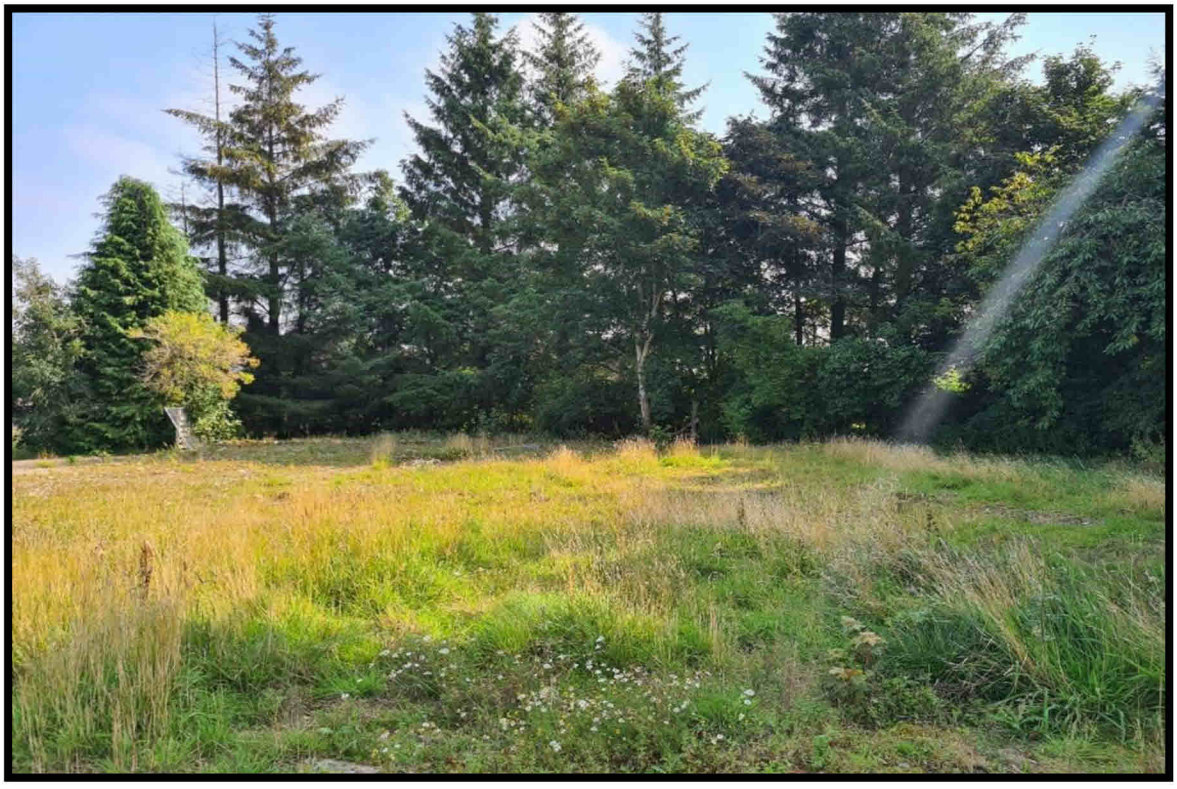
LIDL, CRIEFF ROAD, PERTH



STAGE 2 GEOENVIRONMENTAL INVESTIGATION REPORT

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Our Ref: VG183-12/MKB/ARB

CRIEFF ROAD, PERTH

GROUND INVESTIGATION REPORT

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November 2021	Draft	Draft awaiting completion of the groundwater and gas monitoring programme.	MKB
January 2022	Final	Updated on completion of the groundwater and gas monitoring programme.	MKB

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Drawings Appendix 1

Client Supplied	Proposed Development Layout (Drawing no 4618-SL00)
Engineer Supplied	Proposed earthworks (LDL-BLY-XX-XX-SK-C-92)
VG183-01/R/F/01	Site Location Plan
VG183-12/R/F/01	Approximate Locations of Site Investigations

EXECUTIVE SUMMARY

Johnson Poole & Bloomer Limited (JPB) were commissioned by Blyth & Blyth, on behalf of Lidl, to prepare a Ground Investigation Report for the site at Crieff Road, Perth. The site is located in the Crieff Road, Peth, approximately centred on Ordnance Survey National Grid Reference NO 092, 249. The site covers an area of approximately 0.55 hectares. The purpose of the report was to appraise the ground conditions at the site and to determine what impact these may have on proposed commercial land use for the site.

Johnson Poole & Bloomer (JPB) have previously undertaken a "Stage 1 Geo-environmental Investigation Report" for the site in September 2021 (Report Ref: VG183-01/MKB and it is assumed that a copy of this available to the reader of this report. Information from this report has been used where appropriate and the reader is referred to the original document for the desk study researches which are not repeated here.

This section provides a brief summary of the investigation findings in relation to the geotechnical, mining, chemical contamination and gas emissions constraints at the site.

Historical Background

On Site	Off Site
Greenfield	Farm/Residential development agricultural and sports ground/works.

Invasive Plants

No invasive plants were recorded on the date of the inspection.

Historical Background

On Site	Off Site
Greenfield	Farm/Residential development agricultural and sports ground/works.

Geology

Limited made ground was noted in TP11. The underlying natural superficial deposits glaciofluvial deposits of sands and gravels in the north around 1-3m thick overlying glacial till. The central and southern areas were mainly Glacial Till deposits with possible shallow rock at around 2-3m depth.

Foundation Solution

Deposit Type	Foundation Option	Allowable Bearing Capacity
Made Ground	Not suitable for foundations	N/A
Glacial Till	Pad Foundations	See below

Width (m)	Allowable Bearing Pressure (kN/m^2)	Maximum Column Loading (kN/m)
1.0m x 1.0m	180	180
1.5m x 1.5m	120	187
2.5m x 2.5m	90	562,5

Based on the above and the indicated highest loadings the pads should be 2.5 m x 2.5m in size and these should be placed on the stiff consistency medium strength glacial till materials outlined above. The lower loadings can be accommodated by smaller pads.

As the site requires upfilled and foundation depths may be deeper than 3m therefore piling may be required. As such further discussion with specialist contractors are advised.

Due cognisance of potential settlement should be made in the foundation design in areas of significant upfill

Coal (or other mineral) Mining Risk Assessment

Examination of historical records shows no evidence of underground mining within the vicinity of the site. According to the Gazetteer for Scotland published by the Coal Authority, the site is located in an area where a coal mining search is not required. The geological maps, and memoirs, the mine plans catalogues and Department of the Environment Report "Mining Instability in Great Britain", 1991 contain have no records of any mineworkings or mine entries beneath the site. Therefore, based on our researches **mining is not a constraint.**

Chemical Contamination and Gas Emissions

Based on the risk assessments carried out and in recognition of the validated conceptual site model the following measures are required to address risks posed by chemical contamination and ground gas emissions.

Receptor		Measures required
Chemical Contamination		
Human Health	Contact with soil	No remedial measures are required.
Human Health	Inhalation of Dust and Vapours	No remedial measures are required.
Plant Growth		No remedial measures are required.
Invasive Plants		No remedial measures are required.
Building/ Services	Concrete	pH values and sulphate concentrations indicate that the ground conditions fall within design sulphate class DS-1 and ACEC class AC-1 as defined in BRE Special Digest 1. Therefore, an appropriate concrete specification is required to protect building elements in contact with these conditions.
Building/ Services	Water supply pipes	No contaminant concentrations were identified which are considered to permeate water pipes or impact on their integrity. Therefore, no restriction is made on the type of water pipes which can be used on the site.
Ground Gas Emissions		
Human Health & Buildings/ Services		No remedial measures required.
Radon		
Human Health		Inspection of the BR 211 Appendix A radon map indicates that the site is not within an area where radon protection is required, and, therefore, no radon protective measures are required.

Road Construction

Selective CBR test were carried out along the road/at random locations and these indicated CBR values in the range of 2.2% to 12.9%. Based on this an indicative capping layer would be 350mm. The recorded CBR values were below 2.5% and therefore the material is a soft sub-grade as per Interim Advice Note 73/06 Revision 1 (2009) Design Guidance for Road Pavement Foundations (Draft Hd25) then the measures outlined in that document should be undertaken to address these issues.

However, in areas of upfill full capping may be required, unless CBR testing of formation level is undertaken

PART ONE – INTRODUCTION

1.0 INTRODUCTION AND OBJECTIVES

1.1 Introduction

Lidl are assessing the potential of a site located at Crieff Road, Perth (JPB Drawing VG183-12/R/F/01). It is understood that the intended land use is for a commercial development. A client supplied drawing showing the current development proposals is given in Appendix 1.

Johnson Poole & Bloomer (JPB) have previously undertaken a "Stage 1 Geo-environmental Investigation Report" for the site in September (Ref: VG183-01 /MKB/AF) and it is assumed that a copy of this available to the reader of this report. Information from this report has been used where appropriate and the reader is referred to the original document for the desk study researches which are not repeated here.

This report has been prepared and written on behalf of Lidl in the context of the purpose stated above and should not be used in any differing context. No duty of care extends to any third party that may make use of the information unless written confirmation has been provided by Johnson Poole & Bloomer. In addition, new information, improved practices and legislation may necessitate an alteration to the report in whole or in part after its submission. Therefore, with any change in circumstances, or after the expiry of one year from the date of the report, it should be referred to us for reassessment and, if necessary, amendment. No action or proceedings can be commenced against the JPB after the expiry of 12 years from the date of this report.

1.2 Objectives

JPB were commissioned by Blyth & Blyth, on behalf of Lidl, to undertake site investigation works. The aim of the investigation was to provide information to identify environmental and geotechnical constraints which may have consequences in the design of the development and to provide information to be submitted as part of the planning process and in obtaining regulatory approvals.

Therefore, the investigations had the following objectives:

- To identify any chemical contamination constraints;
- To characterise the groundwater regime and identify any risks posed to water resources;
- To examine the ground gas regime and any constraints posed by gas emissions;
- To determine a foundation horizon and potential foundation solution; and
- To identify any mining constraints.

The investigation of the geotechnical, mining, chemical contamination and gas emission conditions is now complete and this report presents the factual investigation data and JPB's interpretation of the existing ground conditions. Potential development constraints are identified and appropriate remedial actions are recommended. Foundation design considerations are also discussed.

It is anticipated that during the course of any redevelopment works various local authority departments will become involved. We, therefore, advise that, where appropriate, our report and associated information are submitted to the regulatory bodies and approval obtained before detailed design, site works or other irrevocable actions are embarked upon.

2.0 STAGE 1 PRELIMINARY QUALITATIVE RISK ASSESSMENT

2.1 Stage 1 Preliminary Qualitative Risk Assessment

In assessing the research information a Stage 1 Preliminary Qualitative risk assessment has been carried out in order to develop an Initial Conceptual Site Model for the site. The Conceptual Site Model (CSM), is generated in accordance with Guide to Good Practice for the Development of Conceptual Models and the Selection and Application of Mathematical Models of Contaminant Transport Processes in the Subsurface - National Groundwater & Contaminated Land Centre report NC/99/38/2 – Environment Agency 2001.

In the Stage 1 Preliminary Quantitative Risk Assessment the next step in assessing environmental risks and constraints for the site is to use the available research information to develop a Conceptual Site Model (CSM). The CSM describes how potential chemical sources at the site could contribute to increased levels of risk to potentially sensitive receptors. The CSM identifies the sources of contamination, the likely receptors and the potential pathways present which may link them. Where it appears that a pathway links a source to a receptor, this potential significant contaminant linkage should be the focus of site investigations.

The CSM is developed at an early stage and constantly reassessed in light of investigative findings. The first step in producing such a model is to identify whether there are potential hazards on site through desk top research together with the application of professional expertise and judgement. In addition, information regarding the site-specific environmental setting including geology, hydrogeology, hydrology etc., is gathered to identify the environmental resources which could be impacted by potential contaminants at the site. Within this context, a hazard is defined as a property that has the potential to cause harm to a receptor group.

A summary of this preliminary assessment in presented in the following ICSM table which summarises the individual source, pathway and receptors considered to be present.

SPR item	**SPR item present based on desk study (Yes/No)**	Comment
Sources		
S1 – Contamination from former land use	**Yes**	Site recorded to be greenfield. Significant made ground not anticipated, therefore, no major source of contaminants anticipated. However, potential for pesticide residues.
S2 – Contamination from adjacent land use	**Yes**	Site recorded to be greenfield with former Newton Farm adjacent to site boundary. Significant made ground not anticipated, therefore, no major source of contaminants anticipated. However, potential for pesticide residues and fly-tipping.
S3 – Ground gas	**Yes**	Limited made ground beneath site could contain biodegradable material and could degrade to produce elevated levels of gas. Further investigations required.
S4 – Leachable contaminants	**Yes**	Some potential made ground contaminants may be leachable or mobile. Further investigations required.
Contamination groundwater in mineworkings	No	Mining not present under site.
Contamination from substation	No	No substation present.
Pathways		
P1 – Contact with soil	**Yes**	The site is to be a commercial development and contact with the soil is anticipated to be limited to during construction or in landscaping areas.
Ingestion of vegetables	No	The site is a commercial development and there are no garden areas where produce is grown.
P3 – Inhalation of dusts/vapours	**Yes**	Site recorded to be greenfield. No significant made ground anticipated, therefore, no major source of contaminants anticipated.
P4 – Ingestion of groundwater	**Yes**	Potential for contact with groundwater.
P5 – Building contact with soil	**Yes**	Site is to be developed and, therefore, buildings will be present on site.
P6 – Migration via services	**Yes**	Site is to be developed and, therefore, buildings and associated infrastructure will be present on site.
Perched groundwater	No	Researches show site has been a greenfield throughout its history so potential for contaminated made ground overlying cohesive soils and, therefore, perched groundwater is unlikely.
P8 – Vertical migration	**Yes**	Granular deposits may be present allowing vertical contaminant migration.
P9 – Migration of gas	**Yes**	Limited potential for elevated levels of gas migrating through granular soils or made ground.

SPR item	SPR item present based on desk study (Yes/No)	Comment
Groundwater flow through mineworkings	No	No mineworkings present beneath the site.
Receptors		
Human Receptors		
R1 Adults	**Yes**	The site is to be a commercial development and contact with the soil is anticipated to be limited to during construction or in landscaping areas
R2 – Workers & trespassers	**Yes**	The site is to be developed and, therefore, workers and potentially trespassers on site
R3 – Adjacent land users	**Yes**	Adjacent developments include sports ground and residential.
Plant Receptors		
R4 – Plants	**Yes**	The site is to be a commercial development and contact with the soil is anticipated to be limited to during construction or in landscaping areas
Buildings/services receptors		
R5 – Buildings and infrastructure	**Yes**	The site is to be developed and, therefore, buildings will be present on site.
Water environment – surface waters		
Major River	No	There are no major surface water features within influencing distance of the site. In view of the distance to a major surface water, the localised nature of the made ground on site and the presence of intervening very low permeability glacial till soils which significantly retard contaminant migration, it is considered that there is no significant pathway present. In the absence of a significant pathway there is no significant contaminant linkage present and no further assessment is necessary.
R6- Surface drains	**Yes**	The nearest is surface drains located along the eastern boundary of the site
Water environment – groundwater abstraction		
Shallow perched groundwater	No	No groundwater abstractions recorded within 1km. In addition, any perched water in the made ground on site is unlikely to meet the criteria outlined in the WAT-PS-10-01 (Assigning Groundwater Assessment Criteria for Pollutant Inputs) and UKTAG (i.e. that in order to qualify as a body of groundwater an aquifer must be capable of supplying $10m^3$/day or 50 people on a continuous basis). Therefore, in the absence of a receptor or water body no further assessment is required.
Continuous groundwater in soil	No	No groundwater abstractions recorded within 1km. Although natural superficial deposits include permeable granular deposits, in the absence of a receptor no further assessment is required.
Continuous groundwater in rock	No	No groundwater abstractions recorded within 1km. Although the underlying rock is noted to be sedimentary and may be classed as a water body, in the absence of an abstraction receptor no further assessment is required. Researches indicate that rock is overlain by very low permeability glacial till soils which significantly retard downward contaminant migration. It is considered that there is no significant pathway present and in the absence of an intact pathway no further assessment is required.
Water environment – groundwater resource		
Shallow perched groundwater	No	Any perched water in the made ground on site is unlikely to meet the criteria outlined in the WAT-PS-10-01 (Assigning Groundwater Assessment Criteria for Pollutant Inputs) and UKTAG (i.e. that in order to qualify as a body of groundwater an aquifer must be capable of supplying $10m^3$/day or 50 people on a continuous basis). The perched water in the made ground is not considered to be a groundwater body and as such is not a receptor.
Continuous groundwater in soil	No	Although natural superficial deposits include permeable granular deposits, their high clay content and the mainly clay deposits underlying them confirms that there is no groundwater resource receptor within soils and no further assessment is required.
Continuous groundwater in rock	No	Although the underlying rock is noted to be sedimentary and groundwater within it may be classed as a water body, it is overlain by thick very low permeability clays, which will significantly retard vertical contaminant migration. In the absence of a significant pathway to the deeper groundwater resource receptor in rock, no further assessment is required..
Water environment – groundwater dependent terrestrial ecosystem (GDTE or wetland)		
GDTE/Wetland	No	No GDTE/Wetland within 250m of the site.

2.2 Objectives of the Site Investigation and Methodology

The initial conceptual site model was used to inform the design of the site investigation. Where chemical analysis data has been obtained for soils and waters, JPB's risk assessment methodology comprises an initial comparison of potential contaminant concentrations with Stage 2 Risk Assessment generic assessment criteria. The concentrations of contaminants exceeding these criteria and contaminants for which authoritative Stage 3 Risk Assessment criteria were not available are assessed in Stage 3 Risk Assessment, a site-specific quantitative risk assessment.

The Stage 3 Risk Assessment comprises a quantitative risk assessment of contaminant concentrations performed using appropriate risk assessment models and tools. These assessments are discussed in more detail in the later sections of this report.

In order to test and develop the initial CSM, the site investigations had the following objectives:

- To identify the extent of any made ground at the site (potential contaminant source)
- To identify the nature, extent and concentration of contaminants in soil, groundwater and ground gases.
- To determine if contaminants are leachable or otherwise mobile.
- To examine the ground gas regime at the site.
- To determine what threat the site poses to off site water receptors.
- To determine what threat the site contaminants pose to off site human receptors (occupants of adjacent properties).
- To determine what threat the site poses to on site human receptors (workers and occupants).
- To determine geotechnical properties of soils.
- To determine foundation solutions for development.

In order to achieve these objectives, the investigation was designed to include the following; trial pitting, soakaway tests, Terrier boreholes with standpipes installed as required, and specialist laboratory testing of recovered soil and water samples for geotechnical and chemical characteristics. Monitoring of ground gas concentrations and groundwater levels in standpipes was also undertaken. These investigations are described in more detail in the following section of this report.

PART THREE – SITE INVESTIGATIONS

3.0 SITE INVESTIGATIONS

3.1 Programme of Works and Investigation Rationale

The design and performance of this site investigation takes cognisance of the guidance given in BS 10175 – Investigation of Potentially Contaminated Sites – Code of Practice – BSI 2011 and BS5930. Investigation points were located where access, ground conditions and underground services allowed. It should be noted that soil and rock conditions are highly variable and may differ between sampling points and this may affect interpolation. Additional features may exist buried at depth and undetected by investigation. The approximate locations of all trial pits and boreholes are shown on JPB Drawing VG183-12/R/F/01.

Work Item	Description	Appendix
Trial pit excavations	**Twelve trial pits**, to between 1.7 m and 3.0 m depth on a 25m grid, undertaken by a Johnson Poole & Bloomer Engineering Geologist on 6th October 2021.	Appendix 3
Rationale	To investigate the nature, extent and engineering properties of the soils underlying the site and recover soil samples for chemical analysis. Specific targeted investigations are discussed in below.	
Soakaway tests	**Undertaken in 4 trial pits** (TP1, TP3, TP6 and TP7) in accordance with BRE Digest 365.	Appendix 4
Rationale	To investigate the potential for discharge of surface run off to soakaways.	
Terrier Boreholes	**Eight soils boreholes** (BH1 to BH8 including re-drills), to depths of between 2.3 m and 4.8 m, were sunk by SKF Ltd across the site 0m 30 September 2021.	Appendix 5
Rationale	To investigate the nature, extent and engineering properties of the soils underlying the site and recover soil samples for geotechnical and chemical analysis. Specific targeted investigations are discussed below.	
Geotechnical testing	**Geotechnical laboratory** testing of soil samples was performed by SKF Ltd and included the following: i) Bulk Density. ii) Moisture Content and Atterberg Limits. iii) Undrained triaxial compression testing. iv) One dimensional consolidation testing. v) Particle Size Distribution (PSD). vi) California Bearing Ratio (CBR) value.	Appendix 5
Chemical contamination testing	**18 soil samples** (2 made ground and 16 natural), were analysed by I2 analytical at our instruction. The soil testing programme comprised the following chemical parameters; **asbestos (presence and type), pH, total sulphate, water soluble sulphate, sulphides, phenols, total cyanide, Total Petroleum Hydrocarbons (TPH), Polyaromatic Hydrocarbons (PAH), arsenic, mercury, selenium, lead, total chromium, hexavalent chromium, cadmium, copper, nickel, zinc, water soluble boron and percentage soil organic matter (SOM)**. **a suite of commonly encountered pesticides** to determine whether these contaminants were present at the site. All samples were tested for **leachability** where appropriate. **Three sample** was analysed for **Waste Acceptance Criteria Testing (WAC).** **Five soil samples** from the trial pits were analysed for UKWIR water supply pipe suite. The suite comprised the following parameters; **VOCs plus TIC of compounds at >20µg/kg, SVOCs plus TIC of compounds at >20µg/kg, amines, petroleum hydrocarbons split into following ranges; C5-C10, C11-C20 and C20-C40, pH value, electrical conductivity, redox potential.**	Appendix 6
Rationale	To determine concentrations of potential chemical contaminants in the soils, surface water and groundwater underlying the site.	
Gas and water monitoring	**Gas and water monitoring** at standpipes installed in 5 of the boreholes (BH1, BH4 BH6, BH7 and BH8) was carried out. Levels of methane, carbon dioxide, oxygen, nitrogen, carbon monoxide, hydrogen sulphide and atmospheric pressure were recorded. Flow rates were also recorded. Following the collection of the gas data the depth to any water present within the standpipes installed in the boreholes was measured using a dipmeter.	Appendix 7

Work Item	Description	Appendix
	Copies of the calibration certificates are also included in this Appendix.	
Rationale	To determine the groundwater and ground gas regimes at the site	

3.2 Contamination Assessment Sampling Protocols

JPB's sampling protocol is discussed in detail in Appendix 2. Site specific sampling details are discussed below.

Soil Sampling

A mixture of targeted and non-targeted investigation approaches was used. In the investigations, locations were targeted at known historical features such as the farm steading, but were also spread across the site to achieve appropriate site coverage. For main investigations BS10175 indicates that "typical" densities can vary between 10m and 25m centres. However, given the predominantly greenfield nature of the vast majority of the site throughout its history, JPB consider that investigations at between 25m and 50m centres is more appropriate. This was confirmed by trial pits which showed that soils at the site predominantly comprised natural deposits, with localised made ground associated with the former steading.

PART FOUR – GEOTECHNICAL

4.0 SITE GEOLOGY

4.1 General

The general geological conditions beneath the site were assessed from the available information including a review of geological maps and boreholes. This provided an indication of the general thickness of the superficial cover.

The recent investigations appear to confirm the anticipated geological conditions with very localised made ground overlying fluvioglacial overlying Glacial Till deposits.

4.2 Made Ground

Made ground 0.8m thick was encountered in trial pits TP11. This material comprised silty gravelly sand with timber ceramics occasional concrete and shale fragments.

4.3 Natural Deposits

The site is covered by a layer of topsoil which varies in thickness from 0.3m to 0.50m.

The natural superficial deposits in the southern and central areas were indicated to comprise glacial till which generally comprised soft to firm becoming firm then stiff to very stiff medium to high strength mottled brown, orange, grey or grey silty very sandy gravelly clay with cobbles and occasional boulders. These deposits were proven to at least 3.0m although possible rock was noted in TP2 at 2.2m, TP4 at 2.7m TP5 at 2.3m, and TP10 at 2.7m depth. Rotary drilling would be required to definitively prove rock.

The northern site area had clayey silty gravelly sand with cobbles overlying the clay although the sand was proven to at least 3m in TP11 and TP12

4.4 Groundwater

Water was not recorded in the trial pits and boreholes with the exception of TP11.

Trial Pit/Borehole	Depth (m)	Comment
TP11	2.7	Slight seepage at base 3.0m

The standpipes installed during the investigation were subsequently monitored and the results are summarised in the following table. A drawing showing the conjectured groundwater contours is given on JPB Drawing VG183-12/R/F/XX.

BH	Response Zone	Response Materials	Water Depths Recorded (m)					
			29/10/21	5/11/21	11/11/21	1/12/21	20/12/21	6/1/22
1	1m to 3m	Clay	1.02	1.13	0.92	1.20	0.81	1.20
4	1m to 2m	Sand/Clay	0.62	0.97	1.10	0.79	1.18	0.97
5	1m to 2.9m	Sand/Clay	-	-	1.25	1.84	1.13	0.86
6	1m to 2.3m	Clay	0.80	0.82	Dry	Dry	1.11	1.06
7	1m to 2m	Clay	0.62	0.56	0.95	-	0.92	0.94
8	1m to 3m	Sand/Clay	0.54	0.85	1.05	0.73	1.04	0.80

The results do not indicate the presence of a clearly defined water table at the site. Some limited ingress of water has been recorded within the standpipes which may be as a result of the surface water ponding on the site at the time of the investigation. Site results indicate that there was no recharge of groundwater following purging.

5.0 ENGINEERING CHARACTERISTICS OF THE SUPERFICIAL MATERIALS

5.1 General

The results of the in situ and laboratory geotechnical testing of the samples recovered during the recent investigations are included in Appendix 5. The soil parameters from the in situ and laboratory testing of samples are summarised in the following table.

5.2 Made Ground

No standard penetration test carried out within the made ground deposits as very localised and thin.

5.3 Natural Superficial Deposits

Cohesive

Material Type	Glacial Till
Natural Moisture Content (%)	11-12
Plastic Limit (%)	15-16
Liquid Limit (%)	27-28
Plasticity Index (%)	12-13
Soil type based on plasticity chart	Clay with low plasticity
Soil descriptions from PSD	Silty sandy Clay with gravel
Range of consistency	Soft to stiff
Soil Density (Mg/m^3)	2.11-2.15
Hand Vane tests results	84-150kPa
Undrained triaxial test results **c =** **Φ =**	 30-83kPa 5.7-14.2 °
Average Shear Strength	40-120 kPa
Undrained Shear Strength Classification	Medium to high strength
Standard Penetration Test (SPT) N values	7-39
Mass Shear Strength (c) based on SPT value using Stroud Correlation	49-273kPa
Undrained Shear Strength Classification	Medium to very high strength
One-dimensional consolidation testing **m_v =**	 0.24m^2/MN (*)
Compressibility	medium
Modulus of volume compressibility (m_v) based on SPT value (Stroud)	0.03-0.19 m^2/MN
Compressibility	Very low to medium
California Bearing Ratio (CBR) value (%)	2.2-12.9%

(*) - The m_v values recorded for overconsolidated soils such as glacial till can often be out by a factor of up to 2. As such it is anticipated that these soils have a low to medium compressibility. This is confirmed by using the correlation proposed by Stroud using the SPT N value and plasticity index.

Granular

Material Type	Glacial Fluvial
Soil descriptions from PSD	Very silty clayey gravelly sand
Standard Penetration Test (SPT) N values	4-16
State of Compaction	Loose to medium dense

6.0 FOUNDATION DESIGN CONSIDERATIONS

6.1 General

Based upon the engineering properties of the soils as discussed in previous sections of this report, we would offer the following comments regarding suitable founding horizons. The Column loadings for the single storey development are indicated to be 200kN to 425kN. It has been indicated that significant cut/fill will occur and consequently cognisance of final levels will dictate found solution.

6.2 Made Ground

The investigation has indicated the site to have limited made ground. Due to the inherent variability of this material it is considered that this horizon would not be very suitable as a founding horizon in its present condition.

6.3 Natural Deposits

Pad Foundations

Cohesive glacial materials were recorded at surface or below the Till and allowable bearing pressures for various sized pad foundations within the materials were calculated using a conservative shear strength value of 60kN/m^2. It is assumed that these are placed at a at 0.3m penetration into the cohesive glacial soils. All settlements are within acceptable limits less than 25mm. The allowable bearing pressures are summarised in the following table.

Width (m)	Allowable Bearing Pressure (kN/m^2)	Maximum Column Loading (kN/m)
1.0m x 1.0m	180	180
1.5m x 1.5m	120	187
2.5m x 2.5m	90	562.5

Based on the above and the indicated highest loadings the pads should be 2.5 m x 2.5m in size and these should be placed on the glacial till materials outlined above. The lower loadings can be accommodated by smaller pads.

As the site requires upfilled and foundation depths may be deeper than 3m therefore piling may be required, specific to that area. As such further discussion with specialist contractors are advised.

6.4 General Comments

pH values and sulphate levels were recorded above laboratory reporting limits therefore an assessment was carried out in accordance with BRE Special Digest 1. The ground conditions indicate design sulphate class DS-1 and ACEC class AC-1. **Therefore, concrete specifications should be such as to be protective of buildings exposed to these conditions.**

During site works, should any localised softening of the soils be encountered then these materials should be removed and replaced with well compacted hardcore. All excavations should be examined to ensure that the material is consistent with that used in the assessment.

The foundations may span material varying between granular to cohesive in nature and therefore the possibility of differential settlement should be taken into account during the design work.

Perched groundwater was encountered during the investigation at depths of around 3m. As such this should be encountered during any excavations during the site development works. Therefore, during the design of any excavations at the site due consideration should be given to the control of surface water and possible ground inflow and sidewall stability, with all necessary precautions being taken to ensure safe working conditions. This should be carried out in accordance with Health & Safety and CDM Guidance.

Possible shallow rock was encountered at the site and this may be encountered during any excavations during the development such as the construction of sewers.

6.5 Percolation Testing

Assessment of the percolation rates in the underlying soils at seven locations at the site was undertaken in the general spirit of BRE Digest 365 which recommends calculation of infiltration rate from the time taken for the water volume to fall from 75% to 25% of the effective storage depth of the pit. Trial pits were located at positions to test the suitability of the soils for soakaway trenches. Percolation testing was undertaken in Trial pits 1, 3, 6 and 7. It should be noted that in all the trial pits full infiltration did not occur and only one infiltration cycle was completed in many cases. Therefore as a result, the following values should be utilised with caution.

Due to the presence of predominantly clay based soils the deposits are not likely to form a good soakaway.

Trial Pit	Recorded Range(s) of Infiltration Rates (m/s)	Additional Remarks
TP1	2.48×10^{-6}	-
TP3	4.5×10^{-6}	-
TP6	2.2×10^{-6}	-
TP7	9.1×10^{-6}	-

6.6 Settlement of Upfill

Based on the supplied Blyth & Blyth drawings the site requires to be raised. This will involve the loading of the underlying Fluvial and Glacial deposits by up to 3m in places. Detailed modelling will be required but some settlement is likely to occur that will require on site monitoring. It is recommended that suitable granular soils are used for the import to minimise self-weight settlement within the upfill material.

7.0 ROAD CONSTRUCTION

The investigation has indicated that the site is underlain by made ground then natural soil deposits comprising sand and glacial till then possible shallow rock.

Selective CBR test were carried out along the road/at random locations and these indicated CBR values in the range of 2,2% to 12.9%. Based on this, an indicative capping layer would be 350mm.

The recorded CBR values were below 2.5% and therefore the material is a soft sub-grade as per Interim Advice Note 73/06 Revision 1 (2009) Design Guidance for Road Pavement Foundations (Draft Hd25) then the measures outlined in that document should be undertaken to address these issues. The guidance is as follows

The investigation has confirmed that there is no constraint to any adoptable roads on the site due to shallow abandoned mineworkings.

Site Operatives During Construction of the Development

No significantly elevated contaminants were recorded and the risks from exposure to any contaminated materials are considered to be low. Normal Health and Safety precautions should be implemented during the works. Site personnel should maintain vigilance to detect any unpleasant odours, strangely coloured made ground, made ground other than generally observed during this investigation, fibrous materials or chemical residues in order that they can be assessed by suitably qualified personnel.

There are no requirements for gas remedial works in the road although adequate health and safety provisions should be made with regard to monitoring gas levels within any trenches formed on site.

Roads Maintenance Workers in the Completed Development

No elevated contaminants were recorded and the risks from exposure to any contaminated materials are considered to be low. Normal Health and Safety precautions should be implemented during the works. Site personnel should maintain vigilance to detect any unpleasant odours, strangely coloured made ground, made ground other than generally observed during this investigation, fibrous materials or chemical residues in order that they can be assessed by suitably qualified personnel.

General

As with any construction or maintenance activity, risks to workers should be managed by appropriate health and safety risk assessments/COSHH undertaken in the normal manner by the employer prior to works being undertaken as required by health and safety legislation.

PART FIVE – CHEMICAL CONTAMINATION AND GAS EMISSIONS ASSESSMENT

8.0 STAGE 2 GENERIC QUANTITATIVE RISK ASSESSMENT - CHEMICAL CONTAMINATION

8.1 Introduction

The Stage 2 generic quantitative assessment of risk to human health, property, ecology, surface water and ground water considers the potential for exposure based on comparison of the results to conservative generic criteria. JPB's risk assessment methodology is discussed in detail in Appendix 2 and is summarised in the flow chart presented in that appendix.

In terms of human health, the guideline concentration appropriate to the proposed end use of the site is used in the interpretation of the results. The site is proposed for development as a commercial unit, therefore, the most relevant criteria, those for a commercial development have been adopted. At Stage 2 all soil contaminant concentrations are compared with GACs. If necessary, at Stage 3 representative soil contaminant concentrations are calculated and used for comparison with assessment criteria.

8.2 Risk Assessment

The following tables summarise the results of the Stage 2 assessment. For C4SLs, S4ULs and EIC/AGS/CL:AIRE values derived using 1% soil organic matter have been adopted where available. JPB derived GAC have been derived conservatively assuming site soils have 1% soil organic matter.

Human Health - Chemical Contamination

Parameter	Concentration range (mg/kg)	Concentration range exceeding JPB GAC (mg/kg)	JPB GAC Commercial/ Industrial (mg/kg)	Source of GAC	No. and location of exceedences
Arsenic	7.3-24	None	640	C4SL	None
Boron	<0.2-0.8	None	240000	S4UL	None
Cadmium	Below Detectable Limits	None	410	C4SL	None
Chromium (III)	33-48	None	8600	S4UL	None
Hexavalent Chromium (Chromium (VI))	Below Detectable Limits	None	170	C4SL	None
Copper	17-170	None	68000	S4UL	None
Lead	8.7-320	None	2300	C4SL	None
Mercury (Inorganic mercury)	Below Detectable Limits	None	1100	S4UL	None
Nickel	28-83	None	980	S4UL	None
Selenium	Below Detectable Limits	None	12000	S4UL	None
Zinc	43-280	None	730000	S4UL	None
Cyanides	Below Detectable Limits	None	175	JPB GAC	None
Toluene	Below Detectable Limits	None	56000	S4UL	None
Ethylbenzene	Below Detectable Limits	None	5700	S4UL	None
Benzene	Below Detectable Limits	None	98	C4SL	None
o - xylene	Below Detectable Limits	None	6600	S4UL	None
m - xylene	Below Detectable Limits	None	6200	S4UL	None
p – xylene	Below Detectable Limits	None	5900	S4UL	None
Phenols	Below Detectable Limits	None	440	S4UL	None
Aliphatic TPH $>EC_6 –EC_8$	Below Detectable Limits	None	7800	S4UL	None
Aliphatic TPH $>EC_8 –EC_{10}$	Below Detectable Limits	None	2000	S4UL	None
Aliphatic TPH $>EC_{10} –EC_{12}$	Below Detectable Limits	None	9700	S4UL	None

Parameter	Concentration range (mg/kg)	Concentration range exceeding JPB GAC (mg/kg)	JPB GAC Commercial/ Industrial (mg/kg)	Source of GAC	No. and location of exceedences
Aliphatic TPH $>EC_{12}-EC_{16}$	Below Detectable Limits	None	59000	S4UL	None
Aliphatic TPH $>EC_{16}-EC_{35}$	Below Detectable Limits	None	>100%	S4UL	None
Aromatic TPH $>EC_{5}-EC_{7}$	Below Detectable Limits	None	26000	S4UL	None
Aromatic TPH $>EC_{7}-EC_{8}$	Below Detectable Limits	None	56000	S4UL	None
Aromatic TPH $>EC_{8}-EC_{10}$	Below Detectable Limits	None	3500	S4UL	None
Aromatic TPH $>EC_{10}-EC_{12}$	Below Detectable Limits	None	16000	S4UL	None
Aromatic TPH $>EC_{12}-EC_{16}$	Below Detectable Limits	None	36000	S4UL	None
Aromatic TPH $>EC_{16}-EC_{21}$	<10-14	None	28000	S4UL	None
Aromatic TPH $>EC_{21}-EC_{35}$	<10-25	None	28000	S4UL	None
Naphthalene	Below Detectable Limits	None	190	S4UL	None
Acenaphthylene	Below Detectable Limits	None	83000	S4UL	None
Acenaphthene	Below Detectable Limits	None	84000	S4UL	None
Fluorene	Below Detectable Limits	None	63000	S4UL	None
Phenanthrene	<0.05-0.79	None	22000	S4UL	None
Anthracene	Below Detectable Limits	None	520000	S4UL	None
Fluoranthene	<0.05-2.1	None	23000	S4UL	None
Pyrene	<0.05-2.1	None	54000	S4UL	None
Benz(a)anthracene	*	*	*	*	*
Chrysene	*	*	*	*	*
Benzo(b)fluoranthene	*	*	*	*	*
Benzo(k)fluoranthene	*	*	*	*	*
Benzo(a)pyrene	<0.05-1.2	None	77	C4SL	None
Indeno (1,2,3-CD) pyrene	*	*	*	*	*
Dibenzo(a,h)anthracene	*	*	*	*	*
Benzo(g,h,i)perylene	*	*	*	*	*
PCBs (non dioxin-like) Sum of seven congeners	Below Detectable Limits	None	9.5	JPB GAC	None
PCBs (dioxin like)	Below Detectable Limits	None	None available – Automatic Stage 3 Assessment required where MRL exceeded		None
Pesticides	Below detectable LImits	None	Various	Various	None

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* Parameter assessed using the benzo(a)pyrene surrogate marker approach.

Human Health - Asbestos

Ten soil samples were scheduled for laboratory testing for the presence of asbestos. Asbestos was not identified within any of the samples scheduled for analysis.

Phytotoxicity – Soils

Parameter	Concentration range (mg/kg)	Concentrations exceeding GAC (mg/kg)	GAC (mg/kg)	Source of GAC	No. and location of exceedences
Copper	17-170	170	pH dependent	MAFF Guidance	One TP11 0.50m

Parameter	Concentration range (mg/kg)	Concentrations exceeding GAC (mg/kg)	GAC (mg/kg)	Source of GAC	No. and location of exceedences
Zinc	43-280	280	pH dependent	MAFF Guidance	One TP11 at 0.50m
Nickel	27-83	83	pH dependent	MAFF Guidance	One TP11 at 0.50m
Cadmium	Below Detectable Limits	None	3	MAFF Guidance	None
Lead	8.7-320	320	300	MAFF Guidance	One TP11 at 0.50m
Mercury	Below Detectable Limits	None	1	MAFF Guidance	None
Chromium	33-48	None	400	MAFF Guidance	None
Selenium	Below Detectable Limits	None	3	MAFF Guidance	None
Arsenic	7.3-24	None	50	MAFF Guidance	None

Buildings and Services

Buildings and Services – Soils Effect on Concrete

Parameter	Concentration Range	SSAC BRESD1/BRE PBMCL
pH	6.2-8.4	<5 or >8
Total Sulphate	98-760mg/kg	Not Applicable
Water soluble sulphate	5.9-10 mg/L	Not Applicable

Buildings and Services – Soils Effect on Water Supply Pipes

Parameter Group*	Parameter	Sum of Maximum Concentrations or maximum (mg/kg)	PE GAC (mg/kg)	Exceeded Yes/No	PVC GAC (mg/kg)	Exceeded Yes/No
1	Extended VOCs suite by purge and trap or headspace and GC-MS with TIC (but not including group 1a)	Below Detectable Limits	0.5	No	0.125	No
1a	BTEX + Propylbenzene +MTBE	Below Detectable Limits	0.1	No	0.03	No
2	SVOCs (including TIC, but not groups 2e or 2f)	Below Detectable Limits	2	No	1.4	No
2e	Phenols	Below Detectable Limits	2	No	0.4	No
2f	Cresols and chlorinated phenols	Below Detectable Limits	2	No	0.04	No
3	Mineral oil C11-C20	<1-10	10	**Yes**	-	-
4	Mineral oil C21-C40	<10-39	500	No	-	-
5	Conductivity	30-150	-	-	-	-
	pH value	6.2-8.4	-	-	-	-
	Redox potential	187.7-299.1	-	-	-	-
2a**	Ethers	Below Detectable Limits	0.5	No	1	No
2b**	Nitrobenzene	Below Detectable Limits	0.5	No	0.4	No
2c**	Ketones	Below Detectable Limits	0.5	No	0.02	No
2d**	Aldehydes	Below Detectable Limits	0.5	No	0.02	No
6	Amines	Below Detectable Limits	MRL	No	-	-

* Specific compounds included within groups are listed in Table G1 of the UKWIR guidance. Group 2f includes chlorinated phenols, not just those listed in Table G1.

** No specific compounds included within groups listed in Table G1 of the UKWIR guidance were recorded in VOC or SVOC TICs.

8.3 Summary

Human Health

No soil concentrations exceeded human health GACs, therefore, **no remedial measures are required to protect human health from contamination risks.**

Phytotoxicity

No soil concentrations exceeded phytotoxicity GACs, therefore, **no remedial measures are required to protect healthy plant growth with the exception of TP11 which would require localised clean topsoil in soft landscaping is placed in the portion of the site.**

Buildings and Services

pH values and sulphate concentrations indicated that the ground conditions fall within design sulphate class DS-1 and ACEC class AC-1 as defined in BRE Special Digest 1.

The requirements for water supply pipes are outlined in the Water Supply Pipes section of this report.

9.0 WATER SUPPLY PIPES

In accordance with UK Water Industry Research (UKWIR) document, "Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites", UKWIR report reference 10/WM/03/21, 2010 a site investigation has been carried out and a Site Assessment Report has been incorporated into this report. The findings of the comparison of chemical test results with UKWIR threshold values is presented as follows.

Soils –Water Supply Pipes

Parameter Group*	Parameter	Sum of Maximum Concentrations or maximum (mg/kg)	PE GAC (mg/kg)	Exceeded Yes/No	PVC GAC (mg/kg)	Exceeded Yes/No
1	Extended VOCs suite by purge and trap or headspace and GC-MS with TIC (but not including group 1a)	Below Detectable Limits	0.5	No	0.125	No
1a	BTEX + Propylbenzene +MTBE	Below Detectable Limits	0.1	No	0.03	No
2	SVOCs (including TIC, but not groups 2e or 2f)	Below Detectable Limits	2	No	1.4	No
2e	Phenols	Below Detectable Limits	2	No	0.4	No
2f	Cresols and chlorinated phenols	Below Detectable Limits	2	No	0.04	No
3	Mineral oil C11-C20	<1-14	10	**Yes**	-	-
4	Mineral oil C21-C40	<10-39	500	No	-	-
5	Conductivity	30-150	-	-	-	-
	pH value	6.2-8.4	-	-	-	-
	Redox potential	187.7-299.1	-	-	-	-
2a**	Ethers	Below Detectable Limits	0.5	No	1	No
2b**	Nitrobenzene	Below Detectable Limits	0.5	No	0.4	No
2c**	Ketones	Below Detectable Limits	0.5	No	0.02	No
2d**	Aldehydes	Below Detectable Limits	0.5	No	0.02	No
6	Amines	Below Detectable Limits	MRL	No	-	-

** No specific compounds included within groups listed in Table G1 of the UKWIR guidance were recorded in VOC or SVOC TICs.

The suitability of various pipe materials for use at the site is summarised in the table below.

One minor exceedance was noted at TP11 if potable water supply pipes are in this area the localised made ground should be removed with suitable inert soils.

Parameter Group*	Parameter	PE	PVC	Barrier pipe	Wrapped Steel	Wrapped Ductile Iron	Copper
1	Extended VOCs suite by purge and trap or headspace and GC-MS with TIC (but not including group 1a)	Pass	Pass	Pass	Pass	Pass	Pass
1a	BTEX + Propylbenzene +MTBE	Pass	Pass	Pass	Pass	Pass	Pass
2	SVOCs (including TIC, but not groups 2e or 2f)	Pass	Pass	Pass	Pass	Pass	Pass
2e	Phenols	Pass	Pass	Pass	Pass	Pass	Pass
2f	Cresols and chlorinated phenols	Pass	Pass	Pass	Pass	Pass	Pass
3	Mineral oil C11-C20	Pass	Pass	Pass	Pass	Pass	Pass
4	Mineral oil C21-C40	Pass	Pass	Pass	Pass	Pass	Pass

Parameter Group*	Parameter	PE	PVC	Barrier pipe	Wrapped Steel	Wrapped Ductile Iron	Copper
5	Conductivity	Pass	Pass	Pass	Pass	Pass	-
	pH value	Pass	Pass	Pass	Pass	Pass	Pass
	Redox potential	Pass	Pass	Pass	-	Pass	Pass
2a	Ethers	Pass	Pass	Pass	Pass	Pass	Pass
2b	Nitrobenzene	Pass	Pass	Pass	Pass	Pass	Pass
2c	Ketones	Pass	Pass	Pass	Pass	Pass	Pass
2d	Aldehydes	Pass	Pass	Pass	Pass	Pass	Pass
6	Amines	Pass	Pass	Pass	Pass	Pass	Pass
Materials overall pass or fail		Pass	Pass	Pass	Pass	Pass	Pass

No contaminant concentrations were identified which are considered to permeate water pipes or impact on their integrity. Therefore, no restriction is made on the type of water pipes which can be used on the site. Scottish Water supply pipe assessment documents are presented in Appendix 8.

Health and safety

Scottish Water indicated that consideration should be given to the health and safety of any workers working during installation and on the pipe in the future.

Health and Safety Risk Assessments and COSHH Assessments should be carried out by the designated engineer or manager. As contamination is known to be present on the site, appropriate PPE and safety equipment, as determined by the Risk and COSHH assessments should be made available. This may include but is not limited to;

- Dust: Dust protection measures including dust suppression and where required respiratory protection (such as dust masks) must be used.
- Gas Testing: The use of suitable air quality monitoring equipment is advised at all times. Carbon Dioxide, Hydrocarbons, Methane and Sulphide should be considered as part of any test suite.
- Skin Protection: Skin barriers including suitable gloves, clothing and footwear must be worn at all times.

Site personnel should maintain vigilance to detect any unpleasant odours, strangely coloured made ground, made ground other than generally observed during this investigation, fibrous materials or chemical residues in order that they can be assessed by suitably qualified personnel.

10.0 GAS EMISSIONS RISKS

10.1 General

Due to the presence of localised made ground and sands which can produce gas, gas monitoring was undertaken at standpipes installed in five of the recent boreholes (BH1, BH4, BH6, BH7 and BH8)

The assessment of ground gas as a potential constraint to development has been the subject of a great deal of research and published guidance. Ground gas can be a concern for several reasons; flammable gases may cause an explosion, accumulation of gases within poorly ventilated areas may lead to asphyxia or toxic gases may cause harm to those exposed to them. Some physical properties of ground gases are tabulated below.

Gas	Explosive Range	Density at 20ºC	Toxicity (% by volume in air)*
Methane	5-15% by volume	0.72 kg/m^3	30 (low)
Carbon dioxide	N/A	1.98kg/m^3	0.5 (high)
Carbon monoxide	12.5-74.2% by volume	1.25kg/m^3	0.02 (high)
Hydrogen sulphide	4.2-46% by volume	1.54kg/m^3	0.001 (high)

* short term occupational exposure limits. The long term occupational exposure limit for carbon monoxide is 30ppm and for hydrogen sulphide is 5ppm.

