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Knocknagael, Inverness

Phase 2 Ground Investigation Report

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Contents

Appendices

Appendix A - Drawings

Appendix B – Supporting Information

Appendix C – Environmental Testing Results

Appendix D – Tier 1 Thesholds.

Appendix E – Qualitative Risk Assessment Rationale

Executive Summary

Appointment	**Curtins were instructed by Field, to undertake an intrusive Phase 2 Ground Investigation for the proposed battery energy storage system (BESS) in Knocknagael, Inverness. The site is centred on National Grid Reference (NGR) 264900, 839000.** This report has been undertaken to support the development of a battery storage facility with associated access and drainage infrastructure.
Current Site Status	The development site is currently situated on a vacant site, currently used for agricultural purposes, consisting of open fields. The site is topographically sloping at circa 198m AOD in the southeast to 152m AOD in the northwest.
Fieldworks Undertaken	The intrusive ground investigation was undertaken by Curtins between 12th and 14th February 2024. Fieldworks comprised the advancement of 5 No. Hydraulic Percussive boreholes, 1 Cable Percussive borehole and 24 Machine excavated trial pits. A total of three return ground gas and groundwater monitoring visits have been undertaken. The arisings of the boreholes and trial pits were logged by a suitably qualified Curtins engineer and representative samples of the soil were submitted for geotechnical and environmental laboratory testing.
Ground Conditions	Ground level across the site was homogenous, comprising topsoil. Topsoil was overlying superficial Hummock Glacial Deposits with thickness varying between 0.25m and 1.95m. Bedrock deposits across the site consisted of the Inshes Flagstone Formation which featured a mixture of mudstone and sandstone. Topsoil is characterised as a dark brown very gravelly silty sand with very fine rootlets. Topsoil thickness was variable from 0.10m in multiple locations to 0.60m (TP19) in the south-west of the site. Superficial Hummock Glacial Deposits were encountered beneath topsoil in all exploratory hole locations. Typically, superficial deposits were encountered as a light brown or grey, very gravelly clayey fine to coarse subangular SAND with high cobble content. Cobbles were subangular to angular of mudstone and sandstone. Bedrock of the Inshes Flagstone Formation was present beneath superficial deposits in all locations and continued until maximum exploratory location depths of 2.30m bgl (186.38m AOD) were reached, whereby refusals were encountered due to the hard nature of the bedrock. Bedrock was typically characterised as reddish-purple SANDSTONE or MUDSTONE, often initially weathered at shallow depths. Mudstone was typically encountered in the north-west of the site whereas sandstone was typically encountered in south-east.

Laboratory Testing	Representative samples of the site soils were obtained and submitted to a suitably accredited laboratory for environmental and geotechnical analyses. The environmental testing comprised the suite outlined in Table 5.1.1. The geotechnical testing undertaken comprised of water content, bulk density, particle density, CBR, dry density and water content/dry density relationship.
General Quantitative Risk Assessment	Human Health – The risk to future site users is considered Low. Water Environment – The risk presented to water environments is assessed to be Low. Ground Gas – The risk presented by ground gases is assessed as Low for the site and no ground gas protection measures are required for the development site. Radon - The BGS Radon Mapping confirms the site is situated in a low probability radon area. Therefore, no radon protective measures are necessary in the construction of new dwellings or extensions.
Preliminary Geotechnical Assessment	It is anticipated that a cut and fill will be undertaken to achieve formation level. Depending on the level of cut and location, cut materials are likely to comprise Hummock Glacial Deposits and/or weathered bedrock (Inshes Flagstone Formation – mudstone and sandstone). It is likely that the material will classify as a Class 1 or Class 2 Acceptable Earthworks Fill subject to the removal of overside material (>300mm). The proposed development comprises a battery storage facility with a maximum expected loading of 50kN/m2. Without knowing the cut and fill details this foundation advice should be considered as preliminary. A conservative presumed allowable bearing capacity of 150kPa should be assumed, we have provided a conservative bearing capacity from published literature in the absence of rock data and assumed an extremely weak rock. Should a raft solution be adopted, fill should be placed to an earthworks specification and a detailed settlement assessment should be undertaken to determine the material parameters required for the fill and to detail the compaction requirements, to ensure settlements are not excessive. It is anticipated that earthworks will be required during the enabling works and shallow excavations during the construction phase. Given the presence of seepages within the Hummock Glacial Deposits, perched groundwater cannot be discounted and may be present in shallow excavations. A conservative CBR value of 4.5% is recommended for preliminary designs, based on in-situ and laboratory CBR testing.

	Infiltration testing in accordance with BRE365 was undertaken at one location (SA01) at the site. The soakaway test was unsuccessful due to the 75% and 25% drop in water levels being unachieved. The poor infiltration is likely a result of the clayey nature of the Hummock Glacial Deposits and impermeable nature of the mudstone bedrock.
Recommendations	In summary, the following recommendations are made: • Should a raft solution be adopted, fill should be placed to an earthworks specification and a detailed settlement assessment should be undertaken to determine the material parameters. • Earthworks should be completed to an Earthworks specification. Site won material is recommended to be regraded to remove oversized constituents (>300m) to fit a suitable earthworks classification. • Additional CBR testing is required at formation level on the completion of earthworks.

1.0 Introduction

1.1 Project Background

Curtins were instructed by Field, to undertake an intrusive Phase 2 Ground Investigation for the proposed battery energy storage system (BESS) in Knocknagael, Inverness.

This report has been undertaken to support the development of a BESS with associated access and drainage infrastructure. The Proposed Development drawings are included in Appendix A.

Curtins have previously provided a Phase 1 Preliminary Risk Assessment (ref. 085444-CUR-XX-XX-RP-GE-0001) (1) for the Proposed Development which recommended a Phase 2 ground investigation to further determine the contamination risk on-site and support the design.

1.2 Scope of Services

The investigation was undertaken to provide an assessment of both geo-environmental and geotechnical ground conditions on the Site with respect to any potential contamination in the underlying soils and or groundwater.

Specifically, the report is intended to:

a) Determine if there is a risk of the proposed end user being adversely impacted upon by potential contamination in shallow site soils that may be present on the site due to its known current, recent and historical use.

b) Determine if there is a risk of groundwater and/ or surface water being adversely impacted upon by potential contamination that may be present on the site due to its known current, recent and historical use.

c) Determine if there is a risk to the end user from soil gases including methane, carbon dioxide, oxygen, and hydrogen sulphide.

d) Determine shallow and deep ground conditions including the presence of any peat on the Site.

e) Provide recommendations for the design of foundations.

f) Provide recommendations for the hardstanding design.

g) Provide recommendations for the specification of sub-structure concrete.

2.0 Site Setting

2.1 Current Setting

The development site is currently situated on a vacant site, currently used for agricultural purposes, consisting of open fields. The site is topographically sloping at circa 198m AOD in the southeast to 152m AOD in the northwest.

The site is centred on National Grid Reference (NGR) 264900, 839000. The site location is presented in Figure 2.1 below. Curtins have previously undertaken a Phase 1 Preliminary Risk Assessment for the site (085444-CUR-XX-RP-GE-00001). Drawing 085444-CUR-XX-XX-D-GE-00003-P01, contained within Appendix A, shows the main development area to the west of the road running north to south through the planning area. The Proposed Development's overall 'redline' site boundary (42.83 ha) is larger than the proposed development footprint (approximately 6 ha). The primary reason for this has been to incorporate the entire, existing Knocknagael substation site into the planning boundary to ensure appropriate flexibility is provided along the proposed cable route corridor and into the Knocknagael substation site. The cable route corridor is indicative at this stage, and an enlarged planning boundary allows the route to be adjusted, if necessary, once the cable route has been confirmed with SSEN. The point-of-connection sits within the existing Knocknagael substation on SSEN's land. The point-of-connection works will be undertaken by SSEN, with the exact location of the point-of connection and associated cable route subject to SSEN's guidance and coordination with other proposed connections. Additional land is also included in planningboundary in the northern area of the Site to accommodate drainage arrangements and landscape bunding. The increased planning boundary area has allowed for the ongoing refinement of the siting of the northern attenuation basin and the articulation of landscape bunds following the outcomes of environmental studies, detailed cut and fill design, and engagement with the local planning authority.

Figure 2.1 – Site development boundary is outlined in Red

2.2 Surrounding Land Use

The immediate surrounding land use to the development site is highlighted in Table 2.2.

Table 2.2 – Surrounding Area

Surrounding Area	N	Road and agricultural land. Scrubland and trees to north-east of the site
	E	Road with electrical substation beyond
	S	Woodland with agricultural land beyond
	W	Agricultural land

2.3 Site History

With reference to the Curtins Phase 1 Report (1), from the earliest available map extract dating back to 1874, the site was shown as a farmer's field with a small structure in the centre and an adjacent well to the south-west. Between 1874 and 1904, an additional well was shown to the north-east of the central building. There was a gap in map records from 1904 to 1964 and 1964 to 2005, no significant changes on-site were identified during our recent site walkover.

2.4 Geology, Hydrogeology and Hydrology

With reference to the Phase 1 Report, and the 1:50,000 BGS map (Inverness – Sheet 83) the site was noted to be underlain by superficial deposits comprising diamicton, sands and gravels of the Hummock Glacial Deposits. Superficial deposits were in turn underlain by bedrock deposits comprising flaggy sandstones of the Inshes Flagstone Formation. There is no indication on the geological maps that peat is present on the Site.

Details on the hydrogeological classification of the Hummock Glacial Deposits were not given by SEPA mapping tools. The Inshes Flagstone Formation was characterised as a moderately productive aquifer, locally yielding small amounts of groundwater.

There were no licensed surface water abstractions recorded within 1km of the site and no records of a discharge consent within 250m of the site. However, two former wells have been identified on-site from map records.

The nearest surface water feature is the Essich Burn, located circa 50m northwest of the site.

2.5 Unexploded Ordnance (UXO) Risk Assessment

Military activities including those conducted as part of both the First and Second World Wars have resulted in a legacy of unexploded ordnance (UXO) being present within the shallow soils of the UK.

UXO result from various sources including both allied (military training) and German (bombing raids) with a guide figure of approximately 10% of all munitions failing to function as designed.

The likelihood of UXO being encountered on a development site is influenced by several factors including the proximity to strategic targets, the nature of the development works being undertaken and evidence of local damage in the post-war periods amongst others. To determine the likelihood of UXO being present on a site, a stepwise risk assessment process is followed. This process is outlined within CIRIA C681 Unexploded Ordnance: A Guide for the Construction Industry with the following commentary considered to represent a Preliminary Risk Assessment intended to guide if and where there is a requirement for a Detailed Risk Assessment.

The risk presented by Unexploded Ordnance, identified using preliminary Unexploded Bomb (UXB) risk maps retrieved from Zetica UXO, indicates that the site is situated in a designated Low-Risk area in respect to the potential presence of UXB as a result of World War Two bombing (9).

Based on the foregoing commentary, it was recommended that no further action was needed in reference to UXO for the intrusive ground investigation works if undertaken by Curtins.

3.0 Initial Conceptual Site Model

With reference to the Phase 1 Report, the Initial Conceptual Site Model (CSM) provided within the Phase 1 report is included in Table 3.0.

The CSM details the source-pathway-receptor linkages or potential contaminant linkages (PCL) that have been identified for the site. The GQRA details the associated level of risk relating to these potential contaminant linkages**.**

The CSM concerns risk to human health, Water and Environment. The CSM follows the framework outlined within CIRIA C552 which is summarised within Appendix E.

The ‘risk rating’ within the CSM refers to the risk that the source, pathway, receptor linkage or PCL is complete. Unless specifically stated it does not necessarily refer to an immediate risk and is intended to be used as a tool to assess the necessity for further assessment/investigation.

Qualitative Risk Assessment → Generic Quantitative Risk Assessment → Detailed Quantitative Risk Assessment or; Remedial Action

- The table below represents the first stage in the land quality risk assessment process; **the Qualitative Risk Assessment**.
- In order for a development site to be deemed 'suitable for use' the level of risk needs to be brought down to acceptable levels, i.e., low to negligible risk. The purpose of each stage of risk assessment is ultimately to establish if there is a requirement for additional levels of assessment to be made in order to have sufficient confidence to support a risk characterisation or management decision, e.g., remedial action.
- In the absence of specific site data, a Generic Quantitative Risk Assessment is invariably recommended.

Conceptual Site Model			Qualitative Risk Assessment			Recommended Actions
Source	**Pathway(s)**	**Receptor(s)**	**Consequence**	**Likelihood of Occurrence**	**Risk Rating**	
Made Ground and contamination associated with: • Buildings on Site • Infilled pond *Localised Fuel Spills from farming equipment during farming activities on the Site.*	**Direct contact, ingestion,** inhalation (dust and vapours).	**Site end-user**	**Medium** Acute health risk	**Unlikely** Due to the nature of the Site having undergone minimal development over time the presence of made ground is considered unlikely	**Moderate/ Low**	**Generic Quantitative Risk Assessment** recommended as part of the ground investigation to confirm risk assessment
	Vertical migration through the superficial deposits (soils) May occur due physical processes including; capillary action and downwards into the natural deposits through infiltration, however, on Site deposits are likely to be cohesive in nature, reducing the potential for vertical migration.	**Water Environment (groundwater)** Unclassified Aquifer. No active/in use potable abstraction points located within the vicinity of the site, although former wells were noted on historical map extracts.	**Mild** Pollution of sensitive water resources	**Low** There is potential for the leaching of contamination from made ground arising from the site, however the superficial deposits on Site are likely to be cohesive reducing the risk of vertical migration. Wells are assumed to no longer be in use.	**Low**	
	Horizontal migration over and through the superficial deposits (soils).	**Water Environment (surface water)** Burn of Arrachnaras	**Mild** Pollution of sensitive water resources	**Unlikely** Unlikely considering the distance to the receptor and cohesive nature of superficial deposits.	**Low**	
Production of ground generating gases from: • Made ground from infilled pond in the centre of the Site and to the south-east of the Site.	**Vertical and horizontal migration** through existing service corridors and the underlying superficial deposits.	**Site end-user**	**Medium** Human health risk	**Low** With reference to BS8576:2013 (Ref.9), these sources are considered to have a moderate gassing potential.	**Moderate**	**Ground Gas Monitoring** Risk is considered Moderate due to unknown provenance of materials used to infill former ponds and close proximity to the development. However, as the superficial deposits are likely to be cohesive in nature, there is unlikely to be an active pathway on the Site for ground gas to migrate.

4.0 Fieldworks

4.1 General

The intrusive ground investigation was undertaken by Curtins between 12th and 14th February 2024. A summary of the scope and rationale for the intrusive works undertaken is summarised in Table 3.1 below.

The ground investigation was designed by Curtins in relation to the proposed development plans, findings of the Phase 1 Report and in general accordance with current UK guidance, including LCRM (2), British Standard (BS) 10175 (3), BS5930:2020 (4) and Eurocode 7 (5).

Table 3.1 – Phase 2 Ground Investigation Scope and Rationale

Exploratory Hole Type	Exploratory Hole Ref.	Exploratory Hole Depth (m bgl)	Rationale
5 No. Hydraulic-percussive boreholes **1 No. Cable-percussive borehole**	CP01 CP02 CP03 CP04 CP05 CP06 (cable-percussive)	1.40 1.60 1.45 1.55 2.30 1.10	• To determine ground conditions and potential foundation design. • To confirm geotechnical parameters. • To collect soil and groundwater samples (if available) for laboratory analysis. • To determine groundwater depths/ levels.
24 No. Machine-excavated Trial Pits	TP01 TP02 TP03 TP04 TP05 TP06 TP07 TP08 TP09 TP10 TP11 TP12 SA01 TP14	1.20 0.90 1.10 1.00 0.80 1.60 0.80 1.10 1.60 0.80 0.80 1.50 1.60 0.40	• To mass characterize shallow ground conditions. • Target potential areas of contamination. • Obtain bulk geotechnical samples for earthworks laboratory testing. • Perform infiltration tests for potential soakaway design.

Exploratory Hole Type	Exploratory Hole Ref.	Exploratory Hole Depth (m bgl)	Rationale
	TP15	1.20	
	TP16	1.30	
	TP17	1.70	
	TP18	1.00	
	TP19	2.50	
	TP20	1.60	
	TP21	1.00	
	TP22	1.60	
	TP23	1.50	
	TP24	0.80	

Curtins Exploratory Hole Location drawing (085444-CUR-00-XX-DR-GE-0001), records the locations of all exploratory hole locations a copy of which is contained within Appendix A.

4.2 Soil Logging and Sampling

Exploratory hole arisings were logged on site by a suitably qualified Curtins engineer in accordance with the requirements of BS5930:2020 (4). Copies of the exploratory hole logs are provided in Appendix B, with ground conditions presented in Section 5.1.

Representative soil samples were selected for laboratory geochemical and geotechnical analysis, based on field observations and to provide a characterisation of the strata encountered. The samples were placed in laboratory provided containers and stored in cool boxes prior to being transported to the nominated laboratory under the laboratory's chain of custody documentation. The laboratory selected by Curtins for chemical analysis was DETS Ltd and geotechnical analysis was MATtest Ltd.

4.3 Post Investigation Monitoring

An initial programme of three gas and groundwater monitoring visits were proposed in order determine the underlying gas and groundwater regime for the development site. The three return monitoring visits have been undertaken between the 13th March and 09th April 2024.

5.0 In-Situ & Laboratory Testing

5.1 Environmental Chemical Testing

A programme of environmental chemistry testing was scheduled, with analytical suites developed reflecting the preliminary CSM in Section 3.0 and observations made during the ground investigation.

Given the potential for site wide source of contamination the sampling positions were generally located in a semi targeted array to give an adequate and representative coverage of the site accounting for the historical site use and the immediate environmental setting, along with targeting areas of the proposed development.

5.1.1 Soil Analysis

Soil samples were taken from the topsoil across the site and tested for the suite listed in Table 5.1.1

The nature and type of soil contamination potentially present on the site was considered to include, amongst others; ash, hydrocarbons (e.g. fuel oils), heavy metals and asbestos, the extent of which is captured by the broad environmental testing suite detailed in Table 5.1.1. Copies of the environmental chemistry testing certificates can be referred to in Appendix C of this report.

Table 5.1.1 – Environmental Chemistry Analysis Suite: Soils

Analysis	Limit of Detection (LOD)
Asbestos Screen	N/A
pH	N/A
Organic Matter	0.1%
Arsenic	1 mg/kg
Boron (water soluble)	0.2 mg/kg
Cadmium	0.1 mg/kg
Chromium	0.15 mg/kg
Chromium VI	1 mg/kg
Copper	0.2 mg/kg
Lead	0.3 mg/kg
Mercury	0.05 mg/kg
Nickel	1 mg/kg
Selenium	0.5 mg/kg
Zinc	1 mg/kg
TPH (Aro/Ali C5-C35) inc BTEX	0.01 to 10 mg/kg
PAH (speciated)	<0.05 to <0.1 mg/kg
Phenols (total)	<0.1 mg/kg
Cyanide (total)	0.1 mg/kg
Sulphate (SO_4)	<1.25 mg/l

5.2 Geotechnical Testing

Soil samples taken during the ground investigation works were prepared in accordance with BS1377: Part 1:2016. The following geotechnical in-situ and laboratory testing has been undertaken as presented in Table 5.2. The results of the testing are discussed further in Section 6.0 and presented in Appendix C.

Table 1.2 – Geotechnical Testing Soils

Test Type	Quantity	Standard
In-Situ Testing		
Standard Penetration Testing	6	BS5930:2015, Clause 41
In-Situ CBR (by DCP)	2	CS 229
Laboratory Testing		
Particle Size Distribution (wet sieve)	14	BS 1377-2:2022
Water Content	15	
Bulk Density	5	
Particle Density	5	
CBR	3	
Dry Density	4	
Water Content/ Dry Density Relationship	9	

5.3 Infiltration Testing

Infiltration testing in accordance with BRE365 was undertaken at one location (SA01) at the site.

The purpose of the test was to determine the infiltration rate of the shallow soils, to determine if soakaway type drainage is likely to be suitable at the site.

SA01 was excavated to a depth of 1.60m bgl (171.39m AOD). The ground conditions comprised Topsoil (200mm thick) underlain by very gravelly clayey SAND to 1.30m bgl (171.69m AOD). Mudstone was recorded at 1.30m bgl to the base of the pit at 1.60m bgl.

The pit was filled with water to a depth of 0.62m bgl and during a period of 90 minutes a 5mm drop in water level was observed. The soakaway test was unsuccessful due to the 75% and 25% drop in water levels being unachieved.

6.0 Ground Conditions

6.1 Encountered Ground Conditions

The following section discusses the ground conditions determined from the ground investigation and laboratory testing described in Section 5.1 with detailed information presented on the exploratory hole logs in Appendix B.

Where necessary, determination of characteristic parameters has been based on a cautious estimate of results derived from laboratory, published correlations and field tests, complemented with engineering judgement and consideration of the relevant limit state. The parameters are not considered to be absolute and should be referenced with the specific strata text in this section and reviewed when considering a specific area of the site. The below figures should be referenced accordingly in relation to the field and laboratory testing results.

Table 6.1 – Summary of Ground Conditions Encountered

Stratum	Depth to top of strata		Thickness (m)		General Description
	m BGL	m AOD	Min	Max	
Topsoil	GL	168.35 – 192.80	0.10	0.60	Dark brown very gravelly silty sand with very fine rootlets.
Hummock Glacial Deposits	0.10	168.15 – 192.7	0.25 (CP01)	1.95 (CP05)	Light brown very gravelly clayey SAND with high cobble content. Cobbles of mudstone and sandstone.
Inshes Flagstone Formation	0.20	166.85 - 191.50	0.10*	0.45*	Sandstone or Mudstone

Notes - *Total thickness not proven (Base of unit not encountered).

6.1.1 Topsoil

Ground level within all exploratory hole locations across the site comprised topsoil material consisting of a dark brown very gravelly silty sand with very fine rootlets. Topsoil thickness was variable from 0.10m in multiple locations to 0.60m (TP19) in the south-west of the site.

6.1.2 Superficial – Hummock Glacial Deposits

Superficial Hummock Glacial Deposits were encountered beneath topsoil in all exploratory hole locations. Typically, superficial deposits were encountered as a light brown or grey, very gravelly clayey fine to coarse subangular SAND with high cobble content. Cobbles were subangular to angular of mudstone and sandstone. Thickness was variable between 0.25m (CP01) and 1.95m (CP05), both within the south of the site, indicative of a layer of highly variable

thickness. TP19 also encountered a deposit of soft grey sandy silty clay between 0.60 and 2.00m BGL above mudstone bedrock, this clay is regarded as the weathering product of the mudstone.

Classification Testing

Fourteen particle size distribution tests (PSD) were undertaken on samples of Hummocky Glacial Deposits. The results of these tests are presented in Appendix D. The results suggest a predominantly granular material (sand/gravel) with a fines content ranging between 2 – 14%.

One SPT carried out at 1.20 m depth achieved full penetration which recorded an uncorrected 'N' value of 37 which is indicative of a dense granular soil.

Figure 6.12 shows how the angle of shearing resistance for the granular Hummock Glacial Deposits has been evaluated, increasing a base value of 36° based on Peck, Hanson and Thornburn and uniformity coefficients >6. A conservative angle of shearing resistance of 36° is appropriate based on Figure 6.12 below for a subangular and evenly graded soil.

Figure 6.12: Excerpt from BS8004:2015+2020, Table 1

Soil property	Determined from	Classification	Parameter, [D]
Angularity of particles [A]	Visual description of soil	Rounded to well-rounded	$\varphi'_{ang} = 0°$
		Sub-angular to angular	$\varphi'_{ang} = 2°$
		Very angular to angular	$\varphi'_{ang} = 4°$
Uniformity coefficient, C_U. [B]	Soil grading	$C_U < 2$ (evenly graded)	$\varphi'_{PSD} = 0°$
		$2 \le C_U < 6$ (evenly graded)	$\varphi'_{PSD} = 2°$
		$C_U \ge 6$ (medium to multi graded)	$\varphi'_{PSD} = 4°$
		High C_U (gap graded), with C_U of fines < 2 [E]	$\varphi'_{PSD} = 0°$
		High C_U (gap graded), with $2 \le C_U$ of fines < 6 [E]	$\varphi'_{PSD} = 2°$
Density index, I_D, [C]	Standard penetration test blow count, corrected for energy rating and overburden pressure $(N_1)_{60}$	$I_D = 0\%$	$\varphi'_{dil} = 0°$
		$I_D = 25\%$	$\varphi'_{dil} = 0°$
		$I_D = 50\%$	$\varphi'_{dil} = 3°$
		$I_D = 75\%$	$\varphi'_{dil} = 6°$
		$I_D = 100\%$	$\varphi'_{dil} = 9°$

[A] Terms for defining particle shape can be found in BS EN ISO 14688-1.

[B] The uniformity coefficient C_U is defined in BS EN ISO 14688-2.

[C] The density index ID is defined in BS EN ISO 14688-2. Density terms may be estimated from the results of field tests (e.g. Standard Penetration Test, Cone Penetration Test) using correlations given in BS EN 1997-2.

[D] Values of φ'_{dil} are appropriate for siliceous sands and gravels reaching failure at a mean effective stress up to 400 kPa. For non-siliceous sands, see *The strength and dilatancy of sands* [21].

[E] "Fines" refers to that fraction of the soil whose particle size is less than 0.063 mm.

Unit Weight

Eight bulk/dry density results are available for the Hummock Glacial Deposits. The results range between 1.72 - 2.55Mg/m3 (bulk density) and 1.92 - 2.16Mg/m3 dry density.

Based on the average bulk density of 20.9Mg/m3, a unit weight of 20kN/m3 is considered to be appropriate, which is also in agreement with guidance in BS8002 for a granular soil above and below the groundwater table.

Earthworks Testing

The Specification for Highways Works (Volume 1, Series 600 Earthworks) classifies a material with >15% fines (<63µm) as a cohesive material and material with <15% fines as a granular material.

Subject to the removal of oversize material (>300mm) thirteen of the fourteen PSD tests results classify as either a Class 1 or Class 2 acceptable earthworks material.

Four dry density/ moisture content relationship tests were undertaken on samples of granular Hummock Glacial Deposits. Maximum dry density of the Hummock Glacial Deposits ranged from 1.94Mg/m^3 to 2.08Mg/m^3 with an average value of 2.03Mg/m^3. Optimum moisture content are variable between 8.3% and 12.7% with an average of 9.39%. The as-received moisture contents were recorded between 7.5% and 19.7%, with an average value of 12.09% recorded, this value is above the optimum moisture content value and characterises the in-situ soils as wet.

6.1.3 Bedrock – Inshes Flagstone Formation

Bedrock of the Inshes Flagstone Formation was present beneath superficial deposits in all locations and continued until maximum exploratory location depths of 2.30m bgl (186.38m AOD) were reached, whereby refusals were encountered due to the hard nature of the bedrock. Bedrock was typically characterised as reddish-purple SANDSTONE or MUDSTONE, often initially weathered at shallow depths. Extremely weak mudstone was typically encountered in the north-west of the site, whereas sandstone was typically encountered in the south-east.

Classification Testing

Five SPTs were carried out on the upper boundary of the Inshes Flagstone Formation, with all SPTs reaching a refusal SPT ‘N’ value of 50.

A conservative angle of shearing resistance of 35° to 41° is considered to be appropriate based on published guidance for a hard sedimentary rock and an SPT refusal.

Unit Weight

A unit weight of 19kN/m3 is considered to be appropriate, based on guidance in BS8002 for a saturated sedimentary rock.

6.2 Visual and Olfactory Indicators of Contamination

No visual or olfactory indicators of gross or mobile phase contamination were encountered within the topsoil or underlying natural soils during the ground investigation.

6.3 Obstructions Encountered

No unexpected obstructions were encountered within any exploratory hole location throughout the duration of the ground investigations. All exploratory locations were terminated prior to the target depth due to the presence of bedrock

Hummock Glacial Deposits may contain significant amounts of cobbles and boulders, although excavation remains feasible throughout the unit. Bedrock of the Inshes Flagstone Formation is weathered within first 150mm bgl from the top of the unit, competency of the unit increases beyond this with depth

Whilst considered unlikely, the presence of further obstructions not identified during the ground investigation cannot be discounted.

6.4 Groundwater

Three groundwater strikes were encountered during the investigation, between 1.00 and 1.20m bgl (177.00m to 179.99m AOD) within CP01, CP02 and CP04. These strikes are thought to be representative of 'perched groundwater' between superficial and bedrock strata.

The return monitoring visits recorded groundwater within one location, CP04 with levels ranging between damp and 1.16m bgl, as shown Table 6.6 below.

Table 6.6 – *Summary of Groundwater Seepages and Return Groundwater Levels*

Exploratory Hole Location Ref.	During Ground Investigation		Post Investigation Monitored Groundwater Levels		
	Seepage Depth (m bgl/ m AOD)	Installation Strata	Monitored Depth (m bgl/m AOD)		
			13/03/24	27/03/24	09/04/24
CP01	1,00	Hummock Glacial Deposits	DAMP	DAMP	DAMP
CP02	1.20		DAMP	DAMP	DAMP
CP03	N/A		DAMP	DAMP	DAMP
CP04	1.00		1.15	1.16	DAMP
CP05	N/A		DAMP	DAMP	DAMP

Exploratory Hole Location Ref.	During Ground Investigation		Post Investigation Monitored Groundwater Levels		
	Seepage Depth (m bgl/ m AOD)	Installation Strata	Monitored Depth (m bgl/m AOD)		
			13/03/24	27/03/24	09/04/24
CP06	N/A		DAMP	DAMP	DAMP

7.0 Ground and Groundwater Contamination Risk Assessment

This section of the report includes the assessment of the potential solid contamination, liquid, and gas, identified on the subject site which may present a risk to the potential end users, associated utilities, and the wider environment.

