



PHASE 2 GEOENVIRONMENTAL APPRAISAL
LAND OFF BENT STREET, PENISTONE
for
ORION HOMES LTD

January 2017

Phase 2 Geoenvironmental Appraisal
Land off Bent Street, Penistone
for
Orion Homes Ltd

N16417	Phase 2 Report, Land off Bent Street, Penistone
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Executive Summary

Ground Conditions	Cohesive topsoil to a depth of 0.3m below ground level (bgl) is present across the majority of the site, with made ground including topsoil in TP5 in the north western area of the site. Natural deposits comprise of soft and firm clay to depths of between 0.8 and 1.8m bgl but typically 1.0m bgl. The clay is underlain by granular soils of predominantly silty sandy gravel with cobbles and boulders overlying bedrock at depths of between 2.3 and 4.3m bgl. An area of boggy ground is present in the south east of the site. Shallow sandstone rock was encountered in WS6 in the central north at 1.40m bgl.
Groundwater	Groundwater seepages were generally recorded as seepages within the granular soils. Perched groundwater was typically encountered at 1.2m bgl with a deeper strike at the interface with bedrock at 3.0m bgl.
Ground Gas	Due to the requirement of suspended floors the preliminary gassing regime in accordance with the NHBC Traffic Light System suggests Green conditions at this stage which would not require any gas protection measures. Final confirmation of the need for gas protection measures will be provided following completion of the gas monitoring programme.
Contamination and Remediation	<p>Chrysotile fibres and elevated concentrations of lead were positively identified in a sample of made ground taken from TP5, located in the north western area of the site, associated with an area of former occupation. A stockpile of asbestos cement roof sheeting was also visually identified at the surface in the north western area of the site adjacent to the site boundary. No other visual or olfactory evidence of potential contamination was noted.</p> <p>It is recommended that these soils are removed from beneath plot gardens and disposed off-site or relocated beneath an area of landscaping and provided with an appropriate clean cover system to be agreed with the NHBC or local authority. Further delineation and laboratory testing will be required in the north western area of the site to determine the extent of these soils. Topsoil and subsoil from the remainder of the site should be suitable for re-use subject to the volumes present. Further tests in accordance with YAHPAC may be required.</p>
Mining	The site is not within a surface area that is affected by past or present underground mining. There is a low risk of the site being affected by mine workings.
Foundations	<p>Conventional strip or trench fill foundations bearing within the medium dense granular soils present, typically below 1.0m bgl should provide an allowable safe bearing capacity of 90kN/m² due to the presence of a high water table.</p> <p>It is considered that suspended floor slabs will best suited at this site due to the presence of soils of high volume change potential and the preliminary ground gas results.</p>
Tree Influence	Volume change potential of the shallow clay soils is 'high'. Mature trees are present on the eastern and western site boundary and in the north western area of the site. Heave precautions to foundations within the cohesive soils in these areas will be required where within influencing distance of trees.
Concrete Classification	Buried concrete should be designed to BRE Special Digest 1:2005 Design Sulphate Class DS-1 with an ACEC site classification AC-1.

SUDS	The site is not considered suitable for infiltration drainage due to the poor infiltration rate of the underlying clay and silty sandy gravels, as proven by testing in general accordance with BRE DG 365 (2016).
Waste Classification	Made ground containing asbestos in the north western area of the site is likely to be classed as hazardous, subject to confirmation by the receiving landfill and any necessary WAC testing. Some asbestos roof sheeting was noted at the surface which will also be classified as hazardous waste.
Roads & Groundworks	Indicative CBR of the underlying clay is 1%. This will require verification at formation level. Due to the presence of a high water table, provision should be made for temporary dewatering of excavations. Excavations should be achievable using standard earthmoving plant. However, temporary support of excavations particularly within the granular river terrace deposits should be allowed for.

The above summary should not be used in isolation and reference should be made the full report which provides a detailed assessment of the risks affecting the development.

1.0 Introduction

1.1 Commission

Patrick Parsons Ltd (PPL) was commissioned by Orion Homes Ltd (OHL) to undertake a Phase 2 Ground Investigation for a proposed residential development at land off Bent Street, Penistone. A site location plan is presented as Drawing No. N16417-701 in Appendix A.

1.2 Proposals

It is understood that OHL propose to construct residential housing with gardens and associated infrastructure at the site. A proposed development layout is presented as drawing No. N16417-702 in Appendix A.

1.3 Objectives

The objectives of the investigation were as follows:

- Review existing data and reports pertaining to the site.
- Provide information on ground conditions.
- Provide recommendations for foundation solutions.
- Assessment of potential risks from contamination.
- To assess the risk posed by hazardous ground gas.
- Provide recommendations for development.

This report presents the factual information available during this appraisal, interpretation of the data obtained and recommendations with respect to future development. It has been assumed in the production of this report that the site is to be redeveloped for an end use comprising residential housing with home grown produce.

1.4 Information Sources

This Phase II Site Appraisal is based on the findings of the investigation, chemical analysis and geotechnical testing undertaken during the course of the assessment. The results have been used to refine the conceptual model and initial recommendations outlined in the PPL desk study report:

- 'Phase 1 Geoenvironmental Report, Land off Bent Street, Penistone', Ref. N16417 dated November 2016.

1.5 Limitations

This report has been prepared for OHL and their appointed agents only and should not be relied upon by any third party without the written permission of PPL. If any unauthorised third party comes into possession of this report, they rely on it at their own risk and the authors do not owe them any Duty of Care or Skill. This report is based on and limited to an assessment of the information and ground conditions identified here. PPL is not responsible for ground conditions not revealed during these investigations.

2.0 Summary of Phase I Desk Study

The following is a summary of the findings of the Phase I Desk Study and should not be read in isolation. For full details reference should be made to the report outlined in Section 1.4. In summary, the Phase I Site Appraisal highlighted the following:

Site Description	A 0.88ha plot of land off Bent Street, Penistone, South Yorkshire. The site is currently undeveloped agricultural land within residential developments to the north, west and south and a Telephone Exchange building to the east.
Site History	The site comprises undeveloped agricultural land with localised outbuildings from around the 1950s until demolition during the 1990s.
Geology	<p>Superficial deposits are indicated to comprise predominantly river terrace sand and gravels overlying glacial drift.</p> <p>Bedrock comprises sandstone, mudstone and siltstone of the Lower Coal Measures, with the Crow coal seam (thin) likely to underlie the site at undetermined depth.</p>
Coal Mining	There is a negligible to low risk of the site being affected by shallow mine workings.
Contamination	The risk of significant contamination on site is considered to be low and locally low to moderate in the northwest corner.
Environmental	<ul style="list-style-type: none"> • Solid Geology: Secondary A Strata. • Superficial Geology: Secondary A Aquifer. • Sewage Treatment Plant to the northwest.
Ground Gas	<p>The risk of the site being affected by ground gas is considered to be moderate.</p> <p>No radon protection measures are required.</p>
Flooding	There is no flood risk identified. However, a Zone 2 floodplain is recorded 41m north of the site associated with the River Don.
SUDS	Depending on groundwater level considering the proximity of the River Don floodplain, SUDS may not be considered appropriate for this site at this stage.
Foundations	Traditional spread or trench fill foundations should generally be suitable for low rise housing. Mature trees are noted west and east and appropriate deepening of foundations should be anticipated.

2.1 Preliminary Conceptual Site Model

The Phase I Preliminary Conceptual Site Model is provided below:

Source	Pathway	Receptor	Pollutant Linkage: Assessed Risk
Human Health			
Made ground from former and adjacent offsite developments	Direct contact and ingestion/inhalation of contaminated soil and dust	Construction workers	Low : Mitigated by use of appropriate PPE and good site practice
	Direct contact and ingestion/inhalation of contaminated soil and dust. Ingestion of home grown vegetables	End users	Low : Minimal made ground anticipated. Mitigation measures may be required in the northwest corner of the site as part of the development to prevent end users coming into contact with made ground
Off-site sources of contamination: former gasworks, landfill and sewage treatment plant and cemetery	Lateral migration through made ground or permeable natural soils (River Terrace Deposits).	End users	Low - Moderate: the underlying soils are likely to be cohesive which will restrict migration
Ground gas associated with made ground deposits of vapours or migration gases from gasworks, sewage works and cemetery	Vertical and lateral migration into confined spaces. Inhalation	End users	Moderate: Gas monitoring will be required to confirm the ground gas regime.
Controlled Waters			
Made ground from former occupation.	Vertical and lateral migration	Surface Water - River Don, Primary River; Superficial Deposits - River Terrace Deposits, Secondary A Aquifer; Bedrock - Secondary A strata.	Low: Minimal made ground anticipated.

3.0 Fieldwork & Laboratory Testing

Based on the findings of the Phase I Appraisal, the following scope of fieldwork and laboratory analysis was undertaken:

- 9 No. machine excavated trial pits (TP1-9) using a JCB 3CX type backhoe excavator to depths of up to 3.40m bgl to allow logging of soils, obtain samples for laboratory analysis and to undertake in situ tests.
- 3 No. soakaway pits to undertake infiltration testing.
- Drilling of 6 No. window sample boreholes (WS1-6) to depths of up to 4.3m bgl, to assess ground conditions, allow in situ testing and obtain samples for laboratory analysis.
- Installation of 3 No. gas monitoring standpipes.
- Geotechnical testing of soils, including water soluble sulphate, soil pH and Atterberg Limits.
- Contamination testing of topsoil to comprise standard suites of metals, metalloids, non-metals, Polyaromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH) and asbestos.

The fieldwork was undertaken on the 13th and 14th of December 2016.

A plan showing the location of the exploratory holes is included as Drawing No. N16417-704 in Appendix A and copies of the exploratory hole logs are provided in Appendix B.

Laboratory Geotechnical and Chemical Test results are included in Appendix C and D respectively.

3.1 Exploratory Hole Rationale

Based on the findings of the desk study and the preliminary Conceptual Site Model, the location of the exploratory holes was based on the following rationale:

Exploratory Hole	Rationale
TP1 to TP8	General site coverage
WS1, WS2, WS5 and WS6	General site coverage
WS3, WS4 and TP9	To target the area adjacent to the nearby off-site cemetery and former gas works and an area of boggy ground (WS4) in the south east.
TP5	To target the area where there is evidence of human activity including a wooden shed and asbestos cement roof sheeting.
SA1 to SA3	To undertake Infiltration testing and to obtain additional geotechnical information.

Shallow made ground is likely to be present in the area adjacent to the entrance onto Bent Street and extending west towards the western site boundary due to evidence of previous occupation. However, due to the presence of an 11kV electricity cable in this area no exploratory hole positions could be excavated (See Drawing No. N16417-704 for approximate route of 11kV cable).

4.0 Ground Conditions

4.1 Soil Profile

Depth Range to Top of Strata (Thickness)	Material Type
Ground Level (0.3m)	Topsoil: Soft brown slightly sandy slightly gravelly clay, with frequent rootlets was recorded in all exploratory holes. Made Ground: Exceptionally, pieces of plastic, ceramic tile, occasional concrete and Chrysotile fibres were encountered within the topsoil in TP5.
0.3m (0.8 – 1.9m)	Cohesive River Terrace Deposits: Low and medium strength slightly gravelly slightly silty sandy clay was recorded across the site.
0.8 – 1.9m (1.4 – 3.8m)	Granular River Terrace Deposits: Predominantly medium dense with occasional loose slightly silty very sandy subangular to subrounded gravel with high subangular to subrounded cobble and low subangular to subrounded boulder content was identified across the site, with the exception of WS6.
1.4m – 3.8m (recorded depths, some excavations were terminated before bedrock depth was determined)	Bedrock: mudstone or sandstone bedrock was recorded beneath the river terrace deposits in all boreholes and also proven in trial pit TP5 where completely weathered mudstone was proven from 2.20m bgl.

4.2 Material Properties

4.2.1 River Terrace Deposits

Cohesive River Terrace Deposits

Hand shear vane results within the cohesive river terrace deposits ranged between 24 and 84kNm², confirming of soft to stiff (low to high strength) soils. The low strength soils were typically recorded in WS4, WS5, TP8 and TP9 where the soils were softened due to water bearing granular soils.

Plasticity results confirm that the alluvium is a clay of very high plasticity. Calculation of the modified plasticity index in accordance with NHBC Chapter 4.2 indicates that the clay has a high volume change potential.

Corrected SPT N values based on the SPT hammer energy ratio ranged between 15 and 24. Correlation with laboratory plasticity indices indicates a mass shear strength of approximately 75kPa, however, this is significantly higher than the average hand shear vane results.