Gas Emissions Sources

The desk based information and initial CSM identified the following potential gas generation sources at the site;

- Localised made ground – typically a low generation potential source.
- Natural mineral soils, comprising glaciofluvial sands, gravels, silts and clays – normally a low generation potential source. Glacial till where present is highly likely to be a very low gas generation material, and would not normally be considered to be a significant gas generation source.
- The site is not located in Coal Mining Reporting Area(CMRA) and a coal mining search is not required. CL:AIRE publication, “Technical Note – good practice for risk assessment for mine gas emissions” indicates that where this is the case there is no mine gas risk, and no mitigation or further action is required for mine gas.

These sources are discussed further below, in the light of data obtained during intrusive investigations and monitoring.

10.2 Analysis of Results

Gas measurements recorded at borehole standpipes are summarised in the table below.

Summary of Gas Monitoring Results

Borehole	Response zone	Response Strata	Number of monitoring occasions	Methane (% by volume)		Carbon dioxide (% by volume)		Oxygen (% by volume)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Peak Flow Rate (l/hr) (*)	Steady State Flow Rate (l/hr)	Groundwater Depths (m)	
				Min	Max	Min	Max	Min	Max	Min	Max	Min	Max			Min	Max
1	1m to 3m	Clay	6	<0.1	<0.1	0.1	3.1	17.2	21.2	<1	<1	<1	<1	8.7	8.7	0.81	1.20
4	1m to 2m	Sand and gravel/clay	6	<0.1	<0.1	0.1	2.8	18.8	21.8	<1	<1	<1	<1	0.3	0.2	0.62	1.18
5	1m to 2.9m	Sand/clay	4	<0.1	<0.1	0.1	3.2	18.4	21.8	<1	<1	<1	<1	0.2	0.2	0.86	1.84
6	1m to 2.3m	Clay	6	<0.1	<0.1	0.1	2.4	19.5	21.7	<1	2	<1	<1	2.0	0.9	0.80	Dry
7	1m to 2m	Clay	5	<0.1	<0.1	0.1	3.5	17.2	22.0	<1	3	<1	<1	7.0	4.0	0.56	0.95
8	1m to 3m	Sand and gravel/clay	6	<0.1	<0.1	0.1	3.4	18.2	21.8	<1	<1	<1	<1	<0.1	<0.1	0.54	1.05

N.B - (*) Some negative flows recorded.

10.3 Risk Assessment and Conclusions

Gas Sources

The made ground at the site was limited to the TP11 location, was predominantly mineral in nature, relatively thin (0.8m) and was described as silty gravelly sand with timber ceramics occasional concrete and shale fragments. Although standpipes did not include made ground in their response zones, the made ground was underlain by sand deposits, with which they are considered to be in continuity, and gas levels recorded in those strata were very low. In summary, the made ground materials are not considered to be extensive enough to pose a significant gas generation risk, and in any event would be a very low gas generation source.

Natural soils at the site were mineral in nature with low organic contents. Gas concentrations recorded in natural soils at the site were very low or negligible, and flows were generally low or negligible. Although some flows were elevated, this is considered to be due to fluctuations in perched groundwater levels, and his aspect is discussed further below. The natural soils at the site are considered to be very low gas generation potential sources.

Tier 1 ground gas risk assessment

JPB use the following generic screening levels to determine whether a potential risk exists: methane <1% by volume in boreholes and carbon dioxide <5% by volume in boreholes, providing borehole flow rates do not exceed 7 L/h and 1.4 L/h respectively. Although these screening concentrations were not exceeded, some elevated flow rates were recorded and, therefore, a more detailed Tier 2 assessment is required.

Tier 2 ground gas risk assessment

BS8485 requires that the "worst case" scenario is checked as a precursor to any more detailed assessment. Therefore, maximum recorded gas concentrations and flow rates and Characteristic Situation evaluations based on the modified Wilson and Card approach outlined in CIRIA C665 are summarised in the table below. In these calculations we have used the term Hazardous Gas Flow Rate as used in BS8485 this is also known as Gas Screening Value in CIRIA C665. As the proposed development is not classed as low-rise housing with a ventilated underfloor void of at least 150mm, Situation A has been adopted for the purposes of the gas assessment.

Gas	Maximum gas concentration (% by volume)	Maximum borehole flow rate (L/h)	Hazardous gas flow rate (L/h)	Site characteristic situation
Carbon dioxide	3.5	8.7	0.3045	2
Methane	<0.1	8.7	0.0087	1

Although all gas concentrations were low, the characteristic situation based on carbon dioxide was CS-2. However, inspection of the data indicates that flow rates have significantly influenced this characteristic situation. This is discussed further below.

Groundwater levels were elevated above the top of standpipes response at some locations at some monitoring visits, and this has influenced flows recorded at some monitoring events (gas concentrations were recorded post-purging to allow gas to enter standpipes). In the vast majority of events where flow was recorded above negligible levels, flow quickly dissipated to negligible levels within a few minutes of monitoring. This indicates that these flows are caused by internal pressure within standpipes caused by elevated water levels, released as flow when standpipes taps are opened, rather than from gas generated flows. These flows were also predominantly observed where the response zone was in clay, as would be anticipated due to the very low permeability of these soils, resulting in perched groundwater at these locations.

The only significant sustained steady flow recorded when a headspace was present in the standpipe was at BH1 at the final monitoring visit, a flow of 1.9L/h. The carbon dioxide concentration at BH1 on that occasion was 1.6% by volume, resulting in a hazardous gas flow rate of 0.0304L/h, CS-1 conditions. For all other monitoring events, the maximum carbon dioxide concentration was 3.5% by volume, resulting in a hazardous gas flow of 0.0665L/h, CS-1 conditions.

Revised evaluations based on the flow rate of 1.9L/h are given in the table below.

Gas	Maximum gas concentration (% by volume)	Maximum borehole flow rate (L/h)	Hazardous gas flow rate (L/h)	Site characteristic situation
Carbon dioxide	3.5	1.9	0.0665	1
Methane	<0.1	1.9	0.0019	1

Given the nature of the soil types in the response zones of BH1 and BH7 where higher flows were recorded, it is considered highly unlikely that the flows represent gas generation. It is much more likely that fluctuating groundwater levels are increasing internal standpipe pressures. This is also apparent from differential pressures measured and the negative flows recorded, which suggest fluctuating groundwater levels are causing a piston effect.

On the basis of the above comments we consider that gas concentrations at the site are very low, and gas generated flow is also very low, with higher measured flows caused by fluctuation of groundwater levels rather than gas generation. Consequently, we conclude that the site should be classified as a Characteristic Situation 1 site in accordance with the methodology outlined in BS8485/CIRIA C665 and there is no significant source of gas emissions, no intact contaminant linkage and, **therefore, ground gas levels do not present a significant risk to the development and remedial measures are not required based on readings to date.**

Radon

Risks posed by radon have been assessed in accordance with current authoritative guidance as detailed in JPB's risk assessment methodology presented in Appendix 2.

Inspection of the BR 211 Appendix A radon map indicates that the site may be within an area where radon protection is required. However, the more detailed radon map obtained by JPB based on HPA/BGS information (Appendix 14) indicates that the site is not within an area requiring radon protection and, therefore, **no radon protective measures are required.**

11.0 RECOMMENDATIONS FOR CHEMICAL CONTAMINATION AND GAS

11.1 Validated Conceptual Site Model & Requirement for Remedial Measures

A reassessment of the initial conceptual site model in the light of information gained from both the site investigations and risk assessments has been undertaken and a resultant validated conceptual site model compiled. As the potential sources identified in the initial CSM table have now been either identified to be present or absent the source terms and contaminant linkages are re-assessed below.

SPR item	SPR item present based on site investigations (Yes/No)	Comment
Sources		
S1 – Contamination from former land use - Human Health	No	Risk assessment found no significant risks to human health. No remedial measures are required.
S1 – Contamination from former land use - Phytotoxic	No	Risk assessment found no phytotoxic risk at the site. No remedial measures are required.
S1 – Contamination from former land use - Water Pipes	No	No contaminant concentrations were identified which are considered to permeate water pipes or impact on their integrity. Therefore, no restriction is made on the type of water pipes which can be used on the site.
S1 – Contamination from former land use - Concrete Specification	No	pH values and sulphate concentrations indicated that the ground conditions fall within design sulphate class DS-1 and ACEC class AC-1 as defined in BRE Special Digest 1. Therefore, concrete specifications should be such as to protect building elements in contact with these conditions.
S2– Contamination from adjacent land	No	No evidence was encountered of contamination migration onto site from adjacent land. No remedial measures are required.
S3 – Ground gas	No	Risk assessment found no significant ground gas risks at the site and the site is not within a radon affected area. No remedial measures required.
S4 – Leachable/mobile contaminants	No	Water environment assessment indicated no significant risks posed to water environment receptors. No remedial measures required.

11.2 Selection of Remedial Actions

The reassessment of the conceptual site model has confirmed that none of the source pathway receptor linkages are complete and, therefore, there is no requirement for any remedial actions based on the investigations carried out to date.

11.3 Reuse of On-site Materials

SEPA's "Land remediation and waste management guidelines" set out SEPA's approach to regulating the remediation of contaminated sites under the waste regulatory regime.

In general, if materials are to avoid becoming waste, they must be suitable to be reused within an existing site boundary without resulting in an unacceptable risk of harm to human health or pollution of the environment.

To be suitable for reuse materials must also meet the six conditions outlined in the above guidance;

1. The use is a necessary part of the planned works.
2. The material is suitable for that use.
3. The material does not require any processing or treatment before it is reused.
4. No more than the quantity necessary is used.
5. The use of the material is not a mere possibility but a certainty.
6. The use of the soil will not result in pollution of the environment or harm to human health.

Materials which require treatment (such as bioremediation) to make them suitable for use may potentially be reused on site, however, the treatment will require to be licensed or permitted under waste legislation.

It should be noted that the above guidance indicates that SEPA does not consider asbestos to be a suitable material for backfilling or other construction purposes. "Bulk" asbestos must not be backfilled or otherwise reused in site works.

Investigations have confirmed that soils are likely to be suitable for reuse as: general fill under capping as part of groundworks/natural soils within capping. However, the suitability of soils for specific uses will have to be confirmed, and conditions 1, 4 and 5 will have to be satisfied, which can be established when details of soils movements and site relevelling are available.

11.4 Disposal of Waste Materials to Landfill

Waste soil or made ground materials which cannot be accommodated at the site or and is not suitable for reuse at another site should be removed to an appropriately licensed landfill site or "soil hospital" facility. Such material should be disposed of in accordance with the current waste regulations following pre-notification to SEPA.

It should be noted that due to the implementation of the Landfill Directive it is likely that any material being disposed of from the site will require some form of pre-treatment. This may include minimisation or stabilisation.

Waste Classification and Waste Acceptance Criteria Testing

All waste material disposed of to landfill from the site will require to undergo testing in order to characterise the waste properties of the material and to determine an appropriate disposal route. This process will require the assessment of general chemical test results to characterise any hazardous properties the waste may have. Depending on the circumstances, the process may also include assessment of Waste Acceptance Criteria (WAC) testing in order to aid the selection of appropriate disposal route. These tests are a legal obligation and no material will be able to be accepted at a landfill unless the results of the tests are available. The time taken for this testing should be factored into any programme for the site.

Three samples of materials from the site have been analysed for a range of parameters in accordance with the published waste acceptance criteria (WAC). The results of the chemical analysis are presented in Appendix 9 and would be considered inert designation.

11.5 Chemical Contamination

No elevated contaminants in relation to human health, plant growth or the water environment were recorded and, therefore, no remedial measures are required.

11.6 Site Personnel

No elevated contaminants were recorded and the risks from exposure to any contaminated materials are considered to be low. Normal Health and Safety precautions should be implemented during the works. Site personnel should maintain vigilance to detect any unpleasant odours, strangely coloured made ground, made ground other than generally observed during this investigation, fibrous materials or chemical residues in order that they can be assessed by suitably qualified personnel.

It should be noted that care should be taken during the site development works to ensure that no spillage of fuel or other liquids or detrimental material occur on site. This is due to the fact that any spilled material has a high probability of contaminating the ground and surface waters. As such all works should be carried out in accordance with the requirements of the Scottish Environment Protection Agency as set out in Pollution Prevention Guidelines PPG5: "Works in, near or liable to affect watercourses" and PPG6: "Working at construction and demolition sites" and other relevant documents.

11.7 Buildings and Services

pH values and sulphate concentrations indicated that the ground conditions fall within design sulphate class DS-1 and ACEC class AC-1 as defined in BRE Special Digest 1. Therefore, concrete specifications should be such as to protect building elements in contact with these conditions.

No contaminant concentrations were identified which are considered to permeate water pipes or impact on their integrity. Therefore, no restriction is made on the type of water pipes which can be used on the site.

11.8 Gas Emissions

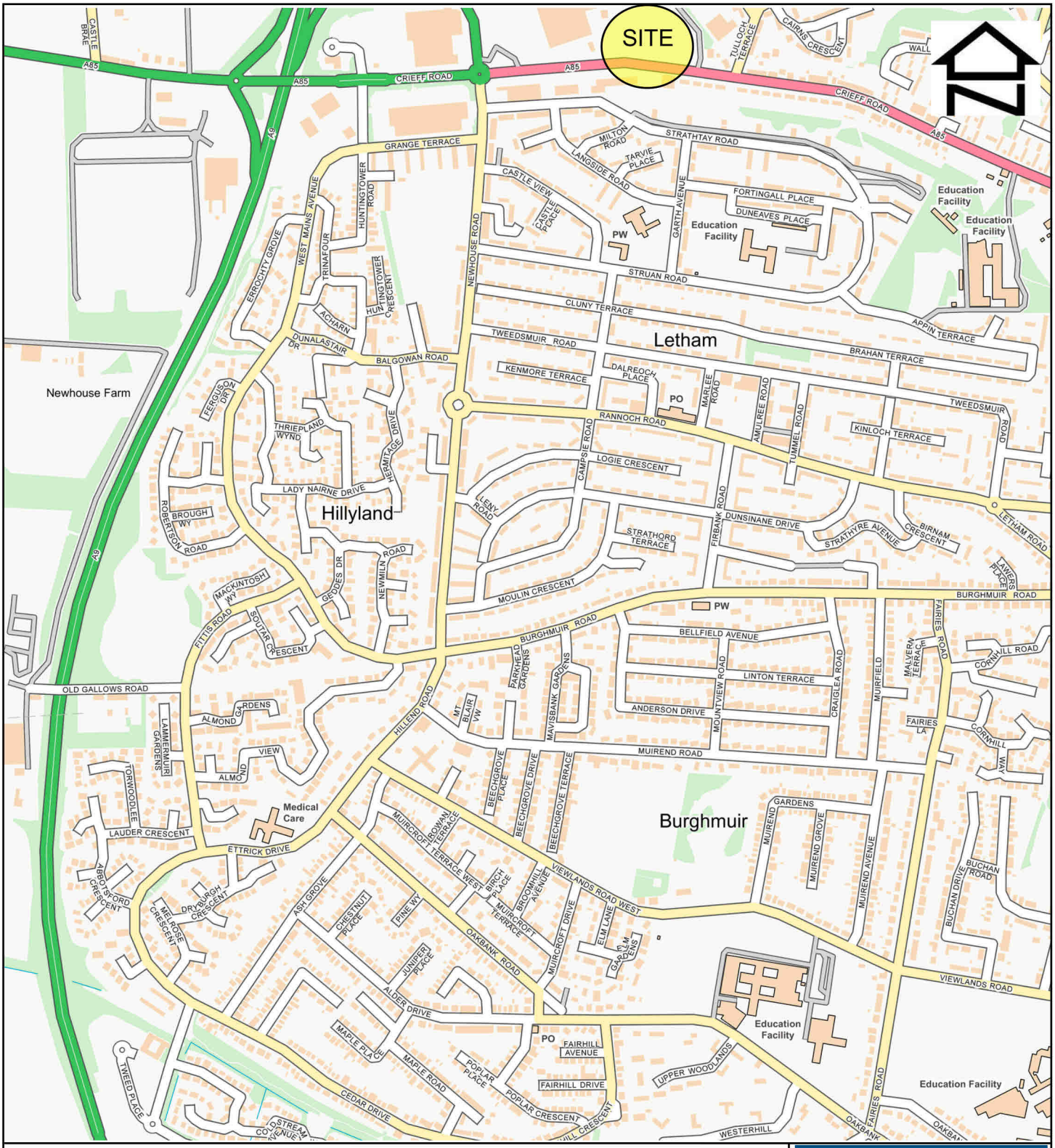
Ground Gases

Based on the gas levels encountered no special precautions or remedial works are required to protect against ground gas emissions.

As part of the development all boreholes must be decommissioned in accordance with SEPA guidance "*Decommissioning Redundant Boreholes and Wells"*.

APPENDICES

Appendix 1 Drawings



CLIENT

LIDL

PROJECT TITLE

LIDL, CRIEFF ROAD, PERTH

DRAWING TITLE

SITE LOCATION PLAN

Johnson Poole & Bloomer Consultants
GEO-ENVIRONMENTAL & MINERALS

DRAWN BY	APPROVED BY	DATE	SCALE	DRAWING No.
AF	MKB	AUGUST 2021	1:25,000	VG183-01/R/F/01

Site	Perth New Store
Sales Area (m^2)	1250
Warehouse Area (m^2)	390
Ancillary (m^2)	266
External Plant (m^2)	On Roof
Aisles	6
Total G.I.F.A (m^2)	1906
Total Site Area (m^2)	9062
Car Spaces (Total)	111
Scale	1:500 @ A3

REV	DATE	DRAWN	DESCRIPTION	CHECK	APP'D

REVISIONS

0 50 100

CLIENT	Lidl Great Britain Ltd
JOB	Proposed Lidl Food Retail Store, Crieff Road
DRAWING	Proposed Site Plan- Bespoke - 6 Aisle Store ECO - Rotated Option
STATUS	INFORMATION

Drawn SM Checked -- Approved -- DATE Jun 21 JOB NO s/4618 DR NO SK01 REV /

SCALE 1:500 SHEET SIZE A3
Do not scale from this drawing

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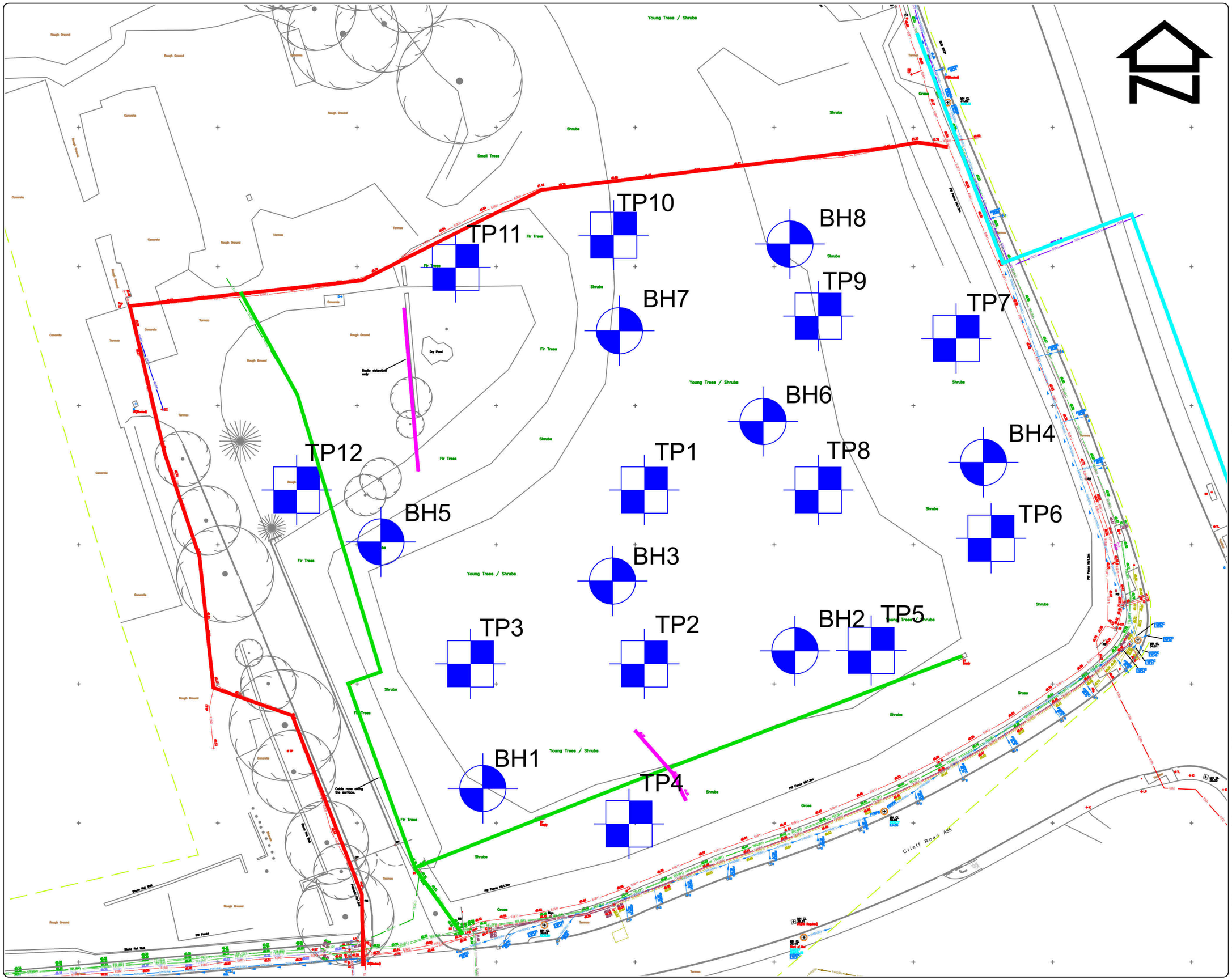


LEGEND

APPROXIMATE LOCATION OF TRIAL PIT EXCAVATED BY JOHNSON POOLE & BLOOMER OCTOBER 2021

APPROXIMATE LOCATION OF BOREHOLE SUNK BY SKF LTD SEPTEMBER 2021

NOTES

DATE	REVISION	No.

Johnson Poole & Bloomer Consultants
GEO-ENVIRONMENTAL & MINERALS

CLIENT: LIDL

PROJECT TITLE: CRIEFF ROAD, PERTH

DRAWING TITLE: APPROXIMATE LOCATIONS OF SITE INVESTIGATIONS

DRAWN BY	APPROVED BY
ARB	MKB
SCALES	ORIGINAL DRAWING SIZE
1:500	A3
DATE	DRAWING No.
NOV 2021	VG183-12/R/F/01

Appendix 2 Methodology for Exposure Assessment and Ground Gas Risk Assessment

METHODOLOGY FOR EXPOSURE ASSESSMENT

The following is a general statement of JPB's methodology for investigating and assessing potentially contaminated sites for the purposes of identifying constraints posed by contamination issues. There is a large body of authoritative technical guidance in this field and it would not be either appropriate or worthwhile for this methodology to repeat verbatim that guidance, and the methodology does not seek to do so. Each site will be different, with different constraints and challenges and site specific investigation and assessment details for individual sites are given within the text of each report. The following text provides an informative summary of the methodology JPB generally apply to such sites.

Regulatory Framework

The assessment of potentially contaminated sites and the associated risk to the proposed development is dependent on a number of factors namely; the intended site end use, distribution and level of contamination, characteristics of the soil (i.e. pH, permeability) the groundwater regime and the sensitivity of the surrounding area. An analysis of the interaction between these various factors allows a decision to be made with regard to the extent of any remedial measures required for the development.

The contaminated land provision of the Environment Protection Act 1990, inserted by Section 57 of the Environment Act 1995, came into force in July 2000. In May 2006 the Scottish Executive issued a revised Statutory Guidance Edition 2 (SE/2000/43). Within this "Contaminated Land" is defined as

> *"any land .....in such a condition by reason of substances in, on or under the land, that*
>
> *a) significant harm is being caused or there is a significant possibility of such harm being caused; or*
> *b) pollution of the water environment is being, or is likely to be caused;"*
>
> In addition *"the questions*
>
> *a) what harm or pollutant of the water environment is likely to be regarded as significant*
> *b) whether the possibility of the significant harm or significant pollution of all the water environment being considered significant"*

In addition, PAN 33 is affected by this and embodies a "suitable for use approach" for land for development, which requires remediation only where there are unacceptable risks to health and the environment depends on the current and proposed end use.

In addition, the guidance requires a significant contaminant linkage to be present which includes;

- A source (pollutant)
- A pathway
- A receptor

JPB have therefore developed a risk assessment approach based on this philosophy, the methodology used is represented diagrammatically in the attached flow chart.

Stage 1 - Preliminary risk assessment-

Desk Study

The methodology utilised for desk studies follows the specifications outlined in CLR2 "Guidance on Preliminary Site Inspection of Contaminated Land", CLR6 "Prioritisation and Categorisation Procedure for Sites which May be Contaminated", CLR11 Model Procedures for the Management of Land Contamination, DEFRA/EA 2004, Contaminated Land Risk Assessment, CIRIA C552 and BS 10175 "Investigation of Potentially Contaminated Sites – Code of Practice", BSI.

During the study, documentary research will include an examination of the Ordnance Survey maps for details regarding previous site and adjacent land uses. Similarly, the available geological maps will be examined to determine the geological/hydrogeological conditions beneath and adjacent to the site. In addition, regional memoirs will be consulted together with mine abandonment plan data and any available borehole records, in order to assess the mining conditions. The assessment also takes cognisance of the information contained in the guidance documents "Risk Based Approach to Development Management – Resources for Developers" published by the Coal Authority and CIRIA SP32 "Construction over Abandoned Mineworkings".

A walkover survey will be carried out to determine the existing site conditions and operations. In addition, a photographic record of the site is taken during the walkover survey.

Information will also be obtained from the SEPA, BGS and Coal Authority websites and other authoritative online resources and from a review of in-house information. A report of environmental database information may also be obtained.

Conceptual Site Model

A Conceptual Site Model (CSM), which describes how potential chemical sources at the site could contribute to increased levels of risk to potentially sensitive receptors, is developed at an early stage and constantly reassessed in light of investigative findings. CSMs are generated in accordance with Guide to Good Practice for the Development of Conceptual Models and the Selection and Application of Mathematical Models of Contaminant Transport Processes in the Subsurface - National Groundwater & Contaminated Land Centre report NC/99/38/2 – Environment Agency 2001.

The first step in developing such a model is to identify whether there are potential hazards which may pose a risk on the site through desk top research and professional judgement. In addition, information regarding the site-specific environmental setting including geology, hydrogeology, hydrology etc, is gathered in order to assess the potential exposure pathways which are likely to exist and the location of humans and environmental resources which could be impacted by the site.

Following this desk-based study and the development of an initial CSM (ICSM), a site investigation is designed in order to determine whether any potentially significant contaminant linkages actually exist on the site. The information gathered during the investigation is then used to revise the ICSM and as the basis of the risk assessment process. While any investigation strategy will be specific to each site the following general comments can be made.

Design of Site Investigations

JPB design and implement site investigations cognisant of the guidance given in BS10175. Care is taken to target investigations at potentially contaminated locations identified in the ICSM from researches and from site visits or other available information. In addition, during the performance of investigations locations are refocused in the light of known site conditions. Further investigations are also undertaken at randomly selected locations resulting in a mixture of random and targeted investigation locations.

The requirement for adequate site coverage is a key consideration at the design stage and the number and type of investigation locations is determined by the available information, the brief and the requirements of the guidance given in CLR4 and R & D Publication Report P5-066/TR Secondary Model Procedure for the development of Appropriate Soil Sampling Strategies for Land Contamination. BS10175 indicates that in order to provide adequate site coverage a sampling grid of between 10m and 25m should normally be applied for a main investigation, for example where a residential development is considered. Where the ICSM indicates there to be no potential source of contamination on the site, or other land uses are envisaged, JPB consider that a wider grid, for example 50m spacing, may be adopted.

Site Zoning

Some sites may need to be divided into geographical sectors where, for example, historical land uses differ or the type of development varies across the site in accordance with R & D Technical Report P5-066/TR. Good practice guidance describes averaging areas as "areas of soil to which a receptor is exposed or which otherwise contributes to the creation of hazardous conditions". Where made ground material is contaminated at variable concentrations, but within a single geological unit, JPB consider that this unit can be adopted as an averaging area for the purposes of making an assessment of human health risks. However, where measured contamination concentrations include statistical outliers of high concentration, where different historical land uses have resulted in different patterns of contamination or where there is a clear distribution of higher contaminant concentrations in one sector of the site, averaging areas are chosen to reflect this contaminant distribution. Single high contaminant concentrations may indicate the presence of "hotspots" which may merit closer scrutiny or additional investigation.

Site Coverage

Investigation locations such as trial pits and boreholes are positioned to provide adequate site coverage, where access is available and avoiding existing services. Boreholes are situated at a mixture of targeted and random locations at the site where access is possible.

During the investigation the sampling strategy in CLR 4 "Sampling strategies for contaminated land" together with the guidance given in R & D Publication Report P5-066/TR is followed. The rationale behind the sampling strategy given in the R & D publication is:

Depth of sample	Rationale
0-0.5	To assess ▪ Human/animal intake arising from ingestion and dermal contact. ▪ Potential for wind entrainment leading to inhalation (of contaminated soils and dusts) or deposition onto neighbouring land. ▪ Surface water run-off (e.g. due to flash flooding). ▪ Uptake by shallow rooting plants (e.g. crops, ornamental and wild species). ▪ Surface leaching to groundwater.
0.5m in made or natural ground	To assess ▪ Intake via ingestion/inhalation/dermal contact from "abnormal" (or unpredicted) excavation (e.g. children digging dens) or for other purposes such as swimming pools, ponds house extensions). ▪ Uptake by deep rooting shrubs and trees. ▪ Intake by, or arising from, the activities of burrowing animals. ▪ Intake arsing from construction / maintenance of buildings and services for example. ▪ Foundations (usually within 2m of formation level). ▪ Water supply pipes, telecommunications, gas & power (0.5-1m of final formation level). ▪ Sewers (from 0.5 > 1m of final formation level). To locate perched water or groundwater. To confirm depth of made ground. To locate possible lateral pathways for gas or vapour migration in made ground. To establish extent of any leaching of soluble constituents from superficial soils. To detect "deep" contaminants (e.g. gas generating materials, leachable materials, dense solvents located on top of an impermeable stratum). To obtain information of "background" soil properties. To locate "natural" lateral migration pathways.

Samples are generally taken at shallow depth, then at where relevant changes are noted in materials with depth. Where any made ground is thick and relatively uniform samples are taken at least every 0.5m to 1.0m. Where organic contamination is observed within made ground, a sample of natural soil is generally taken from beneath each made ground horizon where the base is proven. Samples are recovered from each trial pit. Samples are recovered at these regular intervals with additional samples of any atypical horizons also taken. It should be noted that there will always be the possibility of additional unrecorded conditions outwith the sampling points. Samples obtained are stored within appropriate containers and dispatched for analysis within 24 hours of sampling.

Attempts are made to recover water samples from all of the boreholes at which standpipes are installed. Each borehole is extensively purged to a volume in excess of three times the well volume, where feasible, using a submersible mini-whale pump or bailer. Purging before sampling allows a more representative water sample of groundwater to be obtained and ensures that any water initially present in the boreholes is removed as this may have been chemically altered due to reaction with air or with installation materials. Water samples are transferred to appropriate containers before being transported to the testing laboratory in cooled conditions.

Testing parameters scheduled on soil and water samples are based on historical and current operations information and their importance in relation to health risks, phytotoxicity, impact on the water environment, protection of building materials, services and structures from chemical attack and potential impact on the quality of potable water supplies. Where possible chemical testing is targeted at locations at the site where particular contaminants are anticipated, with additional testing scheduled to give horizontal and vertical site coverage. Selection of test parameters is performed on a site specific basis as described in the text of each investigation report.

Stage 2 Generic Quantitative Risk Assessment

The next stage of the site-specific assessment is to perform a Stage 2 risk assessment using the information gathered during the site investigation to determine the actual nature and extent of contamination, evaluating the data using conservative generic criteria to determine whether any recorded levels of contaminants could be potentially of concern.

Stage 2 Criteria

The Stage 2 generic quantitative assessment of risks to human health, property, ecology, surface water and ground water considers the potential for exposure based on comparison of the results to conservative generic criteria.

Human Health Risks

DEFRA and the Environment Agency including; Soil Guideline Values (SGVs) derived using the CLEA model and the methodology described in EA Science Report SC050021/SR3, EA CLEA science reports and the associated TOX and SGV series of reports. In addition, JPB have adopted S4UL values published by LQM/CIEH and GAC values published by EIC/AGS/CL:AIRE as GACs and, where other suitable values are not available, GACs derived by JPB generated using the CLEA model and in accordance with the above guidance.

The Contaminated Land Exposure Assessment (CLEA) model was developed for the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency. The model estimates child and adult exposures to soil contaminants for those potentially living, working and/or playing on contaminated sites over long time periods and has been used to produce the Soil Guideline Values for the UK, first published in 2002. The guidance was updated following the “Way Forward” process, and the revised technical guidance and SGVs above published in 2009.

The CLEA model used to derive generic criteria has undergone a number of updates, the model used for the derivation of current published criteria; SGVs, S4ULs, EIC/AGS/CL:AIRE was Version 1.06. S4ULs were, however, derived using some exposure parameters amended in the light of the C4SL project (see below).

The CLEA model calculates GACs which represent doses “without appreciable health risk” or “minimal human health risk” depending on whether a contaminant is a threshold or non-threshold substance. An update (version 1.071) was released in 2015, and includes the library data sets from the DEFRA research project SP1010 (Development of Category 4 Screening Levels (C4SLs) for assessment of land affected by contamination), allowing the derivation of generic criteria characterised as representing “low” levels of risk.

In addition, CLEA 1.071 continues to allow the derivation of GACs which represent doses "without appreciable health risk" or "minimal human health risk". This procedure has been adopted to calculate JPB derived GACs using CLEA 1.071. JPB derived criteria are based on conservative assumptions including; the development of small terraced houses on the site, a soil organic matter content of 1% and pH value of 7.

C4SLs represent a higher, but still low, level of risk than SGVs, S4ULs, EIC/AGS/CL:AIRE or JPB GACs. Although they represent different levels of risk, JPB consider that both C4SLs and other JPB GACs are appropriately protective generic criteria for assessing contaminated land for the following reasons. S4ULs, EIC/AGS/CL:AIRE and JPB GACs have been derived in accordance with technical guidance and a risk assessment model which are scientifically based and have been published by authoritative bodies. C4SLs have been confirmed to represent levels of risk which are lower than is required to meet the definition of "contaminated land" ("Simplification of the contaminated land regime", Impact Assessment: Defra 1133). Their use is also endorsed by DEFRA in their Policy Companion Document to the SP1010 project which states that C4SLs "are intended to be more pragmatic (whilst still strongly precautionary) compared to existing generic screening levels".

Where available C4SL values have been adopted as JPB GACs. However, to date only a limited number of HCVs for C4SL have been published and consequently a limited number of contaminants have published C4SLs. As selecting an appropriate C4SL HCV requires specialist toxicological competences, JPB have not derived HCV for additional contaminants. Where a published C4SL is not available for a particular contaminant, JPB have adopted a GAC derived using the CLEA model and based on "without appreciable health risk" or "minimal human health risk" risk levels. Where an S4UL or EIC/AGS/CL:AIRE value is available it has been adopted as a GAC, where no C4SL, S4UL or EIC/AGS/CL:AIRE GAC is available, JPB GAC derived in accordance with the above guidance have been adopted.

Annex E of SP1010 indicates that in order to apply the benzo(a)pyrene surrogate approach and C4SL used in the above guidance, the assumptions made in its derivation must be verified, in particular the PAH profile in the site soils must be similar to the test material used in the toxicological study on which the C4SL HCV is based. To assess the PAH profile in the test soil samples, JPB calculate the ratio of seven other genotoxic PAHs (benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene and indeno(1,2,3-c,d)pyrene), relative to benzo(a)pyrene, to ensure the site soil PAH profile is similar to the test material used in the study. The ratios relative to benzo(a)pyrene must fit within the upper and lower limits detailed in Table 2.5 and Figure 2.1 of Annex E.

These ratios are calculated for soils at each site and the result appended to the report. It should be noted that PAH ratios are calculated for samples with appreciable PAH contents, as the above ratio test does not work correctly where some genotoxic PAH concentrations are near or below laboratory reporting limits as ratios become skewed by zero or "less than reporting limit" values.

Phytotoxic Risks

To assess the site's potential for phytotoxicity JPB refer to the MAFF/DoE document "Review of the Rules for Sewage Sludge Application to Agricultural Land – Soil Fertility Aspects of Potentially Toxic Elements" in the absence of other definitive phytotoxic screening levels. This document is authoritative and scientifically based, it sets out total concentrations of various metallic elements which shouldn't be exceeded in order to maintain soil fertility and avoid toxicity. Therefore, it is considered that these limits can be applied to contaminated land and other situations, e.g. they have been adopted by DEFRA in its "Soil Code" and by the Forestry Commission. It should be noted that plant growth can also be significantly affected by many other factors including: pH, nutrient availability, soil texture and structure, temperature, moisture content and aeration. In addition, reference has been made to "Soil Code" (MAFF 1998), and CLR2, "Guidance on Preliminary Site Inspection of Contaminated Land".

Structures and Services

Where structures or services are considered to be viable receptors, risks are assessed using contemporary best practice guidance given in documents published by the Building Research Establishment (BRE), CIRIA, Water Research Council (WRc), UKWIR, the HSE and other relevant organisations.

Risks posed to buildings and services due to aggressive soil sulphate, chloride and pH conditions are assessed using the guidance given in BRE Special Digest 1 (2005), Concrete in aggressive ground.

Water Supply Pipes

Risks posed by soil and groundwater contaminant concentrations to water supply pipes are assessed in accordance with the UK Water Industry Research (UKWIR) document, "Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites", UKWIR report reference 10/WM/03/21, 2010. This guidance identifies the chemicals present in soils which can either permeate pipes or impact on their integrity by causing swelling, cracking and degradation or corrosion. The main focus is, therefore, on organic contaminants and on the soil's conductivity, pH and redox potential. Due cognisance is also taken of the requirements and guidance issued by utility companies.

UKWIR guidance states that where a site has been greenfield and no chemicals have been historically or currently stored or used on it (or part of the site meets these criteria), no restriction is made on the type of water pipes which can be used on the site (or part of the site as appropriate). Direct communication between JPB and Scottish Water (SW) indicates that SW will not require intrusive investigations on sites which have been greenfield throughout their history, providing supporting documentary evidence is supplied.

Where investigations are required, samples are obtained from locations on site as identified in the site ICSM. Where the route of water supply pipes is known, sample locations during investigations would include locations on or within 15m either side of the route, otherwise investigation coverage for the whole site is as described previously in this methodology, as recommended in section 2.5.5 of the UKWIR report and in SW guidance.

Selected soil samples are tested for the parameters recommended in the UKWIR guidance; VOCs (including TIC), SVOCs (including TIC), amines, petroleum hydrocarbons (including "mineral oils"), conductivity, pH value and redox potential. Results of analyses are collated and compound group concentrations summed as described in section 2.7.9 of the UKWIR guidance, these sums are adopted as Representative Contaminant Concentrations (RCCs). The maximum concentration recorded at the site (or if appropriate within a particular site zone) for each substance is used for summing and tabulation, this is a conservative assumption.

The RCCs are compared with the UKWIR threshold values for polyethylene (PE) and polyvinylchloride (PVC pipes) detailed in Table 3.1 of the UKWIR, which have been adopted as JPB GACs. Exceedence of a single GAC indicates PE or PVC pipework is not appropriate and other pipe materials should be selected. Consideration of the corrosive properties of soils is also required where PE, PVC or barrier pipes are not selected as appropriate. The comparison of RCCs with GACs and the other criteria in Table 3.1 of the UKWIR guidance results in a list of pipe materials which would be suitable in terms of chemical properties, a preferred selection can then be made on the basis of cost, appropriateness etc. or the choice of specific materials to be used made by the engineer/developer. Further recommendations on standards and specifications for water supply pipes and fittings for various pipe materials are given in Part 4 of the UKWIR guidance.

Combustibility

Where potentially combustible materials are encountered the following assessment methodology is adopted. Despite the potential for combustion in many sites characterised by carbonaceous materials, the number of recorded instances of actual combustion are very few and there has been no definitive study of the phenomena. Consequently, there are no commonly accepted criteria for comprehensively assessing and dealing with the risk of spontaneous combustion. The ICRCL Guidance Note 61/84 "notes on fire hazards of contaminated land" suggests that there is an unacceptable risk of combustion if the material has a Calorific Value in excess of 10 MJ/kg or perhaps only 7 MJ/kg.

However, a paper presented at the Fourth Mineral Waste Utilisation Symposium related to the Utilisation of Coal Refuse for Highway Base or Sub-base Material. In this paper it states that "low permeability values are desirable in order to reduce air circulation and the potential for spontaneous combustion". It then goes on to suggest that "proper compaction of coal refuse reduces air voids to less than 10% and the potential for spontaneous combustion is substantially reduced".

There is an imprecise relationship between Loss on Ignition and Calorific Value but previous comparisons by JPB have indicated 10 MJ/kg to be roughly equivalent to 30% Loss on Ignition and 7 MJ/kg to be roughly equivalent to 23% Loss on Ignition.

JPB adopts the following guidelines:

i) combustion may be induced and supported only if the Loss on Ignition value exceeds about 20% and the Calorific Value exceeds 7 MJ/kg.

ii) carbonaceous material needs to be of some bulk ie thicker than 1 metre and greater than 10 m^3 in volume.

iii) spontaneous combustion should not occur in thoroughly compacted material to which air is excluded.

Water Environment

Current SEPA guidance described in document WAT-PS-10-01: Assigning Groundwater Assessment Criteria for Pollutant Inputs (Live Document) notes that for land contamination four receptors were to be assessed, if identified as being present, namely; surface water; groundwater abstraction, groundwater resource, and groundwater dependant terrestrial ecosystem (GWDTE or wetland). Routine leachability testing is carried out for water soluble contaminants in order to determine if there is a threat from soil borne contaminants to ground and surface waters.

For the protection of surface waters and groundwater resources the concentration of each contaminant in soil leachates, groundwaters and surface waters are compared against relevant assessment limits. The assessment limits may be a UK Drinking Water Standard (UKDWS), Resource Protection Value (RPV) or EQS depending on the nature of the receptor which is being considered to potentially be at risk. In addition, reference is made to SEPA guidance document WAT-SG-53: Supporting Guidance, Environmental Standards for Discharges to Surface Waters, The Scotland River Basin District (Standards) Directions 2014, UKTAG's m-BAT tool and SEPA's River Basin Management Plans.

Where no assessment limit has been provided by SEPA, other limits may be adopted such as WHO Drinking Water Guidelines, US EPA National Primary Drinking Water Regulations or the laboratory's minimum reporting limit (MRL).

Stage 2 Risk Evaluation

Stage 2 risk-based guidance levels such as GACs are conservative generic values against which measured contaminant concentrations can be compared. Where measured concentrations are found to be below these screening criteria then the contamination identified is not considered to pose a significant risk. The guidance used to evaluate investigation data is chosen to be relevant for the particular risk and receptor being assessed as well as being applicable to the legislative issues of concern. Where measured concentrations of contaminants exceed generic criteria, the risks posed by the contaminants of concern are considered more fully in a Stage 3 risk assessment. Where no generic criteria are available or a substance, an automatic Stage 3 assessment is carried out if the contaminant is present above laboratory reporting limits.

Stage 2 criteria adopted by JPB for risk assessments are included in reports. If any of the appropriate criteria contained in these documents are exceeded, the conclusion is that significant risk could exist and that a further assessment (Stage 3) is warranted in order to calculate the potential levels of risk. This process, therefore, focuses on the contaminants of concern and can, if necessary, inform any further investigations which may be required for more detailed examination.

Derivation of JPB Human Health Criteria

Assessment of risks to human health

Each contaminant exceeding Stage 2 criteria is examined for its potential to cause harm. Consideration is then given to the significant contaminant linkages which are plausible for the identified hazards, i.e. whether a contaminant can conceivably come into contact with a specified receptor group. It is possible that a contaminant may be deemed a hazard due to its presence above screening criteria but ultimately not constitute a risk as no viable pathway exists between the source and the receptor. The relative sensitivity of all potential receptors identified is quantitatively assessed using the data obtained during the desk study and site investigation phases.

The risk to human health is determined using an exposure assessment, an estimate of potential doses of the chemicals in exposed individuals via the pathways identified in the ICSM. This focuses on a hypothetical individual within each exposed population and involves the use of models which incorporate assumptions regarding human behaviour and physiological attributes. The assumptions are made in a “worst case” or “reasonable worst case” manner to provide estimates of dose which are unlikely to be exceeded by receptors at or in the vicinity of the site. The main focus of the exposure assessment is the estimation of long-term (chronic) dose levels from repeated exposure to chemicals in the soil and groundwater. In some cases, for example cyanides, acute exposure is also considered. Exposure to each chemical is estimated for each viable pathway and for any potential sensitive receptors.

The purpose of the human health assessment is to identify the levels of exposure to contaminants which, if not exceeded, do not cause unacceptable adverse health effects. The subject of human health assessments is covered in depth in the DEFRA/EA Science reports to which the reader is referred for further background information, however, a short review is given below.

Health Criteria Values

Human health assessment criteria are derived by comparing the estimated exposure of critical receptors to the contaminants with Health Criteria Values (HCVs). HCV represent a tolerable or minimal risk to health from chronic exposure to these contaminants or, in the case of C4SLs, a “low” risk level. Acute health risks must be assessed separately. Health Criteria Values are derived through the collation and review of toxicological data and its subsequent use in the derivation of soil contaminant intakes that are considered to be protective of human health. These intakes are guidelines to a risk assessor on the level of long-term human exposure to individual chemicals in soil that are tolerable or pose a minimal risk, or in the case of C4SLs pose a low but acceptable risk. HCVs are established from a review of the evidence from occupational and environmental epidemiological studies, animal studies and from scientific understanding of the mechanisms of absorption, transport, metabolism and toxicity of chemicals within the human body.

The derivation of HCVs for tolerable or minimal risks is described in detail within EA Science report-SC050021/SR2. The derivation of HCVs representing low risks used to derive C4SLs is described in DEFRA report SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination.

Contaminants generally exhibit two possible types of toxicity, threshold toxicity and non-threshold toxicity. For contaminants which exhibit threshold toxicity there is some, non-zero, measurable amount of exposure (dose) that is required before a biological threshold is breached and an adverse health effect is produced. However, in some cases the toxicological mechanism responsible for producing the adverse effect is such that there is no basis to assume a threshold exists. This is most notably the case for genotoxic carcinogens. The biological mechanisms by which these types of chemicals cause damage to DNA and genetic material means that any exposure to these chemicals, no matter how small, will carry some level of risk. The theoretical basis for this is that one 'hit' on DNA can produce a mutation that may eventually lead to a tumour. It is, therefore, not possible to identify the threshold with any confidence. Hence, the prudent assumption is made that such compounds do not have a threshold. It should be noted that not all carcinogens are genotoxic, some may exhibit a threshold, and whether a contaminant is a threshold or non-threshold substance should be determined by a review of the available toxicological evidence.

HCVs for Tolerable or Minimal Risk

HCVs for tolerable risk levels for threshold substances are referred to in the UK as Tolerable Daily Intakes (TDIs), some other authorities or organisations derive similar criteria such as Reference Doses (RfDs) or Provisional Tolerable Weekly Intakes (PTWIs). These values are in principle similar and can be thought of as "safe" levels of exposure at which adverse effects are not likely to occur, although some conversion or further consideration may be required before adoption of values from other jurisdictions in the UK context. These health criteria are typically derived by applying "safety" or "uncertainty" factors to intake levels observed to have little or no effects in humans or animals.

Exposure to receptors will occur not just from soil-borne contamination but also from intakes of food, water and air. Where a contaminant is a threshold substance these background intakes of a contaminant must, therefore, be calculated and subtracted from the TDI, to calculate the intake of the contaminant which could be tolerated from exposure to soil contamination alone (this quantity is the TDSI – Tolerable Daily Soil Intake), in addition to normal background exposure. This background intake is the Mean Daily Intake (MDI). Where information is not available on intake levels of contaminants or where the MDI exceeds the TDI, the Science report-SC050021/SR3 states that the TDSI should be set in the model to be 50% of the TDI.