In guidance published by the Environment Agency, the risk to human health or water environment is determined through an assessment of contaminant linkages between a source of contamination (within the ground or groundwater either on or off-site) and a sensitive receptor such as end users of the site, building materials, edible plants grown in gardens or groundwater abstracted for drinking. This is termed a source-pathway-receptor relationship. The same model is applied to the assessment of risk arising from ground gases as detailed within BS8576:2013 (7).

These models have a common approach, which is one of a tiered assessment. At each stage of the assessment, further detail can be applied to the conceptual site model to provide a detailed interpretation on a site-by-site basis. As part of the planning process, this approach is adopted in order to establish either if the site is 'suitable for use' or whether additional work or else remedial work is required in order for the site to be deemed so.

The sub-sections hereafter therefore incorporate the first tier (Tier 1) of this approach, otherwise referred to as the Generic Quantitative Risk Assessment (GQRA). The GQRA builds on the qualitative risk assessment presented in Section 3.0, in conjunction with observations made during the ground investigation and is based solely on the results of the chemical testing data obtained as part of the recent ground investigation.

The following sections present more detail on the risk assessment methodology rationale for the main receptors.

7.1 Human Health GQRA

Detailed guidance on human health risk assessment is available within several documents, published by both the Environment Agency and Defra. Guidance includes Contaminated Land Exposure Assessment (CLEA) v1.071 model Report SC050021/SR2: Human Health Toxicological Assessment of Contaminants in Soil and Report SC059921/SR3: Updated Technical Background to the CLEA Model (8).

A generic quantitative risk assessment (GQRA) has been carried out for the Potential Contaminant Linkages (PCLs) investigated by screening soil contamination data against relevant Generic Assessment Criteria (GAC) where available, including:

i) **Soil Guideline Values (SGVs):** These have been published by the Environment Agency and are trigger values for screening out low risk areas of land contamination. SGVs give an indication of representative average concentrations of chemicals in soil, below which long-term health risks are likely to be minimal. SGVs have been published for several contaminants including arsenic, cadmium, mercury, nickel, selenium, BTEX, phenols and dioxins, furans and dioxin-like PCB substances for land uses including residential, allotments and commercial settings. The SGVs have been developed for a sandy loam soil with 2.5% soil organic matter (SOM) content;

ii) **Supplementary Screening Values (SSVs):** In addition to the SGVs developed by the EA, other third-party organisations have derived SSVs for a wider range of contaminants and land uses using the CLEA Model. Curtins have adopted these numbers where applicable, including those developed by Atkins AtriskSoil™, the LQM/CIEH Suitable for Use Levels (S4UL) and EIC/AGS/CL:AIRE published thresholds;

iii) **Category 4 Screening Levels (C4SLs):** In March 2014 Defra published C4SLs for arsenic, benzene, benzo(a)pyrene, cadmium, hexavalent chromium, and lead. These values were derived to support the revised Part 2A Statutory Guidance issued in 2012 in which four categories of contaminated land are included, ranging from Category 1 (significant/high risk) to Category 4 (low risk). C4SLs are not representative of significant possibility of significant harm (SPoSH) and are low risk levels. Therefore, where the C4SLs are not exceeded, land can be demonstrated to be in Category 4 and cannot be determined as contaminated land.

The available development plans provided by the client show the Site is anticipated to comprise the construction of battery energy storage units with associated site access and infrastructure.

Given the low-sensitivity nature of the end usage of the proposed development, this GQRA initially considered the following land use scenario for the development as part of a robust conservative assessment:

- Commercial

Details of the GACs adopted for the GQRA are provided in Appendix D.

7.1.1 Soils

As part of the investigation, a total of fourteen environmental samples were submitted for environmental testing based on a suite presented in Table 5. The distribution of samples and quantity of sampling was considered sufficient for the development site.

As discussed within the previous section, comparison of the soil analysis results has been undertaken against conservative Generic Assessment Criteria (GAC) for **Commercial end use**.

Soil organic matter (SOM) has a strong bearing on the availability of potential contaminants and therefore influences the Tier 1 thresholds. The SOM typically ranged from 0.2% to 7.1%, with an average of 1.9%. As such, as part of a conservative assessment, the comparison has been made against GACs developed for a sandy soil with a SOM of 2.5%. The results of the environmental testing are appended in Appendix C. Copies of the adopted Tier 1 thresholds are contained within Appendix D.

With respect to the adopted conservative screening criteria for **Commercial end usage**, the results of the screening did not identify any exceedances within samples submitted for chemical analysis. Consequently, on-site shallow soils were considered unlikely to present a risk to future site users.

7.1.2 Asbestos

A total of fourteen samples were submitted to the laboratory for an asbestos presence screen. The testing concluded that asbestos was not positively identified in any of the samples submitted for laboratory testing.

7.1.3 Groundwater Derived Vapours

Three shallow groundwater seepages were recorded on-site as part of the ground investigation. However, as previously discussed, no gross or mobile phase contamination was encountered within the soils during the ground investigation. With this borne in mind, groundwater-derived vapours were unlikely to present a risk to future site users.

7.2 Water Environment – GQRA

Due to the lack of surface water features both on and near the site (with the exception of a field that drains northward into the Essich burn, located 50 meters to the northwest) and the absence of groundwater detected during monitoring visits, the risk to the water environment was considered to be ***Low***. Additionally, no significant sources of mobile contamination were found on the site.

With reference to the foregoing commentary, the risk to water environments was assessed as Low. Therefore, no requirement for further action in terms of risk to controlled waters was considered necessary.

7.3 Ground Gas – GQRA

The assessment of risk presented by ground gases is assessed with reference to guidance published by CIRIA Assessing Risks Posed by Hazardous Ground Gases to Buildings, C665, (9) BSI Publication code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings BS8485:2019 (10) and BS8576 (7).

The gas risk assessment adopts a tiered approach. In the first instance this involves a re-evaluation of the Conceptual Site Model described within the Phase 1 Preliminary Risk Assessment (desk study) and thereafter validating this conceptual model with the ground gas data, the semi-quantitative risk assessment.

7.3.1 Asphyxiant, Noxious and Explosive Gases

The Preliminary Conceptual Site Model (PCSM) presented within Section 3.0 noted the potential for gases to arise from uncontrolled deposition of Made Ground on-site. The ground investigation did not encounter any Made Ground across the site. The remainder of the site comprised topsoil over natural soils with no obvious organic or putrescible material. With reference to BS8576, Figure 6; the development site would be considered to have a ‘very low’ gassing potential.

Consequently, ground gas monitoring would not necessarily be required to further determine risk. However, to establish a baseline gas regime and validate the qualitative assessment of ground gas risk, six dual-purpose gas and groundwater monitoring installations were constructed within boreholes as detailed in Table 4.3 within Section 4.3.

A programme of three gas and groundwater monitoring visits was proposed with visits undertaken on the 13th March, 27th March, and the 9th April 2024. Gas monitoring to date has been undertaken during stable atmospheric pressures with barometric pressure ranging from 986 mb to 1004 mb. A summary of the soil gas monitoring results is presented in Table 7.3.1 below, with the monitoring results and log sheets presented in Appendix B.

Table 7.3.1 *Summary of Soil Gas Monitoring Results*

Location	CO_2 Range (% $^{vol}/_{vol}$)	CH_4 Range (% $^{vol}/_{vol}$)	O_2 (% $^{vol}/_{vol}$)	Max Flow Rate (l/hr)	Steady State Flow Rate (l/hr)
CP01	0.2 – 0.3	<0.1	20.4	<0.1	<0.1
CP02	0.1	<0.1	20.6	<0.1	<0.1
CP03	0.1 – 0.2	<0.1	20.5	<0.1	<0.1
CP04	0.1 – 0.2	<0.1	20.9	<0.1	<0.1
CP05	0.1	<0.1	21.1	<0.1	<0.1
CP06	0.1	<0.1	20.5	<0.1	<0.1

Hydrogen sulphide and carbon monoxide were not detected during any of the ground gas monitoring visits.

Maximum concentrations of carbon dioxide and methane were recorded at 0.3% $^{vol}/_{vol}$ and <0.1% $^{vol}/_{vol}$ respectively. The ground gas concentrations are consistent with natural soils. As previously detailed, the above is considered to comprise 'very low' gassing potential in accordance with BS8576 Figure 6.

Considering both a 'worst credible scenario' (maximum 'absolute' flow rate, maximum gas concentration within a single borehole location) and 'worst possible scenario' (maximum 'absolute' flow rate, maximum gas concentration across all borehole locations) the Hazardous Gas Flow Rates (Q_{hg}) for the site are evaluated as 0.0004 (carbon dioxide) and <0.0001 (methane).

In this site situation, the calculated Hazardous Gas Flow Rates (Q_{hg}) are considered to be reflective of a conservative assessment of Gas Screening Values (GSV) with generally negligible flow rates and non-detectable concentrations of methane recorded.

With reference to CIRIA C665 (9), the above calculated GSV, indicate a Characteristic Situation (CS) 1 in regard to ground risk.

7.4 Radon Gas

The BGS Radon Mapping confirms the site is situated in a lower probability radon area where less than 1% of homes are estimated to be at or above the action level. Therefore, radon protective measures are not necessary in the construction of new dwellings or extensions.

Where the new development incorporates a basement the advice of a specialist Radon assessor must be obtained

8.0 Revised Conceptual Site Model

The preliminary conceptual site model (PCSM) presented and discussed in Section 3.0 of this report has been revised following the GQRA in Section 7.0 above and this revised Conceptual Site Model (CSM) is presented in the table overleaf.

The CSM details the source-pathway-receptor linkages or potential contaminant linkages (PCL) that have been identified for the site. The GQRA details the associated level of risk relating to these potential contaminant linkages.

The CSM concerns risk to human health, Water and Environment and follows the framework outlined within CIRIA C552 which is summarised within Appendix E.

The 'risk rating' within the CSM refers to the risk that the source, pathway, receptor linkage or PCL is complete. Unless specifically stated it does not necessarily refer to an immediate risk and is intended to be used as a tool to assess the necessity for further assessment/investigation.

Under current health and safety legislation, employers are required to carry out their own appropriate risk assessments and mitigation to protect themselves and their employees, other human receptors and the environment from potential contamination. Such risks must be adequately mitigated by law, specifically the Construction Design Management (CDM) Regulations, 2015 which require that potential risks to human health and the environment from construction activities are appropriately identified and all necessary steps taken to eliminate/manage that risk. It has been assumed that any future construction works on site will be undertaken in compliance with these requirements and therefore construction workers involved in the development works at the site have been discounted as a human receptor in the conceptual site model.

- The table below represents the second stage in the land quality risk assessment process: The Quantitative Risk Assessment.
- In order for a development site to be deemed 'suitable for use', the level of risk needs to be brought down to acceptable levels, i.e., low to negligible risk. The purpose of each stage of risk assessment is ultimately to establish, if there is a requirement for additional levels of assessment to be made in order to have sufficient confidence to support a risk characterisation or management decision, e.g. remedial action.

Conceptual Site Model			Qualitative Risk Assessment			Recommended Actions
Source	**Pathway(s)**	**Receptor(s)**	**Consequence**	**Likelihood of Occurrence**	**Risk Rating**	
None	**Direct contact, ingestion,** inhalation (dust and vapours).	**Site end-user**	**Medium** Acute health risk	**Unlikely** Made Ground was not encountered onsite. Samples of onsite shallow natural soils sent for chemical testing did not identify any chemical exceedances against commercial GACs. The areas of the historical wells were unable to be directly tested due to its archaeological significance. Sampling was undertaken in proximity to the areas, the results were consistent with the wider site, recording no exceedances against commercial GACs.	**Low**	**No further action required**
	Vertical migration through the superficial deposits (soils) May occur due physical processes including; capillary action and downwards into the natural deposits through infiltration, however, on Site deposits are likely to be cohesive in nature, reducing the potential for vertical migration.	**Water Environment (groundwater)** Unclassified Aquifer. No active/in use potable abstraction points located within the vicinity of the site, although former wells were noted on historical map extracts.	**Mild** Pollution of sensitive water resources	**Low** Made Ground was not encountered on site. Four groundwater strikes were recorded during the investigation, these were characterised as perched water and not representative of a sensitive resource. Samples of on site shallow natural soils sent for chemical testing did not identify any chemical exceedances when compared against commercial GACs, in addition no visual or olfactory contamination was encountered on site. Consequently, the risk to the water environment was deemed as low. However, as the infilled pond has not been investigated, it is likely that "pond deposits" may have built up, which may be organic-rich. The potential for ground-made ground still exists in the investigated areas, and it could represent a gas source where construction is undertaken on top of the near-made ground, especially since gas pathways have been identified. Should the made ground be excavated, it would eliminate the risk, provided the material is effectively managed and its organic content evaluated and, if found to be gas-producing - mitigated. It should be considered that construction is not likely to be undertaken in the area of the infilled pond due to it being within an area of archaeological interest.	**Low**	
	Horizontal migration over and through the superficial deposits (soils).	**Water Environment (surface water)** Burn of Arrachnaras	**Mild** Pollution of sensitive water resources		**Low**	

Production of ground gases from: • Made ground from infilled pond in the centre of the Site and to the south-east of the Site.	**Vertical and horizontal migration** through existing service corridors and the underlying superficial deposits.	**Site end-user**	**Medium** Human health risk	**Low** The results of the ground investigation determined no Made Ground on site. With reference to BS8576, Figure 6 such material would have 'very low' gassing potential and unlikely to contribute a site-wide ground gas risk. Consequently, ground gas protection measures are not required on-site.	**Low**	**No further action required**

In conclusion, the previous Revised Risk Assessment indicates a **Low** risk to human health, water environment, and ground gas from on and off-site sources.

9.0 Preliminary Geotechnical Assessment

The recommendations provided within this section are based on a review of the recent records of ground conditions encountered across the Site, along with the Proposed Development. This section will assess the relevant geotechnical issues for the Proposed Development. The Proposed Development plan is contained within Appendix A. The engineering assessment considers foundation design, bearing capacity, settlement, excavations, earthworks, floor slab, drainage, and pavement design for the site. Structural details and loadings have not yet been provided. It should be noted that detail may change in the development of designs beyond the issue of this Phase 2 Report and the construction-stage designer should satisfy themselves regarding the adequacy of their design and proposed approach to construction by reference to the ongoing project design proposals, the ground investigation information, and their own examination of the site.

9.1 Geotechnical Considerations

9.1.1 Earthworks

Prior to the Site Investigation, a detailed cut and fill for the Site had not been designed and the proposed layout was noted as subject to change, however, at the time of writing, Curtins have been provided with a detailed cut and fill design by the client. Drawing 085444-CUR-XX-XX-D-GE-00004 Cut & Fill Site Layout is included in Appendix A. Proposed ground levels vary across the Site at 186.000m AOD in the south east corner and 169.600m AOD in the north, therefore earthworks are required at the Site to achieve the proposed levels.

The Site is set out with three proposed platforms in the south east, the centre west and the north east with swales set out in the west and east and a SUDS pond in the north.

Topsoil is not considered to be an acceptable earthworks material, it is recommended that this is stripped and stockpiled onsite for re-use on proposed bunds.

Following a Topsoil strip, Engineered Fill is likely to be required across the development platforms to achieve the finished levels. The thickness of Engineered Fill is likely to be >2.0m across all three platforms.

Depending on the level of cut and location, cut materials are likely to comprise Hummock Glacial Deposits and/or weathered bedrock (Inshes Flagstone Formation – mudstone and sandstone). Where mudstone was encountered, it was described as weathered to extremely weak.

It is likely that the excavated material will classify as a Class 1 or Class 2 Acceptable Earthworks Fill (in accordance with Table 6/2 SHW Series 600) subject to oversize material >125mm being removed for a Class 2.

A summary of the grading results is provided in Table 9.1 together with the determined material classification (assuming oversize material removed).

Nine Dry Density/ Moisture Content Relationship tests were undertaken on samples of cohesive Hummocky Till Deposits using a 4.5kg rammer. The Maximum Dry Density (MDD) ranged between 1.83Mg/m3 and 2.03Mg/m3.

The test results suggest that the Hummocky Till Deposits are likely to achieve a 95% MDD compaction criteria and the as received moisture contents suggest that the material could be placed without any requirement for treatment i.e. lime modification.

It must be noted that these samples were taken directly from the ground and the moisture content may change if the material is excavated and stockpiled for a duration of time. It is recommended that samples are retested prior to placement to ensure that the moisture content is within the acceptable limits to achieve 95% compaction.

It is recommended that an Earthworks Specification is produced to ensure that the works are undertaken in accordance with the SHW Series 600, and that appropriate validation testing is undertaken to satisfy the local authority.

Table 9.1: Summary of Grading Results and Classification

Sample	Depth	500	300	125	90	75	37.5	28	20	14	10	6.3	5	3.35	2	1.18	600	300	150	63	Class
TP01	0.5	100	100	100	84	84	50	45	37	32	29	25	24	22	19	17	15	14	12	9	1A/1B
TP03	0.6	100	100	100	100	100	83	78	73	68	65	59	57	53	47	43	39	35	29	21	2C
TP08	0.5	100	100	100	86	80	60	53	47	41	37	33	32	29	26	24	21	20	17	13	1A/1B
TP10	0.5	100	100	100	88	88	64	60	54	41	36	33	31	28	25	23	21	19	17	14	1A/1B
TP11	0.5	100	100	100	100	91	77	70	60	51	45	38	37	33	29	26	23	21	18	13	1A/1B
TP12	1.0	100	100	100	100	100	86	74	69	60	56	53	51	48	45	43	40	38	33	27	2C
TP16	0.9	100	100	100	100	100	93	85	78	72	65	57	54	49	44	40	37	33	29	22	2C
TP19	1.0	100	100	100	100	100	93	88	81	74	69	61	58	50	43	39	35	32	28	22	2C
TP19	2.0	100	100	100	100	100	82	74	67	58	52	45	42	38	33	30	27	26	23	18	2C
TP20	1.0	100	100	100	100	100	73	66	58	52	47	40	37	32	27	24	21	19	16	13	1A/1B
TP21	0.5	100	100	100	100	100	83	76	65	62	55	54	51	45	38	33	29	27	23	17	2C
TP23	0.5	100	100	100	81	81	48	46	44	40	38	36	34	31	28	25	22	20	18	14	1A/1B
TP24	0.5	100	100	100	100	100	85	78	71	66	64	59	57	53	48	44	39	35	29	20	2C

9.1.2 Excavations

Significant quantities of cobbles may be present within the Hummock Glacial Deposits which may present difficulties with excavation. Bedrock excavations is suitable for the initial 150mm from the top of the unit, excavations deeper into more competent bedrock may require heavier plant.

In accordance with Health and Safety Regulations, side support for safety purposes should be provided to all excavations which appear unstable and those more than 1.2m deep. Excavations are likely to be stable at suitable batters.

Noticeable amounts of standing water encountered within the excavations could result in weakening of the founding soils, whilst groundwater was not encountered in large quantities during the Intrusive works, there is still the potential for groundwater storage on the Site. As such, where encountered, the water should be

removed facilitating suitable methods such as sump pumping. General advice on de-watering in accordance with CIRIA Report C750: Groundwater Control (13) should be taken into consideration. The chosen contractor should provide details on how they intend to ensure the safety and stability of proposed excavations.

9.1.3 Groundwater

Given the presence of seepages within the Hummock Glacial Deposits, perched groundwater cannot be discounted and may be present in shallow excavations. Where groundwater is encountered, de-watering measures such as sump pumping are likely to be suitable.

9.2 Foundation Design

The Proposed Development comprises a BESS with an average expected loading of 50kN/m^2 based upon Datasheets for equipment provided by Field and loading calculations undertaken by Curtins Structural Engineers. Loads of c. 120 tonnes are anticipated associated with the transformers. It should be noted that the Site layout and equipment for use on the Site is still subject to change, as such further assessment may be required if design changes any further.

Control Building

Where the control building is proposed it is likely that Engineered Fill < 1.0m will be required, and therefore shallow foundations are likely to be suitable, founding in the Hummocky Deposits at c. 168 – 169m AOD.

Presuming a strip foundation, 0.45m wide and 20m long, an allowable bearing capacity of 100kPa is likely to be achievable within the granular Hummocky Glacial Deposits, described as a dense granular deposits. Settlement < 25mm is estimated. This should be validated onsite by an experienced geotechnical engineer. It is important that the foundation is cast wholly on one material type (i.e. weathered bedrock or Hummocky Glacial Deposits) to prevent excessive differential settlement.

A ground bearing floor slab is likely to be suitable founding on the Engineered Fill. An Earthworks Specification is required to detail the strength criteria and validation testing requirements of the formation layer.

Transformers and Batteries

The transformers are likely to be formed on a raft foundation. Due to the variable thicknesses of Engineered Fill likely to be required to achieve finished levels and the heavy loads anticipated, a detailed settlement assessment is required to inform the compaction criteria and validation testing requirements for an Earthworks Specification.

Where shallow bedrock is present shallow foundations are likely to be suitable, founding on the weathered mudstone or sandstone encountered at depths ranging between 166.85 and 191.50m AOD.

Based on published literature (12) a conservative presumed allowable bearing capacity of 150kPa should be assume, a conservative bearing capacity from published literature in the absence of rock data and assumed an extremely weak rock.

Should a raft solution be adopted, fill should be placed to an earthworks specification and a detailed settlement assessment should be undertaken to determine the material parameters required for the fill and to detail the compaction requirements, to ensure settlements are not excessive.

The engineering characteristics of any clayey and silty soils at shallow depth are particularly sensitive to changes in soil moisture content and will soften considerably when exposed to free water. It would therefore be prudent to program pavement construction for the dry summer months where possible. Where this is not possible, steps should be taken to protect construction activities in adverse weather, for example not placing any fill until compaction plant is on site to work it and excavating grips or temporary drainage ditches to collect run off and/ or groundwater during periods of particularly heavy rain.

9.3 Aggressive Ground Conditions

The classification of the site in terms of concrete in aggressive ground is based on the guidance provided in the Building Research Establishment (BRE) Special Digest 1 3rd Edition of 2017 (6). A summary of the results obtained during the ground investigation works are summarised in Table 6.7a. Table 6.7b summarises the classification, based on geology.

Table 9.2a *Summary of pH, sulphate and water soluble (2:1) sulphate testing*

Stratum	Test Type	Range
Hummock Glacial Deposits	pH	6.5 – 7.8
	Sulphate as SO_4 (total) (%)	0.01 – 0.04
	Sulphate aqueous extract as SO_4 (2:1) (mg/l)	<10 – 14

A total of four samples underwent water soluble sulphate and pH testing. Using BRE Special Digest 1, the Aggressive Chemical Environmental for Concrete (ACEC) classification has been derived from sulphate and pH values for each stratum. These are highlighted in Table 9.2b.

Table 9.2b *Aggressive Chemical Environment for Concrete (ACEC) Site Classification*

Stratum	Design Sulphate Class	ACEC Class (1)
Hummock Glacial Deposits	DS-1	AC-1

9.4 Hardstanding Design

CBR values are used to determine road pavement construction thicknesses. Twenty in-situ CBR tests were undertaken across the development site, and the test results ranged from 2.9% to >20%. Of the twenty results, only two recorded CBRs <5% (at depths of 0.00 and 0.15m bgl). Earthworks and final layout were not available

at the time of fieldwork. It felt prudent to undertake CBRs in the location where the access road was most likely to go and then undertake laboratory CBRs at a depth where earthworks are likely.

It should be noted that these tests were undertaken before earthworks. The higher values are thought to be reflective of cobbles within the Hummock Glacial Deposits and/or encountering underlying bedrock and do not reflect a realistic CBR value post-cut and fill.

Laboratory CBR testing was undertaken on three soil samples retrieved from depths of 0.50m to 1.00m, with results ranging from 0.8% to 7.7% with an average CBR of 4.57%.

Taking into consideration the in-situ CBR tests (by DCP) and laboratory results, a conservation CBR value of 4.5% is recommended for preliminary designs. Further in-situ CBR testing should be undertaken at formation level where hardstanding is proposed to confirm the CBR value used in preliminary design. Curtins will also expand our commentary and offer further clarification on different soil/rock types and likley level changes across the site once additional CBR tests are completed.

9.5 Drainage

The poor infiltration is likely a result of the clayey nature of the Hummock Glacial Deposits and impermeable nature of the mudstone bedrock. Soakaway type drainage is therefore not recommended.

10.0 Conclusions

10.1 Geo-Environmental

A revised tabulated Conceptual Site Model has been derived following the findings of the Generic Quantitative Risk Assessment and is presented in Section 8.0.

The environmental chemistry soil results have been compared with the Generic Assessment Criteria (GAC) for soils with respect to human health against Commercial thresholds. The results of environmental testing did not record any exceedances of contaminants above the adopted GACs, nor the presence of asbestos.

The risk to water environments was considered Low.

A review of the ground gas risk highlights no ground gas protection measures are required for the site.

The BGS Radon Mapping confirms that the site in a low probability radon area where less than 1% of homes are estimated to be at or above the action level. Therefore, no radon protective measures are necessary in the construction of new dwellings or extensions.

Where the new development incorporates a basement the advice of a specialist Radon assessor must be obtained.

10.2 Geotechnical

It is anticipated that a cut and fill will be undertaken to achieve formation level. Depending on the level of cut and location, cut materials are likely to comprise Hummock Glacial Deposits and/or weathered bedrock (Inshes Flagstone Formation – mudstone and sandstone). It is likely that the material will classify as a Class 1 or Class 2 Acceptable Earthworks Fill subject to the removal of overside material (>300mm).

The proposed development comprises a BESS with a maximum expected loading of 50kN/m^2. Site layout is subject to change and as such foundation advice should be considered as preliminary and detailed foundation design should be confirmed once final Site layout is agreed. Initially, a conservative presumed allowable bearing capacity of 150kPa for the Inshes Rock Formation should be assumed, we have provided a conservative bearing capacity from published literature in the absence of rock data and assumed an extremely weak rock, however, the cut and fill design indicates that cut in some players is >4.0m. As such further intrusive works may be required to confirm rock quality and ripability, utilising rotary drilling for the retrieval of rock cores for point load testing and unconfined compression test.

Should a raft solution be adopted, fill should be placed to an earthworks specification and a detailed settlement assessment should be undertaken to determine the material parameters required for the fill and to detail the compaction requirements, to ensure settlements are not excessive.

It is anticipated that earthworks will be required during the enabling works and shallow excavations during the construction phase. Given the presence of seepages within the Hummock Glacial Deposits, perched groundwater cannot be discounted and may be present in shallow excavations.

A conservative CBR value of 4.5% is recommended for preliminary designs, based on in-situ and laboratory CBR testing.

Infiltration testing in accordance with BRE365 was undertaken at one location (SA01) at the site. The soakaway test was unsuccessful due to the 75% and 25% drop in water levels being unachieved. The poor infiltration is likely a result of the clayey nature of the Hummock Glacial Deposits and impermeable nature of the mudstone bedrock. Soakaway type drainage is therefore not recommended. Further soakaway testing could be undertaken in proposed SUDs locations in the north of the Site.

10.3 Recommendations

In light of the ground investigation undertaken to-date across the development site, the following recommendations are made:

- Should a raft solution be adopted, Engineered Fill (Site won superficial deposits) should be placed to an earthworks specification and a detailed settlement assessment should be undertaken to determine the material parameters.
- Earthworks should be completed to an Earthworks specification. Site won material is recommended to be regraded to remove oversized constituents (>300m) to fit a suitable earthworks classification.
- Additional CBR testing is required at formation level during earthworks.
- Further intrusive investigation on the Inshes Formation should be undertaken to establish rock quality as the earthworks cut is deeper than initially anticipated. Investigation can include rotary core drilling and/or deep trial pits utilizing increased tonnage excavator with tooth bucket to 4.0m bgl.
- It is recommended that no further **environmental** works are considered necessary and based on this information a remediation strategy is not considered necessary.

