | 0.3 | D=0.3 m | | | | | | |
| 0.5 | | | | | | Stiff brown clay | | 0.5 |
| 1 | 1 - 1.45 | SPT (C) N=15 | 3,3/3,4,4,4 | | | | | 1 |
| 1.5 | 1.7 | D=1.7 m | | | | | | 1.5 |
| 2 | 2 - 2.45 | SPT (C) N=16 | 2,3/4,4,4,4 | | | | | 2 |
| 2.5 | D=2.9 m | D=2.9 m | | | | | | 2.5 |
| 3 | 3 - 3.45 | SPT (C) N=8 | 2,2/2,2,2,2 | | | Brown fine to coarse sand | | 3 |
| 3.5 | | | | | | | | 3.5 |
| 4 | 4 - 4.45 | SPT (C) N=13 | 2,3/3,3,3,4 | | | | | 4 |
| 4.5 | D=4.9 m | D=4.9 m | | | | | | 4.5 |
| 5 | 5 - 5.45 | SPT (C) N=18 | 3,4/4,5,4,5 | | | | | 5 |
| 5.5 | | | | | | Termination Depth at: 5.45 m | | 5.5 |
| 6 | | | | | | | | 6 |
| 6.5 | | | | | | | | 6.5 |

# APPENDIX B CHEMICAL TESTING CERTIFICATES

Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

# FINAL ANALYTICAL TEST REPORT

**Envirolab Job Number:** 21/01826
**Issue Number:** 1 **Date:** 03 March, 2021

**Client:**
BEK Enviro Ltd
Suite One
No 3 Mitton Road Business Park
Mitton Road
Whalley
Lancashire
BB7 9YE

**Project Manager:** Mick Buckley
**Project Name:** Land at Stubbins Lane, Preston
**Project Ref:** Not specified
**Order No:** 7003-21833-J
**Date Samples Received:** 23/02/21
**Date Instructions Received:** 23/02/21
**Date Analysis Completed:** 03/03/21

**Prepared by:**

[redacted]
Melanie Marshall
Laboratory Coordinator

**Approved by:**

[redacted]
Danielle Brierley
Client Manager

1247

**Envirolab Job Number: 21/01826**

**Client Project Name: Land at Stubbins Lane, Preston**

**Client Project Ref: Not specified**

| Lab Sample ID | 21/01826/1 | 21/01826/2 | 21/01826/3 | 21/01826/4 | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS1 | WS4 | WS5 | WS3 | | | | | | |
| Depth to Top | 0.20 | 0.10 | 0.20 | 0.20 | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 19-Feb-21 | 19-Feb-21 | 19-Feb-21 | 19-Feb-21 | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | | | | | | |
| Sample Matrix Code | 2A | 6AE | 2AE | 2AE | | | | | | |
| % Stones >10mm$_A$ | 11.5 | <0.1 | 15.4 | 4.5 | | | | % w/w | 0.1 | A-T-044 |
| pH$_D$ [M#] | 7.07 | 6.83 | 5.24 | 6.86 | | | | pH | 0.01 | A-T-031s |
| Sulphate (water sol 2:1)$_D$ [M#] | 0.04 | <0.01 | <0.01 | 0.02 | | | | g/l | 0.01 | A-T-026s |
| Sulphate (acid soluble)$_D$ [M#] | 650 | 710 | 660 | 840 | | | | mg/kg | 200 | A-T-028s |
| Cyanide (total)$_A$ [M#] | <1 | <1 | <1 | <1 | | | | mg/kg | 1 | A-T-042sTCN |
| Phenols - Total by HPLC$_A$ | <0.2 | <0.2 | <0.2 | <0.2 | | | | mg/kg | 0.2 | A-T-050s |
| Organic matter$_D$ [M#] | 19.6 | 11.2 | 6.8 | 7.8 | | | | % w/w | 0.1 | A-T-032 OM |
| Arsenic$_D$ [M#] | 20 | 18 | 8 | 12 | | | | mg/kg | 1 | A-T-024s |
| Boron (water soluble)$_D$ | <1.0 | <1.0 | <1.0 | <1.0 | | | | mg/kg | 1 | A-T-027s |
| Cadmium$_D$ [M#] | 0.9 | 1.0 | 0.5 | 0.8 | | | | mg/kg | 0.5 | A-T-024s |
| Copper$_D$ [M#] | 79 | 41 | 85 | 43 | | | | mg/kg | 1 | A-T-024s |
| Chromium$_D$ [M#] | 18 | 20 | 20 | 18 | | | | mg/kg | 1 | A-T-024s |
| Chromium (hexavalent)$_D$ | <1 | <1 | <1 | <1 | | | | mg/kg | 1 | A-T-040s |
| Lead$_D$ [M#] | 176 | 127 | 89 | 246 | | | | mg/kg | 1 | A-T-024s |
| Mercury$_D$ | 0.26 | 0.21 | <0.17 | 0.34 | | | | mg/kg | 0.17 | A-T-024s |
| Nickel$_D$ [M#] | 35 | 25 | 19 | 23 | | | | mg/kg | 1 | A-T-024s |
| Selenium$_D$ [M#] | 2 | <1 | <1 | <1 | | | | mg/kg | 1 | A-T-024s |
| Zinc$_D$ [M#] | 361 | 809 | 121 | 524 | | | | mg/kg | 5 | A-T-024s |

