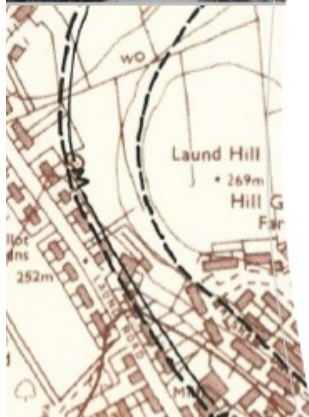
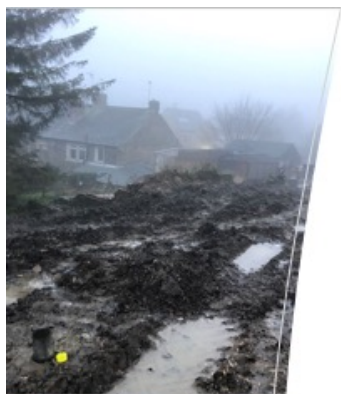




**EARTH ENVIRONMENTAL  
& GEOTECHNICAL**

## **Phase 2 Ground Gas Risk Assessment**

**120 Laund Road**

**Huddersfield**

**February 2020**

**On behalf of**

**Creative Developments  
(Huddersfield) Ltd**

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**PHASE II GROUND GAS RISK  
ASSESSMENT**

**120 LAUND ROAD  
HUDDERSFIELD**

**Report Ref: A0697/20/B.0**

**February 2020**

Prepared on Behalf of:

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**DISTRIBUTION:**

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## PHASE II GEOENVIRONMENTAL SITE INVESTIGATION & GROUND GAS RISK ASSESSMENT

### 120 LAUND ROAD, HUDDERSFIELD

*Report Reference:* A0697/20  
*Version* B.0  
*Date:* 25<sup>th</sup> February 2020  
*Prepared for:* Creative Developments (Huddersfield) Ltd  
*Prepared by:* Earth Environmental & Geotechnical Ltd  
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*Definition of Version Code:*

- D. Applied during initial drafting of the report before it has been reviewed.
- C. Applied after the report has been reviewed but before it has been approved by the Project Manager.
- B. Applied after the Project Manager has approved the report ready for issue to the client.
- A. Applied to reports after external/internal review.

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*Written by:* **Joshua Dixon**  
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**Managing Director**

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## 1.0 INTRODUCTION

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### 1.1 Background

A series of site investigations have been conducted on the site in order to assess ground conditions for foundation design and to determine whether there are any environmental constraints on the site, from ground gases and soil contamination.

A Coal Mining Risk Assessment has also been developed for the site and this has highlighted potential shallow mine workings across the site.

This report provides an updated ground gas assessment for all of the site, with the exception of Phase 1 (Plot 1), which was requested by the local authority.

A separate ground gas assessment has been developed for Plot 1.

Additional boreholes were drilled in December 2019 in order to replace lost monitoring wells which were emplaced during an earlier phase of site investigation work. This report compiles ground gas data from the newly installed and “lost” boreholes.

### 1.2 Previous Site Investigations

#### **1.2.1 *Earth Environmental & Geotechnical Ltd Coal Mining Risk Assessment (Reference: A0697/G/1, December 2014)***

The British Geological Survey 1:10,000 mapping (Sheet SE11NW) and digital mapping indicate that the site is directly underlain by Rough Rock (sandstone) in the west of the site and Pennine Lower Coal Measures (mudstone, siltstone and sandstone) in the east of the site. No superficial deposits are shown to be present and the regional dip of the strata is indicated to be two degrees to the east.

A marine band and a thin coal (the Pot Clay Coal) are indicated to outcrop immediately west of the site, adjacent Laund Road. A second coal outcrop is also shown close to the south eastern corner of the site.

The Coal Authority Mine Mining Report states that coal may have been mined at shallow (<30m) depth beneath the site, although there are no records for this. There are no shafts on or near to the site on historical mapping, however, excavations are shown in an adjacent field to the north of the site on the mapping dated 1894, which may possibly be coal related.

It was concluded that due to the presence of seams of coal at shallow depths, there is potential for unrecorded shallow mine workings in the form of “bell pits” beneath the site, which could be prone to collapse if not properly backfilled.

It was recommended that trenches be dug in the areas of the proposed foundations to investigate voiding and/or evidence of bell pit workings below the site, and subsequent strengthening of foundations if required.

Following submission of the Coal Mining Risk Assessment, the Coal Authority Consultation Response dated 22<sup>nd</sup> January 2015 stated that:

*'The proposed mitigation measures may bring to light the presence of bell pit and other shaft openings; however, they do not fully address the potential risk posed to the proposed development from underground coal mining i.e. from the working of coal seams less than 30m deep. It is quite possible that such workings, if present, may have been accessed via mine entries outside the footprint of the proposed dwellings. A more comprehensive borehole investigation of the south eastern portion of the site would therefore be necessary in order to investigate the presence of shallow coal seams, unrecorded workings and the potential for mine gas emissions.'*

### **1.2.2 Earth Environmental & Geotechnical Ltd Phase I GeoEnvironmental Desk Study (Reference: A0697/17, November 2017)**

The desk study highlighted that the site was first developed with a small structure in the early 1900s, which had been demolished and replaced by a larger (residential) structure in the northwest of the site by 1918, followed by the addition of several other small structures in subsequent years.

The house in the northwest was demolished in the early 1960s and replaced by 1993 with the existing bungalow that remains on-site to the present day. By the early 2000s the remaining smaller structures had been demolished leaving only the bungalow.

The walkover identified several small piles of fly-tipped material close to the residential dwelling, which contained plasterboard, wood, empty gas canisters, glass bottles, metal and plastic.

Early mapping showed neighbouring land uses to be predominantly agricultural, with gradual residential development occurring from the 1930s. Nearby industrial land uses are limited to a pottery, mill and works located to the southwest between 1893 and 1993.

Unspecified ground workings are shown 4-5m to the north of the site, together with a clay pit, on mapping dated between 1893 and 1933.

The following potential contamination sources are identified on-site:

- Contaminated made ground associated with the various phases of development on site.
- Ground gas from potentially infilled ground workings in close proximity of the site.
- Asbestos Containing Materials (ACM) in soils.

There was concluded to be a **MEDIUM** risk to end users from potential soil contamination and ground gas. The risk to groundwater and nearby surface water features was concluded to be **LOW**.

### **1.2.3 Earth Environmental & Geotechnical Ltd Phase II GeoEnvironmental report (Reference: A0697/17, October 2019)**

The site investigation identified made ground to depths of between 0.10 and 2.00m underlain by shallow bedrock of the Pennine Lower Coal Measures Formation (PLCM) comprising weathered mudstone, sandstone and coal. Suspected backfill material described as loose, wet, dark grey very clayey/silty fine to coarse, subangular GRAVEL of mudstone was also encountered in the northwestern part of the site

Observable indications of contamination were observed and included abundant inclusions of brick, concrete, coal, clinker, glass, tile, plastic and general miscellaneous fly-tipped materials

were noted within the Made Ground soils. Suspected asbestos containing materials (ACM) were observed in a stockpile present on site.

In the samples which underwent chemical analysis, 8 samples contained concentrations of various heavy metals and Polycyclic Aromatic Hydrocarbons (PAHs) in exceedance of assessment criteria values relevant to a residential end use with plant uptake. Asbestos was also detected in three of the samples, with a maximum concentration of 0.007% wt/wt.

The site investigation classified the GSV values for methane and carbon dioxide have been calculated as being below 1.3 l/h and 7.2 l/hr respectively. And concluded the site had a classification of CS 1, and gas protection measures will not be required.

The following potential contamination sources are identified on-site:

- Contaminated made ground associated with the various phases of development on site.
- Ground gas from potentially infilled ground workings and made ground onsite.
- Asbestos Containing Materials (ACM) in soils.

There was concluded to be a **MEDIUM** risk to end users from potential soil contamination and ground gas. The risk to groundwater and nearby surface water features was concluded to be **LOW**.

Intact Coal was encountered at shallow depth (1.40m to 1.80m bgl) in the southeastern part of the site, with thickness ranging from 0.20m to 0.40m. However, no broken ground, voids or suspected workings were encountered in the rotary boreholes. However, loose wet collapsible deposits (suspected backfill material associated with bell pit mining) were encountered beneath the natural strata in some areas.