DEFRA/EA have adopted the Index Dose (ID) as the HCV for minimal risk levels for non-threshold substances, which can be considered to present a minimal human health risk from exposure to soil contaminants. For non-threshold contaminants background intake is not considered as there is no "safe level". In addition, application of the ALARP (As Low As Reasonably Practicable) principle for these substances means that intake should be reduced to as low a level as practicable, that this principle is being adopted by the competent authorities for intakes from food, water and air and that actions are being taken to reduce these other intakes.

There are a number of sources of toxicity criteria and background exposure levels which include Department of the Environment, Food and Rural Affairs (DEFRA); World Health Organisation (WHO); the US Environmental Protection Agency (US EPA) IRIS (Integrated Risk Information System) and other published scientific literature. Where available the definitive UK toxicological and background exposure levels published in the DEFRA/EA/SEPA CLEA TOX reports, under the advice of the Department of Health and The Food Standards Agency, are used as the primary source. However, as authoritative UK based information is available for only a limited number of substances, health criteria and other model input data has been sourced from non-UK published information. The methodology outlined in Science report-SC050021/SR2 has been used to derive HCVs where an authoritative UK HCV has not been published.

HCVs for Low Risk

HCVs for low levels of risk are known as LLTC, LLTC used in deriving C4SLs adopted by JPB have been derived as described in DEFRA report SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. The assumptions and decisions used to derive LLTC are discussed in the above document. The overall LLTC derivation methodology described contains several elements which are similar to or, conversely, differ from, those used to derive "minimal risk" HCVs. Key aspects of the similarities and differences between the approaches are summarised in Table 2.4 of the above document.

General Approach to Risk Estimation

Stage 2 generic criteria have been selected from published values or derived by JPB as described above. JPB derived GACs using the CLEA 1.071 model where sufficiently reliable UK authoritative or peer-reviewed input data (including HCVs) is available. In the first instance the model input values published by DEFRA/EA, derived by Land Quality Management (LQM) in association with the Chartered Institute of Environmental Health (CIEH) and data published in Environment Industry Commission (EIC)/CL:AIRE Report: Soil Generic Assessment Criteria for Human Health Risk Assessment have been used for JPB derived GAC if available. Both the CLEA model and C4SL methodology derive GACs for use when considering the risk to human health from chronic exposure to toxic metals, metalloids and organic substances in soil. The assessment criteria represent contaminant concentrations in soils, which if exceeded on site may be indicative of unacceptable risks to human health. It is envisaged that these methodologies can also be used as a tool during either the detailed quantitative risk assessment or the risk management process.

These methodologies adopt the risk-based source-pathway-receptor contaminant linkage framework and a deterministic methodology. The exposure pathways considered are direct ingestion of soil and dust, direct dermal contact with contaminated soil, consumption of home grown or allotment vegetables, ingestion of soil attached to such vegetables, inhalation of soil vapours outdoors and inhalation of soil vapours indoors. The CLEA model used in both methodologies is intended to reflect and be compliant with the guidance in DEFRA/EA Science Reports.

Where input data from the above sources is not available, data published by other organisations has been used. It should be noted that the toxicological data available for particular substances in many cases is very limited and incomplete. In order to adopt a relatively consistent approach, where authoritative or peer reviewed UK data is not available, data has been obtained primarily from USEPA and Dutch RIVM report sources as these sources offer a wide range of expert reviewed parameter values such as health criteria values, physical and chemical property data for commonly encountered soil contaminants.

Risks posed by Polychlorinated biphenyls (PCBs) in soil

For risk assessment purposes PCB congeners are divided into two groups; (1) dioxin-like PCBs and (2) non-dioxin like PCBs. Dioxin-like PCBs have similar structures and toxic mechanisms to dioxins and furans and so are assessed together with dioxin and furans. Non-dioxin like PCBs have a different toxic end point to dioxin-like PCBs and must, therefore, be assessed separately.

If the criteria set out in the SGV report are fulfilled, the PCB test results can be directly compared with the SGV given in the report. However, SGVs relate to background PCB levels where a site source is absent, and this limits the applicability of the SGV.

Where the assumptions required for the use of the SGV are not met, dioxin-like PCBs are assessed using the SGV worksheets for the standard land uses. Where site specific dioxin and furan data is not available, the median urban or rural dioxin and furan values given in the SGV report are used to account for "background" concentrations of these substances. A hazard index (HI) is calculated using the worksheet and if the HI is >1, then dioxin-like PCBs may pose a risk to human health receptors in the scenario being considered.

A specific methodology to assess risks posed by non-dioxin like PCBs has not yet been published by EA/DEFRA, however, JPB have adopted the current UK methodology used to assess other organic compounds. This involves selecting a list of target compounds, a TDI and other input data and using the CLEA model to derive GACs. PCBs are typically present as mixtures. The most persistent and toxic non-dioxin-like PCBs are present at their highest concentrations in PCB mixture aroclor 1254. The 7 ICES list indicator PCBs make up about 50% of aroclor 1254. JPB, therefore, compare the sum of these indicator PCBs with the assessment criteria. The criteria are derived using a TDI for aroclor 1254 and other input data using the CLEA model. The TDI is adjusted to account for the percentage of the 7 ICES compounds present in aroclor 1254. If the sum of the soil concentrations of the 7 ICES exceeds the GAC, then non-dioxin-like PCBs may pose a risk to human health receptors in the scenario being considered.

Therefore, if either the dioxin-like PCB or non-dioxin-like PCB assessment indicates the presence of a risk, remediation may be required or a further assessment may be proposed.

Risks posed by Cyanides in soil

Cyanide compounds exhibit both acute and chronic toxicity, although it should be recognised that complex cyanides are much less toxic than free cyanides. There is currently no UK SGV available to assess chronic cyanide toxicity, although a review of the toxicology of cyanide has been published (DEFRA CLR TOX 5 report).

Criteria derived to be protective of chronic cyanide exposure exceed those derived to be protective of acute exposure to both types of cyanide. Therefore, the criteria derived for acute exposure to free and complex cyanides have been conservatively adopted to be protective of receptors.

The Environment Agency has not published guidance on the assessment of risks due to acute exposure to cyanide compounds. However, HPA publications indicate that hydrogen cyanide and its solutions may be fatal following acute exposure via all intake routes (ingestion, inhalation and dermal). The Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT) published a nominal acute reference dose (ARfD) based on the lowest reported acute lethal dose. JPB have derived assessment criteria for free and complex cyanides in soils based on the above ARfD, exceedence of which is considered to pose a risk to sensitive site receptors.

Stage 3 Detailed Quantitative Risk Assessment

Representative Contaminant Concentrations and Site Specific Assessment Criteria

To merit a Stage 3 assessment concentrations of contaminants will have exceeded Stage 2 criteria, or there are no available Stage 2 criteria. At this stage the chemical dose to potentially exposed human receptors are calculated, incorporating site specific data together with conservative health assumptions where necessary to derive Site Specific Assessment Criteria (SSACs). Data evaluation and statistical procedures are used to derive representative contaminant concentrations (RCC) for contaminants of concern in the relevant averaging areas of sites. RCCs are compared with SSACs at the risk evaluation stage in order to determine their significance. This process effectively reduces the conservatism of the Stage 2 assessment and provides a site specific assessment at Stage 3.

At Stage 2 all soil contaminant concentrations are compared with GACs. At Stage 3 RCCs are calculated and used for comparison with assessment criteria. Depending on the nature of the data the RCC may consist of either the maximum concentration recorded or a 95% Upper Confidence Limit (UCL95). Where small data sets are available, or where point source contamination such as hydrocarbon spillages are present, statistical analysis is not appropriate and the maximum contaminant concentration recorded is adopted as the RCC. Where larger data sets are available statistical analysis may be performed to derive an RCC where appropriate. Where RCCs exceed assessment criteria this indicates that the contaminant poses a human health risk and that remedial actions may be required to prevent actual harm. As an initial assessment, JPB generally alter only specific pH and %SOM values and the development type to generate SSACs. Should a more detailed DQRA assessment be merited, a more extensive re-examination of data inputs may be undertaken.

Statistical analysis is carried out in accordance with the methodology outlined in guidance given in CL:AIRE/CIEH Publication, "Guidance on Comparing Soil Contamination Data with a Critical Concentration". A number of statistical tools may be used for deriving UCL95 values, JPB principally use ProUCL, a software package developed by the US EPA for this purpose. In general, RCC values are selected as follows;

- Determine if there is sufficient data for statistical analysis, if not the maximum concentration is selected as the RCC;
- If data is sufficient the data set for each contaminant is tested for distribution type (normal distribution, lognormal etc.);
- The data set for each contaminant is tested for the presence of outliers, and these are considered for removal or inclusion in further calculations;
- An appropriate UCL95 is calculated, based on the distribution type and revised data set, and this is used as the RCC.

Consideration of whether outliers represent potential contaminant hotpots is also undertaken.

Lead risks are assessed using a C4SL value derived using a model which uses the geometric mean of blood lead levels as one of its input parameters. For this reason, the log transformation of soil lead concentrations across a site is required prior to deriving the RCC.

Stage 3 JPB Risk Estimation Practice

JPB's Stage 3 assessment practice is to calculate SSACs, incorporating site specific data together with conservative health assumptions where necessary. This effectively reduces the conservatism of the Stage 2 assessment and provides a site specific assessment. Depending on the contaminant linkages identified in the conceptual site model and on the nature of contamination identified during site investigations, particular risk assessment tools are selected which are considered to be appropriate to assess risks to human health under the existing site conditions.

The CLEA model used has been designed to comply with current UK DEFRA guidance on the assessment of contaminants on land and where possible this is JPB's risk assessment tool of choice. Health criteria, toxicological, physical and chemical data are input for each contaminant for the land use envisaged. The model derives a Site-Specific Assessment Criteria (SSAC) for the contaminant which, if exceeded, would represent a human health risk to the sensitive receptor. The basis of the CLEA models are more fully discussed in the CLEA software manual and DEFRA report SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination respectively.

The CLEA model used to derive SGVs, C4SLs, GACs and SSACs includes inhalation of outdoor and indoor dust pathways where appropriate. Inhalation pathways are most important in driving risk assessments where inhalation HCVs are low or where inhalation exposure is high. Where a Stage 3 assessment is required, the inhalation SSACs may be presented in JPB's reports to allow further consideration of these pathways and any remedial actions which may be required.

On completion of contemporary developments, the amount of bare soil exposed is generally limited to localised landscaping. This is considered to be minimal as a proportion of the site area and given that clean topsoil will generally be placed to provide a suitable rooting horizon during development, this pathway will be usually be broken by this cover for most inorganic contaminants and, therefore, JPB do not assess this further. An additional degree of conservatism is build into the assessment here as the overall SSACs still have these pathways included. However, where volatile organic contaminants are present, such as BTEX or naphthalene, these substances may potentially migrate through clean cover and, if present at sufficiently high concentrations, may require the introduction of protective measures such as the installation of membranes in solums of buildings etc. to prevent unacceptable exposure to receptors via vapour migration and inhalation. The generation of dust during site works may also expose site operatives or the occupiers of adjacent properties to health risks and should be managed by the provision of appropriate PPE and adoption of appropriate site practices as described in CIRIA document 132 "A guide for safe working on contaminated sites".

Stage 3 Assessment of Risk to Other Receptors

The ecological risk assessment is carried out with respect to both on-site and off-site ecologically sensitive receptors. A review of information can indicate whether any nearby ecologically sensitive areas are likely to be impacted by on-site derived contamination; a comparison of contaminant levels found in the on-site ecologically sensitive areas can also be made with the UK Environmental Quality Standards for the protection of wildlife.

Contaminants which are at concentrations in excess of the Stage 2 screening criteria are determined to present a potential risk to the water environment and these contaminants therefore require assessment at a Stage 3 level. The purpose is to ascertain if the concentrations create a risk. It is important to consider factors such as the background groundwater quality, the sporadic nature of the perched groundwater and the separation of the site from the regional groundwater by an aquiclude.

The most significant receptors in the water environment assessment are generally considered to be the local shallow and deep groundwater and local surface waters. At some sites there is the potential for contaminants detected on-site to detrimentally affect off-site water receptors. Deeper (bedrock) groundwater resources may be important in some areas, or where groundwater may be abstracted for use. The significance of the risk to these receptors is assessed by considering, either conceptually or using groundwater models, the potential effects contaminants may have to groundwater and surface water receptors.

Stage 3 Evaluation of Risks to Groundwater and Surface Waters

An assessment of the potential for both contaminated soil and groundwater to affect the quality of water resources is undertaken in accordance with current SEPA guidance described in document WAT-PS-10-01: Assigning Groundwater Assessment Criteria for Pollutant Inputs (Live Document). This notes that for land contamination four receptor groups are to be assessed, if identified as being present, namely; surface water, groundwater abstraction, groundwater resource and groundwater dependant terrestrial ecosystem (GWDTE or wetland). Each receptor is considered in turn at the in ICSM stage, and investigations scoped to examine these linkages where necessary.

At Stage 2 the potential linkages identified in the ICSM are re-examined in the light of investigation findings, and only the viable linkages are considered further. Where relevant, recorded soil leachate, groundwater and surface water contaminant results are compared with GACs selected as described in the above guidance, dependant on the receptor being considered (e.g. UKDWS would be used where a water abstraction was the receptor). Where exceedences of GACs occur a Stage 3 assessment is undertaken.

In the Stage 3 Risk Assessment - Water Environment a re-examination of the ICSM is undertaken with respect to water environment receptors on the basis of site investigation data. Where a potential linkage remains, a back calculation is undertaken for the recorded soil leachate and/or groundwater concentration exceedences in accordance with the guidance in document WAT-PS-10-01 using the EA's Remedial Targets Methodology (RTM) and the associated Remedial Targets Worksheet hydrogeological modelling tool. After applying a dilution factor and where appropriate, degradation, the theoretical concentration of each contaminant at an assessment point is compared against the relevant assessment limit at that assessment point.

The assessment limit may be a UK Drinking Water Standard (UKDWS), Resource Protection Value (RPV) or EQS depending on the nature of the receptor which is being considered to be potentially at risk. The assessment point is the point at which assessment limit must be met. For the purposes of risk assessment, the assessment point is selected to be the nearest surface water course for surface water receptors, the site boundary (or 50m downgradient of the site boundary or 250m in a sewered urban environment) for the future groundwater resource receptors or in the raw water prior to any treatment this might receive for current abstractions. It should be noted that in contrast the SEPA guidance defines a compliance point as a "real" sampling point to demonstrate that inputs are acceptable. A compliance point may be the same location as the assessment point or between the source and receptor.

In addition, where required the Remedial Targets Worksheet can be used to calculate soil remedial targets which can be used to determine whether soil contaminant levels on site require remedial actions to prevent impact to water environment receptors.

For the above calculations it is assumed that leachate is theoretically produced by water infiltration from rainfall into site groundwater which can then migrate off site. In this case the leachate migrates through permeable strata until it enters a theoretical deeper groundwater. The remedial target which is calculated represents the maximum concentration of that particular contaminant which can be allowed at the assessment point or at its location on the site in the case of soil remedial targets. If concentrations are recorded above remedial targets, then theoretically by the time impacted groundwater has migrated to the assessment point it will be above the relevant assessment limit for that contaminant and remedial measures would be necessary.

Other analytical, numerical and probabilistic groundwater models are available to aid in the quantitative assessment of contaminated waters, the suitability of each which can be determined upon completion of site assessment and project requirements.

RISK-BASED CONCLUSIONS

The comparison of the estimated risks with the appropriate criteria indicates whether;

1) the site presents an insignificant risk based on the analysis; or,

2) there is a potential risk to health or the environment.

Where a risk has been identified remedial strategies can then be developed in order to break any source-pathway-receptor linkage. Strategies may include; source removal, breaking the pathway from the source to the receptor or choosing developments in which sensitive receptors are not included in areas where the risk exists.

As described above a number of remedial strategies can be adopted for a site and JPB select the most appropriate strategy for remediation on a site specific basis. One commonly adopted practice is to break the contaminant linkages by the introduction of clean capping materials. JPB have adopted, where appropriate, the BRE/DTI/NHBC/AGS document as a decision making tool to aid the design of remedial actions. This provides a research and data-based approach to designing cover systems rather than the use of professional judgement alone. It is, however, emphasised this document is used by JPB in the context of professional judgement and experience and a knowledge of site conditions.

As at the time of investigations the concentrations of contaminants present in material to be imported for capping may not be known, a conservative approach in which the imported material is assumed to have a contaminant concentration of 75% of the target guideline value is adopted. The spreadsheet which accompanies the document contains a viability check graph which indicates whether the capping layer calculated is acceptable or whether further consideration is required as to the effectiveness of the cover system proposed. JPB's procedure is to ensure that the effectiveness of the cover system is adequate for the site conditions encountered. Where these are exceeded more stringent remedial actions are recommended. JPB consider that this methodology provides a consistent, scientifically based rationale for designing cover systems in the vast majority of sites we encounter. Where more extreme conditions are encountered, or where there are specific site requirements, these issues will be considered on a site specific basis in order to be protective of receptors at the proposed development.

Specific measures are proposed where asbestos fibres or materials are recorded to be present and are to be retained, encapsulated on site. The recommended design of the environmental capping reflects the magnitude of the risks posed by the different types, concentrations and conditions of asbestos materials recorded to be present.

Remediation Strategy

Before any works can be carried out on site a Remediation Strategy is prepared in accordance with the “Model Procedures for the Management of Land Contamination” (CLR11) and the EA document “Verification of Remediation of Land Contamination”. JPB integrate the requirements for the various stages of remediation works in Remediation Strategy, Implementation and Verification Plan documents.

Ground Gas Assessment Methodology

Introduction

The assessment of ground gas as a potential constraint to development has been the subject of a great deal of research and published guidance. Broadly speaking ground gas can be a concern for several reasons; flammable gases may cause an explosion, build up of gases within poorly ventilated areas may lead to asphyxia or toxic gases may cause harm to those exposed to them. In general, we consider principally methane and carbon dioxide levels, however the presence of other gases such as carbon monoxide, hydrogen sulphide, petroleum vapours etc may also be considered where appropriate. Some physical properties of ground gases are tabulated below.

Gas	Explosive Range	Density of 20ºC	Toxicity % by volume in air*
Methane	5-15% by vol	0.72 kg/m^3	30 (low)
Carbon dioxide	N/A	1.98kg/m^3	0.5 (high)
Carbon monoxide	12.5-74.2% by vol	1.25kg/m^3	0.02 (high)
Hydrogen sulphide	4.2-46% by vol	1.54kg/m^3	0.001 (high)

* short term occupational exposure limits. The long term occupational exposure limit for carbon monoxide is 30ppm and for hydrogen sulphide is 5ppm.

These ground gases may originate from many sources including; mine workings, organic sediments, landfilling, biodegradable materials in made ground on brownfield sites, petroleum hydrocarbons or other site specific sources. The gas concentrations measured are the result of volatile emissions and the microbial degradation of organic materials. The processes by which materials degrade to form ground gases are discussed more fully in EA's Guidance on the Management of Landfill Gas, LFTGN 03, 2004.

Data Requirements and ICSM

JPB's overall methodology for ground gas assessments is summarised in the attached flow chart. In order to assess the degree of risk to receptors we must first develop an initial conceptual site model (ICSM) of the site which can identify the various sources and receptors and any potential pathways by which they may be linked. This process can be undertaken as part of the development of an ICSM for the site for contaminants other than gases. If a potential contaminant linkage is identified for ground gas, site investigations to confirm the nature and extent of ground gases will be required. Guidance on how these site investigations should be undertaken is given in B5930 - Code of Practice for Site Investigations, BS10175 - Investigation of Potentially Contaminated Sites, CIRIA Reports 103 (Vol II) and 150 (Methane Investigation Strategies), CIRIA C665 and BS8485 and other published guidance including the VOC handbook and CIRIA C735.

Investigation methodologies which have been used to measure gas concentrations include spike probe surveys, sinking of boreholes with monitoring standpipes installed and flux boxes. Spike probe surveys are considered to be unreliable for the following reasons: limited depth, spikes into an aerobic layer in an open hole underestimate methane levels and spike probes may not intercept the gas source.

JPB, therefore, generally commission the sinking of boreholes with standpipes to characterise the gas regimes at sites. Where access is restricted, a window sampler is used to install standpipes. The number and position of bores and well response zones are carefully chosen in order to maximise the information to be obtained to fully characterise the site. Table 4.2 in CIRIA C665, reproduced below, gives some guidance on the spacing of wells, which should be interpreted in conjunction with the associated text of that paper ad in the light of actual site conditions.

Gas Hazard	Typical Examples	Sensitivity of end use	Initial nominal spacing of gas monitoring wells[1,2]
High	Domestic landfill sites	High[3]	Very close (<25m)
		Moderate	Close (25-50m)
		Low	Close (25-50m)
Moderate	Older domestic landfills disused shallow mine workings[4]	High	Close/very close (<25m -50m)
		Moderate	Close (25-50m)
		Low	Close/wide (25-75m)
Low	Made ground with limited degradable material, organic clays of limited thickness	High	Close (25-50m)
		Moderate	Wide (50-75m)
		Low	Wide/very wide (50->75m)

1 The initial spacing may need to be reduced if anomalous results indicate this is necessary to give a robust indication of the gas regime below a site. To prove the absence of gas, closer spacings may be required.

2 The spacing assumes relatively uniform ground conditions and the gas source present below a site. The spacing will need to be reduced if ground conditions are varied or if the investigation is trying to assess migration patterns from off site.

3 Placing high-sensitivity end use on a high gas hazard site is not normally acceptable unless the source is removed or treated to reduce gassing potential.

4 Petrol stations and other sources of vapours are most likely to be classified as gas hazard "Moderate" however site specific assessment would be required.

Three bores with standpipes and four sets of readings should be considered an absolute minimum for even the smallest of sites.

Flux boxes can be used to measure surface gas emission rates but do not take into account a deeper source of gas generation. Flux boxes can be used to confirm that a capping layer above a source and the surface has been effective. It should be noted that methane levels at the surface may underestimate ground gas levels as aerobic conditions at the near surface will deplete methane concentrations.

Guidance on the measurement of gas levels at bores is given in the above documents, however, in general a peak gas reading is taken followed by readings at 30 second intervals until a steady state is reached. This allows the assessor to determine how quickly the ground gas is replenished. Flow rate is generally measured first followed by methane/carbon dioxide levels. In addition, atmospheric pressure, weather, date and any other relevant information is recorded.

Flow rates can be positive or negative, they are generally negative where ambient atmospheric pressure is high or where falling groundwater levels reduce pressures in bores. Flow rates between -0.4 and 0.4 L/h indicate that there is probably no overall flow. The length of the monitoring period and frequency of monitoring will vary from site to site depending on the sensitivity of development, geology of the site, the level of risk and other factors. Typical minimum periods and monitoring frequencies are given in Table 5.5 of CIRIA C665. Generally, JPB undertake six visits over 12 weeks for sites proposed for residential development.

Continuous gas monitoring at boreholes over a period of several weeks can also sometimes be utilised to clarify the type of gas generation sources present and levels of risk posed by ground gases at some sites.

The degree of monitoring required must enable the assessor to measure or predict the reasonable worst case gas regime.

Risk Assessment

Having obtained factual data from the investigation the ground gas regime can be assessed in a tiered approach. In the past guidance such as Waste Management Paper 27 recommended a highly conservative precautionary principle, i.e. no development within 250m of a landfill site. This approach was seen as anti-development and does not take into account the site conditions, whether a risk exists at the site for the development proposed, the level of risk and whether if can be mitigated by design. More recent approaches characterise the site and the risk and base recommendations on this assessment. Various reports and standards have recently been published to update the guidance on ground gas assessment and this JPB methodology uses the philosophy outlined in these. These include CIRIA C665 "Assessing risks posed by hazardous ground gases to buildings"), NHBC Report No. 10627-R01(04) "Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present" and British Standard BS8485 "Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings".

Tier 1 assessment

Following the completion of investigations, the assessor reviews the ICSM in the light of site investigation data and identifies any intact contaminant linkages. If intact contaminant linkages exist a Tier 1 risk assessment is performed using generic screening criteria to determine whether a risk exists. JPB use the following screening levels: **Methane <1% by volume in bores and Carbon dioxide <5% by volume in boreholes.**

These values are derived from Waste Management Paper 27, 1% methane by volume represents 20% of methane's lower explosive limit of 5% by volume, 5% carbon dioxide relates to the known health effects of exposure to this gas. Both screening concentrations are detailed in the Building Regulations Approved Document C (2004) and BRE Report "Construction of New Buildings as Gas Contaminated Land" (BR 212).

A limit to gas flow rates for the above trigger values is inferred by the table given below where the limiting borehole gas volume flows for CH_4 and CO_2 are <0.07L/hr for characteristic situation 1. These are equivalent to **a limiting borehole flow rate of 7L/h for CH_4 at 1% by volume and 1.4L/h for CO_2 at 5% by volume.** The above Tier 1 trigger values are only valid, therefore, if these volume flows are not exceeded. Where these volume flows are exceeded a Tier 2 assessment should be undertaken.

Guidelines on screening levels for hydrogen sulphide and other trace gases are given in the VOC Handbook, CIRIA RP711. Other information on VOCs is available in EA Technical Guidance on Management of Landfill Gas (2004) and in the vapour models used in the CLEA model for contamination land assessments.

If these screening concentrations are not exceeded then no significant risk exists and no further action is required. Where screening concentrations are exceeded a Tier 2 assessment is performed.

Tier 2 assessment

Where Tier 1 generic screening concentrations are exceeded a Tier 2 assessment is performed using the Wilson and Card (1999) approach as outlined in CIRIA C665. Each site is classified into a "characteristic situation" based on the maximum methane and carbon dioxide concentrations measured. These measurements combined with the maximum borehole flow rate are used to calculate the gas screening value.

Gas screening value (L/hr) = gas concentration (% by volume) x borehole flow rate (L/hr).

(N.B. gas screening value is also known as "site characteristic hazardous gas flow rate (Q_{hgs}) in BS8485)

For example, for a borehole flow rate of 1.5 L/h and a methane concentration of 20% the gas screening value = 1.5 x 20/100 = 0.3 L/h.

Gas screening value rates for methane and carbon dioxide can be compared with Table 8.5 of CIRIA C665 “Assessing risks posed by hazardous ground gases to buildings” or Tables 14.1 of NHBC Report No. 10627-R01(04) “Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present”, reproduced below, to determine a characteristic situation for the site.

Table 8.5 Modified Wilson & Card Classification (CIRIA Report C665)
NB Use for most scenarios other than low rise housing with a ventilated underfloor void (min 150mm)

Characteristic Situation (CIRIA R149)	Comparable classification in DETR et al (1999)	Risk classification	Gas Screening Value (GSV) CH_4 or CO_2 (L/hr)[1]	Additional Limiting Factors	Typical Source of generation.
1	A	Very low risk	<0.07	Typically methane <1% by volume and/or carbon dioxide < 5%. Otherwise consider increase to Situation 2.	Natural soils with low organic content. “Typical” made ground
2	B	Low risk	<0.7	Borehole air flow rate not to exceed 70L/hr. Otherwise increase to characteristic situation 3	Natural soil, high peat/organic content. “Typical” made ground
3	C	Moderate risk	<3.5		Old landfill, inert waste, mineworking flooded
4	D	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protection measures	Mineworking – susceptible to flooding, completed landfill, inert waste (WMP 26B criteria)
5	E	High risk	<70		Mineworkings unflooded inactive
6	F	Very high risk	>70		Recent landfill site

Table 14.1 Gas Risk Assessment (Traffic Lights) NHBC Report No. 10627-R01(04)
NB To be used for low rise housing with a ventilated underfloor void (min 150mm)

Traffic Light	Methane[1]		Carbon Dioxide[1]	
	Typical max conc.[5] (% by vol)	Gas screening value [2,4,6] (L/hr)	Typical max conc. [5] (% by vol)	Gas screening value [2,3,4,5] (L/hr)
Green	1	0.13	5	0.78
Amber 1	5	0.63	10	1.60
Amber 2	20	1.60	30	3.10
Red				

Protective measures can then be selected for the site buildings based on the Characteristic Situation and the type of development proposed (building types A-D, Table 3 BS8485) using the guidance and scoring system given in BS8485 and its annexes. Protective measures for new buildings can then be designed which are appropriate to the types and magnitude of the risks posed.

Radon

Radon is a naturally occurring radioactive gas that is formed from the decay of uranium and radium present in some types of rocks. It can migrate through cracks and fissures into the soil and by this route into buildings.

Radon can accumulate inside structures over the long term posing a risk to health. Long term exposure increases the risk of developing lung cancer, in a building with high levels of radon, long-term exposure can increase the risk to the point where preventative action is necessary.

For this reason section 3.2 of the Technical Handbook Guidance, which sets functional standards for Scottish buildings under the Building (Scotland) Act 2003, was revised in 2011 to ensure that “every building must be designed and constructed in such a way that there will not be a threat to the health of people in or around the building due to the emission and containment of radon gas”. This document provides guidance on how the risks posed by radon should be assessed. JPB’s methodology for assessing risks posed by radon follows that guidance and this methodology is outlined below.

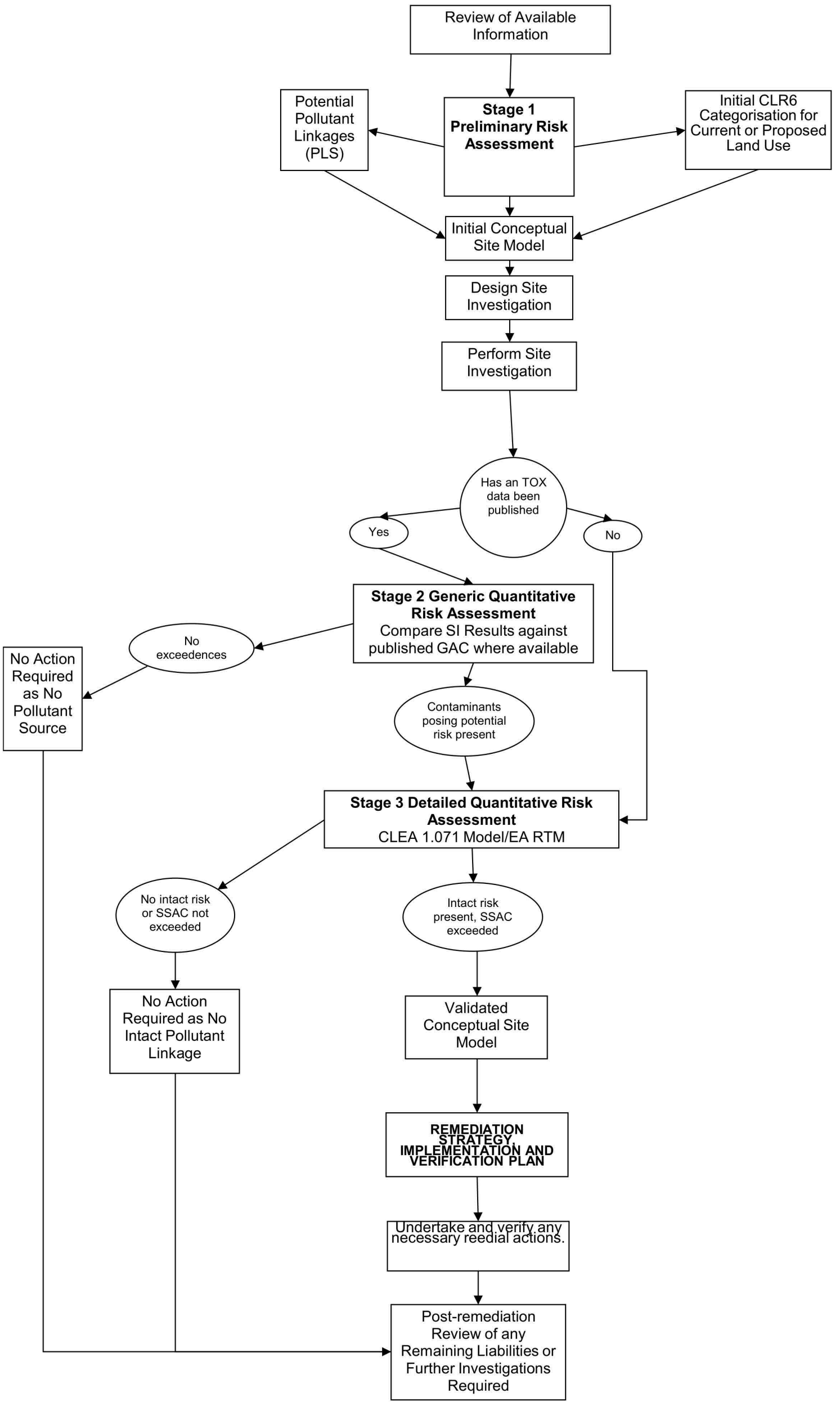
The location of the site is pinpointed on maps published in Appendix A of BRE BR 211. These maps were the result the result of a joint project between The Health Protection Agency (HPA) and the British Geological Society who prepared detailed maps of radon potential in Scotland by testing radon levels in houses. Depending on the level of risk within the geographical grid square within which the development lies, maps indicate whether; no protection measures are required, basic radon protection measures are required or full radon protection measures are required.

Where the site is indicated to be within an area within which radon protection is required, a further assessment of the risks posed by radon is undertaken. The BR211 Appendix A maps provide information on a large scale, and whole grid squares are categorised based on the worst conditions within the grid square, rather than for a specific site or smaller geographical area. Where the BR211 Appendix A map indicates there is a possibility that radon may pose a risk (or it is unclear), more detailed HPA/BGS mapping data is obtained and the site is assessed accordingly.

If the more detailed report indicates that the site is located on ground where radon protection measures are required, protective measures are recommended. Radon protective measures are recommended in accordance with the guidance contained in BRE Report BR211 “Radon: Protective measures for new buildings”. BRE have also confirmed to JPB that, where gas protection measures are being installed to provide protection against ground gases such as methane and carbon dioxide for CS-2 conditions or above, these measures will also provide adequate protection from risks posed by radon.

It should be noted that this approach has been adopted as monitoring radon concentrations in the ground prior to construction is not considered to be a valid methodology for assessing risks posed by radon in buildings. This is because it is difficult to equate the concentrations of radon measured in boreholes with levels inside houses, as many factors can influence the actual indoor air radon concentration experienced, including; radon generation rates, geology, construction details, ventilation rates, seasonal factors, occupant behaviour etc. Similarly, for newly constructed buildings it is impractical to determine indoor air radon concentrations over the recommended three month monitoring period and the results measured in unoccupied properties would not, in any case, be a valid assessment of conditions in occupied houses.

JPB Risk Assessment Methodology Flow Chart



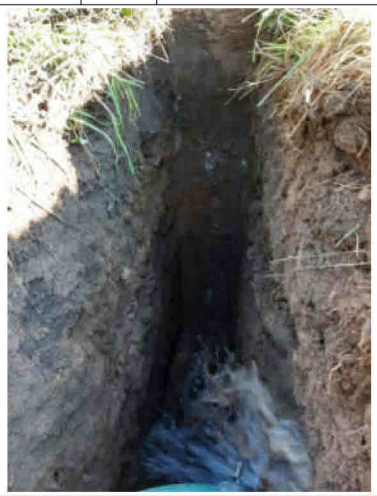
Appendix 3 Trial Pit Logs – Johnson Poole & Bloomer - October 2021

Johnson Poole & Bloomer

Site	Trial Pit Number
Crieff Road, Perth	TP01

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.45x1.5m		Lidl Great Britain Limited	VG183
	Location	**Dates** 06/10/2021	**Engineer** Blyth & Blyth	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Dark grey/brown clayey silty slightly gravelly sandy TOPSOIL with rootlets. Gravel is fine to medium, subangular to subrounded mudstone and sandstone.		
0.20	E1				0.30	Stiff consistency probable high strength friable dark grey/brown silty sandy slightly gravelly CLAY with occasional cobbles and boulders. Gravel is fine to coarse, angular to subrounded mudstone and sandstone. Cobbles and boulders are up to 210mm, subangular to subrounded sandstone.		
					(1.50)			
1.50	E2				1.80	Complete at 1.80m		



Remarks

Pit dry and stable.

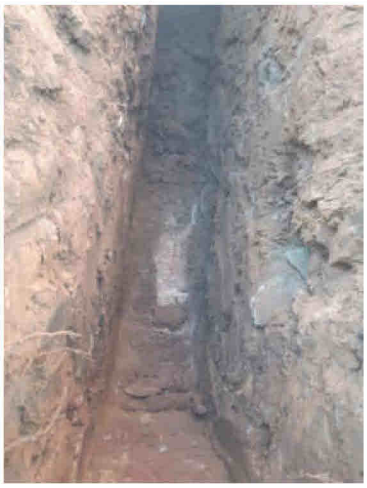
Scale (approx)	Logged By	Figure No.
1:25	KM	VG183.TP01

Johnson Poole & Bloomer

Site	Trial Pit Number
Crieff Road, Perth	TP02

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.45x2.3m		Lidl Great Britain Limited	VG183
	Location	**Dates** 06/10/2021	**Engineer** Blyth & Blyth	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Dark grey/brown clayey silty slightly gravelly sandy TOPSOIL with rootlets. Gravel is fine to medium, subangular to subrounded mudstone and sandstone.		
					0.30			
0.60	B1				(0.80)	Stiff consistency probable high strength friable dark grey/brown silty sandy slightly gravelly CLAY with occasional cobbles and boulders. Gravel is fine to coarse, angular to subrounded mudstone and sandstone. Cobbles and boulders are up to 230mm, subangular to subrounded sandstone.		
					1.10			
1.50	E1				(1.10)	Stiff consistency probable high strength dark red/brown slightly silty slightly gravelly CLAY with occasional cobbles and boulders. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone. Cobbles and boulders are up to 250mm, subangular to rounded sandstone.		
					2.20	Complete at 2.20m		



Remarks

Pit terminated at 2.2m depth due to sandstone bedrock.
Pit dry and stable.

Scale (approx)	Logged By	Figure No.
1:25	KM	VG183.TP02

Johnson Poole & Bloomer

Site	Trial Pit Number
Crieff Road, Perth	TP03

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.45x1.9m		Lidl Great Britain Limited	VG183
	Location	**Dates** 06/10/2021	**Engineer** Blyth & Blyth	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Dark grey/brown clayey silty slightly gravelly sandy TOPSOIL with rootlets. Gravel is fine to medium, subangular to subrounded mudstone and sandstone.		
0.20	E1				0.30			
					(0.50)	Firm consistency high strength dark grey silty sandy slightly gravelly CLAY with occasional cobbles and boulders. Gravel is fine to coarse, angular to subrounded mudstone and sandstone. Cobbles and boulders are up to 210mm, subangular to subrounded sandstone.		
0.60 0.70	B1 V 84kPa		72,80,100/Av. 84.00		0.80			
1.00	V 124.33kPa		110,128,135/Av. 124.33			Stiff consistency high strength dark red/brown silty sandy slightly gravelly CLAY with occasional cobbles and boulders. Gravel is fine to coarse, angular to subrounded mudstone and sandstone. Cobbles and boulders are up to 270mm, subangular to subrounded sandstone.		
					(1.10)			
1.50	E2				1.90			
						Complete at 1.90m		

Remarks

Pit dry and stable.

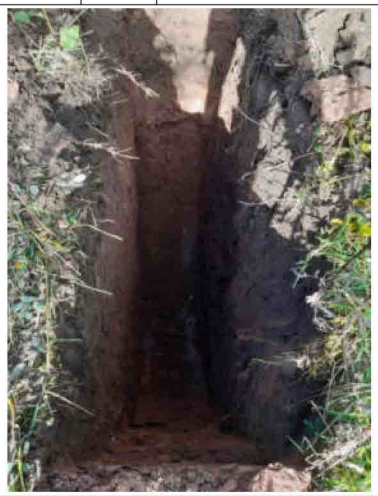
Scale (approx)	Logged By	Figure No.
1:25	KM	VG183.TP03

Johnson Poole & Bloomer

Site	Trial Pit Number
Crieff Road, Perth	TP04

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.6x2.5m		Lidl Great Britain Limited	VG183
	Location	**Dates** 06/10/2021	**Engineer** Blyth & Blyth	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.20	E1				(0.40)	Dark grey/brown silty sandy slightly gravelly clayey TOPSOIL with rootlets. Gravel is fine to medium subangular to subrounded mudstone and sandstone.		
0.70	V 112.33kPa		105,114,118/Av. 112.33		0.40 (0.50)	Stiff consistency high strength dark brown silty sandy slightly gravelly CLAY with occasional cobbles and boulders. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone. Cobbles and boulders are up to 280mm, subrounded to rounded sandstone.		
2.40	E2				0.90 (1.80)	Stiff consistency probable high strength friable dark red/brown slightly silty slightly sandy slightly gravelly CLAY with occasional cobbles and boulders. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone. Cobbles and boulders are up to 310mm, subrounded sandstone.		
					2.70	Complete at 2.70m		



Remarks

Pit terminated at 2.7m depth due to possible rockhead.
Pit dry and stable.

Scale (approx)	Logged By	Figure No.
1:25	KM	VG183.TP04

Johnson Poole & Bloomer

Site	Trial Pit Number
Crieff Road, Perth	TP05

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.6x2.5m		Lidl Great Britain Limited	VG183
	Location	**Dates** 06/10/2021	**Engineer** Blyth & Blyth	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.35) 0.35	Dark grey/brown silty sandy slightly gravelly clayey TOPSOIL with rootlets. Gravel is fine to medium, subangular to subrounded mudstone and sandstone.		
0.50	V 141.67kPa		130,145,150/Av. 141.67		(0.55)	Stiff consistency high strength friable dark grey/brown very silty very sandy slightly gravelly CLAY with occasional cobbles and boulders. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone. Cobbles and boulders are up to 230mm, subrounded sandstone.		
0.80 0.80 0.80	V 138.33kPa E1 WA1		130,135,150/Av. 138.33		0.90 (1.40)	Stiff consistency probable high strength friable dark grey/brown slightly silty slightly sandy slightly gravelly CLAY with occasional cobbles and boulders. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone. Cobbles and boulders are up to 260mm, subrounded and rounded sandstone.		
					2.30 (0.10) 2.40	Dark orange/brown layered sandstone bedrock.		
						Complete at 2.40m		

Remarks

Pit dry and stable.

Scale (approx)	Logged By	Figure No.
1:25	KM	VG183.TP05

Johnson Poole & Bloomer

Site	Trial Pit Number
Crieff Road, Perth	TP06

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.6x2.3m		Lidl Great Britain Limited	VG183
	Location	**Dates** 06/10/2021	**Engineer** Blyth & Blyth	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.35)	Dark grey/brown silty sandy slightly gravelly clayey TOPSOIL with rootlets. Gravel is fine to medium, subangular to subrounded mudstone and sandstone.		
0.20	E1				0.35	Firm consistency high strength dark orange/brown silty sandy gravelly CLAY with occasional cobbles and boulders. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone. Cobbles and boulders are up to 290mm, subrounded sandstone.		
					(1.60)			
1.50	E2							
1.60	V 92.67kPa		70,98,110/Av. 92.67		1.95	Complete at 1.95m		

Plan

Remarks

Pit dry and stable.

Scale (approx)	Logged By	Figure No.
1:25	KM	VG183.TP06

Johnson Poole & Bloomer

Site	Trial Pit Number
Crieff Road, Perth	TP07

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.5x2.0m		Lidl Great Britain Limited	VG183
	Location	**Dates** 06/10/2021	**Engineer** Blyth & Blyth	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Dark grey/brown silty sandy slightly gravelly clayey TOPSOIL with rootlets. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone.		
					0.30			
0.80	V 150kPa		+150,+150,+150/Av. 150.00		(1.40)	Stiff consistency high strength friable dark red/brown silty slightly sandy slightly gravelly CLAY with occasional cobbles and boulders. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone. Cobbles and boulders are up to 300mm, subrounded sandstone.		
1.00	E1							
1.00	WA1							
					1.70	Complete at 1.70m		

Remarks

Pit dry and stable.

Scale (approx)	Logged By	Figure No.
1:25	KM	VG183.TP07

Johnson Poole & Bloomer

Site	Trial Pit Number
Crieff Road, Perth	TP08

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.5x2.0m		Lidl Great Britain Limited	VG183
	Location	**Dates** 06/10/2021	**Engineer** Blyth & Blyth	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Dark grey/brown silty sandy slightly gravelly clayey TOPSOIL with rootlets. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone.		
0.20	E1				0.30			
					(0.40)	Dark brown/grey clayey very silty slightly gravelly SAND with occasional cobbles. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone. Cobbles and boulders are up 160mm, subrounded sandstone.		
					0.70			
1.00	V 111kPa		95,98,140/Av. 111.00		(1.80)	Very stiff consistency high strength friable dark red/brown slightly silty slightly sandy slightly gravelly CLAY with occasional cobbles and boulders. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone. Cobbles and boulders are up to 330mm, subrounded sandstone.		
					2.50	Complete at 2.50m		

Remarks

Pit dry and stable.

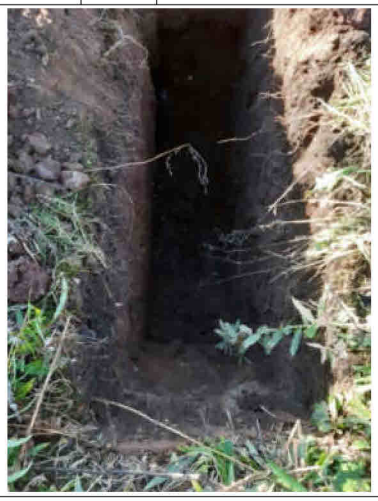
Scale (approx)	Logged By	Figure No.
1:25	KM	VG183.TP08

Johnson Poole & Bloomer

Site	Trial Pit Number
Crieff Road, Perth	TP09

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.5x2.0m		Lidl Great Britain Limited	VG183
	Location	**Dates** 06/10/2021	**Engineer** Blyth & Blyth	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Dark grey/brown silty sandy slightly gravelly clayey TOPSOIL with rootlets. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone.		
					0.30			
					(0.90)	Stiff consistency high strength friable dark grey/brown slightly silty slightly gravelly CLAY with occasional cobbles and boulders. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone. Cobbles and boulders are up to 290mm, subrounded sandstone.		
0.90	V 117.33kPa		95,127,130/Av. 117.33		1.20			
1.50	E1				(1.40)	Stiff consistency probable high strength dark grey/brown silty slightly sandy slightly gravelly CLAY with occasional cobbles and boulders and one rare large boulder. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone. Cobbles and boulders are up to 670mm, subangular to subrounded sandstone.		
					2.60	Complete at 2.60m		



Remarks

Pit terminated at 2.6m due to boulder obstruction.
Pit dry and stable.

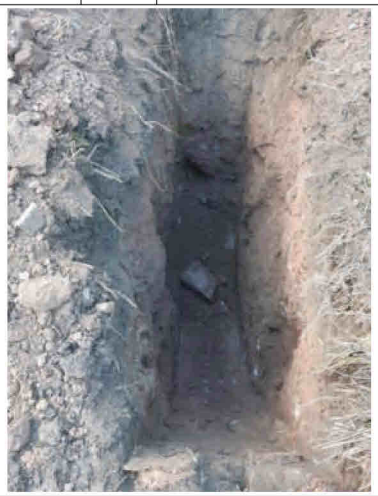
Scale (approx)	Logged By	Figure No.
1:25	KM	VG183.TP09

Johnson Poole & Bloomer

Site	Trial Pit Number
Crieff Road, Perth	TP10

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.5x2.0m		Lidl Great Britain Limited	VG183
	Location	**Dates** 06/10/2021	**Engineer** Blyth & Blyth	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.20	E1				(0.30) 0.30	Dark grey/brown silty sandy slightly gravelly clayey TOPSOIL with rootlets. Gravel is fine to medium, subangular to subrounded mudstone and sandstone.		
					(0.70) 1.00	Dark brown clayey slightly silty slightly gravelly SAND with occasional cobbles and boulders. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone. Cobbles and boulders are up to 60mm, subrounded sandstone.		
1.00	V 131.33kPa		112,132,+150/Av. 131.33		(1.70) 2.70	Stiff consistency high strength friable dark red/brown slightly silty slightly sandy slightly gravelly CLAY with occasional cobbles and boulders. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone. Cobbles and boulders are up to 500mm, subangular to subrounded sandstone.		
2.00	E2					Complete at 2.70m		



Remarks

Pit dry and stable.
Pit terminated at 2.7m due to sandstone and bedrock.

