

J N P G R O U P
CONSULTING ENGINEERS

Phase II Geoenvironmental and
Geotechnical Report

Project: 105 Highgate Lane,
Lepton,
Huddersfield,
HD8 0HQ

Client: Capewell Construction & Developments Ltd.

Reference: S11169-JNP-XX-XX-RP-G-1001

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DOCUMENT CONTROL SHEET



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FOR AND ON BEHALF OF JNP GROUP

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EXECUTIVE SUMMARY

Site location	105 Highgate Lane, Lepton, Huddersfield, HD8 0HQ	
Development scheme	Redevelopment of existing garage, driveway, and garden area with two residential properties with private gardens and car parking areas.	
NGR	SE 19396 15177	
Current use	On-site: Garage, driveway, and garden of adjacent residential property.	Off-site: Residential with private gardens
Geology (from GI)	<p>Topsoil: Ground level to 0.15m bgl in lower southern portion of site. Topsoil: Ground level to 0.40m bgl at northern end of the site. Made Ground: Tarmac and underlying hardcore from ground level to 0.23m bgl in driveway across southern half of the site. Made Ground: Reworked topsoil and underlying clayey sandy gravel from ground level to 0.60m bgl at southern end of raised garden. Buried topsoil: 0.60m – 0.80m bgl at southern end of raised garden beneath Made Ground.</p> <p>Weathered profile of the Pennine Lower Coal Measures Formation: Variable granular soils, and occasional thin layers of cohesive soils, from 0.15m – 0.23m bgl to 0.60 – 0.65m bgl in the lower southern half of the site, and from 0.40m – 0.80m bgl to the base of the trial pits in the raised garden across the northern portion of the site. Weathered sandstone, with occasional thin siltstone beds, was encountered beneath the subsoils from 0.60m – 0.65m bgl in the lower southern portion of the site and was not encountered in the raised garden in the northern portion of the site.</p>	
Groundwater	None encountered during site works or subsequent monitoring period.	
Foundation design	<p>Shallow strip foundations considered feasible, placed within the weathered profile of the Pennine Lower Coal Measures Formation at a minimum depth of 0.60m bgl. Foundations will likely need to be stepped due to the proposed stepped profile of the buildings and may need to be reinforced where they span different soil types, or where they cross the bedrock/subsoil boundary.</p> <p>Design sulphate class DS-1 and ACEC class AC-1 is required for buried concrete with the soils encountered on this site.</p>	
Road construction	A CBR of greater than 2.5% is anticipated, subject to confirmatory testing results. This should be checked upon receipt of an addendum report and on site with plate bearing tests.	

Contamination	<p>A risk to human health exists from marginally elevated concentrations of arsenic and dibenz(a,h)anthracene in the topsoil across the raised garden that takes up the northern portion of the site.</p> <p>Further sampling and testing of this topsoil could be undertaken to allow a statistical analysis to confirm whether the topsoil is or is not suitable for reuse.</p> <p>Alternatively, a decision could be made to either remove the contaminated topsoil from this area of the site, or provide a sufficiently thick, clean capping layer above it, in the proposed softstanding areas, to protect future end-users from the elevated determinant levels. The proposed changes in levels in the garden areas may inform which of these options is most suitable.</p> <p>Standard water supply utility pipes should be sufficient.</p>
Ground gas	<p>Characteristic situation 1 / Green – no gas protection measures required, subject to approval by warranty provider (slightly elevated CO₂). Risk to construction workers during below ground works due to depleted O₂ levels.</p> <p>No radon protection measures required.</p>

1 INTRODUCTION

1.1 General

1.1.1 JNP Group was instructed by the client to undertake a ground investigation of:

105 Highgate Lane,
Lepton,
Huddersfield,
West Yorkshire,
HD8 0HQ

1.1.2 hereinafter referred to as 'the site'. This report is subject to the limitations presented in Appendix A.

1.1.3 It is understood that the existing garage in the centre of the site is to be demolished, and the site redeveloped with two residential properties, with areas of hardstanding for access, servicing, and parking, and with private gardens. The proposed redevelopment layout is shown on external Drawing Reference 001-21-PL01, Rev A, dated 10/01/2021.

1.1.4 All comments given are based on the understanding that the proposed redevelopment will be as detailed above.

1.2 Objectives

1.2.1 The purpose of the investigation was to determine the geotechnical and geo-environmental ground conditions at the site and assess the implications of such relative to the proposed residential redevelopment. The scope of work comprised a site inspection together with intrusive investigation, laboratory testing, and gas and groundwater level monitoring. This report contains details of the site, the work and laboratory testing undertaken, strata encountered, geotechnical and chemical laboratory test results, monitoring results, and provides an interpretative assessment of the ground conditions regarding geotechnical and contaminated land issues.

1.3 Methodology

1.3.1 This report has been compiled in accordance with the on-line Land contamination: risk management (LCRM) guidance produced by the Environment Agency (June 2019). This can be found on the UK government website: <https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks>.

1.3.2 With regard to geotechnical aspects, reference is also made to the requirements of BS EN 1997, Eurocode 7, Geotechnical Design, and associated standards.

2 SITE DESCRIPTION

- 2.1.1 The site is located off Highgate Lane, in Lepton, Huddersfield, West Yorkshire, approximately 5.2km east-south-east of Huddersfield town centre (see Figure 1 Key Plan). The centre of the site is located at National Grid Reference SE 19396 15177. The site covers an area of approximately 0.076 hectares.
- 2.1.2 An engineer from JNP Group visited the site on 18th May 2021, the weather was sunny, and there was no pooling of surface water noted on the site. Photos of the site are included in Appendix B.
- 2.1.3 The boundaries of the site were fences and hedges between the site and residential properties with private gardens to the north, Highgate Lane to the south-west, and more residential properties with private gardens to the west.
- 2.1.4 Adjacent land uses were all residential with private gardens, with Highgate Lane running along the south-western margin of the site.
- 2.1.5 The site was stepped, with the northern half of the site topographically above the southern half. The northern half of the site was a softstanding garden covered with a lawn and several areas of shrubbery. The southern half of the site was largely taken up by the hardstanding driveway of the existing property, with a softstanding area in the southern corner taken up by shrubbery and a few mature trees. The steep slope in the centre of the site, linking the northern and southern halves, was covered with vegetation; some large angular boulders were visible through the vegetation on the slope, which are likely retaining the higher northern portion of the site.
- 2.1.6 There was an existing garage in the eastern portion of the site, the entrance to which was level with the driveway; the roof of the garage was roughly level with the garden in the northern half of the site.
- 2.1.7 There were several large mature trees on the site, in the southern corner, and along the south-western margin.
- 2.1.8 No invasive species were noted during the site work. However, JNP Group recommend that a specialist arboreal consultant be contacted to confirm this.
- 2.1.9 The surrounding land uses are summarised in Table 2-1 below.

Table 2-1 Surrounding Land Use

Direction	Land Use
North	Residential with private gardens
East	Residential with private gardens
South	Highgate Lane, residential with private gardens
West	Residential with private gardens

3 UK CONTAMINATED LAND LEGISLATIVE FRAMEWORK

3.1 General

3.1.1 Given that the site is being assessed with the potential for future development, the most applicable appraisal relates to the requirements of the Planning Regime as described in the National Planning Policy Framework.

3.1.2 In order to proceed with an assessment of contamination issues it is essential that there is compliance with UK guidance as detailed in the on-line Land contamination: risk management (LCRM) guidance produced by the Environment Agency (June 2019). This can be found on the UK government website: <https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks>.

3.1.3 Part IIA of the Environmental Protection Act, 1990, which was enacted by Section 57 of the Environment Act 1995, and the associated Contaminated Land (England) Regulations 2000 (SI 2000/227), was introduced on 1 April 2000. It created a new statutory regime for the identification and remediation of land where contamination poses an unacceptable risk to human health and the environment. The guidance was subject to a review by DEFRA in 2012, and a revision was published.

3.1.4 Part IIA provides a statutory definition of contaminated land:

3.1.5 "any land which appears to the Local Authority in whose area it is situated to be in such a condition by reason of substances in, on or under the land, that significant harm is being caused, or that there is a significant possibility of significant harm being caused, or that pollution of controlled waters is being or is likely to be caused".

3.1.6 Controlled waters are considered to be all groundwaters, inland surface waters, and estuarine and coastal waters.

3.1.7 To determine whether land falls under the Part IIA definition of contaminated land, the site should be evaluated in the context of a risk-based framework. The assessment of contaminated land is typically a two-phase process, which is initially based on a qualitative assessment of the likelihood of complete pollution linkages, with a quantitative element that seeks to determine the degree and the significance of the harm. Land is only defined as 'Contaminated Land' if a "significant pollutant linkage" is present.

3.1.8 A pollutant linkage must comprise the following:

Source - a contaminant at a concentration capable of causing adverse health or environmental effects.

Receptor - there must be a receptor (e.g. human, controlled waters, ecological, or property) present, which may be at risk of harm or impact from the source.

Pathway - there must be an exposure pathway through which the receptor comes into contact with the contamination source.

3.1.9 Each of these elements can exist independently, but they create risk only when they are linked together, so that a particular contaminant affects a particular receptor, through a particular pathway.

3.1.10 The responsible authority then needs to consider whether the identified pollution linkage:

- is resulting in significant harm being caused to the receptor in the pollutant linkage;

- presents a significant possibility of significant harm being caused to that receptor;
 - is resulting in the pollution of controlled waters, which constitute the receptor; or is likely to result in such pollution.
- 3.1.11 If a pollutant linkage is demonstrated, then the Part IIA legislation provides powers for remedial action to be enforced by the Local Authority in whose area the contaminated land is situated.
- 3.1.12 In addition, JNP Group has undertaken a preliminary risk assessment based on the probability of receptor exposure to the identified source and the consequences of such exposure.
- 3.1.13 Risk management, which can include site surfacing, formal management systems, legal requirements; is then considered to provide an overall residual risk. The categories of environmental risk used by JNP Group are given in the table that follows.

Table 7-1: Risk Matrix

Environmental Risks		
HIGH		Issues within this category likely to provide a significant cost or liability. Further detailed investigation may be required to clarify the risk.
MEDIUM		It is possible that issues within this category may provide a cost or liability. Further investigation may be required to clarify the risk.
LOW		It is unlikely that issues within this category will provide a significant cost or liability. Basic investigation may be required to clarify the risk.
NONE		No source – pathway – receptor linkage present.

4 CONCEPTUAL SITE MODEL AND PRELIMINARY RISK ASSESSMENT

4.1 General

4.1.1 This section uses information from field observations and all the data sources presented herein to provide a conceptual model and qualitative assessment of the potential risks posed to human health and environmental receptors from potential on-site and off-site sources of contamination. The assessment is presented as a 'source-pathway-receptor' model in accordance with Part IIA of the Environmental Protection Act 1990.

4.1.2 The conceptual site model has been developed assuming that the site will be redeveloped for residential housing with private gardens.

4.2 Potential Sources of Contamination

4.2.1 Potential On-Site Sources of Contamination

- The south-west margin of the site was occupied by residential properties from 1893 – 1960. By 1963, the residential properties had been demolished and the site redeveloped with the buildings and garden areas that currently exist across the site.
- Heavy metals, hydrocarbons, and soil gas associated with limited Made Ground materials may be present because of previous phases of development including imported and site generated fill materials.
- In accordance with C733 guidance, any structure built, refurbished, or modified during the Twentieth Century has the potential to contain asbestos containing materials (ACM). In addition, any demolition material either stockpiled or used as backfill on site also has the potential to contain asbestos containing materials (intact or broken up).
- Drainage runs including gullies are a potential source of contaminated material such as hydrocarbons and heavy metals.
- The site has clearly been stepped, if parts of the site were backfilled or partially backfilled with material, JNP Group consider that material used would have most likely to have been inert, with a low organic content, such as recycled soils, or rubble rather than domestic waste, chemical or industrial waste.

