GEOENVIRONMENTAL GROUND INVESTIGATION

Unit A, Capitol Park
Capitol Close
Barnsley

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Building Management Services, Proposed Warehouse Unit A, Capitol Park, Capitol Close, Barnsley. Site Layout Plan. Drawing No. M3016-01-SK5 Rev A, dated Febuary 2017.

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CONFIDENTIALITY STATEMENT

This report is addressed to and may be relied upon by the following:

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This report has been prepared for the sole use and reliance of the above-named party. This report shall not be relied upon or transferred to any other parties without the express written authorisation of JPG (Leeds) Limited. No responsibility will be accepted where this report is used, either in its entirety or in part, by any other party.

DOCUMENT HISTORY

VERSION	PURPOSE/DESCRIPTION	DATE
1	Final – For Issue to Client	April 2017

EXECUTIVE SUMMARY

Site Address	**Unit A, Capitol Park, Capitol Close, Barnsley**
NGR	Approximate NGR 431781, 405967.
Current Site Use	The site comprises an engineered level plateau and is currently undeveloped.
Proposals	Commercial development comprising a single unit.
Previous Report	A desk study report for the site has been prepared by JPG which should be read with this report.
Fieldwork	Fieldwork comprised trial pits and cable percussive boreholes with in situ testing. A rotary borehole investigation was also undertaken. Two gas and groundwater monitoring wells were installed. Soil samples were obtained and submitted for chemical and geotechnical analysis. The installations have been monitored for gas and groundwater on six occasions.
Ground and Groundwater Conditions	Made ground to a maximum of 7.5m, overlying natural clay over mudstone. No made ground to north west of site only (TP04). A single stockpile of clay made ground present on the site. No shallow groundwater was encountered during the investigation or during the post investigation monitoring visits.
Geotechnical and Engineering Assessment	**Foundations** – The made ground is unsuitable for the support of structural loads. It is therefore recommended that foundation loads are transferred to deeper natural strata of suitable bearing capacity, by the use of pad foundations. **Ground Floor Construction** - For a ground bearing floor slab for the proposed units, the made ground will need to be subjected to some form of ground improvement techniques in order to provide a uniform formation and ensure an adequate bearing capacity. This may include proof rolling, the excavation of soft materials, and the selection and controlled compaction of suitable materials. **Earthworks, Roads, Pavements and Hardstanding Surfaces** - Locally earthworks will be required for distribution of the stockpile, if required, and also roadways, parking areas and for backfilling excavations. Provided that the materials are properly selected and compacted, then a minimum CBR value of 2% should be adopted for design. **Excavations** - Excavations through both the made ground and natural strata should remain dry and stable in the short term. However, if excavations are left open for long periods of time, it is envisaged instability may eventually occur. Perched groundwater may be encountered. **Obstructions** – No obstructions were encountered during the investigation. Shallow rock, which was found to be hard to dig locally, was encountered across the north west of the site. **Chemical Attack on Buried Concrete** - It is recommended that concrete should be designed to ACEC Design Sulphate Class DS-1 and ACEC Class AC-2z.
Environmental Risk Assessment	Based on the identified potential sources of contamination and available pathways and receptors, the following linkage assessments have been considered. This assessment is based on current site conditions and does not consider exposure pathways following any remediation of the site. **Sources** - The following potential sources of contamination are considered to be present on the site: • Hazardous ground gases. **Mitigation Measures** - In order to mitigate the risks posed by the potential contaminants which are present on the site, consideration should be given to the following mitigation measures. **Development and Maintenance Workers** - In order to mitigate the risks posed by the potential contamination present on the site, consideration should be given to the following mitigation measures: • Site workers involved in groundworks should take the necessary measures to ensure that all works in excavations and confined spaces are carried out in accordance with best practice in order to prevent exposure to potentially hazardous gases. • Site workers involved in groundworks should use appropriate PPE, i.e. overalls and gloves and where appropriate masks. Appropriate health and safety measures, e.g. washing hands prior to eating or drinking, should also be enforced. During development of the site, all workers should remain vigilant to the possible risk of encountering areas of potentially contaminated material. Should potentially contaminated material be encountered, site management should be informed. Further testing may then be required to assess the risk to health and safety of the site workers and the environment. All employers involved in works at the site should produce an appropriate method statement and risk assessment, to which all employees should comply. Reference should also be made to appropriate HSE and other guidance for working on contaminated and potentially contaminated sites. **Future Site Users** - Gas protection measures are required and discussed in Section 8.0 of this report. **Buildings and Services** - Based on the potential sources of contamination which have been identified on the site, there may be a risk to buildings and services, such as buried concrete and supply pipes.
Hazardous Gas	The site is characterised as Characteristic Situation 2 and measures to protect the development against a gas protection score of 1.5 will be required.
This sheet is intended as a summary only of the assessment of the site in relation to ground condition. It does not provide a definitive engineering analysis.	

1.0 INTRODUCTION

1.1 Introduction

JPG (Leeds) Limited has been instructed by Commercial Development Projects Limited, to carry out a geoenvironmental ground investigation for a proposed commercial development at Unit A, Capitol Park, Capitol Close, Barnsley.

In May 2016, JPG (Leeds) Ltd issued a geoenvironmental desk study report (Reference JP/DS/2450.v1), covering a larger site of which the subject site forms part.

The desk study report comprised an inspection and description of the site and a review of the geological and coal mining aspects.

The report also included a review of previous FWS Consultants and Sirius Geoenvironmental reports, a description of Ordnance Survey archive maps, radon gas risk, indicative flood risk, hydrogeology, landfill, and other environmental issues.

In addition to comments and conclusions on a wide range of environmental and geotechnical issues, the report also provided recommendations for a ground investigation and assessment.

The findings and contents of the desk study are not reproduced here in their entirety, but a brief summary of the pertinent information is presented in Section 2.0 of this report.

The ground investigation and assessment works, as recommended in the desk study referenced above, covered the larger site. This report covers Unit A only, therefore, only the works directly relating to Unit A are included.

1.2 Objectives

The main objective of the geoenvironmental ground investigation was to identify potential geotechnical and environmental issues that may represent constraints to the proposed redevelopment of the site.

1.3 Scope of Works

The scope of the investigation included the following works:

- A description of the ground investigation works carried out, i.e. factual reporting.

Interpretative reporting, including:

- Assessment of potential contaminants.
- A generic quantitative (Tier 1) screening assessment using source-pathway-receptor linkages.

- An assessment of the classification of materials for disposal offsite, not including Waste Acceptance Criteria (WAC) testing.
- Engineering assessment to include recommendations with respect to foundations, ground floor and pavement design.
- Comments on the likely requirements for remedial measures on the site, to address potential contamination or ground gas issues.
- Recommendations for further work where appropriate; and
- Presentation of the findings in a tabular non-technical summary.

1.4 Location

The site is located on Capitol Park, adjacent to Junction 37 of the M1 motorway, to the north of Dodworth near Barnsley. The approximate centre of the site is located at NGR 431781, 405967. A site location plan is given as Figure 1 in Appendix A.

1.5 Site Description and Topography

The site is roughly triangular in shape, extending to an area of approximately 1.9ha.

The site is currently undeveloped and comprises a level engineered plateau, which was created during site regrade works sometime between 2005 and 2007. During the site regrade works a large box culvert was constructed. The culvert generally trends north to south, and runs parallel to the western boundary of the site. The line of the culvert is marked on the ground surface by a series of manhole covers. The surrounding area slopes to the south east.

The site generally has a surface covering of short rough grassland and a single large stockpile is present in the eastern corner.

The site is bounded to the west by by further undeveloped land, associated with the current engineered plateau, to the north east by Capitol Close and to the south east by Whinby Road. However, there are no substantial physical boundaries between the site and the adjacent land and roads, except for a sporadic low wooden fence, the site is essentially open on all sides.

To the north, the site batters up from the plateau to the adjacent Capitol Close, with a maximum difference in level of approximately 5m. To the south of the site, a batter slopes down from the site plateau to the adjacent Whinby Road below, again with a maximum difference in level of approximately 5m. An assumed gravel drain follows the base of the batter around the perimeter of the site plateau. Manhole covers were noted periodically along the run of the gravel drain.

The site is located in an area of mixed commercial and industrial use. The town of Dodworth is located to the south of the site, with the M1 motorway and Barnsley beyond to the east.

1.6 Development Proposals

It is proposed to develop the site for a commercial end use. The proposed layout plan is referenced below and a copy is contained in Appendix A.

- Building Management Services, Proposed Warehouse Unit A, Capitol Park, Capitol Close, Barnsley. Site Layout Plan. Drawing No. M3016-01-SK5 Rev A, dated February 2017.

1.7 Limitations

The general limitations to the nature of the investigation are outlined in Appendix F.

2.0 SUMMARY OF RELEVANT JPG DESK STUDY INFORMATION

2.1 Site History

The site remained farmland until it was regraded to its current state, sometime between 2005 and 2007. A railway line has been present 25m to the south of the site since the mid-1800s. Old Silkstone Collieries was present approximately 450m to the south west of the site since the late 1800s, with an associated spoil heap which grew over the preceding years towards the site. The colliery was demolished in the early 1990s.

2.2 Geology

The following BGS maps was consulted:

- British Geological Survey 1:50,000 Series. Sheet 87 Barnsley. Bedrock and Superficial Geology Edition. Published 2008.

The majority of the site is underlain by Pennine Middle Coal Measures Formation, from the Carboniferous Period, comprising sandstone and undifferentiated strata (interbedded sequences of sandstone, siltstone, mudstone and coal seams). There is no drift cover indicated on site and no faults are shown to affect the site.

Two coal seals are shown to outcrop on site. Both trend in a north west to south east direction, dipping towards the north east, with the more northerly outcrop being the Top Haigh Moor Coal and the southerly outcrop being the Low Haigh Moor Coal.

2.3 Mining

The coal mining report states that the site is in a surface area that could be affected by underground workings in six seams of coal at 70m to 280m depth and last worked in 1967. In addition, the site is in an area where the Coal Authority believe there is coal at or close to the surface, which may have been worked at some time in the past. There are no known coal mine entries within, or within 20m of, the boundary of the property.

Rotary boreholes undertaken during the previous site investigation proved coal measures strata to 30m depth, and included several coal seams. However, no evidence of workings in the form of voids, broken ground or soft push material, were encountered.

To confirm the findings of previous investigations, further rotary boreholes were drilled across the site. These are discussed in Section 5.2 of this report.

2.4 Hydrology and Hydrogeology

The bedrock underlying the site is classified as a Secondary A Aquifer. These aquifers generally comprise permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

The nearest surface water feature is a drain (tertiary river) at approximately 120m to the west of the site.

There are no surface, potable or groundwater abstraction licences within 1km of the site.

The site does not lie within a floodplain. However, a flood risk assessment may be required by the Local Authority as part of any planning application for the site.

2.5 Landfills

There are no records of any currently licenced or historical landfill sites with 250m of the site.

However, spoil heaps associated with the former colliery to the west of the site, are located approximately 120m to the west of the site.

2.6 Radon

The property is in a Radon Affected Area, as 1% to 3% of properties are above the Action Level. However, no radon protective measures are necessary in new buildings.

3.0 FIELDWORK

The intrusive investigation was designed to provide information on the general ground, groundwater and hazardous gas conditions at the site.

The boreholes and trial pits were located at the positions of the proposed unit and also at the locations of potential contamination sources, i.e. the onsite stockpile.

The rationale behind each exploratory location is summarised in Table 3.0 below.

Table 3.0 – Exploratory Hole Rationale

Potential Issue	Exploratory Holes
Trial pits and boreholes in vicinity of proposed unit and areas of hard standing.	TP04, TP07, TP10, TP11, TP13, TP16 TP17. BH02, BH04, RO03, RO04 and RO07.
Trial pits within the existing stockpile.	TP12 and TP12a

Exploratory hole locations excavated and drilled during the same phase of investigation, but covering the adjacent site, and not informing the current subject site comprise TP01 to TP03, TP05, TP06, TP08, TP09, TP14, TP15, TP18 to TP21, BH01, BH03, BH05, RO01, RO02, RO05, RO06 and RO08. These locations have been omitted from this report.

3.1 Fieldwork

The fieldwork was carried out between 13 and 16 March 2017. The works undertaken are summarised in Table 3.1 below.

Table 3.1 – Summary of Ground Investigation Works

Investigation Method	No. of Positions	Maximum Depth (m bgl)	Monitoring Wells	Monitoring
Trial pits.	7No. (TP04, TP07, TP10, TP11, TP13, TP16 and TP17)	4	-	-
Trial Pits in Stockpile	2No. (TP12 and TP12a)	2	-	-
Trial Trenches	2No. (TT01 and TT02)	3.4	-	-
Cable percussive boreholes	2No. (BH02 to BH04)	7.25	2 x 50mm	GG, WL
Rotary boreholes	3No. (RO03, RO04 & RO07)	30	-	-

bgl – below ground level
GG – ground gas monitoring (methane, carbon dioxide, oxygen, hydrogen sulphide, gas flow and atmospheric pressure using a portable gas meter)
WL – standing groundwater level using an electric contact dip meter

The ground investigation has been undertaken in general accordance with the techniques outlined in BS5930: 2015 Code of Practice for Site Investigations at the positions shown on the Exploratory Hole Location Plan, which is contained in Appendix B. The Exploratory Hole Records, and trial trench sketches are also contained in Appendix B. The investigation was carried out under the full time supervision of an engineer from JPG.