As a result, remedial measures will be required, such as deepening foundation to ensure they bear upon competent strata and placing a geogrid over the affected area to stabilize the soils and prevent uneven soil settlement.

#### **1.2.4 Earth Environmental & Geotechnical Ltd Ground Gas Assessment Plot 1 (Reference: A0697/20, January 2020)**

Two boreholes (WS301 & WS302) were installed within Plot 1 which has already been constructed (without any gas protection measures).

WS302 was fitted with an Ambisense continuous gas monitor and flow meter, with WS301 monitored by use of a portable infra-red gas GA2000 analyser.

Over the duration of the intensive monitoring period undertaken by an EEG engineer, carbon dioxide, oxygen concentrations and flow rates were very low.

The Ambisense continuous gas monitor was used for a period of four week, over the Christmas period. The data revealed an absence of methane with very low concentrations of carbon-dioxide. In-situ flow rates were also very low.

Plot 1 has therefore been given a classification of CS-1, and gas protection measures do not need to be retrofitted to the new residential dwelling.

### 1.3 Terms of Reference

Earth Environmental and Geotechnical Ltd (EEG) have been commissioned by Creative Developments (Huddersfield) Ltd, the Client, to undertake an investigation of the site in accordance with proposal A0697/19/V6 & V7 dated 4<sup>th</sup> and 16<sup>th</sup> December 2019.

The objectives of this investigation are as follows:

- *Assessment of the presence and likely extent of any potential environmental hazards (ground gas) associated within the areas of the site investigated.*

### 1.4 Limitations of the Study

The report is written in the context of an agreed scope of work and budget and should not be used in a different context. New information, improved practices or changes in legislation may require a reinterpretation of the report in whole or in part. EEG reserve the right to amend either conclusions or recommendations in light of any further information that may become available. The report is provided for the sole use by the client and is confidential to them.

Recommendations within this report are also based on exploratory records and examination of samples and, where applicable, laboratory tests. No liability can be accepted for conditions not revealed by the boreholes particularly at intervening locations. Whilst every effort is made to ensure accuracy of data supplied, all opinions expressed as to the spatial distribution of strata between sampling locations is for guidance only and no responsibility is accepted as to its accuracy.

## 2.0 SITE LOCATION & DESCRIPTION

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The site is located northeast of Laund Road at postcode HD3 3TY, approximately 4km northwest of Huddersfield City centre, and around 900m east of Junction 23 of the M62 motorway. The site is roughly L-shaped with maximum approximate dimensions of 70m northwest-southeast by 30m northeast-southwest, occupying an area of 0.25ha. The National Grid Reference for the centre of the site is SE103182 (410379, 418266)

The site is currently occupied by an existing stone-built bungalow, 120 Laund Road, in the northwest of the site, which is set back from Laund Road, and a recently constructed two-storey four-bedroom house fronting Laund Road. The site is accessed from Laund Road via an unnamed road/track which is surfaced with tarmac in poor condition.

The remainder of the site comprises the front and rear gardens to 120 Laund Road and a parcel of land in the southeast of the site, which is bordered by mature trees and has become overgrown.

At the time of the site investigation, the front garden of the bungalow was used for storage of miscellaneous construction materials and equipment.

The rear garden was observed to be overgrown, elevated and sloping moderately to the west/southwest, with retaining walls along the northwest, northeast and southeast garden boundaries. Due to these obstructions, this part of the site was generally inaccessible for the drilling rigs and machine excavator.

Concrete floor slabs and remains of demolished structures (brick rubble etc) are also present in the southeast of the site, together with a stockpile of surface soil, which is understood to have been stripped from the front garden of 120 Laund Road and the southeastern portion of the site.

The general slope of the surrounding land is down towards the southwest, in the direction of Laund Road. However, the central part of the site itself appears to have been levelled to some extent and sits around 1-2m higher than properties to the southwest the boundary. A retaining wall is present around the rear of the existing bungalow.

The site is bordered by a combination of dry-stone wall, wooden post fencing and mature trees.

The site location is shown in Figure 1, overleaf together with site photographs presented as Figures 2 and 3.

Figure 1 Site Location Plan



**Figure 2 Looking towards the southern part of the site**



**Figure 3 Looking southeast across the site**



## 2.1 Proposed Development

It is understood that the client intends to demolish the existing bungalow (120 Laund Road) and construct 8no. new two-storey detached and semi-detached residential houses with parking, private gardens and associated infrastructure.

The proposed development layout is presented in Figure 4, below.

**Figure 4 Proposed Development Layout Plan**



### 3.0 SITE INVESTIGATION

---

#### 3.1 Exploratory Fieldwork

The fieldwork was carried out by EEG Ltd between Wednesday 18<sup>th</sup> and Thursday 19<sup>th</sup> December 2019 and comprised:

- Three window sample boreholes (designated WS401 to WS403) were drilled to depths of between 1.9 and 2.0m below existing ground level in the vicinity of the former boreholes WS201, WS203 and WS204 from the previous site investigation (Reference: A0697/17, October 2019), to facilitate further gas monitoring of the site.

Window sampler boring is carried out with a small, track-mounted rig, which uses a chain driven trip hammer to drive sampling tubes or penetrometers into the ground. These tools are coupled to the anvil of the hammer by solid drill rods. Sampling tubes comprise “windowless samplers”, which are plain sampler tubes in which a continuous disturbed sample is recovered within a semi-rigid plastic liner. In order to reduce friction within the borehole, sampling tubes of progressively smaller diameter are used as the borehole depth increases. Sampler diameters generally range from between approximately 90mm to 50mm.

- On completion, all of the window sample boreholes WS401- WS402 were installed with 50mm diameter monitoring standpipes to enable subsequent gas and groundwater monitoring.

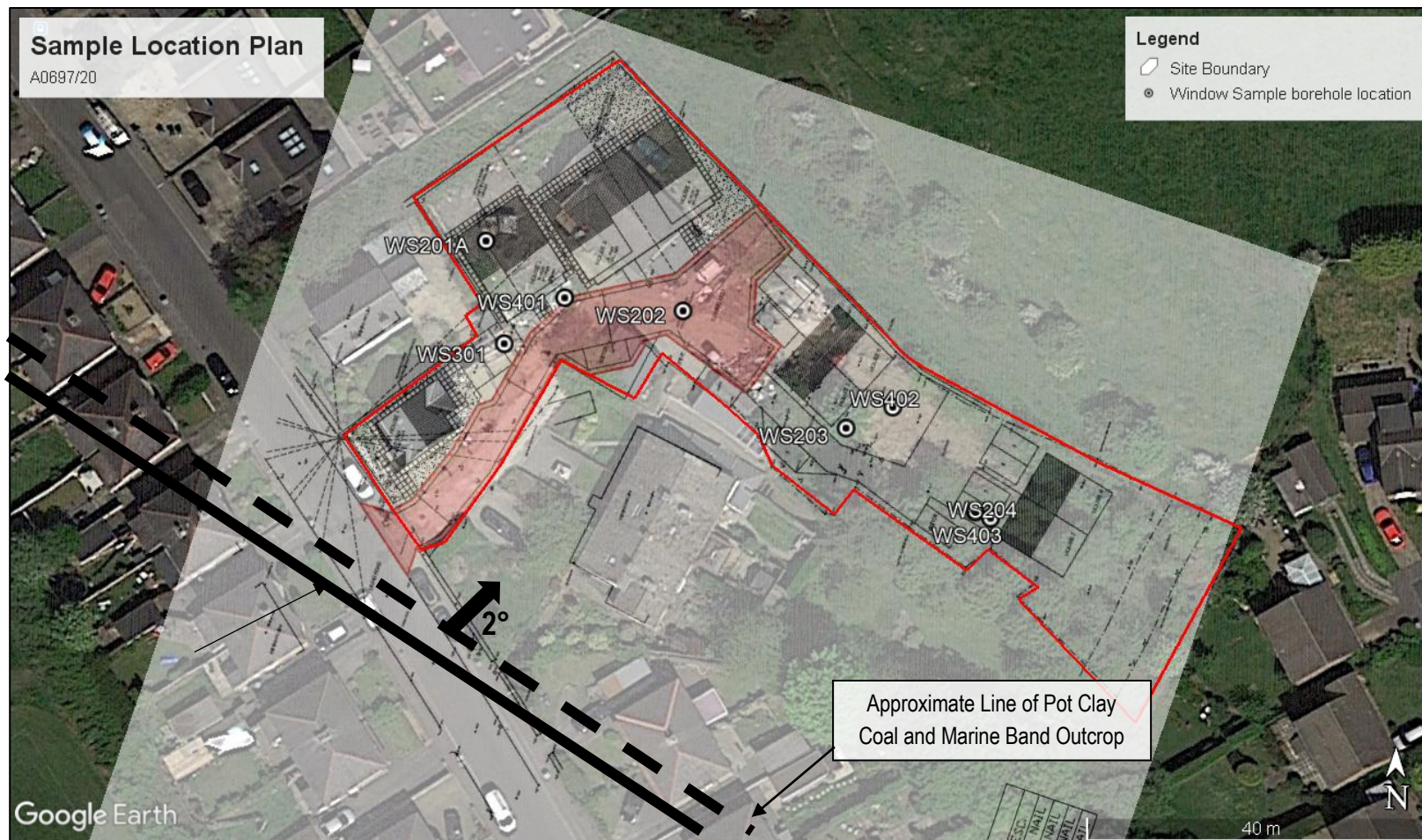
Exploratory hole locations were chosen by an EEG engineer based on the proposed layout and also to target potential coal mine workings and potentially contaminative historical features.