4.2.2 Potential Off-Site Sources of Contamination

- The historical maps show several unspecified, potentially infilled old pits and quarries within 250m of the site.
- There was a fireworks factory 181m south-west of the site until 1960.
- There were several electricity sub-stations within 250m of the site.
- There is a scrap metal recycling centre 54m north-west of the site.
- Heavy metals, hydrocarbons, and soil gas associated with limited Made Ground materials may be present because of the surrounding industrial land uses mentioned above.

4.3 Receptors

4.3.1 The site is to be redeveloped for residential housing with private gardens. In addition, the site overlies a Secondary-A Aquifer (Pennine Lower Coal Measures Formation). The primary

receptors, considered to be potentially at risk from any identified contamination are as follows:

Human Health

- Construction workers during the redevelopment phase.
- Residential end users.

Controlled Waters

- The Pennine Lower Coal Measures Formation beneath the site is classified as a Secondary-A Aquifer. However, there are no Source Protection Zones or licensed abstractions within 250m of the site.
- There are no River Network entries or surface water features within 250m of the site.

Ecological

- The site is located within a nitrate vulnerable zone.
- Given the site setting sensitive species are considered unlikely to be present at the site (subject to any ecological survey undertaken).

Property / Infrastructure

- Concrete vulnerability to aggressive ground conditions.
- Build-up of gases with potential for explosion.
- Water supply pipework.

4.4 Pathways

4.4.1 Potential contaminant migration pathways considered relevant to the site are:

Human Health

- Ingestion of contaminated soils and dust particles.
- Direct physical contact with near surface soils and contaminated dust particles.
- Inhalation of wind-blown contaminated dust.
- Inhalation of vapours and gases, migrating vertically into the atmosphere.
- Inhalation of vapours and gases, migrating vertically into buildings and confined spaces.
- Consumption of vegetables cultivated in contaminated soils.
- Consumption of soil attached to vegetables cultivated in contaminated soils.
- Consumption of contaminated potable water.

Controlled Waters

- Leaching of contaminants in Made Ground / natural ground into groundwater.
- Vertical migration of contaminated shallow groundwater impacting deeper groundwater in the aquifer sequence.

Ecological

- Migration of contamination through groundwater and subsequent uptake by plant roots.
- Direct contact between ecological receptors and contaminated surface water.
- Direct contact between ecological receptors and contaminated soils.
- Ingestion of contaminated soils/surface waters by ecological receptors.
- Inhalation of vapours or wind-blown dust by ecological receptors.

4.5 Pollutant Linkages

4.5.1 A 'pollutant linkage' describes the relationship between a contaminant, a pathway and a receptor, a 'pollutant' being the contaminant in a pollutant linkage. A contaminant, pathway and receptor must all be present for a pollutant linkage to exist, which forms the basis for determination that a piece of land is Contaminated Land. Potential sources, pathways and receptors have been assessed. The following Tables summarise the significant pollutant linkages potentially active at the site.

Table 4-1: Potential Source-Pathway-Receptor Linkages for Human Health Risk Assessment

Source	Pathway	Receptor
Contaminated soils and waters	Ingestion of soil	On-site female child: 0 - 6 yrs old
		On-site construction worker
	Ingestion of household dust	On-site female child: 0 - 6 yrs old
	Ingestion of contaminated vegetables	On-site female child: 0 - 6 yrs old
	Ingestion of soil attached to vegetables	On-site female child: 0 - 6 yrs old
	Dermal contact	On-site female child: 0 - 6 yrs old
		On-site construction worker
	Dermal contact with household dust	On-site female child: 0 - 6 yrs old
	Inhalation of fugitive soil dust	On-site construction worker
		On-site female child: 0 - 6 yrs old
	Inhalation of fugitive household dust	On-site female child: 0 - 6 yrs old
	Inhalation of vapours in outdoor air	On-site female child: 0 - 6 yrs old
On-site construction worker		
Inhalation of vapours in indoor air	On-site female child: 0 - 6 yrs old	
Consumption of contaminated potable water	On-site female child: 0 - 6 yrs old	
Ground Gas	Vertical and Lateral Migration	End Users

Table 4-2: Source Pathway Receptor Linkages for Controlled Waters Risk Assessment

Source	Pathway	Receptor
Contaminated soils	Leaching Mechanisms	Groundwater stored in the Pennine Lower Coal Measures Formation

Contaminated groundwater	Vertical migration	Groundwater stored in the Pennine Lower Coal Measures Formation
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Table 4-3: Potential Source-Pathway-Receptor Linkages for Property Risk Assessment

Source	Pathway	Receptor
Contaminated soils	Contact with contaminated soils	Concrete
		Water supply pipe materials
Ground Gas and Landfill Gas	Vertical and Lateral Migration and accumulation in voids	Residential Housing / Commercial Properties

Table 4-4: Potential Source-Pathway-Receptor Linkages for Ecological Risk Assessment

Source	Pathway	Receptor
Contaminated soils and waters	Migration of contamination through groundwater and subsequent uptake by plant roots;	Ecological receptors
	Direct contact between ecological receptors and contaminated surface water;	
	Direct contact between ecological receptors and contaminated soils;	
	Ingestion of contaminated soils/surface waters by ecological receptors;	
	Inhalation of vapours or wind-blown dust by ecological receptors.	
Ground Gas	Inhalation of gases	

4.6 Preliminary Risk Assessment

4.6.1 From the information obtained from the desk study JNP Group has undertaken a preliminary risk assessment.

Table 4-5: Preliminary Risk Assessment

Risk Receptor	Risk		Justification
HUMAN HEALTH	LOW		Site has only been residential with private gardens. However, potential off-site sources of ground gas were identified in the Phase I Desk Study undertaken by Rogers Geotechnical Services Ltd. (Ref: C1431/21/E/2255).
GROUNDWATER	MEDIUM		The site is located on productive strata (Secondary Aquifer) and is not within a SPZ.
SURFACE WATER	NONE		There are no surface water features within 250m of the site.

PROPERTY & INFRASTRUCURE	LOW		Site has only been residential with private gardens. However, potential off-site sources of ground gas were identified in the Phase I Desk Study undertaken by Rogers Geotechnical Services Ltd. (Ref: C1431/21/E/2255).
ECOLOGY	NONE		Based on the assumption that there are no sensitive/ protected species on site (subject to any ecological survey undertaken).

4.6.2 In line with BS ISO 18400-202:2018 based on the conceptual site model as above the site is considered to be probably uncontaminated.

5 SITE WORK AND MONITORING

5.1 Introduction

5.1.1 The intrusive site work was undertaken by JNP Group on 18th May 2021 and comprised two dynamic sampling boreholes on the driveway in the southern half of the site, and two hand excavated trial pits in the raised garden area in the northern half of the site, which was not accessible for the drilling rig. Four return gas and groundwater level monitoring visits were undertaken during a period from 28th May to 15th June 2021.

5.1.2 All site work was completed under the instruction and supervision of JNP Group with the ground investigation procedures and sample descriptions given in the following publications:

- BS 5930 (2015). Code of Practice for Site Investigations;
- BS 10175 (2001+A1:2013+A2:2017). Investigation of potentially contaminated sites - code of practice;
- BS EN ISO 14688-1. "Soil - Identification and Description;
- BS EN ISO 14688-2. Soil - Classification principles and quantification of descriptive characteristics;
- BS EN ISO 14689. Rock - Identification and description;
- BS 18400-104:2018. Soil Quality – Sampling. Part 104: Strategies;
- BS 18400-202:2018. Soil Quality – Sampling. Part 202: Preliminary Investigations;
- BS 18400-203: 2018. Soil Quality – Sampling. Part 203: Investigation of potentially contaminated sites;
- BS 18400-205: 2018. Soil Quality – Sampling. Part 205: Guidance on the procedure for investigation of natural, near natural and cultivated sites.

5.1.3 For sites affected by asbestos impacted soils, the guidance given in the following publications has been followed:

- Industry Guidance on Interpretation for Managing & Working with Asbestos in Soil and Construction and Demolition Materials (CL:AIRE 2016);
- Asbestos in Soil and Made Ground: a guide to understanding and managing risks (CIRIA C733 2014).

5.1.4 The design and installation of groundwater quality monitoring points has been undertaken following the guidance given in the Environment Agency science report:

- SC020093. Guidance on the design and installation of groundwater quality monitoring points. 2006.

5.1.5 The locations of the exploratory holes are shown on JNP Group Drawing No. S11169-JNP-XX-XX-DR-1001. The exploratory hole records including strata and groundwater encountered, in-situ testing and samples taken are presented in Appendix C. The full details of the site work undertaken are summarised in the following sections.

5.1.6 The purpose of the intrusive sitework was to obtain data to discharge planning conditions for the proposed development.

- 5.1.7 The site investigation strategy comprised a systematic distribution of exploratory holes across the site to suit the proposed redevelopment and address relevant spatial locations considered most likely to be sensitive. Table 5.1 shows the rationale for the location of each exploratory hole.

Table 5-1: Exploratory Hole Location Rationale

Exploratory Hole Reference	Rationale
DS01, DS02	General site coverage. To obtain soil samples for chemical testing. To obtain info to support foundation design. To install monitoring standpipes for ground gas concentration and groundwater level monitoring.
HP01, HP02	General site coverage. To obtain soil samples for chemical testing.

- 5.1.8 The general sampling strategy was to take representative soil samples from the ground to characterise the strata encountered and to provide suitable horizontal distribution, however, where visible contamination was present or suspected, targeted spot samples were taken.

5.2 Dynamic Sampling Boreholes

- 5.2.1 Two dynamic sampling boreholes, designated DS01 and DS02, were formed on 18th May 2021, to depths of 2.0m and 1.0m below ground level (bgl) at either end of the driveway across the southern end of the site. Refusal was reached at 2.0m and 1.0m bgl.

- 5.2.2 The dynamic sampling technique uses a lightweight tracked rig to advance a borehole by 1 m intervals using 1 m long steel sampler tubes, at diameters of 100 mm, reducing to 70 mm. The soils are then recovered from each sample tube as continuous core samples, which are logged and sub-sampled on site. Environmental soil samples were generally taken from each Made Ground material, together with any materials suspected of containing elevated concentrations of contaminants, based on visual and olfactory evidence. The environmental samples comprised a small volatiles jar, and an amber glass jar. Bulk and small plastic tub samples were also taken from selected materials, for laboratory geotechnical testing. In situ Standard Penetration Tests (SPTs) were undertaken in accordance with BS 5930 (2015) at 1.0 m depth intervals in the boreholes in order to obtain in situ strength or relative density parameters for geotechnical design.

- 5.2.3 Both boreholes were completed with 50mm gas monitoring standpipe installations, with flush fitting steel covers set in concrete at ground level.

- 5.2.4 Response zones within the installations were installed between depths of 1.0m bgl to 2.0m bgl in DS01 and between 0.5m to 1.0m bgl in DS02, to target the underlying Pennine Lower Coal Measures Formation.

5.3 Hand Excavated Pits

- 5.3.1 Two trial pits were excavated using hand-tools in the raised garden across the northern half of the site, as there was no way for the drilling rig to gain access to this area of the site. The pits were both formed to depths of 1.2m bgl, and soil samples were collected for geotechnical and chemical laboratory testing.