Scale (approx)	Logged By	Figure No.
1:25	KM	VG183.TP10

Johnson Poole & Bloomer

Site	Trial Pit Number
Crieff Road, Perth	TP11

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.5x2.0m		Lidl Great Britain Limited	VG183
	Location	**Dates** 06/10/2021	**Engineer** Blyth & Blyth	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.50 0.50	E1 WA1				(0.80)	MADE GROUND (Dark grey/black silty very gravelly sand with prepared timber and ceramic fragments. Gravel is fine to coarse, subangular, shale, mudstone, sandstone and concrete fragments)		
1.10	E2				0.80 (0.60)	Dark brown very gravelly SAND with occasional cobbles and boulders. Sand is fine to coarse. Gravel is fine to coarse, subrounded to rounded sandstone.		
					1.40 (1.60)	Dark grey/brown very gravelly SAND with occasional cobbles and boulders. Sand is fine to coarse. Gravel is fine to coarse, subangular to rounded sandstone. Cobbles and boulders are up to 240mm, subrounded to rounded sandstone.		
					3.00	Complete at 3.00m		

Remarks

Rootlets were found from 0.0 to 1.4m depth.
Slow water seepage at base of pit.
Pit damp and stable.

Scale (approx)	Logged By	Figure No.
1:25	KM	VG183.TP11

Johnson Poole & Bloomer

Site	Trial Pit Number
Crieff Road, Perth	TP12

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.5x2.0m		Lidl Great Britain Limited	VG183
	Location	**Dates** 06/10/2021	**Engineer** Blyth & Blyth	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.30	E1				(0.50) 0.50	Dark grey/brown slightly clayey slightly silty slightly gravelly sandy TOPSOIL with rootlets. Sand is fine to coarse. Gravel is fine to medium, subangular to subrounded mudstone and sandstone.		
					(0.70) 1.20	Dark orange/brown slightly gravelly SAND with occasional cobbles. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone. Cobbles are up to 80mm, subangular to rounded sandstone.		
1.50	E2				(1.50) 2.70	Dark orange/brown very gravelly SAND with occasional cobbles and boulders. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded mudstone and sandstone. Cobbles and boulders are up to 250mm, subrounded sandstone.		
						Complete at 2.70m		

Remarks

Pit dry and stable.

Scale (approx)	Logged By	Figure No.
1:25	KM	VG183.TP12

Appendix 4 Results of Soakaway Tests – Johnson Poole & Bloomer – October 2021

SOAKAWAY DESIGN IN ACCORDANCE WITH BRE DIGEST 365:1991

Client:	LIDL	**Test Location:**	TP1
Site:	CRIEFF ROAD, PERTH	**Test Date:**	06_10_2021
JPB Project Ref:	VG183	**Calculation Date:**	08_10_2021

Soil Type CLAY

Size of Soakaway:

Length (m)	1.50
Width (m)	0.45
Depth of pit (m)	1.80
Test Depth (m)	0.43
Water level above base (m)	1.37
Effective volume (m^3)	0.92

input required
calculated

Test Depths of Soakaway:

Depth of water at start (m)	0.43
Water level above base at start (m)	1.37
Depth of water at end (m)	0.72
Water level above base at end (m)	1.08
Effective range of test (m)	0.29

75% effective depth for full cycle depth	1.028
50% effective depth for full cycle depth	0.685
25% effective depth for full cycle depth	0.343
Effective range required for full cycle test	0.685

FULL CYCLE TEST NOT ACHIEVED. RESULTS ARE INDICATIVE

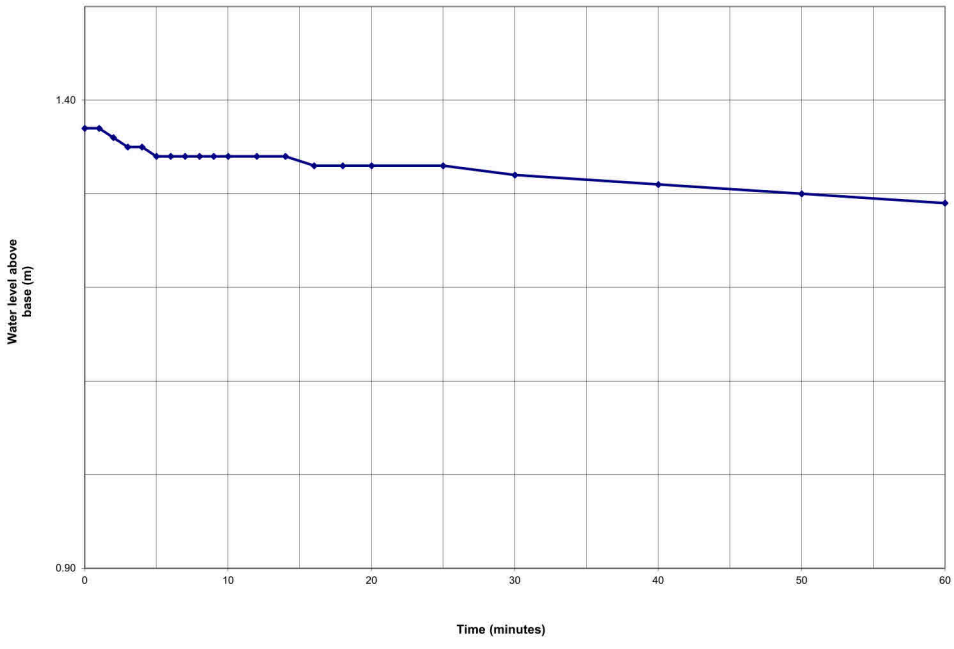
Calculation of Soil Infiltration Rate

Time (minutes)	Depth of water below surface (m)	Water level above base (m)
0	0.43	1.37
1	0.43	1.37
2	0.44	1.36
3	0.45	1.35
4	0.45	1.35
5	0.46	1.34
6	0.46	1.34
7	0.46	1.34
8	0.46	1.34
9	0.46	1.34
10	0.46	1.34
12	0.46	1.34
14	0.46	1.34
16	0.47	1.33
18	0.47	1.33
20	0.47	1.33
25	0.47	1.33
30	0.48	1.32
40	0.49	1.31
50	0.5	1.30
60	0.51	1.29
80	0.53	1.27
100	0.54	1.26
127	0.57	1.23
195	0.6	1.20
287	0.66	1.14
363	0.72	1.08

%	Depth (m)	Water level above base (m)	Time * (minutes)
75%	0.50	1.30	50
50%	0.58	1.23	150
25%	0.65	1.15	265

* estimated from graph

Volume outflow 75%-25% (m^3)	0.10	(V_{p75-25})
Area of pit (50% effective depth) m^2	3.06	(α_{p50})
Time outflow 25%-75% (minutes)	215	(t_{p75-25})



$$f = \frac{V_{p75-25}}{\alpha_{p50} \times t_{p75-25}}$$

Soil Infiltration (f) = **2.48E-06** **m/s**

Completed by:	*AF*	*Checked by:*	

SOAKAWAY DESIGN IN ACCORDANCE WITH BRE DIGEST 365:1991

Client:	LIDL	**Test Location:**	TP3
Site:	CRIEFF ROAD, PERTH	**Test Date:**	06_10_21
JPB Project Ref:	VG183	**Calculation Date:**	08_10_21

Soil Type CLAY

Size of Soakaway:

Length (m)	1.90
Width (m)	0.45
Depth of pit (m)	1.90
Test Depth (m)	0.55
Water level above base (m)	1.35
Effective volume (m^3)	1.15

input required
calculated

Test Depths of Soakaway:

Depth of water at start (m)	0.55
Water level above base at start (m)	1.35
Depth of water at end (m)	0.90
Water level above base at end (m)	1.00
Effective range of test (m)	0.35

75% effective depth for full cycle depth	1.013
50% effective depth for full cycle depth	0.675
25% effective depth for full cycle depth	0.338
Effective range required for full cycle test	0.675

FULL CYCLE TEST NOT ACHIEVED. RESULTS ARE INDICATIVE

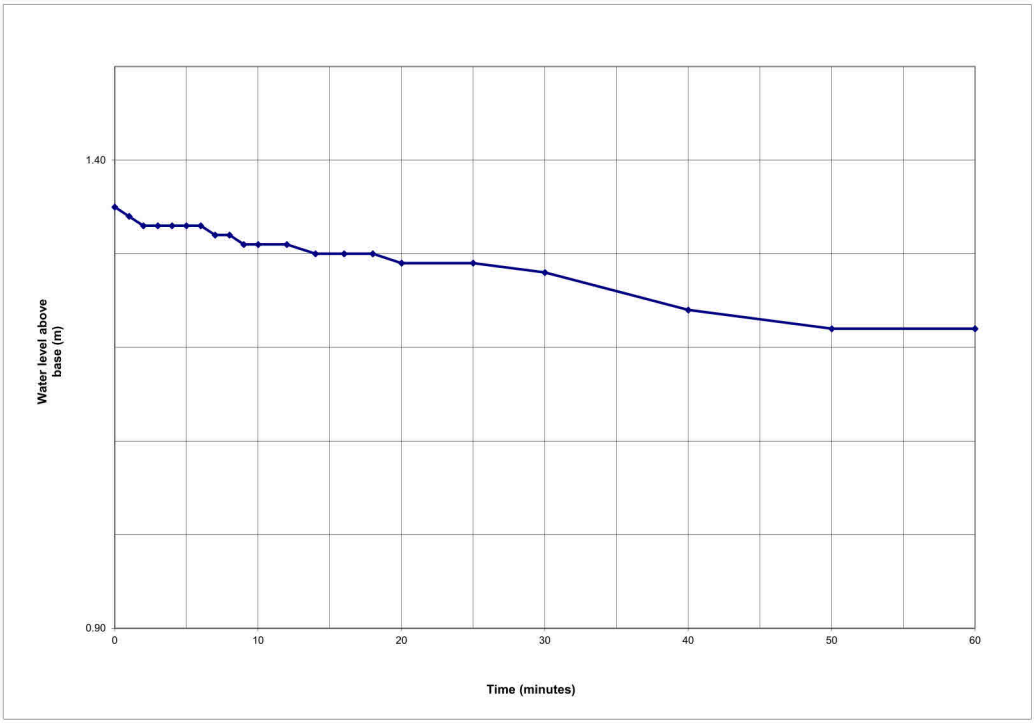
Calculation of Soil Infiltration Rate

Time (minutes)	Depth of water below surface (m)	Water level above base (m)
0	0.55	1.35
1	0.56	1.34
2	0.57	1.33
3	0.57	1.33
4	0.57	1.33
5	0.57	1.33
6	0.57	1.33
7	0.58	1.32
8	0.58	1.32
9	0.59	1.31
10	0.59	1.31
12	0.59	1.31
14	0.6	1.30
16	0.6	1.30
18	0.6	1.30
20	0.61	1.29
25	0.61	1.29
30	0.62	1.28
40	0.66	1.24
50	0.68	1.22
60	0.68	1.22
111	0.75	1.15
201	0.83	1.07
279	0.9	1.00

%	Depth (m)	Water level above base (m)	Time * (minutes)
75%	0.64	1.26	35
50%	0.73	1.18	97
25%	0.81	1.09	187

* estimated from graph

Volume outflow 75%-25% (m^3)	0.15	(V_{p75-25})
Area of pit (50% effective depth) m^2	3.62	(α_{p50})
Time outflow 25%-75% (minutes)	152	(t_{p75-25})



$$f = \frac{V_{p75-25}}{\alpha_{p50} \times t_{p75-25}}$$

Soil Infiltration (f) = **4.54E-06** **m/s**

Completed by:	*AF*	*Checked by:*	

SOAKAWAY DESIGN IN ACCORDANCE WITH BRE DIGEST 365:1991

Client:	LIDL	**Test Location:**	TP6
Site:	CRIEFF ROAD, PERTH	**Test Date:**	06_10_2021
JPB Project Ref:	VG183	**Calculation Date:**	08_10_2021

Soil Type CLAY

Size of Soakaway:

Length (m)	1.70
Width (m)	0.50
Depth of pit (m)	1.95
Test Depth (m)	0.50
Water level above base (m)	1.45
Effective volume (m^3)	1.23

input required
calculated

Test Depths of Soakaway:

Depth of water at start (m)	0.50
Water level above base at start (m)	1.45
Depth of water at end (m)	0.61
Water level above base at end (m)	1.34
Effective range of test (m)	0.11

75% effective depth for full cycle depth	1.088
50% effective depth for full cycle depth	0.725
25% effective depth for full cycle depth	0.363
Effective range required for full cycle test	0.725

FULL CYCLE TEST NOT ACHIEVED. RESULTS ARE INDICATIVE

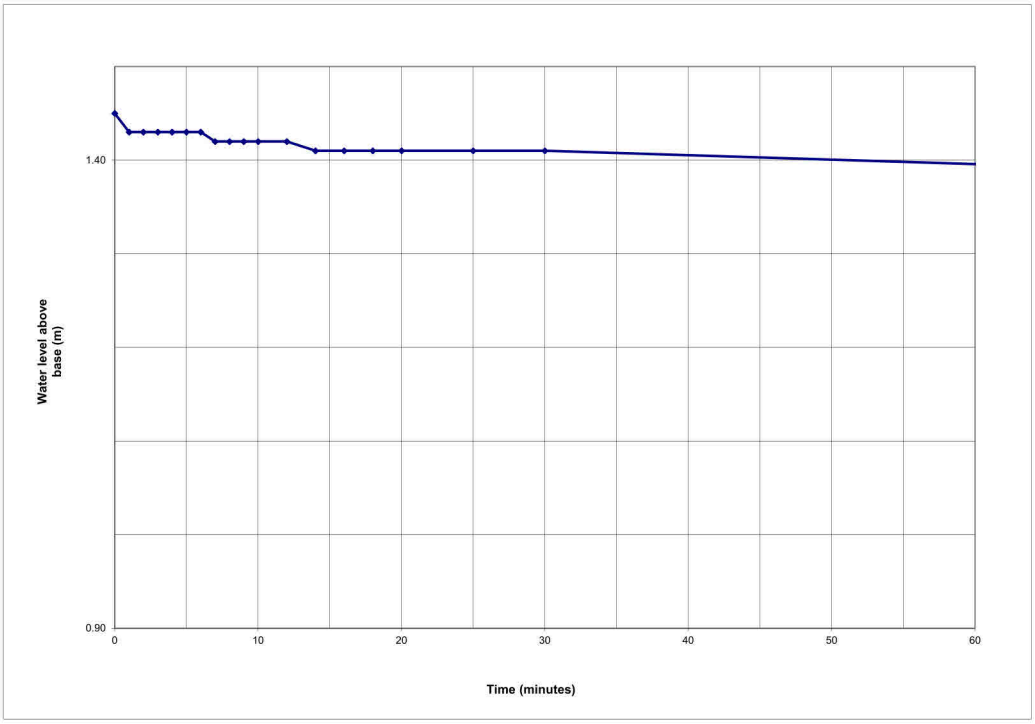
Calculation of Soil Infiltration Rate

Time (minutes)	Depth of water below surface (m)	Water level above base (m)
0	0.5	1.45
1	0.52	1.43
2	0.52	1.43
3	0.52	1.43
4	0.52	1.43
5	0.52	1.43
6	0.52	1.43
7	0.53	1.42
8	0.53	1.42
9	0.53	1.42
10	0.53	1.42
12	0.53	1.42
14	0.54	1.41
16	0.54	1.41
18	0.54	1.41
20	0.54	1.41
25	0.54	1.41
30	0.54	1.41
72	0.56	1.39
108	0.59	1.36
152	0.61	1.34

%	Depth (m)	Water level above base (m)	Time * (minutes)
75%	0.53	1.42	10
50%	0.56	1.40	80
25%	0.58	1.37	100

* estimated from graph

Volume outflow 75%-25% (m^3)	0.05	(V_{p75-25})
Area of pit (50% effective depth) m^2	3.92	(α_{p50})
Time outflow 25%-75% (minutes)	90	(t_{p75-25})



$$f = \frac{V_{p75-25}}{\alpha_{p50} \times t_{p75-25}}$$

Soil Infiltration (f) = **2.21E-06** **m/s**

Completed by:	*AF*	*Checked by:*	

SOAKAWAY DESIGN IN ACCORDANCE WITH BRE DIGEST 365:1991

Client:	LIDL	**Test Location:**	TP 7
Site:	CRIEFF ROAD, PERTH	**Test Date:**	06_10_2021
JPB Project Ref:	VG183	**Calculation Date:**	08_10_2021

Soil Type CLAY

Size of Soakaway:

Length (m)	2.00
Width (m)	0.50
Depth of pit (m)	1.70
Test Depth (m)	0.60
Water level above base (m)	1.10
Effective volume (m^3)	1.10

input required
calculated

Test Depths of Soakaway:

Depth of water at start (m)	0.60
Water level above base at start (m)	1.10
Depth of water at end (m)	0.67
Water level above base at end (m)	1.03
Effective range of test (m)	0.07

75% effective depth for full cycle depth	0.825
50% effective depth for full cycle depth	0.550
25% effective depth for full cycle depth	0.275
Effective range required for full cycle test	0.550

FULL CYCLE TEST NOT ACHIEVED. RESULTS ARE INDICATIVE

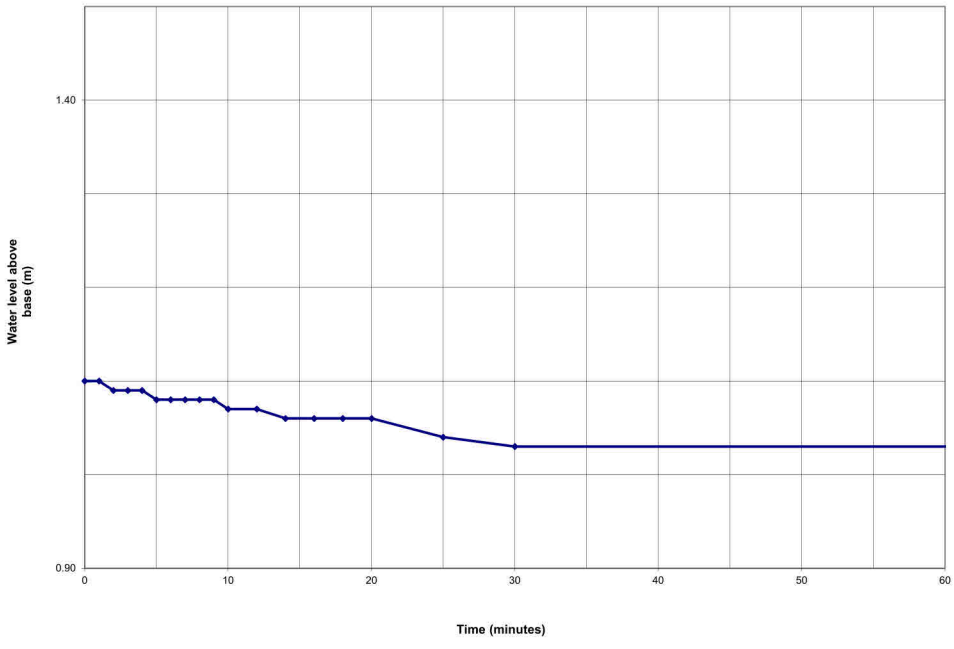
Calculation of Soil Infiltration Rate

Time (minutes)	Depth of water below surface (m)	Water level above base (m)
0	0.6	1.10
1	0.6	1.10
2	0.61	1.09
3	0.61	1.09
4	0.61	1.09
5	0.62	1.08
6	0.62	1.08
7	0.62	1.08
8	0.62	1.08
9	0.62	1.08
10	0.63	1.07
12	0.63	1.07
14	0.64	1.06
16	0.64	1.06
18	0.64	1.06
20	0.64	1.06
25	0.66	1.04
30	0.67	1.03
71	0.67	1.03
117	0.67	1.03

%	Depth (m)	Water level above base (m)	Time * (minutes)
75%	0.62	1.08	5
50%	0.64	1.07	10
25%	0.65	1.05	22.5

* estimated from graph

Volume outflow 75%-25% (m^3)	0.04	(V_{p75-25})
Area of pit (50% effective depth) m^2	3.66	(α_{p50})
Time outflow 25%-75% (minutes)	17.5	(t_{p75-25})



$$f = \frac{V_{p75-25}}{\alpha_{p50} \times t_{p75-25}}$$

Soil Infiltration (f) = **9.10E-06** **m/s**

Completed by:	*AF/AJB*	*Checked by:*	

Appendix 5 Site Investigation Report – SKF Ltd – November 2021

SKF Ltd
Ground Investigation & Site Surveys

SKF Ltd, Constablewood Estate, Brisbane Glen, Largs
Tel: 07795 493892 Email: SKFLTD@BTINTERNET.COM

BOREHOLE NO. BH01

Contract: CRIEFF RD, PERTH
Contract No: 6517
Status: FINAL

Client: JOHNSON POOLE AND BLOOMER
Boring Diameter: 115MM
Co-ordinates E

Date: 30/09/2021
Equipment: PREMIER BADGER
N

Description of Strata	Legend	Depth	Level	Sampling	SPT Blows U Blows Hand Vane	Pipe
Ground Surface						
MADE GROUND: Topsoil / rough grass		0.30		DJV 0.20		
Soft to firm becoming firm reddish brown very sandy gravelly CLAY with occasional cobbles. Gravel fine to coarse and angular to sub rounded.		1.70		DJV 0.50 DJV 1.00 SPT 1.00-1.45 U76 1.00-2.00	2,1,1,2,2,2	
Stiff to very stiff reddish brown sandy gravelly CLAY with occasional cobbles. Gravel fine to coarse and angular to sub rounded.		3.00		D 2.00 SPT 2.00-2.45 U66 2.00-3.00 D 3.00	3,4,5,6,7,9	

Water Strikes	Details	SYMBOLS KEY
Strike: DRY Flow:	Casing: 2.00 Final Depth: 3.00	B - BULK NR - NO RECOVERY U - UNDISTURBED * - ESTIMATED DENSITY D - SMALL DISTURBED HV - HAND VANE J - JAR V - VIAL W - WATER

Inspection Pit: 0.30 X 0.30 X 1.00
Breaking Out / Coring:
Installation: Standpipe 50mm diameter installed to 3.00.
Notes:

Logged by: AH Checked by: SKF

ALL DIMENSIONS ARE IN METRES

SKF Ltd
Ground Investigation & Site Surveys

SKF Ltd, Constablewood Estate, Brisbane Glen, Largs
Tel: 07795 493892 Email: SKFLTD@BTINTERNET.COM

BOREHOLE NO. BH02

Contract: CRIEFF RD, PERTH
Contract No: 6517
Status: FINAL

Client: JOHNSON POOLE AND BLOOMER
Boring Diameter: 115MM
Co-ordinates E

Date: 30/09/2021
Equipment: PREMIER BADGER
N

Description of Strata	Legend	Depth	Level	Sampling	SPT Blows U Blows Hand Vane	Pipe
Ground Surface						
MADE GROUND: Topsoil / rough grass		0.20		DJV 0.20		
Medium dense* reddish brown clayey SAND and GRAVEL. Gravel fine to coarse and angular to sub rounded.		1.35		DJV 0.50 DJV 1.00 SPT 1.00-1.45 U76 1.00-2.00	3,2,1,1,1,1	
Soft to firm at top becoming firm reddish brown very sandy gravelly CLAY with occasional cobbles. Gravel fine to coarse and angular to sub rounded. At 2.30m hard osbtruction, presumed boulder.		2.30		D 2.00 SPT 2.00-2.30	3,3,4,4,45/0mm	

Water Strikes
Strike: DRY Flow:

Details
Casing: 2.00 Final Depth: 2.30

Inspection Pit: 0.30 X 0.30 X 1.00
Breaking Out / Coring:
Installation:
Notes: Borehole backfilled on completion.

Logged by: AH Checked by: SKF

SYMBOLS KEY

B - BULK
U - UNDISTURBED
D - SMALL DISTURBED
J - JAR
V - VIAL
W - WATER
NR - NO RECOVERY
* - ESTIMATED DENSITY
HV - HAND VANE

ALL DIMENSIONS ARE IN METRES

SKF Ltd
Ground Investigation & Site Surveys

SKF Ltd, Constablewood Estate, Brisbane Glen, Largs
Tel: 07795 493892 Email: SKFLTD@BTINTERNET.COM

BOREHOLE NO. BH03

Contract: CRIEFF RD,PERTH **Contract No:** 6517 **Status:** FINAL

Client: JOHNSON POOLE AND BLOOMER **Boring Diameter:** 115MM **Co-ordinates** E

Date: 30/09/2021 **Equipment:** PREMIER BADGER N

Description of Strata	Legend	Depth	Level	Sampling	SPT Blows U Blows Hand Vane	Pipe
Ground Surface						
MADE GROUND: Topsoil / rough grass		0.30		DJV 0.20		
Medium dense* reddish brown clayey SAND and GRAVEL. Gravel fine to coarse and angular to sub rounded.		1.10		DJV 0.50 DJV 1.00 SPT 1.00-1.45 U76 1.00-2.00	4,3,3,2,1,1	
Soft to firm and firm reddish brown very sandy gravelly CLAY with occasional cobbles. Gravel fine to coarse and angular to sub rounded.		2.10		D 2.00 SPT 2.00-2.45 U66 2.00-3.00	2,3,4,16,9,10	
Stiff to very stiff reddish brown sandy gravelly CLAY with occasional cobbles. Gravel fine to coarse and angular to sub rounded. At 2.20m boulder.		3.00		D 3.00		

Water Strikes
Strike: DRY Flow:

Details
Casing: 2.00 Final Depth: 3.00

Inspection Pit: 0.30 X 0.30 X 1.00
Breaking Out / Coring:
Installation:
Notes: Borehole backfilled on completion.

Logged by: AH Checked by: SKF

SYMBOLS KEY

B - BULK NR - NO RECOVERY
U - UNDISTURBED * - ESTIMATED DENSITY
D - SMALL DISTURBED HV - HAND VANE
J - JAR
V - VIAL
W - WATER

ALL DIMENSIONS ARE IN METRES

SKF Ltd
Ground Investigation & Site Surveys

SKF Ltd, Constablewood Estate, Brisbane Glen, Largs
Tel: 07795 493892 Email: SKFLTD@BTINTERNET.COM

BOREHOLE NO. BH04

Contract: CRIEFF RD, PERTH
Contract No: 6517
Status: FINAL

Client: JOHNSON POOLE AND BLOOMER
Boring Diameter: 115MM
Co-ordinates E

Date: 30/09/2021
Equipment: PREMIER BADGER
N

Description of Strata	Legend	Depth	Level	Sampling	SPT Blows U Blows Hand Vane	Pipe
Ground Surface						
MADE GROUND: Topsoil / rough grass.		0.30		DJV 0.20		
Medium dense* becoming loose reddish brown clayey SAND and GRAVEL. Gravel fine to coarse and angular to sub rounded.		1.60		DJV 0.50 DJV 1.00 SPT 1.00-1.45 U76 1.00-2.00	5,4,2,2,1,3	
Soft to firm becoming firm reddish brown very sandy gravelly CLAY with occasional cobbles. Gravel fine to coarse and angular to sub rounded. At 2.15m pushing cobble. At 2.55m hard obstruction, presumed boulder.		2.55		D 2.00 SPT 2.00-2.45 SPT 2.50-2.55	5,6,23,33,43,45 55/50mm	

Water Strikes
Strike: DRY Flow:

Details
Casing: 2.00 Final Depth: 2.55

Inspection Pit: 0.30 X 0.30 X 1.00
Breaking Out / Coring:
Installation: Standpipe 50mm diameter installed to 2.00m.
Notes:

Logged by: AH Checked by: SKF

SYMBOLS KEY

B - BULK
U - UNDISTURBED
D - SMALL DISTURBED
J - JAR
V - VIAL
W - WATER
NR - NO RECOVERY
* - ESTIMATED DENSITY
HV - HAND VANE

ALL DIMENSIONS ARE IN METRES

SKF Ltd
Ground Investigation & Site Surveys

SKF Ltd, Constablewood Estate, Brisbane Glen, Largs
Tel: 07795 493892 Email: SKFLTD@BTINTERNET.COM

BOREHOLE NO. BH05

Contract: CRIEFF RD, PERTH
Contract No: 6517
Status: FINAL

Client: JOHNSON POOLE & BLOOMER
Boring Diameter: 115MM
Co-ordinates E

Date: 30/09/2021
Equipment: PREMIER BADGER
N

Description of Strata	Legend	Depth	Level	Sampling	SPT Blows U Blows Hand Vane	Pipe
Ground Surface						
MADE GROUND: Topsoil / rough grass.		0.35		DJV 0.20		
Medium dense* light brown clayey gravelly fine to coarse SAND. Gravel fine to coarse and angular to sub rounded.		1.30		DJV 0.50 DJV 1.00 SPT 1.00-1.45 U86 1.00-2.00	3,3,3,3,3,4	
Very stiff reddish brown sandy gravelly CLAY. Gravel fine to coarse and angular to sub rounded. Occasional cobbles. At 2.90m hard obstruction, presumed boulder.		2.90		D 2.00 SPT 2.00-2.45 U78 2.00-2.90 D 2.90 SPT 2.90	2,2,2,2,2,4 20/0mm	

Water Strikes
Strike: DRY Flow:

Details
Casing: 2.00 Final Depth: 2.90

Inspection Pit: 0.30 X 0.30 X 1.00
Breaking Out / Coring:
Installation: Standpipe 50mm diameter installed to 2.90m.
Notes:

Logged by: EM Checked by: SKF

SYMBOLS KEY

B - BULK
U - UNDISTURBED
D - SMALL DISTURBED
J - JAR
V - VIAL
W - WATER
NR - NO RECOVERY
* - ESTIMATED DENSITY
HV - HAND VANE

ALL DIMENSIONS ARE IN METRES

SKF Ltd
Ground Investigation & Site Surveys

SKF Ltd, Constablewood Estate, Brisbane Glen, Largs
Tel: 07795 493892 Email: SKFLTD@BTINTERNET.COM

BOREHOLE NO. BH06

Contract: CRIEFF RD, PERTH
Contract No: 6517
Status: FINAL

Client: JOHNSON POOLE & BLOOMER
Boring Diameter: 115MM
Co-ordinates E

Date: 30/09/2021
Equipment: PREMIER BADGER
N

Description of Strata	Legend	Depth	Level	Sampling	SPT Blows U Blows Hand Vane	Pipe
Ground Surface						
MADE GROUND: Topsoil / rough grass.		0.30		DJV 0.20		
Medium dense* light brown clayey silty gravelly fine to coarse SAND. Gravel fine to coarse and angular to sub rounded.		0.80		DJV 0.50		
Soft to firm becoming firm reddish brown sandy gravelly CLAY. Gravel fine to coarse and angular to sub rounded. Occasional cobbles.		1.30		DJV 1.00 SPT 1.00-1.45 U86 1.00-2.00	1,2,1,2,2,2	
Very stiff reddish brown sandy gravelly CLAY. Gravel fine to coarse and angular to sub rounded. Occasional cobbles. At 2.30m hard obstruction, presumed boulder.		2.30		D 2.00 SPT 2.00-2.30 U78 2.00-2.30 D 2.30	19,24,26,35	

Water Strikes	Details	SYMBOLS KEY
Strike: DRY Flow:	Casing: 2.00 Final Depth: 2.30	B - BULK NR - NO RECOVERY U - UNDISTURBED * - ESTIMATED DENSITY D - SMALL DISTURBED HV - HAND VANE J - JAR V - VIAL W - WATER

Inspection Pit: 0.30 X 0.30 X 1.00
Breaking Out / Coring:
Installation: Standpipe 50mm diameter installed to 2.30m.
Notes:

Logged by: EM Checked by: SKF

ALL DIMENSIONS ARE IN METRES

SKF Ltd
Ground Investigation & Site Surveys

SKF Ltd, Constablewood Estate, Brisbane Glen, Largs
Tel: 07795 493892 Email: SKFLTD@BTINTERNET.COM

BOREHOLE NO. BH07

Contract: CRIEFF RD, PERTH
Contract No: 6517
Status: FINAL

Client: JOHNSON POOLE & BLOOMER
Boring Diameter: 115MM
Co-ordinates E

Date: 30/09/2021
Equipment: PREMIER BADGER
N

Description of Strata	Legend	Depth	Level	Sampling	SPT Blows U Blows Hand Vane	Pipe
Ground Surface						
MADE GROUND: Topsoil / rough grass.		0.25		DJV 0.20		
Stiff becoming very stiff reddish brown sandy gravelly CLAY. Gravel fine to coarse and angular to sub rounded. Occasional cobbles. At 4.80m hard obstruction, presumed boulder.				DJV 0.50 DJV 1.00 SPT 1.00-1.45 U86 1.00-2.00 D 2.00 SPT 2.00-2.45 U78 2.00-3.00 D 3.00 SPT 3.00-3.45 U66 3.00-4.00 D 4.00 SPT 4.00-4.45 SPT 4.50-4.80	2,2,2,2,2,3 3,3,4,3,4,4 3,4,5,5,5,5 5,5,5,5,7,9 17,11,16,43	
		4.80				

Water Strikes
Strike: DRY Flow:

Details
Casing: 2.00 Final Depth: 4.80

Inspection Pit: 0.30 X 0.30 X 1.00
Breaking Out / Coring:
Installation: Standpipe 50mm diameter installed to 4.00m.
Notes:

Logged by: EM Checked by: SKF

SYMBOLS KEY

B - BULK
U - UNDISTURBED
D - SMALL DISTURBED
J - JAR
V - VIAL
W - WATER
NR - NO RECOVERY
* - ESTIMATED DENSITY
HV - HAND VANE

ALL DIMENSIONS ARE IN METRES

SKF Ltd
Ground Investigation & Site Surveys

SKF Ltd, Constablewood Estate, Brisbane Glen, Largs
Tel: 07795 493892 Email: SKFLTD@BTINTERNET.COM

BOREHOLE NO. BH08

Contract: CRIEFF RD, PERTH
Contract No: 6517
Status: FINAL

Client: JOHNSON POOLE & BLOOMER
Boring Diameter: 115MM
Co-ordinates E

Date: 30/09/2021
Equipment: PREMIER BADGER
N

Description of Strata	Legend	Depth	Level	Sampling	SPT Blows U Blows Hand Vane	Pipe
Ground Surface						
MADE GROUND: Topsoil / rough grass.		0.30		DJV 0.20		
Medium dense* light brown slightly clayey SAND and GRAVEL. Occasional bands of firm to stiff sandy gravelly clay. Gravel fine to coarse and angular to sub rounded.		2.10		DJV 0.50 DJV 1.00 SPT 1.00-1.45 U86 1.00-2.00 D 2.00 SPT 2.00-2.45 U78 2.00-3.00	2,2,2,3,4,5 2,3,2,3,4,4	
Very stiff reddish brown sandy gravelly CLAY. Gravel fine to coarse and angular to sub rounded. Occasional cobbles. At 3.10m hard obstruction, presumed boulder.		3.10		D 3.00 SPT 3.00-3.10	15,34/25mm	

Water Strikes
Strike: DRY Flow:

Details
Casing: 2.00 Final Depth: 3.10

Inspection Pit: 0.30 X 0.30 X 1.00
Breaking Out / Coring:
Installation: Standpipe 50mm diameter installed to 3.00m.
Notes:

Logged by: EM Checked by: SKF

SYMBOLS KEY

B - BULK
U - UNDISTURBED
D - SMALL DISTURBED
J - JAR
V - VIAL
W - WATER
NR - NO RECOVERY
* - ESTIMATED DENSITY
HV - HAND VANE

ALL DIMENSIONS ARE IN METRES

MATtest Limited
materials testing & consultancy

10 Queenslie Point
Queenslie Industrial Estate
120 Stepps Road
Glasgow
G33 3NQ

Tel: 0141 774 4032

email: info@mattest.org
Website: www.mattest.org

LABORATORY TEST CERTIFICATE

Certificate No : **21/1201 - 01**

To : **Scott Farquhar**

Client : **SKF Ltd.**
Constablewood Estate
Brisbane Glen
Largs
KA30 8SN

LABORATORY TESTING OF SOIL

Introduction

We refer to samples taken from Crieff Road, Perth and delivered to our laboratory on 05th October 2021.

Material & Source

Sample Reference	:	See Report Plates
Sampled By	:	Client
Sampling Certificate	:	Not Supplied
Location	:	See Report Plates
Description	:	See Page 2
Date Sampled	:	Not Supplied
Date Tested	:	05th October 2021 Onwards
Source	:	VG183 - Crieff Road, Perth

Test Results

As Detailed On Page 2 to Page 21 inclusive

Comments

The results contained in this report relate to the sample(s) as received
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
All remaining samples for this project will be disposed of 28 days after issue of this test certificate

Remarks

Approved for Issue

[redacted]

T McLelland (Director)

Date 03/11/2021

UKAS TESTING
2643

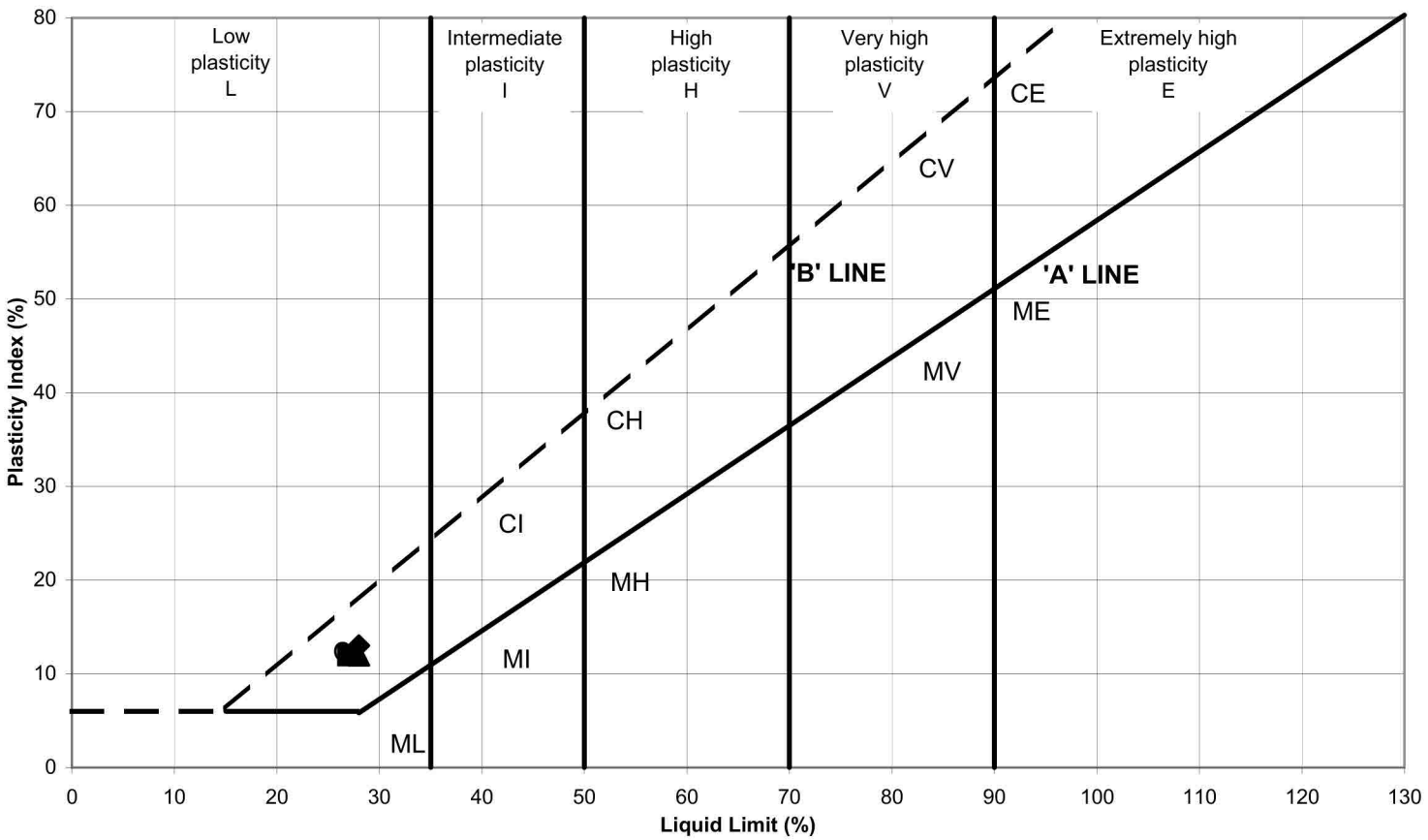
BOREHOLE	SAMPLE	DEPTH (m)	SAMPLE DESCRIPTION
BH2	U	1.00-1.80	Brown very gravelly very sandy CLAY. Gravel is fine to coarse.
BH5	U	1.00-1.90	Brown very gravelly very sandy CLAY. Gravel is fine to coarse.
BH5	U	2.00-2.90	Brown gravelly sandy CLAY. Gravel is fine to coarse.
BH6	U	1.00-1.90	Brown gravelly sandy CLAY. Gravel is fine to coarse.
BH6	U	2.00-2.35	Brown gravelly sandy CLAY. Gravel is fine to coarse.
BH7	U	1.00-2.00	Brown gravelly sandy CLAY. Gravel is fine to coarse.
BH8	U	1.00-1.70	Brown very gravelly very sandy CLAY. Gravel is fine to coarse.
BH8	U	2.00-3.00	Brown gravelly sandy CLAY. Gravel is fine to coarse.

SUMMARY OF SAMPLE DESCRIPTIONS

BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)
BH5	U	2.40	12
BH6	U	2.00	11
BH8	U	2.50	11

Tested in accordance with BS 1377: Part 2: 1990: Clause 3

SUMMARY OF MOISTURE CONTENT TEST RESULTS



Symbol	Borehole	Sample	Depth	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing 0.425mm Sieve	Remarks
■	BH5	U	2.50	12	27	15	12	66	Clay with low plasticity
◆	BH6	U	2.05	11	28	15	13	73	Clay with low plasticity
▲	BH8	U	2.55	11	28	16	12	72	Clay with low plasticity
●									
□									
◇									
△									
○									
×									
✳									

All samples were tested in accordance with BS 1377 : Part 2 : 1990 Clause 4.3, 5.3 and 5.4.
All samples were washed on a 0.425mm test sieve prior to test.

SUMMARY OF ATTERBERG LIMITS TEST RESULTS

SKF LTD.
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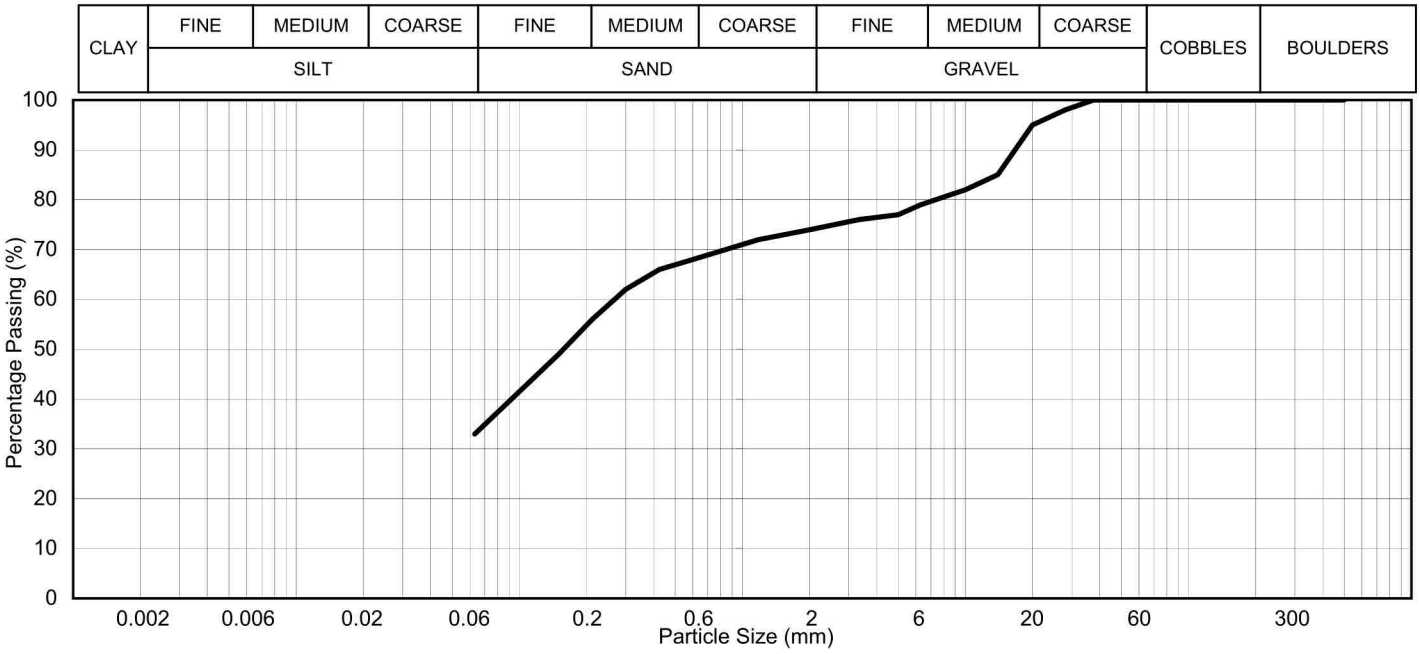
Borehole	BH2
Sample	U
Depth (m)	1.00-1.80



SIEVING				SEDIMENTATION	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.020	
300.0	100	-	-	0.006	
125.0	100	-	-	0.002	
90.0	100	-	-		
75.0	100	-	-	**GRADING CLASSIFICATION (SHW TABLE 6/2)**	
63.0	100	-	-	-	
50.0	100	-	-		
37.5	100	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	98	-	-		
20.0	95	-	-		
14.0	85	-	-		
10.0	82	-	-	**PERCENTAGE SOIL TYPES**	
6.30	79	-	-		
5.00	77	-	-		
3.35	76	-	-		
2.00	74	-	-		
1.18	72	-	-	**UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)**	
0.600	68	-	-		
0.425	66	-	-		
0.300	62	-	-		
0.212	56	-	-		
0.150	49	-	-		
0.063	33	-	-		

CLAY	SILT ₸	SAND	GRAVEL	COBBLES
/	33	41	26	0

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

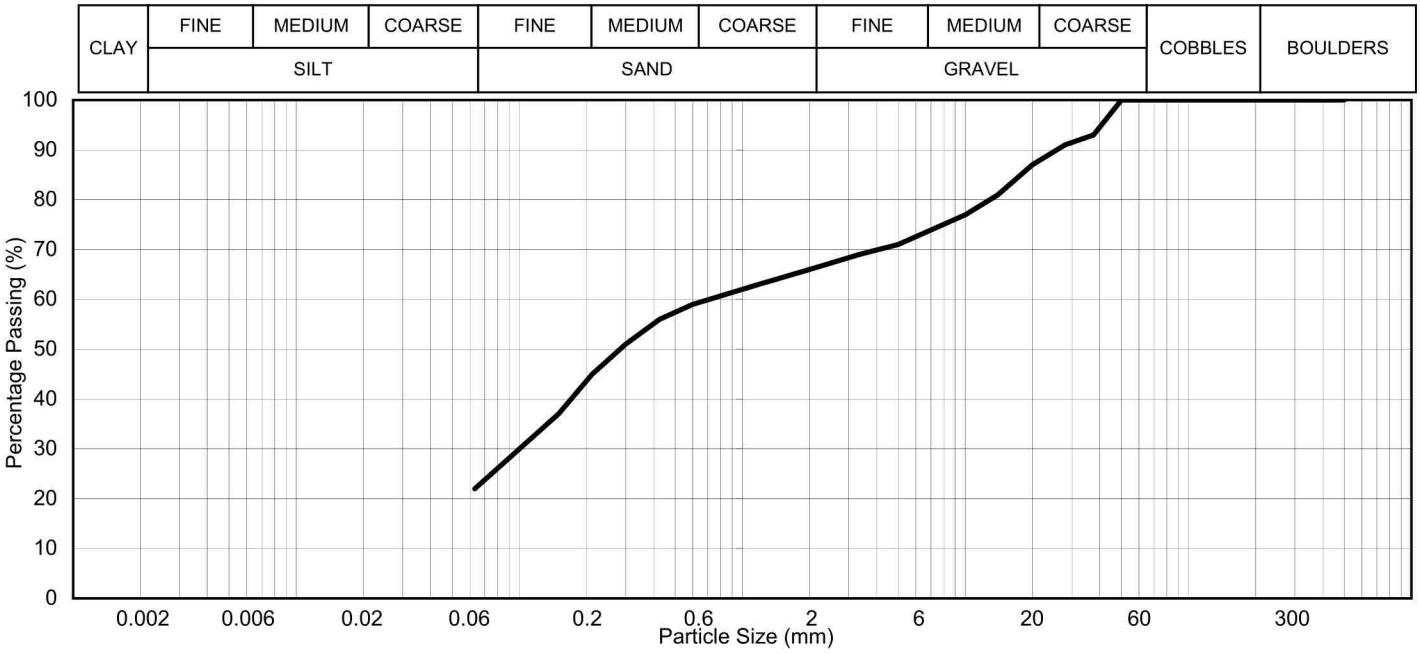
₸ Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

SIEVE ANALYSIS - BS 1377 : Part 2 : 1990 : CLAUSE 9.2

SKF LTD.
CRIEFF ROAD, PERTH

MATtest Limited
materials testing & consultancy

Borehole	BH5
Sample	U
Depth (m)	1.00-1.70



SIEVING				SEDIMENTATION	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable Lower %	Specification Not Applicable Upper %	Particle Size (mm)	Percentage Passing (%)
500.0	100	-	-	0.020	
300.0	100	-	-	0.006	
125.0	100	-	-	0.002	
90.0	100	-	-		
75.0	100	-	-		
63.0	100	-	-		
50.0	100	-	-		
37.5	93	-	-		
28.0	91	-	-		
20.0	87	-	-		
14.0	81	-	-		
10.0	77	-	-		
6.30	73	-	-		
5.00	71	-	-		
3.35	69	-	-		
2.00	66	-	-		
1.18	63	-	-		
0.600	59	-	-		
0.425	56	-	-		
0.300	51	-	-		
0.212	45	-	-		
0.150	37	-	-		
0.063	22	-	-		

GRADING CLASSIFICATION (SHW TABLE 6/2)

-

Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.

