SOUTH HEYWOOD PHASE 6
SEPTEMBER 2019
13-417-R1-1

PHASE II GEOENVIRONMENTAL SITE ASSESSMENT

Phase 6 – South Heywood Development Area
Land off Hareshill Road
Heywood
OL10 2TD

Prepared for: **Russell Homes**

Report Ref: 13-417-R1-1
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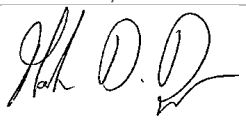
SIGNATURE			

EXECUTIVE SUMMARY

Site Address	Land off Hareshill Road, South Heywood, OL10 2TD	
Grid Reference	E385598, N408847	
Site Area	~1.7Ha	
Current Site Use	The subject site comprises two rectangular parcels of land separated by Hareshill Road in Heywood. The Phase 6 development area generally comprises undeveloped agricultural land. A residential dwelling with gardens is present in the northern sector of the site. Semi-mature trees and mature trees are present to the west and north of the existing residential property. Access to both parcels of the site is via openings in the hedgerows off Manchester Road to the east. There is a high-pressure gas main located to the southern boundary of the development area.	
Proposed Development	Russell Homes intends to construct a low-rise residential development comprising of residential dwellings with associated gardens, estate roads and infrastructure. The majority of the proposed development will be to the south of Hareshill Road, with a few dwellings to the east and one to the west of the existing residential property and gardens located to the north of Hareshill Road.	
Environmental Setting	**Drift Geology**	Till (Devensian – CLAY) across the site.
	Bedrock Geology	Pennine Lower Coal Measures Formation and Pennine Middle Coal Measures Formation – MUDSTONE, SILTSTONE, SANDSTONE.
	Faults	None within the site boundary.
	Hydrogeology	Secondary A aquifer (drift) overlying Secondary A aquifer (Solid).
	Hydrology	A branch of Whittle Brook is located circa 30m to the east.
	Flood Risk	Unaffected by flooding from rivers.
Site History	A review of the pertinent Ordnance Survey mapping dating from circa 1850 to the present day confirmed that the subject site has always been undeveloped agricultural land with the development of a single dwelling and gardens in the north.	
Previous Reports	E3P has previously completed a high-level Desk Study for the complete South Heywood Development, the findings of which are documented within our report dated November 2016 (ref: 11-094-R1).	
Utility Locations	There is a High Pressure Gas Main located to the south of the site. Utility connection are available through Manchester Road to the east and Hareshill Road to the North.	
Landfill Sites and Ground Gases	No Landfill Sites have been recorded within 250m of the subject site.	
Radon	Unaffected – no special precautions required.	

Coal Mining/Land Stability	The Coal Authority does not record either the potential for unrecorded shallow mine workings or coal seams beneath this sector of the development area, however coal seams and probable shallow workings are recorded within 200m to the north east. Four coal mine entries are recorded within the Phase 4 development boundary, with the closest recorded mine shaft circa 140m to the north east of the Phase 6 site boundary.

SITE INVESTIGATION

Ground Investigation Works	E3P has completed an intrusive ground investigation comprising mechanically excavated trial pits, window sample boreholes and rotary boreholes.
Ground Conditions	**MADE GROUND** Made Ground deposits comprised a reworked topsoil of dark brown clayey slightly gravelly fine to medium sand with gravel of sandstone and mudstone. Topsoil was encountered in all exploratory hole locations between depths of 0.20 m and 0.90 m bgl. Deeper Made Ground was identified within TP103 as reworked clay with mudstone, sandstone, coal and tree bark to the base of the trial hole at 2.50m bgl. No other Made Ground deposits were identified.
	DRIFT DEPOSITS Drift deposits were encountered within all exploratory hole locations. The majority of holes were underlain by firm to stiff orange brown to greyish brown sandy slightly gravelly CLAY with gravel of sandstone and mudstone between 0.20m and 5.45m bgl. The cohesive drift deposits were interbedded with light yellow clayey fine to medium SAND, identified between 0.30m and 4.45m bgl. Localised areas of soft to firm CLAY was identified between 0.20 m and 2.00m bgl in TP101, TP107, TP112 and WS105.
	SOLID GEOLOGY The solid geology was only encountered in the rotary boreholes between depths of 10.80m and 12.30m bgl. The bedrock lithology comprised interbedded SANDSTONE and MUDSTONE with occasional coal traces.
	GROUNDWATER – Groundwater was encountered between 2.00 – 3.00m bgl.

CONTAMINATED LAND RISK ASSESSMENT

Human Health	Chemical analysis completed has not highlighted any elevated determinants within the topsoil or underlying natural drift deposits. Therefore, the site is considered to be suitable for use as a residential development with no specialist mitigation measures required Out of the ten samples tested for asbestos during the ground investigation, none of the samples returned a positive result. If localised impacted soils are discovered during ground works correct PPE for construction workers and further assessment will be needed. Topsoil deposits are reworked, however initial chemical testing suggests that the topsoil may be suitable for re-use following screening and confirmation that the topsoil meets British Standards.
Controlled Waters	There is a low risk to controlled waters due to the lack of mobile contaminants and presence of low permeability soils.
Ground Gas	Characteristic situation 1 (Pending completion of gas monitoring).
Potable Water Infrastructure	This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation.

GEOTECHNICAL ASSESSMENT

Underground Obstructions	No underground obstructions were identified during the site investigation. E3P understands that the existing residential dwelling will be retained.
Allowable Bearing Pressure	The underlying natural clay drift deposits have been assessed as being firm, low strength to stiff medium strength with a net allowable bearing pressure (ABP) in the order of 41–134 kN/m^2 between 1.0-5.0 m bgl. The natural granular drift deposits are loose to medium dense, with the net ABP in the order of 42-147 kN/m^2 between 2.0-4.0 m bgl
Foundation Options	Based on existing data and given the predominantly cohesive ground conditions, it is considered that the majority of the proposed dwellings could be constructed using traditional spread footings bearing in the firm to stiff clay at a depth from 1.00m to 1.50m below current ground levels. Where deeper variable soft natural clays, or loose sand and gravels are identified, dependent on development levels, plots may require locally deepening to Mass Trench Fill. Alternatively, it is recommended that Ground Improvement by VSC be considered to ensure a safe and uniform ABP for a doubly reinforced strip foundation bearing within the treated sub-stratum. In the location of soft clays, plots will require a driven pile foundation due the incompatibility with VSC. Foundation depths should take account of the presence of existing and proposed trees with foundations deepened locally, to mitigate the potential for volumetric instability attributed to fluctuations in moisture content, in accordance with the requirements of NHBC standards. It is recommended that at working drawing stage a foundation schedule is prepared for the development taking account of the physical change of natural clay soils and the current / proposed locations of trees.

Building Floor Slabs	Ground-bearing floor slabs are unlikely to be viable given the anticipated depths of shallow cohesive soils.
Heave Precautions	Given that the underlying clay is of low volume change potential, heave precautions will not be required to the internal face of a foundation less than 1.5 m in depth. Heave precautions will be required to the underside of floor slabs (where there is no 200 mm void) and pile ground beams are required within the modelled influencing distance of trees.
Soakaway Drainage	BRE365 infiltration testing suggest that soakaways will not be suitable for the proposed development.
Sulphate Assessment	Concrete classification will be DS1 AC1s.
CBR Design %	Granular soils can be re-engineered to ensure 5% within the subgrade during favourable climatic conditions. Natural clay soils will provide a CBR in the order of 3–5% during drier climatic periods; however, if water is allowed to shed onto the formation, the CBR will reduce to < 2%, which will require specialist engineering of the subgrade.
Cut/Fill	Development levels unknown at this time; however, an element of cut-and-fill works will be required to prepare the development platform.
Waste Characterisation	Any material that is to be disposed off-site should undergo assessment using Technical Guidance WM3: Waste Classification – *Guidance on the classification and assessment of waste.*
Coal Mining	In due consideration of the potential presence of the Arley Coal seam, three rotary boreholes were advanced in accordance with Coal Authority Permission ref: 16633 to assess the potential presence of shallow workings within this seam and the potential for ground instability to induce a future subsidence event within the proposed development. The rotary boreholes have confirmed that sufficient rock cover is present above any coal seams, therefore there is considered to be no risk of instability.

RECOMMENDATIONS

Based on the findings of the geoenvironmental site assessment, the following additional works are recommended to be completed in due course:

- **Plot-specific foundation schedule (upon receipt of the final development levels);**
- **Arboricultural survey; and**
- **Build Phase Strategy.**

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DRAWING 13-417-001 - Site Location Plan
DRAWING 13-417-002 - Proposed Development Plan
DRAWING 13-417-003 - Historic Features Plan
DRAWING 13-417-004 - Exploratory Hole Location Plan
DRAWING 13-417-005 - Depth of Made Ground Plan
DRAWING 13-417-006 - Depth to Bedrock Plan
DRAWING 13-417-007 - Depth to Founding Strata Plan
DRAWING 13-417-008 - Conceptual Site Model
DRAWING 13-417-009 - Concept Foundation Zoning Plan

1. INTRODUCTION

1.1. BACKGROUND

E3P has been commissioned by Russell Homes to undertake a detailed Phase II Geo-Environmental Site Investigation for the 6th phase of development land off Manchester Road in Heywood.

This report is required to determine potential contaminated land liabilities, remediation requirements and geotechnical engineering works that will be required as part of the proposed low-rise residential development.

The scope of work includes the following elements:

- Review of desk study information;
- Design of suitable intrusive ground investigation;
- Window sample probeholes with, and construction of, environmental monitoring installations;
- Mechanically excavated trial pits;
- Rotary open holes;
- In-situ geotechnical testing;
- Chemical and geotechnical laboratory analysis;
- Groundwater monitoring and sampling;
- Ground gas monitoring;
- Contamination risk assessment and conceptual site model;
- Geotechnical assessment and interpretation; and
- Factual and interpretive reporting.

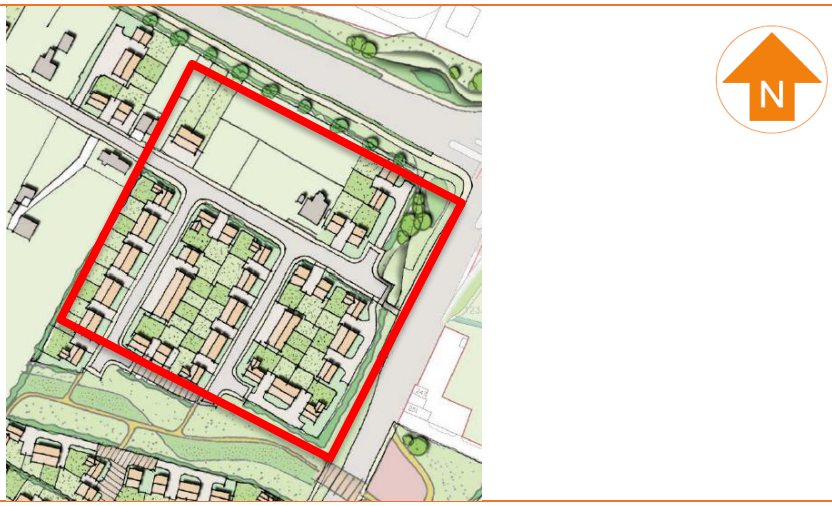
1.2. PROPOSED DEVELOPMENT

E3P understands that Russell Homes have been granted Outline Planning Consent for a strategic mixed-use development that will comprise a 2.2km link road, residential housing and commercial / industrial land use.

Russell Homes intend to develop the phase 6 development area which is located in the central eastern sector of the wider development for a residential end use comprising a series of low rise dwellings with associated private garden and landscaped areas, public open space, estate roads and infrastructure. Drawing 13-417-002 (Appendix III) identifies the proposed development layout. The majority of the proposed development will be to the south of Hareshill Road, with a few dwellings to the east and one to the west of the existing residential property and gardens located to the north of Hareshill Road.

A snapshot of the proposed development layout is indicated in Figure 1.1.

FIGURE 1.1 SNAPSHOT OF PROPOSED DEVELOPMENT (SCHEME 1)



1.3. OBJECTIVES

The objectives of the Geoenvironmental assessment are as follows:

- Undertake a preliminary stage of sampling and analysis to provide an overview of environmental issues identified.
- Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors.
- Assess the geotechnical information and provide preliminary recommendations in relation to foundations, pavement construction and floor slabs.
- Provide recommendations regarding future works required.

1.4. LIMITATIONS

The limitations of this report are presented in Appendix I.

1.5. CONFIDENTIALITY

E3P has prepared this report solely for the use of the client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from E3P; a charge may be levied against such approval.

2. SITE SETTING

2.1. SITE DETAILS

Site Address	Land off Manchester Road, South Heywood, OL10 2TP
National Grid Reference	E385598, N408847
Site Area	~1.7Ha

All acronyms used within this report are defined in the Glossary presented in Appendix II.

A site location map is presented in Appendix III as Drawing 13-417-001.

2.2. CURRENT SITE USE

E3P has undertaken a site walkover of the entire site and a description of the key findings is summarised in Table 2.1.

TABLE 2.1 SITE DESCRIPTION

Occupancy/Use	The subject site comprises two rectangular parcels of land separated by Hareshill Road in Heywood. The Phase 6 development area generally comprises undeveloped agricultural land. A residential dwelling with gardens is present in the northern sector of the site. Semi-mature trees and mature trees are present to the west and north of the existing residential property. Access to both parcels of the site is via openings in the hedgerows off Manchester Road to the east. There is a high-pressure gas main located to the southern boundary of the development area.	
Structures	There is a residential dwelling in the north of the site with an associated garage and out-building.	
Access	Access to both parcels of the site is via openings in the hedgerows off Manchester Road to the east.	
Slope	There is little variance in site topography.	
Retaining Structures	None apparent on the site.	
Surface Cover (%)	**Buildings**	5%
	Hardstand	2.5%
	Soft Cover	92.5%
Vegetation/Ecology	Rough scrub vegetation is present across the site with areas of overgrown grasses, although the majority of the grass is short. Hedgerows are present along field boundaries. Semi-mature trees are present to the west and north of the residential property. A Habitat Survey will be required to support the planning application.	

Hazardous Material Storage	No above-ground storage tanks (ASTs) or underground storage tanks (USTs) were observed at the site during the preliminary site walkover. Due to the previously undeveloped nature of the site, it is unlikely that hazardous materials storage will have occurred on the site.
Asbestos-Containing Material (ACM)	No evidence of ACM was noted during the site walkover.
Polychlorinated Biphenyls (PCBs)	There is no equipment identified which may contain PCBs within the site boundary or in close proximity.
Waste Storage	Potentially hazardous waste streams are unlikely to be generated at the site and none were observed during the preliminary site inspection.
Drainage	Drainage connections are available throughout Hareshill Road and Manchester Road.

2.3. SURROUNDING AREA

The surrounding area land uses are summarised in Table 2.2.

TABLE 2.2 SURROUNDING LAND USES

DIRECTION	LAND USE
North	Industrial buildings and residential dwellings.
East	Agricultural land.
South	Agricultural land.
West	Agricultural land and residential dwellings.

2.4. COAL MINING

The Envirocheck Report states the site is in an area that may be affected by coal mining.

A Coal Authority Mining Report was obtained (Ref: 51002156572001) dated 19th July 2019.

The Coal Authority operates a risk-based approach to the assessment of potential instability issues associated with future development of land located within the predefined Coal Authority Consultation Areas. This risk-based approach subdivides the potential risk into “Low” and “High” risk categories.

The risk categories can be defined as:

Low-Risk Sites – Deemed to be land where coal mining has taken place, however it was at such depth not to pose a risk to new development and it therefore contains no known recorded risks and as such no further assessment is required.

For low-risk sites, the CA categorically states:

> *If your proposed development is within the Development Low Risk Area there is no need for you to submit any coal mining information with your planning application and The Coal Authority will not be consulted by the LPA. The LPA will include our Standing Advice as an informative note within the decision notice.*

High-Risk Sites – Deemed to be landholdings located within an area known to contain legacy risks that include:

- Mine entries (shaft or adit);
- Shallow coal workings (recorded and probable);
- Workable coal seam outcrops;
- Mine gas sites and areas;
- Recorded coal-mining-related hazards;
- Geological features (fissures and break lines); and
- Former surface mining sites (sometimes using historic opencast extraction methods).

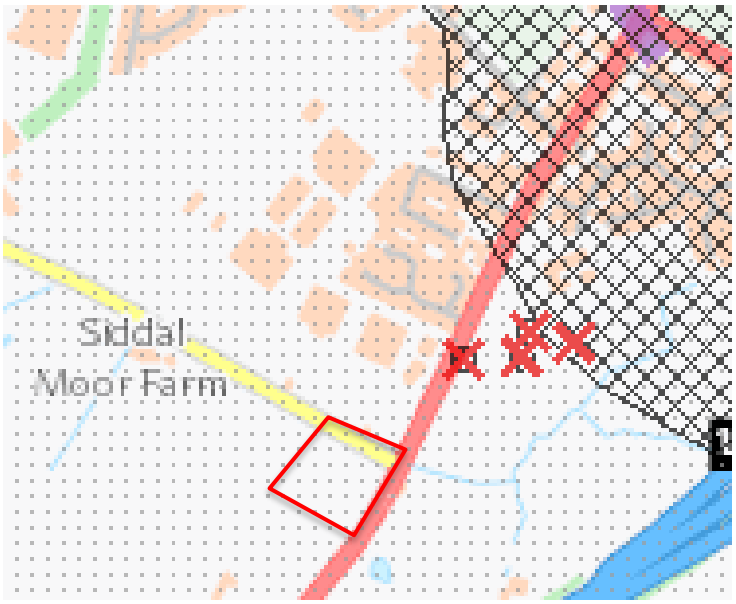
2.4.1. COAL MINING INFORMATION

Prior to the enactment of the Coal Mines Regulation Act (1872), which came into force on the 1st January 1883, there was no statutory requirement to record the extent of abandoned mine workings and as such the Coal Authority has no knowledge of extensive workings throughout the UK Coal Fields where shallow workings are present at a depth which could result in a subsidence event in the future (through successive cavitation) associated with failure of support mechanism.

To determine if a site may have unrecorded or recorded coal mine workings requires a consideration of a wide range of information and E3P has completed a review of relevant information in relation to potential coal mining activities. Table 2.3 provides a summary of pertinent coal mining information.

TABLE 2.3 COAL MINING INFORMATION

SOURCES OF INFORMATION	SUMMARY
Coal Authority Mining Report	The Coal Authority Mining Report (Ref: 51002156572001) dated July 2019 has been obtained for the subject site by E3P. This report confirmed that: • The property is not within a surface area that could be affected by past underground mining; • There are no known coal mine entries within, or within 100 metres of, the site boundary; • The site is not in an area where the Coal Authority believe there is coal at or close to the surface that may have been worked in the past; • There is no record of a mine gas emission requiring action by the Coal Authority within the boundary of the property; • The Coal Authority is not aware of any evidence of damage arising due to geological faults or other lines of weakness that have been affected by coal mining; and • The property is not within the boundary of an opencast site from which coal has been removed by opencast methods.
Coal Authority Interactive Map	The Coal Authority does not record either the potential for unrecorded shallow mine workings or coal seams beneath this sector of the development area, however the Arley coal seam is shown to outcrop to the north of the site, dipping in a south westerly direction with probable shallow coal workings. Four coal mine entries are recorded within the phase 4 development boundary, with the closest recorded mine shaft circa 140m to the north east of the phase 6 site boundary.

SOURCES OF INFORMATION	SUMMARY
	 .
British Geological Survey Mapping	The 1:10,000 geological mapping for the area indicates the presence of the Arley coal seam outcropping at its closest point approximately 780m north east of the site. The seam is understood to be dipping in a south westerly direction. It is likely that there are workings within the identified coal seam.
Review of Coal Authority Archive	No Coal Authority archives/mine abandonment plans are made available.
Historical Ordnance Survey Mapping	A review of the 1:10,000 Ordnance Survey mapping from c. 1850 which has records of mine workings which pre-dated the Mining & Regulation Act of 1872 has not identified any coal mining features within the site boundary.
Historical Site Investigations	E3P has not been provided with any historic site investigation reports.

2.4.2. COAL MINING GEOLOGY

The Arley coal seam outcrops circa 780m to the north east of the site. The seam is understood to be dipping in a south westerly direction.

2.4.3. COAL MINING RISK ASSESSMENT

This risk assessment comprises a desk-based review of all available information on the coal mining issues that are relevant to the application site, deemed to be located within a “High Risk” area. This includes:

- Interpretation of information to identify and assess the risks to the proposed development from coal mining legacy, including the cumulative impact of issues;
- Setting out appropriate mitigation measures to address the coal mining legacy issues affecting the site, including any necessary remedial works and/or demonstrate how coal mining issues have influenced the proposed development; and
- Demonstrating to the local planning authority that the application site is, or can be made, safe and stable to meet the requirements of national planning policy with regard to development on unstable land.

The coal mining risk assessment is summarised in Table 2.4.

TABLE 2.4 SUMMARY OF COAL MINING RISK ASSESSMENT

COAL MINING RISK ASSESSMENT	YES/NO	RISK ASSESSMENT
Recorded Underground Coal Mining at Shallow Depth (< 30 m)	No	Low
Recorded Underground Coal Mining at Shallow Depth (> 30 m)	No	Low
Unrecorded Underground Coal Mining at Shallow Depth (< 30 m)	Yes	High
Mine Entries (Shaft/Adits)	No	Low
Coal Mining Geology – Fractures/Fissures	No	Low
Recorded Gas Emissions	No	Low
Recorded Mining Surface Hazard	No	Low
Surface Mining (Opencast)	No	Very low/low

Based on the above, a high risk of shallow coal mine workings that have the potential to cause ground instability have been identified.

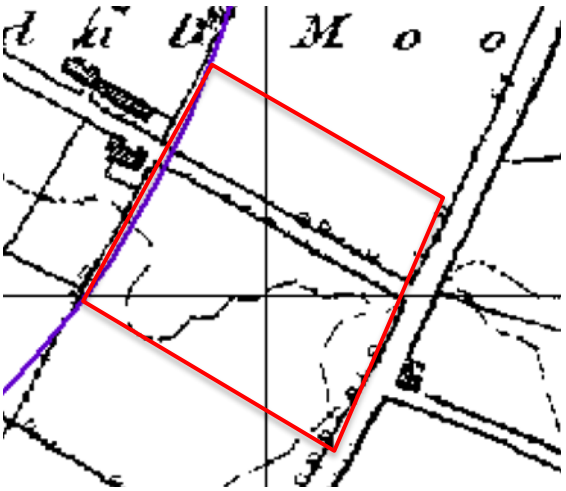
The Coal Authority, as a statutory consultee, will require a series of rotary open holes across the site to determine the presence of any coal on site and to understand the nature of any coal workings.

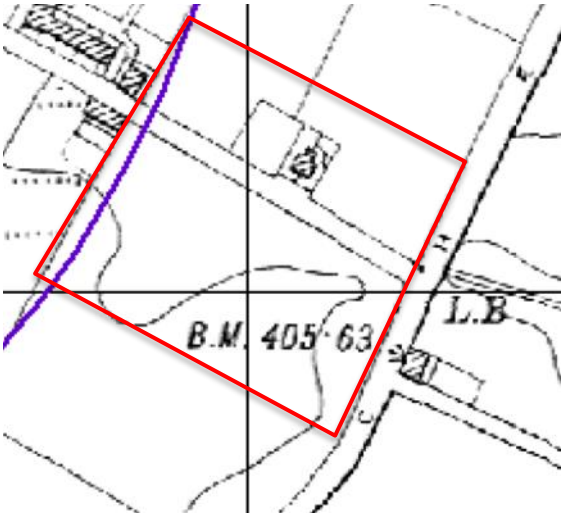
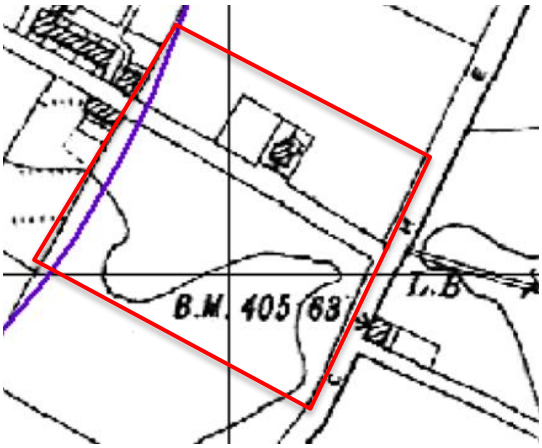
3. SITE HISTORY

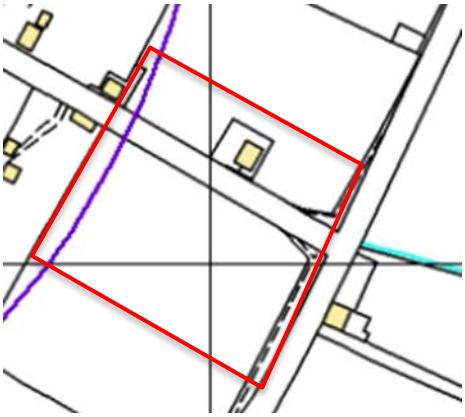
3.1. ON-SITE HISTORICAL DEVELOPMENT

A review of historical mapping and historical aerial imagery pertinent to the site is summarised in Table 3.1. In addition, historical site features are presented on Drawing No 13-417-003 in Appendix III.

TABLE 3.1 HISTORICAL DEVELOPMENT

MAP EDITION	HISTORICAL LAND USE	HISTORICAL MAP EXCERPT
1851 **1:10,560**	The site is recorded as undeveloped agricultural land with Hareshill Road present intersecting the centre of the site.	
1894 **1:10,560**	There are no significant changes to the subject site.	

MAP EDITION	HISTORICAL LAND USE	HISTORICAL MAP EXCERPT
1923 **1:10,560**	A small residential dwelling has been constructed on the northern side of Hareshill Road.	
1938 **1:10,560**	There are no significant changes recorded to the subject site.	
1977 **1:10,000**	There are no significant changes.	

MAP EDITION	HISTORICAL LAND USE	HISTORICAL MAP EXCERPT
1999 **1:10,000**	There are no significant changes.	

3.2. OFF-SITE HISTORICAL DEVELOPMENT

A review of potentially contaminative uses identified on historical Ordnance Survey maps within a 250 m radius of the site is summarised in Table 3.2.

TABLE 3.2 SURROUNDING POTENTIALLY CONTAMINATIVE LAND USES

SURROUNDING FEATURE	DISTANCE	DATES	DIRECTION
New Gap Farm	185m	Pre 1848-Present	South
Siddal Moor Farm	240m	Pre 1848-Present	North West

4. INITIAL CONCEPTUAL SITE MODEL

In accordance with EA CLR 11 (2004) and BSI 10175 (Code of Practice for Investigation of Potentially Contaminated Land), E3P has developed an initial conceptual site model (CSM) to identify potential contamination sources, migration pathways and receptors within the study area. This is summarised within Table 4.1.

TABLE 4.1 INITIAL CONCEPTUAL SITE MODEL

SOURCE	PATHWAY	RECEPTOR
Human Health		
Heavy Metals, PAHs within localised Made Ground	Dermal Contact and Ingestion. Consumption of Homegrown Produce.	Construction Workers. Residential End Users.
Discussion: Due to the largely undeveloped nature of the site, there are limited potential sources of contamination identified. However, Made Ground associated with any localised infilling may be a potential source of heavy metals and semi-volatile Polycyclic Aromatic Hydrocarbons (PAH) which may pose a short-term risk to construction workers who may come into contact with impacted soils during earthworks. All construction works must be undertaken using the appropriate Personal Protection Equipment (PPE) to remove this potential risk. Future residential users may encounter impacted soils within any garden and landscaped areas. If impacted soils are identified then localised remediation or an appropriate cover system, designed in accordance with BRE465 (Cover Systems for land regeneration), Will remove the exposure pathway and therefore risk to future residential site users.		
Asbestos-Containing Materials (ACMs) within Made Ground	Fibre/Dust Inhalation.	Construction Workers. Residential End Users. Third-Party Property.
Discussion: Historic infilling of natural depressions or field boundaries may have occurred with soils containing asbestos, such as ash deposits and building demolition material, therefore this could now be present within Made Ground, however the potential for this is considered to be low. No significant potential sources of ACM are identified, however, if present, disturbance of potentially asbestos impacted Made Ground soils may give rise to dust generation and migration of asbestos fibres on or off site. If present, impacted soil poses a risk to construction workers and future end users. On-site buildings also pose a potential source of ACM and a full survey will needed to be completed before demolition works are carried out. ACM poses a risk through fibre and dust inhalation and if present may pose a risk to construction workers during any future earthworks / demolition and to adjacent third party property should dust be generated during those works. These risks can be mitigated through the development of a detailed enabling works strategy following guidance and protocol specified within the Control of Asbestos Regulations (2012) and industry best practice as detailed in CIRIA733 (Asbestos in Soil and Made Ground: A guide to understanding risk).		



Hazardous Ground Gases		
Methane and Carbon Dioxide Associated with Possible On-Site Fill Material	Inhalation. Accumulation.	Construction Workers. Residential End Users.
Discussion: The presence of infilled depressions or field boundaries may be source of hazardous ground gas (such as carbon dioxide & methane) which may pose a risk to construction workers and residential end users. Carbon dioxide and methane have associated asphyxiation and explosive risks, respectively.		
Controlled Waters		
Mobile contaminants	Vertical/Lateral Migration.	Secondary A Aquifer. Whittle Brook
Discussion: Significant on-site sources of potentially mobile contaminants are not anticipated at the subject site. The secondary A Aquifer within the underlying bedrock geology is a potential receptor, however, given the absence of any potable groundwater abstractions within close proximity to the site the overall sensitivity of this receptor is reduced. Whittle brook is located 30m to the east of the site however, in the absence of any potentially significant sources of mobile contaminants, the site is considered to pose a low risk to controlled waters.		
Buildings and Infrastructure		
pH and Sulphate	Corrosion of Concrete.	Foundations/Concrete.
Discussion: Presence of pH and sulphate within any localised Made Ground deposits may result in corrosion of buried concrete within the proposed development. Assessment must be undertaken to confirm the levels of pH and sulphate within Made Ground deposits and thus determine the concrete classification.		
Ecology		
None Identified	Lateral Migration.	Whittle Brook
Discussion: Mature and semi-mature trees are located along field boundaries which may provide habitats for protected wildlife (nesting birds or roosting bats). A habit survey will be required to support a planning application. In the likely absence of any significant sources of mobile contaminants, the risk to ecology and aquatic ecosystems is considered to be low.		

5. E3P INTRUSIVE GROUND INVESTIGATION

5.1. GENERAL OVERVIEW

A ground investigation has been designed based on the findings of the desk study, with exploratory holes advanced to target specific potential contaminant sources summarised in Table 4.1. The investigation has also been used to collect geotechnical information to assist in the design and construction of the proposed development.

Exploratory fieldwork was completed between 15th May 2019 and 11th June 2019. The works are summarised in Table 5.1.

TABLE 5.1 SUMMARY OF FIELDWORK

POTENTIAL SOURCE/RATIONALE	LOCATION HOLE	TYPE	MAXIMUM DEPTH (m bgl)	MONITORING WELLS RESPONSE ZONE (m bgl)
General Ground Conditions	WS101	Window Sample Probehole	3.45	0.5-3.0
	WS102		5.45	0.5-4.0
	WS103		4.45	0.5-3.0
	WS104		4.45	0.5-4.0
	WS105		3.45	0.5-30
	WS106		4.45	0.5-4.0
To investigate the potential presence of shallow mine workings	RB101	Rotary Open Hole	30.00	N/A
	RB102		30.00	
	RB103		30.00	
General Ground Conditions including the presence / nature of obstructions	TP101-TP115	Mechanically Excavated Trial Pit	2.40	N/A
To investigate permeability characteristics	TP101/SA101	Mechanically Excavated Soakaway	2.20	N/A
	TP107/SA103		2.00	
	TP115/SA102		2.10	

Mechanically excavated trial pits were advanced to investigate ground conditions and to retrieve environmental samples, spatially distributed to offer the maximum site coverage whilst also being advanced to target specific contaminant sources.

