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Consultant:

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Ground Investigation - Geotechnical

Lancashire Farm Dairies, Crawford Street, Rochdale

Sept 2024

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Ground Investigation - Geotechnical

1. Introduction

This report is an account of an intrusive Geotechnical Ground Investigation carried out by GeoAssist Limited at the request of the Client Pakeeza Dairies Limited as the owners and developers of the site at Lancashire Farm Dairies, Crawford Street, Rochdale.

The object of this geotechnical investigation was to obtain information on the nature, depth and extent of the superficial deposits beneath the site to facilitate a Commercial development.

Geotechnical parameters and groundwater regime were to be obtained.

The work was commissioned following acceptance of the quotation and an instruction to proceed issued by the Client Pakeeza Dairies Limited on 10th July 2024.

It is understood that the proposed development for this site involves the construction of a new warehouse and associated hardstanding and access road.

The approximate grid reference for the centre of the site is 390480E, 412500N.

The exploratory hole locations are indicated on the site plan in Appendix A1.

The proposed commercial development is shown on the plan in Appendix A2.

2. Description of the Site

2.1 Present

The site is located within a commercial/ light industrial area at the convergence of Crawford Street and Dodgson Street approximately 1km to the south east of Rochdale Town Centre. The site forms an irregular shape and is generally level with the surrounding area.

The site boundary is formed by commercial property to the west and public roads to the south and north/north east over which lies more commercial property. An area of public open space is located across Dodgson Street to the east.

At the time of the site visit the site had been subject to demolition works and no buildings, structures or hard standing was present on site. The ground cover was noted to be crushed brick and concrete aggregate hardstanding.

2.2 Proposed

It is understood that the proposed development incorporates the construction of a new warehouse and associated hardstanding and access road.

3. Geology

The relevant 1:10,000 digital geological map of the area referenced SD 81 SE published 2007 shows Superficial drift deposits as Devensian Glaciofluvial Sand and Gravel,

The solid geology is shown as being Lower Coal Measures Formation – Mudstone Siltstone and Sandstone of the Carboniferous Epoch.

No faults are shown as passing directly beneath the site.

4. Mineworkings

Information provided by the Coal Authority as part of the Environmental data search report referenced 353121941_1_1 indicates that the property is in an area that may be affected by coal mining.

The Professional Opinion of the The Coal Authority Coal Mining Risk Assessment submitted in the Phase I report states:

According to the official mining information records held by the Coal Authority at the time of this search, evidence of, or the potential for, coal mining related features have been identified. It is unlikely that these features will impact on the stability of the enquiry boundary.

Consequently, the risk to the proposed development on this site in respect of past, present or future coal workings is classified as low.

5. Intrusive Investigation

5.1 Exploratory Hole Programme

Four geotechnical exploratory holes referenced BH1 to BH4 were undertaken by GeoAssist using light cable tool percussive and windowless sampling and dynamic probing techniques at the location as shown on the site plan in Appendix A1.

Gas/groundwater monitoring standpipes were installed in exploratory holes BH1 to BH4 to allow monitoring of ground gas and groundwater over a period of time.

The details of the strata in the exploratory holes were recorded by a suitably qualified Professional Engineer.

All intrusive work was carried out in accordance with British standard 5930: 1999/2015 Code of Practice for Site Investigations and British Standard 10175: 2011 where applicable.

The fieldwork for Exploratory holes was completed between 29th July and 2nd August 2024 in mainly dry weather conditions.

The trial pit for infiltration testing was undertaken from the 5th to 8th August 2024.

5.2 Field Sampling and Testing

Representative samples were taken of all the strata encountered in the exploratory holes.

Undisturbed samples were recovered from cohesive deposits where possible.

In Situ Dynamic Penetration tests using the Standard SPT drop weight and drop height were carried out in the exploratory holes.

All samples were stored in airtight containers and returned to the laboratory for subsequent examination and testing.

Observations of groundwater conditions were made throughout the fieldwork operations.

5.3 Field Results

Full details of the subsoil conditions in the exploratory holes are given in the exploratory hole log sheets, which form Appendix C1 to this report.

6. Laboratory Investigation

6.1 Geotechnical Testing

The following geotechnical tests were performed in GeoAssist's laboratory on samples recovered from the exploratory holes.

Table 6.1 Geotechnical Testing

TEST	PURPOSE
Natural Moisture Content and Classification test	Assessment of in-situ subsoil conditions and compressibility/shrinkage of cohesive deposits
Sulphate and pH test	Assessment of potential aggressive ground conditions with respect to subsurface concrete
Loss on Ignition test	Assessment of variability of organic fibrous Peat deposits
Particle Size Distribution	Determination of grading characteristics of granular deposits
Undrained Triaxial Test	Determination of undrained shear strength of cohesive deposits

6.2 Test Results

The geotechnical test results are given in the laboratory test results summary sheets, which form Appendices D1 to D4 to this report.

7. Subsurface Stratigraphy

The subsoil profile obtained from the exploratory holes consists of granular mixed sandy gravel, brick and concrete fragments Made Ground overlying silty sands and silty clays.

The Made Ground is generally loose to medium dense in state of compaction.

Soft fibrous Peat was present beneath the Made Ground in BH2 and BH3 to 2.50m depth.

The sands extend to between 10.0m and 11.0m depth and vary from loose to medium dense in state of compaction.

Stiff very silty Clay with sand inclusions of low to intermediate plasticity was present beneath the sands and extended to 9.50m depth in BH1.

Further details of the subsurface stratigraphy can be found in the exploratory hole log sheets which form Appendix C1 to this report.

Table 7.0 Subsoil Profile Summary

Strata	Depth of Strata (m) below ground level	
	Top	Base
Made Ground Variable mixed granular	Ground Level	1.00 to 2.50
Soft fibrous Peat present in BH2 and BH3	1.00 to 1.90	2.50
Loose to medium dense silty Sand with occasional gravel inclusions	1.90 to 2.50	10.00 to 11.00
Stiff high strength very silty CLAY with sand inclusions	10.00 to 11.00	13.00 to 13.70
Medium dense SILT/fine Sand with silty clay inclusions	13.70	15.50 BH 1 only
Stiff high strength very silty CLAY with sand inclusions	15.50	>19.50 In BH1 only

8. Groundwater

Seepage groundwater was recorded between 2.80m and 3.00m depth during the course of the fieldwork. The groundwater conditions entered on the exploratory hole logs are those observed at the time of the investigation and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.

Groundwater levels associated with the ground gas monitoring in the standpipes installed on this site indicate that over the monitoring period to date, ground water has been recorded as being present at depths between 2.40m and 2.70m.

Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

9. Geotechnical Properties

The following sections summarise the geotechnical properties for the main strata encountered on this site and are based on physical description, measured and empirical values.

9.1 Made Ground

Mainly granular deposits.

Table 9.1 Summary of Geotechnical Properties – generally very loose to loose silty sandy gravel, brick and concrete fragments.

Property	Number of Tests	Range of Results	Value for Design
Sulphate 2:1 Water:Soil Extract	3	800 to 920 mg/l	920 mg/l
pH	3	7.7 to 8.5	NA
Equivalent N value Uncorrected from SPT tests	6	0 to 12	Not suitable

9.2 Fibrous Peat

The exploratory holes penetrated fibrous Peat beneath the Made Ground in BH2 and BH3.

The clayey peat is generally low in strength, high in organic content and high to very high in compressibility.

Table 9.2 Summary of Geotechnical Properties – Clayey fibrous Peat

Property	Number of Tests	Range of Results	Note
Uncorrected N value	4	0 to 5	Not applicable
Loss on Ignition	4	38% to 80%	Highly compressible

9.3 Loose to medium dense Silty Sand

Granular deposits were encountered to depths between 10.00m and 11.00m.

Table 9.3 Summary of Geotechnical Properties – loose to medium dense silty Sand with occasional gravel inclusions.

Property	Number of Tests	Range of Results	Value for Design
Equivalent N value Uncorrected from SPT tests	37	3 to 31	N =19

9.4 Very silty Clay with sand inclusions

Table 9.4 Summary of Geotechnical Properties – stiff very silty Clay with sand inclusions

Property	Number of Tests	Range of Results	Value for Design
Shear Strength From Triaxial Test	1	86 kN/m ²	86 kN/m ²
Equivalent N value Uncorrected from SPT tests	15	19 to 38	N=19 C _u equivalent = 90 kN/m ²

10. Geotechnical Assessment

10.1 Design Criteria

The design criteria for the proposed development are likely to be piled foundations due to the presence of very loose made ground deposits over highly compressible fibrous peat deposits.

10.2 Foundation Design Considerations

The subsurface profile across the site includes the presence of loose granular made ground and soft fibrous peat deposits which impairs the use of traditional strip or trench fill foundations and the use of ground bearing slabs on this site.

10.3 Ground Stabilisation

The use of vibratory compaction/displacement ground stabilisation of the made ground and superficial deposits is unlikely to be effective in providing a satisfactory increase in bearing capacity and reduced settlements.

The advice of the relevant specialist ground stabilisation contractor should be sought to ascertain whether this is a viable and economical ground treatment for structural foundations on this site given that very soft organic deposits are present on part of the site.

10.4 Pile Foundations

The use of pile foundations penetrating into the more competent deposits at depth may be considered for the structural foundations for this residential development.

The magnitude of the loads to be taken by pile foundations can only be determined by consultation with the relevant piling contractor. However, preliminary assessment would indicate that a single driven pile 300mm diameter and 8.00m long should provide a load capacity of 250kN. It should be noted that piled foundations transfer the loads to deeper depths and consequently pile lengths should be limited to depths that do not exceed the overall depth of the deepest hole undertaken on this site of 19.50m less at least 5.00m to comply with Federation of Piling Contractors (FPS) and typical warranty provider requirements.

10.5 Excavations

Shallow to moderate depth excavations will require full support/sheet piling with groundwater control for vertical faces to prevent instability of the excavation sides and base.

10.6 Subsurface Concrete Attack

The results of the soluble sulphate and pH tests carried out on samples of made ground obtained from this site in general indicate that according to Building Research Establishments Special Digest 1 (2005) particular precautions for concrete foundations will be required.

Generally, the use of concrete mix design sulphate class DS-2 and according to ACEC Class AC-2 of Table C1 conditions can be used for subsurface concrete mix design.