PERCENTAGE SOIL TYPES

CLAY	SILT ₸	SAND	GRAVEL	COBBLES
/	22	44	34	0

UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT -		-

Remarks

₸ Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

SIEVE ANALYSIS - BS 1377 : Part 2 : 1990 : CLAUSE 9.2

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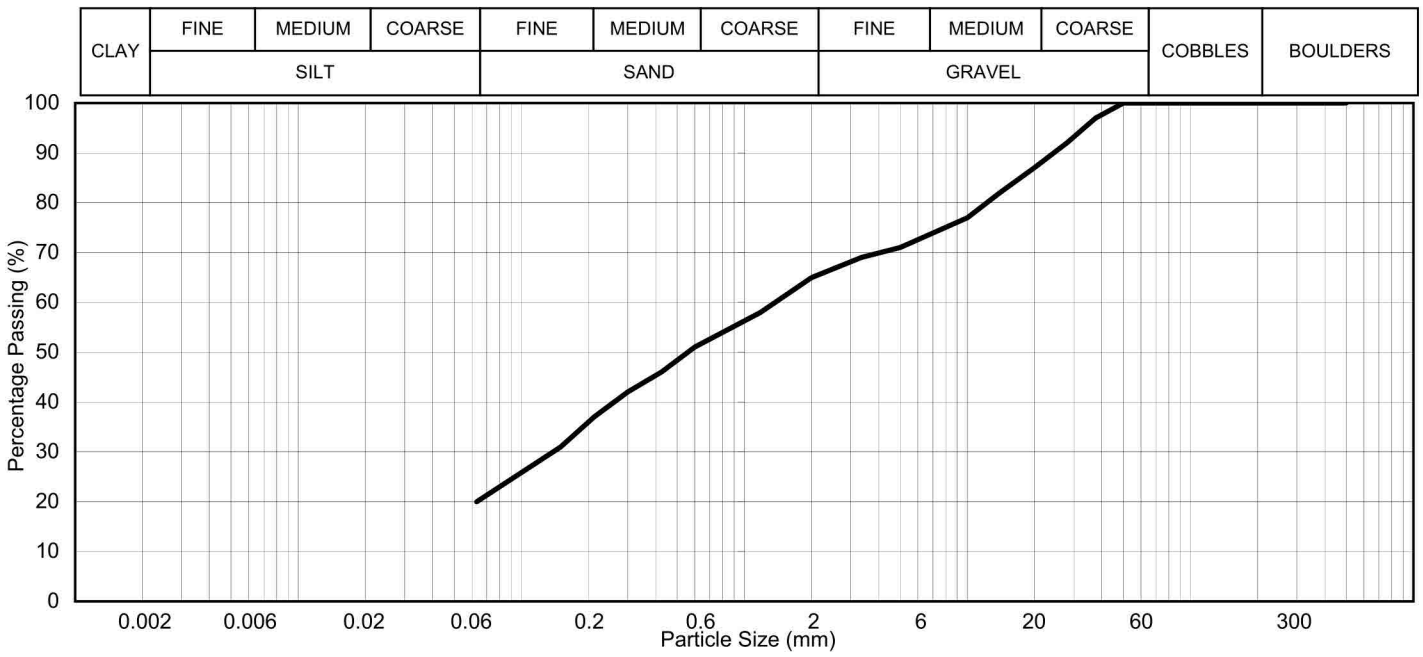
Borehole	BH8
Sample	U
Depth (m)	1.00-1.70



SIEVING				SEDIMENTATION	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.020	
300.0	100	-	-	0.006	
125.0	100	-	-	0.002	
90.0	100	-	-		
75.0	100	-	-	**GRADING CLASSIFICATION (SHW TABLE 6/2)**	
63.0	100	-	-	-	
50.0	100	-	-		
37.5	97	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	92	-	-		
20.0	87	-	-		
14.0	82	-	-		
10.0	77	-	-	**PERCENTAGE SOIL TYPES**	
6.30	73	-	-		
5.00	71	-	-		
3.35	69	-	-		
2.00	65	-	-		
1.18	58	-	-	**UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)**	
0.600	51	-	-		
0.425	46	-	-		
0.300	42	-	-		
0.212	37	-	-		
0.150	31	-	-		
0.063	20	-	-		

CLAY	SILT ₸	SAND	GRAVEL	COBBLES
/	20	45	35	0

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

₸ Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

SIEVE ANALYSIS - BS 1377 : Part 2 : 1990 : CLAUSE 9.2

BOREHOLE	SAMPLE	DEPTH (m)	SPECIMEN § ORIENTATION	PREPARATION METHOD *	BS TEST METHODS *	SAMPLE PASSING 2mm SIEVE (%)	TOTAL SULPHATE (% SO3)	2:1 WATER SOLUBLE SULPHATE (g/l SO3)	pH VALUE
BH5	U	1.70	N/A	5.3 / 9.4	5.5 / 9.5	66	-	<0.01	6.6
BH6	U	2.10	N/A	5.3 / 9.4	5.5 / 9.5	84	-	<0.01	6.5
BH8	U	2.60	N/A	5.3 / 9.4	5.5 / 9.5	77	-	0.01	6.7

All tests performed on fraction of sample passing 2mm sieve
NOTE: To convert sulphate results from SO_3 to SO_4 multiply by 1.2

§ Specimen orientation :	
N/A	Not applicable due to preparation method and/or sample type
V	Cut vertically from undisturbed sample
H	Cut horizontally from undisturbed sample

* Tested in accordance with the following clauses of BS 1377: Part 3: 1990:			
5.2	Acid extract method	9.4	Preparation of pH test specimen
5.3	Water extract method	9.5	Determination of the pH value
5.5	Gravimetric method of analysis		

SUMMARY OF SULPHATE & pH TEST RESULTS

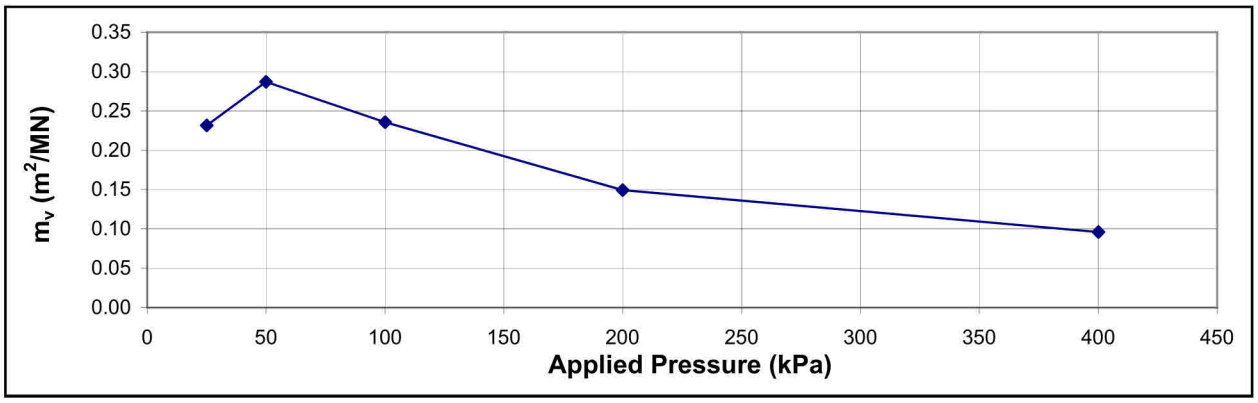
BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m^3)	DRY DENSITY (Mg/m^3)
BH5	U	2.60	14	2.12	1.86

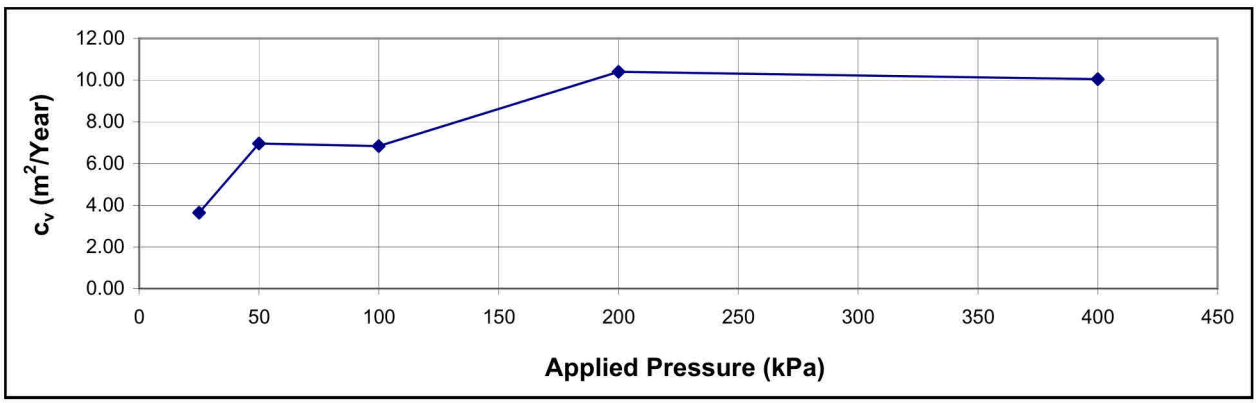
SAMPLE DIAMETER (mm)	SAMPLE HEIGHT (mm)	PARTICLE DENSITY (Mg/m^3)	INITIAL VOIDS RATIO	DEGREE OF SATURATION (%)	SWELLING PRESSURE (kPa)
74.98	20.20	2.65	0.427	90	

The value detailed for Particle Density is an assumed value

PRESSURE (kPa)	SAMPLE HEIGHT (mm)	VOIDS RATIO	m_v (m^2/MN)	c_v (m^2/Year)	c_{sec}
0	20.20	0.427			
25	20.08	0.419	0.23	3.64	
50	19.94	0.409	0.29	6.96	
100	19.70	0.392	0.24	6.83	
200	19.41	0.372	0.15	10.40	
400	19.04	0.345	0.10	10.05	

mv indicates values of coefficient of volume compressibility, cv indicates values of coefficient of consolidation

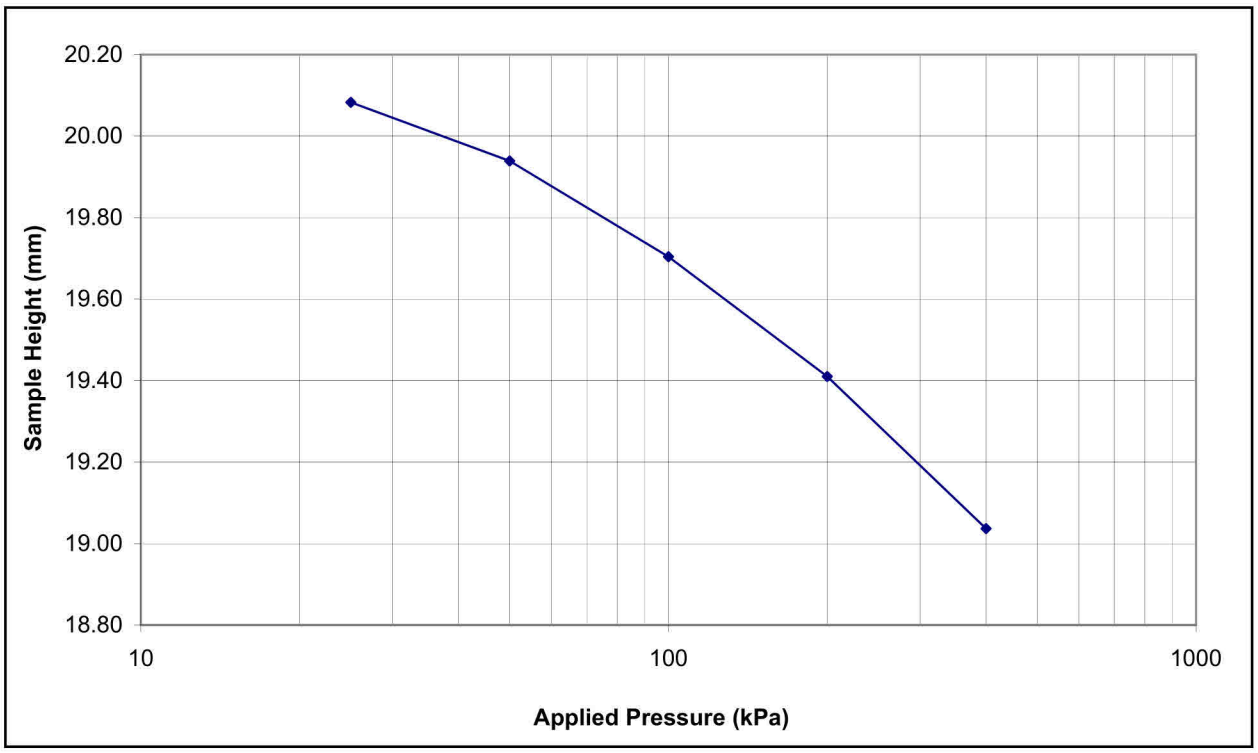


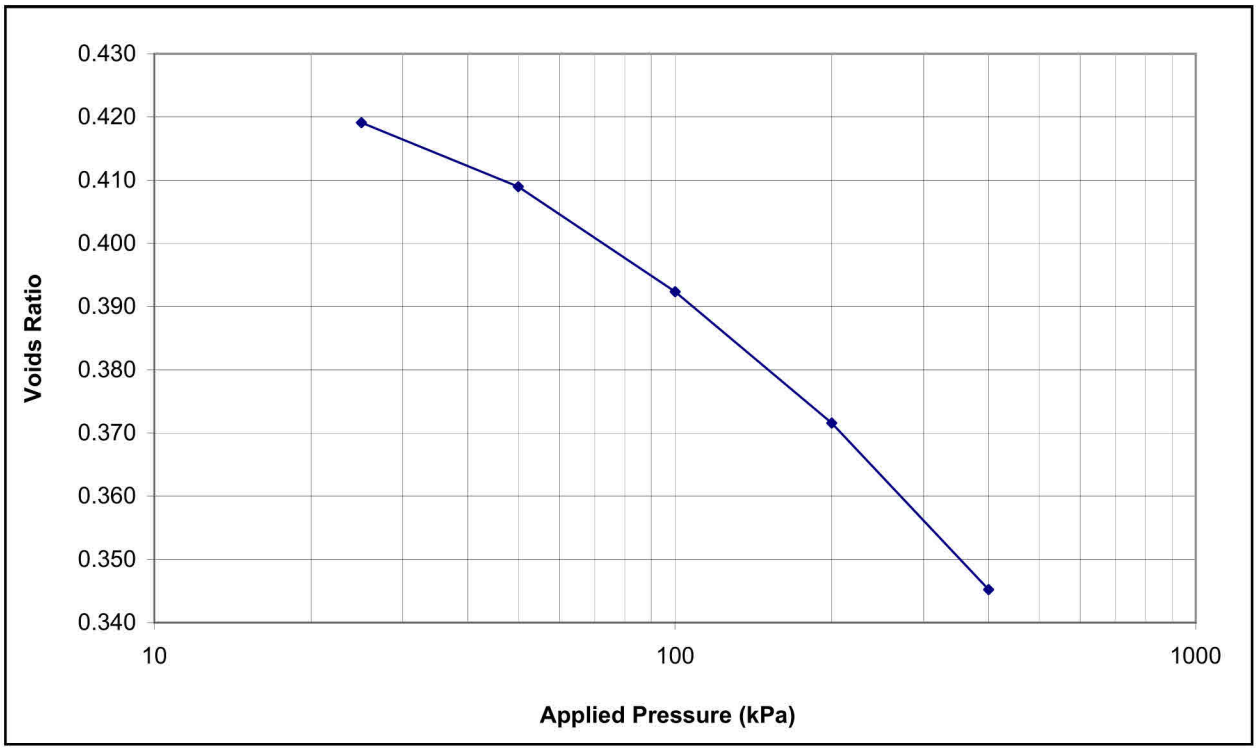


Tested in a temperature controlled room at 20 +/- 2°C
Tested in accordance with BS 1377: Part 5: 1990: Clause 3

ONE DIMENSIONAL CONSOLIDATION TEST RESULTS

BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m^3)	DRY DENSITY (Mg/m^3)
BH5	U	2.60	14	2.12	1.86





Sample was extruded directly from an undisturbed sample and vertical axis was maintained during testing

Tested in a temperature controlled room at 20 +/- 2°C
Tested in accordance with BS 1377: Part 5: 1990: Clause 3

ONE DIMENSIONAL CONSOLIDATION TEST RESULTS

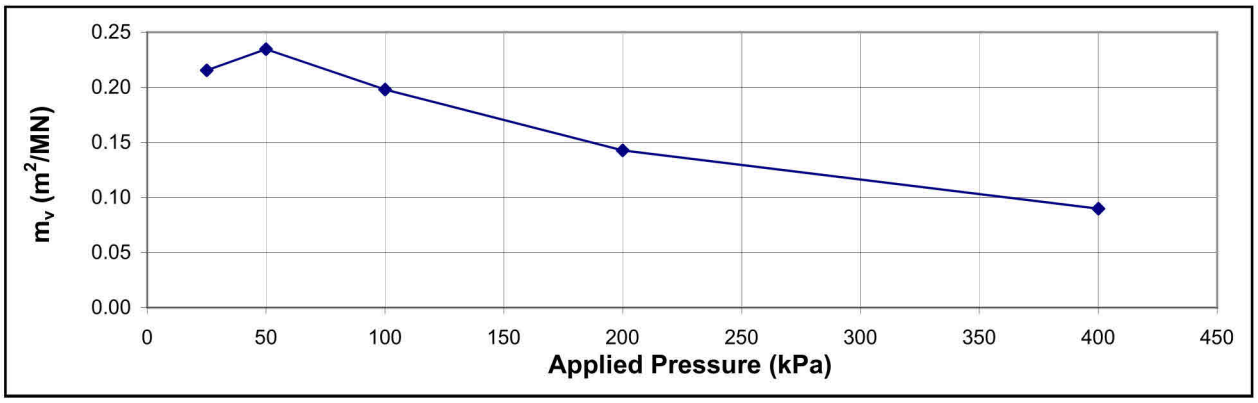
BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m^3)	DRY DENSITY (Mg/m^3)
BH6	U	1.60	12	2.14	1.91

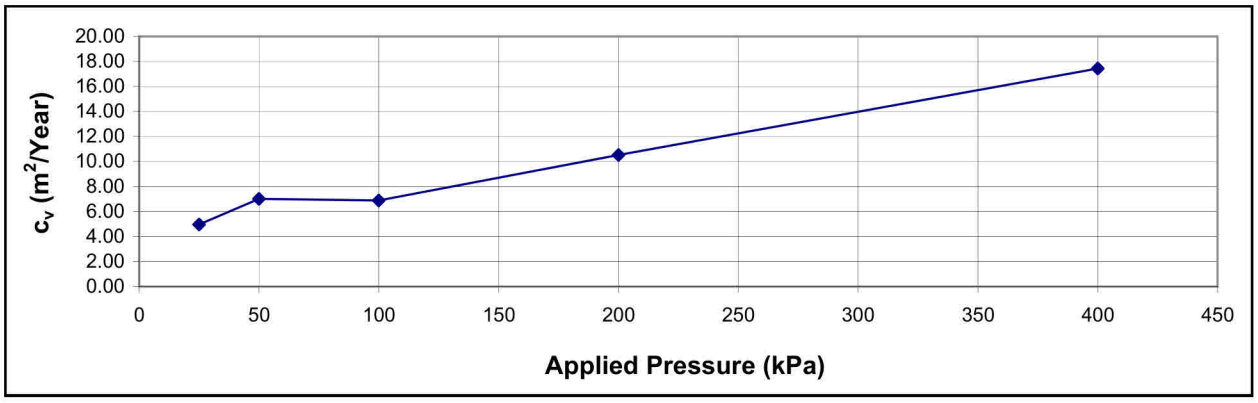
SAMPLE DIAMETER (mm)	SAMPLE HEIGHT (mm)	PARTICLE DENSITY (Mg/m^3)	INITIAL VOIDS RATIO	DEGREE OF SATURATION (%)	SWELLING PRESSURE (kPa)
75.05	20.24	2.65	0.386	81	

The value detailed for Particle Density is an assumed value

PRESSURE (kPa)	SAMPLE HEIGHT (mm)	VOIDS RATIO	m_v (m^2/MN)	c_v (m^2/Year)	c_{sec}
0	20.24	0.386			
25	20.13	0.379	0.22	4.98	
50	20.01	0.371	0.23	7.01	
100	19.82	0.357	0.20	6.90	
200	19.53	0.338	0.14	10.52	
400	19.18	0.314	0.09	17.45	

mv indicates values of coefficient of volume compressibility, cv indicates values of coefficient of consolidation

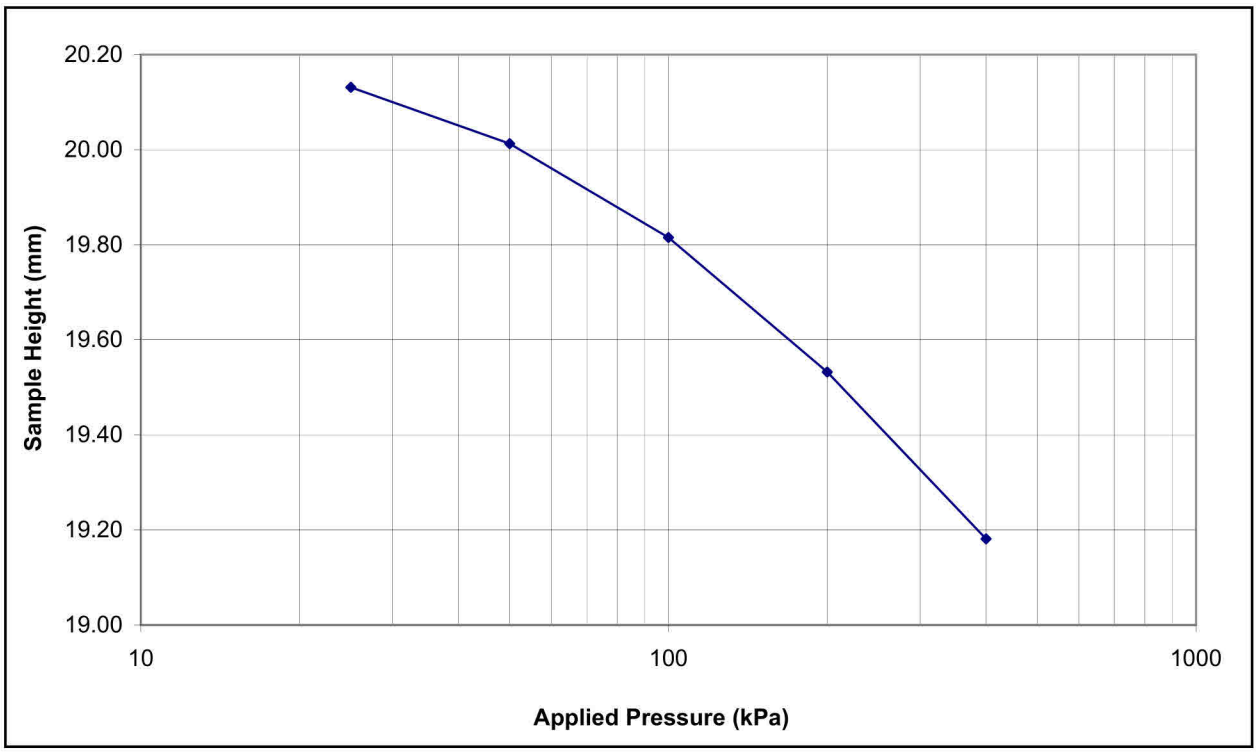


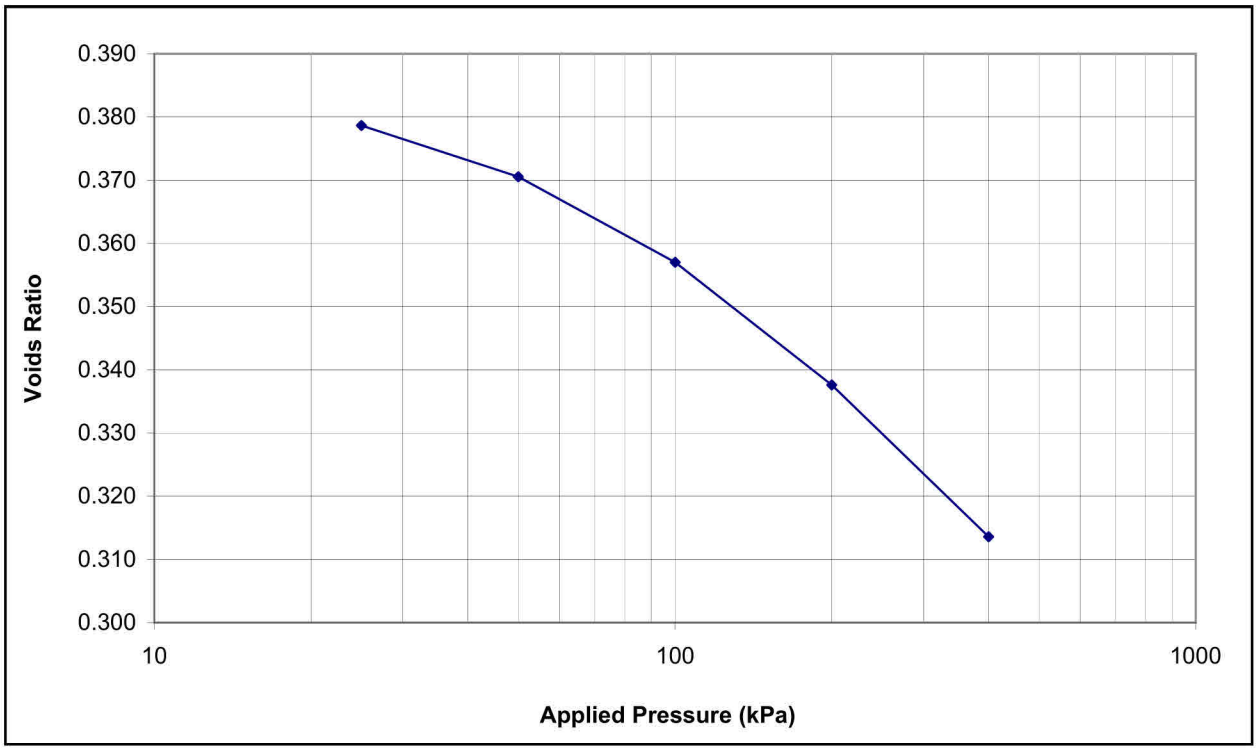


Tested in a temperature controlled room at 20 +/- 2°C
Tested in accordance with BS 1377: Part 5: 1990: Clause 3

ONE DIMENSIONAL CONSOLIDATION TEST RESULTS

BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m^3)	DRY DENSITY (Mg/m^3)
BH6	U	1.60	12	2.14	1.91





Sample was extruded directly from an undisturbed sample and vertical axis was maintained during testing

Tested in a temperature controlled room at 20 +/- 2°C
Tested in accordance with BS 1377: Part 5: 1990: Clause 3

ONE DIMENSIONAL CONSOLIDATION TEST RESULTS

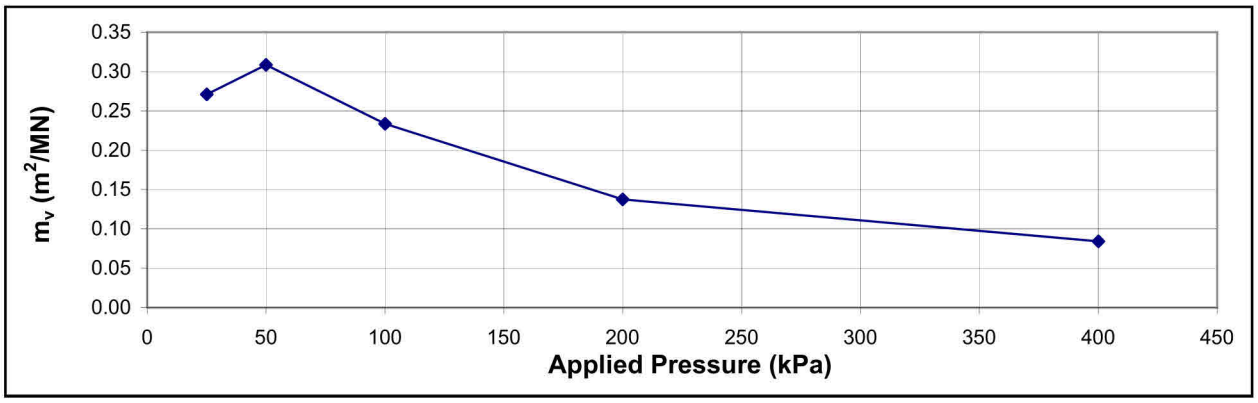
BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m^3)	DRY DENSITY (Mg/m^3)
BH7	U	1.70	14	2.15	1.88

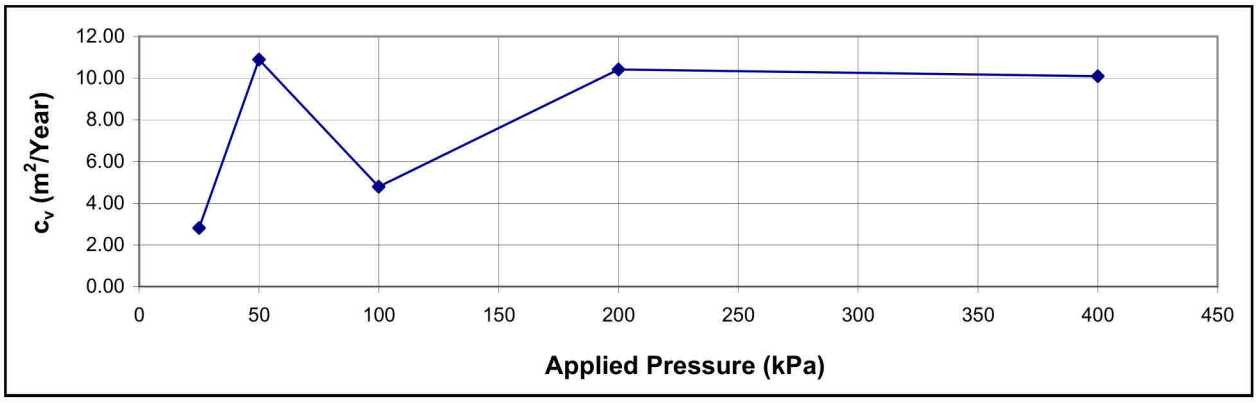
SAMPLE DIAMETER (mm)	SAMPLE HEIGHT (mm)	PARTICLE DENSITY (Mg/m^3)	INITIAL VOIDS RATIO	DEGREE OF SATURATION (%)	SWELLING PRESSURE (kPa)
74.86	20.23	2.65	0.408	91	

The value detailed for Particle Density is an assumed value

PRESSURE (kPa)	SAMPLE HEIGHT (mm)	VOIDS RATIO	m_v (m^2/MN)	c_v (m^2/Year)	c_{sec}
0	20.23	0.408			
25	20.09	0.399	0.27	2.81	
50	19.94	0.388	0.31	10.89	
100	19.71	0.372	0.23	4.80	
200	19.43	0.353	0.14	10.41	
400	19.11	0.330	0.08	10.09	

mv indicates values of coefficient of volume compressibility, cv indicates values of coefficient of consolidation

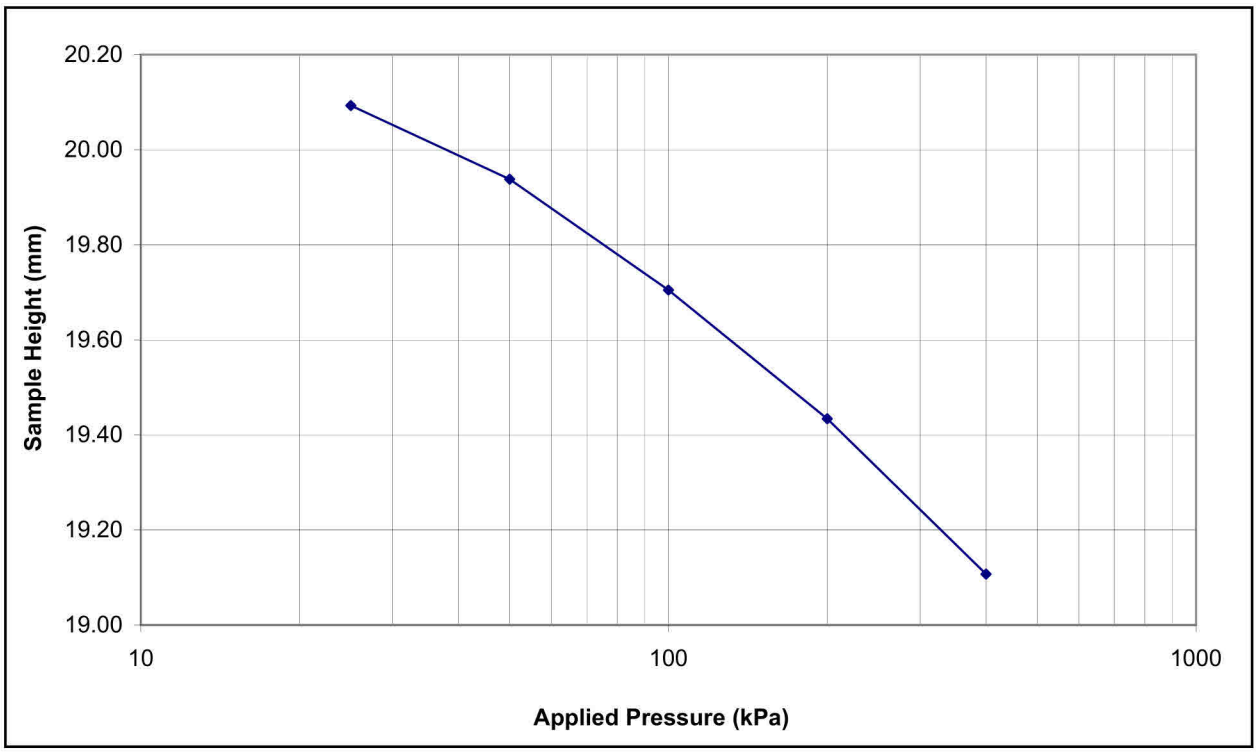


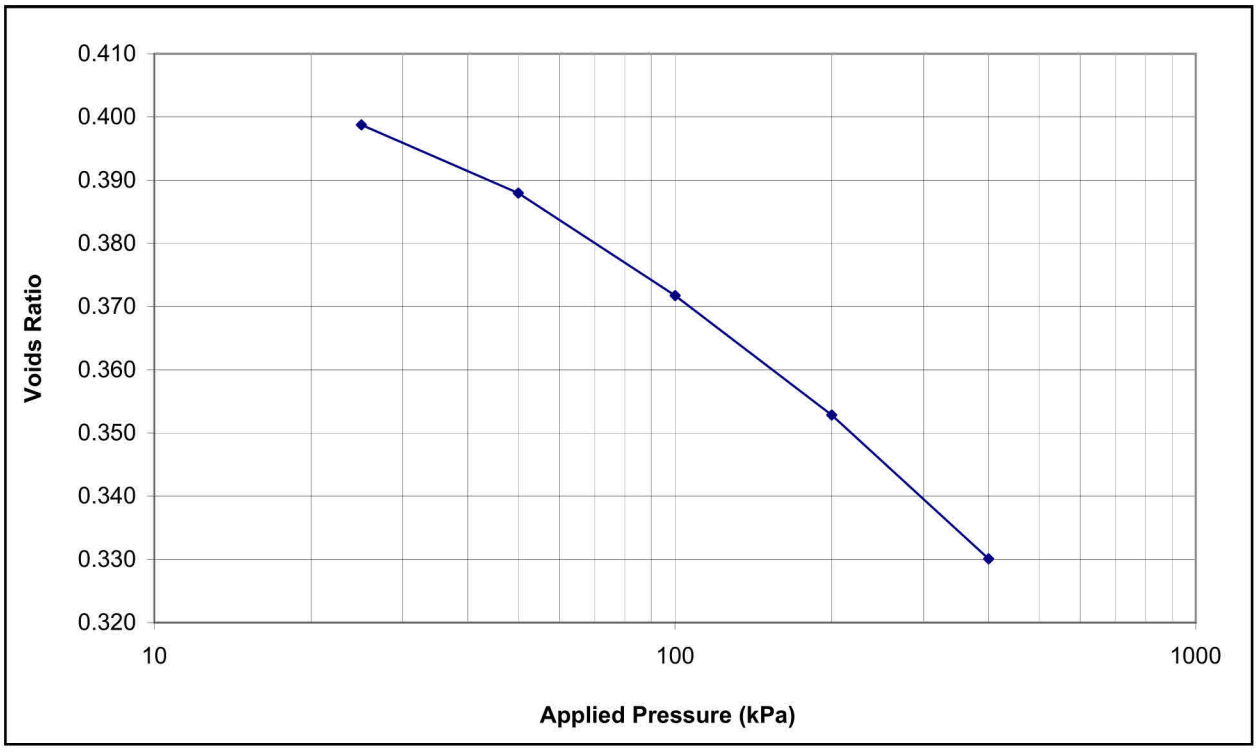


Tested in a temperature controlled room at 20 +/- 2°C
Tested in accordance with BS 1377: Part 5: 1990: Clause 3

ONE DIMENSIONAL CONSOLIDATION TEST RESULTS

BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m^3)	DRY DENSITY (Mg/m^3)
BH7	U	1.70	14	2.15	1.88





Sample was extruded directly from an undisturbed sample and vertical axis was maintained during testing

Tested in a temperature controlled room at 20 +/- 2°C
Tested in accordance with BS 1377: Part 5: 1990: Clause 3

ONE DIMENSIONAL CONSOLIDATION TEST RESULTS

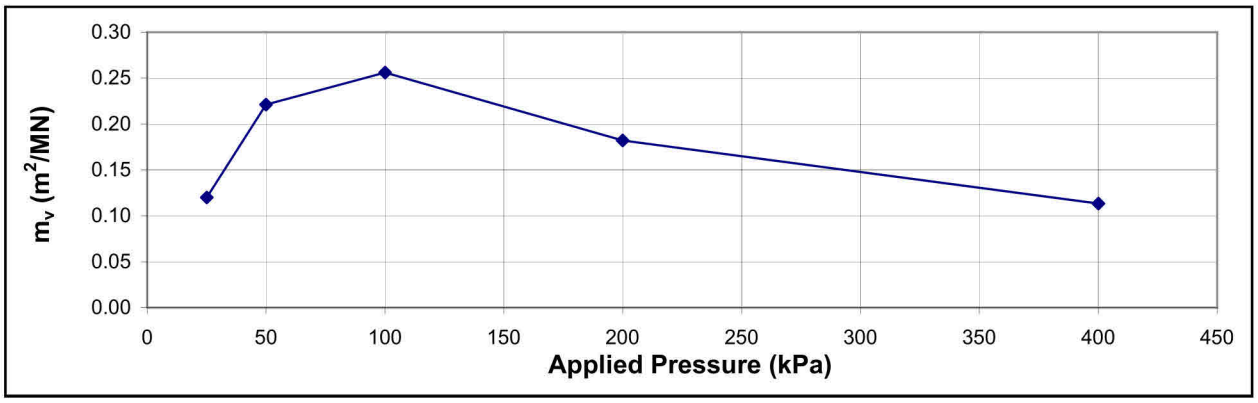
BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m^3)	DRY DENSITY (Mg/m^3)
BH8	U	2.70	13	2.11	1.87

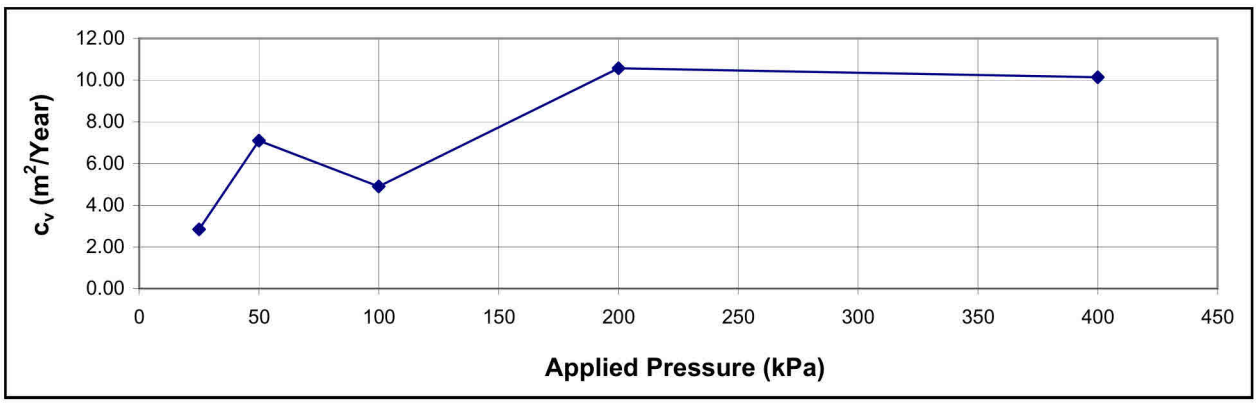
SAMPLE DIAMETER (mm)	SAMPLE HEIGHT (mm)	PARTICLE DENSITY (Mg/m^3)	INITIAL VOIDS RATIO	DEGREE OF SATURATION (%)	SWELLING PRESSURE (kPa)
74.98	20.33	2.65	0.416	82	

The value detailed for Particle Density is an assumed value

PRESSURE (kPa)	SAMPLE HEIGHT (mm)	VOIDS RATIO	m_v (m^2/MN)	c_v (m^2/Year)	c_{sec}
0	20.33	0.416			
25	20.27	0.412	0.12	2.84	
50	20.16	0.404	0.22	7.10	
100	19.90	0.386	0.26	4.90	
200	19.54	0.361	0.18	10.57	
400	19.09	0.330	0.11	10.14	

mv indicates values of coefficient of volume compressibility, cv indicates values of coefficient of consolidation

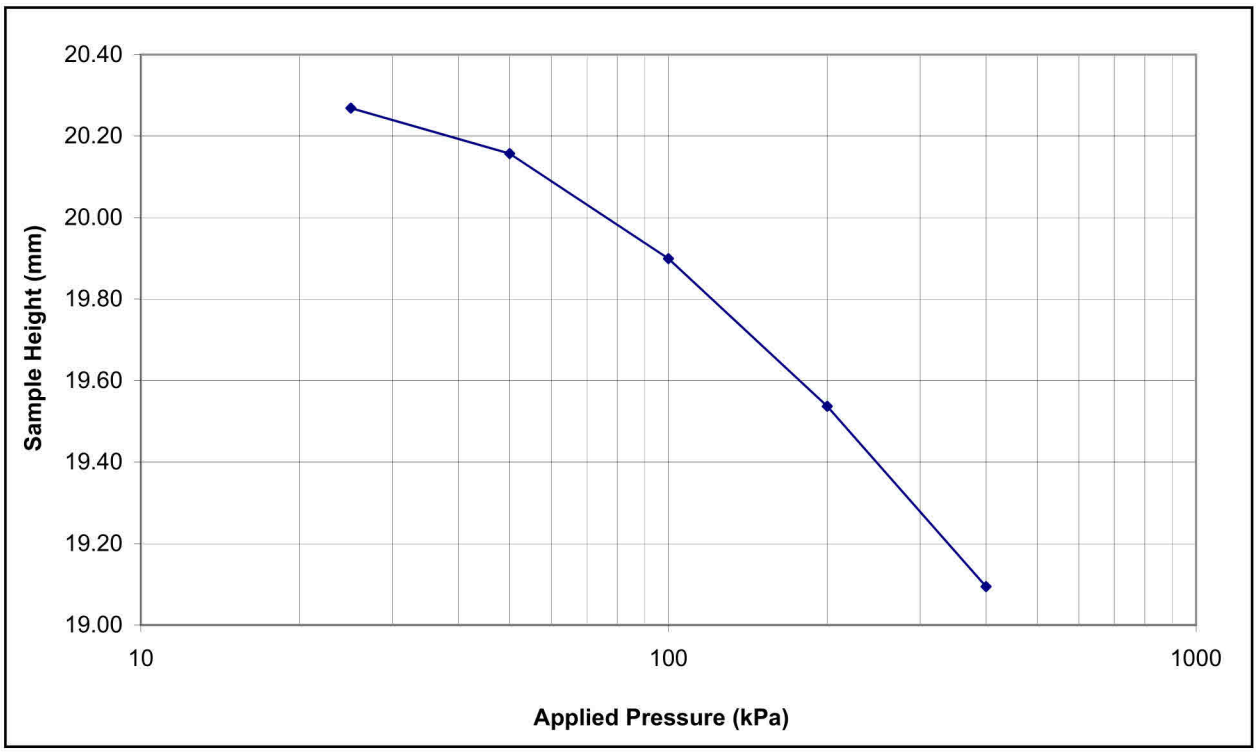


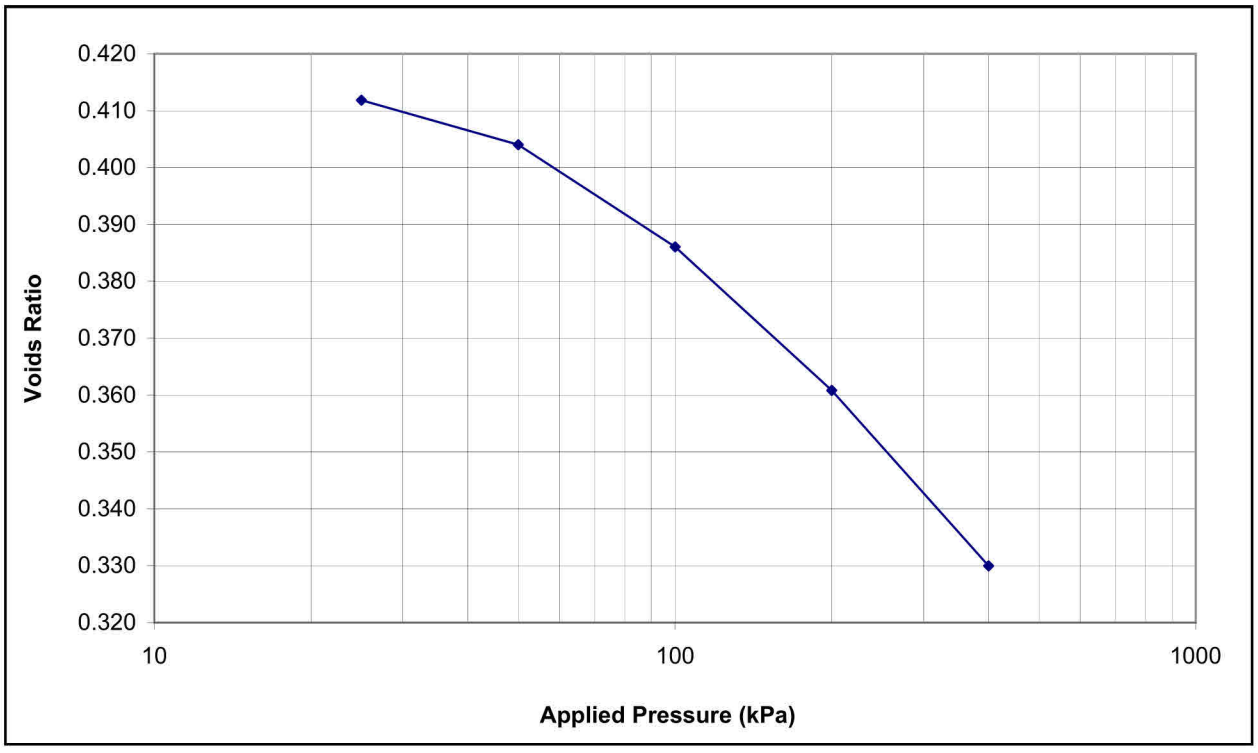


Tested in a temperature controlled room at 20 +/- 2°C
Tested in accordance with BS 1377: Part 5: 1990: Clause 3