3.2 Surveying

The exploratory locations were surveyed by handheld GPS and measurements from site features.

4.0 LABORATORY TESTING

4.1 Chemical Analysis

The chemical analysis suite was designed to:

- Characterise near surface contamination levels to provide an assessment of the risks associated with direct contact with soils on site in its current state.
- Provide information on the general contamination concentrations in the various strata across the site.
- Characterise in detail visible or odorous contamination using targeted analytical testing techniques; and
- Provide information on the solubility of contaminants and therefore the potential for impact on controlled waters.

Chemical testing was carried out for the following determinands by Derwentside Environmental Testing Services Limited (DETS) in County Durham. Chemical analysis certificates are presented in Appendix C.

Soils – General
Selected samples of soil were tested for the following contaminants on a total concentration basis:

Arsenic	Mercury	Copper
Cadmium	Lead	Nickel
Chromium	Zinc	Selenium
Cyanide (free)	Phenol	
Speciated Poly Aromatic Hydrocarbons (PAH)		
Soil Organic Matter		
Sulphate (water soluble) and pH		
Asbestos Screen/Quantification		

In addition, selected samples were submitted for the following analysis:

- Hexavalent chromium, total chloride, total sulphate, total sulphide and ammoniacal nitrogen.
- Total Petroleum Hydrocarbons Criteria Working Group (TPHCWG).

Selected samples of soil leachate were tested for the following contaminants:

Arsenic	Mercury	Copper
Cadmium	Lead	Nickel
Chromium	Zinc	Selenium
Cyanide (free)	Phenol	
Speciated Poly Aromatic Hydrocarbons (PAH)		
Sulphate and pH		

4.2 Geotechnical Testing

In situ standard penetration tests (SPT) were performed within the cable percussive boreholes. The results are presented on the exploratory hole logs provided in Appendix B.

Laboratory geotechnical testing was carried out by Professional Soils Laboratory in Doncaster, in order to determine the physical characteristics of the substrata and comprised the following:

- Moisture content and particle size distribution to confirm the field descriptions of the soils encountered.
- Compaction testing (2.5kg and 4.5kg) and particle density to determine the compaction properties of the soils.
- California Bearing Ratio (CBR) test (2.5kg, unsoaked) to determine the bearing characteristics of the soils.
- pH, 2:1 water extract soluble sulphate, acid soluble sulphate, total sulphur and water soluble chloride.

The geotechnical testing was carried out in accordance with BS 1377:1990, "Methods of Test for Soils for Civil Engineering Purposes". The results of the geotechnical testing are contained in Appendix D.

5.0 GROUND AND GROUNDWATER CONDITIONS

5.1 Introduction

The ground conditions encountered during the investigation were generally consistent with the anticipated sequence of strata indicated by the desk study information.

The trial pit and borehole logs, the trial trench sketch cross sections, and an investigation location plan, are all included in Appendix B.

Geological cross sections through the site are presented as Subsurface Section A-A', B-B' and C-C' in Appendix B.

5.2 Ground Conditions

Shallow ground conditions typically comprise made ground underlain by firm and stiff clay (weathered bedrock) and Pennie Middle Coal Measures strata bedrock at depth, i.e. mudstone, siltstone and sandstone.

Made ground is absent in the northern part of the site (TP04). Beneath the footprint of the proposed building, the thickness of the made ground increases from 0.50m and 2.20m in the north to 3.20m and 3.50m in the south.

Beyond the southern boundary of the proposed building, the thickness of the made ground was confirmed in BH04 at 4.50m, was not determined in TP17 (in excess of 4.00m) and 7.50m in RO7.

More details are provided below: -

Trial Pits
All seven trial pits (TP04, TP07, TP10, TP11, TP13, TP16 and TP17) generally had a surface covering of rough grass, but with some areas being less well vegetated and revealing exposed soil at the surface.

Beneath the surface covering, in the majority of the trial pits across the site, made ground was proven to a maximum depth of 3.5m. TP17 (in the south of the site) was terminated at 4m depth, the full thickness of made ground at this location could not be determined. The deepest made ground was encountered to the south of the site.

No made ground was encountered in TP04, which was located in the north west of the site.

- The made ground typically comprised yellowish brown/grey slightly silty, slightly sandy, gravelly clay with occasional cobbles. The gravel and cobbles comprised sandstone, mudstone and locally rare brick and coal fragments.
- In TP07 only, a 0.2m thickness of made ground comprising dark grey sand and gravel of ash and brick was encountered at a depth of 1.6m.

Below the made ground, natural strata was confirmed at every exploratory trial pit location, except for TP17. Natural strata comprised high strength (stiff), yellowish brown and grey, slightly silty, slightly sandy, clay, generally with rare mudstone gravel, to depths of between 0.7m in TP04 and in the base of TP13 at 3.8m. The clay was interpreted as weathered Pennine Middle Coal Measures Formation. No clay was encountered in TP10, which was excavated in the centre of the proposed building.

Below the natural clay in TP04 and immediately beneath the made ground in TP10, bedrock was proven at depths of 0.7m and 2.45m respectively. The bedrock comprised thinly laminated mudstone.

On completion the trial pits were backfilled with the arisings.

Stockpile
Two trial pits were excavated into the sides of the stockpile. The material within the stockpile was similar to the made ground encountered across the site, and comprised yellowish brown/grey, slightly silty, slightly sandy, gravelly clay, with occasional cobbles. The gravel and cobbles comprised sandstone, mudstone and rare brick and coal fragments. Locally, the stockpile contained rare sandstone boulders, up to 0.5m diameter, and pieces of plastic packaging strapping.

Trial Trenches
Two trial trenches were excavated through the western area of the site, and across the location of the western elevation of the proposed building, to inspect for any potential deep fill, or steps in natural strata, associated with the adjacent box culvert.

The strata encountered, generally conformed with the findings of the trial pits, and revealed made ground over natural clay. The made ground was found to vary in thickness from between 0.5m in the eastern end of the TT01, which then stepped down to 2.7m in thickness close to the culvert in the western end of the trench. TT02 revealed a made ground thickness of 3.2m along the entirety of the trench.

On completion, the trial trenches were backfilled with the arisings.

Cable Percussive Boreholes
The cable percussive boreholes (BH02 and BH04) encountered similar made ground over Pennine Middle Coal Measures strata.

The boreholes revealed medium strength (firm), and locally low strength (soft), clay made ground, as described in the trial pits section above, to depths of 1.2m and 4.5m in BH02 and BH04 respectively. Natural high strength (stiff) clay strata was encountered beneath the made ground, to depths of 3m in BH02 and 6m in BH04, overlying extremely weak mudstone bedrock.

The results of the in situ penetration testing, carried out in the boreholes, has been plotted against depth (m bgl). The results have been corrected in accordance with the energy ratio of the testing equipment. The plot is presented as Figure 2 in Appendix A and the SPT data (uncorrected) is included on the borehole logs contained in Appendix B.

The SPTs show some correlation with increasing strength/density with depth within the natural strata.

On completion of the boreholes, gas and water monitoring standpipes were installed into each hole.

Rotary Boreholes and Coal Mining Risk Assessment
The Coal Authority state that there is coal at or close to the surface, which may have been worked at some time in the past. There are no known coal mine entries within, or within 20m of, the boundary of the site.

Assessment of the geological records indicates the site is underlain by Pennine Middle Coal Measures Formation, with no drift cover and no faults shown. Two coal seams are shown to outcrop on site, both of which trend in a north west to south east direction and dip towards the north east The more northerly outcrop is the Top Haigh Moor Coal and the southerly outcrop is the Low Haigh Moor Coal.

Previous rotary borehole investigations proved coal measures strata to 30m depth and also the presence of several coal seams. No evidence of workings in the form of voids, broken ground or soft push material, were encountered.

The three rotary boreholes (RO03, RO04 and RO07) identified made ground and presumed natural clay, assumed to be weathered Pennine Middle Coal Measures Formation, to depths of between 0.6m (RO03) and 7.5m (RO07), over Pennine Middle Coal Measures strata bedrock. The underlying bedrock comprised successive bands of mainly mudstone, siltstone, and sandstone locally.

Various intact 0.3m to 0.5m thick coal seams were encountered in each borehole. The coal seams are summarised in table 5.2 below:

Table 5.2 – Summary of Coal Seams

RO03		RO04		RO07	
Depth to seam (m bgl)	**Seam thickness (m)**	**Depth to seam (m bgl)**	**Seam thickness (m)**	**Depth to seam (m bgl)**	**Seam thickness (m)**
9.5	0.3	6.3	0.5	9.3	0.5
19.3	0.3	16.1	0.3	22.3	0.4
-	-	27.7	0.3	-	-
-	-	28.7	0.2	-	-

bgl – below ground level

No evidence of workings in the form of voids, broken ground or soft push material, were encountered.

Based on the results of the investigation, the risk to the site from ground movement due to shallow mine workings is low.

Water Seepages and Stability
A single slight water seepage was recorded at 1.85m within the made ground in TP10.

The remaining trial pits and the cable percussive boreholes remained dry during the site works.

Water strikes were encountered in the rotary boreholes RO03 and RO07 at 18.5m and 24m respectively. No water strikes were recorded in RO04.

The trial pits across the majority of the site generally remained stable during excavation. However, trial pits excavated into the stockpiled made ground were found to be unstable.

5.3 Laboratory Testing

A total of four samples, comprising two samples natural clay and two samples of made ground, were submitted for geotechnical testing.

Three samples were submitted for moisture content testing and two samples were submitted for Atterberg limits testing. The results are summarised in Table 5.3 below.

Table 5.3 – Summary of Moisture Content and Atterberg Limits Testing

Material	Moisture Content (%)		Atterberg Limits Modified Plasticity Index (%)	
	No of samples	Range	No of samples	Range
Natural clay	2	17 and 30	2	22 and 34
Made Ground	1	19	-	-

The Plasticity Indices reported have been modified based on the percentage of particles smaller than 425µm. The laboratory results indicate that the natural clay can be classified as intermediate to high plasticity, which indicates a medium potential for volume change.

Particle size distribution testing was carried out on two samples of made ground in order to confirm the field descriptions of the materials.

The two samples of the made ground were submitted for maximum dry density/optimum moisture content (MDD/OMC) relationship testing.

The compaction tests were carried out using both a 2.5kg and 4.5kg hammer. The results are summarised in Table 5.3.2 below.

Table 5.3.2 - Summary of Compaction Test Results

Exp. Hole	Depth (m bgl)	Material	Weight of Rammer	Natural Moisture Content (NMC)	Max. Dry Density (Mg/m3)	Optimum Moisture Content (OMC)	Suitability for Compaction and Range of Acceptable Moisture Contents*
TP12 (SPB)	1.3-1.8	MADE GROUND: gravelly clay with occasional cobbles.	2.5kg	19	1.77	16	OK, 15.8% - 22%
TP12 (SPB)	1.3-1.8	MADE GROUND: gravelly clay with occasional cobbles.	4.5kg	19	1.91	14	Wet, 12% - 17.5%
TP13	0.5-1.0	MADE GROUND: gravelly clay with occasional cobbles.	2.5kg	24	1.65	21	OK, 19.5% - 25.7%
TP13	0.5-1.0	MADE GROUND: gravelly clay with occasional cobbles.	4.5kg	24	1.84	15	Wet, 13.8% - 19.5%

* To achieve >95% of Maximum Dry Density and <5% Air Voids.

Based on the results of the 2.5kg rammer, the made ground across the site, and that contained in the stockpile, is likely to be suitable for compaction to achieve >95% of the maximum dry density and <5% air voids.

The optimum moisture content of the compaction tests utilising the 4.5kg rammer were found to be 2% to 6% lower, than the 2.5kg tests, and the results indicate that the material at its as received moisture content was too wet to achieve sufficient compaction.

Remoulded California Bearing Ratio (CBR) tests were carried out on the same two samples of made ground at their as received moisture contents. The results are summarised in Table 5.3.3 below.

Table 5.3.3 – Summary of CBR Value Tests

Sample	Material	As Received Moisture Content (%)	CBR Value (%)	
			Sample Top	Sample Bottom
TP12 (SPA), 1.3-1.8	MADE GROUND: gravelly clay with occasional cobbles.	19	3.2	2.7
TP13, 0.5-1.0	MADE GROUND: gravelly clay with occasional cobbles.	24	4.2	4.3

CBRs ranging between 2.7 and 4.3 were achieved from the samples at , their as received moisture content.

5.4 Hydrocarbon Odours

No hydrocarbon odours were encountered at any of the exploratory locations.

5.5 Groundwater

Water strikes were encountered in the rotary boreholes RO03 and RO07 at 18.5m and 24m respectively, with single slight perched water seepage also encountered in the made ground I TP10 at 1.85m depth. Groundwater was not encountered during the drilling of cable percussive boreholes.

Monitoring wells were installed in both exploratory cable percussive boreholes. A summary of the monitored groundwater levels is presented in Table 5.5 below.