Matthew Benson MSc GMSCE
Geotechnical/Environmental Engineer



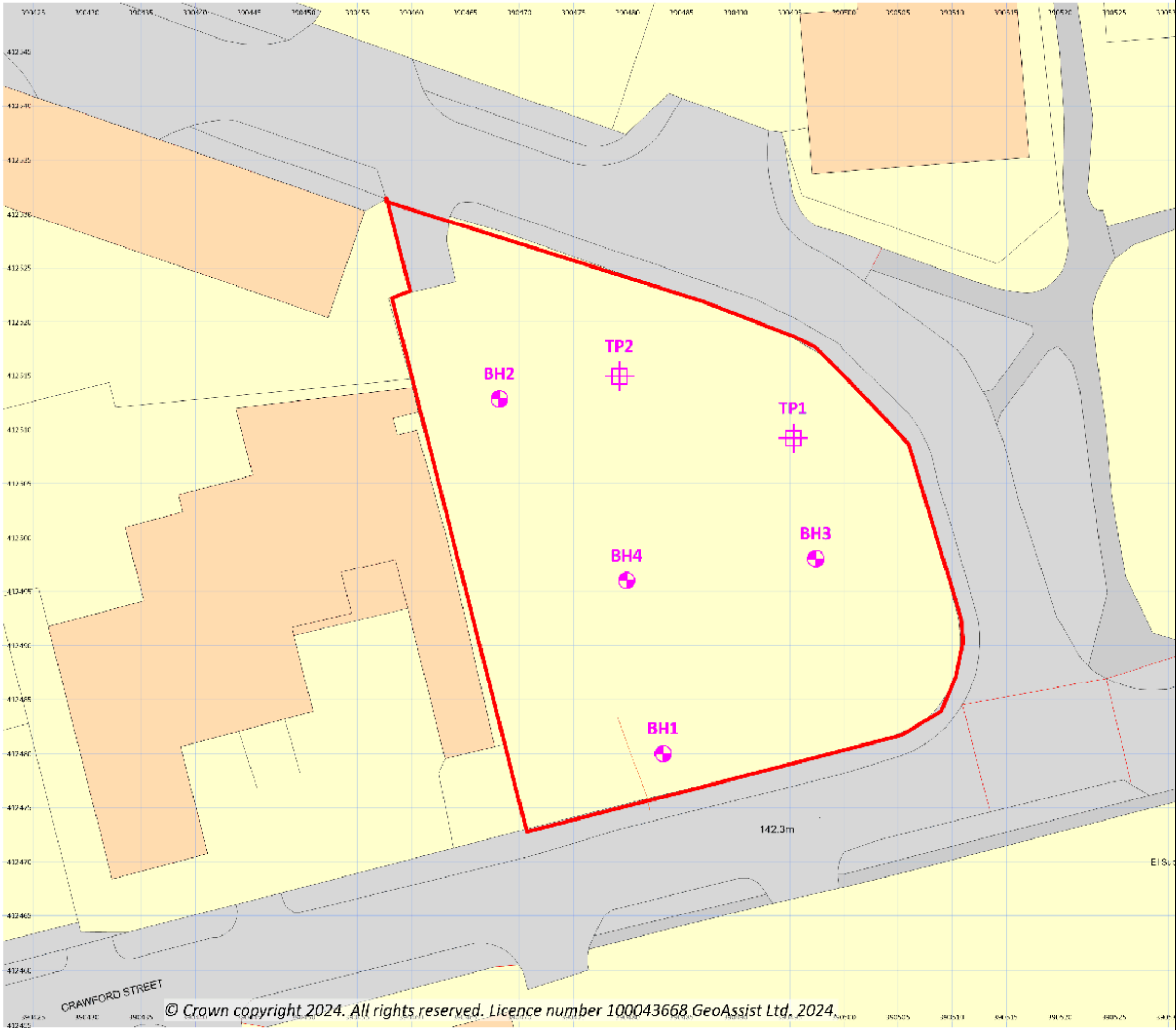
Mark Richardson MSc CEng MICE
Technical Director

Field investigations have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions are, and can be, variable and have only been tested at isolated locations across the site. Therefore, the potential exists for ground conditions to be encountered which are different to those considered in this report.

This report has been prepared by GeoAssist Limited with all reasonable professional skill, care, and diligence within the terms of the contract with Pakeeza Dairies Limited. The report is confidential to Pakeeza Dairies Limited, their/the named persons, advisors and bankers, and GeoAssist Limited accepts no responsibility of whatever nature to third parties to whom this report may be divulged. GeoAssist Limited owns the copyright in this report. All rights are reserved, and unauthorised use is prohibited. Pakeeza Dairies Limited may use the report for their/her/his own purposes, provided always that payment for the ground investigation is made in full by the due date.

Appendix A

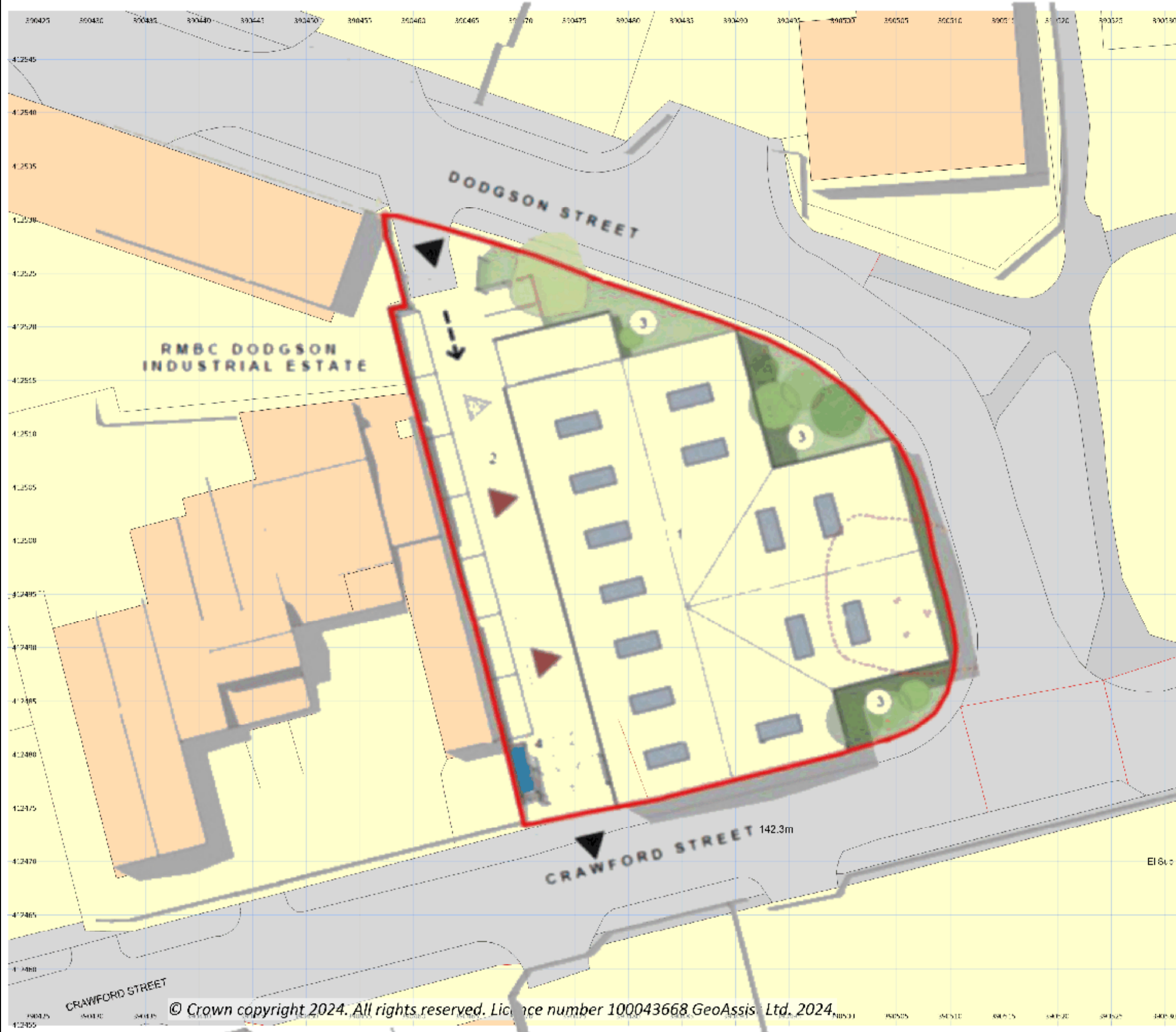
- A1 Site Plan with Exploratory Hole Locations
- A2 Proposed Site Plan



A1 Site Plan

Site Name	Lancashire Farm Dairies
Location	Crawford Street, Rochdale
GeoAssist Ref	6160VDA
Client	Pakeeza Dairies Limited
	Unit 2b Moss Bridge Road Rochdale, Greater Manchester OL16 5LX
Planning Consultant	BrennanConsult Ltd
NGR (centre of site)	390480,412500
Production Date	Aug 2024
Survey Method	
Surveyor	Others
Status	Final v1.00
Base Survey	OSGB36

Do Not Scale



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A2 Site Development Plan

Site Name	Lancashire Farm Dairies
Location	Crawford Street, Rochdale
GeoAssist Ref	6160VDA
Client	Pakeeza Dairies Limited
	Unit 2b Moss Bridge Road Rochdale, Greater Manchester OL16 5LX
Planning Consultant	BrennanConsult Ltd
NGR (centre of site)	390480,412500
Production Date	Aug 2024
Survey Method	
Surveyor	Others
Status	Final v1.00
Base Survey	OSGB36

Do Not Scale

Appendix B

- B1 Terminology used in Soil Descriptions
- B2 List of Abbreviations
- B3 Concrete in Aggressive Ground
- B4 Standard Penetration Test

Terminology used in Soil Descriptions

The procedure and principles given in BS EN ISO 14688-1:2002 Part 1: 'Identification and description' have been adopted in producing the soil descriptions contained within this report.

The general identification and description of soils is based on a flexible system for immediate (field) use by experienced persons, covering both material and mass characteristics by visual and manual techniques.

Details are given of the individual characteristics for identifying soils and the descriptive terms in regular use, including those related to the results of tests from the field.

This part of ISO 14688 is applicable to natural soils *in situ*, similar man-made materials *in situ* and soils redeposited by man.

Particular sections of BS EN ISO 14688-1:2002 Part 1 are reproduced here in order to clarify the production of the soil descriptions contained within this report.

Identification of soil

General

Soil characteristics that generally permit soil to be identified with adequate accuracy for general (or preliminary) characterization are outlined below. A more accurate identification and classification based on grading, plasticity or organic content can be achieved by laboratory tests. In addition to identifying soils, the condition in which a soil is encountered, any particular secondary constituents, other features of a soil, such as carbonate content, particle shape, surface roughness of particles, odour, any common names and the geological classification are indicated.

The identification and description of soils generally follows the flow chart in Figure B1.1 attached.

Particle size

Particle size is the fundamental basis for designating mineral soils using particle fractions to distinguish the soil mechanical behaviour.

Table B1 shows the terms to be used for each soil fraction and its sub-fractions, together with the corresponding chosen range of particle sizes.

Basic soils are soils with uniform grading (i.e. they consist of particles of only one size range as specified in Table B1.1

Table B1.1 Particle Size Fractions

Soil fractions	Sub-fractions	Symbols	Particle sizes mm
Very coarse soil	Large boulder	LBo	> 630
	Boulder	Bo	> 200 to 630
	Cobble	Co	> 63 to 200
Coarse soil	Gravel	Gr	> 2,0 to 63
	Coarse gravel	CGr	> 20 to 63
	Medium gravel	MGr	> 6,3 to 20
	Fine gravel	FGr	> 2,0 to 6,3
	Sand	Sa	> 0,063 to 2,0
	Coarse sand	CSa	> 0,63 to 2,0
	Medium sand	MSa	> 0,2 to 0,63
	Fine sand	FSa	> 0,063 to 0,2
Fine soil	Silt	Si	> 0,002 to 0,063
	Coarse silt	CSi	> 0,02 to 0,063
	Medium silt	MSi	> 0,006 3 to 0,02
	Fine silt	FSi	> 0,002 to 0,006 3
	Clay	Cl	≤ 0,002

APPENDIX B1

Form No.: QF029AEN

Composite soils

General

Most soils are composite and consist of principal and secondary fractions. They are designated by a noun (main term) describing the principal fraction and by one or more adjectives (qualifying terms) describing the secondary fractions (e.g. sandy gravel saGr, gravelly clay grCl).

Principal fraction

The principal fraction in terms of mass determines the engineering properties of the soil and is given in capital letters for clarity.

In the case of very coarse soils, the principal fraction is the relevant very coarse soil fraction predominating in terms of mass. The very coarse fraction should be separated from the sample before identifying the fine and coarse fractions.