Granular River Terrace Deposits

Corrected SPT N values based on the SPT hammer energy ratio ranged between 9 and 43, indicative of loose to dense soils. Generally, these soils showed an increase in density with depth. Average corrected N values of 19 were recorded confirming predominantly medium dense soils.

4.2.2 Bedrock

Uncorrected SPT N values of >50 (mudstone), and 17 and >50 (sandstone) were recorded. A corrected SPT N value based on the SPT hammer energy ratio recorded a value of 21 in sandstone.

4.3 Groundwater

Perched groundwater was encountered in the majority of exploratory locations during the site investigation. The following observations were made:

Location	Depth (m)	Soil Unit	Typical Rate of Flow
TP1, TP5, SA2, WS5	0.8, 1.1, 1.5, 3.0	Perched groundwater encountered through gravels	Slight to Moderate
TP3	1.8	Perched groundwater encountered through sand and gravels	Slight
TP4, TP6, TP7, SA1, SA3	1.0, 0.8, 1.4, 1.2, 1.2	Gravels recovered in a damp condition	Damp
TP8	1.5-2.0	Perched groundwater encountered within gravel and cobbles at 1.5m depth with influx of water below 2.0m depth	Moderate and High
TP9	1.8	Influx of groundwater within gravels and cobbles	Slight
WS1	3.0	Perched groundwater encountered within the sandy clay	-
WS2, WS3, WS4	3.0	Perched groundwater encountered above the bedrock	-

Groundwater observations during the investigation were typically recorded at approximately 1.2m bgl with secondary deeper strikes within the boreholes at the interface with bedrock at approximately 3.0m bgl.

Two groundwater monitoring visits have been undertaken to date, recording a high water table with groundwater in the range 0.27m to 0.54m depth, details of which are provided in Appendix E.

4.4 Contamination - Visual and Olfactory

During the investigation, a stockpile of suspected asbestos cement roof sheeting was observed in the north western area. No other significant forms of visual or olfactory contamination was identified during the site works.

4.5 Obstructions

No significant obstructions were encountered during the investigation. Natural obstructions comprising cobbles and boulders were encountered within the river terrace deposits. In WS5 in the north eastern area of the site, the sampler refused at 2.5m bgl on a probable natural cobble obstruction.

An 11kV electricity cable was detected with the Cable Avoidance Tool (CAT) in the north western area of the site. As a result, limited excavation in this area were carried out.

4.6 Infiltration Testing

Three soil infiltration tests (SA1, SA2 and SA3) were performed in general accordance with BRE 365, 2016 at the locations indicated on Drawing No N16417-704 presented in Appendix A. The excavations were cut as square as possible and targeted the granular river terrace deposits and remained stable for the duration of the tests. The dimensions of each excavation were carefully recorded and logged prior to commencement of each test. Clean mains water was used in the tests, supplied by a water tanker.

The test cycle was run for 240 minutes at each test location. Due to the length of the tests only one cycle was attempted in each location. The maximum observable fall in water levels was recorded as 2cm in SA1 which fell from 1.00m bgl to 1.02m bgl. Water levels within test locations SA2 and SA3 remained static for the duration of the test.

The raw data for the infiltration tests is included in Appendix B.

5.0 Preliminary Ground Gas Assessment

The monitoring assessment provided below is preliminary and subject to change until completion of the full monitoring programme.

Three gas and groundwater monitoring wells were installed during the investigation. In the absence of any deep made ground, response zones were placed between 1.0m and 3.0m bgl within WS3 and WS4 predominantly within natural granular materials. In WS1 the response zone was located between 1.0 and 3.9m within both natural cohesive and granular soils.

To date, 2 monitoring visits have been carried out. As gas and groundwater monitoring is presently ongoing the full results and recommendations will be presented in an addendum report following completion of the monitoring period. Copies of the results from the two monitoring visits to date are included in Appendix E.

A provisional summary and assessment of the monitoring information obtained to date is presented below.

Location	Methane (% v/v)	Carbon Dioxide (% v/v)	Oxygen (% v/v)	Flow (l/hr)	Barometric Pressure (mb)	Maximum GSV*	
						CO ₂	CH ₄
WS1	0.0	0.1– 0.2	21.4-21.5	0.0	1016-1033	0.12	<0.07
WS3	0.0	0.5 – 0.8	21.4 – 21.8	0.0	1016 - 1033		
WS4	0.0	0.2 – 1.2	21.1 – 21.6	10.1	1016 - 1033		

* GSV: CIRIA C665 Gas Screening Value, based on maximum flow and concentration

5.1 Provisional Assessment of Gas Protection Measures

Assessment of ground gas monitoring results has been carried out in general accordance with CIRIA C665, the NHBC Traffic Light System and BS8485 (2015). The calculated GSV of 0.12 l/hr based on the worst case steady state carbon dioxide concentration and worst case borehole flow rate is less than 0.78 l/hr. Due to the presence of soft cohesive soils of high volume change potential, the use of ground bearing slabs is considered unsuitable. In accordance with the above documents and adoption of suspended floors (with a clear 150mm subfloor void) this would classify the site as Green in accordance with the NHBC Traffic Light system.

The high flow rate detected in WS4 during the second monitoring visit may be attributable to changes in the water table as no other significant a rise in gas concentrations is noted. At this stage, it would be prudent to assume that ground gas protection measures may be required at this site. Further clarification on this situation will be given in the addendum report following monitoring completion.

6.0 Contamination Assessment

6.1 Generic Risk Assessment for Human Health

The assessment involves the screening of the measured concentrations of contaminants of concern obtained during the investigations against published generic assessment criteria (GAC) values which are representative of a 'minimal' or 'tolerable' risk to human health. The assessment criteria adopted are the LQM/CIEH Suitable for Use Levels (S4ULs) for Human Health Risk Assessment (Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3279; All rights reserved). Where no S4UL is available, reference is made to other relevant standards as appropriate.

Based on the proposed end use, GACs for a residential end use with home produce have been adopted. The soil organic matter content was calculated to be 6%, based on the average TOC concentration. A summary assessment table of all chemical results and GACs is provided in Appendix F.

6.1.1 Metals, Metalloids, Non-metals

One made ground, one subsoil and three topsoil samples were analysed. The sample of made ground from TP5 in the north western area of the site at 0.25m bgl recorded lead at a concentration exceeding the relevant GAC value. No other parameters exceeded their GAC values.

6.1.2 Petroleum Hydrocarbons

One sample of made ground and one sample of topsoil were tested for speciated TPH. No samples exceeded the relevant GAC values.

6.1.3 Polycyclic Aromatic Hydrocarbons

One sample of made ground, one sample of subsoil and three samples of topsoil were tested for speciated PAH. No samples exceeded the relevant GAC.

6.1.4 Asbestos Containing Materials (ACMs)

All five soil samples tested were screened for the presence of asbestos. One sample of made ground from TP5 was found to contain disbursed fibres of chrysotile (white) asbestos. Quantification analysis on this sample confirmed asbestos to be above trace quantities (<0.001%) at 0.013% w/v.

With the exception of the stockpiled suspected asbestos cement sheeting located in the north west section of the site, no other ACMs were noted in other parts of the site, nor within the exploratory holes and excavations

6.2 Controlled Waters Risk Assessment

There is no significant made ground on the site and therefore no significant leachable contamination. As a result of the findings of this investigation the risks to controlled waters are deemed to be low.

7.0 Revised Conceptual Site Model

Based on the findings of the ground investigation, the CSM developed in the Phase I desk study has been revised to reflect the increased level of data now available.

7.1 Background

Risk to human health or environmental receptors is based on an assessment of one or more source-pathway-receptor linkages. The 'source' is any substance which has the potential to cause significant harm to a relevant receptor and the 'pathway' is any route by which contamination may travel to impact on a 'receptor'.

The Conceptual Site Model (CSM) summarises the principal contaminant sources, pathways and receptors for this site and the likelihood of the existence of a pollutant linkage. The assessment is based on a presumed end use of a residential development with homegrown produce.

7.2 Contaminants of Concern

The ground investigation has confirmed the presence of the following contaminants of concern within the topsoil in the north western area of the site:

- lead and asbestos.

7.3 Gas Risk

No elevated concentrations of gases have been recorded within the standpipes. However, an elevated borehole flow reading of 10.1 (l/hr) was recorded in WS4. It is considered that given the preliminary gas regime and presence of high volume change potential soils, that suspended floors may be best suited at this site. On the basis of the results to date and assuming a suspended floor with a 150mm ventilated underfloor void, then the site would be classed as Green which would not require any gas protection measures. However, final conclusions relating to the gassing regime will be provided at the end of the monitoring period.

7.4 Phase 2 CSM and Environmental Risk Assessment

The significance of the potential source-pathway-receptor linkages identified in the CSM can be assessed using the following criteria:

- Low risk – not likely to cause significant harm to human health or controlled waters. Remedial measures are not likely to be required;
- Moderate risk – it is possible that significant harm to human health or controlled waters could occur depending on site specific circumstances. Remedial measures may be required to mitigate potential risks;
- High risk – it is likely that significant harm to human health or controlled waters will occur unless appropriate remedial measures are incorporated into the development.

The potential pollutant linkages pertaining to the site and the assessed significance are summarised in the CSM table below.

Source	Pathway	Receptor	Pollutant Linkage: Assessed Risk
Human Health			
Lead and asbestos contamination within topsoil in TP5 in the north western area of the site	Direct contact and ingestion/inhalation of contaminated soil and dust	Construction workers	Negligible across majority of the site, moderate locally to TP5: Mitigated by use of appropriate PPE and good site practice.
	Direct contact and ingestion/inhalation of contaminated soil and dust. Ingestion of home grown vegetables	End users	Negligible across majority of the site, moderate locally to TP5: Elevated lead and asbestos concentrations have only been proven in TP5. Complete removal of affected soils should be sufficient to sever the pollutant linkage. Careful segregation of the made ground soils from that area will be needed to prevent cross contamination with unaffected topsoil from other parts of the site.
Ground gas associated with made ground deposits, coal mining or volatile vapour as well as possible gases associated with the nearby off-site cemetery in the south eastern area of the site	Vertical and lateral migration into confined spaces. Inhalation	End users	Low: Gas monitoring to date has confirmed no elevated gas levels. Investigations suggest suspended floors will be best suited for this site. Presently no gas protection measures are considered required, subject to the results of the completed gas monitoring programme.

8.0 Remediation

8.1 Contaminants of Concern

The generic risk assessment confirmed that lead and asbestos are contaminants of concern which may potentially pose a risk to human health for the proposed residential end-use. In order to break the potential pollutant linkage, remedial measures are required.

8.2 Remediation Recommendations

The elevated concentrations of asbestos and lead in TP5 in the north western area of the site would provide a hazard to end users of the site. Consequently, these soils are unsuitable to remain within the development without remedial measures. It is advised that further delineation of the made ground soils in the north west, including further sampling is undertaken to determine the extent of these unsuitable soils and the extent of contamination present. On the basis of this investigation it is likely that these soils are limited to the north western corner of the site where previous occupation has been recorded. Once delineated these soils should be removed from all proposed gardens to expose the natural underlying clean soils. As the made ground comprises topsoil in part, such soils will be unsuitable for use beneath areas of hard engineering (roads/ driveways etc). Subject to volumes, such materials may be suitable to remain on site within landscaping areas subject to provision of a suitable clean cover system approved by the NHBC and regulatory authority. Alternatively, if disposed to landfill, then these soils may be classified as hazardous waste subject to further confirmatory testing.

The suspected ACMs comprising cement sheeting will need to be removed by a suitably licensed asbestos removal contractor under an appropriate duty of care.

It is recommended that a Remediation Strategy should be completed to provide more detail on the remedial requirements and validation procedures to be agreed with the NHBC and local regulatory authorities.

8.3 Utilities

The results of laboratory chemical tests should be provided to the appropriate utility companies to allow their assessment for the correct selection of water supply pipework.

8.4 Waste Disposal

Any materials which the developer intends to discard as part of the construction of the development would be classed as wastes and must be appropriately handled in accordance with current Waste Legislation. The developer should be aware of and utilise the waste hierarchy where possible – Reduce → Reuse → Recycle → Recovery → Disposal. Where materials are unable to remain on site and disposal is the only option the waste should be classified and sent to an appropriate waste receiving facility. Waste Acceptance Criteria (WAC) testing would be required by the waste receiving facility prior to disposal. It is considered that the majority of the topsoil encountered is likely to be classified as inert, with the exception of the contaminated made ground, including topsoil limited to the north western area of the site, which may be classed as hazardous due to the presence of asbestos above trace quantities. Some asbestos roof sheeting was noted at the surface which will also be classified as hazardous waste.