ONE DIMENSIONAL CONSOLIDATION TEST RESULTS

BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m^3)	DRY DENSITY (Mg/m^3)
BH8	U	2.70	13	2.11	1.87

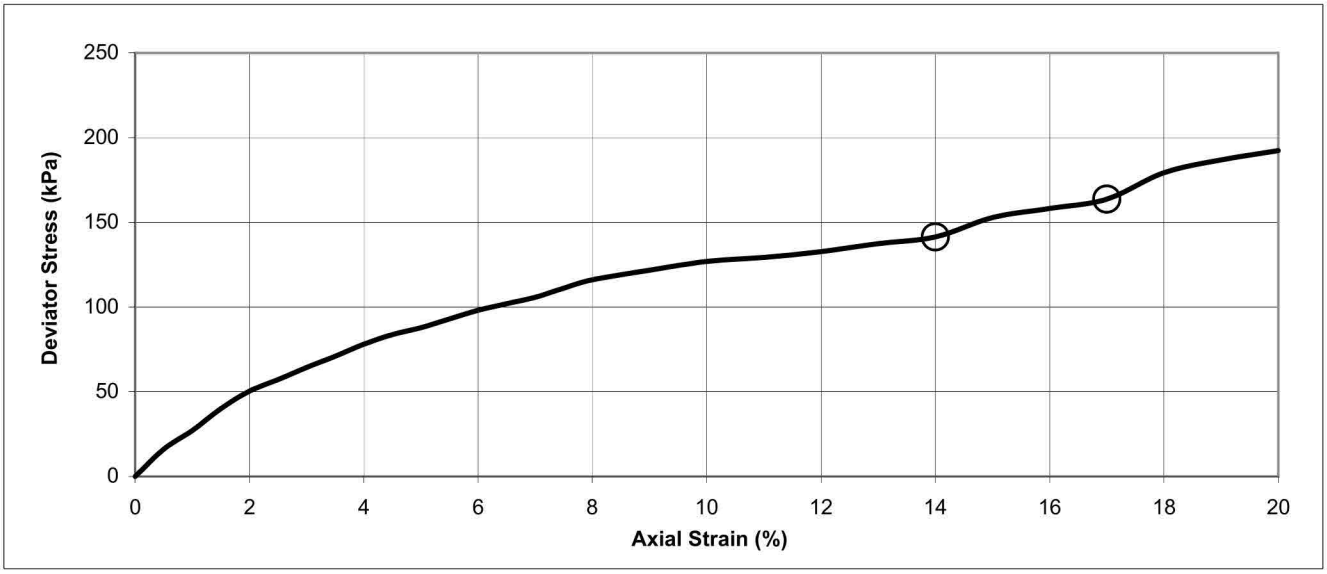


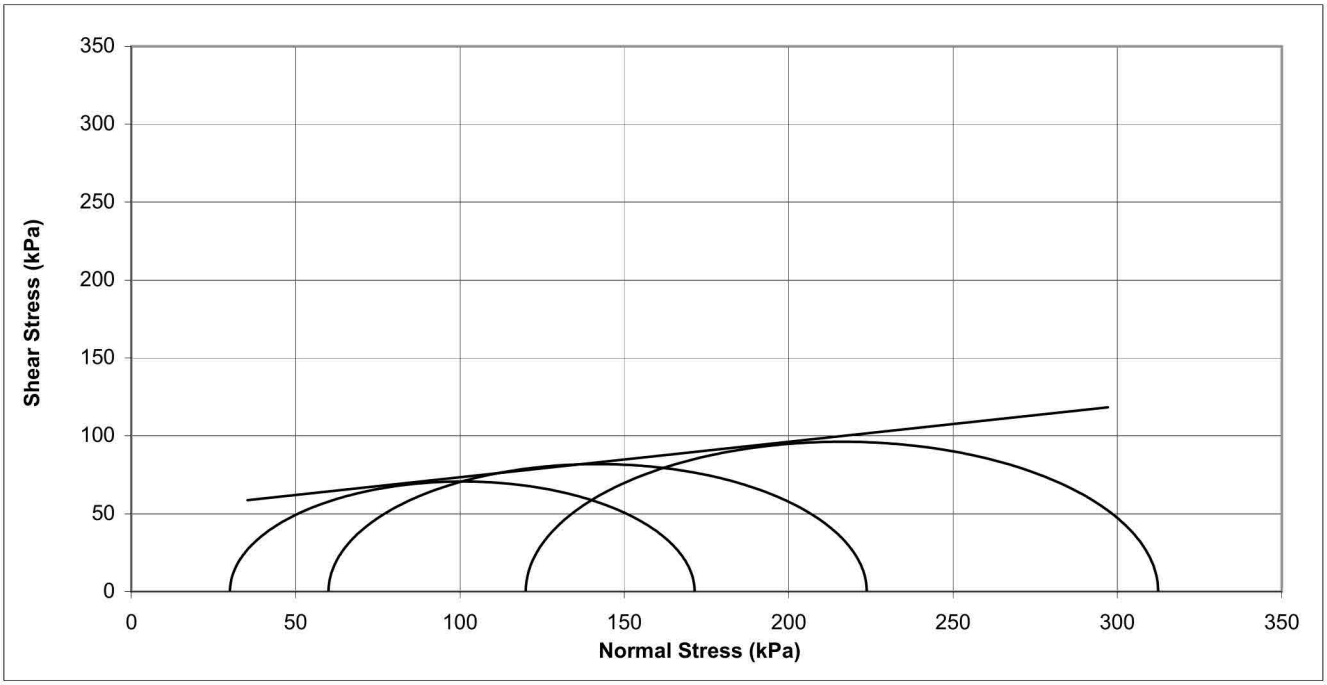


Sample was extruded directly from an undisturbed sample and vertical axis was maintained during testing

Tested in a temperature controlled room at 20 +/- 2°C
Tested in accordance with BS 1377: Part 5: 1990: Clause 3

ONE DIMENSIONAL CONSOLIDATION TEST RESULTS





Failure Conditions				
Cell pressure	kPa	30	60	120
Membrane correction	kPa	0.8	0.9	1.0
Strain at failure	%	14.0	17.0	20.0
Failure Type		Intermediate	Intermediate	Intermediate
Corrected deviator stress	kPa	141	164	192
Undrained shear stress	kPa	71	82	96

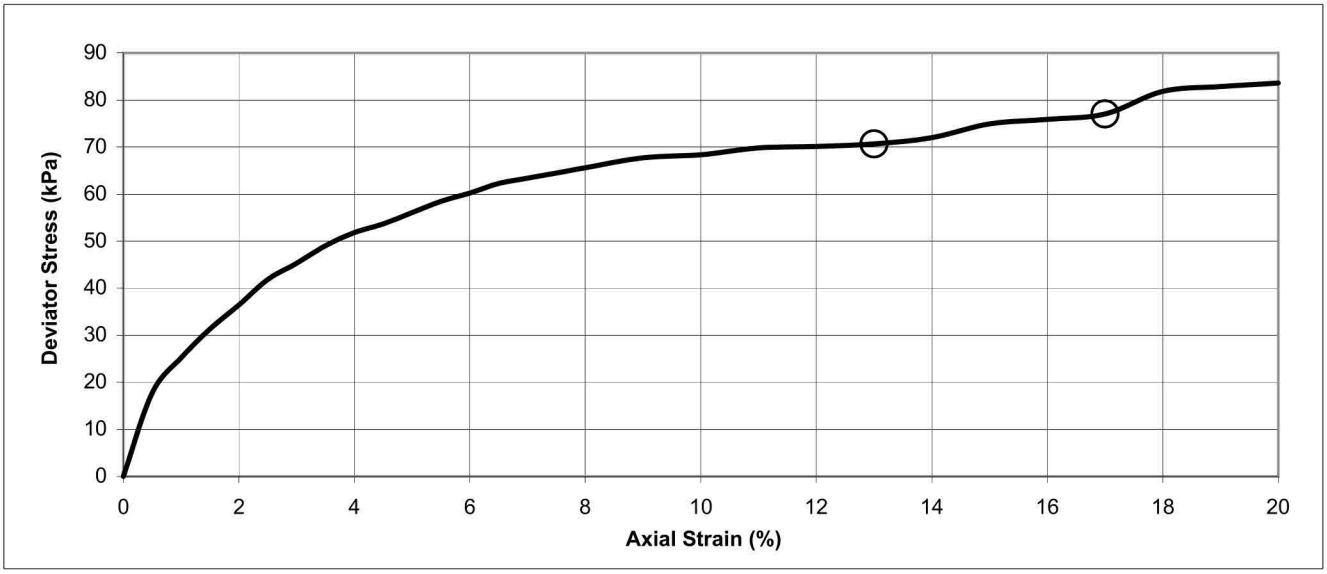
Cohesion	kPa	50.7	Friction Angle °	12.8

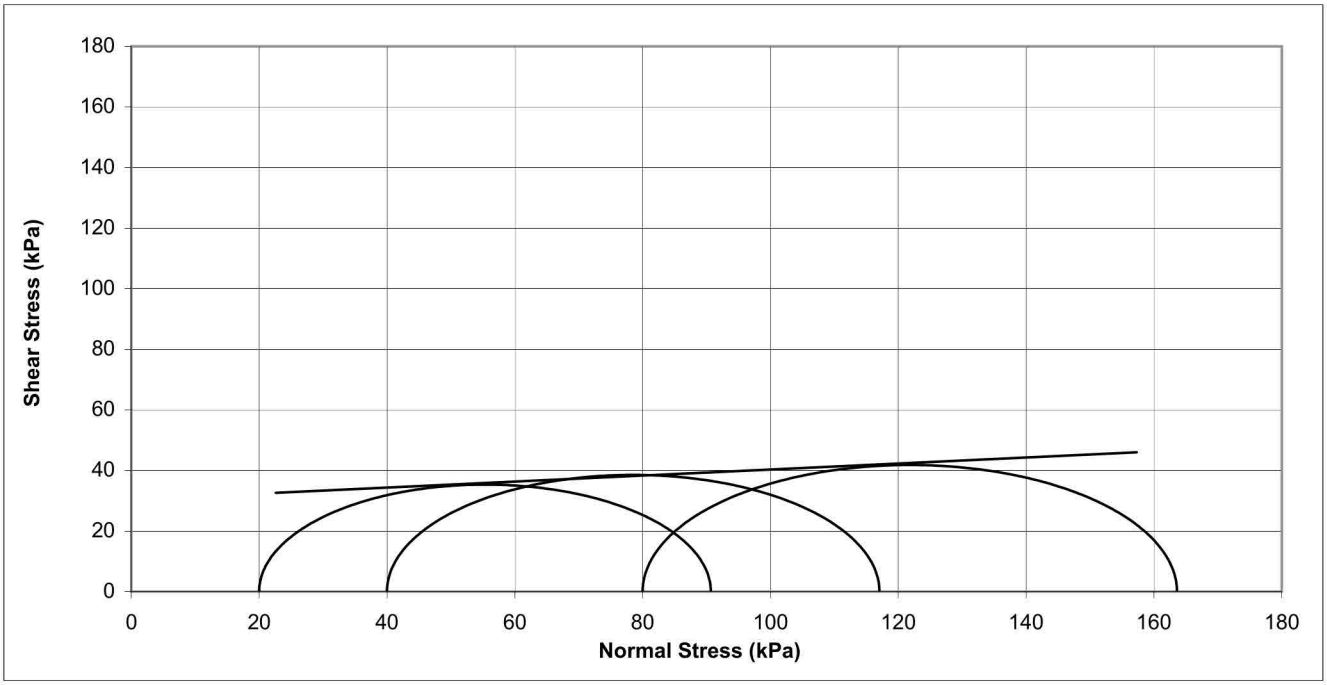
Initial Conditions						
Sample length	mm	145.45	Rate of strain	%/min	2.0	Borehole BH5
Sample diameter	mm	72.97	Bulk Density	Mg/m^3	2.19	Sample U
Membrane type		Latex	Dry Density	Mg/m^3	1.94	Depth (m) 2.70
Membrane thickness	mm	0.20	Moisture Content	%	13	

Undisturbed sample, taken directly from the sample tube and retaining axial orientation

DETERMINATION OF MULTI STAGE UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

Tested in accordance with BS 1377 : Part 7 : 9.0 : 1990





Failure Conditions				
Cell pressure	kPa	20	40	80
Membrane correction	kPa	0.7	0.8	0.9
Strain at failure	%	13.0	17.0	20.0
Failure Type		Intermediate	Intermediate	Intermediate
Corrected deviator stress	kPa	71	77	84
Undrained shear stress	kPa	35	39	42

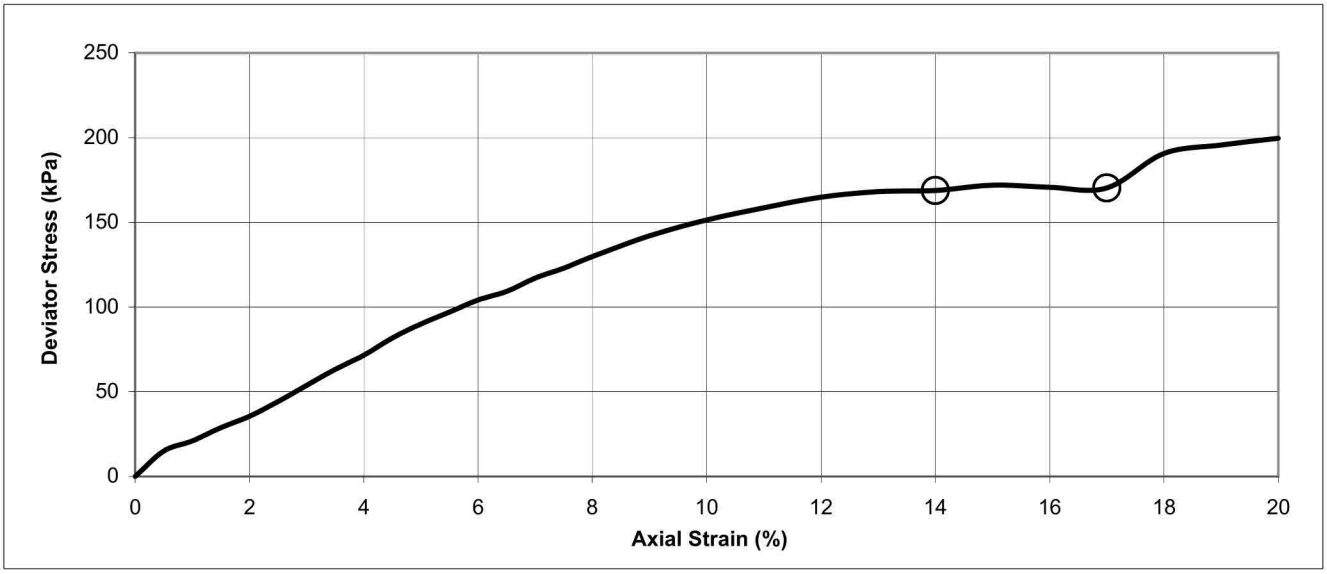
Cohesion	kPa	30.4	Friction Angle	°	5.7

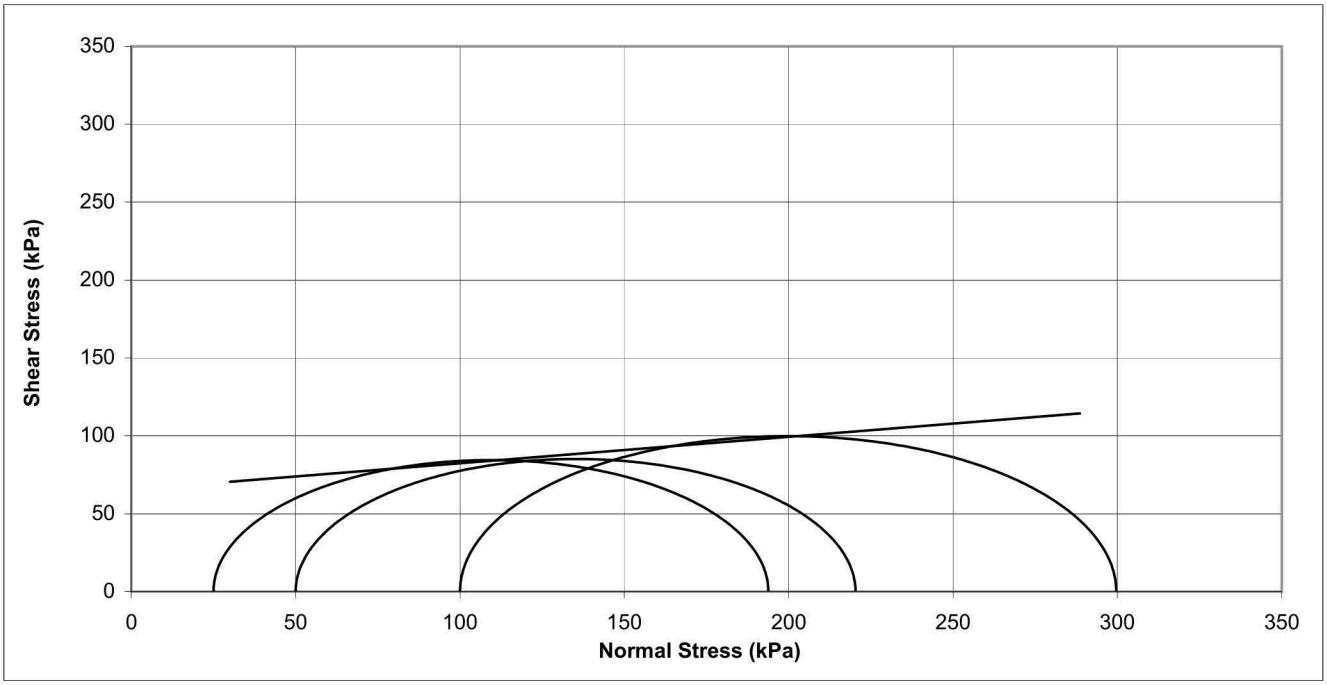
Initial Conditions							
Sample length	mm	169.26	Rate of strain	%/min	2.0	Borehole	BH6
Sample diameter	mm	84.66	Bulk Density	Mg/m^3	2.08	Sample	U
Membrane type		Latex	Dry Density	Mg/m^3	1.80	Depth (m)	1.70
Membrane thickness	mm	0.20	Moisture Content	%	15		

Undisturbed sample, taken directly from the sample tube and retaining axial orientation

DETERMINATION OF MULTI STAGE UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

Tested in accordance with BS 1377 : Part 7 : 9.0 : 1990





Failure Conditions				
Cell pressure	kPa	25	50	100
Membrane correction	kPa	0.8	1.0	1.1
Strain at failure	%	14.0	17.0	20.0
Failure Type		Intermediate	Intermediate	Intermediate
Corrected deviator stress	kPa	169	170	200
Undrained shear stress	kPa	84	85	100

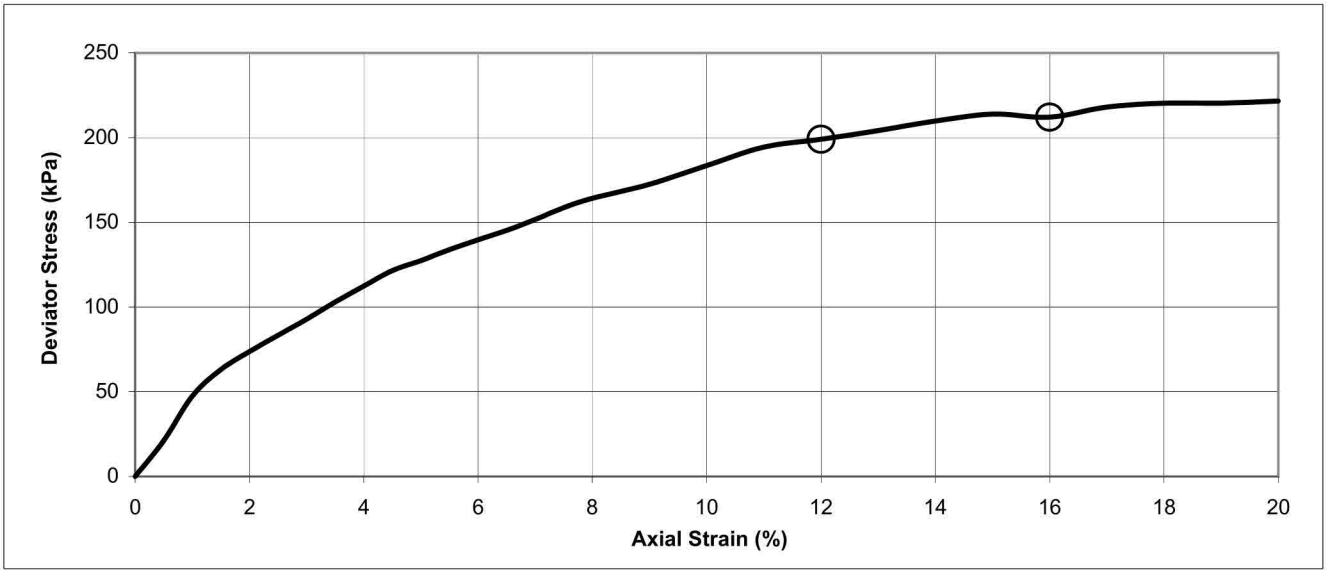
Cohesion	kPa	65.4	Friction Angle	°	9.6

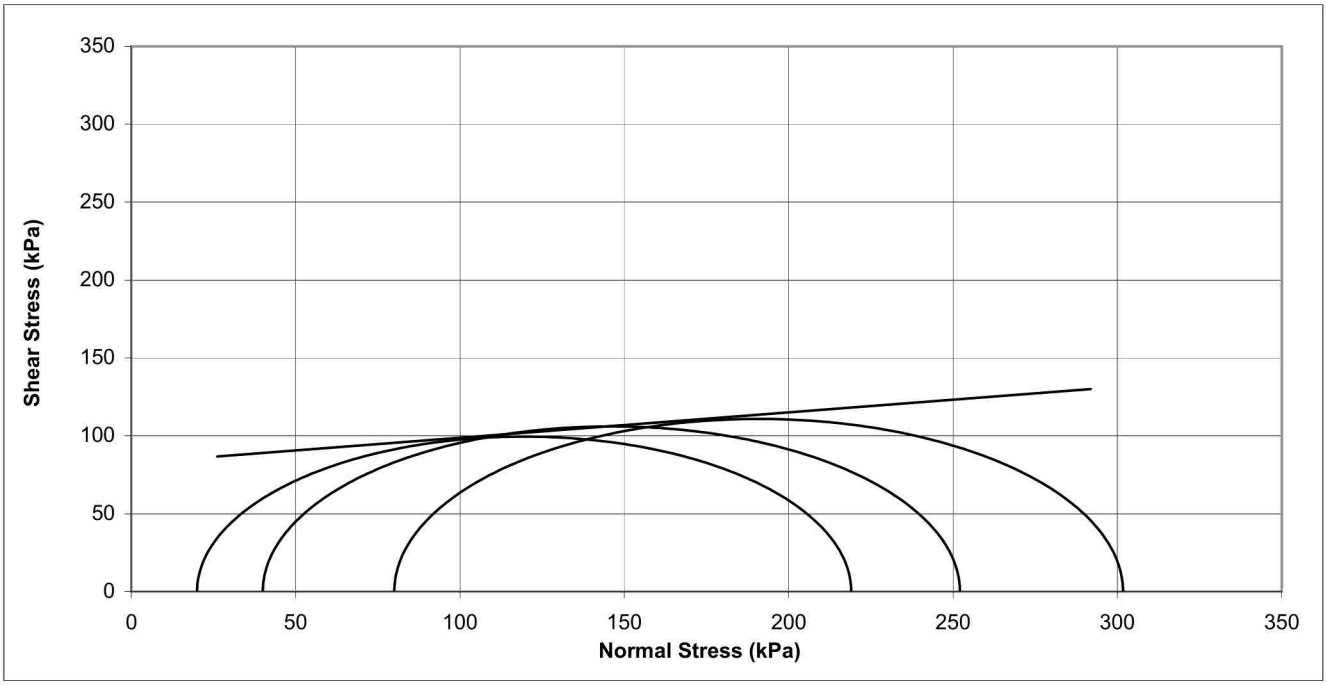
Initial Conditions							
Sample length	mm	140.52	Rate of strain	%/min	2.0	Borehole	BH6
Sample diameter	mm	70.21	Bulk Density	Mg/m^3	2.16	Sample	U
Membrane type		Latex	Dry Density	Mg/m^3	1.94	Depth (m)	2.15
Membrane thickness	mm	0.20	Moisture Content	%	12		

Undisturbed sample, taken directly from the sample tube and retaining axial orientation

DETERMINATION OF MULTI STAGE UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

Tested in accordance with BS 1377 : Part 7 : 9.0 : 1990





Failure Conditions				
Cell pressure	kPa	20	40	80
Membrane correction	kPa	0.7	0.8	0.9
Strain at failure	%	12.0	16.0	20.0
Failure Type		Intermediate	Intermediate	Intermediate
Corrected deviator stress	kPa	199	212	222
Undrained shear stress	kPa	100	106	111

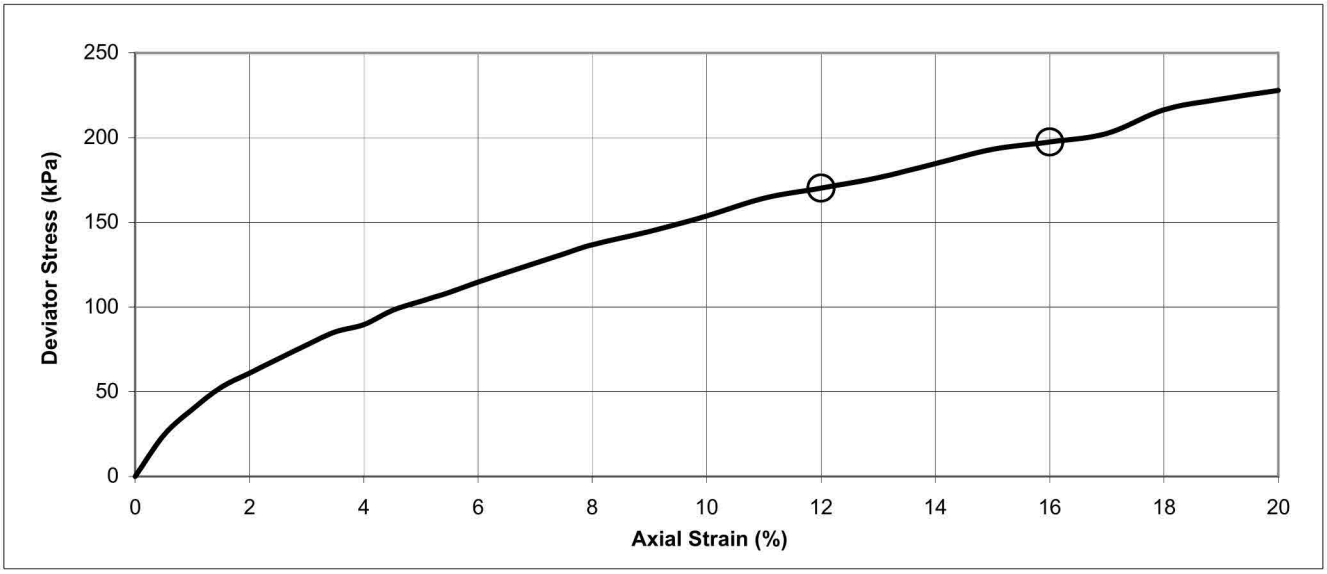
Cohesion	kPa	82.6	Friction Angle	°	9.2

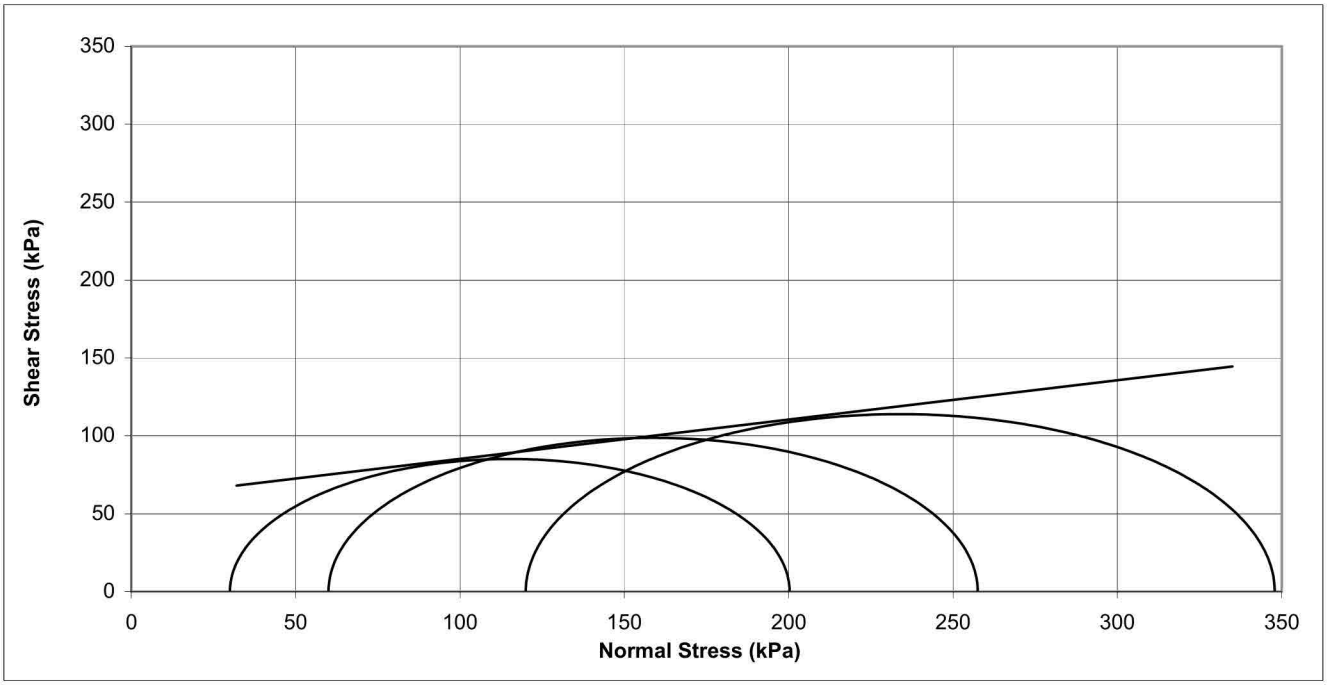
Initial Conditions							
Sample length	mm	161.66	Rate of strain	%/min	2.0	Borehole	BH7
Sample diameter	mm	80.51	Bulk Density	Mg/m^3	2.19	Sample	U
Membrane type		Latex	Dry Density	Mg/m^3	1.98	Depth (m)	1.80
Membrane thickness	mm	0.20	Moisture Content	%	11		

Undisturbed sample, taken directly from the sample tube and retaining axial orientation

DETERMINATION OF MULTI STAGE UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

Tested in accordance with BS 1377 : Part 7 : 9.0 : 1990





Failure Conditions				
Cell pressure	kPa	30	60	120
Membrane correction	kPa	0.7	0.9	1.0
Strain at failure	%	12.0	16.0	20.0
Failure Type		Intermediate	Intermediate	Intermediate
Corrected deviator stress	kPa	170	197	228
Undrained shear stress	kPa	85	99	114

Cohesion	kPa	59.9	Friction Angle	°	14.2

Initial Conditions							
Sample length	mm	143.24	Rate of strain	%/min	2.0	Borehole	BH8
Sample diameter	mm	71.63	Bulk Density	Mg/m^3	2.15	Sample	U
Membrane type		Latex	Dry Density	Mg/m^3	1.93	Depth (m)	2.80
Membrane thickness	mm	0.20	Moisture Content	%	12		

Undisturbed sample, taken directly from the sample tube and retaining axial orientation

DETERMINATION OF MULTI STAGE UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

Tested in accordance with BS 1377 : Part 7 : 9.0 : 1990

LABORATORY TEST CERTIFICATE

MATtest Limited
materials testing & consultancy

10 Queenslie Point
Queenslie Industrial Estate
120 Stepps Road
Glasgow
G33 3NQ

Tel: 0141 774 4032

email: info@mattest.org
Website: www.mattest.org

Certificate No : **21/1208 - 01**

To : **Kevin McColm**

Client : **Johnson Poole & Bloomer**
50 Speirs Wharf
Glasgow
G4 9TB

LABORATORY TESTING OF SOIL

Introduction

We refer to samples taken from Crieff Road, Perth and delivered to our laboratory on 07th October 2021.

Material & Source

Sample Reference	:	See Report Plates
Sampled By	:	Client
Sampling Certificate	:	Not Supplied
Location	:	See Report Plates
Description	:	See Page 2
Date Sampled	:	Not Supplied
Date Tested	:	07th October 2021 Onwards
Source	:	VG183 - Crieff Road, Perth

Test Results

As Detailed On Page 2 to Page 6 inclusive

Comments

The results contained in this report relate to the sample(s) as received
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
All remaining samples for this project will be disposed of 28 days after issue of this test certificate

Remarks

Approved for Issue

[redacted]

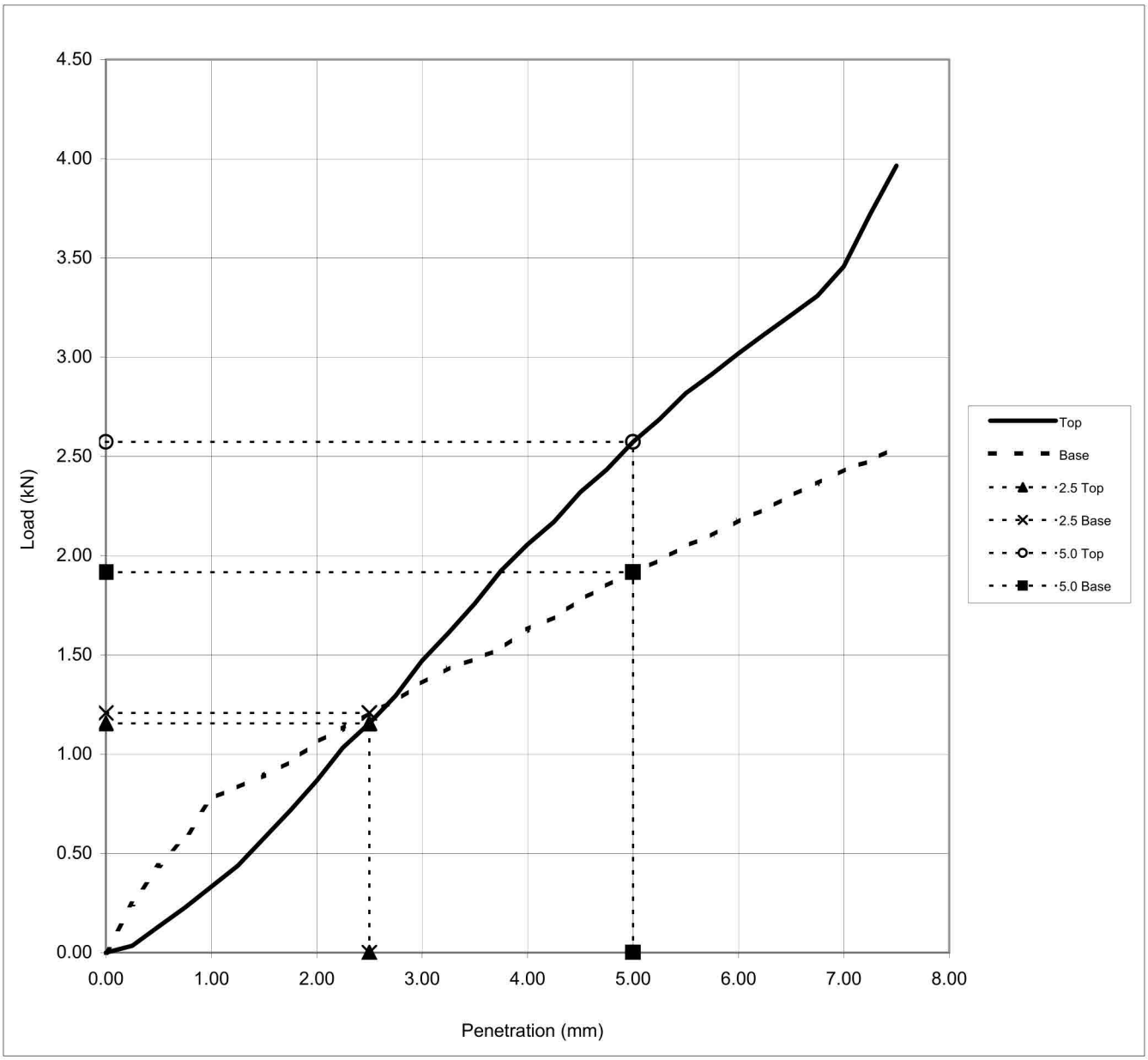
T McLelland (Director)

Date 05/11/2021

UKAS TESTING
2643

TRIAL PIT	SAMPLE	DEPTH (m)	SAMPLE DESCRIPTION
TP2	B	0.60	Brown gravelly very sandy CLAY. Gravel is fine to coarse.
TP3	B	0.60	Brown gravelly very sandy CLAY. Gravel is fine to coarse.
TP5	B	0.60	Brown gravelly very sandy CLAY. Gravel is fine to coarse.
TP7	B	0.60	Brown gravelly very sandy CLAY. Gravel is fine to coarse.

SUMMARY OF SAMPLE DESCRIPTIONS

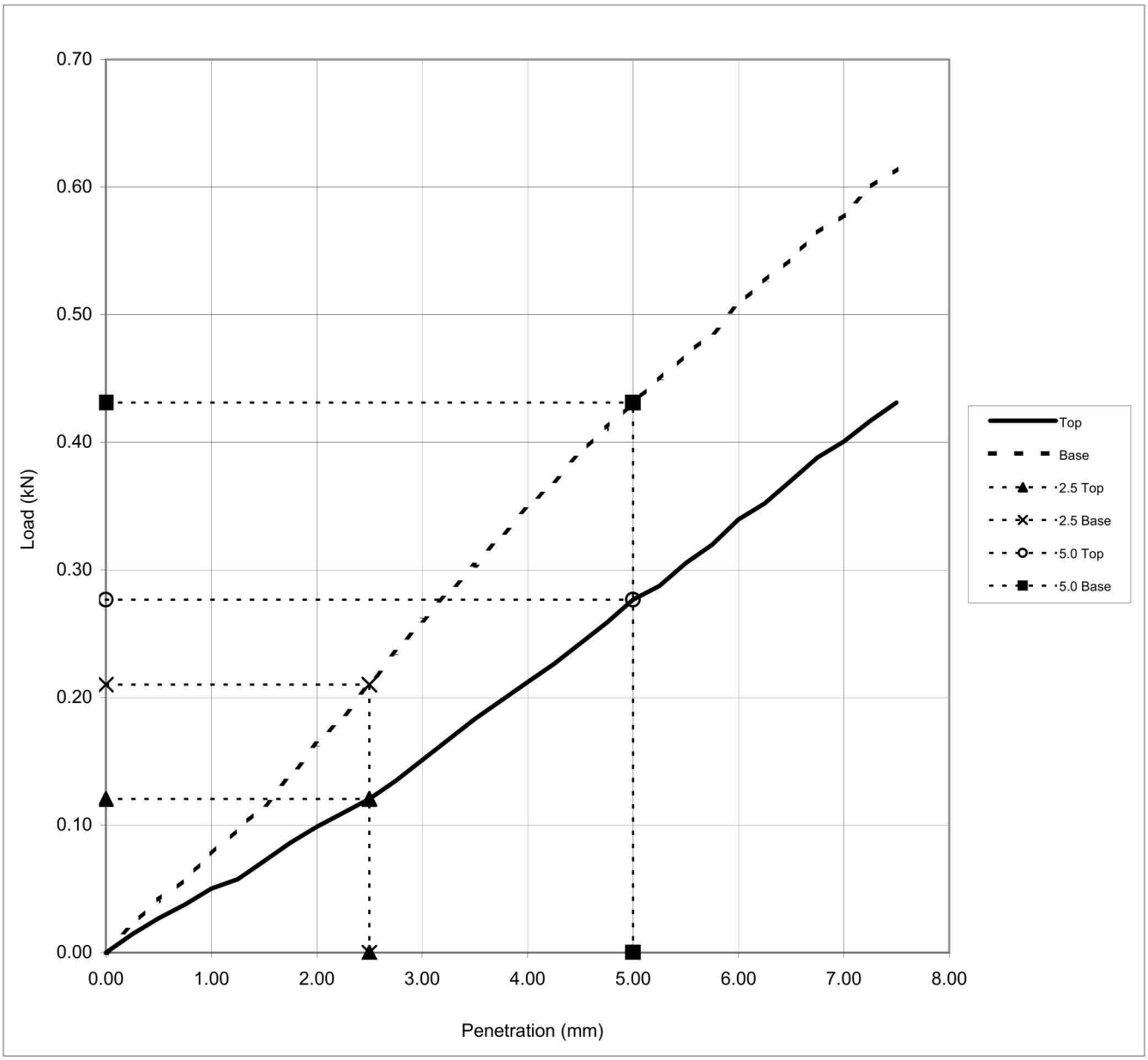


				Top	Base			
Moisture Content	11	%						
Bulk Density	2.09	Mg/m^3	Moisture Content	11	11	%	**Borehole**	**TP2**
Dry Density	1.88	Mg/m^3	CBR (%) at 2.5mm	8.8	9.2	%	**Sample**	**B**
Compactive Effort	2.5kg Rammer		CBR (%) at 5.0mm	12.9	9.6	%	**Depth (m)**	**0.60**
Surcharge Used	-	kg	Curve Corrected	No			**Lime Added (%)**	**-**
Soaking Period	-	days	Test Condition	Unsoaked			**Cement Added (%)**	**-**
Amount of swell	-	mm	Material Removed	3		%	**Accepted CBR (%)**	**12.9**

Remarks;

DETERMINATION OF CALIFORNIA BEARING RATIO (CBR)

Tested in accordance with BS 1377 : Part 4 : 1990



Moisture Content	15	%
Bulk Density	2.10	Mg/m^3
Dry Density	1.83	Mg/m^3
Compactive Effort	2.5kg Rammer	
Surcharge Used	-	kg
Soaking Period	-	days
Amount of swell	-	mm

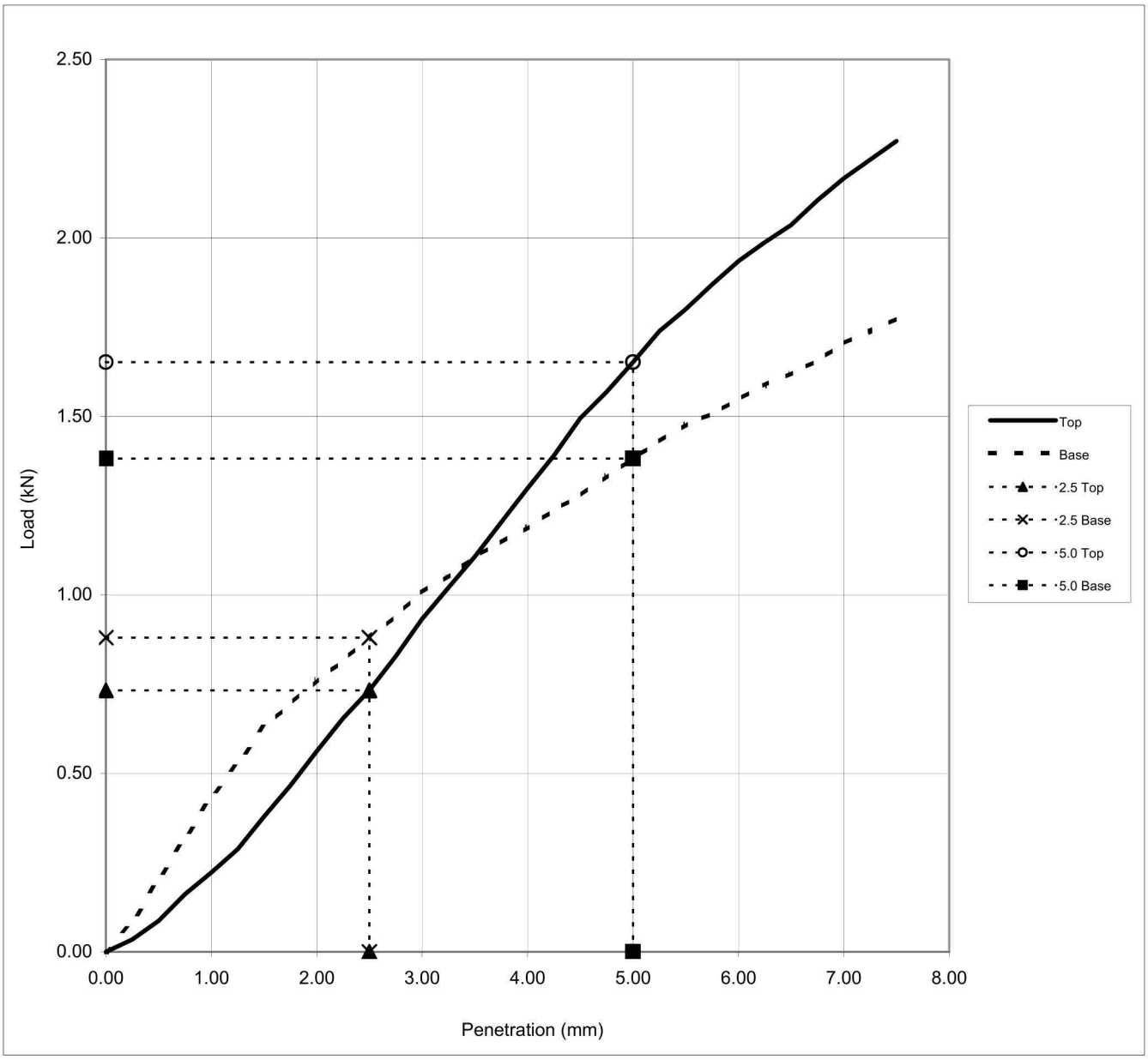
	Top	Base	
Moisture Content	16	14	%
CBR (%) at 2.5mm	0.9	1.6	%
CBR (%) at 5.0mm	1.4	2.2	%
Curve Corrected	No		
Test Condition	Unsoaked		
Material Removed	12		%

Borehole	**TP3**
Sample	**B**
Depth (m)	**0.60**
Lime Added (%)	**-**
Cement Added (%)	**-**
Accepted CBR (%)	**2.2**

Remarks;

DETERMINATION OF CALIFORNIA BEARING RATIO (CBR)

Tested in accordance with BS 1377 : Part 4 : 1990

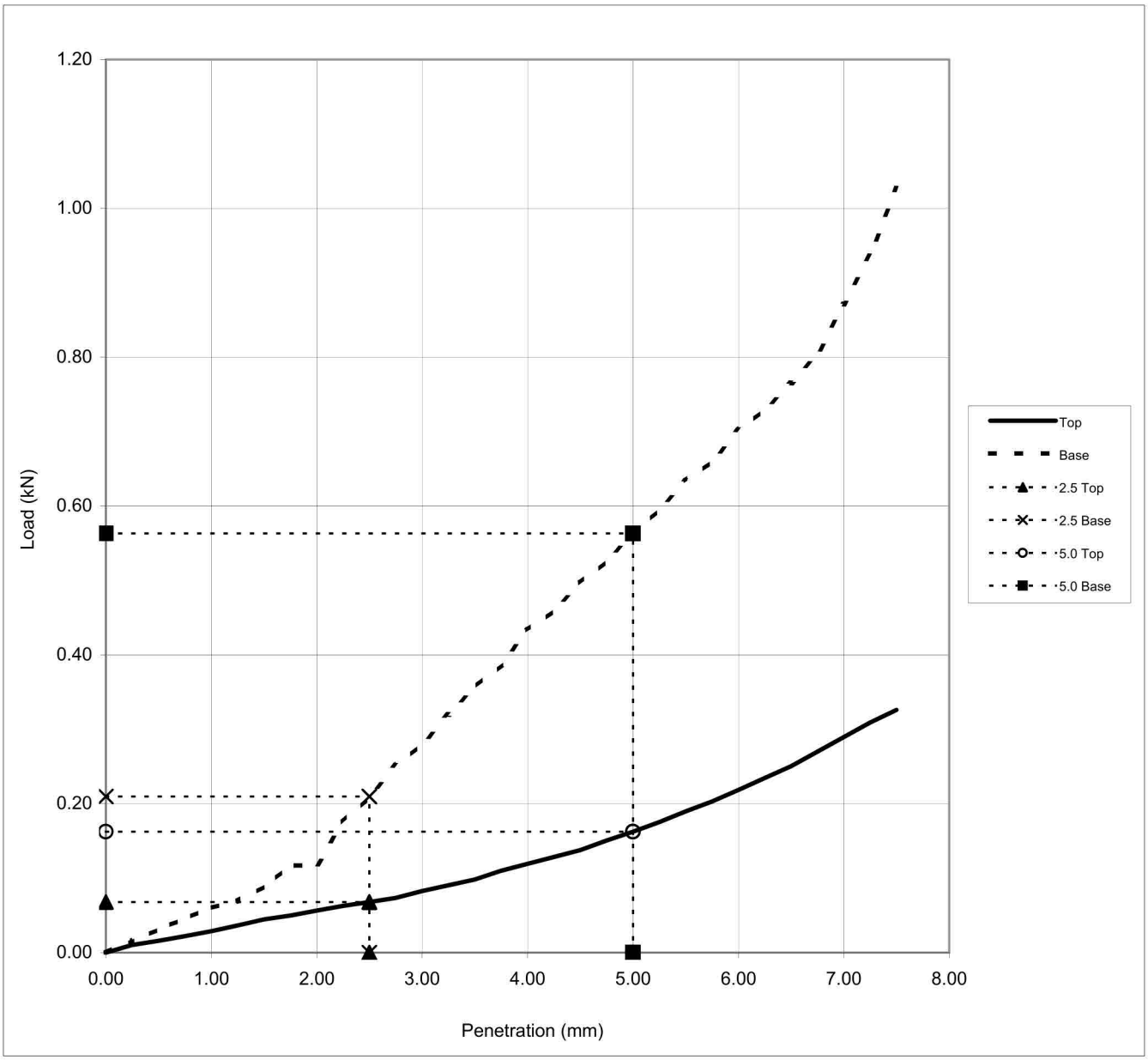


				Top	Base			
Moisture Content	12	%						
Bulk Density	2.12	Mg/m^3	Moisture Content	12	12	%	**Borehole**	**TP5**
Dry Density	1.89	Mg/m^3	CBR (%) at 2.5mm	5.5	6.7	%	**Sample**	**B**
Compactive Effort	2.5kg Rammer		CBR (%) at 5.0mm	8.3	6.9	%	**Depth (m)**	**0.60**
Surcharge Used	-	kg	Curve Corrected	No			**Lime Added (%)**	**-**
Soaking Period	-	days	Test Condition	Unsoaked			**Cement Added (%)**	**-**
Amount of swell	-	mm	Material Removed	12		%	**Accepted CBR (%)**	**8.3**

Remarks;

DETERMINATION OF CALIFORNIA BEARING RATIO (CBR)

Tested in accordance with BS 1377 : Part 4 : 1990



Moisture Content	14	%
Bulk Density	2.17	Mg/m^3
Dry Density	1.91	Mg/m^3
Compactive Effort	2.5kg Rammer	
Surcharge Used	-	kg
Soaking Period	-	days
Amount of swell	-	mm

	Top	Base	
Moisture Content	14	13	%
CBR (%) at 2.5mm	0.5	1.6	%
CBR (%) at 5.0mm	0.8	2.8	%
Curve Corrected	No		
Test Condition	Unsoaked		
Material Removed	7		%

Borehole	**TP7**
Sample	**B**
Depth (m)	**0.60**
Lime Added (%)	**-**
Cement Added (%)	**-**
Accepted CBR (%)	**2.8**

Remarks;

DETERMINATION OF CALIFORNIA BEARING RATIO (CBR)

Tested in accordance with BS 1377 : Part 4 : 1990

Appendix 6 Chemical Test Results – I2 analytical - October 2021

Mike Bradley
Johnson Poole & Bloomer
50 Speirs Wharf
Glasgow
G4 9TB

e: mike.bradley@jpbscotland.co.uk

i2 Analytical Ltd.
40 Carron Pl,
East Kilbride,
Glasgow
G75 0YL

t: 01355202915
f: 01923237404
e: scotland@i2analytical.com

Analytical Report Number : 21-14840

Project / Site name:	Creiff Road, Perth	**Samples received on:**	07/10/2021
Your job number:	VG183	**Samples instructed on/ Analysis started on:**	07/10/2021
Your order number:	2825	**Analysis completed by:**	21/10/2021
Report Issue Number:	1	**Report issued on:**	21/10/2021
Samples Analysed:	10 leachate samples - 10 soil samples		

Signed: [redacted]

Jennifer Fitzpatrick
Customer Services Advisor
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.