Window sample probeholes were advanced to undertake in-situ detailed geotechnical testing, obtain environmental samples and install groundwater and ground gas monitoring wells.

The rotary boreholes were advanced into deep rock horizons to investigate the potential for shallow mine workings.

The sampling locations are illustrated in Drawing 13-417-004 (Appendix III). The ground conditions encountered are indicated on the logs, which are provided in Appendix V.

Return visits were made to monitor installations for groundwater level and gas concentrations. In addition, selected wells were purged, and samples of groundwater recovered for chemical analysis.

5.2. IN-SITU STANDARD PENETRATION TESTING (SPT)

In-situ geotechnical testing was conducted using the standard penetration test (SPT) and, where the ground is granular, a 60° cone (SPT(C)) was used instead of the sampling tube. The results are shown in the probehole logs in Appendix V and presented in Table 6.5 and discussed in Section 11.

5.3. IN-SITU CALIFORNIA BEARING RATIO (CBR)

In-situ CBR tests were undertaken at selected locations using a TRL probe. Tests were undertaken at depths of between 0.3 m and 1 m below ground level in order to intersect the likely pavement subformation level. The results are presented in Table 6.9 and test certificates are included within Appendix IX.

5.4. PERMEABILITY TESTS

Three soakaway tests were undertaken within Trial Pits TP101, TP107 and TP115 in order to assess the likely permeability of the underlying strata to determine the potential suitability for soakaway drainage within the proposed development. The results are presented in Table 6.7 and the test certificates are included within Appendix X.

5.5. LABORATORY ANALYSIS

Selected soil samples were submitted for a range of chemical analysis comprising:

- Metals.
- pH, total sulphate, water-soluble sulphate (2:1 extract).
- Sulphide.
- Cyanide.
- Phenols.
- Total and speciated polycyclic aromatic hydrocarbons (PAHs).
- Asbestos identification and quantification.
- Speciated and banded total petroleum hydrocarbon (TPH).

I2 Analytical undertook the analytical work and the testing results are included in Appendix VI and discussed in Section 11.

Selected samples were submitted to PSL Laboratory where the following geotechnical tests were undertaken:

- Atterberg limits determinations;
- Single-stage triaxial tests;
- Consolidation tests; and
- Particle Size Distribution tests.

Laboratory analysis sheets are included in Appendix VIII and are summarised in Section 9.

6. GROUND AND GROUNDWATER CONDITIONS

6.1. SUMMARY OF GROUND CONDITIONS

The ground investigation generally confirms the published geology and identifies the strata set out in Table 6.1.

TABLE 6.1 SUMMARY OF STRATA

HOLE	DEPTH TO STRATUM (m bgl)					
	MADE GROUND	SOFT - FIRM CLAY	FIRM CLAY	STIFF CLAY	SAND	BEDROCK
TP101	0.0-0.4	0.40–2.2				
TP102	0.0-2.1					
TP103	0.0–0.3				0.3-1.2	
TP104	0.0-0.9		0.9-2.1			
TP105	0.0-0.5		1.8-2.0		0.5-1.8	
TP106	0.0-0.3		0.5-2.5			
TP107	0.0-0.4	0.4-2.0				
TP108	0.0-0.2		0.5-1.2	1.8-2.2	1.2-1.8	
TP109	0.0-0.5		0.5-1.8		1.8-2.2	
TP110	0-0.4		0.4-2.2			
TP111	0.0-0.4		1.6-2.5		0.4-1.6	
TP112	0.0-0.4	0.4-1.6	1.6-2.2			
TP113	0.0-0.4		0.4-1.5	1.5-2.2		
TP114	0.0-0.4		1.0-2.3		0.4-1.0	
TP115	0.0-0.4			1.2-2.1	0.4-1.2	
WS101	0.0-0.3		0.3-2.0		2.00-3.45	
WS102	0.0-0.4			0.40-2.00 4.00-5.45	2.00-4.00	
WS103	0.0-0.4		0.4-1.5	3.0-4.45	1.50-3.00	
WS104	0.0-0.2		2.0-2.7	0.20-2.00	2.70-4.45	
WS105	0.0-0.2	0.2-0.8			0.80-3.45	
WS106	0.0-0.4		0.4-1.7 2.2-3.8		1.70-2.20 3.80-4.45	
RB101	0.0-0.3		0.3-12.3			12.3-30.0
RB102	0.0-0.3		0.3-11.6			11.6-30.0
RB103	0.0-0.2		0.2-10.8			10.8-30.0

6.2. MADE GROUND

Made Ground deposits comprised a reworked topsoil of dark brown clayey slightly gravelly fine to medium sand with gravel of sandstone and mudstone. Topsoil was encountered in all exploratory hole locations between depths of 0.20 m and 0.90 m bgl.

Deeper Made Ground was identified within TP103 as reworked clay with mudstone, sandstone, coal and tree bark to the base of the trial hole at 2.50m bgl.

No other Made Ground deposits were identified.

6.3. DRIFT DEPOSITS

Drift deposits were encountered within all exploratory hole locations. The majority of holes were underlain by firm to stiff orange brown to greyish brown sandy slightly gravelly CLAY with gravel of sandstone and mudstone between 0.20m and 5.45m bgl.

The cohesive drift deposits were interbedded with light yellow clayey fine to medium SAND, identified between 0.30m and 4.45m bgl.

Localised areas of soft to firm CLAY was identified between 0.20 m and 2.00m bgl in TP101, TP107, TP112 and WS105.

6.4. SOLID GEOLOGY

The solid geology was only encountered in the rotary boreholes between depths of 10.80m and 12.30m bgl. The bedrock lithology comprised interbedded SANDSTONE and MUDSTONE with occasional coal traces.

6.5. GROUNDWATER

Groundwater strikes were encountered as seepages. The depth of the seepages are shown on the exploratory hole records in Appendix V and are summarised in Table 6.2.

TABLE 6.2 SUMMARY GROUNDWATER STRIKES

LOCATION	DEPTH TO STRIKE (m)	NOTES
TP101	2.1	Slow ingress
TP103	2.1	Slow ingress
TP106	2.5	Slow ingress
TP107	2.0	Slow ingress
TP108	2.2	Slow ingress
TP109	2.2	Slow ingress
WS102	2.0	Saturated Strata
WS106	3.0	Fast strike

Monitoring was undertaken using an electronic dip meter and interface probe to record the depth to groundwater and the thickness of any free-phase hydrocarbon product, if present. These results are summarised in Table 6.12.

6.6. SOIL CONSISTENCY

Undrained shear strength values were measured using both field hand shear vane tests and laboratory undrained triaxial tests. Results of the tests are presented in Table 6.3 and Table 6.4, which indicate the clay soils to vary between soft and stiff. Strength test data is generally consistent with the field descriptions of the aforementioned soils.

TABLE 6.3 SUMMARY OF HAND SHEAR VANE TESTS

LOCATION	DEPTH	SHEAR STRENGTH (kPA)	CALCULATED ALLOWABLE BEARING PRESSURE (kN/m^2)
TP101	0.6	28.6	65.78
TP101	0.9	50	115
TP101	1.3	58	133.4
TP101	1.6	57.3	131.79
TP101	1.9	84.6	194.58
TP102	0.9	52.6	120.98
TP102	1.3	63.3	145.59
TP102	1.6	54	124.2
TP102	1.9	56	128.8
TP104	0.9	76.6	176.18
TP104	1.3	82	188.6
TP104	1.6	68.6	157.78
TP104	2	62	142.6
TP105	1.9	58	133.4
TP105	2.1	67.3	154.79
TP106	0.9	72	165.6
TP106	1.3	38	87.4
TP106	1.7	70.6	162.38
TP106	1.9	74.6	171.58
TP107	0.6	38	87.4
TP107	0.9	35.3	64.4
TP107	1.3	40	138
TP107	1.6	35.3	142.6
TP107	1.9	28	188.6
TP108	0.6	60	193.2
TP108	0.9	62	133.4
TP108	1.9	82	128.8
TP108	2	84	92
TP109	0.6	58	102.58
TP109	0.9	56	136.39

LOCATION	DEPTH	SHEAR STRENGTH (kPA)	CALCULATED ALLOWABLE BEARING PRESSURE (kN/m^2)
TP109	1.3	40	180.78
TP109	1.6	44.6	128.8
TP110	0.6	59.3	139.38
TP110	0.9	78.6	126.5
TP110	1.3	56	154.79
TP110	1.8	60.6	157.78
TP110	2	55	143.98
TP112	1.6	67.3	128.8
TP112	1.9	68.6	165.6
TP113	0.6	62.6	188.6
TP113	0.9	56	210.68
TP113	1.3	72	154.79
TP113	1.6	82	188.6
TP113	1.9	91.6	176.18
TP114	1.3	67.3	126.5
TP114	1.6	82	124.89
TP114	1.9	76.6	170.2
TP114	2.2	55	64.4
TP115	1.5	54.3	138
TP115	1.9	74	142.6

TABLE 6.4 SUMMARY OF UNDRAINED SHEAR STRENGTH TEST RESULTS

LOCATION	SAMPLE DEPTH (m)	LAB DESCRIPTION	UNDRAINED SHEAR STRENGTH (kN/m^2)	CONSISTENCY
WS102	1.50–2.0	Stiff, brown slightly gravelly very sandy CLAY	88	Stiff
WS106	0.5-1.0	Stiff brown, gravelly very sandy CLAY	129	Stiff

Results of the standard penetration tests, including undrained shear strengths derived from SPTs are included in Table 6.5.

6.7. SIDE STABILITY AND EASE OF EXCAVATION

The sides of the exploratory trial pit excavations appeared to be generally stable during excavation, however trial pits were less stable in granular drift deposits.

The natural strata was excavated with relative ease.

TABLE 6.5 STANDARD/CONE PENETRATION TEST RESULTS

BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE $(N_1)_{60}$	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m^2)
WS101	1.0	sandy CLAY	6	6.05	N/A	Low strength	Firm	30.24
WS101	2.0	sandy CLAY	11	10.05	N/A	Medium strength	Stiff	50.24
WS101	3.0	sandy CLAY	10	8.70	N/A	Medium strength	Stiff	43.48
WS102	1.0	sandy CLAY	9	9.07	N/A	Medium strength	Stiff	45.37
WS102	2.0	clayey SAND	4	3.65	Very Loose	N/A	N/A	N/A
WS102	3.0	clayey SAND	8	6.96	Loose	N/A	N/A	N/A
WS102	4.0	sandy CLAY	11	9.29	N/A	Medium strength	Stiff	46.47
WS102	5.0	sandy CLAY	11	9.13	N/A	Medium strength	Stiff	45.63
WS103	1.0	sandy CLAY	4	4.03	N/A	Low strength	Firm	20.16
WS103	2.0	clayey SAND	9	8.22	Loose	N/A	N/A	N/A
WS103	3.0	sandy CLAY	15	13.04	N/A	Medium strength	Stiff	65.22
WS103	4.0	sandy CLAY	9	7.60	N/A	Low strength	Firm	38.02
WS104	1.0	sandy CLAY	11	11.09	N/A	Medium strength	Stiff	55.45
WS104	2.0	silty CLAY	5	4.57	N/A	Low strength	Firm	22.84
WS104	3.0	clayey SAND	9	7.83	Loose	N/A	N/A	N/A
WS104	4.0	clayey SAND	5	4.22	Loose	N/A	N/A	N/A
WS105	1.0	sandy CLAY	7	7.06	N/A	Low strength	Firm	35.29
WS105	2.0	clayey SAND	5	4.57	Loose	N/A	N/A	N/A
WS105	3.0	clayey SAND	17	14.78	Medium Dense	N/A	N/A	N/A
WS106	1.0	sandy CLAY	4	4.03	N/A	Low strength	Firm	20.16



BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE $(N_1)_{60}$	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m^2)
WS106	2.0	clayey SAND	9	8.22	Loose	N/A	N/A	N/A
WS106	3.0	sandy CLAY	9	7.83	N/A	Low strength	Firm	39.13
WS106	4.0	clayey SAND	15	12.67	Medium Dense	N/A	N/A	N/A

6.8. SOIL COMPRESSIBILITY

Consolidation tests have been undertaken on selected samples of CLAY using an odometer to obtain consolidation properties. Tests include an unload cycle to help assess potential heave. The results are included in Table 6.6 and show the CLAY to be of very low to high compressibility – consistent with the soil's visual description.

TABLE 6.6 SUMMARY CONSOLIDATION TEST DATA

LOCATION	DEPTH (m)	LOAD INCREMENT	VOLUME CHANGE COEFFICIENT, Mv	CONSOLIDATION COEFFICIENT, Cv
WS102	1.5-2.0	0–35	0.701	1.309
		35–70	0.271	1.461
		70–140	0.171	1.372
		140–280	0.098	1.616
		280–35	0.027	5.140
WS106	0.5-1.0	0–15	0.234	30.791
		15–30	0.154	4.562
		30–60	0.160	2.828
		60–120	0.112	2.146
		120–15	0.044	1.091

The results have determined that the clay soil is of medium compressibility under a loading of 140 kN/m^2. It should be noted that if this material is excavated for use in a cut/fill operation, then careful consideration should be taken in the stabilisation of this material as it would appear that at depth, the cohesive deposits are wetter than the optimum.

Engineering of this type of material will need to be completed during dry weather periods only.

6.9. SOIL INFILTRATION

In-situ BRE 365 Soakaway tests were undertaken within trial pits TP101, TP107 and TP115.

The results are presented in Table 6.7 below and the test certificates are included within Appendix X.

TABLE 6.7 BRE365 SOAKAWAY TESTING RESULTS

LOCATION	DEPTH (m)	MATERIAL	TEST No.	SOIL INFILTRATION RATE (m/s)
SA101/TP101	0–2.2	Soft to firm sandy CLAY	1	Fail
SA103/TP107	0–2.0	Soft sandy CLAY	1	Fail
SA105/TP115	0–2.1	Clayey SAND/Stiff CLAY	1	Fail

Soil infiltration was taken over the wetted area from between 75% and 25% of the effective depth. All tests showed that the natural strata has very poor soakaway drainage.

Therefore considering the significant volumes of poorly permeable cohesive Clays present on site, it is considered that soakaway drainage is un-suitable for the proposed development. However, the application of soakaway drainage will ultimately be dependent on the specific requirements of the development. All soakaways should be designed in accordance with BRE Special Digest 365 – *Soakaway Design*.

6.10. SOIL PLASTICITY

The liquid and plastic limits of samples of natural in-situ clay are determined using the cone penetrometer method and the rolling thread test. These tests enable determination of an average plasticity index (PI) for each "type" of clay, although judgement is applied where variable results are reported.

PI can be related to shrinkability (low, medium or high) and then to minimum founding depth.

E3P typically only consider a soil to be shrinkable if the proportion finer than 63 µm is > 35%.

PI results are compared against guidance given in the NHBC standards, Chapter 4.2 (revised January 2014), which advocates the use of modified plasticity index (I′p), defined as:

$$I'p = Ip \times (\% < 425\ \mu m/100)$$

In other words, if PI is 30%, but the soil contains 80% < 425 µm, then I′p = 30 × 80/100 = 24%.

It should be noted that in accordance with the requirements of BS 1377, the % passing the 425 µm sieve is routinely reported by testing labs.

E3P apply engineering judgement where PI results are spread over a range of classifications. Consideration is given to the average values for each particular soil type (differentiate between residual soil and alluvium), the number of results in each class and the actual values.

The Atterberg limits determinations, summarised in Table 6.8, show the CLAY to be of low plasticity.

TABLE 6.8 SUMMARY OF PLASTICITY INDEX TEST RESULTS

LOCATION	DEPTH (m)	NATURAL MOISTURE CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING 425 µm SIEVE (%)	MODIFIED PLASTICITY INDEX	NHBC VOLUME CHANGE POTENTIAL
WS101	1.00	13	14	28	14	98	13.72	Low
WS102	2.00	14	16	32	16	97	15.52	Low
WS103	1.00	16	15	27	12	100	12	Low
WS104	1.00	11	-	-	-	-	-	Non-Plastic

The results of the Atterberg limits testing confirmed that the soils would be deemed to be Low Volume Change Potential in accordance with the classification system utilised by the LABC/NHBC industry guidance.

6.11. CALIFORNIA BEARING RATIO

The California bearing ratio (CBR) for the soils were measured using an in-situ TRL probe. The results are summarised in Table 6.9.

The result sheets are included in Appendix IX and the locations are shown on Drawing 13-417-004 (Appendix III). CBR results have been averaged from the blow counts across the strata tested and any abnormally high blow counts ignored as these are likely to be from larger granular material and so represent anomalies.

TABLE 6.9 SUMMARY OF DCP RESULTS

LOCATION	DEPTH (m)	STRATA	IN-SITU OR LAB TEST	CBR (%)
DCP101	0.29–0.56	Stiff slightly gravelly CLAY	In-situ	4.47
DCP102	0.30–0.66	Firm sandy slightly gravelly CLAY	In-situ	4.02
DCP103	0.26–0.64	Firm sandy slightly gravelly CLAY	In-situ	5.05
DCP104	0.41–0.67	Soft sandy slightly gravelly CLAY	In-situ	3.30
DCP105	0.63–0.83	Slightly gravelly clayey SAND	In-situ	5.02
DCP106	0.41–0.88	Slightly gravelly SAND	In-situ	3.55

It should be noted that the reported CBR results were obtained from soils in a highly undisturbed state. If, however, the topsoil and surface cover is removed during periods of wetter climatic condition, the formation will soften, reducing the CBR.

6.12. pH AND SULPHATE

Chemical analyses for pH and soluble sulphate content contained in Appendix VI (summarised in Table 6.10), shows that the soils at the site generally meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE *Special Digest 1* (2005).

TABLE 6.10 SUMMARY OF pH AND SULPHATE DATA

LOCATION	DEPTH (m)	SO_4 IN 2:1 WATER/SOIL (g/l)	pH VALUE	CLASSIFICATION
TP101	0.2	0.0066	6.1	DS-1, AC-1S
TP103	0.6	0.0057	5.8	
TP105	0.4	0.013	5.9	
WS102	2.5	0.024	7.2	
TP107	0.3	0.014	5.9	
TP114	0.2	0.021	6.2	
WS103	0.2	0.0080	5.9	
WS104	1.6	0.016	7.9	
WS105	1.2	0.0088	7.7	

6.13. GROUND GAS

A ground gas assessment has been completed in accordance with guidance provided within CIRIA 665 – *Assessing risk posed by hazardous ground gases to buildings*.

6.14. INVESTIGATION RATIONALE

The ICSM has identified that the underlying Made Ground may represent a potential source of ground gas generation. Based on the identification of these sources, E3P has determined that the site represents a Low to moderate round gas source generation potential.

Within the context of the proposed residential end use and ground gas generation potential, the gas assessment requires that 9 visits are required over 6 months, with at least two sets of readings at low or falling atmospheric pressure as set out within CIRIA 665 Tables 5.5a and 5.5b.

The spacing requirements for monitoring wells are detailed within CIRIA 665 Table 4.2, which indicates that for low gas hazard sites (MADE GROUND with limited degradable material, organic clay of limited thickness) and a high sensitivity development, nominal well spacing should be between 25 m and 50 m.

TABLE 6.11 GROUND GAS MONITORING LOCATION RATIONALE

LOCATION	GROUND GAS SOURCE	DEPTH OF MONITORING WELL (m)
WS101	Natural Strata (CLAY)	0.5–3.0
WS102	Natural Strata (CLAY & SAND)	0.5-4.0
WS103	Natural Strata (CLAY & SAND)	0.5-3.0
WS104	Natural Strata (CLAY & SAND)	0.5-4.0
WS105	Natural Strata (CLAY & SAND)	0.5-3.0
WS106	Natural Strata (CLAY & SAND)	0.5-4.0

6.15. MONITORING METHODOLOGY

Concentrations of methane (CH_4), carbon dioxide (CO_2) and oxygen (O_2) were measured using an infra-red gas analyser (GFM435) calibrated to a reference standard (before and after each survey) and gas flow rates were measured using an attached flow pod.

Gas measurements were recorded for a minimum of 60 seconds at each location, at which point the maximum concentration of CH_4 and CO_2, together with the lowest concentration of O_2 were recorded. The results of the ground gas monitoring are presented in Table 6.12.

TABLE 6.12 SUMMARY OF GROUND GAS MONITORING RESULTS

WELL	DATE	CH_4 INITIAL (%V/V)	CH_4 STEADY (%V/V)	CH_4 GSV (l/hr)	CO_2 INITIAL (%V/V)	CO_2 STEADY (%V/V)	CO_2 GSV (l/hr)	O_2 (%V/V)	ATMOS (mb)	ATMOS. DYNAMIC	FLOW (l/hr)	RESPONSE ZONE (m bgl)	DEPTH TO BASE (m bgl)	DEPTH TO WATER (m bgl)
WS101	31/05/19	0.1	0.1	0.001	4.2	4.2	0.0042	17.1	1005	Falling	0.10	0.5–3.0	2.42	1.31
	13/6/19	0.1	0.1	0.0001	3.9	3.9	0.0051	17.3	1004	Falling	0.13		2.41	1.29
	11/7/19	0.1	0.1	0.0001	1.7	1.7	0.0017	19.6	994	Steady	0.10		2.40	0.93
WS102	31/05/19	0.1	0.1	0.0001	1.8	1.8	0.0018	18.9	1005	Falling	0.10	0.5–4.0	2.00	1.60
	13/6/19	0.1	0.1	0.0003	1.5	1.5	0.0039	19.1	1004	Falling	0.26		2.00	1.58
	11/7/19	Monitoring Well Damaged											-	-
WS103	31/05/19	0.1	0.1	0.0013	3.6	3.6	-0.0479	17.1	1005	Falling	-1.33	0.5–3.0	1.75	1.26
	13/6/19	0.1	0.1	-0.0005	3.1	3.1	-0.0152	17.6	1004	Falling	-0.49		1.75	1.30
	11/7/19	0.1	0.1	0.0014	3.0	3.0	0.0432	18.6	994	Steady	1.44		1.98	1.40
WS104	31/05/19	0.1	0.1	-0.0009	1.3	1.3	0.0114	19.3	1005	Falling	0.88	0.5–4.0	2.56	2.09
	13/6/19	0.1	0.1	0.0005	1.4	1.4	0.0073	19.2	1004	Falling	0.52		2.55	2.10
	11/7/19	0.1	0.1	0.0011	1.6	1.6	0.0179	19.8	994	Steady	1.12		2.60	2.15
WS105	31/05/19	0.1	0.1	0.0001	1.0	1.0	0.0016	19.5	1005	Falling	0.13	0.5–3.0	2.27	1.23
	13/6/19	0.1	0.1	0.0001	0.8	0.8	0.0010	19.6	1004	Falling	0.13		1.95	1.80
	11/7/19	0.1	0.1	0.0001	0.7	0.7	0.0007	19.7	994	Steady	0.1		1.95	1.74

WELL	DATE	CH_4 INITIAL (%V/V)	CH_4 STEADY (%V/V)	CH_4 GSV (l/hr)	CO_2 INITIAL (%V/V)	CO_2 STEADY (%V/V)	CO_2 GSV (l/hr)	O_2 (%V/V)	ATMOS (mb)	ATMOS. DYNAMIC	FLOW (l/hr)	RESPONSE ZONE (m bgl)	DEPTH TO BASE (m bgl)	DEPTH TO WATER (m bgl)
WS106	31/05/19	0.1	0.1	0.001	1.2	1.2	0.0016	19.4	1005	Falling	0.13	0.5-4.0	2.27	1.23
	13/6/19	0.1	0.1	0.0003	1.1	1.1	0.0029	19.5	1004	Falling	0.26		2.26	1.21
	11/7/19	0.1	0.1	0.0001	1.0	1.0	0.0010	20.1	994	Steady	0.1		2.26	0.95

7. TIER I QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

E3P has undertaken a Tier 1 qualitative risk assessment to determine if any potential contaminants within the underlying soils and groundwater pose an unacceptable level of risk to the identified receptors.

7.1. HUMAN HEALTH RISK ASSESSMENT

At Tier 1 stage, the long term (chronic) human health toxicity of the soil has been assessed by comparing the on-site concentrations of organic and inorganic compounds with reference values published in LQM/CIEH S4UL (S4UL3267).

The results of this comparison have been summarised within Table 7.1.



TABLE 7.1 SUMMARY OF INORGANIC AND HYDROCARBON TOXICITY ASSESSMENT FOR A RESIDENTIAL END USE

DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PATH-WAY	ASSESSMENT
Arsenic	mg/kg	37	20	25	N/A	1	No Further Action
Cadmium	mg/kg	17	20	0.3	N/A	1	No Further Action
Chromium (VI)	mg/kg	6.1	20	< 4.0	N/A	1	No Further Action
Lead	mg/kg	200	20	120	N/A	1	No Further Action
Mercury	mg/kg	1.2	20	0.6	N/A	3	No Further Action
Nickel	mg/kg	180	20	26	N/A	1	No Further Action
Selenium	mg/kg	250	20	2.5	N/A	1	No Further Action
Copper	mg/kg	2400	20	150	N/A	1	No Further Action
Zinc	mg/kg	3700	20	100	N/A	1	No Further Action
Cyanide – Total	mg/kg	791	20	< 1.0	N/A	1	No Further Action
Phenols – Total	mg/kg	210	10	< 1.0	N/A	1	No Further Action
Asbestos	Fibres	NFD	10	ND	N/A	4	No Further Action
Naphthalene	mg/kg	2.3	20	< 0.05	N/A	3	No Further Action
Acenaphthylene	mg/kg	170	20	< 0.05	N/A	2	No Further Action
Acenaphthene	mg/kg	210	20	< 0.05	N/A	1	No Further Action
Fluorene	mg/kg	170	20	< 0.05	N/A	1	No Further Action
Phenanthrene	mg/kg	95	20	< 0.05	N/A	2	No Further Action
Anthracene	mg/kg	2400	20	0.66	N/A	2	No Further Action
Fluoranthene	mg/kg	280	20	1.8	N/A	2	No Further Action
Pyrene	mg/kg	620	20	1.7	N/A	2	No Further Action
Benzo(a)Anthracene	mg/kg	7.2	20	0.38	N/A	2	No Further Action
Chrysene	mg/kg	15	20	0.40	N/A	2	No Further Action
Benzo(b)Fluoranthene	mg/kg	2.6	20	1.2	N/A	2	No Further Action
Benzo(k)Fluoranthene	mg/kg	77	20	0.68	N/A	2	No Further Action
Benzo(a)Pyrene	mg/kg	2.2	20	3	N/A	2	No Further Action
Indeno(123-cd)Pyrene	mg/kg	27	20	0.40	N/A	2	No Further Action
Dibenzo(a,h)Anthracene	mg/kg	0.24	20	< 0.05	N/A	2	No Further Action
Benzo(ghi)Perylene	mg/kg	320	20	0.52	N/A	2	No Further Action
TPH C5-C6 (aliphatic)*	mg/kg	42	20	< 1.0	N/A	3	No Further Action
TPH C6-C8 (aliphatic)*	mg/kg	100	20	< 0.1	N/A	3	No Further Action
TPH C8-C10 (aliphatic)*	mg/kg	27	20	< 0.1	N/A	3	No Further Action
TPH C10-C12 (aromatic)*	mg/kg	74	19	< 2.0	N/A	3	No Further Action
TPH C12-C16 (aromatic)*	mg/kg	140	20	4.4	N/A	3	No Further Action
TPH C16-C21 (aromatic)*	mg/kg	260	20	13	N/A	1	No Further Action

DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PATH-WAY	ASSESSMENT
TPH C21-C35 (aromatic)*	mg/kg	1100	20	56	N/A	1	No Further Action

Notes
Main exposure pathways: 1 = soil ingestion, 2 = dermal contact and ingestion, 3 = vapour inhalation (indoor), 4 = dust inhalation.

Referring to Table 9.1, the results of this direct comparison indicates that no data exceeds the screening criteria for a residential end use for the listed contaminants. However, this cannot negate the presence of potential contaminants on site.

No specific clean cover to mitigate from non-identified contaminants across the site is required, however, the NHBC will require the construction of gardens with a suitable growing medium that comprises as a minimum 150mm topsoil over 150mm sub-soil.

RISK ASSESSMENT AND MITIGATION

Chemical analysis of the natural drift deposits have identified these soils to be acceptable for use as subsoil within the proposed garden areas; however, further chemical validation samples will be required to confirm this.

Topsoil deposits are reworked, however initial chemical testing suggests that the topsoil may be suitable for re-use following screening and confirmation that the topsoil meets British Standards.

7.2. CONTROLLED WATERS RISK ASSESSMENT

The site sensitivity with respect to controlled waters is summarised within Table 7.2.

TABLE 7.2 CONTROLLED WATERS SENSITIVITY PROFILE

RISK PROFILE	DISCUSSION	SENSITIVITY RATING
Groundwater Source Protection Zone or Drinking Water Safeguard Zone	The site is not located within a groundwater SPZ.	**Low**
Distance to the Closest Groundwater Abstraction Point	There is one groundwater abstraction point recorded within 1km of the site. This is recorded at Siddal fold farm circa 450m south east, for farm and domestic use.	**Moderate**
Aquifer Classification in Superficial Drift Deposits	Secondary undifferentiated.	**Low**
Aquifer Classification in Bedrock	Secondary A Aquifier	**Moderate**
Viability for Anthropogenic Soil in Direct Contact with Aquifer (Drift or Bedrock)	Reworked topsoil and localised reworked clays with no contaminants.	**Low**
Is the Site Located Within 50 m of a Surface Watercourse?	A branch of Whittle Brook is located 30m to the east.	**Moderate**
SUMMARY The ICSM developed within the context of the site setting has identified two viable pollutant risks which would be the downward migration of potentially mobile phase soluble contaminants towards the underlying Secondary A aquifer and the lateral migration to Whittle Brook. There is a groundwater abstraction point situated within 1km of the site that may offer a pathway for contaminants. However, the overall sensitivity of the receptors is reduced given that the site is predominantly underlain by low permeability predominantly cohesive Glacial Till Deposits which would reduce the migration of potential mobile contaminants, as well as, the lack of identified contaminant sources across the site.		

To further refine the ICSM, E3P has undertaken an initial qualitative assessment of the soil data analysis to assess the potential for a source of separate-phase or dissolved-phase contamination originating from either a defined on-site source or from impacted soils. This assessment is summarised in Table 7.3.

TABLE 7.3 QUALITATIVE RISK TO CONTROLLED WATERS FROM SOIL ANALYTICAL RESULTS

BTEX > 1 mg/kg	The soil data analysis has not identified any detectable concentrations of TPH C5 to C6 that might otherwise be indicative of VOC impact
Total VOC > 1 mg/kg	
Total SVOC > 1 mg/kg	PAH analysis recorded concentrations either below or only slightly elevated above the laboratory LOD
C5-C10 > 5 mg/kg	All concentrations are below the laboratory LOD
C10-C12 > 10 mg/kg	All concentrations are below the laboratory LOD
C12-C16 > 50 mg/kg	All concentrations are below the laboratory LOD
Phenols > 2 mg/kg	All concentrations are below the laboratory LOD
Naphthalene > 2 mg/kg	All concentrations are below the laboratory LOD
Total PAH > 10 mg/kg	Concentrations of low-solubility PAH compounds greater than 1.8 mg/kg have not been detected in the soil analysis
PCB > 1 mg/kg	No potential sources of PCB have been identified
Heavy metals > 500 mg/kg	Concentrations of heavy metals are all below 500 mg/kg

In due consideration of the ICSM, which has identified a potential pollutant linkage associated with the migration towards Whittle Brook, E3P has undertaken a Tier I controlled waters risk assessment. The Tier I assessment has included a comparison of groundwater samples to environmental quality standards (EQS) in the first instance and in absence of drinking water standards.