If any materials are to be removed from site, this should be undertaken in accordance with Duty of Care Regulations, 1991 and the Hazardous Waste Regulations, 2005.

8.5 Gas Protection Measures

Ground gas monitoring is presently ongoing and will be fully reported upon completion of the full monitoring period. The results of the ground investigation and preliminary ground gas monitoring indicate that suspended floor construction (with a 150mm ventilated underfloor void) will be best suited at this site. In accordance with CIRIA C665 and NHBC guidance this would classify the site as 'Green', which would not require any gas protection measures to new structures. **The requirements for gas protection measures will be confirmed following completion of the monitoring period in an addendum letter report.**

The site does not lie within an area where radon protection measures are required.

9.0 Geotechnical Appraisal

It is understood that OHL are proposing to develop low rise residential properties with associated access roads, parking and private gardens. In preparing this report, we have made assumptions on typical loadings for such a development. If any heavier loaded structures are proposed in the future, or significant changes in ground level are required then the recommendations made here may require amendment.

9.1 Foundations

The investigation recorded soft topsoil deposits at a typical thickness of 0.3m with made ground identified in the north west at 0.3m thick. Natural deposits beneath the topsoil typically comprise low and medium strength clays, which are generally underlain by silty clayey sandy gravels at a typical depth of 1.0m bgl but exceptionally as deep at 1.8m bgl (TP9). Due to the strength variability (soft to firm (low and medium strength)) and potential for unacceptable high total and differential settlement, the clay is not considered suitable as a bearing stratum.

It is considered that conventional strip or trench fill foundations will be appropriate, founding in medium dense sands and/or gravels or where these soils are absent (WS6), founding within the sandstone or mudstone rock. Given the presence of a high groundwater table, the potential for fluctuations in the water table to be present at foundation formation level has been considered. For example, an allowable safe bearing capacity of 90kN/m² would be applicable for a 0.6m wide foundation bearing within the natural granular soils at approximately 1.4m bgl.

The presence of boggy ground and soft clay and silt in the vicinity of WS4 extending to depths of 1.90m bgl may require deepened foundations in this area such as trench fill to bear within the deeper river terrace gravels at circa 2.0m depth.

9.2 Building Near Trees

Mature trees are present on the eastern boundary, occasionally on the western boundary and in the north western area of the site. Property foundations will generally be founded within the underlying granular soils. Heave precautions will be required to plots where cohesive soils are present in proximity to trees.

9.3 Floor Slabs

Suspended floors are considered to be appropriate at this site due to the presence of soils of high volume change potential and due to the preliminary gas regime for the site. Further consideration will be provided in the final gas assessment upon completion of the monitoring period.

9.4 Roads and Pavements

In-situ CBR testing undertaken with a Mexe Cone Penetrometer indicates a typical CBR value of 1% within the cohesive natural soils.

Any soft spots encountered in the prepared surface should be removed and replaced with appropriate engineering fill.

Highway design should be agreed with the local highways department before work begins on site.

9.5 Excavations

Generally, excavations within the natural soils should be achievable using conventional plant. However, support and battering back of temporary excavations should be undertaken, particularly within the granular soils which were noted to be prone to collapse during investigations. Such measures if required, should be undertaken in accordance with CIRIA Report 97 Trenching Practice (2nd Edition 2001).

9.6 Concrete Classification

Five samples of natural soils were tested for water soluble sulphate and pH.

The results indicate water soluble sulphate at concentrations between <10 and 21 mg/l and pH values between 6.0 and 6.7 which equates to a design sulphate class of DS-1 and ACEC class of AC-1 for concrete in accordance with BRE Special Digest 1, 2005, 3rd Edition.

9.7 Drainage

The results of infiltration tests have demonstrated that the natural soils at the site have a poor infiltration rate, which may be associated with a high perched water table and presence of clay and silt within the granular soils. It is therefore considered that the site is not suitable for a infiltration drainage solution.

9.8 Slope Stability

No significant slopes are present on site.

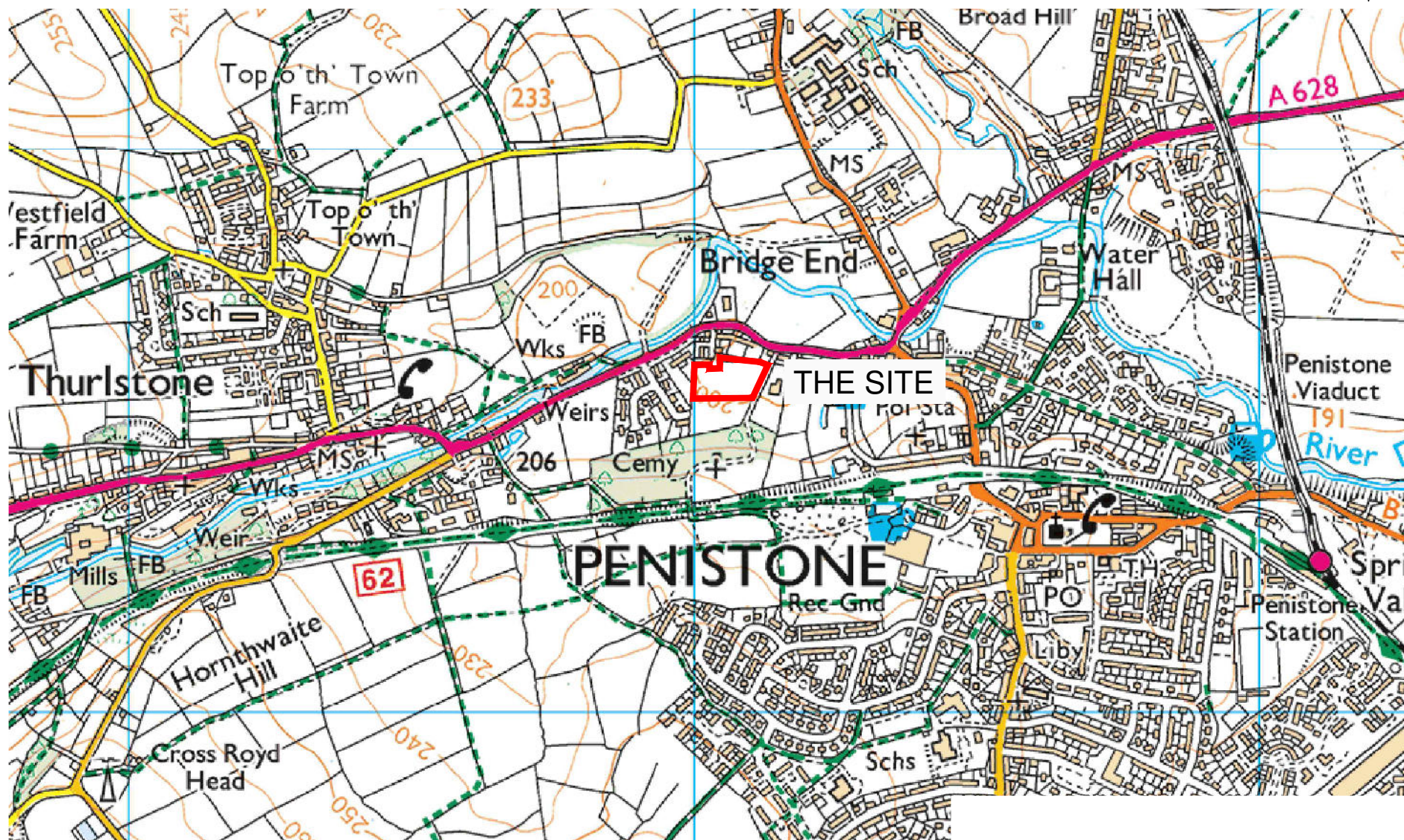
10.0 Further Works

Based on the findings of the desk study and ground investigation, the following works will be required for detailed design purposes:

- Completion of the gas monitoring and issue of a final gas risk assessment;
- Further delineation of the extent of made ground, including chemical testing of soils within the north western area of the site to determine volumes requiring remedial action;
- Further delineation of the boggy ground identified in the south east corner of the site (WS4);
- Subject to proposals to retain the made ground on site within non sensitive areas, carry out validation of the cover soil thickness following approval by the NHBC and local authority.

Appendix A

Figures



 PATRICK PARSONS T. +44 (0)191 261 9000 E. info@patrickparsons.co.uk W. www.patrickparsons.co.uk	Client ORION HOMES	Drawing SITE LOCATION PLAN	Scales 1 : 10,000	Drawn JCF NOV 2016	Checked SHJ
	Project LAND OFF BENT STREET, PENISTONE		Drawing No. N16417-701	Rev. P1	





Appendix B

Exploratory Hole Logs & Infiltration Test Data

Project Name Land off Bent Street		Project No. N16417	Co-ords: - Level: 200.26 m AOD	Date 13/12/2016
Location: Penistone, Barnsley			Dimensions: - Depth 2.60m	Scale 1:25
Client: Orion Homes Ltd				Logged By EM

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.50	IVN 1	45	0.30	199.96		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone. Frequent rootlets (TOPSOIL).	
0.70	D		0.80	199.46		Firm orange brown mottled grey slightly gravelly slightly silty sandy CLAY, with medium cobble content. Gravel is subangular to subrounded fine to coarse sandstone. Cobbles are subrounded to rounded sandstone.	
1.20	D					Brown slightly sandy slightly silty subangular to rounded fine to coarse GRAVEL, with high cobble content. Gravel is of sandstone. Cobbles are subrounded to rounded of sandstone (RIVER TERRACE DEPOSITS).	1
2.50	D		2.60	197.66		Trialpit Complete at 2.60 m	2
							3
							4

Remarks: Trial pit unstable all sides collapsing below ground level. Mexecon test at 0.50m: 1, 1, 3, 5, refused. Excavation difficult below 2.30m, trial pit terminated at 2.60m unable to excavate further due to probable sandstone bedrock.

Groundwater: Slight groundwater seepage below 0.80m.



Project Name Land off Bent Street		Project No. N16417	Co-ords: - Level: 200.08 m AOD	Date 13/12/2016
Location: Penistone, Barnsley			Dimensions: - Depth 2.60m	Scale 1:25
Client: Orion Homes Ltd				Logged By EM

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.30	IVN 1	40	0.30	199.78		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone. Frequent rootlets (TOPSOIL).	
0.80	D					Soft to firm orange brown mottled grey slightly gravelly slightly silty sandy CLAY, with medium cobble content. Gravel is subangular to subrounded fine to coarse of sandstone. Cobbles are subrounded to rounded of sandstone.	1
1.10			1.10	198.98		Brown silty sandy very gravelly subangular to rounded COBBLES of sandstone. Gravel is subangular to rounded fine to coarse of sandstone (RIVER TERRACE DEPOSITS).	
1.50	D						2
2.60			2.60	197.48		Trialpit Complete at 2.60 m	3
							4

Remarks: Trial pit unstable all sides collapsing below 1.10m. Mexecon test at 0.50m: 1,1, 2, refused. Excavation difficult below 2.20m, trial pit terminated at 2.60m unable to excavate further due to probable sandstone bedrock.

Groundwater: No groundwater encountered.



Project Name Land off Bent Street	Project No. N16417	Co-ords: - Level: 200.27 m AOD	Date 13/12/2016
Location: Penistone, Barnsley	Dimensions: - Depth 3.40m		Scale 1:25
Client: Orion Homes Ltd			Logged By EM

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.30			0.30	199.97		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone. Frequent rootlets (TOPSOIL).	
0.60	IVN 1	46				Firm orange brown mottled grey slightly gravelly slightly silty sandy CLAY. Gravel is subangular to subrounded fine to coarse of sandstone.	
0.70	D						
1.00	D		0.90	199.37		Orange brown fine to coarse SAND AND GRAVEL. Gravel is subangular to rounded fine to coarse of sandstone (RIVER TERRACE DEPOSITS).	1
1.90	D		1.80	198.47		Brown silty sandy subangular to rounded fine to coarse GRAVEL, with high cobble and medium boulder content. Gravel is of sandstone. Cobbles are subangular to subrounded of sandstone. Boulders are subrounded of sandstone (0.3 x 0.4 x 0.15m) (RIVER TERRACE DEPOSITS).	2
			3.40	196.87		Trialpit Complete at 3.40 m	3
							4

Remarks: Trial pit unstable all sides collapsing below 0.9m. Mexecone test at 0.5m: 1, 1, 1, 1, 1, 2, 2, 2.
Excavation becoming difficult below 3.2m, trial pit terminated at 3.40m, no further progress possible due to probable sandstone bedrock.