In the case of coarse soils, the principal fraction is the relevant coarse soil fraction predominating in terms of mass.

Composite coarse soils include a fines fraction (silt and/or clay) that does not determine the engineering properties of the soil.

In the case of fine soils, the principal fraction is the relevant fine soil type determining the engineering properties of the soil.

In the case of composite fine soils, the fines fraction determines the engineering properties of the soil. The fines fraction is regarded as determining the characteristics of a composite soil if this is of at least medium dry strength or exhibits a certain degree of plasticity.

In both cases, the soil is termed either "clay" or "silt", depending on the plasticity of the fines fraction and not on the grading.

Secondary fractions

Secondary and further fractions do not determine but will affect the engineering properties of the soil. The secondary fractions as adjectives are placed with the term describing the principal fraction in the order of their relevance.

If coarse secondary fractions are present in a particularly small or particularly large proportion, the term "slightly" or "very" shall precede the qualifying term.

If it is a fine soil, the properties of which are determined by fines fractions, a soil can be identified as "silt" or "clay" by checking for the presence of fine secondary constituents on the basis of its plasticity properties.

If, in the case of coarse soils, two soil fractions are present in approximately equal proportions, an oblique shall be placed between the relevant terms, e.g. gravel/sand (Gr/Sa) or fine/medium sand (FSa/MSa).

Plasticity

Assessment of the plasticity and identification of a soil as either silt or clay permits the soil to be qualified as being of low plasticity or high plasticity.

An exact determination can only be made by establishing the liquid limit and the plastic limit in laboratory tests.

Organic content

Small quantities of dispersed organic matter in a soil can produce a distinctive odour and colour. The intensity of odour and colour indicates the proportion of organic matter and should be described.

Determination of consistency

The consistency of a cohesive soil shall be determined in a manual test, permitting the following identification and description:

- a) a soil is to be identified as **very soft** if it exudes between the fingers when squeezed in the hand;
- b) a soil is to be identified as **soft** if it can be moulded by light finger pressure;
- c) a soil is to be identified as **firm** if it cannot be moulded by the fingers, but rolled in the hand to thick threads without breaking or crumbling;
- d) a soil is to be identified as **stiff** if it crumbles and breaks when rolled to thick threads but is still sufficiently moist to be moulded to a lump again;
- e) a soil is to be identified as **very stiff** if it has dried out and is mostly light coloured. It can no longer be moulded but crumbles under pressure. It can be indented by the thumbnail.

Preliminary descriptions are based on visual and manual identification only.

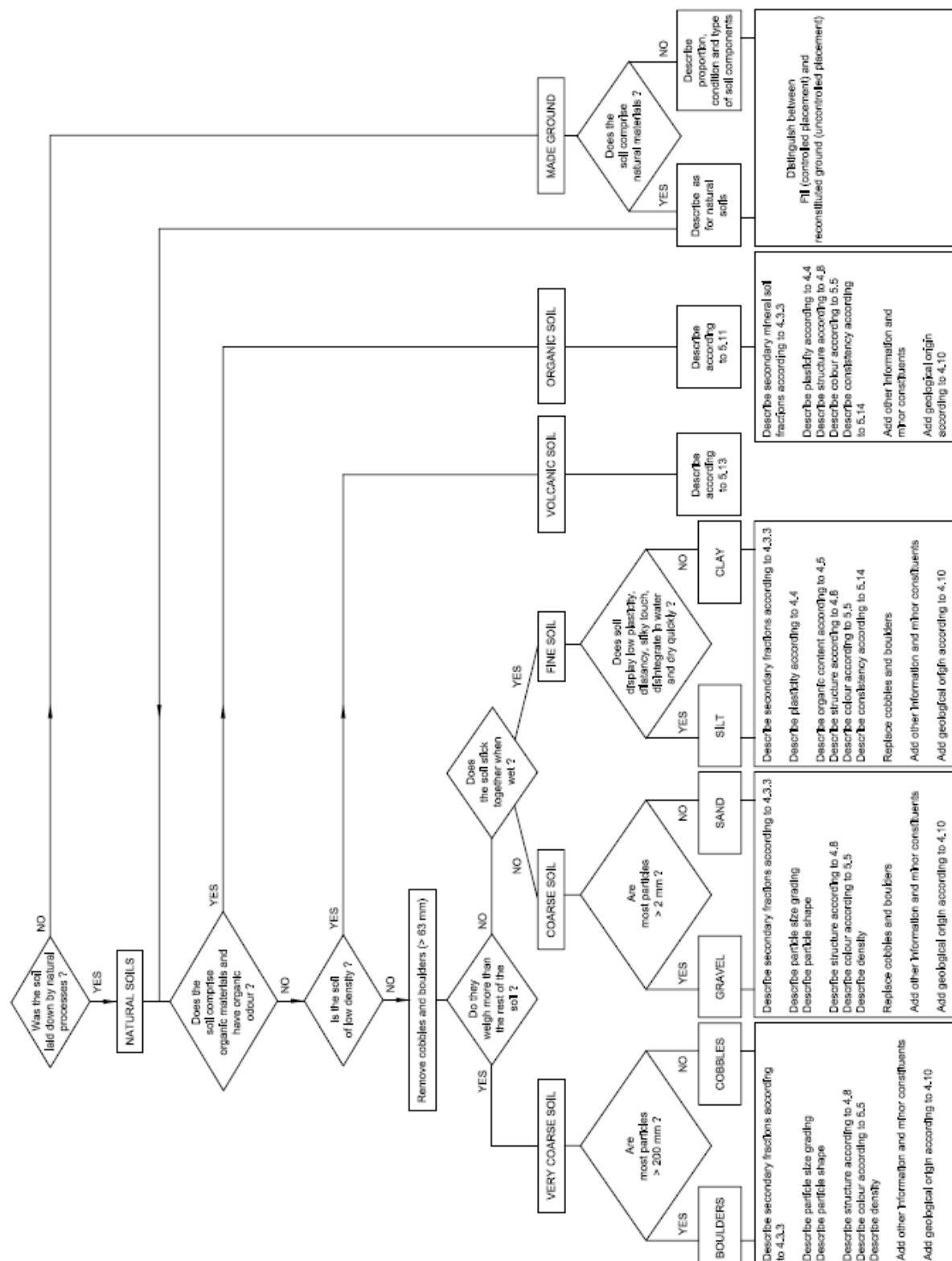


Figure B1.1 Flow chart for the identification and description of soils

Terminology used in Soil Classification

The procedure and principles given in BS EN ISO 14688-2:2004 Part 2: 'Principles for a classification' have been adopted in producing the soil descriptions contained within this report where laboratory or in situ field tests have been carried out.

The classification principles established in this part of ISO 14688 permit soils to be grouped into classes of similar composition and geotechnical properties and, with respect to their suitability for geotechnical engineering purposes.

This part of ISO 14688 is applicable to natural soil and similar man-made material *in situ* and redeposited, but it is not a classification of soil by itself.

Particular sections of BS EN ISO 14688-1:2002 Part 2 are reproduced here in order to clarify the production of the soil descriptions contained within this report.

Principles of soil classifications

General

Soils shall be classified into soil groups on the basis of their nature, which is the composition only, irrespective of their water content or compactness, taking into account the particle size distribution (grading), plasticity, organic content, genesis as appropriate.

The most common approach to classification is to divide the soils on the basis of particle size grading and plasticity. The division is made on the relative size fractions present for the coarser soil fractions, determined on the whole sample, and on the plasticity of the finer fractions (Table B1.2).

Table B1.2 Principles of a classification of soils

Criterion	Soil group	Quantification	Denomination into groups of similiar properties			Further subdivision as appropriate by
Wet soil does not stick together	very coarse	most particles > 200 mm	Bo	xBo		Requires special consideration
			boCo	coBo		
	most particles > 63 mm	Co	saCo, grCo	sagrCo		
	coarse	most particles > 2 mm	Gr	coGr	cosaGr	Particle size (grading) Shape of grading curve Relative density Permeability
		saGr, grSa	sasiGr, grsiSa			
	most particles > 0,063 mm	Sa	siGr, clGr orSa	siSa, clSa, saclGr	(Mineralogy) (Particle shape)	
Wet soils sticks together	fine	low plasticity dilatant	Si	saSi	sagrSi saclSi	Plasticity Water content Strength, sensitivity Compressibility, stiffness (Clay mineralogy)
			clSi, siCl			
		plastic non-dilatant	Cl	orSi, orCl	sagrCl	
Dark colour, low density	organic		Or	saOr, siOr	clOr	Requires special consideration
Not naturally	Made ground	deposited	Mg	xMg	Man-made material	Requires special consideration
					Relaid natural materials	As for natural soils
Key to symbols						Cases requiring special consideration should be classified according to national or project requirements
Soil	Principal	Secondary or tertiary component				
Boulders	Bo	bo				
Cobbles	Co	co				
Gravel	Gr	gr	Gr(gr) and Sa(sa) can be subdivided into fine F(f), medium M(m) or coarse C(c)			
Sand	Sa	sa				
Silt	Si	si				
Clay	Cl	cl				
Organic	Or	or				
Made ground	Mg	—				
		x	any combination of components			

APPENDIX B1

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Fractions

Soil is a mixture of materials of different particle size, which are grouped into fractions as specified in BS EN ISO 14688-1.

Classification of coarse and very coarse soils is to be based on the particle size distribution alone (see Table B1.3)

Table B1.3 Classification of very coarse soils

Fraction	Percent by mass	Term
Boulders	< 5	low boulder content
	5 to 20	medium boulder content
	> 20	high boulder content
Cobbles	< 10	low cobble content
	10 to 20	medium cobble content
	> 20	high cobble content

In the case of soils composed of both fine and coarse material, classification is to be based on both plasticity and particle size distribution.

Particle size distribution (grading)

The particle sizes and their distribution in a soil are determined by mechanical analysis carried out by the separation of the coarser fractions by sieving on a series of standard sieves and the determination of the finer fractions by sedimentation.

The results of the sieving and sedimentation process are plotted as a grading curve.

Plasticity

The fine fractions of soil, represented by clay and silt and containing clay minerals (see also BS EN ISO 14688-1), both alone or in mixtures with coarser material, are usually classified according to their plasticity characteristics. This is carried out on the basis of laboratory tests to determine the liquid limit w_L and plastic limit w_P .

Organic content

When soils with organic constituents are classified according to their organic content (Table B1.4), a distinction is to be made between organic soils and mineral soils with an organic content.

Table B1.4 Classification of soils with organic constituents

Soil	Organic content (≤ 2 mm) % of dry mass
Low-organic	2 to 6
Medium-organic	6 to 20
High-organic	> 20

Classification of coarse and composite organic soils accumulated *in situ* is based on the type of organic matter and that of organic soils, on the genetic origin and the degree of decomposition of the organic constituents.

APPENDIX B1

Form No.: QF029AEN

Undrained shear strength of fine soils

The terms to be used for the designation of the undrained shear strength according to the results of laboratory and field tests are given in Table B1.5.

Table B1.5 Undrained shear strength of fine soils

Undrained shear strength of clays	Undrained shear strength c_u kPa
Extremely low	< 10
Very low	10 to 20
Low	20 to 40
Medium	40 to 75
High	75 to 150
Very high	150 to 300
Extremely high ^a	> 300
^a Materials with shear strength greater than 300 kPa may behave as weak rocks and should be described as rocks according to ISO 14689-1.	