Table 5.5 – Summary of Monitored Groundwater Levels

Location	Water level during monitoring (m bgl)					
	20/03/2017	28/03/2017	05/04/2017	12/04/2017	20/04/2017	25/04/2017
BH02	Not recorded	Dry	Dry	NR	NR	NR
BH04	Dry	Dry	Dry	Dry	Dry	Dry

NR – Not recorded

The monitoring well in BH02 was installed within the natural strata, with the well in BH04 installed in the made ground.

Groundwater monitoring has been carried out on six occasions. All the boreholes remained dry throughout the monitoring period.

It should be noted that the groundwater conditions recorded are based on observations made at the time that site work was carried out. Groundwater levels will vary owing to seasonal and weather related effects.

5.6 Ground Gas

Ground gas monitoring has been undertaken on six occasions. The works were carried out using a portable gas meter in accordance with the standard JPG methodology and included measurements of methane, carbon dioxide, oxygen, hydrogen sulphide, gas flows and atmospheric pressure. The results of the gas monitoring are presented in Appendix E and discussed in Section 8.0 of this report.

6.0 GEOTECHNICAL AND ENGINEERING ASSESSMENT

6.1 Development Proposals

It is proposed to develop the site for a commercial end use. The proposed Unit A is shown on the on the layout plan, referenced below, and contained in Appendix A.

- Building Management Services, Proposed Warehouse Unit A, Capitol Park, Capitol Close, Barnsley. Site Layout Plan. Drawing No. M3016-01-SK5 Rev A, dated Febuary 2017.

The scope of the site works was based on this layout plan. Should development proposals change, then additional site investigation works may be recommended.

6.2 Foundations

The selection of foundation type will be largely governed by the thickness of the made ground and the nature of the underlying natural strata. Made ground is unsuitable for the support of structural loads due to variations in material properties. If shallow spread foundations were to be used within the made ground, the materials would become overstressed, leading to significant settlements. It is therefore recommended that foundation loads are transferred to deeper natural strata of suitable bearing capacity.

Made ground was encountered in all of the exploratory holes beneath the footprint of the proposed building at depths ranging between 0.50m and 2.20m in the north to 3.20m and 3.50m in the south.

The underlying natural strata comprised high strength (stiff) clay overlying mudstone bedrock. In TP10, in the centre of the proposed building, mudstone bedrock was encountered immediately beneath the made ground at a depth of 2.45m.

It is understood that the preferred foundation solution is pad foundations.

Based on the thickness of the made ground, mass concrete will be required to extend the pad bases to reach suitable natural founding strata.

Where the underlying natural strata comprises medium strength (firm) clay, an allowable bearing capacity of 75kN/m² for total settlements of less than 25mm will be available.

Where the underlying natural strata comprises high strength (stiff) clay, an allowable bearing capacity of 150kN/m² for total settlements of less than 25mm will be available.

Where bedrock is encountered, an allowable bearing capacity in excess of 200kN/m² will be available.

The allowable bearing capacity is a function of the foundation configuration, depth and the ability of the structure to tolerate such movements and should therefore be validated during detailed design.

6.3 Ground Floor Construction

The made ground beneath the proposed building was found to be variable in strength, ranging between locally low and medium strength (soft to firm) cohesive materials.

For a ground bearing floor slab for the unit, the made ground should be subjected to ground improvement techniques in order to provide a uniform formation and ensure an adequate bearing capacity.

The formation level should be proof rolled and inspected. Any soft or loose spots should be removed and replaced with suitably compacted granular materials.

Any earthworks should be designed in order to achieve the specified allowable bearing capacity and limits on settlement for a ground bearing floor slab.

The advice of a specialist contractor will be required to confirm that ground conditions are suitable and that adequate bearing values and tolerable settlements can be achieved.

6.4 Earthworks

Locally earthworks will be required to incorporate the stockpiled material, and for roadways, parking areas and for backfilling of excavations.

Based on the results of the geotechnical testing, the made ground and stockpiled materials are likely to be suitable to achieve adequate compaction.

Proper selection and control will be required as part of the works to use this material. The material should not be allowed to deteriorate during excavation and compaction and must be sufficiently protected from traffic and adverse weather conditions after placement.

If the material does deteriorate then consideration should be given to the addition of lime and/or cement to improve the material for use as general fill.

It is recommended that a detailed Earthworks Specification is produced prior to commencement of works on the site. This should be developed in conjunction with the Earthworks Contractor/Stabilisation Contractor and should include a strategy to deal with the treatment of the material during the works.

6.5 Roads, Pavements and Hardstanding Surfaces

In accordance with the current proposed layout, the formation for road pavements and parking areas is unlikely to be natural clay strata.

Laboratory CBR values of 2.7% to 4.3% were obtained for samples of the made ground. Due to the variability in material properties of the made ground, it is recommended that a CBR value of 2% should be adopted.

Prior to roads and hardstanding being formed, the formation should be proof rolled and any soft spots removed and replaced with well compacted suitable granular fill. Any substructure remains should be "grubbed out" to a minimum depth of 500mm below the underside of formation to prevent hard spots from forming.

Any earthworks carried out as part of the redevelopment works may result in changes to the sub-grade materials. The works should therefore be designed to achieve a suitable CBR value for the proposed development.

6.6 Excavations

Excavations through the made ground and shallow natural ground should remain dry and stable in the short term. However, if excavations are left open for long periods of time, it is envisaged instability may eventually occur.

Small volumes of perched water may be encountered in deeper excavations which may be dealt with by pumping from sumps.

Good working practice with respect to drainage of excavations and formations will be required to protect materials. Any excavation for structural foundations must be covered without delay with blinding concrete to prevent softening by water.

The requirement for temporary support of excavations should be assessed on an individual basis and, in any case, excavations of greater than 1.2m depth requiring man entry will require temporary support in accordance with HSE guidance. Alternatively, the sides of the excavation will need to be battered back for the safety of operatives. Guidance on safe batter slopes can be obtained from CIRIA Report 97 Trenching Practice.

6.7 Obstructions

No obstructions were encountered during the site investigation. However, shallow rock, which was found to be hard to dig locally, and was also substantial enough to halt the progress of the boreholes, was encountered across the site.

6.8 Chemical Attack on Buried Concrete

Laboratory testing has been undertaken on samples of the made ground and natural ground to determine the sulphate content and acidity and hence the concrete class required for buried concrete.

Laboratory testing in the made ground recorded water soluble sulphate contents ranging between 31mg/l and 94mg/l and pH values between 5.1 and 8.4.

In the natural ground, water soluble sulphate contents of 24mg/l and 31mg/l and pH values of 6.9 and 7.4 were recorded.

Foundations are likely to come into contact with made ground and natural ground.

On this basis it is recommended that concrete should be designed to Aggressive Chemical Environment for Concrete (ACEC) Design Sulphate Class DS-1 and ACEC Class AC-2z.

This assessment has been made in accordance with BRE Special Digest 1: 2005, entitled 'Concrete in Aggressive Ground'.

7.0 ENVIRONMENTAL RISK ASSESSMENT

7.1 Introduction

Legislation and guidance on the assessment of contaminated sites acknowledges the need for a tiered risk based approach comprising:

Tier 1 Assessment	Comparison of site contaminant concentrations against generic assessment criteria (GAC), i.e. a generic quantitative risk assessment (GQRA). Including an assessment of risk using the source-pathway-receptor model.
Tier 2 Assessment	Derivation of site specific risk assessment criteria and calculation of site specific clean up goals, i.e. a detailed quantitative risk assessment (DQRA).

A Tier 1 Assessment has been completed; however, a Tier 2 Assessment has not been undertaken as part of this report.

The statutory definition of contaminated land is given in the Environmental Protection Act, Part IIA, Section 78, 1990, which was introduced by the Environment Act, Section 57, Department of Environment, 1995 and is defined as:

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 there is a significant possibility of such harm being caused (where harm is defined as harm to health of living organisms or other interference with the ecological systems of which they form a part and, in the case of man, includes harm to his property); and/or
- Significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused (by the land).

The presence of contaminated materials on a site is generally only of concern if an actual or potentially unacceptable risk exists. The potential for harm to occur requires three conditions to be satisfied:

- **Sources** – The presence of substances (potential contaminants/pollutants), in or under the ground, that may cause harm or pollution.
- **Receptors** - The presence of a receptor which may be harmed, e.g. the water environment or humans, buildings, fauna and flora; and
- **Pathway** - The existence of a linkage between the Source and the Receptor.

In order to assess the contamination risk at the site, the above rationale has been applied and is discussed in the context of Contamination Sources and Potential Pollutant Linkages.

In summary, the presence of measurable concentrations of contaminants within the ground and subsurface environment does not automatically imply that a contamination problem exists, since contamination must be defined in terms of pollutant linkages and an unacceptable risk of harm to available receptors.

The nature and importance of both pathways and receptors, which are relevant to a particular site, will vary according to the sensitivity of the intended end use of the site and the sites characteristics and environmental setting.

7.2 Assessment Approach

The results of the chemical analysis for each determinand will be assessed against their respective GAC.

These include the LQM/CIEH Suitable 4 Use Levels (S4UL) and Category 4 Screening Levels (C4SL) which were developed using the UK Contaminated Land Exposure Assessment (CLEA) Framework Documents and Software.

The CLEA model uses generic assumptions about the fate and transport of chemicals in the environment and a generic conceptual model (referred to as generic land use scenarios) for site conditions and human behaviour, to estimate child and adult exposures to soil contaminants for those living, working and/or playing on contaminated sites over long time periods.

The S4UL and C4SL screening levels have been derived for a variety of land uses including residential, allotments, commercial and public open space.

In the absence of S4UL and C4SL for potential contaminants, appropriate alternative GAC will be used.

Controlled Waters
No standards currently exist in the UK which provides threshold values for potential contamination in groundwater. Alternative guidance is therefore used, against which the significance of potential contaminants can be assessed.

The results of the leachate analyses will be compared to the same standards as for groundwater.

7.3 Evaluation of Soils Analysis

Initially, the results of the chemical analysis for each potential contaminant will be compared directly with their respective GAC. Based on the current development proposals for the site, i.e. commercial, the results of the chemical analysis for the soil samples have been assessed against GAC for a commercial end use.

If any significant exceedances of the GAC are noted, then the results will be subject to statistical analysis if appropriate. An outline of the methodology of the statistical analysis is presented in Appendix C.

In total, seven samples of made ground were submitted for chemical analysis and an asbestos screen, with selected samples submitted further for TPHCWG analysis. A summary of the results of the chemical analysis is provided below.

Human Health

The results have been compared directly with their respective GAC and are summarised in Table 7.3 below.

Table 7.3 – Summary of Chemical Analysis for Samples of Made Ground

Determinand	GAC for Commercial End Use (mg/kg)	Sample Mean (mg/kg)	Range of Results (mg/kg)	Do any samples exceed the GAC?
Arsenic	640(1)	11.6	8 – 24	No
Cadmium	190(1)	0.1	<0.1-0.2	No
Chromium	8600(1)	18.7	17 – 22	No
Hexavalent Chromium	33 (1)	1.0	All <1.0	No
Copper	68000(1)	35.6	24 – 53	No
Lead	2330(2)	24.4	17 – 40	No
Mercury (Inorganic)	1,100 (1)	0.1	All < 0.05	No
Nickel	980(1)	25.1	16 – 37	No
Selenium	12000(1)	0.5	< 0.5 – 0.7	No
Zinc	730000(1)	74.1	43 – 99	No
Cyanide (free)	20(3)	< 0.1	All < 0.1	No
Total Phenols	440*(1)	0.4	< 0.3 – 0.6	No
Naphthalene	190*(1)	< 0.1	All < 0.1	No
Acenaphthylene	83,000*(1)	< 0.1	All < 0.1	No
Acenaphthene	84,000*(1)	0.1	< 0.1 – 0.1	No
Fluorene	63,000*(1)	< 0.1	All < 0.1	No
Phenanthrene	22000*(1)	0.2	< 0.1 – 0.6	No
Anthracene	520,000*(1)	0.1	< 0.1 – 0.3	No
Fluoranthene	23000*(1)	0.5	< 0.1 – 2.2	No
Pyrene	54000*(1)	0.5	< 0.1 – 1.8	No
Benz(a)anthracene	170*(1)	0.4	< 0.1 – 1.3	No
Chrysene	350*(1)	0.3	< 0.1 – 1.0	No
Benzo(b)fluoranthene	44*(1)	0.2	< 0.1 – 0.6	No
Benzo(k)fluoranthene	1200*(1)	0.2	< 0.1 – 0.5	No
Benzo(a)pyrene	35*(1)	0.4	< 0.1 – 1.4	No
Indeno(123-cd)pyrene	500*(1)	0.2	< 0.1 – 0.6	No
Dibenzo(ah)anthracene	3.5*(1)	< 0.1	All < 0.1	No
Benzo(ghi)perylene	3,900*(1)	0.2	< 0.1 – 0.5	No

(1) S4UL * BASED ON 1% SOM, (2) C4SL, (3) DUTCH

None of the above determinands were detected at concentrations in excess of their respective GAC.