Groundwater: Slight groundwater seepage at 1.80m.



Project Name Land off Bent Street	Project No. N16417	Co-ords: - Level: 199.52 m AOD	Date 13/12/2016
Location: Penistone, Barnsley	Dimensions: - Depth 2.80m		Scale 1:25
Client: Orion Homes Ltd			Logged By EM

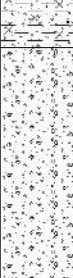
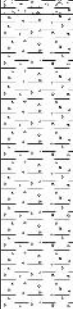
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.40 0.50	ES IVN 1	40	0.30	199.22		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone. Frequent rootlets (TOPSOIL).	
0.90 0.96	D IVN 2	52	1.00	198.52		Firm orange brown mottled grey slightly gravelly slightly silty sandy CLAY, with medium cobble content. Gravel is subangular to subrounded fine to coarse sandstone. Cobbles are subrounded to rounded of sandstone.	1
						Orange brown slightly silty very sandy GRAVEL, with medium cobble content. Gravel is subangular to rounded fine to coarse of sandstone. Cobbles are subangular to rounded of sandstone (RIVER TERRACE DEPOSITS). Below 1.5m medium boulder and high cobble content. Boulders are subangular to subrounded of sandstone (0.30 x 0.35 x 0.15m).	2
			2.80	196.72		Trialpit Complete at 2.80 m	3
							4

Remarks: Trial pit unstable all sides collapsing below 1.0m. Mexecone test at 0.50m: 1,1,1,1, refused. Excavation difficult below 2.50m, trial pit terminated at 2.80m unable to excavate further due to probable sandstone bedrock.

Groundwater: 1.00 to 2.80m damp.



Project Name Land off Bent Street	Project No. N16417	Co-ords: - Level: 199.80 m AOD	Date 13/12/2016
Location: Penistone, Barnsley	Dimensions: - Depth 3.40m		Scale 1:25
Client: Orion Homes Ltd			Logged By EM

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.25	ES		0.30	199.50		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone mudstone plastic ceramic tile and occasional concrete. Frequent rootlets (MADE GROUND).	
0.60	IVN 1	46				Firm orange brown mottled grey slightly gravelly slightly silty sandy CLAY. Gravel is subangular to rounded fine to coarse of sandstone.	
1.00 1.00	IVN 2 D	22	1.10	198.70		Becomes low strength from 1.0m bgl.	1
2.00 2.00	IVN 3 D	64	1.90	197.90		Orange brown very sandy subangular to rounded fine to coarse GRAVEL, with high cobble and low boulder content. Gravel is of sandstone and mudstone. Cobbles are subangular to rounded sandstone. Boulders are subrounded of sandstone (0.40 x 0.30 x 0.20m) (RIVER TERRACE DEPOSITS).	
2.30	IVN 4	84	2.20	197.60		Firm brown slightly sandy slightly silty gravelly CLAY. Gravel is subangular to rounded fine to coarse of various lithologies including sandstone and mudstone (GLACIAL TILL).	2
						Stiff grey CLAY, with gravel sized lithorelicts of mudstone (completely weathered mudstone).	
3.30	D		3.20	196.60		Weak grey MUDSTONE. Recovered as tabular angular to subangular fine to coarse gravel.	3
			3.40	196.40			
Trialpit Complete at 3.40 m							4

Remarks: Trial pit unstable 1.10 to 1.90m.
Mexecone test at 0.50m: 1, 1, 1, 1, 1, 1, 1.
Trial pit terminated at 3.40m unable to excavate further.

Groundwater: Slight groundwater seepage 1.10 to 1.90m.



Project Name Land off Bent Street	Project No. N16417	Co-ords: - Level: 199.90 m AOD	Date 13/12/2016
Location: Penistone, Barnsley	Dimensions: - Depth 2.10m		Scale 1:25
Client: Orion Homes Ltd			Logged By EM

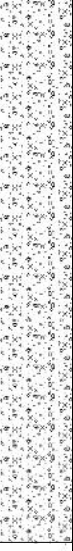
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.60	IVN 1	68	0.30	199.60		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone. Frequent rootlets (TOPSOIL).	
			0.80	199.10		Firm orange brown mottled grey slightly sandy slightly silty gravelly CLAY, with medium cobble content. Gravel is subangular to rounded fine to coarse sandstone. Cobbles are subangular to subrounded of sandstone.	
1.00	D					Brown and grey silty very sandy subangular to subrounded fine to coarse GRAVEL, with high cobble content. Gravel is of mudstone and sandstone. Cobbles are subangular to subrounded of sandstone (RIVER TERRACE DEPOSITS).	1
						Below 1.80m, becomes medium boulder content.	
			2.10	197.80		Trialpit Complete at 2.10 m	2
							3
							4

Remarks: Trial pit unstable all sides collapsing between 0.80 and 2.1m. Mexecon test at 0.50m: 1, 1, 2, 2, refused. Excavation difficult below 1.80m, trial pit terminated at 2.10m unable to excavate further due to probable sandstone bedrock.

Groundwater: 0.80 to 2.10m damp.



Project Name Land off Bent Street		Project No. N16417	Co-ords: - Level: 199.09 m AOD	Date 13/12/2016
Location: Penistone, Barnsley			Dimensions: - Depth 3.20m	Scale 1:25
Client: Orion Homes Ltd				Logged By EM

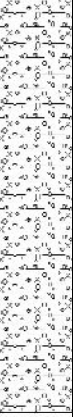
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.71	IVN 1	46	0.30	198.79		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone. Frequent rootlets (TOPSOIL).	
						Firm orange brown mottled grey slightly gravelly slightly silty sandy CLAY, with medium cobble content. Gravel is subangular to subrounded fine to coarse sandstone. Cobbles are subrounded to rounded of sandstone.	1
			1.40	197.69		Brown silty slightly sandy angular to rounded fine to coarse GRAVEL, with high cobble content. Gravel is of sandstone. Cobbles are subangular to subrounded of sandstone (RIVER TERRACE DEPOSITS).	2
2.30	D					Between 2.8 and 3.20m, high boulder content. Boulders are subangular sandstone.	3
			3.20	195.89		Trialpit Complete at 3.20 m	4

Remarks: Trial pit unstable all sides collapsing below 1.40m. Mexecon test at 0.50m: 1, 1, 2, 2, refused. Excavation difficult below 2.80m, trial pit terminated at 3.20m unable to excavate further due to probable sandstone bedrock.

Groundwater: 1.40 to 2.20m damp.



Project Name Land off Bent Street		Project No. N16417	Co-ords: - Level: 199.20 m AOD	Date 14/12/2016
Location: Penistone, Barnsley			Dimensions: - Depth 2.40m	Scale 1:25
Client: Orion Homes Ltd				Logged By EM

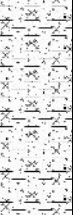
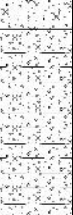
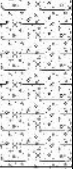
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.15	ES		0.30	198.90		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone. Frequent rootlets (TOPSOIL).	
0.60	IVN 1	34	1.00	198.20		Soft orange brown mottled grey slightly silty slightly gravelly sandy CLAY, with medium cobble and low boulder content. Gravel is subangular to subrounded fine to coarse of sandstone. Cobbles are subangular to subrounded of sandstone. Boulders are subrounded of sandstone (0.40 x 0.35 x 0.25m). Below 0.80m, becoming very sandy.	1
2.00	D		2.40	196.80		Brown very sandy clayey silty subangular to subrounded fine to coarse GRAVEL AND COBBLES. Gravel is of sandstone and mudstone. Cobbles are subangular to subrounded of sandstone (RIVER TERRACE DEPOSITS). Below 2.0m, low boulder content. Boulders are subrounded of sandstone.	2
Trialpit Complete at 2.40 m							3
							4

Remarks: Trial pit unstable all sides collapsing below 1.0m. Mexecone test at 0.50m: 1, 1, 2, 2, refused. Excavation difficult below 2.00m, trial pit terminated at 2.40m unable to excavate further due to influx of water into trial pit and subsequent undermining.

Groundwater: Medium groundwater seepage at 1.5m.
Rapid Influx of groundwater below 2.0m.



Project Name Land off Bent Street		Project No. N16417	Co-ords: - Level: 200.09 m AOD	Date 14/12/2016
Location: Penistone, Barnsley			Dimensions: - Depth 3.00m	Scale 1:25
Client: Orion Homes Ltd				Logged By EM

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.30			0.30	199.79		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone. Frequent rootlets (TOPSOIL).	
0.50	IVN 1	34				Soft orange brown mottled grey slightly silty slightly gravelly sandy CLAY. Gravel is subangular to subrounded fine to coarse of sandstone.	
1.00	IVN 2	24					1
1.40	IVN 3	30					
1.80			1.80	198.29		Greyish brown clayey silty sandy subangular to subrounded fine to coarse GRAVEL, with high cobble content. Gravel is of sandstone and mudstone. Cobbles are subangular to subrounded of sandstone (RIVER TERRACE DEPOSITS).	2
3.00			3.00	197.09			3
Trialpit Complete at 3.00 m							4

Remarks: Trial pit unstable all sides collapsing below 1.80m.
Mexecone test at 0.50m: 1, 1, 2, 2, 3, 5, refused.
Trial pit terminated at 3.00m, unable to excavate further due to sides being undermined.

Groundwater: Groundwater strike at 1.80m (slow flow rate).



Project Name
Land off Bent Street

Project No.
N16417

Co-ords: -

Hole Type
WS

Location: Penistone, Barnsley

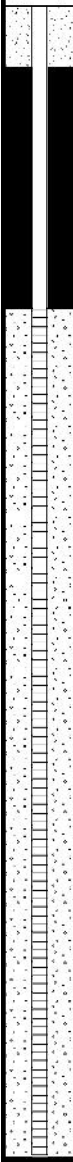
Level: 200.21 m AOD

Scale
1:25

Client: Orion Homes Ltd

Dates: 13/12/2016

Logged By
EM

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.25	ES		0.30	199.91		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone. Frequent rootlets (TOPSOIL).	
		0.50	IVN 1	50				Firm orange brown mottled grey slightly gravelly slightly silty sandy CLAY. Gravel is subangular to subrounded fine to coarse of sandstone.	
		0.70	D						
		1.00	SPT	N=17 (2,2/ 2,4,5,6)					1
		1.35	IVN 2	44					
					1.80	198.41		Medium dense orange brown subangular GRAVEL of sandstone.	
		2.00	SPT	N=17 (6,7/ 6,3,4,4)	2.20	198.01		Medium strength grey slightly sandy CLAY with gravel sized lithorelicts of mudstone (completely weathered mudstone).	2
		2.70	IVN 3	68					
		3.00	SPT	N=20 (2,3/ 4,5,5,6)					3
		3.90 4.00	D SPT	50 (8,14/ 20,30 for 70mm)	3.80	196.41		Extremely to very weak thinly laminated grey MUDSTONE.	4
					4.30	195.91		End of Borehole at 4.30 m	
			Type	Results					

Remarks: Groundwater strike at 3.00m.
Monitoring well installed at 3.80m

Project Name
Land off Bent Street

Project No.
N16417

Co-ords: -

Hole Type
WS

Location: Penistone, Barnsley

Level: 200.17 m AOD

Scale
1:25

Client: Orion Homes Ltd

Dates: 13/12/2016

Logged By
EM

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.40	ES		0.30	199.87		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone. Frequent rootlets (TOPSOIL).	
		0.80	D					Medium dense orange brown slightly sandy clayey subangular GRAVEL of sandstone (RIVER TERRACE DEPOSITS).	
		1.00	SPT	N=15 (2,3/ 4,3,4,4)					1
		2.00	SPT	N=23 (2,4/ 5,6,6,6)					2
		3.00 3.00	SPT D	50 (8,11/ 14,16,20 for 30mm)	2.90 2.95	197.27 197.22		Stiff grey CLAY with gravel size lithorelicts of mudstone (completely weathered mudstone). Extremely weak grey MUDSTONE.	3
					3.30	196.87		End of Borehole at 3.30 m	4
			Type	Results					

Remarks: Groundwater strike at 3.00m.
Borehole backfilled with arisings between ground level and 3.30m upon completion.