5.4 Monitoring

- 5.4.1 An initial monitoring programme of the installed standpipes was undertaken on four occasions at weekly intervals during a period from 28th May to 15th June 2021 after the completion of the site work.
- 5.4.2 Monitoring involved the measurement of the ground gas composition at each of the installations for methane (CH₄), carbon dioxide (CO₂) and oxygen (O₂) concentrations, together with atmospheric pressure, downhole pressure and flow rates, using a Geotech GA5000 gas meter. After the measurement of gas concentrations, the depth to any groundwater within the standpipe was recorded.
- 5.4.3 The frequency and duration of gas monitoring was broadly based on the guidance given in the following publications:
- CIRIA C665. Assessing risks posed by hazardous gases to buildings. 2007.
 - BS 8485. Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings. 2015.
 - CL:AIRE RB 17. A Pragmatic Approach to Ground Gas Risk Assessment. 2012.
- 5.4.4 Although a potential off-site ground gas risk was identified in the Phase I Desk Study undertaken by others, it is the opinion of JNP Group that the ground gas risk to the proposed development from this off-site source is extremely low, given the distance of the source from the site. Therefore, an initial monitoring programme of four visits over one month was scheduled to provide an initial indication of the ground gas conditions at the site. If elevated gas concentrations or flow readings are recorded over the initial monitoring period, then it is recommended that two further monitoring visits be undertaken within 2 months of the completion of the initial period, so that a total of six visits are undertaken over a three-month period, to fully characterise the ground gas regime at the site, as per the guidance given in CIRIA C665.
- 5.4.5 It should be noted that long-term groundwater levels may vary from those reported due to seasonal fluctuation or weather events, such as droughts, significant rainfall, or recent flooding.
- 5.4.6 The monitoring results are presented in Appendix D.
- 5.4.7 It should be noted that once the gas and groundwater monitoring boreholes are no longer required, they need to be decommissioned following the guidance given in the EA science report SC020093 (EA 2008).

6 LABORATORY TESTING

6.1 Geotechnical

6.1.1 A programme of laboratory testing was scheduled by JNP Group to determine geotechnical properties of selected soil samples obtained from the investigation. The details of the geotechnical testing are summarised below:

Table 6-1: Scheduled Geotechnical Laboratory Tests

Test Description	Number of Tests
Ground Aggressivity Suite (in accordance with BRE SD1)	2

6.1.2 Tests were undertaken in accordance with BS1377 (1990) "Methods of test for Soils for Civil Engineering purposes". The results of the laboratory testing are presented in Appendix E.

6.2 Environmental

6.2.1 A programme of chemical laboratory testing was scheduled by JNP Group on selected soil samples taken from various depths in the Made Ground and natural ground recovered from the exploratory holes. Samples of any soils displaying visual or olfactory evidence of contamination were also collected and submitted for laboratory analyses. The samples were placed into suitable containers for the required chemical analyses.

6.2.2 All samples were transported, on the day after collection, to Eurofins Chemtest, which is accredited under UKAS and MCerts. The following Table 6-2 summarises the contaminants scheduled:

Table 6-2: Scheduled Soil Chemical Analyses

Determinant	No
Metals and semi-metals (arsenic, beryllium, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium, vanadium and zinc)	4
Polycyclic Aromatic Hydrocarbons (PAH) 16 USEPA Speciated	4
TPH Criteria Working Group (TPH CWG)	1
Soil Organic Matter (SOM)	2
Asbestos screening	3

6.2.3 The results of the laboratory chemical testing are presented in full in Appendix E.

7 GROUND AND GROUNDWATER CONDITIONS

7.1 Strata Encountered

7.1.1 The ground conditions encountered during the intrusive investigation were generally consistent with the published geological map. A limited thickness of Made Ground was encountered in two of the four exploratory holes, overlying various soils of the weathered profile of the Pennine Lower Coal Measures Formation, overlying weathered sandstone of the same unit.

7.1.2 A summary of the stratigraphy encountered during the investigation is presented in Table 7-1 and described in the following sections, but for full details and descriptions, reference should be made to the exploratory hole records presented in Appendix C.

Table 7-1: Stratigraphy Encountered

Stratum	Depth to Top (m bgl)	Depth to Base (m bgl)	Thickness (m)
Topsoil (including buried topsoil) DS01, HP01	Ground level – 0.60	0.15 – 0.80	0.15 – 0.20
Made Ground (including hardstanding) DS02, HP01	Ground level	0.23 – 0.60	0.23 – 0.60
Weathered profile of the Pennine Lower Coal Measures Formation (soils) All exploratory holes	0.15 – 0.80	0.60 – not proven	0.42 – not proven
Weathered profile of the Pennine Lower Coal Measures Formation (weathered rock) DS01, DS02	0.60 – not proven	Not proven	Not proven

7.2 Topsoil and/or Made Ground

7.2.1 A dark brown loamy silt topsoil was encountered in DS01 from ground level to 0.15m bgl.

7.2.2 Tarmac hardstanding was encountered in DS02 from ground level to a depth of 0.13m bgl. Angular to subangular, fine to coarse, mixed lithology gravel was encountered beneath the tarmac to a depth of 0.23m bgl.

7.2.3 A brown loamy clay topsoil was encountered in HP01 from ground level to 0.20m bgl, overlying a brown clayey sandy gravel with occasional sandstone cobbles to 0.60m bgl. These soils were inferred to be Made Ground, as a buried topsoil was encountered beneath them from 0.60m – 0.80m bgl, overlying an orange and brown clayey cobbly gravel. The Made Ground topsoil and subsoil were likely cut from the southern half of the site when it was stepped and used to level the garden area across the northern half of the site.

7.2.4 A brown loamy gravelly topsoil was encountered in HP02 from ground level to 0.40m bgl.

7.3 Weathered Profile of the Pennine Lower Coal Measures Formation (soils)

7.3.1 Soils inferred to be of the weathered profile of the Pennine Lower Coal Measures Formation were encountered in all exploratory holes.

7.3.2 In DS01, a brown clayey gravel was encountered beneath the topsoil from 0.15m – 0.40m bgl, overlying a stiff brown sandy clay to 0.60m bgl.

- 7.3.3 In DS02, a gravelly sandy silt was encountered beneath the Made Ground from 0.23m – 0.53m bgl, overlying a stiff orange and grey mottled clay to 0.65m bgl.
- 7.3.4 In HP01, an orange and brown clayey cobbly gravel was encountered beneath the buried topsoil from 0.80m bgl to the base of the pit at 1.20m bgl.
- 7.3.5 In HP02, an orange and grey mottled gravelly clay was encountered beneath the topsoil from 0.40m – 0.60m bgl.
- 7.4 Weathered Profile of the Pennine Lower Coal Measures Formation (weathered rock)
 - 7.4.1 Weathered rock inferred to be of the Pennine Lower Coal Measures Formation was encountered beneath the cohesive and granular soils of the same unit in DS01, DS02, and HP02.
 - 7.4.2 In DS01, a yellow weathered sandstone, with occasional thin beds of weathered siltstone, was encountered from 0.60m bgl to the base of the hole at 2.0m bgl, at which point refusal was reached.
 - 7.4.3 In DS02, an orange and grey weathered sandstone, with some thin beds of siltstone, was encountered from 0.65m bgl to the base of the hole at 1.0m bgl, at which point refusal was reached.
 - 7.4.4 In HP02, gravelly cobbles of weathered sandstone were encountered from 0.60m bgl to the base of the pit at 1.20m bgl.

Table 7-2: Weathered Profile of the Pennine Lower Coal Measures Formation – Geotechnical Laboratory Test Results Summary

Property	Number of Tests	Range	Mean	Assessment
SPT 'N' Values (granular)	3	40 – 50	47	Dense to very dense

- 7.4.5 The SPT N value / depth profile is presented as Figure 2.
- 7.5 Groundwater
 - 7.5.1 Details of groundwater entries recorded during the site work period, and levels recorded subsequently during the monitoring visits, are summarised in Table 7-3 which follows.

Table 7-3: Summary of groundwater observations

Exploratory Location	Groundwater during site work		Groundwater during monitoring
	Strikes (m bgl)	Comments	Range
DS01	-	Not encountered	Not encountered
DS02	-	Not encountered	Not encountered
HP01	-	Not encountered	-
HP02	-	Not encountered	-

- 7.5.2 No groundwater was encountered during the site works or subsequent monitoring period.
- 7.6 Ground Contamination and Deleterious Material
 - 7.6.1 There was no visual or olfactory evidence of contamination, and there were no deleterious materials noted during the site works.

7.7 Ground Gas Conditions

7.7.1 Following the completion of the four monitoring visits, a maximum methane concentration of 0.2% was recorded, and a maximum carbon dioxide concentration of 1.6% was recorded, with negligible flow rates. Full details of the gas concentrations and flow rates recorded during the monitoring period are presented in Appendix D.

7.8 Trees and Tree Roots

7.8.1 Several mature trees are present along the western and southern margins of the site. No roots were encountered in any of the exploratory holes during the site works.

7.9 Data Gaps and Uncertainties

7.9.1 The raised garden across the northern half of the site was inaccessible for the drilling rig, so SPT N values could not be obtained for the soils in the northern half of the site. However, as rockhead was proven to be relatively shallow beneath the southern half of the site, it is anticipated that rockhead will be at a similarly shallow level across the northern half of the site.

8 HUMAN HEALTH DETAILED QUANTITATIVE RISK ASSESSMENT

8.1 Introduction

8.1.1 Qualitative assessment of risks may be sufficient in many cases to eliminate the possibility of significant pollutant linkages. However, quantitative risk assessment is formally required to determine whether there is a 'significant possibility of significant harm being caused'. Part IIA of the Environmental Protection Act 1990 recommends that 'authoritative and scientifically based guideline values for concentrations of the potential pollutants in or under the land' be used to quantify the risk posed by contamination.

8.1.2 Under the Planning Regime, a quantitative risk assessment can be used to decide whether the site is suitable for the proposed use. In addition, the National Planning Policy Framework (March 2012) also indicates that after remediation, as a minimum land should not be capable of being determined as contaminated land under Part IIA.

8.2 Current UK Screening Values

8.2.1 The UK technical guidance for assessing risks to human health is issued from various UK bodies, including the Environment Agency (EA), DEFRA, Contaminated Land: Applications in Real Environment (CL:AIRE), Chartered Institute of Environmental Health (CIEH), and Land Quality Management (LQM) Ltd (part of the University of Nottingham).

8.2.2 New and updated screening values in the form of provisional Category 4 Screening Levels (C4SL) (published in 2014), and Suitable for Use Levels (S4UL), (published 2015), have been produced by DEFRA and CIEH / LQM respectively using modified versions of the EA's Contaminated Land Exposure Assessment (CLEA) software.

8.2.3 C4SL

8.2.4 Provisional C4SL have been derived by CL:AIRE (project team for DEFRA's SP1010 project) following revised statutory guidance, and as a tool to assist in applying the Part IIA Category 1- 4 classifications to a site. The purpose of the C4SL is to provide a simple test for deciding that land is suitable for use, and definitely not contaminated land under Part IIA. They describe a level of risk that is above minimal, but is still low.

8.2.5 In calculating provisional C4SL some of the exposure modelling scenarios and exposure parameters used in the CLEA software have been modified. These modifications are not discussed further, but reference should be made to the original CL:AIRE / DEFRA publications should further information or clarification be required. A list of the new publications is included in the references section at the end of this report.

8.2.6 To date, six contaminants have been assigned provisional C4SL: arsenic; benzene; benzo[a]pyrene; cadmium; chromium VI, and lead, for the standard land uses (residential with, and without plant uptake, allotments, commercial, and public open space (parks and residential)).

8.2.7 The C4SL are also considered suitable to be used under the planning regime, and DEFRA have confirmed this to all local authorities.

8.2.8 S4UL

8.2.9 The LQM / CIEH S4UL represent generic assessment criteria based on minimal or tolerable risk that are intended to be protective of human health. They have been derived in

accordance with current UK legislation using a modified version of the CLEA software, and are still based on many conservative assumptions. They represent values above which further assessment of the risks or remedial actions may be needed.