Table B1.6 Guiding values for the division of mineral soils on a basis of the contents of various fractions

Fraction	Content of fraction in wt % of material ≤ 63 mm	Content of fraction in wt % of material ≤ 0,063 mm	Name of soil	
			Modifying term	Main term
Gravel	20 to 40 > 40		gravelly	gravel
Sand	20 to 40 > 40		sandy	sand
Silt + clay (fine soil)	5 to 15 15 to 40 > 40	< 20 ≥ 20 < 20 ≥ 20 < 10 10 to 20 20 to 40 > 40	slightly silty slightly clayey silty clayey clayey silty	 silt silt clay clay

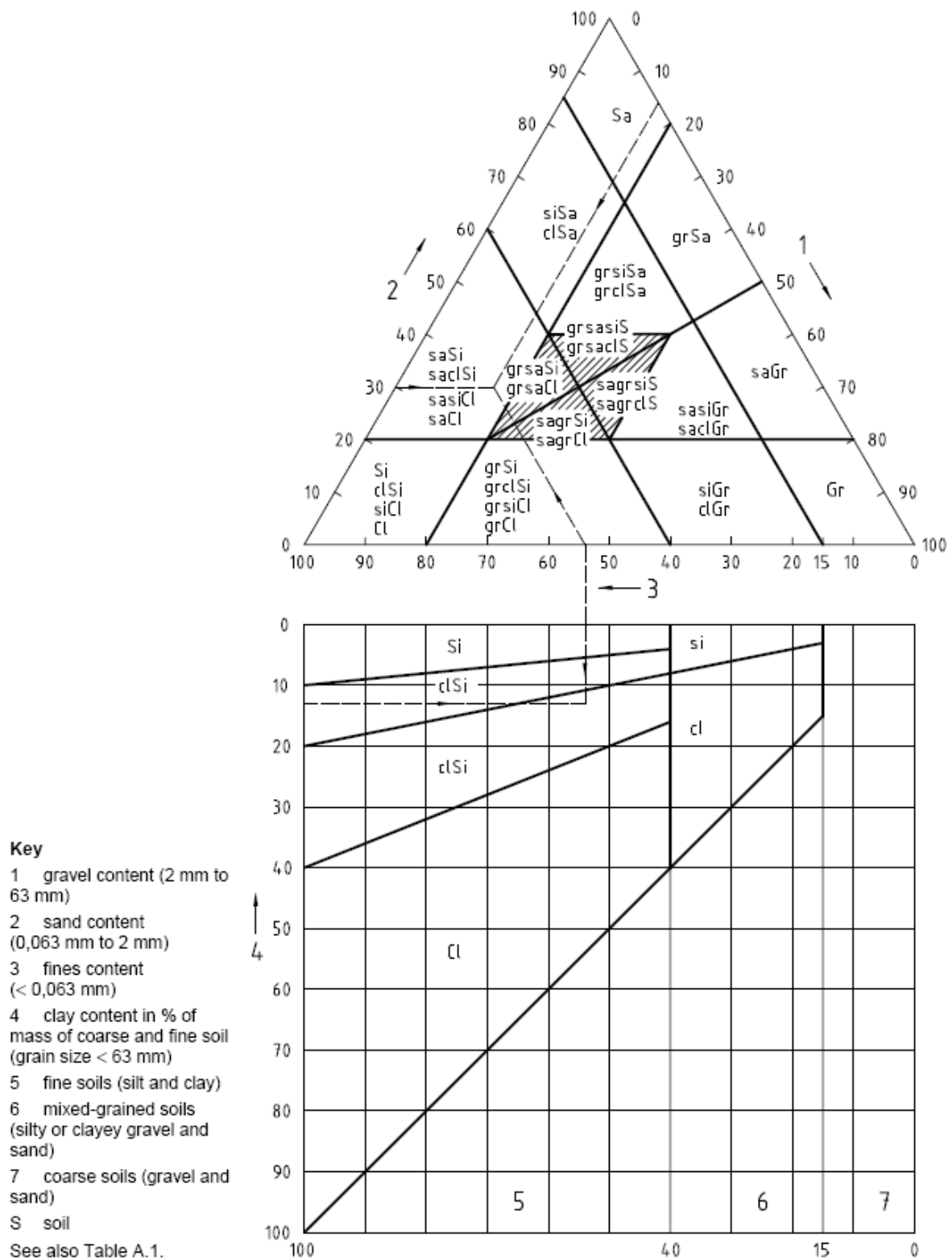


Figure B1.2 Classification of soils, based on grading alone

References

BS EN ISO 14688-1: 2002

Geotechnical investigation and testing — Identification and classification of soil — Part 1: Identification and description

BS EN ISO 14688-2: 2004

Geotechnical investigation and testing — Identification and classification of soil — Part 2: Principles for a classification

Abbreviations**Exploratory Hole log****Sample Type**

AGS Code	Sample Type	AGS Code	Sample Type
B	Bulk Disturbed sample	SPT	Penetration Test – split spoon
CBR	CBR sample	U	Undisturbed sample – open drive
CPT	Penetration Test – cone	UF	Undisturbed sample failed recovery
D	Small disturbed sample	W	Water sample
PU	Piston sample	C - ES	Environmental sample

SPT and CPT – Standard Penetration Test

Blow Count (N) – If full penetration of 450mm then the total number of blows for the last 300mm is given.

If limited penetration following 150mm seating blows then the number of blows for the stated penetration is given.

If limited penetration then the total number of blows for the stated penetration is given.

The N values are actual blows recorded and uncorrected.

U - Undisturbed Sample

Blow Count – total number of blows for recovered length

Legend – As per British Standard – if blank then CAVITY/OPEN HOLE

Core Rec.:

T - Total Core Recovery as a percentage of the cored run

S – Solid Core Recovery as a percentage of the cored run

RQD – Rock Quality Designation as a percentage of the cored run

FI – Fracture index as number of fractures per metre

l_f – Fracture spacing as the average length of solid core pieces between natural fractures over core length of reasonable uniform characteristics

APPENDIX B2

Form No.: QF033AEN

Laboratory Test Summary Sheet

Tests on Soils

AGS Code	Test Name	AGS Code	Test Name
ASB	Asbestos	IDEN	In Situ Density
BDEN	Bulk Density	IGNIS	Loss on Ignition
CBR	California Bearing Ratio	IVAN	In Situ Vane
CD	Consolidated drained (single stage)	LS	Linear shrinkage
CDM	Consolidated drained (multi stage)	MCVG	Moisture Condition Value
CLSS	Atterberg Limits	NMC	Natural Moisture content
CMPG	Compaction	OMS	Organic Matter
CNMT	Contaminant and Chemical	PD	Particle density
CONG	Consolidation	PHS	pH
CU	Consolidated undrained with pwp measurement (single stage)	PTST	Laboratory permeability
CUM	Consolidated undrained with pwp measurement (multi stage)	RELD	Relative Density
DDEN	Dry Density	SHBG	Shear box
FRST	Frost Susceptibility	SLIM	Shrinkage Limit
GRAD HY	Particle Size (Hydrometer)	SULWS SULTS	Sulphate on 2:1 Water:Soil Extract Sulphate Total on Acid Extract
GRAD WS	Particle size (wet Sieve)	TNPC	Ten Per Cent Fines
HVP	Hand vane – peak	UU	Unconsolidated quick undrained (single stage)
ICBR	In situ CBR	UUM	Unconsolidated quick undrained (multi stage)

Tests on rocks and Aggregates

AGS Code	Test Name	AGS Code	Test Name
ACV	Aggregate crushing value	SHOR	Shore hardness
BRAZ	Tensile Strength by Brazilian method	SOUN	Aggregate Soundness Test
LOSA	Aggregate Los Angeles Abrasion	UCS	Uniaxial Compressive Strength
PLSI	Point Load Index – size corrected	WTAB	Aggregate Water Absorption

4. Reference AGS Format Edition 3

Concrete in Aggressive Ground

1. Assessing the Aggressive Chemical Environment

In order to assess the levels of sulphate in the ground or groundwater, which may have a deleterious effect on concrete, the sulphate content of soil and groundwater may be determined in accordance with BS 1377 (2001) Test 3:5. The sulphate contents determined are grouped into Aggressive Chemical Environment for Concrete (ACEC) site classifications in Building Research Establishment Special Digest 1 – Part 1 (2005) Tables C1 and C2 as reproduced below.

Based on this classification BRE Special Digest 1 gives recommendations for the design of suitable concrete mixes to resist chemical attack for each ACEC classification. Care should be taken in the interpretation of results over the site area, if classification is based solely on groundwater analysis, it should be based on the highest sulphate concentration recorded. Where a large number of results from soil analysis are available it should be based on the average of the highest 20 per cent of the results. If a varied set of results are recorded from a limited sampling programme it is important to carry out further analyses before a detailed classification is given.

2. References

BS 1377: 2001: 'Methods of Test for Soils for Civil Engineering Purposes': British Standards Institution.

BRE Special Digest 1: 2005: 'Concrete in Aggressive Ground': Building Research Establishment.

Table C1 Aggressive Chemical Environment for Concrete (ACEC) classification for natural ground locations ^a						
Sulfate Design Sulfate Class for location	2:1 water/soil extract ^b	Groundwater	Total potential sulfate ^c	Groundwater Static water	Mobile water	ACEC Class for location
1	2 (SO ₄ mg/l)	3 (SO ₄ mg/l)	4 (SO ₄ %)	5 (pH)	6 (pH)	7
DS-1	< 500	< 400	< 0.24	≥ 2.5	> 5.5 ^d 2.5–5.5	AC-1s AC-1 ^e AC-2z
DS-2	500–1500	400–1400	0.24–0.6	> 3.5 2.5–3.5	> 5.5 2.5–5.5	AC-1s AC-2 AC-2s AC-3z
DS-3	1600–3000	1500–3000	0.7–1.2	> 3.5 2.5–3.5	> 5.5 2.5–5.5	AC-2s AC-3 AC-3s AC-4
DS-4	3100–6000	3100–6000	1.3–2.4	> 3.5 2.5–3.5	> 5.5 2.5–5.5	AC-3s AC-4 AC-4s AC-5
DS-5	> 6000	> 6000	> 2.4	> 3.5 2.5–3.5	≥ 2.5	AC-4s AC-5

Notes

- Applies to locations on sites that comprise either undisturbed ground that is in its natural state (ie is not brownfield – Table C2) or clean fill derived from such ground.
- The limits of Design Sulfate Classes based on 2:1 water/soil extracts have been lowered relative to previous Digests (Box C7).
- Applies only to locations where concrete will be exposed to sulfate ions (SO₄) which may result from the oxidation of sulfides (eg pyrite) following ground disturbance (Appendix A1 and Box C8).
- For flowing water that is potentially aggressive to concrete owing to high purity or an aggressive carbon dioxide level greater than 15 mg/l (Section C2.2.3), increase the ACEC Class to AC-2z.

