



Mill Bay Homes Ltd

Ground Investigation

**Cleggars Park
Lamphey
Pembrokeshire
SA71 5JY**

**Report No: 22.09.023
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Client	Mill Bay Homes Ltd

	<u>Signature</u>	<u>Name and Qualifications</u>
Prepared By:		Lee Chippington Associate Director BSc(Hons), MSc, FGS
Checked and Approved By:		Ian Evetts Managing Director HNC, MSc, FGS, CGeol, RoGEP

For and on behalf of ListersGeo, trading name of Listers Geotechnical Consultants Ltd

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EXECUTIVE SUMMARY

Project Reference	22.09.023.
Site Location	Cleggars Park, Lamphey, Pembrokeshire, SA71 5JY.
OS Grid Reference	Approximate centre of the site – 201517, 199963.
Development Proposals	Residential development of two-storey houses, with an access road, driveways and gardens.
Current Site Usage and Existing Buildings	The site is currently two undeveloped grassed fields.
Topography	The site is generally flat lying, however there are two roughly circular depressions in the ground surface in the northern half of the site.
Vegetation	Trees and hedgerows around the site's external boundaries and an internal boundary aligned west to east across the centre of the site.
Published Geology	Bedrock of the Carboniferous age Black Rock Subgroup and Gully Oolite Formation across most of the site with the overlying Pembroke Limestone Group across the northern area.
Hydrology	The Envirocheck data indicates streams in the southeastern and northern areas of the site. During the walkover a dry channel was noted in the southeastern area, but no evidence of a stream in the northern area was observed. These streams are shown to connect with a north flowing stream just beyond the western boundary.
Hydrogeology	The Black Rock Subgroup and Gully Oolite Formation and the Pembroke Limestone Group are Principal Aquifers.
Site History	The site has remained part of undeveloped fields since the earliest map reviewed, 1869, up to present day.
Unexploded Ordnance	The site is located in an area classified as being at low risk of UXO.
Ground Conditions Encountered	The site and laboratory works have shown the ground conditions to comprise Topsoil over bedrock of the Black Rock Subgroup and Gully Oolite Formation down to the base of the exploratory holes at depths down to 6.0m.
Groundwater Encountered	No groundwater seepages or strikes were encountered in the fieldworks and bot borehole standpipe wells were recorded to be dry down to their bases at depths down to 3.0m during the subsequent monitoring visit.
Risks to Human Health	It is considered the site does not pose a significant risk to the identified human health receptors.
Ground Gas Risks	No special precautions for carbon dioxide or methane ground gases, however full radon protection is required.
Risks to Controlled Waters	It is considered the site does not pose a significant risk to the identified controlled waters receptors.
Remediation Required	None required.
Chemical Attack on Buried Concrete	Design Sulphate Class DS – 1. ACEC Class AC – 1.
Geotechnical Hazards	The main geotechnical hazard is the potential risk posed by dissolution features under the site. Further investigations should be carried out to allow a more detailed assessment.
Foundations	In areas not affected by dissolution features, the Black Rock Subgroup and Gully Oolite Formation is considered suitable for shallow spread foundations at 1.0m depth. However, further investigations should be carried out to allow a more detailed assessment of the risks posed by dissolution features and therefore the requirements for zoning the site and possibly deeper foundations.
Floor Slabs	To take account of the risks posed by dissolution features, suspended floor slabs are recommended.
Roads and Hardstanding Design	A preliminary design CBR value of 2% is recommended for formation at 0.5m depth in the Black Rock Subgroup and Gully Oolite Formation. In addition, mitigation measures to account for the risks posed by dissolution features are recommended.

Infiltration Measures	Due to the risks posed by dissolution features, soakaway drainage should be located well away from all structures. The infiltration testing carried out as part of this investigation indicates the limestone bands present at approximately 2.0m depth may be suitable for soakaway drainage.
Waste Soil Classification	Topsoil – Non-hazardous. Natural Soils – Inert.
Further Work and Recommendations	Further investigations to allow a more detailed assessment of the risks posed by ground dissolution should be carried out. A two-phase approach is recommended, involving geophysics followed by boreholes and probe holes.

This executive summary should be read in conjunction with the main report.

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- Continuous Tube Sampler Borehole Logs
- Dynamic Probe Results
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- Dynamic Plate Loading Test Results
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- Geotechnical Laboratory Test Report
- Chemical Laboratory Test Report

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- HazWasteOnline Report
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- PBA Natural/Mining Cavities Database Search Report
- Site Sensitivity Report and Maps
- Geology Report
- Mining and Ground Stability Report and Maps
- Historical Ordnance Survey Maps



GROUND INVESTIGATION REPORT

INTRODUCTION

A Ground Investigation has been undertaken for a proposed residential development at Cleggars Park, Lamphey, Pembrokeshire, SA71 5JY. A Site Location Plan is provided in Appendix A. The Ordnance Survey National Grid reference for the approximate centre of the site is 201517, 199963.

Instructions to undertake the investigation were received from our client, Mill Bay Homes Ltd, in their budget estimate acceptance form, dated the 26th September 2022.

This report describes the desk study and intrusive site investigation activities carried out by ListersGeo in order to provide an evaluation of the ground conditions and the extent of any soil, gas or groundwater contamination present on the site. The report presents initial human health and groundwater risk assessments based on the findings of the desk study information and subsequent contamination laboratory testing. The contamination risk assessment has been carried out using the source-pathway-receptor risk assessment methodology.

The report also discusses the geotechnical implications with regard to the proposed development based on the findings of the fieldwork and subsequent laboratory testing.

This report has been prepared for the sole use of the client and their professional advisors. This report shall not be relied upon by third parties without the express written authority of ListersGeo. If an unauthorised third-party comes into possession of this report, they must not rely on it and the authors owe them no duty of care and skill.

SCOPE OF THE INVESTIGATION

The scope of the investigation was to undertake a desk study and walkover survey, provide an assessment of the geotechnical engineering properties of the ground and the extent of any soil, gas or groundwater contamination on the site. A contaminated land risk assessment was undertaken based on the Contaminated Land Exposure Assessment (CLEA) and Environment Agency (EA) Remedial Targets Methodology (RTM) guidelines.

The investigation also includes parameters to aid pavement and drainage design.

PROPOSALS

It is proposed to redevelop the site to accommodate a residential development of two storey houses and apartments, with an access road, driveways and gardens. It is our understanding the main development will be in the northern area of the site, with the southern area potentially used for soakaway drainage.

SITE INFORMATION AND WALKOVER SURVEY

A walkover survey of the site and its immediate surrounds was undertaken on the 18th October 2022, preceding the fieldwork. A selection of site photographs is presented in Appendix A along with a plan showing the salient features identified.

The site lies on the southern outskirts of Lamphey village in a predominantly agricultural area. It consists of two grassed fields that form an irregular shaped parcel of land, and it is our understanding the proposals are to develop the northern field with houses and associated infrastructure, with the southern field potentially being used for soakaway drainage. The site has overall dimensions of approximately 265m by 220m and covers an area of approximately 5 hectares. Access to the site was gained via a gate in the western boundary.

The site lies at the foot of a shallow north facing valley slope but is generally flat lying. However, there are two circular depressions in the ground surface in the northern field and a channel in the southeastern area of the site. One of the depressions is located in the central western area of the northern field, with the other straddling the eastern boundary and continuing into the neighbouring field. The channel is located in the eastern area of the southern field and is aligned roughly south to north, it slopes gently downwards to the north. Each of these features are annotated on the site plan in Appendix A.

The site is bordered by:

Direction	Feature
North	Houses and gardens
East	A grass field and track
South	Grass fields
West	A road, Freshwater East Road, and houses and gardens

The fields are currently used for grazing sheep or cattle and there are no existing buildings. There is a manhole cover close to the western boundary in the northern field, and it is our understanding there is an old sewer aligned roughly north to south in this area.

There are a few trees close to the channel in the southeastern area of the site and trees and hedgerows along each of the field boundaries, which includes an internal boundary, aligned roughly east to west across the centre of the site.

At the time of the walkover there was no surface water on the site. However, it is our understanding that during wet weather water flows towards the north in the channel noted above, into the circular depression just beyond the eastern boundary. In addition, this area is prone to flooding during prolonged wet periods.

No obvious signs or sources of contamination were noted during the walkover.

DESK STUDY AND BACKGROUND INFORMATION

A desk study review of the site and its history has been undertaken to determine the former land use and the potential for any historically derived sources of chemical contamination, as well as provide information to aid our geotechnical assessment.

The information provided in the desk study is obtained from independent third-party sources. We have relied on this information, but no guarantee can be given for the accuracy or completeness of the third-party data used. It should be appreciated that such data is not exhaustive and is constantly being updated and reviewed in light of new information and procedures. Therefore, improved practices, technology and new information may affect our conclusions and hence this report should be referred back to us for reassessment if new data comes to light, or changes in legislation/best practise is identified prior to development. Similarly, should the development commence after expiry of one year from publication of this report, then we recommend this report is referred back to us for reassessment.

A copy of the desk study information obtained from Landmark is presented in Appendix E of this report.

The desk study comprises a review of the following consultations and information sources:

- Natural Resources Wales
- National Geoscience Information Service
- UK Health Security Agency (UKHSA) and Office for Health Improvement and Disparities (DHSC)
- Centre for Ecology & Hydrology
- British Geological Survey (BGS)
- Contemporary Trade Directories
- Historical Ordnance Survey maps
- Aerial Imagery
- Unexploded Ordnance (UXO) maps
- Stantec (PBA) Non-Coal Mining and Natural Cavities Databases
- Conversations with the Regulators

Information from the above referenced sources has been utilised to develop a conceptual model of the site for use in the geotechnical appraisal and source-pathway-receptor risk assessment.

GEOLOGY

Published Geology

Reference to the BGS 1:50,000 scale map, Sheets 244 and 245 for Pembroke and Linney Head, and other published geological information on the area indicates that most of the site is likely to be underlain by bedrock of the Carboniferous age Black Rock Subgroup and Gully Oolite Formation, with the northern area underlain by the overlying Pembroke Limestone Group, which is also Carboniferous age.

Reference to the geological map indicates superficial Till a few metres to the west of the site and Carboniferous age Avon Group a few metres to the southeast. Therefore, it is possible some Till or Avon Group soils may be present.

Superficial Deposits

Till is described as diamicton, which is unsorted particles ranging in size from clay to boulder suspended in a clay or sand matrix. It was deposited in an environment previously dominated by ice age conditions.

Bedrock

The Black Rock Subgroup and Gully Oolite Formation is described as limestone interbedded with mudstone that was deposited in an environment previously dominated by warm seas. In this area it is known to be up to 630m thick and underlain by the Avon Group, which is described as interbedded limestone and mudstone.

The Pembroke Limestone Group is described as limestone interbedded with mudstone and sandstone that was deposited in an environment previously dominated by warm seas. In this area it is known to be up to 370m thick and underlain by the Black Rock Subgroup and Gully Oolite Formation.

Structural Geology

Locally there are numerous faults aligned roughly north to south, with the downthrow side to the east. The nearest fault to the site is tentatively located on the geological map just beyond the southwestern corner.

Artificial or Made Ground

There is no Artificial or Made Ground shown on, or close to, the site.

Solution Features

Limestone, as a calcium-carbonate rich rock, is susceptible to dissolution by water containing carbon dioxide. This dissolution can create three common types of features within the limestone, grouped together under the generic term 'dissolution features'. These features include:

- **Sinkholes:** Depressions at the ground surface caused by the collapse of overlying limestone or superficial deposits into underground voids created by dissolution. The shape and size are dependent on the underlying void feature.
- **Solution pipes:** A feature in the surface of the limestone caused by increased dissolution in an area of closely spaced discontinuities. These features may, or may not, have a ground surface expression. They occur up to 20m in diameter, though are commonly much smaller.
- **Swallow Holes:** A void within the surface of the limestone where a stream is 'swallowed' by the limestone to flow underground. They often occur at the junction of impermeable strata and limestone. Infilled ancient swallow holes do exist where streams used to flow and may not have any surface expression. They can occur up to 14m in diameter, though commonly a few metres.

Further site-specific information is provided in the Geotechnical Hazards section of the report.

Historical Boreholes

There are no freely available historical borehole logs on, or close to, the site.

HYDROLOGY

The site is at the foot of a gentle north facing valley slope. Reference to the Envirocheck Report indicates there is a north flowing stream in the southeastern area of the site and a west flowing stream across the central area of the site. No streams were noted on the site during the walkover; however a dry channel was noted in the southeastern area. No evidence of a stream was noted in the central area of the site, however the route of the stream shown on the Envirocheck Map appears to connect the two depressions and chamber cover noted in the Walkover section with a north flowing stream just beyond the western boundary. There is no river quality data available for any of the streams noted in the Envirocheck Report.

On the basis of site observations, the OS map for the area and the Envirocheck data, it is considered the likely direction of hydraulic flow for the southern half of the site is towards the north and for the northern half of the site is towards the south.

The Envirocheck Report indicates the site is not with a Zone of Extreme Flooding from Rovers or Seas without defences. However, it does show parts of the site to be at risk of flooding from surface water. Please note, these data do not constitute a site-specific Flood Risk Assessment and we recommend further enquiries to determine if such an assessment would be required to support a development application for the site.

There are no recorded current surface water abstraction licenses located within 250m of the site.

HYDROGEOLOGY

Aquifer designation data are based on geological mapping provided by the British Geological Survey.

The aquifer designation is initially divided as below:

- **Superficial (Drift)** - Permeable unconsolidated (loose) deposits. For example, sands and gravels
- **Bedrock** - Solid permeable formations. For example, sandstone, chalk and limestone

And, for each of these, there are sub-classifications as Principal, Secondary A and Secondary B Aquifers and Unproductive Strata, each with a decreasing rank of importance.

The EA records both the Black Rock Subgroup and Gully Oolite Formation and the Pembroke Limestone Group to be Principal Aquifers.

There are no recorded current groundwater abstraction licenses located within 250m of the site.

The Envirocheck Report indicates the site is not within a Source Protection Zone.

HISTORY OF THE SITE

The history of the site has been assessed by reviewing available historical Ordnance Survey maps, on-line information sources and aerial imagery of the area. This has revealed the following:

Time Period	Historical Site Use	Historical Use of the Surrounding Area
1869 to 2022	The site is shown as two undeveloped fields, with a north flowing stream in the southeastern area of the site.	<p>A road is shown close to the western boundary, and a house just beyond the southwestern corner of the site.</p> <p>By 1969 many houses had been constructed beyond the northern boundary and Rose Cottage just beyond the western boundary. Also, the stream in the southeastern area is shown to flow into 'sinks' just beyond the eastern boundary.</p> <p>By 1994 further houses had been constructed beyond the northern and western boundaries and the previously labelled 'sinks' was labelled as a 'pond.'</p> <p>By 1999 the areas to the west and north had been developed as present.</p> <p>Between 2006 and 2021 a housing estate was constructed approximately 50m to the east.</p>

The stream, sinks and pond referred to above were noted to be dry at the time of the walkover.

UNEXPLODED ORDNANCE AND BOMB SITES

The Zetica bomb risk map shows that the site is located in an area where there is a low risk of unexploded ordnance. Low-risk regions are those with a bombing density of up to 15 bombs per 1,000 acres and there is a low potential for encountering UXO on the site. Works can normally proceed without any special precautions.

INDUSTRIAL USE SITES

The Envirocheck Report records one contemporary trade entry within 250m of the site. This was a wood burning stoves company, which is classified as inactive, and was located 82m to the north. The nearest active fuel filling station is the Lamphey Service Station, which is located 187m to the north.

Considering the nature of the businesses and their distances, they are not considered to pose a significant risk to the site.

ENVIRONMENTAL PERMITS, INCIDENTS AND REGISTERS

There have been two recorded pollution incidents to controlled waters on the site and a further one within 250m. The two on the site occurred in 1996 and involved direct discharge of algae and farm slurry. The other incident was located 30m to the west, occurred 1995 and involved direct discharge of treated effluent. All three incidents were classified as Category 3 – Minor Incidents. Considering the time since the incidents and their minor classifications, none are considered to pose a significant risk to the site.

There have been no substantiated pollution incidents to land or air within 250m of the site.

There are no discharge consents within 250m.

There is one Local Authority Pollution Prevention and Control License within 250m. This is for the Lamphey Service station, which is located 187m north.

WASTE TREATMENT AND LANDFILL SITES

Reference to records indicates there is one Registered Landfill site within 250m. This is located 209m to the northwest and is recorded to accept construction and demolition and excavated waste. Considering its distance from the site and nature of the accepted waste, which does not include any decomposable materials, this landfill is not considered to pose a significant risk to the site.

There are no waste transfer or treatment sites, or waste management facilities recorded within 250m in the Envirocheck Report.

RADON GAS

Desk study information indicates the site lies within an area where greater than 30% of homes exceed the action level of 200Bq/m³ for radon gas. Therefore, in accordance with BR 211, 'Radon: Guidance on Protective Measures for New Buildings,' full radon protection measures are necessary in the construction of new buildings or extensions on this site.

GEOTECHNICAL HAZARDS

Geological

The risk of naturally occurring geotechnical hazards at the site is recorded in the Envirocheck report to be as follows:

Ground Stability Hazard	Hazard Potential Rating	Comments
Ground dissolution from soluble rocks	High	See the Natural Cavities and Dissolution Risk Assessment sections below.
Collapsible deposits	Very low	-
Shrinking and swelling clays	Very low	-
Landslides	Very low	-
Running sand	No hazard	-
Compressible deposits	No hazard	-

Mining and Man-Made Cavities

The desk study information identified that the site does not lie within an area likely to be affected by coal or non-coal mining.

Natural Cavities Database

As the site is underlain by strata known to be susceptible to dissolution, limestone, suspicious depressions in the ground surface were noted in the Walkover, and 'sinks' were noted on the historical OS maps, a factual Natural Cavities Database search was commissioned from Stantec (formerly Peter Brett Associates) and is provided in Appendix E. The search indicated one known natural cavity location on the site and another one

within 1,000m. The on-site feature is a swallow hole and the grid reference given coincides with the depression noted in the central western area of the northern field, as noted in the Walkover section. The off-site dissolution feature is also a swallow hole and located 780m to the southeast.

No reference to the depression close to and just beyond the eastern site boundary is made in the Stantec Report.

Dissolution Feature Risk Assessment

The site is located on strata that is known to be susceptible to dissolution features, suspicious looking depressions in the ground surface were noted at two locations on, or close to, the site in the walkover and 'sinks' are recorded on the historical OS maps. The Envirocheck Report records the Hazard rating for Ground Dissolution at the site as 'High.' The Natural cavities database search carried out by Stantec records one known dissolution feature under the site. This is a swallow hole, and its location coincides with one of the depressions noted above. Although only one known dissolution feature is recorded under or close to the site, this does not mean there are no other unrecorded similar features, including related to the depression noted close to and just beyond the eastern boundary.

Taking account of the above findings from this desk study, at this stage it is considered dissolution features pose a significant risk to the site.

Building Control

Pembrokeshire County Council was contacted to see if they have any information regarding dissolution features in the area, or requirements for foundations etc in the area. However, at the time of writing this report we are still awaiting their reply.

BACKGROUND SOIL CHEMISTRY

Information from the BGS is provided in the table below listing the background soil chemistry of some commonly occurring heavy metals in the sediment in the site area:

Heavy Metal	Level in Rural Soil (mg/kg)
Arsenic	<15
Cadmium	<1.8
Chromium	60-90
Lead	<100
Nickel	15-30

These concentrations are all below the generic assessment criteria (GACs) for a residential site.

POTENTIALLY SENSITIVE LAND USES

The site is within the Pembroke Coast National Park, and this will need to be considered as part of the design.

INITIAL CONTAMINATION CONCEPTUAL SITE MODEL

A qualitative Preliminary Risk Assessment (PRA) has been undertaken in line with the EA's online guidance, 'Land Contamination: Risk Management,' (LCRM), published in October 2020. The guidance is based upon the principles of CLR11, 'Model Procedures for the Management of Land Contamination,' 2004.

It is understood that the development proposals are for residential houses with private gardens.

Potential sources of contamination and potential receptors have been assessed using the source-pathway-receptor principle to create a Conceptual Site Model (CSM). This takes into account the fact that a complete pathway must exist between a potential source of contamination and a potential receptor for there to be considered a risk.

POTENTIAL CONTAMINATION SOURCES

Potential Solid-, Liquid- and Vapour-phase Contamination Sources

The results of the desk study and walkover indicate that the following potential sources of soil or groundwater contamination are present at, or in close proximity to, the site:

- Made Ground associated with historical local development is possibly present.

Potential Ground Gas Contamination Sources

In consideration of the source-pathway-receptor methodology for ground gas risk assessment set out in CIRIA C665, the sensitivity of the residential development is considered to be high.

We have provisionally assessed the risk of ground gases impacting the site, by reference to the CL:AIRE research bulletin RB17, 'A Pragmatic Approach to Ground Gas Risk Assessment,' 2012.

The following potential sources have been assessed:

- No credible sources or pathways for landfill gas migration from an off-site landfill have been identified.
- The site has not been a registered landfill.
- Any Made Ground present is not expected to be greater than 5m deep or an average of greater than 3m in thickness.
- The site does not lie on potentially natural organic soil.
- Full radon protection measures are required for this development.

Based on the above assessment, carbon dioxide and methane ground gases do not pose a significant risk to the site.

Therefore, the following potential ground gases have been identified for the site:

- Radon gas

RECEPTORS

The following most sensitive receptors have been identified at the site:

Human Health – Long Term Exposure

- End users of the site - the future residents

Human Health – Short Term Exposure

- Construction and maintenance workers

Controlled Waters and Environment

- The underlying Principal Aquifers, Black Rock Subgroup and Gully Oolite Formation and Pembroke Limestone Group
- On-site streams

Infrastructure

- Substructures
- Water supply pipes

PATHWAYS

It is considered that a number of potential pathways exist between these potential sources and the above identified receptors. The viability of these pathways is discussed in the preliminary risk assessment.

Human Health

- Direct soil ingestion in areas of exposed soil
- Ingestion of soil attached to homegrown produce
- Ingestion of homegrown produce with contamination uptake
- Inhalation of indoor and outdoor vapours and dust
- Dermal contact with contaminated soil
- Inhalation of radon gases entering the building

Controlled Waters and Environment

- Migration/leaching of contaminants through the unsaturated zone
- Migration of contaminants through the groundwater
- Movement of contaminants through drains or services runs
- Surface run-off into the on-site streams

Infrastructure

- Leachable or corrosive contaminants within the soil
- Corrosive contaminants within the groundwater

PRELIMINARY RISK ASSESSMENT

Based on the desk study research, the following potentially-complete pollutant linkages have been assessed and in accordance with CIRIA C552, a consequence and probability rating has been applied to each potential contamination source to create an overall risk rating. The definitions and methodology are presented in Appendix D and the results are presented in the following table.

ON-SITE SOURCES

Potential On-site Source	Pathway	Potential Receptor	Probability	Consequence	Risk Classification	Explanation
Contaminants within the Made Ground <i>- Including: heavy metals, PAH, petroleum hydrocarbons, asbestos</i>	Ingestion Dermal Contact	End Users - Residents	Low likelihood	Medium	Moderate / Low	On-site contamination is anticipated to be minimal and much of the site will be surfaced with hardstanding with soft landscaping limited to garden areas.
	Inhalation	Construction Workers	Low likelihood	Mild	Low	Exposure to maintenance and construction workers can be mitigated by use of appropriate PPE and maintaining good hygiene levels.
	Migration through unsaturated zone Migration through groundwater	Principal Aquifers	Low likelihood	Medium	Moderate / Low	There are no groundwater abstraction licenses within 250m, and the site is not within an SPZ. In addition, on-site contamination is anticipated to be minimal.
	Migration through drains or service runs Surface run-off	On-site streams	Low likelihood	Mild	Low	There are no surface water abstraction licenses within 250m, and on-site contamination is anticipated to be minimal.
	Direct contact	Substructures Water supply pipes	Low likelihood	Mild	Low	On-site contamination is anticipated to be minimal.
	Radon gas	Inhalation	End Users - Residents	High likelihood	Severe	High

The geoenvironmental investigation and risk assessment detailed in the remainder of this report have been conducted to validate this CSM.

INITIAL GEOTECHNICAL GROUND MODEL

The ground model for the site is for most of the site is to be underlain by bedrock of the Carboniferous age Black Rock Subgroup and Gully Oolite Formation, with the northern area underlain by the Pembroke Limestone Group. However, some superficial Glacial Till and and/or bedrock of the Avon Group may also present.

The Black Rock Subgroup and Gully Oolite Formation, Pembroke Limestone Group and Avon Group are likely to comprise limestone interbedded with mudstone and/or sandstone. Therefore, differentiating between them is not easy. Till is likely to comprise sandy gravelly clay.

Considering the likely geology some variable ground conditions should be expected.

Allowable bearing pressures from the anticipated strata should be suitable for shallow conventional foundations. However, a swallow hole is known to be present under the site and evidence of other dissolution features on or close to the site has been noted in the desk study and walkover. At this stage, these dissolution features are considered to be the most significant geotechnical hazards for the site and may require zoning of the site for engineering purposes, including foundation design.

Other potential geotechnical hazards include variable strata, vegetation influence (should fine-grained soils with volume change potential be present) and surface flooding during wet periods.

Considering the likely strata, soakaway drainage is potentially possible, however consideration will need to be made for the possibility of existing dissolution features and strata that may be susceptible to formation of future dissolution features.

EXPLORATION AND TESTING

Twenty-one exploratory holes were formed at the site between the 18th and 20th October 2022. These comprised sixteen machine excavated trial pits, three continuous tube sample boreholes and two dynamic probe tests.

The positions of the exploratory holes undertaken at the site as part of this investigation can be seen on the Exploratory Hole Location Plan in Appendix A. The logs are provided in Appendix B and the results of the geotechnical and chemical laboratory testing are provided in Appendix C.

Coordinates for exploratory positions have been extracted from freely available georeferenced on-line information/aerial imagery/smartphone app and should be treated with an appropriate level of accuracy in the order of say $\pm 5\text{m}$.

Engineering and geoenvironmental conclusions given in this report are based on data obtained from these sources but it should be noted that variations, which affect these conclusions, may inevitably occur between and beyond the test locations. Also, water levels may vary seasonally and with other factors.

SAMPLING STRATEGY

The investigation was undertaken in accordance with the scope of works agreed with our client. As the development proposals are to develop the northern field with houses and associated infrastructure, with the southern field potentially being used for soakaway drainage, most of the exploratory locations were positioned across the northern field. As no potential point sources of contamination were identified in the desk study, the positions of the exploratory holes were selected to provide a wide coverage of information across both fields.

METHODOLOGY

Health and Safety

In order to minimise the dangers from/to buried services, prior to commencement of boring/testing the proposed locations were scanned using a Cable Avoidance Tool. At the borehole and probe locations, a service avoidance pit was dug, using hand tools, to a depth of around 1.2m below ground level (bgl).

Exploratory Holes

Trial pits TP01 to TP16a were excavated with an 8-tonne rubber-tired backhoe excavator to depths of between 0.7m and 3.0m bgl, under the supervision of an engineer, who made a record of the arisings. Disturbed samples were taken at selected depths down to the base of the holes for subsequent laboratory testing and inspection. In-situ measurements of shear strength were taken using a shear vane, where suitable. On completion, the trial pits were carefully backfilled with arisings in thin layers, ensuring that excavated material was replaced in the same order as it had been removed.

Continuous tube sample boreholes CT01 to CT03, were put down using an Archway Competitor Dart down to depths between 2.2m and 6.0m. The boreholes were advanced using a plastic lined steel tube sampling system, driven into the ground by a top drive percussive hammer. A near continuous 85mm to 55mm diameter

core sample was recovered for subsequent examination, sub-sampling and laboratory testing. Standard Penetration Tests (SPTs) were taken at 1.0m intervals at TP01 and TP02. Measurements of unconfined compressive strength were made in the tube samples in the field using a pocket penetrometer.