11.0 References

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12.0 Appendices

Appendix A – Drawings

Appendix B – Supporting Information

Appendix C – Environmental Testing Results

Appendix D – Tier 1 Thresholds

Appendix E – Qualitative Risk Assessment Rationale

Appendix A - Drawings

Key

Cable Percussive Boreholes	CP
Machine Excavated Trial Pits	TP
Soakaway Tests	SA
CBR Test	CBR01

Rev:	Description:	Date:	By:	Chkd:
REV	ISSUED	23/04/24	MTL	CD

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Project:	KNOCKNAGAEL
Drg Title:	FINAL GROUND INVESTIGATION LOCATIONS
Status:	FINAL
Drawn By	MTL
Checked By	CD
Designed By	MTL
Date	12/04/24
Scales @ A3	NTS

Project No - Originator - Function - Spatial - Form - Discipline - Number	Revision
085444 - CUR - XX - XX - D - GE - 00002	P01

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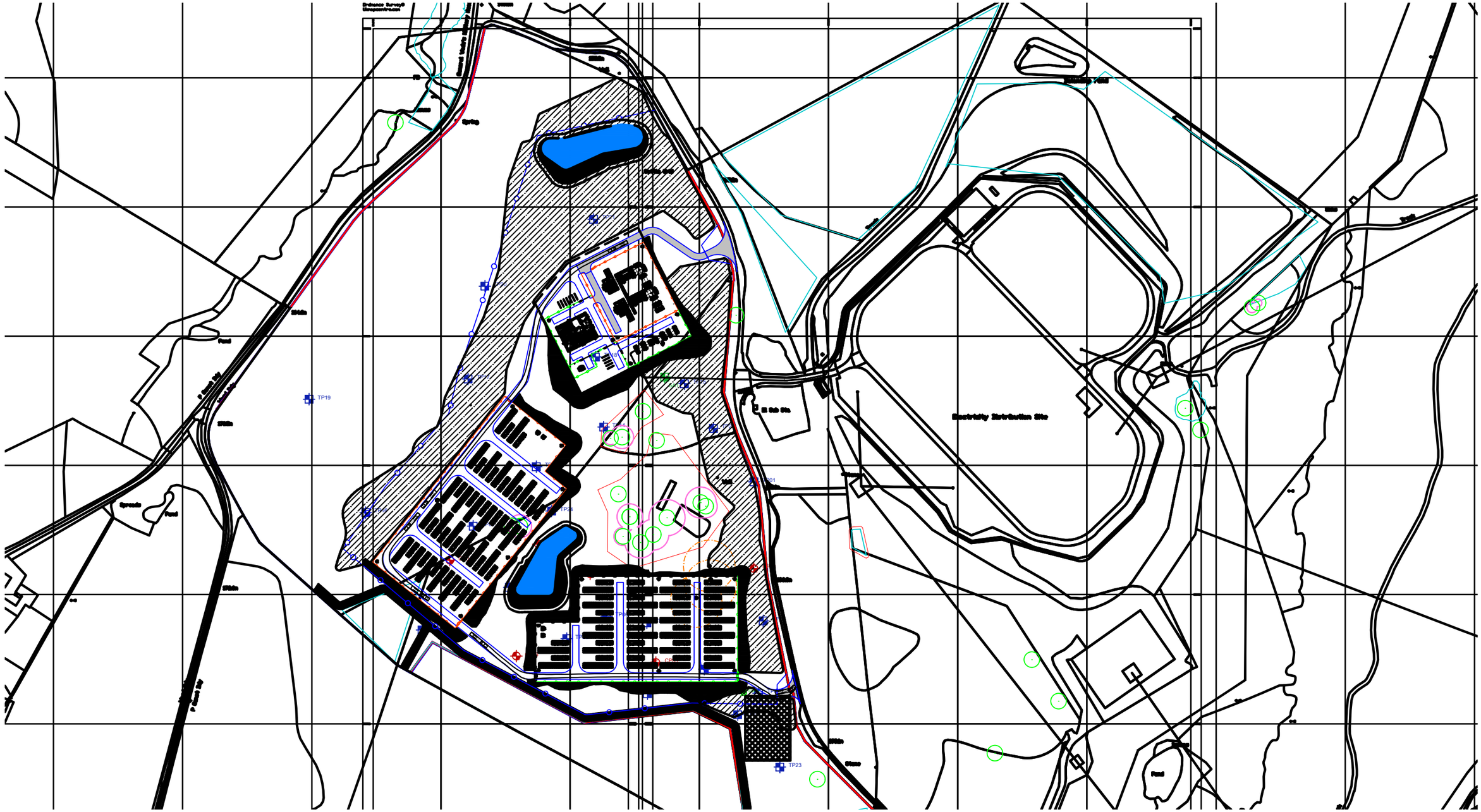

Key

Cable Percussive Boreholes	CP
Machine Excavated Trial Pits	TP
Soakaway Tests	SA
CBR Test	CBR01

Rev:	Description:	Date:	By:	Chkd:
REV	ISSUED	23/04/24	MTL	CD

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Project:	KNOCKNAGAEL
Drg Title:	UPDATED SITE LAYOUT
Status:	FINAL
Drawn By	MTL
Checked By	CD
Designed By	MTL
Date	28/06/24
Scales @ A3	NTS

Project No - Originator - Function - Spatial - Form - Discipline - Number	Revision
085444 - CUR - XX - XX - D - GE - 00003	P02

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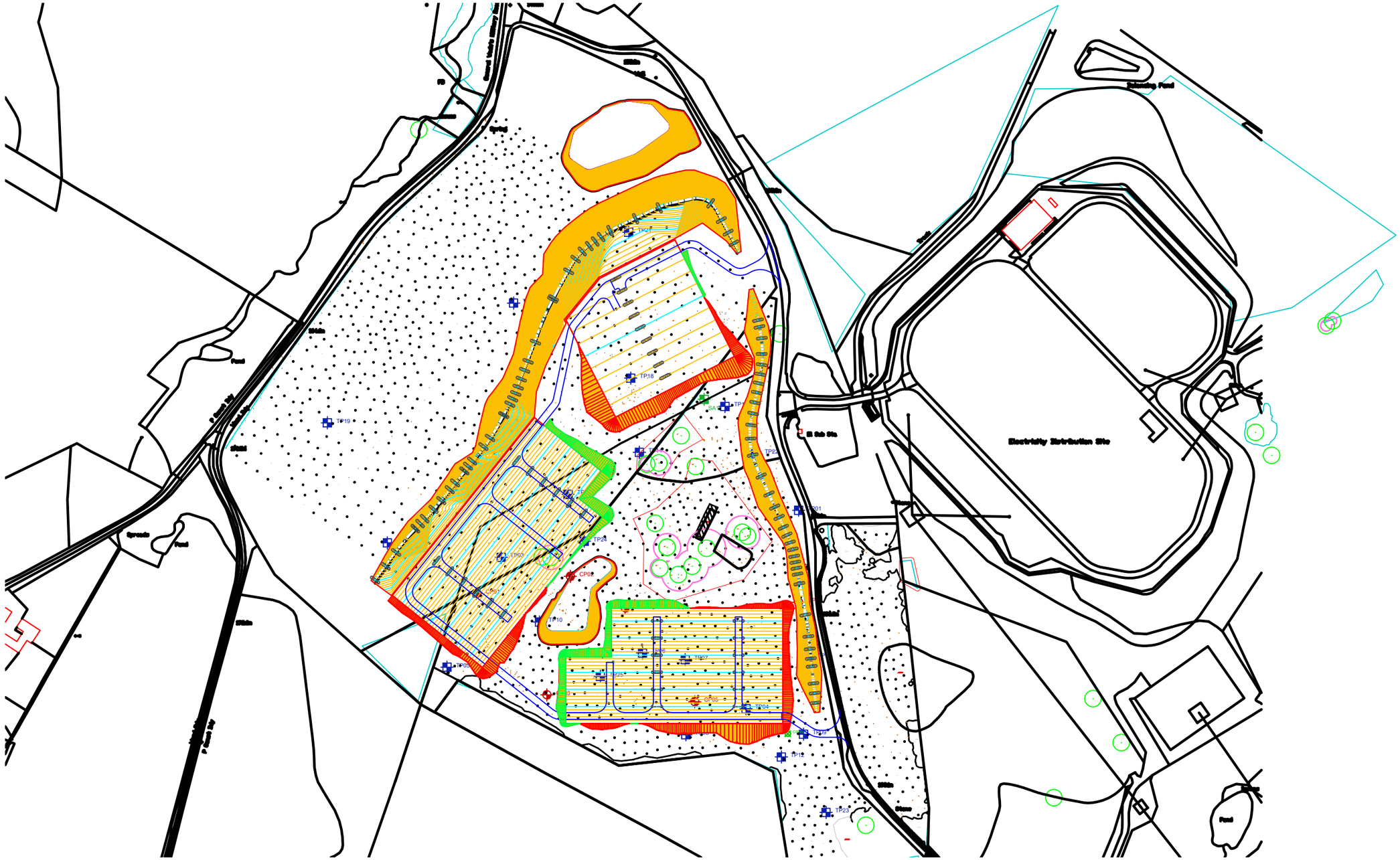

Key

Cable Percussive Boreholes	CP
Machine Excavated Trial Pits	TP
Soakaway Tests	SA
CBR Test	CBR01

REV	ISSUED	23/04/24	MTL	CD
Rev:	Description:	Date:	By:	Chkd:

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Project: KNOCKNAGAEL		Status: FINAL	
Drg Title: CUT & FILL SITE LAYOUT		Drawn By MTL	Checked By CD
		Designed By MTL	Date 24/06/24
		Scales @ A3 NTS	
Project No - Originator - Function - Spatial - Form - Discipline - Number			Revision
085444 - CUR - XX - XX - D - GE - 00004			P01

\\ed-fs-1\Projects\Vision Job Numbers\085444 - Knocknagael, Inverness\Q4-Production\4A-Models-Drawings\GE\CAD\XREF\

Appendix B – Supporting Information

Trial Pit Log

Trialpit No
SA01
Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 264973.20 - 839068.40 Level: 172.99	Date 12/02/2024
Location: Inverness		Dimensions (m): Depth 1.60	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	172.79		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
							Light brown very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles angular of mudstone.
				1.30	171.69		MUDSTONE
				1.60	171.39		End of pit at 1.60 m

1
2
3
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Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No **TP01**

Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 265042.30 - 838987.30 Level: 181.72	Date 13/02/2024
Location: Inverness		Dimensions (m): Depth 1.20	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	ES		0.15	181.57		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
				0.20	181.52		Light brown very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone and sandstone.
	0.50	BB					Grey very gravelly clayey fine to coarse sub angular SAND with very high cobble content. Cobbles angular of mudstone.
	1.00	BB		1.00	180.72		MUDSTONE
				1.20	180.52		End of pit at 1.20 m

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No
TP02
Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 264877.40 - 838990.90 Level: 176.19	Date 13/02/2024
Location: Inverness		Dimensions (m): Depth 0.90	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	175.99		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
▼	0.50 0.50	BB ES		0.70	175.49		Light brown very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone and sandstone.
				0.90	175.29		SANDSTONE End of pit at 0.90 m

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No **TP03**

Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 264781.70 - 838954.70 Level: 176.34	Date 14/02/2024
Location: Inverness		Dimensions (m): Depth 1.00	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	ES		0.15	176.19		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
	0.60	BB					Light brown very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone and sandstone.
▼				0.90	175.44		SANDSTONE
				1.10	175.24		End of pit at 1.00 m

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No **TP04**

Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 265015.50 - 838830.00 Level: 189.43	Date 13/02/2024
Location: Inverness		Dimensions (m): Depth 1.00	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	ES					TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
				0.20	189.22		Light brown very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone and sandstone.
	0.50	BB					
				0.80	188.62		SANDSTONE
				1.00	188.42		End of pit at 1.00 m

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No **TP05**

Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 264804.70 - 838888.50 Level: 179.46	Date 13/02/2024
Location: Inverness		Dimensions (m): Depth 0.70	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20	179.26		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
▼	0.50 0.50	BB ES		0.60	178.86		Grey very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone.
				0.80	178.66		MUDSTONE End of pit at 0.70 m

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No
TP06
Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 264864.90 - 838874.20 Level: 183.08	Date 13/02/2024
Location: Inverness		Dimensions (m): Depth 0.60	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	ES		0.20	182.88		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
	0.30	BB					Light brown very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone and sandstone.
				1.40	181.68		SANDSTONE
				1.60	181.48		End of pit at 0.60 m

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2
3
4

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No
TP07
Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 264976.10 - 838886.60 Level: 187.67	Date 13/02/2024
Location: Inverness		Dimensions (m): Depth 0.80	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.10	187.57		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets Light brown very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone and sandstone.
	0.50 0.50	BB ES					
				0.60	187.07		SANDSTONE
				0.80	186.87		End of pit at 0.80 m

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No **TP08**

Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 264975.00 - 838816.30 Level: 189.01	Date 13/02/2024
Location: Inverness		Dimensions (m): Depth 1.00	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20	188.81		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
	0.50	ES					Light brown very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone and sandstone.
	0.60	BB					
				0.90	188.11		SANDSTONE
				1.10	187.91		End of pit at 1.00 m

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No **TP09**

Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 265061.80 - 838831.80 Level: 189.01	Date 13/02/2024
Location: Inverness		Dimensions (m): Depth 1.50	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20	188.81		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
	0.50	ES					Light brown very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone and sandstone.
	1.00	BB					
				1.40	187.61		SANDSTONE
				1.60	187.41		End of pit at 1.50 m

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No
TP10
Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 264845.90 - 838899.50 Level: 181.10	Date 13/02/2024
Location: Inverness		Dimensions (m): Depth 0.70	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.50 0.50	BB ES		0.20	180.90		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
				0.60	180.50		Light brown very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone and sandstone.
				0.80	180.30		SANDSTONE End of pit at 0.70 m

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No
TP11
Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 265041.00 - 838931.70 Level: 185.35	Date 13/02/2024
Location: Inverness		Dimensions (m): Depth 0.80	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.10	185.25		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
	0.50 0.50	BB ES					Light brown very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone and sandstone.
				0.65	184.70		SANDSTONE
				0.80	184.55		End of pit at 0.80 m

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No
TP12
Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 265037.10 - 838779.00 Level: 192.80	Date 13/02/2024
Location: Inverness		Dimensions (m): Depth 1.40	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10	192.70		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
	0.50 0.50	BB ES					Light brown very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone and sandstone.
	1.00	BB					
				1.30	191.50		SANDSTONE
				1.50	191.30		End of pit at 1.40 m

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No **TP14**

Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 264930.40 - 839041.50 Level: 173.78	Date 14/02/2024
Location: Inverness		Dimensions (m): Depth 0.40	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	ES					TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
				0.20	173.58		MUDSTONE
	0.30	BB					
				0.40	173.38		End of pit at 0.40 m

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No **TP15**

Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 264977.70 - 839059.60 Level: 174.24	Date 12/02/2024
Location: Inverness		Dimensions (m): Depth 1.20	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.25	173.99		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
	0.40 0.40	BB ES		0.50	173.74		Light brown very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles angular of mudstone.
	0.90 0.90	BB ES		1.00	173.24		Grey very gravelly clayey fine to coarse sub angular SAND with very high cobble content. Cobbles angular of mudstone.
				1.20	173.04		MUDSTONE End of pit at 1.20 m

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No **TP16**

Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 264715.60 - 838968.60 Level: 175.60	Date 14/02/2024
Location: Inverness		Dimensions (m): Depth 1.20	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	ES					TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
				0.20	175.40		Grey very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone.
	1.00	BB					
				1.10	174.50		MUDSTONE
							End of pit at 1.20 m
				1.30	174.30		

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No
TP17
Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 264775.50 - 839045.30 Level: 174.11	Date 14/02/2024
Location: Inverness		Dimensions (m): Depth 1.60	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.30	173.81		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
	1.00	BB					Grey very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone.
				1.50	172.61		MUDSTONE
							End of pit at 1.60 m
				1.70	172.41		

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No **TP18**

Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 264927.10 - 839091.20 Level: 172.14	Date 14/02/2024
Location: Inverness		Dimensions (m): Depth 0.90	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.30	171.84		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
	0.50 0.50	BB ES					Grey very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone.
				0.80	171.34		MUDSTONE
							End of pit at 0.90 m
				1.00	171.14		

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No **TP19** Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 264688.30 - 839055.70 Level: 170.09	Date 14/02/2024
Location: Inverness		Dimensions (m): Depth 2.50	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.60	169.49		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
	0.70	ES					Soft grey sandy silty CLAY
	1.00	BB					
	2.00	BB		2.00	168.09		MUDSTONE
				2.50	167.59		End of pit at 2.50 m

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No **TP20**

Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 264801.80 - 839102.20 Level: 170.50	Date 14/02/2024
Location: Inverness		Dimensions (m): Depth 1.60	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20	170.30		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
	0.50	ES					Grey very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone.
	1.00	BB					
				1.50	169.00		MUDSTONE
							End of pit at 1.60 m
				1.70	168.80		

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No **TP21**

Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 264879.90 - 839138.10 Level: 168.35	Date 14/02/2024
Location: Inverness		Dimensions (m): Depth 1.00	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20	168.14		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
	0.50	BB					Grey very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone.
				1.50	166.84		MUDSTONE
				1.70	166.64		End of pit at 1.00 m

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No **TP22**

Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 265009.30 - 839040.70 Level: 178.54	Date 12/02/2024
Location: Inverness		Dimensions (m): Depth 1.60	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	178.34		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
	0.30	BB		0.50	178.04		Light brown very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles angular of mudstone.
	0.80	ES					Grey very gravelly clayey fine to coarse sub angular SAND with very high cobble content. Cobbles angular of mudstone.
	1.00	BB					
				1.50	177.04		MUDSTONE
				1.60	176.94		End of pit at 1.60 m

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No
TP23
Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 265059.10 - 838772.70 Level: 192.45	Date 13/02/2024
Location: Inverness		Dimensions (m): Depth 1.50	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.10	192.35		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
	0.30	BB					Light brown very gravelly clayey fine to coarse sub angular SAND with high cobble content. Cobbles sub angular to angular of mudstone and sandstone.
	0.50	BB					
				1.40	191.05		SANDSTONE
							End of pit at 1.50 m
				1.60	190.85		

1
2
3
4

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Trial Pit Log

Trialpit No **TP24**

Sheet 1 of 1

Project Name: Knocknagael, Inverness	Project No. 085444	Co-ords: 264888.00 - 838957.30 Level: 178.69	Date 13/02/2024
Location: Inverness		Dimensions (m): Depth 0.60	Scale 1:20
Client: Field Energy			Logged ML

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20	178.49		TOPSOIL. Dark brown very gravelly silty sand with very fine rootlets
	0.50 0.50	BB ES		0.50	178.19		Light brown very gravelly clayey fine to coarse sub angular SANDSTONE with high cobble content. Cobbles sub angular to angular of mudstone and sandstone.
				0.70	177.99		SANDSTONE End of pit at 0.60 m

Remarks: No Groundwater Encountered. Pit Terminated on rockhead.

Stability:

Borehole Log

Drilling Ltd

Borehole No. CP01

Sheet 1 of 1

Project Name:	Knocknagael	**Project No.** GD 0718	**Co-ords:**	E: 264806.8 N: 838926.6	**Hole Type** WS
Location:	Inverness		**Level:**	178.00	**Scale** 1:25
Client:	Curtins		**Dates:**	13/02/2024	**Rig Type** Competitor Dart

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.10	ES					Grass over dark brown sandy TOPSOIL with occasional rootlets and broken sandstone. Driller's description.
		0.40	ES		0.45	177.55		Firm to stiff reddish brown weathered sandy gravelly CLAY. Driller's description.
		0.80	B		0.70	177.30		Reddish purple sandy angular fine to coarse GRAVEL of sandstone with frequent angular cobbles of sandstone (presumed weathered bedrock). Sand is fine to coarse.
	▼	1.00	ES					
		1.20 - 1.40	D		1.20	176.80		Extremely weak reddish purple SANSTONE, recovered as a fine to coarse gravel (presumed weathered bedrock).
		1.20	SPT	50 (25 for 100mm/50 for 100mm)	1.40	176.60		*No further progress, presumed bedrock.* End of Borehole at 1.40m

1 2 3 4 5

Remarks:

Inspection pit dug to a depth of 1.20m. Borehole progressed with windowless sampling techniques to a depth of 1.40m and terminated on presumed bedrock. Slight Seepage at 1.00m. Borehole fitted with a wellpoint on completion.

Logged By:	Checked By:
KP	GD

Drilling Ltd

FINAL

Borehole Log

Drilling Ltd

Borehole No. CP02

Sheet 1 of 1

Project Name:	Knocknagael	**Project No.** GD 0718	**Co-ords:**	E: 264875.4 N: 838939.0	**Hole Type** WS
Location:	Inverness		**Level:**	179.33	**Scale** 1:25
Client:	Curtins		**Dates:**	14/02/2024	**Rig Type** Competitor Dart

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	ES					Grass over dark brown sandy TOPSOIL with occasional rootlets and broken sandstone. Driller's description.
		0.50	ES		0.40	178.93		Reddish brown clayey very gravelly fine to coarse SAND. Gravel is angular and subangular fine to coarse of various lithologies including frequent sandstone.
		0.80	B					
		1.00	ES					
	▼	1.20 - 1.60	D					
		1.20	SPT	N=50 (12,12/50 for 250mm)	1.30	178.03		Extremely weak reddish purple SANSTONE, recovered as a fine to coarse gravel (presumed weathered bedrock).
					1.60	177.73		*No further progress, presumed bedrock.* End of Borehole at 1.60m

1 2 3 4 5

Remarks:

Inspection pit dug to a depth of 1.20m. Borehole progressed with windowless sampling techniques to a depth of 1.60m and terminated on presumed bedrock. Slight Seepage at 1.20m. Borehole fitted with a wellpoint on completion.

Logged By:	Checked By:
KP	GD

Drilling Ltd

FINAL

Drilling Ltd

Borehole Log

Borehole No. **CP03**

Sheet 1 of 1

Project Name:	Knocknagael	**Project No.** GD 0718	**Co-ords:**	E: 264858.3 N: 838852.4	**Hole Type** WS
Location:	Inverness		**Level:**	183.32	**Scale** 1:25
Client:	Curtins		**Dates:**	13/02/2024	**Rig Type** Competitor Dart

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.25	183.07		Grass over dark brown sandy TOPSOIL with occasional rootlets and cobbles. Driller's description.
		0.40	ES					Brown very clayey SAND and GRAVEL. Driller's description.
					0.50	182.82		Brown clayey very gravelly fine to coarse SAND with occasional cobbles. Gravel is angular and subangular fine to coarse of predominantly sandstone. Cobbles are angular of sandstone.
		0.80	B					
		1.00	ES					
		1.20 - 1.45	D		1.20	182.12		Extremely weak reddish purple SANSTONE, recovered as a fine to coarse gravel (presumed weathered bedrock).
		1.20	SPT	50 (11,14/50 for 100mm)				
					1.45	181.87		*No further progress, presumed bedrock.* End of Borehole at 1.45m

1 2 3 4 5

Remarks:

Inspection pit dug to a depth of 1.20m. Borehole progressed with windowless sampling techniques to a depth of 1.45m and terminated on presumed bedrock. No groundwater encountered. Borehole fitted with a wellpoint on completion.

Logged By:	Checked By:
KP	GD

Drilling Ltd

FINAL

Drilling Ltd

Borehole Log

Borehole No. **CP04**

Sheet 1 of 1

Project Name:	Knocknagael	**Project No.** GD 0718	**Co-ords:**	E: 264915.4 N: 838916.0	**Hole Type** WS
Location:	Inverness		**Level:**	181.09	**Scale** 1:25
Client:	Curtins		**Dates:**	14/02/2024	**Rig Type** Competitor Dart

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	ES					Grass over dark brown sandy TOPSOIL with occasional rootlets and cobbles. Driller's description.
		0.50	ES		0.45	180.64		Brown clayey very sandy angular and subangular fine to coarse GRAVEL of predominantly sandstone. Sand is fine to coarse. Frequent angular cobbles of sandstone noted.
		0.80	B					
	▼	1.00	ES					
		1.20 - 1.50	D		1.10	179.99		Extremely weak reddish purple SANSTONE, recovered as a fine to coarse gravel (presumed weathered bedrock).
		1.20	SPT	50 (10,14/50 for 200mm)				
					1.55	179.54		*No further progress, presumed bedrock.* End of Borehole at 1.55m

Remarks:

Inspection pit dug to a depth of 1.20m. Borehole progressed with windowless sampling techniques to a depth of 1.55m and terminated on presumed bedrock. Slight Seepage at 1.00m. Borehole fitted with a wellpoint on completion.

Logged By:	Checked By:
KP	GD

Drilling Ltd

FINAL

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Borehole Log

Borehole No. **CP05**

Sheet 1 of 1

Project Name:	Knocknagael	**Project No.** GD 0718	**Co-ords:**	E: 264966.4 N: 838847.4	**Hole Type** WS
Location:	Inverness		**Level:**	188.68	**Scale** 1:25
Client:	Curtins		**Dates:**	13/02/2024	**Rig Type** Competitor Dart

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	ES		0.15	188.53		Grass over dark brown sandy TOPSOIL with occasional rootlets and cobbles. Driller's description.
		0.40	ES		0.50	188.18		Brown very clayey SAND and GRAVEL. Driller's description.
		0.80	B					Brown slightly silty very gravelly fine to coarse SAND with frequent pockets of firm gravelly clay. Gravel is angular of predominantly siltstone, sandstone and mudstone. .
		1.00	ES					
		1.20 - 1.65 1.20	D SPT	N=37 (8,8/8,8,9,12)				
		1.80	B		1.50	187.18		Firm brown slightly sandy gravelly CLAY. Gravel is angular of predominantly siltstone, sandstone and mudstone. .
		2.00 - 2.30 2.00	D SPT	50 (12,12/50 for 150mm)	2.10	186.58		Extremely weak reddish purple SANSTONE, recovered as a fine to coarse gravel (presumed weathered bedrock).
					2.30	186.38		*No further progress, presumed bedrock.* End of Borehole at 2.30m

1 2 3 4 5

Remarks:

Inspection pit dug to a depth of 1.20m. Borehole progressed with windowless sampling techniques to a depth of 2.30m and terminated on presumed bedrock. No groundwater encountered. Borehole fitted with a wellpoint on completion.

Logged By:	Checked By:
KP	GD

Drilling Ltd

FINAL

Drilling Ltd

Borehole Log

Borehole No. **CP06**

Sheet 1 of 1

Project Name:	Knocknagael	**Project No.** GD 0718	**Co-ords:**	E: 265042.1 N: 838920.1	**Hole Type** CP
Location:	Inverness		**Level:**	185.95	**Scale** 1:25
Client:	Curtins		**Dates:**	12/02/2024	**Rig Type** DANDO 2000

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.30	185.65		Grass over dark brown sandy TOPSOIL with occasional rootlets and cobbles. Driller's description.
		0.50	ES					Soft brown very sandy very gravelly CLAY with occasional angular cobbles. Gravel is subangular fine to coarse of predominantly sandstone. Cobbles are subangular of sandstone.
		0.80	B					
		1.00	ES		1.00	184.95		
					1.10	184.85		Extremely weak reddish purple SANSTONE, recovered as a fine to coarse gravel (presumed weathered bedrock).
								No further progress, presumed bedrock.
								End of Borehole at 1.10m

1 2 3 4 5

Remarks:

Inspection pit dug to a depth of 1.10m and terminated on presumed bedrock. No groundwater encountered. Borehole fitted with a wellpoint on completion.

Logged By:	Checked By:
KP	GD

Drilling Ltd

FINAL

Curtins Ltd
1a Belford Mews, Edinburgh
Tel: 0121 643 4694

CALCULATION SHEET - SOIL INFILTRATION RATE

Project:	Knocknagael, Inverness
Job Number:	085444
Author:	KD

Hole Ref.:	SA01
Test Date:	12/02/2024
Test No.:	1 of 1

1.80	m	Length of trial pit
0.60	m	Width of trial pit
1.60	m	Depth (total) of trial pit
1.08	m^2	Area of trial pit base
0.62	m bgl	Water level at start of test (approximate invert level)
0.65	m bgl	Water level at end of test
0.03	m	Effective storage depth
0.63	m bgl	Effective storage depth (75% full)
0.64	m bgl	Effective storage depth (25% full)
0.016	**m^3**	**Effective storage volume (V_{75-25})**
1.152	**m^2**	**Internal surface area (50% effective depth) (a_{50})**
3420	**s**	**Time for head to fall from 75% to 25% effective depth (t_{75-25})**

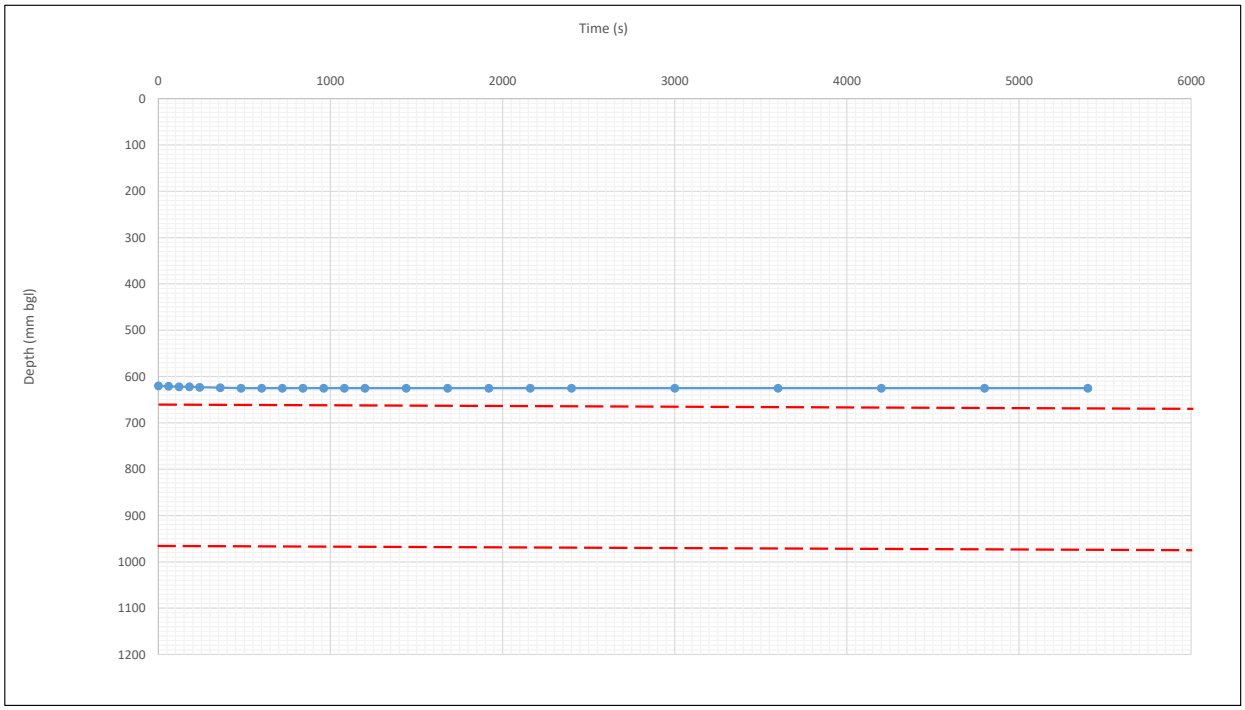
4.11E-06	**m/s**	**Soil infiltration rate (f)**

RAW DATA

Project:	Knocknagael, Inverness
Job Number:	085444
Author:	KD

Hole Ref.:	SA01
Test Date:	12/02/2024
Test No.:	1 of 1

Time (min)	Time (s)	Depth (mm bgl)	Stratum
0	0	620	**Light brown very gravelly clayey fine to coarse sub angular SAND with high cobble content/MUDSTONE**
1	60	621	
2	120	622	
3	180	622	
4	240	623	
6	360	624	
8	480	625	
10	600	625	
12	720	625	
14	840	625	
16	960	625	
18	1080	625	
20	1200	625	
24	1440	625	
28	1680	625	
32	1920	625	
36	2160	625	
40	2400	625	
50	3000	625	
60	3600	625	
70	4200	625	
80	4800	625	
90	5400	625	



Note 1: Pit backfilled with arisings.