Appendix B3

Page 1 of 2

GeoAssist Limited

Table C2 Aggressive Chemical Environment for Concrete (ACEC) classification for brownfield locations^a

Sulfate and magnesium						Groundwater		ACEC Class for location
Design Sulfate Class for location	2:1 water/soil extract ^b		Groundwater		Total potential sulfate ^c	Static water	Mobile water	
1	2 (SO ₄ mg/l)	3 (Mg mg/l)	4 (SO ₄ mg/l)	5 (Mg mg/l)	6 (SO ₄ %)	7 (pH) ^d	8 (pH) ^d	9
DS-1	< 500		< 400		< 0.24	≥ 2.5	> 6.5 ^e 5.5–6.5 4.5–5.5 2.5–4.5	AC-1s AC-1 AC-2z AC-3z AC-4z
DS-2	500–1500		400–1400		0.24–0.6	> 5.5 2.5–5.5	> 6.5 5.5–6.5 4.5–5.5 2.5–5.5	AC-1s AC-2 AC-2s AC-3z AC-4z AC-5z
DS-3	1600–3000		1500–3000		0.7–1.2	> 5.5 2.5–5.5	> 6.5 5.5–6.5 2.5–5.5	AC-2s AC-3 AC-3s AC-4 AC-5
DS-4	3100–6000	≤ 1200	3100–6000	≤ 1000	1.3–2.4	> 5.5 2.5–5.5	> 6.5 2.5–6.5	AC-3s AC-4 AC-4s AC-5
DS-4m	3100–6000	> 1200 ^e	3100–6000	> 1000 ^e	1.3–2.4	> 5.5 2.5–5.5	> 6.5 2.5–6.5	AC-3s AC-4m AC-4ms AC-5m
DS-5	> 6000	≤ 1200	> 6000	≤ 1000	> 2.4	> 5.5 2.5–5.5	> 2.5	AC-4s AC-5
DS-5m	> 6000	> 1200 ^e	> 6000	> 1000 ^e	> 2.4	> 5.5 2.5–5.5	≥ 2.5	AC-4ms AC-5m

Notes

- a Brownfield locations are those sites, or parts of sites, that might contain chemical residues produced by or associated with industrial production (Section C5.1.3).
- b The limits of Design Sulfate Classes based on 2:1 water/soil extracts have been lowered from previous Digests (Box C7).
- c Applies only to locations where concrete will be exposed to sulfate ions (SO₄²⁻), which may result from the oxidation of sulfides such as pyrite, following ground disturbance (Appendix A1 and Box C8).
- d An additional account is taken of hydrochloric and nitric acids by adjustment to sulfate content (Section C5.1.3).
- e The limit on water-soluble magnesium does not apply to brackish groundwater (chloride content between 12 000 mg/l and 17 000 mg/l). This allows 'm' to be omitted from the relevant ACEC classification. Seawater (chloride content about 18 000 mg/l) and stronger brines are not covered by this table.

Standard Penetration Test

The full procedure for carrying out the Standard Penetration Test (SPT) is given in EN ISO 22476-3:2005: Geotechnical investigation and testing - Field testing - Part 3: Standard penetration test.

The Energy ratio for the hammer used on this site is 72% as given in the test certificate as attached.

The blow counts N noted on the borehole logs are the uncorrected field blows counts as recorded.

Essentially the test consists of driving a 50mm external diameter split barrel sampler into the soil using a 63.4kg hammer dropping 760mm. The penetration resistance is expressed as the number of blows required to obtain 300mm penetration below an initial seating drive of 150mm through any disturbed ground at the bottom of the borehole. The number of blows for the 300mm test drive penetration is recorded on the borehole log as the N-value.

The test is normally performed on sands, but may also be used in gravels, weak rocks and glacial tills in which case the driving shoe may be replaced by a cone. When attempting the standard penetration test in very dense materials or weathered bedrock it may be necessary to terminate the test before completion to prevent damage to the equipment. In these circumstances it is important to distinguish how the blow count relates to the penetration of the sampler. This may be achieved in the following manner.

- (a) Where the 150mm seating drive is complete and where the test drive is terminated at 50 blows the number of blows for the partial test drive (usually 50) and the penetration of the sampler within the test drive are recorded. An approximate N-value may be obtained by linear extrapolation of the number of blows recorded for the partial test drive.
- (b) If the total penetration is equal to or less than the 150mm seating drive then the number of blows (usually 50) and the depth of penetration within the initial seating penetration are recorded on the borehole logs.

The N-value obtained from the Standard Penetration Test may be used to assess the relative density of sands and gravels only in accordance with Clause 41.3.2 of BS 5930: 1999: Code of Practice for Site Investigations, as follows:

Term	SPT N-value Blows/300mm Penetration
Very Loose	0-4
Loose	4-10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	over 50

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

ARCHWAY ENGINEERING (UK) LTD
AINLEYS INDUSTRIAL ESTATE
ELLAND
WEST YORKSHIRE
HX5 9JP

SPT Hammer Ref: AR3561
Test Date: 02/02/2024
Report Date: 02/02/2024
File Name: AR3561.spt
Test Operator: MT

Instrumented Rod Data

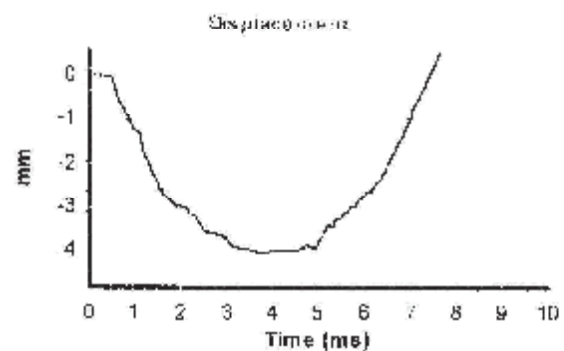
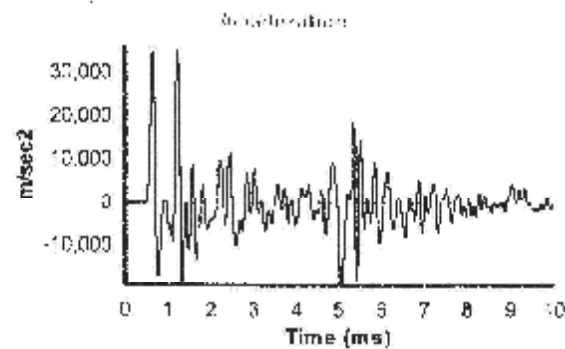
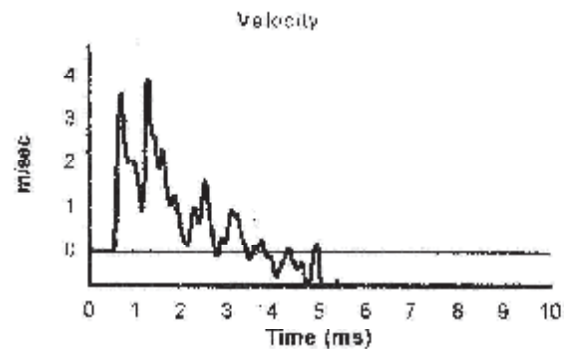
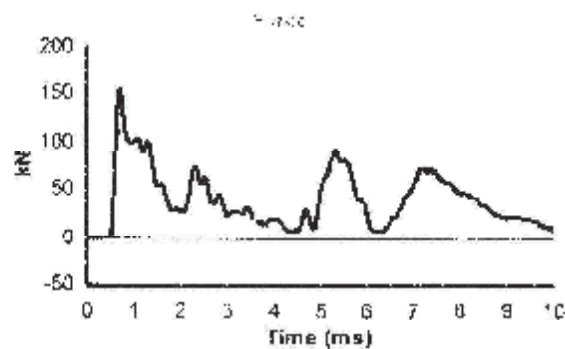
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.6
Assumed Modulus E_s (GPa): 200
Accelerometer No.1: 7080
Accelerometer No.2: 11609

SPT Hammer Information

Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
SPT String Length L (m): 10.0

Comments / Location

GEO ASSIST 88173



Calculations

Area of Rod A (mm²): 983
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 341

Energy Ratio E_r (%): **72**

Signed: C. McCLUSKEY
Title: FITTER

The recommended calibration interval is 12 months

Appendix C

- C1 Exploratory Hole Logs BH1 to BH4
- C2 Infiltration Test TP2

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: BH1						
Consultant: BrennanConsult Ltd		Project: Lancashire Farm Dairies					Sheet: 1						
Client: Pakeeza Dairies Limited		Location: Crawford Street, Rochdale				Equipment: Dando LCP Rig (150mm casing)							
						Ground Level: 142.09 m.AOD							
						Co-ordinates: Easting: 390483.3(m) Northing: 412480(m)							
						Dates: 29/07/2024 to 31/07/2024							
Lead Driller: M Walton Assistant Driller: STRATUM DESCRIPTION		Depth (Thick) (m)		Reduced Level (mAOD)		Strata Legend/ Standpipe Backfill		Samples/Tests/Core Records				Field Records	
Site Geotechnical Engineer/Geologist: M Benson								Depth (m) from to		Ref.	Count N/(U) T S RQD % % %		
0 Very loose to loose dark brown/grey sandy gravel with brick and slate fragments - MADE GROUND								0.50 0.60		C1			
1		(2.50)						1.00 1.45		P1	4	P1 at 1.00m - 7,2/1,1,1,1	
								1.50 1.60		D1			
2								2.00 2.45		P2	7	P2 at 2.00m - 1,3/3,2,1,1	
3		2.50		139.59				2.50 2.60		D2			
4								3.00 3.45		P3	12	Water struck at 3.00m depth. Water level at 2.80m after 20mins. P3 at 3.00m - 2,2/2,3,3,4	
								3.50 3.60		D3			
5		(2.70)						4.00 4.45		P4	18	P4 at 4.00m - 3,4/5,5,4,4	
								4.50 4.60		D4			
6		5.20		136.89				5.00 5.45		P5	26	P5 at 5.00m - 2,3/4,5,9,8	
7								5.50 5.60		D5			
								6.00 6.45		P6	16	P6 at 6.00m - 2,3/3,5,3,5	
8								6.50 6.60		D6			
								7.00 7.45		P7	11	P7 at 7.00m - 2,2/2,2,3,4	
9		(3.80)						7.50 7.60		D7			
								8.00 8.45		P8	16	P8 at 8.00m - 2,3/3,4,4,5	
10		9.00		133.09				8.50 8.60		D8			
11								9.00 9.45		P9	22	P9 at 9.00m - 2,4/5,5,5,7	
								9.50 9.60		D9			
12		10.00		132.09									
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.													
Logged: M Benson Date: 02/08/2024 Checked: M Richardson Date: 05/09/2024 Site Ref: 6160/VDA Scale 1:50 nominal													

GeoAssist Limited		Exploratory Hole Record Sheet							Ref: BH1		
Consultant: BrennanConsult Ltd		Project: Lancashire Farm Dairies							Sheet: 2		
		Location: Crawford Street, Rochdale									
Client: Pakeeza Dairies Limited		Equipment: Dando LCP Rig (150mm casing)					Ground Level: 142.09 m.AOD				
							Co-ordinates: Easting: 390483.3(m) Northing: 412480(m)				
							Dates: 29/07/2024 to 31/07/2024				
Lead Driller: M Walton Assistant Driller:		STRATUM DESCRIPTION Site Geotechnical Engineer/Geologist: M Benson	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records				Field Records	
						Depth (m) from to		Ref.	Count N/(U)		
									T %	S %	RQD %
10 Continued Stratum - Medium dense brown SILT/fine SAND			(0.60)			10.20	10.65	P10		17	P10 at 10.20m - 3,4/4,4,4,5
			10.60	131.49		10.60	10.70	D10			
11 Stiff brown/grey sandy very silty CLAY with sand inclusions											
						11.20	11.65	P11		19	P11 at 11.20m - 3,3/4,5,5,5
12											
			(3.10)			12.00	12.45	U1		(35)	Undrained Triaxial at 12.00m-86kPa
						12.50	12.60	D11			
13											
						13.10	13.55	P12		26	P12 at 13.10m - 5,5/6,6,7,7
			13.70	128.39		13.50	13.60	D12			Water struck at 13.70m depth.
14 Medium dense brown SILT/fine SAND with silty clay inclusions						13.70	13.80	D13			Water level at 13.40m after 20mins.
15			(1.80)			15.00	15.45	P13		19	P13 at 15.00m - 3,3/3,5,5,6
			15.50	126.59		15.50	15.60	D14			
16 Stiff grey/brown very sandy very silty CLAY with sand inclusions											
						16.00	16.45	P14		22	P14 at 16.00m - 2,3/4,6,6,6
						16.50	16.60	D15			
17											
			(4.00)			17.00	17.45	P15		21	P15 at 17.00m - 4,5/5,5,5,6
						17.50	17.60	D16			
18											
						18.00	18.45	P16		24	P16 at 18.00m - 3,4/5,6,6,7
						18.50	18.60	D17			31/08/2024: Borehole at 18.50m. Casing at 18.00m. Water level at 6.40m.
19											01/09/2024: Overnight water level at 3.20m. On withdrawal of casing 50mm groundwater monitoring standpipe installed to 5.00m with response zone from 1.00m to 5.00m depth.
						19.00	19.45	P17		38	P17 at 19.00m - 3,4/7,9,10,12
20 Exploratory Hole complete at 19.50m			19.50	122.59							
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.									Logged: M Benson Date: 02/08/2024 Checked: M Richardson Date: 05/09/2024 Site Ref: 6160/VDA Scale 1:50 nominal		