Dynamic probe tests, SHDP02 and SHDP03, were performed (using the 'Super Heavy B' specification) adjacent to the positions of the correspondingly numbered continuous tube boreholes to provide a relative penetration resistance profile of the ground. Regular readings of shaft torque were recorded and are reported on the test record, together with the blow count record.

Installations

On completion of the boring, boreholes CT01 and CT02 were utilised for the installation of a 50mm diameter slotted uPVC standpipe from 3.0m and 2.2m respectively up to 1.0m below existing ground level. From 1.0m depth up to ground level a plain pipe was added. The slotted section of the standpipe was surrounded with pea gravel, while expansive bentonite clay was added around the plain pipe and below the slotted section of CT01 to seal the borehole. The standpipe was finished with a rubber bung and gas tap and protected with a stopcock cover, which was then concreted flush with ground level.

In-situ Testing

In-situ Dynamic Plate Loading tests were undertaken in seven of the trial pits, TP01 to TP04, TP06, TP07 and TP09, using a Light Weight Deflectometer (LWD) at 0.5m depth. The tests determine the dynamic deformation modulus (E_{vd}) of the formation soils and have been used to assess the California Bearing Ratio (CBR) of the formation. The 300mm diameter plate was subject to pulse loads applied by a dropped weight and the mean value of three measurements of vertical displacement is recorded.

Infiltration testing was undertaken in seven trial pits, TP01 to TP03 and TP10 to TP13, in general accord with BRE Digest 365, 'Soakaway Design.'

GROUND CONDITIONS

The intrusive investigation revealed the ground conditions to comprise Topsoil over bedrock of interbedded clay and limestone. Reference to the Geology section earlier in this report indicates both the Black Rock Subgroup and Gully Oolite Formation and the Pembroke Limestone Group comprise interbedded limestone and mudstone. To avoid confusion, we have described all the bedrock under the site as Black Rock Subgroup and Gully Oolite Formation.

TOPSOIL

Topsoil was encountered at each location from ground level down to depths ranging from 0.3m to 0.4m, but typically 0.3m. It generally comprised brown slightly sandy slightly organic clay.

BLACK ROCK SUBGROUP AND GULLY OOLITE FORMATION

Encountered at each test location beneath the Topsoil down to the base of the exploratory holes at depths down to 6.0m. It generally comprised firm medium strength brown slightly sandy clay containing some gravel and cobble sized siltstone lithorelicts, interbedded with medium strong fractured grey limestone. At most of the test locations where the limestone was encountered it was too hard to penetrate, however at some locations the thickness of the limestone bed was proven. The table below gives details of the depths to and thickness of the limestone, where encountered.

Test Location	Depth to top of Limestone	Comments
TP01	1.7m	Base penetrated at 1.8m depth
TP02	2.0m	Trial pit terminated at 2.2m depth
TP04	2.6m	Trial pit terminated at 2.7m depth
TP05	0.6m	Trial pit terminated at 1.9m depth
TP07	2.5m	Trial pit terminated at 2.7m depth
TP09	2.8m	Trial pit terminated at 2.9m depth
TP13	2.2m	Trial pit terminated at 2.3m depth
CT02	2.2m	Borehole refused at 2.2m depth
CT03	2.6m	Base penetrated at 4.1m depth

The results of the field strength tests carried out in the fine-grained Black Rock Subgroup and Gully Oolite Formation strata, and other relevant data, are summarised below:

Parameter	Range	Comments
Undrained Shear Strength (kPa)	45 to >150	Converted from Pocket Penetrometer (using conversion factor of 30). Medium to Very High strength (BS 5930-2015, Table 9)
SPT 'N' values	9 to 14	Tentatively equivalent to undrained shear strengths of between 41kPa and 63kPa (using Stroud, f_1 , conversion factor = 4.5). Medium strength (BS 5930-2015, Table 9)

The results of the field strength tests carried out in the limestone are summarised below:

Parameter	Range	Comments
Dynamic Probe Results	2 to >50	2 to 7 at CT03 between 2.6m and 4.1m depth, indicating weathered rock recovered as medium dense gravel. >50 at 2.2m depth at CT02, indicating less weathered rock.

Laboratory testing on fine-grained samples of the Black Rock Subgroup and Gully Oolite Formation revealed the following:

Parameter	Range	Comments
Water Content (%)	10 to 32	-
Liquid Limit (%)	23 to 41	Clay of Low and Intermediate Plasticity (BS5930 Casagrande)
Plastic Limit (%)	16 to 22	
Plasticity Index (%)	8 to 21	
Modified Plasticity Index (%)	5 to 18	Non-shrinkable and Shrinkable soil of Low Volume-Change Potential (NHBC Standards)
Retained on 425 μ m sieve (%)	5 to 40	BS1377 'coarse soil' fraction
Passing 63 μ m sieve (%)	37 to 85	Fines fraction

Laboratory testing on a sample of the limestone, taken from CT03 at 3.0m to 4.1m depth, revealed it to have been recovered as:

Parameter	Range	Comments
Portion <63mm and >2mm (%)	54	Gravel fraction
Portion <2mm and >63 μ m (%)	16	Sand fraction
Passing 63 μ m sieve (%)	30	Fines fraction

GROUNDWATER

No groundwater strikes or seepages were encountered during the fieldworks, at depths down to 6.0m, and both of the monitoring standpipes were recorded to be dry at the subsequent monitoring visit, at depths down to 3.0m.

OBSERVED SOIL CONTAMINATION

No obvious evidence of contamination was noted during the fieldworks.

CALIFORNIA BEARING RATIO (CBR) TESTS

In-situ Dynamic Plate Loading tests were undertaken at 0.5m depth in the Black Rock Subgroup and Gully Oolite Formation in seven of the trial pits using a Light Weight Deflectometer (LWD).

Results of the testing recorded corresponding CBR values between 3% and 23%, as listed in the table below and presented in Appendix B.

Location	Stratum	Depth (m)	E_{vd} (MN/m ²)	Equivalent CBR (%)
TP01	Black Rock Subgroup and Gully Oolite Formation	0.5m	32.16	18
TP02			12.15	5
TP03			8.37	3
TP04			40.74	23
TP06			31.62	17
TP07			22.82	12
TP09			23.45	12

INFILTRATION TESTING

To assess the infiltration capacity of the soils, infiltration testing was carried out at the site in general accord with BRE Digest 365, 'Soakaway Design.'

Testing was undertaken in the Black Rock Subgroup and Gully Oolite Formation strata at seven locations between 0.23m and 2.3m depth, as shown in the table below.

Location	Depth of trial pit (m)	Soil Infiltration Rate f (m/s)		
		Test 1	Test 2	Test 3
TP01	2.3	3.7×10^{-6}	7.6×10^{-5}	4.4×10^{-6}
TP02	2.2	1.1×10^{-6}	-	-
TP03	0.7	2.4×10^{-6}	-	-
TP10	2.2	6.5×10^{-7}	-	-
TP11	0.7	8.1×10^{-6}	0.4×10^{-6}	-

Location	Depth of trial pit (m)	Soil Infiltration Rate f (m/s)		
		Test 1	Test 2	Test 3
TP12	0.7	1.8×10^{-5}	2.8×10^{-6}	-
TP13	2.3	1.9×10^{-3}	1.0×10^{-3}	5.1×10^{-4}

Results in italics indicates extrapolated results

Limestone bands were encountered at TP01 and TP13 between 1.7m and 1.8m depth and 2.2m and 2.3m depth respectively. It is considered the water at these locations was likely to be soaking into the limestone and therefore the results from these locations are representative of the limestone not the overlying fine-grained soils.

The results of the infiltration tests are included in Appendix B.

Infiltration rates generally reduce as the soil become saturated and the worse-case infiltration rate for each test should be used for design.

GROUND GAS MONITORING

Ground gas monitoring was carried out in the monitoring wells installed in CT01 and CT02 on one occasion, using a calibrated Geotech GA 5000 gas analyser.

The results of the monitoring are shown in the table below, and provided in Appendix B:

Parameter	Range	Comments
Oxygen (%v/v)	17.2 and 17.8	Normal ranges for non-gassing ground
Carbon Dioxide (%v/v)	0.9 and 1.7	
Methane (%v/v)	<0.1	
Flow rate (l/h)	0.0	

CONCRETE AGGRESSION TESTS

The results of laboratory aggression tests on selected samples of soil are summarised below:

Stratum	Water-soluble Sulphate SO_4 (mg/l)	pH (pH units)	Number tested
Topsoil	<10	6.7 and 7.2	2
Black Rock Subgroup and Gully Oolite Formation	<10 to 360	5.8 to 7.9	12

GROUND CONTAMINATION ASSESSMENT

The following is a description of the testing schedule, the guidelines adopted for assessing the results and a comparison of the test results from this investigation with those adopted guideline values. The implications of these comparisons are provided in the Risk Assessment sections that follow.

The contamination risk assessment has been undertaken in line with the EA's online guidance, 'Land Contamination: Risk Management,' (LCRM) published in October 2020 in order to validate the Preliminary Risk Assessment (PRA) using a Generic Quantitative Risk Assessment (GQRA), followed by a Detailed Quantitative Risk Assessment (DQRA), if required.

The results of the chemical tests from this investigation are included in Appendix C.

SOIL TESTING

Two samples of the Topsoil and three samples of the underlying Black Rock Subgroup and Gully Oolite Formation soils collected on site during this investigation were tested for a range of constituents of potential concern (CoPC).

The suite of testing carried out on the samples was decided upon following consultation of R&D CLR Publications, published as part of the Contaminated Land Exposure Assessment (CLEA), a joint venture between the Department for Environment, Food and Rural Affairs (DEFRA) and the EA.

The test suite included:

Group	Details
Asbestos	Screening for ACMs and fibres with the naked eye and microscopy
Inorganic substances	Arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc Sulphates
Organic substances	16 (EPA) Speciated Polycyclic Aromatic Hydrocarbons (PAH) Total Petroleum Hydrocarbons (TPH) with eight-band split
Other	pH

Unless stated on the laboratory report, the soil samples were tested to obtain 'Total' values within the soil.

LEACHATE TESTING

As the site lies above a Principal Aquifer, the Black Rock Subgroup and Gully Oolite Formation, two soil samples collected as part of the investigation were tested from a solution obtained using the BS EN 12457-1 method / NRA R&D301 leachate procedure, simulating leachability of a substance to underlying groundwater.

The test suite included a range of inorganic substances targeted in the soil sample testing suite, namely arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc.

The Remedial Targets Methodology (RTM) guidance published in 2006 by the EA, states that the leachate test procedure is not appropriate for highly hydrophobic organics (i.e. organics characterised by low solubility and high sorption coefficients, such as hydrocarbons) as these compounds are not readily leached and tend to sorb to test equipment and therefore commonly produce erroneous results. Therefore, the leachate suite does not include organic compounds.

RISK ASSESSMENT GUIDELINES – HUMAN HEALTH

The human health risk assessment has been undertaken using the guidance provided in the EA's LCRM guidance, published October 2020 and the CLEA guidelines.

This assesses risks associated with the ingestion, dermal contact, and vapour inhalation pathways related to contaminated soils and groundwater. Risks associated with the inhalation of Ground Gas, for example that resulting from landfill, is not addressed by LCRM. The assessment for ground gases has been undertaken separately in the Ground Gas Risk Assessment section of this report.

Human health assessment criteria used are based upon the proposed final land use of the site. As the site is to be redeveloped to accommodate a residential development, with gardens, the Generic Assessment Criteria (GACs) for the standard land-use, 'Residential with homegrown produce' have been used.

The results of the soil samples tested have been compared to the following published assessment criteria:

Category 4 Screening Levels (C4SLs)

Published in March 2014 by DEFRA, a limited number of generic Category 4 Screening Levels (C4SLs) were produced to support the revised Statutory Guidance to support Part 2A of the Environmental Protection Act 1990, which was published in April 2012. This Guidance introduced a new four-category system for classifying land under Part 2A for cases of a Significant Possibility of Significant Harm to human health, where Category 1 includes land where the level of risk is clearly unacceptable and Category 4 includes land where the level of risk posed is acceptably low.

Further C4SLs have been and are being produced by CL:AIRE, with support from SoBRA and SAGTA, for a limited number of volatile organic compounds, as time allows.

Suitable 4 Use Levels (S4ULs)

To supplement the small number of C4SL, a set of Suitable for Use Levels (S4UL) were produced, in 2015, by Land Quality Management (LQM) and the Chartered Institute of Environmental Health (CIEH), using the EA's Contaminated Land Exposure Assessment (CLEA) software, version 1.06 (2009), and the revised assumptions used in deriving the C4SL. The S4UL are more conservative than the C4SL and are derived to represent the minimal levels of risk to human health as described in the EA's SR2 guidance, with the intention of being 'suitable for use' under planning.

RISK ASSESSMENT GUIDELINES – CONTROLLED WATERS

The procedures set out in EA's RTM, 'Hydrogeological Risk Assessment for Contaminated Land,' (2006), have been followed.

The leachate test results are compared to the UK Drinking Water Standards (UKDWS) set out in The Water Supply (Water Quality) Regulations 2016. Where the environmental setting is sensitive, results are also compared to the Environmental Quality Standards (EQS) as set out in the Water Framework Directive 2015.

RESULTS OF ASBESTOS SCREENING

Screening for the presence of asbestos did not reveal any asbestos containing material (ACM) or fibres in the two samples of Topsoil tested.

RESULTS OF TOTAL SOIL TESTS

Results of the total soil testing have been compared to relevant published GAC as discussed above. For S4ULs, a range of values have been published for the organic contaminants based on the soil's organic matter content.

As site-specific soil organic content was not determined for the site, where S4ULs have been adopted for the organic contaminants, analytical results have been compared to the most conservative value, which is that for soils of 1% soil organic matter (SOM) as a preliminary screening tool.

None of the determinands tested for recorded any values higher than their relevant GAC for human health for a residential setting.

RESULTS OF LEACHATE TESTS

Neither of the samples tested recorded any values above their respective UK Drinking Water Standard (UKDWS).

HUMAN HEALTH RISK ASSESSMENT

The following quantitative risk assessment has been carried out using the source-pathway-receptor principle. Potential sources of contamination identified in the Conceptual Site Model (CSM) have been assessed using the CLEA Guidelines. This takes into account the fact that a complete pathway must exist between a potential source of contamination and a potential receptor for there to be considered a risk.

The potential human receptors evaluated for their individual risk are:

Long-Term Exposure

- End users of the site – The future residents

Short-Term Exposure

- Construction and maintenance workers

If the proposed site use or layout should alter significantly, then the human health risk assessment will require re-evaluation.

SOIL CONTAMINATION RISK

No Made Ground was encountered, no obvious signs of contamination were noted during the investigation and no results above the relevant thresholds were recorded in the soil testing.

On the basis of the above, it is considered the site does not pose a significant risk to the identified long-term human health receptors and therefore remedial measures for these are not required.

CONSTRUCTION AND MAINTENANCE WORKERS

For construction workers and maintenance workers that are exposed to the ground, there is a short-term exposure risk (at each site they attend, which contributes to an overall lifetime exposure risk) and the pathway of primary concern is 'direct soil ingestion'.

Redevelopment activities have the potential to create short-term pollutant linkages to the general public. These risks should be managed by means of the Construction Phase (Health & Safety) Plan.

To reduce the risk to as low as reasonably practicable for the construction workers it is recommended that appropriate health and safety measures be implemented along with the use of Personal Protective Equipment (PPE). All personnel coming into contact with the soil, ground workers in particular, should be instructed to use gloves when on site to avoid dermal contact and restrict inadvertent hand-to-mouth ingestion. Washing facilities should be provided for the site staff to use and should be used prior to eating or smoking. Reference should be made to the HSE Document, 'Protection of Workers and the General Public during Development of Contaminated Land.'



REGULATORY APPROVAL

We recommend that the conclusions of this report are agreed with the relevant Local Authority at the earliest stage, to reduce potential delays to the development.

GROUND GAS RISK ASSESSMENT

Carbon Dioxide and Methane Gas

The preliminary ground gas risk assessment indicated that carbon dioxide and methane ground gases do not pose a significant risk to the site and therefore ground gas monitoring was not required. The intrusive investigation has not revealed anything to contradict this and therefore it is considered that no special precautions will be required for carbon dioxide or methane ground gases.

Radon Gas

The BGS advises that full radon gas protection measures are necessary for this site.

REGULATORY APPROVAL

The above conclusions regarding ground gases should be agreed with the relevant local Regulatory Authority as soon as possible prior to development, to reduce any potential delays to the development should they require further clarification of this report or further ground gas monitoring.

CONTROLLED WATERS RISK ASSESSMENT

The following Controlled Waters risk assessment has been carried out in accordance with the procedures set out in the EA's RTM, 'Hydrogeological Risk Assessment for Contaminated Land,' (2006). Using the source-pathway-receptor principle, this takes into account the fact that a complete pathway must exist between a potential source of contamination and a potential receptor for there to be considered a risk.

The potential Controlled Waters receptors considered during this risk assessment were:

- The underlying Principal Aquifer, Black Rock Subgroup and Gully Oolite Formation
- On-site streams

DISCUSSION

Although the site is underlain by a Principal Aquifer, there are no surface or groundwater abstraction licenses within 250m and the site is not within a Source Protection Zone.

No obvious evidence of contamination was noted during this investigation and the results of the soil testing indicates no evidence for widespread contamination. In addition, none of the leachate testing results were above the relevant thresholds. It is therefore considered that the site does not pose a significant risk to the above recognised Controlled Waters receptors.

REGULATORY APPROVAL

We recommend that the conclusions of this report are agreed with the relevant Local Authority at the earliest stage, to reduce potential delays to the development.

INFRASTRUCTURE RISK ASSESSMENT

SUBSURFACE CONCRETE

Using the results of the concrete aggression tests, the concrete design mix recommendations for subsurface concrete have been assessed in terms of BRE Special Digest 1, as follows:

Type of Site	Groundwater	Characteristic Sulphate	Characteristic	
		Soil Soluble (mg/l)	Design Sulphate Class	pH (pH units)
Natural	Mobile	220	DS-1	6.0

The above assessment provides an Aggressive Chemical Environment for Concrete (ACEC) class of **AC-1**.

UNDERGROUND SERVICES

Only low levels of heavy metals and hydrocarbons were recorded in the soils at the site. However, it should be noted that the utility companies often have their own local guidelines and standards on levels of shallow soil contamination in the ground that may or may not be acceptable for the installation of below ground services. These standards may be different to those specified for assessing risks to human health and groundwater.

The local requirements should be obtained from the particular service supply company as soon as possible to avoid unexpected delays or additional development costs.

GEOTECHNICAL ENGINEERING CONCLUSIONS

It is proposed to redevelop the site to accommodate a residential development of two storey houses and apartments, with an access road, driveways and gardens. It is our understanding the main development will be in the northern area of the site, with the southern area potentially used for soakaway drainage.

REVISED GROUND MODEL

The desk study information indicates the risk of ground dissolution under the site to be high, with one dissolution feature recorded under the site. This dissolution feature is recorded to be a swallow hole and located beneath a surface depression in the northern area that was noted in the walkover survey. A second surface depression was noted in the walkover straddling the eastern boundary.

The site and laboratory works have shown the ground conditions across the site to comprise Topsoil with a typical thickness of 0.3m over bedrock of the Black Rock Subgroup and Gully Oolite Formation down to the base of the test locations at depths down to 6.0m depth.

The Topsoil generally comprised brown slightly sandy slightly organic clay.

The Black Rock Subgroup and Gully Oolite Formation strata generally comprised firm medium strength brown slightly sandy clay that contained some gravel and cobble sized siltstone lithorelicts, interbedded with limestone. Classification testing indicates some of the fine-grained soils are non-shrinkable and some have low volume change potential. To allow a conservative approach we recommend the soils be classified as low volume change potential. The limestone was typically encountered at approximately 2.0m depth and generally was sufficiently strong to result in the exploratory hole being terminated. However, there was some variability in its depth, thickness and strength.

No groundwater strikes or seepages were encountered during the fieldworks and the standpipe wells were recorded to be dry down to their bases at depths down to 3.0m at the subsequent monitoring visits. Based on observations made during the fieldworks and follow-on monitoring visit, it is considered the local groundwater level is not shallow and is likely to be below 3.0m depth.

GROUND DISSOLUTION HAZARDS

The site is underlain by strata known to be susceptible to dissolution, i.e., limestone, and the Natural Cavities Database search revealed one recorded dissolution feature under the site. This is a swallow hole, and its location coincides with a surface depression under the northern area of the site. There is a further similar depression close to and extending beyond the eastern boundary and it is our understanding that during wet weather this collects and drains surface water from the southern area of the site. It is considered possible this feature may be associated with another dissolution feature.

No obvious evidence of other dissolution features was encountered during this investigation; however it is considered further investigations should be carried out to allow a more detailed assessment of the potential risks posed to the site by them.

SITE EXCAVATION

Conventional hydraulic plant will be satisfactory for excavations in the fine-grained Black Rock Subgroup and Gully Oolite Formation strata; however specialist breaking plant will be required for excavations into and through the limestone.

Most excavations were noted to be stable in the short time they were open in this investigation, however some collapse of coarse-grained materials was noted in one of the trial pits in the eastern area, i.e., TP05. In line with HSE guidelines, all excavations requiring personnel access should be adequately supported to avoid the risk of collapse. Consideration should also be given to the stability of open trenches where personnel are working in close proximity.

It is considered the local groundwater level is below 3.0m depth. Therefore, should any shallow minor seepages of groundwater be encountered then the use of conventional pumping from a sump should be sufficient to keep the excavation dry. It is our understanding some surface flooding has occurred in the eastern area of the site previously, in these circumstances a larger capacity pump will be required to keep excavations dry.

It would be prudent to carry out all ground works in the late summer or autumn when groundwater levels and flows are usually at their lowest.

There are numerous trees and hedgerows around the site's boundaries and an internal hedgerow with some trees aligned west to east across the centre of the site. Consideration should be given to the effects of trees and shrubs on service runs that cross the site. Soil movements brought on by the influence of vegetation can severely disrupt the drain runs and mains services, and measures should be incorporated into the excavations to allow for future ground movements.

Should any trees be removed from site, care should be taken to ensure the root ball of each tree is completely removed from the ground. Given time, any remnant root fragments may weather down to produce localised areas of soft organic soils which may induce local differential settlements.

Where new foundations are placed over a felled tree, consideration should be given to spanning these features to ensure no soft spots result in localised settlement.

FOUNDATION SOLUTIONS

Shallow Foundations

Prior to final design of substructures for this development further investigations should be carried out to allow a more detailed assessment of the risks posed by ground dissolution. Please see the Further Works/Recommendations section at the end of the report for more details.

However, the investigation has shown the ground conditions at 1.0m depth generally comprise medium strength slightly sandy clay of the Black Rock Subgroup and Gully Oolite Formation. Where the site is not affected by dissolution features then these soils are considered to be suitable for traditional spread

foundations. In these areas a minimum foundation depth of 1.0m below existing ground level is recommended, or 0.20m into the top of the formation, whichever is the deeper.

At this stage, in view of the potential risks from ground dissolution, for design purposes we recommend that spread foundations should be of the 'cruciform' type, extending beyond the corners and with full reinforcement to span a potential loss of support of suitable size. In addition, it is possible some areas may require deeper foundations to take the loads of structures down below dissolution affected strata, or even exclusion zones for development may be needed, should very deep features be encountered.

For buildings that do not require deeper foundations, the allowable bearing pressure recommended below is made on the assumption of an acceptable total settlement for the proposed structures of 25mm. Should the building design require a significantly different serviceability limit state (tolerance to settlement) then it is recommended that these recommendations be revised accordingly.

At the minimum founding depth provided above, an allowable bearing pressure (or net loading intensity increase) of 100kPa may be adopted for conventional foundations up to 1.0m in width. This allows for a suitable factor of safety against shear failure and should result in acceptable levels of differential and total vertical settlement some of which will take place in the short term, with the rest taking place over a number of years.

Some of the founding soils have low volume change potential; where foundations are to be constructed within the vicinity of trees or shrubs on this site then they will require deepening in accord with guidelines given in NHBC Building Standards Chapter 4.2. For trees that are not to be removed, mature tree heights should be assumed when determining the foundation depths.

GROUND FLOOR SLABS

Although the site is underlain by natural soils that would normally be considered suitable for ground bearing floor slabs, to take account of the risks posed by ground dissolution, at this stage we recommend suspended floor slabs be used.

Following further investigations and a more detailed assessment of the risks then it is possible some areas of the site will be deemed suitable for ground bearing floor slabs. Where this is the case then the Topsoil we need removal and the exposed surface should be proof-rolled to expose any excessively soft or compressible zones, which should also be removed. Coarse-grained backfill should then be placed in layers and subjected to controlled compaction.

ACCESS ROADS AND PARKING

The structural design of a road or hardstanding is based on the strength of the subgrade, which is assessed on the California Bearing Ratio (CBR) scale. Based on laboratory classification testing, in-situ dynamic plate testing and site observations, for formation at 0.5m depth in the Black Rock Subgroup and Gully Oolite Formation soils we recommend a value of 2% is adopted for preliminary design.

Site conditions should be reassessed at the time of construction and the CBR/pavement design updated accordingly if considered necessary. If pavement construction is undertaken during wetter parts of the year, then a greater pavement thickness or geogrid reinforcement may be required.

Classification testing indicates the soils under this site are likely to be frost susceptible, therefore a suitable minimum pavement thickness will need to be specified depending upon the proposed pavement usage.

Dissolution Risk Mitigation

At this stage, taking account of the risks posed by ground dissolution, we recommend that the proposed development includes for a degree of redundancy within the road pavement design. This should include for the provision of reinforcement within foundations to cater for a potential future localised loss of ground support and considerations of geogrids within road pavements to limit the risk of a sudden collapse should underlying dissolution occur.

Following further investigations and a more detailed assessment of the risks it may be possible to reduce the requirements for geotextiles, please see the Further Works/Recommendations section below for more details.

INFILTRATION MEASURES

Appropriately designed sustainable drainage systems (SuDS) are more sustainable than using piped drainage to local sewer systems. However, infiltration measures close to buildings may result in undermining of foundations and softening of soils leading to instability. Attenuation measures should be located at suitable distances from foundations and infrastructure and consideration given to the effects on slopes, flooding and mobilisation of contaminants.

Test Results

Infiltration testing was carried out at seven locations across the northern and southern areas of the site. Three locations tested the clay soils at shallow depth, with the other four locations testing the deeper strata. At one of the deeper locations the test was carried out entirely in clay soils, however at the other three the trial pits were taken down into the top of the underlying fractured limestone.

The results indicate the shallower clay soils have an infiltration rate in the region of 1.0×10^{-6} m/s and the deeper clay soils, down to approximately 2.2m depth, have an infiltration rate of less than 6.5×10^{-7} m/s.

The tests carried out into the top of the fractured limestone recorded results that varied from less than 1.1×10^{-6} m/s to 5.1×10^{-4} m/s. This range of results is considered to reflect the nature of the fracturing in the limestone, with thicker more fractured beds having a higher infiltration capacity.

Taking account of the risks of ground dissolution at this site it is considered prudent to keep soakaway drainage in the southern half of the site, well away from the houses and roads. Testing in this area recorded an infiltration rate of less than 6.5×10^{-7} m/s in the clay and 5.1×10^{-4} m/s in the limestone.

On the basis of the above, there is the potential for soakaway drainage taken down into the fractured limestone.

DISPOSAL OF ARISINGS

Site excavations, such as for foundations and services trenches are likely to produce arisings, some of which may be able to be re-used on-site and some of which will be surplus to requirements. The options for disposal of these arisings are discussed below:

RE-USE OF MATERIAL ON SITE

Currently, if surplus arisings are 'fit for re-use' on the site and have not been treated, their re-use is allowed within the planning law. If the arisings need treating prior to re-use, exemptions can be sought from the EA to allow this activity.

A recent voluntary code of practice published by CL:AIRE, in conjunction with the EA, (the Definition of Waste: Development Industry Code of Practice, Version 2) endorses the re-use of arisings on and off the site of origin without the need for exemptions from the EA, dependent on whether it is "fit for purpose". It also supports the use of "Hub and Cluster" sites (to enable surplus soil to be used on agreed sites in the local vicinity, dependent on the soil being 'fit for purpose').