Exploratory hole logs are presented in Appendix 1, and an exploratory Hole Location Plan (with proposed development plan underlay) are presented as Figure 5 overleaf.

Each exploratory location was scanned using a Cable Avoidance Tool (CAT) in order to locate unrecorded underground services, and the exploratory locations were repositioned if necessary.

All site investigation work was supervised full time by a representative of EEG. The logging of soils and rocks has been carried out in accordance with BS5930(2015) except where superseded by the soil and rock description methodology in BS EN14688-1<sup>(2002)</sup>, BS EN 14688-2<sup>(2004)</sup> and BS EN 14689-1<sup>(2003)</sup>.

Figure 5 Exploratory Hole Location Plan



A summary of exploratory holes undertaken during the investigation is presented in Table 1, below.

**Table 1: Summary of Exploratory Holes Undertaken**

| Hole                                                       | Type* | Depth (m) | Date Started | Date Finished | Response Zone (m)/<br>Material         |
|------------------------------------------------------------|-------|-----------|--------------|---------------|----------------------------------------|
| WS201                                                      | WS    | 2.60      | 04/09/2019   | 04/09/2019    | None                                   |
| WS201A                                                     | WS    | 2.60      | 04/09/2019   | 04/09/2019    | 1.0-2.6/Made<br>Ground/Clay/Sandstone) |
| WS202                                                      | WS    | 1.70      | 04/09/2019   | 04/09/2019    | 0.6-1.70/Mudstone                      |
| WS203                                                      | WS    | 1.70      | 04/09/2019   | 04/09/2019    | 0.7-1.70/Mudstone                      |
| WS204                                                      | WS    | 2.80      | 04/09/2019   | 04/09/2019    | 0.8-2.80 Mudstone                      |
| WS401                                                      | WS    | 2.00      | 18/12/2019   | 18/12/2019    | 1.0-2.0/ Mudstone                      |
| WS402                                                      | WS    | 2.00      | 19/12/2019   | 19/12/2019    | 1.0-2.0 Mudstone                       |
| WS403                                                      | WS    | 2.00      | 19/12/2019   | 19/12/2019    | 1.0-2.0 Mudstone                       |
| * WS=Window Sampler Borehole<br>** SP=Monitoring Standpipe |       |           |              |               |                                        |

---

## 4.0 GROUND CONDITIONS ENCOUNTERED

---

### 4.1 Soil Profile Encountered

The British Geological Survey 1:10,000 Sheet SE11NW and digital mapping for the area indicate the site to be directly underlain by Carboniferous strata of the Lower Coal Measures, comprising mudstones, sandstones (Soft Bed Flags) and coal seams. Superficial deposits are not shown to be present.

A marine band and a thin coal (Pot Clay Coal) are conjectured to outcrop adjacent Laund Road and dip at a shallow angle (2°) site to the north east, beneath the site.

The sequence of strata encountered beneath the site in the Window Sampler Boreholes was as follows:

- **Topsoil** – encountered in WS401 and WS402 to depths of between 0.20m and 0.60m bgl and described as:
  - Grass over brown sandy, gravelly CLAY with roots and gravel of sandstone, mudstone and rare brick inclusions.
- **Made Ground** – encountered at the surface all other exploratory holes to depths of between 0.00m and 0.80m and typically described as:
  - Soft greyish brown, sandy, gravelly CLAY with gravel and cobble sized inclusions of concrete, brick, mudstone, sandstone, coal, clinker, glass, tile, plastic and general miscellaneous fly-tipped waste in variable proportions. Or;
  - Dark brownish black, clayey, gravelly SAND with inclusions as above.
- **Pennine Lower Coal Measures Formation (PLCM)** – encountered beneath the Topsoil or Made Ground in all locations as:
  - Soft to firm greyish brown or orangish brown mottled grey, sandy, gravelly CLAY (destructured/completely weathered).
  - Weakly bedded dark grey mottled orange weathered MUDSTONE recovered as weak shaley gravel with clayey matrix.
  - Yellow, thinly bedded SANDSTONE recovered as silty, sandy gravel.

The depths of the various materials encountered in the window sampler boreholes from site investigations undertaken on dates 04/09/19, 10/12/19 and 17/18-12-19 are summarised in Table 2 overleaf.

**Table 2: Summary of Ground Conditions Encountered**

| Borehole ID | Date drilled | Depth to Stratum (m) |             |                                            |            |           |      |
|-------------|--------------|----------------------|-------------|--------------------------------------------|------------|-----------|------|
|             |              | TOPSOIL              | MADE GROUND | PENNINE LOWER COAL MEASURES                |            |           |      |
|             |              |                      |             | Sandy Gravelly CLAY (Completely Weathered) | MUDSTONE   | SANDSTONE | COAL |
| WS201       | 04/09/2019   | -                    | GL-2.0      |                                            | -          | 2.00-2.60 | -    |
| WS201A      | 04/09/2019   | -                    | GL-1.20     | 1.20-1.80                                  | -          | 1.80-2.60 | -    |
| WS202       | 04/09/2019   | -                    | GL-0.55     | -                                          | 0.55-1.70  | -         | -    |
| WS203       | 04/09/2019   | -                    | GL-0.30     | -                                          | 0.30-1.70  | -         | -    |
| WS204       | 04/09/2019   | -                    | GL-0.80     | -                                          | 0.80-2.80  | -         | -    |
| WS301       | 10/12/2019   | GL-0.40              | -           | 0.40-1.80                                  | 0.80-2.00+ | -         | -    |
| WS302       | 10/12/2019   | GL-0.20              | 0.20-0.80   | 0.80-1.50                                  | 1.80-2.00+ | 1.50-1.80 | -    |
| WS401       | 18/12/2019   | GL-0.40              | NE          | 0.40-0.60                                  | 0.60-2.00+ | -         |      |
| WS402       | 19/12/2019   | GL-0.60              | NE          |                                            | 0.60-2.00+ | -         | -    |
| WS403       | 19/12/2019   | -                    | NE          | 0.0-1.00                                   | 1.00-2.00+ | -         | -    |

**Notes for Table 2**

NE Not encountered

## 4.2 Observable Indications of Contamination

Inclusions of brick, concrete, coal, clinker, glass, tile and plastic were noted within the Made Ground soils in variable proportions. However, these inclusions are generally inert and not considered to pose a significant risk of soil contamination.

No other visual or olfactory evidence of contamination was identified during the investigation.

## 4.3 Obstructions

Relict buried services, particularly drainage, are considered likely to remain in-situ in the southeastern part of the site.

## 4.4 Groundwater

No groundwater strikes were recorded during the fieldwork.

Subsequent monitoring of groundwater in standpipes (WS301 WS202 WS401 WS402 WS403) recorded water levels to be between 1.20m and 2m bgl.

## 4.5 Rockhead

Shallow bedrock (weathered mudstone) was encountered in all exploratory holes at depths of between 0.30 and 1.8m bgl.