Curtins
Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
Tel: 0161 236 2394
Fax: 0161 228 7902

GAS MONITORING LOG SHEET

Project:	Knocknagael	**Date:**	13/03/2024
Job Number:	####	**Visit:**	1
Client:	Field.Energy	**Weather:**	Weather
Barometric State:	Stable	**Ground Conditions:**	Dry

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
CP01	996	0.0	0.0	0.0	0.0	0.3	0.3	20.1	0	0	DAMP	1.15	
CP02	996	0.0	0.0	0.0	0.0	0.1	0.1	20.5	0	0	DAMP	1.20	
CP03	996	0.0	0.0	0.0	0.0	0.1	0.1	20.3	0	0	DAMP	1.18	
CP04	996	0.0	0.0	0.0	0.0	0.2	0.2	20.9	0	0	1.15	1.20	
CP05	996	0.0	0.0	0.0	0.0	0.1	0.1	21.1	0	0	DAMP	1.95	
CP06	996	0.0	0.0	0.0	0.0	0.1	0.1	20.4	0	0	DAMP	1.05	

Notes

Logged by

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

Curtins
Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
Tel: 0161 236 2394
Fax: 0161 228 7902

GAS MONITORING LOG SHEET

Project:	Knocknagael	**Date:**	27/03/2024
Job Number:	####	**Visit:**	2
Client:	Field.Energy	**Weather:**	Wet
Barometric State:	Stable	**Ground Conditions:**	Wet

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
CP01	986	0.0	0.0	0.0	0.0	0.2	0.2	20.40	0	0	DAMP	1.15	
CP02	986	0.0	0.0	0.0	0.0	0.1	0.1	20.60	0	0	DAMP	1.20	
CP03	986	0.0	0.0	0.0	0.0	0.1	0.1	20.50	0	0	DAMP	1.18	
CP04	986	0.0	0.0	0.0	0.0	0.1	0.1	20.80	0	0	1.16	1.20	
CP05	986	0.0	0.0	0.0	0.0	0.1	0.1	21.00	0	0	DAMP	1.95	
CP06	986	0.0	0.0	0.0	0.0	0.1	0.1	20.5	0	0	DAMP	1.05	
0													
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Notes

Logged by

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

Curtins
Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
Tel: 0161 236 2394
Fax: 0161 228 7902

GAS MONITORING LOG SHEET

Project:	Knocknagael	**Date:**	09/04/2024
Job Number:	####	**Visit:**	3
Client:	Field.Energy	**Weather:**	Wet
Barometric State:	Steady	**Ground Conditions:**	Wet

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
CP01	1004	0.0	0.0	0.0	0.0	0.2	0.2	20.2	0	0	DAMP	1.15	
CP02	1004	0.0	0.0	0.0	0.0	0.1	0.1	20.5	0	0	DAMP	1.20	
CP03	1004	0.0	0.0	0.0	0.0	0.2	0.2	20.4	0	0	DAMP	1.18	
CP04	1004	0.0	0.0	0.0	0.0	0.1	0.1	20.6	0	0	DAMP	1.20	
CP05	1004	0.0	0.0	0.0	0.0	0.1	0.1	21.1	0	0	DAMP	1.95	
CP06	1004	0.0	0.0	0.0	0.0	0.1	0.1	20.1	0	0	DAMP	1.05	
0													
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Notes

Logged by

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

LABORATORY TEST CERTIFICATE

MATtest Limited
materials testing & consultancy

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

Tel: 0141 774 4032

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

Certificate No : **24/260 - 01-1**

To : **Mark Lane**

Client : **Curtins Ltd.**
1a Belford Road
Edinburgh
EH4 3BL

LABORATORY TESTING OF SOIL

Introduction

We refer to samples taken from Knock and delivered to our laboratory on 20th February 2024.

Material & Source

Sample Reference	:	See Report Plates
Sampled By	:	Client
Sampling Certificate	:	Not Supplied
Location	:	See Report Plates
Description	:	See Page 2
Date Sampled	:	Not Supplied
Date Tested	:	28th February 2024 Onwards
Source	:	085444 - Knock

Test Results

As Detailed On Page 2 to Page 32 inclusive

Comments

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

Remarks

Approved for Issue

T McLelland (Director)

Date 18/03/2024

UKAS TESTING
2643

TRIAL PIT	SAMPLE	DEPTH (m)	SAMPLE DESCRIPTION
TP01	B	0.50	Brown silty fine to coarse CRUSHED ROCK with cobbles.
TP02	B	0.50	Brown slightly clayey sandy fine to coarse SAND and GRAVEL / CRUSHED ROCK with cobbles.
TP03	B	0.60	Brown slightly clayey silty fine to coarse SAND and GRAVEL.
TP08	B	0.50	Brown slightly clayey silty sandy fine to coarse GRAVEL with cobbles.
TP10	B	0.50	Brown very silty sandy fine to coarse GRAVEL / CRUSHED ROCK with cobbles.
TP11	B	0.50	Brown silty very clayey fine to coarse CRUSHED ROCK / SAND and GRAVEL with cobbles.
TP12	B	1.00	Brown slightly clayey very silty very sandy fine to coarse GRAVEL.
TP16	B	0.50	Brown slightly silty clayey fine to coarse SAND and GRAVEL / CRUSHED ROCK.
TP16	B	0.90	Brown slightly clayey very silty fine to coarse SAND and GRAVEL with cobbles.
TP19	B	1.00	Brown clayey very silty fine to coarse SAND and GRAVEL.
TP19	B	2.00	Brown slightly clayey silty very sandy fine to coarse GRAVEL with cobbles.
TP20	B	1.00	Brown silty slightly clayey fine to coarse SAND and GRAVEL / CRUSHED ROCK.
TP21	B	0.50	Brown slightly clayey silty fine to coarse SAND and GRAVEL with cobbles.
TP22	B	1.00	Brown slightly silty very clayey fine to coarse CRUSHED ROCK.
TP23	B	0.50	Brown slightly silty clayey fine to cobble-sized CRUSHED ROCK.
TP24	B	0.50	Brown slightly clayey silty fine to coarse SAND and GRAVEL / CRUSHED ROCK.

SUMMARY OF SAMPLE DESCRIPTIONS

TRIAL PIT	SAMPLE	DEPTH (m)	WATER CONTENT (%)
TP01	B	0.50	7.5
TP02	B	0.50	10.4
TP03	B	0.60	10.4
TP08	B	0.50	12.8
TP10	B	0.50	10.7
TP11	B	0.50	10.3
TP12	B	1.00	10.4
TP16	B	0.50	11.1
TP16	B	0.90	11.8
TP19	B	1.00	19.7
TP20	B	1.00	13.1
TP21	B	0.50	19.6
TP22	B	1.00	11.1
TP23	B	0.50	8.5
TP24	B	0.50	14.0

Tested in accordance with BS 1377 - 2 : 2022 : Clause 4.1

SUMMARY OF WATER CONTENT TEST RESULTS

TRIAL PIT	SAMPLE	DEPTH (m)	WATER CONTENT (%)	BULK DENSITY (Mg/m^3)	DRY DENSITY (Mg/m^3)
TP01	B	0.50	7.5	1.92	1.79
TP08	B	0.50	12.8	2.08	1.84
TP11	B	0.50	10.3	2.16	1.96
TP16	B	0.90	11.8	2.15	1.92
TP23	B	0.50	8.5	2.14	1.97

Tested in accordance with BS 1377 - 2 : 2022 : Clause 8
Bulk Density : Linear Measurement

SUMMARY OF WATER CONTENT AND BULK DENSITY TEST RESULTS

TRIAL PIT	SAMPLE	DEPTH (m)	PARTICLE DENSITY (Mg/m³)
TP01	B	0.50	2.55
TP08	B	0.50	2.53
TP11	B	0.50	2.52
TP16	B	0.90	2.51
TP23	B	0.50	2.54

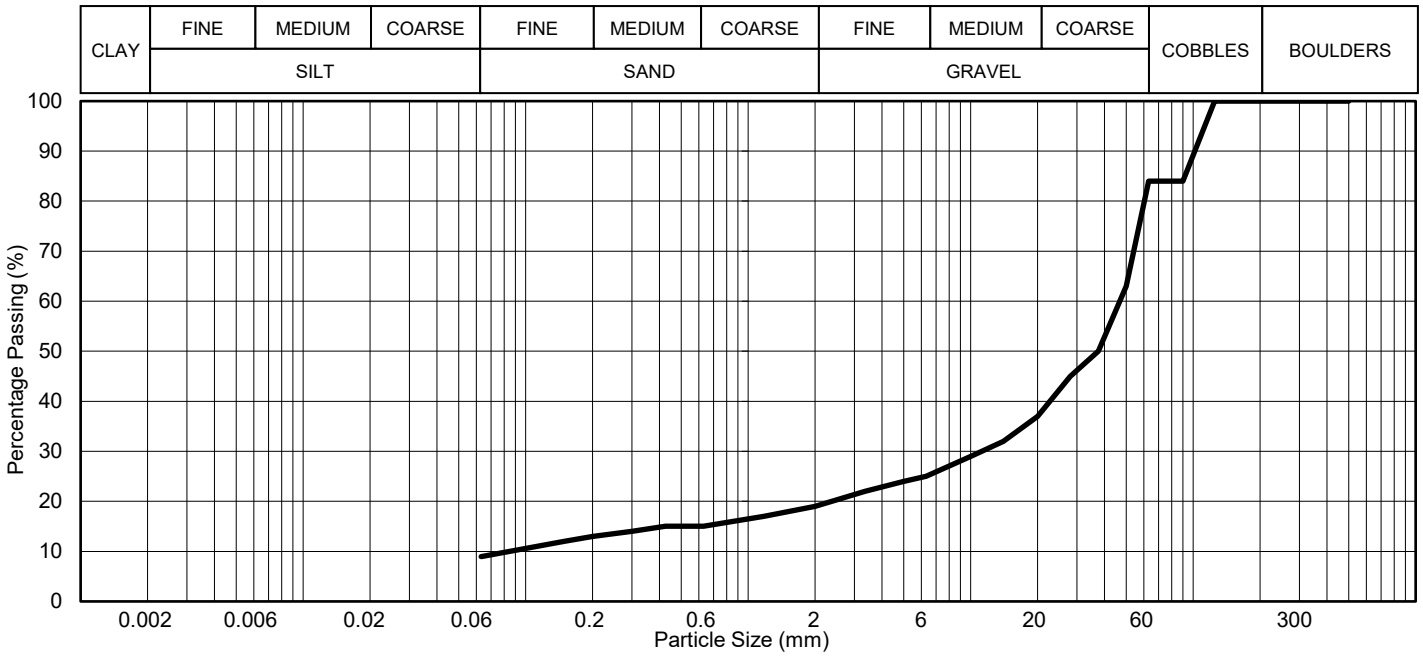
Tested in accordance with BS 1377 - 2 : 2022 : Clause 9.2
(Gas jar method)

SUMMARY OF PARTICLE DENSITY TEST RESULTS

CURTINS LTD.
KNOCK

MATtest Limited
materials testing & consultancy

Borehole	TP01
Sample	B
Depth (m)	0.50



SIEVING				SEDIMENTATION (Assumed ρs of 2.65Mg/m³)	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.0200	
300.0	100	-	-	0.0063	
125.0	100	-	-	0.0020	
90.0	84	-	-		
75.0	84	-	-		
63.0	84	-	-		
50.0	63	-	-		
37.5	50	-	-		
28.0	45	-	-		
20.0	37	-	-		
14.0	32	-	-		
10.0	29	-	-		
6.3	25	-	-		
5.0	24	-	-		
3.350	22	-	-		
2.000	19	-	-		
1.180	17	-	-		
0.630	15	-	-		
0.600	15	-	-		
0.425	15	-	-		
0.300	14	-	-		
0.200	13	-	-		
0.150	12	-	-		
0.063	9	-	-		

GRADING CLASSIFICATION (SHW TABLE 6/2)

-

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

PERCENTAGE SOIL TYPES

CLAY	SILT ₸	SAND	GRAVEL	COBBLES
/	9	10	65	16

UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

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

Sample does not meet minimum mass requirement for material type

PARTICLE SIZE DISTRIBUTION - BS 1377 - 2 : 2022 : CLAUSE 10

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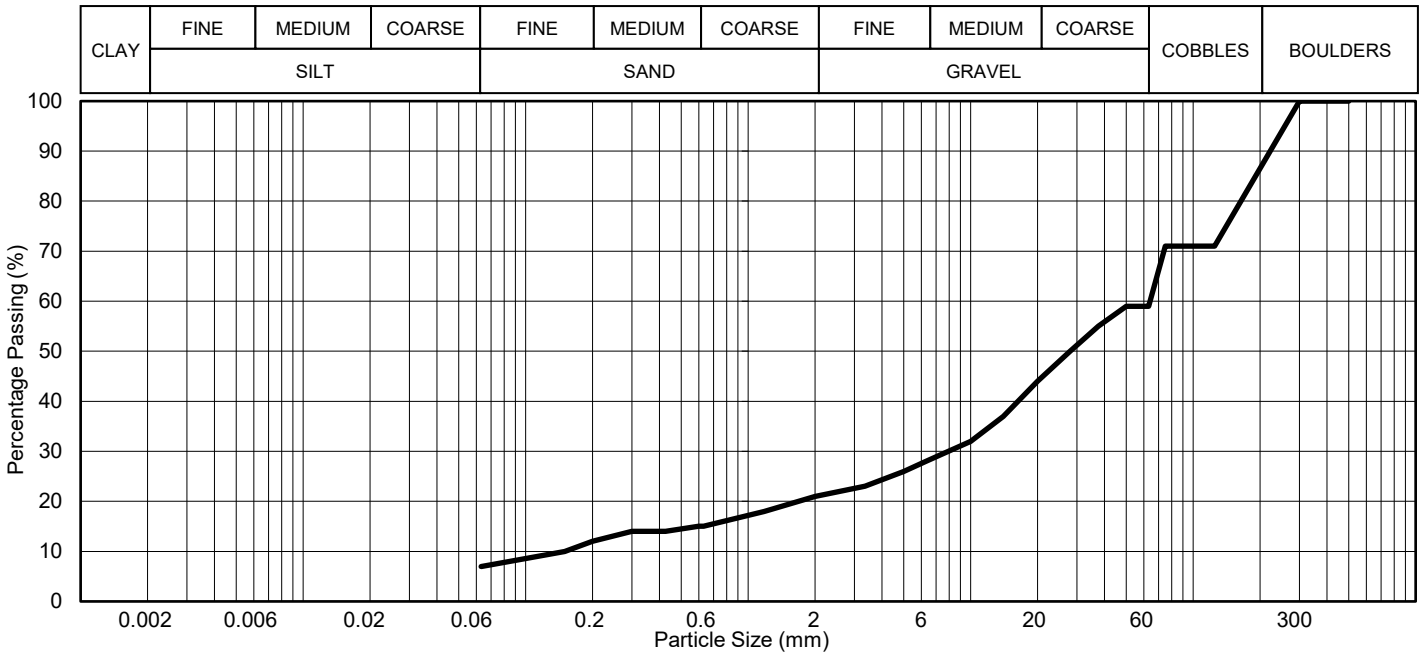
Borehole	TP02
Sample	B
Depth (m)	0.50



SIEVING			
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable Lower %	Specification Not Applicable Upper %
500.0	100	-	-
300.0	100	-	-
125.0	71	-	-
90.0	71	-	-
75.0	71	-	-
63.0	59	-	-
50.0	59	-	-
37.5	55	-	-
28.0	50	-	-
20.0	44	-	-
14.0	37	-	-
10.0	32	-	-
6.3	28	-	-
5.0	26	-	-
3.350	23	-	-
2.000	21	-	-
1.180	18	-	-
0.630	15	-	-
0.600	15	-	-
0.425	14	-	-
0.300	14	-	-
0.200	12	-	-
0.150	10	-	-
0.063	7	-	-

SEDIMENTATION (Assumed ρs of 2.65Mg/m³)

Particle Size (mm)	Percentage Passing (%)
0.0200	
0.0063	
0.0020	

GRADING CLASSIFICATION (SHW TABLE 6/2)

-

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

PERCENTAGE SOIL TYPES

CLAY	SILT ₸	SAND	GRAVEL	COBBLES
/	7	14	38	41

UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

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

Sample does not meet minimum mass requirement for material type

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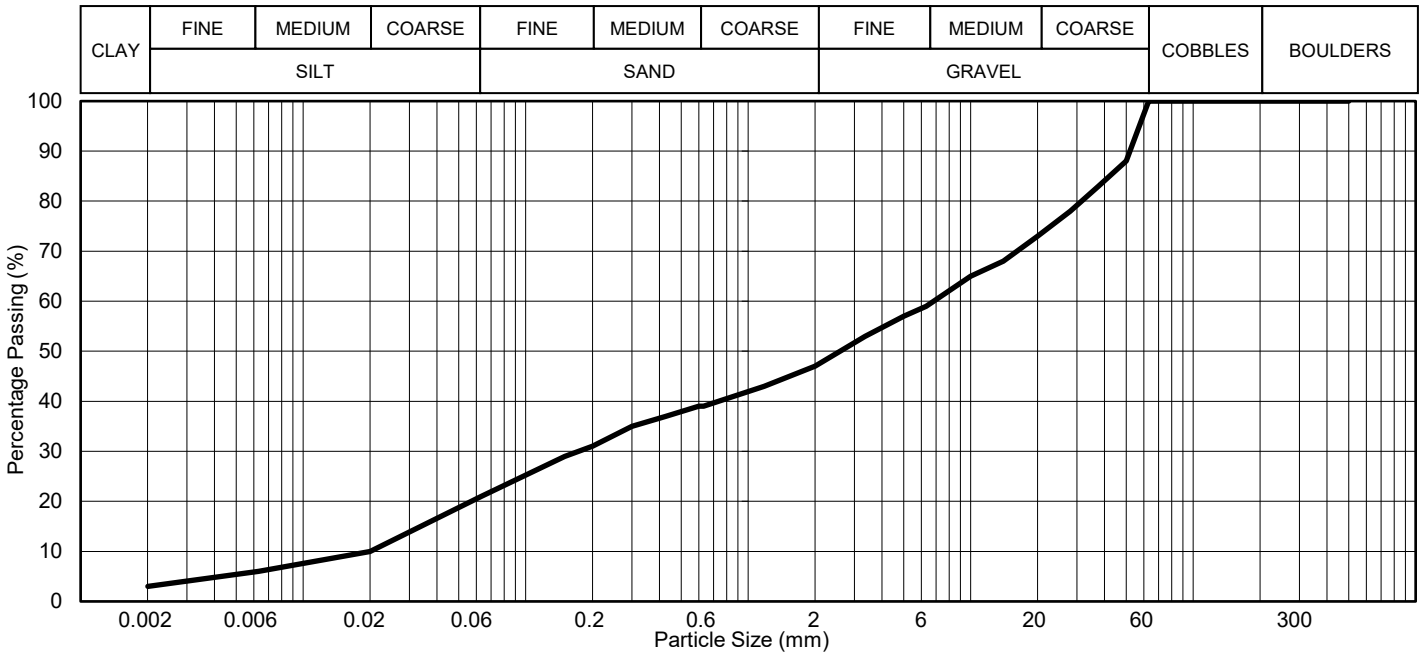
Borehole	TP03
Sample	B
Depth (m)	0.60



SIEVING				SEDIMENTATION (Assumed ρs of 2.65Mg/m³)	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.0200	10
300.0	100	-	-	0.0063	6
125.0	100	-	-	0.0020	3
90.0	100	-	-		
75.0	100	-	-	**GRADING CLASSIFICATION (SHW TABLE 6/2)**	
63.0	100	-	-	-	
50.0	88	-	-		
37.5	83	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	78	-	-		
20.0	73	-	-		
14.0	68	-	-		
10.0	65	-	-	**PERCENTAGE SOIL TYPES**	
6.3	59	-	-		
5.0	57	-	-		
3.350	53	-	-		
2.000	47	-	-		
1.180	43	-	-	**UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)**	
0.630	39	-	-		
0.600	39	-	-		
0.425	37	-	-		
0.300	35	-	-		
0.200	31	-	-		
0.150	29	-	-		
0.063	21	-	-		

CLAY	SILT ₸	SAND	GRAVEL	COBBLES
3	18	26	53	0

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

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

Sample does not meet minimum mass requirement for material type

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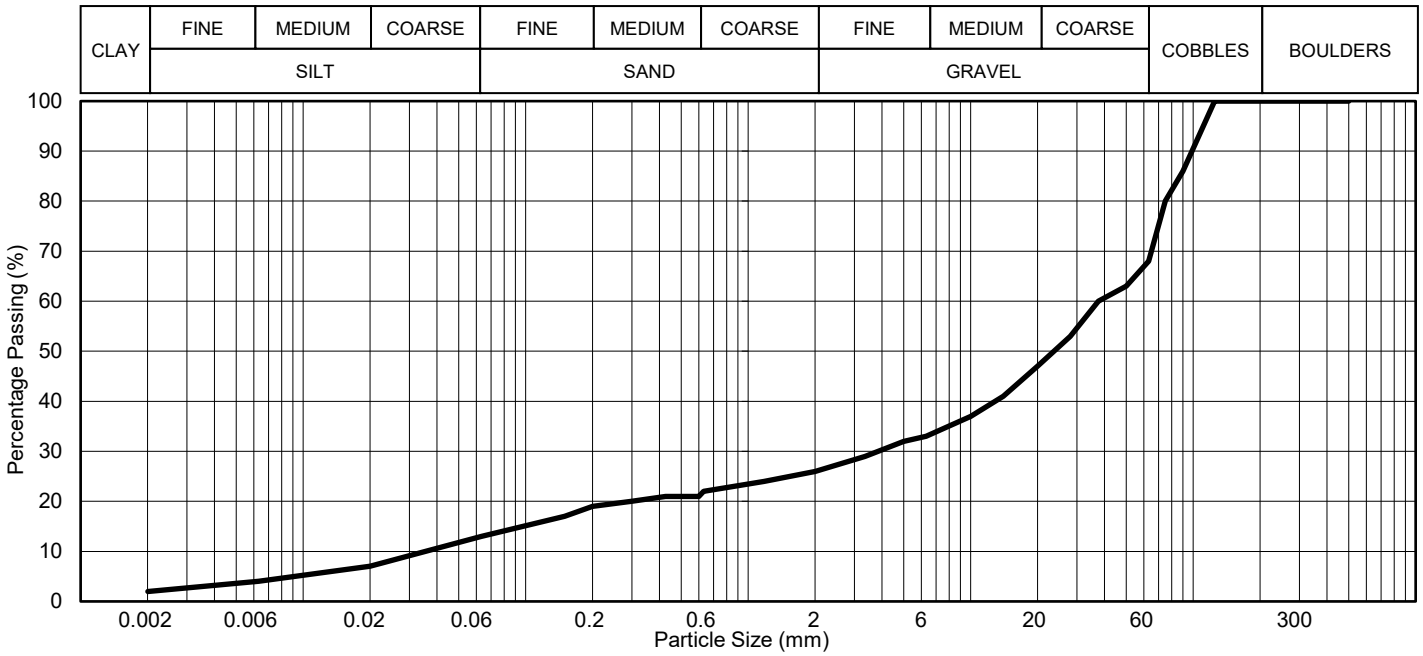
Borehole	TP08
Sample	B
Depth (m)	0.50



SIEVING				SEDIMENTATION (Assumed ρs of 2.65Mg/m³)	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.0200	7
300.0	100	-	-	0.0063	4
125.0	100	-	-	0.0020	2
90.0	86	-	-		
75.0	80	-	-	**GRADING CLASSIFICATION (SHW TABLE 6/2)**	
63.0	68	-	-	-	
50.0	63	-	-		
37.5	60	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	53	-	-		
20.0	47	-	-		
14.0	41	-	-		
10.0	37	-	-	**PERCENTAGE SOIL TYPES**	
6.3	33	-	-		
5.0	32	-	-		
3.350	29	-	-		
2.000	26	-	-		
1.180	24	-	-	**UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)**	
0.630	22	-	-		
0.600	21	-	-		
0.425	21	-	-		
0.300	20	-	-		
0.200	19	-	-		
0.150	17	-	-		
0.063	13	-	-		

CLAY	SILT ₸	SAND	GRAVEL	COBBLES
2	11	13	42	32

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

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

Sample does not meet minimum mass requirement for material type

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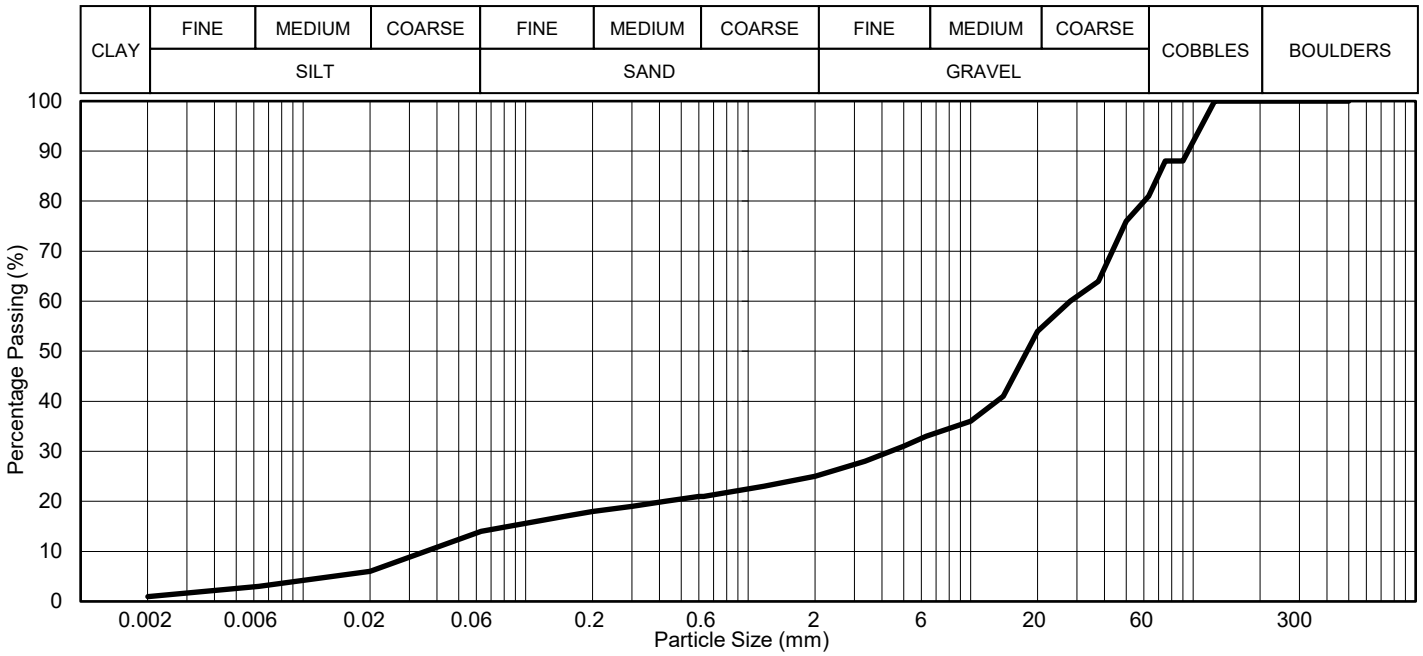
Borehole	TP10
Sample	B
Depth (m)	0.50



SIEVING				SEDIMENTATION (Assumed ρs of 2.65Mg/m³)	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.0200	6
300.0	100	-	-	0.0063	3
125.0	100	-	-	0.0020	1
90.0	88	-	-		
75.0	88	-	-	**GRADING CLASSIFICATION (SHW TABLE 6/2)**	
63.0	81	-	-	-	
50.0	76	-	-		
37.5	64	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	60	-	-		
20.0	54	-	-		
14.0	41	-	-		
10.0	36	-	-	**PERCENTAGE SOIL TYPES**	
6.3	33	-	-		
5.0	31	-	-		
3.350	28	-	-		
2.000	25	-	-		
1.180	23	-	-	**UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)**	
0.630	21	-	-		
0.600	21	-	-		
0.425	20	-	-		
0.300	19	-	-		
0.200	18	-	-		
0.150	17	-	-		
0.063	14	-	-		