- 8.2.10 S4UL have been derived for a comprehensive list of metals, non-metals, petroleum hydrocarbons, polycyclic aromatic hydrocarbons, chlorinated hydrocarbons, phenolic compounds, explosives, and pesticides, for the standard land uses (residential with, and without plant uptake, allotments, commercial, and public open space (residential and park)).
- 8.2.11 For details of the exposure parameters and scenarios used to derive the S4UL the reader is reference to the original LQM / CIEH document "The LQM/CIEH S4UL for Human Health Risk Assessment" (2015).
- 8.2.12 Both sets of screening values can be used to undertake a generic risk assessment by comparing the data directly to the screening value which is considered a conservative approach or statistically to the screening value. Alternatively and if a sufficient dataset is available, a statistical assessment can be undertaken following the guidance given in the joint Chartered Institute of Environmental Health (CIEH) and the Contaminated Land: Applications in Real Environment (CL:AIRE) organisation publication "Guidance On Comparing Soil Contamination Data with a Critical Concentration" (CIEH / CL:AIRE May 2008).
- 8.3 Atkins ATRISK Soil Values
- 8.3.1 Further to the above screening values, Atkins Ltd, have derived their own screening values in March 2011 for a wide range of contaminants, including PAH species, chlorinated hydrocarbons, metals and inorganics. These have been derived for either a 1% Soil Organic matter (SOM) sand soil type, or 6% SOM sandy loam soil type, using the CLEA software V1.04-1.06, and are available for standard (residential with plant uptake, residential without plant uptake, commercial, and allotments) and non-standard land uses (parks, playing fields, and open spaces). Where S4UL are not available, JNP Group have adopted the ATRISK soil values.
- 8.4 Petroleum Hydrocarbons
- 8.4.1 JNP Group have followed the guidance given in the Environment Agency publication 'The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils' (Environment Agency, 2005). LQM S4UL values have been published based on carbon banded hydrocarbons with aliphatic and aromatic split, corresponding to the TPH CWG bands.
- 8.4.2 The Society of Brownfield Risk Assessment (SoBRA) have produced some Generic Assessment Criteria for assessing chronic risks from the inhalation of vapours arising from groundwater (GAC_{gwwap}) for a short list of 66 organic contaminants (SoBRA February 2017). These are designed to a defensible screening criteria to assist in evaluating this exposure pathway. They represent concentrations below which the chronic risks from vapour migration and inhalation can be considered low / tolerable. GAC_{gwwap} have been developed in line with current UK risk assessment guidance, and CLEA v1.07 software was used for residential and commercial land use scenarios.
- 8.4.3 Further details of the input parameters selected for use to generate the GAC_{gwwap} can be found in the SoBRA report, and have not been reproduced here. However, it should be noted that they have been derived using some conservative assumptions:
- Impacted ground / perched water is beneath the buildings;

- An infinite source term is present;
- There is no biodegradation;
- Groundwater depth is 0.65m below ground;
- Use of a sand soil type (in line with SR3)

8.5 Water Supply Pipes

8.5.1 Where plastic water supply pipes are proposed, the Thames Water Threshold Values have been used to compare the chemical test results with a published set of guideline values for metal, organic and inorganic contaminants found in soil, that may have a detrimental effect upon plastic water supply pipes.

9 SOIL AND GROUNDWATER ASSESSMENT RESULTS

9.1 Soil Results

9.1.1 The results of chemical testing of two samples of Made Ground and five samples of natural soils have been compared with the C4SL and the LQM S4UL values for a 'residential with gardens end use'. These comparisons are summarised in the following Table 9-1.

9.1.2 The following determinants were recorded at concentrations less than their respective limits of laboratory detection, and hence have not been included in this assessment: asbestos, boron, chromium (hexavalent), TPH CWG.

9.1.3 Two Soil Organic Matter (SOM) tests were undertaken on the topsoil and subsoil identified at the site. These were the topsoil encountered in HP02 at 0.3m bgl, and the weathered profile of the Pennine Lower Coal Measures Formation encountered in DS01 at 0.8m bgl. A SOM of 6% is applicable to the topsoil across the site, and a SOM of 1% is applicable to the subsoils of the weathered profile of the Pennine Lower Coal Measures Formation across the site.

Table 9-1: Comparison of Soil Chemical Test Results with Residential with plant uptake Guideline Values

Determinant	Maximum Measured Concentration	Background Concentration	LOM/CIEH S4UL:			Number of tests	Number of exceedances
			Residential with plant uptake (mg/kg)				
Arsenic	41	18	37			4	1 (HP02 @ 0.3m bgl – topsoil)
Beryllium	1.5	N/A	1.7			4	None
Cadmium	0.34	0.31	11			4	None
Chromium (trivalent)	27	80	910			4	None
Copper	50	37	2400			4	None
Lead	170	59	200**			4	None
Mercury (elemental)	0.15	N/A	1.2			4	None
Nickel	22	33	180			4	None
Selenium	0.7	0.47	250			4	None
Vanadium	44	98	410			4	None
Zinc	140	97	3700			4	None
			1%	2.5%	6%		
Naphthalene	4	N/A	2.3	5.6	13	4	None
Acenaphthylene	1.3	N/A	170	420	920	4	None
Acenaphthene	0.9	N/A	210	510	1100	4	None
Fluorene	0.67	N/A	170	400	860	4	None
Phenanthrene	3.5	N/A	95	220	440	4	None
Anthracene	0.35	N/A	2400	5400	11000	4	None
Fluoranthene	2.6	N/A	280	560	890	4	None
Pyrene	3.1	N/A	620	1200	2000	4	None
Benzo(a)anthracene	1.4	N/A	7.2	11	13	4	None
Chrysene	3.5	N/A	15	22	27	4	None
Benzo(b)fluoranthene	2.1	N/A	2.6	3.3	3.7	4	None
Benzo(k)fluoranthene	3.6	N/A	77	93	100	4	None
Benzo(a)pyrene	1.5	N/A	2.2	2.7	3.0	4	None
Indeno(1,2,3-c,d)pyrene	1.1	N/A	27	36	41	4	None

Determinant	Maximum Measured Concentration	Background Concentration	LOM/CIEH S4UL:			Number of tests	Number of exceedances
			Residential with plant uptake (mg/kg)				
Dibenz(a,h)anthracene	0.79	N/A	0.24	0.28	0.3	4	2 (HP01 @ 0.2m bgl – topsoil) (HP02 @ 0.3m bgl – topsoil)
Benzo(g,h,i)perylene	1.2	N/A	320	340	350	4	None

** provisional C4SL

9.2 Interpretation

9.2.1 The analyses recorded marginally elevated concentrations of arsenic and dibenz(a,h)anthracene in the topsoil samples from HP01 at 0.2m bgl, and HP02 at 0.3m bgl, in the raised garden across the northern half of the site. The occurrences are discussed in the following sections.

Heavy Metals

9.2.2 Elevated concentrations of arsenic were found in the topsoil in HP02 at 0.3m bgl. This trial pit was located at the northern end of the site, at the northern end of the raised garden. There was no obvious source of this contaminant on the site; the topsoil may have been imported from a slightly contaminated off-site source when the garden was originally levelled and landscaped.

Elevated PAH

9.2.3 Elevated concentrations of dibenz(a,h)anthracene were found in the topsoil in HP01 at 0.2m bgl, and in HP02 at 0.3m bgl. These trial pits were in the raised garden across the northern half of the site. Again, there were no obvious sources of this contaminant on the site, and it is assumed that the topsoil was imported from a slightly contaminated off-site source when the garden was originally levelled and landscaped.

9.3 Summary

9.3.1 Based on the chemical testing undertaken, JNP Group considers that a viable risk to human health exists from elevated concentrations of arsenic and dibenz(a,h)anthracene in the topsoil across the raised garden in the northern half of the site. Hence, remedial actions at the site may be necessary in this area for the proposed development. As the exceedances are so marginal above the C4SL and LQM S4UL values, further sampling and heavy metal and PAH chemical testing of the topsoil in this area would allow a statistical analysis of the results to be undertaken, so that the topsoil could be classified as either suitable or unsuitable for reuse in the softstanding areas of the proposed development. However, due to the proposed changes in levels in the garden areas of the proposed development, and the relatively small extent of the proposed softstanding areas, it may be preferable to forego the further testing, and either remove the slightly contaminated topsoil from the site or provide a clean capping layer of topsoil above the existing soils, particularly given that further testing and analysis is not guaranteed to prove that the existing topsoil is suitable for reuse.

9.4 Risk to Controlled Waters

9.4.1 Based upon a review of the contaminants recorded in Table 9.1, elevated concentrations of highly mobile organic hydrocarbons, such as lighter TPH fractions, or naphthalene, were not recorded within the soils across the site. In addition, the metal concentrations recorded were similar to typical background concentrations. Therefore, JNP Group do not consider that there is a risk posed to controlled waters.

9.5 Soil Results and Water Supply Pipeline Assessment

9.5.1 The results of chemical testing of seven samples of soil from depths of between 0.1m – 1.4m bgl (the anticipated depth of the pipeline), have been compared with the Thames Water Threshold Levels as an example of water pipeline threshold levels; the Yorkshire Water threshold values were not available. These are summarised in Table 9-2 below.

Table 9-2: Comparison of Chemical Laboratory Test Results with Thames Water Threshold Levels

Determinant	Maximum Measured Concentration (mg/kg)	Thames Water Threshold Levels (mg/kg)	No. of tests undertaken	No. of exceedances
Naphthalene	4	5	4	None
TPH Aliphatic C ₅ – C ₁₂	<dl*	0.5	1	None
TPH Aromatic C ₅ – C ₁₂	<dl*	0.5	1	None
TPH Aliphatic C ₁₂ – C ₂₁	<dl*	10	1	None
TPH Aromatic C ₁₂ – C ₂₁	<dl*	10	1	None
TPH Aliphatic C ₂₁ – C ₃₅	<dl*	500	1	None
TPH Aromatic C ₂₁ – C ₃₅	<dl*	500	1	None

<dl* below laboratory detection limits.

9.5.2 Based on the results of the chemical testing undertaken there is considered no risk to the proposed plastic water pipeline subject to approval by Yorkshire Water.

9.5.3 The results of the chemical testing are presented in Appendix E.

10 GROUND GAS PROTECTION REQUIREMENTS

10.1 Guidance and Standards

10.1.1 JNP Group has used the guidance given in the following document to assess the risks from ground gases

- CIRIA C665. Assessing risks posed by hazardous gases to buildings. 2007;
- BS 8485. Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings. 2015 +A1 2019;
- CL:AIRE RB 17. A Pragmatic Approach to Ground Gas Risk Assessment. 2012.

10.1.2 It is intended that the proposed new build will be low rise housing.

10.1.3 The level of gas protection is determined by comparing the following parameters to reference values prescribed within BS 8485 (2015):

- "Typical Maximum Concentrations" for initial screening purposes;
- Risk based "Gas Screening Values" (GSV) for consideration where the typical maximum concentrations are exceeded.

10.1.4 The GSV is calculated using the following equation, and the resulting GSVs are compared to the Site Characteristic GSV given in Table 2 of BS 8485: 2015 +A1 2019.

- Maximum gas concentration (%) x worst case borehole flow rate (l/h)

10.2 Definitions

10.2.1 In accordance with Table 4 of BS 8485: 2015 +A1 2019, varying levels of protection are required for each category of risk for 'Type A' buildings (private housing), 'Type B' buildings (hotels, managed apartments, small commercial/retail), 'Type C' buildings (commercial, retail, industrial), and 'Type D' buildings (large industrial / commercial / warehouse).

- A 'CS1' determination requires no ground gas protection measures to be installed.
- A 'CS2' determination requires ground gas protection measures to be installed. The level of ground gas protection required should be equal or greater than 3.5 points for a Type A building, when at least two items from the following three: Table 5 (structural barrier); Table 6 (ventilation), and Table 7 (gas resistant membrane) within BS 8485: 2015 +A1 2019 are selected.

10.3 Results

10.3.1 The maximum CO₂ concentrations, the maximum flow rate, and the screening values for each borehole during the first two monitoring visits, are summarised in the following Table 10-1.

10.3.2 The raw and collated results of the ground gas monitoring undertaken are presented in Appendix D. This includes a graph showing the atmospheric pressure trend throughout the monitoring period.

Table 10-1: Calculated Gas Screening Values

Location	Maximum CH4 Concentration (% v/v)	Maximum CO2 Concentration (% v/v)	Maximum Flow Rate (l/hr)	Maximum Gas Screening Value (l/hr)
DS01	0.2	1.6	<0.1	<0.0016
DS02	0.1	1.1	<0.1	<0.0011

10.4 Interpretation

- 10.4.1 Based on the results of the first two monitoring visits, a 'CS1' determination has been derived from the monitoring results from DS01 and DS02. Therefore, gas protection measures will not be required at the site for the proposed development, subject to approval by the warranty provider.