Two samples (TP07 at 1.6m to 1.8m and TP12a at 0.5m to 1.0m) were submitted for TPHCWG analysis. No hydrocarbon fractions were detected at concentrations above their respective S4UL GAC.

All seven samples were submitted for an asbestos screen. No asbestos was detected in any of the samples.

7.4 Evaluation of Controlled Waters Analysis

Seven samples of made ground were submitted for leachability analysis. The result for each determinand was compared directly with their respective GAC, the results are summarised in Table 7.4 below.

Table 7.4 – Summary of Leachability Results

Determinand	GAC (µg/l)	TP07, 1.6-1.8	TP10, 0-0.5	TP11, 0-0.5	TP16, 0.5-1.0	TP17, 0-0.5	TP12 (SPB), 0-0.5	TP12A(SPB), 0.5-1.0
Arsenic	50(1)	< 0.16	< 0.16	1.8	0.31	0.73	1.5	0.18
Cadmium	5(1)	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Chromium	50(1)	< 0.25	< 0.25	0.33	< 0.25	< 0.25	0.87	< 0.25
Copper	2000(1)	< 0.4	< 0.4	2.1	0.5	0.8	2.6	0.4
Lead	10(1)	0.11	< 0.09	0.44	0.15	0.38	0.92	< 0.09
Mercury	1(1)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Nickel	20(1)	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	1.3	< 0.5
Selenium	10(1)	< 0.25	< 0.25	< 0.25	0.25	1.4	0.58	0.38
Zinc	5000(1) *	< 1.3	9.1	5	< 1.3	< 1.3	3.5	< 1.3
pH	6.5-9.5(1)	6.4	6.7	6.8	6.1	6.5	6.6	6.8
Cyanide free	50(1)	20	20	20	20	20	20	20
Sulphate as SO4	250000(1)	1600	24000	2500	4100	7100	2300	4100
Naphthalene	4.24 (2)	< 0.01	0.01	0.04	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	NA	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	NA	< 0.01	0.06	0.07	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	NA	< 0.01	0.05	0.07	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	NA	< 0.01	0.07	0.17	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	0.193(2)	< 0.01	0.02	0.05	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	0.0122(2)	< 0.01	0.07	0.1	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	NA	< 0.01	0.05	0.07	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	NA	< 0.01	0.01	0.09	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	NA	< 0.01	< 0.01	0.51	< 0.01	< 0.01	< 0.01	< 0.01
Sum of: benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-c,d)pyrene benzo(g,h,i)perylene	0.1(1)	0.04	0.04	0.09	0.04	0.04	0.04	0.04
Benzo(a)pyrene	0.01(1)	< 0.01	< 0.01	0.04	< 0.01	< 0.01	< 0.01	< 0.01
Dibenzo (a, h) anthracene	NA	< 0.01	< 0.01	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenol	14.9 (2)	< 0.05	< 0.05	0.05	< 0.05	< 0.05	< 0.05	< 0.05

(1) Water Supply (Water Quality) Regulations 2000.
*Historical 1989 Threshold Value.
(2) Water Framework Directive 2015, Surface Water, Maximum Threshold Value.

Slightly elevated concentrations of potentially leachable fluoranthene were detected in two samples (TP10 and TP11, both 0m to 0.5m).

A slightly elevated concentration of benzo(a)pyrene was also detected in one sample (TP11, 0m to 0.5m).

7.5 Summary of Potential Sources, Pathways and Receptors

Potential Sources
Based on the results of the analysis carried out, the following potential sources of contamination are considered to be present on the site:

- Slightly elevated concentrations of potentially leachable fluoranthene and benzo(a)pyrene from shallow depth in TP10 and TP11.
- Hazardous ground gases.

Potential Pathways
Based on the available information and the proposed redevelopment of the site for a commercial end use, the following potential exposure pathways will require consideration, both during the redevelopment works and on completion of the construction:

- Inhalation of hazardous gases.
- Leaching/migration of contaminants into groundwater and surface water via groundwater and surface water flow.
- Permeation of water supply pipes and other services by organic and aggressive contaminants; and
- Uptake of contaminants by amenity planting.

Potential Receptors
The potential receptors are considered to be:

- Development workers and future maintenance workers involved in excavations, e.g. foundations or where services are being installed or repaired following development.
- Future end users of the site (e.g. employees and customers).
- Groundwater in the underlying Secondary A Aquifer.
- Surface Watercourse – a drain at 120m to the west of the site.
- Buildings and services; and
- Amenity planting.

7.6 Source – Pathway – Receptor Linkages

Based on the above potential sources, pathways and receptors, the following linkage assessments have been considered. A conceptual site model illustrating the pollutant linkages at the site is presented as Figure 3 in Appendix A and discussed below.

This assessment is based on current site conditions (unless stated) and does not consider exposure pathways following any further works on the site.

Development and Maintenance Workers
Based on the sources of potential contamination which have been identified on the site, there is a risk to development and maintenance workers involved in groundworks at the site.

There is the potential for exposure to the following:

- Hazardous ground gases. (Discussed in Section 8.0).

Future Site End Users
It is unlikely that future site end users will come into contact with the site in its current condition. However, there is the potential for exposure to the following:

- Hazardous ground gases (Discussed in Section 8.0).

The Underlying Aquifers and Surface Watercourse
The risk to controlled water receptors is assessed below:

- Slightly elevated concentrations of potentially leachable fluoranthene and benzo(a)pyrene was detected in samples of made ground from shallow depth in TP10 and TP11.
- The Water Supply (Water Quality) Regulations, from which the GAC for benzo(a)pyrene has been derived, is considered to be conservative when applied to an assessment of risks to groundwater.

In addition, consideration has been given to the environmental setting of the site.

- Where made ground was encountered, it was generally underlain by natural strata comprising impermeable clay. The underlying clay will form a barrier and reduce the potential for downward migration.
- No significant shallow groundwater was encountered on or in the vicinity of the site (i.e. no shallow groundwater was encountered in a deeper borehole drilled on the adjacent site).
- There are no groundwater or surface water abstractions within 1km of the site.
- There are no surface watercourses within 120m.

Based on the slightly elevated concentrations of potentially leachable contaminants which have been detected and the environmental setting of the site. There are no plausible linkages to surface or groundwater receptors. The risk to controlled waters is therefore considered to be low.

Buildings and Services
Based on the potential sources of contamination which have been identified on the site, there may be a risk to buildings and services, such as water supply pipes and buried concrete.

Amenity Planting
Based on the potential source of contamination and nature of the made ground, there is not considered to be a significant risk to plants on the site. However, for areas of proposed soft landscaping, provision of a suitable thickness of clean growing medium, i.e. subsoil/topsoil, will be required in order to promote plant growth.

7.7 Mitigation Measures

In order to mitigate the risks posed by the potential contaminants which are present on the site, consideration should be given to the following mitigation measures.

Development and Maintenance Workers
In order to mitigate the risks posed by the potential slightly elevated PAH species present on the site, consideration should be given to the following mitigation measures:

- Site workers involved in groundworks should take the necessary measures to ensure that all works in excavations and confined spaces are carried out in accordance with best practice in order to prevent exposure to potentially hazardous gases.
- Site workers involved in groundworks should use appropriate PPE, i.e. overalls and gloves and where appropriate, masks. Appropriate health and safety measures, e.g. washing hands prior to eating or drinking, should also be enforced.

During development of the site, all workers should remain vigilant to the possible risk of encountering areas of potentially contaminated material. Should potentially contaminated material be encountered, site management should be informed. Further testing may then be required to assess the risk to health and safety of the site workers and the environment.

All employers involved in works at the site should produce an appropriate method statement and risk assessment, to which all employees should comply.

Reference should also be made to appropriate HSE and other guidance for working on contaminated and potentially contaminated sites.

Future Site Users
Recommendations for gas protection measures are provided in Section 8.0 of this report.

Buildings and Services
Recommendations with respect to the chemical attack on buried concrete are given section 6.8.

Based on the concentrations of potential contaminants within the made ground, it is considered unlikely that there will be a requirement for upgrading any proposed new water service pipes. Confirmation should be sought from the utilities provider.

7.8 Classification of Materials for Disposal Off-Site

Five samples of made ground from across the site, and two samples of the material from the stockpile, were assessed using HazWasteOnline^{tm} in order to determine the classification of the materials for disposal offsite.

Based on the results of the chemical analysis, all the samples can be classified as non-hazardous. Details of the classification generated by HazWasteOnlinetm, are presented in Appendix C.

The results of the chemical analysis and the waste classification should be forwarded to the landfill operator to confirm this assessment and provide a price for disposal.

8.0 HAZARDOUS GAS MONITORING

8.1 Potential Gas Sources

Based on the desk study information and ground conditions encountered, it is considered that there is the potential for the presence of hazardous gases on the site.

8.2 Ground Gas Monitoring

In order to assess the potential risks posed to the proposed development from hazardous gases, monitoring wells were installed the cable percussive boreholes.

Ground gas monitoring has been undertaken on six occasions. The works were carried out using a portable infra-red gas meter in accordance with the standard JPG methodology and included the measurement of methane, carbon dioxide, oxygen, hydrogen sulphide, gas flows and atmospheric pressure.

8.3 Summary of Results

The results of the gas monitoring are presented on the site visit record sheets in Appendix E and are summarised below:

- A single steady concentration of methane of 1.1%v/v was recorded BH04 during the first monitoring visit. No other concentrations of methane were recorded.
- Steady concentrations of carbon dioxide were recorded in both installations, ranging between 1.9%v/v and 5.5%v/v. A single concentration of greater than 5%v/v was recorded in BH02 during the fourth monitoring visit.
- Reduced oxygen concentrations (i.e. <16%v/v) were recorded in both installations on the majority of monitoring visits.
- A single steady flow of 0.5 l/hr was recorded in BH02 during the fourth monitoring visit. No other steady flows were recorded.
- Three of the monitoring visits were carried out during periods of falling atmospheric pressure.

Barometric pressures during the monitoring period ranged between 994mB and 1012mB.

No water has been detected in either borehole and, therefore, there are no flooded response zones.

8.4 Requirements for Gas Protection Measures

The results of the gas monitoring have been assessed in accordance with CIRIA Report C665 'Assessing risks posed by hazardous ground gases to buildings' and BS 8485:2015, 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'.

A single steady concentration of methane of 1.1%v/v was recorded in BH04. A concentrations of carbon dioxide of 5.5%v/v was recorded in BH02 and a single isolated steady flow was recorded in BH02. Reduced oxygen concentrations have also been recorded.

Steady concentration of carbon dioxide in excess of 5% v/v and steady flows have also been recorded on the adjacent site.

Based on these results, the site is characterised as Characteristic Situation 2.

CIRIA C665
The risk to the site has been assessed in accordance with 'Situation A', i.e. a commercial end use.

The measures should comprise the following:

- Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with at least 1200 g DPM2.
- Beam and block or pre-cast concrete slab and minimum 2000 g DPM/reinforced gas membrane.
- Possibly underfloor venting or pressurisation in combination with the above, depending on use.
- All joints and penetrations sealed.

BS 8485:2015
The British Standard takes into account the gas characteristic situation and the nature of the proposed development.

Four building types are prescribed in the standard, ranging from small buildings, e.g. houses (Type A), through to large well ventilated buildings, e.g. warehouses (Type D). A gas protection score is then determined, based on the characteristic situation and building type.

This assessment will be carried out based on the proposed development comprising a commercial unit, with the following assumptions:

- The proposed development will comprise industrial style buildings with large volume well ventilated internal spaces.
- There will be building management controls on alterations to the ground floor and any basement areas.
- Ground gas protective measures will be maintained for the life of the building.

Gas characteristic situation 2 has been determined for the development. Therefore, for building Type D, a gas protection score of 1.5 will be required.

Based on the gas protection score, an element or combination of elements should be selected from the following:

- Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations. The slab should be well reinforced to control cracking.
- A sufficiently impervious sealed gas resistant membrane lapped through walls and sealed around penetrations.

It is also recommended that further advice be sought from a gas protection specialist to assess whether alternative measures may offer the same level of protection for the proposed development.

8.5 Radon Risks

The site is in a radon affected area, as between 1% and 3% of properties are above the action level for radon gas. However, no radon protective measures are required in the construction of new properties.