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: BH2						
Consultant: BrennanConsult Ltd		Project: Lancashire Farm Dairies				Sheet: 1						
Client: Pakeeza Dairies Limited		Location: Crawford Street, Rochdale				Ground Level: 141.64 m.AOD						
		Equipment: Dart WSL + DCP Rig				Co-ordinates: Easting: 390468.1(m) Northing: 412512.8(m)						
						Dates: 02/08/2024 to 02/08/2024						
Lead Driller: M Walton Assistant Driller: STRATUM DESCRIPTION		Depth (Thick) (m)		Reduced Level (mAOD)		Strata Legend/ Standpipe Backfill		Samples/Tests/Core Records			Field Records	
Site Geotechnical Engineer/Geologist: M Benson						Depth (m) from to		Ref.		Count N/(U) T % S % RQD %		
0 Dark brown/grey sandy gravel with brick and slate fragments - MADE GROUND						0.50 0.60 0.70 0.80		C1 D1				
1		(1.90)				1.00		P1		9		
						1.50		P2		0		
2 Dark brown fibrous PEAT		1.90 139.74				2.00		P3		0		
		(0.60)				2.30 2.40		D2				
3		2.50 139.14				2.50		P4		19		
Medium dense orange/brown slightly gravelly slightly silty fine to medium SAND						3.00		P5		27		
		(1.00)				3.50 3.60		D3				
4		3.50 138.14				4.00 4.10		P6 D4		25		
Medium dense light grey gravelly slightly silty fine to medium SAND with sandy gravel inclusions						5.00		P7		31		
5		5.00 136.64				6.00		P8		17		
		(1.50)				7.00		P9		24		
6						8.00		P10		19		
		(5.00)				9.00		P11		19		
7												
8												
9												
10		10.00 131.64										

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Benson
Date: 05/08/2024
Checked: M Richardson
Date: 05/09/2024
Site Ref: 6160/VDA
Scale 1:50 nominal

GeoAssist Limited Consultant: BrennanConsult Ltd Client: Pakeeza Dairies Limited	Exploratory Hole Record Sheet					Ref: BH2			
	Project: Lancashire Farm Dairies					Sheet: 2			
	Location: Crawford Street, Rochdale					Ground Level: 141.64 m.AOD			
	Equipment: Dart WSL + DCP Rig					Co-ordinates: Easting: 390468.1(m) Northing: 412512.8(m) Dates: 02/08/2024 to 02/08/2024			
Lead Driller: M Walton Assistant Driller: STRATUM DESCRIPTION		Depth (Thick (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records				Field Records
Site Geotechnical Engineer/Geologist: M Benson					Depth (m) from to	Ref.	Count N/(U) T % S % RQD %		
10 Continued Stratum - Medium dense orange/brown slightly gravelly silty fine to medium SAND - Interpreted Stratum		(1.00)			10.00	P12		24	02/08/2024: Borehole complete at 13.00m. Casing at 5.00m. Water level at 5.00m. On withdrawal of casing 50mm groundwater monitoring standpipe installed to 5.00m with response zone from 1.00m to 5.00m depth.
11 Stiff brown very sandy very silty CLAY with sand inclusions - Interpreted Stratum		11.00	130.64		11.00	P13		21	
12		(2.00)			12.00	P14		28	
13 Exploratory Hole complete at 13.00m		13.00	128.64		12.90	P15		31	
14									
15									
16									
17									
18									
19									
20									
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							Logged: M Benson Date: 05/08/2024 Checked: M Richardson Date: 05/09/2024 Site Ref: 6160/VDA Scale 1:50 nominal		

GeoAssist Limited		Exploratory Hole Record Sheet						Ref: BH3	
Consultant: BrennanConsult Ltd		Project: Lancashire Farm Dairies Location: Crawford Street, Rochdale						Sheet: 1	
Client: Pakeeza Dairies Limited		Equipment: Dart WSL + DCP Rig				Ground Level: 142.13 m.AOD Co-ordinates: Easting: 390497.4(m) Northing: 412498.1(m) Dates: 02/08/2024 to 02/08/2024			
Lead Driller: M Walton Assistant Driller: STRATUM DESCRIPTION		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records				Field Records
Site Geotechnical Engineer/Geologist: M Benson					Depth (m) from to		Ref.	Count N/(U) T S RQD % % %	
0 Dark brown/grey sandy gravel with brick and slate fragments - MADE GROUND		(1.00)							

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: BH3				
Consultant: BrennanConsult Ltd		Project: Lancashire Farm Dairies					Sheet: 2				
Client: Pakeeza Dairies Limited		Location: Crawford Street, Rochdale			Equipment: Dart WSL + DCP Rig						
					Ground Level: 142.13 m.AOD						
					Co-ordinates: Easting: 390497.4(m) Northing: 412498.1(m)						
					Dates: 02/08/2024 to 02/08/2024						
Lead Driller: M Walton Assistant Driller: STRATUM DESCRIPTION		Depth (Thick (m)		Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records			Field Records		
Site Geotechnical Engineer/Geologist: M Benson						Depth (m) from to	Ref.	Count N/(U)			
								T %	S %	RQD %	
10 Continued Stratum - Medium dense orange/brown slightly gravelly silty fine to medium SAND - Interpreted Stratum		(1.00)				10.00	P12		23		
11 Stiff to very stiff brown very sandy very silty CLAY with sand inclusions - Interpreted Stratum		11.00		131.13		11.00	P13		25		
12		(2.00)				12.00	P14		31		
13 Exploratory Hole complete at 13.00m		13.00		129.13		12.90	P15		33	02/08/2024: Borehole complete at 13.00m. Casing at 5.00m. Water level at 4.70m. On withdrawal of casing 50mm groundwater monitoring standpipe installed to 5.00m with response zone from 1.00m to 5.00m depth.	
14											
15											
16											
17											
18											
19											
20											
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.								Logged: M Benson Date: 05/08/2024 Checked: M Richardson Date: 05/09/2024 Site Ref: 6160/VDA Scale 1:50 nominal			

GeoAssist Limited		Exploratory Hole Record Sheet						Ref: BH4	
Consultant: BrennanConsult Ltd		Project: Lancashire Farm Dairies Location: Crawford Street, Rochdale						Sheet: 1	
Client: Pakeeza Dairies Limited		Equipment: Dart WSL + DCP Rig				Ground Level: 141.65 m.AOD Co-ordinates: Easting: 390479.9(m) Northing: 412496(m) Dates: 02/08/2024 to 02/08/2024			
Lead Driller: M Walton Assistant Driller: STRATUM DESCRIPTION		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records				Field Records
Site Geotechnical Engineer/Geologist: M Benson					Depth (m) from to		Ref.	Count N/(U) T S RQD % % %	
0 Dark brown/grey sandy gravel with brick and slate fragments - MADE GROUND					0.50 0.60	C1			
1		(1.90)			1.00	P1		7	
					1.50	P2			12
		1.90	139.75		1.50 1.60	D1			
2 Loose to medium dense dark brown silty fine to medium SAND		(0.80)			2.00	P3		14	
		2.70	138.95		2.50	P4		5	
3 Medium dense orange/brown gravelly silty fine to medium SAND					3.00	P5		18	Wet from 3.00m
4		(2.50)			4.00	P6		28	
5		5.00	136.65		5.00	P7		28	
6					6.00	P8		25	
7		(5.00)			7.00	P9		21	
8					8.00	P10		21	
9					9.00	P11		24	
10		10.00	131.65						
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							Logged: M Benson Date: 05/08/2024 Checked: M Richardson Date: 05/09/2024 Site Ref: 6160/VDA Scale 1:50 nominal		

GeoAssist Limited Consultant: BrennanConsult Ltd Client: Pakeeza Dairies Limited	Exploratory Hole Record Sheet Project: Lancashire Farm Dairies Location: Crawford Street, Rochdale Equipment: Dart WSL + DCP Rig						Ref: BH4 Sheet: 2 Ground Level: 141.65 m.AOD Co-ordinates: Easting: 390479.9(m) Northing: 412496(m) Dates: 02/08/2024 to 02/08/2024				
	Lead Driller: M Walton Assistant Driller: M Benson		STRATUM DESCRIPTION Site Geotechnical Engineer/Geologist: M Benson	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests/Core Records				Field Records
	Depth (m) from to						Ref.	Count N/(U) T % S % RQD %			
	10 Continued Stratum - Medium dense orange/brown slightly gravelly silty fine to medium SAND - Interpreted Stratum			(1.00)			10.00	P12		22	02/08/2024: Borehole complete at 13.00m. Casing at 5.00m. Water level at 3.70m. On withdrawal of casing 50mm groundwater monitoring standpipe installed to 5.00m with response zone from 1.00m to 5.00m depth.
11 Stiff to very stiff brown very sandy very silty CLAY with sand inclusions - Interpreted Stratum			11.00	130.65		11.00	P13		29		
12			(2.00)			12.00	P14		32		
13 Exploratory Hole complete at 13.00m			13.00	128.65		12.90	P15		36		
14											
15											
16											
17											
18											
19											
20											
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.								Logged: M Benson Date: 05/08/2024 Checked: M Richardson Date: 05/09/2024 Site Ref: 6160/VDA Scale 1:50 nominal			

GeoAssist Limited	Site:	Lancashire Farm Dairies, Crawford Street, Rochdale	
	Job Ref:	6160 VDA	TP2
Soil Infiltration Rate Test	Originator:	MB	
	Checked:	MR	
	Date:	09/09/2024	

Easting 390479.3 Northing 412514.90 Level (mAOD) 141.70

Test Pit Dimensions (m)

Inlet Pipe Invert Level (m) 0.4 Assumed

Width (m)	Length (m)	Depth (m)	Volume (m ³)	Effective Depth (m)	
0.6	1.3	2.3	1.794	2	

Test Results

Test Date: 05/08/2024

Principal Material Type

Made ground over Silty Peat with a very Sandy Silty Base

Date	Time (mins)	TEST 1 Depth Below Surface (m)	Date	Time (mins)	TEST 2 Depth Below Surface (m)	Date	Time (mins)	TEST 3 Depth Below Surface (m)
05.08.24 12:30	0	0.77						
05.08.24 12:31	0	0.77						
05.08.24 12:35	4	0.78						
05.08.24 12:40	10	0.78						
05.08.24 13:00	29	0.8						
05.08.24 13:30	59	0.81						
05.08.24 14:30	119	0.81						
05.08.24 15:00	149	0.82						
06.08.24 10:10	1299	0.95						