CLAY	SILT Ŧ	SAND	GRAVEL	COBBLES
1	13	11	56	19

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

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

Sample does not meet minimum mass requirement for material type

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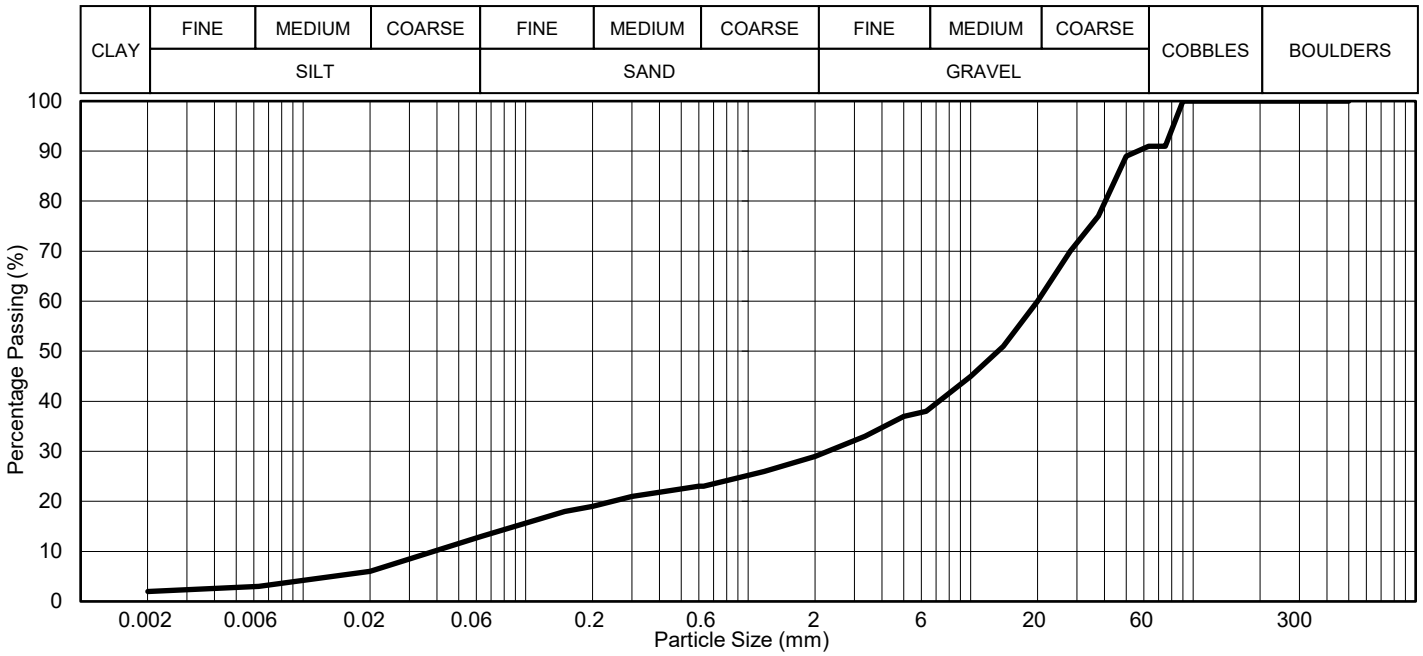
Borehole	TP11
Sample	B
Depth (m)	0.50



SIEVING				SEDIMENTATION (Assumed ρs of 2.65Mg/m³)	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.0200	6
300.0	100	-	-	0.0063	3
125.0	100	-	-	0.0020	2
90.0	100	-	-		
75.0	91	-	-	**GRADING CLASSIFICATION (SHW TABLE 6/2)**	
63.0	91	-	-	-	
50.0	89	-	-		
37.5	77	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	70	-	-		
20.0	60	-	-		
14.0	51	-	-		
10.0	45	-	-	**PERCENTAGE SOIL TYPES**	
6.3	38	-	-		
5.0	37	-	-		
3.350	33	-	-		
2.000	29	-	-		
1.180	26	-	-	**UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)**	
0.630	23	-	-		
0.600	23	-	-		
0.425	22	-	-		
0.300	21	-	-		
0.200	19	-	-		
0.150	18	-	-		
0.063	13	-	-		

CLAY	SILT ₸	SAND	GRAVEL	COBBLES
2	11	16	62	9

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

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

Sample does not meet minimum mass requirement for material type

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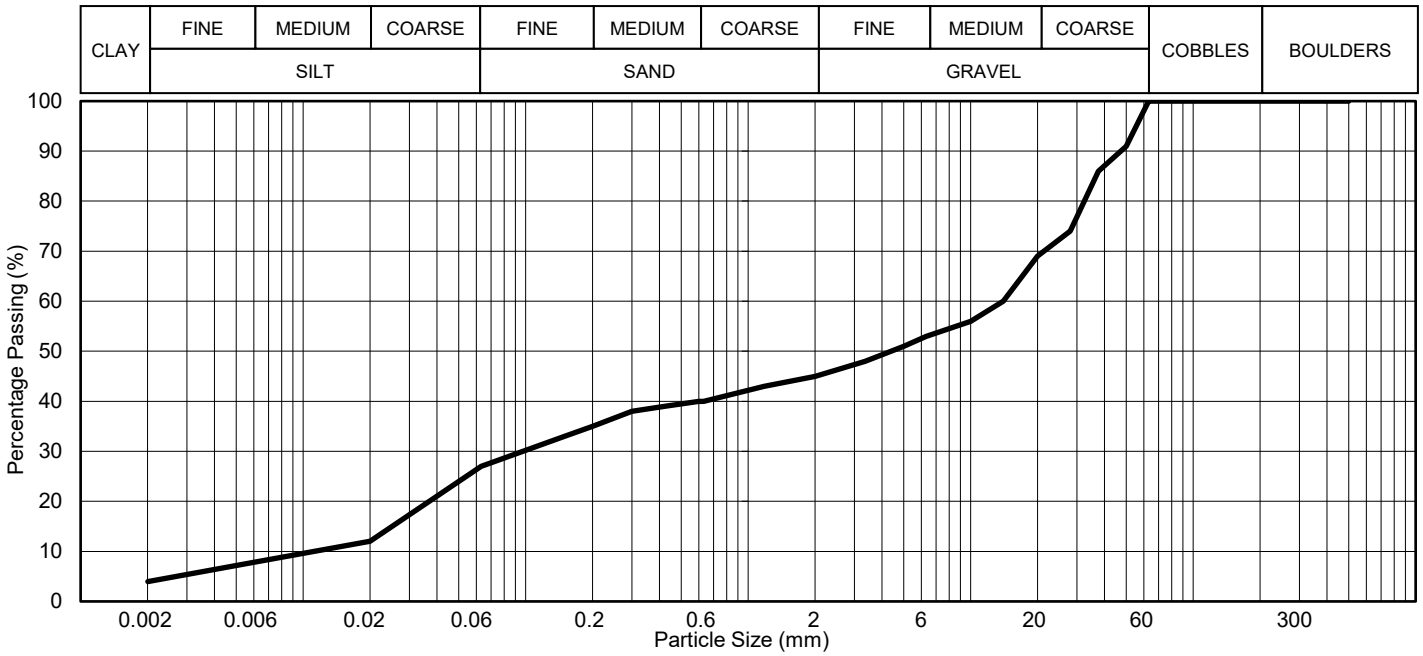
Borehole	TP12
Sample	B
Depth (m)	1.00



SIEVING				SEDIMENTATION (Assumed ρs of 2.65Mg/m³)	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.0200	12
300.0	100	-	-	0.0063	8
125.0	100	-	-	0.0020	4
90.0	100	-	-		
75.0	100	-	-	**GRADING CLASSIFICATION (SHW TABLE 6/2)**	
63.0	100	-	-	-	
50.0	91	-	-		
37.5	86	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	74	-	-		
20.0	69	-	-		
14.0	60	-	-		
10.0	56	-	-	**PERCENTAGE SOIL TYPES**	
6.3	53	-	-		
5.0	51	-	-		
3.350	48	-	-		
2.000	45	-	-		
1.180	43	-	-	**UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)**	
0.630	40	-	-		
0.600	40	-	-		
0.425	39	-	-		
0.300	38	-	-		
0.200	35	-	-		
0.150	33	-	-		
0.063	27	-	-		

CLAY	SILT Ŧ	SAND	GRAVEL	COBBLES
4	23	18	55	0

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

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

Sample does not meet minimum mass requirement for material type

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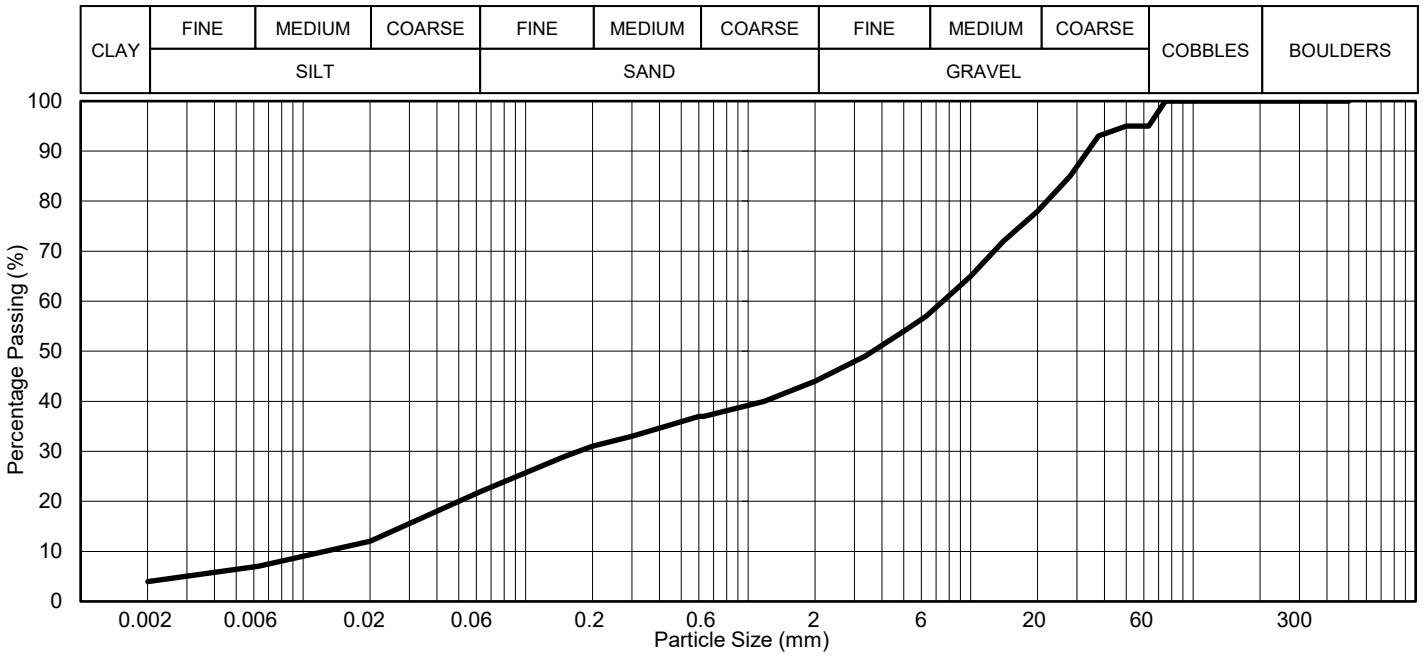
Borehole	TP16
Sample	B
Depth (m)	0.90



SIEVING				SEDIMENTATION (Assumed ρs of 2.65Mg/m³)	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.0200	12
300.0	100	-	-	0.0063	7
125.0	100	-	-	0.0020	4
90.0	100	-	-		
75.0	100	-	-	**GRADING CLASSIFICATION (SHW TABLE 6/2)**	
63.0	95	-	-	-	
50.0	95	-	-		
37.5	93	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	85	-	-		
20.0	78	-	-		
14.0	72	-	-		
10.0	65	-	-	**PERCENTAGE SOIL TYPES**	
6.3	57	-	-		
5.0	54	-	-		
3.350	49	-	-		
2.000	44	-	-		
1.180	40	-	-	**UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)**	
0.630	37	-	-		
0.600	37	-	-		
0.425	35	-	-		
0.300	33	-	-		
0.200	31	-	-		
0.150	29	-	-		
0.063	22	-	-		

CLAY	SILT ₸	SAND	GRAVEL	COBBLES
4	18	22	51	5

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

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

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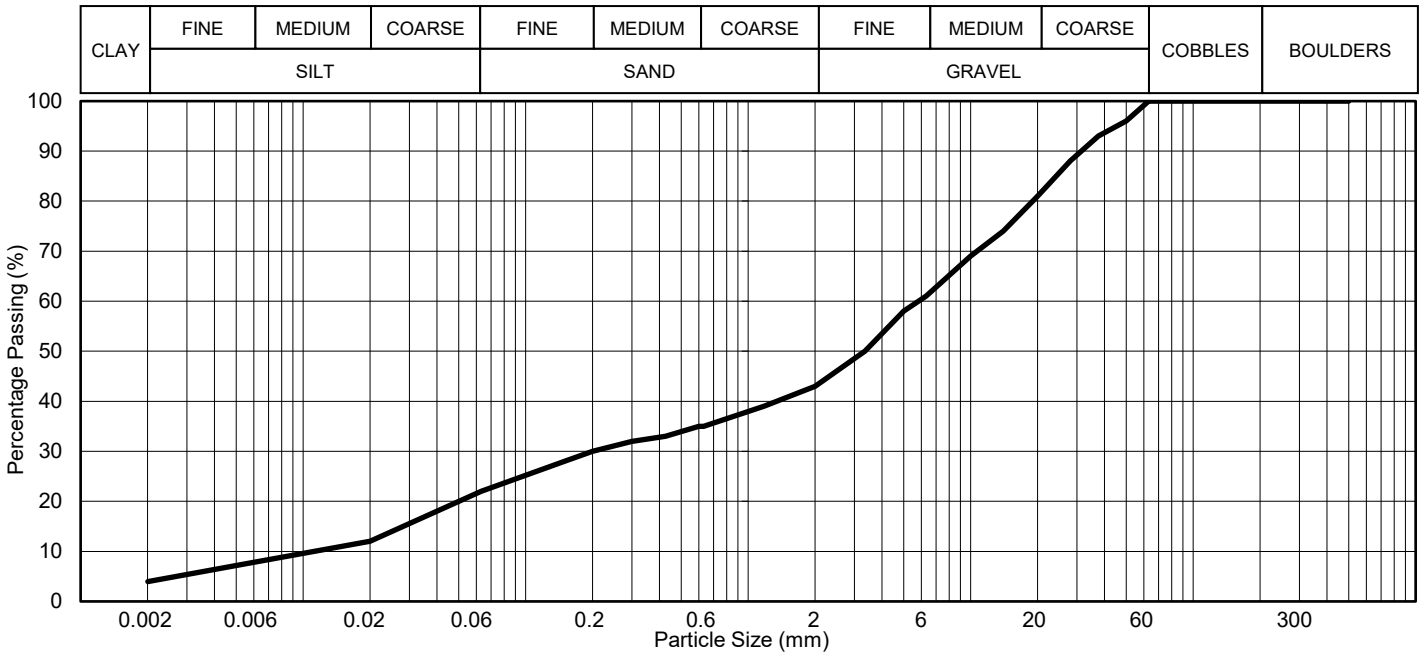
Borehole	TP19
Sample	B
Depth (m)	1.00



SIEVING				SEDIMENTATION (Assumed ρs of 2.65Mg/m³)	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.0200	12
300.0	100	-	-	0.0063	8
125.0	100	-	-	0.0020	4
90.0	100	-	-		
75.0	100	-	-	**GRADING CLASSIFICATION (SHW TABLE 6/2)**	
63.0	100	-	-	-	
50.0	96	-	-		
37.5	93	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	88	-	-		
20.0	81	-	-		
14.0	74	-	-		
10.0	69	-	-	**PERCENTAGE SOIL TYPES**	
6.3	61	-	-		
5.0	58	-	-		
3.350	50	-	-		
2.000	43	-	-		
1.180	39	-	-	**UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)**	
0.630	35	-	-		
0.600	35	-	-		
0.425	33	-	-		
0.300	32	-	-		
0.200	30	-	-		
0.150	28	-	-		
0.063	22	-	-		

CLAY	SILT Ŧ	SAND	GRAVEL	COBBLES
4	18	21	57	0

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

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

Sample does not meet minimum mass requirement for material type

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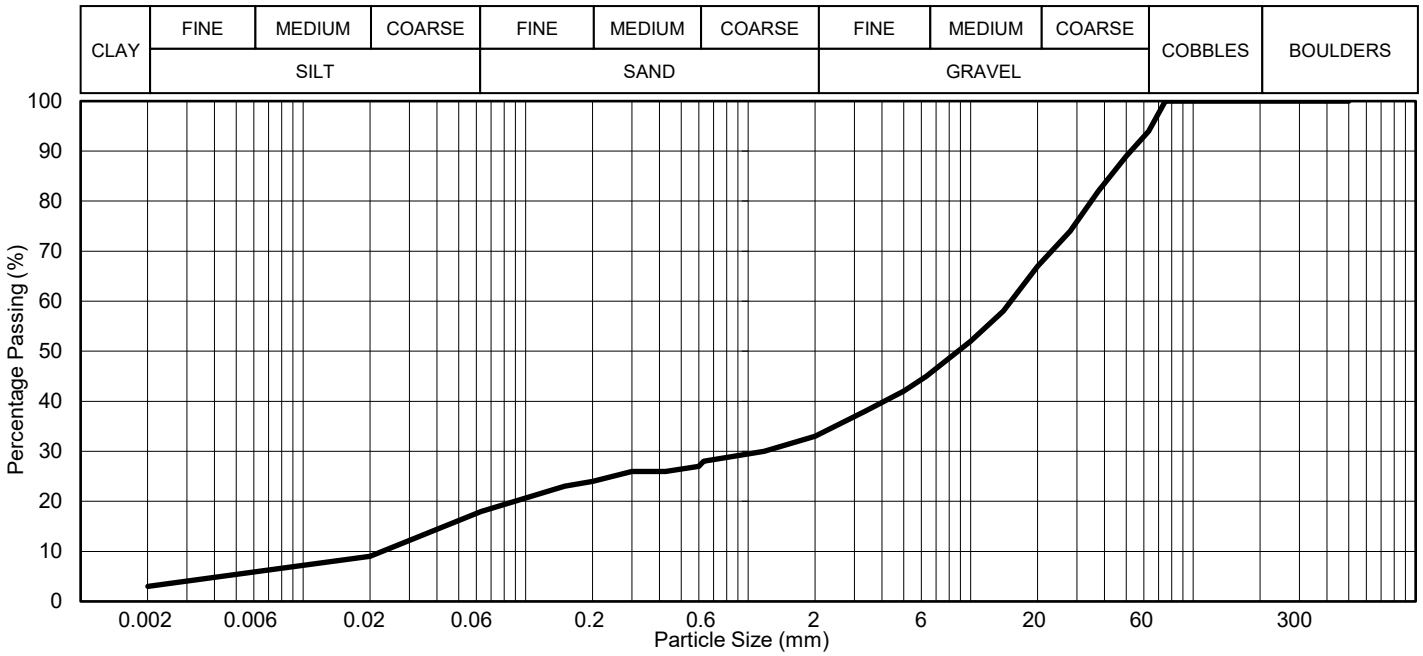
Borehole	TP19
Sample	B
Depth (m)	2.00



SIEVING				SEDIMENTATION (Assumed ρs of 2.65Mg/m³)	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.0200	9
300.0	100	-	-	0.0063	6
125.0	100	-	-	0.0020	3
90.0	100	-	-		
75.0	100	-	-	**GRADING CLASSIFICATION (SHW TABLE 6/2)**	
63.0	94	-	-	-	
50.0	89	-	-		
37.5	82	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	74	-	-		
20.0	67	-	-		
14.0	58	-	-		
10.0	52	-	-	**PERCENTAGE SOIL TYPES**	
6.3	45	-	-		
5.0	42	-	-		
3.350	38	-	-		
2.000	33	-	-		
1.180	30	-	-	**UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)**	
0.630	28	-	-		
0.600	27	-	-		
0.425	26	-	-		
0.300	26	-	-		
0.200	24	-	-		
0.150	23	-	-		
0.063	18	-	-		

CLAY	SILT ₸	SAND	GRAVEL	COBBLES
3	15	15	61	6

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

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

Sample does not meet minimum mass requirement for material type

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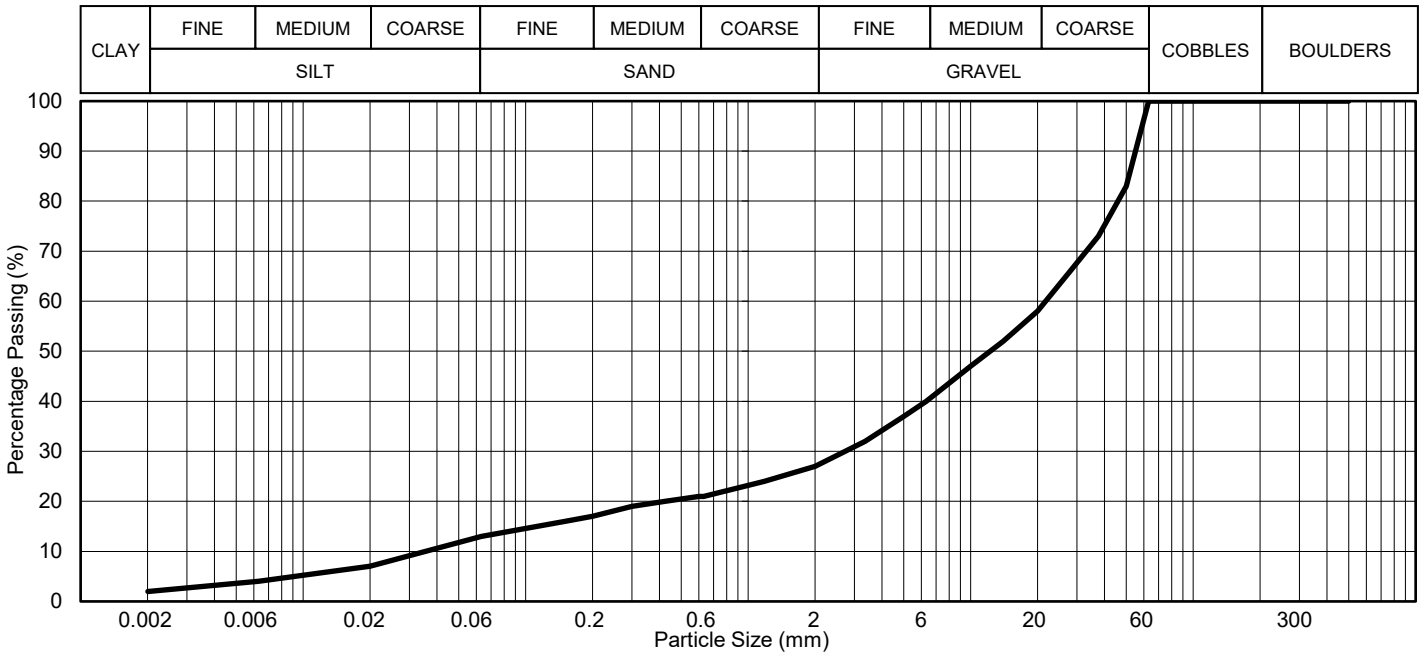
Borehole	TP20
Sample	B
Depth (m)	1.00



SIEVING				SEDIMENTATION (Assumed ρs of 2.65Mg/m³)	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.0200	7
300.0	100	-	-	0.0063	4
125.0	100	-	-	0.0020	2
90.0	100	-	-		
75.0	100	-	-	**GRADING CLASSIFICATION (SHW TABLE 6/2)**	
63.0	100	-	-	-	
50.0	83	-	-		
37.5	73	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	66	-	-		
20.0	58	-	-		
14.0	52	-	-		
10.0	47	-	-	**PERCENTAGE SOIL TYPES**	
6.3	40	-	-		
5.0	37	-	-		
3.350	32	-	-		
2.000	27	-	-		
1.180	24	-	-	**UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)**	
0.630	21	-	-		
0.600	21	-	-		
0.425	20	-	-		
0.300	19	-	-		
0.200	17	-	-		
0.150	16	-	-		
0.063	13	-	-		

CLAY	SILT ₸	SAND	GRAVEL	COBBLES
2	11	14	73	0

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

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

Sample does not meet minimum mass requirement for material type

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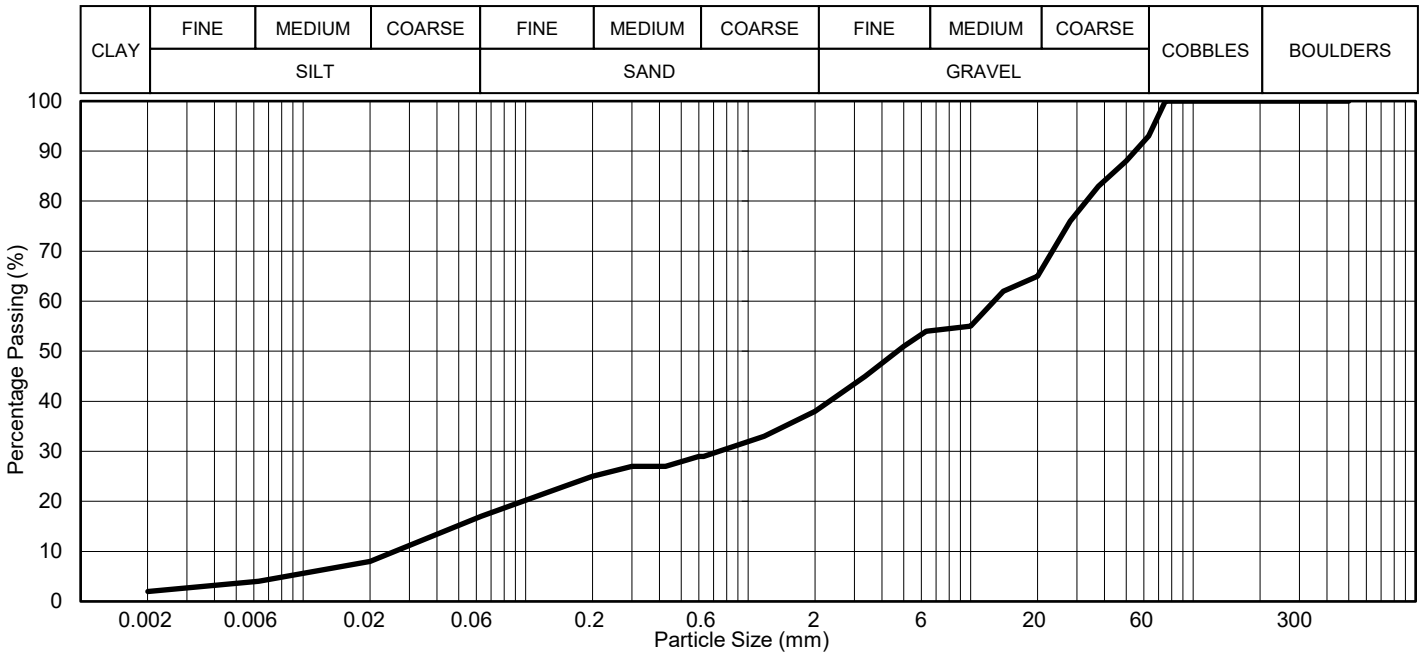
Borehole	TP21
Sample	B
Depth (m)	0.50



SIEVING			
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable Lower %	Specification Not Applicable Upper %
500.0	100	-	-
300.0	100	-	-
125.0	100	-	-
90.0	100	-	-
75.0	100	-	-
63.0	93	-	-
50.0	88	-	-
37.5	83	-	-
28.0	76	-	-
20.0	65	-	-
14.0	62	-	-
10.0	55	-	-
6.3	54	-	-
5.0	51	-	-
3.350	45	-	-
2.000	38	-	-
1.180	33	-	-
0.630	29	-	-
0.600	29	-	-
0.425	27	-	-
0.300	27	-	-
0.200	25	-	-
0.150	23	-	-
0.063	17	-	-

SEDIMENTATION (Assumed ρs of 2.65Mg/m³)

Particle Size (mm)	Percentage Passing (%)
0.0200	8
0.0063	4
0.0020	2

GRADING CLASSIFICATION (SHW TABLE 6/2)

-

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

PERCENTAGE SOIL TYPES

CLAY	SILT ₸	SAND	GRAVEL	COBBLES
2	15	21	55	7

UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

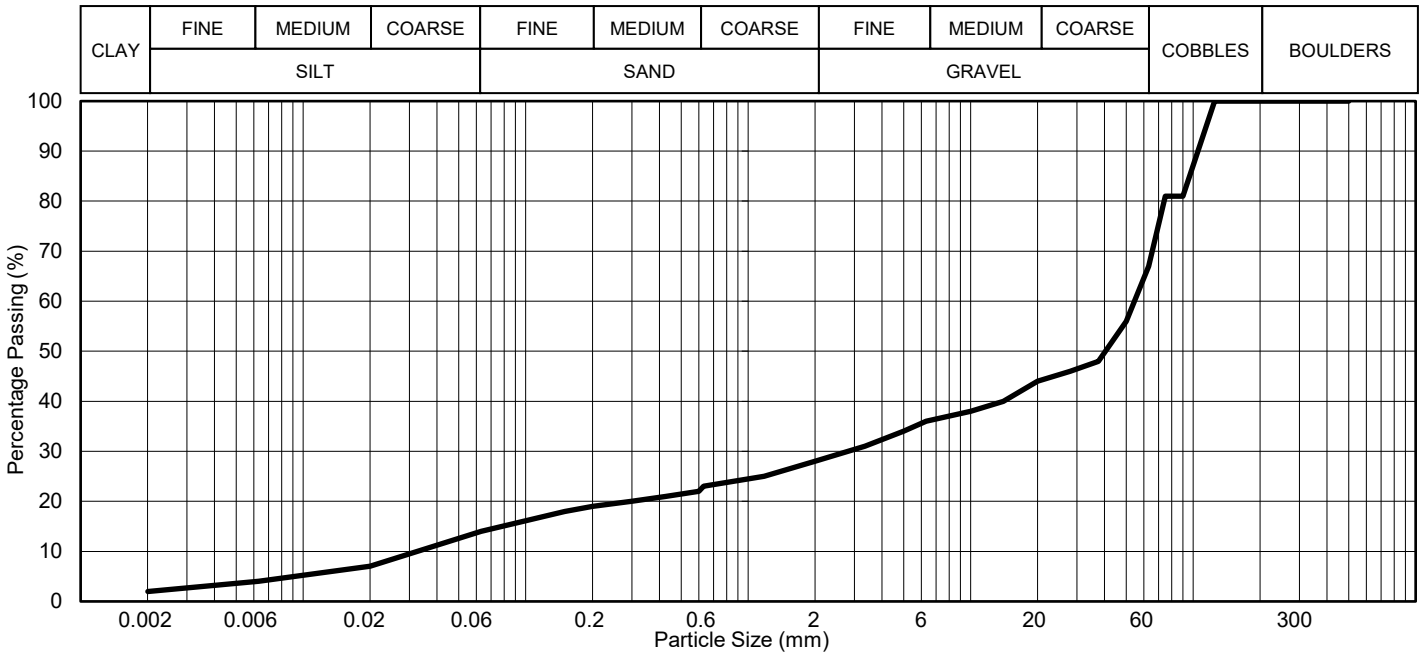
Remarks

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

Sample does not meet minimum mass requirement for material type

PARTICLE SIZE DISTRIBUTION - BS 1377 - 2 : 2022 : CLAUSE 10

Borehole	TP23
Sample	B
Depth (m)	0.50



SIEVING				SEDIMENTATION (Assumed ρs of 2.65Mg/m³)	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.0200	7
300.0	100	-	-	0.0063	4
125.0	100	-	-	0.0020	2
90.0	81	-	-		
75.0	81	-	-	**GRADING CLASSIFICATION (SHW TABLE 6/2)**	
63.0	67	-	-	-	
50.0	56	-	-		
37.5	48	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	46	-	-		
20.0	44	-	-		
14.0	40	-	-		
10.0	38	-	-	**PERCENTAGE SOIL TYPES**	
6.3	36	-	-		
5.0	34	-	-		
3.350	31	-	-		
2.000	28	-	-		
1.180	25	-	-	**UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)**	
0.630	23	-	-		
0.600	22	-	-		
0.425	21	-	-		
0.300	20	-	-		
0.200	19	-	-		
0.150	18	-	-		
0.063	14	-	-		