## 5.0 GROUND GAS RISK ASSESSMENT

The potential risk associated with gases being generated in the ground (whether from natural or man-made sources) depends on the concentrations of gas and its flow rate to the surface. These factors are assessed by monitoring of a sealed response zone in borehole gas installations.

Table 1 provides a summary of the individual borehole response zones.

Eight gas monitoring visits have been completed by Earth Environmental & Geotechnical Ltd.

A full copy of the monitoring to date is provided within Appendix 2.

Table 4 overleaf, adapted from Table 1 of the technical paper Risk and Reliability in Gas Protection Design by Card et al. 2019, shows a summary of the current UK practice with respect to appropriate gas protection measures based upon a Gas Screening Value (GSV). A GSV for the site has been obtained by multiplying the maximum concentration of gas by the maximum flow rate, which represents worst-case scenario conditions

Table 3 below summarises the maximum concentrations of carbon dioxide and methane, together with the maximum flow rate and maximum Gas Screening Value (GSV) for both site investigations undertaken on site.

**Table 3: Summary of Ground Gas Monitoring Data**

| Dates between site visit | Wells monitored                           | Max. Steady CO <sub>2</sub> Concentration (% v/v) | Max. Steady CH <sub>4</sub> Concentration (% v/v) | Max. Steady Flow Rate (l/hr) | Calculated CO <sub>2</sub> GSV (l/hr) | Calculated CH <sub>4</sub> GSV (l/hr) | CIRIA 149 Characteristic Situation (CS) |
|--------------------------|-------------------------------------------|---------------------------------------------------|---------------------------------------------------|------------------------------|---------------------------------------|---------------------------------------|-----------------------------------------|
| 11-09-19 to 01-10-19     | WS201<br>WS202<br>WS203<br>WS204          | 15.2                                              | 0.0                                               | 37 (1.3)                     | 0.19                                  | 0.00                                  | CS-1                                    |
| 23-12-19 to 22-01-20     | WS201<br>WS302<br>WS401<br>WS402<br>WS403 | 11.5                                              | 0.50                                              | 1.3                          | 0.1495                                | 0.0065                                | CS-1                                    |

**Notes for Table 3:**

Values in **red** exceed CS-1 criteria based Modified Wilson & Card Classification (CIRIA Report 665)

During the initial monitoring period some of the flow rates were very high with a maximum of 37litres/hour. This has been attributed to barometric pumping with a fluctuating shallow water table. The high gas flow rates can therefore be discounted.

As a result, flow rates from the second phase of monitoring have instead been utilised in calculating gas screening values. This is justified as within Plot 1 the Ambisense Continuous gas monitor also identified an absence of any significant gas flow.

The above results suggest the site can be given a Characteristic Situation-1 (CS-1), i.e. 'Negligible to very low risk' classification, in accordance with Table 4 overleaf. This is due to the GSV values for methane and carbon dioxide being below 1.3 litres/hour and 7.2 litres/hour respectively.

Despite the above assessment of the ground gas regime, given the site is located on Coal Measures strata, a precautionary approach is advised, particularly in relation to carbon-dioxide.

As a result, Plot 2-8 will incorporate Characteristic Situation 2 measures for a Type A structure (private housing) in accordance with BS8485:2015+A1:2019 (Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings, January 2019).

The chosen protection elements/system will achieve a minimum solution score of 3.5 points for CS2 (for a Type A building) in accordance with BS8485:2015+A1:2019. For this development this will comprise the following elements depending on the chosen foundation solution, examples of appropriate solutions are detailed below:

*In-situ Concrete Suspended Slab:*

- Reinforced cast in situ suspended floor slab with minimal penetrations **(1.5 points)** and;
- Gas resistant membrane in accordance with the criteria set out in BS8485:2015+A1:2019 and independently verified in accordance with CIRIA C735 **(2 points)**.
- **Overall Solution Score 3.5 points**

*Beam and Block:*

- Good performance passive sub floor dispersal layer **(1.5 points)** and
- Gas resistant membrane in accordance with the criteria set out in BS8485:2015 and independently verified in accordance with CIRIA C735 **(2 points)**.
- **Overall Solution Score 3.5 points**

Additionally, the installation of a pressure relief pathway would contribute a further minimum **0.5 points**. Precast suspended segmental subfloor (i.e. beam and block) contributes **0 points**.

The final mitigation scheme will need to be verified and approved by the Local Authority prior to implementation.

The chosen foundation solution will need to be validated by an independent 3<sup>rd</sup> party to verify correct installation.

**Table 4: Modified Ground Gas Classification Table (Risk and Reliability in Gas Protection Design, 2019)**

| <b>Characteristic Situation</b> | <b>Pathway vertical permeability (m/s)</b>                                                      | <b>GSV CH<sub>4</sub> (l/hr)</b>      | <b>GSV CO<sub>2</sub> (l/h)</b> | <b>GSV oxygen deficient gas (Nitrogen) (l/h)</b>                                                                                                              | <b>Maximum borehole gauge pressure (Pa)</b> | <b>Limiting sustained gas concentrations in unsaturated zone within 10m of surface</b>                          | <b>Limitations</b>                                                                                                                                                                                                                                               | <b>Risk level</b>      |
|---------------------------------|-------------------------------------------------------------------------------------------------|---------------------------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CS-1                            | $\leq 1 \times 10^{-7}$<br>$1 \times 10^{-7} < k < 1 \times 10^{-5}$<br>$\geq 1 \times 10^{-5}$ | $< 2$<br>$< 1.5$<br>$< 1.3$           | $< 12.0$<br>$< 9.0$<br>$< 7$    | < 217 for all permeability (care when using this value. Usually oxygen deficient gas emissions are sporadic, and monitoring should cover suitable situations) | 500 (50mm water) – ASTM (2016)              | $< 30\%$ methane<br>$< 21\%$ carbon dioxide<br>No limit on oxygen depletion because it is widespread in natural | No nearby Municipal Solid Waste landfills or other credible source of gas. No pathway for migration to the site being considered. No potential high-volume gas reservoirs in ground.                                                                             | Negligible to very low |
| CS-2                            | $\leq 1 \times 10^{-7}$<br>$1 \times 10^{-7} < k < 1 \times 10^{-5}$<br>$\geq 1 \times 10^{-5}$ | $\leq 10$<br>$\leq 7.5$<br>$\leq 6.0$ | $< 140$<br>$< 100$<br>$< 85$    | No limit                                                                                                                                                      | No limit                                    |                                                                                                                 | Where oxygen deficient ground gas or carbon dioxide is likely to be emitted from shaft, fractured rock or ground where $k > 1 \times 10^{-4}$ m/s assume CS3 for Type A and B development and CS2 for Type C and D development (or alternatively undertake DQRA) | Low to moderate        |
| CS-3                            | $\leq 1 \times 10^{-7}$<br>$1 \times 10^{-7} < k < 1 \times 10^{-5}$<br>$\geq 1 \times 10^{-5}$ | $\leq 100$<br>$\leq 75$<br>$\leq 60$  | No limiting values              | No limiting values (site specific check required that gas emission can be managed by protection measures)                                                     | No limit                                    | No limit                                                                                                        |                                                                                                                                                                                                                                                                  | Moderate to high       |
| CS-4                            |                                                                                                 | N/A                                   | N/A                             | N/A                                                                                                                                                           |                                             |                                                                                                                 | Sites that are domestic/commercial landfill sites where gas generation is still managed by extraction systems such as calorific flaring                                                                                                                          | Very high              |

## 6.0 REVIEW OF CONCEPTUAL SITE MODEL

A revised conceptual model is presented as Table 17 in the EEG Ltd Phase II GeoEnvironmental site investigation report (A0697/19, October 2019). The findings of which are summarised in Section 1.2.2. The PRA concluded there to be a **MODERATE** risk to end users from potential soil contamination and ground gas. The risk to groundwater and nearby surface water features was concluded to be **LOW**.

A revised risk assessment and Conceptual Model (For ground gases) have been prepared for the site based on the results of the site investigation and subsequent chemical analysis and presented as Table 7, overleaf. The conceptual site model considers the source-pathway-receptor linkages present alongside the likelihood, severity and risk level as defined within Table 5 and Table 6 below. The assessment of probability, a modified risk table, and certain consequence definitions are based on CIRIA C552 and CLR11.