**Envirolab Job Number: 21/01826**

**Client Project Name: Land at Stubbins Lane, Preston**

**Client Project Ref: Not specified**

| Lab Sample ID | 21/01826/1 | 21/01826/2 | 21/01826/3 | 21/01826/4 | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS1 | WS4 | WS5 | WS3 | | | | | | |
| Depth to Top | 0.20 | 0.10 | 0.20 | 0.20 | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 19-Feb-21 | 19-Feb-21 | 19-Feb-21 | 19-Feb-21 | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | | | | | | |
| Sample Matrix Code | 2A | 6AE | 2AE | 2AE | | | | | | |
| Asbestos in Soil (inc. matrix) ^ | | | | | | | | | | |
| Asbestos in soil$_{D}^{\#}$ | NAD | NAD | NAD | NAD | | | | | | A-T-045 |
| Asbestos ACM - Suitable for Water Absorption Test?$_{D}$ | N/A | N/A | N/A | N/A | | | | | | A-T-045 |

**Envirolab Job Number: 21/01826**

**Client Project Name: Land at Stubbins Lane, Preston**

**Client Project Ref: Not specified**

| Lab Sample ID | 21/01826/1 | 21/01826/2 | 21/01826/3 | 21/01826/4 | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS1 | WS4 | WS5 | WS3 | | | | | | |
| Depth to Top | 0.20 | 0.10 | 0.20 | 0.20 | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 19-Feb-21 | 19-Feb-21 | 19-Feb-21 | 19-Feb-21 | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | | | | | | |
| Sample Matrix Code | 2A | 6AE | 2AE | 2AE | | | | | | |
| PAH-16MS | | | | | | | | | | |
| Acenaphthene$_{A}^{M\#}$ | 0.41 | 0.10 | 0.20 | 0.20 | | | | mg/kg | 0.01 | A-T-019s |
| Acenaphthylene$_{A}^{M\#}$ | 0.13 | 0.04 | 0.03 | 0.08 | | | | mg/kg | 0.01 | A-T-019s |
| Anthracene$_{A}^{M\#}$ | 0.29 | 0.13 | 0.09 | 0.19 | | | | mg/kg | 0.02 | A-T-019s |
| Benzo(a)anthracene$_{A}^{M\#}$ | 2.94 | 0.99 | 0.70 | 1.69 | | | | mg/kg | 0.04 | A-T-019s |
| Benzo(a)pyrene$_{A}^{M\#}$ | 4.47 | 1.03 | 0.79 | 2.12 | | | | mg/kg | 0.04 | A-T-019s |
| Benzo(b)fluoranthene$_{A}^{M\#}$ | 6.71 | 1.55 | 1.13 | 3.09 | | | | mg/kg | 0.05 | A-T-019s |
| Benzo(ghi)perylene$_{A}^{M\#}$ | 2.26 | 0.47 | 0.36 | 0.99 | | | | mg/kg | 0.05 | A-T-019s |
| Benzo(k)fluoranthene$_{A}^{M\#}$ | 2.17 | 0.43 | 0.42 | 1.07 | | | | mg/kg | 0.07 | A-T-019s |
| Chrysene$_{A}^{M\#}$ | 6.02 | 1.54 | 1.24 | 2.94 | | | | mg/kg | 0.06 | A-T-019s |
| Dibenzo(ah)anthracene$_{A}^{M\#}$ | 0.55 | 0.13 | 0.09 | 0.24 | | | | mg/kg | 0.04 | A-T-019s |
| Fluoranthene$_{A}^{M\#}$ | 11 | 3.23 | 2.67 | 5.80 | | | | mg/kg | 0.08 | A-T-019s |
| Fluorene$_{A}^{M\#}$ | 0.52 | 0.11 | 0.23 | 0.26 | | | | mg/kg | 0.01 | A-T-019s |
| Indeno(123-cd)pyrene$_{A}^{M\#}$ | 2.98 | 0.65 | 0.49 | 1.33 | | | | mg/kg | 0.03 | A-T-019s |
| Naphthalene $_{A}^{M\#}$ | 3.63 | 0.39 | 2.14 | 1.42 | | | | mg/kg | 0.03 | A-T-019s |
| Phenanthrene$_{A}^{M\#}$ | 8.01 | 1.82 | 2.45 | 3.75 | | | | mg/kg | 0.03 | A-T-019s |
| Pyrene$_{A}^{M\#}$ | 7.98 | 2.35 | 1.93 | 4.28 | | | | mg/kg | 0.07 | A-T-019s |
| Total PAH-16MS$_{A}^{M\#}$ | 60.1 | 15 | 15 | 29.4 | | | | mg/kg | 0.01 | A-T-019s |