Project Name
Land off Bent Street

Project No.
N16417

Co-ords: -

Hole Type
WS

Location: Penistone, Barnsley

Level: 200.10 m AOD

Scale
1:25

Client: Orion Homes Ltd

Dates: 13/12/2016

Logged By
EM

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30			0.30	199.80		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone. Frequent rootlets (TOPSOIL).	
		0.45 0.50	ES IVN 1	44				Firm orange brown mottled grey slightly gravelly slightly silty sandy CLAY. Gravel is subangular to subrounded fine to coarse of sandstone.	
		1.00	SPT	N=12 (3,2/ 2,3,3,4)	1.00	199.10		Medium dense orange brown gravelly fine to medium SAND. Gravel is angular to subangular of sandstone (RIVER TERRACE DEPOSITS).	1
		1.30	D						
					1.50	198.60		Medium dense brown slightly silty clayey very sandy subangular to subrounded fine to coarse GRAVEL of sandstone (RIVER TERRACE DEPOSITS).	2
		2.00	SPT	N=19 (5,5/ 4,5,6,4)					
		3.00	SPT	N=17 (1,2/ 3,3,4,7)	3.00	197.10		Extremely weak thinly laminated dark grey MUDSTONE.	3
		3.80	SPT	50 (13,12/ 50 for 60mm)	3.80	196.30		Very weak thinly laminated grey MUDSTONE.	
					4.00	196.10		End of Borehole at 4.00 m	4
			Type	Results					

Remarks: Groundwater strike at 3.00m.
Sampler refused at 3.80m.
Monitoring well installed at 3.00m.

Project Name
Land off Bent Street

Project No.
N16417

Co-ords: -

Hole Type
WS

Location: Penistone, Barnsley

Level: 200.00 m AOD

Scale
1:25

Client: Orion Homes Ltd

Dates: 13/12/2016

Logged By
EM

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30	199.70		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone. Frequent rootlets (TOPSOIL).	
		0.50	IVN 1	34				Soft orange brown mottled grey slightly sandy slightly gravelly silty CLAY. Gravel is subangular to subrounded fine to coarse sandstone.	
		1.00	SPT	N=7 (1,1/ 1,1,2,3)	1.00	199.00		Loose brown silty sandy very clayey GRAVEL. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone (RIVER TERRACE DEPOSITS).	1
		1.60	IVN 2	28	1.50	198.50		Soft grey mottled orange brown slightly sandy gravelly CLAY/SILT. Gravel is subangular to subrounded fine to coarse of sandstone (RIVER TERRACE DEPOSITS).	
		2.00	SPT	N=13 (2,3/ 3,3,3,4)	1.90	198.10		Medium dense brown silty clayey subangular to subrounded fine to coarse GRAVEL of various lithologies including sandstone and mudstone (RIVER TERRACE DEPOSITS).	2
		3.00	SPT	50 (8,17/ 17,23,10 for 10mm)	3.00	197.00		Extremely weak orange brown SANDSTONE.	3
					3.30	196.70		End of Borehole at 3.30 m	4
			Type	Results					

Remarks: Groundwater strike at 3.00m.
Monitoring well installed at 3.00m.

Project Name
Land off Bent Street

Project No.
N16417

Co-ords: -

Hole Type
WS

Location: Penistone, Barnsley

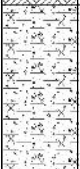
Level: 199.47 m AOD

Scale
1:25

Client: Orion Homes Ltd

Dates: 13/12/2016

Logged By
EM

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES		0.30	199.17		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone. Frequent rootlets (TOPSOIL).	
		0.60 0.60	IVN 1 D	26	0.85	198.62		Soft orange brown slightly sandy slightly silty gravelly CLAY. Gravel is subangular fine to coarse of sandstone.	
		1.00	SPT	N=35 (2,6/ 6,7,9,13)				Medium dense orange brown very sandy subangular to subrounded fine to coarse GRAVEL of sandstone and mudstone (RIVER TERRACE DEPOSITS).	1
		2.00	SPT	N=18 (8,8/ 9,3,3,3)					2
		2.50	SPT	N=33 (19,6/ 9,6,7,11)				probable cobble at 2.5m.	
		3.00	SPT	N=21 (1,3/ 4,5,6,6)					3
		4.00 4.00	SPT D	50 (10,12/ 15,20,15 for 20mm)	3.80	195.67		Extremely weak thinly laminated grey MUDSTONE.	4
					4.30	195.17		End of Borehole at 4.30 m	
		Type	Results						

Remarks: Groundwater strike at 3.00m.
Sampler refused at 2.5m (probable cobble).
Borehole backfilled with arisings between ground level and 4.30m upon completion.

Project Name
Land off Bent Street

Project No.
N16417

Co-ords: -

Hole Type
WS

Location: Penistone, Barnsley

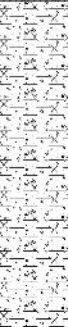
Level: 199.37 m AOD

Scale
1:25

Client: Orion Homes Ltd

Dates: 13/12/2016

Logged By
EM

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.30	199.07		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone. Frequent rootlets (TOPSOIL).	
		0.50	IVN 1	58				Firm orange brown mottled grey slightly gravelly slightly silty sandy CLAY. Gravel is subangular to subrounded fine to coarse of sandstone.	
		0.95 1.00	IVN 2 SPT	28 N=12 (1,1/ 1,2,5,4)	1.40	197.97		Extremely weak orange brown SANDSTONE.	1
		2.00	SPT	20 (25,30/ 15,5 for 70mm)	2.30	197.07		End of Borehole at 2.30 m	2
									3
									4
			Type	Results					

Remarks: Borehole backfilled with arisings between ground level and 2.30m upon completion.
No groundwater encountered.

Project Name
Land off Bent Street

Project No.
N16417

Co-ords: -
Level: 199.83 m AOD

Date
14/12/2016

Location: Penistone, Barnsley

Dimensions: 2.50m

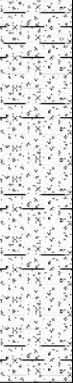
Scale
1:25

Client: Orion Homes Ltd

Depth
2.30m

0.65m

Logged By
EM

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.50 0.60	IVN 1 D	36	0.30	199.53		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone. Frequent rootlets (TOPSOIL).	
			1.00	198.83		Soft orange brown slightly gravelly slightly silty sandy CLAY, with medium cobble content. Gravel is subangular to subrounded fine to coarse of sandstone. Cobbles are subangular to subrounded of sandstone.	
						Below 0.8m, high boulder content. Boulders are subrounded of sandstone (0.40 x 0.35 x 0.35m).	
						Brown slightly clayey sandy silty subangular to rounded fine to coarse GRAVEL, with high cobble content. Gravel is of sandstone and mudstone. Cobbles are subangular to rounded of sandstone (RIVER TERRACE DEPOSITS).	1
			2.30	197.53		Trialpit Complete at 2.30 m	2
							3
							4

Remarks: Trial pit stable. Mexecon test at 0.50m: 1, 3, refused.
Excavation difficult below 2.00m, trial pit terminated at 2.30m unable to excavate further due to probable sandstone bedrock.

Groundwater: 1.20 to 2.30m damp.



Project Name
Land off Bent Street

Project No.
N16417

Co-ords: -
Level: 200.19 m AOD

Date
14/12/2016

Location: Penistone, Barnsley

Dimensions: 2.50m

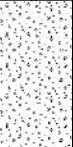
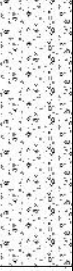
Scale
1:25

Client: Orion Homes Ltd

Depth
2.40m

0.65m

Logged By
EM

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.70	IVN 1	64	0.30	199.89		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone. Frequent rootlets (TOPSOIL).	
			1.00	199.19		Firm orange brown mottled grey slightly gravelly slightly silty sandy CLAY. Gravel is subangular to subrounded fine to coarse of sandstone.	
			1.50	198.69		Orange brown silty very clayey SAND and GRAVEL, with high cobble content. Gravel is subangular to rounded fine to coarse of sandstone. Cobbles are subangular to subrounded of sandstone (RIVER TERRACE DEPOSITS).	1
1.60	D		2.40	197.79		Greyish brown slightly sandy subangular to subrounded fine to coarse GRAVEL, with high cobble content. Gravel is of sandstone and mudstone. Cobbles are subangular to rounded of sandstone (RIVER TERRACE DEPOSITS).	2
						At 2.30m, 1no. subrounded sandstone boulder.	
						Trialpit Complete at 2.40 m	
							3
							4

Remarks: Trial pit unstable all sides collapsing below 0.80m. Mexecone test at 0.50m: 1, 1, 1, 2, 2, 3, refused. Excavation difficult below 2.00m, trial pit terminated at 2.40m unable to excavate further due to probable sandstone bedrock.

Groundwater: Groundwater strike at 1.5m (moderate flow rate).



Project Name
Land off Bent Street

Project No.
N16417

Co-ords: -
Level: 199.81 m AOD

Date
14/12/2016

Location: Penistone, Barnsley

Dimensions: 2.50m

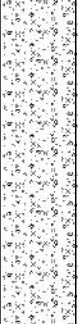
Scale
1:25

Client: Orion Homes Ltd

Depth
2.30m

0.70m

Logged By
EM

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.50	D		0.30	199.51		Soft brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies including sandstone and mudstone. Frequent rootlets (TOPSOIL).	
0.60	IVN 1	42				Firm brown mottled grey slightly silty slightly gravelly sandy CLAY. Gravel is subangular to subrounded fine to coarse of sandstone and mudstone.	
			1.00	198.81		Orange brownish grey clayey silty fine to coarse SAND and GRAVEL, with medium cobble content. Gravel is subangular to subrounded fine to coarse of sandstone and mudstone. Cobbles are subrounded of sandstone (RIVER TERRACE DEPOSITS).	1
			1.20	198.61		Brown slightly sandy slightly silty subangular to subrounded fine to coarse GRAVEL, with high cobble content. Gravel is of various lithologies including sandstone and mudstone. Cobbles are subangular to subrounded of sandstone (RIVER TERRACE DEPOSITS).	2
			2.30	197.51		Trialpit Complete at 2.30 m	3
							4

Remarks: Trial pit stable.
Mexecone test at 0.50m: 1, 1, 1, 2, 3 refused. Excavation difficult below 2.00m, trial pit terminated at 2.30m unable to excavate further due to probable sandstone bedrock.

Groundwater: 1.20 to 2.30m, damp.



Trial Pit:	SA1
Time (mins)	Water Depth (bgl)
0.0	1.00
0.5	1.00
1.0	1.00
1.5	1.00
2.0	1.00
3.0	1.00
4.0	1.00
5.0	1.00
10.0	1.00
15.0	1.02
20	1.02
25	1.02
30	1.02
40	1.02
50	1.02
60	1.02
90	1.02
120	1.02
150	1.02
180	1.02
240	1.02