J Parkinson
BSc
For and on behalf of JPG (Leeds) Limited

April 2017

Appendix A Figures/Drawings



Figure 1 – Site Location Plan	
Site	**Unit A, Capitol Park, Capitol Close, Barnsley**
Client	**Commercial Development Projects Limited**
Job Number	**2450**
Scale	**NTS**

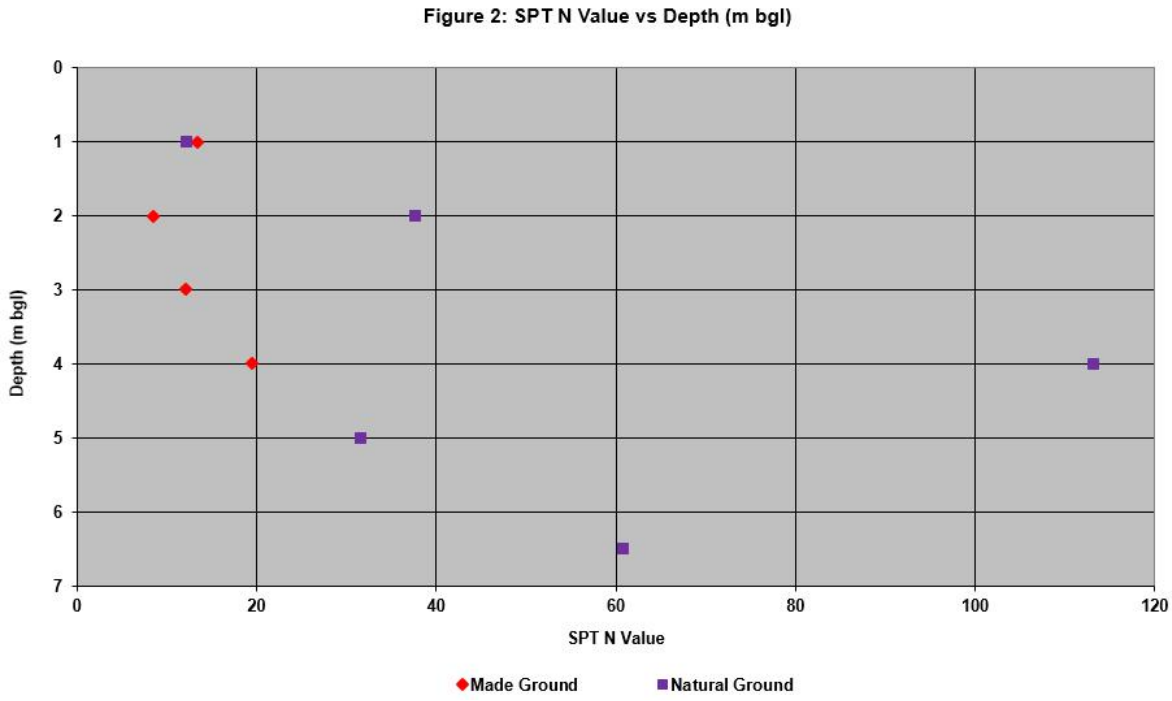


Figure 2 – SPT N Value vs Depth	
Site	**Unit A, Capitol Park, Capitol Close, Barnsley**
Client	**Commercial Development Projects Limited**
Job Number	**2450**

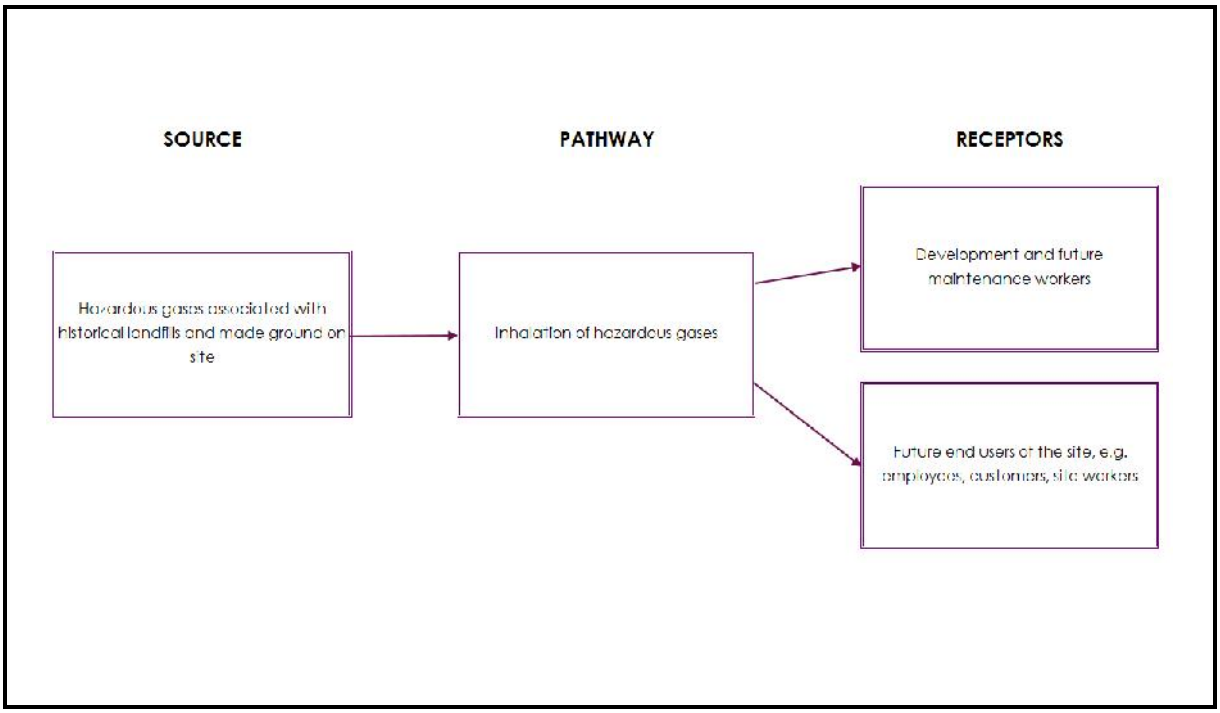
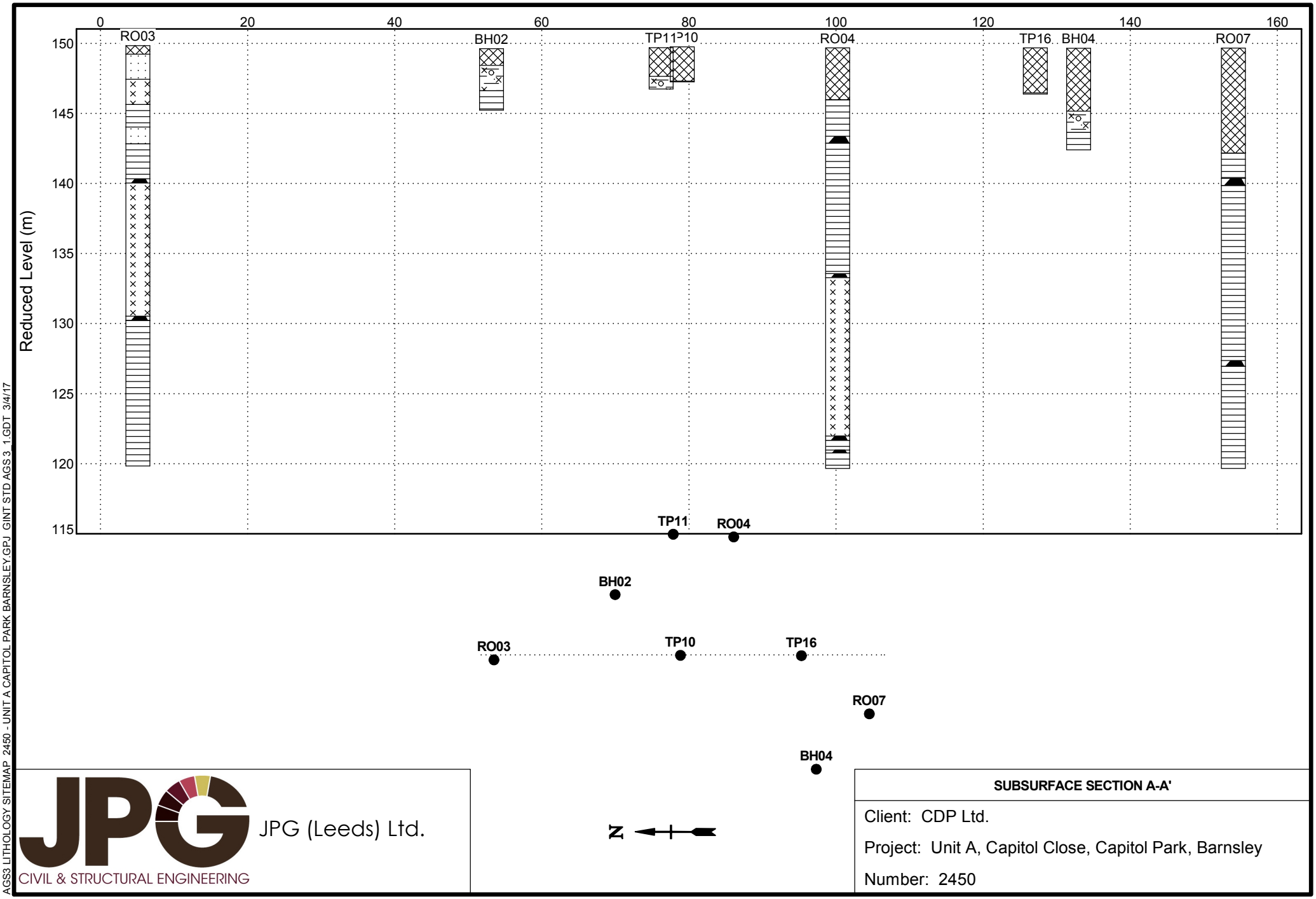


Figure 3 – Conceptual Site Model	
Site	**Unit A, Capitol Park, Capitol Close, Barnsley**
Client	**Commercial Development Projects Limited**
Job Number	**2450**



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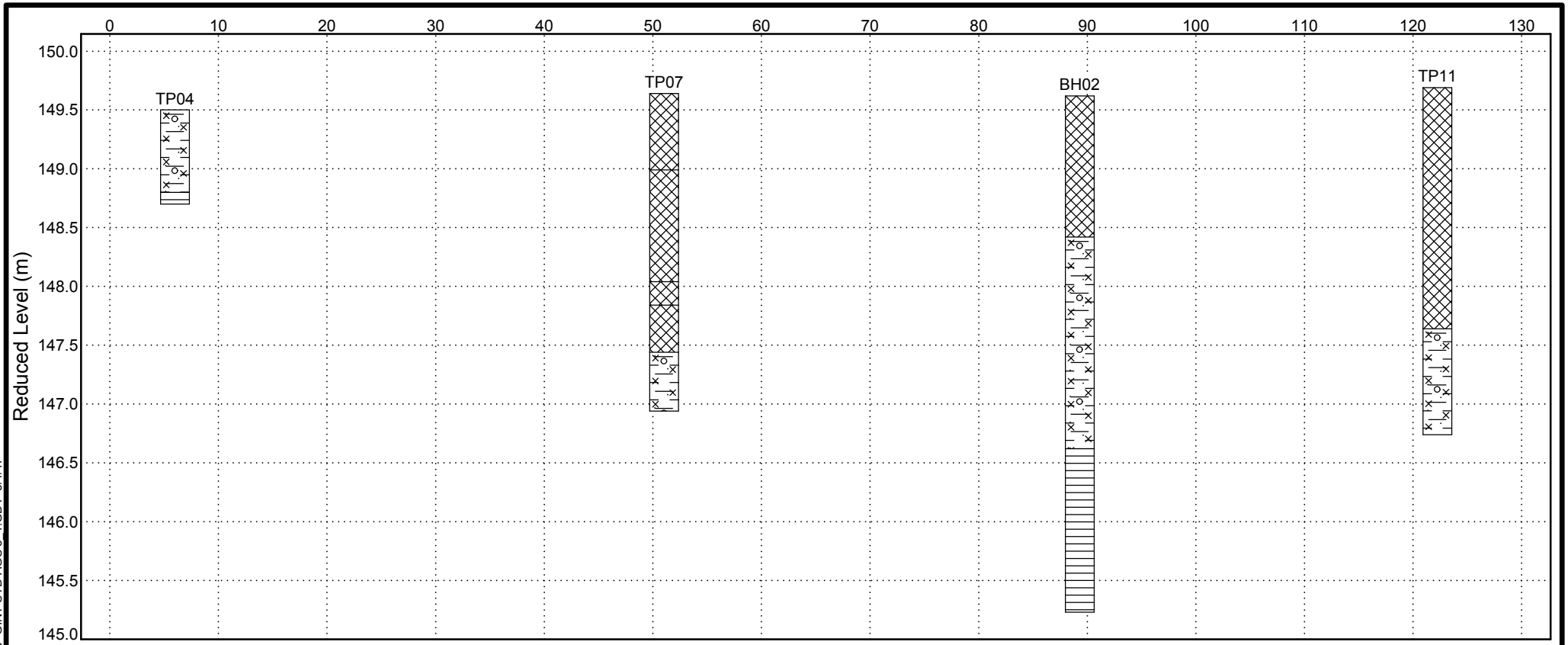
SUBSURFACE SECTION A-A'

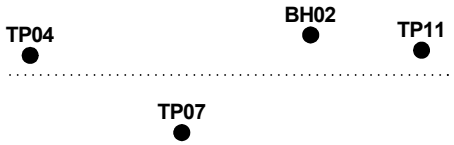
Client: CDP Ltd.