The use of a Materials Management Plan (MMP) during the earthworks phase will help to avoid paying tax on soil movements that might otherwise attract tax, if they are construed by the HMRC as being waste without the relevant documentation to prove otherwise.

Based upon the human health and groundwater risk assessments, the soils on this site are considered to be suitable to be re-used on site for landscaping purposes, dependent on the agreement of the Local Authority.

Further testing, specifically on the existing topsoil, could show that this material is suitable for re-use on site, negating the need to remove or dispose of this soil off site and purchase new soil later on.

WASTE CLASSIFICATION

Under current waste management legislation, arisings that are surplus to requirements will be classified as waste and need disposing off-site. Records must be kept of where the waste is taken upon leaving site and its final destination.

The classification is a twofold process using the soil chemical testing results and the European Waste Catalogue for off-site disposal, followed by testing under the Waste Acceptance Criteria (WAC) specifically for landfill disposal.

EUROPEAN WASTE CATALOGUE DETERMINATION

Any soil classified as waste requires classification of the chemical constituents prior to leaving site in accordance with the European Waste Catalogue. Soils containing asbestos fragments or fibres will be classified as a mixed waste unless the asbestos can be separated.

Soils

The 'Total' soil contamination test results from this investigation, excluding asbestos, have been used in conjunction with the HazWasteOnline spreadsheets and the Technical Guidance WM3 published by the EA.

Two samples of Topsoil and three samples of the underlying natural soils were included in the assessment.

All of the soils tested have been classified as Non-hazardous waste.

The assessment report is provided in Appendix D.

WASTE ACCEPTANCE CRITERIA (WAC) TESTING RESULTS

If it is decided that the surplus arisings will be disposed of at a landfill facility, the implementation of the Landfill Directive means that the waste soil requires additional classification under the Waste Acceptance Criteria (WAC) to determine whether it should be destined for an Inert, Non-hazardous, Stable non-reactive hazardous, or Hazardous landfill, or whether an alternative disposal method must be sought.

WAC testing has been carried out on a representative sample of the natural soils collected from 0.8m depth in TP04, TP07 and TP09. The laboratory testing results are presented in Appendix D.

The samples from TP04, TP07 and TP09 were initially classified as Non-hazardous waste and the WAC testing indicates that the soil passes the Inert criteria.

OVERALL WASTE CLASSIFICATION

From the results of the HazWasteOnline spreadsheets and the WAC testing, currently, the waste soil on this site is classified as follows:

Waste Stream	EWC Classification	WAC for Landfill Disposal	Comments
Topsoil	Non-hazardous	Likely non-hazardous	High organic content
Natural soils	Non-hazardous	Inert	-

Different categories of waste soils must not be mixed. The action of mixing hazardous waste with non-hazardous waste to dilute hazardous concentrations or to dispose of one waste type as/with another is illegal.

Analytical results relevant to the materials being disposed of should be provided to the waste management contractors and landfill operators to confirm whether it meets their license agreements and to confirm tipping costs.

Should any soils be encountered that differ from those encountered during this investigation, further testing and waste classification of those soils will be required.

It should be noted that in May/June 2012, HMRC issued Briefs 15/12 and 18/12 clarifying how construction spoil and excess soils will be assessed for landfill tax purposes. Detailed accurate descriptions of waste are required for all wastes to support the landfill tax assessment. Uncontaminated naturally occurring soils will remain inert by default and eligible for the lower rate of landfill tax. Similarly, 'reworked soils' and demolition

'stone' comprising ONLY materials listed in the Schedule of the Landfill Tax (Qualifying Material) Order 2011 (SI 2011/1017) will also be eligible for the lower rate of landfill tax.

Tax relief may be available to developers involved in the rehabilitation of brownfield sites via corporation tax relief.

Waste Treatment

The Landfill Regulations dictate that all non-Inert waste must be treated before going to landfill. This treatment should include the following criteria, where they are likely to be effective:

- Physical, thermal, chemical or biological process including sorting.
- Change the characteristics of the waste.
- Reduce the volume, reduce the hazardous nature, facilitate its handling or enhance its recovery.

The most basic method of pre-treatment is sorting of the waste and re-cycling of any possible component materials and many waste disposals companies will have on-site recycling facilities.

The Environment Agency expect all landfill operators to obtain written evidence that the waste they accept has been pre-treated. We recommend that a signed certificate describing the treatment should be obtained to give to the receiving landfill. Further testing may be required after the treatment and before the soil is accepted by the relevant landfill.

LIMITATIONS AND RECOMMENDATIONS FOR FURTHER WORK

The ground is seldom homogeneous and variations, which affect our conclusions, may inevitably occur between and beyond the test locations. Should ground conditions vary noticeably from our Ground Model, then we recommend further assessment by a suitably qualified person.

To allow a more detailed assessment of the risks posed by dissolution features, further investigations should be carried out. We recommend these are carried out in two phases, with phase one being a site-wide non-intrusive geophysical survey. This will allow anomalous and suspicious features to be identified, with the phase two works involving intrusive investigative measures, boreholes and probe holes, to target the identified features.

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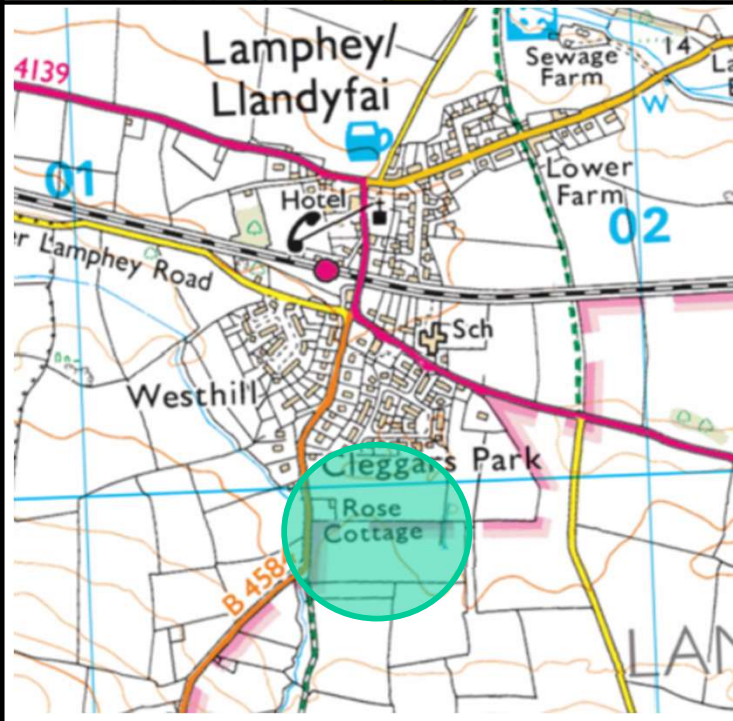
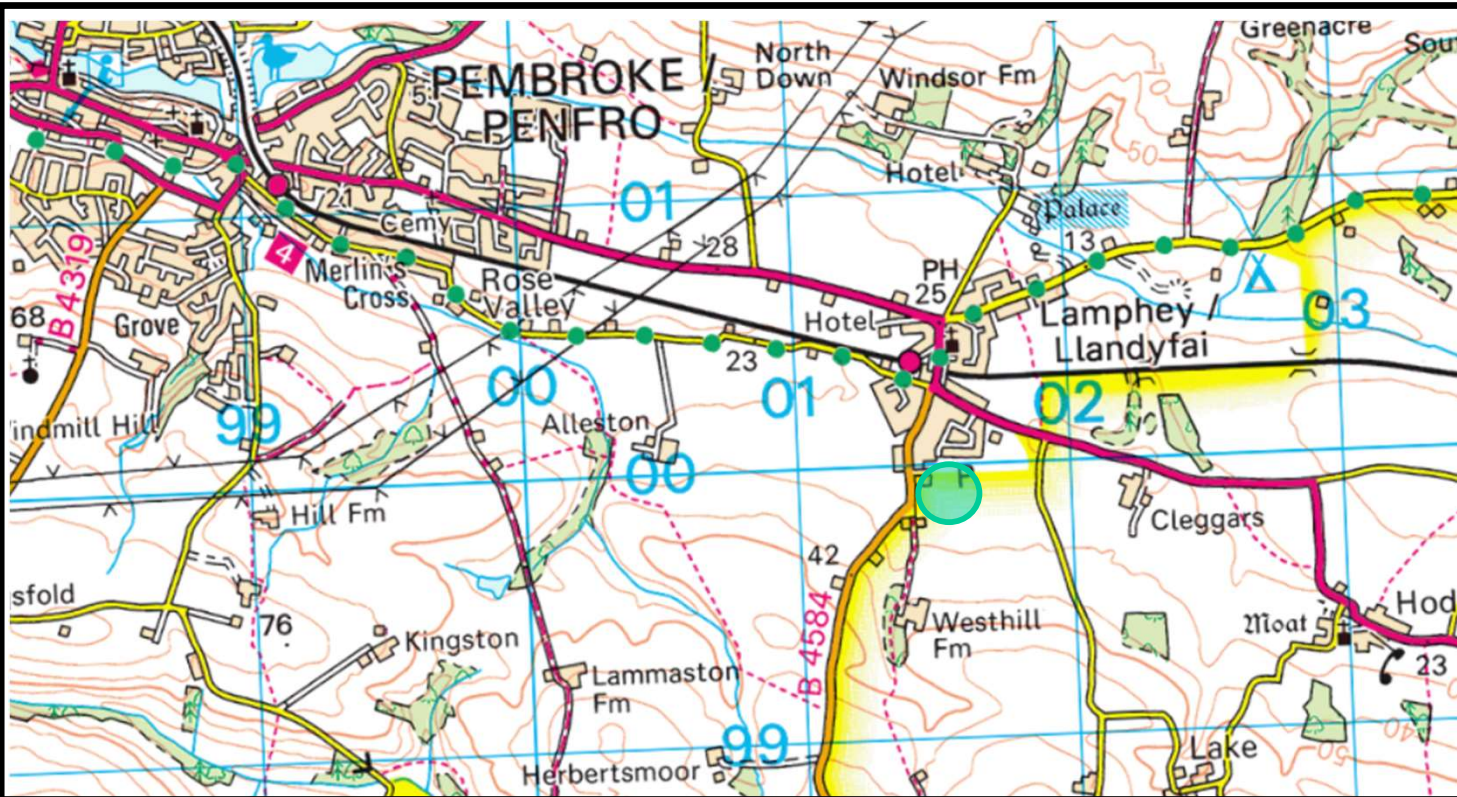
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APPENDIX A PLANS & PHOTOGRAPHS

Project Ref: 22.09.023

-  Approximate Site Location
-  Site Boundaries



 **LISTERS GEO**
Geotechnical and Geoenvironmental Consultants

Slapton Hill Barn,
Blakesley Road,
Slapton,
Towcester,
Northants,
NN12 8QD
Telephone: (01327) 860060
Email: info@listersgeotechnics.co.uk

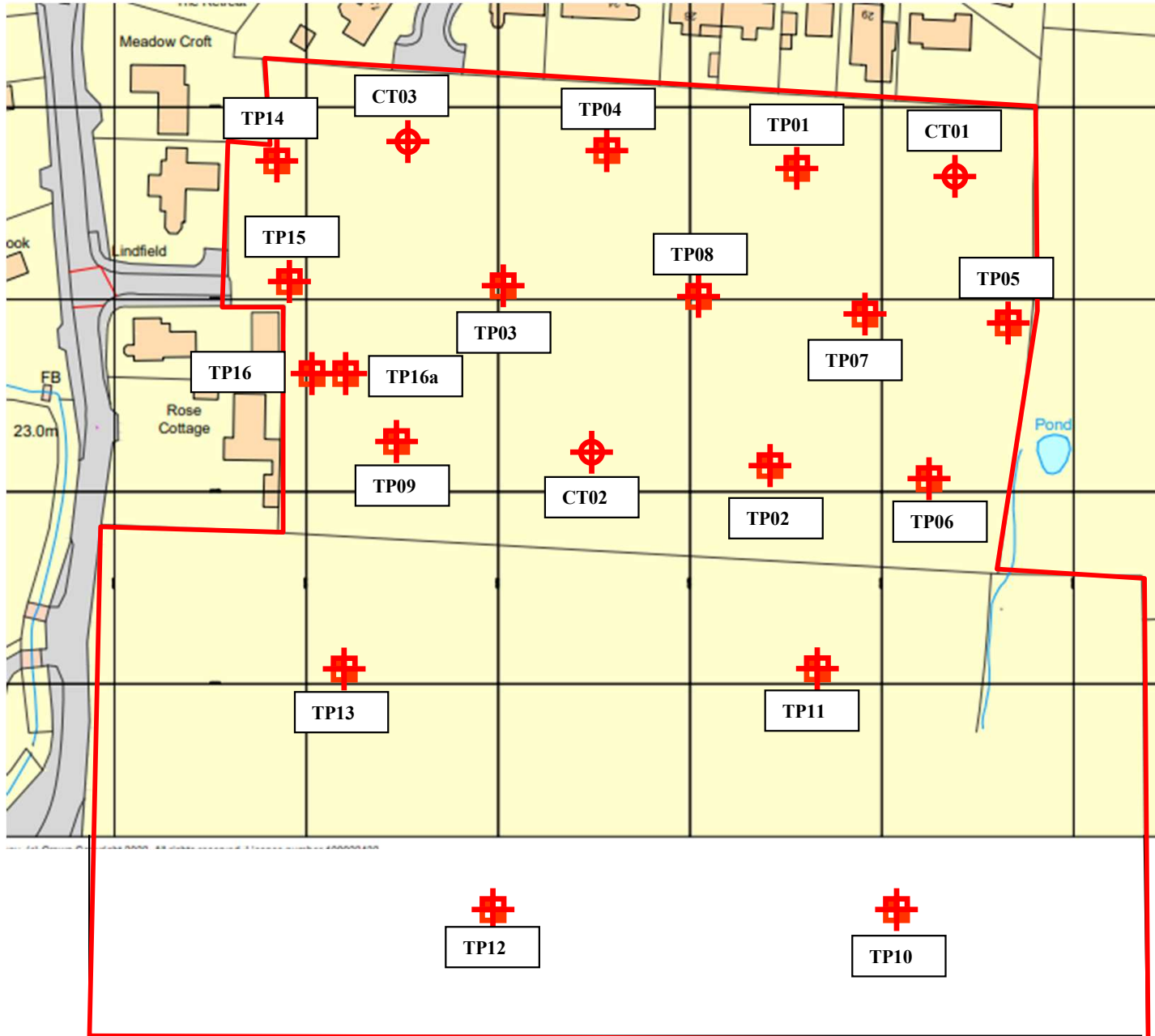
Title: Site Location Plan



Site: Cleggars Park,
Lamphey, SA71 5JY

Scale: NTS **Drawn by:** LC

Date: 12/2022 **Dwg No:** Fig 1

Project Ref: 22.09.023



-  Approximate locations of boreholes
-  Approximate locations of trial pits



Slapton Hill Barn,
Blakesley Road,
Slapton,
Towcester,
Northants,
NN12 8QD
Telephone: (01327) 860060
Email: info@listersgeotechnics.co.uk

Title: Exploratory Hole Location Plan

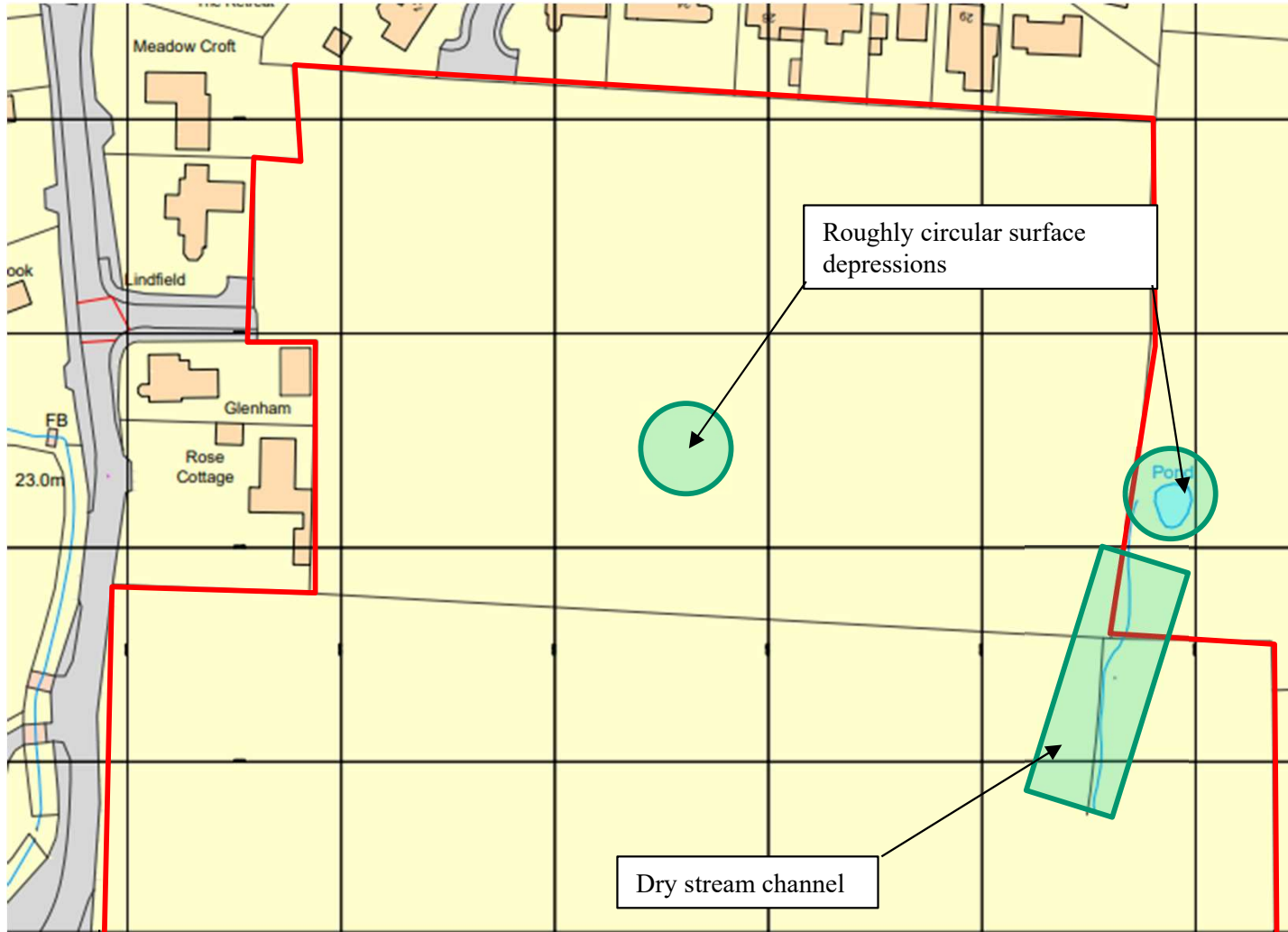
Site: Cleggars Park
Lamphey, SA71 5JY

Scale: NTS

Drawn by: LC

Date: 12/2022

Dwg No: Fig 2



Slapton Hill Barn,
Blakesley Road,
Slapton,
Towcester,
Northants,
NN12 8QD
Telephone: (01327) 860060
Email: info@listersgeotechnics.co.uk

Title: Site Features Plan

**Site: Cleggars Park
Lamphey, SA71 5JY**

Scale: NTS

Drawn by: LC

Date: 12/2022

Dwg No: Fig 3



Viewing eastern along northern boundary from the northwestern corner



Viewing southeast across the northern area from the northeastern corner



Viewing south along the western boundary from the northwestern corner



Surface depression in the eastern area of the site



Viewing south across the southeastern area of the site



Viewing southwest across the southern area of the site



Viewing northeast across the southern area of the site

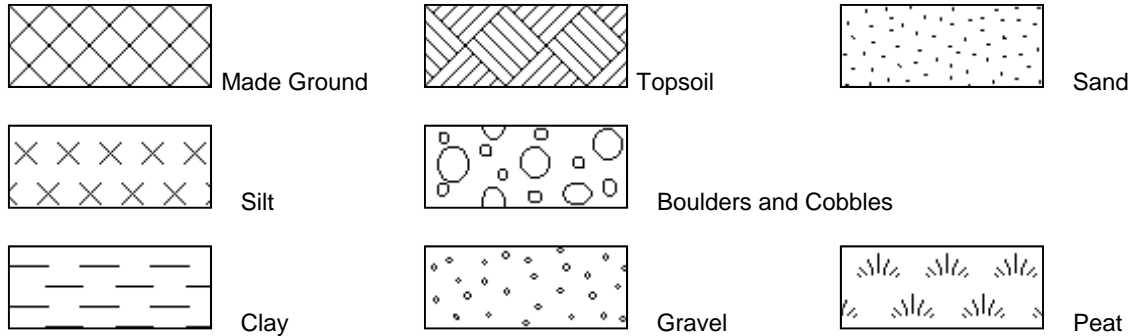


Surface depression in the northern area

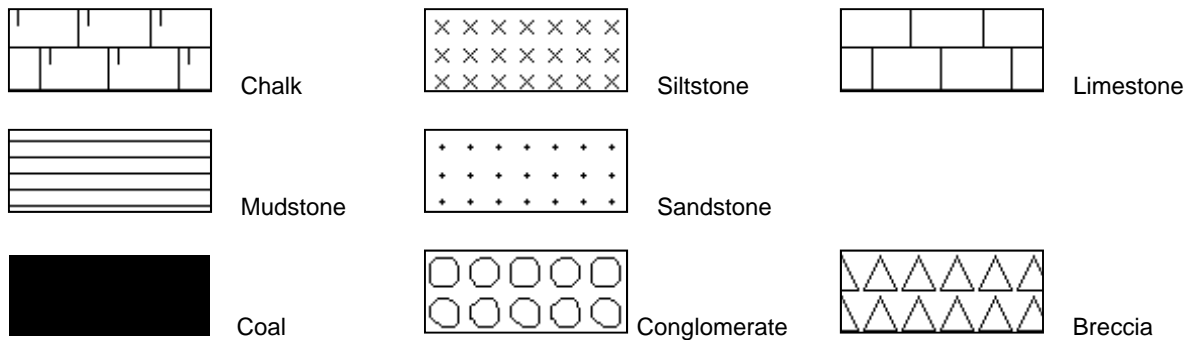


APPENDIX B FIELDWORK AND TESTING



LEGEND - Soils



LEGEND - Rocks (Sedimentary)



LOG ABBREVIATIONS

W	Water Sample		Water Strike
B	Bulk Sample		Water (Standing Level)
D	Disturbed Sample	PP	Pocket Penetrometer
J	Jar Sample	HV	Hand Vane
U	Undisturbed Sample	SPT	Standard Penetration Test
(No. of blows shown in brackets for U100 samples)		CPT	Cone Penetration Test
WAC	Waste Acceptance Criteria Sample	CBR	California Bearing Ratio
		*	Extrapolated Value

Pocket penetrometer testing provides values of unconfined compressive strength. The results have been converted to an approximate equivalent shear strength which should be used with due circumspection. As the pocket penetrometer tends to overestimate shear strength, we have used an appropriate reduction factor.

LOG KEY

Continuous Tube Sampler Log

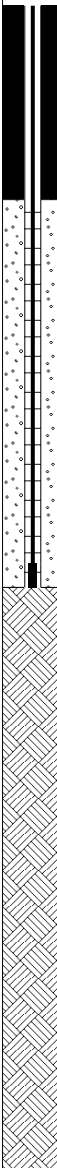

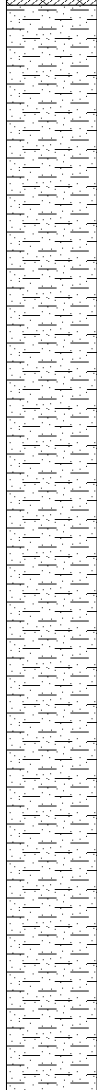
Borehole No.
CT 01
Project Location: Pembroke

Co-ords: 201609E - 200038N

Project Number:
22.09.023

Level:
Logged By:
Dates: 18/10/2022

 Lee Chippington
to BS 5930:2015

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Result					
		0.10 - 0.45	D		0.40		TOPSOIL Brown slightly sandy slightly organic CLAY	1 2 3 4 5 6 7	
		0.45 - 1.00	D						BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Stiff high strength brown slightly sandy CLAY. Contains some gravel sized siltstone lithorelicts
		1.00 - 1.50	D						
		1.00	PP	3.5kg/cm ²					
		1.00	SPT(S)	N=14 (4/4,3,4,3)					
		1.25	PP	2.8kg/cm ²					
		1.50 - 2.00	D						
		1.50	PP	4.2kg/cm ²					
		1.75	PP	3.5kg/cm ²					
		2.00	PP	1.8kg/cm ²					
		2.00	SPT(S)	N=10 (3/2,3,2,3)					
		2.25	PP	1.8kg/cm ²					
		2.50	PP	1.5kg/cm ²					
		2.75	PP	1.5kg/cm ²					
		3.00	PP	1.8kg/cm ²					
		3.00	SPT(S)	N=13 (4/3,3,3,4)					
		3.25	PP	1.8kg/cm ²					
		3.50 - 4.00	D						
		3.50	PP	1.8kg/cm ²					
		3.75	PP	2.0kg/cm ²					
	4.00	PP	2.0kg/cm ²						
	4.00	SPT(S)	N=13 (4/2,3,4,4)						
	4.50	PP	1.5kg/cm ²						
	5.00 - 6.00	D							
	5.00	PP	1.5kg/cm ²						
	5.00	SPT(S)	N=14 (4/3,4,3,4)						
	5.50	PP	1.8kg/cm ²						
	6.00	PP	1.2kg/cm ²	6.00					
						End of Borehole at 6.00m			

Borehole Diameter: 87mm to 57mm

Groundwater: Not encountered

Instrumentation: Gas/Groundwater pipe installed to 3.00m

Remarks: Logged by Lee Chippington to BS5930 + A2


Continuous Tube Sampler Log



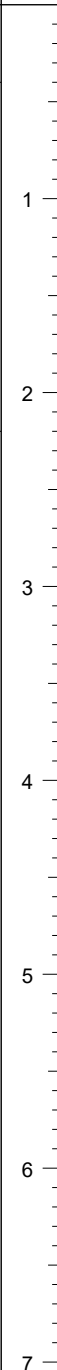
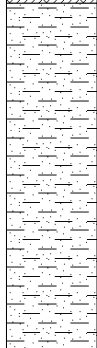
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CT 02
Project Location: Pembroke

Co-ords: 201517E - 199975N

Project Number:
22.09.023

Level:
Logged By:
Dates: 18/10/2022

 Lee Chippington
to BS 5930:2015

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Result					
		0.10 - 0.40	D		0.40		TOPSOIL Brown slightly sandy slightly organic CLAY.		
		0.40 - 1.00	D				BLACK ROCK SUB-GROUP AND GULLY OOLITE FORMATION Stiff high strength brown slightly sandy CLAY. Contains some gravel sized siltstone lithorelicts		
		1.00 - 1.50	D		2.20				
		1.00	PP	3.2kg/cm ²					
		1.00	SPT(S)	N=9 (4/2,3,2,2)					
		1.25	PP	5.0kg/cm ²					
		1.50 - 2.00	D						
		1.50	PP	5.0kg/cm ²					
		1.75	PP	2.8kg/cm ²					
		2.00 - 2.20	D						
	2.00	PP	2.5kg/cm ²						
	2.00	SPT(S)	N=13 (3/3,3,3,4)						
		End of Borehole at 2.20m							

Borehole Diameter: 87mm to 57mm

Groundwater: Not encountered

Instrumentation: Gas/Groundwater monitoring installed to 2.20m

Remarks: Logged by Lee Chippington to BS5930 + A2




Continuous Tube Sampler Log

Borehole No.