CLAY	SILT ₸	SAND	GRAVEL	COBBLES
2	12	14	39	33

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

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

Sample does not meet minimum mass requirement for material type

PARTICLE SIZE DISTRIBUTION - BS 1377 - 2 : 2022 : CLAUSE 10

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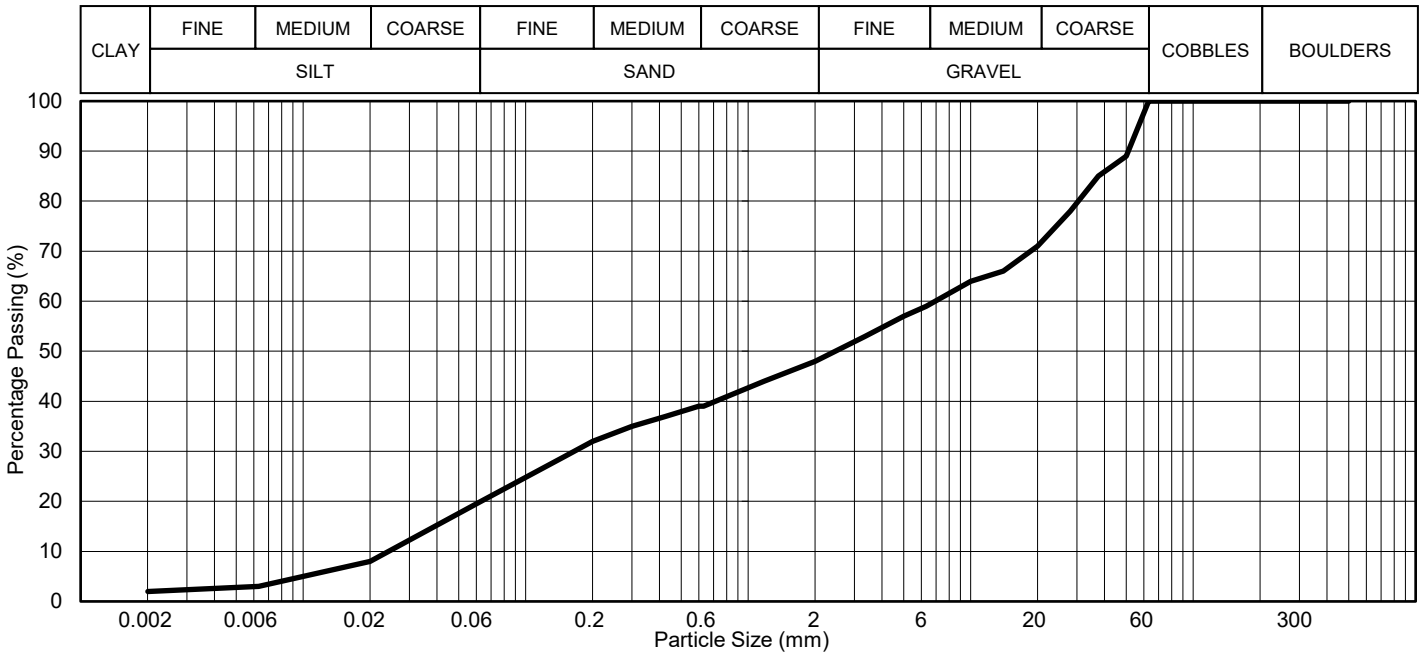
Borehole	TP24
Sample	B
Depth (m)	0.50



SIEVING			
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable Lower %	Specification Not Applicable Upper %
500.0	100	-	-
300.0	100	-	-
125.0	100	-	-
90.0	100	-	-
75.0	100	-	-
63.0	100	-	-
50.0	89	-	-
37.5	85	-	-
28.0	78	-	-
20.0	71	-	-
14.0	66	-	-
10.0	64	-	-
6.3	59	-	-
5.0	57	-	-
3.350	53	-	-
2.000	48	-	-
1.180	44	-	-
0.630	39	-	-
0.600	39	-	-
0.425	37	-	-
0.300	35	-	-
0.200	32	-	-
0.150	29	-	-
0.063	20	-	-

SEDIMENTATION (Assumed ρs of 2.65Mg/m³)	
Particle Size (mm)	Percentage Passing (%)
0.0200	8
0.0063	3
0.0020	2

GRADING CLASSIFICATION (SHW TABLE 6/2)

-

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

PERCENTAGE SOIL TYPES

CLAY	SILT ₸	SAND	GRAVEL	COBBLES
2	18	28	52	0

UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT -		-

Remarks

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

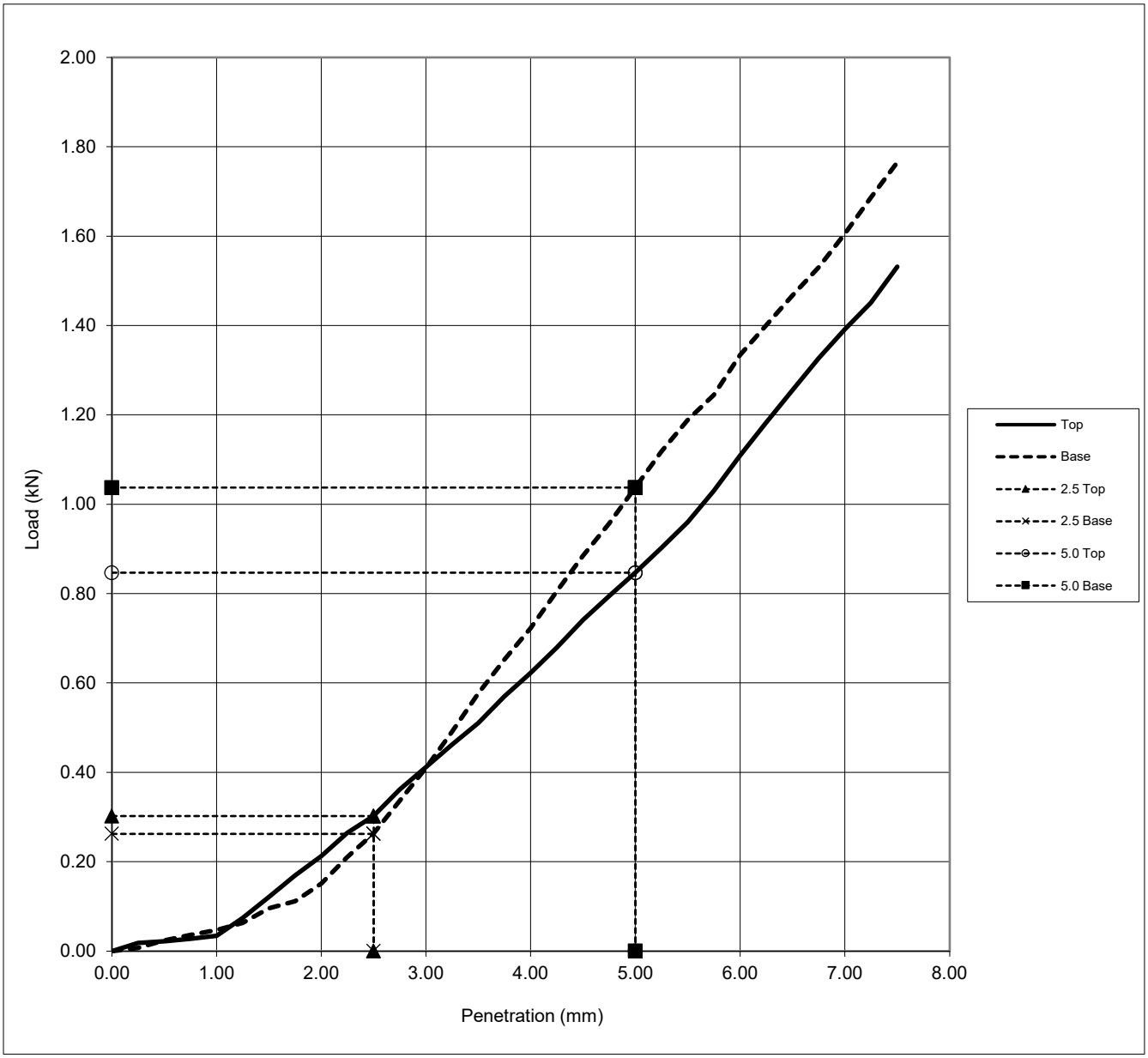
Sample does not meet minimum mass requirement for material type

PARTICLE SIZE DISTRIBUTION - BS 1377 - 2 : 2022 : CLAUSE 10

TRIAL PIT	SAMPLE	DEPTH (m)	BS TEST METHOD * (see below)	% MATERIAL GREATER THAN 2mm	% MATERIAL GREATER THAN 6.3mm	MAXIMUM DRY DENSITY (Mg/m³)	MINIMUM DRY DENSITY (Mg/m³)
TP03	B	0.60	12.1 / 12.3	36	52	2.08	1.35
TP16	B	0.90	12.1 / 12.3	35	49	2.03	1.37
TP23	B	0.50	12.1 / 12.3	45	68	2.05	1.39
TP24	B	0.50	12.1 / 12.3	63	72	1.94	1.40

* Tested in accordance with the following clauses of BS 1377 - 2 : 2022 :			
Multi-point Maximum density determination by compaction:		Minimum density determination and one-point Maximum density determinations:	
11.3	2.5kg rammer, 3 layers, 27 blows	12.1	Maximum density of sands
11.4	2.5kg rammer, 3 layers, 62 blows	12.2	Maximum density of gravels
11.5	4.5kg rammer, 5 layers, 27 blows	12.3	Minimum density of sands
11.6	4.5kg rammer, 5 layers, 62 blows	12.4	Minimum density of gravels
11.7	Vibrating hammer, 3 layers	12.5	Derivation of density index

SUMMARY OF MINIMUM AND MAXIMUM DRY DENSITY TEST RESULTS



Water Content	10.1	%
Bulk Density	2.09	Mg/m^3
Dry Density	1.90	Mg/m^3
Compactive Effort	2.5kg Rammer	
Surcharge Used	-	kg
Soaking Period	-	days
Amount of swell	-	mm

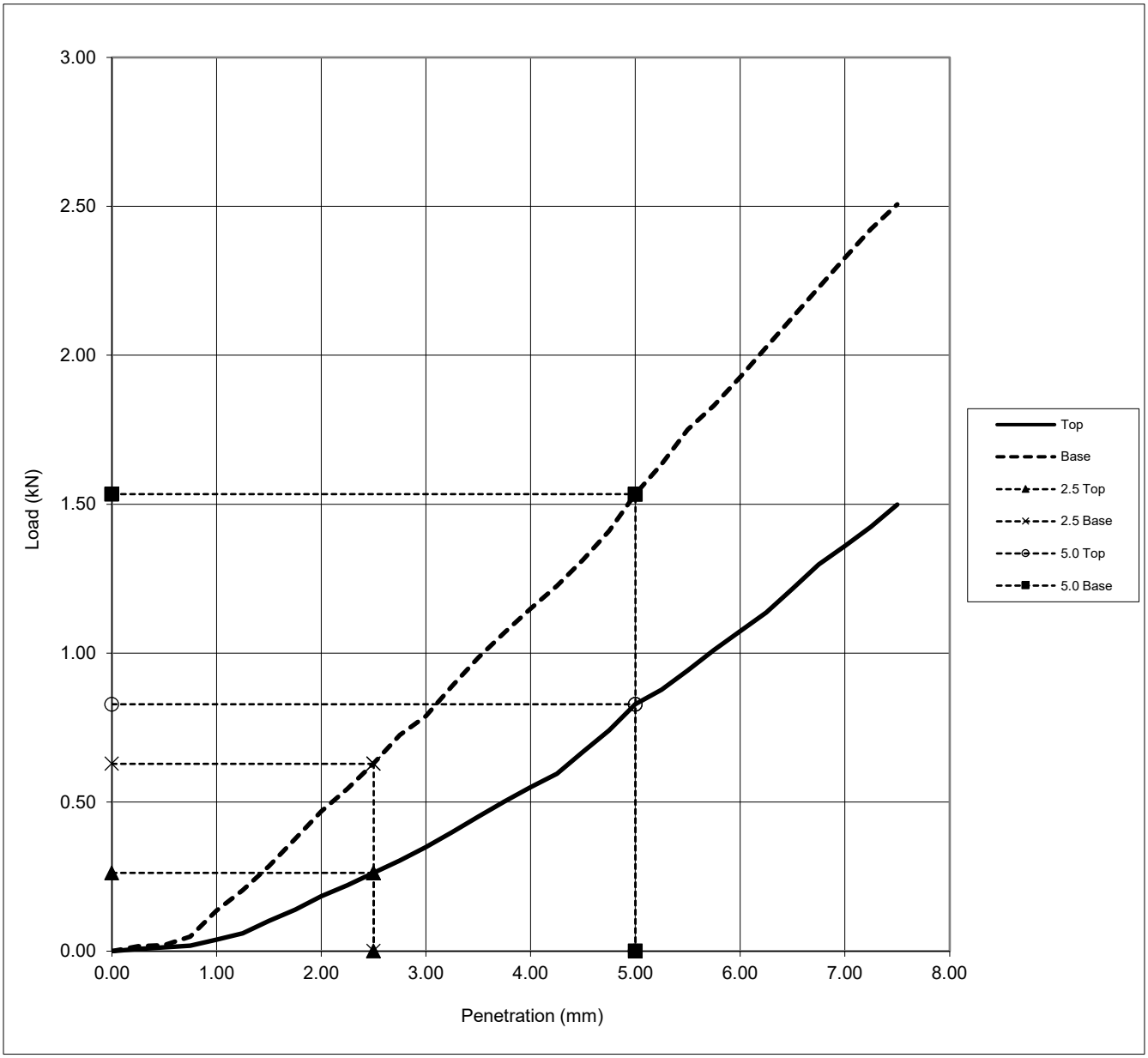
	Top	Base	
Water Content	10.1	10.2	%
CBR (%) at 2.5mm	2.3	2.0	%
CBR (%) at 5.0mm	4.2	5.2	%
Curve Corrected	No		
Test Condition	Unsoaked		
Material Removed	27		%

Borehole	**TP03**
Sample	**B**
Depth (m)	**0.60**
Lime Added (%)	**-**
Cement Added (%)	**-**
Accepted CBR (%)	**5.2**

Remarks;

DETERMINATION OF CALIFORNIA BEARING RATIO (CBR)

Tested in accordance with BS 1377 - 2 : 2022 : Clause 15

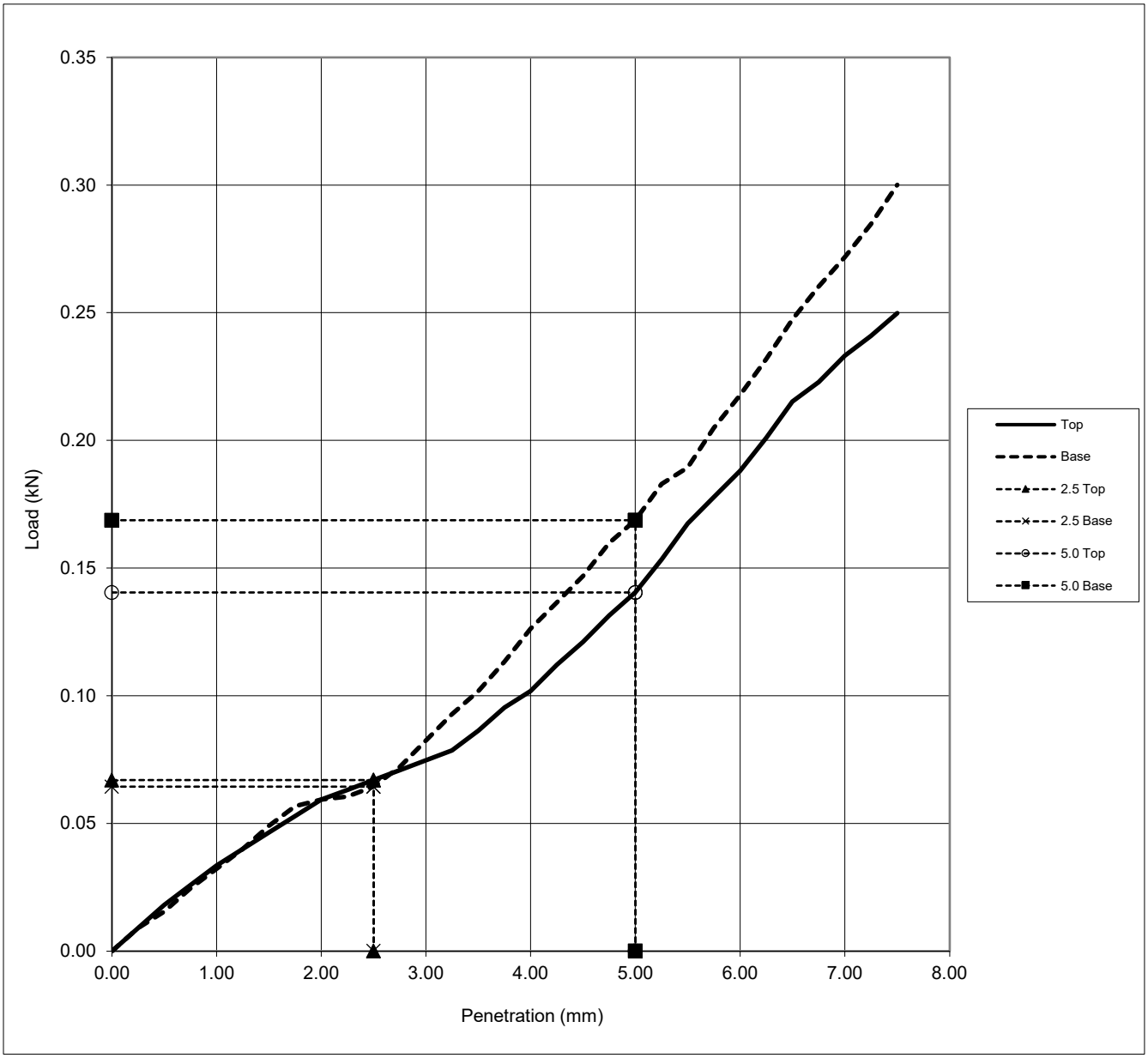


				Top	Base			
Water Content	10.3	%						
Bulk Density	2.14	Mg/m^3	Water Content	10.2	10.5	%	**Borehole**	**TP12**
Dry Density	1.94	Mg/m^3	CBR (%) at 2.5mm	2.0	4.8	%	**Sample**	**B**
Compactive Effort	2.5kg Rammer		CBR (%) at 5.0mm	4.1	7.7	%	**Depth (m)**	**1.00**
Surcharge Used	-	kg	Curve Corrected	No			**Lime Added (%)**	**-**
Soaking Period	-	days	Test Condition	Unsoaked			**Cement Added (%)**	**-**
Amount of swell	-	mm	Material Removed	31		%	**Accepted CBR (%)**	**7.7**

Remarks;

DETERMINATION OF CALIFORNIA BEARING RATIO (CBR)

Tested in accordance with BS 1377 - 2 : 2022 : Clause 15



				Top	Base			
Water Content	16.9	%						
Bulk Density	2.01	Mg/m^3	Water Content	17.4	16.5	%	**Borehole**	**TP16**
Dry Density	1.72	Mg/m^3	CBR (%) at 2.5mm	0.5	0.5	%	**Sample**	**B**
Compactive Effort	2.5kg Rammer		CBR (%) at 5.0mm	0.7	0.8	%	**Depth (m)**	**0.50**
Surcharge Used	-	kg	Curve Corrected	No			**Lime Added (%)**	**-**
Soaking Period	-	days	Test Condition	Unsoaked			**Cement Added (%)**	**-**
Amount of swell	-	mm	Material Removed	41		%	**Accepted CBR (%)**	**0.8**

Remarks;

DETERMINATION OF CALIFORNIA BEARING RATIO (CBR)

Tested in accordance with BS 1377 - 2 : 2022 : Clause 15

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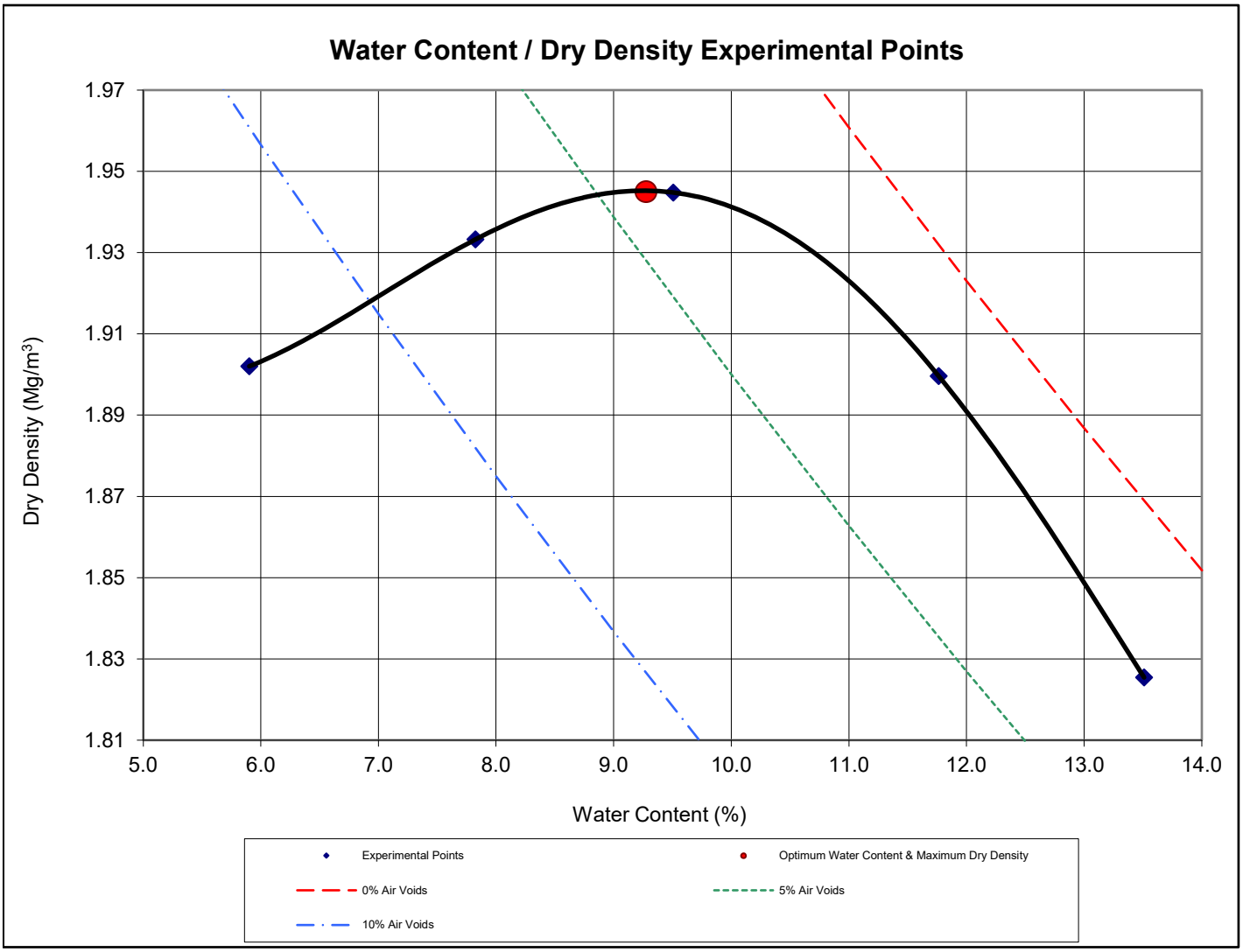

Test Method	:	Clause 11.6: 4.5kg rammer, 5 layers, 62 blows/layer
Preparation Method	:	Separate samples
% Passing 37.5mm	:	83
% Passing 20mm	:	73
Grading Zone	:	x
Particle Density	:	2.50 Mg/m^3 (Assumed)

Experimental Points	
Water Content (%)	Dry Density (Mg/m^3)
5.9	1.90
7.8	1.93
9.5	1.94
11.8	1.90
13.5	1.83

Optimum Water Content (%)	**Maximum Dry Density (Mg/m^3)**
9.3	**1.95**

Remarks

Materials which contain more than 10% retained on a 37.5mm test sieve and 30% retained on a 20mm test sieve are not suitable for this test (Zone X - BS 1377 - 2 : 2022 : 11, Figure 4). In this instance only material passing the 37.5mm sieve was tested.

Borehole :	TP03
Sample :	B
Depth (m) :	0.60

Tested in accordance with BS 1377 - 2 : 2022

DETERMINATION OF WATER CONTENT / DRY DENSITY RELATIONSHIP

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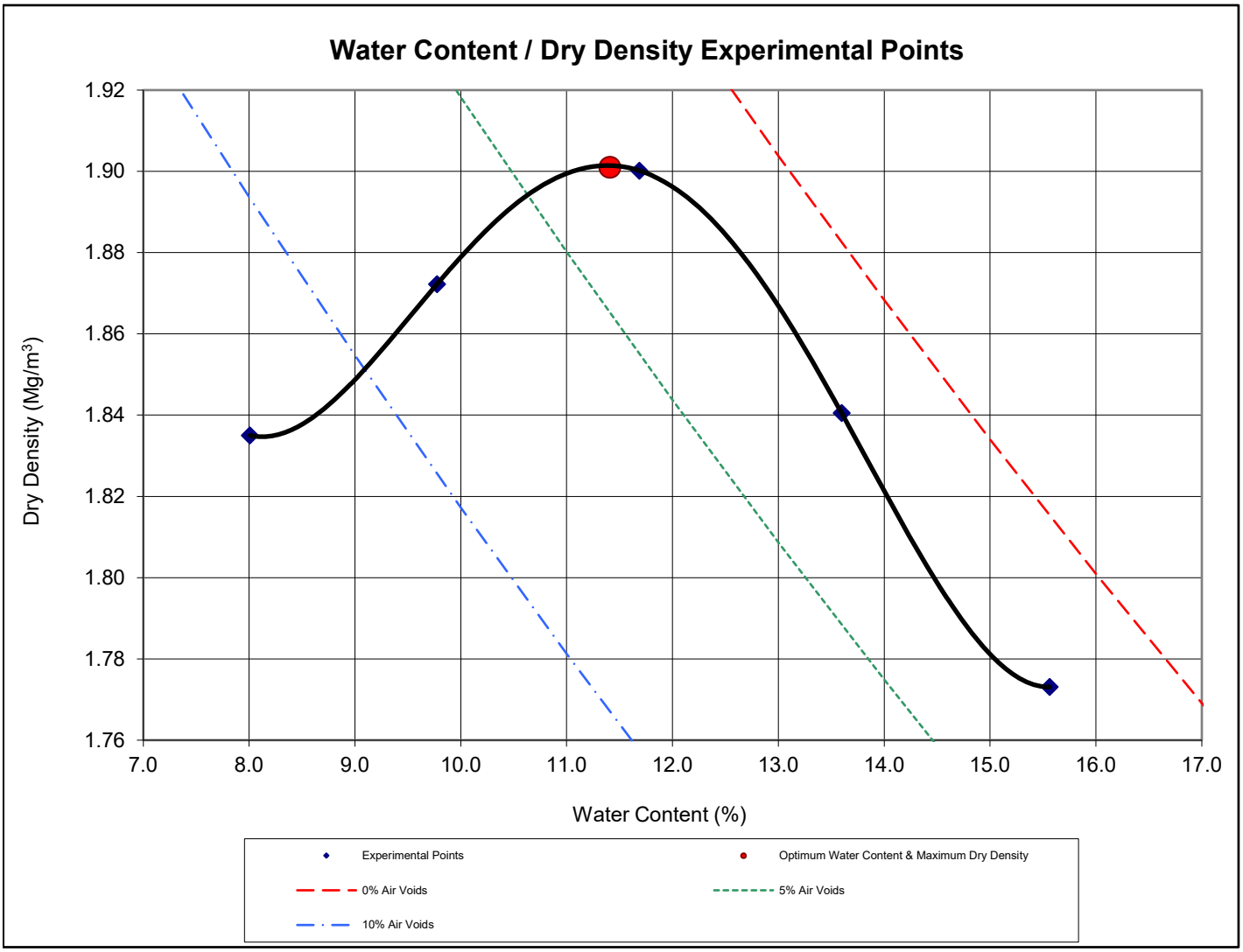

Test Method	:	Clause 11.6: 4.5kg rammer, 5 layers, 62 blows/layer	
Preparation Method	:	Separate samples	
% Passing 37.5mm	:	60	
% Passing 20mm	:	47	
Grading Zone	:	x	
Particle Density	:	2.53	Mg/m^3 (Measured in accordance with BS 1377 - 2 : 2022 : Clause 9)

Experimental Points	
Water Content (%)	Dry Density (Mg/m^3)
8.0	1.84
9.8	1.87
11.7	1.90
13.6	1.84
15.6	1.77

Optimum Water Content (%)	**Maximum Dry Density (Mg/m^3)**
11.4	**1.90**

Remarks

Materials which contain more than 10% retained on a 37.5mm test sieve and 30% retained on a 20mm test sieve are not suitable for this test (Zone X - BS 1377 - 2 : 2022 : 11, Figure 4). In this instance only material passing the 37.5mm sieve was tested.