**Envirolab Job Number: 21/01826**

**Client Project Name: Land at Stubbins Lane, Preston**

**Client Project Ref: Not specified**

| Lab Sample ID | 21/01826/1 | 21/01826/2 | 21/01826/3 | 21/01826/4 | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS1 | WS4 | WS5 | WS3 | | | | | | |
| Depth to Top | 0.20 | 0.10 | 0.20 | 0.20 | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 19-Feb-21 | 19-Feb-21 | 19-Feb-21 | 19-Feb-21 | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | | | | | | |
| Sample Matrix Code | 2A | 6AE | 2AE | 2AE | | | | | | |
| SVOC | | | | | | | | | | |
| 4-Bromophenyl phenyl ether$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| Hexachlorobenzene$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| Diethyl phthalate$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| Dimethyl phthalate$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| Dibenzofuran$_A$ | - | - | - | 258 | | | | µg/kg | 100 | A-T-052s |
| Carbazole$_A$ | - | - | - | 320 | | | | µg/kg | 100 | A-T-052s |
| Butylbenzyl phthalate$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| Bis(2-ethylhexyl)phthalate$_A$ | - | - | - | <500 | | | | µg/kg | 500 | A-T-052s |
| Bis(2-chloroethoxy)methane$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| Bis(2-chloroethyl)ether$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| 4-Nitrophenol$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| 3+4-Methylphenol$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| 4-Chloro-3-methylphenol$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| 2-Nitrophenol$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| 2-Methylphenol$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| 2-Chlorophenol$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| 2,6-Dinitrotoluene$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| 2,4-Dinitrotoluene$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| 2,4-Dimethylphenol$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| 2,4-Dichlorophenol$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| 2,4,6-Trichlorophenol$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| 2,4,5-Trichlorophenol$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| 2-Chloronaphthalene$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| 2-Methylnaphthalene$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| Bis(2-chloroisopropyl)ether$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| Phenol$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| Pentachlorophenol (SVOC)$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| n-Nitroso-n-dipropylamine$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| n-Dioctylphthalate$_A$ | - | - | - | <500 | | | | µg/kg | 500 | A-T-052s |
| n-Dibutylphthalate$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| Nitrobenzene$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| Isophorone$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |

**Envirolab Job Number: 21/01826**

**Client Project Name: Land at Stubbins Lane, Preston**

**Client Project Ref: Not specified**

| Lab Sample ID | 21/01826/1 | 21/01826/2 | 21/01826/3 | 21/01826/4 | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS1 | WS4 | WS5 | WS3 | | | | | | |
| Depth to Top | 0.20 | 0.10 | 0.20 | 0.20 | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 19-Feb-21 | 19-Feb-21 | 19-Feb-21 | 19-Feb-21 | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | | | | | | |
| Sample Matrix Code | 2A | 6AE | 2AE | 2AE | | | | | | |
| Hexachloroethane$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| Hexachlorocyclopentadiene$_A$ | - | - | - | <100 | | | | µg/kg | 100 | A-T-052s |
| Perylene$_A$ | - | - | - | 720 | | | | µg/kg | 100 | A-T-052s |