11 REVISED CONCEPTUAL SITE MODEL AND OVERALL ENVIRONMENTAL RISK

11.1 Summary

11.1.1 Following the ground investigation and subsequent assessment undertaken, the conceptual site model and overall environmental risk assessment have been updated as detailed in Table 11-1 below.

Table 11-1: Updated Conceptual Model and Risk Assessment

Issue	Risk	Justification
HUMAN HEALTH	MEDIUM	Slightly elevated concentrations of arsenic and dibenz(a,h)anthracene were found in the topsoil across the raised garden across the northern half of the site. Remediation may be required at the site to reduce the risks to acceptable levels. No elevated concentrations of gases have been recorded.
GROUNDWATER	LOW	No significantly elevated concentrations of mobile species of metals or hydrocarbons present.
SURFACE WATER	LOW	No significantly elevated concentrations of mobile species of metals or hydrocarbons present. Nearest surface water feature is more than 250m away from the site.
PROPERTY & INFRASTRUCTURE	NONE	No elevated concentrations of gases have been recorded. Highly acidic or mobile hydrocarbons have not been recorded at the site. However, this should be subject to agreement by the water supply provider.
ECOLOGY	NONE	Based on the assumption that there are no sensitive/ protected species on site (subject to any ecological survey undertaken)

12 GEOTECHNICAL ENGINEERING ASSESSMENT

12.1 Proposed Development / Redevelopment

12.1.1 It is proposed to redevelop the site with a pair of stepped residential properties with private gardens and areas of hardstanding for car parking.

12.2 Summary of Ground and Groundwater Conditions

12.2.1 The ground conditions encountered during the intrusive investigations were generally consistent with the published geological records. A limited thickness of Made Ground was encountered beneath the hardstanding area across the southern half of the site, and along the southern portion of the raised garden across the northern half of the site; across the rest of the site, topsoil was encountered from ground level. The Made Ground and topsoil were found to overlie occasionally cohesive, but mostly granular, subsoils of the weathered profile of the Pennine Lower Coal Measures Formation; the thin portions of cohesive soils were encountered at depths above the likely depth of foundations. The subsoils were found to overly weathered sandstones with occasional thin siltstone beds, of the Pennine Lower Coal Measures Formation, proven to depths of 1.0m – 2.0m bgl in the southern half of the site. No groundwater was encountered during the site works, or during the subsequent monitoring period.

12.3 Site Preparation and Earthworks

12.3.1 As mentioned previously, it may be necessary to remove the slightly contaminated topsoil across the existing raised garden or cover it with a sufficiently thick capping layer of clean soils.

12.3.2 There will also be requirements for topsoil and subsoil stripping to accommodate the proposed changes in levels across the site, and in places it may be necessary to break out weathered bedrock to achieve the proposed levels.

12.3.3 It will also be necessary to demolish the existing garage building and break out the concrete slab and foundations beneath it, as well as breaking out and removing the existing hardstanding tarmac across the southern half of the site.

12.3.4 A Materials Management Plan may be required in accordance with the Definition of Waste: Code of Practice.

12.4 Shallow Foundations

12.4.1 The Made Ground deposits are considered unsuitable to support foundation loads due to their poor engineering characteristics, and inherent variability.

12.4.2 Traditional shallow strip or pad foundations are considered feasible, placed within the weathered profile of the Pennine Lower Coal Measures Formation. Due to the stepped profile of the proposed buildings, it may be that the lower southern section of the foundations can be placed directly on weathered bedrock. If this is the case we would recommend that the higher level is also placed on weathered bedrock in order to prevent differential settlement.

12.4.3 If foundations need to be placed on mixed lithologies (weathered rock and rock) then we would recommend that reinforcement is included within the foundations in order to mitigate any differential settlement.

- 12.4.4 Foundations should be placed within the weathered bedrock and granular soils of the Pennine Lower Coal Measures Formation at a minimum founding depth of 0.60m below final ground level. An allowable bearing pressure of 125kN/m² would be available at 0.60m below existing ground level, based upon standard 0.60m wide foundations. The allowable bearing pressure includes an overall factor of safety of 3 against bearing capacity failure, whilst ensuring total settlements are maintained at less than 25mm. However, there are several trees, bushes and hedges in and around the site, and the influence of these may be the controlling criteria for determining foundation type and depth.
- 12.4.5 As mentioned previously, the proposed buildings are stepped across the site, so the foundations will likely need to be stepped.
- 12.4.6 It should be noted that trench fill foundations deeper than 2.50m would only be acceptable by the NHBC if they were designed by an engineer.
- 12.5 Basements and Retaining Walls and/or Engineered Slopes
- 12.5.1 It is understood that the proposed buildings are to be stepped across the site, with the southern sections of the properties roughly level with the adjacent Highgate Lane, and the northern sections roughly 2m – 3m higher, at the level of the existing raised garden. Therefore, there is the potential for excavation issues to arise due to the ground conditions encountered at the site.
- 12.5.2 Where levels are to be decreased, particularly in the southern and central portions of the site, it may be necessary to break out bedrock, which was encountered at around 0.60m – 0.65m below existing ground level at the lower, southern end of the site. Although bedrock was not encountered within 1.2m of the existing ground level in the raised garden in the northern portion of the site, it is anticipated that rockhead rises northward, following the local topography.
- 12.5.3 In addition, the granular soils encountered above the weathered bedrock across most of the site may present stability issues during excavation of the stepped slope and the foundations and may require temporary works to support them.
- 12.6 Ground Floor Slabs
- 12.6.1 The underlying soils are considered to be non-shrinkable, therefore, ground-bearing floor slabs can be placed directly on to the granular soils of the weathered profile of the Pennine Lower Coal Measures Formation.
- 12.7 Groundwater and Excavations
- 12.7.1 While the hand excavated trial pits remained stable during excavation, and no groundwater was encountered, in larger scale excavations, such as foundation / service trenches, and the stepping of the slope to the desired levels, the granular soils above the weathered bedrock encountered across most of the site may be subject to collapse or spalling. Hence, JNP Group considers that support, and potentially temporary works, may be required to stabilise excavations in these granular soils.
- 12.7.2 Groundwater was not encountered during the site work or subsequent monitoring period. However, the groundwater levels may fluctuate due to seasonal or other effects, such as extreme, prolonged meteorological events or periods.

12.7.3 Trial pits and boreholes carried out as part of this, or previous investigations may represent soft spots and conduits/sumps for groundwater or surface water. In excavations, such materials may also be loose and unstable. Unless specifically stated, exploratory hole locations should be regarded as approximate. Consideration should be given to accurate location of such features where it is considered they may impact on the proposed development.

12.7.4 Conventional mechanical backhoe excavators should prove to be suitable for excavation through the shallower granular material however a breaker will be required to penetrate rock for any deeper excavations.

12.8 Pavement Design
 California Bearing Ratio

12.8.1 No in-situ or laboratory CBR testing was included in the scope of works for this report; however, given the granular, and relatively well-compacted, nature of the soils, it is anticipated that CBR values in excess of 2.5% will be achievable across the proposed driveway and access road areas. This should be confirmed by onsite testing if required.

12.9 Ground Aggressivity to Buried Concrete

12.9.1 Chemical analyses of two samples have been undertaken in accordance with BRE SD1 2005 "Concrete in aggressive ground" to determine their concrete classification.

Table 122-1: Concrete Classification Assessment

Strata	Details	Range	Concrete Class
Weathered profile of the Pennine Lower Coal Measures Formation	Number of Tests	2	DS-1 – AC-1
	Water Soluble Sulphates (mg/l)	<0.01	
	pH	7.4 – 8	
	Total Potential Sulphate %	0.04 – 0.15	

12.9.2 Based on the above assessment, and in accordance with BRE SD1 (2005) "Concrete in aggressive ground", a Design Sulphate Class of DS-1, with an ACEC of AC-1, would apply for all buried concrete.

13 CONCLUSIONS AND RECOMMENDATIONS

13.1 Conclusions

13.1.1 JNP Group has determined through intrusive investigation, laboratory testing, monitoring, and assessment that:

- Ground conditions at the site comprise a limited thickness of Made Ground beneath the hardstanding area across the southern half of the site, and along the southern portion of the raised garden across the northern half of the site; across the rest of the site, topsoil was encountered from ground level. The Made Ground and topsoil were found to overlie occasionally cohesive, but mostly granular, subsoils of the weathered profile of the Pennine Lower Coal Measures Formation; the thin portions of cohesive soils were encountered at shallow depths above the likely depth of foundations. The subsoils were found to overly weathered sandstones with occasional thin siltstone beds, of the Pennine Lower Coal Measures Formation, proven to depths of 1.0m – 2.0m bgl in the southern half of the site. No groundwater was encountered during the site works, or during the subsequent monitoring period.
- A risk to future residential end users is present from arsenic and dibenz(a,h)anthracene in the topsoil across the existing raised garden across the northern half of the site due to marginal exceedances.
- There is no risk to controlled waters.
- Ground gas protection measures are not required, subject to approval by the warranty provider.
- Radon gas protection measures are not required.
- Traditional shallow strip or pad foundations are considered feasible, placed within the weathered profile of the Pennine Lower Coal Measures Formation. An allowable bearing pressure of 125kN/m² would be available at 0.6m below existing ground level, based upon standard 0.6 m wide foundations. Foundations will likely have to be stepped and reinforced where they cross different soil types.
- Trench fill foundations may be required in the northern part of the site, due to the increased thickness of topsoil and subsoils above the weathered bedrock.
- The pavement subgrade at an approximate depth of 0.6m below existing ground level is likely to have an equilibrium subgrade CBR value greater than 2.5%, subject to in-situ testing.

13.2 Recommendations

13.2.1 In line with the guidelines given in LCRM and consequent to the ground investigation conclusions, JNP Group recommends that:

- Further sampling and testing of the topsoil across the raised garden to allow a statistical analysis to be undertaken to determine whether the topsoil is or is not suitable for reuse, given the slightly elevated concentrations of arsenic and dibenz(a,h)anthracene found. However, this may just further confirm that the topsoil is contaminated and requires remediation.

- Instead of undertaking the further sampling and testing, a decision could be made to either remove the contaminated topsoil from this area of the site, or provide a sufficiently thick, clean capping layer above it, in the proposed softstanding areas, to protect future end-users from the elevated determinant levels. The proposed changes in levels in the garden areas may inform which of these options is most suitable.
- An options appraisal and remediation strategy (OARS) report may be required for the site. This would include undertaking an options appraisal of potential remediation options and assess the feasibility of short-listed remedial options, undertaking a hazardous waste assessment, designing a sustainable remediation strategy for the site, and an outline validation plan. Due to the limited extent of the proposed softstanding areas, and two of the contaminant concentration limits only being marginally exceeded, it is the opinion of JNP Group that an OARS report would come to the same conclusions as above, that either the removal, or capping, of the contaminated topsoil would both be suitable remediation options for this site, subject to approval by the EHO.
- A materials management plan may be required for the site.
- There is no risk posed to buried water supply pipework.
- An asbestos demolition and refurbishment survey should be undertaken of the garage present at the site.
- A copy of this report is submitted to the Regulatory Authorities for their approval before any further work is undertaken at the site.

13.2.2 In addition, JNP Group recommends that the proposed development works are undertaken in accordance with the definition of Waste Code of Practice (DoWCoP); in following this guidance and to ensure materials are managed correctly, A Materials Management Plan will need to be prepared and declared in advance by a Qualified Person, then implemented and documented in a Verification Report. If this process is not undertaken, then following recent changes in Landfill Tax Regulations by HMRC. There is a risk of penalties equating to twice the Landfill Tax being applied to the re-use of material on site. If the proposed works are to be undertaken outside the DoWCoP, there would need to be some of Environmental Permitting or suitable equivalent. The requirements of such are likely to be more onerous and may take longer to be granted.