These are presented in Table 7.4.

TABLE 7.4 COMPARISON OF GROUNDWATER ANALYSIS WITH TIER 1 SCREENING LEVELS

DETERMINAND	UNIT	EQS SCREENING VALUE[1, 2, 3]		DWS [3,4,5]	N		MC	LOC. OF EX	ASSESS-MENT
		AA	MAC		L	GW			
Arsenic	µg/l	50	–	10	-	3	2.76	N/A	No Further Action
Cadmium	µg/l	0.08	0.45	5	-	3	0.15	N/A	No Further Action
Chromium (VI)	µg/l	3.4	–	–	-	3	< 5.0	N/A	No Further Action
Chromium (III)	µg/l	4.7	–	50	-	3	< 0.2	N/A	No Further Action
Copper (hardness)	µg/l	1–28	–	2000	-	3	1.4	N/A	No Further Action
Total Cyanide	µg/l	1	–	50	-	3	< 1.0	N/A	No Further Action
Lead	µg/l	1.2	14	10	-	3	0.4	N/A	No Further Action
Mercury	µg/l	–	0.07	1.0	-	3	< 0.05	N/A	No Further Action
Nickel	µg/l	4	34	20	-	3	39	WS101 WS105	Further Action
Selenium	µg/l	–	–	10	-	3	0.8	N/A	No Further Action
Zinc (hardness)	µg/l	8–125	–	–	-	3	7.8	N/A	No Further Action
pH	6–9				-	3	6.7	N/A	No Further Action
PAH									
Naphthalene	µg/l	2	130	10*	-	3	0.01	N/A	No Further Action
Anthracene	µg/l	0.1	0.1		-	3	< 0.01	N/A	No Further Action
Benzo[b]fluoranthene	µg/l	1.7–4	0.017		-	3	< 0.01	N/A	No Further Action
Benzo[k]fluoranthene	µg/l	1.7–4	0.017		-	3	< 0.01	N/A	No Further Action
Benzo(a)pyrene	µg/l	1.7–4	0.27		-	3	<0.05	N/A	No Further Action
Fluoranthene	µg/l	0.0063	0.12		-	3	0.01	N/A	No Further Action
Benzo(ghi)perylene	µg/l	1.7–4	8.2–3		-	3	0.01	N/A	No Further Action
TPH-Aromatic									
TPH C5-C6 (benzene)	µg/l	10	50	1	-	3	0.01	N/A	No Further Action
TPH C6-C8 (toluene)	µg/l	50	–	700	-	3	<1.0	N/A	No Further Action
TPH C8-C10 (ethyl Benzene)	µg/l	20	–	300	-	3	<1.0	N/A	No Further Action
TPH C10-C12 (xylene)	µg/l	30	–	500	-	3	<1.0	N/A	No Further Action
TPH C12-C16	µg/l	2	130	90[5]	-	3	<10	N/A	No Further Action
TPH C16-C35	µg/l	50#	50#	90[5]	-	3	<10	N/A	No Further Action
TPH Aliphatic[5]									
TPH C5-C6	µg/l	–	–	15000	-	3	<1.0	N/A	No Further Action
TPH C6-C8	µg/l	–	–	15000	-	3	<1.0	N/A	No Further Action
TPH C8-C10	µg/l	–	–	300	-	3	<1.0	N/A	No Further Action
TPH C10-C12	µg/l	–	–	300	-	3	<1.0	N/A	No Further Action
TPH C12-C16	µg/l	–	–	300	-	3	<10	N/A	No Further Action
TPH C16 – C21	µg/l	–	–	300**	-	3	<10	N/A	No Further Action
TPH C21-C35	µg/l	–	–	300**	-	3	180	N/A	No Further Action

DETERMINAND	UNIT	EQS SCREENING VALUE[1, 2, 3]		DWS [3,4,5]	N		MC	LOC. OF EX	ASSESS-MENT
		AA	MAC		L	GW			
VOC									
Tetrachloroethylene	µg/l	0.4	–	10	-	3	<1.0	N/A	No Further Action
Trichloroethylene	µg/l	10	–	10	-	3	<1.0	N/A	No Further Action
Trichlorobenzene	µg/l	0.4	–	–	-	3	<1.0	N/A	No Further Action
Trichloromethane	µg/l	2.5	–	–	-	3	<1.0	N/A	No Further Action
Dichloromethane	µg/l	20	–	200	-	3	<1.0	N/A	No Further Action
Carbon Tetrachloride	µg/l	12	–	3	-	3	<1.0	N/A	No Further Action
Vinyl Chloride	µg/l	–	–	0.3	-	3	<1.0	N/A	No Further Action

Notes
Solubility < 0.01 µg/l.
AA – Annual average.
MAC – Maximum admissible concentration.
L – Leachate
GW - Groundwater
* Sum of The specified compounds are benzo[b]fluoranthene (CAS 205-99-2), benzo[k]fluoranthene (CAS 207-08-9), benzo[g,h,i]perylene (CAS 191-24-2) and indeno[1,2,3-c,d]pyrene (CAS 193-39-5)

1. The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations (2015)
2. *Directive establishing a framework for Community action in the field of water policy (Water Framework Directive)*
3. *Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances*
4. *Council Directive on the quality of water intended for human consumption (Drinking Water Directive)*
5. WHO Guidelines for Drinking Water Quality. Third edition (2004)

CONTROLLED WATER RISK ASSESSMENT AND MITIGATION

This comparison indicates that the data exceeds the EQS values for Nickel in the groundwater in WS101 and WS105.

It should be noted that the Tier I assessment criteria provides a conservative view, which may overstate the risk. Inorganic determinands are of a general low solubility and therefore mobility, suggesting that these will not migrate to controlled water receptors. Furthermore, they may be representative of suspended solids within the water samples obtained rather, than the true dissolved phase.

Given that the site is underlain by low-permeability, predominantly cohesive glacial till deposits, which will inhibit migration to Whittle Brook and will afford protection to the underlying secondary A aquifer, there is considered to be a low risk to controlled waters and the wider environ as no complete pollutant linkage can be determined.

Based on the above, there is considered to be no unacceptable level of risk to the controlled water receptors.

7.3. GROUND GAS

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published in CIRIA Report 665 – *Assessing risks posed by hazardous ground gases to buildings* (2007). However, it is recommended that the full ground gas assessment and recommended protection measures are agreed with the local authority prior to their adoption on site. Furthermore, all protection measures adopted should be validated by a suitably qualified engineer.

CIRIA C665 and NHBC Report No 10627-R01 provide assessments for carbon dioxide and methane based upon gas screening values (GSVs) utilising flow rates and concentrations. The site-based GSVs for steady state methane and carbon dioxide are based upon the following equation:

$$GSV = \frac{concentration\ (by\ vol)}{100} \times flowrate\ (1\ /\ hr)$$

The GSVs within CIRIA C665 are based upon all buildings other than standard residential houses. The NHBC GSVs are based upon standard residential houses with precast concrete floors (block and beam). The CIRIA 665 report author (Steve Wilson) since provided further clarification regarding which guidance should be adopted for residential houses that have suspended cast in-situ concrete floor slab: for the avoidance of doubt, it was confirmed that the GSVs within the CIRIA 665 guidance should be adopted. The thresholds for GSVs based upon NHBC and CIRIA guidance are provided within Table 7.5.

TABLE 7.5 RESIDENTIAL THRESHOLDS FOR GAS SCREENING VALUES (GSV) IN ACCORDANCE WITH CIRIA C665 AND NHBS REPORT NO 10627-R01 – RESIDENTIAL END USE

CIRIA – NO SUBFLOOR VOID		NHBC – SUBFLOOR VOID		
CLASSIFICATION	**GSV (METHANE AND CARBON DIOXIDE)**	**CLASSIFICATION**	**GSV (METHANE)**	**GSV (CARBON DIOXIDE)**
CS1	< 0.07	Green	< 0.13	< 0.76
CS2	< 0.70	Amber 1	< 0.63	< 1.60
CS3	< 3.5	Amber 2	< 1.60	< 3.10
CS4	< 15	Red	> 1.60	> 3.10
CS5	< 70	N/A	N/A	N/A
CS6	> 70	N/A	N/A	N/A

7.3.1. SOURCES OF GROUND GAS

The Phase I report and subsequent ground investigation has identified the following potential sources of ground gas:

- Localised Made Ground deposits;
- Coal Measures.

7.3.2. GROUNDWATER

Within the monitoring wells groundwater levels were observed to be steady over the monitoring period. The greatest groundwater change occurred within WS103 where levels decreased by 0.04 m over the monitoring period. WS103 was set within a low-permeability clay stratum and groundwater may be a result of surface water collecting in the well rather than a measure of true groundwater.

7.3.3. GAS FLOW

During the monitoring a positive flow was noted in within all monitoring wells. The measure of positive flow is considered to be the result of groundwater fluctuations and flooding of the well causing compression – as opposed to gas generation – as the highest flows are recorded during periods of high groundwater levels.

Negative flows are indicative of back pressure from wind being greater than the active flow from the wells. Negative flows were recorded in WS103.

7.3.4. GAS CONCENTRATIONS

No elevated concentrations of methane were recorded within any of the monitoring wells.

Carbon dioxide concentrations were recorded within all the monitoring wells at concentrations ranging from 1.0% v/v to 4.2% v/v (WS101).

7.3.5. GAS ASSESSMENT

In accordance with the methodology outlined with the CIRIA publication C665, E3P have utilised the results of the ground gas monitoring surveys to calculate a tentative gas screening value (GSV). The GSVs for the monitoring positions are summarised in Table 7.6.

TABLE 7.6 GAS RISK PROFILE AND LOCATION

LOCATION	MAX CO_2 (% v/v)	GSV (l/hr)	MAX CH_4 (% v/v)	GSV (l/hr)	CLASSIFICATION
WS101	4.2	0.0051	0.1	0.0001	Green/CS1
WS102	1.8	0.0039	0.1	0.0003	
WS103	3.6	0.0479	0.1	-0.0479	
WS104	1.6	0.0073	0.1	0.0179	
WS105	1.0	0.0010	0.1	0.0010	
WS106	1.2	0.0029	0.1	0.0029	

The GSV has been compared to the criteria outlined with CIRIA C665 to determine the level of risk to the proposed development and to ensure the appropriate remedial options are incorporated into any future building design in this area.

Preliminary ground gas monitoring suggests that the site can be classified as CS1, and it is considered that gas protection measures will not be required. The final ground gas regime will be confirmed following the completion of the ground gas monitoring programme.

7.4. CONCEPTUAL SITE MODEL

Following the completion of the intrusive site investigation, chemical analysis and risk assessment, the conceptual model shown in Table 7.7 has been prepared for the site.

TABLE 7.7 CONCEPTUAL MODEL

POLLUTANT LINKAGE	PATHWAY	RECEPTOR	CONTAMINANT (SOURCE)	PROBA-BILITY	RISK	ASSESSMENT AND RECOMMENDATIONS	RESIDUAL RISK AFTER MITIGATION
PL1	Inhalation of gas migration through permeable strata and prefential pathways. Explosion in confused spaces	Future site users. Off-site receptors.	Methane, carbon dioxide. (Localised Made Ground).	Low Likelihood	Moderate	**Assessment:** Low likelihood due to the lack of ground gas sources. **Recommendation:** Further assessment on completion of monitoring period.	LOW
PL2	Surface runoff. Migration through permeable strata and preferential pathways. Perched waters migration.	Groundwater (secondary A aquifer). Surface water (Whittle Brook).	Mobile contaminants	Low Likelihood	Moderate	**Assessment:** Low likelihood as no significant sources of mobile contaminants have been identified. The soil analysis has not identified any exceedances of the GAC. **Recommendation:** No further action is required.	LOW

POLLUTANT LINKAGE	PATHWAY	RECEPTOR	CONTAMINANT (SOURCE)	PROBA-BILITY	RISK	ASSESSMENT AND RECOMMENDATIONS	RESIDUAL RISK AFTER MITIGATION
PL3	Sulphate attack on concrete.	Building structure.	Sulphate (potential ash within Made Ground)	Low Likelihood	Moderate/ Low	**Assessment:** Low likelihood as only localised shallow made ground has been identified on the site. **Recommendation:** DS1, AC-1s.	**LOW**
PL4	Direct Contact (plant uptake).	Flora.	Phytotoxic contaminants (Made Ground)	Low Likelihood	Low	**Assessment:** Low likelihood as no exceedances in contaminants have been identified across the site. **Recommendation:** NHBC compliant cover system.	**LOW**

8. GEOTECHNICAL ASSESSMENT

8.1. PROPOSED DEVELOPMENT

Russell Homes intends to construct a low-rise residential development comprising of residential dwellings with associated gardens, estate roads and infrastructure. Drawing 13-417-002 (Appendix III) identifies the proposed development layout.

8.2. SUMMARY OF GROUND CONDITIONS

- Made Ground - Made Ground deposits comprised a reworked topsoil of dark brown clayey slightly gravelly fine to medium sand with gravel of sandstone and mudstone. Topsoil was encountered in all exploratory hole locations between depths of 0.20 m and 0.90 m bgl. Deeper MADE GROUND was identified within TP103 as reworked clay with mudstone, sandstone, coal and tree bark to the base of the trial hole at 2.50m bgl.

- Drift – Drift deposits were encountered within all exploratory hole locations. The majority of holes were underlain by firm to stiff orange brown to greyish brown sandy slightly gravelly CLAY with gravel of sandstone and mudstone between 0.20m and 5.45m bgl. The cohesive drift deposits were interbedded with light yellow clayey fine to medium SAND, identified between 0.30m and 4.45m bgl. Localised areas of soft to firm CLAY was identified between 0.20 m and 2.00m bgl in TP101, TP107, TP112 and WS105.

- Solid - The solid geology was only encountered in the rotary boreholes between depths of 10.80m and 12.30m bgl. The bedrock lithology comprised interbedded SANDSTONE and MUDSTONE with occasional coal traces.

8.3. SITE PREPARATION

The site should be cleared and any vegetation below areas of proposed development stripped in accordance with Series 200 of the *Specification for Highway Works*. This should include the following:

- Roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting void infilled with suitable compacted engineered fill.

- Redundant services should be sealed off and grubbed out and replaced with suitable compacted engineered fill.

- Any foundations should be excavated from below the proposed development footprint with the resulting void backfilled.

8.4. FOUNDATION CONDITIONS AND ASSESSMENT OF POTENTIAL BEARING CAPACITIES

In due consideration of the identified ground conditions, in-situ and laboratory geotechnical testing, E3P has undertaken an assessment of the net safe allowable bearing pressure (ABP) within the underlying natural stratum to assist in the detailed design of foundations and infrastructure and determine the target founding stratum. The results of this assessment are summarised in Table 8.1

TABLE 8.1 SUMMARY OF ABPS

COHESIVE SOILS			
Description	**Depth (range m bgl)**	**Undrained Shear Strength (Cu) (kN/m²)**	**Allowable Bearing Pressure (kN/m²)**
Firm low strength slightly gravelly, sandy CLAY	1.00–4.00	20-39	41-80
Stiff medium strength slightly gravelly, sandy CLAY	1.00–5.00	43-65	89-134
GRANULAR SOILS			
Description	**Depth (Range m bgl)**	**Relative Density**	**Allowable Bearing Pressure (kN/m²)**
Clayey SAND	2.00-4.00	Loose – Medium Dense	42-147

Based on existing data and given the predominantly cohesive ground conditions, it is considered that the majority of the proposed dwellings could be constructed using traditional spread footings bearing in the firm to stiff Clay at a depth from 1.00m to 1.50m below current ground levels.

Where deeper variable soft natural clays, or loose sand and gravels are identified, dependent on development levels, plots may require locally deepening to Mass Trench Fill. Alternatively, it is recommended that Ground Improvement by VSC be considered to ensure a safe and uniform ABP for a doubly reinforced strip foundation bearing within the treated sub-stratum.

In the location of soft clays, plots will require a driven pile foundation due the incompatibility with VSC.

Foundation depths should take account of the presence of existing and proposed trees with foundations deepened locally, to mitigate the potential for volumetric instability attributed to fluctuations in moisture content, in accordance with the requirements of NHBC standards.

It is recommended that at working drawing stage a foundation schedule is prepared for the development taking account of the physical change of natural clay soils and the current / proposed locations of trees.

TABLE 8.2 ANTICIPATED FOUNDATIONS

LOCATION	ANTICIPATED FOUNDING STRATA DEPTH (m bgl)	GROUND WATER (m bgl)	TARGET STRATUM	TREES	FOUNDATION TYPE	TYPE OF CONCRETE
WS101	0.75	N/A	Firm CLAY	Y	Shallow Strip	DS-1 AC-1s
WS102	0.85	2.0	Stiff CLAY	N	Shallow Strip	DS-1 AC-1s
WS103	0.85	N/A	Firm CLAY	N	Shallow Strip	DS-1 AC-1s
WS104	0.75	N/A	Stiff CLAY	N	Shallow Strip	DS-1 AC-1s
WS105	3.35	N/A	MD SAND	N	Vibro	DS-1 AC-1s
WS106	0.75	3.0	Firm CLAY	N	Shallow Strip	DS-1 AC-1s
TP101	1.35	N/A	Firm CLAY	Y	Shallow Strip	DS-1 AC-1s
TP102	0.95	2.1	Firm CLAY	Y	Shallow Strip	DS-1 AC-1s
TP103	>2.5	2.10	TBC	Y	Pile	DS-1 AC-1s
TP104	1.35	N/A	Firm CLAY	N	Shallow Strip	DS-1 AC-1s
TP105	2.25	N/A	Firm CLAY	N	Mass Trench	DS-1 AC-1s
TP106	0.95	2.5	Firm CLAY	N	Shallow Strip	DS-1 AC-1s
TP107	>2.0	2.0	TBC	N	Pile	DS-1 AC-1s
TP108	0.95	2.2	Firm CLAY	N	Shallow Strip	DS-1 AC-1s
TP109	0.95	N/A	Firm CLAY	N	Shallow Strip	DS-1 AC-1s
TP110	0.85	N/A	Firm CLAY	N	Shallow Strip	DS-1 AC-1s
TP111	2.05	N/A	Firm CLAY	N	Mass Trench	DS-1 AC-1s
TP112	2.05	N/A	Firm CLAY	N	Mass Trench	DS-1 AC-1s
TP113	0.85	N/A	Firm CLAY	N	Shallow Strip	DS-1 AC-1s
TP114	1.45	N/A	Firm CLAY	N	Shallow Strip	DS-1 AC-1s
TP115	1.65	N/A	Stiff CLAY	N	Mass Trench	DS-1 AC-1s

Foundation depths should take account of the presence of existing and proposed trees with foundations deepened locally to mitigate the potential for volumetric instability attributed to fluctuations in moisture content, in accordance with the requirements of NHBC standards.

It is recommended that, at working drawing stage, a foundation schedule is prepared for the development taking account of the physical change of natural clay soils and the current/proposed locations of trees.



At this time it is not possible to accurately define the foundation types due to the absence of a detailed tree survey and final development levels; however, based on our extensive experience of similar sites, we would anticipate that the final foundation solution would be a combination of the following:

- Shallow strip foundations bearing on firm to stiff sandy CLAY at circa 1 m bgl;
- Trench fill to support reinforced strip foundations in areas of variable ground and/or potential tree influence;
- Ground improvement by the installation of Vibro Stone Columns to ensure increased / uniform safe ABP within variable firm clays and granular soils to support a doubly re-enforced strip foundation; and
- Localised driven piles within areas of low strength clay soils.

E3P has prepared a ground improvement design risk matrix, which is summarised in Table 8.3, to assessment the suitability of ground improvement techniques.

TABLE 8.3 GROUND IMPROVEMENT DESIGN RISK MATRIX

RISK ITEM	COMMENT	PASS/FAIL
Soft clays with an undrained shear strength less than 30 kN/m^2	CLAY soils are generally firm to stiff with Cu > 80 kN. Isolated areas of softer clay soils were encountered with Cu > 30 kN/m^2; however, it is considered that these will either be piled or soft material excavated to remove the organic deposits.	**PASS**
Voided filled ground, e.g. old water tanks, pottery, glass bottles, concrete rubble or brick fill of unsuitable grading	Deep Made Ground has only been identified within TP103 in the form or reworked clays.	**PASS – on completion of enabling works**
Loose or non-engineered fill not previously subject to rising or fluctuating water levels saturation	None identified.	**PASS**
Filled ground still settling or expected to settle under its own weight or due to the effects of surcharging/upfilling where there is a high organic content or where decay is continuing	None identified.	**PASS**
Fill, containing degradable material where organic material forms more than 15% of fill by volume	None identified.	**PASS**
Clays with a plasticity index greater than 40%	None identified.	**PASS**
Highly sensitive soils liable to collapse or remoulding	None identified.	**PASS**

RISK ITEM	COMMENT	PASS/FAIL
Cohesive soils with trees in influencing distance	Plots where tree influence has been modelled and will either be subject to a piled or mass trench-fill solution.	**PASS**
Sensitive utility infrastructure	A high pressure gas main has been identified outside of the southern boundary of the site, a 20m easement has been placed around the high pressure gas main.	**Fail at southern boundary**
Overall Risk Rating and Suitability for Vibratory Ground Improvement		**PASS**

A concept foundation zoning plan is included as Drawing 13-417-009 in Appendix III.

8.5. GROUND FLOOR SLABS

Current building control regulations require that where infilled ground is present to depths in excess of 600 mm, or where the substratum is variable in terms of the structure and settlement potential, or where clay soils are present within the influence of existing or proposed trees, a suspended floor slab is required.

In this instance, it is considered that for the majority of substructures, the underlying stratum would have in excess of 600 mm of infill and, as such, a suspended floor slab will be required.

Where a cast in-situ suspended slab is utilised with no subfloor void, appropriate compressible material (heave precautions) will be required in the construction of the substructure.

8.6. HEAVE PRECAUTIONS

The site has been proven to be underlain by clay soils, which are susceptible to volumetric instability due to fluctuations in moisture content, particularly within influencing distance of trees as per the NHBC/LABC conjectured zones of influence.

As the clay is deemed to be low plasticity, heave precautions are not required to the internal face of the external load-bearing walls (outside or within tree influence).

If a ground beam is to be constructed within the zone of tree influence, heave precautions are required to the underside of this and edge beams.

If the ground floor slab is to be constructed with a beam and block floor, a minimum subfloor void of 200 mm is required within any structures located in the zone of conjectured tree influence.

If the ground floor slab is constructed with a cast in-situ suspended floor slab, then heave precautions that can tolerate 50 mm of clay swelling are required within any part of the floor slab to be located within the zone of influence of a tree.

A summary of heave precautions is presented in Table 8.4.

TABLE 8.4 SUMMARY OF HEAVE PRECAUTIONS

		MINIMUM VOID DIMENSION FOR FOUNDATIONS, GROUND BEAMS AND SUSPENDED IN-SITU CONCRETE GROUND FLOORS		MINIMUM VOID DIMENSIONS UNDER PRECAST CONCRETE AND SUSPENDED TIMBER FLOORS
Plasticity Index of Soil	**Required Foundation Depth (m)**	**Thickness of Void Former Against Side of Foundation or Ground Beam (mm)**	**Thickness of Void Former on Underside of Edge Beam and Floor Slab (mm)**	**Void Dimension (mm)**
High Plasticity (> 40)	> 2.5	Engineer Design		Engineer Design
	2.0–2.5	35	150	300
	1.5–2.0	25	75	
Moderate Plasticity (20–40)	> 2.5	Engineer Design		Engineer Design
	2.0–2.5	25	100	250
	1.5–2.0	25	50	
Low Plasticity (< 20)	2.0–2.5	N/A	50	200
	> 2.0	No Special Precautions		

8.7. PAVEMENT CONSTRUCTION

A programme of remediation and enabling works will be required to remediate the proposed road subgrade in accordance with the requirements of the *highways design manual* (series 600) for a method compaction.

It is considered that the material can be re-engineered using method compaction to achieve a CBR in excess of 5% if works are completed in favourable climatic conditions.

8.8. DRAINAGE

BRE365 soakaway testing has been completed, however, it is considered that the presence of cohesive soils would preclude the use of infiltration drainage systems for much of the proposed development site.

8.9. CONCRETE DURABILITY

Based upon the results of the chemical analyses it is considered that subsurface concrete can be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with the recommendations provided in BRE *Special Digest 1* (2005).

8.10. EXCAVATIONS

Trial pits were generally stable; as such, it is considered that near-surface excavations will be feasible. In areas where granular soils exceeded 2.0 m, excavations were generally less stable.

Site observations indicated that excavations should be feasible in the near surface with normal plant.

If local pumping of groundwater is required during the advancement of excavations for the proposed foundations then consideration should be given to the potential for dewatering gravels in the surrounding areas that may cause structural damage to building substructures in close proximity to the site.

TABLE 8.5 CIVIL ENGINEERING EXCAVATION RISK MATRIX

RISK ITEM	PRESENT	COMMENT
Running Sands	No	Running sands have not been identified.
Water Ingress	Yes	Minor water ingress will require localised dewatering/sump pumping during the construction of site drainage infrastructure.
Shallow Bedrock	No	Shallow bedrock has not been identified during the ground investigation.

8.11. COAL MINING RISK ASSESSMENT AND RECOMMENDATIONS

A detailed coal mining risk assessment has been undertaken due to the identified presence of shallow coal mining (recorded shaft/potential shallow workings) on site and in the immediate surrounding area.

8.11.1. RECORDED COAL SCOPE OF INTRUSIVE GROUND INVESTIGATION

In due consideration of the potential presence of the Arley Coal seam, a series of rotary boreholes have been advanced in accordance with Coal Authority Permission ref: 16633 to assess the potential presence of shallow workings within this seam and the potential for ground instability to induce a future subsidence event within the proposed development.

8.11.2. SUMMARY OF GROUND INVESTIGATION WORKS

ROTARY BOREHOLES TO INVESTIGATE WORKINGS IN COAL

Three rotary boreholes have been advanced at the locations detailed within the E3P exploratory borehole location plan at positions to interject the potential coal seams and assess the potential for any workings.

TABLE 8.6 ROTARY BOREHOLES

ROTARY BOREHOLE	DEPTH TO ROCKHEAD (m bgl)	DEPTH TO TOP OF COAL (m bgl)	THICKNESS OF COAL/ WORKINGS (m)	REMARKS
RB101	12.30	N/A	None Identified	Low Risk
RB102	11.60	N/A	None Identified	Low Risk
RB103	10.80	N/A	None Identified	Low Risk

No coal seams were identified during the advancement of the rotary boreholes, therefore a minimum of 17.70-19.20 m of rock cover is present over any workings.

8.11.3. SUMMARY OF COAL MINING ISSUES

- The intrusive ground investigations comprising three, deep, rotary boreholes did not identify any shallow coal seams or evidence of historic mine workings to the base of the boreholes;
- The rotary boreholes have confirmed that sufficient rock cover is present above any coal seams, therefore there is considered to be no risk of instability.

8.12. FURTHER WORKS

Based on the findings of the intrusive site investigation, the following additional works are recommended to be completed in due course:

- Plot-specific foundation schedule (upon receipt of the final development levels);
- Arboricultural survey; and
- Build Phase Strategy.

8.13. CONSTRUCTION ACTIVITY AND INSPECTION

The following activities and inspections should be incorporated into the site works:

- Due to the variability of the soils at the site, it is recommended that sufficient allowance is made for the inspection of formations and subformations to foundations and pavement construction.
- Excavations where access is required should be subject to a risk assessment from a competent person and, where appropriate, mitigation measures such as benching back the sides or use of support systems in accordance with CIRIA R97 should be utilised.
- It is considered that dewatering may be required, especially following periods of heavy rainfall. Removal of surface water and water within trenches should be possible with conventional sump pumping. Discharge of any water should be agreed with the relevant regulatory body and be undertaken under a trade effluent discharge, where required. Measures to remove silt and suspended solids may be required and consideration should be given to provision of space for settling tanks or an attenuation pond.
- Where access to confined spaces is required, appropriate mitigation measures should be addressed within the construction stage health and safety plan. Particular account should be taken of the gas results.
- The presence of potential contamination and mitigation measures should be addressed as part of the construction stage health and safety plan and should include measures to design out the risks, reduce their impact and, finally, to include the use of personnel protective equipment (PPE).

9. CONCLUSIONS AND RECOMMENDATIONS

9.1. CONTAMINATED LAND ASSESSMENT

Human Health	Chemical analysis completed has not highlighted any elevated determinants within the topsoil or underlying natural drift deposits. Therefore, the site is considered to be suitable for use as a residential development with no specialist mitigation measures required Out of the ten samples tested for asbestos during the ground investigation, none of the samples returned a positive result. If localised impacted soils are discovered during ground works correct PPE for construction workers and further assessment will be needed. Topsoil deposits are reworked, however initial chemical testing suggests that the topsoil may be suitable for re-use following screening and confirmation that the topsoil meets British Standards.
Controlled Waters	Low risk to controlled waters.
Ground Gas	Characteristic Situation 1 (pending completion of gas monitoring).
Potable Water	This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation.

9.2. GEOTECHNICAL ASSESSMENT

Based on existing data and given the predominantly cohesive ground conditions, it is considered that the majority of the proposed dwellings could be constructed using traditional spread footings bearing in the firm to stiff Clay at a depth from 1.00m to 1.50m below current ground levels.

Where deeper variable soft natural clays, or loose sand and gravels are identified, dependent on development levels, plots may require locally deepening to Mass Trench Fill. Alternatively, it is recommended that Ground Improvement by VSC be considered to ensure a safe and uniform ABP for a doubly reinforced strip foundation bearing within the treated sub-stratum.

In the location of soft clays, plots will require a driven pile foundation due the incompatibility with VSC.

Foundation depths should take account of the presence of existing and proposed trees with foundations deepened locally, to mitigate the potential for volumetric instability attributed to fluctuations in moisture content, in accordance with the requirements of NHBC standards.

It is recommended that at working drawing stage a foundation schedule is prepared for the development taking account of the physical change of natural clay soils and the current / proposed locations of trees.

END OF REPORT

APPENDIX I
LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between E3P and the client as indicated in Section 1.3.

2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.

3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.

4. During the site walkover, reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover, no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not been made known or accessible.

5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.

6. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.

7. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials, this is for indicative purposes only and do not constitute or replace full and proper surveys.

8. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

9. E3P cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by E3P is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by E3P in this connection without their explicit written agreement there to by E3P.

10. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

APPENDIX II
GLOSSARY

TERMS

ACM	Asbestos-containing material	**MMP**	Materials management plan
ADS	Acoustic design statement	**ND**	Not detected
AST	Above-ground storage tank	**NDP**	Nuclear density probe
BGS	British Geological Survey	**NMP**	Noise management plan
BSI	British Standards Institute	**NPSE**	Noise policy statement for England
BTEX	Benzene, toluene, ethylbenzene, xylenes	**NR**	Not recorded
CA	Coal Authority	**PAH**	Polycyclic aromatic hydrocarbon
CBR	California bearing ratio	**PCB**	Polychlorinated biphenyl
CIEH	Chartered Institute of Environmental Health	**PI**	Plasticity index
CIRIA	Construction Industry Research Association	**PID**	Photo ionisation detector
CLEA	Contaminated land exposure assessment	**POS**	Public open space
CML	Council of Mortgage Lenders	**PPE**	Personnel protective equipment
CoC	Contaminants of concern	**ProPG**	Professional practice guidance
CSM	Conceptual site model	**QA**	Quality assurance
DNAPL	Dense non-aqueous phase liquid (chlorinated solvents, PCB)	**SGV**	Soil guideline value
DWS	Drinking water standard	**SPH**	Separate-phase hydrocarbon
EA	Environment Agency	**SPT**	Standard penetration test
EQS	Environmental quality standard	**SVOC**	Semi-volatile organic compound
FFL	Finished floor level	**TPH**	Total and speciated petroleum hydrocarbon
GAC	General assessment criteria	**TPH CWG**	Total Petroleum Hydrocarbon (Criteria Working Group)
GL	Ground level	**UKWIR**	United Kingdom Water Infrastructure Risk
GSV	Gas screening value	**UST**	Underground storage tank
HCV	Health criteria value	**VCC**	Vibro-concrete column
ICSM	Initial conceptual site model	**VOC**	Volatile organic compound
LEL	Lower explosive limit	**VRSC**	Vibro-replacement stone columns
LMRL	Lower method reporting limit	**VSC**	Vibro-stone columns
LNAPL	Light non-aqueous phase liquid (petrol, diesel, kerosene)	**WHO**	World Health Organisation
MCV	Moisture condition value	**WRAP**	Waste and Resources Action Programme

MIBK	Methyl isobutyl ketone	**WTE**	Water table elevation
m	Metres	**ppm**	Parts per million
km	Kilometres	**mg/m^3**	Milligram per metre cubed
% v/v	Percent volume in air	**m bgl bgl**	Metres below ground level
mb	Millibars (atmospheric pressure)	**m bcl**	Metre below cover level
l/hr	Litres per hour	**mAOD**	Metres above ordnance datum (sea level)
µg/l	Micrograms per litre (parts per billion)	**kN/m^2**	Kilonewtons per metre squared
ppb	Parts per billion	**µm**	Micrometre
mg/kg	Milligrams per kilogram (parts per million)	**SSRT**	Site Specific Remediation Target
PSD	Particle Size Distribution	**DD**	Dry Density
CL:AIRE	Contaminated Land: Applications in Real Environments	**Mc**	Moisture Content
ρ	Bulk Density	**GPR**	Ground Penetrating Radar
NDP	Nuclear Density Probe	**FFL**	Finished Floor Level
LEL	Lower Explosive Limit	**UKWIR**	UK Water Industry Research
CIRIA	Construction Industry Research and Information Association	**LOD**	Limit of Detection

APPENDIX III
DRAWINGS

DRAWING 13-417-001 – SITE LOCATION PLAN





P1	-	10.07.2019	Draft	CB	NS
Phase	Revision	Date	Issue	Drawn	Checked

Notes:

Client:
Russell Homes

Job No:
13-417

Date:
10.07.2019

Drawing No:
002

Scale:
NTS @ A3

Job Title:
South Heywood - Phase 6

Drawing Title:
Proposed Development Plan

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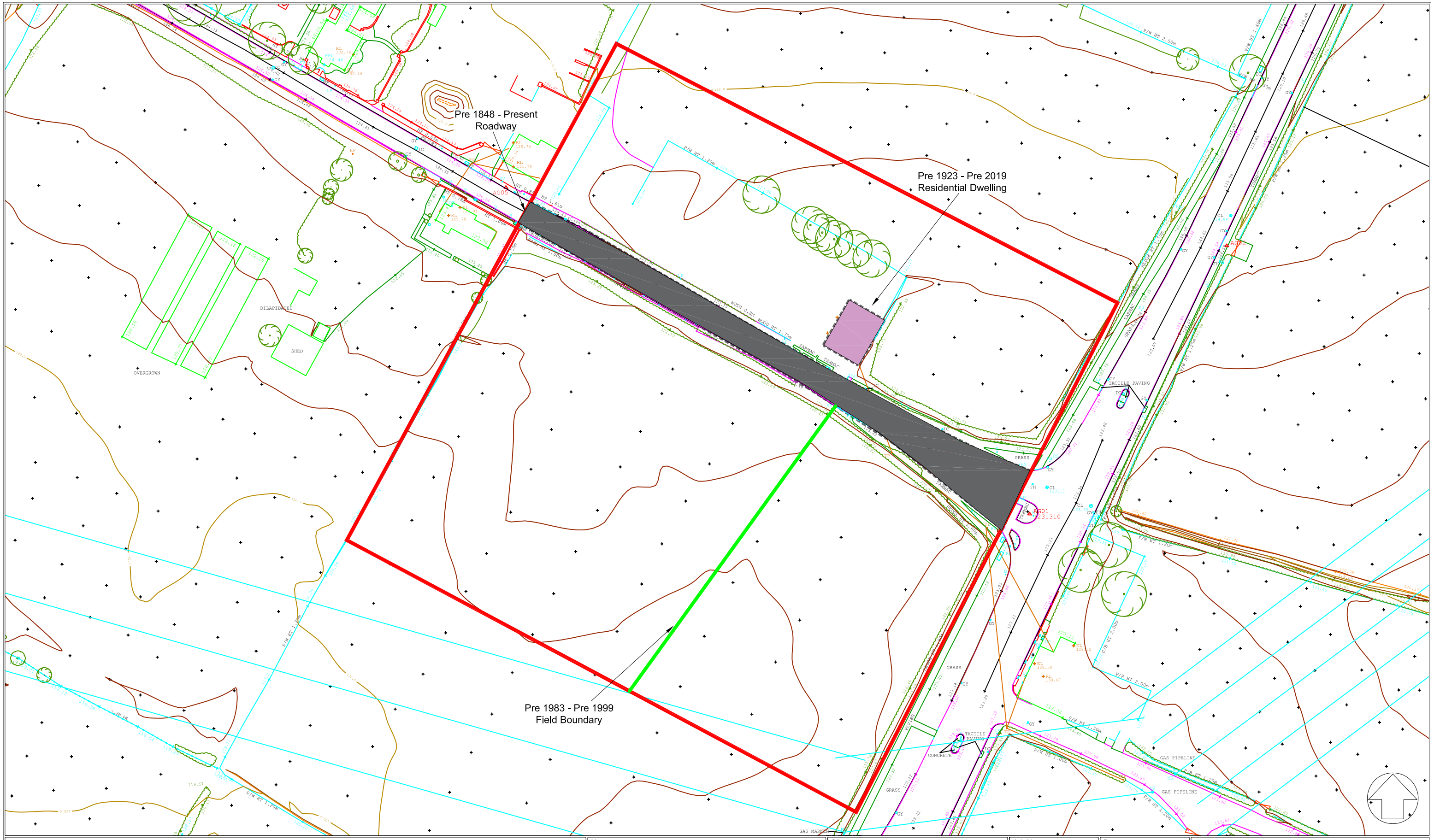

Historical Features

- Roadway
- Former Buildings
- Former Field Boundaries

Notes:

Phase	Revision	Date	Issue	Drawn	Checked
P1	-	10.07.2019	Draft	CB	NS

Client: Russell Homes

Job No: 13-417

Date: 10.07.2019

Drawing No: 003

Scale: NTS @ A3

Job Title: South Heywood - Phase 6

Drawing Title: Historical Features Plan

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Location Symbols

- Approximate Window Sample Probehole Location
- Approximate Trial Pit Location
- Approximate Soakaway Test Location
- Approximate Rotary Borehole Location
- Approximate Dynamic Cone Penetrometer Test Location

Historical Features

- Roadway
- Former Buildings
- Former Field Boundaries

Notes:

Phase	Revision	Date	Issue	Drawn	Checked
P1	R2	04.11.2019	Revision	HM	NS
P1	R1	16.07.2019	Revision	HM	NS
P1	-	10.07.2019	Draft	CB	NS

Client: Russell Homes

Job No: 13-417

Date: 04.11.2019

Drawing No: 004

Scale: NTS @ A3

Job Title: South Heywood - Phase 6

Drawing Title: Exploratory Hole Location Plan

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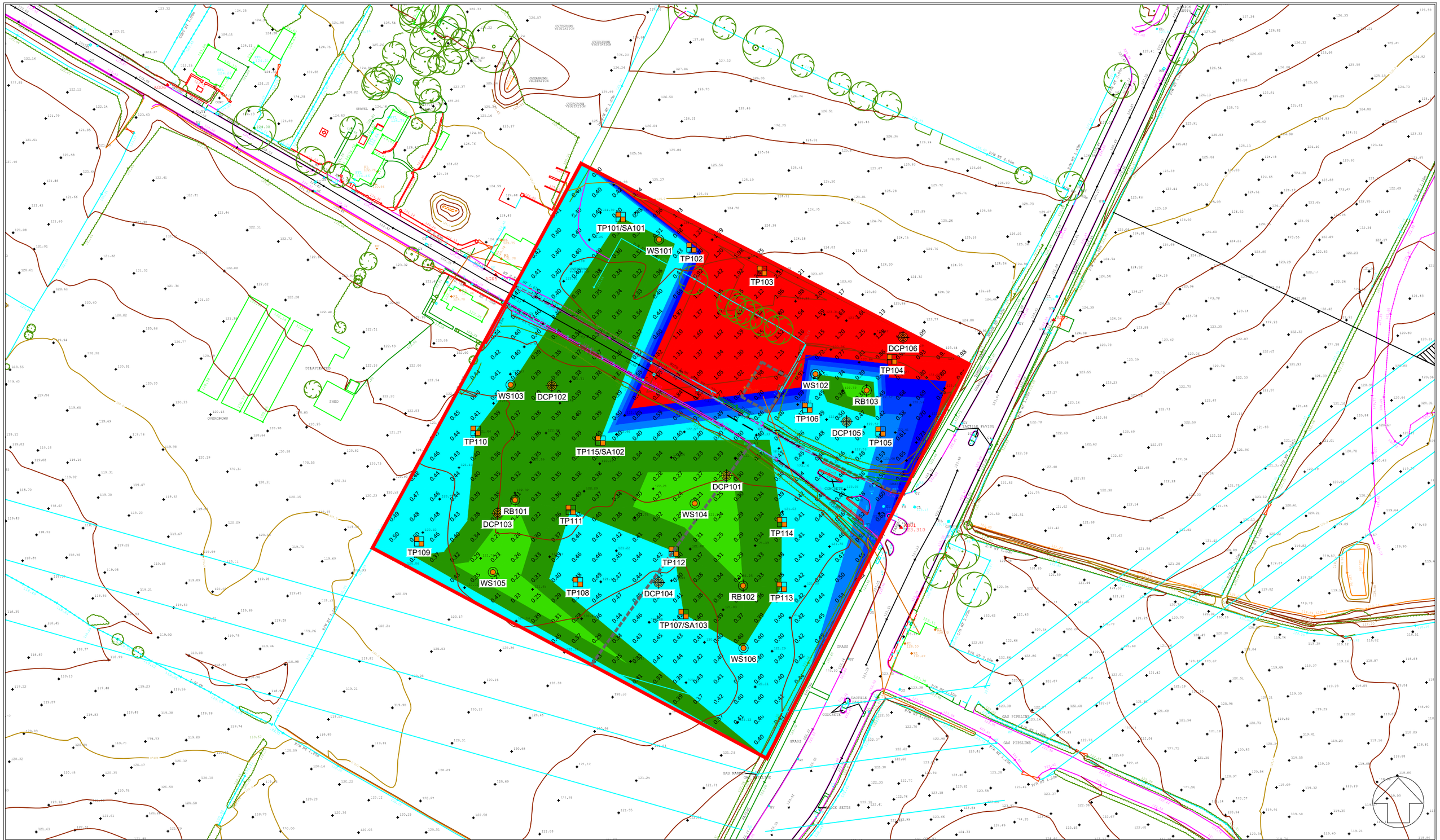

Location Symbols

- WS101 — Approximate Window Sample Probehole Location
- TP101 — Approximate Trial Pit Location
- SA101 — Approximate Soakaway Test Location
- RB101 — Approximate Rotary Borehole Location
- DCP101 — Approximate Dynamic Cone Penetrometer Test Location
- Approximate Location of Historical Features

Made Ground Depth (m)

- Depth of Made Ground 0.00 - 0.09m
- Depth of Made Ground 0.10 - 0.19m
- Depth of Made Ground 0.20 - 0.29m
- Depth of Made Ground 0.30 - 0.39m
- Depth of Made Ground 0.40 - 0.49m
- Depth of Made Ground 0.50 - 0.59m
- Depth of Made Ground 0.60 - 0.69m
- Depth of Made Ground 0.70 - 0.79m
- Depth of Made Ground >0.80m

Notes:

Phase	Revision	Date	Issue	Drawn	Checked
P1	-	22.07.2019	Draft	CB	NS

Client: Russell Homes

Job No: 13-417

Date: 22.07.2019

Drawing No: 005

Scale: NTS @ A3

Job Title: South Heywood - Phase 6

Drawing Title: Depth of Made Ground Plan

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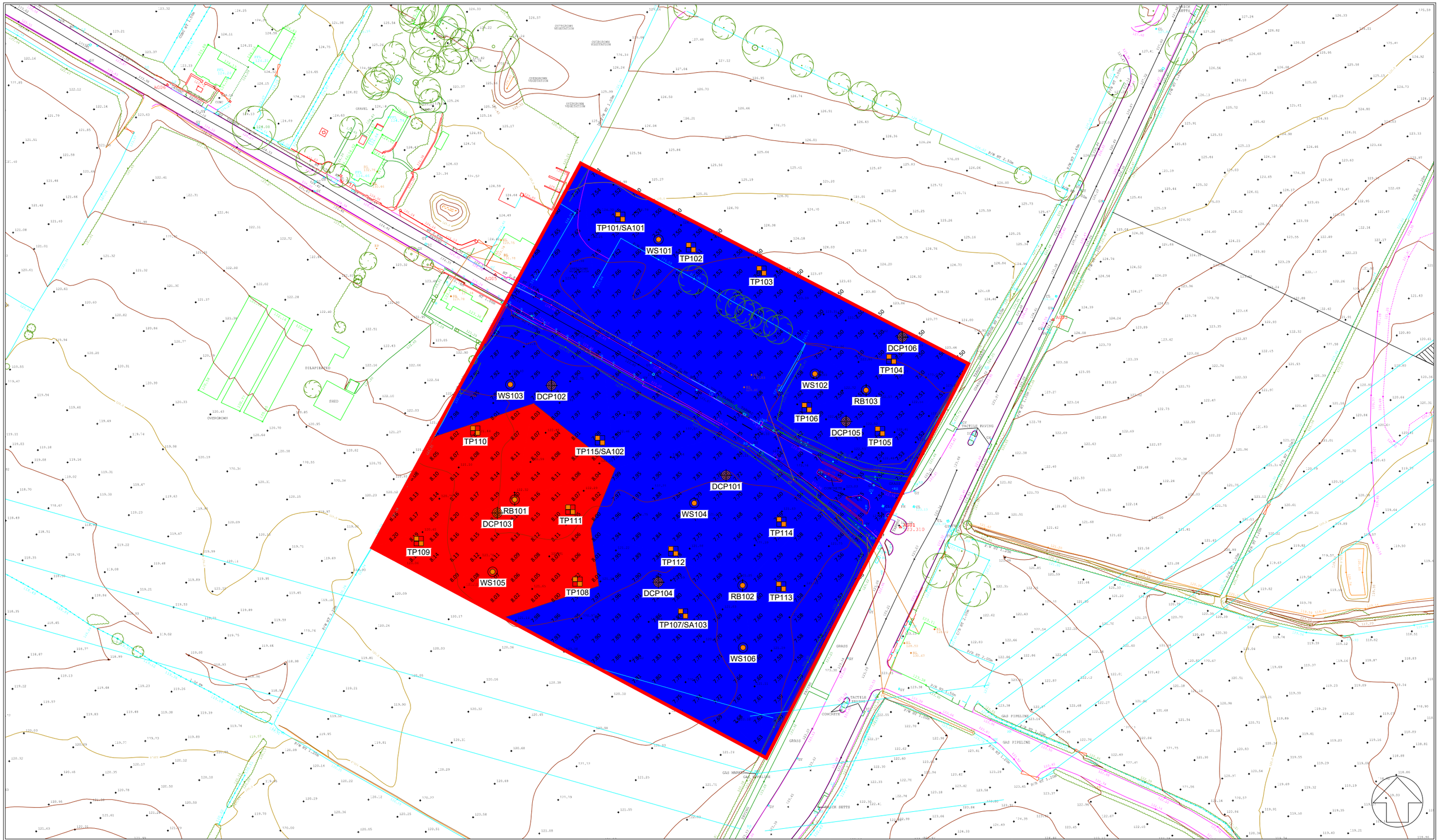

Location Symbols

- WS101 — Approximate Window Sample Probehole Location
- TP101 — Approximate Trial Pit Location
- SA101 — Approximate Soakaway Test Location
- RB101 — Approximate Rotary Borehole Location
- DCP101 — Approximate Dynamic Cone Penetrometer Test Location

Bedrock Depth (m)

- Depth to Bedrock 0.00 - 0.99m
- Depth to Bedrock 1.00 - 1.99m
- Depth to Bedrock 2.00 - 2.99m
- Depth to Bedrock 3.00 - 3.99m
- Depth to Bedrock 4.00 - 4.99m
- Depth to Bedrock 5.00 - 5.99m
- Depth to Bedrock 6.00 - 6.99m
- Depth to Bedrock 7.00 - 7.99m
- Depth to Bedrock >8.00m

Notes:

Phase	Revision	Date	Issue	Drawn	Checked
P1	-	22.07.2019	Draft	CB	NS

Client: Russell Homes

Job No: 13-417

Date: 22.07.2019

Drawing No: 006

Scale: NTS @ A3

Job Title: South Heywood - Phase 6

Drawing Title: Depth to Bedrock Plan

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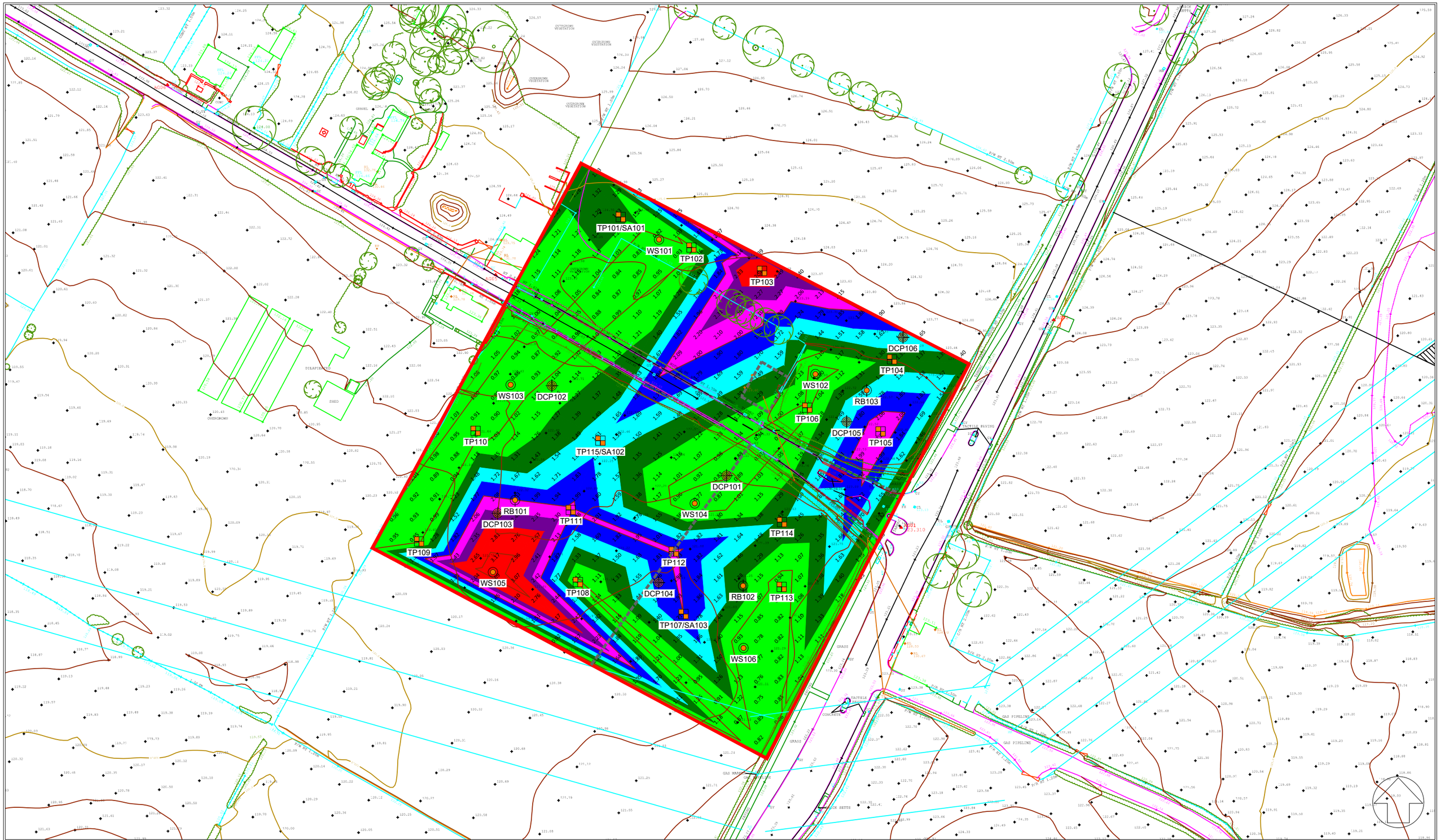

Location Symbols

- Approximate Window Sample Probehole Location
- Approximate Trial Pit Location
- Approximate Soakaway Test Location
- Approximate Rotary Borehole Location
- Approximate Dynamic Cone Penetrometer Test Location
- Approximate Location of Historical Features

Shallow Spread Footings

- Depth to Founding Strata 0.00 - 1.24m
- Depth to Founding Strata 1.25 - 1.49m

Mass Trench Fill Footings

- Depth to Founding Strata 1.50 - 1.74m
- Depth to Founding Strata 1.75 - 1.99m
- Depth to Founding Strata 2.00 - 2.24m

Engineered Footings

- Depth to Founding Strata 2.25 - 2.49m
- Depth to Founding Strata >2.50m

Notes:

Phase	Revision	Date	Issue	Drawn	Checked
P1	-	22.07.2019	Draft	CB	NS

Client: Russell Homes

Job No: 13-417

Date: 22.07.2019

Drawing No: 007

Scale: NTS @ A3

Job Title: South Heywood - Phase 6

Drawing Title: Depth to Founding Strata Plan

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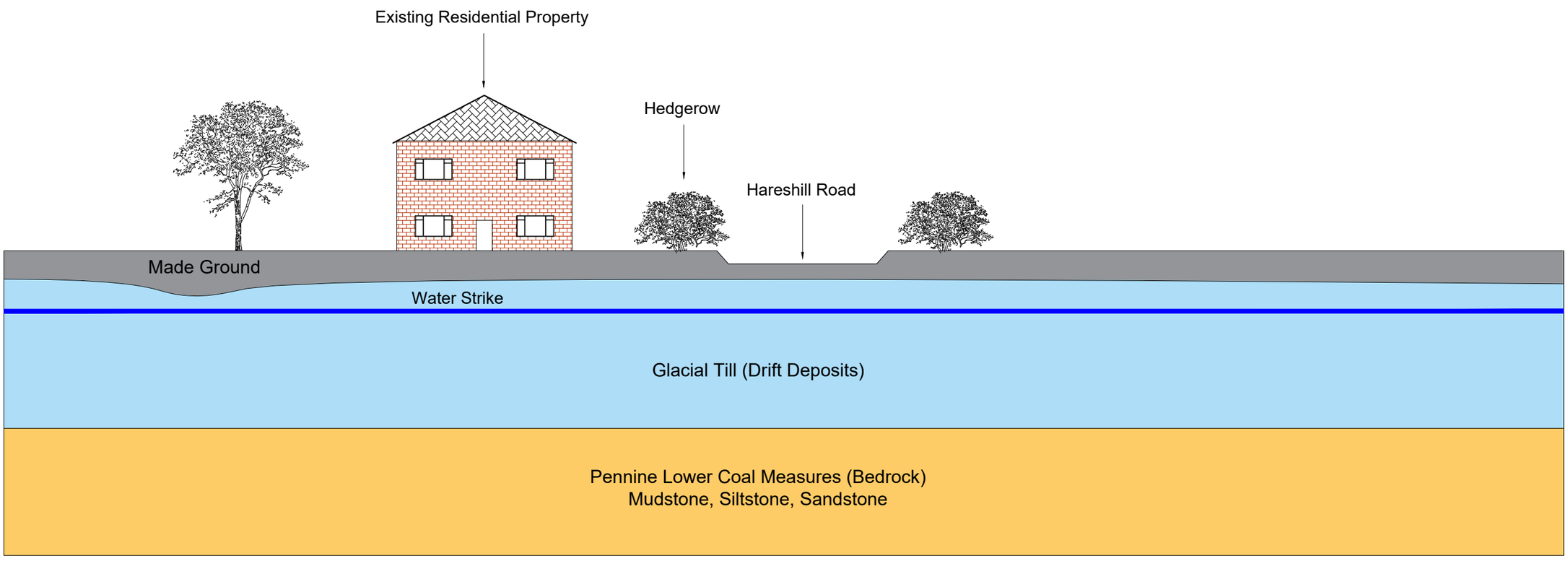
ID	SOURCE	EXPOSURE	POTENTIAL PATHWAY
	HUMAN HEALTH		
1	Heavy Metals, heavy end Hydrocarbons & Non Volatile Polycyclic Aromatic Hydrocarbon (PAH)	Dermal Contact and Ingestion	Construction Workers &
		Consumption of Home-grown Produce	Residential End Users
2	Semi Volatile Polycyclic Aromatic, and petroleum and diesel range Hydrocarbon Compounds, Chlorinated Hydrocarbons	Volatilisation / Accumulation, Vapour Inhalation	Construction Workers &
			Residential End Users
3	Asbestos Containing Materials (ACM)	Fibre / Dust Inhalation	Construction Workers, Residential End Users &Third Party Property
4	Hazardous Ground Gases	Inhalation	Construction Workers
		Accumulation	Residential End Users
5	PCB's	Dermal Contact and Ingestion	Construction Workers &
		Consumption of Home-grown Produce	Residential End Users
	CONTROLLED WATERS		
6	Water Soluble Mobile Contaminants	Vertical Migration	Secondary A Aquifer
7	Water Soluble Mobile Contaminants	Lateral Migration	Surface Water Courses
	BUILDING & INFRASTRUCTURE		
8	pH & Sulphate	Corrosion of Concrete	Foundations / Concrete
9	VOC, TPH's Phenols, pH	Chemical Corrosion	Potable Water Supply



P1	-	22.07.2019	Draft	CB	NS
Phase	Revision	Date	Issue	Drawn	Checked

Notes:

Client: Russell Homes

Job No: 13-417

Date: 22.07.2019

Drawing No: 008

Scale: NTS @ A3

Job Title: South Heywood - Phase 6

Drawing Title: Conceptual Site Model

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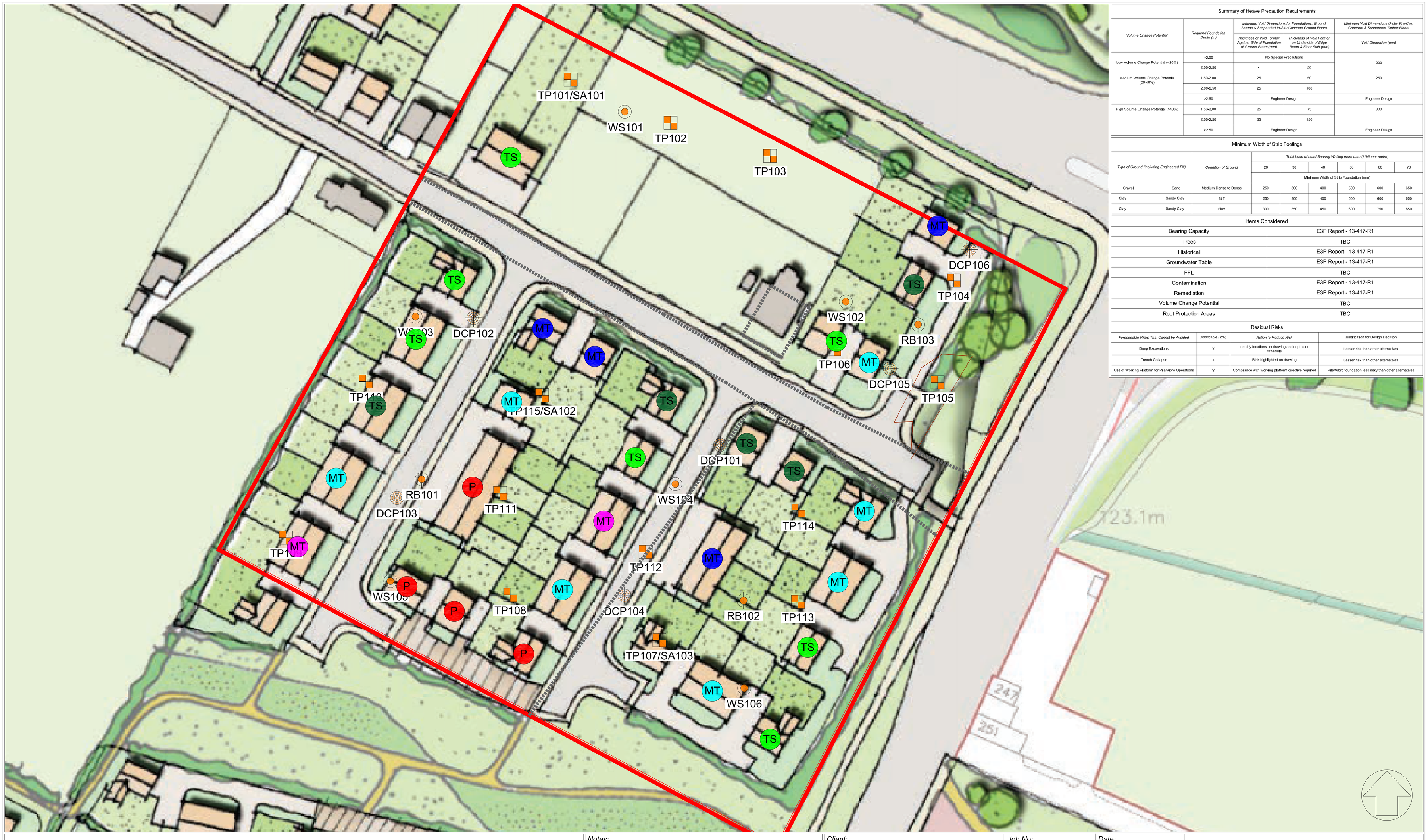

Summary of Heave Precaution Requirements

Volume Change Potential	Required Foundation Depth (m)	Minimum Void Dimensions for Foundations, Ground Beams & Suspended In-Situ Concrete Ground Floors		Minimum Void Dimensions Under Pre-Cast Concrete & Suspended Timber Floors
		Thickness of Void Former Against Side of Foundation of Ground Beam (mm)	Thickness of Void Former on Underside of Edge Beam & Floor Slab (mm)	Void Dimension (mm)
Low Volume Change Potential (<20%)	>2.00	No Special Precautions		200
	2.00-2.50	-	50	
Medium Volume Change Potential (20-40%)	1.50-2.00	25	50	250
	2.00-2.50	25	100	
	>2.50	Engineer Design		Engineer Design
High Volume Change Potential (>40%)	1.50-2.00	25	75	300
	2.00-2.50	35	150	
	>2.50	Engineer Design		Engineer Design

Minimum Width of Strip Footings

Type of Ground (Including Engineered Fill)		Condition of Ground	Total Load of Load-Bearing Walling more than (kN/linear metre)					
			20	30	40	50	60	70
			Minimum Width of Strip Foundation (mm)					
Gravel	Sand	Medium Dense to Dense	250	300	400	500	600	650
Clay	Sandy Clay	Stiff	250	300	400	500	600	650
Clay	Sandy Clay	Firm	300	350	450	600	750	850

Items Considered

Bearing Capacity	E3P Report - 13-417-R1
Trees	TBC
Historical	E3P Report - 13-417-R1
Groundwater Table	E3P Report - 13-417-R1
FFL	TBC
Contamination	E3P Report - 13-417-R1
Remediation	E3P Report - 13-417-R1
Volume Change Potential	TBC
Root Protection Areas	TBC

Residual Risks

Foreseeable Risks That Cannot be Avoided	Applicable (Y/N)	Action to Reduce Risk	Justification for Design Decision
Deep Excavations	Y	Identify locations on drawing and depths on schedule	Lesser risk than other alternatives
Trench Collapse	Y	Risk highlighted on drawing	Lesser risk than other alternatives
Use of Working Platform for Pile/Vibro Operations	Y	Compliance with working platform directive required	Pile/Vibro foundation less risky than other alternatives

Anticipated Foundation Types

- TS — Traditional Strip Foundations. Minimum depth 900mm below proposed Final Finished Level, Maximum safe bearing pressure limited to 100kN/m2.
- MT — Mass Trench Fill Foundations. Minimum depth 1250mm below proposed Final Finished Level, Maximum safe bearing pressure limited to 100kN/m2.
- V — Vibro Stone Ground Compaction. In accordance with NHBC Chapter 4.2
- P — Piled Foundations. Where the maximum foundation depth exceeds 2.50m a piled foundation option rather than a trench fill / deep reinforced strip foundations may be adopted, Column or line loads supported by ground beams.
- R — Raft Foundations. Maximum safe bearing pressure limited to 50kN/m2 on approved engineered granular fill, Raft foundations to be designed by a structural engineer in accordance with Chapter 4.5 of NHBC 2013, Raft foundations are considered suitable to mitigate against potential influence of clay heave / desiccation in accordance with Section 4.2, sub section D7E.
- TB — Traditional Strip / Trench Block Foundations. Traditional strip founded at 450mm below current level with build up in Trench Block and subsequent backfill to development level.
- Colours on Plot Corners to be Used When Referring to Foundation Schedule. (Pending Final Layout & Levels)

Depth to Target Founding Strata

- Footings 0.75 - 0.90m Deep. From Final Finished Level. In accordance with NHBC Chapter 4.2
- Footings 0.90 - 1.25m Deep. From Final Finished Level. In accordance with NHBC Chapter 4.2
- Footings 1.25 - 1.50m Deep. From Final Finished Level. In accordance with NHBC Chapter 4.2
- Footings 1.50 - 1.75m Deep. From Final Finished Level. In accordance with NHBC Chapter 4.2
- Footings 1.75 - 2.00m Deep. From Final Finished Level. In accordance with NHBC Chapter 4.2
- Footings 2.00 - 2.25m Deep. From Final Finished Level. In accordance with NHBC Chapter 4.2
- Footings 2.25 - 2.50m Deep. From Final Finished Level. In accordance with NHBC Chapter 4.2

Engineered Foundation Solutions

- Footings >2.50m Deep. From Final Finished Level. In accordance with NHBC Chapter 4.2
- Low Volume Change Potential Clay. Heave precautions required to underside of cast in-situ floor slab (with no sub-floor void) within conjected zone of tree influence. Heave precautions not required to foundation.