Analytical Report Number: 21-14840
Project / Site name: Creiff Road, Perth
Your Order No: 2825

Lab Sample Number				2038750	2038751	2038752	2038753	2038754
Sample Reference				TP01	TP02	TP03	TP04	TP05
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	1.50	0.20	0.20	0.80
Date Sampled				06/10/2021	06/10/2021	06/10/2021	06/10/2021	06/10/2021
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	%	0.01	NONE	16	8.3	21	17	9.2
Total mass of sample received	kg	0.001	NONE	2.0	2.0	2.0	2.0	2.0
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	6.7	7.0	6.3	6.4	6.6
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO4	mg/kg	50	MCERTS	590	200	670	490	600
Water Soluble Sulphate as SO4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	14	12	17	11	27
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0071	0.0059	0.0085	0.0055	0.013
Sulphide	mg/kg	1	MCERTS	< 1.0	2.7	< 1.0	< 1.0	3.7
Organic Matter (automated)	%	0.1	MCERTS	3.3	0.8	3.5	3.2	2.3
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 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	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 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	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	14	9.2	10	12	14
Boron (water soluble)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.4	< 0.2	< 0.2
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	36	48	36	36	42
Copper (aqua regia extractable)	mg/kg	1	MCERTS	30	22	43	50	26
Lead (aqua regia extractable)	mg/kg	1	MCERTS	42	13	41	52	29
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	28	35	28	29	34
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	66	54	72	79	60

Analytical Report Number: 21-14840
Project / Site name: Creiff Road, Perth
Your Order No: 2825

Lab Sample Number				2038750	2038751	2038752	2038753	2038754
Sample Reference				TP01	TP02	TP03	TP04	TP05
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	1.50	0.20	0.20	0.80
Date Sampled				06/10/2021	06/10/2021	06/10/2021	06/10/2021	06/10/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Petroleum Hydrocarbons								
TPH6 - Aliphatic (C6 - C8)	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH6 - Aliphatic (C8 - C10)	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH6 - Aliphatic (C10 - C12)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH6 - Aliphatic (C12 - C16)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH6 - Aliphatic (C16 - C21)	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0
TPH6 - Aliphatic (C21 - C35)	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0
TPH6 - Aliphatic (C6 - C35)	mg/kg	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH6 - Aromatic (C6 - C8)	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH6 - Aromatic (C8 - C10)	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH6 - Aromatic (C10 - C12)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH6 - Aromatic (C12 - C16)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH6 - Aromatic (C16 - C21)	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10
TPH6 - Aromatic (C21 - C35)	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10
TPH6 - Aromatic (C6 - C35)	mg/kg	10	NONE	< 10	< 10	< 10	< 10	< 10
Pesticides								
Alachlor	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Aldrin	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Azinphos-ethyl	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Azinphos-methyl	µg/kg	10	NONE	< 10	-	< 10	< 10	-
BHC-alpha (benzene hexachloride)	µg/kg	10	NONE	< 10	-	< 10	< 10	-
BHC-beta	µg/kg	10	NONE	< 10	-	< 10	< 10	-
BHC-delta	µg/kg	10	NONE	< 10	-	< 10	< 10	-
BHC-gamma (Lindane, gamma HCH)	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Bifenthrin	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Carbophenothion	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Chlordane-cis	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Chlordane-trans	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Chlorfenvinphos	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Chlorothalonil	µg/kg	20	NONE	< 20	-	< 20	< 20	-
Chlorpyrifos	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Cyfluthrin (Sum)	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Cyhalothrin (Lambda)	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Cypermethrin (Sum)	µg/kg	10	NONE	< 10	-	< 10	< 10	-
DDD-o,p'	µg/kg	10	NONE	< 10	-	< 10	< 10	-
DDD-p,p'	µg/kg	10	NONE	< 10	-	< 10	< 10	-
DDE-o,p'	µg/kg	10	NONE	< 10	-	< 10	< 10	-
DDE-p,p'	µg/kg	10	NONE	< 10	-	< 10	< 10	-
DDT-o,p'	µg/kg	10	NONE	< 10	-	< 10	< 10	-
DDT-p,p'	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Deltamethrin	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Demeton-O	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Demeton-S	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Diazinon	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Dichlorobenzonitrile, 2,6-	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Dichlorvos	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Dieldrin	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Dimethoate	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Dimethylvinphos	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Endosulfan I (alpha isomer)	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Endosulfan II (beta isomer)	µg/kg	10	NONE	< 10	-	< 10	< 10	-

Analytical Report Number: 21-14840
Project / Site name: Creiff Road, Perth
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Lab Sample Number				2038750	2038751	2038752	2038753	2038754
Sample Reference				TP01	TP02	TP03	TP04	TP05
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	1.50	0.20	0.20	0.80
Date Sampled				06/10/2021	06/10/2021	06/10/2021	06/10/2021	06/10/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Endosulfan sulfate	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Endrin	µg/kg	20	NONE	< 20	-	< 20	< 20	-
Endrin aldehyde	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Endrin ketone	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Ethion	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Etrimfos	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Fenitrothion	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Fenthion	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Fenvalerate (Sum)	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Heptachlor	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Heptachlor exo-epoxide	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Hexachlorobenzene	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Hexachlorobutadiene	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Isodrin	µg/kg	20	NONE	< 20	-	< 20	< 20	-
Malathion	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Methacrifos	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Methoxychlor, p,p'-	µg/kg	20	NONE	< 20	-	< 20	< 20	-
Mevinphos, E+Z	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Omethoate	µg/kg	20	NONE	< 20	-	< 20	< 20	-
Parathion	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Parathion-methyl	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Pendimethalin	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Pentachlorobenzene	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Permethrin, Cis-	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Permethrin, Trans-	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Phorate	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Phosalone	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Phosphamidon (Sum)	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Pirimiphos-ethyl	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Pirimiphos-methyl	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Propetamphos	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Propyzamide	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Tecnazene	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Tetrachlorobenzene, 1,2,4,5-	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Trichlorobenzene, 1,2,3-	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Trichlorobenzene, 1,3,5-	µg/kg	10	NONE	< 10	-	< 10	< 10	-
Trifluralin	µg/kg	10	NONE	< 10	-	< 10	< 10	-

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

Analytical Report Number: 21-14840
Project / Site name: Creiff Road, Perth
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Lab Sample Number				2038755	2038756	2038757	2038758	2038759
Sample Reference				TP06	TP07	TP10	TP11	TP11
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	1.00	0.20	0.50	1.10
Date Sampled				06/10/2021	06/10/2021	06/10/2021	06/10/2021	06/10/2021
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	%	0.01	NONE	10	8.2	12	12	2.9
Total mass of sample received	kg	0.001	NONE	2.0	2.0	2.0	2.0	2.0
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	6.5	7.0	6.7	6.9	7.6
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO4	mg/kg	50	MCERTS	180	98	470	760	420
Water Soluble Sulphate as SO4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	20	12	48	32	28
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.010	0.0061	0.024	0.016	0.014
Sulphide	mg/kg	1	MCERTS	< 1.0	37	2.2	17	< 1.0
Organic Matter (automated)	%	0.1	MCERTS	0.4	0.3	2.9	11	2.3
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 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	0.79	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	2.1	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	2.1	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	1.3	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	1.1	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	1.1	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.75	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	1.2	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.54	< 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	0.67	< 0.05
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	< 0.80	11.6	< 0.80
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	7.3	9.5	13	24	14
Boron (water soluble)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.7	0.8	< 0.2
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	35	40	35	35	33
Copper (aqua regia extractable)	mg/kg	1	MCERTS	17	30	54	170	43
Lead (aqua regia extractable)	mg/kg	1	MCERTS	8.7	10	49	320	39
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	27	31	30	83	32
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	43	50	78	280	76

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Project / Site name: Creiff Road, Perth
Your Order No: 2825

Lab Sample Number				2038755	2038756	2038757	2038758	2038759
Sample Reference				TP06	TP07	TP10	TP11	TP11
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	1.00	0.20	0.50	1.10
Date Sampled				06/10/2021	06/10/2021	06/10/2021	06/10/2021	06/10/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Petroleum Hydrocarbons								
TPH6 - Aliphatic (C6 - C8)	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH6 - Aliphatic (C8 - C10)	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH6 - Aliphatic (C10 - C12)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH6 - Aliphatic (C12 - C16)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH6 - Aliphatic (C16 - C21)	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0
TPH6 - Aliphatic (C21 - C35)	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0
TPH6 - Aliphatic (C6 - C35)	mg/kg	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH6 - Aromatic (C6 - C8)	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH6 - Aromatic (C8 - C10)	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH6 - Aromatic (C10 - C12)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH6 - Aromatic (C12 - C16)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH6 - Aromatic (C16 - C21)	mg/kg	10	MCERTS	< 10	< 10	< 10	14	< 10
TPH6 - Aromatic (C21 - C35)	mg/kg	10	MCERTS	< 10	< 10	< 10	25	< 10
TPH6 - Aromatic (C6 - C35)	mg/kg	10	NONE	< 10	< 10	< 10	39	< 10
Pesticides								
Alachlor	µg/kg	10	NONE	< 10	-	< 10	-	-
Aldrin	µg/kg	10	NONE	< 10	-	< 10	-	-
Azinphos-ethyl	µg/kg	10	NONE	< 10	-	< 10	-	-
Azinphos-methyl	µg/kg	10	NONE	< 10	-	< 10	-	-
BHC-alpha (benzene hexachloride)	µg/kg	10	NONE	< 10	-	< 10	-	-
BHC-beta	µg/kg	10	NONE	< 10	-	< 10	-	-
BHC-delta	µg/kg	10	NONE	< 10	-	< 10	-	-
BHC-gamma (Lindane, gamma HCH)	µg/kg	10	NONE	< 10	-	< 10	-	-
Bifenthrin	µg/kg	10	NONE	< 10	-	< 10	-	-
Carbophenothion	µg/kg	10	NONE	< 10	-	< 10	-	-
Chlordane-cis	µg/kg	10	NONE	< 10	-	< 10	-	-
Chlordane-trans	µg/kg	10	NONE	< 10	-	< 10	-	-
Chlorfenvinphos	µg/kg	10	NONE	< 10	-	< 10	-	-
Chlorothalonil	µg/kg	20	NONE	< 20	-	< 20	-	-
Chlorpyrifos	µg/kg	10	NONE	< 10	-	< 10	-	-
Cyfluthrin (Sum)	µg/kg	10	NONE	< 10	-	< 10	-	-
Cyhalothrin (Lambda)	µg/kg	10	NONE	< 10	-	< 10	-	-
Cypermethrin (Sum)	µg/kg	10	NONE	< 10	-	< 10	-	-
DDD-o,p'	µg/kg	10	NONE	< 10	-	< 10	-	-
DDD-p,p'	µg/kg	10	NONE	< 10	-	< 10	-	-
DDE-o,p'	µg/kg	10	NONE	< 10	-	< 10	-	-
DDE-p,p'	µg/kg	10	NONE	< 10	-	< 10	-	-
DDT-o,p'	µg/kg	10	NONE	< 10	-	< 10	-	-
DDT-p,p'	µg/kg	10	NONE	< 10	-	< 10	-	-
Deltamethrin	µg/kg	10	NONE	< 10	-	< 10	-	-
Demeton-O	µg/kg	10	NONE	< 10	-	< 10	-	-
Demeton-S	µg/kg	10	NONE	< 10	-	< 10	-	-
Diazinon	µg/kg	10	NONE	< 10	-	< 10	-	-
Dichlorobenzonitrile, 2,6-	µg/kg	10	NONE	< 10	-	< 10	-	-
Dichlorvos	µg/kg	10	NONE	< 10	-	< 10	-	-
Dieldrin	µg/kg	10	NONE	< 10	-	< 10	-	-
Dimethoate	µg/kg	10	NONE	< 10	-	< 10	-	-
Dimethylvinphos	µg/kg	10	NONE	< 10	-	< 10	-	-
Endosulfan I (alpha isomer)	µg/kg	10	NONE	< 10	-	< 10	-	-
Endosulfan II (beta isomer)	µg/kg	10	NONE	< 10	-	< 10	-	-

Analytical Report Number: 21-14840
Project / Site name: Creiff Road, Perth
Your Order No: 2825

Lab Sample Number				2038755	2038756	2038757	2038758	2038759
Sample Reference				TP06	TP07	TP10	TP11	TP11
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	1.00	0.20	0.50	1.10
Date Sampled				06/10/2021	06/10/2021	06/10/2021	06/10/2021	06/10/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Endosulfan sulfate	µg/kg	10	NONE	< 10	-	< 10	-	-
Endrin	µg/kg	20	NONE	< 20	-	< 20	-	-
Endrin aldehyde	µg/kg	10	NONE	< 10	-	< 10	-	-
Endrin ketone	µg/kg	10	NONE	< 10	-	< 10	-	-
Ethion	µg/kg	10	NONE	< 10	-	< 10	-	-
Etrimfos	µg/kg	10	NONE	< 10	-	< 10	-	-
Fenitrothion	µg/kg	10	NONE	< 10	-	< 10	-	-
Fenthion	µg/kg	10	NONE	< 10	-	< 10	-	-
Fenvalerate (Sum)	µg/kg	10	NONE	< 10	-	< 10	-	-
Heptachlor	µg/kg	10	NONE	< 10	-	< 10	-	-
Heptachlor exo-epoxide	µg/kg	10	NONE	< 10	-	< 10	-	-
Hexachlorobenzene	µg/kg	10	NONE	< 10	-	< 10	-	-
Hexachlorobutadiene	µg/kg	10	NONE	< 10	-	< 10	-	-
Isodrin	µg/kg	20	NONE	< 20	-	< 20	-	-
Malathion	µg/kg	10	NONE	< 10	-	< 10	-	-
Methacrifos	µg/kg	10	NONE	< 10	-	< 10	-	-
Methoxychlor, p,p'-	µg/kg	20	NONE	< 20	-	< 20	-	-
Mevinphos, E+Z	µg/kg	10	NONE	< 10	-	< 10	-	-
Omethoate	µg/kg	20	NONE	< 20	-	< 20	-	-
Parathion	µg/kg	10	NONE	< 10	-	< 10	-	-
Parathion-methyl	µg/kg	10	NONE	< 10	-	< 10	-	-
Pendimethalin	µg/kg	10	NONE	< 10	-	< 10	-	-
Pentachlorobenzene	µg/kg	10	NONE	< 10	-	< 10	-	-
Permethrin, Cis-	µg/kg	10	NONE	< 10	-	< 10	-	-
Permethrin, Trans-	µg/kg	10	NONE	< 10	-	< 10	-	-
Phorate	µg/kg	10	NONE	< 10	-	< 10	-	-
Phosalone	µg/kg	10	NONE	< 10	-	< 10	-	-
Phosphamidon (Sum)	µg/kg	10	NONE	< 10	-	< 10	-	-
Pirimiphos-ethyl	µg/kg	10	NONE	< 10	-	< 10	-	-
Pirimiphos-methyl	µg/kg	10	NONE	< 10	-	< 10	-	-
Propetamphos	µg/kg	10	NONE	< 10	-	< 10	-	-
Propyzamide	µg/kg	10	NONE	< 10	-	< 10	-	-
Tecnazene	µg/kg	10	NONE	< 10	-	< 10	-	-
Tetrachlorobenzene, 1,2,4,5-	µg/kg	10	NONE	< 10	-	< 10	-	-
Trichlorobenzene, 1,2,3-	µg/kg	10	NONE	< 10	-	< 10	-	-
Trichlorobenzene, 1,3,5-	µg/kg	10	NONE	< 10	-	< 10	-	-
Trifluralin	µg/kg	10	NONE	< 10	-	< 10	-	-

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

Analytical Report Number: 21-14840
Project / Site name: Creiff Road, Perth

Your Order No: 2825

Lab Sample Number				2038760	2038761	2038762	2038763	2038764
Sample Reference				TP01	TP02	TP03	TP04	TP05
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	1.50	0.20	0.20	0.80
Date Sampled				06/10/2021	06/10/2021	06/10/2021	06/10/2021	06/10/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
General Inorganics								
pH	pH Units	N/A	ISO 17025	6.3	6.5	6.4	6.4	6.5
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Sulphate as SO4	mg/l	0.1	ISO 17025	1.6	3.2	1.9	1.6	1.6
Sulphide	µg/l	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Phenols								
Total Phenols (monohydric)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Heavy Metals / Metalloids								
Arsenic (dissolved)	µg/l	1	ISO 17025	3.5	2.2	2.7	3.6	4.3
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08	< 0.08	0.27	< 0.08	< 0.08
Chromium (dissolved)	µg/l	0.4	ISO 17025	1.7	2.7	1.4	3.4	1.2
Copper (dissolved)	µg/l	0.7	ISO 17025	31	19	37	43	25
Lead (dissolved)	µg/l	1	ISO 17025	5.1	4.1	4.9	6.7	3.0
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	5.6	5.7	4.7	6.5	4.1
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0	< 4.0	< 4.0	5.6	7.5
Zinc (dissolved)	µg/l	0.4	ISO 17025	25	12	16	15	12
Calcium (dissolved)	mg/l	0.012	ISO 17025	1.9	1.7	2.3	1.9	1.2
Magnesium (dissolved)	mg/l	0.005	ISO 17025	0.54	0.83	0.67	0.90	0.33

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

Analytical Report Number: 21-14840
Project / Site name: Creiff Road, Perth

Your Order No: 2825

Lab Sample Number				2038765	2038766	2038767	2038768	2038769
Sample Reference				TP06	TP07	TP10	TP11	TP11
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	1.00	0.20	0.50	1.10
Date Sampled				06/10/2021	06/10/2021	06/10/2021	06/10/2021	06/10/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
General Inorganics								
pH	pH Units	N/A	ISO 17025	6.4	6.6	6.5	7.3	7.1
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Sulphate as SO4	mg/l	0.1	ISO 17025	3.7	2.5	1.9	7.0	5.7
Sulphide	µg/l	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Phenols								
Total Phenols (monohydric)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Heavy Metals / Metalloids								
Arsenic (dissolved)	µg/l	1	ISO 17025	4.2	3.1	6.4	5.9	5.7
Cadmium (dissolved)	µg/l	0.08	ISO 17025	0.21	< 0.08	0.26	0.26	0.12
Chromium (dissolved)	µg/l	0.4	ISO 17025	3.1	0.6	4.3	2.6	2.4
Copper (dissolved)	µg/l	0.7	ISO 17025	16	4.2	48	33	50
Lead (dissolved)	µg/l	1	ISO 17025	3.7	3.0	7.7	13	9.7
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	6.3	3.6	7.9	7.2	5.8
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0	< 4.0	4.1	< 4.0	5.4
Zinc (dissolved)	µg/l	0.4	ISO 17025	17	4.8	27	24	14
Calcium (dissolved)	mg/l	0.012	ISO 17025	1.5	0.93	2.3	11	4.5
Magnesium (dissolved)	mg/l	0.005	ISO 17025	0.83	0.24	1.1	1.1	0.88

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

Analytical Report Number : 21-14840
Project / Site name: Creiff Road, Perth

* 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 *
2038750	TP01	None Supplied	0.2	Brown loam and clay with gravel and vegetation.
2038751	TP02	None Supplied	1.5	Brown loam and clay with gravel and vegetation.
2038752	TP03	None Supplied	0.2	Brown loam and clay with gravel and vegetation.
2038753	TP04	None Supplied	0.2	Brown loam and clay with gravel and vegetation.
2038754	TP05	None Supplied	0.8	Brown loam and clay with gravel and vegetation.
2038755	TP06	None Supplied	0.2	Brown loam and clay with gravel and vegetation.
2038756	TP07	None Supplied	1	Brown loam and clay with gravel.
2038757	TP10	None Supplied	0.2	Brown loam and clay with gravel and vegetation.
2038758	TP11	None Supplied	0.5	Brown loam and clay with gravel and vegetation.
2038759	TP11	None Supplied	1.1	Brown loam with gravel and vegetation.

Analytical Report Number : 21-14840
Project / Site name: Creiff Road, Perth

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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.	L038-PL	D	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
BS EN 12457-1 (2:1) Leachate Prep	2:1 (as recieved, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis.	In-house method based on BSEN12457-1.	L043-PL	W	NONE
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
Metals by ICP-OES in leachate	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
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
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in leachate - LOW LEVEL 1 ug/l	Determination of phenols in leachate by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
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
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
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
pH at 20oC in leachate	Determination of pH in leachate by electrometric measurement.	In house method.	L005-PL	W	ISO 17025
Sulphide in leachate	Determination of sulphide in leachate by ion selective electrode.	In-house method	L010-PL	W	NONE
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 sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-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

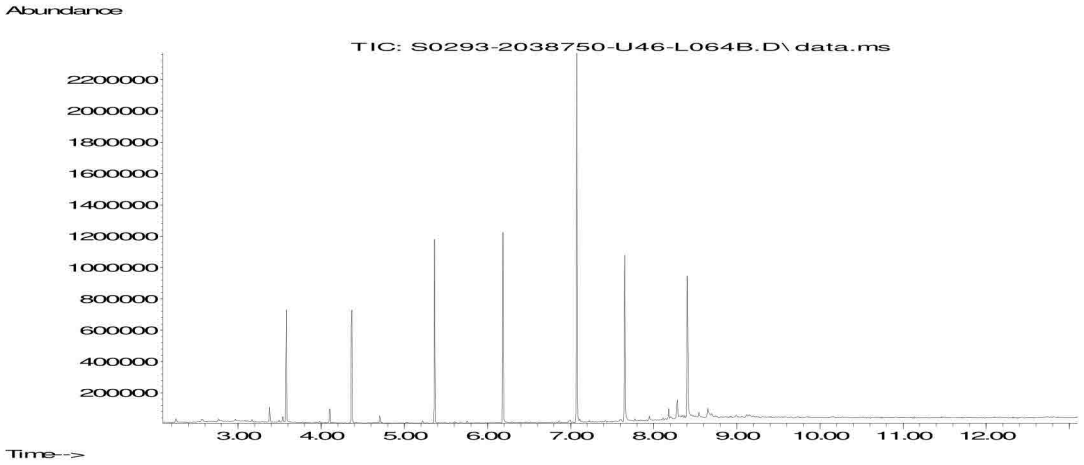
Analytical Report Number : 21-14840
Project / Site name: Creiff Road, Perth

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
TPH6 (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method with silica gel split/clean up.	L076-PL	D	MCERTS
Total cyanide in leachate	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	ISO 17025
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
TPH Chromatogram in Soil	TPH Chromatogram in Soil.	In-house method	L064-PL	D	NONE
Pesticides by GC-MS/MS	Detemination of Pesticides in soil by GC MS/MS	In-house method	L055B-PL	W	NONE
Sulphate in leachates	Determination of sulphate in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L039-PL	W	ISO 17025
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
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

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.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.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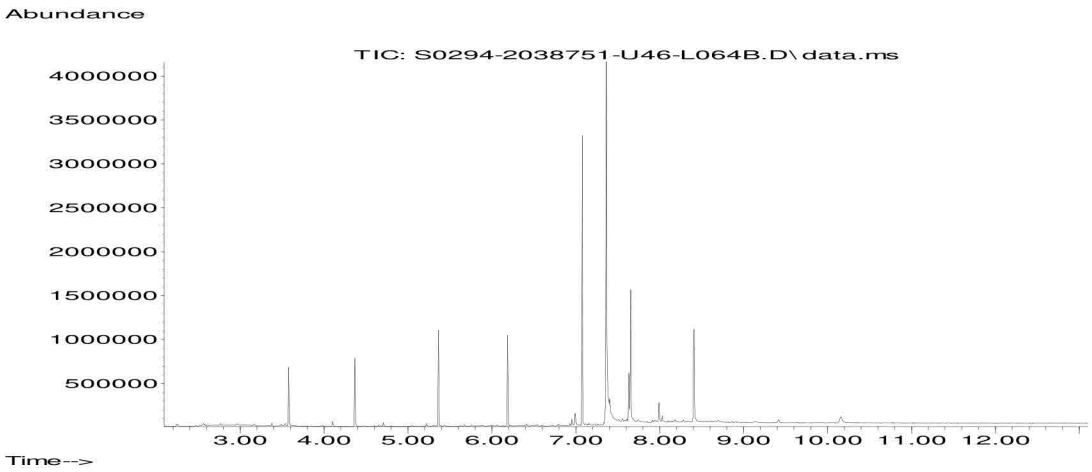
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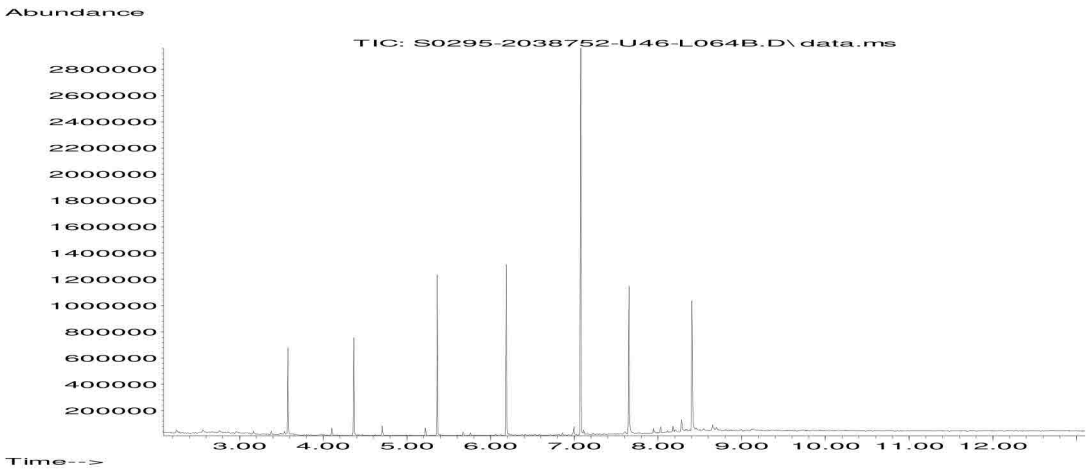
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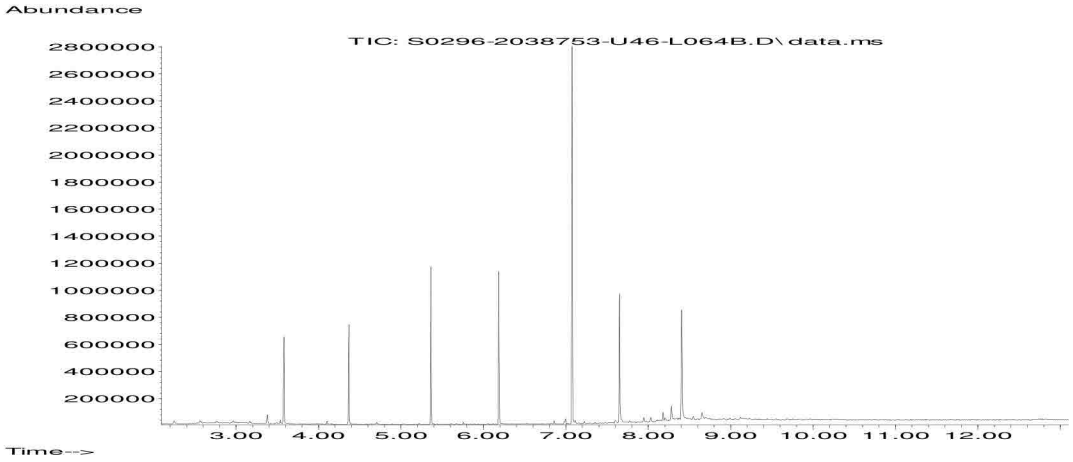
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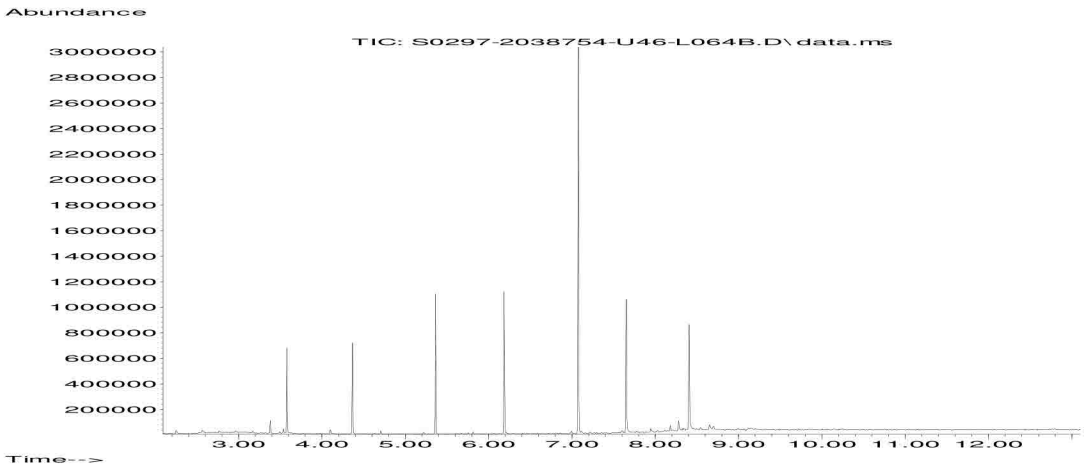
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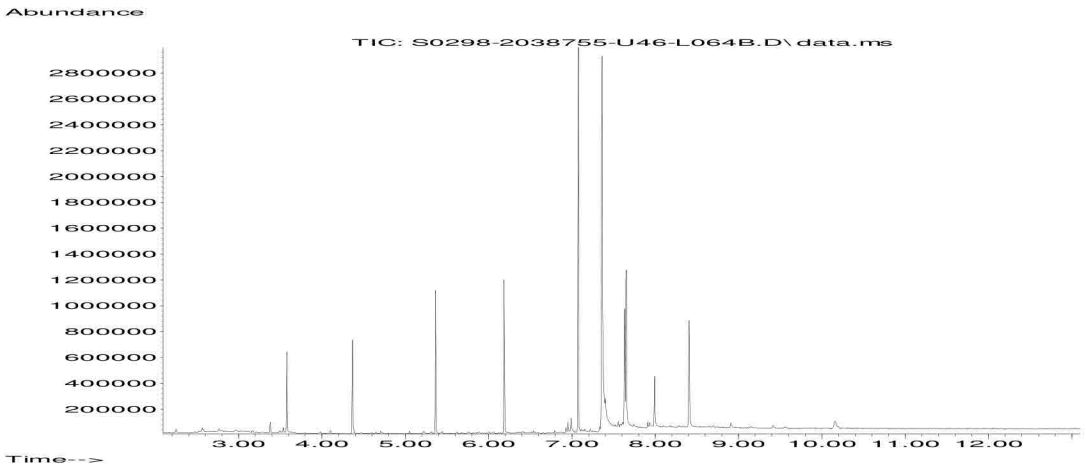
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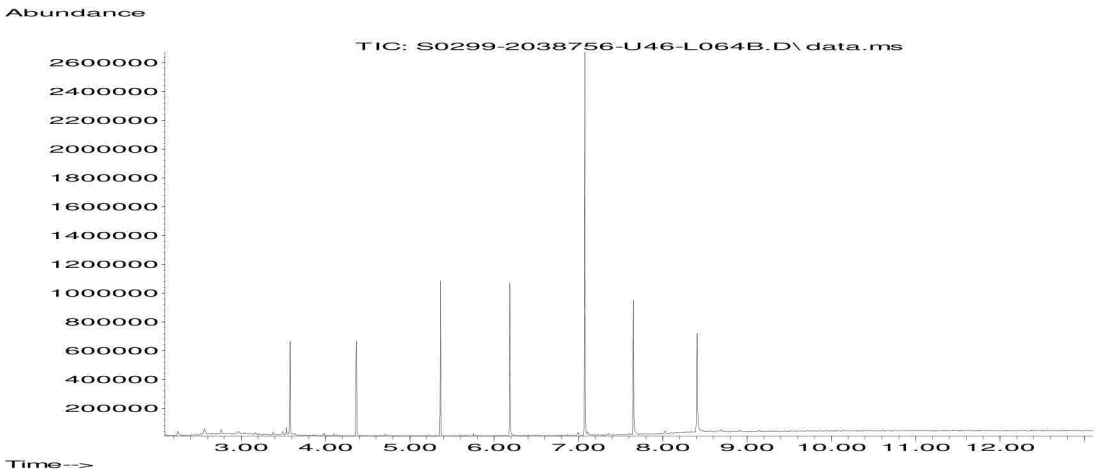
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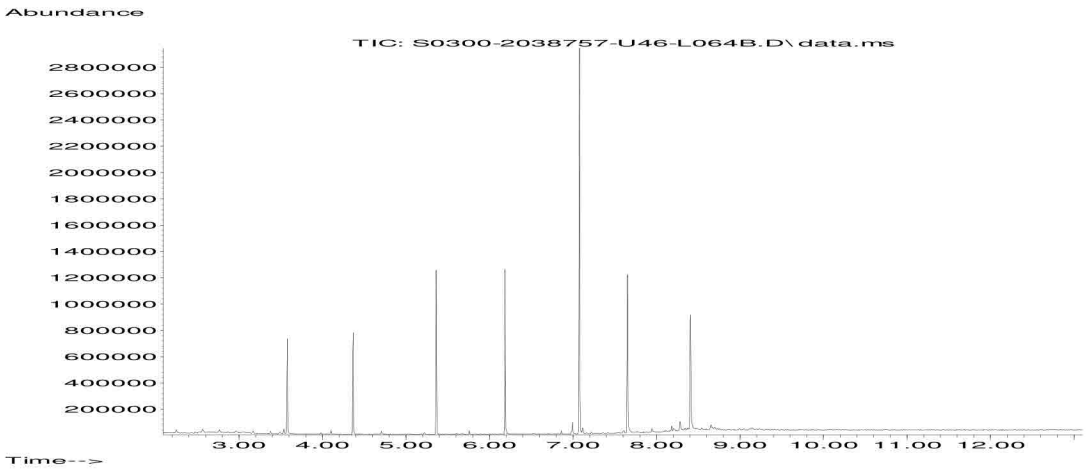
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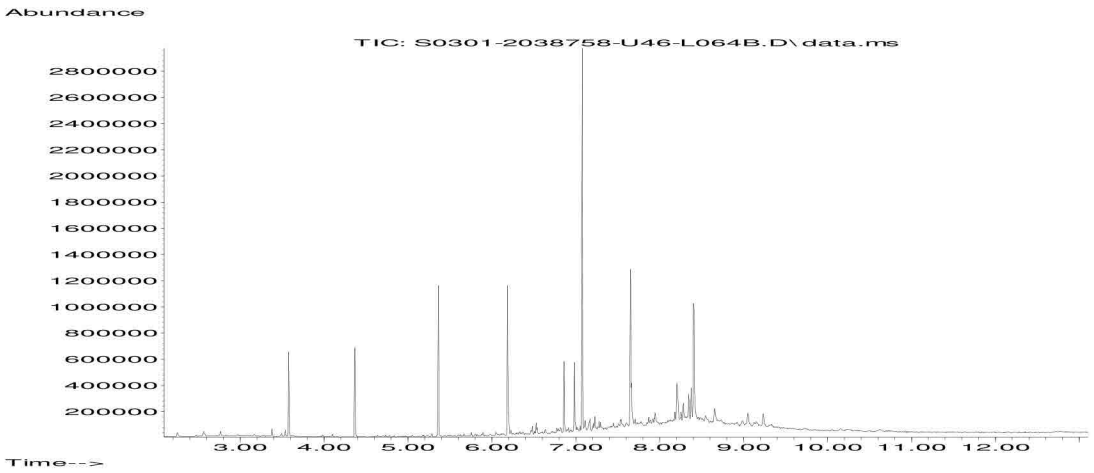
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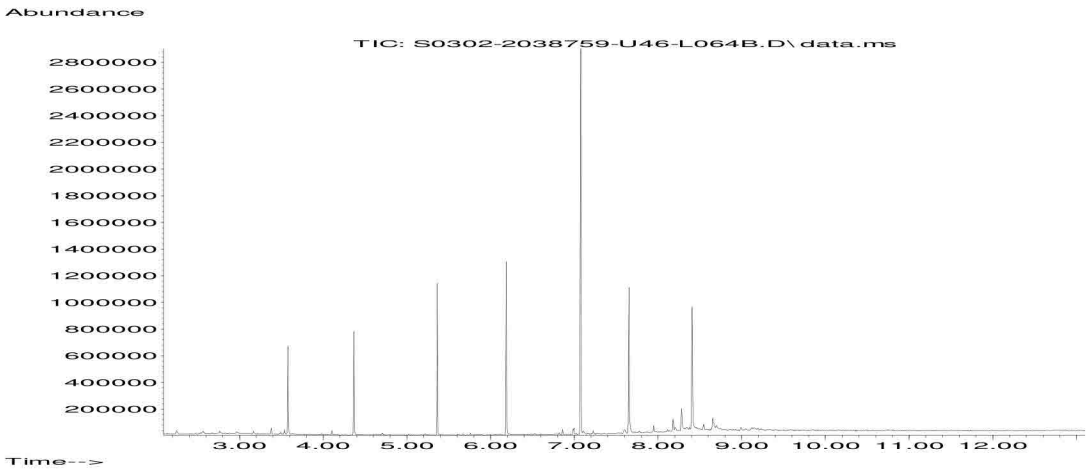
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Analytical Report Number : 21-14848

Project / Site name:	Creiff Road, Perth	**Samples received on:**	07/10/2021
Your job number:	VG183	**Samples instructed on/ Analysis started on:**	07/10/2021
Your order number:	2825	**Analysis completed by:**	22/10/2021
Report Issue Number:	1	**Report issued on:**	22/10/2021
Samples Analysed:	3 wac multi samples		

Signed: [redacted]

Ashleigh Cunningham
Customer Service
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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Waste Acceptance Criteria Analytical Results

Report No:	**21-14848**						
					Client: JPB		
Location	**Creiff Road, Perth**						
Lab Reference (Sample Number)	2038789				**Landfill Waste Acceptance Criteria Limits**		
Sampling Date	06/10/2021				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID	TP05						
Depth (m)	0.80						
Solid Waste Analysis							
TOC (%)**	1.1				3%	5%	6%
Loss on Ignition (%) **	3.3				--	--	10%
BTEX (µg/kg) **	< 10				6000	--	--
Sum of PCBs (mg/kg) **	< 0.30				1	--	--
Mineral Oil (mg/kg) #	< 10				500	--	--
Total PAH (WAC-17) (mg/kg)	< 0.85				100	--	--
pH (units)**	5.7				--	>6	--
Acid Neutralisation Capacity (mol / kg)	-4.2				--	To be evaluated	To be evaluated
Eluate Analysis	2:1	8:1		Cumulative 10:1	Limit values for compliance leaching test		
(BS EN 12457 - 3 preparation utilising end over end leaching procedure)	mg/l	mg/l		mg/kg	using BS EN 12457-3 at L/S 10 l/kg (mg/kg)		
Arsenic *	< 0.010	< 0.010		< 0.050	0.5	2	25
Barium *	0.019	0.033		0.32	20	100	300
Cadmium *	< 0.0005	< 0.0005		< 0.0020	0.04	1	5
Chromium *	0.0014	0.0020		0.020	0.5	10	70
Copper *	0.030	< 0.0030		0.041	2	50	100
Mercury *	< 0.0015	< 0.0015		< 0.010	0.01	0.2	2
Molybdenum *	< 0.0030	< 0.0030		< 0.020	0.5	10	30
Nickel *	0.0054	0.0061		0.061	0.4	10	40
Lead *	< 0.0050	< 0.0050		< 0.020	0.5	10	50
Antimony *	< 0.0050	< 0.0050		< 0.020	0.06	0.7	5
Selenium *	< 0.010	< 0.010		< 0.040	0.1	0.5	7
Zinc *	0.034	0.0078		0.10	4	50	200
Chloride *	< 4.0	< 4.0		< 15	800	15000	25000
Fluoride	0.23	0.25		2.5	10	150	500
Sulphate *	3.6	4.0		39	1000	20000	50000
TDS*	15	17		170	4000	60000	100000
Phenol Index (Monohydric Phenols) *	< 0.13	< 0.13		< 0.50	1	-	-
DOC	11	12		120	500	800	1000
Leach Test Information							
Stone Content (%)	< 0.1						
Sample Mass (kg)	2.0						
Dry Matter (%)	91						
Moisture (%)	9.2						
Stage 1							
Volume Eluate L2 (litres)	0.33						
Filtered Eluate VE1 (litres)	0.16						

Results are expressed on a dry weight basis, after correction for moisture content where applicable.

*= UKAS accredited (liquid eluate analysis only)

Stated limits are for guidance only and i2 cannot be held responsible for any discrepancies with current legislation

** = MCERTS accredited

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes as defined by the Waste (England and Wales) Regulations 2011 (as amended) and EA Guidance WM3.
This analysis is only applicable for landfill acceptance criteria (The Environmental Permitting (England and Wales) Regulations) and does not give any indication as to whether a waste may be hazardous or non-hazardous.

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Waste Acceptance Criteria Analytical Results

Report No:	**21-14848**						
					Client: JPB		
Location	**Creiff Road, Perth**						
Lab Reference (Sample Number)	2038790				**Landfill Waste Acceptance Criteria Limits**		
Sampling Date	06/10/2021				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID	TP07						
Depth (m)	1.00						
Solid Waste Analysis							
TOC (%)**	0.2				3%	5%	6%
Loss on Ignition (%) **	0.8				--	--	10%
BTEX (µg/kg) **	< 10				6000	--	--
Sum of PCBs (mg/kg) **	< 0.30				1	--	--
Mineral Oil (mg/kg) #	< 10				500	--	--
Total PAH (WAC-17) (mg/kg)	< 0.85				100	--	--
pH (units)**	7.3				--	>6	--
Acid Neutralisation Capacity (mol / kg)	0.11				--	To be evaluated	To be evaluated
Eluate Analysis	2:1	8:1		Cumulative 10:1	Limit values for compliance leaching test		
(BS EN 12457 - 3 preparation utilising end over end leaching procedure)	mg/l	mg/l		mg/kg	using BS EN 12457-3 at L/S 10 l/kg (mg/kg)		
Arsenic *	< 0.010	< 0.010		< 0.050	0.5	2	25
Barium *	0.018	0.021		0.20	20	100	300
Cadmium *	< 0.0005	< 0.0005		< 0.0020	0.04	1	5
Chromium *	0.0021	0.0013		0.014	0.5	10	70
Copper *	0.0086	< 0.0030		< 0.020	2	50	100
Mercury *	< 0.0015	< 0.0015		< 0.010	0.01	0.2	2
Molybdenum *	< 0.0030	< 0.0030		< 0.020	0.5	10	30
Nickel *	0.0046	0.0039		0.040	0.4	10	40
Lead *	< 0.0050	< 0.0050		0.036	0.5	10	50
Antimony *	< 0.0050	< 0.0050		< 0.020	0.06	0.7	5
Selenium *	< 0.010	< 0.010		< 0.040	0.1	0.5	7
Zinc *	0.016	0.0045		0.058	4	50	200
Chloride *	< 4.0	< 4.0		< 15	800	15000	25000
Fluoride	0.30	0.24		2.4	10	150	500
Sulphate *	5.4	3.4		36	1000	20000	50000
TDS*	14	16		160	4000	60000	100000
Phenol Index (Monohydric Phenols) *	< 0.13	< 0.13		< 0.50	1	-	-
DOC	6.8	7.7		76	500	800	1000
Leach Test Information							
Stone Content (%)	< 0.1						
Sample Mass (kg)	2.0						
Dry Matter (%)	92						
Moisture (%)	8.2						
Stage 1							
Volume Eluate L2 (litres)	0.34						
Filtered Eluate VE1 (litres)	0.20						

Results are expressed on a dry weight basis, after correction for moisture content where applicable.