Table 7 considers whether a pollution linkage is potentially present and provides a qualitative assessment of risk based on a proposed residential end use.

**Table 5: Consequence, Probability and Risk**

| Probability                                                                                                                                                                                                                                        | Consequence                                                                                                                                                                                                                                                                                         | Risk                                                                                                                                                                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| High Likelihood- There is a pollution linkage and an event either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution                                        | Very High – acute risk to the human health likely to result in significant harm. Risk of severe or irreversible effect on ground/surface water quality. Catastrophic damage to buildings / property.                                                                                                | Very High – there is a high potential that the source-pathway-receptor scenarios may give rise to harm to human health or the environment and remedial action is likely to be required.                                                                                             |
| Likely – there is a pollution linkage and all the elements are present, which means that it is probable an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term. | High – Severe or irreversible effect on human health. Temporary severe or irreversible effect on ground/surface water quality. Reduction of water quality rendering groundwater or surface water unfit to drink and/or substantial adverse impact on groundwater dependent environmental receptors. | High – it is likely that the source-pathway-receptor scenarios may give rise to an impact on human health or the environment, which may require remediation and/or control measures to mitigate risks                                                                               |
| Low likelihood– there is a pollutant linkage and circumstances are possible for an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term        | Moderate – Long term or short-term moderate effect on human health. Moderate effect on ground/surface water quality, reversible with time. Reduced reliability of a supply at a groundwater or surface water abstraction source                                                                     | Moderate – it is possible that the source-pathway-receptor scenarios may give rise to an impact on human health or the environment, however it is either relatively unlikely that such are would be severe, or if any harm were to occur it is more likely that harm would be mild. |
| Unlikely – there is a pollution linkage, but circumstances are such that it is doubtful that an event would occur even in the very long term.                                                                                                      | Low – Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc.) Slight effect on ground/surface water quality, reversible with time. Marginal reduced reliability of a supply at a groundwater or surface water abstraction source.        | Low – it is possible that harm could arise at the source, however it is likely that the risk would at worst be mild.                                                                                                                                                                |
|                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                     | Very Low – it is unlikely that the source-pathway-receptor scenarios will give rise to an impact on human health or the environment.                                                                                                                                                |

**Table 6: Estimation of Level of Risk**

|             |                 | Consequence          |                      |                      |                      |
|-------------|-----------------|----------------------|----------------------|----------------------|----------------------|
|             |                 | High                 | Moderate             | Low                  | Very low             |
| Probability | High Likelihood | Very High            | High risk            | Moderate risk        | Moderate to low risk |
|             | Likely          | High risk            | Moderate risk        | Moderate to low risk | Low risk             |
|             | Low Likelihood  | Moderate risk        | Moderate to low risk | Low risk             | Very low risk        |
|             | Unlikely        | Moderate to low risk | Low risk             | Very low risk        | Very low risk        |

### 6.1 Sources of Contamination

The Phase II report for the site outlined the potential for the presence contaminated soils associated with the former site land uses and development history, notably:

- Made Ground
- Mine gases from Coal Measures strata

### 6.2 Receptors

The following receptors have been considered for the construction and operational stages of the proposed redevelopment.

- Current site users
- Adjacent land users
- Future land users
- Construction workers during site development works

### 6.3 Pollutant Pathways

The following pathways have been considered for the construction and operational stages of the proposed redevelopment.

- Vertical or lateral migration of ground gas associated with permeable strata and service ducts.

**Table 7: Revised Conceptual Model (Ground Gas only)**

| Source                               | Pathway                                                                                                    | Receptor             | Probability    | Consequence | Risk            | Comment                                                                                                                                                                                                                                                                                                                            |
|--------------------------------------|------------------------------------------------------------------------------------------------------------|----------------------|----------------|-------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Made ground and Coal Measures strata | Vertical or lateral migration of ground gas associated with Made Ground & Backfilled Shallow Mine Workings | Current Site Users   | Low Likelihood | Moderate    | Moderate        | The existing bungalow is currently occupied. GSVs calculated from the ground gas monitoring characterize the site as CS-1. The risk of ground gas to current site users is therefore considered to be <b>LOW</b> .                                                                                                                 |
|                                      |                                                                                                            | Adjacent land users  | Unlikely       | Moderate    | Low risk        | Migration of any potential ground gas will be inhibited by the predominantly low permeability of the underlying geology. The risk to adjacent users from ground gas is considered <b>LOW</b> .                                                                                                                                     |
|                                      |                                                                                                            | Future land users    | Low Likelihood | Moderate    | Moderate to Low | The proposed development will include eight new residential dwellings. GSVs calculated from ground gas monitoring visits characterise the site as CS-1. The risk from ground gas to future site users is therefore considered to be <b>LOW</b> . <b>However, CS2 measures will be adopted as part of a precautionary approach.</b> |
|                                      |                                                                                                            | Construction Workers | Unlikely       | Moderate    | Low             | Construction workers may be exposed to ground gases in excavations. However, the exposure duration will be short. The risk to construction workers from ground gas is considered <b>LOW</b> .                                                                                                                                      |

## **7.0 CONCLUSIONS AND RECOMMENDATIONS**

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Based on eight monitoring visits the site has been given a classification of CS1, however a precautionary approach will be adopted, due to the site being located on Coal Measures strata.

The site is therefore classified as Characteristic Situation 2 a low to moderate gas risk.

In accordance with BS8485:2015+A1:2019 a ground gas membrane will be installed on a suspended ground floor slab.

The installation of the ground protection measures will be independently validated by a third-party environmental consultant, with the Validation Report, provided to the Local Authority.

It is understood that on Plot 2 the ground floor slab has been emplaced. The walling would be removed with a gas membrane laid on top of the slab, continuing through the wall to bridge the cavity, providing a complete seal.

## **APPENDIX 1**

### **EXPLORATORY HOLE LOGS**

## **APPENDIX 2**

### **GAS MONITORING DATA**

## **APPENDIX 3**

### **REPORT LIMITATIONS**

## **REPORT LIMITATIONS**

This contract was completed by Earth Environmental & Geotechnical Ltd on the basis of a defined programme and scope of works and terms and conditions agreed with the client. This report was compiled with all reasonable skill, and care, bearing in mind the project objectives, the agreed scope of works, the prevailing site conditions, the budget and staff resources allocated to the project.

Other than that, expressly contained in the above paragraph, Earth Environmental & Geotechnical Ltd provides no other representation or warranty whether express or implied, is made in relation to the services. Unless otherwise agreed this report has been prepared exclusively for the use and reliance of the client in accordance with generally accepted consulting practices and for the intended purposes as stated in the agreement under which this work was completed. This report may not be relied upon, or transferred to, by any other party without the written agreement of a Director of Earth Environmental & Geotechnical Ltd.

If a third party relies on this report, it does so wholly at its own and sole risk and Earth Environmental & Geotechnical Ltd disclaims any liability to such parties.

It is Earth Environmental & Geotechnical Ltd understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was an important factor in determining the scope and level of the services. Should the purpose for which the report is used, or the proposed use of the site change, this report will no longer be valid and any further use of, or reliance upon the report in those circumstances by the client without Earth Environmental & Geotechnical Ltd review and advice shall be at the client's sole and own risk.

The report was written in 2020 and should be read in light of any subsequent changes in legislation, statutory requirements and industry best practices. Ground conditions can also change over time and further investigations or assessment should be made if there is any significant delay in acting on the findings of this report. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of Earth Environmental & Geotechnical Ltd. In the absence of such written advice of Earth Environmental & Geotechnical Ltd, reliance on the report in the future shall be at the client's own and sole risk. Should Earth Environmental & Geotechnical Ltd be requested to review the report in the future, Earth Environmental & Geotechnical Ltd shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between Earth Environmental & Geotechnical Ltd and the client.

The observations and conclusions described in this report are based solely upon the services that were provided pursuant to the agreement between the client and Earth Environmental & Geotechnical Ltd. Earth Environmental & Geotechnical Ltd has not performed any observations, investigations, studies or testing not specifically set out or mentioned within this report.

Earth Environmental & Geotechnical Ltd is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, Earth Environmental & Geotechnical Ltd did not seek to evaluate the presence on or off the site of electromagnetic fields, lead paint, radon gas or other radioactive materials.