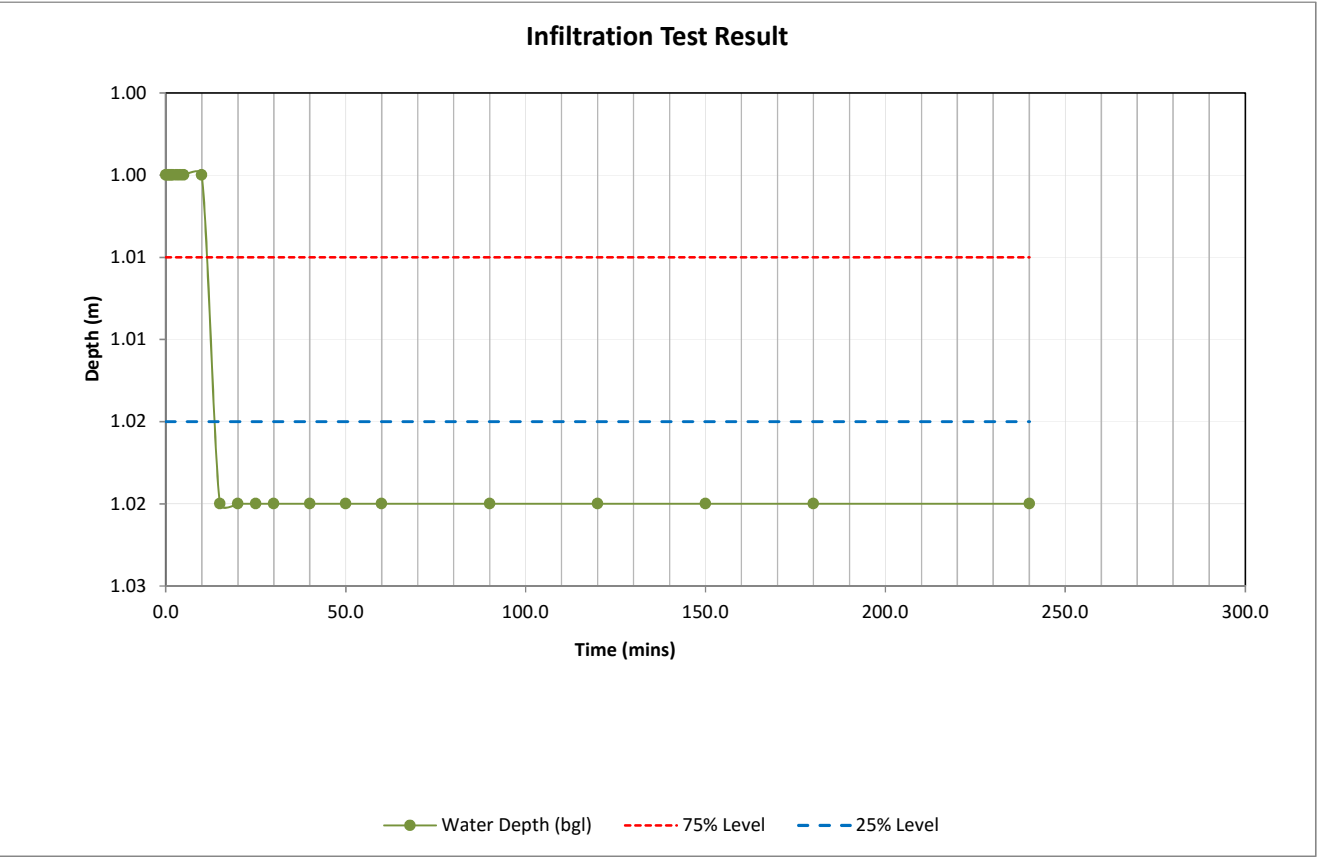
Trial Pit Depth	2.30
Total Fall in Water Level(m):	0.02
Water Depth at Start of Test (m):	1.00
Water Depth at End of Test (m):	1.02
Theoretical 25% Effective Depth (assuming complete drainage):	1.98

As water drop did not reach 25% Effective Depth during the test, the calculated outflow volume from 75% and 25% will be based on the total water level drop from 1m to 1.02m

OUTFLOW VOLUME

75% Level (m)	1.005
25% Level (m)	1.015
Effective Range 75% - 25% (m)	0.010

Time to fall to 75% Depth (mins)	11
Time to fall to 25% Depth (mins)	14
Time from 75% to 25% Depth (mins)	3



Trial Pit:	SA1
Time (mins)	Water Depth (bgl)
0.0	1.00
0.5	1.00
1.0	1.00
1.5	1.00
2.0	1.00
3.0	1.00
4.0	1.00
5.0	1.00
10.0	1.00
15.0	1.00
20	1.00
25	1.00
30	1.00
40	1.00
50	1.00
60	1.00
90	1.00
120	1.00
150	1.00
180	1.00
240	1.00

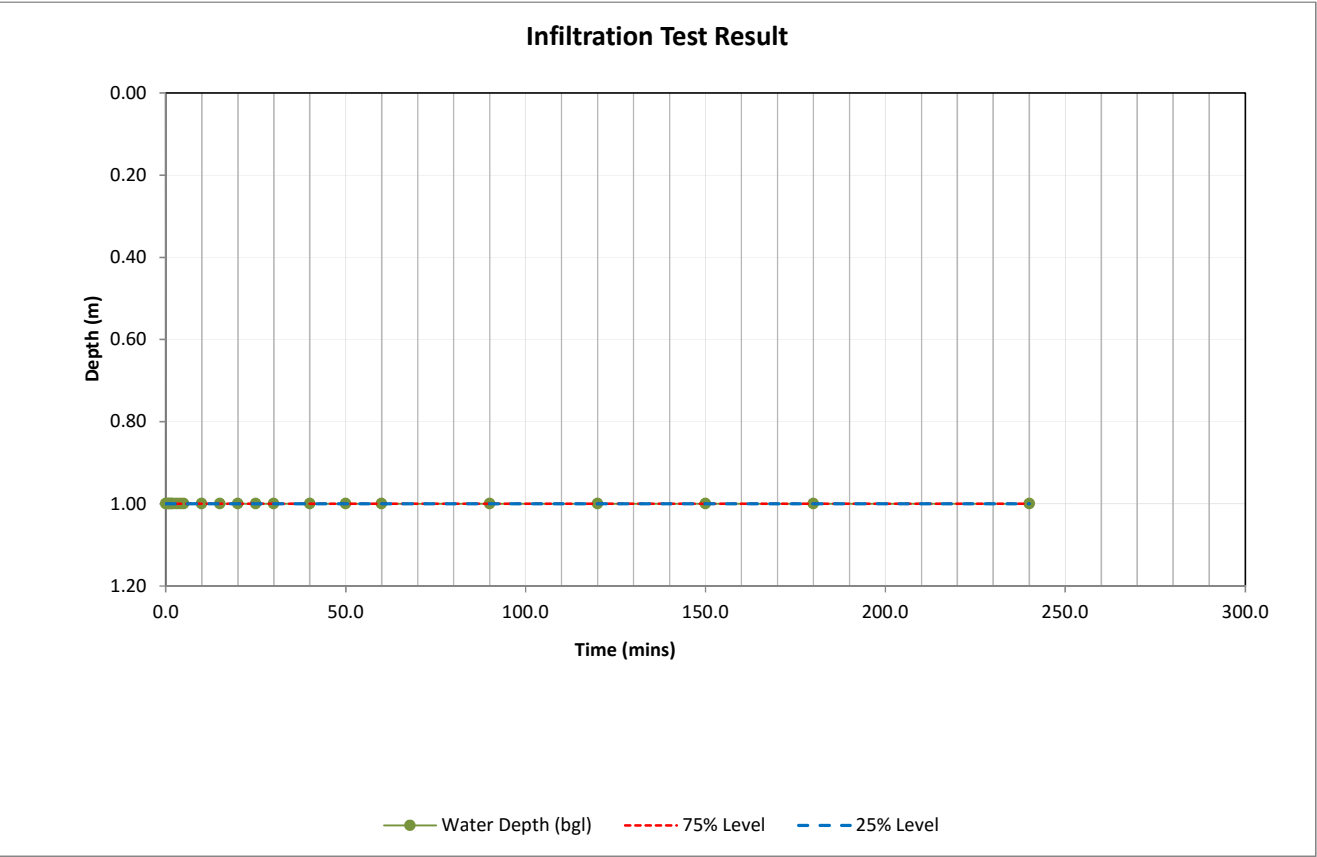
Trial Pit Depth	2.40
Total Fall in Water Level(m):	0.00
Water Depth at Start of Test (m):	1.00
Water Depth at End of Test (m):	1.00
Theoretical 25% Effective Depth (assuming complete drainage):	2.05

As water drop did not reach 25% Effective Depth during the test, the calculated outflow volume from 75% and 25% will be based on the total water level drop from 1m to 1m

OUTFLOW VOLUME

75% Level (m)	1.000
25% Level (m)	1.000
Effective Range 75% - 25% (m)	0.000

Time to fall to 75% Depth (mins)	0
Time to fall to 25% Depth (mins)	0
Time from 75% to 25% Depth (mins)	0



Appendix C

Geotechnical Test Results



LABORATORY REPORT



4043

Contract Number: PSL16/5956

Report Date: 22 December 2016

Client's Reference: N16417/EM/2271

Client Name: Patrick Parsons
5 Waverley Road
Huddersfield
West Yorkshire
HD1 5NA

For the attention of: Lee Brown

Contract Title: Land Off Bent Street, Penistone

Date Received: 19/12/2016

Date Commenced: 19/12/2016

Date Completed: 22/12/2016

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 in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson
(Director)

A Watkins
(Director)

R Berriman
(Quality Manager)

D Lambe
(Senior Technician)

S Royle
(Senior Technician)

L Knight
(Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
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e-mail: rgunson@prosoils.co.uk
awatkins@prosoils.co.uk

Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

PSL
Professional Soils Laboratory

Checked / Approved		Date	22/12/16	Contract No:
Land off Bent Street, Penistone				PSL16/5956
				Client Ref:
				N16417

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

[illegible]

SYMBOLS : NP : Non Plastic

*** : Liquid Limit and Plastic Limit Wet Sieved.**



PSL
Professional Soils Laboratory

Checked / Approved

R. Kutt

Date

22/12/16

Contract No:

PSL16/5956

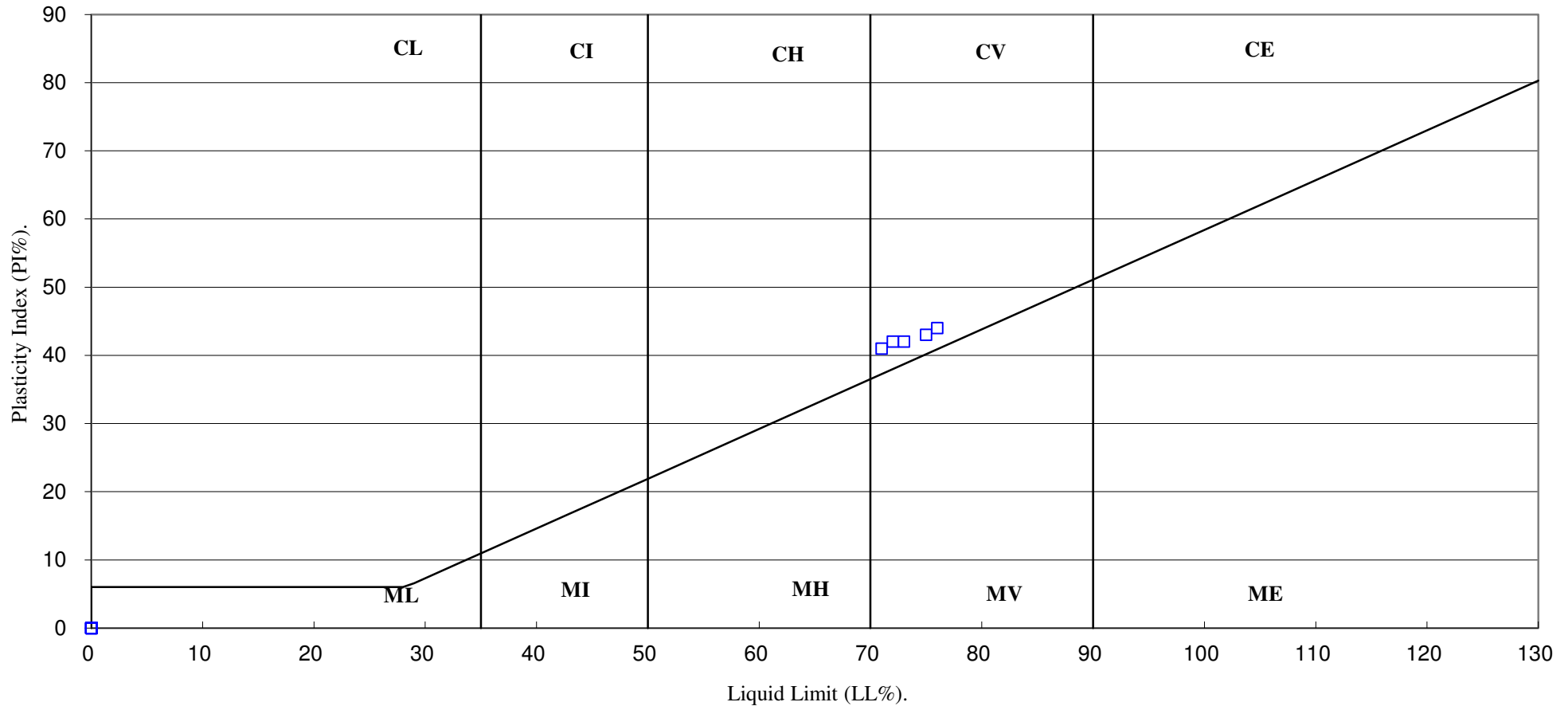
Client Ref:

N16417

Land off Bent Street, Penistone

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(BS5930 :2015)



PSL
Professional Soils Laboratory

Checked /Approved

[Signature]

Date

22/12/16

Contract No:

PSL16/5956

Client Ref:

N16417

Land off Bent Street, Penistone

Appendix D

Chemical Test Results



Certificate of Analysis

Certificate Number 16-87208-1

06-Jan-17

Client Patrick Parson Consulting Engineering
Waterloo House
Thornton Street
Newcastle upon Tyne
NE1 4AP

Our Reference 16-87208-1

Client Reference N16417

Order No N16417/EM/2270

Contract Title Land off Bent Street penistone

Description 10 Soil samples.