Borehole :	TP08
Sample :	B
Depth (m) :	0.50

Tested in accordance with BS 1377 - 2 : 2022

DETERMINATION OF WATER CONTENT / DRY DENSITY RELATIONSHIP

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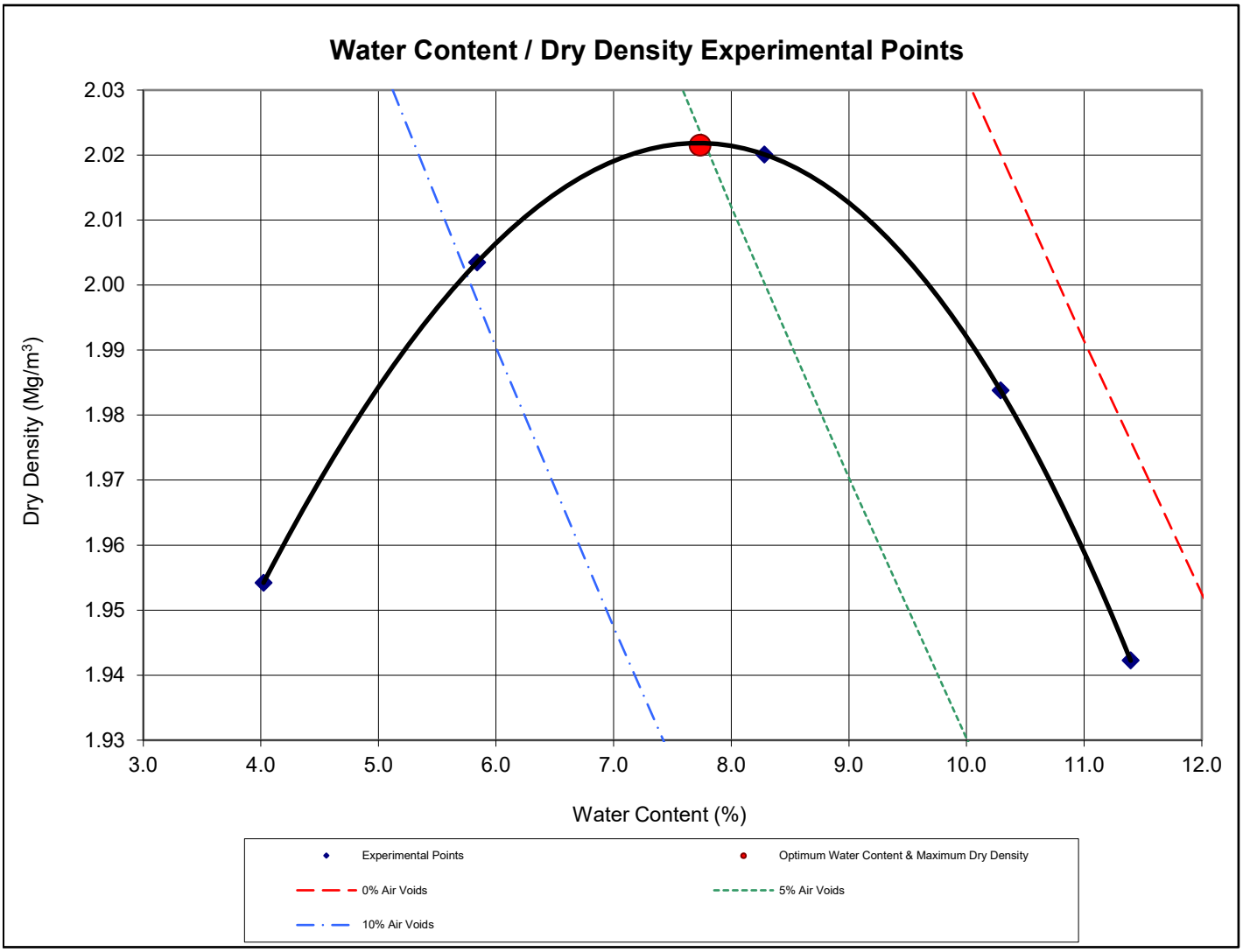

Test Method	:	Clause 11.6: 4.5kg rammer, 5 layers, 62 blows/layer
Preparation Method	:	Separate samples
% Passing 37.5mm	:	64
% Passing 20mm	:	54
Grading Zone	:	x
Particle Density	:	2.55 Mg/m^3 (Assumed)

Experimental Points	
Water Content (%)	Dry Density (Mg/m^3)
4.0	1.95
5.8	2.00
8.3	2.02
10.3	1.98
11.4	1.94

Optimum Water Content (%)	**Maximum Dry Density (Mg/m^3)**
7.7	**2.02**

Remarks

Materials which contain more than 10% retained on a 37.5mm test sieve and 30% retained on a 20mm test sieve are not suitable for this test (Zone X - BS 1377 - 2 : 2022 : 11, Figure 4). In this instance only material passing the 37.5mm sieve was tested.

Borehole :	TP10
Sample :	B
Depth (m) :	0.50

Tested in accordance with BS 1377 - 2 : 2022

DETERMINATION OF WATER CONTENT / DRY DENSITY RELATIONSHIP

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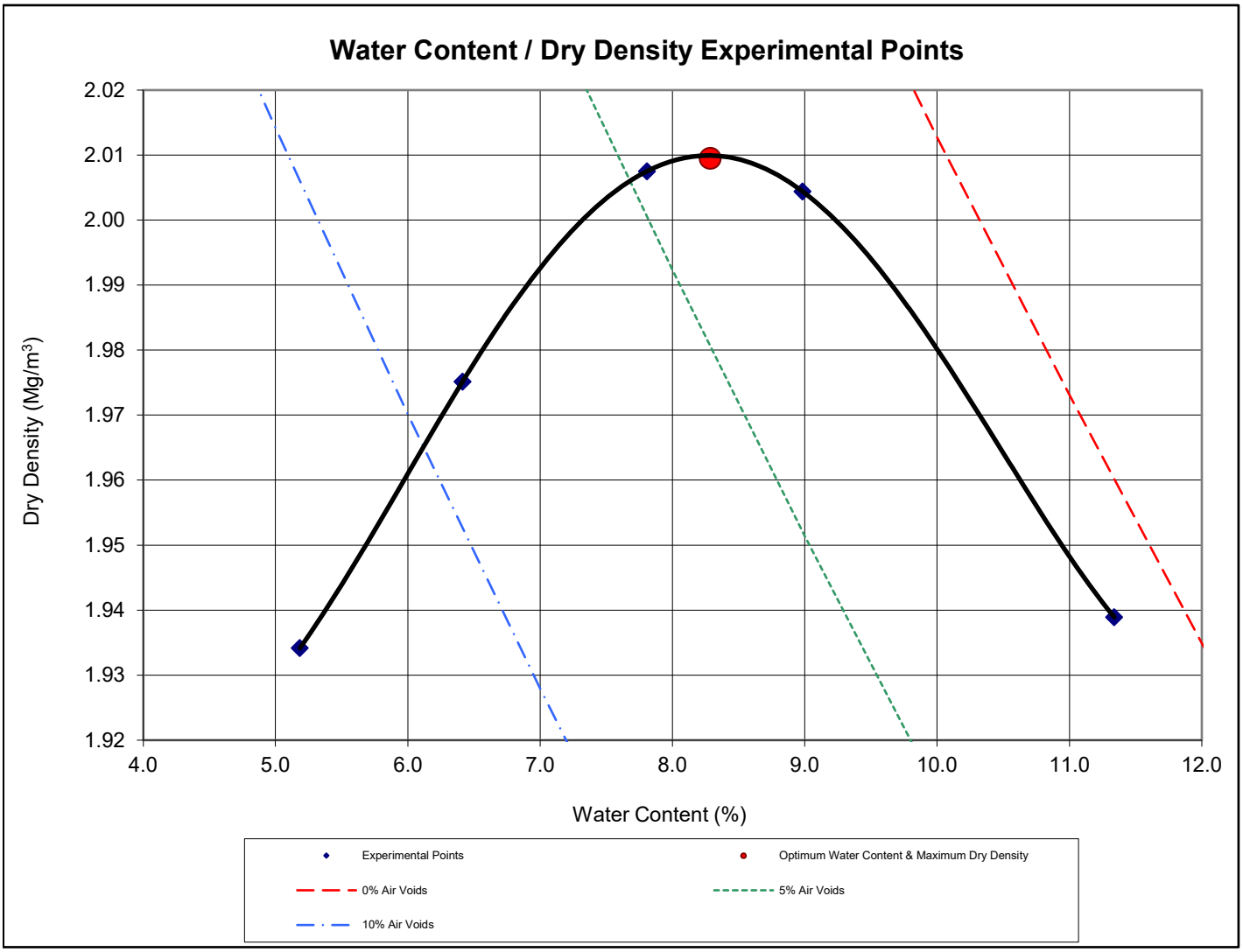

Test Method	:	Clause 11.6: 4.5kg rammer, 5 layers, 62 blows/layer	
Preparation Method	:	Separate samples	
% Passing 37.5mm	:	77	
% Passing 20mm	:	60	
Grading Zone	:	x	
Particle Density	:	2.52	Mg/m^3 (Measured in accordance with BS 1377 - 2 : 2022 : Clause 9)

Experimental Points	
Water Content (%)	Dry Density (Mg/m^3)
5.2	1.93
6.4	1.98
7.8	2.01
9.0	2.00
11.3	1.94

Optimum Water Content (%)	**Maximum Dry Density (Mg/m^3)**
8.3	**2.01**

Remarks

Materials which contain more than 10% retained on a 37.5mm test sieve and 30% retained on a 20mm test sieve are not suitable for this test (Zone X - BS 1377 - 2 : 2022 : 11, Figure 4). In this instance only material passing the 37.5mm sieve was tested.

Borehole :	TP11
Sample :	B
Depth (m) :	0.50

Tested in accordance with BS 1377 - 2 : 2022

DETERMINATION OF WATER CONTENT / DRY DENSITY RELATIONSHIP

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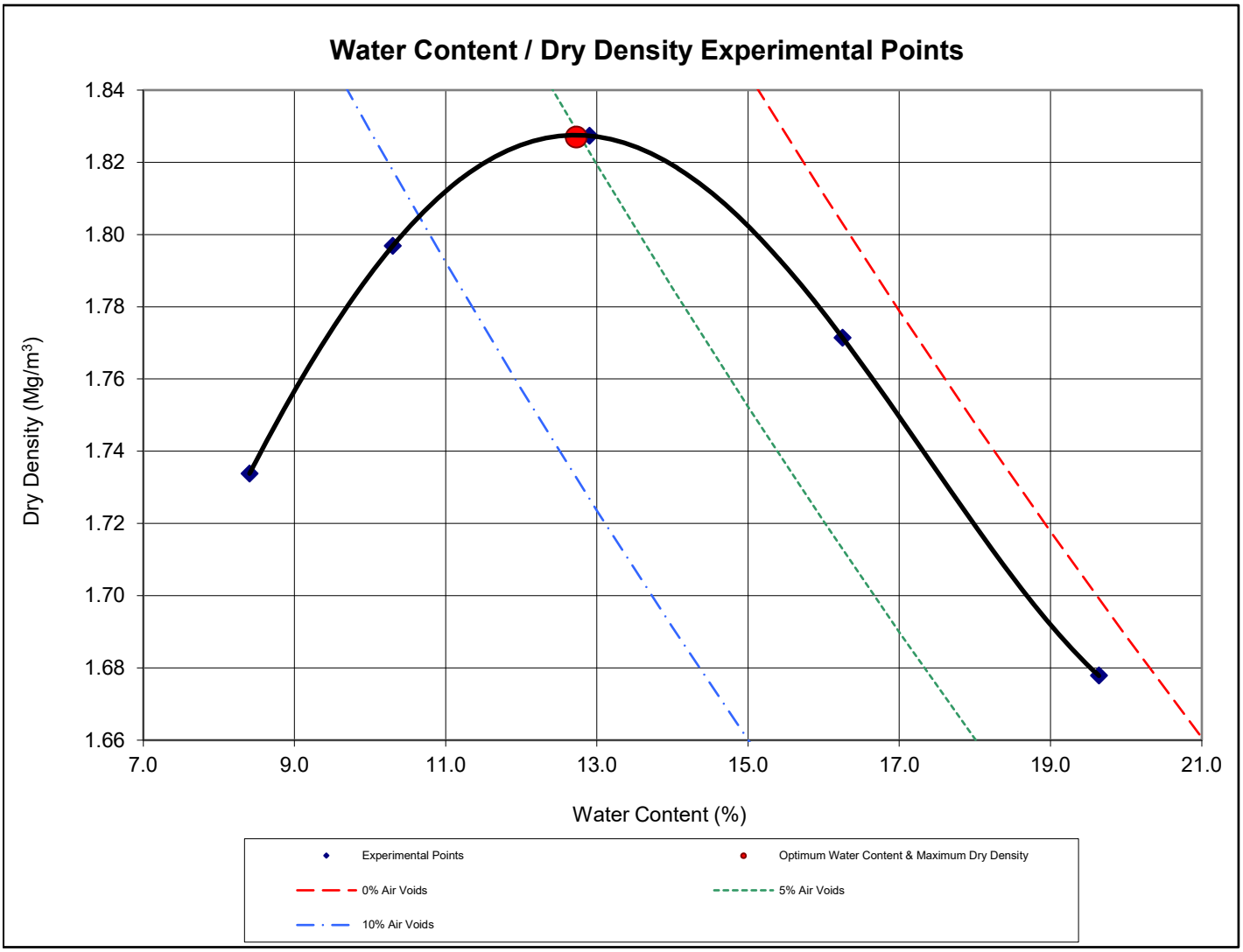

Test Method	:	Clause 11.6: 4.5kg rammer, 5 layers, 62 blows/layer
Preparation Method	:	Separate samples
% Passing 37.5mm	:	74
% Passing 20mm	:	59
Grading Zone	:	x
Particle Density	:	2.55 Mg/m^3 (Assumed)

Experimental Points	
Water Content (%)	Dry Density (Mg/m^3)
8.4	1.73
10.3	1.80
12.9	1.83
16.2	1.77
19.6	1.68

Optimum Water Content (%)	**Maximum Dry Density (Mg/m^3)**
12.7	**1.83**

Remarks

Materials which contain more than 10% retained on a 37.5mm test sieve and 30% retained on a 20mm test sieve are not suitable for this test (Zone X - BS 1377 - 2 : 2022 : 11, Figure 4). In this instance only material passing the 37.5mm sieve was tested.

Borehole :	TP16
Sample :	B
Depth (m) :	0.50

Tested in accordance with BS 1377 - 2 : 2022

DETERMINATION OF WATER CONTENT / DRY DENSITY RELATIONSHIP

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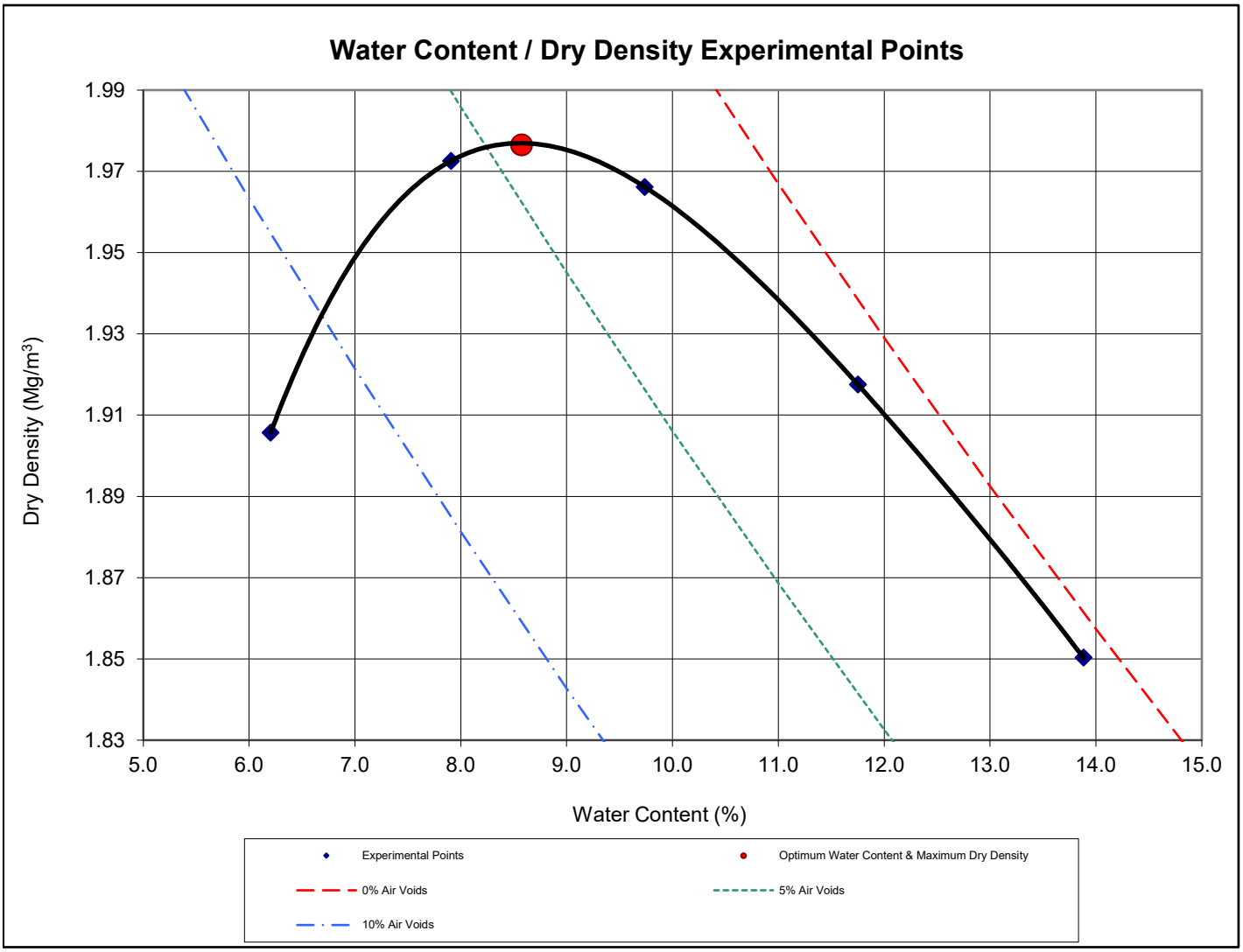

Test Method	:	Clause 11.6: 4.5kg rammer, 5 layers, 62 blows/layer	
Preparation Method	:	Separate samples	
% Passing 37.5mm	:	93	
% Passing 20mm	:	78	
Grading Zone	:	5	
Particle Density	:	2.51	Mg/m^3 (Measured in accordance with BS 1377 - 2 : 2022 : Clause 9)

Experimental Points	
Water Content (%)	Dry Density (Mg/m^3)
6.2	1.91
7.9	1.97
9.7	1.97
11.8	1.92
13.9	1.85

Optimum Water Content (%)	**Maximum Dry Density (Mg/m^3)**
8.6	**1.98**

Remarks

Borehole :	TP16
Sample :	B
Depth (m) :	0.90

Tested in accordance with BS 1377 - 2 : 2022

DETERMINATION OF WATER CONTENT / DRY DENSITY RELATIONSHIP

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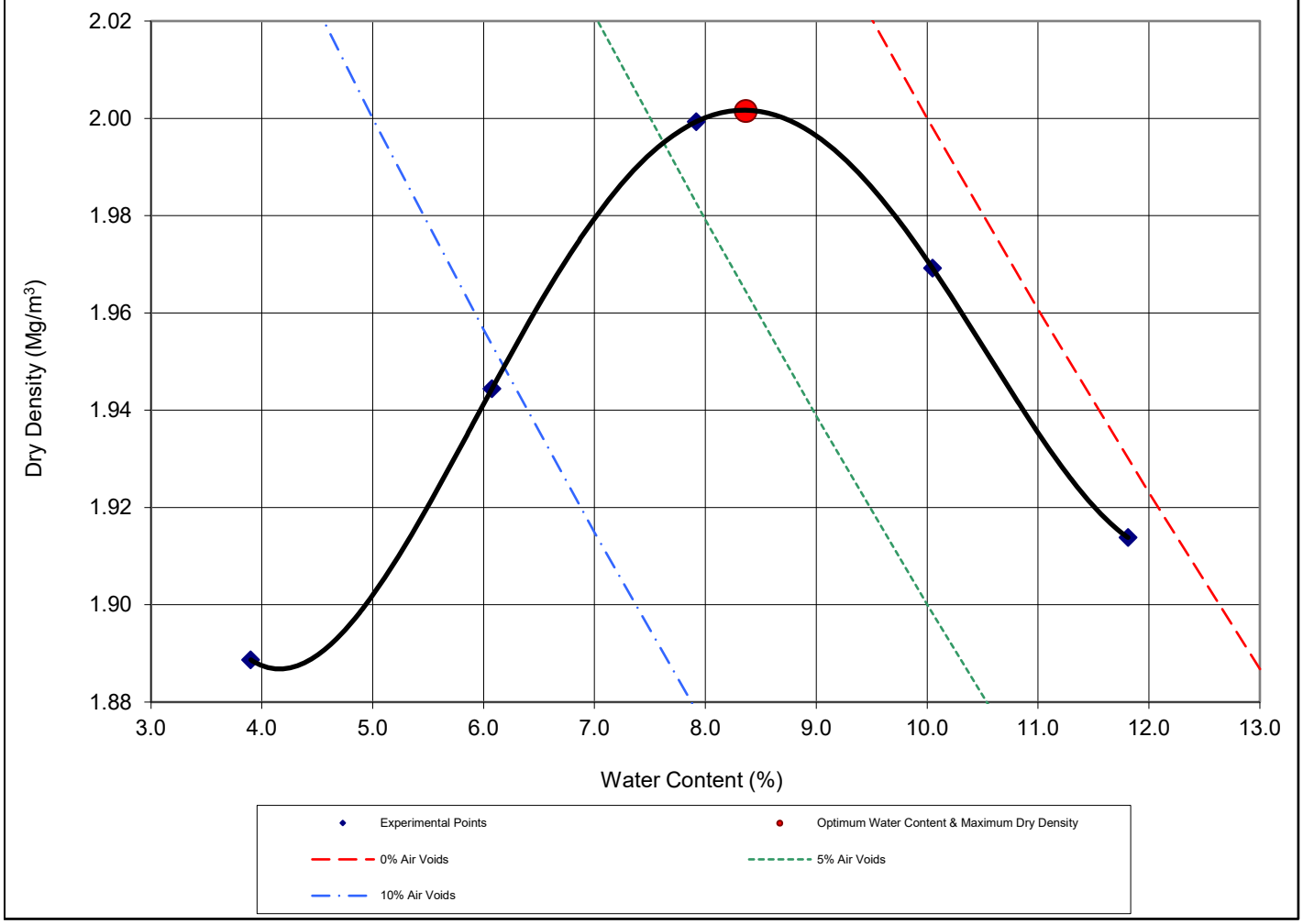
Water Content / Dry Density Experimental Points



Test Method	:	Clause 11.6: 4.5kg rammer, 5 layers, 62 blows/layer
Preparation Method	:	Separate samples
% Passing 37.5mm	:	82
% Passing 20mm	:	67
Grading Zone	:	x
Particle Density	:	2.50 Mg/m^3 (Assumed)

Experimental Points	
Water Content (%)	Dry Density (Mg/m^3)
3.9	1.89
6.1	1.94
7.9	2.00
10.0	1.97
11.8	1.91

Optimum Water Content (%)	**Maximum Dry Density (Mg/m^3)**
8.4	**2.00**

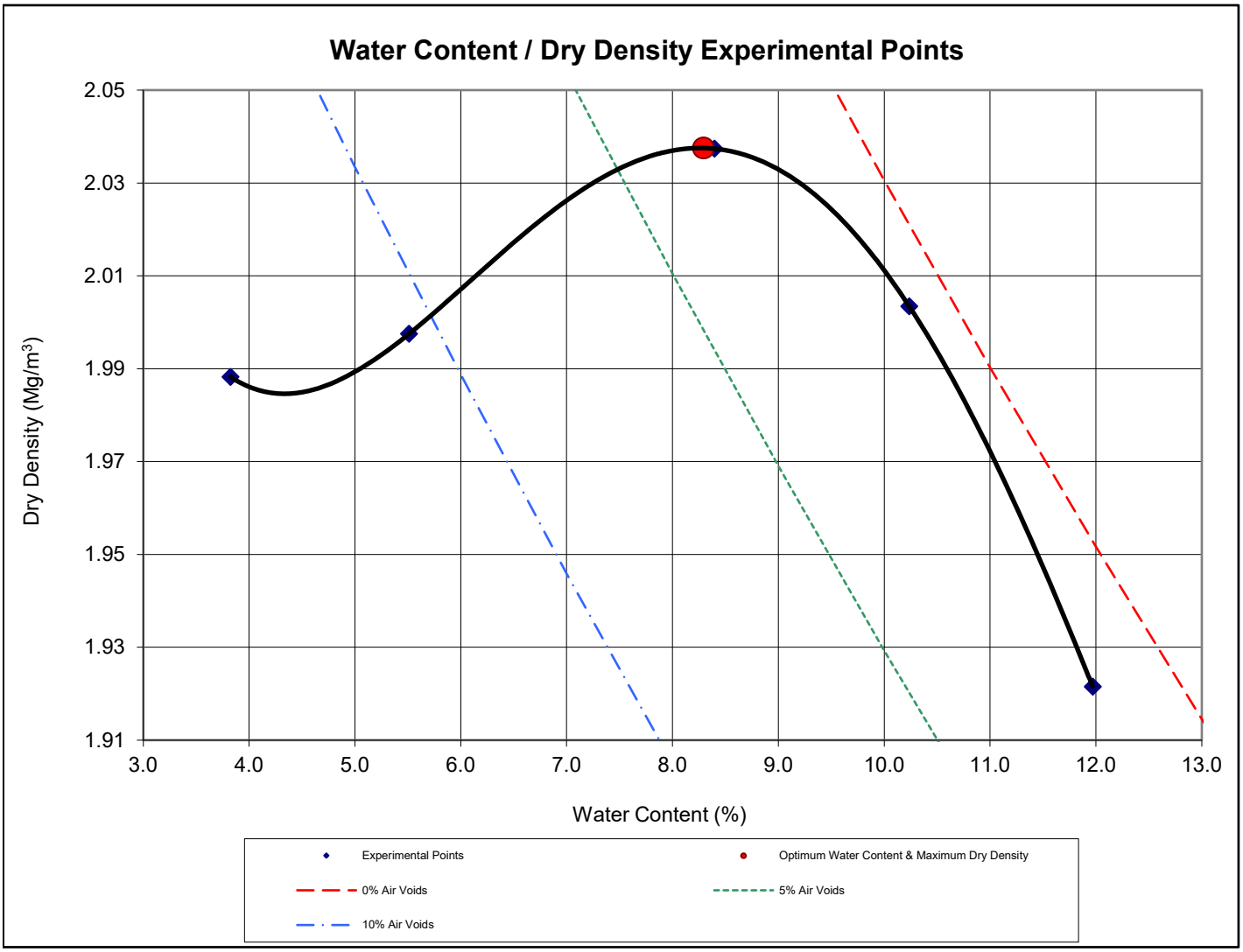
Remarks

Materials which contain more than 10% retained on a 37.5mm test sieve and 30% retained on a 20mm test sieve are not suitable for this test (Zone X - BS 1377 - 2 : 2022 : 11, Figure 4). In this instance only material passing the 37.5mm sieve was tested.

Borehole :	TP19
Sample :	B
Depth (m) :	2.00

Tested in accordance with BS 1377 - 2 : 2022

DETERMINATION OF WATER CONTENT / DRY DENSITY RELATIONSHIP



Test Method	:	Clause 11.6: 4.5kg rammer, 5 layers, 62 blows/layer	
Preparation Method	:	Separate samples	
% Passing 37.5mm	:	48	
% Passing 20mm	:	44	
Grading Zone	:	x	
Particle Density	:	2.54	Mg/m^3 (Measured in accordance with BS 1377 - 2 : 2022 : Clause 9)

Experimental Points	
Water Content (%)	Dry Density (Mg/m^3)
3.8	1.98
5.5	1.99
8.4	2.03
10.2	2.00
12.0	1.92

Optimum Water Content (%)	**Maximum Dry Density (Mg/m^3)**
8.3	**2.03**

Remarks

Materials which contain more than 10% retained on a 37.5mm test sieve and 30% retained on a 20mm test sieve are not suitable for this test (Zone X - BS 1377 - 2 : 2022 : 11, Figure 4). In this instance only material passing the 37.5mm sieve was tested.