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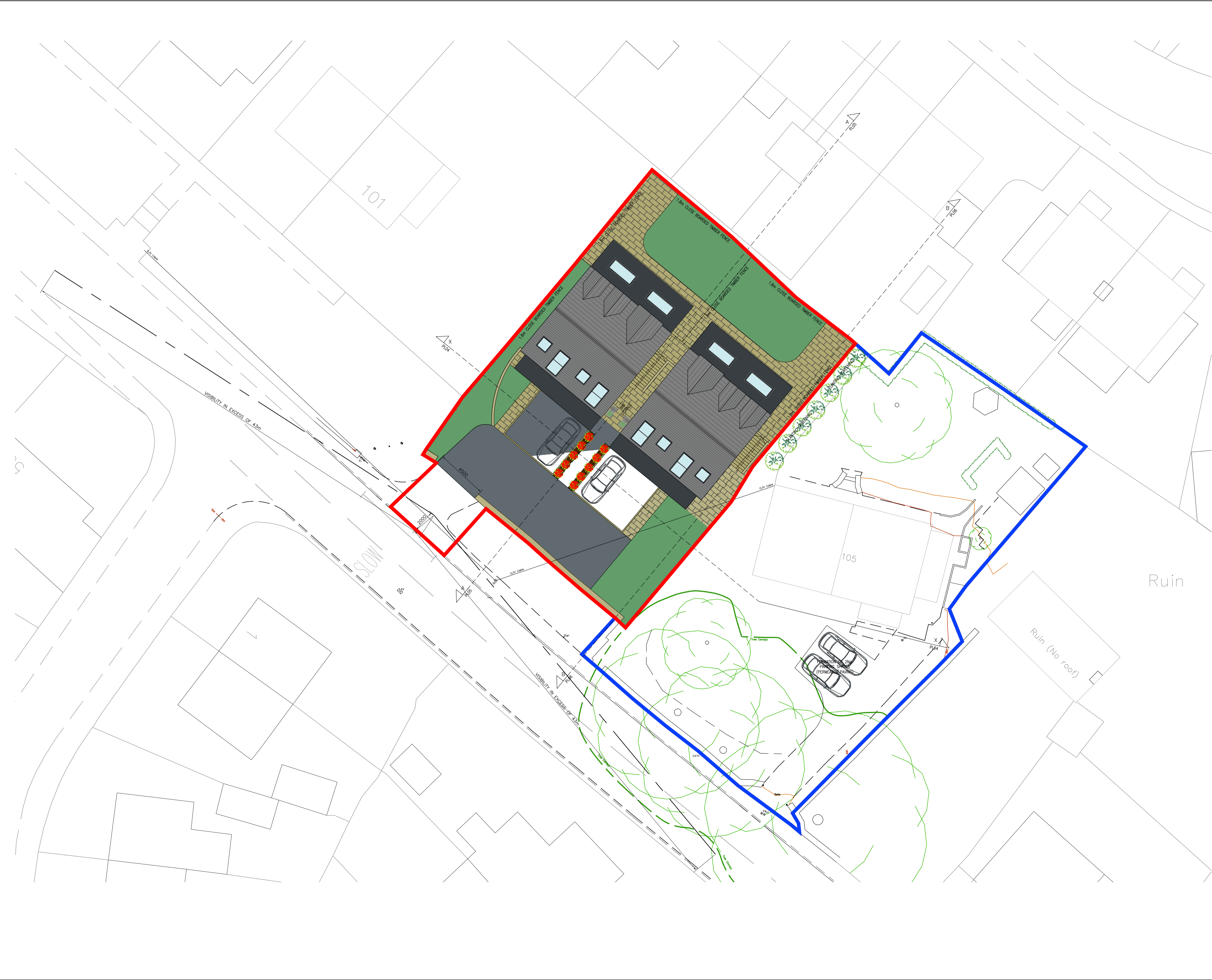
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FIGURES / DRAWINGS



- NOTES**
1. No dimensions to be scaled. IF IN DOUBT ASK.
 2. All dimensions must be checked and verified on site by the Contractor prior to the commencement of works and Hincliffe Architecture & Design Ltd. to be notified of any discrepancies.
 3. The copyright of these drawings remains the property of Hincliffe Architecture & Design Ltd. They must not be reproduced in any way without prior written consent from the originator (Hincliffe Architecture & Design Ltd.)
 4. Any works undertaken on site prior to obtaining full written approval from Building Control is at the Contractor/Clients own risk. Works should not commence until full approval is granted.

Rev.	Date	Description
A	08/21	AMENDMENTS FOLLOWING PLANNING OFFICER COMMENTS.

Status: **PLANNING**

hincliffe
architecture & design

Hincliffe A&D
24 Carl View Road
Huddersfield
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HD7 5JL

07721 907 742
01484 520 784
info@hincliffe-architecture.co.uk
www.hincliffe-architecture.co.uk

Client:

CAPEWELL
Construction & Developments Ltd

Project:
105 HIGHGATE LANE
LEPTON
HUDDERSFIELD
HD8 0HQ

Drawing Title:
PROPOSED SITE PLAN

Scale (at A1)	Date
1:150	10.01.2021

Drg. no.	Rev.
001-21-PL01	A

Figure 1

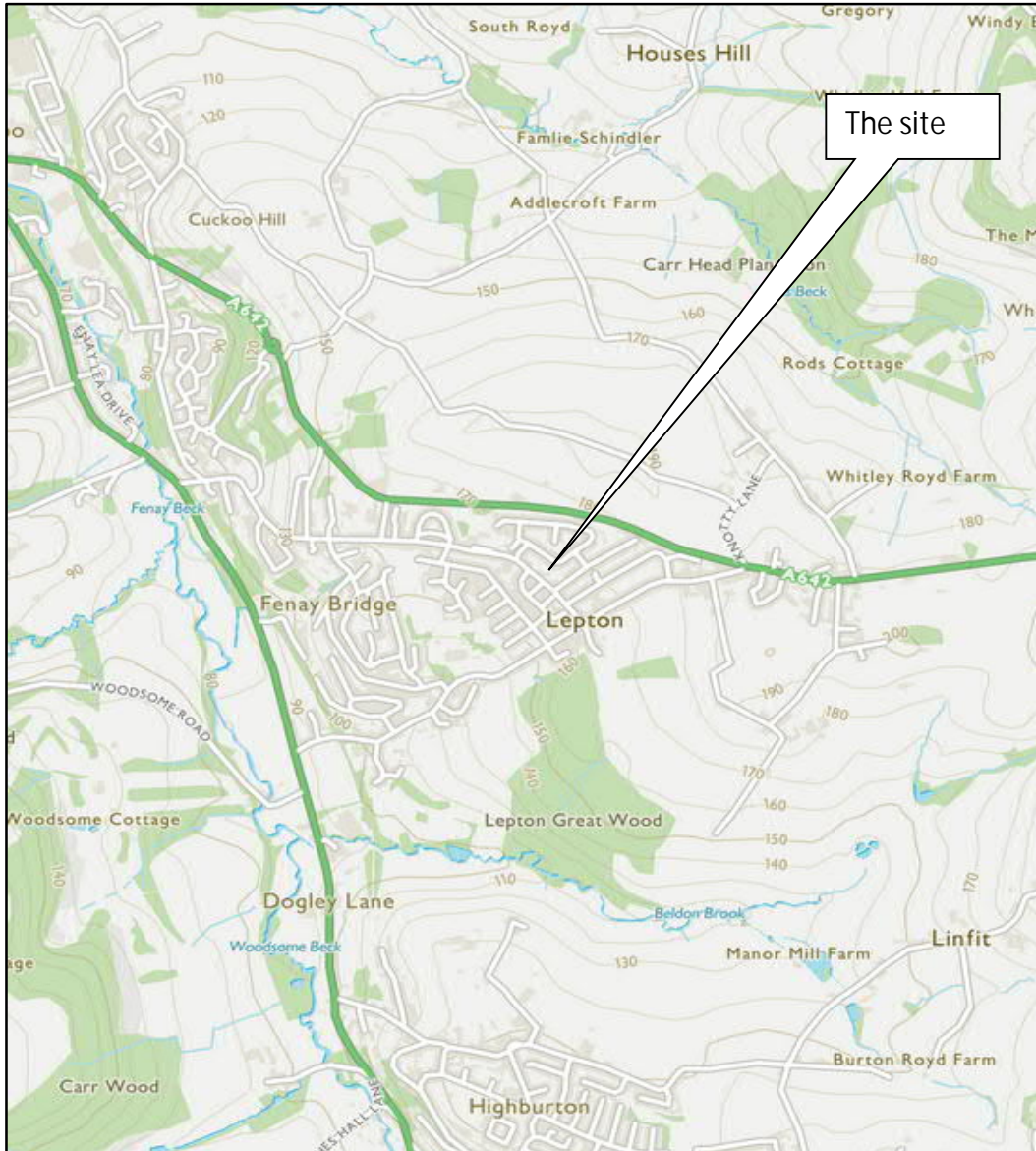
Site Location Plan

Project:

105 Highgate Lane, Lepton, Huddersfield

Project No:

S11169



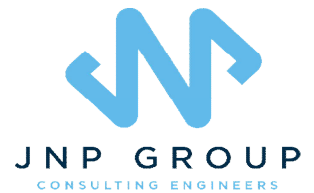
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Figure 2

SPT / Depth Relationship

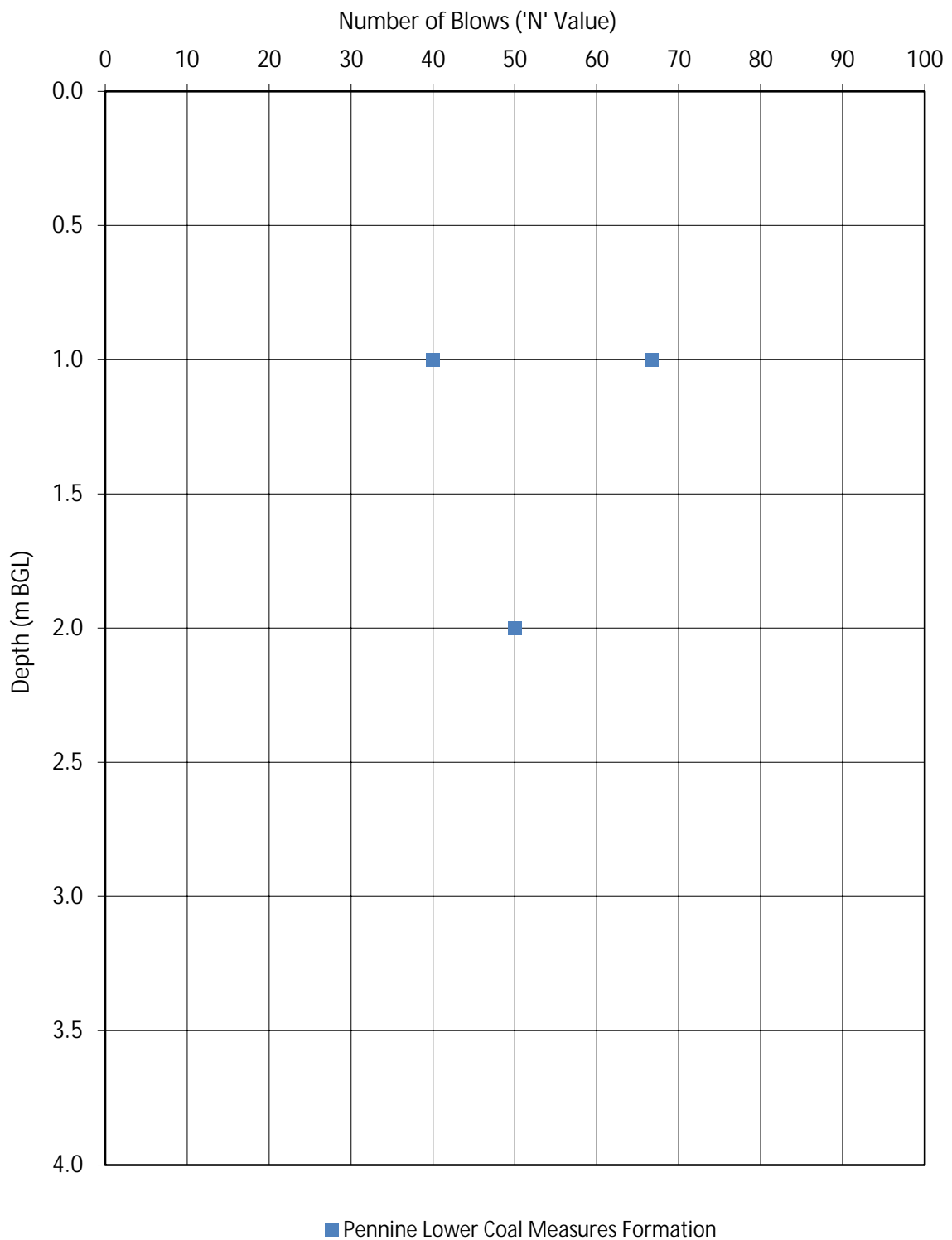
Project:

105 Highgate Lane, Lepton, Huddersfield



Project No:

S11169





Health & Safety Note

The details on this drawing have been prepared on the assumption that a competent contractor will be carrying out the works. If the contractor(s) considers that there is insufficient Health and Safety information on this drawing, this should immediately be brought to the attention of the designer.