Notes:

Phase	Revision	Date	Issue	Drawn	Checked
P1	R2	04.11.2019	Revision	HM	NS
P1	R1	31.10.2019	Revision	HM	NS
P1	-	22.07.2019	Draft	CB	NS

Client: Russell Homes

Job No: 13-417

Date: 04.11.2019

Drawing No: 009

Scale: NTS @ A1

Job Title: South Heywood - Phase 6

Drawing Title: Concept Foundation Zoning Plan

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APPENDIX IV
PHOTOGRAPHS

PLATE 1 VIEW OF EXISTING RESIDENTIAL DWELLING, FACING SOUTH



PLATE 2 VIEW OF SITE FACING NORTH



PLATE 3 TP101 EXCAVATION



PLATE 4 TP103 EXCAVATION



PLATE 5 TP103 ARISINGS



PLATE 6 TP111 EXCAVATION



APPENDIX V
EXPLORATORY LOGS

Trial Pit Log

TrialPit No TP101/ SA101
Sheet 1 of 1

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords: 385576.44 - 408919.22 Level: 124.70	Date 15/04/2019
Location: Heywood		Dimensions (m): 1.60 x 1.20 Depth 2.20	Scale 1:24
Client: Russell Homes			Logged A.Ahmed

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	ES		0.40	124.30		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
	0.60	HVP	29				Soft low strength becoming firm medium strength greyish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone with bands of clayey fine to medium sand.
	0.90	HVP	50				
	1.30	ES					
	1.30	HVP	58				
	1.60	HVP	57				
				2.20	122.50		End of Pit at 2.20m

1
2
3
4
5

Remarks: 1.Complete.

Stability: Stable

Trial Pit Log

TrialPit No: TP102
Sheet 1 of 1

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords: 385600.89 - 408908.67 Level: 124.50	Date 15/04/2019
Location: Heywood		Dimensions (m): 1.80 x 1.20 Depth 2.10	Scale 1:24
Client: Russell Homes			Logged A.Ahmed

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.30	ES		0.50	124.00		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
	0.90	HVP	52.6				Firm medium strength greyish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone.
	1.30	HVP	63.3				
	1.60	HVP	54				
	1.90	HVP	56				
▼ 2.10				2.10	122.40		End of Pit at 2.10m

Remarks: 1.Complete.

Stability: Stable

Trial Pit Log

TrialPit No: TP103
Sheet 1 of 1

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords: 385625.27 - 408900.61 Level: 123.79	Date 15/04/2019
Location: Heywood		Dimensions (m): 1.70 x 1.20 Depth 2.50	Scale 1:24
Client: Russell Homes			Logged A.Ahmed

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30	123.49		MADE GROUND: Dark brown very clayey slightly gravelly sand gravel is fine to coarse sub-angular to rounded sandstone and mudstone (TOPSOIL).
	0.60	ES					MADE GROUND: Light yellow slightly gravelly clayey fine to medium sand. Gravel is fine to coarse sub-rounded to rounded sandstone and mudstone.
	1.00	B					
				1.20	122.59		MADE GROUND: Soft to firm greyish brown sandy slightly gravelly clay. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone with bands of clayey sand.
				1.80	121.99		MADE GROUND: Firm dark brown slightly sandy clay. Gravel is fine to coarse sub-angular to rounded of mudstone, coal, bark and sandstone.
▼ 2.10	2.00	ES					
				2.50	121.29		End of Pit at 2.50m

Remarks: 1.Complete 2.Stable 3. Slow water ingress 2.1m bgl

Stability: Stable

Trial Pit Log

TrialPit No: TP104
Sheet 1 of 1

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords: 385670.19 - 408870.07 Level: 122.77	Date 15/04/2019
Location: Heywood		Dimensions (m): Depth 2.10, 2.00 x 1.20	Scale 1:24
Client: Russell Homes			Logged A.Ahmed

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	ES		0.90	121.87		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
	0.90	HVP	76.6				Firm medium strength to stiff high strength grenish brown slightly gravelly sandy CLAY. Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
	1.30	HVP	82				
	1.50	ES					
	1.60	HVP	68.6				
	2.00	HVP	62				
				2.10	120.67		End of Pit at 2.10m

Remarks: 1.Complete.

Stability: Stable

Trial Pit Log

TrialPit No: TP105
Sheet 1 of 1

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords: 385666.25 - 408845.16 Level: 122.52	Date 15/04/2019
Location: Heywood		Dimensions (m): Depth 2.00, 1.20 × 2.00	Scale 1:24
Client: Russell Homes			Logged A.Ahmed

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.40	ES		0.50	122.02		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand. Gravel is fine to coarse sub-angular to rounded sandstone, mudstone, brick and ceramics.
				1.00	121.52		Light yellow slightly gravelly clayey SAND gravel is fine to coarse sub-rounded to rounded sandstone mudstone.
				1.50	121.02		Soft to firm greyish brown very sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
				1.80	120.72		Light yellow slightly gravelly clayey fine to medium SAND. Gravel is fine to coarse sub-rounded to rounded of sandstone and mudstone.
	1.90 1.90 2.00	ES HVP HVP	 58 67.3	2.00	120.52		Firm medium strength greyish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey sand. End of Pit at 2.00m

Remarks: 1.Complete.

Stability: Stable

Trial Pit Log

TrialPit No: TP106
Sheet 1 of 1

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords: 385640.94 - 408853.35 Level: 122.67	Date 15/04/2019
Location: Heywood		Dimensions (m): 1.80 x 1.20 Depth 2.50	Scale 1:24
Client: Russell Homes			Logged A.Ahmed

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.30	ES		0.50	122.17		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
	0.90	HVP	72	1.00	121.67		Firm medium strength grey mottled brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
	1.30	HVP	38				Soft low strength becoming firm medium strength greyish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
	1.70	HVP	70.6				
	1.90	HVP	74.6				
▼ 2.50				2.50	120.17		End of Pit at 2.50m

Remarks: 1. Complete 2.Stable 3. Slight ingress at 2.50m bgl.

Stability: Stable

Borehole Log

Borehole No. **TP107/SA103**

Sheet 1 of 1

Project Name:	South Heywood Parcel 6	Project No. 13-417	Co-ords:	385598E - 408782N	Hole Type WS
Location:	Heywood		Level:	120.70 m AOD	Scale 1:50
Client:	Russell Homes		Dates:	15/04/2019	Logged By A.Ahmed

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.40	120.70		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
		0.60		HVP=38				Soft low strength greyish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
		0.90		HVP=35				
		1.30		HVP=47				
		1.60		HVP=35				
	▼ 2.00	1.90		HVP=28	2.00	120.30		End of Borehole at 2.00m

Remarks

1. Complete 2. Slow ingress at 2.00m bgl.

Trial Pit Log

TrialPit No: TP108
Sheet 1 of 1

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords: 385561.65 - 408793.15 Level: 121.30	Date 15/04/2019
Location: Heywood		Dimensions (m): 1.80 x 1.20 Depth 2.20	Scale 1:24
Client: Russell Homes			Logged A.Ahmed

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	ES		0.50	120.80		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
	0.60	HVP	60				Firm medium strength orangish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
	0.90	HVP	62	1.20	120.10		Light yellow slightly gravelly clayey fine to medium SAND. Gravel is fine to coarse sub-rounded to rounded of sandstone mudstone.
	1.90	HVP	82	1.80	119.50		Stiff high strength greyish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
▼ 2.20	2.00	HVP	84	2.20	119.10		End of Pit at 2.20m

Remarks: 1.Complete 2.Stable 3.Slow water ingress at 2.2m bgl

Stability: Stable

Trial Pit Log

TrialPit No: TP109
Sheet 1 of 1

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords: 385506.76 - 408807.16 Level: 120.40	Date 15/04/2019
Location: Heywood		Dimensions (m): 2.00 x 1.20 Depth 2.20	Scale 1:24
Client: Russell Homes			Logged A.Ahmed

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.30	ES		0.50	119.90		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
	0.60	HVP	58				Firm medium strength orangish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded mudstone and sandstone. With bands of clayey fine to medium sand.
	0.90	HVP	56				
	1.30	HVP	40				
	1.60 1.60	ES HVP	44.6	1.80	118.60		Light yellow slightly gravelly clayey fine to medium SAND. Gravel is fine to coarse sub-rounded to rounded of sandstone and mudstone.
				2.20	118.20		End of Pit at 2.20m

Remarks: 1. Complete 2. Slow ingress

Stability: Stable

Trial Pit Log

TrialPit No: TP110
Sheet 1 of 1

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords: 385526.32 - 408845.36 Level: 121.44	Date 15/04/2019
Location: Heywood		Dimensions (m): 2.20 x 1.20 Depth 2.20	Scale 1:24
Client: Russell Homes			Logged A.Ahmed

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.40	121.04		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
	0.60	HVP	59.3				Firm medium strength orangish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
	0.90	HVP	78.6				
	1.20	ES					
	1.30	HVP	56				
	1.80	HVP	60.6				
	2.00	HVP	55				
				2.20	119.24		End of Pit at 2.20m

Remarks: 1.Complete.

Stability: Stable

Trial Pit Log

TrialPit No: TP111
Sheet 1 of 1

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords: 385559.18 - 408818.04 Level: 122.17	Date 15/04/2019
Location: Heywood		Dimensions (m): Depth 2.50, 2.00 x 1.20	Scale 1:24
Client: Russell Homes			Logged A.Ahmed

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	ES		0.40	121.77		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
	0.80	ES		1.60	120.57		Light yellow slightly gravelly clayey fine to medium SAND. Gravel is fine to coarse sub-rounded to rounded of sandstone and mudstone.
				2.50	119.67		Firm to stiff orangish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
							End of Pit at 2.50m

Remarks: 1.Complete.

Stability: Stable

Trial Pit Log

TrialPit No: TP112
Sheet 1 of 1

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords: 385594.79 - 408803.68 Level: 121.05	Date 15/04/2019
Location: Heywood		Dimensions (m): Depth 2.20 (2.20 × 1.20)	Scale 1:24
Client: Russell Homes			Logged A.Ahmed

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.40	120.65		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
	0.80	ES					Soft to firm greyish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
	1.00	B					
	1.00	ES					
	1.60	HVP	67.3	1.60	119.45		Firm medium strength orangish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
	1.90	HVP	68.6				
				2.20	118.85		End of Pit at 2.20m

1 2 3 4 5

Remarks: 1.Complete.

Stability: Stable

Trial Pit Log

TrialPit No: TP113
Sheet 1 of 1

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords: 385632.08 - 408791.46 Level: 121.65	Date 15/04/2019
Location: Heywood		Dimensions (m): Depth 2.20 — 2.00 × 1.20	Scale 1:24
Client: Russell Homes			Logged A.Ahmed

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	ES		0.40	121.25		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
	0.60	HVP	62.6				Firm medium strength greyish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
	0.90	HVP	56				
	1.30	HVP	72				
	1.60	HVP	82	1.50	120.15		Stiff high strength greyish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fome to medium sand.
	1.90	HVP	91.6				
	2.00	ES					
				2.20	119.45		End of Pit at 2.20m

Remarks: 1.Complete.

Stability: Stable

Trial Pit Log

TrialPit No: TP114
Sheet 1 of 1

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords: 385632.16 - 408813.85 Level: 121.60	Date 15/04/2019
Location: Heywood		Dimensions (m): 1.80 x 1.20 Depth 2.30	Scale 1:24
Client: Russell Homes			Logged A.Ahmed

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	ES		0.40	121.20		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
				1.00	120.60		Light yellow slightly gravelly clayey fine to medium SAND. Gravel is fine to coarse sub-rounded to rounded of sandstone and mudstone.
	1.30	HVP	67.3				Firm medium strength to stiff high strength dark brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
	1.60	HVP	82				
	1.90	HVP	76.6	1.80	119.80		Firm medium strength to stiff high strength greyish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
	2.20	HVP	55				
				2.30	119.30		End of Pit at 2.30m

Remarks: 1.Complete.

Stability: Stable

Trial Pit Log

TrialPit No TP115/ SA102
Sheet 1 of 1

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords: 385569.44 - 408841.98 Level: 122.45	Date 15/04/2019
Location: Heywood		Dimensions (m): 1.80 x 1.20 Depth 2.10	Scale 1:24
Client: Russell Homes			Logged A.Ahmed

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.40	122.05		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
				1.20	121.25		Light yellow slightly gravelly clayey fine to medium SAND. Gravel is fine to coarse sub-rounded to rounded of sandstone and mudstone.
				1.70	120.75		Stiff dark brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey sand.
				2.10	120.35		Stiff greyish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey sand.
							End of Pit at 2.10m

1 2 3 4 5

Remarks: 1.Complete.

Stability: Stable

Borehole Log

Borehole No. **WS101**

Sheet 1 of 1

Project Name:	South Heywood Parcel 6	Project No. 13-417	Co-ords:	385590E - 408911N	Hole Type WS
Location:	Heywood		Level:	124.10 m AOD	Scale 1:50
Client:	Russell Homes		Dates:	15/04/2019	Logged By A.Ahmed

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.30	124.10		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
		0.60	PP					Firm low strength greyish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
		0.90	PP					
		1.00	SPT	N=6 (2,2/1,2,2,1)				
		1.60	PP					
		1.90	PP					
		2.00	SPT	N=11 (2,3/3,3,2,3)	2.00	123.80		Medium dense dark brown clayey slightly gravelly SAND. Gravel is fine to medium sub-rounded to rounded of mudstone and sandstone (Becoming loose at circa 3.00m bgl).
		2.20	ES					
		3.00	SPT	N=10 (3,3/2,3,3,2)				
					3.45	122.10		End of Borehole at 3.45m

Remarks

Terminated due to sand falling in.

Borehole Log

Borehole No. **WS102**

Sheet 1 of 1

Project Name:	South Heywood Parcel 6	Project No. 13-417	Co-ords:	385644E - 408865N	Hole Type WS
Location:	Heywood		Level:	122.83 m AOD	Scale 1:50
Client:	Russell Homes		Dates:	15/04/2019	Logged By A.Ahmed

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.30	ES		0.40	122.83		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
		0.70	PP					Stiff medium strength greyish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
		0.90	PP					
		1.00	D					
		1.00	SPT	N=9 (2,3/2,2,3,2)				
		1.30	PP					
		1.50	U					
		1.50	PP					
	2.00	2.00	D		2.00	122.43		Very loose to loose light yellow slightly gravelly clayey SAND. Gravel is fine to coarse sub-rounded to rounded of sandstone and mudstone.
		2.00	SPT	N=4 (2,1/1,1,1,1)				
		2.50	ES					
		3.00	D					
		3.00	SPT	N=8 (2,2/2,1,2,3)				
		4.00	D		4.00	120.83		Stiff medium strength greyish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
		4.00	SPT	N=11 (2,3/3,3,2,3)				
		5.00	D					
		5.00	SPT	N=11 (3,3/2,3,3,3)				
					5.45	118.83		End of Borehole at 5.45m

1 2 3 4 5 6 7 8 9 10

Remarks
1.Complete

Borehole Log

Borehole No. **WS103**

Sheet 1 of 1

Project Name:	South Heywood Parcel 6	Project No. 13-417	Co-ords:	385538E - 408861N	Hole Type WS
Location:	Heywood		Level:	122.20 m AOD	Scale 1:50
Client:	Russell Homes		Dates:	15/04/2019	Logged By A.Ahmed

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.40	122.20		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
		0.60	PP					Firm low strength orangish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
		0.90	PP					
		1.00	D					
		1.00	SPT	N=4 (2,2/1,1,1,1)				
		1.30	PP					
					1.50	121.80		Dark brown slightly gravelly clayey SAND. Gravel is fine to coarse sub-rounded to rounded of sandstone and mudstone.
		1.80	ES					
		2.00	SPT	N=9 (5,3/2,3,2,2)				
		3.00	SPT	N=15 (3,4/4,3,4,4)	3.00	120.70		Stiff to firm dark brown slightly sandy slightly gravelly CLAY. Gravel is fine to medium sub-rounded to round mudstone.
		3.30	PP					
		3.60	PP					
		4.00	D		4.00	119.20		Stiff medium strength dark brown slightly sandy slightly gravelly CLAY. Gravel is fine to medium sub-rounded to rounded of mudstone (Becoming firm low strength at circa 4.00m bgl).
		4.00	SPT	N=9 (3,3/2,3,2,2)				
					4.45	119.20		End of Borehole at 4.45m

1 2 3 4 5 6 7 8 9 10

Remarks

Terminated due to sand falling in.

Borehole Log

Borehole No. **WS104**

Sheet 1 of 1

Project Name:	South Heywood Parcel 6	Project No. 13-417	Co-ords:	385602E - 408820N	Hole Type WS
Location:	Heywood		Level:	121.53 m AOD	Scale 1:50
Client:	Russell Homes		Dates:	15/04/2019	Logged By A.Ahmed

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20	121.53		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
		0.60	ES					Stiff medium strength orangish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
		0.60	PP					
		0.90	PP					
		1.00	D					
		1.00	SPT	N=11 (2,3/3,2,3,3)				
		1.30	PP					
		1.60	ES					
		1.60	PP					
		1.90	PP					
		2.00	D		2.00	121.33		Firm low strength dark brown silty CLAY.
		2.00	SPT	N=5 (2,2/1,1,2,1)				
		2.30	PP					
		2.60	PP					
					2.70	119.53		Loose dark brown slightly gravelly clayey fine to medium SAND. Gravel is fine to coarse sub-rounded to rounded of sandstone and mudstone.
		3.00	SPT	N=9 (2,2/3,2,2,2)				
		4.00	SPT	N=5 (1,1/0,1,2,2)				
					4.45	118.83		End of Borehole at 4.45m

Remarks

Terminated due to sand falling in.

Borehole Log

Borehole No. **WS105**

Sheet 1 of 1

Project Name:	South Heywood Parcel 6	Project No. 13-417	Co-ords:	385532E - 408797N	Hole Type WS
Location:	Heywood		Level:	121.72 m AOD	Scale 1:50
Client:	Russell Homes		Dates:	15/04/2019	Logged By A.Ahmed

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20	121.72		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
		0.60	PP		0.80	121.52		Soft to firm orangish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
		1.00	SPT	N=7 (2,2/2,1,2,2)				loose dark brown slightly gravelly clayey SAND. Gravel is fine to coarse sub-rounded to rounded of sandstone and mudstone (Becoming medium dense at circa 3.00m bgl).
		1.20	ES					
		2.00	SPT	N=5 (2,3/2,1,1,1)				
		3.00	SPT	N=17 (3,3/4,4,5,4)				
					3.45	120.92		End of Borehole at 3.45m

1 2 3 4 5 6 7 8 9 10

Remarks

Terminated due to sand falling in.

Borehole Log

Borehole No. **WS106**

Sheet 1 of 1

Project Name:	South Heywood Parcel 6	Project No. 13-417	Co-ords:	385619E - 408770N	Hole Type WS
Location:	Heywood		Level:	121.11 m AOD	Scale 1:50
Client:	Russell Homes		Dates:	15/04/2019	Logged By A.Ahmed

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.50	U		0.40	121.11		MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
		1.00	SPT	N=4 (2,1/1,1,1,1)	1.20	120.71		Firm low strength orangish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. With bands of clayey fine to medium sand.
		1.80	ES		1.70	119.91		Firm silty slightly sandy CLAY.
		2.00	SPT	N=9 (2,2/3,2,2,2)	2.20	119.41		Loose dark brown slightly gravelly clayey fine to medium SAND. Gravel is fine to coarse sub-rounded to rounded of sandstone and mudstone.
	3.00	3.00	SPT	N=9 (2,3/3,2,2,2)				Firm silty slightly sandy CLAY.
		4.00	SPT	N=15 (2,4/4,3,4,4)	3.80	118.91		Medium dense dark brown slightly gravelly clayey fine to medium SAND. Gravel is fine to coarse sub-rounded to rounded of sandstone and mudstone.
					4.45	117.31		End of Borehole at 4.45m

Remarks

1.Incomplete 2.Collapse in loose sands

Borehole Log

Borehole No. **RB101**

Sheet 1 of 3

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords:	Hole Type BH
Location: Heywood		Level:	Scale 1:50
Client: Russell Homes		Dates: 11/06/2019	Logged By E. Moss

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30			MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone. Brown CLAY with bands of sand and gravel.
					8.20			Grey brown MUDSTONE.

Remarks
Complete.

Borehole Log

Borehole No. **RB101**

Sheet 2 of 3

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords:	Hole Type BH
Location: Heywood		Level:	Scale 1:50
Client: Russell Homes		Dates: 11/06/2019	Logged By E. Moss

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Grey brown MUDSTONE.
					12.30			Grey MUDSTONE.
					18.90			Grey SANDSTONE.

11 12 13 14 15 16 17 18 19 20

Remarks
Complete.

Borehole Log

Borehole No. **RB101**

Sheet 3 of 3

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords:	Hole Type BH
Location: Heywood		Level:	Scale 1:50
Client: Russell Homes		Dates: 11/06/2019	Logged By E. Moss

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Grey SANDSTONE.
					20.60			Grey MUDSTONE.
					21.70			Grey SANDSTONE.
					23.80			Grey MUDSTONE with coal traces.
					24.20			Grey MUDSTONE with sandstone bands.
					30.00			End of Borehole at 30.00m

21 22 23 24 25 26 27 28 29 30

Remarks
Complete.

Borehole Log

Borehole No. **RB102**

Sheet 1 of 3

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords:	Hole Type BH
Location: Heywood		Level:	Scale 1:50
Client: Russell Homes		Dates: 11/06/2019	Logged By E. Moss

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30			MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone.
								Brown CLAY with bands of sand.
					7.60			Brown grey MUDSTONE.

Remarks
Complete.

Borehole Log

Borehole No. **RB102**

Sheet 2 of 3

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords:	Hole Type BH
Location: Heywood		Level:	Scale 1:50
Client: Russell Homes		Dates: 11/06/2019	Logged By E. Moss

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Brown grey MUDSTONE.
					11.60			Grey MUDSTONE with bands of sandstone.
					16.20			Grey MUDSTONE with coal traces.
					17.30			Grey SANDSTONE.
					19.90			

Remarks
Complete.

Borehole Log

Borehole No. **RB102**

Sheet 3 of 3

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords:	Hole Type BH
Location: Heywood		Level:	Scale 1:50
Client: Russell Homes		Dates: 11/06/2019	Logged By E. Moss

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Grey MUDSTONE with sandstone bands.
					24.10			Grey MUDSTONE with coal traces.
					25.00			Grey MUDSTONE with sandstone bands.
					30.00			End of Borehole at 30.00m

21 22 23 24 25 26 27 28 29 30

Remarks
Complete.

Borehole Log

Borehole No. **RB103**

Sheet 1 of 3

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords:	Hole Type BH
Location: Heywood		Level:	Scale 1:50
Client: Russell Homes		Dates: 11/06/2019	Logged By E. Moss

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20			MADE GROUND: Dark brown very clayey slightly gravelly fine to medium sand (Topsoil). Gravel is fine to coarse sub-angular to rounded of sandstone and mudstone. Grey CLAY.
					7.50			Grey MUDSTONE.

Remarks
Complete.

Borehole Log

Borehole No. **RB103**

Sheet 2 of 3

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords:	Hole Type BH
Location: Heywood		Level:	Scale 1:50
Client: Russell Homes		Dates: 11/06/2019	Logged By E. Moss

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								Grey MUDSTONE.	
					10.80			Grey SANDSTONE.	11
									12
					13.10			Grey MUDSTONE with sandstone bands.	13
					13.60			Grey MUDSTONE with traces of coal.	14
									15
									16
									17
									18
									19
									20

Remarks
Complete.

Borehole Log

Borehole No. **RB103**

Sheet 3 of 3

Project Name: South Heywood Parcel 6	Project No. 13-417	Co-ords:	Hole Type BH
Location: Heywood		Level:	Scale 1:50
Client: Russell Homes		Dates: 11/06/2019	Logged By E. Moss

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Grey MUDSTONE with traces of coal.
					20.60			Grey MUDSTONE with bands of sandstone.
					21.50			Grey SANDSTONE with mudstone bands.
					27.60			Grey SANDSTONE.
					30.00			End of Borehole at 30.00m

Remarks
Complete.