*= UKAS accredited (liquid eluate analysis only)

Stated limits are for guidance only and i2 cannot be held responsible for any discrepencies with current legislation

** = MCERTS accredited

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes as defined by the Waste (England and Wales) Regulations 2011 (as amended) and EA Guidance WM3.
This analysis is only applicable for landfill acceptance criteria (The Environmental Permitting (England and Wales) Regulations) and does not give any indication as to whether a waste may be hazardous or non-hazardous.

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Waste Acceptance Criteria Analytical Results

Report No:	**21-14848**						
					Client: JPB		
Location	**Creiff Road, Perth**						
Lab Reference (Sample Number)	2038791				**Landfill Waste Acceptance Criteria Limits**		
Sampling Date	06/10/2021				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID	TP11						
Depth (m)	0.50						
Solid Waste Analysis							
TOC (%)**	4.1				3%	5%	6%
Loss on Ignition (%) **	15				--	--	10%
BTEX (µg/kg) **	< 10				6000	--	--
Sum of PCBs (mg/kg) **	< 0.30				1	--	--
Mineral Oil (mg/kg) #	< 10				500	--	--
Total PAH (WAC-17) (mg/kg)	11.6				100	--	--
pH (units)**	7.7				--	>6	--
Acid Neutralisation Capacity (mol / kg)	0.91				--	To be evaluated	To be evaluated
Eluate Analysis	2:1	8:1		Cumulative 10:1	Limit values for compliance leaching test		
(BS EN 12457 - 3 preparation utilising end over end leaching procedure)	mg/l	mg/l		mg/kg	using BS EN 12457-3 at L/S 10 l/kg (mg/kg)		
Arsenic *	< 0.010	< 0.010		< 0.050	0.5	2	25
Barium *	0.025	0.017		0.18	20	100	300
Cadmium *	< 0.0005	< 0.0005		< 0.0020	0.04	1	5
Chromium *	0.0017	0.0010		0.011	0.5	10	70
Copper *	0.025	0.0082		0.11	2	50	100
Mercury *	< 0.0015	< 0.0015		< 0.010	0.01	0.2	2
Molybdenum *	< 0.0030	< 0.0030		< 0.020	0.5	10	30
Nickel *	0.0076	0.0056		0.059	0.4	10	40
Lead *	0.0064	< 0.0050		0.052	0.5	10	50
Antimony *	< 0.0050	< 0.0050		< 0.020	0.06	0.7	5
Selenium *	< 0.010	< 0.010		< 0.040	0.1	0.5	7
Zinc *	0.066	0.0102		0.18	4	50	200
Chloride *	< 4.0	< 4.0		< 15	800	15000	25000
Fluoride	0.26	0.29		2.9	10	150	500
Sulphate *	9.5	4.2		50	1000	20000	50000
TDS*	84	38		440	4000	60000	100000
Phenol Index (Monohydric Phenols) *	< 0.13	< 0.13		< 0.50	1	-	-
DOC	11	11		110	500	800	1000
Leach Test Information							
Stone Content (%)	< 0.1						
Sample Mass (kg)	2.0						
Dry Matter (%)	88						
Moisture (%)	12						
Stage 1							
Volume Eluate L2 (litres)	0.31						
Filtered Eluate VE1 (litres)	0.26						

Results are expressed on a dry weight basis, after correction for moisture content where applicable.

*= UKAS accredited (liquid eluate analysis only)

Stated limits are for guidance only and i2 cannot be held responsible for any discrepencies with current legislation

** = MCERTS accredited

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes as defined by the Waste (England and Wales) Regulations 2011 (as amended) and EA Guidance WM3.
This analysis is only applicable for landfill acceptance criteria (The Environmental Permitting (England and Wales) Regulations) and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Analytical Report Number : 21-14848
Project / Site name: Creiff Road, Perth

* 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 *
2038789	TP05	None Supplied	0.8	Brown loam and clay with gravel and vegetation.
2038790	TP07	None Supplied	1	Brown loam and clay with gravel.
2038791	TP11	None Supplied	0.5	Brown loam and clay with gravel and vegetation.

Analytical Report Number : 21-14848
Project / Site name: Creiff Road, Perth

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
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
Preparation WAC leachate		In-house method	L043-PL	W	NONE
Speciated WAC-17 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. MCERTS accredited except Coronene.	L064-PL	D	MCERTS
Chloride in WAC leachate (BS EN 12457-3 Prep)	Determination of Chloride colorimetrically by discrete analyser.	In house based on MEWAM Method ISBN 0117516260.	L082-PL	W	ISO 17025
Fluoride in WAC leachate (BS EN 12457-3 Prep)	Determination of fluoride in leachate by 1:1ratio with a buffer solution followed by Ion Selective Electrode.	In-house method based on Standard Methods for the Examination of Water and Waste Water, 21st Ed.	L033-PL	W	ISO 17025
Phenol Index in WAC leachate (BS EN 12457-3 Prep)	Determination of monohydric phenols in leachate by continuous flow analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Sulphate in WAC leachate (BS EN 12457-3 Prep)	Determination of sulphate in leachate by acidification followed by ICP-OES.	In-house method based on Standard Methods for the Examination of Water and Waste Water, 21st Ed.	L039-PL	W	ISO 17025
TDS in WAC leachate (BS EN 12457-3 Prep)	Determination of total dissolved solids in leachate by electrometric measurement.	In-house method based on Standard Methods for the Examination of Water and Waste Water, 21st Ed.	L031-PL	W	NONE
DOC in WAC leachate (BS EN 12457-3 Prep)	Determination of dissolved organic carbon in leachate by TOC/DOC NDIR analyser.	In-house method based on Standard Methods for the Examination of Water and Waste Water, 21st Ed.	L037-PL	W	NONE
PCB's by GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	NONE
BTEX (Sum of BTEX compounds) in soil	Determination of BTEX in soil by headspace GC-MS. Individual components MCERTS accredited	In-house method based on USEPA8260	L073B-PL	W	NONE
Acid neutralisation capacity of soil	Determination of acid neutralisation capacity by addition of acid or alkali followed by electronic probe.	In-house method based on Guidance an Sampling and Testing of Wastes to Meet Landfill Waste Acceptance	L046-PL	W	NONE
Loss on ignition of soil @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace.	In house method.	L047-PL	D	MCERTS
Mineral Oil in Soil C10 - C40	Determination of dichloromethane/hexane extractable hydrocarbons in soil by GC-MS.	In-house method based on USEPA 8270	L076-PL	D	NONE
pH in soil	Determination of pH in soil by addition of water followed by electrometric measurement.	In house method.	L005-PL	W	MCERTS
Total organic carbon in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L023-PL	D	MCERTS

Analytical Report Number : 21-14848
Project / Site name: Creiff Road, Perth

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in WAC leachate (BS EN 12457-3 Prep)	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on Standard Methods for the Examination of Water and Waste Water, 21st Ed.	L039-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.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

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Analytical Report Number : 21-14856

Project / Site name:	Creiff Road, Perth	**Samples received on:**	07/10/2021
Your job number:	VG183	**Samples instructed on/ Analysis started on:**	07/10/2021
Your order number:	2825	**Analysis completed by:**	18/10/2021
Report Issue Number:	1	**Report issued on:**	20/10/2021
Samples Analysed:	5 soil samples		

Signed: [redacted]

Jennifer Fitzpatrick
Customer Services Advisor
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.

Analytical Report Number: 21-14856
Project / Site name: Creiff Road, Perth
Your Order No: 2825

Lab Sample Number				2038806	2038807	2038808	2038809	2038810
Sample Reference				TP01	TP03	TP06	TP09	TP12
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.50	1.50	1.50	1.50	1.50
Date Sampled				06/10/2021	06/10/2021	06/10/2021	06/10/2021	06/10/2021
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	%	0.01	NONE	10	10	12	12	5.2
Total mass of sample received	kg	0.001	NONE	2.0	2.0	2.0	2.0	2.0
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.0	8.4	6.2	6.8	6.6
Electrical Conductivity	µS/cm	10	ISO 17025	32	130	30	38	150
Redox Potential	mV	-800	NONE	187.70	199.20	291.30	266.10	299.10
Phenols by HPLC								
Catechol	mg/kg	0.1	ISO 17025	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Resorcinol	mg/kg	0.1	ISO 17025	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Cresols (o-, m-, p-)	mg/kg	0.3	ISO 17025	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30
Total Naphthols (sum of 1- and 2- Naphthol)	mg/kg	0.2	ISO 17025	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
2-Isopropylphenol	mg/kg	0.1	ISO 17025	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenol	mg/kg	0.1	ISO 17025	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Trimethylphenol (2,3,5-)	mg/kg	0.1	ISO 17025	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Xylenols and Ethylphenols	mg/kg	0.3	ISO 17025	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30
Total Phenols								
Total Phenols (HPLC)	mg/kg	1.3	ISO 17025	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3
Monoaromatics & Oxygenates								
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Petroleum Hydrocarbons								
Mineral Oil (C10 - C20)	mg/kg	10	NONE	< 10	< 10	< 10	< 10	< 10
Mineral Oil (C21 - C40)	mg/kg	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH (C5 - C10)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorinated Solvents								
Total Chlorinated Solvents	µg/kg	100	NONE	< 100	< 100	< 100	< 100	< 100

Analytical Report Number: 21-14856
Project / Site name: Creiff Road, Perth
Your Order No: 2825

Lab Sample Number				2038806	2038807	2038808	2038809	2038810
Sample Reference				TP01	TP03	TP06	TP09	TP12
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.50	1.50	1.50	1.50	1.50
Date Sampled				06/10/2021	06/10/2021	06/10/2021	06/10/2021	06/10/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
VOCs								
Chloromethane	µg/kg	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane	µg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromomethane	µg/kg	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vinyl Chloride	µg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichlorofluoromethane	µg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	µg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,2-Dichloropropane	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloromethane	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,2-dichloroethene	µg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloromethane	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromomethane	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromodichloromethane	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,2-Trichloroethane	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	µg/kg	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromochloromethane	µg/kg	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloroethene	µg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromoethane	µg/kg	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorobenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-Xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Styrene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tribromomethane	µg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Isopropylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromobenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
n-Propylbenzene	µg/kg	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Chlorotoluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
tert-Butylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
sec-Butylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p-Isopropyltoluene	µg/kg	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Butylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Analytical Report Number: 21-14856
Project / Site name: Creiff Road, Perth
Your Order No: 2825

Lab Sample Number				2038806	2038807	2038808	2038809	2038810
Sample Reference				TP01	TP03	TP06	TP09	TP12
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.50	1.50	1.50	1.50	1.50
Date Sampled				06/10/2021	06/10/2021	06/10/2021	06/10/2021	06/10/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

VOCs TICs

VOCs TICs Compound Name		N/A	NONE	ND	ND	ND	ND	ND
VOC % Match	%	N/A	NONE	0	0	0	0	0

SVOCs

Aniline	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenol	mg/kg	0.2	ISO 17025	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
2-Chlorophenol	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
2-Methylphenol	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Hexachloroethane	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nitrobenzene	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
4-Methylphenol	mg/kg	0.2	NONE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Isophorone	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
2-Nitrophenol	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
4-Chloroaniline	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Hexachlorobutadiene	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
2,4,6-Trichlorophenol	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
2,4,5-Trichlorophenol	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
2-Methylnaphthalene	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
2-Chloronaphthalene	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Dimethylphthalate	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
2,6-Dinitrotoluene	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
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
2,4-Dinitrotoluene	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Dibenzofuran	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
4-Chlorophenyl phenyl ether	mg/kg	0.3	ISO 17025	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Diethyl phthalate	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
4-Nitroaniline	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Azobenzene	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Hexachlorobenzene	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
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
Carbazole	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Dibutyl phthalate	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2

Analytical Report Number: 21-14856
Project / Site name: Creiff Road, Perth
Your Order No: 2825

Lab Sample Number				2038806	2038807	2038808	2038809	2038810
Sample Reference				TP01	TP03	TP06	TP09	TP12
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.50	1.50	1.50	1.50	1.50
Date Sampled				06/10/2021	06/10/2021	06/10/2021	06/10/2021	06/10/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Anthraquinone	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Butyl benzyl phthalate	mg/kg	0.3	ISO 17025	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 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

SVOCs TICs

SVOCs TICs Compound Name		N/A	NONE	ND	ND	ND	ND	ND
SVOC % Match	%	N/A	NONE	0	0	0	0	0

Analytical Report Number: 21-14856
Project / Site name: Creiff Road, Perth
Your Order No: 2825

Lab Sample Number				2038806	2038807	2038808	2038809	2038810
Sample Reference				TP01	TP03	TP06	TP09	TP12
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.50	1.50	1.50	1.50	1.50
Date Sampled				06/10/2021	06/10/2021	06/10/2021	06/10/2021	06/10/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Aldehydes (various)								
Acetaldehyde	mg/kg	1	NONE	< 1	< 1	< 1	< 1	< 1
Propanal	mg/kg	1	NONE	< 1	< 1	< 1	< 1	< 1
Butanal	mg/kg	1	NONE	< 1	< 1	< 1	< 1	< 1
Methacrolein [Crotonaldehyde]	mg/kg	1	NONE	< 1	< 1	< 1	< 1	< 1
Pentanal	mg/kg	1	NONE	< 1	< 1	< 1	< 1	< 1
Hexanal	mg/kg	1	NONE	< 1	< 1	< 1	< 1	< 1
Heptanal	mg/kg	1	NONE	< 1	< 1	< 1	< 1	< 1
Benzaldehyde	mg/kg	1	NONE	< 1	< 1	< 1	< 1	< 1
Octanal	mg/kg	1	NONE	< 1	< 1	< 1	< 1	< 1
Nonanal	mg/kg	1	NONE	< 1	< 1	< 1	< 1	< 1
Decanal	mg/kg	1	NONE	< 1	< 1	< 1	< 1	< 1
Ethers								
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Bis(2-chloroethoxy)methane	mg/kg	0.3	NONE	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30
4-Chlorophenyl phenyl ether	mg/kg	0.3	ISO 17025	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
MTBE	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Nitrobenzene								
Nitrobenzene	mg/kg	0.3	MCERTS	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30
1,2-Nitrobenzene	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
1,3-Nitrobenzene	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
1,4-Nitrobenzene	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
2,6-Dinitrotoluene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
2,4-Dinitrotoluene	mg/kg	0.2	NONE	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Ketones								
Isophorone	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Acetone	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Amines								
Aniline	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
4-Chloroaniline	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
4-Nitroaniline	mg/kg	0.2	NONE	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
3-Nitroaniline	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2-Nitroaniline	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Diphenylamine	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Carbazole	mg/kg	0.3	MCERTS	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30

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

Analytical Report Number : 21-14856
Project / Site name: Creiff Road, Perth

* 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 *
2038806	TP01	None Supplied	1.5	Brown loam and sand with gravel.
2038807	TP03	None Supplied	1.5	Brown loam and clay with gravel and vegetation.
2038808	TP06	None Supplied	1.5	Brown loam and clay with gravel and vegetation.
2038809	TP09	None Supplied	1.5	Brown clay and loam with gravel.
2038810	TP12	None Supplied	1.5	Brown loam and clay with gravel.

Analytical Report Number : 21-14856
Project / Site name: Creiff Road, Perth

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Phenols, speciated, in soil, by HPLC	Determination of speciated phenols by HPLC.	In house method based on Blue Book Method.	L030-PL	W	ISO 17025
Electrical conductivity of soil	Determination of electrical conductivity in soil by electrometric measurement.	In-house method	L031-PL	D	ISO 17025
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Redox Potential of soil	Determination of redox potential in soil by electrometric measurement.	In house method.	L084-PL	W	NONE
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
Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds in soil by extraction in dichloromethane and hexane followed by GC-MS.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Tentatively identified compounds (SVOC) in soil	Determination of semi-volatile organic compounds total ion count in soil by extraction with dichloromethane and hexane followed by GC-MS followed by a full library scan.	In-house method based on USEPA 8270	L064-PL	D	NONE
Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Tentatively identified compounds (VOC) in soil	Determination of volatile organic compounds total ion count in soil by headspace GC-MS followed by a full library scan.	In-house method based on USEPA8260	L073-PL	W	NONE
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Total Chlorinated Solvents in soil	Determination of chlorinated solvents in soil by headspace GC-MS.	In-house method based on USEPA8260	L017-UK	W	MCERTS
TPH Chromatogram in Soil	TPH Chromatogram in Soil.	In-house method	L064-PL	D	NONE
Acetone in soil	Determination of Acetone by HS-GC-MS.	In house method	L073B-PL	W	NONE
Aldehydes in soil		In-house method	L073B-PL	W	NONE
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	NONE
Mineral Oil (Soil) C10 - C40	Determination of mineral oil fraction extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L076-PL	D	NONE

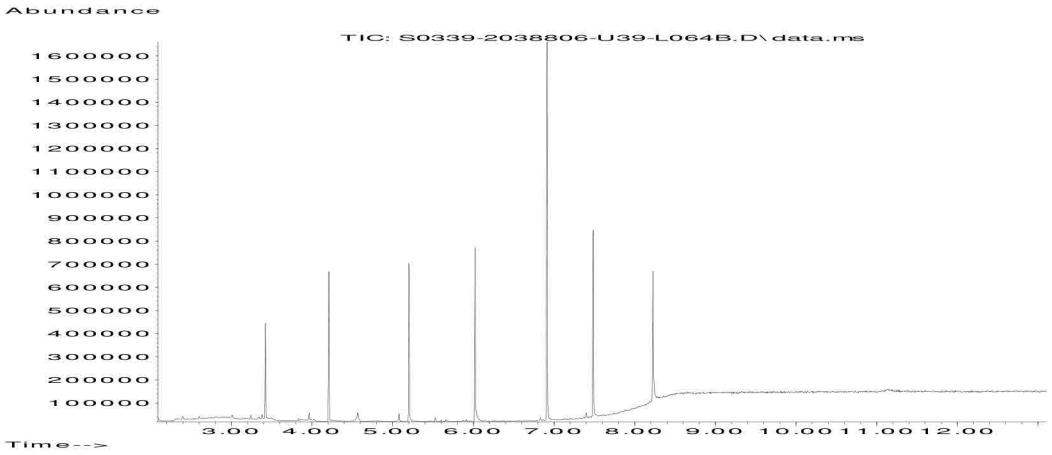
Analytical Report Number : 21-14856
Project / Site name: Creiff Road, Perth

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
WIR compounds	Determination of WIR compounds by various methods listed in the Methods Table.	In House Method		W	NONE

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.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.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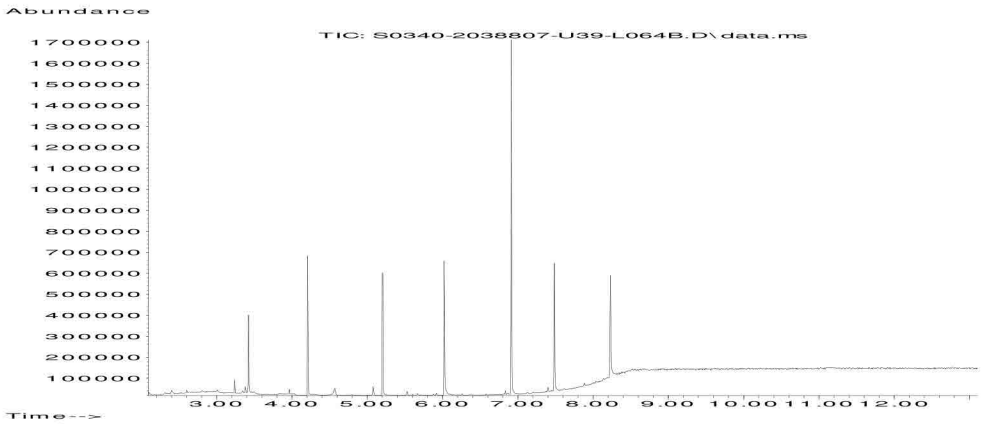
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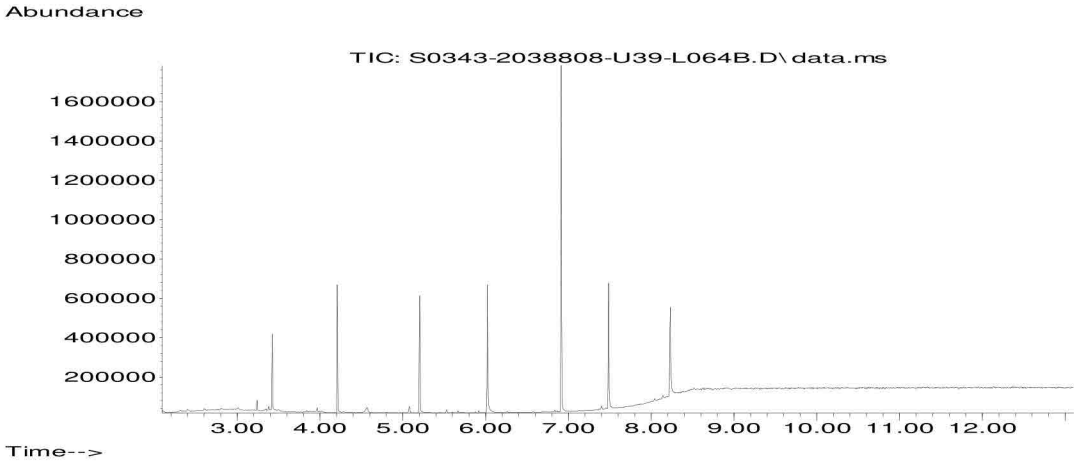
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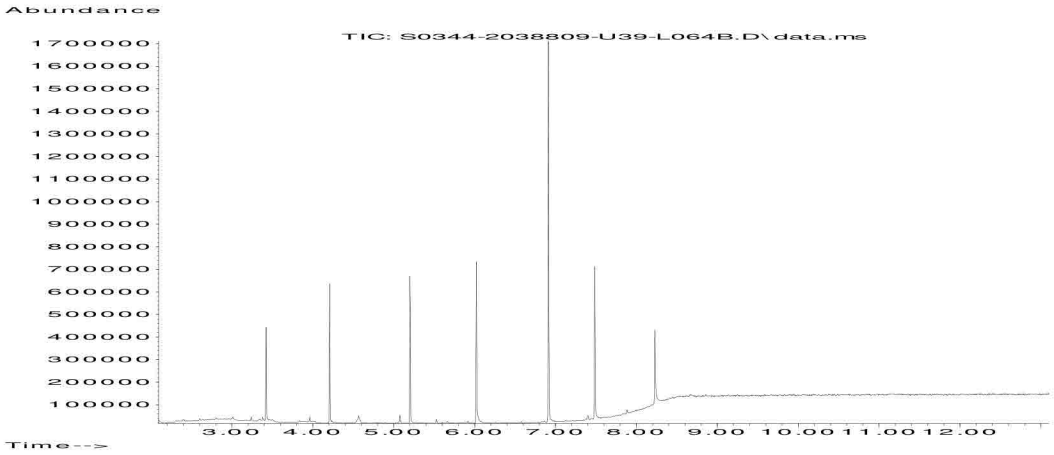
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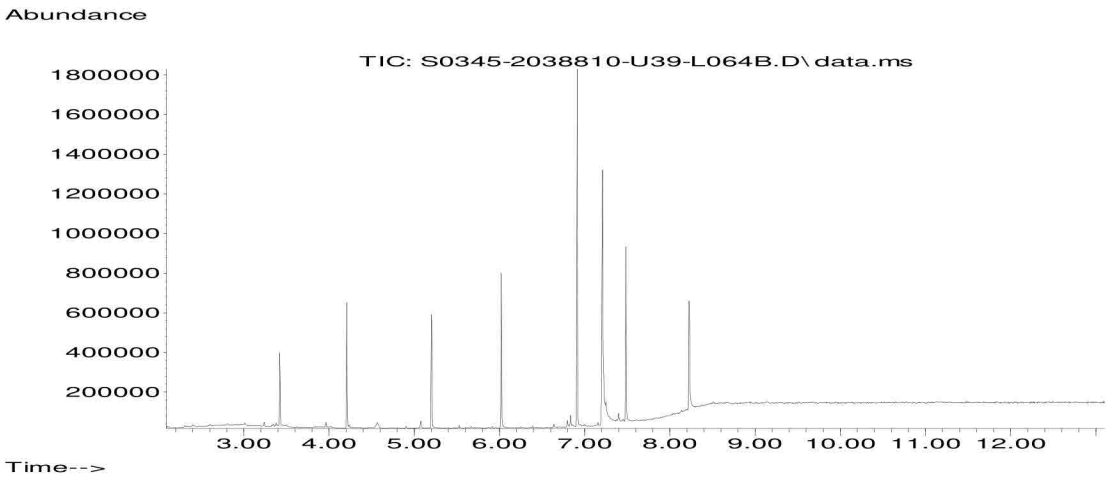
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Appendix 7 Results of On-Site Groundwater and Gas Monitoring and Gas Monitor Calibration Certificate– Johnson Poole & Bloomer – October 2021 - January 2022

CERTIFICATION OF CALIBRATION

4533

Date Of Calibration: 25-Jun-2021

Certificate Number: G505965_2/28338

Issued by: QED Environmental Systems Ltd.

Customer: **Johnson Poole & Bloomer Ltd**
50 Speirs Wharf Glasgow Lanarkshire
G4 9TH UNITED KINGDOM

Description: Gas Analyser

Model: GA5000

Serial Number: G505965

UKAS Accredited results:

Results after adjustment :

Methane (CH_4)		
Certified Gas (%)	**Instrument Reading (%)**	**Uncertainty (%)**
5.0	4.9	0.072
15.0	14.9	0.13
60.0	59.6	0.42

Carbon Dioxide (CO_2)		
Certified Gas (%)	**Instrument Reading (%)**	**Uncertainty (%)**
5.0	4.8	0.074
15.0	14.6	0.13
40.0	40.0	0.29

Oxygen (O_2)		
Certified Gas (%)	**Instrument Reading (%)**	**Uncertainty (%)**
21.1	21.2	0.25

The inwards assessment was carried out 18-Jun-2021.
The maximum adjustment is larger than the specification limit.
Inwards assessment data is available if requested.

All concentrations are molar.

CH_4, CO_2 readings recorded at : 32.4 °C ± 2.5 °C

O2 readings recorded at : 22.5 °C ± 2.5 °C

Barometric Pressure : 1006 mbar ± 4 mbar

Method of Test : The analyser is calibrated in a temperature controlled chamber using a series of reference gases, in compliance with procedure LP004.

Instrument has passed calibration as the measurement result is within the specification limit. The specification limit takes into account the measurement uncertainty.
The results relate only to the item calibrated

Calibration Instance:112 IGC Instance:112

www.qedenv.com +44 (0) 333 800 0088 sales@qedenv.co.uk

QED Environmental Systems Ltd. Cyan Park - Unit 3, Jimmy Hill Way, Coventry, CV2 4QP, UNITED KINGDOM

Registered in England and Wales 1898734

CERTIFICATION OF CALIBRATION

4533

Date Of Calibration: 25-Jun-2021

Certificate Number: G505965_2/28338

Issued by: QED Environmental Systems Ltd.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Calibrations marked 'Non-UKAS Accredited results' on this certificate have been included for completeness.

Non-UKAS accredited results after adjustment:

Barometer (mbar)	
Reference	**Instrument Reading**
1006	1006

Additional Gas Cells		
Gas	**Certified Gas (ppm)**	**Instrument Reading (ppm)**
CO	509	512
H_2S	250	250

Internal Flow	
Applied (l/hr)	**Instrument Reading (l/hr)**
5.00	5.00
10.00	10.10

Date of Issue : 28-Jun-2021 **Approved by Signatory** [redacted]

Dawn Hemings

Laboratory Inspection

End of Certificate

Calibration Instance:112 IGC Instance:112

www.qedenv.com +44 (0) 333 800 0088 sales@qedenv.co.uk

QED Environmental Systems Ltd. Cyan Park - Unit 3, Jimmy Hill Way, Coventry, CV2 4QP, UNITED KINGDOM

Registered in England and Wales 1898734

Project Number	VG183	
Project Name	Crieff Road, Perth	
Client	Lidl	
Date	29th October 2021	
Engineer	JC	
Weather	Overcast, heavy rain	
Atmospheric Pressure	Start	**982**
	Finish	**981**
Atmospheric Gas Readings	CH4 % by vol	**0**
	CO2 % by vol	**0.2**
	O2 % by vol	**21.2**
	CO ppm	**0**
	H2S ppm	**0**
Gas monitor Model	Set A	
Gas Monitor Serial Number	G505965	
Date of Next Calibration		

Borehole Number	Borehole level mAOD	CH_4 %vol		CH_4 %vol		CO_2 % vol		CO_2 % vol		O_2 % vol		O_2 % vol		N_2 % vol		H_2S ppm		H_2S ppm		CO ppm		CO ppm		Atmos Pressure (mb)	Diff Pressure (Pa)	Ave Flow (l/h)	
		Peak	Steady	Min	Max	Peak	Steady	Min	Max	Peak	Steady	Min	Max	Peak	Steady	Peak	Steady	Min	Max	Peak	Steady	Min	Max			Peak	Steady
BH1		**0**	**0**	**0**	**0**	**1.1**	**1.1**	**0.2**	**1.1**	**21.2**	**20.5**	**20.5**	**21.2**	**78.7**	**78.4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**982**	**1633**	**-1.9**	**-1.8**
BH4		**0**	**0**	**0**	**0**	**0.2**	**0.2**	**0.2**	**0.2**	**21.8**	**21.7**	**21.7**	**21.8**	**78.1**	**78**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**981**	**3**	**0.3**	**0.2**
BH6		**0**	**0**	**0**	**0**	**2.3**	**2.2**	**0.9**	**2.3**	**21.4**	**19.6**	**19.5**	**21.4**	**78.2**	**78.2**	**0**	**0**	**0**	**0**	**2**	**2**	**0**	**2**	**982**	**146**	**-2**	**-1.9**
BH7		**0**	**0**	**0**	**0**	**2.7**	**2.7**	**0.2**	**2.7**	**21.5**	**17.6**	**17.6**	**21.5**	**79.7**	**79.7**	**0**	**0**	**0**	**0**	**3**	**3**	**0**	**3**	**982**	**704**	**4**	**4**
BH8		**0**	**0**	**0**	**0**	**0.2**	**0.2**	**0.2**	**0.2**	**21.5**	**21.5**	**21.5**	**21.5**	**78.3**	**78.3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**983**	**500**	**-2.2**	**-2.2**

Comments	

Project Number	VG183
Client	Lidl
Date	29th October 2021
Engineer	JC
Weather	Overcast, heavy rain
Instrument Used	
Serial Number	
Calibrated before use	✓

Borehole Number	Water Level m	Depth of BH (m)			pH			Temperature °C			Conductivity (uS/cm)	Dissolved Oxygen (mg/?L)
Calibration Check												
Calibration Check												

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Flow (l/h)	Flow (l/h)	G/water Depth (m)	Depth of BH (m)	Water Level (mAOD)	Water Sampling		
Steady - end of monitoring	Max				Purge 3 x well volume	Recharged	Sample taken
-1.8	**-1.9**	**1.32**	**3**	**-1.32**	✓	✘	✘
0.2	**0.3**	**1.42**	**2**	**-1.42**			
-1.9	**2**	**1.27**	**2.22**	**-1.27**			
4	**4**	**1.42**	**4**	**-1.42**			
-2.2	**-2.2**	**1.32**	**2.98**	**-1.32**			
				0			
				0			
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				0			

Johnson Poole & Bloomer

Project Number	VG183	
Project Name	Crieff Road	
Client	Lidl	
Date	05/11/2021	
Engineer	JC	
Weather	Sunny/Clouds	
Atmospheric Pressure	Start	1017
	Finish	1018
Atmospheric Gas Readings	CH4 % by vol	0
	CO2 % by vol	0.2
	O2 % by vol	20.7
	CO ppm	0
	H2S ppm	0
Gas monitor Model	Set A	
Gas Monitor Serial Number	G505965	
Date of Next Calibration		

Borehole Number	Borehole level mAOD	CH_4 %vol		CH_4 %vol		CO_2 % vol		CO_2 % vol		O_2 % vol		O_2 % vol		N_2 % vol		H_2S ppm		H_2S ppm		CO ppm		CO ppm		Atmos Pressure (mb)	Diff Pressure (Pa)	Ave Flow (l/h)		Flow (l/h)	Flow (l/h)	G/water Depth (m)	Depth of BH (m)	Water Level (mAOD)	Water Sampling		
		Peak	Steady	Min	Max	Peak	Steady	Min	Max	Peak	Steady	Min	Max	Peak	Steady	Peak	Steady	Min	Max	Peak	Steady	Min	Max			Peak	Steady	Steady - end of monitoring	Max				Purge 3 x well volume	Recharged	Sample taken
BH1		0	0	0	0	0.2	0.4	0.2	0.4	20.7	20.5	20.5	20.7	79.1	79.1	0	0	0	0	0	0	0	0	1017	266	0.1	0.1	0.1	0.1	2.25	3	-2.25			
BH4		0	0	0	0	0.6	0.6	0.2	0.6	20.7	20.5	20.5	20.7	79.1	78.9	0	0	0	0	0	0	0	0	1018	3	0	0	0	0	1.52	2	-1.52			
BH6		0	0	0	0	2.1	2.1	0.2	2.1	21.1	19.5	19.5	21.1	78.7	78.4	0	0	0	0	0	0	0	0	1018	12	0	0	0	0	1.36	2.22	-1.36			
BH7		0	0	0	0	0.2	0.2	0.2	0.2	21.2	21.2	20.6	21.2	79.1	78.6	0	0	0	0	0	0	0	0	1018	26	0	0	0	0	1.86	4	-1.86			
BH8		0	0	0	0	3.4	3.4	0.2	3.4	21.1	18.2	18.2	21.1	78.7	78.3	0	0	0	0	0	0	0	0	1018	150	0	0	0	0	1.37	2.98	-1.37			
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Comments	

Johnson Poole & Bloomer

Project Number	VG183	
Project Name	Crieff Road, Perth	
Client	Lidl	
Date	11/11/2021	
Engineer	SM	
Weather	Overcast, heavy rain	
Atmospheric Pressure	Start	1016
	Finish	
Atmospheric Gas Readings	CH4 % by vol	0
	CO2 % by vol	0.1
	O2 % by vol	21
	CO ppm	0
	H2S ppm	0
Gas monitor Model		GA5000 (c)
Gas Monitor Serial Number		G503122
Date of Next Calibration		22/03/2022

Borehole Number	Borehole level mAOD	CH_4 %vol		CH_4 %vol		CO_2 % vol		CO_2 % vol		O_2 % vol		O_2 % vol		N_2 % vol		H_2S ppm		H_2S ppm		CO ppm		CO ppm		Atmos Pressure (mb)	Diff Pressure (Pa)	Ave Flow (l/h)		Flow (l/h)	Flow (l/h)	G/water Depth (m)	Depth of BH (m)	Water Level (mAOD)	Water Sampling		
		Peak	Steady	Min	Max	Peak	Steady	Min	Max	Peak	Steady	Min	Max	Peak	Steady	Peak	Steady	Min	Max	Peak	Steady	Min	Max			Peak	Steady	Steady - end of monitoring	Max				Purge 3 x well volume	Recharged	Sample taken
BH1		0	0	0	0	3.1	3.1	0.1	3.1	20.9	17.2	17.2	20.9	79.7	79.7	0	0	0	0	0	0	0	0	1016	10	1.4	0	0	1.4	0.92	3.04	-0.92			
BH4		0	0	0	0	2.8	2.8	0.1	2.8	21	18.8	18.8	21	79	78.4	0	0	0	0	0	0	0	0	1016	7	0	0	0	0	1.1	1.99	-1.1			
BH5		0	0	0	0	3	3	0.1	3	21.2	18.4	18.4	21.2	78.7	78.7	0	0	0	0	0	0	0	0	1016	7	0.1	0	0	0.1	1.25	2.78	-1.25			
BH6		0	0	0	0	2.1	1.9	0.1	2.1	21.1	19.7	19.6	21.1	78.9	78.4	0	0	0	0	0	0	0	0	1016	7	0.1	0.1	0.1	0.1	Dry	0.86	#VALUE!			
BH7		0	0	0	0	3.3	3.3	0.1	3.3	21.4	17.2	17.2	21.4	79.7	79.5	0	0	0	0	0	0	0	0	1016	9	0.7	0.2	0.2	0.7	0.95	4.02	-0.95			
BH8		0	0	0	0	2.5	2.5	0.1	2.5	21.3	18.9	18.9	21.3	78.6	78.5	0	0	0	0	0	0	0	0	1016	3	0	0	0	0	1.05	2.8	-1.05			
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Comments	

Johnson Poole & Bloomer

Project Number	VG183	
Project Name	Crieff Road, Perth	
Client	Lidl	
Date	01/12/2021	
Engineer	SM	
Weather	Clear and Dry	
Atmospheric Pressure	Start	998
	Finish	998
Atmospheric Gas Readings	CH4 % by vol	0
	CO2 % by vol	0.1
	O2 % by vol	20.8
	CO ppm	0
	H2S ppm	0
Gas monitor Model		GA5000 (c)
Gas Monitor Serial Number		G503122
Date of Next Calibration		22/03/2022

Borehole Number	Borehole level mAOD	CH_4 %vol		CH_4 %vol		CO_2 % vol		CO_2 % vol		O_2 % vol		O_2 % vol		N_2 % vol		H_2S ppm		H_2S ppm		CO ppm		CO ppm		Atmos Pressure (mb)	Diff Pressure (Pa)	Ave Flow (l/h)		Flow (l/h)	Flow (l/h)	G/water Depth (m)	Depth of BH (m)	Water Level (mAOD)	Water Sampling		
		Peak	Steady	Min	Max	Peak	Steady	Min	Max	Peak	Steady	Min	Max	Peak	Steady	Peak	Steady	Min	Max	Peak	Steady	Min	Max			Peak	Steady	Steady - end of monitoring	Max				Purge 3 x well volume	Recharged	Sample taken
BH1		0	0	0	0	2.3	2.3	0.2	2.3	21.2	17.3	17.3	21.2	80.4	80.4	0	0	0	0	0	0	0	0	998	257	2.5	0.3	0.3	2.5	1.2	3.05	-1.2			
BH4		0	0	0	0	2.4	2.4	0.2	2.4	21.2	19.2	19.2	21.2	78.7	78.4	0	0	0	0	0	0	0	0	998	5	0	0	0	0	0.79	1.98	-0.79			
BH5		0	0	0	0	3.2	3.2	0.1	3.2	21.1	18.9	18.9	21.1	78.7	77.9	0	0	0	0		0	0	0	998	5	0	0	0	0	1.84	2.82	-1.84			
BH6		0	0	0	0	2	1.9	0.2	2	21.1	19.9	19.9	21.1	78.7	78.1	0	0	0	0	0	0	0	0	998	26	0.8	0	0	0.8	dry	0.9	#VALUE!			
BH7																																0			
BH8		0	0	0	0	2.4	2.4	0.1	2.4	21.3	19.3	19.3	21.3	78.6	78.3	0	0	0	0	0	0	0	0	998	2	0	0	0	0	0.73	2.84	-0.73			
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Comments	

Johnson Poole & Bloomer

Project Number	VG183	
Project Name	Crieff Road, Perth	
Client	Lidl	
Date	20/12/2021	
Engineer	SM	
Weather	Light Rain, Fog	
Atmospheric Pressure	Start	1028
	Finish	1028
Atmospheric Gas Readings	CH4 % by vol	0
	CO2 % by vol	0.2
	O2 % by vol	20.8
	CO ppm	0
	H2S ppm	0
Gas monitor Model		GA5000 (c)
Gas Monitor Serial Number		G503122
Date of Next Calibration		22/03/2022

Borehole Number	Borehole level mAOD	CH_4 %vol		CH_4 %vol		CO_2 % vol		CO_2 % vol		O_2 % vol		O_2 % vol		N_2 % vol		H_2S ppm		H_2S ppm		CO ppm		CO ppm		Atmos Pressure (mb)	Diff Pressure (Pa)	Ave Flow (l/h)		Flow (l/h)	Flow (l/h)	G/water Depth (m)	Depth of BH (m)	Water Level (mAOD)	Water Sampling		
		Peak	Steady	Min	Max	Peak	Steady	Min	Max	Peak	Steady	Min	Max	Peak	Steady	Peak	Steady	Min	Max	Peak	Steady	Min	Max			Peak	Steady	Steady - end of monitoring	Max				Purge 3 x well volume	Recharged	Sample taken
BH1		0	0	0	0	0.3	0.3	0.1	0.3	21.2	21	21	21.2	78.7	78.7	0	0	0	0	0	0	0	0	1028	36	1.5	0	0	1.5	0.81	3.04	-0.81			
BH4		0	0	0	0	2.1	2.1	0.1	2.1	21.5	20.1	20.1	21.5	78.4	77.8	0	0	0	0	0	0	0	0	1028	-2	0	0	0	0	1.18	2.01	-1.18			
BH5		0	0	0	0	2.7	2.7	0.1	2.7	21.8	19.4	19.4	21.8	78.1	77.9	0	0	0	0	0	0	0	0	1028	3	0	0	0	0	1.13	2.79	-1.13			
BH6		0	0	0	0	2.2	2.1	0.1	2.2	21.7	20.4	20.4	21.7	78.2	77.5	0	0	0	0	0	0	0	0	1028	-2	0	0	0	0	1.11	1.31	-1.11			
BH7		0	0	0	0	3.5	3.5	0.1	3.5	22	18.2	18.2	22	78.8	78.2	0	0	0	0	0	0	0	0	1028	3	7	0.2	0.2	7	0.92	4.03	-0.92			
BH8		0	0	0	0	2.2	2.2	0.1	2.2	21.8	20.1	20.1	21.8	78.1	77.7	0	0	0	0	0	0	0	0	1028	3	0	0	0	0	1.04	2.82	-1.04			
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Comments	

Johnson Poole & Bloomer

Project Number	VG183	
Project Name	Crieff Road, Perth	
Client	Lidl	
Date	06/01/2022	
Engineer	SM	
Weather	Rain	
Atmospheric Pressure	Start	995
	Finish	995
Atmospheric Gas Readings	CH4 % by vol	0
	CO2 % by vol	0.1
	O2 % by vol	20.5
	CO ppm	0
	H2S ppm	0
Gas monitor Model		GA5000
Gas Monitor Serial Number		G503122
Date of Next Calibration		22/03/2022

Borehole Number	Borehole level mAOD	CH_4 %vol		CH_4 %vol		CO_2 % vol		CO_2 % vol		O_2 % vol		O_2 % vol		N_2 % vol		H_2S ppm		H_2S ppm		CO ppm		CO ppm		Atmos Pressure (mb)	Diff Pressure (Pa)	Ave Flow (l/h)		Flow (l/h)	Flow (l/h	G/water Depth (m)	Depth of BH (m)	Water Level (mAOD)	Water Sampling		
		Peak	Steady	Min	Max	Peak	Steady	Min	Max	Peak	Steady	Min	Max	Peak	Steady	Peak	Steady	Min	Max	Peak	Steady	Min	Max			Peak	Steady	Steady - end of monitoring	Max						
BH1		0	0	0	0	1.6	1.6	0.1	1.6	20.5	20	19.7	20.5	79.3	78.4	0	0	0	0	0	0	0	0	995	1490	8.7	1.9	1.9	8.7	1.2	3.04	-1.2			
BH4		0	0	0	0	2.2	2.2	0.1	2.2	20.9	19	19	20.9	79	78.8	0	0	0	0	0	0	0	0	995	2	0	-0.1	-0.1	0	0.97	1.99	-0.97			
BH5		0	0	0	0	2.4	2.4	0.1	2.4	20.7	18.9	18.9	20.7	79.2	78.7	0	0	0	0	0	0	0	0	995	5	0.2	0.1	0.1	0.2	0.86	2.77	-0.86			
BH6		0	0	0	0	2.4	2.2	0.1	2.4	21.1	19.6	19.5	21.1	78.8	78.2	0	0	0	0	0	0	0	0	995	5	0.9	0.1	0.1	0.9	1.06	1.3	-1.06			
BH7		0	0	0	0	2.7	2.7	0.1	2.7	21.2	18.2	18.2	21.2	79.2	79.1	0	0	0	0	0	0	0	0	995	3	1	0	0	1	0.94	4.04	-0.94			
BH8		0	0	0	0	1.9	1.9	0.1	1.9	21.3	19.7	19.7	21.3	78.7	78.4	0	0	0	0	0	0	0	0	995	9	0	-0.1	-0.1	0	0.8	2.79	-0.8			
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Comments	

Appendix 8 Scottish Water Pipe Materials Assessment Forms

Site Soils Investigation Contamination Checklist

Please refer to Water for Scotland 1st Edition (Parts 2 and 3 section numbers 2.2.2 and 3.2) and to associated documents particularly UK Water Industry Research (UKWIR) document, "Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites", UKWIR report reference 10/WM/03/21, 2010.

Please note that all assessments / evaluations regarding soil contamination issues must be carried out by a suitably qualified environmental specialist. These should include comment on the suitability of the pipe material selected, conclusions or recommendations regarding additional protective measures pertaining to the installation of the mains and service pipes and selection of pipe bedding, surround and trench backfill.

For Greenfield sites:

Required:	Included? (tick)
At least 6 historic O.S. land usage maps covering 150 years (1 from 150 years ago and 1 from each period since at approximately 25 to 30 year intervals).	✓
Walk through survey	✓

It is recognised that even virgin Greenfield sites can contain naturally occurring contaminants. If an intrusive soils investigation has been carried out with respect to potential contaminants then the results of the survey and the recommendations of the environmental specialist regarding the installation and material of water mains, communication pipes and supply pipes should be included in support of the design.

If Completed:	Included? (tick)
Soil Chemical Analysis	

For Brownfield sites:

Required:	Included? (tick)
History of site and surrounding area giving details of historic and current land usage and any other pertinent information.	
Walk through survey	
Soil investigation results with risk based evidence to support choice of pipe material with reference to WRAS and UKWIR guidelines.	
Plan showing location of all trial pits/boreholes in relation to proposed water main	
Evidence from manufacturer that choice of pipe material is suitable for the ground conditions	-
Any Health & Safety considerations due to contaminants	

Completed by (name): Michael K Bradley

Position: Director

RECOMMENDATIONS FOR WATER MAINS SPECIFICATION

Site Name; Crieff Road
Job Number: VG183-12

SUMMARY OF GROUND CONDITIONS

Parameter Group*	Parameter	PE	PVC
1	VOCs (including TIC, but not group 1a)	Pass	Pass
1a	BTEX + Propylbenzene +MTBE	Pass	Pass
2	SVOCs (including TIC, but not groups 2e or 2f)	Pass	Pass
2e	Phenols	Pass	Pass
2f	Cresols and chlorinated phenols	Pass	Pass
3	Mineral oil C11-C20	Pass	Pass
4	Mineral oil C21-C40	Pass	Pass
5	Conductivity	Pass	Pass
	pH value	Pass	Pass
	Redox potential	Pass	Pass
Materials overall pass or fail		Pass	Pass

SUITABILITY OF MATERIALS

The above assessment indicates the following pipe materials are suitable for use at the site; polyethylene (PE), polyvinylchloride (PVC)

WATER MAINS: PE is recommended. Trenches must be bedded and back-filled with certified inert material.

SERVICE PIPE-WORK: PE is recommended. Trenches must be bedded and back-filled with certified inert material.

POTENTIAL HAZARDS TO CONTRACTORS LAYING MAINS/SERVICES

Dust: Dust protection measures including dust suppression and where required respiratory protection (such as dust masks) must be used.

Skin Protection: Skin barriers including suitable gloves, clothing and footwear must be used at all times

Excavations: Due care must be paid to stability issues in any excavations.

Where any doubts exist over the selection of suitable PPE or its use advice must be sought from the relevant H&S and Technical advisors. Staff must be vigilant and aware and report any unusual illness, odours, appearance or event. If encountered further sampling/advice must be sought.

Reviewed By: **Validated By:**

[redacted]

Date : 5/11/2021


Johnson
Poole &
Bloomer
Consultants
GEO-ENVIRONMENTAL & MINERALS
Established in 1844