Rev.	Date	Description	Drm / Chk'd / App'd
-	06/21	First issue	

Suitability: S2 - Suitable for Information



Chesham • Brighouse • Glasgow • Hartlepool
Leamington Spa • Sheffield

www.jnpgroup.co.uk

Client: Capewell Construction & Development Ltd.

Job: 105 Highgate Lane, Lepton, Huddersfield

Title: Exploratory Hole Location Plan

Classification: FI_60_20
Scale @ A3: As Shown







Project - Originator - Volume/System - Level/Location - Type - Discipline - Number
S11169-JNP-XX-XX-DR-G-1001
Document/Drawing Number

Revision: -

APPENDIX A: LIMITATIONS

Introduction

This report is confidential and has been prepared solely for the benefit of the client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from JNP Group; a charge may be levied against such approval. JNP Group accepts no responsibility or liability for the consequences of this document being used for any purpose or project other than for which it was commissioned, and: this document to any third party with whom and agreement has not been executed.

Any comments given within this report are based on the understanding that the proposed works to be undertaken will be as described in the introduction and the information referred to and provided by others and will be assumed to be correct and will not have been checked by JNP Group and JNP Group will not accept any liability or responsibility for any inaccuracy in such information.

Any deviation from the recommendations or conclusions contained in this report should be referred to JNP Group in writing for comment and JNP Group reserve the right to reconsider their recommendations and conclusions contained within. JNP Group will not accept any liability or responsibility for any changes or deviations from the recommendations noted in this report without prior consultation and our full approval.

The details contained within this report reflect the site conditions prevailing at the time of investigation. JNP Group warrants the accuracy of this report up to and including that date. Additional information, improved practice or changes in legislation may necessitate this report having to be reviewed in whole or in part after that date. If necessary, this report should be referred back to JNP Group for re-assessment and, if necessary, re-appraisal.

This report is only valid when used in its entirety. Any information or advice included in the report should not be relied upon until considered in the context of the whole report. Whilst this report and the opinion made herein are correct to the best of JNP Group' belief, JNP Group cannot guarantee the accuracy or completeness of any information provided by third parties.

The report represents the finding and opinions of experience geotechnical and geo-environmental engineers. JNP Group does not provide legal advice and the advice of lawyers may also be required.

It should be noted that the following were not included as part of the agreed scope of works with the client: detailed ecological surveys and assessment.

JNP Group has provided advice and made recommendations based on the findings of the work undertaken, however this is subject to the approval / acceptance by the relevant Regulatory Authorities.

Objectives

The work undertaken to provide the basis of this report comprised a study of available documented information from a variety of sources (including the Client), together with (where appropriate) a brief walk over inspection of the site. The opinions given in this report have been dictated by the finite data on which they are based and are relevant only to the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, JNP Group reserves the right to review such information and, if warranted, to modify the opinions accordingly. It should be noted

that any risks identified in this report are perceived risks based on the information reviewed; actual risks can only be assessed following a physical investigation of the site.

Phase II Intrusive Investigations

The investigation of the site has been carried out to provide sufficient information concerning the type and degree of contamination, and ground and groundwater conditions to allow a reasonable risk assessment to be made.

Where intrusive investigations have been undertaken, they have been designed to provide a reasonable level of assurance on the conditions. Given the discrete nature sampling, no investigation technique is capable of identifying all conditions present in all areas. The number of sampling points and the methods of sampling and testing do not preclude the existence of localised “hotspots” of contamination where concentrations may be significantly higher than those actually encountered. The risk assessment and opinions provided, *inter alia*, take into consideration currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values.

The objectives of the investigation have been linked to establishing the risks associated with potential human targets, building materials, the environment (including adjacent land), and to surface and ground water. The amount of exploratory work and chemical testing undertaken has necessarily been restricted by the short timescale available, and the locations of exploratory holes have been restricted to areas unoccupied by the building(s) on the site and by buried services.

Gas and groundwater levels may vary from those reported due to seasonal, or other effects.

Although preliminary comment has been provided by JNP Group regarding UXO and Invasive Species, JNP Group not experts in these and as such specialist advice should be sought regarding the presence of UXO and invasive species at the site.

Remediation and Verification Reports Limitations

The risk assessment and opinions provided, *inter alia*, take into consideration currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values.

Where intrusive investigations have been undertaken, they have been designed to provide a reasonable level of assurance on the conditions. Given the discrete nature sampling, no investigation technique is capable of identifying all conditions present in all areas. The number of sampling points and the methods of sampling and testing do not preclude the existence of localised “hotspots” of contamination where concentrations may be significantly higher than those actually encountered.

If costs have been included in relation to the site remediation these must be confirmed by a qualified quantity surveyor. The opinions given in this report have been dictated by the finite data on which they are based and are relevant only to the purpose for which the report was commissioned. The information reviewed from Third Party should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, JNP Group reserves the right to review such information and, if warranted, to modify the opinions accordingly.

Whilst this report and the opinion made herein are correct to the best of JNP Group’s belief, JNP Group cannot guarantee the accuracy or completeness of any information provided by third parties.

Gas and groundwater levels may vary from those reported due to seasonal, or other effects.

APPENDIX B PHOTO DOCUMENT

Photo 1: Entrance to site, showing driveway and vegetated slope leading up to raised garden.



Photo 2: Driveway, vegetated slope leading up to raised garden, and garage.



Photo 3: Raised garden at northern end of site.



Photo 4: Raised garden and rear of garage.



Photo 5: Raised garden.



Photo 6: Raised garden, rear of garage, and existing residential property.



Photo 7: Returns from DS01.



Photo 8: Returns from DS02.



Photo 9: Returns from HP01, showing current topsoil and Made Ground (light yellow) overlying natural buried topsoil and granular subsoil.



APPENDIX C EXPLORATORY HOLE RECORDS

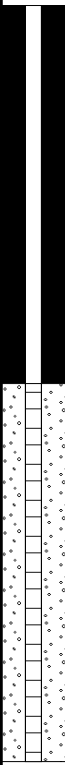




Borehole Log

Borehole No.

DS01

Sheet 1 of 1

Project Name: Highgate Lane, Huddersfield	Project No. S11169	Co-ords: 419386.00 - 415172.00	Hole Type WS
Location: 105 Highgate Lane, Lepton, Huddersfield, HD8 0HQ		Level: 165.00	Scale 1:20
Client: Capewell Construction & Development Ltd.		Dates: 18/05/2021 - 18/05/2021	Logged By CJ

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	ES		0.15	164.85		Dark brown loamy silt TOPSOIL. TOPSOIL
					0.40	164.60		Brown clayey GRAVEL. Gravel was medium to coarse fragments of sandstone. PENNINE LOWER COAL MEASURES FORMATION
		0.50	D		0.60	164.40		Stiff brown sandy CLAY. PENNINE LOWER COAL MEASURES FORMATION
		0.80	ES					Yellow weathered SANDSTONE with occasional thin weathered siltstone beds. PENNINE LOWER COAL MEASURES FORMATION
		1.00						
		1.40	D					
	2.00			N=50 (7,15/9,8,12,21)	2.00	163.00		End of borehole at 2.00 m

Remarks
No groundwater encountered. Refusal at 2.00m bgl.










Borehole Log

Borehole No.

DS02

Sheet 1 of 1

Project Name: Highgate Lane, Huddersfield	Project No. S11169	Co-ords: 419398.00 - 415167.00	Hole Type WS
Location: 105 Highgate Lane, Lepton, Huddersfield, HD8 0HQ		Level: 165.00	Scale 1:20
Client: Capewell Construction & Development Ltd.		Dates: 18/05/2021 - 18/05/2021	Logged By CJ

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
Well	No Water Strikes	0.10	ES		0.13	164.87		TARMAC.	
					0.23	164.77		Fine to coarse, angular to subangular, mixed lithology GRAVEL.	
									MADE GROUND
									Firm brown gravelly sandy silt. Gravel was coarse subangular fragments of weathered sandstone.
					0.53	164.47		PENNINE LOWER COAL MEASURES FORMATION	
					0.65	164.35		Stiff orange and grey mottled CLAY.	
									PENNINE LOWER COAL MEASURES FORMATION
									Orange and grey weathered SANDSTONE with some thin beds of siltstone.
					1.00	164.00			PENNINE LOWER COAL MEASURES FORMATION
									End of borehole at 1.00 m

Remarks
No groundwater encountered. Refusal at 1.00m bgl.

Trial Pit Log

Project Name: Highgate Lane, Huddersfield	Project No. S11169	Co-ords: 419389.00 - 415179.00 Level: 167.00	Date: 18/05/2021
Location: 105 Highgate Lane, Lepton, Huddersfield, HD8 0HQ		Dimensions (m): Depth 1.20 	Scale 1:20
Client: Capewell Construction & Development Ltd.			Logged CJ

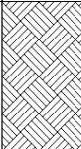

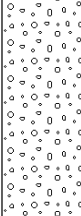
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.20	166.80		Brown loamy clay TOPSOIL. MADE GROUND	
				0.60	166.40		Brown clayey sandy GRAVEL with occasional cobbles. Gravel was medium to coarse, gravel and cobbles were subangular fragments of sandstone. Likely cut from driveway area of site and used to level the front of the raised garden. MADE GROUND	
				0.80	166.20		Buried brown loamy silty TOPSOIL. TOPSOIL	
	1.00	D		1.20	165.80		Orange and brown clayey cobbly GRAVEL. Gravel and cobbles were subangular fragments of sandstone. PENNINE LOWER COAL MEASURES FORMATION	1
							End of pit at 1.20 m	2
								3
								4

Remarks: No groundwater encountered.

Stability:

Trial Pit Log

Project Name: Highgate Lane, Huddersfield	Project No. S11169	Co-ords: 419401.00 - 415186.00 Level: 167.00	Date 18/05/2021
Location: 105 Highgate Lane, Lepton, Huddersfield, HD8 0HQ		Dimensions (m): Depth 1.20	Scale 1:20 Logged CJ
Client: Capewell Construction & Development Ltd.			

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.30	ES		0.40	166.60		Brown loamy gravelly TOPSOIL. TOPSOIL
	0.50	D		0.60	166.40		Orange and grey mottled gravelly CLAY. PENNINE LOWER COAL MEASURES FORMATION
				1.20	165.80		Gravelly cobbles of weathered SANDSTONE. PENNINE LOWER COAL MEASURES FORMATION
							End of pit at 1.20 m

Remarks: No groundwater encountered.