**Envirolab Job Number: 21/01826**

**Client Project Name: Land at Stubbins Lane, Preston**

**Client Project Ref: Not specified**

| Lab Sample ID | 21/01826/1 | 21/01826/2 | 21/01826/3 | 21/01826/4 | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS1 | WS4 | WS5 | WS3 | | | | | | |
| Depth to Top | 0.20 | 0.10 | 0.20 | 0.20 | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 19-Feb-21 | 19-Feb-21 | 19-Feb-21 | 19-Feb-21 | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | | | | | | |
| Sample Matrix Code | 2A | 6AE | 2AE | 2AE | | | | | | |
| VOC | | | | | | | | | | |
| Dichlorodifluoromethane$_{A}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Chloromethane$_{A}$ | - | - | - | <10 | | | | µg/kg | 10 | A-T-006s |
| Vinyl Chloride (Chloroethene)$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Bromomethane$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Chloroethane$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Trichlorofluoromethane$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 1,1-Dichloroethene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Carbon Disulphide$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Dichloromethane$_{A}$ | - | - | - | <5 | | | | µg/kg | 5 | A-T-006s |
| trans 1,2-Dichloroethene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 1,1-Dichloroethane$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| cis 1,2-Dichloroethene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 2,2-Dichloropropane$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Bromochloromethane$_{A}^{\#}$ | - | - | - | <5 | | | | µg/kg | 5 | A-T-006s |
| Chloroform$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 1,1,1-Trichloroethane$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 1,1-Dichloropropene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Carbon Tetrachloride$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 1,2-Dichloroethane$_{A}^{\#}$ | - | - | - | <2 | | | | µg/kg | 2 | A-T-006s |
| Benzene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Trichloroethene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 1,2-Dichloropropane$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Dibromomethane$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Bromodichloromethane$_{A}^{\#}$ | - | - | - | <10 | | | | µg/kg | 10 | A-T-006s |
| cis 1,3-Dichloropropene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Toluene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| trans 1,3-Dichloropropene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 1,1,2-Trichloroethane$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 1,3-Dichloropropane$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Tetrachloroethene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Dibromochloromethane$_{A}^{\#}$ | - | - | - | <3 | | | | µg/kg | 3 | A-T-006s |
| 1,2-Dibromoethane$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |

**Envirolab Job Number: 21/01826**

**Client Project Name: Land at Stubbins Lane, Preston**

**Client Project Ref: Not specified**

| Lab Sample ID | 21/01826/1 | 21/01826/2 | 21/01826/3 | 21/01826/4 | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS1 | WS4 | WS5 | WS3 | | | | | | |
| Depth to Top | 0.20 | 0.10 | 0.20 | 0.20 | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 19-Feb-21 | 19-Feb-21 | 19-Feb-21 | 19-Feb-21 | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | | | | | | |
| Sample Matrix Code | 2A | 6AE | 2AE | 2AE | | | | | | |
| Chlorobenzene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 1,1,1,2-Tetrachloroethane$_{A}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Ethylbenzene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| m & p Xylene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| o-Xylene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Styrene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Bromoform$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Isopropylbenzene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 1,1,2,2-Tetrachloroethane$_{A}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 1,2,3-Trichloropropane$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| Bromobenzene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| n-Propylbenzene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 2-Chlorotoluene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 1,3,5-Trimethylbenzene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 4-Chlorotoluene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| tert-Butylbenzene$_{A}^{\#}$ | - | - | - | <2 | | | | µg/kg | 2 | A-T-006s |
| 1,2,4-Trimethylbenzene$_{A}^{\#}$ | - | - | - | 1 | | | | µg/kg | 1 | A-T-006s |
| sec-Butylbenzene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 4-Isopropyltoluene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 1,3-Dichlorobenzene$_{A}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 1,4-Dichlorobenzene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| n-Butylbenzene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 1,2-Dichlorobenzene$_{A}^{\#}$ | - | - | - | *<1* | | | | µg/kg | 1 | A-T-006s |
| 1,2-Dibromo-3-chloropropane (DCBP)$_{A}$ | - | - | - | <2 | | | | µg/kg | 2 | A-T-006s |
| 1,2,4-Trichlorobenzene$_{A}$ | - | - | - | <3 | | | | µg/kg | 3 | A-T-006s |
| Hexachlorobutadiene$_{A}^{\#}$ | - | - | - | <1 | | | | µg/kg | 1 | A-T-006s |
| 1,2,3-Trichlorobenzene$_{A}$ | - | - | - | <3 | | | | µg/kg | 3 | A-T-006s |