APPENDIX VI
CHEMICAL TESTING RESULTS

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t: 01923 225404
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e: reception@i2analytical.com

Analytical Report Number : 19-41750

Project / Site name:	South Heywood Phase 6	**Samples received on:**	16/05/2019
Your job number:	13-417	**Samples instructed on:**	16/05/2019
Your order number:	13417-32485-NS	**Analysis completed by:**	23/05/2019
Report Issue Number:	1	**Report issued on:**	23/05/2019
Samples Analysed:	20 soil samples		

Signed:

Zina Abdul Razzak
Senior Quality Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 19-41750

Project / Site name: South Heywood Phase 6
Your Order No: 13417-32485-NS

Lab Sample Number				1224317	1224318	1224319	1224320	1224321
Sample Reference				TP101	TP103	TP103	TP105	TP105
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	0.60	2.00	0.40	1.90
Date Sampled				15/05/2019	15/05/2019	15/05/2019	15/05/2019	15/05/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	15	14	11	20	11
Total mass of sample received	kg	0.001	NONE	0.40	0.51	0.57	0.33	0.54
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	-	Not-detected	-
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	6.1	5.8	-	5.9	-
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Total Sulphate as SO_4	mg/kg	50	MCERTS	650	170	-	760	-
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	13	11	-	25	-
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0066	0.0057	-	0.013	-
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	6.6	5.7	-	12.6	-
Sulphide	mg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	-
Total Sulphur	mg/kg	50	MCERTS	380	95	-	430	-
Total Organic Carbon (TOC)	%	0.1	MCERTS	-	0.7	0.6	3.9	-
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	-
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.37	< 0.05	< 0.05	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	0.35	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.22	< 0.05	< 0.05	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	0.26	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	0.24	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.17	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.21	< 0.05	< 0.05	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	1.82	< 0.80	< 0.80	< 0.80	< 0.80

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Analytical Report Number: 19-41750

Project / Site name: South Heywood Phase 6
Your Order No: 13417-32485-NS

Lab Sample Number				1224317	1224318	1224319	1224320	1224321
Sample Reference				TP101	TP103	TP103	TP105	TP105
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	0.60	2.00	0.40	1.90
Date Sampled				15/05/2019	15/05/2019	15/05/2019	15/05/2019	15/05/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	15	1.7	2.3	9.5	8.0
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	120	-	56
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	-	0.64	-	0.73
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	18	14	-	17	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	43	13	21	26	17
Lead (aqua regia extractable)	mg/kg	1	MCERTS	62	8.6	9.0	35	10
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	0.6	< 0.3	< 0.3	0.5	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	16	11	20	13	20
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	19	-	22
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	62	18	43	34	48

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	-
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	-
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	-
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	-
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	-
TPH (C16 - C21)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	-
TPH (C21 - C35)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	-
TPH (C35 - C40)	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	-
TPH Total C5 - C40	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	-

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Analytical Report Number: 19-41750

Project / Site name: South Heywood Phase 6
Your Order No: 13417-32485-NS

Lab Sample Number				1224322	1224323	1224324	1224325	1224326
Sample Reference				WS101	WS102	TP107	TP109	TP110
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				2.20	2.50	0.20	0.30	1.20
Date Sampled				15/05/2019	15/05/2019	15/05/2019	15/05/2019	15/05/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	14	19	20	17	17
Total mass of sample received	kg	0.001	NONE	0.50	0.42	0.35	0.39	0.40
Asbestos in Soil	Type	N/A	ISO 17025	-	-	Not-detected	Not-detected	-
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	-	7.2	5.9	-	-
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Total Sulphate as SO_4	mg/kg	50	MCERTS	-	190	120	-	-
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	-	47	28	-	-
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-	0.024	0.014	-	-
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-	23.5	14.0	-	-
Sulphide	mg/kg	1	MCERTS	-	< 1.0	< 1.0	-	-
Total Sulphur	mg/kg	50	MCERTS	-	240	340	-	-
Total Organic Carbon (TOC)	%	0.1	MCERTS	-	-	-	4.1	-
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	-	< 1.0	< 1.0	-	-
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	-
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	-
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	-
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	-
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.61	-
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	-
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.26	1.8	-
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.27	1.7	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	1.1	-
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	1.2	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	1.4	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.68	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	1.2	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	-
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	< 0.80	9.67	-

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Analytical Report Number: 19-41750

Project / Site name: South Heywood Phase 6
Your Order No: 13417-32485-NS

Lab Sample Number				1224322	1224323	1224324	1224325	1224326
Sample Reference				WS101	WS102	TP107	TP109	TP110
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				2.20	2.50	0.20	0.30	1.20
Date Sampled				15/05/2019	15/05/2019	15/05/2019	15/05/2019	15/05/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	2.4	8.2	9.8	25	6.9
Barium (aqua regia extractable)	mg/kg	1	MCERTS	17	-	-	81	66
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.33	-	-	0.82	0.87
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	20	19	-	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	12	18	25	48	29
Lead (aqua regia extractable)	mg/kg	1	MCERTS	5.5	17	38	63	16
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	0.4	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	7.7	22	11	19	24
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	7.4	-	-	39	23
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	15	53	35	95	61

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	-
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	-
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	-
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	-
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	-
TPH (C16 - C21)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	6.9	-
TPH (C21 - C35)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	8.6	-
TPH (C35 - C40)	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	-
TPH Total C5 - C40	mg/kg	10	MCERTS	< 10	< 10	< 10	18	-

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Analytical Report Number: 19-41750

Project / Site name: South Heywood Phase 6
Your Order No: 13417-32485-NS

Lab Sample Number				1224327	1224328	1224329	1224330	1224331
Sample Reference				TP111	TP113	TP113	TP114	WS103
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	0.20	2.00	0.20	0.20
Date Sampled				15/05/2019	15/05/2019	15/05/2019	15/05/2019	15/05/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	14	18	12	21	21
Total mass of sample received	kg	0.001	NONE	0.40	0.34	0.50	0.35	0.36
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	-	Not-detected	Not-detected
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	-	-	-	6.2	5.9
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Total Sulphate as SO_4	mg/kg	50	MCERTS	-	-	-	780	930
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	-	-	-	41	16
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-	-	-	0.021	0.0080
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-	-	-	20.7	8.0
Sulphide	mg/kg	1	MCERTS	-	-	-	1.1	< 1.0
Total Sulphur	mg/kg	50	MCERTS	-	-	-	490	600
Total Organic Carbon (TOC)	%	0.1	MCERTS	-	-	-	-	-
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-	-	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	0.23	< 0.05	< 0.05	0.93
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.21
Fluoranthene	mg/kg	0.05	MCERTS	0.32	0.66	< 0.05	0.32	2.2
Pyrene	mg/kg	0.05	MCERTS	0.31	0.62	< 0.05	0.30	2.0
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.18	0.37	< 0.05	0.20	0.99
Chrysene	mg/kg	0.05	MCERTS	0.19	0.38	< 0.05	0.23	1.1
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.44	< 0.05	< 0.05	1.2
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.25	< 0.05	< 0.05	0.44
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.38	< 0.05	< 0.05	0.93
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.40
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.52
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	1.00	3.33	< 0.80	1.05	10.9

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Analytical Report Number: 19-41750

Project / Site name: South Heywood Phase 6
Your Order No: 13417-32485-NS

Lab Sample Number				1224327	1224328	1224329	1224330	1224331
Sample Reference				TP111	TP113	TP113	TP114	WS103
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	0.20	2.00	0.20	0.20
Date Sampled				15/05/2019	15/05/2019	15/05/2019	15/05/2019	15/05/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	11	18	3.4	11	21
Barium (aqua regia extractable)	mg/kg	1	MCERTS	72	120	180	-	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.75	1.2	0.87	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	0.3	< 0.2	< 0.2	0.3
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	13	21
Copper (aqua regia extractable)	mg/kg	1	MCERTS	43	65	22	42	71
Lead (aqua regia extractable)	mg/kg	1	MCERTS	53	100	10	52	120
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	0.4	< 0.3	0.8
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	12	19	26	15	19
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	2.5	< 1.0	1.0	1.7
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	22	29	21	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	60	81	48	50	100

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	4.4
TPH (C16 - C21)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	13
TPH (C21 - C35)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	56
TPH (C35 - C40)	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	12
TPH Total C5 - C40	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	87

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Analytical Report Number: 19-41750

Project / Site name: South Heywood Phase 6
Your Order No: 13417-32485-NS

Lab Sample Number				1224332	1224333	1224334	1224335	1224460
Sample Reference				WS103	WS104	WS104	WS105	TP104
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.80	0.60	1.60	1.20	0.20
Date Sampled				15/05/2019	15/05/2019	15/05/2019	15/05/2019	15/05/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	11	13	13	16	19
Total mass of sample received	kg	0.001	NONE	0.42	0.45	0.44	0.50	0.40
Asbestos in Soil	Type	N/A	ISO 17025	-	-	-	-	Not-detected
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	-	-	7.9	7.7	-
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Total Sulphate as SO_4	mg/kg	50	MCERTS	-	-	180	100	-
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	-	-	33	18	-
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-	-	0.016	0.0088	-
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-	-	16.3	8.8	-
Sulphide	mg/kg	1	MCERTS	-	-	4.1	< 1.0	-
Total Sulphur	mg/kg	50	MCERTS	-	-	570	62	-
Total Organic Carbon (TOC)	%	0.1	MCERTS	-	1.8	-	0.3	-
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-	< 1.0	< 1.0	-
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.24
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.59
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.56
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.38
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.40
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.50
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.18
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.37
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	< 0.80	< 0.80	3.22

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 19-41750

Project / Site name: South Heywood Phase 6
Your Order No: 13417-32485-NS

Lab Sample Number				1224332	1224333	1224334	1224335	1224460
Sample Reference				WS103	WS104	WS104	WS105	TP104
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.80	0.60	1.60	1.20	0.20
Date Sampled				15/05/2019	15/05/2019	15/05/2019	15/05/2019	15/05/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	4.5	7.8	2.0	2.5	16
Barium (aqua regia extractable)	mg/kg	1	MCERTS	32	46	-	-	71
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.43	0.50	-	-	0.80
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	22	6.3	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	16	15	21	13	53
Lead (aqua regia extractable)	mg/kg	1	MCERTS	7.4	9.9	8.9	5.4	61
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	0.5
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	13	15	26	7.8	11
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	12	26	-	-	23
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	40	32	44	20	64

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	-	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	-	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	-	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	-	< 2.0
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	-	< 4.0
TPH (C16 - C21)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	5.4
TPH (C21 - C35)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	21
TPH (C35 - C40)	mg/kg	10	MCERTS	< 10	< 10	< 10	-	< 10
TPH Total C5 - C40	mg/kg	10	MCERTS	< 10	< 10	< 10	-	29

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Analytical Report Number : 19-41750

Project / Site name: South Heywood Phase 6

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1224317	TP101	None Supplied	0.20	Black clay and sand with vegetation.
1224318	TP103	None Supplied	0.60	Light brown sandy loam.
1224319	TP103	None Supplied	2.00	Brown sandy clay.
1224320	TP105	None Supplied	0.40	Brown sandy clay with vegetation.
1224321	TP105	None Supplied	1.90	Light brown clay and sand with gravel.
1224322	WS101	None Supplied	2.20	Brown sand.
1224323	WS102	None Supplied	2.50	Light brown clay and sand.
1224324	TP107	None Supplied	0.20	Black clay and sand with gravel and vegetation.
1224325	TP109	None Supplied	0.30	Grey clay and sand with gravel and vegetation.
1224326	TP110	None Supplied	1.20	Brown sandy clay.
1224327	TP111	None Supplied	0.20	Brown loam and sand with vegetation and gravel.
1224328	TP113	None Supplied	0.20	Brown loam and sand with vegetation and gravel.
1224329	TP113	None Supplied	2.00	Brown clay and sand with vegetation and gravel
1224330	TP114	None Supplied	0.20	Brown loam and sand with vegetation and gravel.
1224331	WS103	None Supplied	0.20	Brown loam and clay with vegetation and gravel
1224332	WS103	None Supplied	1.80	Brown sand with vegetation and gravel
1224333	WS104	None Supplied	0.60	Brown sandy clay with vegetation and gravel
1224334	WS104	None Supplied	1.60	Brown clay and sand with gravel.
1224335	WS105	None Supplied	1.20	Brown sand with gravel.
1224460	TP104	None Supplied	0.20	Brown loam and sand with vegetation and gravel.

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Analytical Report Number : 19-41750

Project / Site name: South Heywood Phase 6

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	NONE
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L009-PL	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, and MEWAM 2006 Methods for the Determination of Metals in Soil	L038-PL	D	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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Analytical Report Number : 19-43374

Replaces Analytical Report Number : 19-43374, issue no. 1

Project / Site name:	South Heywood P6	**Samples received on:**	29/05/2019
Your job number:	13-417	**Samples instructed on:**	29/05/2019
Your order number:	10-481-32420-AD	**Analysis completed by:**	06/06/2019
Report Issue Number:	2	**Report issued on:**	06/06/2019
Samples Analysed:	3 water samples		

Signed:

Zina Abdul Razzak
Senior Quality Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

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Analytical Report Number: 19-43374

Project / Site name: South Heywood P6

Your Order No: 10-481-32420-AD

Lab Sample Number				1233194	1233195	1233196		
Sample Reference				WS101	WS106	WS105		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				None Supplied	None Supplied	None Supplied		
Date Sampled				29/05/2019	29/05/2019	29/05/2019		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
General Inorganics								
pH	pH Units	N/A	ISO 17025	6.6	6.7	6.7		
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Total Phenols								
Total Phenols (monohydric)	µg/l	1	ISO 17025	< 1.0	2.6	< 1.0		
Heavy Metals / Metalloids								
Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.56	2.76	0.47		
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.15	< 0.02	0.17		
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0		
Chromium (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	< 0.2		
Copper (dissolved)	µg/l	0.5	ISO 17025	1.1	1.0	1.4		
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	0.4	< 0.2		
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05		
Nickel (dissolved)	µg/l	0.5	ISO 17025	39	14	39		
Selenium (dissolved)	µg/l	0.6	ISO 17025	0.7	< 0.6	0.8		
Zinc (dissolved)	µg/l	0.5	ISO 17025	7.8	6.8	7.8		
Monoaromatics & Oxygenates								
Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Petroleum Hydrocarbons								
TPH1 (C10 - C40)	µg/l	10	NONE	< 10	180	< 10		
TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	180	< 10		
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	180	< 10		
TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10		

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Analytical Report Number: 19-43374

Project / Site name: South Heywood P6

Your Order No: 10-481-32420-AD

Lab Sample Number				1233194	1233195	1233196		
Sample Reference				WS101	WS106	WS105		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				None Supplied	None Supplied	None Supplied		
Date Sampled				29/05/2019	29/05/2019	29/05/2019		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
VOCs								
Chloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Chloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Bromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Vinyl Chloride	µg/l	1	NONE	< 1.0	< 1.0	< 1.0		
Trichlorofluoromethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0		
1,1-Dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Cis-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,1-Dichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
2,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Trichloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,1,1-Trichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,2-Dichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,1-Dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Trans-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Tetrachloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Trichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Dibromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Bromodichloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Cis-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Trans-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,1,2-Trichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,3-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Dibromochloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Tetrachloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,2-Dibromoethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Chlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,1,1,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
p & m-Xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Styrene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Tribromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
o-Xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,1,2,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Isopropylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Bromobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
n-Propylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
2-Chlorotoluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
4-Chlorotoluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,3,5-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
tert-Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,2,4-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
sec-Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,3-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
p-Isopropyltoluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,2-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,4-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,2-Dibromo-3-chloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,2,4-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Hexachlorobutadiene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,2,3-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		

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Analytical Report Number: 19-43374

Project / Site name: South Heywood P6

Your Order No: 10-481-32420-AD

Lab Sample Number				1233194	1233195	1233196		
Sample Reference				WS101	WS106	WS105		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				None Supplied	None Supplied	None Supplied		
Date Sampled				29/05/2019	29/05/2019	29/05/2019		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
SVOCs								
Aniline	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Phenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
2-Chlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Bis(2-chloroethyl)ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
1,3-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
1,2-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
1,4-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Bis(2-chloroisopropyl)ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
2-Methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Hexachloroethane	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Nitrobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
4-Methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Isophorone	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
2-Nitrophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
2,4-Dimethylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Bis(2-chloroethoxy)methane	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
1,2,4-Trichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
2,4-Dichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
4-Chloroaniline	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Hexachlorobutadiene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
4-Chloro-3-methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
2,4,6-Trichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
2,4,5-Trichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
2-Methylnaphthalene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
2-Chloronaphthalene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Dimethylphthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
2,6-Dinitrotoluene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
2,4-Dinitrotoluene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Dibenzofuran	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
4-Chlorophenyl phenyl ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Diethyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
4-Nitroaniline	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Azobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Bromophenyl phenyl ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Hexachlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Carbazole	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Dibutyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Anthraquinone	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Butyl benzyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05		
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		

U/S = Unsuitable Sample I/S = Insufficient Sample

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number : 19-43374

Project / Site name: South Heywood P6

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW.	L080-PL	W	ISO 17025
Low level total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Monohydric phenols in water - LOW LEVEL 1 ug/l	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Semi-volatile organic compounds in water	Determination of semi-volatile organic compounds in leachate by extraction in dichloromethane followed by GC-MS.	In-house method based on USEPA 8270	L102B-PL	W	NONE
TPH1 (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS.	In-house method	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE
Volatile organic compounds in water	Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report are representative of the samples submitted for analysis.

APPENDIX VII
ORIGIN OF TIER I GENERIC ASSESSMENT CRITERIA

CONSTITUENT	ORIGIN OF RISK ASSESSMENT VALUE
Arsenic	2014 LQM/CIEH S4ULs
Cadmium	2014 LQM/CIEH S4ULs
Chromium	2014 LQM/CIEH S4ULs
Lead	2014 LQM/CIEH S4ULs
Mercury	2014 LQM/CIEH S4ULs – methylmercury
Nickel	2014 LQM/CIEH S4ULs
Selenium	2014 LQM/CIEH S4ULs
Copper	2014 LQM/CIEH S4ULs
Zinc	2014 LQM/CIEH S4ULs
Cyanide – Total	2014 LQM/CIEH S4ULs
Phenols – Total	2014 LQM/CIEH S4ULs
Naphthalene	General assessment criteria (GAC) developed by CIEH/LQM Suitable 4 Use Levels with supporting data from SR3, SR7 and existing Tox report where applicable. 1% SOM.
Acenaphthylene	
Acenaphthene	
Fluorene	
Phenanthrene	
Anthracene	
Fluoranthene	
Pyrene	
Benzo(a)Anthracene	
Chrysene	
Benzo(b/k)Fluoranthene (iii)	
Benzo(a)Pyrene	
Indeno(123-cd)Pyrene	
Dibenzo(a,h)Anthracene	
Benzo(ghi)Perylene	
TPH C_5-C_6 (aliphatic)	
TPH C_6-C_8 (aliphatic)	
TPH C_8-C_{10} (aliphatic)	
TPH C_{10}-C_{12} (aliphatic)	
TPH C_{12}-C_{16} (aromatic)	
TPH C_{16}-C_{21} (aromatic)	
TPH C_{21}-C_{35} (aromatic)	

The Tier 1 GAC for the hydrocarbon fraction is derived from the CIEH assessment for petroleum hydrocarbons criteria working group (CWG) for both aliphatic and aromatic compounds. E3P has utilised the Tier 1 values for aliphatic compounds for the volatile and semi-volatile fractions (C_5-C_{12}) and the Tier 1 values for aromatic compound for the non-volatile fractions (C_{12}-C_{35}). The comparison of total (aliphatic/aromatic) compounds to an individual fraction is considered to be a conservative approach and satisfactory for the protection of human health.

CONTROLLED WATERS

* Sum of The specified compounds are benzo[b]fluoranthene (CAS 205-99-2), benzo[k]fluoranthene (CAS 207-08-9), benzo[g,h,i]perylene (CAS 191-24-2) and indeno[1,2,3-c,d]pyrene (CAS 193-39-5)

1) The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations (2015)
2) Directive establishing a framework for Community action in the field of water policy (Water Framework Directive)
3) Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances
4) Council Directive on the quality of water intended for human consumption (Drinking Water Directive)
5) WHO Guidelines for Drinking Water Quality. Third edition (2004)

APPENDIX VIII
GEOTECHNICAL TESTING RESULTS

LABORATORY REPORT

4043

Contract Number: PSL19/3179

Report Date: 18 June 2019

Client's Reference: 13-417

Client Name: E3P
Heliport Business Park
Liverpool Road
Eccles
Manchester
M30 7RU

For the attention of: Adeel Ahmed/Nicola Sellers

Contract Title: Heywood P6

Date Received: 22/5/2019
Date Commenced: 22/5/2019
Date Completed: 18/6/2019

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson (Director)	A Watkins (Director)	R Berriman (Quality Manager)
S Royle (Laboratory Manager)	S Eyre (Senior Technician)	L Knight (Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
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awatkins@prosoils.co.uk

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
TP103		B	1.00		Brown gravelly clayey silty SAND.
WS102		U	1.50	2.00	Stiff brown slightly gravelly very sandy CLAY.
WS106		U	0.50	1.00	Stiff brown gravelly very sandy CLAY.
TP112		B	1.00		Brown slightly gravelly clayey very silty SAND.
WS102		D	1.00		Brown slightly gravelly very sandy CLAY.
WS102		D	4.00		Brown slightly gravelly very sandy CLAY.
WS103		D	1.00		Brown very sandy CLAY.
WS104		D	1.00		Brown slightly gravelly silty SAND.

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
WS102		D	1.00		13			28	14	14	98	Low plasticity CL.
WS102		D	4.00		14			32	16	16	97	Low plasticity CL.
WS103		D	1.00		16			27	15	12	100	Low plasticity CL.
WS104		D	1.00		11				NP			

SYMBOLS : **NP : Non Plastic** *** : Liquid Limit and Plastic Limit Wet Sieved.**

UKAS TESTING 4043

PSL Professional Soils Laboratory

Heywood P6

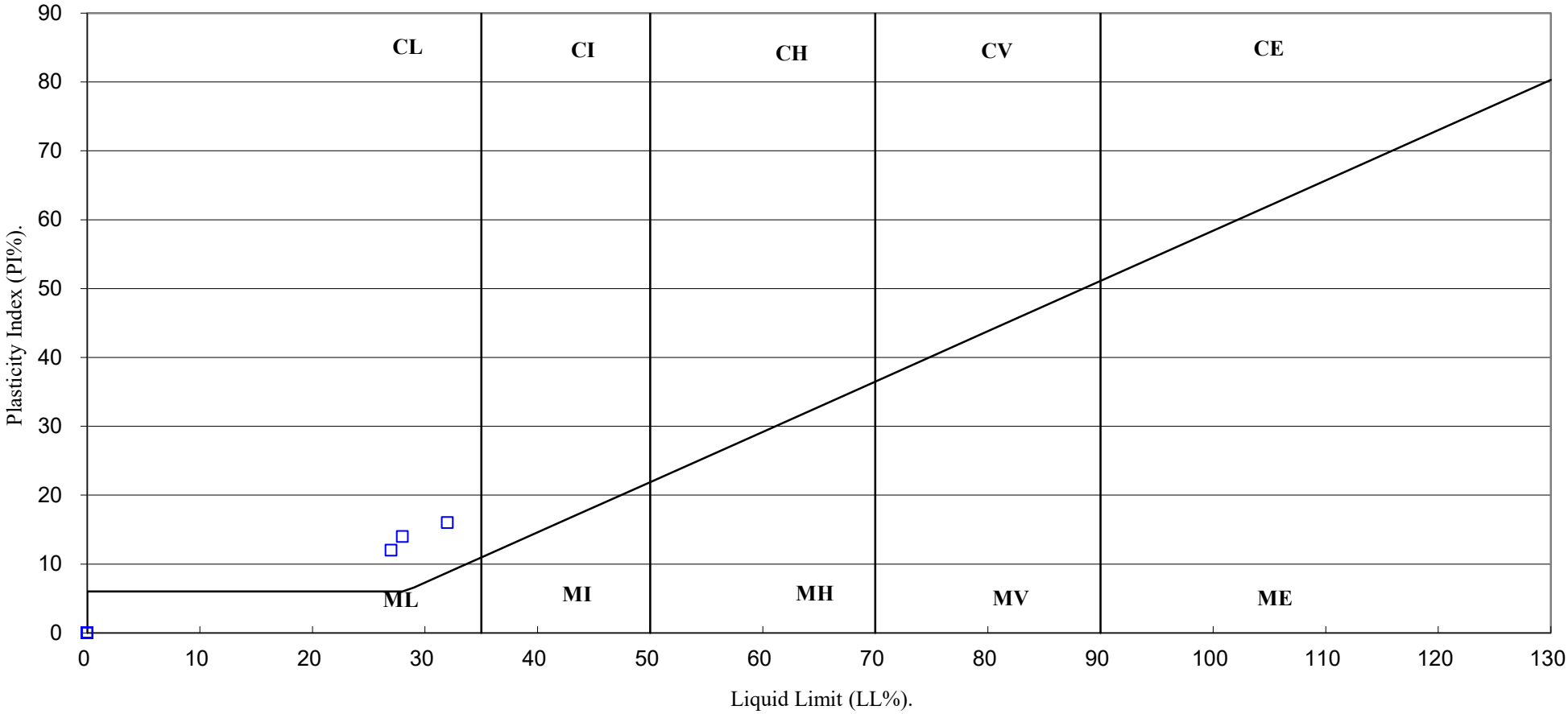
Contract No:

PSL19/3179

Client Ref:

13-417-AD

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



UKAS TESTING 4043	PSL Professional Soils Laboratory	Heywood P6	Contract No: PSL19/3179 Client Ref: 13-417-AD

PARTICLE SIZE DISTRIBUTION TEST

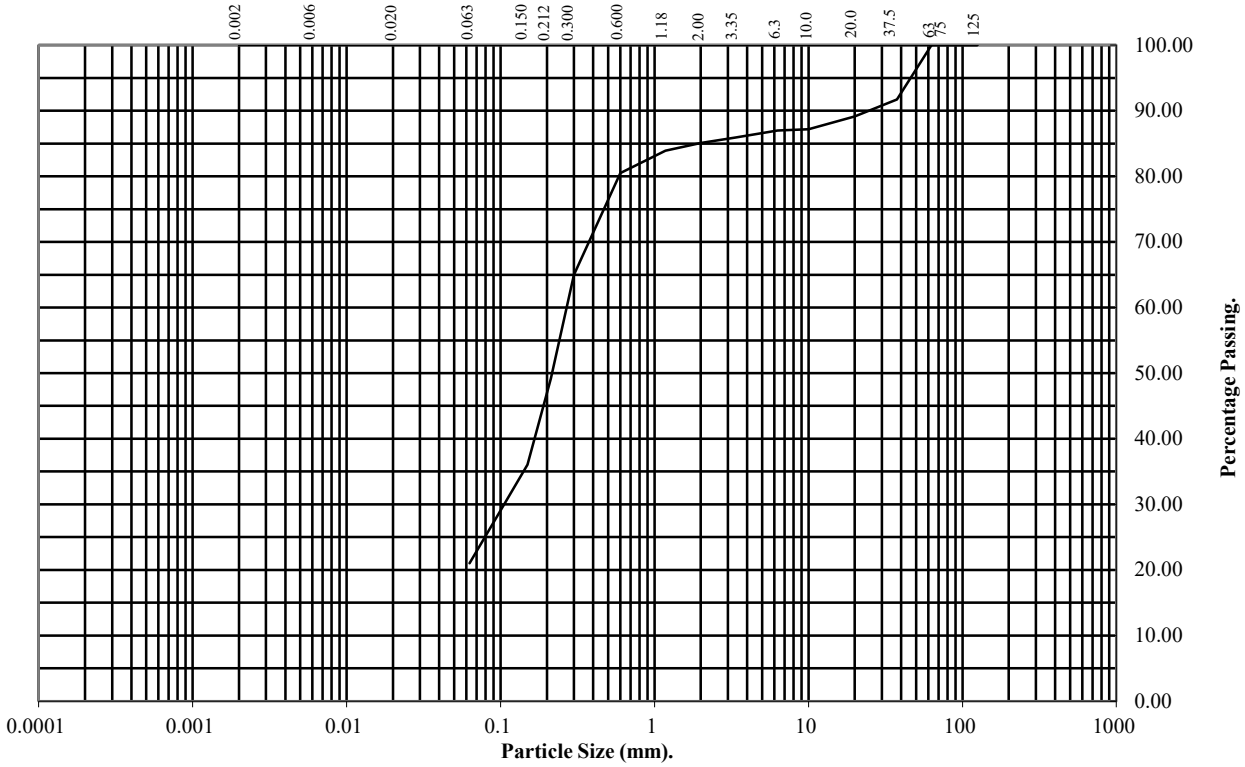
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: TP103 **Top Depth (m):** 1.00

Sample Number: **Base Depth(m):**

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	92
20	89
10	87
6.3	87
3.35	86
2	85
1.18	84
0.6	81
0.3	65
0.212	49
0.15	36
0.063	21

Soil Fraction	Total Percentage
Cobbles	0
Gravel	15
Sand	64
Silt/Clay	21

Remarks:

See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

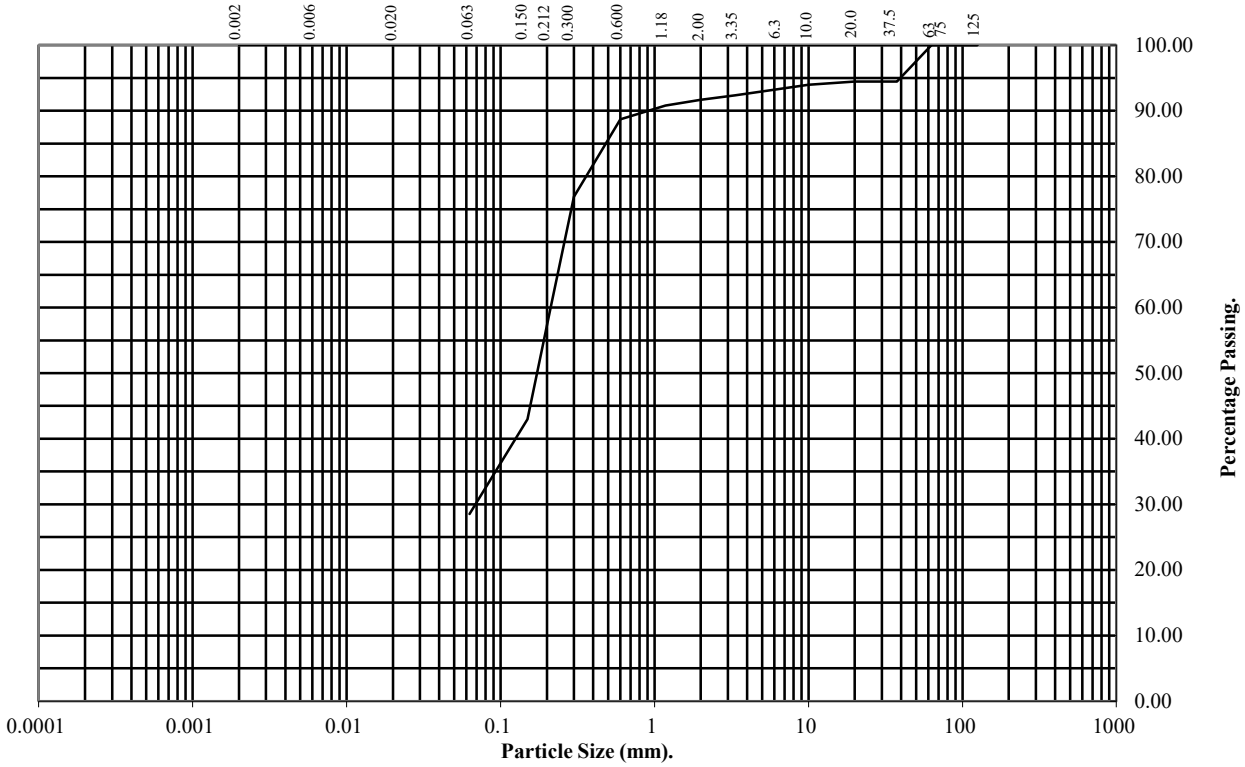
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: TP112 **Top Depth (m):** 1.00

Sample Number: **Base Depth(m):**

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	94
20	94
10	94
6.3	93
3.35	92
2	92
1.18	91
0.6	89
0.3	77
0.212	60
0.15	43
0.063	29

Soil Fraction	Total Percentage
Cobbles	0
Gravel	8
Sand	63
Silt/Clay	29

Remarks:

See Summary of Soil Descriptions

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

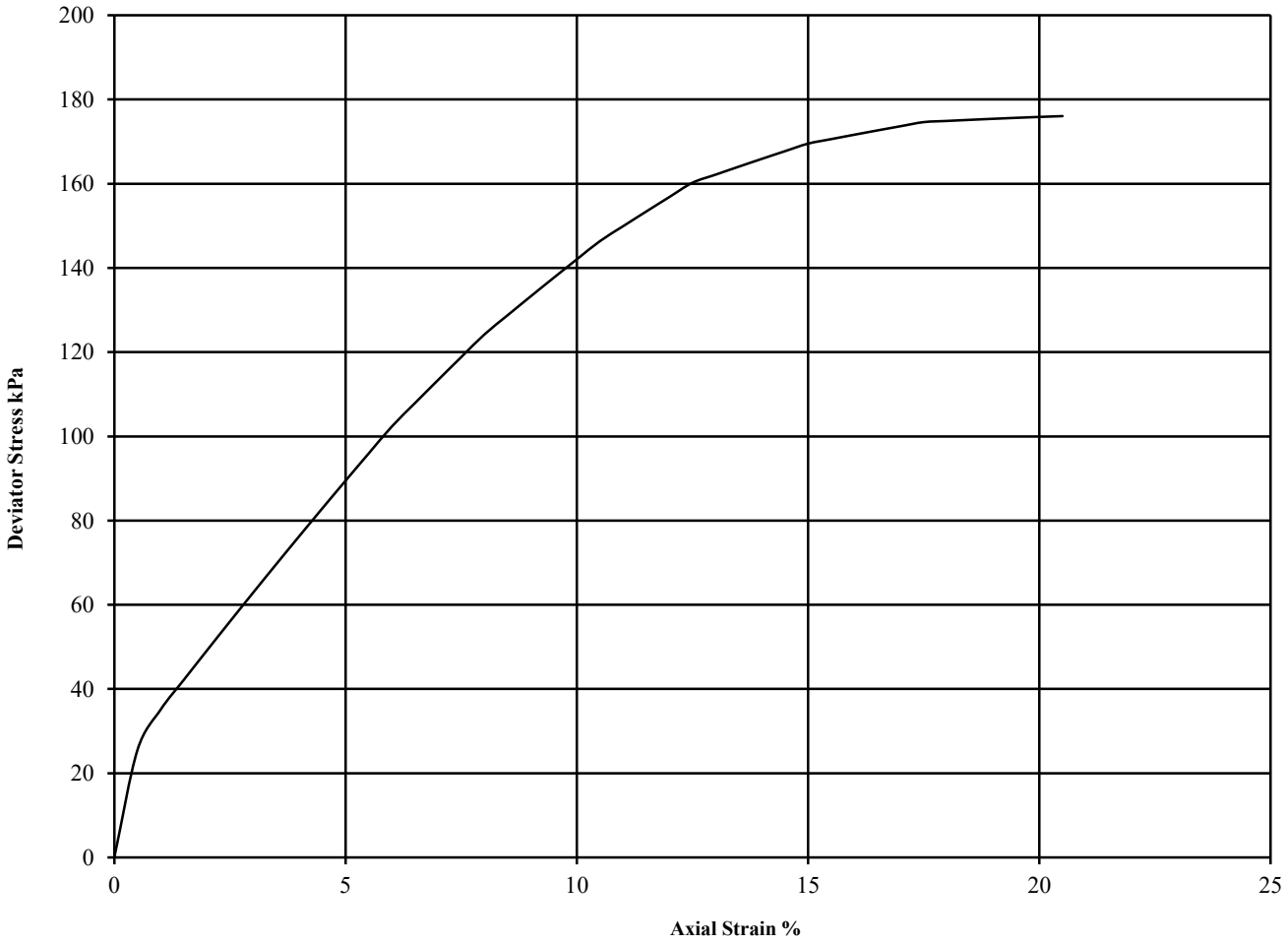
WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number: WS102 **Top Depth (m):** 1.50