CT 03

Project Location: Pembroke

Co-ords: 201472E - 200049N




Project Number:
22.09.023

Level:

Logged By:

Dates: 18/10/2022

Lee Chippington
to BS 5930:2015

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Result					
		0.10 - 0.40	D		0.40		 TOPSOIL Brown slightly sandy slightly organic CLAY	1	
		0.40 - 1.00	D				 BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Stiff high strength brown slightly sandy CLAY. Contains some gravel sized siltstone lithorelicts		
		1.00 - 1.50	D		2.60			2	
		1.00	PP	5.0kg/cm ²					
		1.25	PP	5.0kg/cm ²					
		1.50 - 2.00	D						
		1.50	PP	4.0kg/cm ²					
		1.75	PP	1.8kg/cm ²					
		2.00	PP	3.0kg/cm ²					
		2.25	PP	4.2kg/cm ²					
		2.50	PP	5.0kg/cm ²					
		3.00 - 4.10	D		4.10		 BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Weak highly fractured brown LIMESTONE. Recovered as very silty sandy GRAVEL	3	
		4.25	PP	1.8kg/cm ²					
		4.50	PP	2.0kg/cm ²					
		4.75	PP	1.8kg/cm ²					
		5.00 - 5.25	D						
		5.00	PP	2.0kg/cm ²					
					5.30		End of Borehole at 5.30m	4	
								5	
								6	
								7	

Borehole Diameter: 87mm to 57mm

Groundwater: Not encountered

Instrumentation:

Remarks: Logged by Lee Chippington to BS5930 + A2





Super Heavy Dynamic Probe

Borehole No.
SHDP 2

Project Location: Pembroke

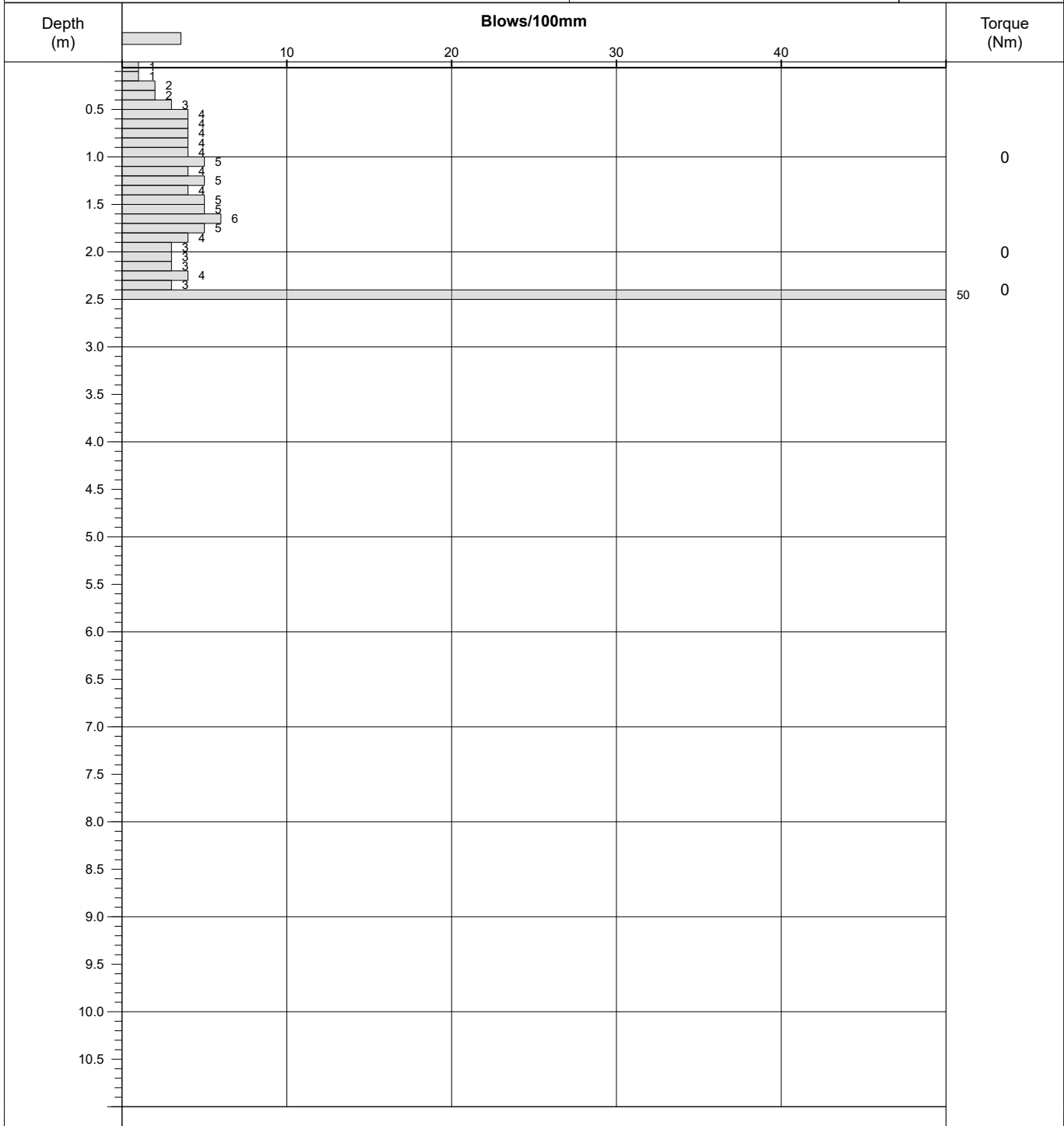
Co-ords:

Level: mAOD

Dates: 18/10/2022

Project Number:
22.09.023

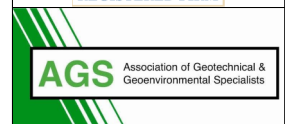
Test Type:
SHDP - B



Hammer Weight: 63.5kgs Fall Height: 0.75m Cone Area: 20cm²

Remarks:

* = settled under own weight





Super Heavy Dynamic Probe

Borehole No.
SHDP 3

Project Location: Pembroke

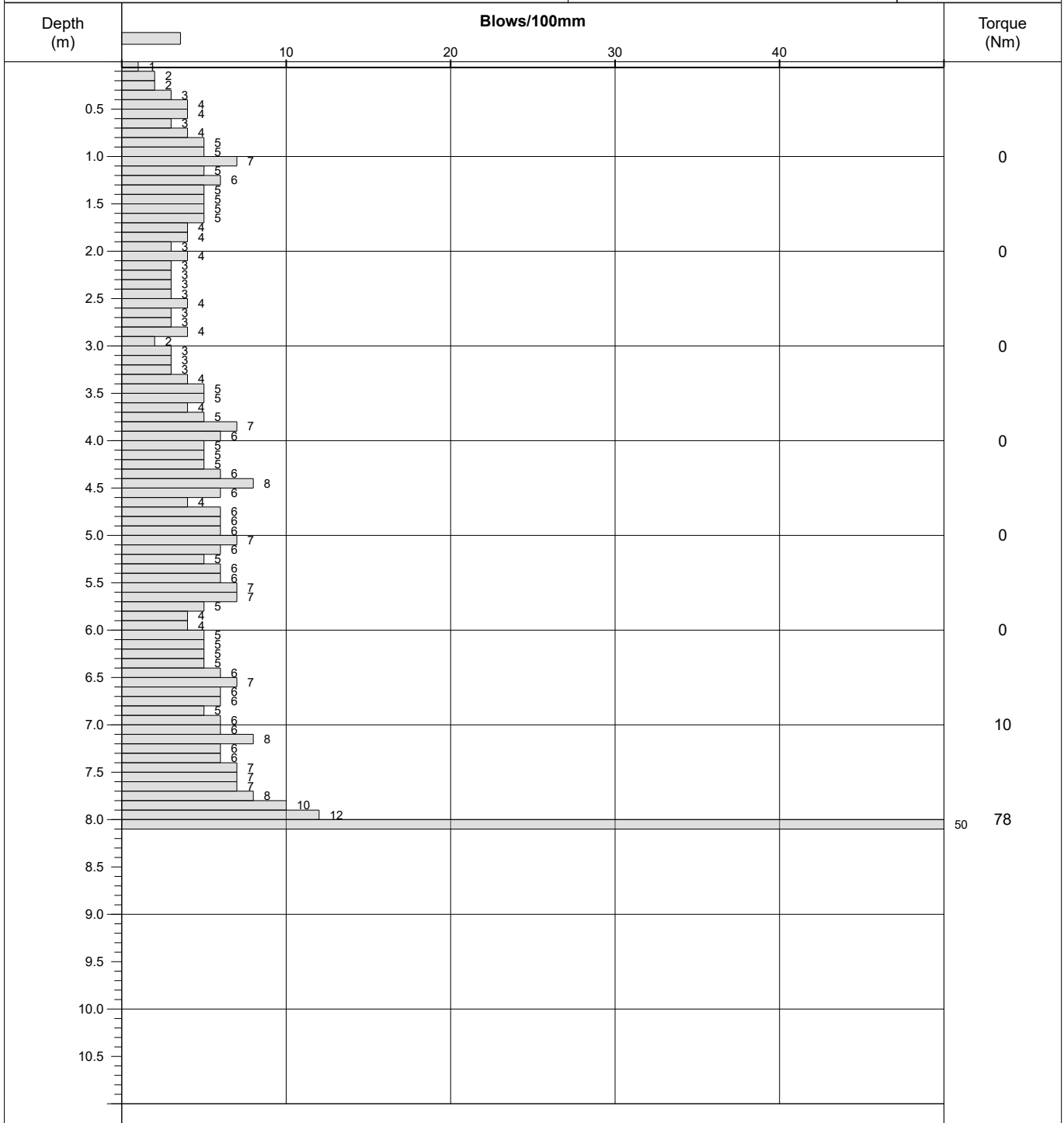
Co-ords:

Level: mAOD

Dates: 18/10/2022

Project Number:
22.09.023

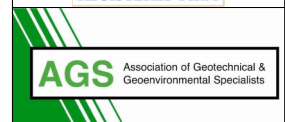
Test Type:
SHDP - B



Hammer Weight: 63.5kgs Fall Height: 0.75m Cone Area: 20cm²

Remarks:

* = settled under own weight





Trial Pit Log

Trial Pit No.

TP 01

Project Location: Pembroke

Co-ords: 201570E - 200035N

Project Number:
22.09.023

Level:

Logged By:

Dates: 18/10/2022

Lee Chippington
to BS 5930:2015

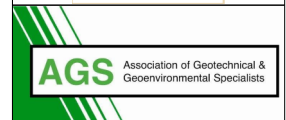
Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
				0.30			TOPSOIL Brown slightly sandy slightly organic CLAY	
	0.70	D					BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Fine medium strength brown slightly sandy CLAY	
	1.00	HV	60kPa					1
	1.30	D						
				1.70			BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Medium strong fractured grey LIMESTONE. Recovered as gravelly angular cobbles	
	2.00	D		1.80			BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Firm to stiff brown slightly sandy CLAY. Contains some gravel to cobble sized limestone lithorelicts	2
				2.30			End of Trial Pit at 2.30m	
								3
								4

Method of excavation: JCB 3CX **Dimensions:** 0.60m (w) x 2.50m (l) x 2.30m (d)

Stability: Sides Stable

Groundwater: Not encountered

Remarks: Logged by Lee Chippington to BS5930:2015





Trial Pit Log

Trial Pit No.
TP 02

Project Location: Pembroke

Co-ords: 201565E - 199964N

Project Number:
22.09.023

Level:

Logged By:
Lee Chippington
to BS 5930:2015

Dates: 18/10/2022

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
				0.30			TOPSOIL Brown slightly sandy slightly organic CLAY.	
	0.80	D					BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Firm medium strength brown slightly sandy CLAY. Contains patches of clayey fine sand	1
	1.00	HV	60kPa					
				2.00			BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION	2
	1.80	D		2.20			Medium strong fractured grey LIMESTONE End of Trial Pit at 2.20m	
								3
								4

Method of excavation: JCB 3CX **Dimensions:** 0.60m (w) x 2.50m (l) x 2.20m (d)

Stability: Sides Stable

Groundwater: Not encountered

Remarks: Logged by Lee Chippington to BS5930:2015



Trial Pit Log

Trial Pit No.


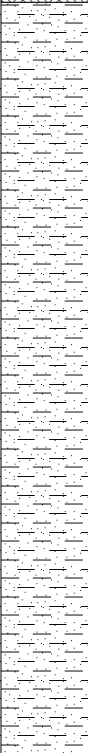

TP 04
Project Location: Pembroke

Co-ords: 201525E - 200042N

Project Number:
22.09.023

Level:
Logged By:
Dates: 18/10/2022

 Lee Chippington
to BS 5930:2015

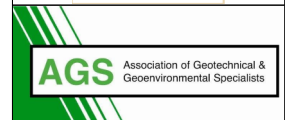
Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
				0.30			TOPSOIL Brown slightly sandy slightly organic CLAY	
	1.00	HV	60kPa				BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Firm medium strength brown slightly sandy CLAY. Contains some gravel sized siltstone lithorelicts and patches of clayey sand	1
	1.40	D						
	2.00	D						2
	2.50	D						
				2.60 2.70			BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Medium strong fractured grey LIMESTONE End of Trial Pit at 2.70m	3
								4

Method of excavation: JCB 3CX

Dimensions: 0.60m (w) x 2.50m (l) x 2.70m (d)

Stability: Sides Stable

Groundwater: None encountered

Remarks: Logged by Lee Chippington to BS5930:2015




Trial Pit Log

Trial Pit No.

TP 05

Project Location: Pembroke

Co-ords: 201623E - 200008N

Project Number:
22.09.023

Level:

Logged By:

Dates: 18/10/2022

Lee Chippington
to BS 5930:2015

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
	0.50	D		0.30			TOPSOIL Brown slightly sandy slightly organic CLAY	
			0.60			BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Firm brown slightly sandy CLAY		
			1.90			BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Medium strong fractured grey LIMESTONE. Recovered as angular cobbles and boulders	1	
							End of Trial Pit at 1.90m	2
								3
								4

Method of excavation: JCB 3CX **Dimensions:** 0.60m (w) x 2.5m (l) x 1.90m (d)

Stability: Sides Stable

Groundwater: Not encountered

Remarks: Logged by Lee Chippington to BS5930:2015
Some blocks falling from excavation sides

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Trial Pit Log

Trial Pit No.

TP 06

Project Location: Pembroke

Co-ords: 201604E - 199970N

Project Number:
22.09.023

Level:

Logged By:

Dates: 18/10/2022

Lee Chippington
to BS 5930:2015

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
				0.30			TOPSOIL Brown slightly sandy slightly organic CLAY	
	0.80	D					BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Firm medium strength brown slightly sandy CLAY. Contains some gravel sized silstone lithorelics and patches of clayey sand	
	1.00	HV	55kPa					1
	1.50	D						
	2.10	D						2
	2.90	D		3.10				3
							End of Trial Pit at 3.10m	4

Method of excavation: JCB 3CX **Dimensions:** 0.60m (w) x 2.50m (l) x 3.10m (d)

Stability: Sides Stable

Groundwater: Not encountered

Remarks: Logged by Lee Chippington to BS5930:2015





Trial Pit Log

Trial Pit No.

TP 07

Project Location: Pembroke

Co-ords: 201582E - 200017N

Project Number:
22.09.023

Level:

Logged By:

Dates: 18/10/2022

Lee Chippington
to BS 5930:2015

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
				0.30			TOPSOIL Brown slightly sandy slightly organic CLAY	
	1.00	HV	65kPa				BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Firm medium strong brown slightly sandy CLAY. Contains some gavel sized siltstone lithorelicts	1
	1.50	D						
	2.20	D						2
				2.50			BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION	
				2.70			Medium strong fractured grey LIMESTONE End of Trial Pit at 2.70m	3
								4

Method of excavation: JCB 3CX **Dimensions:** 0.60m (w) x 2.50m (l) x 2.70m (d)

Stability: Sides Stable

Groundwater: Not encountered

Remarks: Logged by Lee Chippington to BS5930:2015



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Trial Pit Log

Trial Pit No.

TP 08

Project Location: Pembroke

Co-ords: 201547E - 200014N

Project Number:
22.09.023

Level:

Logged By:

Dates: 18/10/2022

Lee Chippington
to BS 5930:2015

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
				0.30		TOPSOIL Brown slightly sandy slightly organic CLAY		
	1.00	HV	60kPa			BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Firm medium strength slightly silty CLAY. Contains fairly abundant gravel and cobble sized siltstone lithorelicts		1
	1.20	D						
	2.50	D						2
				3.00			End of Trial Pit at 3.00m	3
								4

Method of excavation: JCB 3CX **Dimensions:** 0.60m (w) x 2.50m (l) x 3.00m (d)

Stability: Sides Stable

Groundwater: Not encountered

Remarks: Logged by Lee Chippington to BS5930:2015



Trial Pit Log

Trial Pit No.


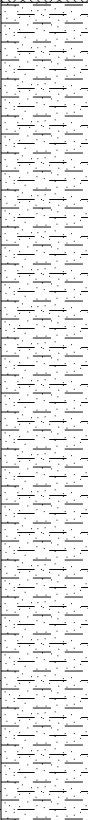

TP 09
Project Location: Pembroke

Co-ords: 201468E - 199971N

Project Number:
22.09.023

Level:
Logged By:
Dates: 18/10/2022

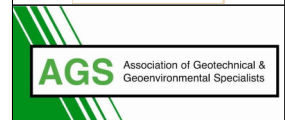
 Lee Chippington
to BS 5930:2015

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
				0.30			TOPSOIL Brown slightly sandy slightly organic CLAY	
	1.00	HV	55kPa				BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Firm medium strong brown slightly sandy CLAY. Contains some gravel and cobble sized siltstone lithorelicts	1
	1.90	D						2
	2.70	D		2.80			BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Medium strong fractured grey LIMESTONE End of Trial Pit at 2.90m	3
				2.90				4

Method of excavation: JCB 3CX **Dimensions:** 0.60m (w) x 2.5m (l) x 2.90m (d)

Stability: Sides Stable

Groundwater: Not encountered

Remarks: Logged by Lee Chippington to BS5930:2015




Trial Pit Log

Trial Pit No.

TP 10

Project Location: Pembroke

Co-ords: 201586E - 199866N

Project Number:
22.09.023

Level:

Logged By:

Dates: 19/10/2022

Lee Chippington
to BS 5930:2015

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
				0.30			TOPSOIL Brown slightly sandy slightly organic CLAY	1
	1.50	D					BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Firm medium strength slightly sandy CLAY. Contains some gravel sized siltstone and mudstone lithorelicts	2
				2.20			End of Trial Pit at 2.20m	3
								4

Method of excavation: JCB 3CX **Dimensions:**

Stability: Sides Stable

Groundwater: Not encountered

Remarks: Logged by Lee Chippington to BS5930:2015





Trial Pit Log

Trial Pit No.

TP 12

Project Location: Pembroke

Co-ords: 201535E - 199915N

Project Number:
22.09.023

Level:

Logged By:

Dates: 19/10/2022

Lee Chippington
to BS 5930:2015

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
	0.60	D		0.30			TOPSOIL Brown slightly sandy slightly organic CLAY	
			0.70			BLACK ROCK SUB-GROUP GALTY OOLITE FORMATION Firm brown slightly sandy CLAY		
							End of Trial Pit at 0.70m	1
								2
								3
								4

Method of excavation: JCB 3CX **Dimensions:** 0.60m (w) x 2.00m (l) x 0.70m (d)

Stability: Sides Stable

Groundwater:

Remarks: Logged by Lee Chippington to BS5930:2015

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Trial Pit Log

Trial Pit No.

TP 13

Project Location: Pembroke

Co-ords: 201450E - 199916N


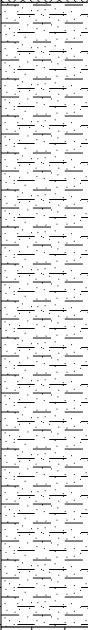


Project Number:
22.09.023

Level:

Logged By:

Dates: 19/10/2022

Lee Chippington
to BS 5930:2015

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
				0.30			TOPSOIL Brown slightly sandy slightly organic CLAY	
	1.00	HV	65kPa				BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Firm medium strength slightly sandy CLAY. Contains some gravel siltstone sized lithorelicts	1
	1.50	D					BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Medium strong fractured grey LIMESTONE End of Trial Pit at 2.30m	2
				2.20 2.30				3
								4

Method of excavation: JCB 3CX **Dimensions:** 0.60m (w) x 2.50m (l) x 2.30m (d)

Stability: Sides Stable

Groundwater: Not encountered

Remarks: Logged by Lee Chippington to BS5930:2015



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Trial Pit Log

Trial Pit No.
TP 14

Project Location: Pembroke

Co-ords: 201438E - 200037N

Project Number:
22.09.023

Level: mAOD

Logged By:
Lee Chippington
to BS 5930:2015

Dates: 20/10/2022

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
				0.30			TOPSOIL Brown slightly sandy slightly organic CLAY	
	1.00	HV	70kPa				BLACK ROCK SUB-GROUP AND GULLY OOLITE FORMALTION Firm medium strength brown slightly sandy CLAY	
				1.40			<i>Plastic pipe adjoined roughly west to east at 0.90m depth</i>	1
							<i>Concrete pipe aligned roughly north to south at 1.20m depth</i>	
							End of Trial Pit at 1.40m	2
								3
								4

Method of excavation: JCB 3CX **Dimensions:** 2.30m (w) x 2.50m (l) x 1.40m (d)

Stability: Sides Stable

Groundwater: Not encountered

Remarks: Logged by Lee Chippington to BS5930:2015





Trial Pit Log

Trial Pit No.

TP 15

Project Location: Pembroke

Co-ords: 201447E - 200011N


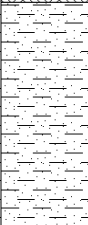
Project Number:
22.09.023

Level: mAOD

Logged By:

Dates: 20/10/2022

Lee Chippington
to BS 5930:2015

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
				0.30			TOPSOIL Brown slightly sandy slightly organic CLAY	
				1.00			BLACK ROCK SUB-GROUP & GULLY OOLITE FORMATION Firm brown slightly sandy CLAY	
							End of Trial Pit at 1.00m	1
								2
								3
								4

Method of excavation: JCB 3CX **Dimensions:** 2.00m (w) x 2.00m (l) x 1.00m (d)

Stability: Sides Stable

Groundwater: Not encountered

Remarks: Logged by Lee Chippington to BS5930:2015






Trial Pit Log

Trial Pit No.

TP 16

Project Location: Pembroke

Co-ords: 201448E - 199980N

Project Number:
22.09.023

Level: mAOD

Logged By:

Dates: 20/10/2022

Lee Chippington
to BS 5930:2015

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
				0.30			TOPSOIL Brown slightly sandy slightly organic CLAY	
				0.90			BLACK ROCK-SUB-GROUP & GULLY OOLITE FORMATION Firm brown slightly sandy CLAY	
							End of Trial Pit at 0.90m	1
								2
								3
								4

Method of excavation: JCB 3CX **Dimensions:** 1.50m (w) x 3.00m (l) x 0.90m (d)

Stability: Sides Stable

Groundwater: Not encountered

Remarks: Logged by Lee Chippington to BS5930:2015

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Trial Pit Log

Trial Pit No.

TP 16a

Project Location: Pembroke

Co-ords: 201453E - 199982N

Project Number:
22.09.023

Level: mAOD

Logged By:
Lee Chippington
to BS 5930:2015

Dates: 20/10/2022

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
				0.30			TOPSOIL Brown slightly sandy slightly organic CLAY	1
							End of Trial Pit at 0.30m	2
								3
								4

Method of excavation: JCB 3CX **Dimensions:** 1.50m (w) x 3.00m (l) by 0.30m (d)

Stability: Sides Stable

Groundwater: Not encountered

Remarks: Logged by Lee Chippington to BS5930:2015
Trial pit terminated at 0.30m depth on a sub brick structure

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Report No: 22.09.023
Site: , Cleggars Park, , Lamphey, Pembroke, SA71 5JY

Test Details

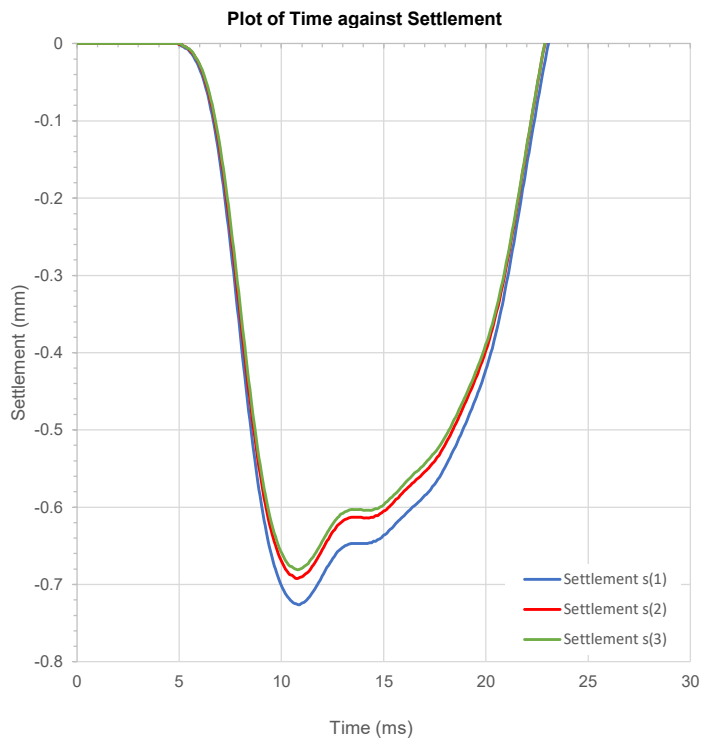
Test Location Reference TP01
Test Number 1
Depth of test 0.70
Plate size 300 **mm diameter circular**
Sample reference -
Sample depth - **m (below Ground Level)**
Technician BS
Date of test 18.10.2022
Weather -

Description of test stratum/strata

Test Record

Device No. 8342
Measuring Series 166
Plate diameter 300
Mass of drop weight 10
Height of drop 1,135
Max impact force 7070
Duration of impact 18

mm
kg
mm
N
ms



Max Settlement (mm) **Max Velocity (mm/s)**
s(1) = 0.726 mm v(1) = 240.7 mm/s
s(2) = 0.692 mm v(2) = 232.6 mm/s
s(3) = 0.681 mm v(3) = 229.2 mm/s

Mean Settlement (mm) **Mean Velocity (mm/s)**
s(m) = 0.700 mm v(m) = 234.1 mm/s

Calculation and Result

Dynamic compactness ratio, s/v = 0.003
Dynamic Modulus of Deformation, E_{vd} = 32.16 MPa

Equivalent CBR value **18** %

Remarks:

DYNAMIC PLATE LOAD TEST CERTIFICATE

TP BF-StB, Part B 8.3. Technical specification for soil and rock in road construction, Dynamic Plate Loading Test, German Road and Transportation Research Association, 2003

Report No.:

22.09.023

Report No: 22.09.023
Site: , Cleggars Park, , Lamphey, Pembroke, SA71 5JY

Test Details

Test Location Reference TP02
Test Number 1
Depth of test 0.70
Plate size 300 mm diameter circular
Sample reference -
Sample depth - m (below Ground Level)
Technician BS
Date of test 18.10.2022
Weather -

Description of test stratum/strata

Device No. 8342
Measuring Series 167
Plate diameter 300 mm
Mass of drop weight 10 kg
Height of drop 1,135 mm
Max impact force 7070 N
Duration of impact 18 ms