**Envirolab Job Number: 21/01826**

**Client Project Name: Land at Stubbins Lane, Preston**

**Client Project Ref: Not specified**

| Lab Sample ID | 21/01826/1 | 21/01826/2 | 21/01826/3 | 21/01826/4 | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS1 | WS4 | WS5 | WS3 | | | | | | |
| Depth to Top | 0.20 | 0.10 | 0.20 | 0.20 | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 19-Feb-21 | 19-Feb-21 | 19-Feb-21 | 19-Feb-21 | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | | | | | | |
| Sample Matrix Code | 2A | 6AE | 2AE | 2AE | | | | | | |
| TPH CWG | | | | | | | | | | |
| Ali >C5-C6$_A$ # | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |
| Ali >C6-C8$_A$ # | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |
| Ali >C8-C10$_A$ | 2 | <1 | <1 | 3 | | | | mg/kg | 1 | A-T-055s |
| Ali >C10-C12$_A$ M# | 6 | 3 | <1 | 5 | | | | mg/kg | 1 | A-T-055s |
| Ali >C12-C16$_A$ M# | 2 | <1 | <1 | 1 | | | | mg/kg | 1 | A-T-055s |
| Ali >C16-C21$_A$ M# | 3 | 3 | 1 | 3 | | | | mg/kg | 1 | A-T-055s |
| Ali >C21-C35$_A$ M# | 19 | 19 | 10 | 19 | | | | mg/kg | 1 | A-T-055s |
| Total Aliphatics$_A$ | 33 | 24 | 11 | 31 | | | | mg/kg | 1 | A-T-055s |
| Aro >C5-C7$_A$ # | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |
| Aro >C7-C8$_A$ # | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |
| Aro >C8-C10$_A$ | 30 | 9 | 4 | 35 | | | | mg/kg | 1 | A-T-055s |
| Aro >C10-C12$_A$ | 51 | 11 | 8 | 50 | | | | mg/kg | 1 | A-T-055s |
| Aro >C12-C16$_A$ | 29 | 11 | 7 | 27 | | | | mg/kg | 1 | A-T-055s |
| Aro >C16-C21$_A$ M# | 159 | 83 | 26 | 130 | | | | mg/kg | 1 | A-T-055s |
| Aro >C21-C35$_A$ M# | 479 | 349 | 99 | 351 | | | | mg/kg | 1 | A-T-055s |
| Total Aromatics$_A$ | 747 | 463 | 144 | 592 | | | | mg/kg | 1 | A-T-055s |
| TPH (Ali & Aro >C5-C35)$_A$ | 780 | 488 | 155 | 623 | | | | mg/kg | 1 | A-T-055s |
| BTEX - Benzene$_A$ # | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |
| BTEX - Toluene$_A$ # | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |
| BTEX - Ethyl Benzene$_A$ # | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |
| BTEX - m & p Xylene$_A$ # | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |
| BTEX - o Xylene$_A$ # | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |
| MTBE$_A$ # | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |

## REPORT NOTES

**General**
This report shall not be reproduced, except in full, without written approval from Envirolab.
The results reported herein relate only to the material supplied to the laboratory.
The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.
If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.
The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

**Soil chemical analysis:**
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

**TPH analysis of water by method A-T-007:**
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

**Electrical Conductivity of water by Method A-T-037:**
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

**Asbestos:**
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed.
Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

**Predominant Matrix Codes:**
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
**Secondary Matrix Codes:**
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,
E = contains roots/twigs.