Borehole :	TP23
Sample :	B
Depth (m) :	0.50

Tested in accordance with BS 1377 - 2 : 2022

DETERMINATION OF WATER CONTENT / DRY DENSITY RELATIONSHIP

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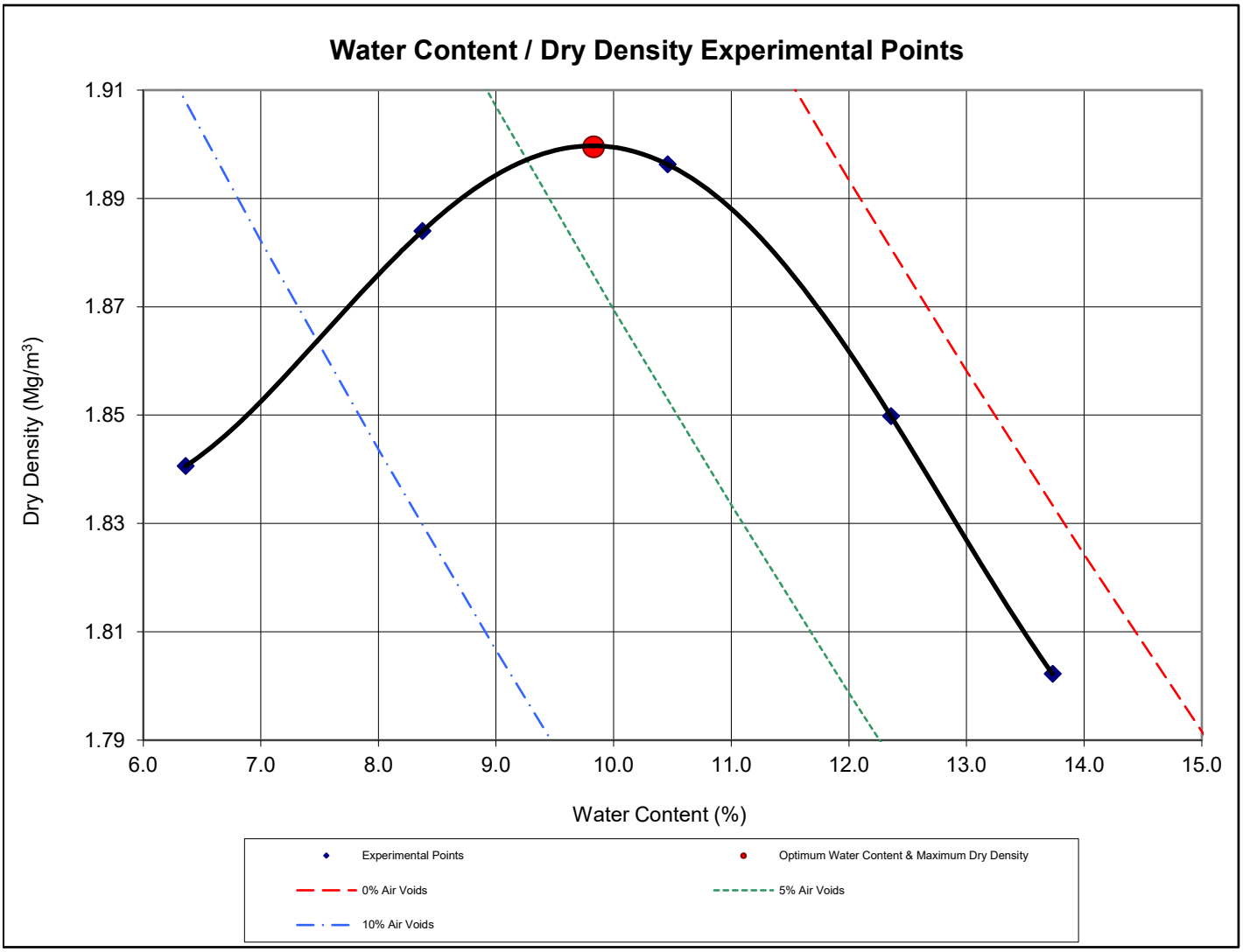

Test Method	:	Clause 11.6: 4.5kg rammer, 5 layers, 62 blows/layer
Preparation Method	:	Separate samples
% Passing 37.5mm	:	85
% Passing 20mm	:	71
Grading Zone	:	x
Particle Density	:	2.45 Mg/m^3 (Assumed)

Experimental Points	
Water Content (%)	Dry Density (Mg/m^3)
6.4	1.84
8.4	1.88
10.5	1.90
12.4	1.85
13.7	1.80

Optimum Water Content (%)	**Maximum Dry Density (Mg/m^3)**
9.8	**1.90**

Remarks

Materials which contain more than 10% retained on a 37.5mm test sieve and 30% retained on a 20mm test sieve are not suitable for this test (Zone X - BS 1377 - 2 : 2022 : 11, Figure 4). In this instance only material passing the 37.5mm sieve was tested.

Borehole :	TP24
Sample :	B
Depth (m) :	0.50

Tested in accordance with BS 1377 - 2 : 2022

DETERMINATION OF WATER CONTENT / DRY DENSITY RELATIONSHIP

Appendix C – Environmental Testing Results

Certificate of Analysis

Certificate Number 24-04340 *Issued:* 08-Mar-24

Client Curtins Consulting
29 St Vincent Place
Glasgow
G1 2DT

Our Reference 24-04340

Client Reference ~ (not supplied)

Order No ~ (not supplied)

Contract Title ~ KNOCK

Description 18 Soil samples.

Date Received 23-Feb-24

Date Started 29-Feb-24

Date Completed 08-Mar-24

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

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Kirk Bridgewood
General Manager

2139

Summary of Chemical Analysis
Soil Samples

Our Ref 24-04340
Client Ref
Contract Title KNOCK

	Lab No	2306227	2306228	2306229	2306230	2306231	2306232
	Sample ID ~	TP22	TP11	TP12	TP08	TP06	TP05
	Depth ~	0.80	0.50	0.50	0.50	0.10	0.50
	Other ID ~						
	Sample Type ~	ES	ES	ES	ES	ES	ES
	Sampling Date ~	12/02/2024	13/02/2024	13/02/2024	13/02/2024	13/02/2024	13/02/2024
	Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Metals							
Arsenic	DETSC 2301#	0.2	mg/kg	7.9	3.7	5.3	3.0	3.2	3.5
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Cadmium	DETSC 2301#	0.1	mg/kg	< 0.1	< 0.1	0.8	< 0.1	< 0.1	< 0.1
Chromium	DETSC 2301#	0.15	mg/kg	24	23	21	17	11	40
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	14	13	15	4.6	7.1	20
Lead	DETSC 2301#	0.3	mg/kg	11	8.6	14	5.8	18	6.2
Magnesium Aqueous Extract (2:1)	DETSC 2076*	10	mg/l				< 10		
Mercury	DETSC 2325#	0.05	mg/kg	0.09	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel	DETSC 2301#	1	mg/kg	24	20	17	14	5.1	47
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Zinc	DETSC 2301#	1	mg/kg	53	52	89	48	49	83
Inorganics									
pH	DETSC 2008#		pH	7.8	7.2	6.8	6.9	6.5	7.3
Cyanide, Total	DETSC 2130#	0.1	mg/kg	< 0.1	0.2	< 0.1	0.1	0.6	< 0.1
Organic matter	DETSC 2002#	0.1	%	0.5	0.6	0.4	0.4	4.8	0.2
Ammonia Aqueous Extract as N	DETSC 2119*	10	mg/l				< 10		
Chloride Aqueous Extract (2:1)	DETSC 2055	1	mg/l				4.0		
Nitrate Aqueous Extract as NO3 (2:1)	DETSC 2055	1	mg/l				2.9		
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l	12	< 10	14	11	29	< 10
Sulphur as S, Total	DETSC 2320	0.01	%				< 0.01		
Sulphate as SO4, Total	DETSC 2321#	0.01	%				0.02		
Petroleum Hydrocarbons									
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4	< 3.4	< 3.4	< 3.4	< 3.4	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
TPH Ali/Aro Total C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10

Key: ~ Sample details provided by client and can affect the validity of the results: * -not accredited.: # -MCERTS (accreditation only applies if report carries the MCERTS logo).

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Summary of Chemical Analysis
Soil Samples

Our Ref 24-04340
Client Ref
Contract Title KNOCK

			Lab No	2306227	2306228	2306229	2306230	2306231	2306232
			Sample ID ~	TP22	TP11	TP12	TP08	TP06	TP05
			Depth ~	0.80	0.50	0.50	0.50	0.10	0.50
			Other ID ~						
			Sample Type ~	ES	ES	ES	ES	ES	ES
			Sampling Date ~	12/02/2024	13/02/2024	13/02/2024	13/02/2024	13/02/2024	13/02/2024
			Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
PAHs									
Naphthalene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pyrene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PAH 16 Total	DETSC 3301	1.6	mg/kg	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6
Phenols									
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3	0.7	< 0.3

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Summary of Chemical Analysis
Soil Samples

Our Ref 24-04340
Client Ref
Contract Title KNOCK

	Lab No	2306233	2306234	2306235	2306236	2306237	2306238
	Sample ID ~	TP03	TP24	TP19	TP20	TP14	TP10
	Depth ~	0.20	0.50	0.70	0.50	0.10	0.50
	Other ID ~						
	Sample Type ~	ES	ES	ES	ES	ES	ES
	Sampling Date ~	13/02/2024	13/02/2024	14/02/2024	14/02/2024	14/02/2024	13/02/2024
	Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Metals							
Arsenic	DETSC 2301#	0.2	mg/kg	3.4	5.3	12	21	5.7	4.1
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	< 0.2	< 0.2	0.3	< 0.2	0.4	< 0.2
Cadmium	DETSC 2301#	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1
Chromium	DETSC 2301#	0.15	mg/kg	20	27	25	34	14	23
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	11	13	9.9	27	7.8	14
Lead	DETSC 2301#	0.3	mg/kg	6.4	9.5	14	11	20	5.9
Magnesium Aqueous Extract (2:1)	DETSC 2076*	10	mg/l		< 10				< 10
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel	DETSC 2301#	1	mg/kg	17	30	16	41	7.5	23
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	0.8	< 0.5	< 0.5	< 0.5
Zinc	DETSC 2301#	1	mg/kg	140	57	88	63	60	41
Inorganics									
pH	DETSC 2008#		pH	6.6	6.8	6.5	6.9	6.4	6.7
Cyanide, Total	DETSC 2130#	0.1	mg/kg	< 0.1	0.1	0.4	< 0.1	0.9	0.1
Organic matter	DETSC 2002#	0.1	%	0.5	0.5	2.2	0.4	7.1	0.5
Ammonia Aqueous Extract as N	DETSC 2119*	10	mg/l		< 10				< 10
Chloride Aqueous Extract (2:1)	DETSC 2055	1	mg/l		5.0				5.1
Nitrate Aqueous Extract as NO3 (2:1)	DETSC 2055	1	mg/l		3.0				1.9
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l	< 10	< 10	< 10	< 10	37	< 10
Sulphur as S, Total	DETSC 2320	0.01	%		< 0.01				< 0.01
Sulphate as SO4, Total	DETSC 2321#	0.01	%		0.01				0.02
Petroleum Hydrocarbons									
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.09
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4	< 3.4	< 3.4	< 3.4	< 3.4	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
TPH Ali/Aro Total C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10

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Summary of Chemical Analysis
Soil Samples

Our Ref 24-04340
Client Ref
Contract Title KNOCK

			Lab No	2306233	2306234	2306235	2306236	2306237	2306238
			Sample ID ~	TP03	TP24	TP19	TP20	TP14	TP10
			Depth ~	0.20	0.50	0.70	0.50	0.10	0.50
			Other ID ~						
			Sample Type ~	ES	ES	ES	ES	ES	ES
			Sampling Date ~	13/02/2024	13/02/2024	14/02/2024	14/02/2024	14/02/2024	13/02/2024
			Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
PAHs									
Naphthalene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pyrene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PAH 16 Total	DETSC 3301	1.6	mg/kg	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6
Phenols									
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3	2.3	< 0.3

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Summary of Chemical Analysis
Soil Samples

Our Ref 24-04340
Client Ref
Contract Title KNOCK

	Lab No	2306239	2306240	2306241	2306242	2306243	2306244
	Sample ID ~	TP04	TP01	TP16	TP09	TP07	TP02
	Depth ~	0.10	0.10	0.50	0.50	0.50	0.20
	Other ID ~						
	Sample Type ~	ES	ES	ES	ES	ES	ES
	Sampling Date ~	13/02/2024	13/02/2024	14/02/2024	13/02/2024	13/02/2024	14/02/2024
	Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Metals							
Arsenic	DETSC 2301#	0.2	mg/kg	3.8	2.9		
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	< 0.2	0.4		
Cadmium	DETSC 2301#	0.1	mg/kg	< 0.1	< 0.1		
Chromium	DETSC 2301#	0.15	mg/kg	18	14		
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0		
Copper	DETSC 2301#	0.2	mg/kg	6.3	5.4		
Lead	DETSC 2301#	0.3	mg/kg	9.0	9.1		
Magnesium Aqueous Extract (2:1)	DETSC 2076*	10	mg/l			< 10	< 10	< 10	< 10
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	< 0.05		
Nickel	DETSC 2301#	1	mg/kg	8.0	6.8		
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5		
Zinc	DETSC 2301#	1	mg/kg	32	31		
Inorganics							
pH	DETSC 2008#		pH	6.4	5.9	7.1	6.6	6.5	6.4
Cyanide, Total	DETSC 2130#	0.1	mg/kg	0.5	0.6		
Organic matter	DETSC 2002#	0.1	%	2.3	6.1		
Ammonia Aqueous Extract as N	DETSC 2119*	10	mg/l			< 10	< 10	< 10	< 10
Chloride Aqueous Extract (2:1)	DETSC 2055	1	mg/l			3.9	4.1	5.9	5.6
Nitrate Aqueous Extract as NO3 (2:1)	DETSC 2055	1	mg/l			3.2	1.7	5.0	3.6
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l	12	20	< 10	< 10	< 10	< 10
Sulphur as S, Total	DETSC 2320	0.01	%			< 0.01	0.01	< 0.01	0.02
Sulphate as SO4, Total	DETSC 2321#	0.01	%			0.02	0.02	0.02	0.04
Petroleum Hydrocarbons							
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01		
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01		
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01		
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5		
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2	< 1.2		
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5		
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4	< 3.4		
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10		
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01		
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01		
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01		
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9	< 0.9		
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5	< 0.5		
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6	< 0.6		
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4	< 1.4		
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10		
TPH Ali/Aro Total C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10		

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: n/s -not

Summary of Chemical Analysis
Soil Samples

Our Ref 24-04340
Client Ref
Contract Title KNOCK

	Lab No	2306239	2306240	2306241	2306242	2306243	2306244
	Sample ID ~	TP04	TP01	TP16	TP09	TP07	TP02
	Depth ~	0.10	0.10	0.50	0.50	0.50	0.20
	Other ID ~						
	Sample Type ~	ES	ES	ES	ES	ES	ES
	Sampling Date ~	13/02/2024	13/02/2024	14/02/2024	13/02/2024	13/02/2024	14/02/2024
	Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
PAHs							
Naphthalene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1		
Acenaphthylene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1		
Acenaphthene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1		
Fluorene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1		
Phenanthrene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1		
Anthracene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1		
Fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1		
Pyrene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1		
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1		
Chrysene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1		
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1		
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1		
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1		
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1		
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1		
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1		
PAH 16 Total	DETSC 3301	1.6	mg/kg	< 1.6	< 1.6		
Phenols							
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	1.7		

Key: ~ Sample details provided by client and can affect the validity of the results: * -not accredited.: # -MCERTS (accreditation only applies if report carries the MCERTS logo).

: n/s -not

Summary of Asbestos Analysis
Soil Samples

Our Ref 24-04340
Client Ref
Contract Title KNOCK

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
2306227	TP22 0.80	SOIL	NAD	none	Josh Best
2306228	TP11 0.50	SOIL	NAD	none	Josh Best
2306229	TP12 0.50	SOIL	NAD	none	Josh Best
2306230	TP08 0.50	SOIL	NAD	none	Josh Best
2306231	TP06 0.10	SOIL	NAD	none	Josh Best
2306232	TP05 0.50	SOIL	NAD	none	Josh Best
2306233	TP03 0.20	SOIL	NAD	none	Josh Best
2306234	TP24 0.50	SOIL	NAD	none	Josh Best
2306235	TP19 0.70	SOIL	NAD	none	Josh Best
2306236	TP20 0.50	SOIL	NAD	none	Josh Best
2306237	TP14 0.10	SOIL	NAD	none	Josh Best
2306238	TP10 0.50	SOIL	NAD	none	Josh Best
2306239	TP04 0.10	SOIL	NAD	none	Josh Best
2306240	TP01 0.10	SOIL	NAD	none	Josh Best

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

Information in Support of the Analytical Results

Our Ref 24-04340
Client Ref ~
Contract ~ KNOCK

Containers Received & Deviating Samples

Lab No	Sample ID ~	Date Sampled ~	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
2306227	TP22 0.80 SOIL	12/02/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2306228	TP11 0.50 SOIL	13/02/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2306229	TP12 0.50 SOIL	13/02/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2306230	TP08 0.50 SOIL	13/02/24	GJ 250ml, GJ 60ml, PT 1L	Ammonia Aqueous Extract (3 days), Total Sulphur ICP (7 days), pH + Conductivity (7 days)	
2306231	TP06 0.10 SOIL	13/02/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2306232	TP05 0.50 SOIL	13/02/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2306233	TP03 0.20 SOIL	13/02/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2306234	TP24 0.50 SOIL	13/02/24	GJ 250ml, GJ 60ml, PT 1L	Ammonia Aqueous Extract (3 days), Total Sulphur ICP (7 days), pH + Conductivity (7 days)	
2306235	TP19 0.70 SOIL	14/02/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2306236	TP20 0.50 SOIL	14/02/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2306237	TP14 0.10 SOIL	14/02/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2306238	TP10 0.50 SOIL	13/02/24	GJ 250ml, GJ 60ml, PT 1L	Ammonia Aqueous Extract (3 days), Total Sulphur ICP (7 days), pH + Conductivity (7 days)	
2306239	TP04 0.10 SOIL	13/02/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2306240	TP01 0.10 SOIL	13/02/24	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
2306241	TP16 0.50 SOIL	14/02/24	GJ 250ml, GJ 60ml, PT 1L	Ammonia Aqueous Extract (3 days), Total Sulphur ICP (7 days), pH + Conductivity (7 days)	
2306242	TP09 0.50 SOIL	13/02/24	GJ 250ml, GJ 60ml, PT 1L	Ammonia Aqueous Extract (3 days), Total Sulphur ICP (7 days), pH + Conductivity (7 days)	
2306243	TP07 0.50 SOIL	13/02/24	GJ 250ml, GJ 60ml, PT 1L	Ammonia Aqueous Extract (3 days), Total Sulphur ICP (7 days), pH + Conductivity (7 days)	
2306244	TP02 0.20 SOIL	14/02/24	GJ 250ml, GJ 60ml, PT 1L	Ammonia Aqueous Extract (3 days), Total Sulphur ICP (7 days), pH + Conductivity (7 days)	

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

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

Information in Support of the Analytical Results

Our Ref 24-04340
Client Ref ~
Contract ~ KNOCK

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.
Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.
The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-
Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

Key: ~ Sample details provided by client and can affect the validity of the results

Appendix D – Tier 1 Thesholds.

Adopted Soil Generic Assessment Criteria
Sandy loam with 1% SOM

curtins

Contaminants	Residential with home grown produce	Residential without home grown produce	Allotments	Commercial	Public open space near residential housing POS_{resi}	Public park POS_{park}
Metals						
Beryllium	*1.7*	*1.7*	*35*	*12*	*2.2*	*63*
Boron	*290*	*11,000*	*45*	*240,000*	*21,000*	*46,000*
Cadmium	**10**[13] 22	**85**[13] 150	**1.8** 3.9	**230** 410	*120* 220	*560* 880
Chromium III	*910*	*910*	*18,000*	*8,600*	*1,500*	*33,000*
Chromium VI	*6* 21	*6* 21	*1.8* 170	*33* 49	*7.7* 21	*220* 250
Lead	200	310	80	2,300	630	1,300
Mercury *(elemental)*	**1**	**1**	**26**	**26**	*16*	**26**[8] *[30]*
Mercury (inorganic)	**170**	**240**	**80**	**3600**	*120*	*240*
Nickel	*130*[10]	*180*[10]	*53*[11]	*980*[10]	*230*	*800*
Vanadium	*410*	*1200*	*91*	*9000*	*2000*	*5000*
Copper	*2400*	*7100*	*520*	*68000*	*12000*	*44000*
Zinc	*3700*	*40000*	*620*	*730000*	*81000*	*170000*
Semi-Metals and non-metals						
Arsenic	**32**[12] 37	**35**[12] 40	**43**[12] 49	**640**[12] 640	*79* 79	*170* 170
Antimony		***550***		***7500***	***1500***	***3300***
Selenium	**350**	**600**	**120**	**13000**	*1100*	*1800*
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
Aliphatic risk banded hydrocarbons - TPHCWG method						
$EC_{>5}$ - EC_6	*42*	*42*	*730*	*3200*	*570000*	*95000*
$EC_{>6}$ - EC_8	*100*	*100*	*2300*	*7800*	*600000*	*150000*
$EC_{>8}$ - EC_{10}	*27*	*27*	*320*	*2000*	*13000*	*14000*
EC_{10}-EC_{12}	*130*	*130*	*2200*	*9700*	*13000*	*21000*
EC_{12}-EC_{16}	*1100*	*1100*	*11000*	*59000*	*13000*	*25000*
$EC_{>16}$ - EC_{35}	*65000*	*65000*	*260000*	*1600000*	*250000*	*450000*
$EC_{>35}$ - EC_{44}	*65000*	*65000*	*260000*	*1600000*	*250000*	*450000*
Aromatic risk banded hydrocarbons - TPHCWG method						
$EC_{>5}$ - EC_7	*70*	*370*	*13*	*26000*	*56000*	*76000*
$EC_{>7}$ - EC_8	*130*	*860*	*22*	*56000*	*56000*	*87000*
$EC_{>8}$ - EC_{10}	*34*	*47*	*8.6*	*3500*	*5000*	*7200*
EC_{10} - EC_{12}	*74*	*250*	*13*	*16000*	*5000*	*9200*
EC_{12} - EC_{16}	*140*	*1800*	*23*	*36000*	*5100*	*10000*
$EC_{>16}$ - EC_{21}	*260*	*1900*	*46*	*28000*	*3800*	*7600*
$EC_{>21}$ - EC_{35}	*1100*	*1900*	*370*	*28000*	*3800*	*7800*
$EC_{>35}$ - EC_{44}	*1100*	*1900*	*370*	*28000*	*3800*	*7800*
Aliph + Arom EC >44-70	*1600*	*1900*	*1200*	*28000*	3800	7800
Aromatic						
Benzene	**0.08**	**0.3**	**0.017**	**28**	*72*	*90*
Ethyl benzene	**65**	**170**	**16**	**520**[8] [17000]	**520**[8] *[24000]*	**520**[8] *[17000]*
Toluene	**120**	**610**	**22**	**860**[8] [59000]	**860**[8] *[56000]*	**860**[8] *[87000]*
Xylene[9]	**41**	**53**	**28**	**480**[8] [69000]	**480**[8] *[41000]*	**480**[8] *[17000]*
Phenol	**180**	**310**	**66**	**760**[14] (31000)	**760**[14] *(10000)*	**760**[14] *(7600)*
Polycyclic Aromatic Hydrocarbons (PAH)						
Naphthalene	*2.3*	*2.3*	*4.1*	*190*	*4900*	*1200*
Acenaphthylene	*170*	*2900*	*28*	*83000*	*15000*	*29000*
Acenaphthene	*210*	*3000*	*34*	*84000*	*15000*	*29000*
Fluorene	*170*	*2800*	*27*	*63000*	*9900*	*20000*
Phenanthrene	*95*	*1300*	*15*	*22000*	*3100*	*6200*
Anthracene	*2400*	*31000*	*380*	*520000*	*74000*	*150000*
Fluoranthene	*280*	*1500*	*52*	*23000*	*3100*	*6300*
Pyrene	*620*	*3700*	*110*	*54000*	*7400*	*15000*
Benz(a)anthracene	*7.2*	*11*	*2.9*	*170*	*29*	*49*
Chrysene	*15*	*30*	*4.1*	*350*	*57*	*93*
Benzo(b)fluoranthene	*2.6*	*3.9*	*0.99*	*44*	*7.1*	*13*
Benzo(k)fluoranthene	*77*	*110*	*37*	*1200*	*190*	*370*
Benzo(a)pyrene	*2.2*	*3.2*	*0.97*	*35*	*5.7*	*11*
Indeno(123cd)pyrene	*27*	*45*	*9.5*	*500*	*82*	*150*
Dibenzo(ah)anthracene	*0.24*	*0.31*	*0.14*	*3.5*	*0.57*	*1.1*
Benzo(ghi)perylene	*320*	*360*	*290*	*3900*	*640*	*1400*
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	*0.00064*	*0.00077*	*0.00055*	*0.059*	*3.5*	*4.8*
Trichloroethene (TCE)	*0.016*	*0.017*	*0.041*	*1.2*	*120*	*70*
1,1,1,2 Tetrachlorethane	*1.2*	*1.5*	*0.79*	*110*	*1400*	*1500*
Tetrachlorethene (PCE)	*0.18*	*0.18*	*0.65*	*19*	*1400*	*810*
1,1,1 Trichlorethane	*8.8*	*9*	*48*	*660*	*140000*	*57000*

Notes

1. All values above are in mg/kg
2. **Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters**, *numbers in italics are S4ULs*, ***numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters*** and underlined numbers are C4SLs
3. Soil organic matter (SOM) is assumed to be 1% - DEFAULT VALUE
4. Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
5. For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
6. For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
7. For classrooms consider increasing the dust loading fator in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m^{-3}
8. Based on vapour saturation limt as suggested by EA / [ ] model value
9. Lowest of o-, m- and p-xylene
10. Based on comparison of inhalation exposure with inhalation TDI
11. Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
12. Based on a comparison of oral and dermal soil exposure with oral Index Dose only
13. Averaged over and based on lifetime exposure
14. Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
15. NA: Not applicable

Appendix E – Qualitative Risk Assessment Rationale

The site-specific risk assessment, presented in this report, follows the principle of establishing whether there is a viable linkage between a contaminant source to a potential receptor, via an exposure pathway.

The risk assessment corresponds with the total site area and incorporates both descriptive (qualitative) and, where available, numerical (quantitative) lines of evidence.

Risk assessment is the process of collating known information on a hazard or set of hazards to estimate actual or potential risk to receptors. The receptor may be humans, a water resource, a sensitive local ecosystem, or future construction materials. Receptors can be connected to the source by one or several exposure pathways such as direct contact for example. Risks are managed by isolating the receptor or intercepting the exposure pathway or by isolating or removing the hazard.

Without the three essential components of a source, pathway, and receptor there can be no risk. Therefore, the presence of contaminant source on a site does not necessarily mean there is a risk.

The risk assessment considers the likelihood of a particular event taking place (accounting for the presence of the source and receptor and the viability of the exposure pathway) in conjunction with the severity of the potential consequence (accounting for the potential severity of the hazard and the sensitivity of the receptor).

In the risk assessment the consequence of the hazard has been classified as severe, medium, mild, or minor and the probability (likelihood) of the circumstances occurring classified as high likelihood or low likelihood or unlikely.

The consequences and probabilities are subsequently cross correlated to give a qualitative estimation of the risk using Department of the Environment risk classifications as detailed in the table below and as referenced in CIRIA C552.

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability (Likelihood)	**High Likelihood**	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

In accordance with DoE guidance, the following categorisation of **consequence** has been developed.

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to an ecosystem or organisation forming part of such ecosystem.	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).
Medium	Chronic damage to Human Health. Pollution of sensitive water resources. A significant change in an ecosystem or organism forming part of such ecosystem.	Concentration of a contaminant from site exceeds the generic or site-specific assessment criteria. Leaching of contaminants from a site to a Principal or Secondary A aquifer. Death of a species within a designated nature reserve. Lesser toxic and asphyxiate effects
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures, and services. Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater (Inc. Secondary B aquifers). Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc). Easily repairable effects of damage to buildings, structures, and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

In accordance with DoE guidance, the following categorisation of **probability** has been developed.

Classification	Definition
High Likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and over the long term.
Low Likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place and is less likely in the shorter term.
Unlikely	There is a pollution linkage, but circumstances are such that it is improbable that an event would occur even in the very long term.

In accordance with DoE guidance, the following categorisation of **risk** has been developed.

Classification	Definition
Very High Risk	There is a *high probability* that *severe harm* could arise to a designated receptor from an identified hazard at the site without appropriate further action.
High Risk	*Harm* is *likely to arise* to a designated receptor from an identified hazard at the site without appropriate further action.
Moderate Risk	*It is possible* that without appropriate further action *harm could arise* to a designated receptor. It is relatively *unlikely* that any such harm would be *severe**,*** and if any harm were to occur it is *more likely* that such harm would be *relatively mild.*
Low Risk	*It is possible* that *harm could arise* to a designated receptor from an identified hazard. It is *likely* that, at worst, if any harm was realised any effects would be *mild.*
Negligible Risk	The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor.

The term ‘risk’ in this instance refers to the risk that the source, pathway, receptor linkage for a given source of contamination is complete. It does not refer to immediate risk to individuals or features present on the site from potential contaminants and is intended to be used as a tool to assess the necessity of further investigation.