The services are based upon Earth Environmental & Geotechnical Ltd observations of existing physical conditions at the site gained from a walkover survey of the site together with Earth

Environmental & Geotechnical Ltd interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The findings and recommendations contained in this report are based in part upon information provided by third parties, and whilst Earth Environmental & Geotechnical Ltd have no reason to doubt the accuracy and that it has been provided in full from those it was requested from, the items relied on have not been verified.

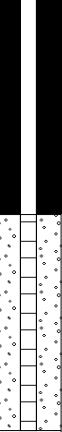
No responsibility can be accepted for errors within third party items presented in this report. Further Earth Environmental & Geotechnical Ltd was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the services. Earth Environmental & Geotechnical Ltd is not liable for any inaccurate information, misrepresentation of data or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to Earth Environmental & Geotechnical Ltd and including the doing of any independent investigation of the information provided to Earth Environmental & Geotechnical Ltd save as otherwise provided in the terms of the contract between the client and Earth Environmental & Geotechnical Ltd.

Where field investigations have been carried out these have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions can also be variable and as investigation excavations only allow examination of the ground at discrete locations. The potential exists for ground conditions to be encountered which are different to those considered in this report. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and Earth Environmental & Geotechnical Ltd] based on an understanding of the available operational and historical information, and it should not be inferred that other chemical species are not present.

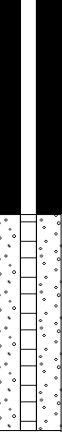
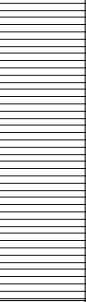
The groundwater conditions entered on the exploratory hole records are those observed at the time of investigation. The normal speed of investigation usually does not permit the recording of an equilibrium water level for any one water strike. Moreover, groundwater levels are subject to seasonal variation or changes in local drainage conditions and higher groundwater levels may occur at other times of the year than were recorded during this investigation.

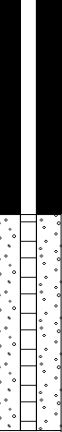
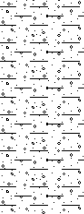
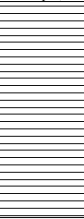
Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site.

|                                                                                                                                                                         |  |  |  |                                |  |                                |  |                                              |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--------------------------------|--|--------------------------------|--|----------------------------------------------|--|
|  Houldsworth Mill Business & Arts Centre<br>Houldsworth Street<br>Stockport<br>SK5 6DA |  |  |  | <h1>Borehole Log</h1>          |  |                                |  | Borehole No.<br><b>WS401</b><br>Sheet 1 of 1 |  |
| Project Name: 120 Laund Road                                                                                                                                            |  |  |  | Project No. A0697              |  | Co-ords: 410366.00 - 418264.00 |  | Hole Type<br>WS                              |  |
| Location: Huddersfield                                                                                                                                                  |  |  |  | Level: 0.00                    |  | Scale<br>1:35                  |  |                                              |  |
| Client: Creative Developments (Huddersfield) Ltd                                                                                                                        |  |  |  | Dates: 18/12/2019 - 18/12/2019 |  | Logged By<br>JD                |  |                                              |  |

| Well                                                                              | Water Strikes | Samples and In Situ Testing |      |         | Depth (m) | Level (m) | Legend                                                                            | Stratum Description                                                                                                              |                                                                                      |
|-----------------------------------------------------------------------------------|---------------|-----------------------------|------|---------|-----------|-----------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|                                                                                   |               | Depth (m)                   | Type | Results |           |           |                                                                                   |                                                                                                                                  |                                                                                      |
|  |               |                             |      |         | 0.40      | -0.40     |  | Brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse angular of red brick (TOPSOIL).             |  |
|                                                                                   |               |                             |      |         | 0.60      | -0.60     |  | Soft yellow mottled grey sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse subangular of sandstone. |                                                                                      |
|                                                                                   |               |                             |      |         | 0.70      | -0.70     |  | Coal recovered as a gravelly fine to coarse SAND. Gravel is angular to subangular fine to coarse and of coal.                    |                                                                                      |
|                                                                                   |               |                             |      |         |           |           |  | Thinly laminated light grey MUDSTONE recovered as weak shaley fine to coarse gravel with clay matrix and partings.               |                                                                                      |
|                                                                                   |               |                             |      |         | 2.00      | -2.00     | End of borehole at 2.00 m                                                         |                                                                                                                                  |                                                                                      |

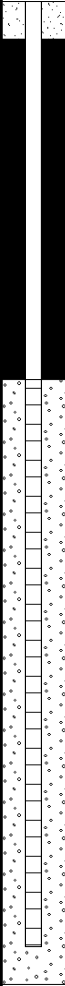
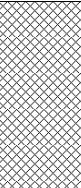
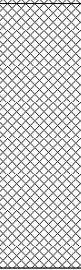
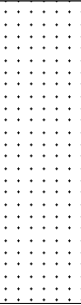
|                                                                                                                                         |  |                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------|
| Remarks<br>1) Hole location scanned with CAT. 2) Hand dug pit to 1.20m. 3) Standpipe installed to 2.00m. 4) No groundwater encountered. |  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------|

|  Houldsworth Mill Business & Arts Centre<br>Houldsworth Street<br>Stockport<br>SK5 6DA |               |                             |      | <h1>Borehole Log</h1>          |           |                                |                                                                                   | Borehole No.<br><b>WS402</b><br>Sheet 1 of 1                                                                             |                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------------|------|--------------------------------|-----------|--------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Project Name: 120 Laund Road                                                                                                                                            |               |                             |      | Project No. A0697              |           | Co-ords: 410403.00 - 418252.00 |                                                                                   | Hole Type<br>WS                                                                                                          |                                                                                       |
| Location: Huddersfield                                                                                                                                                  |               |                             |      | Level: 0.00                    |           | Scale<br>1:35                  |                                                                                   |                                                                                                                          |                                                                                       |
| Client: Creative Developments (Huddersfield) Ltd                                                                                                                        |               |                             |      | Dates: 19/12/2019 - 19/12/2019 |           | Logged By<br>JD                |                                                                                   |                                                                                                                          |                                                                                       |
| Well                                                                                                                                                                    | Water Strikes | Samples and In Situ Testing |      |                                | Depth (m) | Level (m)                      | Legend                                                                            | Stratum Description                                                                                                      |                                                                                       |
|                                                                                                                                                                         |               | Depth (m)                   | Type | Results                        |           |                                |                                                                                   |                                                                                                                          |                                                                                       |
|                                                                                        |               |                             |      |                                | 0.60      | -0.60                          |  | Dark brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse angular of mudstone (TOPSOIL). | 1                                                                                     |
|                                                                                                                                                                         |               |                             |      |                                | 2.00      | -2.00                          |  | Thinly lamianted light grey MUDSTONE recovered as weak shaley fine to coarse gravel with clay matirx and partings.       |                                                                                       |
|                                                                                                                                                                         |               |                             |      |                                |           |                                | End of borehole at 2.00 m                                                         |                                                                                                                          | 2                                                                                     |
|                                                                                                                                                                         |               |                             |      |                                |           |                                |                                                                                   |                                                                                                                          | 3                                                                                     |
|                                                                                                                                                                         |               |                             |      |                                |           |                                |                                                                                   |                                                                                                                          | 4                                                                                     |
|                                                                                                                                                                         |               |                             |      |                                |           |                                |                                                                                   |                                                                                                                          | 5                                                                                     |
|                                                                                                                                                                         |               |                             |      |                                |           |                                |                                                                                   |                                                                                                                          | 6                                                                                     |
|                                                                                                                                                                         |               |                             |      |                                |           |                                |                                                                                   |                                                                                                                          | 7                                                                                     |
| Remarks<br>1) Hole location scanned with CAT. 2) Hand dug pit to 1.20m. 3) Standpipe installed to 2.00m. 4) No groundwater encountered.                                 |               |                             |      |                                |           |                                |                                                                                   |                                                                                                                          |  |