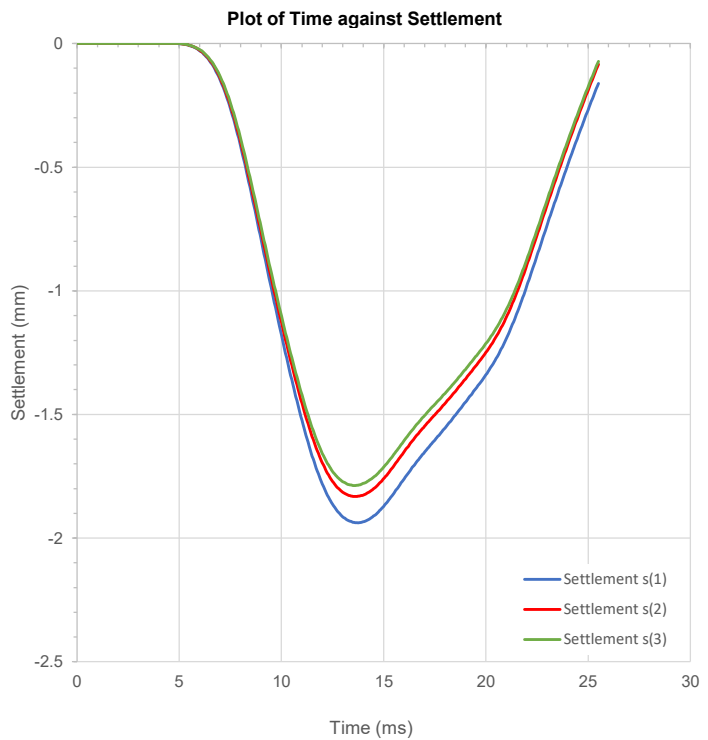
Max Settlement (mm)
s(1) = 1.938 mm
s(2) = 1.832 mm
s(3) = 1.787 mm

Max Velocity (mm/s)
v(1) = 392.7 mm/s
v(2) = 376.1 mm/s
v(3) = 370.4 mm/s

Mean Settlement (mm)
s(m) = 1.852 mm

Mean Velocity (mm/s)
v(m) = 379.7 mm/s

Test Record



Calculation and Result

Dynamic compactness ratio, s/v = 0.005
Dynamic Modulus of Deformation, E_{vd} = 12.15 MPa

Equivalent CBR value 5 %

Remarks:

DYNAMIC PLATE LOAD TEST CERTIFICATE

TP BF-StB, Part B 8.3. Technical specification for soil and rock in road construction, Dynamic Plate Loading Test, German Road and Transportation Research Association, 2003

Report No.:

22.09.023

Report No: 22.09.023
Site: , Cleggars Park, , Lamphey, Pembroke, SA71 5JY

Test Details

Test Location Reference TP03
Test Number 1
Depth of test 0.70
Plate size 300 **mm diameter circular**
Sample reference -
Sample depth - **m (below Ground Level)**
Technician BS
Date of test 18.10.2022
Weather -

Description of test stratum/strata

Device No. 8342
Measuring Series 168
Plate diameter 300
Mass of drop weight 10
Height of drop 1,135
Max impact force 7070
Duration of impact 18

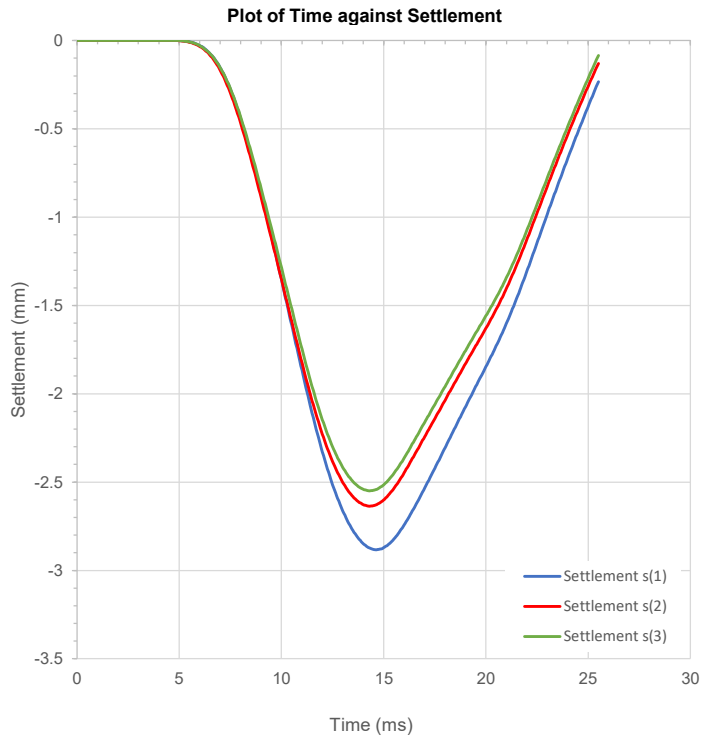
Max Settlement (mm)
s(1) = 2.883 mm
s(2) = 2.636 mm
s(3) = 2.549 mm

Max Velocity (mm/s)
v(1) = 511.2 mm/s
v(2) = 473.6 mm/s
v(3) = 460.7 mm/s

Mean Settlement (mm)
s(m) = 2.689 mm

Mean Velocity (mm/s)
v(m) = 481.8 mm/s

Test Record



Calculation and Result

Dynamic compactness ratio, s/v = 0.006
Dynamic Modulus of Deformation, E_{vd} = 8.37 MPa

Equivalent CBR value 3 %

Remarks: Test for guidance only - result outside acceptable range for this method: $10\text{MPa} < E_{vd} < 70\text{MPa}$

DYNAMIC PLATE LOAD TEST CERTIFICATE

TP BF-StB, Part B 8.3. Technical specification for soil and rock in road construction, Dynamic Plate Loading Test, German Road and Transportation Research Association, 2003

Report No.:

22.09.023

Report No: 22.09.023
Site: , Cleggars Park, , Lamphey, Pembroke, SA71 5JY

Test Details

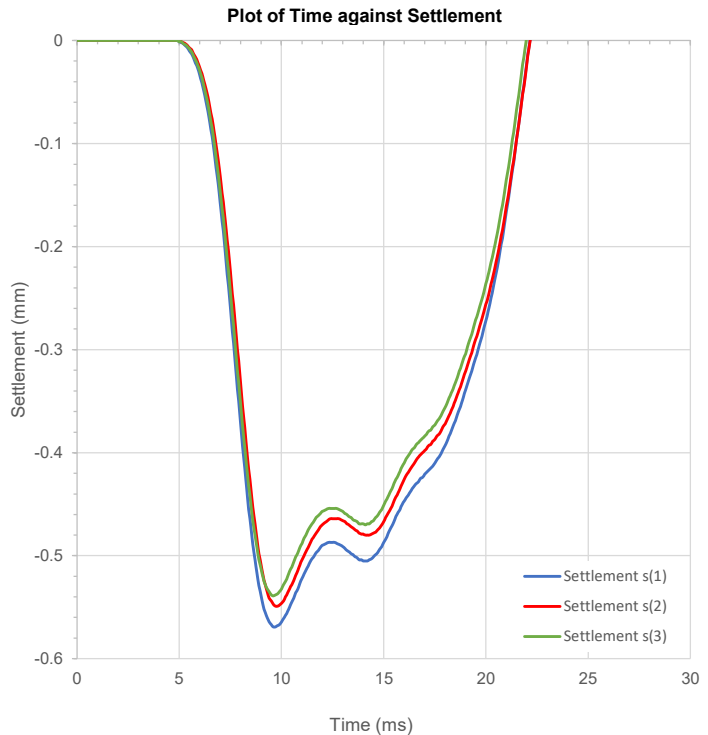
Test Location Reference TP04
Test Number 1
Depth of test 0.70
Plate size 300 mm diameter circular
Sample reference -
Sample depth - m (below Ground Level)
Technician BS
Date of test 18.10.2022
Weather -

Description of test stratum/strata

Device No. 8342
Measuring Series 169
Plate diameter 300 mm
Mass of drop weight 10 kg
Height of drop 1,135 mm
Max impact force 7070 N
Duration of impact 18 ms

Max Settlement (mm)	Max Velocity (mm/s)
s(1) = 0.569 mm	v(1) = 221.5 mm/s
s(2) = 0.549 mm	v(2) = 214.3 mm/s
s(3) = 0.539 mm	v(3) = 213.8 mm/s
Mean Settlement (mm)	Mean Velocity (mm/s)
s(m) = 0.552 mm	v(m) = 216.5 mm/s

Test Record



Calculation and Result

Dynamic compactness ratio, s/v = 0.003
Dynamic Modulus of Deformation, E_{vd} = 40.74 MPa

Equivalent CBR value 23 %

Remarks:

DYNAMIC PLATE LOAD TEST CERTIFICATE

TP BF-StB, Part B 8.3. Technical specification for soil and rock in road construction, Dynamic Plate Loading Test, German Road and Transportation Research Association, 2003

Report No.:

22.09.023

Report No: 22.09.023
Site: , Cleggars Park, , Lamphey, Pembroke, SA71 5JY

Test Details

Test Location Reference TP06
Test Number 1
Depth of test 0.70
Plate size 300 mm diameter circular
Sample reference -
Sample depth - m (below Ground Level)
Technician BS
Date of test 18.10.2022
Weather -

Description of test stratum/strata

Device No. 8342
Measuring Series 170
Plate diameter 300 mm
Mass of drop weight 10 kg
Height of drop 1,135 mm
Max impact force 7070 N
Duration of impact 18 ms

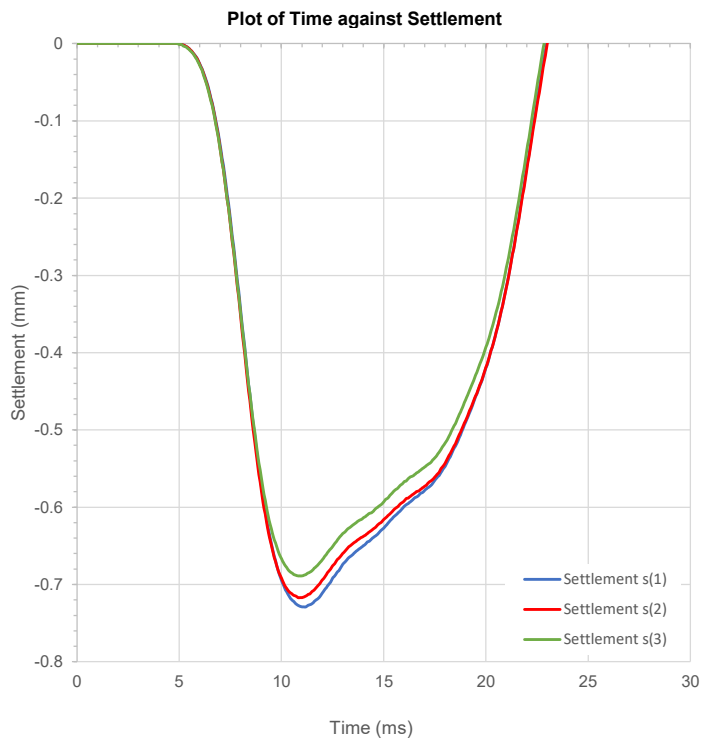
Max Settlement (mm)
s(1) = 0.729 mm
s(2) = 0.717 mm
s(3) = 0.689 mm

Max Velocity (mm/s)
v(1) = 239.8 mm/s
v(2) = 241.6 mm/s
v(3) = 231.8 mm/s

Mean Settlement (mm)
s(m) = 0.712 mm

Mean Velocity (mm/s)
v(m) = 237.8 mm/s

Test Record



Calculation and Result

Dynamic compactness ratio, $s/v = 0.003$
Dynamic Modulus of Deformation, $E_{vd} = 31.62$ MPa

Equivalent CBR value 17 %

Remarks:

DYNAMIC PLATE LOAD TEST CERTIFICATE

TP BF-StB, Part B 8.3. Technical specification for soil and rock in road construction, Dynamic Plate Loading Test, German Road and Transportation Research Association, 2003

Report No.:

22.09.023

Report No: 22.09.023
Site: , Cleggars Park, , Lamphey, Pembroke, SA71 5JY

Test Details

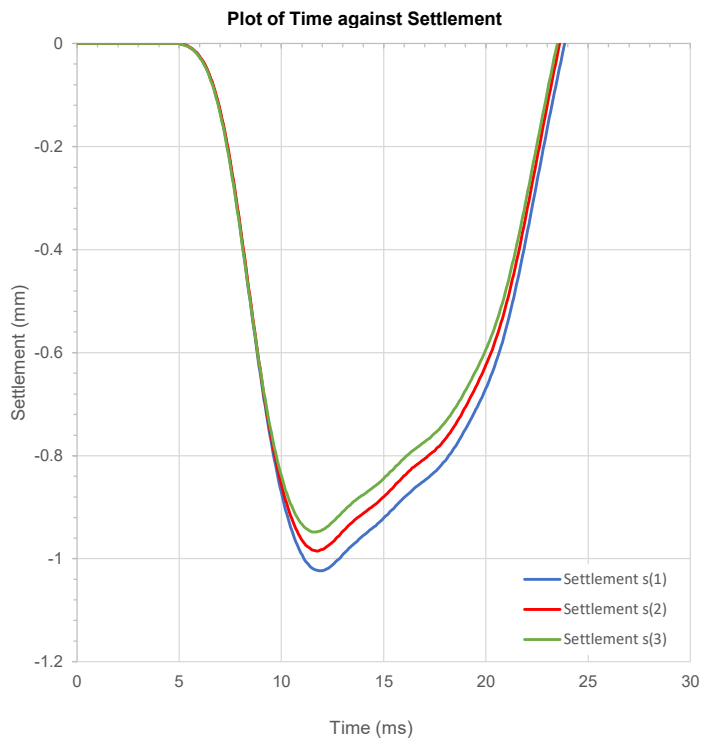
Test Location Reference TP07
Test Number 1
Depth of test 0.70
Plate size 300 mm diameter circular
Sample reference -
Sample depth - m (below Ground Level)
Technician BS
Date of test 18.10.2022
Weather -

Description of test stratum/strata

Device No. 8342
Measuring Series 171
Plate diameter 300 mm
Mass of drop weight 10 kg
Height of drop 1,135 mm
Max impact force 7070 N
Duration of impact 18 ms

Max Settlement (mm)	Max Velocity (mm/s)
s(1) = 1.024 mm	v(1) = 289.9 mm/s
s(2) = 0.985 mm	v(2) = 287.6 mm/s
s(3) = 0.949 mm	v(3) = 280.3 mm/s
Mean Settlement (mm)	Mean Velocity (mm/s)
s(m) = 0.986 mm	v(m) = 285.9 mm/s

Test Record



Calculation and Result

Dynamic compactness ratio, $s/v = 0.003$
Dynamic Modulus of Deformation, $E_{vd} = 22.82$ MPa

Equivalent CBR value 12 %

Remarks:

DYNAMIC PLATE LOAD TEST CERTIFICATE

TP BF-StB, Part B 8.3. Technical specification for soil and rock in road construction, Dynamic Plate Loading Test, German Road and Transportation Research Association, 2003

Report No.:

22.09.023

Report No: 22.09.023
Site: , Cleggars Park, , Lamphey, Pembroke, SA71 5JY

Test Details

Test Location Reference TP09
Test Number 1
Depth of test 0.70
Plate size 300 mm diameter circular
Sample reference -
Sample depth - m (below Ground Level)
Technician BS
Date of test 18.10.2022
Weather -

Description of test stratum/strata

Device No. 8342
Measuring Series 172
Plate diameter 300
Mass of drop weight 10
Height of drop 1,135
Max impact force 7070
Duration of impact 18

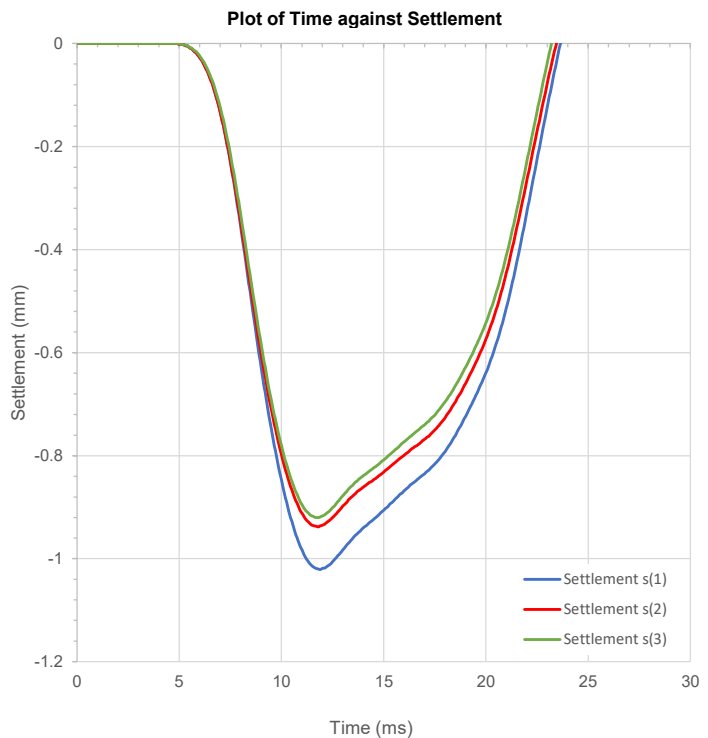
Max Settlement (mm)
s(1) = 1.021 mm
s(2) = 0.938 mm
s(3) = 0.920 mm

Max Velocity (mm/s)
v(1) = 274.0 mm/s
v(2) = 256.8 mm/s
v(3) = 253.3 mm/s

Mean Settlement (mm)
s(m) = 0.960 mm

Mean Velocity (mm/s)
v(m) = 261.4 mm/s

Test Record



Calculation and Result

Dynamic compactness ratio, s/v = 0.004
Dynamic Modulus of Deformation, E_{vd} = 23.45 MPa

Equivalent CBR value 12 %

Remarks:

DYNAMIC PLATE LOAD TEST CERTIFICATE

TP BF-StB, Part B 8.3. Technical specification for soil and rock in road construction, Dynamic Plate Loading Test, German Road and Transportation Research Association, 2003

Report No.:

22.09.023

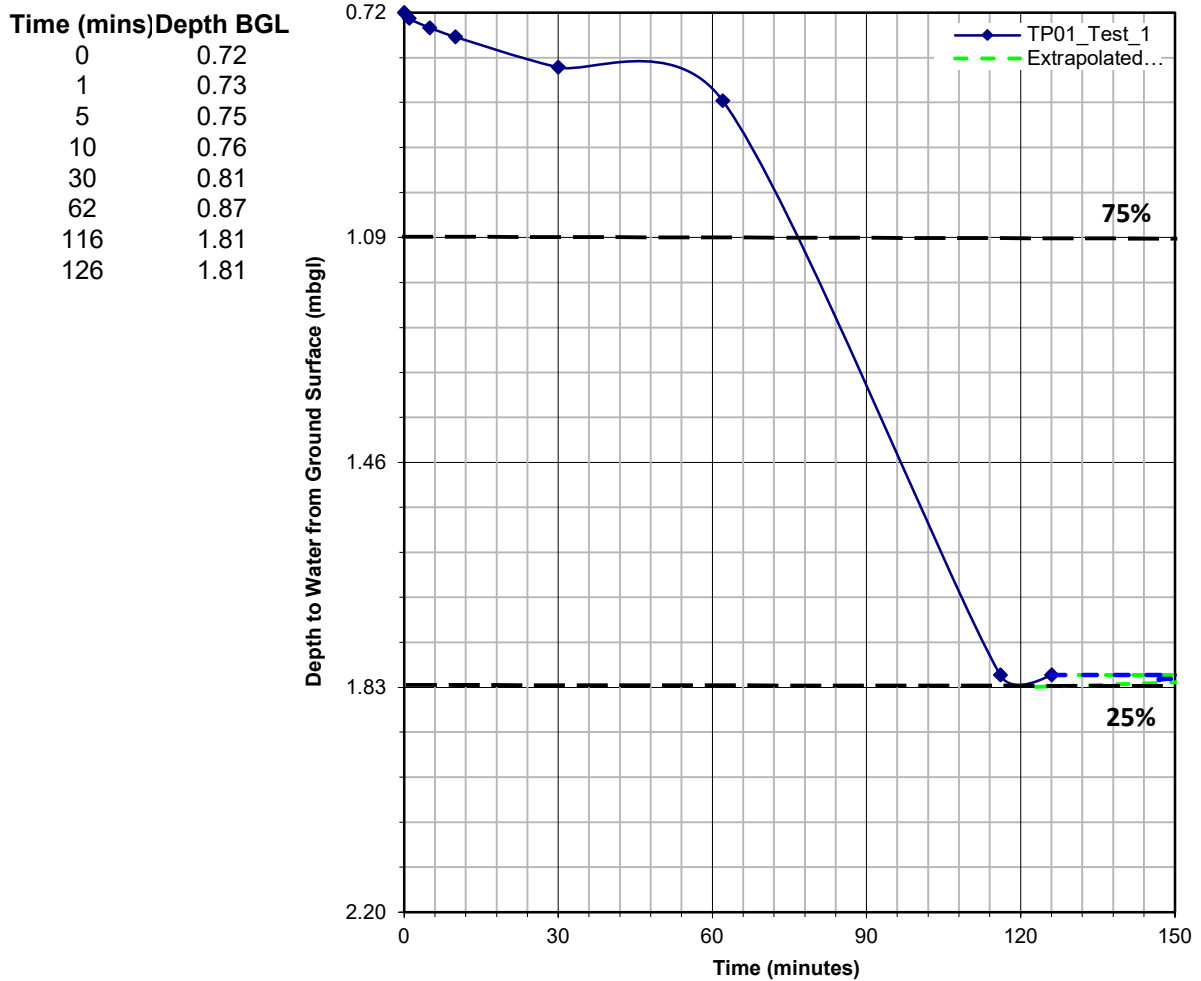
Site: , Cleggars Park, , Lamphey, Pembroke, SA71
5JY

Report No: 22.09.023
Date Tested: 18/10/2022
Test Location: TP01_Test_1
Dimensions: 0.5mWx2.1mLx2.20mD

Groundwater: unknown

Soil Description - test response zone:

0.3m to 1.7m - Brown slightly sandy Clay
1.7m to 1.8m - Fractured grey limestone
1.8m to 2.3m - Brown slightly sandy slightly gravelly clay



Water drained to the base of the limestone, indicating an infiltration rate between $3.69 \times 10^{-5} \text{m/s}$ and $6.14 \times 10^{-5} \text{m/s}$

**TRIAL PIT INFILTRATION TESTING
to BRE Digest 365**

Report:
22.09.023

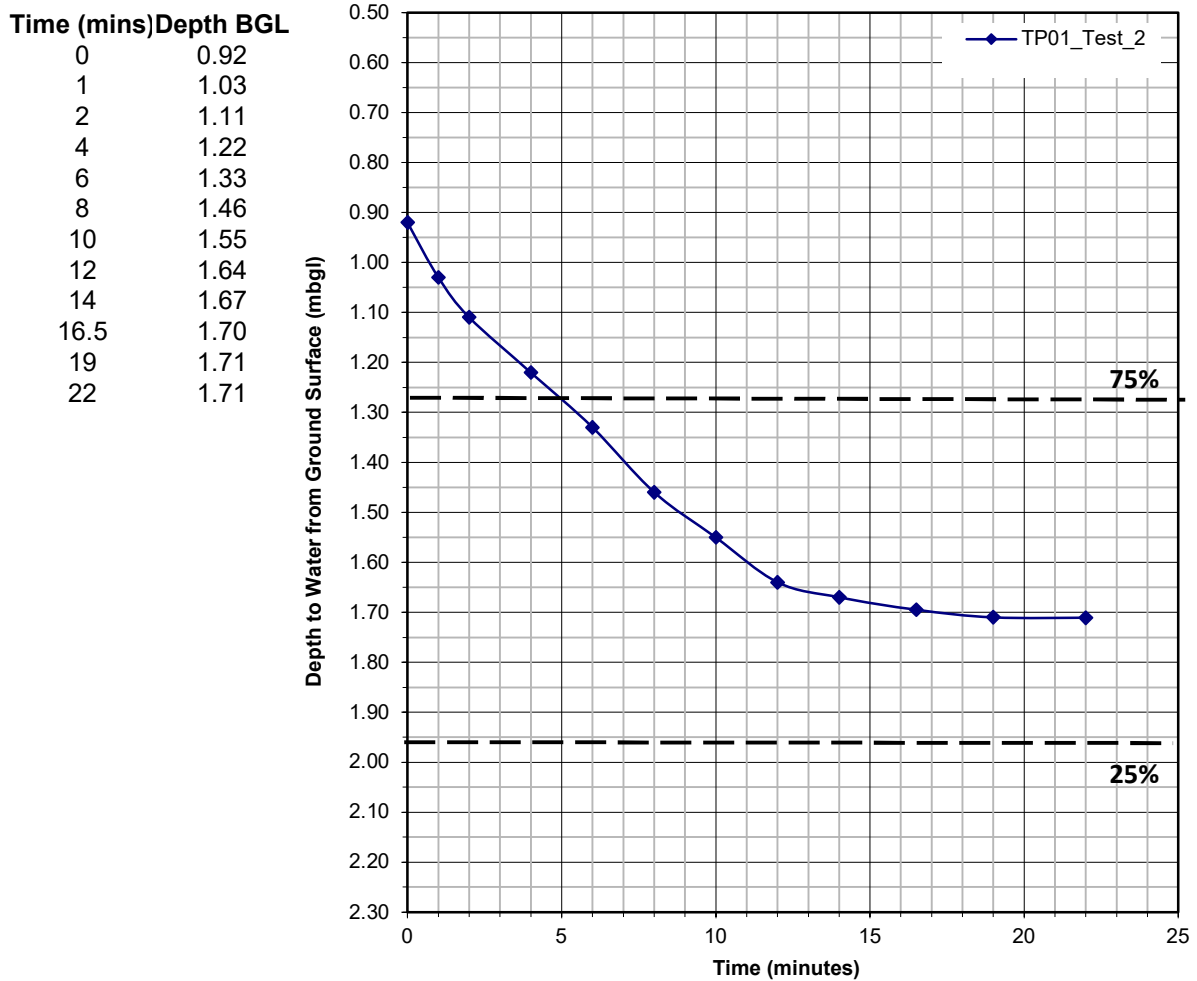
Site: , Cleggars Park, , Lamphey, Pembroke, SA71
5JY

Report No: 22.09.023
Date Tested: 18/10/2022
Test Location: TP01_Test_2
Dimensions: 0.5mWx2.1mLx2.30mD

Groundwater: unknown

Soil Description - test response zone:

0.3m to 1.7m - Brown slightly sandy Clay
1.7m to 1.8m - Fractured grey limestone
1.8m to 2.3m - Brown slightly sandy slightly gravelly clay



Water drained to the the limestone, indicating an ifiltration rate between $7.6 \times 10^{-5}m/s$ and $1.04 \times 10^{-4}m/s$