Date Received 19-Dec-16

Date Started 19-Dec-16

Date Completed 06-Jan-17

Test Procedures Identified by prefix DETSn (details on request).

Notes **This report supersedes 16-87208, Extra Testing**

Opinions and interpretations are outside the scope of UKAS accreditation. 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. Observations and interpretations are outside the scope of ISO 17025. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

A handwritten signature in black ink, appearing to read 'Rob Brown'.

Rob Brown
Business Manager



Summary of Chemical Analysis

Matrix Descriptions

Our Ref 16-87208-1

Client Ref N16417

Contract Title Land off Bent Street penistone

Sample ID	Depth	Lab No	Completed	Matrix Description
TP5	0.25	1102345	23/12/2016	Brown gravelly, sandy CLAY including odd rootlets
WS2	0.4	1102346	23/12/2016	Brown gravelly, sandy CLAY including odd rootlets
TP8	0.15	1102347	23/12/2016	Brown gravelly, sandy CLAY including odd rootlets
WS5	0.1	1102348	23/12/2016	Brown gravelly, sandy CLAY including odd rootlets
WS1	0.25	1102349	23/12/2016	Brown gravelly, sandy CLAY including odd rootlets

Summary of Chemical Analysis

Soil Samples

Our Ref 16-87208-1

Client Ref N16417

Contract Title Land off Bent Street penistone

Lab No	1102345	1102346	1102347	1102348	1102349	1102350
Sample ID	TP5	WS2	TP8	WS5	WS1	TP2
Depth	0.25	0.40	0.15	0.10	0.25	1.50
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	13/12/16	13/12/16	13/12/16	13/12/16	13/12/16	13/12/16
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
Asbestos Quantification	DETS 1102	0		Y					
Metals									
Arsenic	DETS 2301#	0.2	mg/kg	14	5.6	11	17	14	
Cadmium	DETS 2301#	0.1	mg/kg	0.7	0.2	0.4	0.3	0.3	
Chromium	DETS 2301#	0.15	mg/kg	28	20	17	23	17	
Chromium, Hexavalent	DETS 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Copper	DETS 2301#	0.2	mg/kg	48	17	25	40	48	
Lead	DETS 2301#	0.3	mg/kg	240	41	89	78	87	
Mercury	DETS 2325#	0.05	mg/kg	0.28	< 0.05	0.11	0.11	0.12	
Nickel	DETS 2301#	1	mg/kg	18	12	8.4	11	8.5	
Selenium	DETS 2301#	0.5	mg/kg	0.6	< 0.5	0.5	0.9	< 0.5	
Zinc	DETS 2301#	1	mg/kg	310	64	59	79	49	
Inorganics									
pH	DETS 2008#			8.8	6.8	6.3	6.2	6.0	6.0
Total Organic Carbon	DETS 2002	0.1	%	4.7	1.0	4.3	3.0	3.3	
Sulphate Aqueous Extract as SO4	DETS 2076#	10	mg/l	90	17	26	14	29	16
Sulphate as SO4, Total	DETS 2321#	0.01	%	0.21	0.05	0.11	0.09	0.09	
Petroleum Hydrocarbons									
Aliphatic C5-C6	DETS 3321*	0.01	mg/kg	< 0.01				< 0.01	
Aliphatic C6-C8	DETS 3321*	0.01	mg/kg	< 0.01				< 0.01	
Aliphatic C8-C10	DETS 3321*	0.01	mg/kg	< 0.01				< 0.01	
Aliphatic C10-C12	DETS 3072#	1.5	mg/kg	< 1.5				< 1.5	
Aliphatic C12-C16	DETS 3072#	1.2	mg/kg	< 1.2				< 1.2	
Aliphatic C16-C21	DETS 3072#	1.5	mg/kg	< 1.5				< 1.5	
Aliphatic C21-C35	DETS 3072#	3.4	mg/kg	< 3.4				< 3.4	
Aliphatic C5-C35	DETS 3072*	10	mg/kg	< 10				< 10	
Aromatic C5-C7	DETS 3321*	0.01	mg/kg	< 0.01				< 0.01	
Aromatic C7-C8	DETS 3321*	0.01	mg/kg	< 0.01				< 0.01	
Aromatic C8-C10	DETS 3321*	0.01	mg/kg	< 0.01				< 0.01	
Aromatic C10-C12	DETS 3072#	0.9	mg/kg	< 0.9				< 0.9	
Aromatic C12-C16	DETS 3072#	0.5	mg/kg	0.7				< 0.5	
Aromatic C16-C21	DETS 3072#	0.6	mg/kg	5.4				< 0.6	
Aromatic C21-C35	DETS 3072#	1.4	mg/kg	2.3				< 1.4	
Aromatic C5-C35	DETS 3072*	10	mg/kg	< 10				< 10	
TPH Ali/Aro Total	DETS 3072*	10	mg/kg	< 10				< 10	
PAHs									
Naphthalene	DETS 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	
Acenaphthylene	DETS 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	
Acenaphthene	DETS 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	
Fluorene	DETS 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	
Phenanthrene	DETS 3301	0.1	mg/kg	1.2	< 0.1	< 0.1	< 0.1	< 0.1	
Anthracene	DETS 3301	0.1	mg/kg	0.3	< 0.1	< 0.1	< 0.1	< 0.1	

Summary of Chemical Analysis Soil Samples

Our Ref 16-87208-1

Client Ref N16417

Contract Title Land off Bent Street penistone

Lab No	1102345	1102346	1102347	1102348	1102349	1102350
Sample ID	TP5	WS2	TP8	WS5	WS1	TP2
Depth	0.25	0.40	0.15	0.10	0.25	1.50
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	13/12/16	13/12/16	13/12/16	13/12/16	13/12/16	13/12/16
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
Fluoranthene	DETSC 3301	0.1	mg/kg	2.7	< 0.1	< 0.1	< 0.1	0.2	
Pyrene	DETSC 3301	0.1	mg/kg	2.5	< 0.1	< 0.1	< 0.1	0.2	
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg	1.1	< 0.1	< 0.1	< 0.1	< 0.1	
Chrysene	DETSC 3301	0.1	mg/kg	1.1	< 0.1	< 0.1	< 0.1	< 0.1	
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg	0.8	< 0.1	< 0.1	< 0.1	< 0.1	
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg	0.4	< 0.1	< 0.1	< 0.1	< 0.1	
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	1.4	< 0.1	< 0.1	< 0.1	< 0.1	
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg	1.2	< 0.1	< 0.1	< 0.1	< 0.1	
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg	0.3	< 0.1	< 0.1	< 0.1	< 0.1	
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg	0.7	< 0.1	< 0.1	< 0.1	< 0.1	
PAH Total	DETSC 3301	1.6	mg/kg	14	< 1.6	< 1.6	< 1.6	< 1.6	

Summary of Chemical Analysis

Soil Samples

Our Ref 16-87208-1

Client Ref N16417

Contract Title Land off Bent Street penistone

Lab No	1102351	1102352	1102353	1102354
Sample ID	TP3	TP6	SA3	WS1
Depth	1.90	1.00	0.50	0.70
Other ID				
Sample Type	SOIL	SOIL	SOIL	SOIL
Sampling Date	13/12/16	13/12/16	13/12/16	13/12/16
Sampling Time	n/s	n/s	n/s	n/s

Test	Method	LOD	Units				
Asbestos Quantification	DETSC 1102	0					
Metals							
Arsenic	DETSC 2301#	0.2	mg/kg				
Cadmium	DETSC 2301#	0.1	mg/kg				
Chromium	DETSC 2301#	0.15	mg/kg				
Chromium, Hexavalent	DETSC 2204*	1	mg/kg				
Copper	DETSC 2301#	0.2	mg/kg				
Lead	DETSC 2301#	0.3	mg/kg				
Mercury	DETSC 2325#	0.05	mg/kg				
Nickel	DETSC 2301#	1	mg/kg				
Selenium	DETSC 2301#	0.5	mg/kg				
Zinc	DETSC 2301#	1	mg/kg				
Inorganics							
pH	DETSC 2008#			6.1	6.5	6.6	6.7
Total Organic Carbon	DETSC 2002	0.1	%				
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	21	< 10	12	< 10
Sulphate as SO4, Total	DETSC 2321#	0.01	%				
Petroleum Hydrocarbons							
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg				
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg				
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg				
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg				
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg				
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg				
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg				
Aliphatic C5-C35	DETSC 3072*	10	mg/kg				
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg				
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg				
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg				
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg				
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg				
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg				
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg				
Aromatic C5-C35	DETSC 3072*	10	mg/kg				
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg				
PAHs							
Naphthalene	DETSC 3301	0.1	mg/kg				
Acenaphthylene	DETSC 3301	0.1	mg/kg				
Acenaphthene	DETSC 3301	0.1	mg/kg				
Fluorene	DETSC 3301	0.1	mg/kg				
Phenanthrene	DETSC 3301	0.1	mg/kg				
Anthracene	DETSC 3301	0.1	mg/kg				

Summary of Chemical Analysis Soil Samples

Our Ref 16-87208-1

Client Ref N16417

Contract Title Land off Bent Street penistone

Lab No	1102351	1102352	1102353	1102354
Sample ID	TP3	TP6	SA3	WS1
Depth	1.90	1.00	0.50	0.70
Other ID				
Sample Type	SOIL	SOIL	SOIL	SOIL
Sampling Date	13/12/16	13/12/16	13/12/16	13/12/16
Sampling Time	n/s	n/s	n/s	n/s

Test	Method	LOD	Units				
Fluoranthene	DETSC 3301	0.1	mg/kg				
Pyrene	DETSC 3301	0.1	mg/kg				
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg				
Chrysene	DETSC 3301	0.1	mg/kg				
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg				
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg				
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg				
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg				
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg				
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg				
PAH Total	DETSC 3301	1.6	mg/kg				

Summary of Asbestos Analysis

Soil Samples

Our Ref 16-87208-1

Client Ref N16417

Contract Title Land off Bent Street penistone

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1102345	TP5 0.25	SOIL	Chrysotile	bundle of Chrysotile fibres	Colin Patrick
1102346	WS2 0.40	SOIL	NAD	none	Colin Patrick
1102347	TP8 0.15	SOIL	NAD	none	Colin Patrick
1102348	WS5 0.10	SOIL	NAD	none	Colin Patrick
1102349	WS1 0.25	SOIL	NAD	none	Colin Patrick

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * -not included in laboratory scope of accreditation.