|  Houldsworth Mill Business & Arts Centre<br>Houldsworth Street<br>Stockport<br>SK5 6DA |               |                             |      | <h1>Borehole Log</h1>          |           |                                |                                                                                   | Borehole No.<br><b>WS403</b><br>Sheet 1 of 1                                                                                     |                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------------|------|--------------------------------|-----------|--------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Project Name: 120 Laund Road                                                                                                                                            |               |                             |      | Project No. A0697              |           | Co-ords: 410413.00 - 418241.00 |                                                                                   | Hole Type<br>WS                                                                                                                  |                                                                                       |
| Location: Huddersfield                                                                                                                                                  |               |                             |      | Level: 0.00                    |           | Scale<br>1:35                  |                                                                                   |                                                                                                                                  |                                                                                       |
| Client: Creative Developments (Huddersfield) Ltd                                                                                                                        |               |                             |      | Dates: 19/12/2019 - 19/12/2019 |           | Logged By<br>JD                |                                                                                   |                                                                                                                                  |                                                                                       |
| Well                                                                                                                                                                    | Water Strikes | Samples and In Situ Testing |      |                                | Depth (m) | Level (m)                      | Legend                                                                            | Stratum Description                                                                                                              |                                                                                       |
|                                                                                                                                                                         |               | Depth (m)                   | Type | Results                        |           |                                |                                                                                   |                                                                                                                                  |                                                                                       |
|                                                                                        |               |                             |      |                                | 1.00      | -1.00                          |  | Soft yellow mottled grey sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse subangular of sandstone. | 1                                                                                     |
|                                                                                                                                                                         |               |                             |      |                                | 2.00      | -2.00                          |  | Thinly laminated light grey MUDSTONE recovered as weak shaley fine to coarse gravel with clay matric and partings.               | 2                                                                                     |
|                                                                                                                                                                         |               |                             |      |                                |           |                                | ----- End of borehole at 2.00 m -----                                             |                                                                                                                                  | 3                                                                                     |
|                                                                                                                                                                         |               |                             |      |                                |           |                                |                                                                                   |                                                                                                                                  | 4                                                                                     |
|                                                                                                                                                                         |               |                             |      |                                |           |                                |                                                                                   |                                                                                                                                  | 5                                                                                     |
|                                                                                                                                                                         |               |                             |      |                                |           |                                |                                                                                   |                                                                                                                                  | 6                                                                                     |
|                                                                                                                                                                         |               |                             |      |                                |           |                                |                                                                                   |                                                                                                                                  | 7                                                                                     |
| Remarks<br>1) Hole location scanned with CAT. 2) Hand dug pit to 1.20m. 3) Standpipe installed to 2.00m. 4) No groundwater encountered.                                 |               |                             |      |                                |           |                                |                                                                                   |                                                                                                                                  |  |

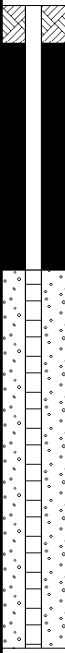
|  Houldsworth Mill Business & Arts Centre<br>Houldsworth Street<br>Stockport<br>SK5 6DA |               |                             |      | <h1>Borehole Log</h1>          |           |                 |                           | Borehole No.<br><b>WS01</b><br>Sheet 1 of 1                                                                                                                                                                                                                      |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------------|------|--------------------------------|-----------|-----------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Project Name: 120 Laundry Road                                                                                                                                          |               |                             |      | Project No. A0697              |           | Co-ords: -      |                           | Hole Type<br>WS                                                                                                                                                                                                                                                  |  |
| Location: Huddersfield                                                                                                                                                  |               |                             |      | Level:                         |           | Scale<br>1:20   |                           |                                                                                                                                                                                                                                                                  |  |
| Client: Creative Developments (Huddersfield) Ltd                                                                                                                        |               |                             |      | Dates: 04/09/2019 - 04/09/2019 |           | Logged By<br>AB |                           |                                                                                                                                                                                                                                                                  |  |
| Well                                                                                                                                                                    | Water Strikes | Samples and In Situ Testing |      |                                | Depth (m) | Level (m)       | Legend                    | Stratum Description                                                                                                                                                                                                                                              |  |
|                                                                                                                                                                         |               | Depth (m)                   | Type | Results                        |           |                 |                           |                                                                                                                                                                                                                                                                  |  |
|                                                                                                                                                                         |               |                             |      |                                | 1.20      |                 |                           | Soft dark brown sandy gravelly CLAY with frequent cobbles and boulders. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of brick, tile, concrete and sandstone. Cobbles and boulders are subangular of sandstone and brick. (MADE GROUND) |  |
|                                                                                                                                                                         |               |                             |      |                                | 2.00      |                 |                           | Soft to firm brown mottled black slightly clayey SILT with frequent pockets of extremely weak mudstone (up to 70mm). Occasional angular fine to coarse gravel of clinker. (MADE GROUND)                                                                          |  |
|                                                                                                                                                                         |               |                             |      |                                | 2.60      |                 |                           | Very weak yellow mottled orange fine to medium grained SANDSTONE.                                                                                                                                                                                                |  |
|                                                                                                                                                                         |               |                             |      |                                |           |                 | End of borehole at 2.60 m |                                                                                                                                                                                                                                                                  |  |
| Remarks<br>Location scanned with CAT prior to excavation.<br>Hand dug pit excavated to 1.20m.<br>No monitoring installation; backfilled with arisings.                  |               |                             |      |                                |           |                 |                           |                                                                                                                                                                                                                                                                  |  |

|                                                                                                                                                                         |  |                                |  |                 |                                              |                 |
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|  Houldsworth Mill Business & Arts Centre<br>Houldsworth Street<br>Stockport<br>SK5 6DA |  | <h1>Borehole Log</h1>          |  |                 | Borehole No.<br><b>WS01A</b><br>Sheet 1 of 1 |                 |
| Project Name: 120 Laundry Road                                                                                                                                          |  | Project No. A0697              |  | Co-ords: -      |                                              | Hole Type<br>WS |
| Location: Huddersfield                                                                                                                                                  |  | Level:                         |  | Scale<br>1:20   |                                              |                 |
| Client: Creative Developments (Huddersfield) Ltd                                                                                                                        |  | Dates: 04/09/2019 - 04/09/2019 |  | Logged By<br>AB |                                              |                 |

| Well                                                                               | Water Strikes | Samples and In Situ Testing |      |         | Depth (m) | Level (m) | Legend                                                                                                                                                                                                                                                                                                                                              | Stratum Description |   |
|------------------------------------------------------------------------------------|---------------|-----------------------------|------|---------|-----------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---|
|                                                                                    |               | Depth (m)                   | Type | Results |           |           |                                                                                                                                                                                                                                                                                                                                                     |                     |   |
|  |               |                             |      |         | 0.50      |           |  Soft dark brown very sandy gravelly CLAY with rare cobbles and boulders. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of brick, tile, concrete and sandstone. Cobbles and boulders are subangular of sandstone and brick. (MADE GROUND) | 1                   |   |
|                                                                                    |               |                             |      |         | 1.20      |           |  Soft grey mottled yellowish brown slightly clayey SILT. Frequent pockets of very weak mudstone (up to 80mm). (MADE GROUND)                                                                                                                                        |                     |   |
|                                                                                    |               |                             |      |         | 1.80      |           |  Stiff grey mottled black and orange slightly silty CLAY. Frequent mudstone fragments.<br><u>50mm thick band of clinker.</u>                                                                                                                                      | 2                   |   |
|                                                                                    |               |                             |      |         | 2.60      |           |  Very weak weathered yellow mottled orange fine to medium grained SANDSTONE.                                                                                                                                                                                     |                     |   |
|                                                                                    |               |                             |      |         |           |           | End of borehole at 2.60 m                                                                                                                                                                                                                                                                                                                           |                     | 3 |
|                                                                                    |               |                             |      |         |           |           |                                                                                                                                                                                                                                                                                                                                                     |                     | 4 |