Sample Number: **Base Depth (m):** 2.00

Sample Type U



Diameter (mm):		79	Height (mm):		158	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa) θ_3	Corr. Max. Deviator Stress (kPa) $(\theta_1-\theta_3)_f$	Shear Strength Cu (kPa) $^1/_2(\theta_1-\theta_3)_f$	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.41
1	14	2.12	1.87	35	176	88	20.5	Plastic	See summary of soil descriptions

UKAS TESTING 4043

PSL Professional Soils Laboratory

Heywood P6

Contract No: PSL19/3179

Client Ref: 13-417-AD

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

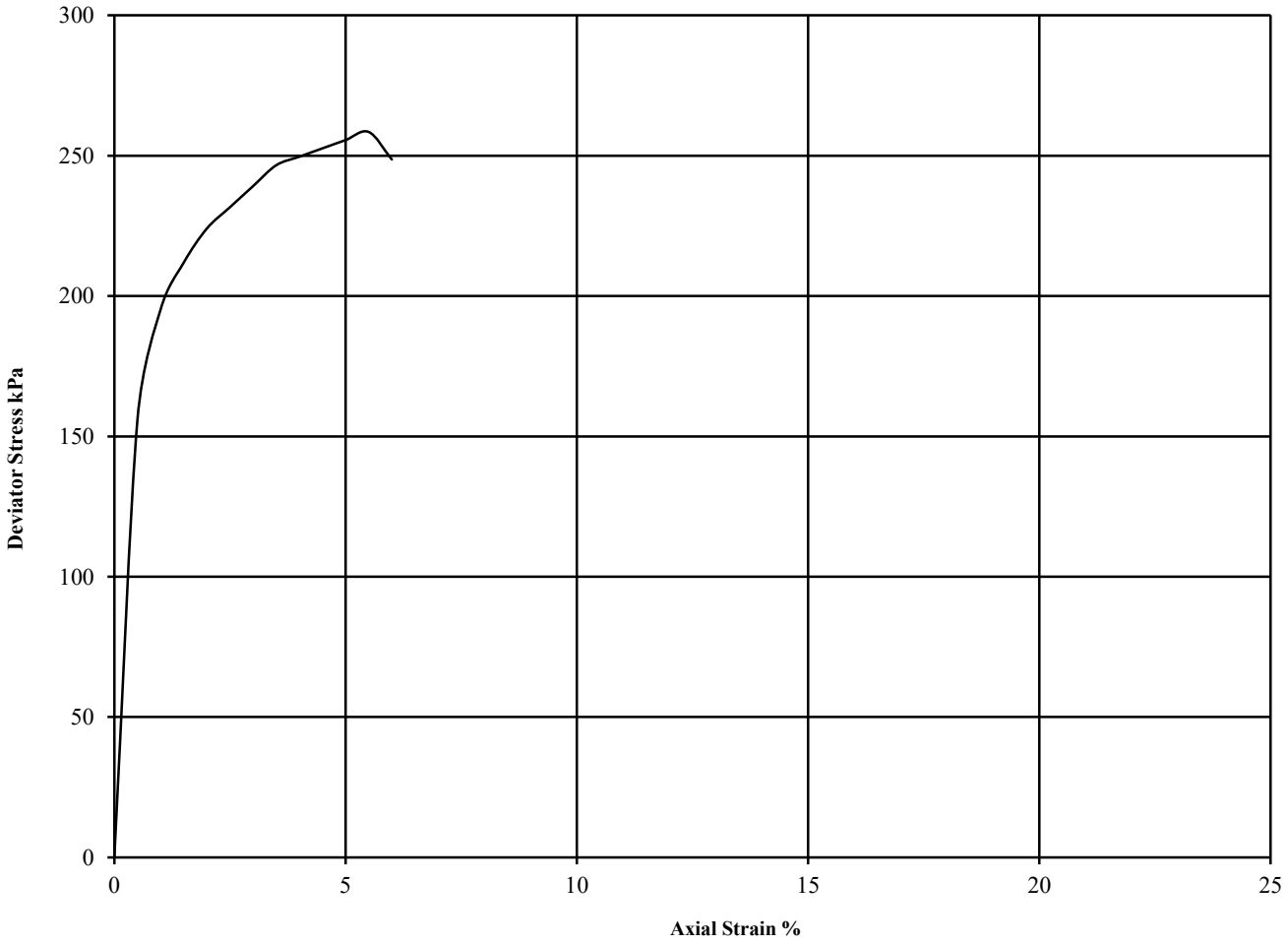
WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number: WS106 **Top Depth (m):** 0.50

Sample Number: **Base Depth (m):**

Sample Type U



Diameter (mm):		83	Height (mm):		166	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa) θ_3	Corr. Max. Deviator Stress (kPa) $(\theta_1-\theta_3)_f$	Shear Strength Cu (kPa) $^1/_2(\theta_1-\theta_3)_f$	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.44
1	11	2.04	1.83	15	258	129	5.5	Brittle	See summary of soil descriptions

UKAS TESTING 4043

PSL Professional Soils Laboratory

Heywood P6

Contract No: PSL19/3179

Client Ref: 13-417-AD

ONE DIMENSIONAL CONSOLIDATION TEST

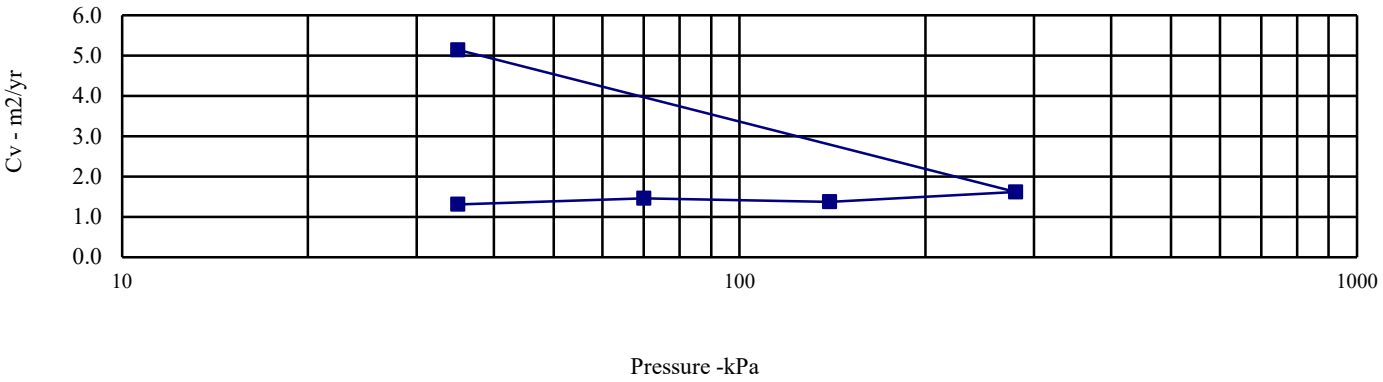
BS 1377: Part 5: 1990: Clause 3

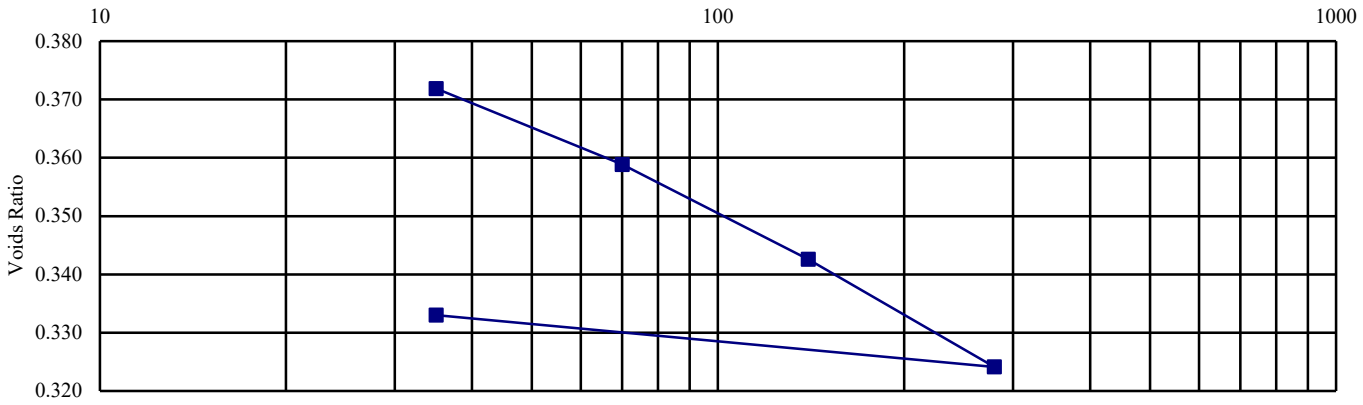
Hole Number: **WS102** **Top Depth (m):** **1.50**

Sample Number: **Base Depth (m) :** **2.00**

Sample Type: **U**

Initial Conditions		Pressure Range kPa		Mv m2/MN	Cv m2/yr	Specimen location within tube:	Top
Moisture Content (%):	14						
Bulk Density (Mg/m3):	2.15	0	35	0.701	1.309	Method used to	
Dry Density (Mg/m3):	1.88	35	70	0.271	1.461	determine CV:	T90
Voids Ratio:	0.406	70	140	0.171	1.372	Nominal temperature	
Degree of saturation:	91.8	140	280	0.098	1.616	during test ' C:	20
Height (mm):	19.974	280	35	0.027	5.140	Remarks:	
Diameter (mm)	75.108					See summary of soil descriptions	
Particle Density (Mg/m3): Assumed	2.65						





UKAS TESTING 4043	PSL Professional Soils Laboratory	**Heywood P6**	**Contract No: PSL19/3179** **Client Ref: 13-417-AD**

ONE DIMENSIONAL CONSOLIDATION TEST

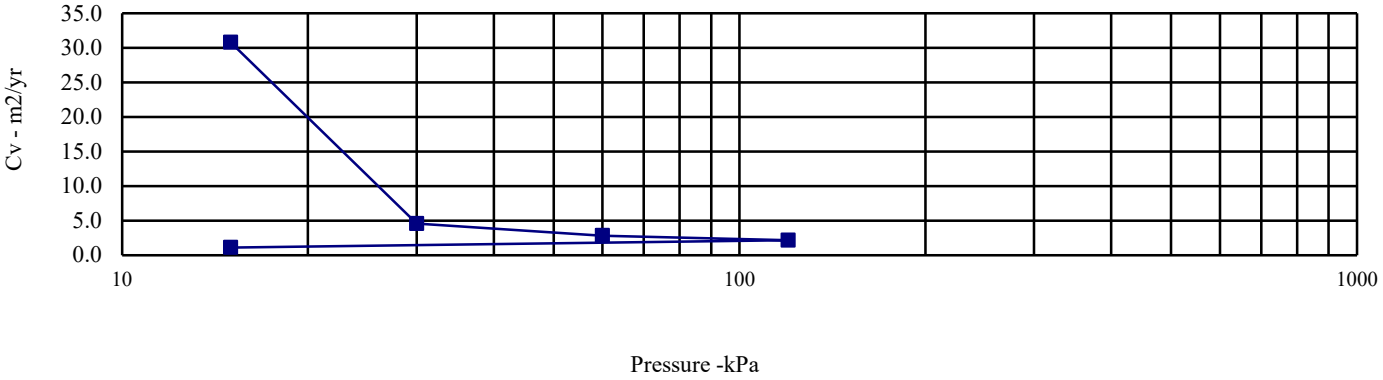
BS 1377: Part 5: 1990: Clause 3

Hole Number: **WS106** **Top Depth (m):** **0.50**

Sample Number: **Base Depth (m) :** **1.00**

Sample Type: **U**

Initial Conditions		Pressure Range kPa		Mv m2/MN	Cv m2/yr	Specimen location within tube:	Top
Moisture Content (%):	11						
Bulk Density (Mg/m3):	2.07	0	15	0.234	30.792	Method used to	
Dry Density (Mg/m3):	1.86	15	30	0.154	4.562	determine CV:	T90
Voids Ratio:	0.426	30	60	0.160	2.828	Nominal temperature	
Degree of saturation:	70.6	60	120	0.112	2.146	during test ' C:	20
Height (mm):	19.938	120	15	0.044	1.091	Remarks:	
Diameter (mm)	75.035					See summary of soil descriptions	
Particle Density (Mg/m3): Assumed	2.65						





UKAS TESTING 4043	PSL Professional Soils Laboratory	**Heywood P6**	**Contract No:** PSL19/3179 **Client Ref:** 13-417-AD

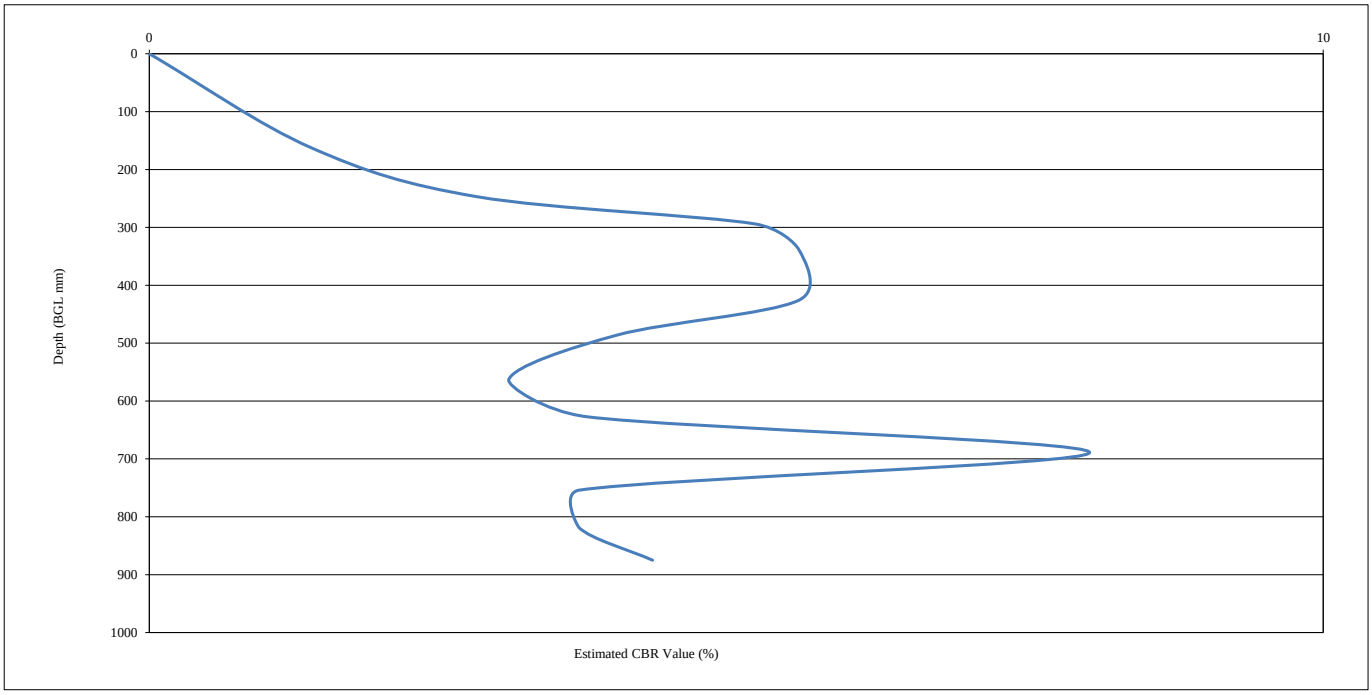
APPENDIX IX
DYNAMIC CONE PENETROMETER TEST CERTIFICATES

Determination of Dynamic Cone Penetrometer - Estimated CBR Value (%)

In Accordance with TRL Report PR/INT/277/04

Site Name	South Heywood Phase 6	**Test Date:**	10/06/2019
Site Ref	13-417	**Test Location:**	Heywood
Test No.:	DCP101	**Easting:**	
Initial Depth (mm BGL):	0	**Northing:**	
Final Depth (mm BGL):	875		

Estimated California Bearing Ratio Graph



Start Depth (mm) BGL	Finish Depth (mm) BGL	No. of Blows	Blows Per Layer	DCP mm/Blows	Ave Estimated Layer (CBR %)
0	**294**	**3**	3	98.00	2.37
294	**563**	**8**	5	53.80	4.47
563	**689**	**11**	3	42.00	5.81
689	**875**	**14**	3	62.00	3.85

Comments

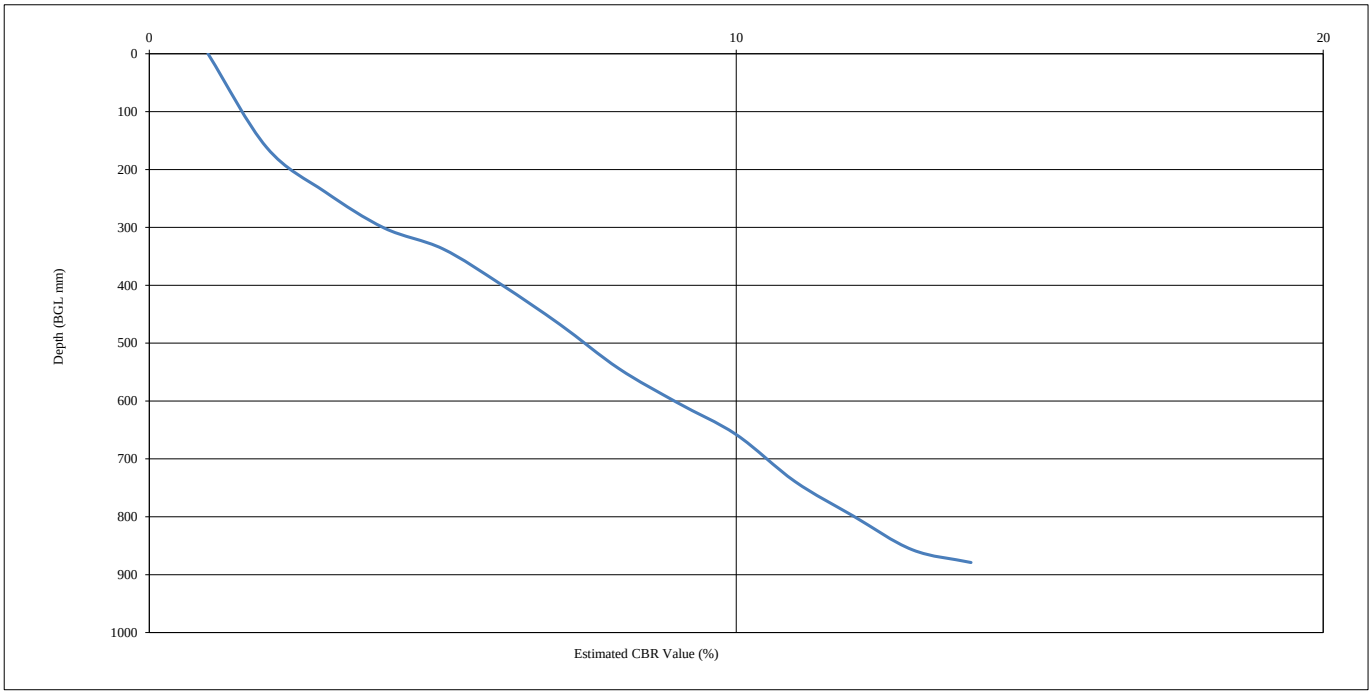
Site Engineer:	Checked By:	Date:	Approved By:	Date:
TP	**NS**	**18/07/2019**	**MD**	**18/07/2019**

Determination of Dynamic Cone Penetrometer - Estimated CBR Value (%)

In Accordance with TRL Report PR/INT/277/04

Site Name	South Heywood Phase 6	**Test Date:**	10/06/2019
Site Ref	13-417	**Test Location:**	Heywood
Test No.:	DCP102	**Easting:**	
Initial Depth (mm BGL):	0	**Northing:**	
Final Depth (mm BGL):	879		

Estimated California Bearing Ratio Graph



Start Depth (mm) BGL	Finish Depth (mm) BGL	No. of Blows	Blows Per Layer	DCP mm/Blows	Ave Estimated Layer (CBR %)
0	301	3	3	100.33	2.31
301	658	9	6	59.50	4.02
658	879	16	7	31.57	7.86

Comments

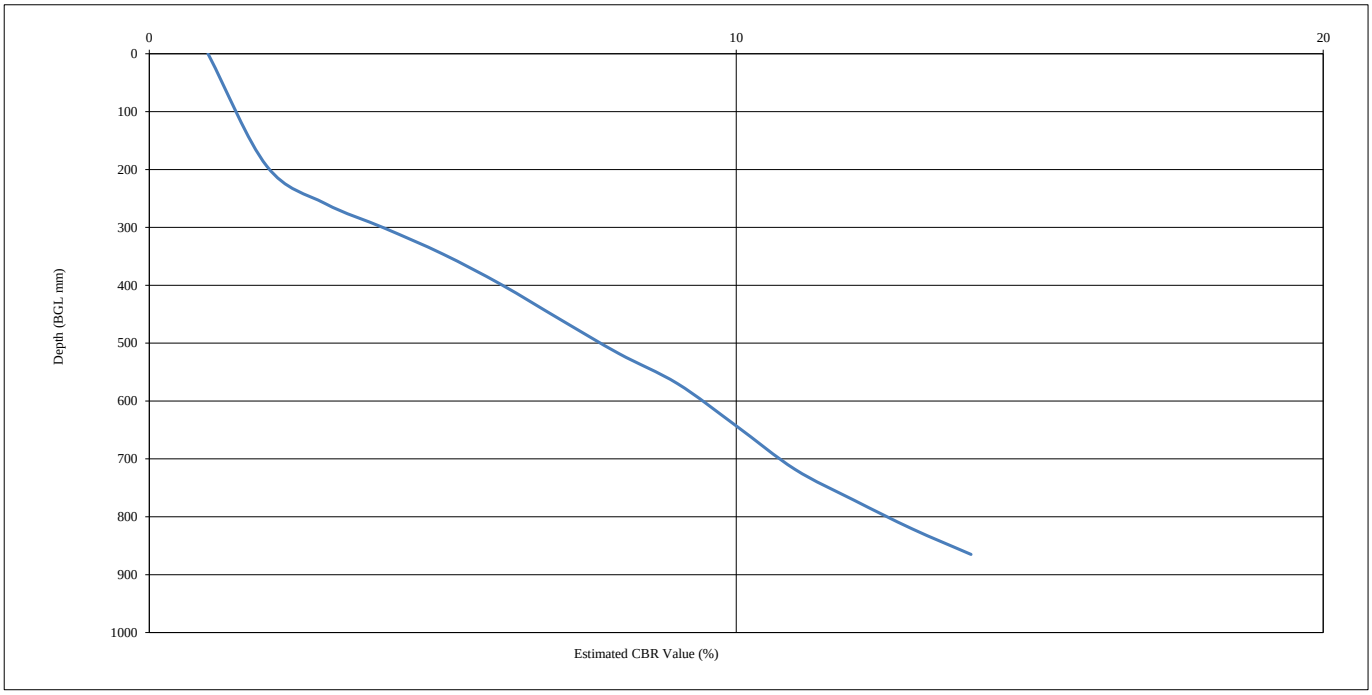
Site Engineer:	Checked By:	Date:	Approved By:	Date:
TP	NS	18/07/2019	MD	18/07/2019

Determination of Dynamic Cone Penetrometer - Estimated CBR Value (%)

In Accordance with TRL Report PR/INT/277/04

Site Name	South Heywood Phase 6	**Test Date:**	10/06/2019
Site Ref	13-417	**Test Location:**	Heywood
Test No.:	DCP103	**Easting:**	
Initial Depth (mm BGL):	0	**Northing:**	
Final Depth (mm BGL):	865		

Estimated California Bearing Ratio Graph



Start Depth (mm) BGL	Finish Depth (mm) BGL	No. of Blows	Blows Per Layer	DCP mm/Blows	Ave Estimated Layer (CBR %)
0	259	2	2	129.50	1.77
259	643	10	8	48.00	5.05
643	865	15	5	44.40	5.48

Comments

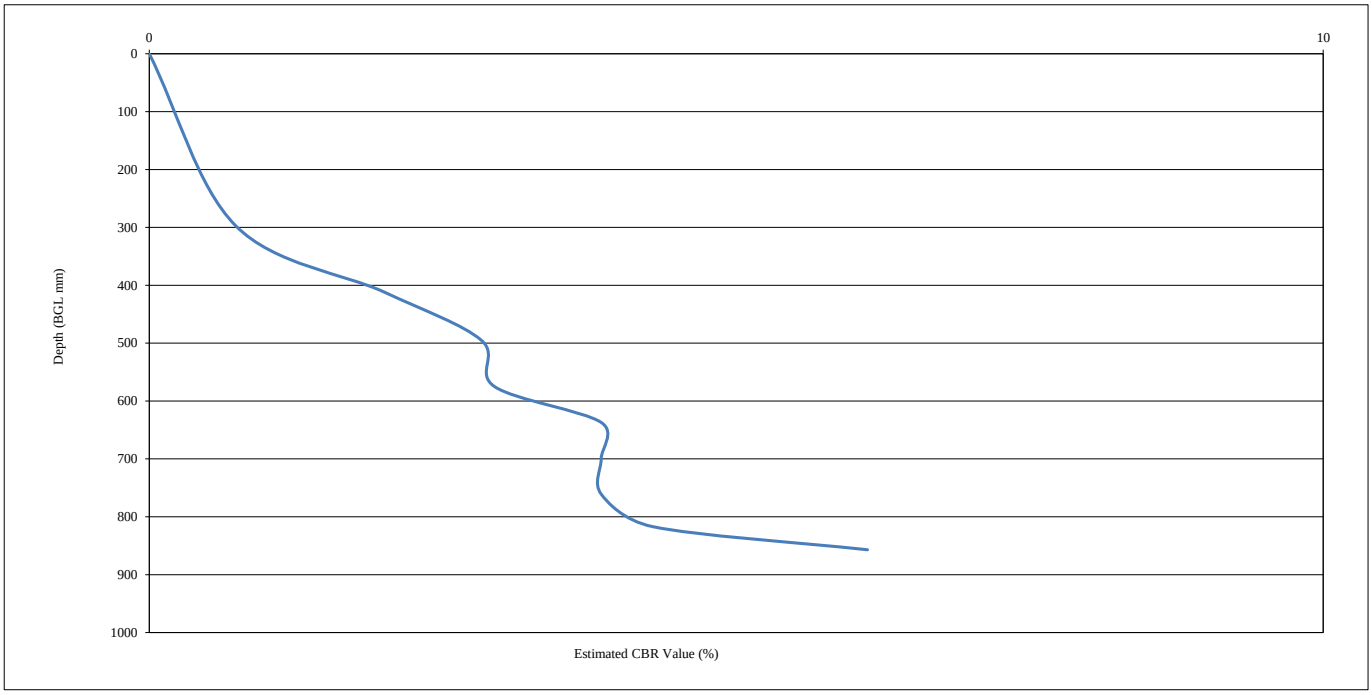
Site Engineer:	Checked By:	Date:	Approved By:	Date:
TP	NS	18/07/2019	MD	18/07/2019

Determination of Dynamic Cone Penetrometer - Estimated CBR Value (%)

In Accordance with TRL Report PR/INT/277/04

Site Name	South Heywood Phase 6	**Test Date:**	10/06/2019
Site Ref	13-417	**Test Location:**	Heywood
Test No.:	DCP104	**Easting:**	
Initial Depth (mm BGL):	0	**Northing:**	
Final Depth (mm BGL):	857		

Estimated California Bearing Ratio Graph



Start Depth (mm) BGL	Finish Depth (mm) BGL	No. of Blows	Blows Per Layer	DCP mm/Blows	Ave Estimated Layer (CBR %)
0	412	2	2	206.00	1.08
412	699	6	4	71.75	3.30
699	857	9	5	31.60	7.85

Comments

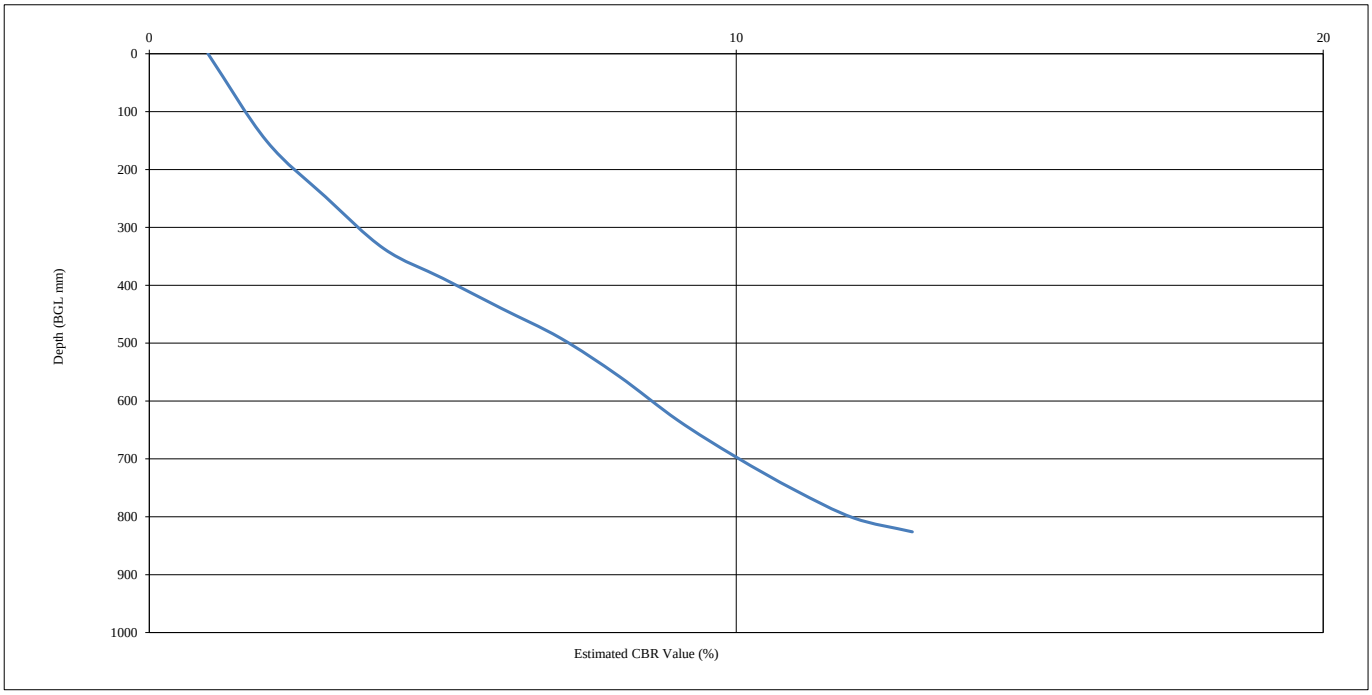
Site Engineer:	Checked By:	Date:	Approved By:	Date:
TP	NS	18/07/2019	MD	18/07/2019