Calculations

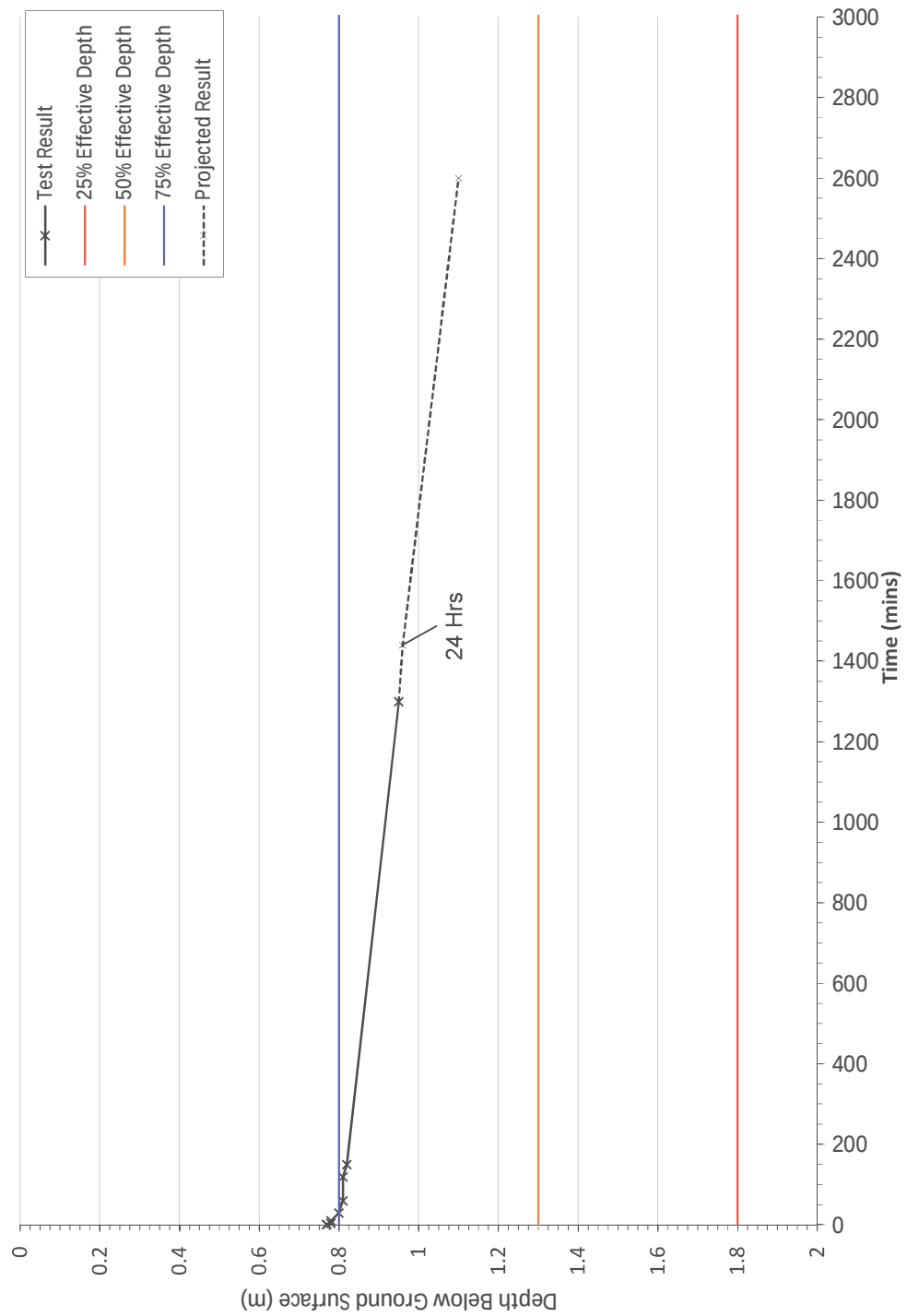
Effective Depth (m)	
75%	0.80
25%	1.80
50%	1.30

$$\begin{aligned}
 &as_{50} && 3.8 \text{ m}^2 \\
 &0.675 V_{p75-25} && 0.78 \text{ m}^3 \\
 &1.225 a_{p50} && 4.58 \text{ m}^2 \\
 &t_{p75-25} && 528000 \text{ seconds (projected)}
 \end{aligned}$$

Soil Infiltration Rate f from Test 1 **3.2E-07** m/sec

Notes: Test did not half empty in 24hrs therefore the soil infiltration rate is considered unsuitable for soakaway drainage

Results of Field Observations 6160 VDA TP2 Soakaway Test 05th & 06th Aug 2024



Appendix D

D1	Laboratory Summary Sheet
D2	Classification Test Summary
D3	Sulphate and pH Summary
D4	Particle Size Distribution Graphs

GeoAssist Limited SOIL LABORATORY SUMMARY SHEET	Project: Lancashire Farm Dairies Location: Crawford Street, Rochdale Client: Pakeeza Dairies Limited Consultant : BrennanConsult Ltd	Site Ref: 6160/VDA Project Code :
		Hole Ref BH1 to BH4

Sample Ref.	Depth m	Sample Description	Classification					Triaxial Compression					Chemical		Test Code
			LL %	PL %	PI %	% passing 425 m	Moist Cont. %	Bulk Density Mg/m ³	Sample Diameter mm	Confining Pressure kN/m ²	Deviator /Shear Stress kN/m ²	Shear Cohesion kN/m ² /Friction angle degrees	Loss on	pH	
													Ignition %	So4 2:1 extract Soil:Water mg/l	
BH1 D1	1.50	Dark brown/grey sandy gravel with brick and slate fragments - MADE GROUND					-							7.7 800	SULWS PH
BH1 P3	3.00	Dark brown slightly gravelly silty fine to medium SAND					-								GRAD WS
BH1 P7	7.00	Orange/brown gravelly slightly silty fine to medium SAND					-								GRAD WS
BH1 P11	11.20	Brown sandy very silty CLAY with sand inclusions	37	21	16	96	19								NMC CLSS
BH1 U1	12.00	Brown sandy very silty CLAY with sand inclusions					20	2.25	102	100 200 300	161 176 176	86			NMC UUM
BH1 P14	16.00	Brown very sandy very silty CLAY with sand inclusions	26	16	10	96	21								NMC CLS
BH2 D1	0.70	Dark brown/grey sandy gravel with brick and slate fragments - MADE GROUND					-							8.5 880	SULWS PH
BH2 D2	2.30	Dark brown fibrous PEAT					250						38		NMC LOI
BH2 D2	2.30	Dark brown fibrous PEAT					250						39		NMC LOI
BH2 D3	3.50	Orange/brown slightly gravelly slightly silty fine to medium SAND					-								GRAD WS
BH2 D4	4.00	Orange/brown slightly silty SAND and GRAVEL					-								GRAD WS

GeoAssist Limited SOIL LABORATORY SUMMARY SHEET	Project: Lancashire Farm Dairies Location: Crawford Street, Rochdale Client: Pakeeza Dairies Limited Consultant : BrennanConsult Ltd	Site Ref: 6160/VDA Project Code :
		Hole Ref BH1 to BH4

Sample Ref.	Depth m	Sample Description	Classification					Triaxial Compression					Chemical		Test Code
			LL %	PL %	PI %	% passing 425 m	Moist Cont. %	Bulk Density Mg/m ³	Sample Diameter mm	Confining Pressure kN/m ²	Deviator /Shear Stress kN/m ²	Shear Cohesion kN/m ² /Friction angle degrees	Loss on	pH	
													Ignition %	So4 2:1 extract Soil:Water mg/l	
BH3 D1	1.50	Dark brown fibrous PEAT with sand inclusions					-							8.0	SULWS PH
														520	
BH3 D2	2.00	Dark brown fibrous PEAT					314						79		NMC LOI
BH3 D2	2.30	Dark brown fibrous PEAT					314						80		NMC LOI
BH3 D3	3.50	Orange/brown slightly gravelly very silty fine to medium SAND					-								GRAD WS
BH4 D1	1.50	Dark brown/grey sandy gravel with brick and slate fragments - MADE GROUND					-							7.70	SULWS PH
														9.20	

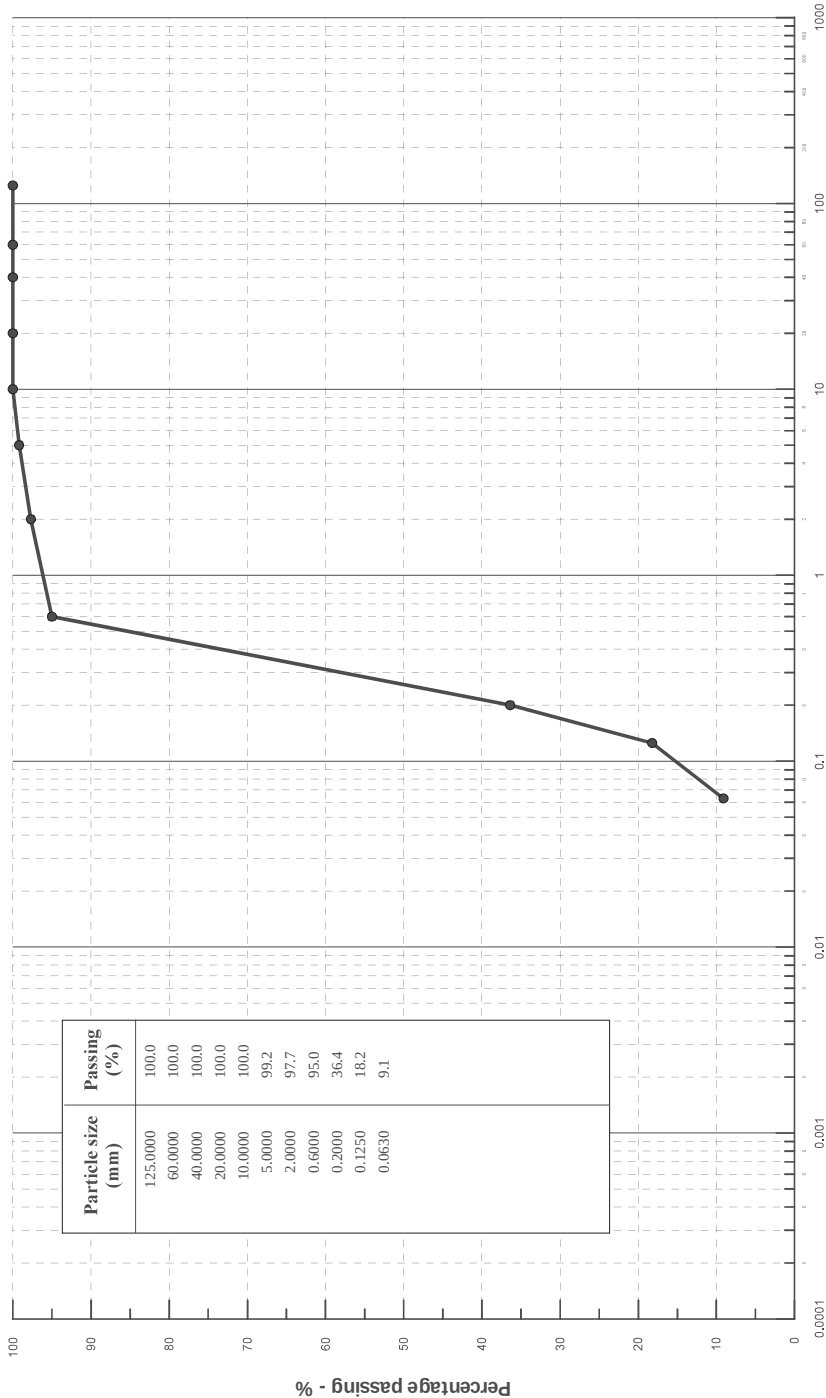
Site Reference:			6160 VDA					
Project Site:			Lancashire Farm Dairies					
Project Location:			Crawford Street, Rochdale					
Client:			Pakeeza Dairies Limited					
Consultant:			BrennanConsult Ltd					
CLASSIFICATION TEST								
Borehole Reference	Sample	Depth	Liquid Limit	Plastic Limit	Plasticity Index	% passing 425 micro	Natural Moisture Content	Material Code
BH1	P11	11.20	37	21	16	96	19	CI
BH1	P14	16.00	26	16	10	96	21	CL
		Mean	32	19	13	96	20	
		Maximum	37	21	16	96	21	
CLAY		Minimum	26	16	10	96	19	
	Standard Deviation		8	4	4	0	1	
	Count		2	2	2	2	2	