Stability:

APPENDIX D GAS MONITORING RESULTS

GAS MONITORING DATA

Site:	105 Highgate Lane, Lepton		
Project:	S11169	Date:	28/05/2021

Operator:	CJ
Weather:	Sunny



Monitoring Location	Standpipe diameter (mm)	Standpipe Depth (m bgl)	Water Level (m bgl)	Atmos. Pressure (mb)	Initial Flow Rate (litres/hr)	Average Flow Rate (litres/hr)	Temp (°C)	Reading Duration (s)	CH ₄ (% v/v)	CO ₂ (% v/v)	O ₂ (% v/v)	Notes
DS01	50	2.00	Dry	1004	0.0	0.0		15	0.2	0.5	20.3	
								30	0.2	0.5	20.1	
								60	0.2	0.5	20.1	
								90	0.2	0.5	20.1	
								120	0.2	0.5	20.1	
								180	0.2	0.5	20.1	
								240	0.2	0.5	20.1	
								300	0.2	0.5	20.1	
DS02	50	1.00	Dry	1004	0.0	0.0		15	0.1	0.4	20.2	
								30	0.1	0.4	20.3	
								60	0.1	0.4	20.3	
								30	0.1	0.4	20.3	
								120	0.1	0.4	20.3	
								180	0.1	0.4	20.3	
								240	0.1	0.4	20.3	
								300	0.1	0.4	20.3	

GAS MONITORING DATA

Site:	105 Highgate Lane, Lepton		
Project:	S11169	Date:	01/06/2021

Operator:	CJ
Weather:	Sunny



Monitoring Location	Standpipe diameter (mm)	Standpipe Depth (m bgl)	Water Level (m bgl)	Atmos. Pressure (mb)	Initial Flow Rate (litres/hr)	Average Flow Rate (litres/hr)	Temp (°C)	Reading Duration (s)	CH ₄ (% v/v)	CO ₂ (% v/v)	O ₂ (% v/v)	Notes
DS01	50	2.00	Dry	998	0.0	0.0		15	0.2	0.1	20.4	
								30	0.2	0.1	20.3	
								60	0.2	0.3	20.1	
								90	0.1	0.3	20.0	
								120	0.1	0.3	19.9	
								180	0.1	0.3	19.8	
								240	0.1	0.3	19.8	
								300	0.1	0.3	19.8	
DS02	50	1.00	Dry	998	0.0	0.0		15	0.1	0.1	20.3	
								30	0.1	0.1	20.4	
								60	0.1	0.1	20.4	
								30	0.1	0.2	20.3	
								120	0.1	0.2	20.3	
								180	0.1	0.2	20.3	
								240	0.1	0.2	20.3	
								300	0.1	0.2	20.3	

GAS MONITORING DATA

Site:	105 Highgate Lane, Lepton		
Project:	S11169	Date:	09/06/2021

Operator:	CJ
Weather:	Sunny



Monitoring Location	Standpipe diameter (mm)	Standpipe Depth (m bgl)	Water Level (m bgl)	Atmos. Pressure (mb)	Initial Flow Rate (litres/hr)	Average Flow Rate (litres/hr)	Temp (°C)	Reading Duration (s)	CH ₄ (% v/v)	CO ₂ (% v/v)	O ₂ (% v/v)	Notes
DS01	50	2.00	Dry	1000	0.0	0.0		15	0.2	1.2	19.3	
								30	0.2	1.2	19.0	
								60	0.2	1.2	18.9	
								90	0.2	1.2	18.9	
								120	0.2	1.2	18.9	
								180	0.2	1.2	18.9	
								240	0.2	1.2	18.9	
								300	0.2	1.2	18.9	
DS02	50	1.00	Dry	1000	0.0	0.0		15	0.1	0.8	19.9	
								30	0.1	0.8	19.8	
								60	0.1	0.8	19.8	
								30	0.1	0.9	19.8	
								120	0.1	0.9	19.8	
								180	0.1	0.9	19.8	
								240	0.1	0.9	19.8	
								300	0.1	0.9	19.8	

GAS MONITORING DATA

Site:	105 Highgate Lane, Lepton		
Project:	S11169	Date:	15/06/2021

Operator:	CJ
Weather:	Sunny



Monitoring Location	Standpipe diameter (mm)	Standpipe Depth (m bgl)	Water Level (m bgl)	Atmos. Pressure (mb)	Initial Flow Rate (litres/hr)	Average Flow Rate (litres/hr)	Temp (°C)	Reading Duration (s)	CH ₄ (% v/v)	CO ₂ (% v/v)	O ₂ (% v/v)	Notes
DS01	50	2.00	Dry	1003	0.0	0.0		15	0.2	1.6	20.0	
								30	0.2	1.6	19.4	
								60	0.2	1.6	19.2	
								90	0.1	1.6	19.2	
								120	0.0	1.5	19.1	
								180	0.0	1.5	18.9	
								240	0.0	1.4	18.8	
								300	0.0	1.4	18.6	
DS02	50	1.00	Dry	1003	0.0	0.0		15	0.1	1.1	20.0	
								30	0.1	1.0	20.1	
								60	0.0	1.0	19.6	
								30	0.0	0.9	19.5	
								120	0.0	0.9	19.5	
								180	0.0	0.9	19.5	
								240	0.0	0.9	19.5	
								300	0.0	0.9	19.5	

APPENDIX E LABORATORY TEST RESULTS



Final Report

Report No.:	21-17191-1		
Initial Date of Issue:	01-Jun-2021		
Client	JNP Group Consulting Engineers		
Client Address:	GF2 MBP2 Meadowhall Business Park Carbrook Hall Road Sheffield S9 2EQ		
Contact(s):	Ciaran Jeanes		
Project	S11169 Lepton		
Quotation No.:	Q21-22536	Date Received:	21-May-2021
Order No.:	G1067	Date Instructed:	21-May-2021
No. of Samples:	7		
Turnaround (Wkdays):	7	Results Due:	01-Jun-2021
Date Approved:	01-Jun-2021	Subcon Results Due:	30-May-2021

Approved By:

Details: Glynn Harvey, Technical Manager

Results - Soil

Project: S11169 Lepton

Client: JNP Group Consulting Engineers		Chemtest Job No.:		21-17191	21-17191	21-17191	21-17191	21-17191	21-17191	21-17191
Quotation No.: Q21-22536		Chemtest Sample ID.:		1205881	1205882	1205883	1205884	1205885	1205886	1205887
		Client Sample ID.:		DS01	DS01	DS01	DS02	HP01	HP01	HP02
		Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):		0.1	0.8	1.4	0.1	0.2	1	0.3
		Date Sampled:		18-May-2021	18-May-2021	18-May-2021	18-May-2021	18-May-2021	18-May-2021	18-May-2021
		Asbestos Lab:		DURHAM			DURHAM	DURHAM		
Determinand	Accred.	SOP	Units	LOD						
ACM Type	U	2192		N/A	-			-	-	
Asbestos Identification	U	2192		N/A	No Asbestos Detected			No Asbestos Detected	No Asbestos Detected	
ACM Detection Stage	U	2192		N/A	-			-	-	
Moisture	N	2030	%	0.020	12	8.3	9.1	13	16	14
Soil Colour	N	2040		N/A	Brown	Brown	Brown	Brown	Brown	Brown
Other Material	N	2040		N/A	Stones and Roots	Stones	Stones	Stones	Stones and Roots	Stones
Soil Texture	N	2040		N/A	Sand	Sand	Sand	Sand	Sand	Sand
pH	M	2010		4.0	7.9	8.1	8.0	8.3		7.4
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	< 0.40	< 0.40		< 0.40		< 0.40
Magnesium (Water Soluble)	N	2120	g/l	0.010			< 0.010		< 0.010	
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010			< 0.010		< 0.010	
Total Sulphur	M	2175	%	0.010			0.013		0.049	
Chloride (Water Soluble)	M	2220	g/l	0.010			0.044		< 0.010	
Nitrate (Water Soluble)	N	2220	g/l	0.010			< 0.010		< 0.010	
Sulphate (Acid Soluble)	M	2430	%	0.010			< 0.010		0.044	
Arsenic	M	2450	mg/kg	1.0	9.0	4.4		12		41
Beryllium	U	2450	mg/kg	1.0	< 1.0	< 1.0		< 1.0		1.5
Cadmium	M	2450	mg/kg	0.10	0.15	< 0.10		0.12		0.34
Chromium	M	2450	mg/kg	1.0	17	19		14		27
Copper	M	2450	mg/kg	0.50	33	17		21		50
Mercury	M	2450	mg/kg	0.10	< 0.10	< 0.10		< 0.10		0.15
Nickel	M	2450	mg/kg	0.50	20	22		17		20
Lead	M	2450	mg/kg	0.50	35	13		16		170
Selenium	M	2450	mg/kg	0.20	0.27	0.36		< 0.20		0.70
Vanadium	U	2450	mg/kg	5.0	19	21		20		44
Zinc	M	2450	mg/kg	0.50	65	50		43		140
Chromium (Trivalent)	N	2490	mg/kg	1.0	17	19		14		27
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50		< 0.50		< 0.50
Organic Matter	M	2625	%	0.40		0.95				8.8
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0				< 1.0		
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0				< 1.0		
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0				< 1.0		
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0				< 1.0		
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0				< 1.0		
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0				< 1.0		
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0				< 1.0		

Results - Soil

Project: S11169 Lepton

Client: JNP Group Consulting Engineers		Chemtest Job No.:		21-17191	21-17191	21-17191	21-17191	21-17191	21-17191	21-17191
Quotation No.: Q21-22536		Chemtest Sample ID.:		1205881	1205882	1205883	1205884	1205885	1205886	1205887
		Client Sample ID.:		DS01	DS01	DS01	DS02	HP01	HP01	HP02
		Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):		0.1	0.8	1.4	0.1	0.2	1	0.3
		Date Sampled:		18-May-2021	18-May-2021	18-May-2021	18-May-2021	18-May-2021	18-May-2021	18-May-2021
		Asbestos Lab:		DURHAM			DURHAM	DURHAM		
Determinand	Accred.	SOP	Units	LOD						
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0			< 1.0			
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0			< 5.0			
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0			< 1.0			
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0			< 1.0			
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0			< 1.0			
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0			< 1.0			
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0			< 1.0			
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0			< 1.0			
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0			< 1.0			
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0			< 1.0			
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0			< 5.0			
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0			< 10			
Naphthalene	M	2700	mg/kg	0.10	< 0.10		< 0.10	0.91		4.0
Acenaphthylene	M	2700	mg/kg	0.10	< 0.10		< 0.10	0.49		1.3
Acenaphthene	M	2700	mg/kg	0.10	< 0.10		< 0.10	0.37		0.90
Fluorene	M	2700	mg/kg	0.10	< 0.10		< 0.10	0.67		0.33
Phenanthrene	M	2700	mg/kg	0.10	< 0.10		< 0.10	2.0		3.5
Anthracene	M	2700	mg/kg	0.10	< 0.10		< 0.10	0.35		0.16
Fluoranthene	M	2700	mg/kg	0.10	0.69		< 0.10	2.6		2.3
Pyrene	M	2700	mg/kg	0.10	0.70		< 0.10	2.7		3.1
Benzo[a]anthracene	M	2700	mg/kg	0.10	0.32		< 0.10	1.4		1.4
Chrysene	M	2700	mg/kg	0.10	0.89		< 0.10	2.2		3.5
Benzo[b]fluoranthene	M	2700	mg/kg	0.10	0.54		< 0.10	2.1		1.9
Benzo[k]fluoranthene	M	2700	mg/kg	0.10	0.83		< 0.10	2.1		3.6
Benzo[a]pyrene	M	2700	mg/kg	0.10	0.28		< 0.10	1.5		1.3
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10	< 0.10		< 0.10	1.1		0.81
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10	< 0.10		< 0.10	0.79		0.37
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10	< 0.10		< 0.10	1.2		1.1
Total Of 16 PAH's	M	2700	mg/kg	2.0	4.3		< 2.0	22		29

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measurement by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazine.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2680	TPH A/A Split	Aliphatics: >C5-C6, >C6-C8,>C8-C10, >C10-C12, >C12-C16, >C16-C21, >C21-C35, >C35- C44Aromatics: >C5-C7, >C7-C8, >C8- C10, >C10-C12, >C12-C16, >C16- C21, >C21- C35, >C35- C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied

B - Sample age exceeds stability time (sampling to extraction)

C - Sample not received in appropriate containers

D - Broken Container

E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com



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