**Key:**
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

# Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

| | | | |
|---|---|---|---|
| **Client:** | BEK Enviro Ltd, Suite One , No 3 Mitton Road Business Park , Mitton Road , Whalley , Lancashire , BB7 9YE | **Project No:** | 21/01826 |
| | | **Date Received:** | 23/02/2021 (am) |
| **Project:** | Land at Stubbins Lane, Preston | **Cool Box Temperatures (°C):** | 12.4 |
| **Clients Project No:** | | | |

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

# APPENDIX C GEOTECHNICAL TESTING CERTIFICATES

# STRUCTURAL SOILS LTD

## TEST REPORT

1774

Report No. 584453 01 (00)

| | | | |
|---|---|---|---|
| Date | 15-March-2021 | Contract | Land at Stubbins Lane, Preston |
| Client | Envirolab | | |
| Address | Units 7-8<br>Sandpits Business Park<br>Mottram Road<br>Hyde<br>SK14 3AR | | |
| For the Attention of | Michael Knight | | |

| | | | |
|---|---|---|---|
| Samples submitted by client | 02-March-2021 | Client Reference | 21/01926 |
| Testing Started | 04-March-2021 | Client Order No. | P0745821 |
| Testing Completed | 11-March-2021 | Instruction Type | Written |

Tests marked 'Not UKAS Accredited' in this report are not included in the UKAS Accreditation Schedule for our Laboratory.

UKAS Accredited Tests

| | |
|---|---|
| 1.1 | Moisture Content (oven drying method) BS1377:Part 2:1990:clause 3.2 (superseded)* |
| 1.2 | Liquid Limit (definitive method ) & Plastic Limit BS1377:Part 2:1990,clause 4.3/5.3 (superseded)* |

* This clause of BS1377 is no longer the most up to date method due to the publication of ISO17892

Please Note: Remaining samples will be retained for a period of one month from today and will then be disposed of .
Test were undertaken on samples 'as received' unless otherwise stated.
Opinions and interpretations expressed in this report are outside the scope of accreditation for this laboratory.

Structural Soils Ltd 18 Frogmore Rd Hemel Hempstead HP3 9RT Tel.01442 416661 e-mail dimitris.xirouchakis@soils.co.uk

# TESTING VERIFICATION CERTIFICATE

UKAS TESTING
1774

The test results included in this report are certified as:-

ISSUE STATUS: **FINAL**

In accordance with the Structural Soils Ltd Laboratory Quality Management System, results sheets and summaries of results issued by the laboratory are checked by an approved signatory. The integrity of the test data and results are ensured by control of the computer system employed by the laboratory as part of the Software Verification Program as detailed in the Laboratory Quality Manual.

This testing verification certificate covers all testing compiled on or before the following datetime: **15/03/2021 12:19:43**.

Testing reported after this date is not covered by this Verification Certificate.

[redacted]

Approved Signatory
**Sharon Cairns (Laboratory Manager)**

(Head Office)
Bristol Laboratory
Unit 1A, Princess Street
Bedminster
Bristol
BS3 4AG

Castleford Laboratory
The Potteries, Pottery Street
Castleford
West Yorkshire
WF10 1NJ

Hemel Laboratory
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Tonbridge Laboratory
Anerley Court, Half Moon Lane
Hildenborough
Tonbridge
TN11 9HU

| | | |
|---|---|---|
| **STRUCTURAL SOILS LTD** | Contract: **Land at Stubbins Lane, Preston** | Job No: **584453** AGS |

# SUMMARY OF SOIL CLASSIFICATION TESTS

In accordance with clauses 3.2,4.3,4.4,5.3,5.4,7.2,8.2,8.3 of BS1377:Part 2:1990

| Exploratory Position ID | Sample Ref | Sample Type | Depth (m) | Moisture Content % | Liquid Limit % | Plastic Limit % | Plasticity Index | % <425µm | Description of Sample |
|---|---|---|---|---|---|---|---|---|---|
| WS1 | 21/01926/1 | D | 1.00 | 16 | 30 | 14 | 16 | 87 | Brown mottled orange and grey slightly sandy slightly gravelly CLAY |
| | | | | | | | | | |
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STRUCTURAL SOILS LTD

Contract:

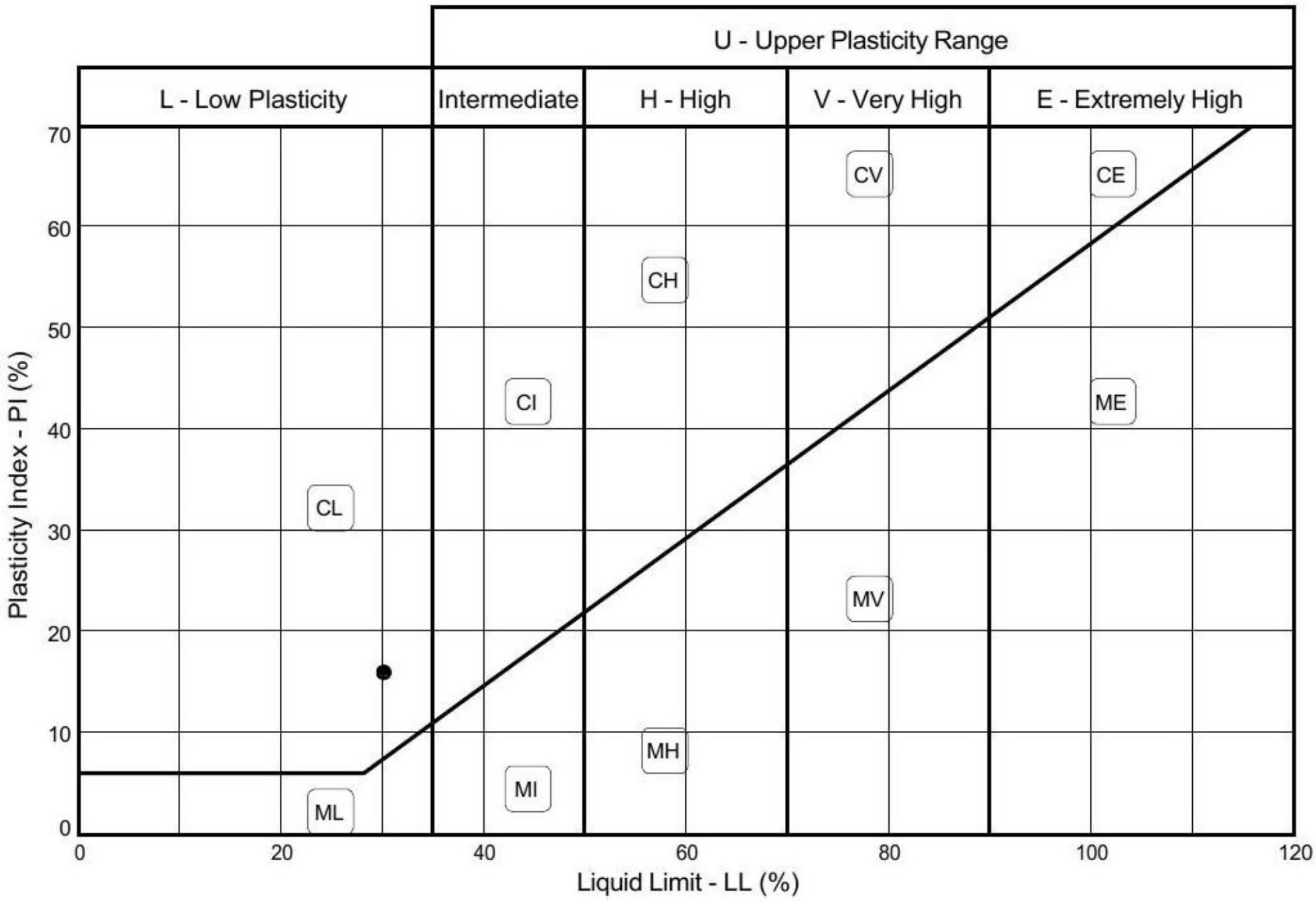
Land at Stubbins Lane, Preston

Contract Ref:

584453

# PLASTICITY CHART - PI Vs LL

In accordance with BS5930:2015
Testing in accordance with BS1377-2:1990




| Sample Identification | | | | BS Test Method # | Preparation Method + | MC % | LL % | PL % | PI % | <425µm % | Lab location | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Exploratory Position ID | Sample | Depth (m) | | | | | | | | | |
| ● | WS1 | 21/01926/1D | 1.00 | 3.2/4.3/5.3/5.4 | 4.2.4 | 16 | 30 | 14 | 16 | 87 | T | |

# Tested in accordance with the following clauses of BS1377-2:1990.

3.2 - Moisture Content
4.3 - Cone Penetrometer Method
4.4 - One Point Cone Penetrometer Method
4.6 - One Point Casagrande Method
5.3 - Plastic Limit Method
5.4 - Plasticity Index

+ Tested in accordance with the following clauses of BS1377-2:1990.