Summary of Asbestos Quantification Analysis

Soil Samples

Our Ref 16-87208-1

Client Ref N16417

Contract Title Land off Bent Street penistone

Lab No	1102345
Sample ID	TP5
Depth	0.25
Other ID	
Sample Type	SOIL
Sampling Date	13/12/16
Sampling Time	

Test	Method	Units	
Total Mass% Asbestos (a+b+c)	DETSC 1102	Mass %	0.013
Gravimetric Quantification (a)	DETSC 1102	Mass %	na
Detailed Gravimetric Quantification (b)	DETSC 1102	Mass %	0.013
Quantification by PCOM (c)	DETSC 1102	Mass %	na
Potentially Respirable Fibres (d)	DETSC 1102	Fibres/g	na
Breakdown of Gravimetric Analysis (a)			
Mass of Sample		g	24.23
ACMs present*		type	
Mass of ACM in sample		g	
% ACM by mass		%	
% asbestos in ACM		%	
% asbestos in sample		%	
Breakdown of Detailed Gravimetric Analysis (b)			
% Amphibole bundles in sample		Mass %	na
% Chrysotile bundles in sample		Mass %	0.013
Breakdown of PCOM Analysis (c)			
% Amphibole fibres in sample		Mass %	na
% Chrysotile fibres in sample		Mass %	na
Breakdown of Potentially Respirable Fibre Analysis (d)			
Amphibole fibres		Fibres/g	na
Chrysotile fibres		Fibres/g	na

* Denotes test or material description outside of UKAS accreditation.
 % asbestos in Asbestos Containing Materials (ACMs) is determined by
 by reference to HSG 264.
 Recommended sample size for quantification is approximately 1kg
 # denotes deviating sample

Information in Support of the Analytical Results

Our Ref 16-87208-1
 Client Ref N16417
 Contract Land off Bent Street penistone

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1102345	TP5 0.25 SOIL	13/12/16	GJ 1L, GV		
1102346	WS2 0.40 SOIL	13/12/16	GJ 1L, GV		
1102347	TP8 0.15 SOIL	13/12/16	GJ 1L, GV		
1102348	WS5 0.10 SOIL	13/12/16	GJ 1L, GV		
1102349	WS1 0.25 SOIL	13/12/16	GJ 1L, GV		
1102350	TP2 1.50 SOIL	13/12/16	PT 1L		
1102351	TP3 1.90 SOIL	13/12/16	PT 1L		
1102352	TP6 1.00 SOIL	13/12/16	PT 1L		
1102353	SA3 0.50 SOIL	13/12/16	PT 1L		
1102354	WS1 0.70 SOIL	13/12/16	PT 1L		

Key: G-Glass J-Jar V-Vial P-Plastic T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

Appendix A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETS 2002	Organic matter	%	0.1	Air Dried	No	Yes	Yes
DETS 2003	Loss on ignition	%	0.01	Air Dried	No	Yes	Yes
DETS 2008	pH	pH Units	1	Air Dried	No	Yes	Yes
DETS 2024	Sulphide	mg/kg	10	Air Dried	No	Yes	Yes
DETS 2076	Sulphate Aqueous Extract as SO ₄	mg/l	10	Air Dried	No	Yes	Yes
DETS 2084	Total Carbon	%	0.5	Air Dried	No	Yes	Yes
DETS 2084	Total Organic Carbon	%	0.5	Air Dried	No	Yes	Yes
DETS 2119	Ammoniacal Nitrogen as N	mg/kg	0.5	Air Dried	No	Yes	Yes
DETS 2130	Cyanide free	mg/kg	0.1	Air Dried	No	Yes	Yes
DETS 2130	Cyanide total	mg/kg	0.1	Air Dried	No	Yes	Yes
DETS 2130	Phenol - Monohydric	mg/kg	0.3	Air Dried	No	Yes	Yes
DETS 2130	Thiocyanate	mg/kg	0.6	Air Dried	No	Yes	Yes
DETS 2321	Total Sulphate as SO ₄	%	0.01	Air Dried	No	Yes	Yes
DETS 2325	Mercury	mg/kg	0.05	Air Dried	No	Yes	Yes
DETS 3049	Sulphur (free)	mg/kg	0.75	Air Dried	No	Yes	Yes
DETS 2123	Boron (water soluble)	mg/kg	0.2	Air Dried	No	Yes	Yes
DETS 2301	Arsenic	mg/kg	0.2	Air Dried	No	Yes	Yes
DETS 2301	Barium	mg/kg	1.5	Air Dried	No	Yes	Yes
DETS 2301	Beryllium	mg/kg	0.2	Air Dried	No	Yes	Yes
DETS 2301	Cadmium Available	mg/kg	0.1	Air Dried	No	Yes	Yes
DETS 2301	Cadmium	mg/kg	0.1	Air Dried	No	Yes	Yes
DETS 2301	Cobalt	mg/kg	0.7	Air Dried	No	Yes	Yes
DETS 2301	Chromium	mg/kg	0.15	Air Dried	No	Yes	Yes
DETS 2301	Copper	mg/kg	0.2	Air Dried	No	Yes	Yes
DETS 2301	Manganese	mg/kg	20	Air Dried	No	Yes	Yes
DETS 2301	Molybdenum	mg/kg	0.4	Air Dried	No	Yes	Yes
DETS 2301	Nickel	mg/kg	1	Air Dried	No	Yes	Yes
DETS 2301	Lead	mg/kg	0.3	Air Dried	No	Yes	Yes
DETS 2301	Selenium	mg/kg	0.5	Air Dried	No	Yes	Yes
DETS 2301	Zinc	mg/kg	1	Air Dried	No	Yes	Yes
DETS 3072	Ali/Aro C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aliphatic C10-C12	mg/kg	1.5	As Received	No	Yes	Yes
DETS 3072	Aliphatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aliphatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aliphatic C12-C16	mg/kg	1.2	As Received	No	Yes	Yes
DETS 3072	Aliphatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aliphatic C16-C21	mg/kg	1.5	As Received	No	Yes	Yes
DETS 3072	Aliphatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETS 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETS 3072	Aromatic C10-C12	mg/kg	0.9	As Received	No	Yes	Yes
DETS 3072	Aromatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aromatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aromatic C12-C16	mg/kg	0.5	As Received	No	Yes	Yes
DETS 3072	Aromatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aromatic C16-C21	mg/kg	0.6	As Received	No	Yes	Yes
DETS 3072	Aromatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETS 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETS 062	Benzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Ethylbenzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Toluene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	m+p Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	o Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 3311	C10-C24 Diesel Range Organics (DRO)	mg/kg	10	As Received	No	Yes	Yes
DETS 3311	C24-C40 Lube Oil Range Organics (LORO)	mg/kg	10	As Received	No	Yes	Yes
DETS 3311	EPH (C10-C40)	mg/kg	10	As Received	No	Yes	Yes

Appendix A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETS 3303	Acenaphthene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Acenaphthylene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Benzo(a)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Benzo(a)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Benzo(b)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Benzo(k)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Benzo(g,h,i)perylene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Dibenzo(a,h)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Indeno(1,2,3-c,d)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Naphthalene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Phenanthrene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3401	PCB 28 + PCB 31	mg/kg	0.01	As Received	No	Yes	Yes
DETS 3401	PCB 52	mg/kg	0.01	As Received	No	Yes	Yes
DETS 3401	PCB 101	mg/kg	0.01	As Received	No	Yes	Yes
DETS 3401	PCB 118	mg/kg	0.01	As Received	No	Yes	Yes
DETS 3401	PCB 153	mg/kg	0.01	As Received	No	Yes	Yes
DETS 3401	PCB 138	mg/kg	0.01	As Received	No	Yes	Yes
DETS 3401	PCB 180	mg/kg	0.01	As Received	No	Yes	Yes
DETS 3401	PCB Total	mg/kg	0.01	As Received	No	Yes	Yes

Method details are shown only for those determinands listed in Annex A of the MCERTS standard. Anything not included on this list falls outside the scope of MCERTS. No Recovery Factors are used in the determination of results. Results reported assume 100% recovery. Full method statements are available on request.

Appendix E
Gas and Groundwater
Monitoring Results

Ground Gas and Groundwater Monitoring Records



Job No: N16417
 Site: Land off Bent Street, Penistone
 Client: Orion Homes Limited

Visit No: 1 of 6
 Date: 23/12/2016
 Operator: EM

	GAS CONCENTRATIONS												VOCs		GAS FLOWS				WELL AND GROUNDWATER DATA					Comment
Monitoring Point	Methane (%v/v)		Carbon dioxide (%v/v)		LEL (%)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (%)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Diff. borehole Pressure (Pa)	Time for flow to equalise (sec)	Water level (m bgl)	Depth of well (m bgl)	Reduced level (m AOD)	Water level (m AOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady			Peak	Steady								
WS1	0.00	0.00	0.10	0.10			0.00	0.00	0.00	0.00	21.50	21.50			0.00	0.00			0.34					
WS3	0.00	0.00	1.00	0.80			0.00	0.00	0.00	0.00	21.40	21.40			0.00	0.00			0.54					
WS4	0.00	0.00	0.20	0.21			0.00	0.00	0.00	0.00	21.60	21.60			0.00	0.00			0.46					
Max	0.00	0.00	1.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	21.60	21.60	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.00	0.00	0.00		
Min	0.00	0.00	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	21.40	21.40	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00		
GSV (l/hr)	0		0																					

METEOROLOGICAL AND SITE INFORMATION:

State of ground:

Wind:

Cloud cover:

Precipitation:

Barometric pressure (mbar)

Pressure trend:

Air Temperature (Deg. C):

☐	Dry
☐	Calm
☐	None
☒	None

(Select correct box with X or enter data, as applicable)

☐	Moist	☒	Wet
☒	Light	☐	Moderate
☐	Slight	☒	Cloudy
☐	Slight	☐	Moderate
1016	Before	☐	Steady
☒	Falling	☐	
☐	Before	☐	

☐	Snow	☐	Frozen
☐	Strong		
☐	Overcast		
☐	Heavy		
1016	After		
☐	Rising		
☐	After		

Visit No: 2 of 6
Date: 05/01/2016
Operator: EM

[illegible]

(Select correct box with X or enter data, as applicable)

	Dry
X	Calm
X	None
X	None

X	Calm
---	------

X	None
---	------

X	None
---	------

1033	Before
------	--------

2000	2001
	Falling

	Planning
	Before

Moist		Wet
Light		Moderate
Slight		Cloudy
Slight		Moderate

Before		Moderate
--------	--	----------

Falling	☐	Steady
---------	--------------------------	--------

Running	☐	Steady
Before		

	Snow
	Strong
	Overcast
	Heavy
1033	After
X	Rising
	After

X Frozen

Appendix F

PPL Generic Assessment Criteria

GAC Summary Table

Parameter	No. of samples tested	Range of results	GAC (2.5% SOM)	No. of samples exceeding GAC
Metals, Metalloids, Non-metals				
Arsenic	5	5.60 - 17.00	37.00	0
Cadmium	5	0.20 - 0.70	11.00	0
Chromium III	5	17.00 - 28.00	910.00	0
Chromium VI	5	<1.00	6.00	0
Copper	5	17.00 - 48.00	2400.00	0
Lead	5	41.00 - 240.00	200.00	1
Mercury, Inorganic	5	<0.05 - 0.28	40.00	0
Nickel	5	8.40 - 18.00	130.00	0
Selenium	5	<0.50 - 0.90	250.00	0
Zinc	5	49.00 - 310.00	3700.00	0
Inorganics				
pH	5	6.00 - 8.80		
Calorific Value	0			
Total Organic Carbon	5	1.00 - 4.70		
Sulphate Aqueous Extract as SO ₄	5	14.00 - 90.00		
Total Sulphate as SO ₄	5	0.05 - 0.21		
Petroleum Hydrocarbons				
Aliphatic C5-C6	2	<0.01	78.00	0
Aliphatic C6-C8	2	<0.01	230.00	0
Aliphatic C8-C10	2	<0.01	65.00	0
Aliphatic C10-C12	2	<1.50	330.00	0
Aliphatic C12-C16	2	<1.20	2400.00	0
Aliphatic C16-C21	2	<1.50	92000.00	0
Aliphatic C21-C35	2	<3.40	92000.00	0
Aliphatic C5-C35	2	<10.00		
Aromatic C5-C7	2	<0.01	140.00	0
Aromatic C7-C8	2	<0.01	290.00	0
Aromatic C8-C10	2	<0.01	83.00	0
Aromatic C10-C12	2	<0.90	180.00	0
Aromatic C12-C16	2	<0.50 - 0.70	330.00	0
Aromatic C16-C21	2	<0.60 - 5.40	540.00	0
Aromatic C21-C35	2	<1.40 - 2.30	1500.00	0
Aromatic C5-C35	2	<10.00		
TPH Ali/Aro	2	<10.00		
Polycyclic aromatic hydrocarbons				
Acenaphthene	5	<0.10	510.00	0
Acenaphthylene	5	<0.10	420.00	0
Anthracene	5	<0.10 - 0.30	5400.00	0

Parameter	No. of samples tested	Range of results	GAC (2.5% SOM)	No. of samples exceeding GAC
Benzo(a)anthracene	5	<0.10 - 1.10	11.00	0
Benzo(a)pyrene	5	<0.10 - 1.40	2.70	0
Benzo(b)fluoranthene	5	<0.10 - 0.80	3.30	0
Benzo(g,h,i)perylene	5	<0.10 - 0.70	340.00	0
Benzo(k)fluoranthene	5	<0.10 - 0.40	93.00	0
Chrysene	5	<0.10 - 1.10	22.00	0
Dibenzo(a,h)anthracene	5	<0.10 - 0.30	0.28	1
Fluoranthene	5	<0.10 - 2.70	560.00	0
Fluorene	5	<0.10	400.00	0
Indeno(1,2,3-c,d)pyrene	5	<0.10 - 1.20	36.00	0
Naphthalene	5	<0.10	5.60	0
Phenanthrene	5	<0.10 - 1.20	220.00	0
Pyrene	5	<0.10 - 2.50	1200.00	0
PAH Total	0			
Others				
Asbestos	5	Present	Present	1

London – Central

Ash Vale

Birmingham

Chester

Manchester

Huddersfield

Newcastle upon Tyne

Glasgow

Dubai

Sydney