Project: Unit A, Capitol Close, Capitol Park, Barnsley

Number: 2450

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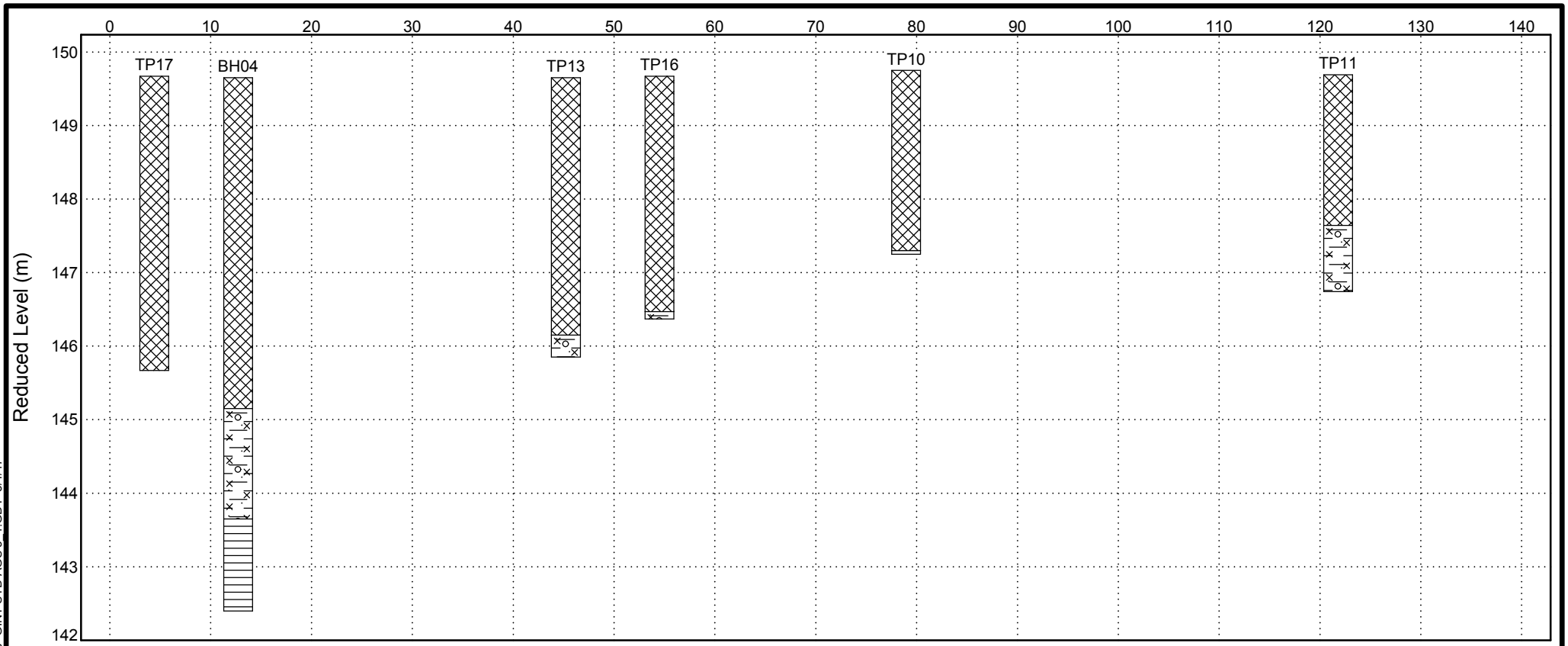
SUBSURFACE SECTION B-B'

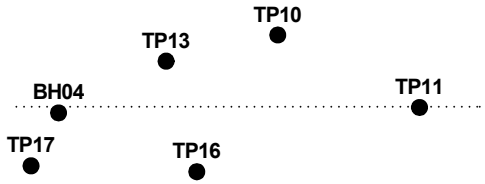
Client: CDP Ltd.

Project: Unit A, Capitol Close, Capitol Park, Barnsley

Number: 2450

AGS3 LITHOLOGY SITEMAP 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17





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SUBSURFACE SECTION C-C'

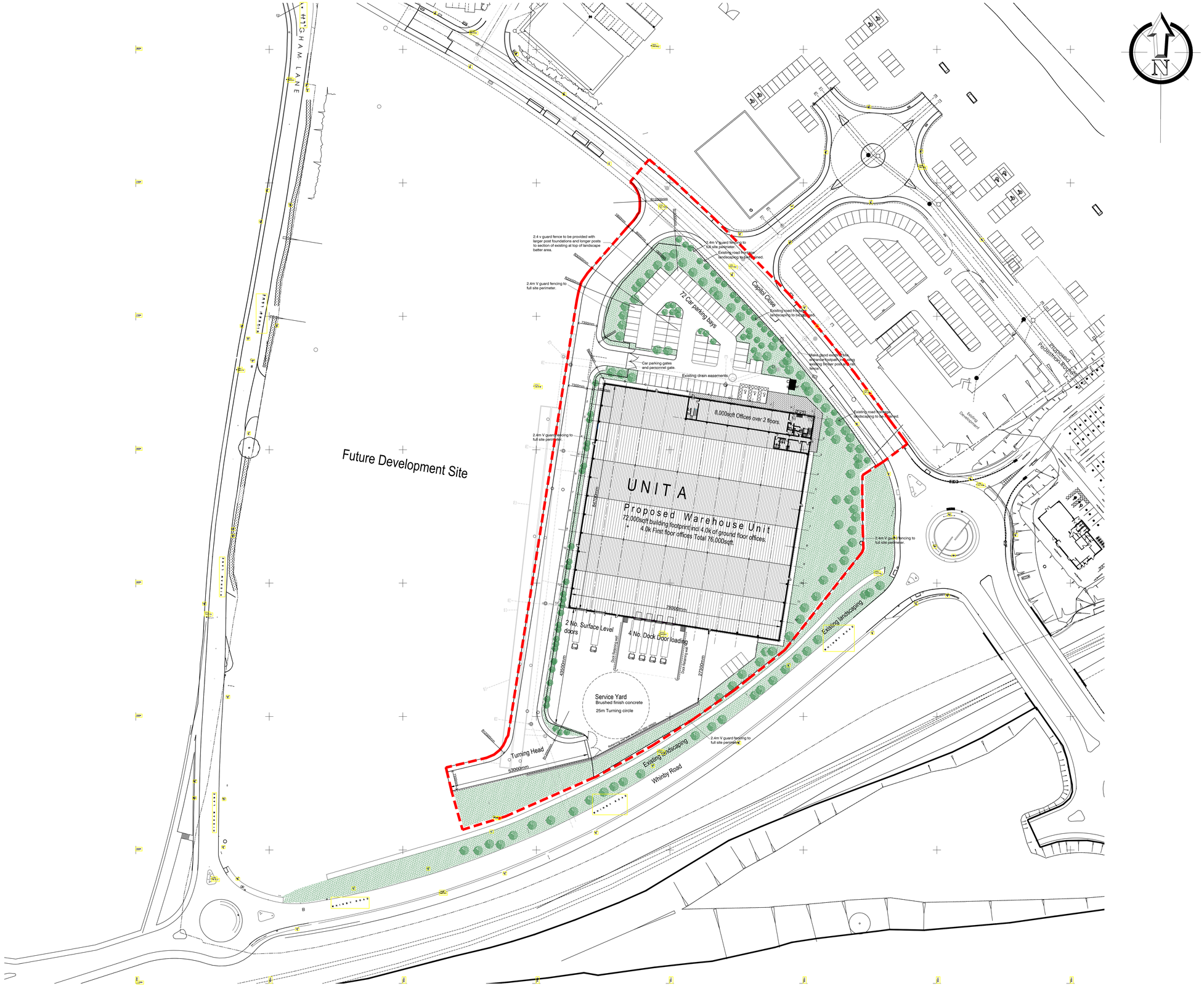
Client: CDP Ltd.

Project: Unit A, Capitol Close, Capitol Park, Barnsley

Number: 2450

AGS3 LITHOLOGY SITEMAP 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

Unit A - Capitol Park, Capitol Close, Barnsley.



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Notes

Revisions

Rev	Date	Description
Rev A	21.2.17	Left hand side radius to new access road revised to 15m.

BUILDING MANAGEMENT SERVICES LTD

Huddersfield Road
Elland, West Yorkshire
HX5 9BW
TELEPHONE : ELLAND (01422) 371616
FAX No : (01422) 376717
email : mail@bmselland.com

Building Management Services

Client

commercial development projects limited

Project

Proposed Warehouse Unit A,
Capitol Park, Capitol Close,
Barnsley.

Sheet

Site Layout Plan.

Drawn: DCH	Date: FEB 17
Scale: 1:500@A0	
Status: PLANNING	
Drawing No.: M3016-01-SK5	Revision: Rev A

Appendix B Exploratory Hole Logs and Plan

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DO NOT SCALE

NOTES

KEY:

BH01	INDICATES JPG BOREHOLES - MARCH 2017
TP07	INDICATES JPG TRIAL PITS - MARCH 2017
R04	INDICATES JPG ROTARY OPEN HOLES - MARCH 2017
TT01/TT01'	INDICATES JPG TRIAL TRENCHES - MARCH 2017

REV	DESCRIPTION	DATE	BY

Job Title
UNIT A - CAPITOL PARK
CAPITOL CLOSE
BARNSLEY

Drawing Title
EXPLORATORY HOLE
LOCATION PLAN

Architect
BUILDING MANAGEMENT SERVICES

JPG
www.jpggroup.global
Leeds: +44 (0)113 263 1155 | Also: London & Muscat

Checked	Date	Scale		Drawn
KB	Feb '17	1:250	A0	MT

Drawing No 2450-EHLP01

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BOREHOLE LOG

Project				BOREHOLE No
Unit A, Capitol Close, Capitol Park, Barnsley				**BH02**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	13-03-17 13-03-17	149.62	E 431,801.0 N 406,011.0	
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.50	B					(1.20)	MADE GROUND: Medium strength (firm) grey slightly silty slightly sandy slightly gravelly clay. Gravel is angular, of sandstone and mudstone, and also of rare brick and coal fragments.		
1.00		N10		148.42		1.20			
1.50-2.00	B						High strength (stiff) yellowish brown and light grey mottled slightly silty slightly sandy CLAY with rare gravel. Gravel is tabular, of brown mudstone. (Weathered Pennine Middle Coal Measures Formation)		
2.00		N31				(1.80)			
2.50-3.00	B								
3.00		N50/ 185 mm		146.62		3.00	Extremely weak brown thinly laminated MUDSTONE. Arising as angular and tabular gravel. (Pennine Middle Coal Measures Formation)		
3.50-4.00	B					(1.39)			
4.00		N50/ 240 mm		145.23		4.39			
							- borehole terminated on impenetrable strata.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
						3.5	4	1			-No groundwater encountered. -No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:62.5	Client CDP Ltd.	Method/ Plant Used Dando 2000	Logged By JP

AGS3 UK BH 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

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CIVIL & STRUCTURAL ENGINEERING

BOREHOLE LOG

Project				BOREHOLE No
Unit A, Capitol Close, Capitol Park, Barnsley				**BH04**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	14-03-17 14-03-17	149.65	E 431,732.0 N 405,931.0	
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.50-1.00	B						MADE GROUND: Medium strength (firm) grey slightly silty slightly sandy slightly gravelly clay. Gravel is angular, of sandstone and mudstone, and also of rare brick and coal fragments.		
1.00		N11							
1.50-2.00	B								
2.00		N7				(4.50)	2.00 - low strength (soft).		
2.50-3.00	B								
3.00		N10					3.00 - medium strength (firm).		
3.50-4.00	B								
4.00		N26		145.15		4.50			
4.50-5.00	B						High strength (stiff) yellowish brown and light grey mottled slightly silty slightly sandy CLAY with rare gravel. Gravel is tabular, of brown mudstone. (Weathered Pennine Middle Coal Measures Formation)		
5.00		N26				(1.50)			
5.50-6.00	B								
6.00		N50		143.65		6.00			
6.50-7.00	B						Extremely weak brown thinly laminated MUDSTONE. Arising as angular and tabular gravel. (Pennine Middle Coal Measures Formation)		
7.00		N50/ 100 mm				(1.25)			
				142.40		7.25			
							- borehole terminated on impenetrable strata.		