|                                                                                                                                                   |                                                                                       |
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| Remarks<br>Location scanned with CAT prior to excavation.<br>Hand dug pit excavated to 1.20m.<br>Monitoring installation; 1m Plain, 1.5m Slotted. |  |
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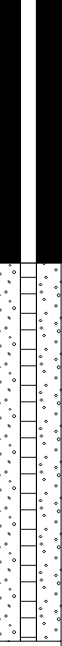
|                                                                                                                                                                         |  |  |  |                                |  |                 |  |                                             |  |
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|  Houldsworth Mill Business & Arts Centre<br>Houldsworth Street<br>Stockport<br>SK5 6DA |  |  |  | <h1>Borehole Log</h1>          |  |                 |  | Borehole No.<br><b>WS02</b><br>Sheet 1 of 1 |  |
| Project Name: 120 Laundry Road                                                                                                                                          |  |  |  | Project No. A0697              |  | Co-ords: -      |  | Hole Type<br>WS                             |  |
| Location: Huddersfield                                                                                                                                                  |  |  |  | Level:                         |  | Scale<br>1:20   |  |                                             |  |
| Client: Creative Developments (Huddersfield) Ltd                                                                                                                        |  |  |  | Dates: 04/09/2019 - 04/09/2019 |  | Logged By<br>AB |  |                                             |  |

| Well                                                                               | Water Strikes | Samples and In Situ Testing |      |         | Depth (m) | Level (m) | Legend                                                                                                                                                                                                                                                                                                                  | Stratum Description                                 |  |
|------------------------------------------------------------------------------------|---------------|-----------------------------|------|---------|-----------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|--|
|                                                                                    |               | Depth (m)                   | Type | Results |           |           |                                                                                                                                                                                                                                                                                                                         |                                                     |  |
|  |               |                             |      |         | 0.20      |           |  Black gravelly clayey fine to coarse SAND with frequent cobbles. Gravel is angular to subangular fine to coarse of brick, sandstone and mudstone. Cobbles and boulders are angular to subangular of brick and concrete. (MADE GROUND) | <div>1</div> <div>2</div> <div>3</div> <div>4</div> |  |
|                                                                                    |               |                             |      |         | 0.55      |           |  Soft light brown mottled grey slightly silty slightly sandy slightly gravelly CLAY. Sand is fine. Gravel is angular fine of brick and mudstone. (MADE GROUND)                                                                         |                                                     |  |
|                                                                                    |               |                             |      |         | 1.20      |           |  Thinly laminated light grey MUDSTONE recovered as extremely weak shaley fine to coarse gravel with clay matrix and partings.                                                                                                          |                                                     |  |
|                                                                                    |               |                             |      |         | 1.70      |           |  70mm thick band of intact mudstone with high clay content.                                                                                                                                                                            |                                                     |  |
|                                                                                    |               |                             |      |         |           |           | End of borehole at 1.70 m                                                                                                                                                                                                                                                                                               |                                                     |  |

Remarks  
 Location scanned with CAT prior to excavation.  
 Hand dug pit excavated to 1.20m.  
 Monitoring installation; 0.7m Plain, 1.0m Slotted.

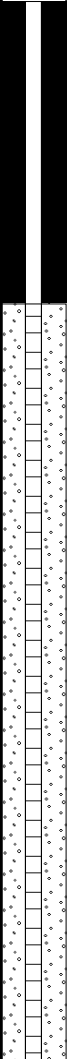
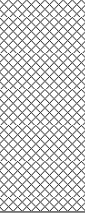
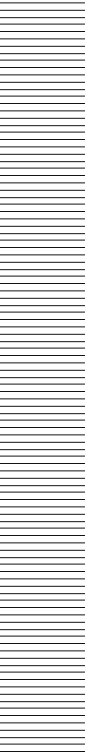


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|  Houldsworth Mill Business & Arts Centre<br>Houldsworth Street<br>Stockport<br>SK5 6DA |  |  |  | <h1>Borehole Log</h1>          |  |                 |  | Borehole No.<br><b>WS03</b><br>Sheet 1 of 1 |  |
| Project Name: 120 Laund Road                                                                                                                                            |  |  |  | Project No. A0697              |  | Co-ords: -      |  | Hole Type<br>WS                             |  |
| Location: Huddersfield                                                                                                                                                  |  |  |  | Level:                         |  | Scale<br>1:20   |  |                                             |  |
| Client: Creative Developments (Huddersfield) Ltd                                                                                                                        |  |  |  | Dates: 04/09/2019 - 04/09/2019 |  | Logged By<br>AB |  |                                             |  |

| Well                                                                               | Water Strikes | Samples and In Situ Testing |      |         | Depth (m) | Level (m) | Legend                                                                             | Stratum Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |
|------------------------------------------------------------------------------------|---------------|-----------------------------|------|---------|-----------|-----------|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|                                                                                    |               | Depth (m)                   | Type | Results |           |           |                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |
|  |               |                             |      |         | 0.15      |           |  | <p>Soft brown mottled light brown slightly silty sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to subrounded fine to medium of mudstone, sandstone and occasional clinker. Frequent roots and rootlets. (MADE GROUND)</p> <p>Extremely weak grey mottled orangish brown thinly laminated (up to 5mm) MUDSTONE (MADE GROUND).</p> <p>Soft brown slightly silty gravelly CLAY. Gravel is subangular fine to coarse of sandstone, clinker and mudstone. Occasional wood fragments (MADE GROUND).</p> <p>Extremely weak grey mottled orange and black thinly laminated (up to 5mm) MUDSTONE. Frequent clay partings.</p> <p><i>Green plastic sheet.</i></p> | 1 |
|                                                                                    |               |                             |      |         | 0.20      |           |                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1 |
|                                                                                    |               |                             |      |         | 0.30      |           |                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1 |
|                                                                                    |               |                             |      |         | 1.70      |           |                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2 |
|                                                                                    |               |                             |      |         |           |           | End of borehole at 1.70 m                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3 |
|                                                                                    |               |                             |      |         |           |           |                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 4 |

|                                                                                                                                                     |  |  |  |  |  |  |  |                                                                                       |
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| Remarks<br>Location scanned with CAT prior to excavation.<br>Hand dug pit excavated to 1.20m.<br>Monitoring installation; 0.7m Plain, 1.0m Slotted. |  |  |  |  |  |  |  |  |
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|  Houldsworth Mill Business & Arts Centre<br>Houldsworth Street<br>Stockport<br>SK5 6DA |  |  |  |  | <h1>Borehole Log</h1>          |  |                 | Borehole No.<br><b>WS04</b><br>Sheet 1 of 1 |                 |
| Project Name: 120 Laund Road                                                                                                                                            |  |  |  |  | Project No. A0697              |  | Co-ords: -      |                                             | Hole Type<br>WS |
| Location: Huddersfield                                                                                                                                                  |  |  |  |  | Level:                         |  | Scale<br>1:20   |                                             |                 |
| Client: Creative Developments (Huddersfield) Ltd                                                                                                                        |  |  |  |  | Dates: 04/09/2019 - 04/09/2019 |  | Logged By<br>AB |                                             |                 |

| Well                                                                               | Water Strikes | Samples and In Situ Testing |      |         | Depth (m) | Level (m) | Legend                                                                                                                                                                                                                                                                                    | Stratum Description |   |
|------------------------------------------------------------------------------------|---------------|-----------------------------|------|---------|-----------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---|
|                                                                                    |               | Depth (m)                   | Type | Results |           |           |                                                                                                                                                                                                                                                                                           |                     |   |
|  |               |                             |      |         | 0.10      |           |  Soft brown sandy gravelly CLAY with rare cobbles. Sand is fine to coarse. Gravel is subangular of sandstone. Cobbles are subangular of sandstone MADE GROUND).                                          |                     |   |
|                                                                                    |               |                             |      |         | 0.80      |           |  Soft dark brown mottled reddish brown slightly silty slightly sandy CLAY. Frequent roots and rootlets (up to 80mm long). Rare glass and tile fragments. Rare subangular quartzite cobbles MADE GROUND). | 1                   |   |
|                                                                                    |               |                             |      |         | 2.80      |           |  Dark grey extremely weak thinly laminated (up to 5 mm) MUDSTONE with frequent orangish brown clay partings.                                                                                            | 2                   |   |
|                                                                                    |               |                             |      |         |           |           | End of borehole at 2.80 m                                                                                                                                                                                                                                                                 |                     | 3 |
|                                                                                    |               |                             |      |         |           |           |                                                                                                                                                                                                                                                                                           |                     | 4 |

|                                                                                                                                                     |  |  |  |  |  |  |  |                                                                                       |
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| Remarks<br>Location scanned with CAT prior to excavation.<br>Hand dug pit excavated to 1.20m.<br>Monitoring installation; 0.8m Plain, 2.0m Slotted. |  |  |  |  |  |  |  |  |
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[illegible]