**TRIAL PIT INFILTRATION TESTING
to BRE Digest 365**

Report:
22.09.023

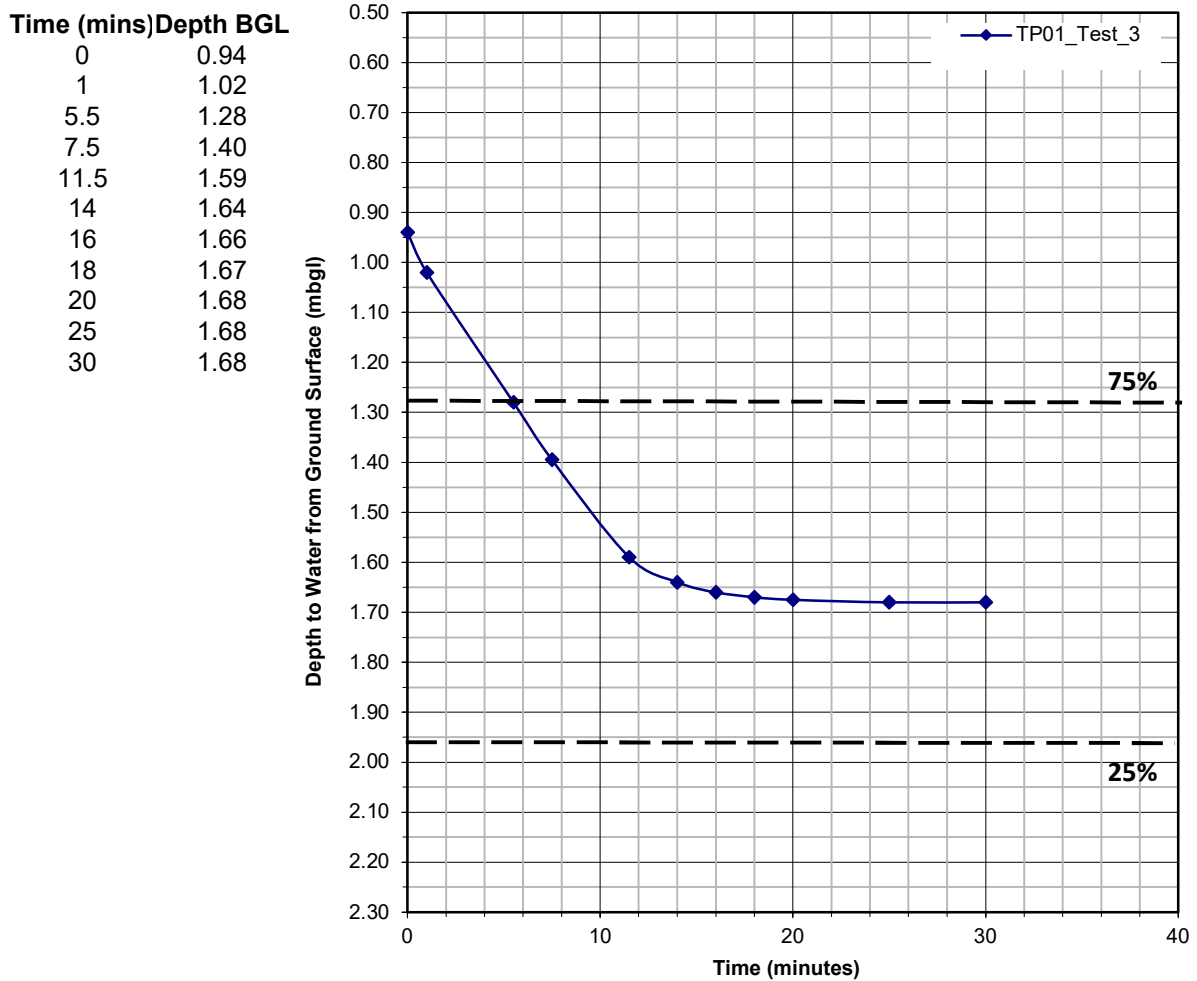
Site: , Cleggars Park, , Lamphey, Pembroke, SA71
5JY

Report No: 22.09.023
Date Tested: 18/10/2022
Test Location: TP01_Test_3
Dimensions: 0.5mWx2.1mLx2.30mD

Groundwater: unknown

Soil Description - test response zone:

0.3m to 1.7m - Brown slightly sandy Clay
1.7m to 1.8m - Fractured grey limestone
1.8m to 2.3m - Brown slightly sandy slightly gravelly clay



Water drained to the base of the limestone, indicating an infiltration rate between 4.4×10^{-6} m/s and 3.1×10^{-5} m/s

**TRIAL PIT INFILTRATION TESTING
to BRE Digest 365**

Report:
22.09.023

Site: , Cleggars Park, , Lamphey, Pembroke, SA71 5JY

Report No: 22.09.023

Date Tested: 18/10/2022

Test Location: TP02_Test_1

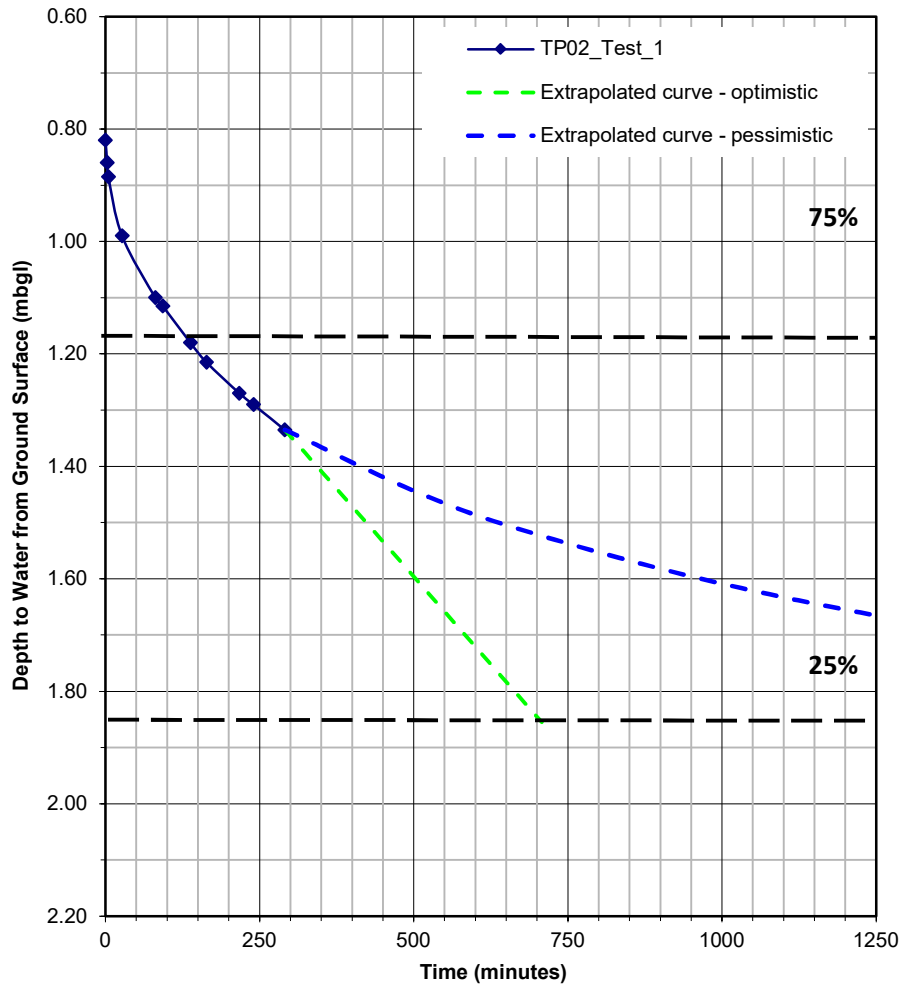
Groundwater: unknown

Dimensions: 0.5mWx2.1mLx2.20mD

Soil Description - test response zone:

0.3m to 2.0m - Slightly sandy clay
2.0m to 2.2m - Fractured limestone

Time (mins)	Depth BGL
0	0.82
3	0.86
5	0.89
27	0.99
81	1.10
93	1.12
138	1.18
164	1.22
217	1.27
240	1.29
291	1.34



Calculated Soil Infiltration Rate, $f = 1.1 \times 10^{-6}$ to 4.5×10^{-6} m/s

**TRIAL PIT INFILTRATION TESTING
to BRE Digest 365**

Report:
22.09.023

Site: , Cleggars Park, , Lamphey, Pembroke, SA71 5JY

Report No: 22.09.023

Date Tested: 18/10/2022

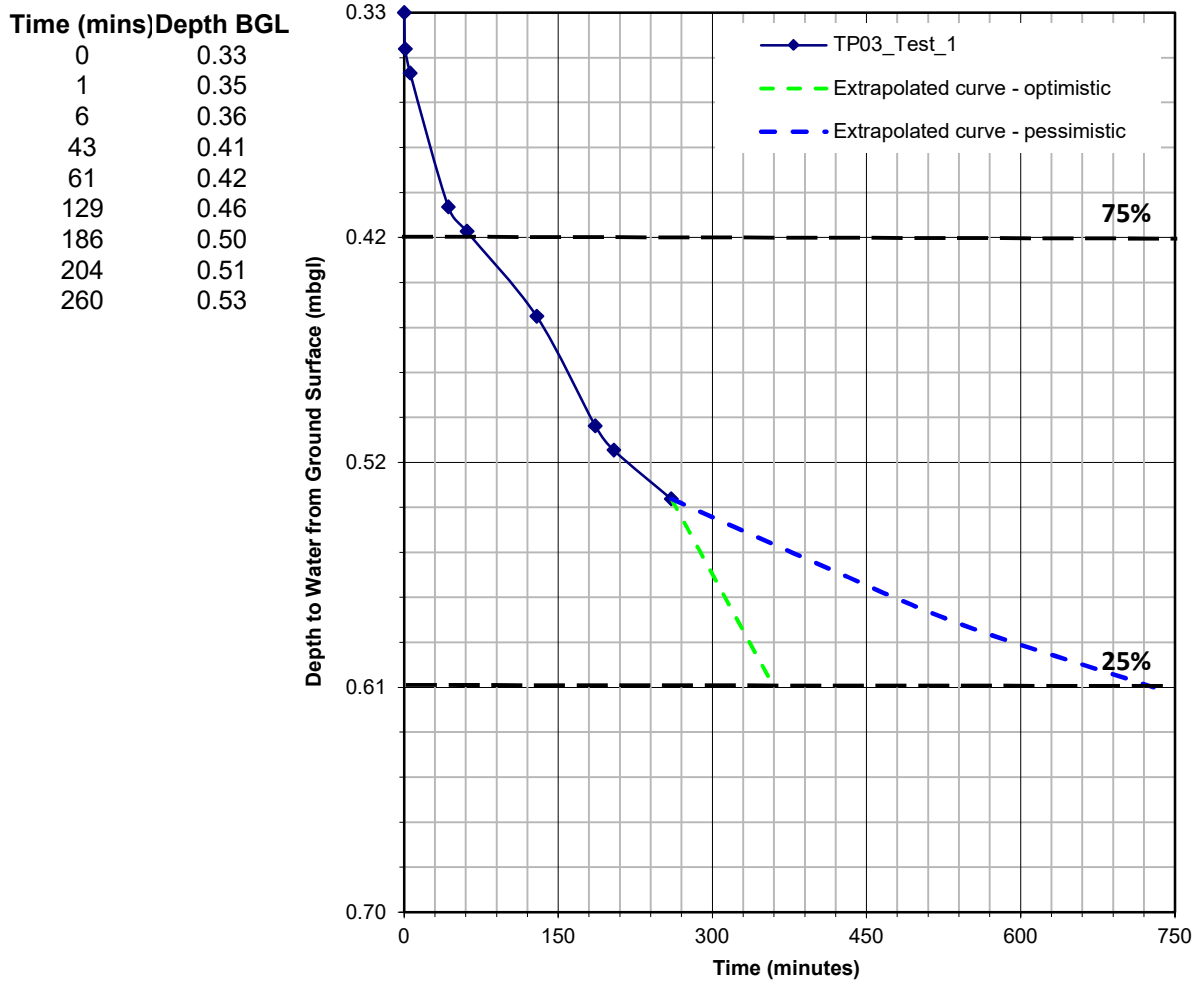
Test Location: TP03_Test_1

Groundwater: unknown

Dimensions: 0.5mWx1.8mLx0.70mD

Soil Description - test response zone:

0.3m to 0.7m - Slightly sandy clay



Calculated Soil Infiltration Rate, $f = 2.4 \times 10^{-6}$ to 5.4×10^{-6} m/s

**TRIAL PIT INFILTRATION TESTING
to BRE Digest 365**

Report:
22.09.023

Site: , Cleggars Park, , Lamphey, Pembroke, SA71 5JY

Report No: 22.09.023

Date Tested: 18/10/2022

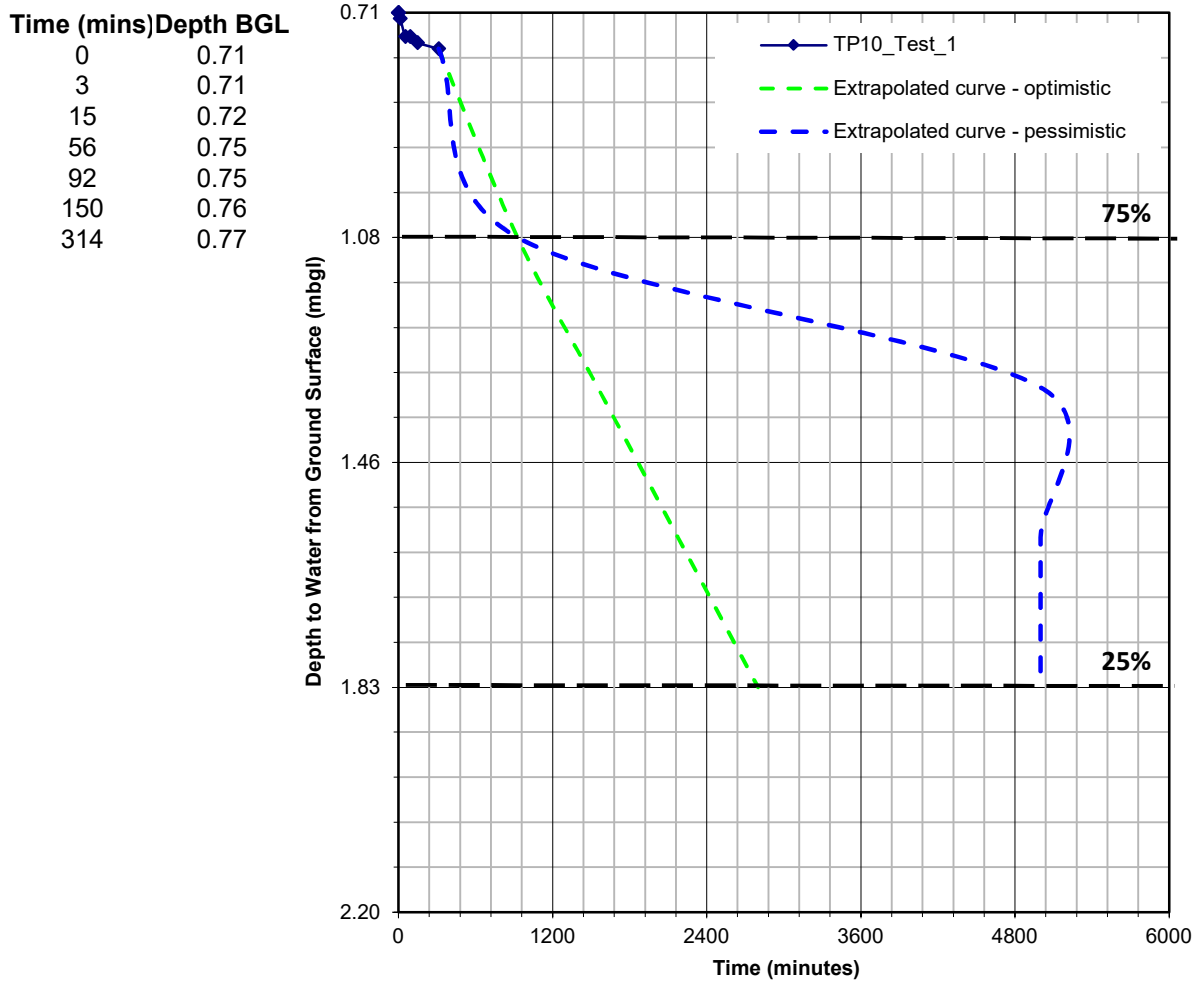
Test Location: TP10_Test_1

Groundwater: unknown

Dimensions: 0.5mWx2.2mLx2.20mD

Soil Description - test response zone:

0.3m to 2.2m - Slightly sandy clay



Calculated Soil Infiltration Rate, $f = 6.5 \times 10^{-7}$ to 1.4×10^{-6} m/s

**TRIAL PIT INFILTRATION TESTING
to BRE Digest 365**

Report:
22.09.023

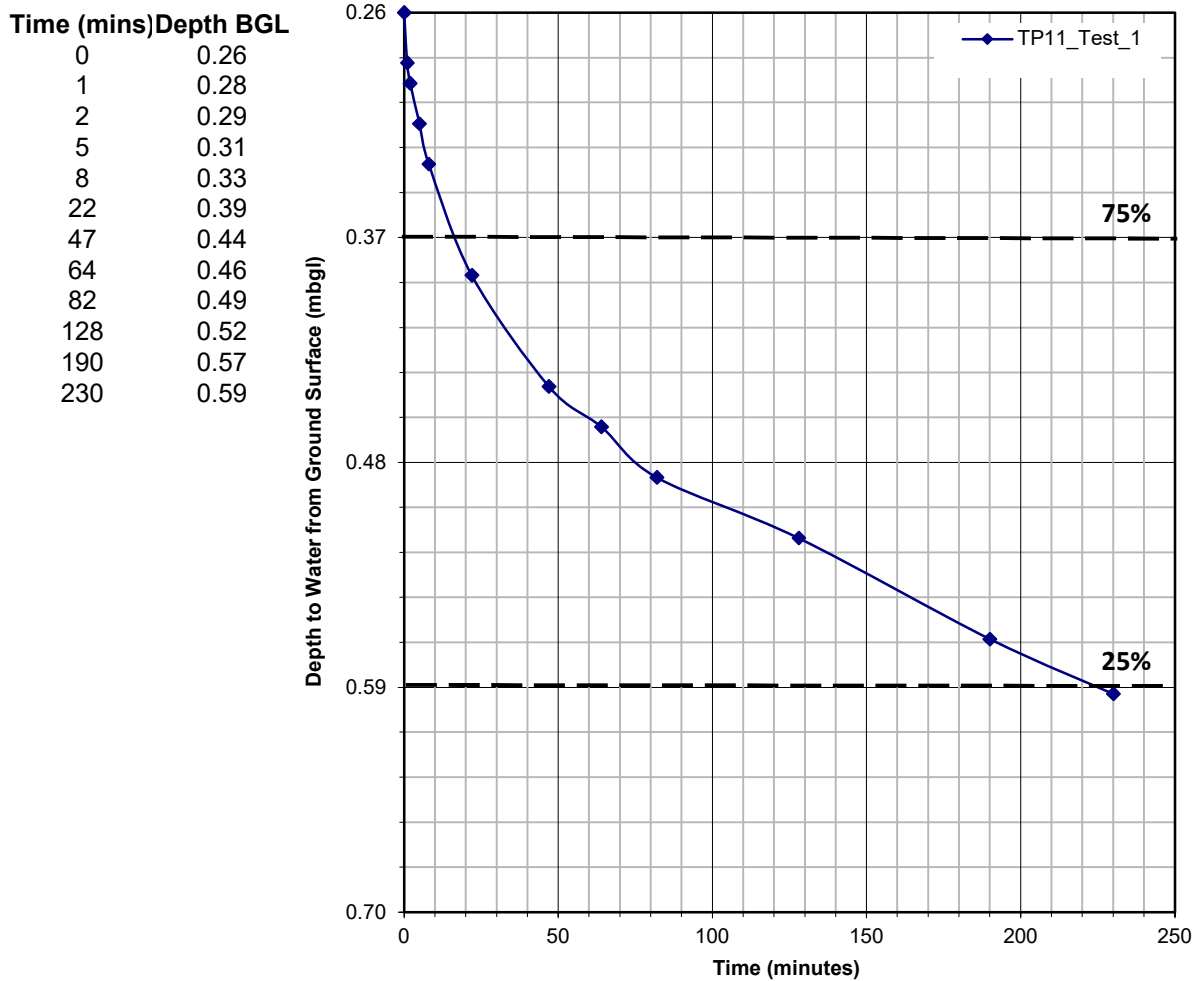
Site: , Cleggars Park, , Lamphey, Pembroke, SA71
5JY

Report No: 22.09.023
Date Tested: 18/10/2022
Test Location: TP11_Test_1
Dimensions: 0.5mWx1.8mLx0.70mD

Groundwater: unknown

Soil Description - test response zone:

0.3m to 0.7m - Slightly sandy clay



Calculated Soil Infiltration Rate, $f = 8.1 \times 10^{-6}$ m/s

**TRIAL PIT INFILTRATION TESTING
to BRE Digest 365**

Report:
22.09.023

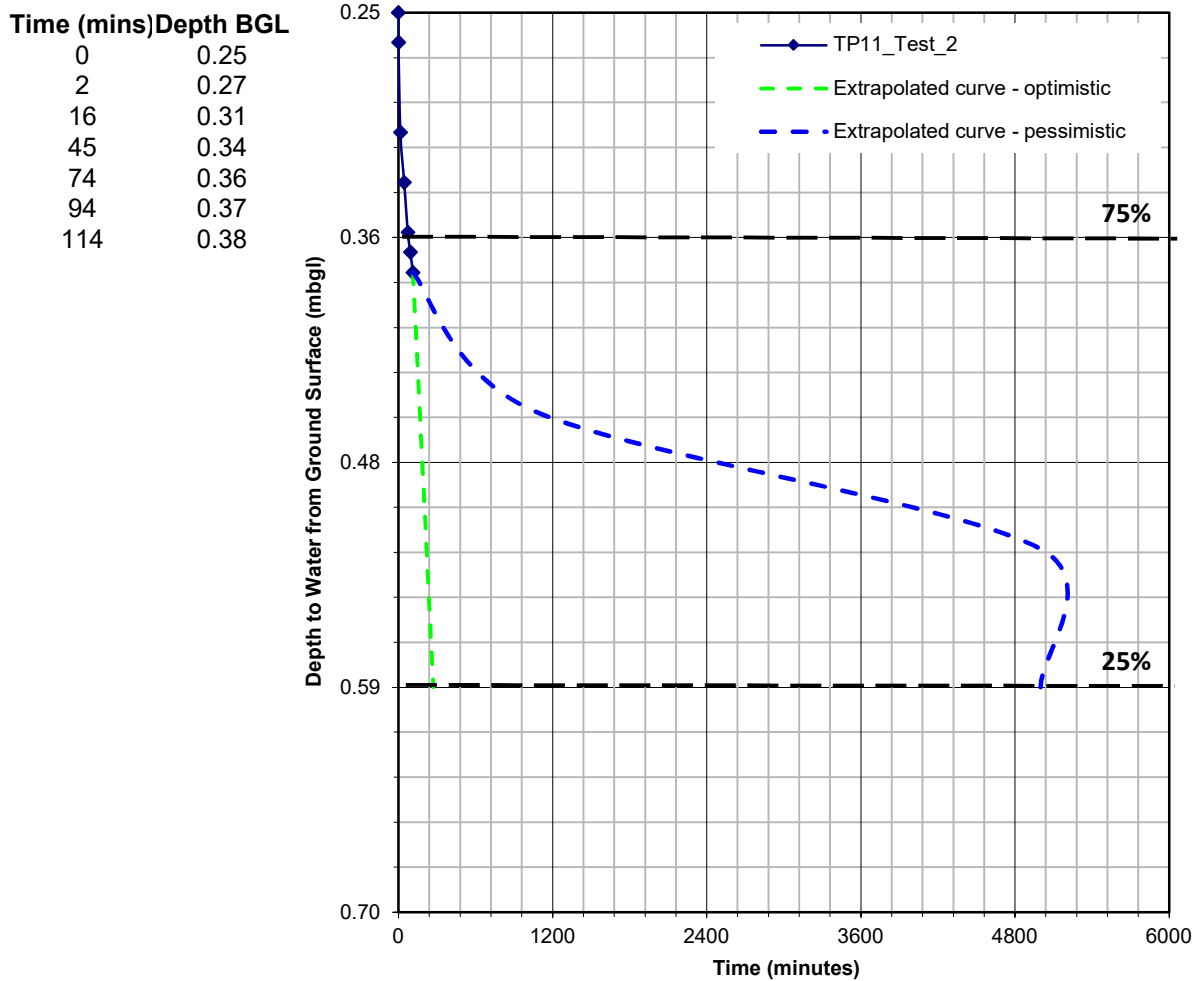
Site: , Cleggars Park, , Lamphey, Pembroke, SA71 5JY

Report No: 22.09.023
Date Tested: 18/10/2022
Test Location: TP11_Test_2
Dimensions: 0.5mWx1.8mLx0.70mD

Groundwater: unknown

Soil Description - test response zone:

0.3m to 0.7m - Slightly sandy clay



Calculated Soil Infiltration Rate, $f = 0.4 \times 10^{-6}$ to 8.9×10^{-6} m/s

**TRIAL PIT INFILTRATION TESTING
to BRE Digest 365**

Report:
22.09.023

Site: , Cleggars Park, , Lamphey, Pembroke, SA71 5JY

Report No: 22.09.023

Date Tested: 18/10/2022

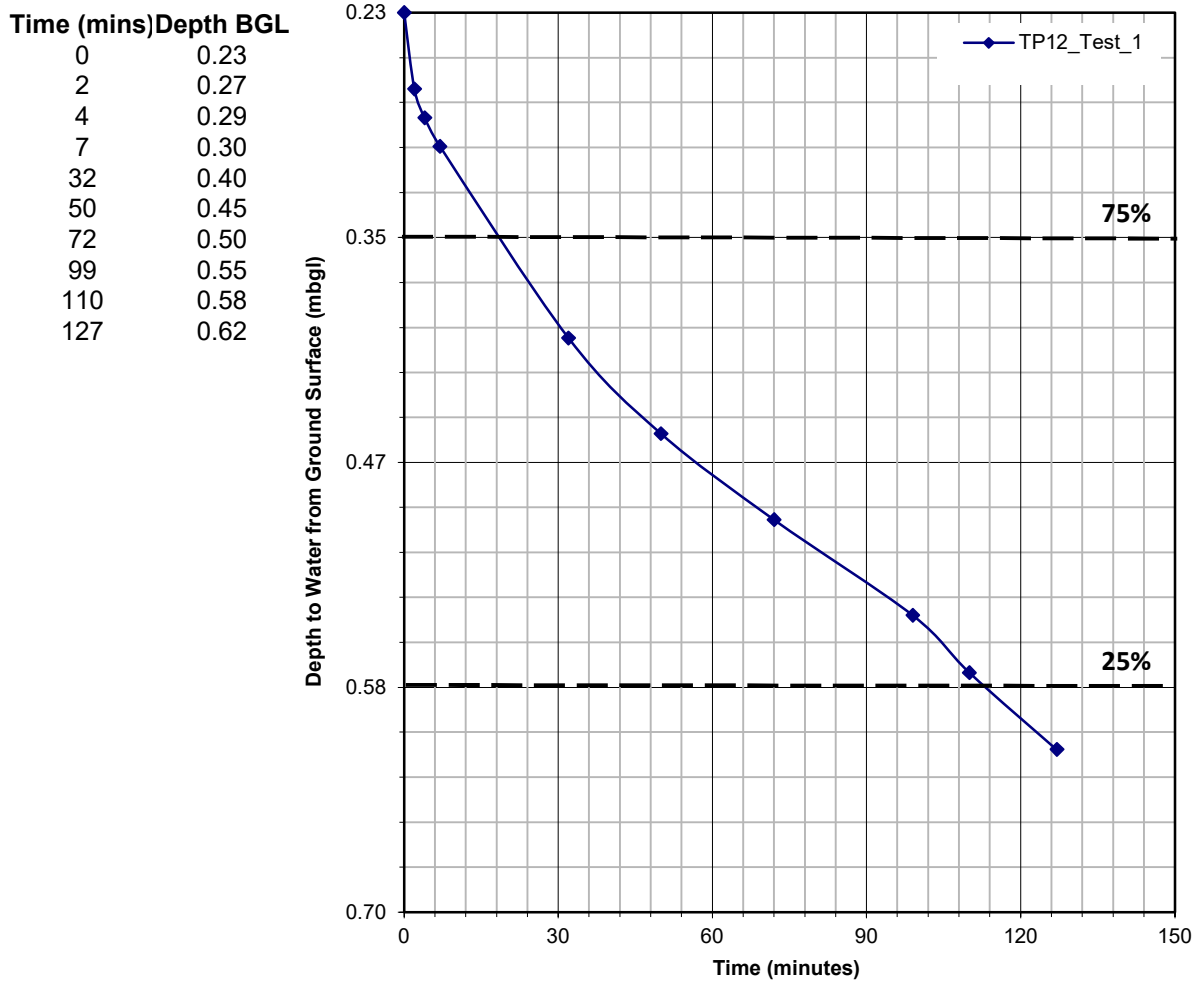
Test Location: TP12_Test_1

Groundwater: unknown

Dimensions: 0.5mWx1.8mLx0.70mD

Soil Description - test response zone:

0.3m to 0.7m - Slightly sandy clay



Calculated Soil Infiltration Rate, $f = 1.8 \times 10^{-5}$ m/s

**TRIAL PIT INFILTRATION TESTING
to BRE Digest 365**

Report:
22.09.023

Site: , Cleggars Park, , Lamphey, Pembroke, SA71 5JY

Report No: 22.09.023

Date Tested: 18/10/2022

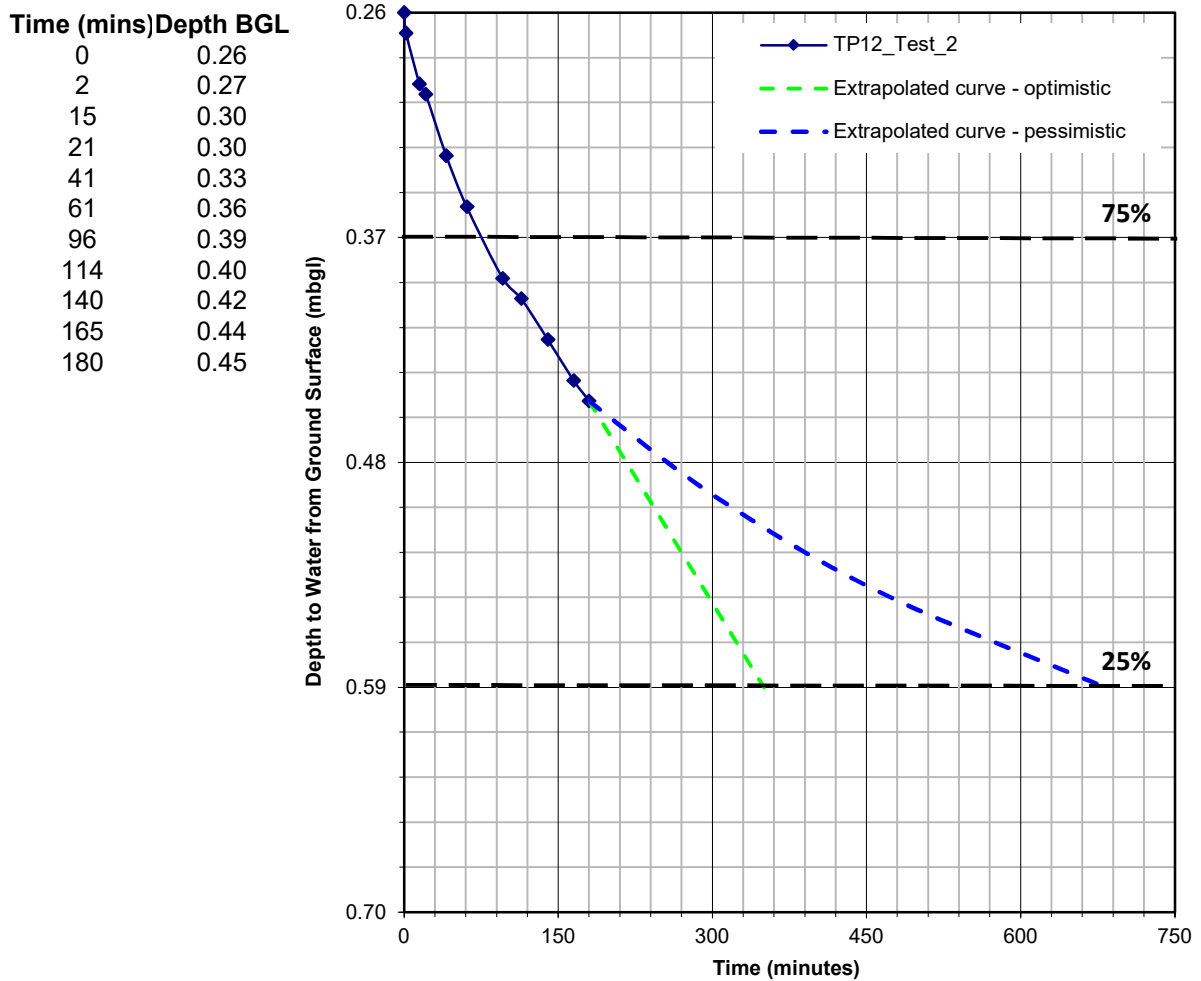
Test Location: TP12_Test_2

Groundwater: unknown

Dimensions: 0.5mWx1.8mLx0.70mD

Soil Description - test response zone:

0.3m to 0.7m - Slightly sandy clay



Calculated Soil Infiltration Rate, $f = 2.8 \times 10^{-6}$ to 6.2×10^{-6} m/s

**TRIAL PIT INFILTRATION TESTING
to BRE Digest 365**

Report:
22.09.023

Site: , Cleggars Park, , Lamphey, Pembroke, SA71 5JY

Report No: 22.09.023

Date Tested: 18/10/2022

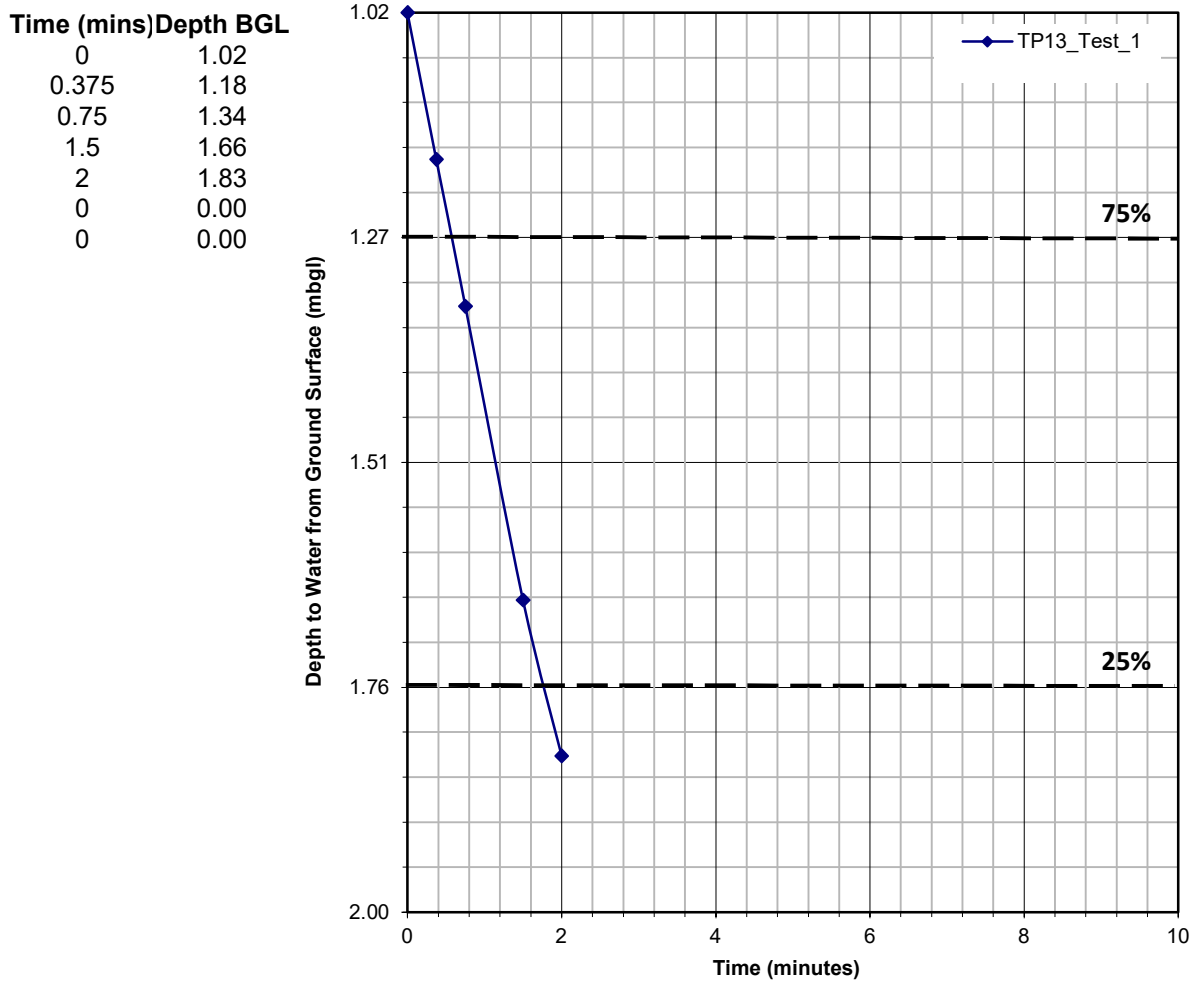
Test Location: TP13_Test_1

Groundwater: unknown

Dimensions: 0.5mWx2.0mLx2.00mD

Soil Description - test response zone:

0.3m to 2.2m - Slightly sandy clay
 2.2m to 2.3m - Fractured limestone



**TRIAL PIT INFILTRATION TESTING
 to BRE Digest 365**

Report:
 22.09.023

Site: , Cleggars Park, , Lamphey, Pembroke, SA71
5JY

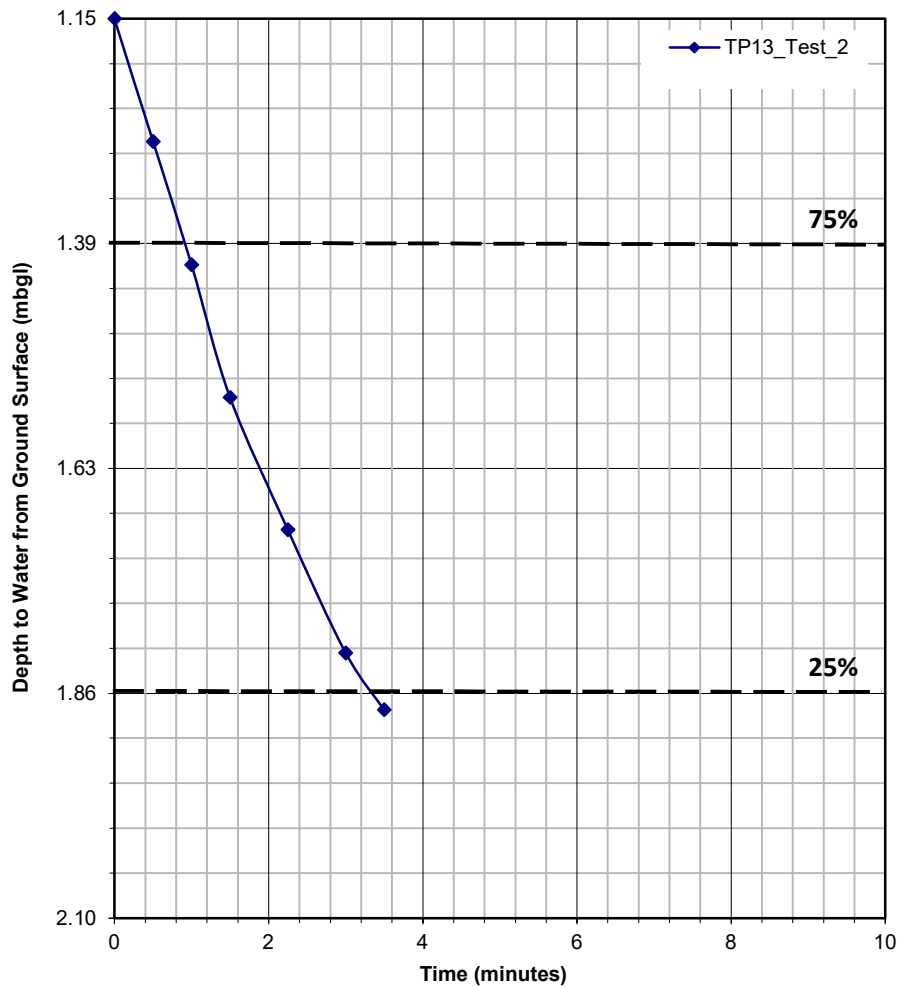
Report No: 22.09.023
Date Tested: 18/10/2022
Test Location: TP13_Test_2
Dimensions: 0.5mWx2.0mLx2.10mD

Groundwater: unknown

Soil Description - test response zone:

0.3m to 2.2m - Slightly sandy clay
2.2m to 2.3m - Fractured limestone

Time (mins)	Depth BGL
0	1.15
0.5	1.28
1	1.41
1.5	1.55
2.25	1.69
3	1.82
3.5	1.88



Calculated Soil Infiltration Rate, $f = 1.0 \times 10^{-3}$ m/s

**TRIAL PIT INFILTRATION TESTING
to BRE Digest 365**

Report:
22.09.023

Site: , Cleggars Park, , Lamphey, Pembroke, SA71 5JY

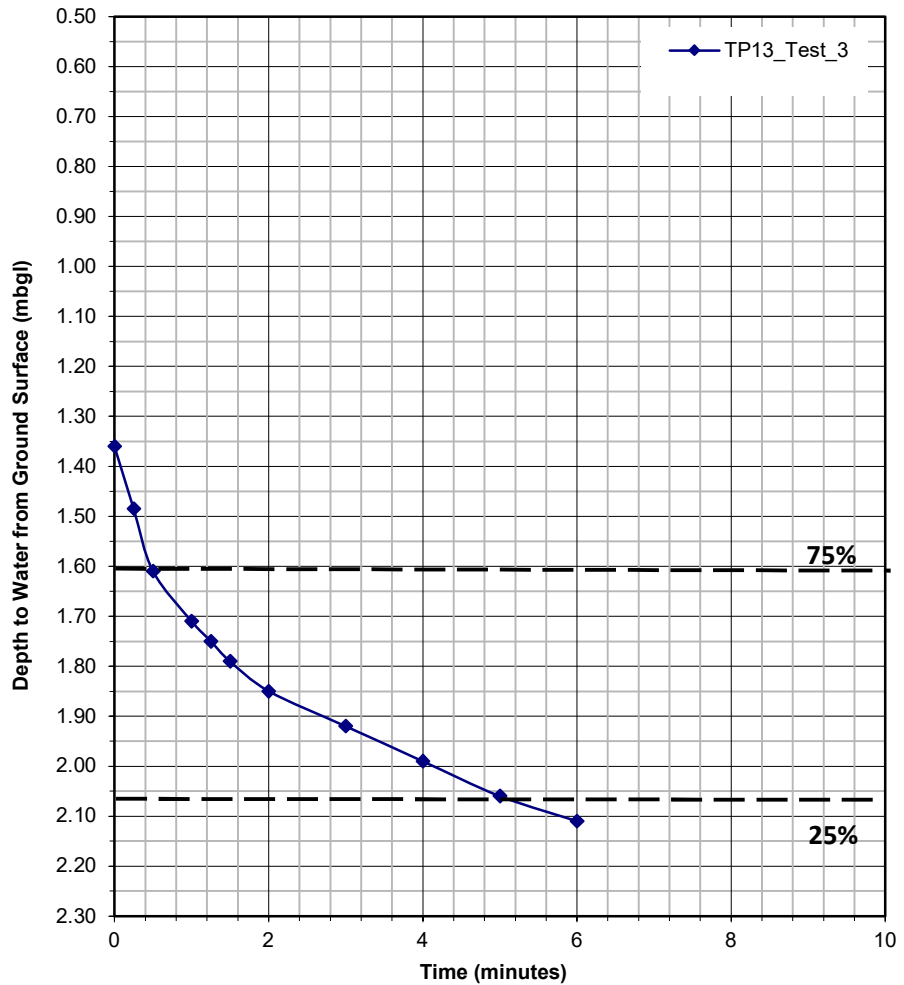
Report No: 22.09.023
Date Tested: 18/10/2022
Test Location: TP13_Test_3
Dimensions: 0.5mWx2.0mLx2.30mD

Groundwater: unknown

Soil Description - test response zone:

0.3m to 2.2m - Slightly sandy clay
 2.2m to 2.3m - Fractured limestone

Time (mins)	Depth BGL
0	1.36
0.25	1.49
0.5	1.61
1	1.71
1.25	1.75
1.5	1.79
2	1.85
3	1.92
4	1.99
5	2.06
6	2.11



Calculated Soil Infiltration Rate, $f = 5.1 \times 10^{-4}$ m/s

**TRIAL PIT INFILTRATION TESTING
 to BRE Digest 365**

Report:
 22.09.023

Project: Cleggars Park, Lamphey, Pembrokeshire, SA71 5JY

Date: 02/12/2022	Ambient air temperature (°C): 5
Time: 14:00	Barometric pressure (mB): 1023
Recorded by: BS	Barometric trend: Stable
Equipment: Geotech GA5000 gas monitor and dip-meter	Weather conditions: Sunny

Groundwater monitoring

Hole ID	Ground level (mAOD)	Water depth (m)	Water level (mAOD)	Depth of pipe base (m)	Remarks
CT01		Dry		3.00	
CT02		Dry		2.20	

Gas monitoring

Hole ID	Methane CH ₄ (%v/v)	Carbon Dioxide CO ₂ (%v/v)	Oxygen O ₂ (%v/v)	Flow Rate (l/h)	Well Pressure (mBar)	PID* (ppm)	Remarks
CT01	<0.1	1.7	17.2	0.0	0.20		
CT02	<0.1	0.9	17.8	0.0	0.03		

SUMMARY OF GAS & GROUNDWATER MONITORING - 02.Dec.22

Report No.
22.09.023



APPENDIX C

LABORATORY TEST REPORTS


GroundTech Laboratories

Geotechnical Testing Facility

Slapton Hill Barn, Blakesley Road, Slapton, Towcester, Northants. NN12 8QD

Telephone:- 01327 860947/860060

Email: lab@listersgeotechnics.co.uk

PROJECT INFORMATION	SAMPLE INFORMATION																																																						
<p>Site Location:- Cleggars Park Lamphey Pembroke SA71 N5JY</p> <p>Client Reference:-</p> <p>Date Samples Received:- 24th October 2022 Date Testing Completed:- 5th November 2022</p> <p>The results relate only to the samples tested</p>	<p>Laboratory Tests Undertaken:-</p> <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:40%;">TEST TYPE</th> <th style="width:40%;">TEST METHOD</th> <th style="width:20%;">TESTED</th> </tr> </thead> <tbody> <tr> <td>Natural Moisture Contents (MC%)</td> <td>(BS 1377:Part 2:1990 Clause 3.2)</td> <td style="text-align:center;">✓</td> </tr> <tr> <td>Liquid Limits (%)</td> <td>(BS 1377:Part 2:1990 Clause 4.3)</td> <td style="text-align:center;">✓</td> </tr> <tr> <td>Plastic Limits (%)</td> <td>(BS 1377:Part 2:1990 Clause 5.3)</td> <td style="text-align:center;">✓</td> </tr> <tr> <td>Plasticity Index (%)</td> <td>(BS 1377:Part 2:1990 Clause 5.4)</td> <td style="text-align:center;">✓</td> </tr> <tr> <td>Linear Shrinkage (%)</td> <td>(BS 1377:Part 2:1990 Clause 6.5)</td> <td></td> </tr> <tr> <td>PSD - Wet Sieving</td> <td>(BS 1377:Part 2:1990 Clause 9.2)</td> <td style="text-align:center;">✓</td> </tr> <tr> <td>Engineering Sample Descriptions</td> <td>(BS 5930 : Section 6)</td> <td style="text-align:center;">✓</td> </tr> <tr> <td>Passing 425/63 (µm)</td> <td>-</td> <td style="text-align:center;">✓</td> </tr> <tr> <td>Hydrometer</td> <td>(BS 1377:Part 2:1990 Clause 9.5)</td> <td></td> </tr> <tr> <td>Loss on Ignition (%)</td> <td>-</td> <td></td> </tr> <tr> <td>Soil Suctions (kPa)</td> <td>BRE Digest IP 4/93, 1993</td> <td></td> </tr> <tr> <td>Bulk Density (Mg/m³)</td> <td>(BS 1377:Part 2:1990 Clause 7.2)</td> <td></td> </tr> <tr> <td>Strength Tests</td> <td>(BS 1377:Part 7:1990 Clause 8 & 9)</td> <td></td> </tr> <tr> <td>Soluble Sulphate Content (SO₄g/l)</td> <td>(BS 1377:Part 3:1990 Clause 5.3)</td> <td style="text-align:center;">✓</td> </tr> <tr> <td>pH value</td> <td>(BS 1377:Part 3:1990 Clause 9.4)</td> <td style="text-align:center;">✓</td> </tr> <tr> <td>California Bearing Ratios (CBR)</td> <td>(BS 1377:Part 4:1990 Clause 7)</td> <td></td> </tr> <tr> <td>Compaction Tests</td> <td>(BS 1377:Part 4:1990 Clauses 3.0-3.6)</td> <td></td> </tr> </tbody> </table>	TEST TYPE	TEST METHOD	TESTED	Natural Moisture Contents (MC%)	(BS 1377:Part 2:1990 Clause 3.2)	✓	Liquid Limits (%)	(BS 1377:Part 2:1990 Clause 4.3)	✓	Plastic Limits (%)	(BS 1377:Part 2:1990 Clause 5.3)	✓	Plasticity Index (%)	(BS 1377:Part 2:1990 Clause 5.4)	✓	Linear Shrinkage (%)	(BS 1377:Part 2:1990 Clause 6.5)		PSD - Wet Sieving	(BS 1377:Part 2:1990 Clause 9.2)	✓	Engineering Sample Descriptions	(BS 5930 : Section 6)	✓	Passing 425/63 (µm)	-	✓	Hydrometer	(BS 1377:Part 2:1990 Clause 9.5)		Loss on Ignition (%)	-		Soil Suctions (kPa)	BRE Digest IP 4/93, 1993		Bulk Density (Mg/m ³)	(BS 1377:Part 2:1990 Clause 7.2)		Strength Tests	(BS 1377:Part 7:1990 Clause 8 & 9)		Soluble Sulphate Content (SO ₄ g/l)	(BS 1377:Part 3:1990 Clause 5.3)	✓	pH value	(BS 1377:Part 3:1990 Clause 9.4)	✓	California Bearing Ratios (CBR)	(BS 1377:Part 4:1990 Clause 7)		Compaction Tests	(BS 1377:Part 4:1990 Clauses 3.0-3.6)	
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pH value	(BS 1377:Part 3:1990 Clause 9.4)	✓																																																					
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Compaction Tests	(BS 1377:Part 4:1990 Clauses 3.0-3.6)																																																						
This test-report may not be reproduced, except with full and written approval of GROUNDTECH LABORATORIES	Laboratory testing in accord with BS EN ISO/IEC 17025-2000 and Quality Management in accord with ISO 9001																																																						
Signed on behalf of GroundTech Laboratories:- 	Technical Signatory																																																						
Quality Assured to ISO 9001																																																							
GEOTECHNICAL LABORATORY TEST RESULTS	Report No: 22.09.023																																																						

GroundTech Laboratories

Geotechnical Testing Facility

Slapton Hill Barn, Blakesley Road, Slapton, Towcester, Northants. NN12 8QD

Telephone: 01327 860947/860060

Fax: 01327 860430

Email: groundtech@listersgeotechnics.co.uk

**Quality Assured
to ISO 9001**

SAMPLES				CLASSIFICATION TESTS						CLASSIFICATION TESTS						STRENGTH TESTS					CHEMICAL TESTS			
Test Location	Sample Type	Sample Depth -m	Test Type	WC %	LL %	PL %	PI %	Passing 425 µm %	Modified PI %	Class	Passing 63 µm %	WC/LL	PL+ 2%	Liquidity Index	Loss on Ignition %	Soil Suction kPa	Bulk Density Mg/m ³	Test Type	Cell Pressure kN/m ²	Deviator Stress kN/m ²	Apparent Cohesion kN/m ²	φ	pH Value	Soluble Sulphate Content SO ₄ g/l
CT 01	D	0.10		31																				
	D	0.45		13																				
	D	1.00	PI/63	15	27	16	11	61	7	CL	37	0.56	18	-0.09									7.0	0.12
	D	1.50	PI/63	12	28	18	10	81	8	CL	56	0.43	20	-0.60										
	D	3.50	PI/63	21	38	21	17	68	11	CI	52	0.55	23	0.00										
CT 02	D	5.00		23																				
	D	0.10		20																				
	D	0.40	PI/63	15	37	22	15	60	9	CI	44	0.41	24	-0.47										
	D	1.00		13																				
CT 03	D	1.50	PI/63	30	32	19	13	81	10	CL	67	0.94	21	0.85									6.9	0.10
	D	2.00		23																				
	D	0.10		24																				
	D	0.40		10																			6.4	0.12
TP 01	D	1.00	PI/63	11	23	16	7	71	5	ML	48	0.48	18	-0.71										
	D	1.50	PI/63	12	28	16	12	68	8	CL	48	0.43	18	-0.33										
	D	3.00	PSD	20																				
	D	5.00	PI/63	32	38	21	17	95	16	CI	85	0.84	23	0.65										
TP 02	D	0.70		21																				
	D	1.30	PI/63	15	31	18	13	74	10	CL	58	0.48	20	-0.23									6.8	0.10
TP 03	D	2.00		21																				
	D	1.80	PI/63	17	40	21	19	94	18	CI	79	0.43	23	-0.21										
				24																			5.8	0.17

Symbols:

U Undisturbed Sample	R Remoulded	PI Plasticity Index	T Triaxial Undrained	L 100mm specimen
D Disturbed Sample	63 Passing 63µm	F Filter Paper Suction Tests	M Multistage Triaxial	S 38mm specimen
B Bulk Sample	H Hydrometer	CC Continuous Core	HP Hand Penetrometer	
W Water Sample	PSD Wet Sieving		V Vane Test	

LABORATORY TEST RESULTS

Project Reference
22.09.023

GroundTech Laboratories

Geotechnical Testing Facility

Slapton Hill Barn, Blakesley Road, Slapton, Towcester, Northants. NN12 8QD

Telephone: 01327 860947/860060

Fax: 01327 860430

Email: groundtech@listersgeotechnics.co.uk

**Quality Assured
to ISO 9001**

SAMPLES				CLASSIFICATION TESTS							CLASSIFICATION TESTS							STRENGTH TESTS					CHEMICAL TESTS		
Test Location	Sample Type	Sample Depth -m	Test Type	WC %	LL %	PL %	PI %	Passing 425 µm %	Modified PI %	Class	Passing 63 µm %	WC/LL	PL+ 2%	Liquidity Index	Loss on Ignition %	Soil Suction kPa	Bulk Density Mg/m ³	Test Type	Cell Pressure kN/m ²	Deviator Stress kN/m ²	Apparent Cohesion kN/m ²	φ	pH Value	Soluble Sulphate Content SO ₄ g/l	
TP 04	D	1.40	PI/63	22	29	17	12	69	8	CL	54	0.76	19	0.42											
	D	2.00	PSD	15																					
	D	2.50	PI/63	12	35	21	14	79	11	CL	64	0.34	23	-0.64											
TP 05	D	0.50		16																			6.2	0.10	
	D	0.80		18																					
TP 06	D	1.50	PI/63	14	32	18	14	86	12	CL	57	0.44	20	-0.29											
	D	2.10		15																					
	D	2.90	PI/63	9.7	41	20	21	87	18	CI	55	0.24	22	-0.49											
TP 07	D	1.50		25																					
	D	2.20	PI/63	14	38	21	17	83	14	CI	64	0.37	23	-0.41										6.6	0.10
TP 08	D	1.20	PSD	19																					
	D	2.50	PI/63	12	26	18	8	61	5	CL	43	0.46	20	-0.75											
TP 09	D	1.90	PI/63	16	25	17	8	83	7	CL	58	0.64	19	-0.13										5.9	0.13
	D	2.70		15																					
TP 10	D	1.50	PI/63	21	28	18	10	72	7	CL	54	0.75	20	0.30											
TP 12	D	0.60	PI/63	14	30	20	10	89	9	CL	78	0.47	22	-0.60											
TP 13	D	1.50	PI/63	15	28	17	11	69	8	CL	58	0.54	19	-0.18										6.7	0.36

Symbols:	U	Undisturbed Sample	R	Remoulded	PI	Plasticity Index	T	Triaxial Undrained	L	100mm specimen
	D	Disturbed Sample	63	Passing 63µm	F	Filter Paper Suction Tests	M	Multistage Triaxial	S	38mm specimen
	B	Bulk Sample	H	Hydrometer	CC	Continuous Core	HP	Hand Penetrometer		
	W	Water Sample	PSD	Wet Sieving			V	Vane Test		