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt

Chiselling			Water Added	
From	To	Hours	From	To
6.5	7	0.75		

GENERAL REMARKS

-No groundwater encountered.
-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:62.5	Client CDP Ltd.	Method/ Plant Used Dando 2000	Logged By JP

AGS3 UK BH 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

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DRILLHOLE LOG

Project				DRILLHOLE No
Unit A, Capitol Close, Capitol Park, Barnsley				**RO03**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	14-03-17 14-03-17	149.83	E 431,775.0 N 406,059.0	
Contractor				Sheet 1 of 3

RUN DETAILS					STRATA			
Depth / Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION Main/Detail	Discontinuities	Geology	Instrument/ Backfill
			149.23		(0.60) 0.60	MADE GROUND: Brown clay.			
			147.43		(1.80) 2.40	Brown SANDSTONE. (Pennine Middle Coal Measures Formation)			
			145.63		(1.80) 4.20	Brown/grey SILTSTONE. (Pennine Middle Coal Measures Formation)			
			144.03		(1.60) 5.80	Grey MUDSTONE. (Pennine Middle Coal Measures Formation)			
			142.83		(1.20) 7.00	Brown SANDSTONE. (Pennine Middle Coal Measures Formation)			
			140.33		(2.50) 9.50	Grey MUDSTONE. (Pennine Middle Coal Measures Formation)			
			140.03		9.80	COAL. (Pennine Middle Coal Measures Formation)			

Drilling Progress and Water Observations						
Date	Time	Depth	Casing	Core Dia mm	Water Strike	Water Standing

Rotary Flush			
From	To	Type	Returns
0	30	Mist.	100

GENERAL REMARKS

-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:62.5	Client CDP Ltd.	Method/ Plant Used Lorry Mounted Rig	Logged By JP

AGS3 UK DH - JPG 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

JPG (Leeds) Ltd.
CIVIL & STRUCTURAL ENGINEERING

DRILLHOLE LOG

Project				DRILLHOLE No
Unit A, Capitol Close, Capitol Park, Barnsley				RO03
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	14-03-17 14-03-17	149.83	E 431,775.0 N 406,059.0	
Contractor				Sheet 2 of 3

RUN DETAILS					STRATA			
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION Main/Detail	Discontinuities	Geology	Instrument/ Backfill
					(9.50)	Grey SILTSTONE. (Pennine Middle Coal Measures Formation) *(continued)*			
			130.53		19.30				
			130.23		19.60	COAL. (Pennine Middle Coal Measures Formation)			

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Water Strike	Standing	From	To	Type	Returns	
					18.5						-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:62.5	Client CDP Ltd.	Method/ Plant Used Lorry Mounted Rig	Logged By JP

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DRILLHOLE LOG

Project				DRILLHOLE No
Unit A, Capitol Close, Capitol Park, Barnsley				**RO03**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	14-03-17 14-03-17	149.83	E 431,775.0 N 406,059.0	
Contractor				Sheet 3 of 3

RUN DETAILS						STRATA			
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION Main/Detail	Discontinuities	Geology	Instrument/ Backfill
						Grey MUDSTONE. (Pennine Middle Coal Measures Formation) *(continued)*			
					(10.40)				
			119.83		30.00				

Drilling Progress and Water Observations						
Date	Time	Depth	Casing	Core Dia mm	Water Strike	Water Standing

Rotary Flush			
From	To	Type	Returns

GENERAL REMARKS

-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:62.5	Client CDP Ltd.	Method/ Plant Used Lorry Mounted Rig	Logged By JP

AGS3 UK DH - JPG 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

JPG (Leeds) Ltd.
CIVIL & STRUCTURAL ENGINEERING

DRILLHOLE LOG

Project				DRILLHOLE No
Unit A, Capitol Close, Capitol Park, Barnsley				RO04
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	14-03-17 14-03-17	149.67	E 431,824.0 N 405,964.0	
Contractor				Sheet 1 of 3

RUN DETAILS						STRATA			
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION Main/Detail	Discontinuities	Geology	Instrument/ Backfill
					(3.70)	MADE GROUND: Brown clay.			
			145.97		3.70				
					(2.60)	Grey/brown MUDSTONE. (Pennine Middle Coal Measures Formation)			
			143.37		6.30				
			142.87		(0.50) 6.80	COAL. (Pennine Middle Coal Measures Formation)			
						Grey MUDSTONE. (Pennine Middle Coal Measures Formation)			

Drilling Progress and Water Observations						
Date	Time	Depth	Casing	Core Dia mm	Water Strike	Water Standing

Rotary Flush			
From	To	Type	Returns
0	30	Air.	100

GENERAL REMARKS

-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:62.5	Client CDP Ltd.	Method/ Plant Used Lorry Mounted Rig	Logged By JP

AGS3 UK DH - JPG 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

JPG (Leeds) Ltd.
CIVIL & STRUCTURAL ENGINEERING

DRILLHOLE LOG

Project				DRILLHOLE No
Unit A, Capitol Close, Capitol Park, Barnsley				**RO04**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	14-03-17 14-03-17	149.67	E 431,824.0 N 405,964.0	
Contractor				Sheet 2 of 3

RUN DETAILS					STRATA			
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION Main/Detail	Discontinuities	Geology	Instrument/ Backfill
						Grey MUDSTONE. (Pennine Middle Coal Measures Formation) *(continued)*			
					(9.30)				
			133.57		16.10				
			133.27		16.40	COAL. (Pennine Middle Coal Measures Formation)			
						Grey SILTSTONE. (Pennine Middle Coal Measures Formation)			

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Water Strike	Water Standing	From	To	Type	Returns	-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:62.5	Client CDP Ltd.	Method/ Plant Used Lorry Mounted Rig	Logged By JP

JPG (Leeds) Ltd.

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DRILLHOLE LOG

Project				DRILLHOLE No
Unit A, Capitol Close, Capitol Park, Barnsley				**RO04**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	14-03-17 14-03-17	149.67	E 431,824.0 N 405,964.0	
Contractor				Sheet 3 of 3

RUN DETAILS						STRATA			
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION Main/Detail	Discontinuities	Geology	Instrument/ Backfill
						Grey SILTSTONE. (Pennine Middle Coal Measures Formation) *(continued)*			
					(11.30)				
			121.97		27.70				
			121.67		28.00	COAL. (Pennine Middle Coal Measures Formation)			
					(0.70)	Grey MUDSTONE. (Pennine Middle Coal Measures Formation)			
			120.97		28.70				
			120.77		28.90	COAL. (Pennine Middle Coal Measures Formation)			
					(1.10)	Grey MUDSTONE. (Pennine Middle Coal Measures Formation)			
			119.67		30.00				

Drilling Progress and Water Observations						
Date	Time	Depth	Casing	Core Dia mm	Water Strike	Water Standing

Rotary Flush			
From	To	Type	Returns

GENERAL REMARKS

-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:62.5	Client CDP Ltd.	Method/ Plant Used Lorry Mounted Rig	Logged By JP

AGS3 UK DH - JPG 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

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DRILLHOLE LOG

Project				DRILLHOLE No
Unit A, Capitol Close, Capitol Park, Barnsley				RO07
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	14-03-17 14-03-17	149.66	E 431,754.0 N 405,910.0	
Contractor				Sheet 1 of 3

RUN DETAILS					STRATA			
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION Main/Detail	Discontinuities	Geology	Instrument/ Backfill
					(7.50)	MADE GROUND: Brown clay.			
			142.16		7.50				
					(1.80)	Grey MUDSTONE. (Pennine Middle Coal Measures Formation)			
			140.36		9.30				
			139.86		(0.50) 9.80	COAL. (Pennine Middle Coal Measures Formation)			

Drilling Progress and Water Observations						
Date	Time	Depth	Casing	Core Dia mm	Water Strike	Water Standing

Rotary Flush			
From	To	Type	Returns
0	30	Air.	100

GENERAL REMARKS

-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:62.5	Client CDP Ltd.	Method/ Plant Used Lorry Mounted Rig	Logged By JP

AGS3 UK DH - JPG 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

JPG (Leeds) Ltd.
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DRILLHOLE LOG

Project				DRILLHOLE No
Unit A, Capitol Close, Capitol Park, Barnsley				RO07
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	14-03-17 14-03-17	149.66	E 431,754.0 N 405,910.0	
Contractor				Sheet 2 of 3

RUN DETAILS				STRATA				
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION Main/Detail	Discontinuities	Geology	Instrument/ Backfill
					(12.50)	Grey MUDSTONE. (Pennine Middle Coal Measures Formation) *(continued)*			

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Water Strike	Water Standing	From	To	Type	Returns	-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:62.5	Client CDP Ltd.	Method/ Plant Used Lorry Mounted Rig	Logged By JP

AGS3 UK DH - JPG 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

JPG (Leeds) Ltd.
CIVIL & STRUCTURAL ENGINEERING

DRILLHOLE LOG

Project				DRILLHOLE No
Unit A, Capitol Close, Capitol Park, Barnsley				RO07
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	14-03-17 14-03-17	149.66	E 431,754.0 N 405,910.0	
Contractor				Sheet 3 of 3

RUN DETAILS					STRATA			
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION Main/Detail	Discontinuities	Geology	Instrument/ Backfill
						Grey MUDSTONE. (Pennine Middle Coal Measures Formation) *(continued)*			
			127.36		22.30				
			126.96		22.70	COAL. (Pennine Middle Coal Measures Formation)			
						Grey MUDSTONE. (Pennine Middle Coal Measures Formation)			
					(7.30)				
			119.66		30.00				

1

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Water Strike	Water Standing	From	To	Type	Returns	
					24						-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:62.5	Client CDP Ltd.	Method/ Plant Used Lorry Mounted Rig	Logged By JP

AGS3 UK DH - JPG 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

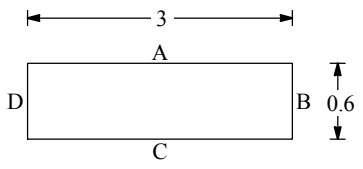
JPG (Leeds) Ltd.
CIVIL & STRUCTURAL ENGINEERING

TRIAL PIT LOG

Project				TP No
Unit A, Capitol Close, Capitol Park, Barnsley				**TP04**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	13-03-17 13-03-17	149.50	E 431,730.0 N 406,055.0	
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result kPa		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.50	D					(0.70)	High strength (stiff) light grey and yellowish brown mottled slightly silty slightly sandy gravelly CLAY. Gravel is tabular, of brown mudstone. (Weathered Pennine Middle Coal Measures Formation)		
0.50		130		148.80		0.70			
				148.70		0.80	Brown thinly laminated MUDSTONE. Arising as angular and tabular gravel and occasional cobbles with an occasional light grey clay smear on bedding surfaces. (Pennine Middle Coal Measures Formation)		

Shoring/Support: None
Stability: Trial pit sides remained stable



GENERAL REMARKS

-No groundwater encountered.
-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:25	Client CDP Ltd.	Method/ Plant Used JCB 3CX type machine with 600mm toothed bucket	Logged By JP

TP VOG V9 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

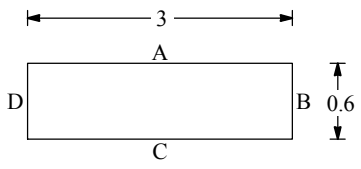
JPG (Leeds) Ltd.
CIVIL & STRUCTURAL ENGINEERING

TRIAL PIT LOG

Project				TP No
Unit A, Capitol Close, Capitol Park, Barnsley				**TP07**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	13-03-17 13-03-17	149.64	E 431,753.0 N 406,010.0	
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result kPa		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
				148.99		(0.65) 0.65	MADE GROUND: Firm to stiff grey slightly silty slightly sandy gravelly clay. Gravel is angular and tabular, of mudstone, dark grey shale and rare coal fragments.		
				148.04		(0.95) 1.60	MADE GROUND: Firm to stiff yellowish brown/grey slightly silty slightly sandy gravelly slightly cobbly clay. Gravel and cobbles are angular, of sandstone and mudstone.		
1.60-1.80	ES			147.84		(0.20) 1.80	MADE GROUND: Dark grey sand and gravel with occasional cobbles. Gravel is angular, of ash and brick. Cobbles are angular, of brick.		
				147.44		(0.40) 2.20	MADE GROUND: Firm to stiff yellowish brown/grey slightly silty slightly sandy gravelly slightly cobbly clay. Gravel and cobbles are angular, of sandstone and mudstone.		
				146.94		(0.50) 2.70	Stiff light grey and yellowish brown mottled slightly silty slightly sandy gravelly CLAY. Gravel is tabular, of brown mudstone. (Weathered Pennine Middle Coal Measures Formation)		

Shoring/Support: None
Stability: Trial pit sides remained stable



GENERAL REMARKS

-No groundwater encountered.
-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:25	Client CDP Ltd.	Method/ Plant Used JCB 3CX type machine with 600mm toothed bucket	Logged By JP

TP VOG V9 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

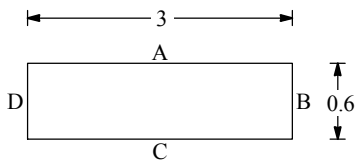
JPG (Leeds) Ltd.
CIVIL & STRUCTURAL ENGINEERING

TRIAL PIT LOG

Project				TP No
Unit A, Capitol Close, Capitol Park, Barnsley				**TP10**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	14-03-17 14-03-17	149.75	E 431,777.0 N 405,985.0	
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result kPa		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.50	ES						MADE GROUND: Firm to stiff yellowish brown slightly silty slightly sandy slightly gravelly clay with occasional cobbles and rare boulders (up to 0.4m diameter). Gravel, cobbles and rare boulders are angular, of sandstone and mudstone, and rare brick and coal fragments. Rare pieces of clay pipe and rubber hose.		
							0.50 - becoming yellowish brown and grey.		
						(2.45)			
			1				1.85 - slight water seepage.		
				147.30		2.45			
				147.25		2.50	Brown thinly laminated MUDSTONE. Arising as angular and tabular gravel with an occasional light grey clay smear on bedding surfaces. (Pennine Middle Coal Measures Formation)		

Shoring/Support: None
Stability: Trial pit sides remained stable



GENERAL REMARKS

-Slight water seepage at 1.85m.
-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:25	Client CDP Ltd.	Method/ Plant Used JCB 3CX type machine with 600mm toothed bucket	Logged By JP

TP VOG V9 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

JPG (Leeds) Ltd.