Determination of Dynamic Cone Penetrometer - Estimated CBR Value (%)

In Accordance with TRL Report PR/INT/277/04

Site Name	South Heywood Phase 6	**Test Date:**	10/06/2019
Site Ref	13-417	**Test Location:**	Heywood
Test No.:	DCP105	**Easting:**	
Initial Depth (mm BGL):	0	**Northing:**	
Final Depth (mm BGL):	826		

Estimated California Bearing Ratio Graph



Start Depth (mm) BGL	Finish Depth (mm) BGL	No. of Blows	Blows Per Layer	DCP mm/Blows	Ave Estimated Layer (CBR %)
0	388	4	2	194.00	1.15
388	633	8	4	61.25	3.90
633	826	12	4	48.25	5.02

Comments

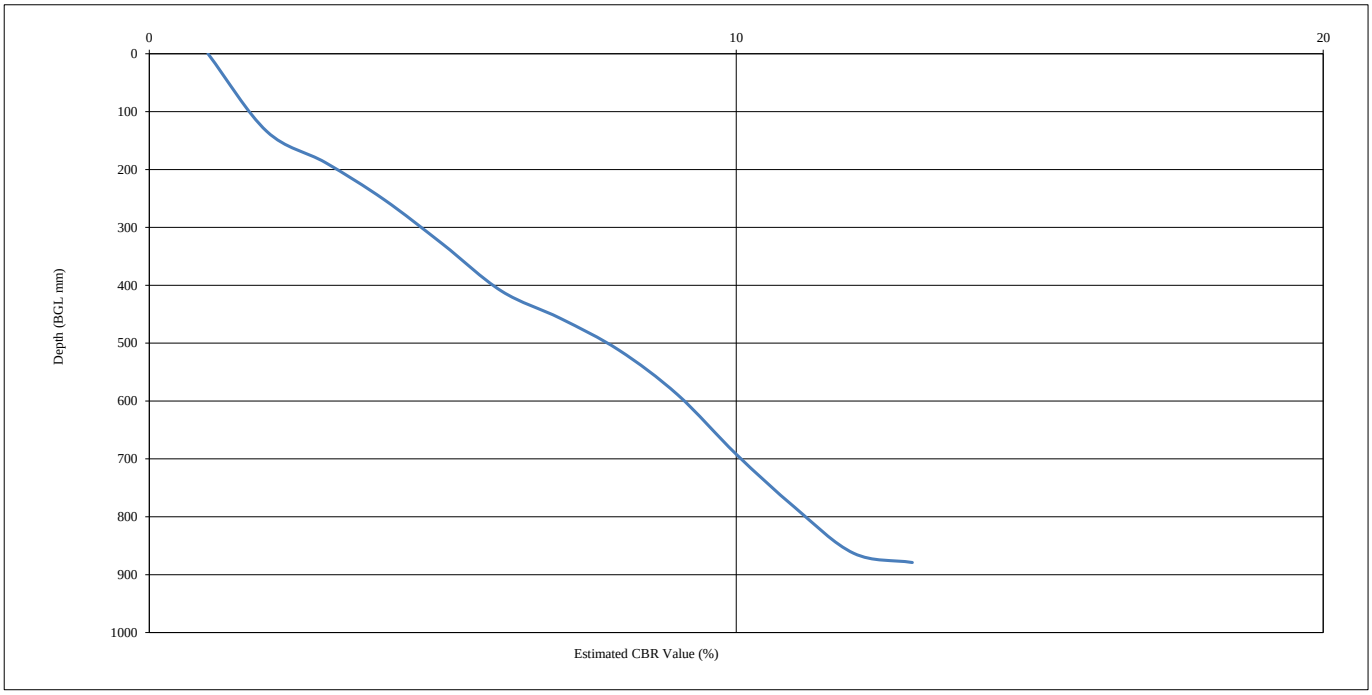
Site Engineer:	Checked By:	Date:	Approved By:	Date:
TP	NS	18/07/2019	MD	18/07/2019

Determination of Dynamic Cone Penetrometer - Estimated CBR Value (%)

In Accordance with TRL Report PR/INT/277/04

Site Name	South Heywood Phase 6	**Test Date:**	10/06/2019
Site Ref	13-417	**Test Location:**	Heywood
Test No.:	DCP106	**Easting:**	
Initial Depth (mm BGL):	0	**Northing:**	
Final Depth (mm BGL):	879		

Estimated California Bearing Ratio Graph



Start Depth (mm) BGL	Finish Depth (mm) BGL	No. of Blows	Blows Per Layer	DCP mm/Blows	Ave Estimated Layer (CBR %)
0	188	2	2	94.00	2.48
188	410	5	3	74.00	3.19
410	879	12	7	67.00	3.55

Comments

Site Engineer:	Checked By:	Date:	Approved By:	Date:
TP	NS	18/07/2019	MD	18/07/2019

APPENDIX X
SOAKAWAY TEST CERTIFICATES

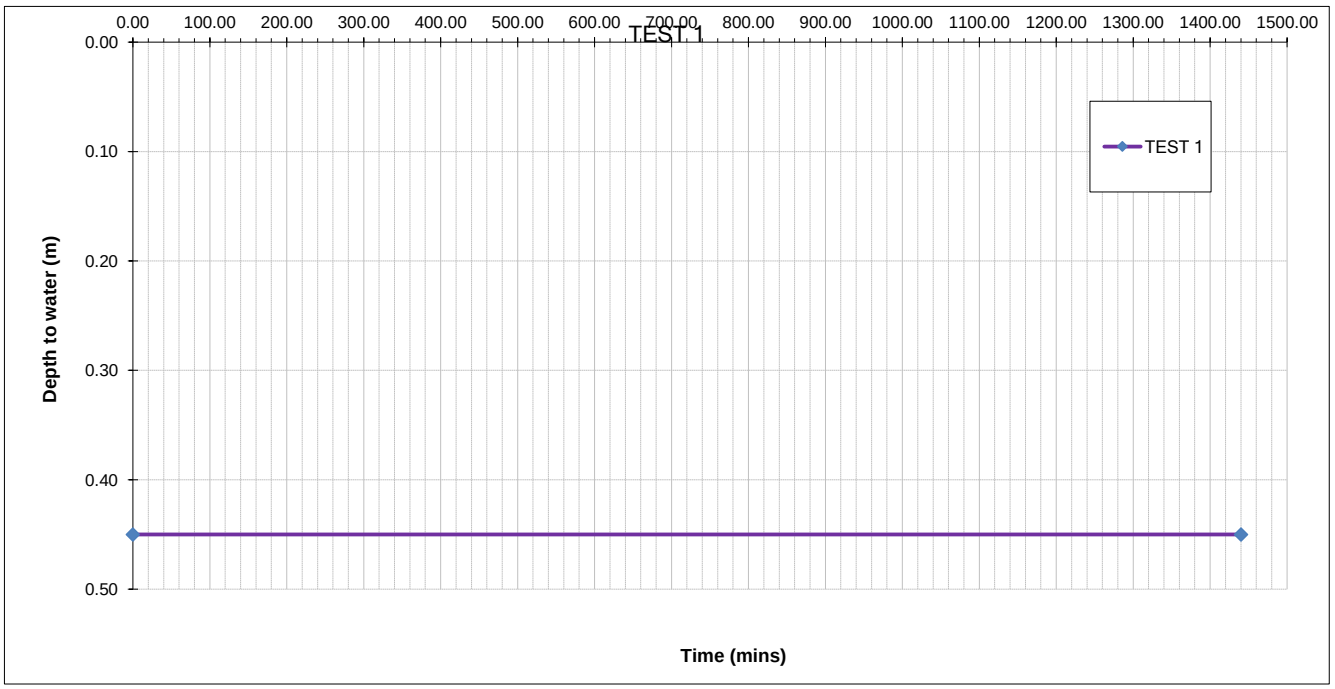
Site:	South Heywood Phase 6	**Trial Pit Number:**	TP101/ SA101
Job Number:	13-417	**Length:**	1.50 m
Date of Test:	15/04/2019	**Width:**	0.30 m
		Depth:	2.20 m
		Groundwater Level:	m

The test did not reach 25% or 75% effective storage depth and therefore has failed.

TEST 1		TEST 2		TEST 3	
Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
0.00	0.45				
1440.00	0.45				

Effective Storage Depth	m	1.75		
75% Effective Storage Depth	m	1.31		
(i.e. depth below GL)	m	0.89		
25% Effective Storage Depth	m	0.44		
(i.e. depth below GL)	m	1.76		
Effective Storage Depth 75%-25%	m	0.88		
Time to fall to 75% effective depth	mins	0.00		
Time to fall to 25% effective depth	mins	0.00		
V (75%-25%)	m3	0.39		
a (50%)	m2	3.60		
t (75%-25%)	mins	0.00		
SOIL INFILTRATION RATE	m/s	**N/A**		

DESIGN SOIL INFILTRATION RATE, f	**0.00E+00**



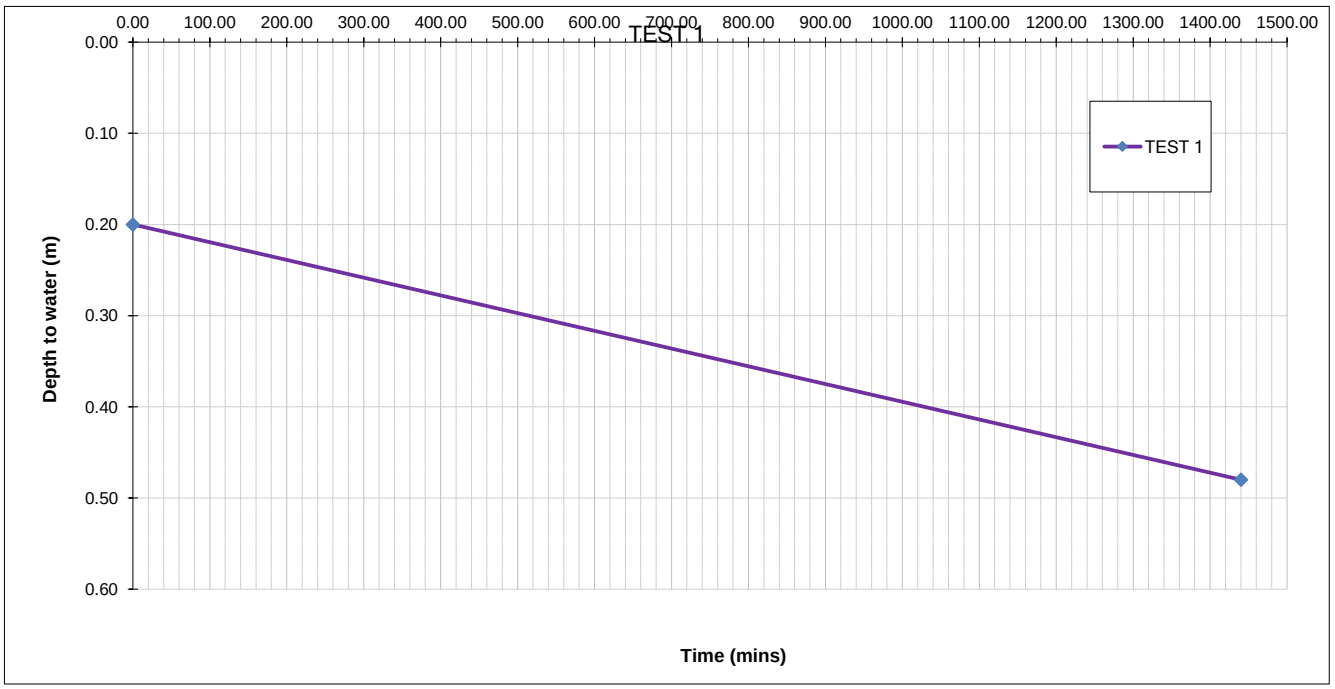
Site:	South Heywood Phase 6	**Trial Pit Number:**	TP115/ SA102
Job Number:	13-417	**Length:**	1.50 m
Date of Test:	15/04/2019	**Width:**	0.30 m
		Depth:	2.10 m
		Groundwater Level:	m

The test did not reach 25% or 75% effective storage depth and therefore has failed.

TEST 1		TEST 2		TEST 3	
Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
0.00	0.20				
1440.00	0.48				

Effective Storage Depth	m	1.90		
75% Effective Storage Depth	m	1.43		
(i.e. depth below GL)	m	0.68		
25% Effective Storage Depth	m	0.48		
(i.e. depth below GL)	m	1.63		
Effective Storage Depth 75%-25%	m	0.95		
Time to fall to 75% effective depth	mins	0.00		
Time to fall to 25% effective depth	mins	0.00		
V (75%-25%)	m3	0.43		
a (50%)	m2	3.87		
t (75%-25%)	mins	0.00		
SOIL INFILTRATION RATE	m/s	**N/A**		

DESIGN SOIL INFILTRATION RATE, f	**0.00E+00**



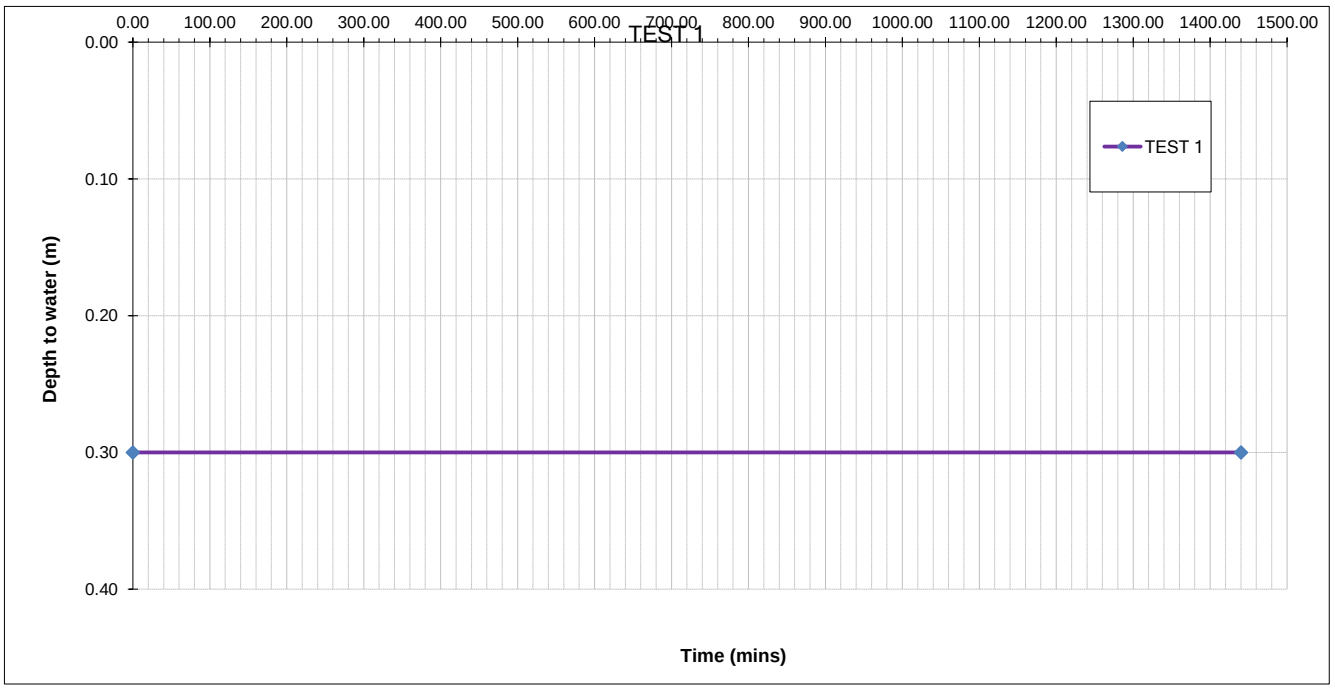
Site:	South Heywood Phase 6	**Trial Pit Number:**	TP107/ SA103
Job Number:	13-417	**Length:**	1.50 m
Date of Test:	15/04/2019	**Width:**	0.30 m
		Depth:	2.00 m
		Groundwater Level:	m

The test did not reach 25% or 75% effective storage depth and therefore has failed.

TEST 1		TEST 2		TEST 3	
Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
0.00	0.30				
1440.00	0.30				

Effective Storage Depth	m	1.70		
75% Effective Storage Depth	m	1.28		
(i.e. depth below GL)	m	0.73		
25% Effective Storage Depth	m	0.43		
(i.e. depth below GL)	m	1.58		
Effective Storage Depth 75%-25%	m	0.85		
Time to fall to 75% effective depth	mins	0.00		
Time to fall to 25% effective depth	mins	0.00		
V (75%-25%)	m3	0.38		
a (50%)	m2	3.51		
t (75%-25%)	mins	0.00		
SOIL INFILTRATION RATE	m/s	**N/A**		

DESIGN SOIL INFILTRATION RATE, f	**0.00E+00**



APPENDIX XI
COAL AUTHORITY REPORT

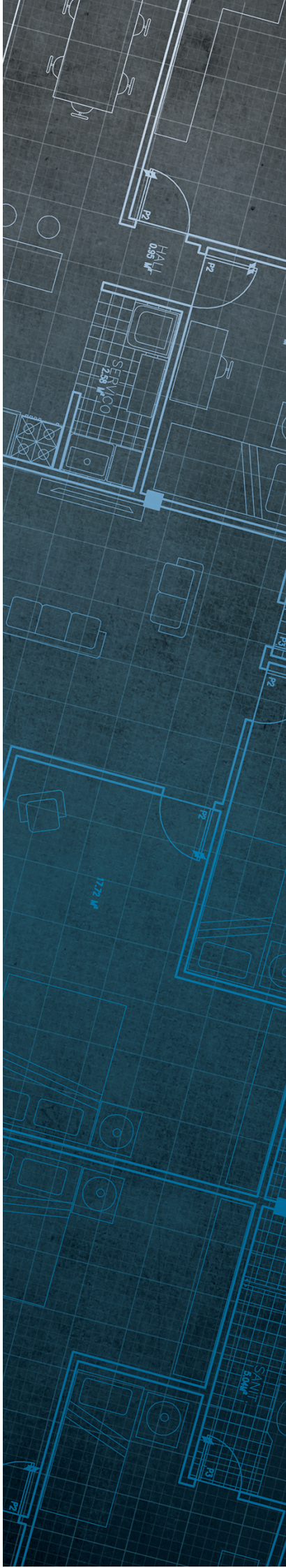
The Coal Authority

Consultants

Coal Mining Report

Land Off Hareshill Road
Heywood
Rochdale
OL10 2TD

Date of enquiry:	**19 July 2019**
Date enquiry received:	**19 July 2019**
Issue date:	**19 July 2019**
Our reference:	**51002156572001**
Your reference:	**13-417-NS-32732**



Consultants

Coal Mining Report

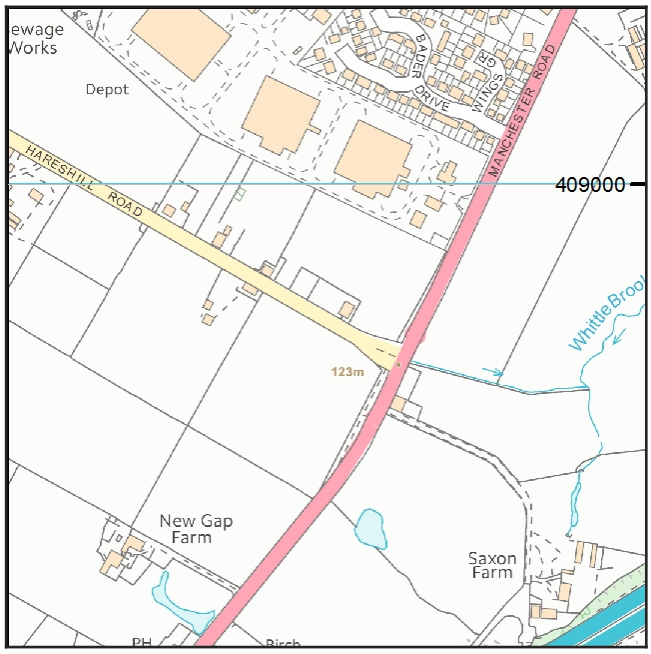
This report is based on and limited to the records held by the Coal Authority at the time the report was produced.

Client name

E3P

Enquiry address

Land Off Hareshill Road
Heywood
Rochdale
OL10 2TD



Approximate position of property

Map data

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How to contact us

0345 762 6848 (UK)
+44 (0)1623 637 000 (International)

200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

www.groundstability.com

@coalauthority
/company/the-coal-authority
/thecoalauthority
/thecoalauthority

Section 1 – Mining activity and geology

Past underground mining
No past mining recorded.

Probable unrecorded shallow workings
None.

Spine roadways at shallow depth
No spine roadway recorded at shallow depth.

Mine entries
None recorded within 100 metres of the enquiry boundary.

Abandoned mine plan catalogue numbers
The following abandoned mine plan catalogue numbers intersect with some, or all, of the enquiry boundary:

16820		

Please contact us on 0345 762 6848 to determine the exact abandoned mine plans you require based on your needs.

Outcrops
No outcrops recorded.

Geological faults, fissures and breaklines
No faults, fissures or breaklines recorded.

Opencast mines
None recorded within 500 metres of the enquiry boundary.

Coal Authority managed tips
None recorded within 500 metres of the enquiry boundary.

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Section 2 – Investigative or remedial activity

Please refer to the 'Summary of findings' map (on separate sheet) for details of any activity within the area of the site boundary.

Site investigations
None recorded within 50 metres of the enquiry boundary.

Remediated sites
None recorded within 50 metres of the enquiry boundary.

Coal mining subsidence
The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

Mine gas
None recorded within 500 metres of the enquiry boundary.

Mine water treatment schemes
None recorded within 500 metres of the enquiry boundary.

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Section 3 – Licensing and future mining activity

Future underground mining
None recorded.

Coal mining licensing
None recorded within 200 metres of the enquiry boundary.

Court orders
None recorded.

Section 46 notices
No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

Withdrawal of support notices
The property is not in an area where a notice to withdraw support has been given.

The property is not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support.

Payments to owners of former copyhold land
The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

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Section 4 – Further information

Based on the responses in this report, no further information has been highlighted.

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Section 5 – Data definitions

The datasets used in this report have limitations and assumptions within their results. For more guidance on the data and the results specific to the enquiry boundary, please **call us on 0345 762 6848** or **email us at groundstability@coal.gov.uk.**

Past underground coal mining

Details of all recorded underground mining relative to the enquiry boundary. Only past underground workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination, will be included.

Probable unrecorded shallow workings

Areas where the Coal Authority believes there to be unrecorded coal workings that exist at or close to the surface (less than 30 metres deep).

Spine roadways at shallow depth

Connecting roadways either, working to working, or, surface to working, both in-seam and cross measures that exist at or close to the surface (less than 30 metres deep), either within or within 10 metres of the enquiry boundary.

Mine entries

Details of any shaft or adit either within, or within 100 metres of the enquiry boundary including approximate location, brief treatment details where known, the mineral worked from the mine entry and conveyance details where the mine entry has previously been sold by the Authority or its predecessors British Coal or the National Coal Board.

Abandoned mine plan catalogue numbers

Plan numbers extracted from the abandoned mines catalogue containing details of coal and other mineral abandonment plans deposited via the Mines Inspectorate in accordance with the Coal Mines Regulation Act and Metalliferous Mines Regulation Act 1872. A maximum of 9 plan extents that intersect with the enquiry boundary will be included. This does not infer that the workings and/or mine entries shown on the abandonment plan will be relevant to the site/property boundary.

Outcrops

Details of seam outcrops will be included where the enquiry boundary intersects with a conjectured or actual seam outcrop location (derived by either the British Geological Survey or the Coal Authority) or intersects with a defined 50 metres buffer on the coal (dip) side of the outcrop. An indication of whether the Coal Authority believes the seam to be of sufficient thickness and/or quality to have been worked will also be included.

Geological faults, fissures and breaklines

Geological disturbances or fractures in the bedrock. Surface fault lines (British Geological Survey derived data) and fissures and breaklines (Coal Authority derived data) intersecting with the enquiry boundary will be included. In some circumstances faults, fissures or breaklines have been known to contribute to surface subsidence damage as a consequence of underground coal mining.

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Opencast mines
Opencast coal sites from which coal has been removed in the past by opencast (surface) methods and where the enquiry boundary is within 500 metres of either the licence area, site boundary, excavation area (high wall) or coaling area.

Coal Authority managed tips
Locations of disused colliery tip sites owned and managed by the Coal Authority, located within 500 metres of the enquiry boundary.

Site investigations
Details of site investigations within 50 metres of the enquiry boundary where the Coal Authority has received information relating to coal mining risk investigation and/or remediation by third parties.

Remediated sites
Sites where the Coal Authority has undertaken remedial works either within or within 50 metres of the enquiry boundary following report of a hazard relating to coal mining under the Coal Authority's Emergency Surface Hazard Call Out procedures.

Coal mining subsidence
Details of alleged coal mining subsidence claims made since 31 October 1994 either within or within 50 metres of the enquiry boundary. Where the claim relates to the enquiry boundary confirmation of whether the claim was accepted, rejected or whether liability is still being determined will be given. Where the claim has been discharged, whether this was by repair, payment of compensation or a combination of both, the value of the claim, where known, will also be given.

Details of any current 'Stop Notice' deferring remedial works or repairs affecting the property/site, and if so the date of the notice.

Details of any request made to execute preventative works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991. If yes, whether any person withheld consent or failed to comply with any request to execute preventative works.

Mine gas
Reports of alleged mine gas emissions received by the Coal Authority, either within or within 500 metres of the enquiry boundary that subsequently required investigation and action by the Coal Authority to mitigate the effects of the mine gas emission.

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Mine water treatment schemes
Locations where the Coal Authority has constructed or operates assets that remove pollutants from mine water prior to the treated mine water being discharged into the receiving water body.

These schemes are part of the UK's strategy to meet the requirements of the Water Framework Directive. Schemes fall into 2 basic categories: Remedial – mitigating the impact of existing pollution or Preventative – preventing a future pollution incident.

Mine water treatment schemes generally consist of one or more primary settlement lagoons and one or more reed beds for secondary treatment. A small number are more specialised process treatment plants.

Future underground mining
Details of all planned underground mining relative to the enquiry boundary. Only those future workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination will be included.

Coal mining licensing
Details of all licenses issued by the Coal Authority either within or within 200 metres of the enquiry boundary in relation to the under taking of surface coal mining, underground coal mining or underground coal gasification.

Court orders
Orders in respect of the working of coal under the Mines (Working Facilities and Support) Acts of 1923 and 1966 or any statutory modification or amendment thereof.

Section 46 notices
Notice of proposals relating to underground coal mining operations that have been given under section 46 of the Coal Mining Subsidence Act 1991.

Withdrawal of support notices
Published notices of entitlement to withdraw support and the date of the notice. Details of any revocation notice withdrawing the entitlement to withdraw support given under Section 41 of the Coal Industry Act 1994.

Payment to owners of former copyhold land
Relevant notices which may affect the property and any subsequent notice of retained interests in coal and coal mines, acceptance or rejection notices and whether any compensation has been paid to a claimant.

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The Coal Authority

Summary of findings

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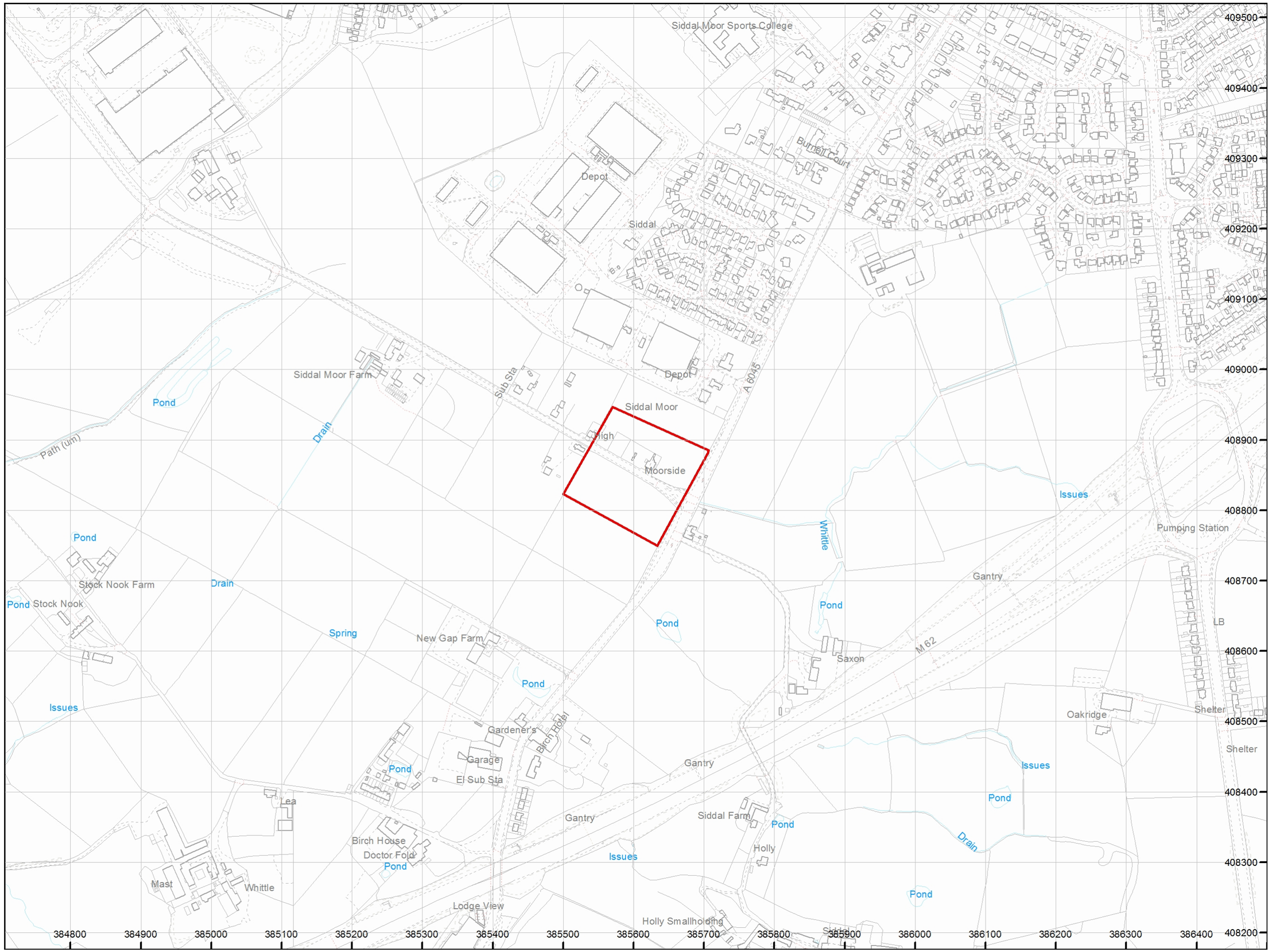
Map data

The map highlights any specific surface or subsurface features within or near to the boundary of the site.

Key

Approximate position of the enquiry boundary shown



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