LABORATORY TEST RESULTS	Project Reference 22.09.023
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GroundTech Laboratories

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Telephone: 01327 860947/860060

Fax: 01327 860430

Email: groundtech@listersgeotechnics.co.uk

**Quality
Assured
ISO 9001**

Test Method: BS 1377 : Part 2 : 1990 : 9.2

Site: Cleggars Park, Lamphey, Pembroke, SA71 5JY

Test Location: CT 03

Sample Depth: 3.00m -4.10m

Sample Description:

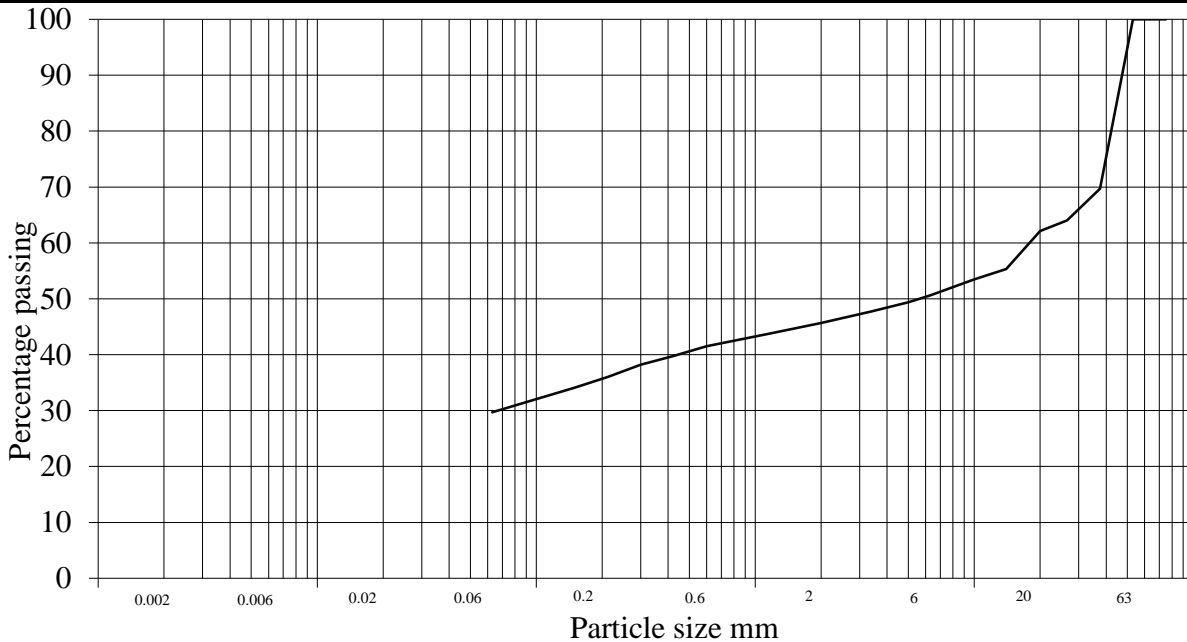
Hydrometer No.:

SG Gs:

Water Visc. (N):

Dry Mass of Soil after pretreatment (g):

BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
75mm	100.00		
63mm	100.00		
50mm	100.00		
37.5mm	69.70		
26.5mm	64.00		
20mm	62.10		
14mm	55.30		
10mm	53.50		
6.3mm	50.60		
5mm	49.40		
3.5mm	47.70		
2mm	45.70		
1.18mm	43.80		
600µm	41.50		
425µm	39.80		
300µm	38.20		
212µm	36.00		
150µm	34.10		
63µm	29.70		



CLAY	SILT			SAND			GRAVEL			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	30%			16%			54%			0%

PARTICLE SIZE DISTRIBUTION

Project Reference
22.09.023

GroundTech Laboratories

Geotechnical Testing Facility

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Fax: 01327 860430

Email: groundtech@listersgeotechnics.co.uk

**Quality
Assured
ISO 9001**

Test Method: BS 1377 : Part 2 : 1990 : 9.2

Site: Cleggars Park, Lamphey, Pembroke, SA71 5JY

Test Location: TP 04

Sample Depth: 2.00m

Sample Description:

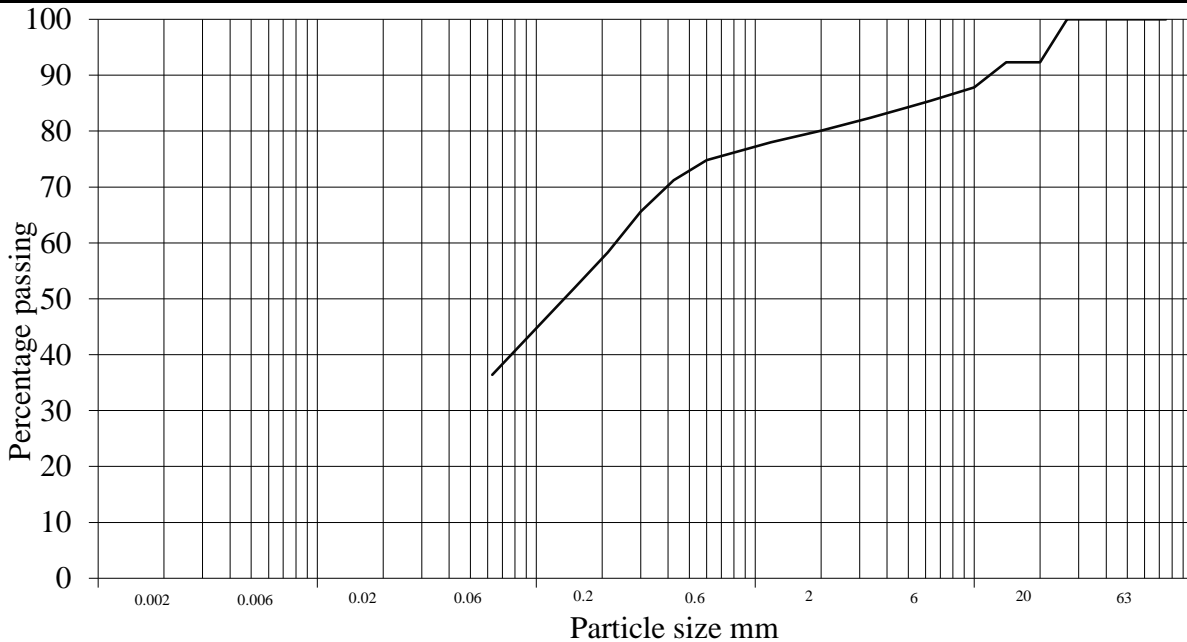
Hydrometer No.:

SG Gs:

Water Visc. (N):

Dry Mass of Soil after pretreatment (g):

BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
75mm	100.00		
63mm	100.00		
50mm	100.00		
37.5mm	100.00		
26.5mm	100.00		
20mm	92.30		
14mm	92.30		
10mm	87.80		
6.3mm	85.40		
5mm	84.30		
3.5mm	82.40		
2mm	80.10		
1.18mm	78.00		
600µm	74.80		
425µm	71.20		
300µm	65.60		
212µm	58.30		
150µm	52.00		
63µm	36.40		



CLAY	SILT			SAND			GRAVEL			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	36%			44%			20%			0%

PARTICLE SIZE DISTRIBUTION

Project Reference
22.09.023

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**Quality
Assured
ISO 9001**

Test Method: BS 1377 : Part 2 : 1990 : 9.2

Site: Cleggars Park, Lamphey, Pembroke, SA71 5JY

Test Location: TP 08

Sample Depth: 1.20m

Sample Description:

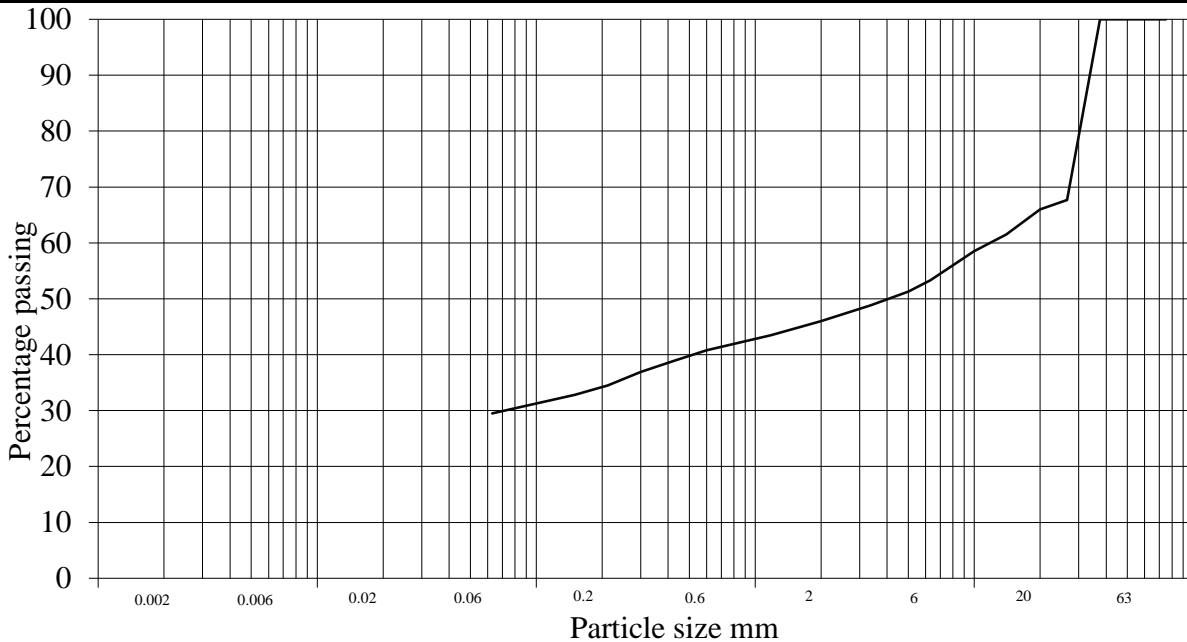
Hydrometer No.:

SG Gs:

Water Visc. (N):

Dry Mass of Soil after pretreatment (g):

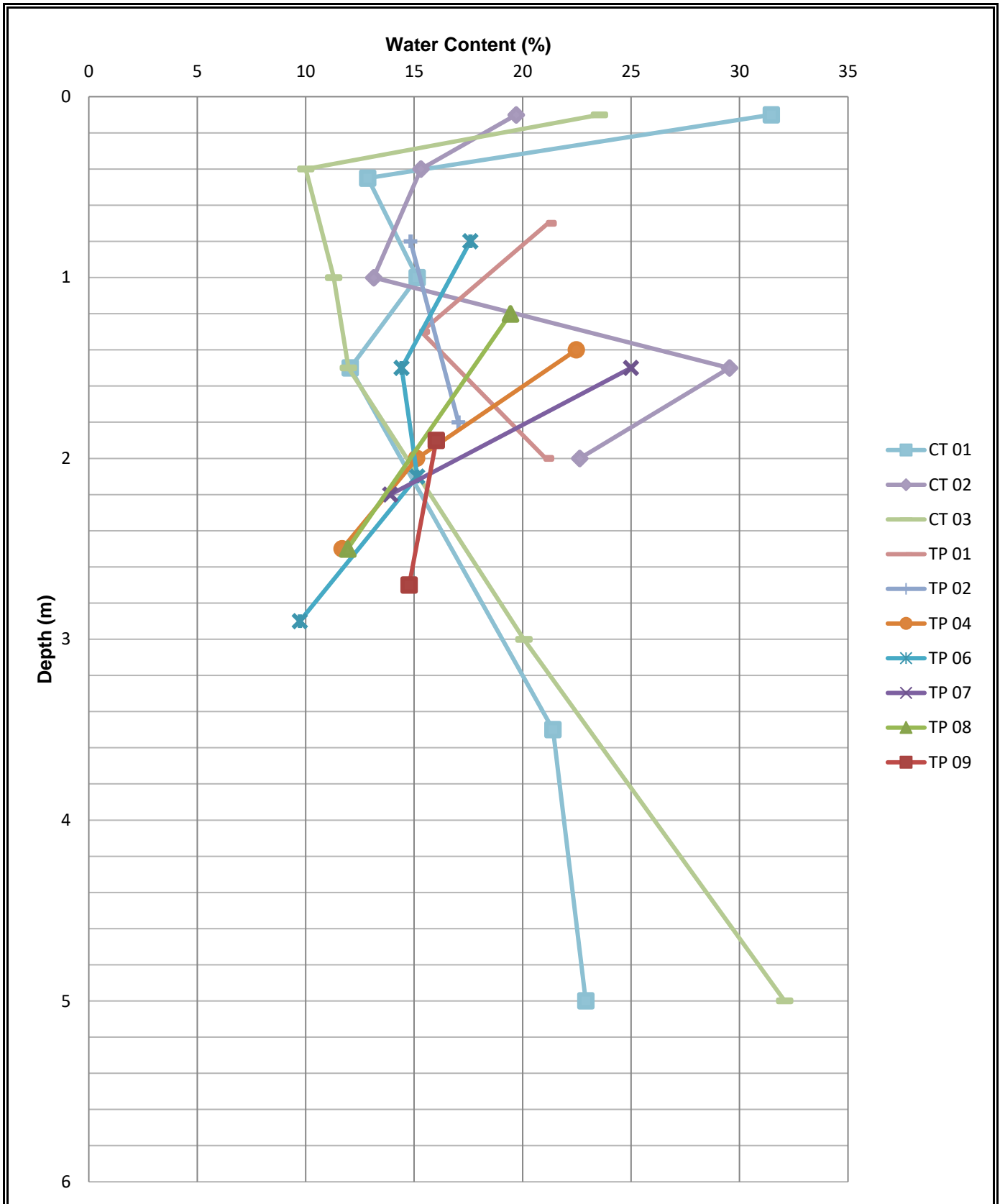
BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
75mm	100.00		
63mm	100.00		
50mm	100.00		
37.5mm	100.00		
26.5mm	67.70		
20mm	66.00		
14mm	61.50		
10mm	58.50		
6.3mm	53.30		
5mm	51.30		
3.5mm	48.80		
2mm	46.00		
1.18mm	43.50		
600µm	40.80		
425µm	38.90		
300µm	36.90		
212µm	34.50		
150µm	32.80		
63µm	29.50		



CLAY	SILT			SAND			GRAVEL			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	30%			17%			54%			0%

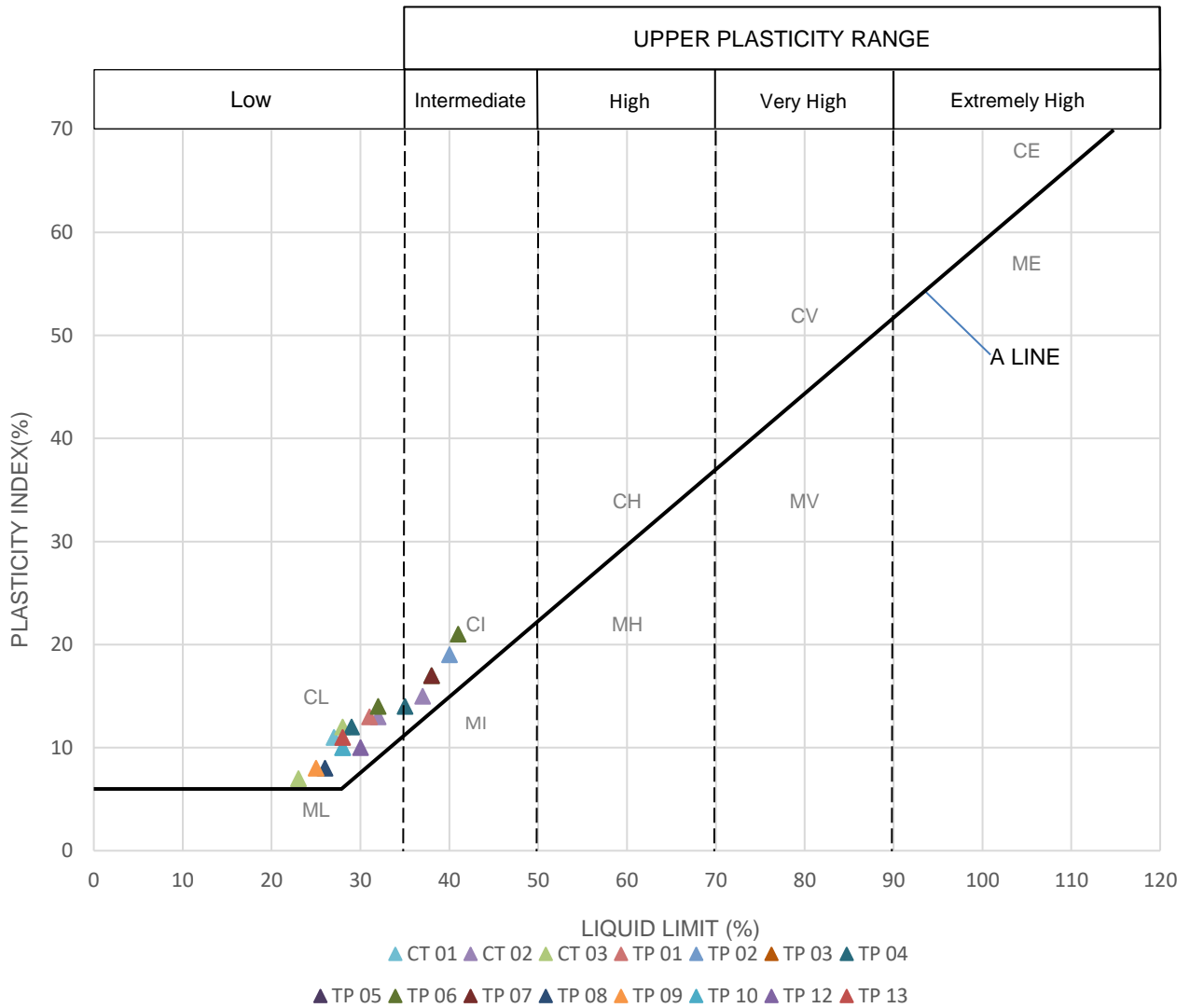
PARTICLE SIZE DISTRIBUTION

Project Reference
22.09.023



WATER CONTENT v DEPTH

Report:
22.09.023



PLASTICITY CHART

Report:
22.09.023



Final Report

Report No.: 22-40980-1
Initial Date of Issue: 01-Nov-2022
Client: Listers Geotechnical Consultants
Client Address: Slapton Hill Barn, Blakesley Road
Slapton
Towcester
Northamptonshire
NN12 8QD
Contact(s): Lee Chippington
Project: 22.09.023 Lamphey
Quotation No.: Q18-12046 **Date Received:** 26-Oct-2022
Order No.: 22.09.023/727 **Date Instructed:** 26-Oct-2022
No. of Samples: 5
Turnaround (Wkdays): 5 **Results Due:** 01-Nov-2022
Date Approved: 01-Nov-2022

Approved By:

Details: Stuart Henderson, Technical
Manager

Results - Leachate

Project: 22.09.023 Lamphey

Client: Listers Geotechnical Consultants	Chemtest Job No.:		22-40980	22-40980			
Quotation No.: Q18-12046	Chemtest Sample ID.:		1532481	1532483			
	Sample Location:		TP04	TP09			
	Sample Type:		SOIL	SOIL			
	Top Depth (m):		0.8	0.8			
	Date Sampled:		18-Oct-2022	18-Oct-2022			
Determinand	Accred.	SOP	Type	Units	LOD		
Arsenic (Dissolved)	U	1455	2:1	µg/l	0.20	0.32	0.47
Boron (Dissolved)	U	1455	2:1	µg/l	10.0	17	12
Cadmium (Dissolved)	U	1455	2:1	µg/l	0.11	< 0.11	< 0.11
Chromium (Dissolved)	U	1455	2:1	µg/l	0.50	< 0.50	< 0.50
Copper (Dissolved)	U	1455	2:1	µg/l	0.50	< 0.50	< 0.50
Nickel (Dissolved)	U	1455	2:1	µg/l	0.50	< 0.50	0.64
Lead (Dissolved)	U	1455	2:1	µg/l	0.50	< 0.50	< 0.50
Selenium (Dissolved)	U	1455	2:1	µg/l	0.50	0.54	0.55
Zinc (Dissolved)	U	1455	2:1	µg/l	2.5	5.8	3.3
Mercury Low Level	U	1460	2:1	µg/l	0.010	< 0.010	< 0.010

Results - Soil

Project: 22.09.023 Lamphey

Client: Listers Geotechnical Consultants		Chemtest Job No.:		22-40980	22-40980	22-40980	22-40980	22-40980
Quotation No.: Q18-12046		Chemtest Sample ID.:		1532479	1532480	1532481	1532482	1532483
		Sample Location:		TP02	TP03	TP04	TP07	TP09
		Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):		0.2	0.2	0.8	0.8	0.8
		Date Sampled:		18-Oct-2022	18-Oct-2022	18-Oct-2022	18-Oct-2022	18-Oct-2022
		Asbestos Lab:		DURHAM	DURHAM			
Determinand	Accred.	SOP	Units	LOD				
ACM Type	U	2192		N/A	-	-		
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected		
Moisture	N	2030	%	0.020	22	17	11	9.7
Chromatogram (TPH)	N			N/A	See Attached	See Attached	See Attached	See Attached
pH	U	2010		4.0	6.7	7.2	6.8	7.9
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010
Arsenic	U	2455	mg/kg	0.5	6.9	5.8	4.7	4.6
Cadmium	U	2455	mg/kg	0.10	0.21	0.29	0.11	0.19
Chromium	U	2455	mg/kg	0.5	30	21	19	19
Copper	U	2455	mg/kg	0.50	12	12	12	12
Mercury	U	2455	mg/kg	0.05	0.05	< 0.05	< 0.05	< 0.05
Nickel	U	2455	mg/kg	0.50	14	18	23	21
Lead	U	2455	mg/kg	0.50	23	23	16	17
Selenium	U	2455	mg/kg	0.25	0.76	0.93	0.60	0.62
Zinc	U	2455	mg/kg	0.50	53	46	47	45
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50
TPH >C6-C8	N	2670	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH >C8-C10	N	2670	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH >C10-C12	N	2670	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH >C12-C16	N	2670	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH >C16-C21	N	2670	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH >C21-C25	N	2670	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH >C25-C35	N	2670	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH >C35-C40	N	2670	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total TPH >C6-C40	U	2670	mg/kg	10	< 10	< 10	< 10	< 10
Naphthalene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10

Results - Soil

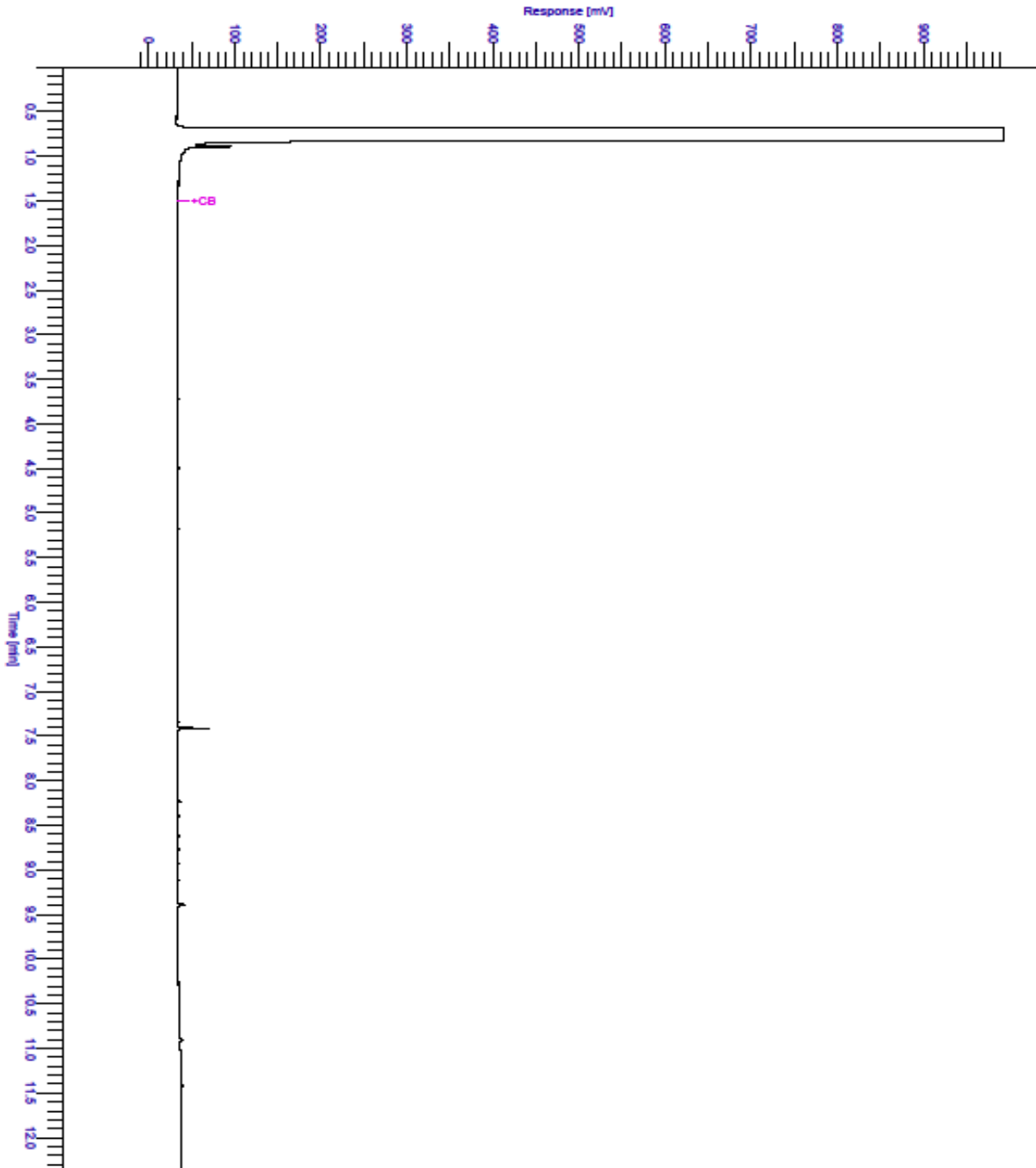
Project: 22.09.023 Lamphey

Client: Listers Geotechnical Consultants	Chemtest Job No.:		22-40980	22-40980	22-40980	22-40980	22-40980
Quotation No.: Q18-12046	Chemtest Sample ID.:		1532479	1532480	1532481	1532482	1532483
	Sample Location:		TP02	TP03	TP04	TP07	TP09
	Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):		0.2	0.2	0.8	0.8	0.8
	Date Sampled:		18-Oct-2022	18-Oct-2022	18-Oct-2022	18-Oct-2022	18-Oct-2022
	Asbestos Lab:		DURHAM	DURHAM			
Determinand	Accred.	SOP	Units	LOD			
Benzo[a]pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0	< 2.0

TPH Chromatogram on Soil Sample: 1532479

Chromatogram

Sample Name : 1532479_sx1-22-40980 Sample #: 048 Page 1 of 1
FileName : U:\2022\GC34\10\Oct12710_1_TPH2A\2710_1_TPH2A_AD48.raw
Date : 01/11/2022 12:47:02
Method : Time of Injection: 29/10/2022 04:30:11
Start Time : 0.00 min End Time : 12.36 min Low Point : -18.08 mV High Point : 993.88 mV
Plot Offset: -18.08 mV Plot Scale: 1012.0 mV



TPH Chromatogram on Soil Sample: 1532480

Chromatogram

Sample Name : 1532480_sx1-22-40980 Sample #: 049 Page 1 of 1
FileName : U:\2022\GC34\10\Oct\27\10_1_TPH2A\2710_1_TPH2A_AD49.raw
Date : 01/11/2022 12:47:35
Method : Time of Injection: 29/10/2022 04:48:53
Start Time : 0.00 min End Time : 12.36 min Low Point : -18.14 mV High Point : 993.88 mV
Plot Offset: -18.14 mV Plot Scale: 1012.0 mV