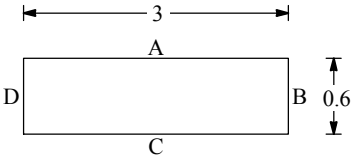
CIVIL & STRUCTURAL ENGINEERING

TRIAL PIT LOG

Project				TP No
Unit A, Capitol Close, Capitol Park, Barnsley				**TP11**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	14-03-17 14-03-17	149.69	E 431,825.0 N 405,988.0	
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result kPa		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.50	ES					(2.05)	MADE GROUND: Firm to stiff yellowish brown slightly silty slightly sandy slightly gravelly clay with occasional cobbles and rare boulders (up to 0.55m diameter). Gravel, cobbles and rare boulders are angular, of sandstone and mudstone, and rare brick and coal fragments.		
				147.64		2.05			
2.10-2.60 2.25	D	115				(0.90)	High strength (stiff) yellowish brown and light grey mottled slightly silty slightly sandy CLAY with rare gravel. Gravel is tabular, of brown mudstone. (Weathered Pennine Middle Coal Measures Formation)		
				146.74		2.95			

Shoring/Support: None
Stability: Trial pit sides remained stable



GENERAL REMARKS

-No groundwater encountered.
-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:25	Client CDP Ltd.	Method/ Plant Used JCB 3CX type machine with 600mm toothed bucket	Logged By JP

TP VOG V9 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

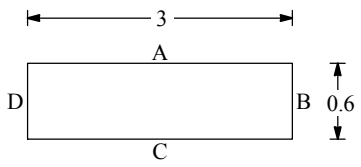
JPG (Leeds) Ltd.
CIVIL & STRUCTURAL ENGINEERING

TRIAL PIT LOG

Project				TP No
Unit A, Capitol Close, Capitol Park, Barnsley				**TP12**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	16-03-17 16-03-17	152.80	E 431,791.0 N 405,959.0	
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result kPa		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.30	ES						MADE GROUND: Firm to stiff yellowish brown slightly silty slightly sandy slightly gravelly clay with occasional cobbles and rare boulders (up to 0.5m diameter). Gravel, cobbles and rare boulders are angular, of sandstone and mudstone, and also of rare brick and coal fragments. Rare plastic packaging strapping.		
1.30-1.80	B					(1.80)			
				151.00		1.80			

Shoring/Support: None
Stability: Trial pit sides slightly unstable



GENERAL REMARKS

-No groundwater encountered.
-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:25	Client CDP Ltd.	Method/ Plant Used JCB 3CX type machine with 600mm toothed bucket	Logged By JP

TP VOG V9 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

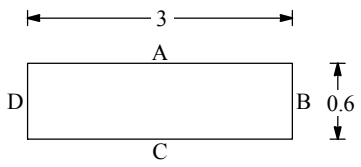
JPG (Leeds) Ltd.
CIVIL & STRUCTURAL ENGINEERING

TRIAL PIT LOG

Project				TP No
Unit A, Capitol Close, Capitol Park, Barnsley				**TP12a**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	16-03-17 16-03-17	151.40	E 431,805.0 N 405,995.0	
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result kPa		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.50-1.00	ES					(2.00)	MADE GROUND: Firm to stiff yellowish brown slightly silty slightly sandy slightly gravelly clay with occasional cobbles. Gravel and cobbles are angular, of sandstone and mudstone, and also of rare brick and coal fragments.		
				149.40		2.00			

Shoring/Support: None
Stability: Trial pit sides slightly unstable



GENERAL REMARKS

-No groundwater encountered.
-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:25	Client CDP Ltd.	Method/ Plant Used JCB 3CX type machine with 600mm toothed bucket	Logged By JP

TP VOG V9 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

JPG (Leeds) Ltd.

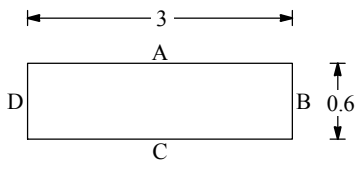
CIVIL & STRUCTURAL ENGINEERING

TRIAL PIT LOG

Project				TP No
Unit A, Capitol Close, Capitol Park, Barnsley				**TP13**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	14-03-17 14-03-17	149.65	E 431,752.0 N 405,961.0	
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result kPa		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.50-1.00	ES					(3.50)	MADE GROUND: Firm to stiff yellowish brown slightly silty slightly sandy slightly gravelly clay with occasional cobbles. Gravel and cobbles are angular, of sandstone and mudstone, and also of rare brick and coal fragments.		
3.50		130		146.15 145.85		3.50 (0.30) 3.80	High strength (stiff) yellowish brown and light grey mottled slightly silty slightly sandy CLAY with rare gravel. Gravel is tabular, of brown mudstone. (Weathered Pennine Middle Coal Measures Formation)		

Shoring/Support: None
Stability: Trial pit sides remained stable



GENERAL REMARKS

-No groundwater encountered.
-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:25	Client CDP Ltd.	Method/ JCB 3CX type machine with Plant Used 600mm toothed bucket	Logged By JP

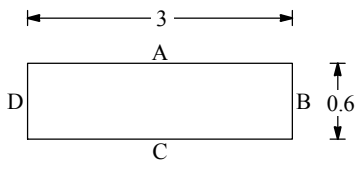
JPG (Leeds) Ltd.
CIVIL & STRUCTURAL ENGINEERING

TRIAL PIT LOG

Project				TP No
Unit A, Capitol Close, Capitol Park, Barnsley				**TP16**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	14-03-17 14-03-17	149.67	E 431,777.0 N 405,937.0	
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result kPa		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-1.00	B					(3.20)	MADE GROUND: Firm to stiff grey and yellowish brown slightly silty slightly sandy slightly gravelly clay with occasional cobbles. Gravel and cobbles are angular, of sandstone and mudstone, and also of rare brick and coal fragments.		
3.20		115		146.47 146.37		3.20 3.30	High strength (stiff) yellowish brown and light grey mottled slightly silty slightly sandy CLAY with rare gravel. Gravel is tabular, of brown mudstone. (Weathered Pennine Middle Coal Measures Formation)		

Shoring/Support: None
Stability: Trial pit sides remained stable



GENERAL REMARKS

-No groundwater encountered.
-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:25	Client CDP Ltd.	Method/ Plant Used JCB 3CX type machine with 600mm toothed bucket	Logged By JP

TP VOG V9 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

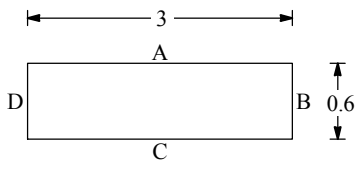
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CIVIL & STRUCTURAL ENGINEERING

TRIAL PIT LOG

Project				TP No
Unit A, Capitol Close, Capitol Park, Barnsley				**TP17**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
2450	14-03-17 14-03-17	149.67	E 431,733.0 N 405,913.0	
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result kPa		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						(4.00)	MADE GROUND: Firm to stiff grey and yellowish brown slightly silty slightly sandy slightly gravelly clay with occasional cobbles. Gravel and cobbles are angular, of sandstone and mudstone, and also of rare brick and coal fragments.		
				145.67		4.00			

Shoring/Support: None
Stability: Trial pit sides remained stable



GENERAL REMARKS

-No groundwater encountered.
-No visual or olfactory evidence of contamination.

All dimensions in metres Scale 1:25	Client CDP Ltd.	Method/ Plant Used JCB 3CX type machine with 600mm toothed bucket	Logged By JP

TP VOG V9 2450 - UNIT A CAPITOL PARK BARNSLEY.GPJ GINT STD AGS 3_1.GDT 3/4/17

JPG
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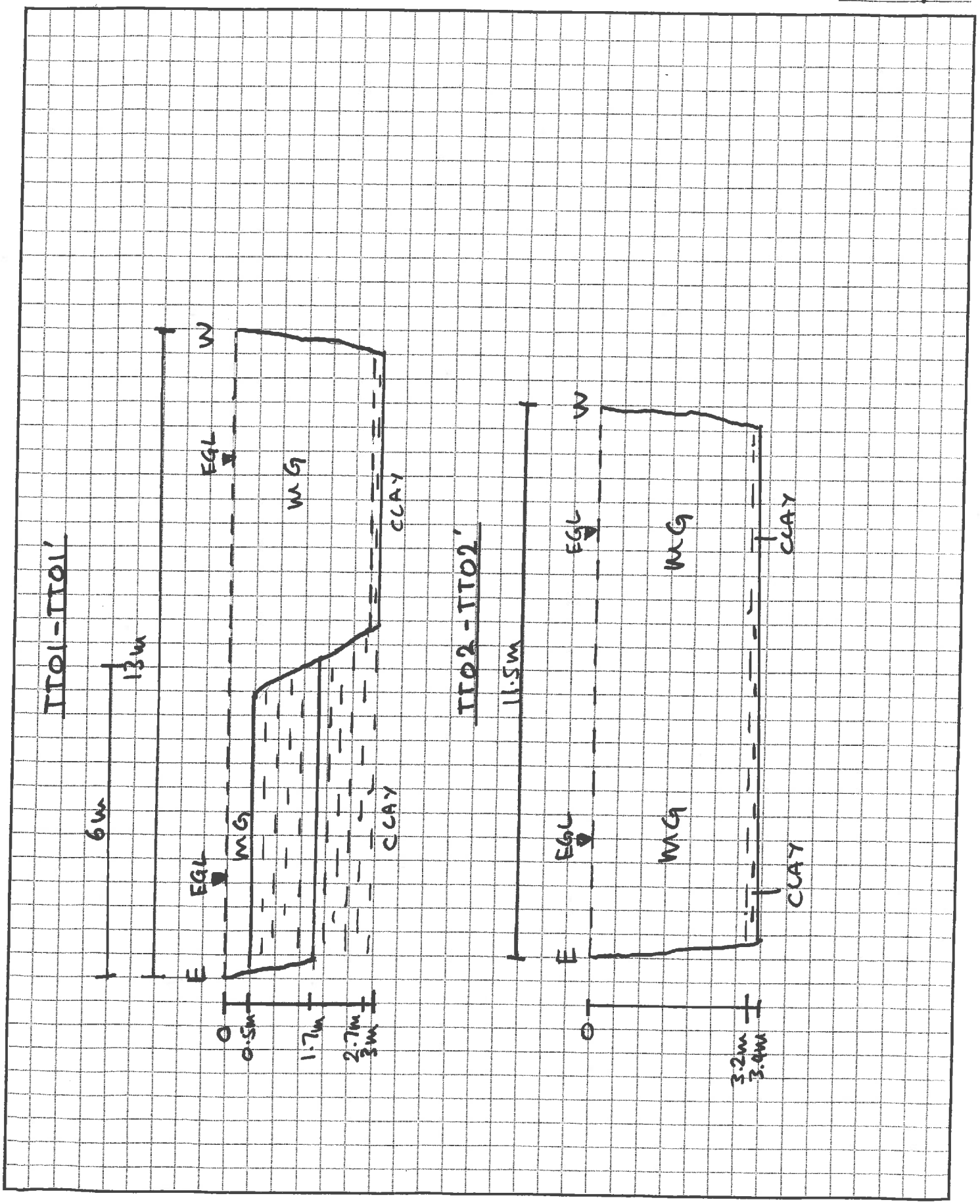
Project No 2450

Sheet No 1

Made By JRP

Project UNITA, CAPITOL PARK.

Date 17/03/2017



Appendix C Chemical Analysis Certificates and HazWasteOnline Waste Classification

STATISTICAL ASSESSMENT OF CHEMICAL ANALYSIS

The results of the chemical analysis have been assessed in accordance with CL:AIRE (Contaminated Land: Applications in Real Environments) 'Guidance on Comparing Soil Contamination Data with a Critical Concentration' published by the CIEH, May 2008.

This guidance provides a statistical approach to objectively evaluate the evidence for and against particular propositions/hypothesis and has the useful attribute of enabling decision makers to reach conclusions about the available evidence, with at least some understanding of the validity of the results.

The guidance approaches this in the context of assessing the results from two different perspectives, the Planning Scenario and Part 2A.

When assessing in terms of the Planning Scenario, the key question would be 'can we confidently say that the level of contamination on this land is low relative to some appropriate measure of risk?'
Under Part 2A, the question would be 'can we confidently say that the level of contamination is high relative to some appropriate measure of risk?'

These questions are addressed through the use of formal hypothesis – the "Null Hypothesis" and the "Alternative Hypothesis".

This assessment will be carried out in accordance with the Planning Scenario, where the aim is to demonstrate 'suitability for use'. The Null Hypothesis is that the level of contamination is the same as, or higher than the critical concentration/GAC. The Alternative Hypothesis is that the level of contamination is lower than the critical concentration/GAC. Under Part 2A the opposite set of propositions are applicable.

By convention, the Null Hypothesis is the starting proposition against which the key question, as expressed by the Alternative Hypothesis, can be tested.

The assessment of the results relies on there being a normal distribution of results for a particular contaminant and that the data set under consideration is representative of the particular material which is being assessed. If more than one dataset is present, then the hypothesis should be applied individually for each data set.

Under the Planning Scenario, the statistical test is used to demonstrate that there is a 95% probability that the true population mean falls below the critical concentration/GAC.

Appropriate data sets must be created to enable the statistical testing to be carried out and three key elements must be considered prior to statistical analysis. These are as follows:

- Dealing with non-detects;
- Understanding the statistical distribution of data; and
- Dealing with outliers.