4.2.3 - Natural State
4.2.4 - Wet Sieved

Key: * = Non-standard test, NP = Non plastic.

Lab location: B = Bristol (BS3 4AG), C = Castleford (WF10 1NJ), H = Hemel Hempstead (HP3 9RT), T = Tonbridge (TN11 9HU)


STRUCTURAL SOILS
Anerley Court
Half Moon Lane
Hildenborough
Tonbridge TN11 9HU


| Compiled By | | Date |
|---|---|---|
| [redacted] | SHARON CAIRNS | 15/03/21 |

| Contract | Contract Ref: |
|---|---|
| **Land at Stubbins Lane, Preston** | **584453** |

AGS

# APPENDIX D ANALYSIS OF CHEMICAL TEST RESULTS

| Determinands | Chemical Concentrations (mg/kg) | Assessment Criteria (mg/kg) | Exceedence |
|---|---|---|---|
| Arsenic | 8.0 - 20.0 | 37[1] | -- |
| Cadmium | 0.5 - 1.3 | 11[1] | -- |
| Copper | 47 - 85 | 2400[3] | -- |
| Chromium | 18 - 20 | 910[3] | -- |
| Lead | 89 - 248 | 210[2] | -- |
| Mercury | <0.17 - 0.84 | 40[1] | -- |
| Nickel | 18 - 35 | 180[3] | -- |
| Selenium | <1 - 2 | 250[3] | -- |
| Zinc | 121 - 809 | 3700[3] | -- |
| Acenaphthene | 0.1 - 3.41 | 1100[3] | -- |
| Acenaphthylene | 0.03 - 0.73 | 920[3] | -- |
| Anthracene | 0.09 - 0.29 | 10000[1] | -- |
| Benzo(a)anthracene | 0.7 - 2.94 | 13[1] | -- |
| Benzo(a)pyrene | 0.79 - 4.47 | 5[2] | -- |
| Benzo(b)fluoranthene | 1.13 - 6.7[4] | 3.7[3] | WS[4] (0.2 m) |
| Benzo(ghi)perylene | 0.38 - 2.28 | 350[3] | -- |
| Benzo(k)fluoranthene | 0.42 - 2.47 | 100[3] | -- |
| Chrysene | 124 - 8.02 | 27[1] | -- |
| Dibenzo(ah)anthracene | 0.09 - 0.55 | 0.3[3] | WS[4] (0.2 m) |
| Fluoranthene | 2.87 - 11 | 890[3] | -- |
| Fluorene | 0.1[4] - 0.52 | 860[3] | -- |
| Indeno(123-cd)pyrene | 0.48 - 2.88 | 41[1] | -- |
| Naphthalene | 0.88 - 3.83 | 13[1] | -- |
| Phenanthrene | 1.82 - 8.3[4] | 440[3] | -- |
| Pyrene | 1.93 - 7.88 | 2000[3] | -- |
| Dibenzofuran | 0.258 | 25.6[3] | -- |
| Carbazole | 0.32 | 4.3[3] | -- |
| Perylene | 0.72 | **** | -- |
| 1,2,4-Trimethylbenzene | 0.30[4] | 17.3[3] | -- |
| Ali >C8-C10 | <1 - 3 | 150[3] | -- |
| Ali >C10-C12 | <1 - 6 | 760[3] | -- |
| Ali >C12-C16 | <1 - 2 | 4800[3] | -- |
| Ali >C16-C21 | 1.3 - 3.3 | 10000[3] | -- |
| Ali >C21-C35 | 10.0 - 19 | 10000[3] | -- |
| Aro >C8-C10 | 4.3 - 35 | 190[3] | -- |
| Aro >C10-C12 | 8 - 57.3 | 380[3] | -- |
| Aro >C12-C16 | 7.3 - 29 | 860[3] | -- |
| Aro >C16-C21 | 26 - 158 | 930[3] | -- |
| Aro >C21-C35 | 99 - 479.0 | 1720[3] | -- |
| Asbestos in soil | 0 of 4 Samples | N.A.D | -- |

**Comparison of chemical test results against generic assessment criteria**

1 C4SL=LQM Derived Assessment Criteria (S4ULs based on 6% SOM)
2 Category 4 Screening Levels
3 In House Derived Assessment Criteria
N.A.D. = No Asbestos Detected