Site Reference:			6160	VDA		
Project Site:			Lancashire Farm Dairies			
Project Location:			Crawford Street, Rochdale			
Client:			Pakeeza Dairies Limited			
Consultant:			BrennanConsult Ltd			
	GEOTECHNICAL SULPHATE AND PH TEST					
Borehole Reference	Sample	Depth	SO4 2:1 Water:Soil extract mg/l	pH	SO4 Water mg/l	
BH1	D1	1.50	800	7.7		
BH2	D1	0.70	880	8.5		
BH3	D1	1.50	520	8.0		
BH4	D1	1.50	920	7.7		
		Mean	780	8.0		
ALL		Maximum	920	8.5		
		Minimum	520	7.7		
	Standard Deviation		180	0.4		
		Count	4			

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6160
Site Reference: VDA

Project: Lancashire Farm Dairies
Location: Crawford Street, Rochdale
Client: Pakeeza Dairies Limited
Consultant: BrennanConsult Ltd



BH No: BH1
Sample: P3
Depth: 3.00m

%	SIZE
0.0	Cobbles
2.3	Gravel
88.6	Sand
9.1	Silt and Clay

CLAY	SILT			SAND			GRAVEL	COB- BLES	BOUL- DERS
	Fine	Medium	Coarse	Fine	Medium	Coarse			

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6160
Site Reference: VDA

Project: Lancashire Farm Dairies
Location: Crawford Street, Rochdale
Client: Pakeeza Dairies Limited
Consultant: BrennanConsult Ltd



BH No: BH1
Sample: P7
Depth: 7.00m

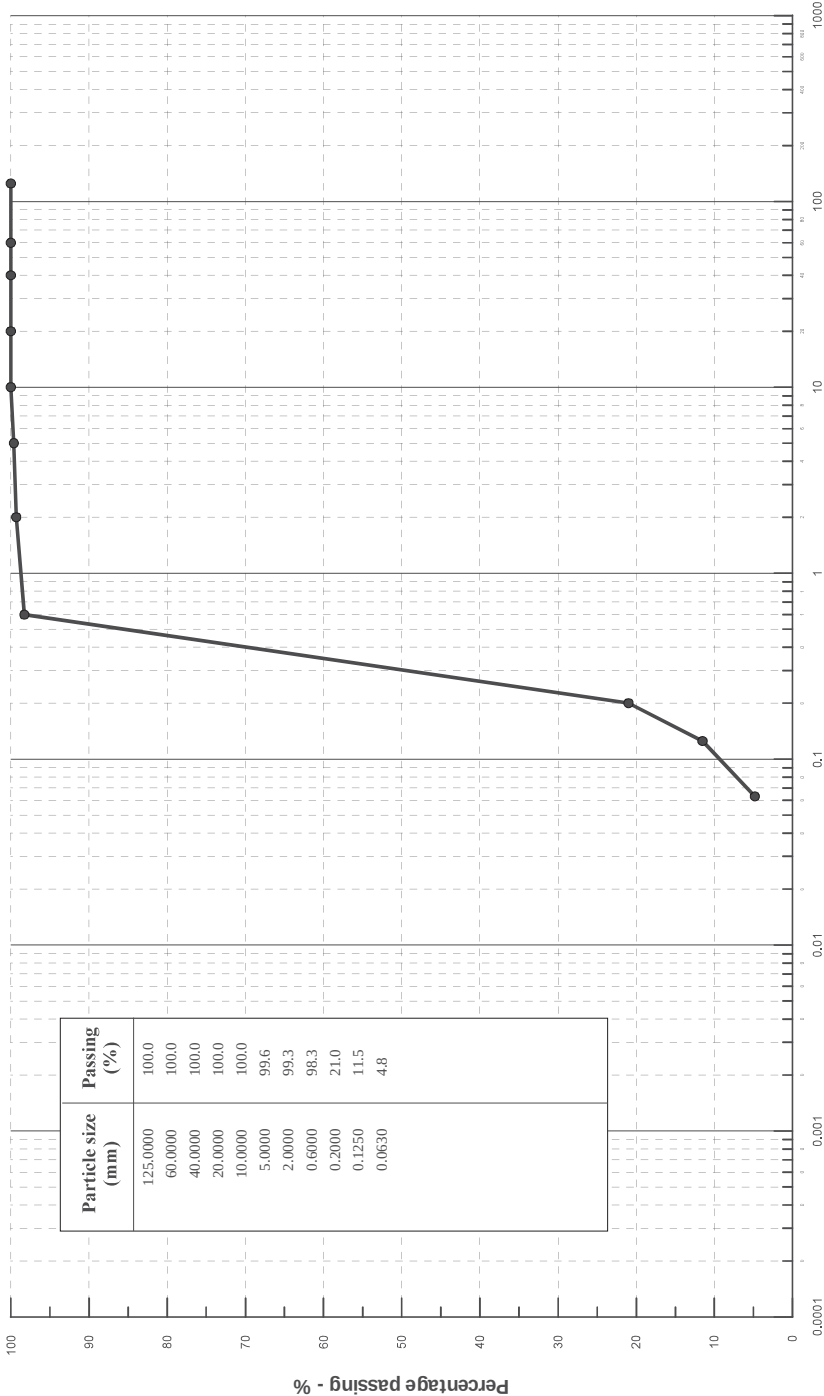
%	SIZE
0.0	Cobbles
6.5	Gravel
88.8	Sand
4.7	Silt and Clay

CLAY	SILT			SAND			GRAVEL	COB- BLES	BOUL- DERS
	Fine	Medium	Coarse	Fine	Medium	Coarse			

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6160
Site Reference: VDA

Project: Lancashire Farm Dairies
Location: Crawford Street, Rochdale
Client: Pakeeza Dairies Limited
Consultant: BrennanConsult Ltd



BH No: BH2
Sample: D3
Depth: 3.50m

%	SIZE
0.0	Cobbles
0.7	Gravel
94.5	Sand
4.8	Silt and Clay

CLAY	SILT			SAND			GRAVEL	COB- BLES	BOUL- DERS
	Fine	Medium	Coarse	Fine	Medium	Coarse			

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6160
Site Reference: VDA

Project: Lancashire Farm Dairies
Location: Crawford Street, Rochdale
Client: Pakeeza Dairies Limited
Consultant: BrennanConsult Ltd



BH No: BH2
Sample: D4
Depth: 4.00m

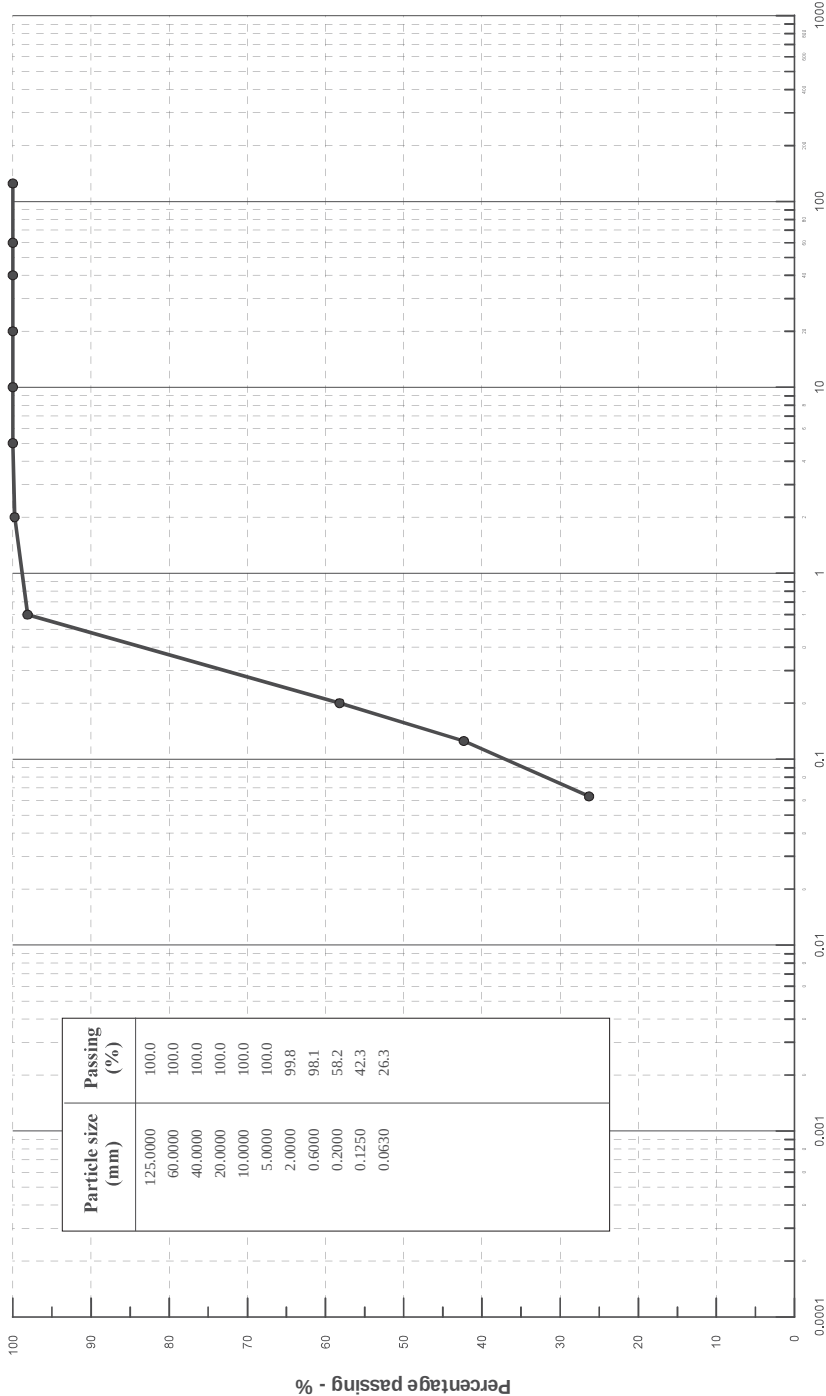
%	SIZE
0.0	Cobbles
55.7	Gravel
39.9	Sand
4.4	Silt and Clay

CLAY	SILT			SAND			GRAVEL	COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse			

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6160
Site Reference: VDA

Project: Lancashire Farm Dairies
Location: Crawford Street, Rochdale
Client: Pakeeza Dairies Limited
Consultant: BrennanConsult Ltd



BH No: BH3
Sample: D3
Depth: 3.50m

%	SIZE
0.0	Cobbles
0.2	Gravel
73.4	Sand
26.3	Silt and Clay

CLAY	SILT			SAND			GRAVEL	COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse			