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Ground Investigation - Geotechnical

Development at Greenhill Road, Middleton

Sept 2023

Site Ref: 6127/VGH-G

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1. Introduction	4
2. Description of the Site	4
2.1 Present	4
2.2 Proposed	5
3. Geology	5
4. Mineworkings	5
5. Intrusive Investigation	6
5.1 Exploratory Hole Programme	6
5.2 Field Sampling and Testing	6
5.3 Field Results	6
6. Laboratory Investigation	6
6.1 Geotechnical Testing	6
6.2 Test Results	7
7. Subsurface Stratigraphy	7
8. Groundwater	8
9. Geotechnical Properties	8
9.1 Made Ground	8
9.2 Interbedded organic silty Clay and Sand	8
9.3 Superficial Clay	9
9.4 Medium dense Silty Sand	9
10. Geotechnical Assessment	9
10.1 Design Criteria	9
10.2 Foundation Design Considerations	9
10.3 Pile Foundations	9
10.4 Excavations	9
10.5 Ground Stabilisation	9
10.6 Subsurface Concrete Attack	10

Appendices

- A1. Site Plan with Exploratory Hole Locations
- A2. Proposed Site Plan
- B1. Terminology used in Soil Descriptions
- B2. List of Abbreviations
- B3. Concrete in Aggressive Ground
- C1. Exploratory Hole Logs WS01 and WS12
- C2. Trial Pit Logs TP1 and TP2
- D1. Laboratory Test Summary Sheet
- D2. Classification test Summary Sheet
- D3. Sulphate and pH Test Summary
- D4. Particle Size Distribution Graphs

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1. Introduction

This report is an account of an intrusive Geotechnical Ground Investigation carried out by GeoAssist Limited at the request of the Client J Walker Homes Limited as the developers of the Development at Greenhill Road, Middleton. 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 Residential 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 J Walker Homes Limited 09/08/2023.

It is understood that the proposed development for this site involves the construction of low rise residential housing.

The approximate grid reference for the centre of the site is 388610E, 405180N.

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

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

2. Description of the Site

2.1 Present

The site is located directly to the south of the Greenhill Road in the Middleton Junction area of Oldham, Greater Manchester. The site forms an irregular L shape and can be accessed from Greenhill Road and Smethurst Street. The topography of the site is relatively level.

At the time of the site visit the site was sub divided into three distinct plots.

1. Area one is the former junction vehicle refuelling garage and associated repair workshop to the rear. There are numerous visual indications refuelling infrastructure including vapour vents, interceptors drains and manholes at Underground Storage Tanks. Four bunded above ground diesel tanks were noted to the rear of the former forecourt building. It was noted that the pump island and any forecourt canopy had been long since decommissioned and the ground cover at the forecourt had been disturbed in places. The building to the rear of the forecourt building had been used for general maintenance and repair work and there were several parts from vehicles noted across the external area including wheels and panels. A large

area of open scrubland incorporating brambles and other self establishing undergrowth species is present to the rear.

2. Area two has until recently been used as a plant nursery and consequently there are several poly/mesh tunnels for horticultural purposes and a pair of shipping containers for storage. There was no evidence of the use of pesticides or herbicides and there were no obvious visual or olfactory observations of contaminants noted during the site walkover of this area.
3. Area three is used as a storage yard for an interior decorator/builder and there was evidence of a bonfire and a general builders waste in a skip at the site. Used paint containers had been bagged in special blue dulux trade waste scheme disposal bags ready for recycling. Storage containers were noted to contain ceramic tiles and other decorating and building materials. Asides from the aforementioned bonfire and surface waste. There were no other obvious visual or olfactory observations of contaminants noted during the site walkover in this area.

2.2 Proposed

The proposal is to develop the site with 24 residential dwelling houses with associated private gardens and off road residents parking as well as an access road.

3. Geology

The relevant county series geological map (1932 revision) of the area sheet number 96NE shows the site to be underlain by superficial deposits of Fluvio-Glacial Sands and Gravels overlying Glacial Boulder Clay. The thickness of the drift deposits is not readily discernible but is likely to be in excess of 40m. The solid bedrock is shown to be Middle Coal Measures of the Carboniferous period. The more recent 2008 digital geological plan for the site differs from the 1932 county revision and indicates that the site is underlain by drift deposits of Devensian Till (Boulder Clay).

The Chamber Fault is shown as passing directly beneath the site in a north west to south east direction with the downthrow to the south west.

4. Mineworkings

Information provided by the Coal Authority as part of the Environmental data search report referenced 313644564_1_1 indicates that the property is in an area which may be affected by coal mining.

A Coal Authority Coal mining report referenced 51003356889001, confirms that:

- The property is not within a surface area that could be affected by any past recorded underground coal mining.

The Professional Opinion of the 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.

The site is not located within a Coal Authority High Risk Area

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

Twelve geotechnical exploratory holes referenced WS01 to WS12 were undertaken by GeoAssist using windowless sampling and dynamic probing techniques at the location as shown on the site plan in Appendix A1.

Two Trial Pits referenced TP1 and TP2 were machine excavated in areas where it was anticipated that granular deposits would be present to allow infiltration testing to be undertaken.

Gas/groundwater monitoring standpipes were installed in exploratory holes WS01, WS02, WS03, WS06, WS09 and WS12 to allow monitoring of ground gas and groundwater over a period of time.

All the other exploratory holes were backfilled and reinstated.

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 main fieldwork was completed on between 19th and 26th July 2023 in mixed weather conditions.

The trial pits for infiltration testing were undertaken on the 17th August 2023.

5.2 Field Sampling and Testing

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

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
Shear Strength from Hand Vane/Hand Penetrometer test	Assessment of in-situ shear strength of cohesive deposits
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
Particle Size Distribution	Determination of grading characteristics of granular deposits

6.2 Test Results

The results of the Hand Vane/Hand Penetrometer shear strength tests are given on the exploratory hole logs.

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 WS01 and WS12 consists of Topsoil/Concrete/Tarmac surface over mainly granular mixed sandy gravel, brick and concrete fragments Made Ground overlying intermixed clays and sands overlying sands with gravel.

The Made Ground varies from very loose to medium dense in state of compaction generally. Very soft to soft organic silty clay Made Ground was present in WS05 to 4.10m depth.

The clay horizons in the intermixed subsoils vary from very soft to soft in consistency with the sand horizons varying from very loose to loose in state of compaction.

The majority of the WS holes terminated in medium dense silty sands. WS05 and WS11 terminated in firm to stiff gravelly sandy silty clay. Firm to stiff clay was present at irregular horizons in WS01, WS02, WS06 and WS07. The clay fraction is generally of low plasticity. Very soft organic clay and peat was penetrated in WS 11 from 2.80m to 4.00 depth. Further details of the subsurface stratigraphy can be found in the exploratory hole log sheets which form Appendix B1 to this report.

Table 7.0 Subsoil Profile Summary

Strata	Depth of Strata (m) below ground level	
	Top	Base
Topsoil/concrete/tarmac over Made Ground Variable mixed granular over cohesive	Ground Level	1.00 to 4.10
Intermixed very soft to soft very low to low strength gravelly sandy silty to very silty Clay and Very loose to loose clayey silty Sand	1.00 to 3.00	2.20 to 5.20
Medium dense clayey silty Sand with gravel	2.20 to 5.20	>6.00

8. Groundwater

Seepage groundwater was recorded between 2.00m and 5.60m depth in the majority of the WS holes during the course of the fieldwork. Seepage groundwater was not recorded in WS06 and WS07. 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 2.35m and 3.75m.

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 with cinders and ash.

Property	Number of Tests	Range of Results	Value for Design
Sulphate Total from contamination tests	16	0.006% to 0.473%	0.473%
Sulphate 2:1 Water:Soil Extract	6	240 to 560 mg/l	560 mg/l
pH	22	5.8 to 8.8	NA
Equivalent N value Uncorrected from SPT tests	18	0 to 11	Not suitable

9.2 Interbedded organic silty Clay and Sand

Table 9.2 a Summary of Geotechnical Properties – very soft to soft sandy silty organic Clay

Property	Number of Tests	Range of Results	Value for Design
Equivalent N value Uncorrected from SPT tests	6	Nil to 5	Unsuitable for foundations

Table 9.2 b Summary of Geotechnical Properties – very loose to loose clayey silty to very silty Sand

Property	Number of Tests	Range of Results	Value for Design
Equivalent N value Uncorrected from SPT tests	12	Nil to 10	Unsuitable for foundations

9.3 Superficial Clay

Cohesive deposits were encountered varying from firm to stiff gravelly sandy silty Clay of intermediate plasticity.

Table 9.3 Summary of Geotechnical Properties – Upper Superficial Deposits gravelly sandy silty Clay

Property	Number of Tests	Range of Results	Derived
Equivalent N value Uncorrected from SPT tests	9	10 to 21	N =12
Shear Strength From Hand Vane Test	6	48 to 127N/m ²	68

9.4 Medium dense Silty Sand

Granular deposits were encountered at depth.

Table 9.4 Summary of Geotechnical Properties – Medium dense clayey silty Sandy Gravel with cobbles.

Property	Number of Tests	Range of Results	Derived
Equivalent N value Uncorrected from SPT tests	31	10 to 31	N =19

10. Geotechnical Assessment

10.1 Design Criteria

The following design criteria have been assumed for the proposed development.

1. Structural loads of up to 50kN/m on strip foundations/trench fill foundations at shallow to moderate depth.
2. Allowable foundation settlement of less than 25mm and differential settlement of less than 10mm.

10.2 Foundation Design Considerations

The subsurface profile across the site is very irregular and includes the presence of very loose/very soft variable made ground over mixed organic very soft and very loose deposits up to 5.20m depth which precludes the use of traditional strip or trench fill foundations and the use of ground bearing slabs on this site.

10.3 Pile Foundations

The use of pile foundations penetrating into the more competent deposits at depth are recommended 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.

It is recommended that supplementary holes extending to deeper depth are undertaken to confirm properties of the strata at depth and to allow for more economical pile foundation design.

10.4 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.

10.5 Ground Stabilisation

The use of vibratory compaction/displacement ground stabilisation of the made ground and superficial very soft

organic clays is unlikely to be effective in providing a satisfactory increase in bearing capacity within tolerable settlements.

The advice of the relevant specialist ground stabilisation contractor should be sought to ascertain whether this is a viable ground treatment for structural foundations on this site.

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.



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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 J Walker Homes Limited. The report is confidential to J Walker Homes 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. J Walker Homes 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	Development at Greenhill Road
Location	Middleton
GeoAssist Ref	6127VGH
Client	J Walker Homes Limited
	Joshua House 35 Joshua Lane Middleton Manchester M24 2AY
Planning Consultant	Trevena Blake & Associates
NGR (centre of site)	388610/405180
Production Date	September 2023
Survey Method	Others
Surveyor	Final v1.00
Status	
Base Survey	OSGB36



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A2 Proposed Plan

Site Name	Development at Greenhill Road
Location	Middleton
GeoAssist Ref	6127VGH
Client	J Walker Homes Limited Joshua House 35 Joshua Lane Middleton Manchester M24 2AY
Planning Consultant	Trevena Blake & Associates
NGR (centre of site)	388610/405180
Production Date	September 2023
Survey Method	
Surveyor	Others
Status	Final v1.00
Base Survey	OSGB36



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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.

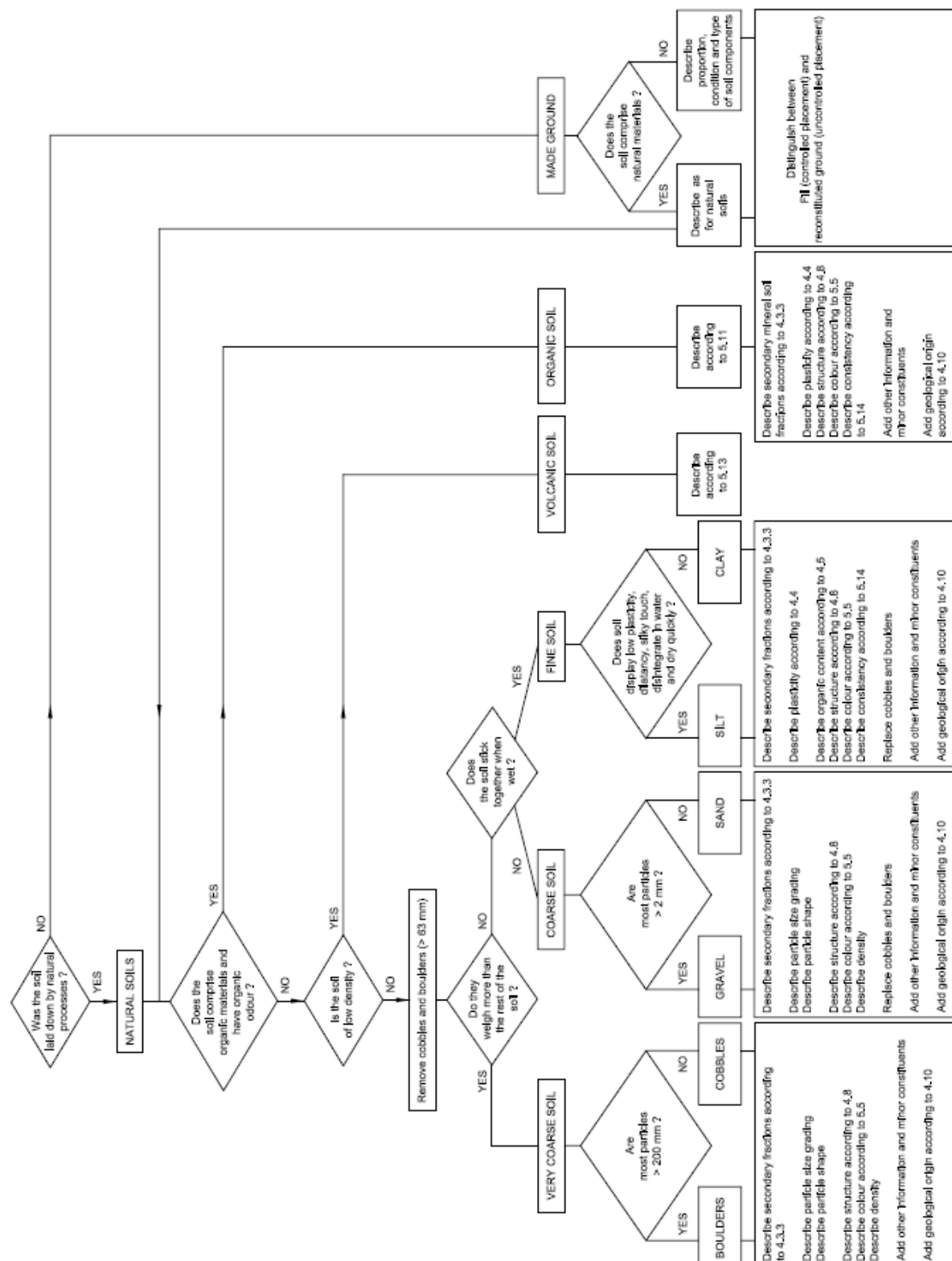


Figure B1.1 Flow chart for the identification and description of soils

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

Form No.: QF029AEN

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

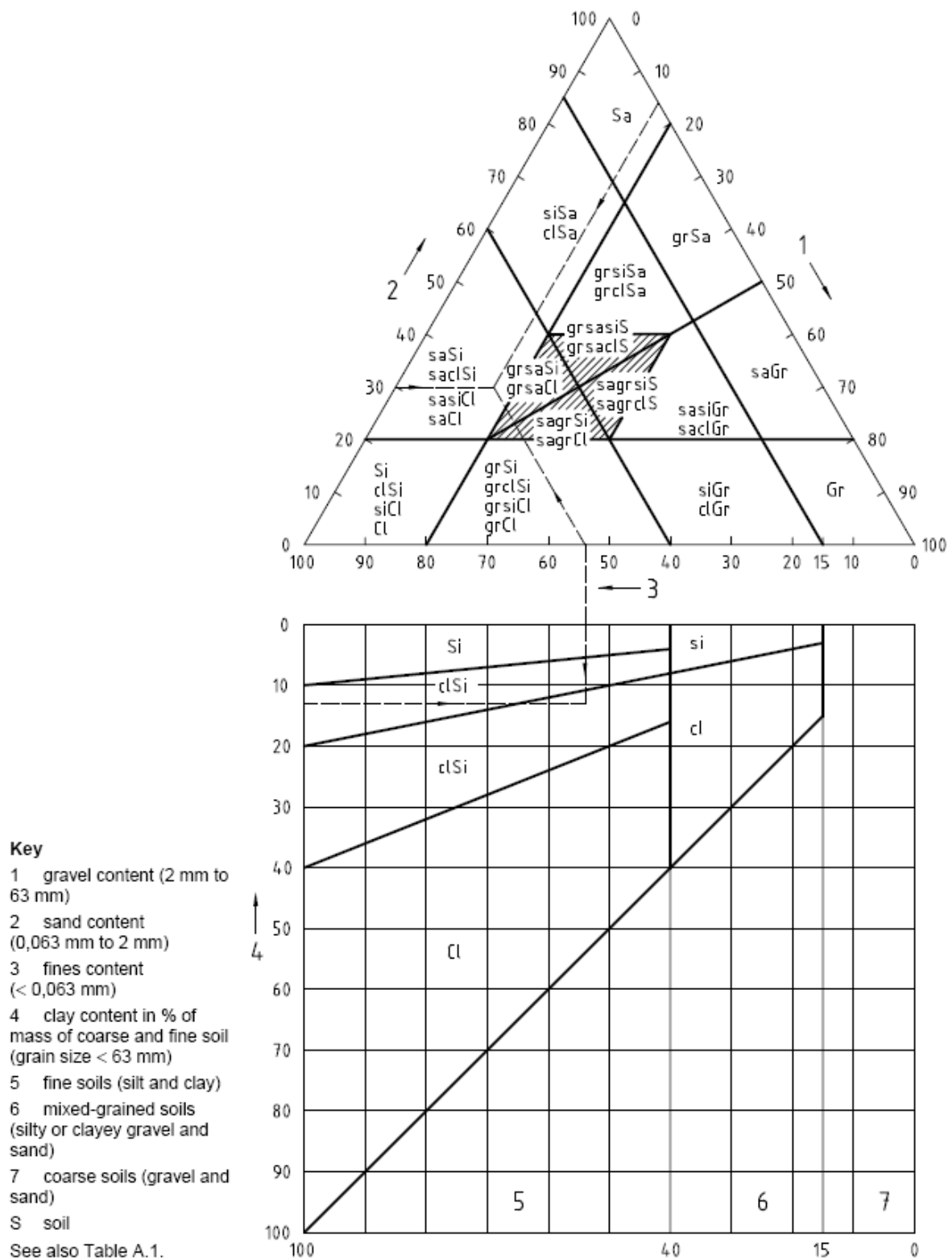


Figure B1.2 Classification of soils, based on grading alone

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

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.

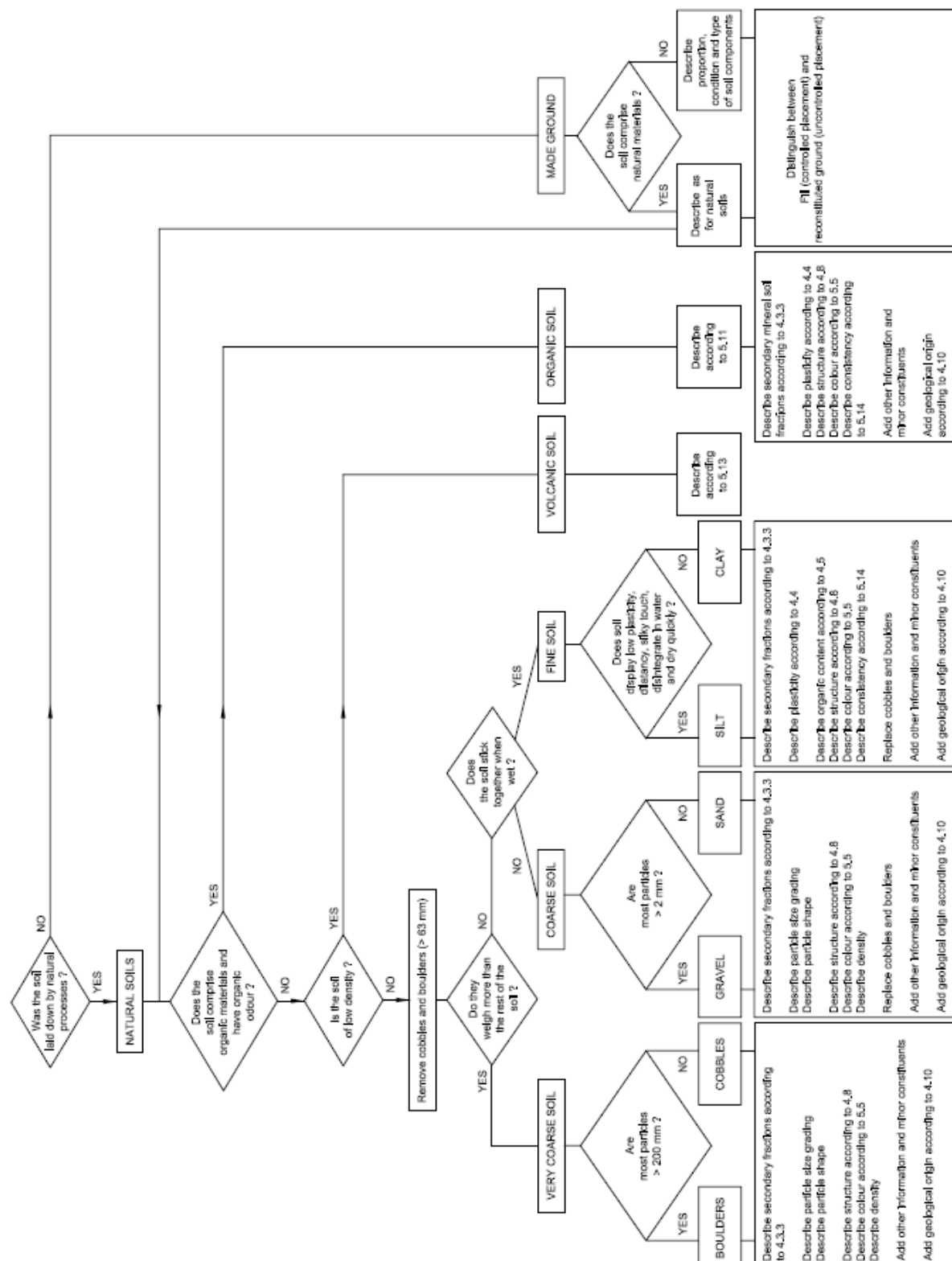


Figure B1.1 Flow chart for the identification and description of soils

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	
		most particles > 63 mm	Co	boCo, saCo, grCo sagrCo		
	coarse	most particles > 2 mm	Gr	coGr saGr, grSa	cosaGr sasiGr, grsiSa	Particle size (grading) Shape of grading curve Relative density Permeability
		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)
		plastic non-dilatant	Cl	clSi, siCl 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

Form No.: QF029AEN

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

Page 5 of 8

GeoAssist Limited

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

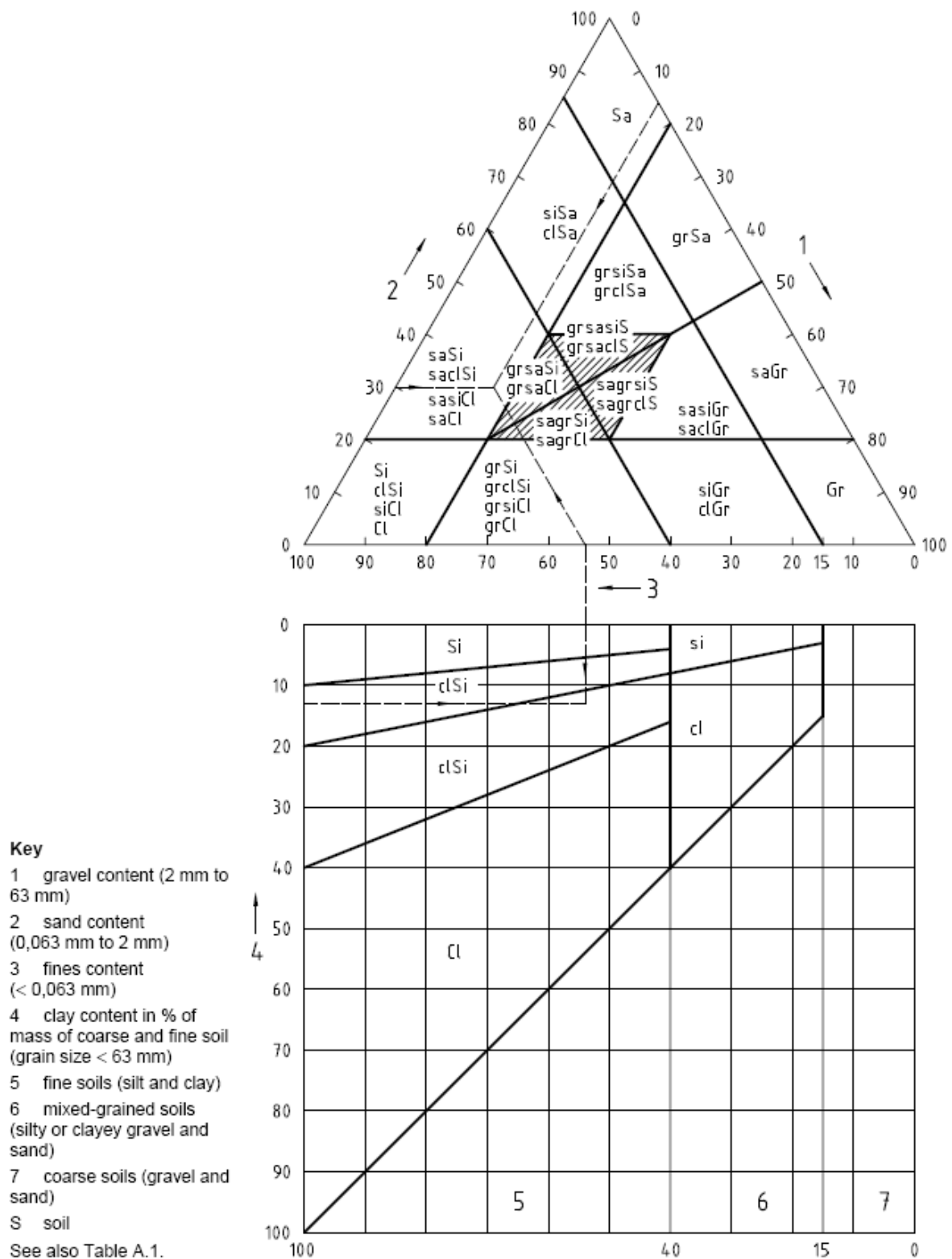


Figure B1.2 Classification of soils, based on grading alone

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	Sulphate on 2:1 Water:Soil 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.

Table C2 Aggressive Chemical Environment for Concrete (ACEC) classification for brownfield locations ^a								
Sulfate and magnesium						Groundwater		ACEC
Design Sulfate Class for location	2:1 water/soil extract ^b		Groundwater		Total potential sulfate ^c	Static water	Mobile water	Class for location
1	2	3	4	5	6	7	8	9
	(SO ₄ mg/l)	(Mg mg/l)	(SO ₄ mg/l)	(Mg mg/l)	(SO ₄ %)	(pH) ^d	(pH) ^d	
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+A1:2011: Geotechnical investigation and testing - Field testing - Part 3: Standard penetration test.

The Energy ratio for the hammer used on this site is 59% as given in the test certificate 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 63.5kg 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 terms for classification of relative density of sands and gravels only in accordance with Table 10 of BS 5930: 2015+A1:2020, Code of Practice for Site Investigations, as follows:

Term	Classification based on uncorrected SPT N-values for use of borehole logs Blows/300mm Penetration
Very loose	0-4
Loose	4-10
Medium dense	10 - 30
Dense	30 - 50
Very dense	over 50

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

SPT Hammer Energy Test Report

In accordance with BSEN ISO 22476-3:2005

ARCHWAY ENGINEERING
AINLEYS INDUSTRIAL ESTATE
ELLAND
WEST YORKSHIRE
HX5 9JP

SPT Hammer Ref: DART314
Test Date: 02/03/2023
Report Date: 02/03/2023
File Name: DART314.spt
Test Operator: JL

Instrumented Rod Data

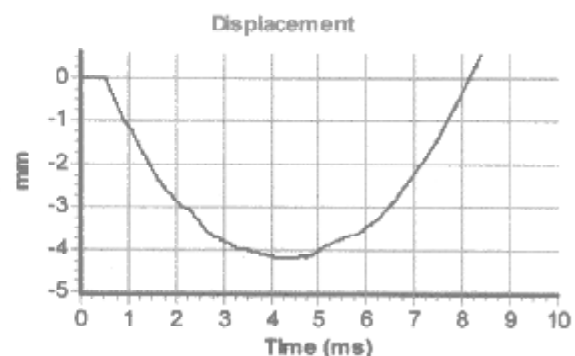
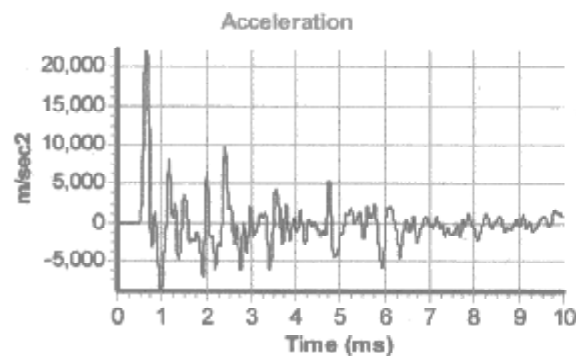
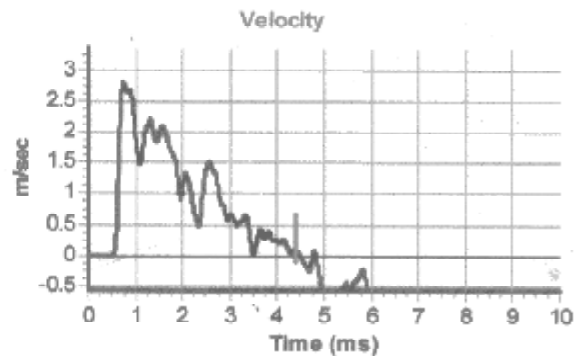
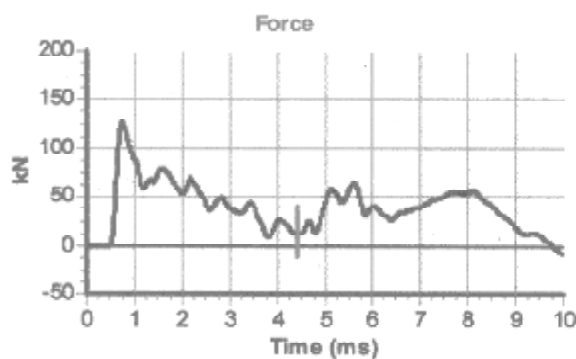
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.5
Assumed Modulus E_a (GPa): 208
Accelerometer No.1: 72572
Accelerometer No.2: 72757

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 - 83909



Calculations

Area of Rod A (mm^2): 970
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 281

Energy Ratio E_r (%):

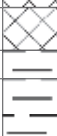
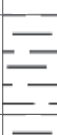
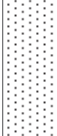
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Signed: J. LOCK
Title: FITTERS

The recommended calibration interval is 12 months

Appendix C

- C1 Exploratory Hole Logs WS01 to WS12
- C2 Exploratory Hole Log TP1 and TP2

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS01		
Consultant: Trevena Blake & Associates		Project: Development at Greenhill Road Location: Middleton				Sheet: 1		
Client: J Walker Homes Limited		Equipment: Archway Dart Rig				Ground Level: 104.1 m.AOD Co-ordinates: Easting: 388592.8(m) Northing: 405226.3(m) Dates: 19/07/2023 to 19/07/2023		
Drilling Foreman: M Walton Engineer/Geologist: M Benson		STRATUM DESCRIPTION		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to Sample Type/No Blow Count N/(U)	Field Records
0 CONCRETE Dark brown clayey sandy gravel with brick fragments and rubble, concrete fragments and roots - MADE GROUND Brown sand and gravel with brick fragments - MADE GROUND		0.10 0.40 (0.60) 1.00	104.00 103.70 103.10		0.80 1.00 1.30 1.40	C1 CP1 D1 CP2	3 2	PID at 3.10m - 54ppm Hand penetrometer at 3.20m - 105kPa PID at 3.50m - 76ppm PID at 3.90m - 36ppm PID at 4.10m - 599ppm PID at 4.50m - 832ppm PID at 4.90m - 889ppm Wet from 5.00m depth PID at 5.10m - 479ppm PID at 5.50m - 239ppm PID at 5.90m - 145ppm 19/07/2023: On completion of exploratory hole at 6.00m. Casing at 5.00m. Standing water level at 5.20m with casing. On withdrawal of casing groundwater/gas monitoring standpipe installed to 5.00m with response zone from 1.00m to 5.00m.
1 Brown with grey sand and gravel - MADE GROUND Dark grey organic very sandy silty CLAY Brown with grey gravelly sandy silty CLAY		1.30 1.50 (0.50) 2.00	102.80 102.60 102.10		2.00 2.50	CP3 CP4	2 Nil	
2 Very soft to soft light brown very silty CLAY Firm to stiff brown medium to high strength slightly gravelly very sandy silty CLAY		(0.70) 2.70 (0.70) 3.40	101.40 100.70		3.00 3.20 3.30 3.50 3.60	CP5 D2 D3	4	
3 Medium dense brown with occasional black silty fine to medium SAND - Hydrocarbon Odour		(2.60)	4.00 4.50 5.00		CP6 C2 CP7	12 21		
4 Exploratory Hole complete at 6.00m		6.00	98.10		5.90	CP8	12	
5 6 7 8 9 10								
Remarks: 19/07/2023: Inspection pit excavated to 1.00m to avoid services. Breaking out concrete - 30mins 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: 26/07/2023 Checked: M Richardson Date: 14/08/2023 Site Ref: 6127/VGH Scale 1:50						

GeoAssist Limited

Consultant:

Trevena Blake & Associates

Client:

J Walker Homes Limited

Exploratory Hole Record Sheet

Project: Development at Greenhill Road

Location: Middleton

Equipment: Archway Dart Rig

Ground Level: 103.85 m.AOD

Co-ordinates: Easting: 388604.2(m)
Northing: 405238.3(m)

Dates: 20/07/2023 to 20/07/2023

Ref: WS02

Sheet: 1

Drilling Foreman: M Walton

Engineer/Geologist: M Benson

STRATUM DESCRIPTION

Depth (Thick) (m)

Reduced Level (mAOD)

Strata Legend/ Standpipe Backfill

Samples/Tests

Depth (m) from to

Sample Type/No

Blow Count N/(U)

Field Records

0	TARMAC	0.05	103.80									
	Brown/grey sandy gravel with brick and concrete fragments - MADE GROUND	(1.15)										
-1		1.20	102.65									
	Firm brown with grey slightly gravelly sandy silty clay - MADE GROUND	(0.50)	102.15									
	Dark grey sandy gravel, cinders and ash - MADE GROUND	1.90	101.95									
-2	Firm brown gravelly sandy silty clay - MADE GROUND	(0.40)	101.55									
	Dark grey organic very sandy silty CLAY	2.50	101.35									
	Loose brown/grey silty fine to medium SAND - Hydrocarbon Odour											PID at 2.50m - 101ppm
-3		(1.00)										PID at 2.90m - 134ppm PID at 3.10m - 352ppm
		3.50	100.35									PID at 3.50m - 548ppm
	Medium dense to dense light grey silty fine to medium SAND - Hydrocarbon Odour	(0.70)										PID at 3.90m - 696ppm PID at 4.10m - 426ppm
-4		4.20	99.65									
	Firm brown/grey gravelly sandy to very sandy silty CLAY	(1.00)										PID at 4.50m - 312ppm
-5		5.20	98.65									PID at 4.90m - 106ppm PID at 5.10m - 67ppm Wet from 5.20m depth
	Medium dense brown with occasional black slightly silty fine to medium SAND	(0.80)										
-6		6.00	97.85									
	Exploratory Hole complete at 6.00m											20/07/2023: On completion of exploratory hole at 6.00m. Casing at 5.00m. Standing water level at 5.00m with casing. On withdrawal of casing groundwater/gas monitoring standpipe installed to 5.00m with response zone from 1.00m to 5.00m.
-7												
-8												
-9												
-10												

Remarks: 20/07/2023: Inspection pit excavated to 1.00m to avoid services

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: 26/07/2023

Checked: M Richardson

Date: 14/08/2023

Site Ref: 6127/VGH

Scale 1:50

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS03		
Consultant: Trevena Blake & Associates		Project: Development at Greenhill Road Location: Middleton				Sheet: 1		
Client: J Walker Homes Limited		Equipment: Archway Dart Rig				Ground Level: 103.52 m.AOD Co-ordinates: Easting: 388609.2(m) Northing: 405222.1(m) Dates: 19/07/2023 to 19/07/2023		
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Blow Count N/(U)	Field Records
0 CONCRETE Brown/grey sandy gravel, brick and concrete fragments - MADE GROUND		0.10	103.42					
		(0.70)						
		0.80	102.72		0.80	C1		
Brown sandy gravel, brick fragments and cinders - MADE GROUND		1.00	102.52		1.00	CP1	3	PID at 1.10m - 51ppm
1 Brown with dark grey gravelly sandy silty clay with cinders and ash - MADE GROUND		(0.70)			1.50	C2		PID at 1.50m - 91ppm
		1.70	101.82					
Dark grey silty sand with clay inclusions - MADE GROUND		2.00	101.52		2.00	CP2	2	
2 Brown with grey gravelly sandy silty CLAY		2.20	101.32					
Very loose dark grey organic silty fine to medium SAND		(0.80)			2.50	CP3	1	
		3.00	100.52		2.50	C1		
3 Loose light brown with dark grey silty fine to medium SAND with occasional black coal fragments - Hydrocarbon Odour					3.00	CP4	6	
		(1.00)			3.30 3.40	D1		PID at 3.50m - 50ppm
		4.00	99.52		4.00	CP5	22	PID at 3.90m - 100ppm
4 Medium dense brown with occasional dark grey silty fine to medium SAND		(1.00)						
		5.00	98.52		4.90	CP6	16	
5 Exploratory Hole complete at 5.00m								19/07/2023: On completion of exploratory hole at 5.00m. Casing at 5.00m. Standing water level at 5.00m with casing. On withdrawal of casing groundwater/gas monitoring standpipe installed to 5.00m with response zone from 1.00m to 5.00m.
6								
7								
8								
9								
10								
Remarks: 19/07/2023: Inspection pit excavated to 1.00m to avoid services. Breaking out concrete - 30mins 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: 26/07/2023 Checked: M Richardson Date: 14/08/2023 Site Ref: 6127/VGH Scale 1:50		

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: WS04		
Consultant: Trevena Blake & Associates		Project: Development at Greenhill Road Location: Middleton					Sheet: 1		
Client: J Walker Homes Limited		Equipment: Archway Dart Rig				Ground Level: 104.91 m.AOD Co-ordinates: Easting: 388607.4(m) Northing: 405211.6(m) Dates: 20/07/2023 to 20/07/2023			
Drilling Foreman: M Walton Engineer/Geologist: M Benson		STRATUM DESCRIPTION		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests		Field Records
							Depth (m) from to	Sample Type/No	Blow Count N/(U)
0 CONCRETE		0.05	104.86						
Dark brown/grey sandy gravel and brick fragments with occasional rootlets - MADE GROUND		(0.95)							
1 Dark grey/brown gravelly sandy silty clay with brick and concrete fragments - MADE GROUND		1.00	103.91				0.80 1.00	C1 CP1	8
							1.50 1.60	D1	
2		(2.00)					2.00	CP2	1
3 Grey organic silty fine to medium SAND		3.00	101.91				3.00	CP3	2
Loose to medium dense brown with grey slightly clayey silty fine to medium SAND		3.20	101.71						
		(0.80)					3.50	CP4	10
4 Medium dense brown slightly silty fine to medium SAND		4.00	100.91				4.00	CP5	13
		(0.70)					4.50 4.60	D2	
5 Medium dense brown with black silty fine to medium SAND with black coal fragments		4.70	100.21						
		(1.30)					5.00	CP6	17
6 Exploratory Hole complete at 6.00m		6.00	98.91				5.90	CP7	19
7									
8									
9									
10									
Remarks: 20/07/2023: Inspection pit excavated to 1.00m to avoid services							Logged: M Benson Date: 26/07/2023 Checked: M Richardson Date: 14/08/2023 Site Ref: 6127/VGH Scale 1:50		
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.									

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS06		
Consultant: Trevena Blake & Associates		Project: Development at Greenhill Road Location: Middleton				Sheet: 1		
Client: J Walker Homes Limited		Equipment: Archway Dart Rig				Ground Level: 105.17 m.AOD Co-ordinates: Easting: 388568.4(m) Northing: 405179.5(m) Dates: 21/07/2023 to 21/07/2023		
Drilling Foreman: M Walton Engineer/Geologist: M Benson		STRATUM DESCRIPTION		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to Sample Type/No Blow Count N/(U)	Field Records
0 Dark brown/grey clayey silty sand with brick, glass, pottery and metal fragments - MADE GROUND		(0.70) 0.70	104.47	[Pattern]	0.40	C1		
1 Brown sandy silty clay with gravel, brick and concrete fragments - MADE GROUND		1.00	104.17	[Pattern]	1.00	CP1	7	
Dark brown/grey sandy gravel and brick fragments and rubble - MADE GROUND		(1.30)		[Pattern]	1.50 1.60	D1		
2 Dark grey silty sand with ash - MADE GROUND		2.30	102.87	[Pattern]	2.00	CP2	3	
Brown silty fine to medium SAND		2.50	102.67	[Pattern]				
3 Firm to stiff brown medium to high strength gravelly sandy silty CLAY		(1.00)		[Pattern]	2.80 2.90	D2		Hand penetrometer at 2.80m - 127kPa
		3.70	101.47	[Pattern]	3.00	CP3	6	Hand penetrometer at 3.40m - 74kPa
4 Medium dense brown/light brown with black slightly silty fine to medium SAND		(1.30)		[Pattern]	4.00	CP4	23	
		5.00	100.17	[Pattern]	4.50 4.60	D3		
5 Medium dense light brown with dark brown silty fine to medium SAND		(0.80)		[Pattern]	5.00	CP5	24	
6 Black/ironstained silty fine to medium SAND		5.80	99.37	[Pattern]				
Exploratory Hole complete at 6.00m		6.00	99.17	[Pattern]	5.90	CP6	26	21/07/2023: On completion of exploratory hole at 6.00m. Casing at 5.00m. Standing water level Nil with casing. On withdrawal of casing groundwater/gas monitoring standpipe installed to 5.00m with response zone from 1.00m to 5.00m.
7								
8								
9								
10								
Remarks: 21/07/2023: Inspection pit excavated to 1.00m to avoid services 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: 26/07/2023 Checked: M Richardson Date: 14/08/2023 Site Ref: 6127/VGH Scale 1:50	

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS07		
Consultant: Trevena Blake & Associates		Project: Development at Greenhill Road				Sheet: 1		
Client: J Walker Homes Limited		Location: Middleton				Ground Level: 104.99 m.AOD		
		Equipment: Archway Dart Rig				Co-ordinates: Easting: 388584.2(m) Northing: 405171.4(m)		
						Dates: 21/07/2023 to 21/07/2023		
Drilling Foreman: M Walton		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests		Field Records	
Engineer/Geologist: M Benson					Depth (m) from to	Sample Type/No		Blow Count N/(U)
0 Poor vegetation over brown clayey gravelly TOPSOIL		0.10	104.89					
Brown/grey sandy gravel with brick, glass and slate fragments - MADE GROUND					0.60	C1		
-1		(1.90)			1.00	CP1	4	
2 Medium dense brown SAND and GRAVEL		2.00	102.99		2.00	CP2	25	
Firm to stiff brown medium to high strength slightly gravelly sandy silty CLAY		2.30	102.69					
3 Medium dense brown with occasional black silty fine to medium SAND with occasional gravel and ironstaining in parts		(0.70)			2.50 2.60	D1		Hand penetrometer at 2.50m - 82kPa
		3.00	101.99		3.00	CP3	13	
-4		(3.00)			3.50 3.60	D2		
-5					4.00	CP4	16	
-6					5.00	CP5	21	
-7					5.90	CP6	15	
Exploratory Hole complete at 6.00m		6.00	98.99					21/07/2023: On completion of exploratory hole at 6.00m. Casing at 3.00m. Standing water level Nil with casing. On withdrawal of casing exploratory hole backfilled and reinstated.
-8								
-9								
-10								

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: 26/07/2023

Checked: M Richardson

Date: 14/08/2023

Site Ref: 6127/VGH

Scale 1:50

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: 26/07/2023 Checked: M Richardson Date: 14/08/2023 Site Ref: 6127/VGH Scale 1:50
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Logged: M Benson
 Date: 26/07/2023
 Checked: M Richardson
 Date: 14/08/2023
 Site Ref: **6127/VGH**
 Scale 1:50

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS09		
Consultant: Trevena Blake & Associates		Project: Development at Greenhill Road				Sheet: 1		
Client: J Walker Homes Limited		Location: Middleton				Ground Level: 101.51 m.AOD		
		Equipment: Archway Dart Rig				Co-ordinates: Easting: 388655.8(m) Northing: 405190.1(m)		
						Dates: 25/07/2023 to 25/07/2023		
Drilling Foreman: M Walton		STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests		Field Records
Engineer/Geologist: M Benson						Depth (m) from to	Sample Type/No	
0 Grey/brown clayey sand and gravel with brick fragments - MADE GROUND		0.10	101.41					
0.40		0.40	101.11					
Brown with dark grey gravelly sandy silty clay - MADE GROUND		(0.60)						
Dark brown/grey sandy gravel with brick and concrete fragments - MADE GROUND		1.00	100.51					
1 Very loose grey organic silty fine to medium SAND with occasional rootlets		(0.50)						
Light brown/brown with dark grey silty fine to medium SAND		1.50	100.01					
2 Soft light grey sandy very silty CLAY		(0.50)						
Medium dense brown/grey silty to very silty fine to medium SAND with occasional coal fragments		2.00	99.51					
2.20		2.20	99.31	2.00	CP2	5	Wet at 2.00m depth	
3		(1.80)						
4		4.00	97.51					
Loose to medium dense brown gravelly very silty fine SAND		(1.00)						
5		5.00	96.51					
Loose to medium dense brown silty fine SAND		(1.00)						
6		6.00	95.51					
Exploratory Hole complete at 6.00m				3.90	CP5	10		
7								
8								
9								
10								
Remarks:		25/07/2023: On completion of exploratory hole at 6.00m. Casing at 5.00m. Standing water level at 3.90m with casing. On withdrawal of casing groundwater/gas monitoring standpipe installed to 5.00m with response zone from 1.00m to 5.00m.						
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: 26/07/2023						
Checked: M Richardson		Date: 14/08/2023						
Site Ref: 6127/VGH		Scale 1:50						

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: WS10		
Consultant: Trevena Blake & Associates		Project: Development at Greenhill Road Location: Middleton					Sheet: 1		
Client: J Walker Homes Limited		Equipment: Archway Dart Rig				Ground Level: 102.69 m.AOD Co-ordinates: Easting: 388629.2(m) Northing: 405203.5(m) Dates: 25/07/2023 to 25/07/2023			
Drilling Foreman: M Walton Engineer/Geologist: M Benson		STRATUM DESCRIPTION		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests		Field Records
							Depth (m) from to	Sample Type/No	Blow Count N/(U)
0 Poor vegetation over brown gravel with roots - MADE GROUND		0.10	102.59						
Sandstone/concrete cobble - MADE GROUND		0.30	102.39						
Grey/brown sandy gravel, cinders, ash and concrete fragments - MADE GROUND		(0.90)				0.50		C1	
-1		1.20	101.49			1.00		CP1	8
Grey clayey silty SAND with gravel		1.50	101.19			1.30 1.40		D1	
Soft to firm brown with light brown and grey low to medium strength very silty CLAY with organic inclusions		(0.70)				1.90 2.00		D2	4
-2		2.20	100.49			2.00 2.30		CP2	
Dark grey gravelly very silty SAND		2.40	100.29					D3	
Soft to firm dark brown organic very sandy CLAY		(0.40)							
Brown/light brown silty fine to medium SAND with organic inclusions		2.80	99.89						
-3		3.00	99.69			3.00		CP3	21
Medium dense dark grey/brown SAND and GRAVEL with cobbles		(1.00)							
-4		4.00	98.69			3.90		CP4	29
Exploratory Hole complete at 4.00m									
-5									
-6									
-7									
-8									
-9									
-10									

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: 26/07/2023
Checked: M Richardson
Date: 14/08/2023
Site Ref: 6127/VGH
Scale 1:50

Remarks:	Logged: M Benson Date: 26/07/2023 Checked: M Richardson Date: 14/08/2023 Site Ref: 6127/VGH Scale 1:50
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.	

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS12			
Consultant: Trevena Blake & Associates		Project: Development at Greenhill Road				Sheet: 1			
Client: J Walker Homes Limited		Location: Middleton				Ground Level: 103.63 m.AOD			
		Equipment: Archway Dart Rig				Co-ordinates: Easting: 388657.5(m) Northing: 405149.6(m)			
						Dates: 26/07/2023 to 26/07/2023			
Drilling Foreman: M Walton		STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests		Field Records	
Engineer/Geologist: M Benson						Depth (m) from to	Sample Type/No		Blow Count N/(U)
0 Grass over dark grey clayey TOPSOIL			0.10	103.53					
Dark grey with brown sandy gravel, cinders and ash with brick and concrete fragments - MADE GROUND									
1			(1.20)			0.50	C1		
2			1.30	102.33		1.00	CP1	11	
Brown/light brown silty fine to medium sand with roots and occasional - MADE GROUND						1.30 1.40	D1		
			(1.10)			1.70 1.80	D2		
3			2.40	101.23		2.00	CP2	8	
Brown brick rubble/cobble - MADE GROUND			2.60	101.03					
Medium dense brown with dark grey inclusions slightly gravelly slightly silty fine to medium SAND with black coal fragments									
			(1.40)			3.00	CP3	22	
			4.00	99.63		3.40 3.50	D3		
4						4.00	CP4	20	
Medium dense brown/grey silty fine to medium SAND			(1.00)						
			5.00	98.63		4.90	CP5	13	
5									
Exploratory Hole complete at 5.00m									
6									
7									
8									
9									
10									
Remarks:							Logged: M Benson		
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.							Date: 26/07/2023		
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.							Checked: M Richardson		
							Date: 14/08/2023		
							Site Ref: 6127/VGH		
							Scale 1:50		

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: TP1		
Consultant: Trevena Blake & Associates		Project: Development at Greenhill Road Location: Middleton					Sheet: 1		
Client: J Walker Homes Limited		Equipment: Archway Dart Rig				Ground Level: 104.18 m.AOD Co-ordinates: Easting: 388581.7(m) Northing: 405189.6(m) Dates: 17/08/2023 to 17/08/2023			
Drilling Foreman: M Walton Engineer/Geologist: M Benson		STRATUM DESCRIPTION		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests		Field Records
						Depth (m) from to	Sample Type/No	Blow Count N/(U)	
0 Daek brown/black sandy gravel, cinders and ash with metal fragments - MADE GROUND - strong odour		(0.70)				0.40	0.50	C1	17/08/2023: On competeion of exploratory hole at 2.30m. Seepage water at 2.20m. Trial pit sides collapsing from 1.50m depth. Trial pit terminated and backfilled with arisings.
1 Grey/brown silty SAND with gravel - strong odour		0.70	103.48						
(0.80)									
1.50		102.68							
2 Brown/grey slightly sandy clayey SILT - strong odour		(0.80)				2.20	2.30	C2	
2.30		101.88							
Exploratory Hole complete at 2.30m									
3									
4									
5									
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: 17/08/2023 Checked: M Richardson Date: 17/08/2023 Site Ref: 6127/VGH Scale 1:25	

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: TP2		
Consultant: Trevena Blake & Associates		Project: Development at Greenhill Road Location: Middleton					Sheet: 1		
Client: J Walker Homes Limited		Equipment: Archway Dart Rig				Ground Level: 104.38 m.AOD Co-ordinates: Easting: 388598.1(m) Northing: 405165.6(m) Dates: 17/08/2023 to 17/08/2023			
Drilling Foreman: M Walton Engineer/Geologist: M Benson		STRATUM DESCRIPTION		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests		Field Records
						Depth (m) from to	Sample Type/No	Blow Count N/(U)	
0 Brown silty sandy gravel with brick fragments - MADE GROUND			(1.10)						17/08/2023: On completion of exploratory hole at 2.30m. Water Nil. Infiltration test undertaken. Trial pit terminated and backfilled with arisings.
1 Dark grey/black sand, cinders and ash - MADE GROUND		1.10	103.28						
Orange/brown very silty SAND with rare gravel		1.30	103.08						
2		(1.00)							
2.30		102.08							
Exploratory Hole complete at 2.30m									
3									
4									
5									
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: 17/08/2023 Checked: M Richardson Date: 17/08/2023 Site Ref: 6127/VGH Scale 1:25	

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:	Development at Greenhill Road	Site Ref:	6127/VGH
	Location:	Middleton	Project Code :	
	Client:	J Walker Homes Limited		
	Consultant :	Trevena Blake & Associates	Hole Ref	WS01 to WS12

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 Size mm	Confining Pressure kN/m ²	Deviator /Shear Stress kN/m ²	Shear Cohesion kN/m ² /Friction angle degrees	So4 Total % So4 2:1 extract Soil:Water mg/l	pH	
WS01 D1	1.30	Dark grey organic very sandy silty CLAY					-						- 560	7.3	SULWS PHS
WS01 D2	3.20	Brown slightly gravelly very sandy silty CLAY	18	15	3	95	16								NMC CLSS
WS01 D3	3.50	Brown with occasional black silty fine to medium SAND					-								GRAD WS
WS02 D1	1.70	Dark grey sandy gravel, cinders and ash - MADE GROUND					-						- 240	7.4	SULWS PHS
WS02 D2	4.70	Brown/grey gravelly sandy to very sandy silty CLAY	19	14	5	91	14								NMC CLSS
WS02 D3	5.70	Brown with occasional black slightly silty fine to medium SAND					-								GRAD WS
WS03 D1	3.30	Light brown with dark grey slightly silty fine to medium SAND					-								GRAD WS
WS04 D1	1.50	Dark grey/brown gravelly sandy silty clay with brick and concrete fragments - MADE GROUND					-						- 240	7.2	SULWS PHS
WS04 D2	4.50	Brown slightly gravelly slightly silty fine to medium SAND					-								GRAD WS
WS05 D1	1.30	Brown with light grey gravelly sandy silty clay with organic inclusions - MADE GROUND													

GeoAssist Limited SOIL LABORATORY SUMMARY SHEET	Project: Development at Greenhill Road Location: Middleton Client: J Walker Homes Limited Consultant : Trevena Blake & Associates	Site Ref: 6127/VGH Project Code :
		Hole Ref WS01 to WS12

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 Size mm	Confining Pressure kN/m ²	Deviator /Shear Stress kN/m ²	Shear Cohesion kN/m ² /Friction angle degrees	So4 Total %	pH	
WS05 D2	1.80	Brown with light grey gravelly sandy silty clay with organic inclusions - MADE GROUND	23	14	9	97	17								NMC CLSS
WS06 D1	1.50	Dark brown/grey sandy gravel and brick fragments and rubble - MADE GROUND					-						- 380	7.6	SULWS PHS
WS06 D2	2.80	Brown silty fine to medium SAND	22	14	8	94	13								NMC CLSS
WS06 D3	4.50	Brown/light brown with black slightly silty fine to medium SAND					-								GRAD WS
WS07 D1	2.50	Brown slightly gravelly sandy silty CLAY	24	14	10	94	16								NMC CLSS
WS07 D2	3.50	Brown with occasional black slightly silty fine to medium SAND with occasional gravel and ironstained in parts					-								GRAD WS
WS08 D1	0.90	Brown/grey clayey sandy gravel with brick, sandstone and concrete fragments - MADE GROUND					-						- 260	7.5	SULWS PHS
WS08 D2	1.80	Orange/brown gravelly silty fine to medium SAND					-								GRAD WS
WS09 D1	1.40	Grey organic silty fine to medium SAND with occasional rootlets					-						- 160	7.3	SULWS PHS
WS09 D2	1.90	Light brown/brown with dark grey silty fine to medium SAND					-								GRAD WS

GeoAssist Limited SOIL LABORATORY SUMMARY SHEET	Project: Development at Greenhill Road Location: Middleton Client: J Walker Homes Limited Consultant : Trevena Blake & Associates	Site Ref: 6127/VGH Project Code :
		Hole Ref WS01 to WS12

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 Size mm	Confining Pressure kN/m ²	Deviator /Shear Stress kN/m ²	Shear Cohesion kN/m ² /Friction angle degrees	So4 Total % So4 2:1 extract Soil:Water mg/l	pH	
WS09 D3	2.80	Brown/grey silty fine to medium SAND with occasional coal fragments					-								GRAD WS
WS10 D1	1.30	Grey clayey silty SAND with gravel					-						- 360	7.2	SULWS PHS
WS10 D2	1.90	Brown with light brown and grey very silty CLAY with organic inclusions	21	15	6	97	15								NMC CLSS
WS10 D3	2.20	Dark grey gravelly very silty SAND					-								GRAD WS
WS11 D1	1.00	Brown silty to very silty fine to medium SAND					-						- 440	7.2	SULWS PHS
WS11 D2	4.50	Grey/brown slightly gravelly very silty CLAY	21	16	5	90	15								NMC CLSS
WS12 D1	1.30	Brown/light brown silty fine to medium sand with roots and occasional - MADE GROUND					-						- 560	7.2	SULWS PHS
WS12 D2	1.70	Brown/light brown slightly gravelly silty fine to medium sand with roots - MADE GROUND					-								GRAD WS
WS12 D3	3.40	Brown with dark grey inclusions slightly gravelly slightly silty fine to medium SAND with black coal fragments					-								GRAD WS

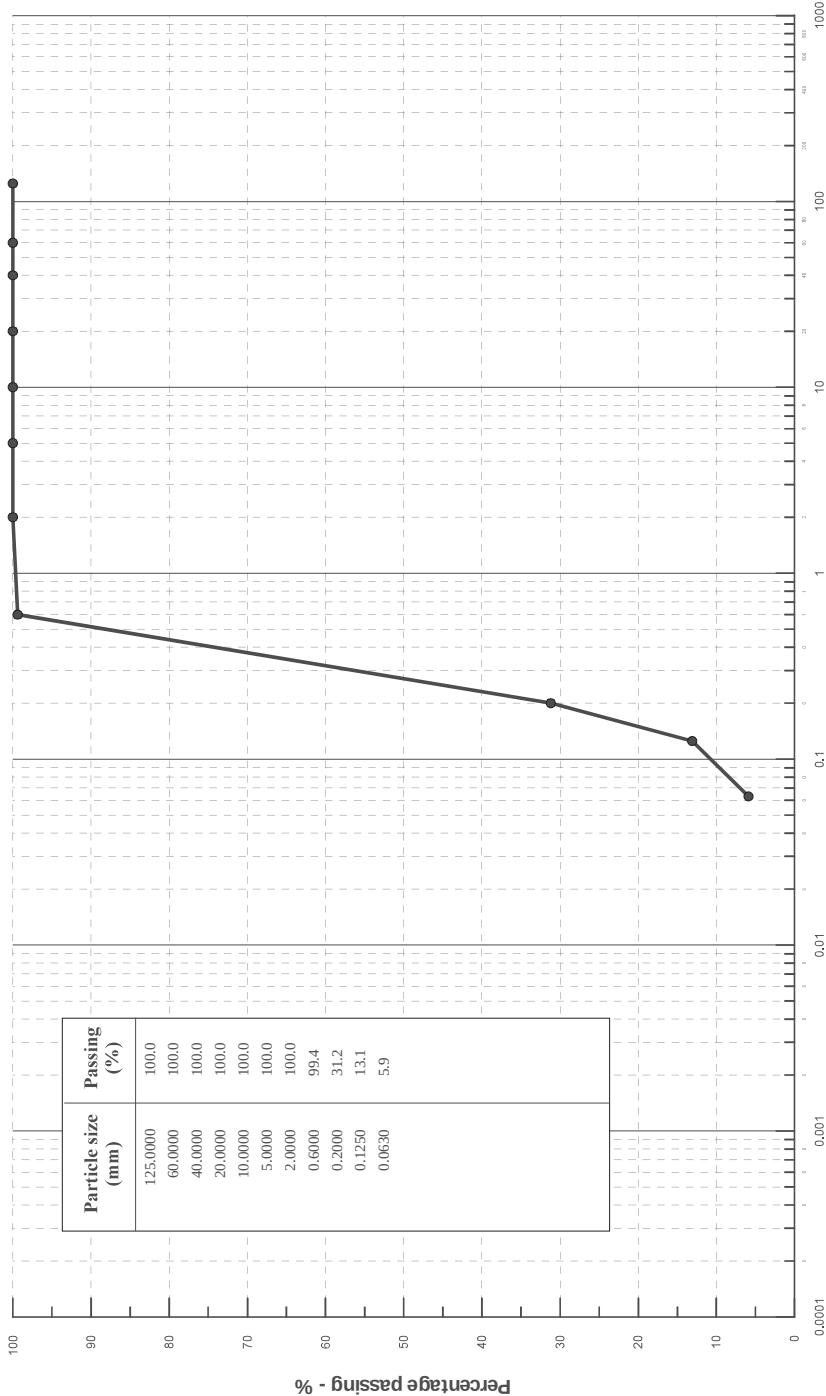
Site Reference:			6127 VGH					
Project Site:			Development at Greenhill Road					
Project Location:			Middleton					
Client:			J Walker Homes Limited					
Consultant:			Trevena Blake & Associates					
CLASSIFICATION TEST								
Borehole Reference	Sample	Depth	Liquid Limit	Plastic Limit	Plasticity Index	% passing 425 micro	Natural Moisture Content	Material Code
WS01	D2	3.20	18	15	3	95	16	SC
WS02	D2	4.70	19	14	5	91	14	CL
WS05	D2	1.80	23	14	9	97	17	CL
WS06	D2	2.80	22	14	8	94	13	CL
WS07	D1	2.50	24	14	10	94	16	CL
WS10	D2	1.90	21	15	6	97	15	CL/ML
WS11	D2	4.50	21	16	5	90	15	ML
		Mean	21	15	7	94	15	
		Maximum	24	16	10	97	17	
CLAY		Minimum	18	14	3	90	13	
	Standard Deviation		2	1	3	3	1	
		Count	7	7	7	7	7	

Site Reference:			6127 VGH			
Project Site:			Development at Greenhill Road			
Project Location:			Middleton			
Client:			J Walker Homes Limited			
Consultant:			Trevena Blake & Associates			
GEOTECHNICAL SULPHATE AND PH TEST						
Borehole Reference	Sample	Depth	SO4 2:1 Water:Soil extract mg/l	pH	SO4 Water mg/l	
WS01	D1	1.30	560	7.3		
WS02	D1	1.70	240	7.4		
WS04	D1	1.50	240	7.2		
WS06	D1	1.50	380	7.6		
WS08	D1	0.90	260	7.6		
WS09	D1	1.40	160	7.3		
WS10	D1	1.30	360	7.2		
WS11	D1	1.00	440	7.2		
WS12	D1	1.30	560	7.2		
		Mean	356	7.3		
ALL		Maximum	560	7.6		
		Minimum	160	7.2		
	Standard Deviation		144	0.2		
		Count	9			

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6127
Site Reference: VGH

Project: Development at Greenhill Road
Location: Middleton
Client: J Walker Homes Limited
Consultant: Trevena Blake & Associates



BH No: WS01
Sample: D3
Depth: 3.50m

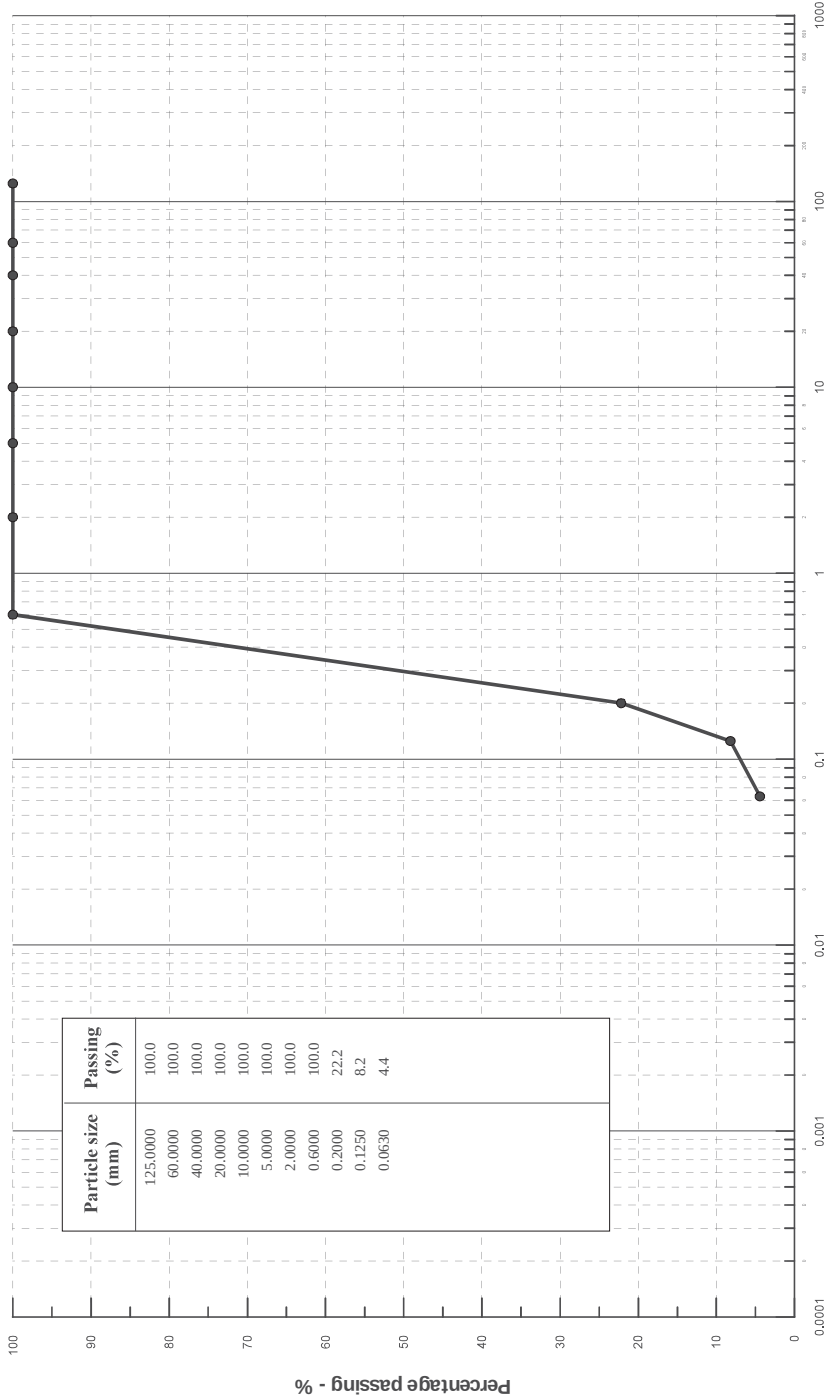
%	SIZE
0.0	Cobbles
0.0	Gravel
94.0	Sand
5.9	Silt and Clay

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

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6127
Site Reference: VGH

Project: Development at Greenhill Road
Location: Middleton
Client: J Walker Homes Limited
Consultant: Trevena Blake & Associates



BH No: WS02
Sample: D3
Depth: 5.70m

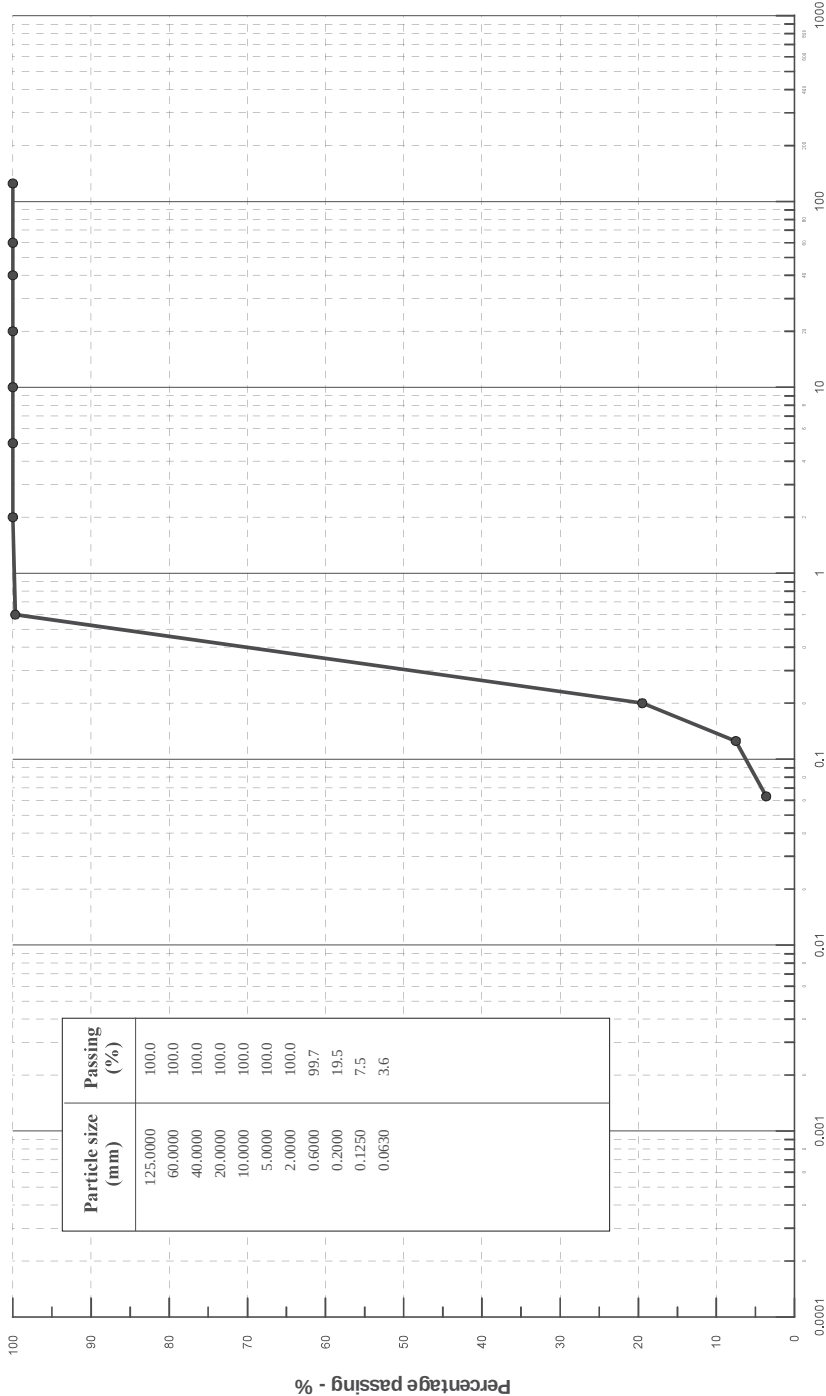
%	SIZE
0.0	Cobbles
0.0	Gravel
95.6	Sand
4.4	Silt and Clay

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

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6127
Site Reference: VGH

Project: Development at Greenhill Road
Location: Middleton
Client: J Walker Homes Limited
Consultant: Trevena Blake & Associates



BH No: WS03
Sample: D1
Depth: 3.30m

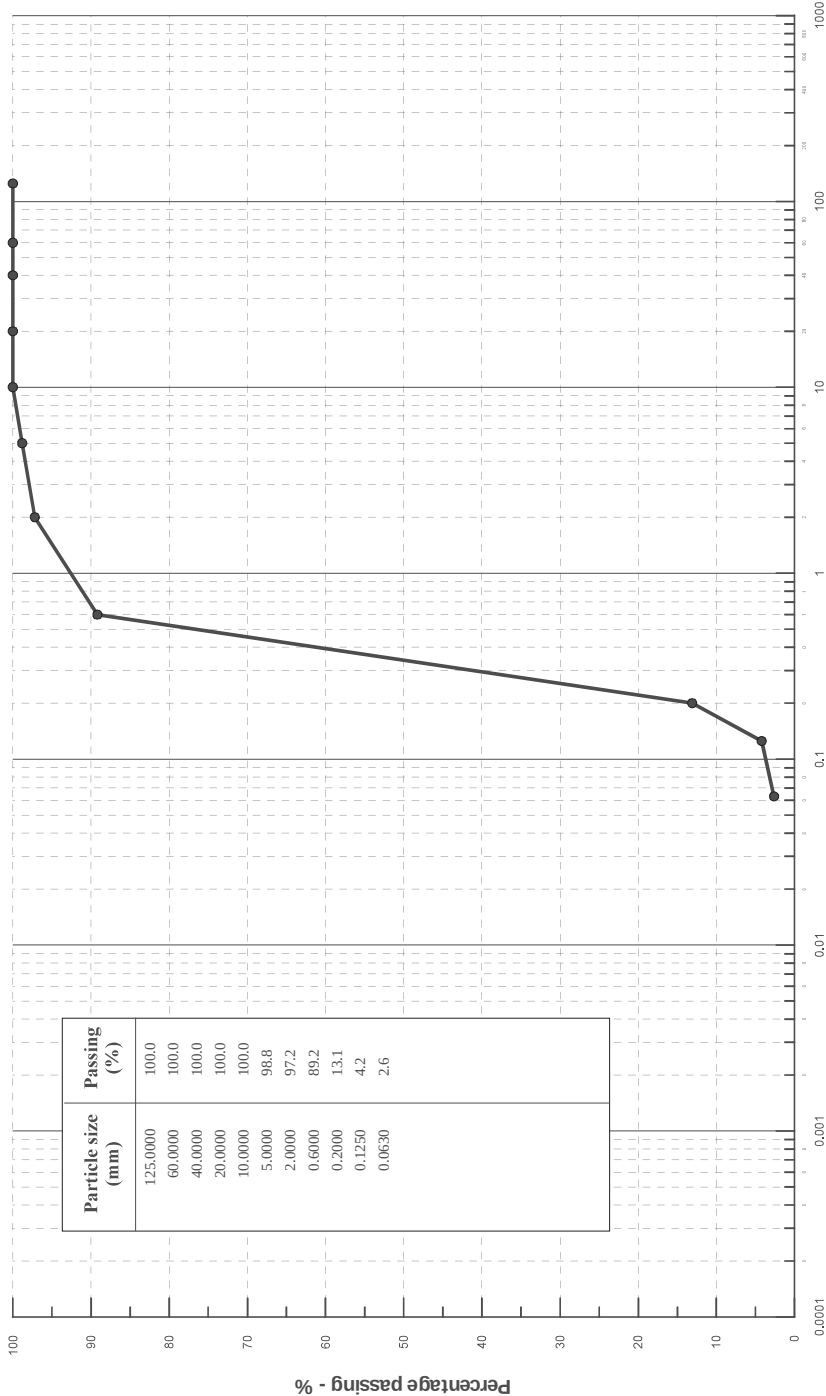
%	SIZE
0.0	Cobbles
0.0	Gravel
96.3	Sand
3.6	Silt and Clay

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

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6127
Site Reference: VGH

Project: Development at Greenhill Road
Location: Middleton
Client: J Walker Homes Limited
Consultant: Trevena Blake & Associates



BH No: WS04
Sample: D2
Depth: 4.50m

%	SIZE
0.0	Cobbles
2.8	Gravel
94.6	Sand
2.6	Silt and Clay

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

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6127
Site Reference: VGH

Project: Development at Greenhill Road
Location: Middleton
Client: J Walker Homes Limited
Consultant: Trevena Blake & Associates



BH No: WS06
Sample: D3
Depth: 4.50m

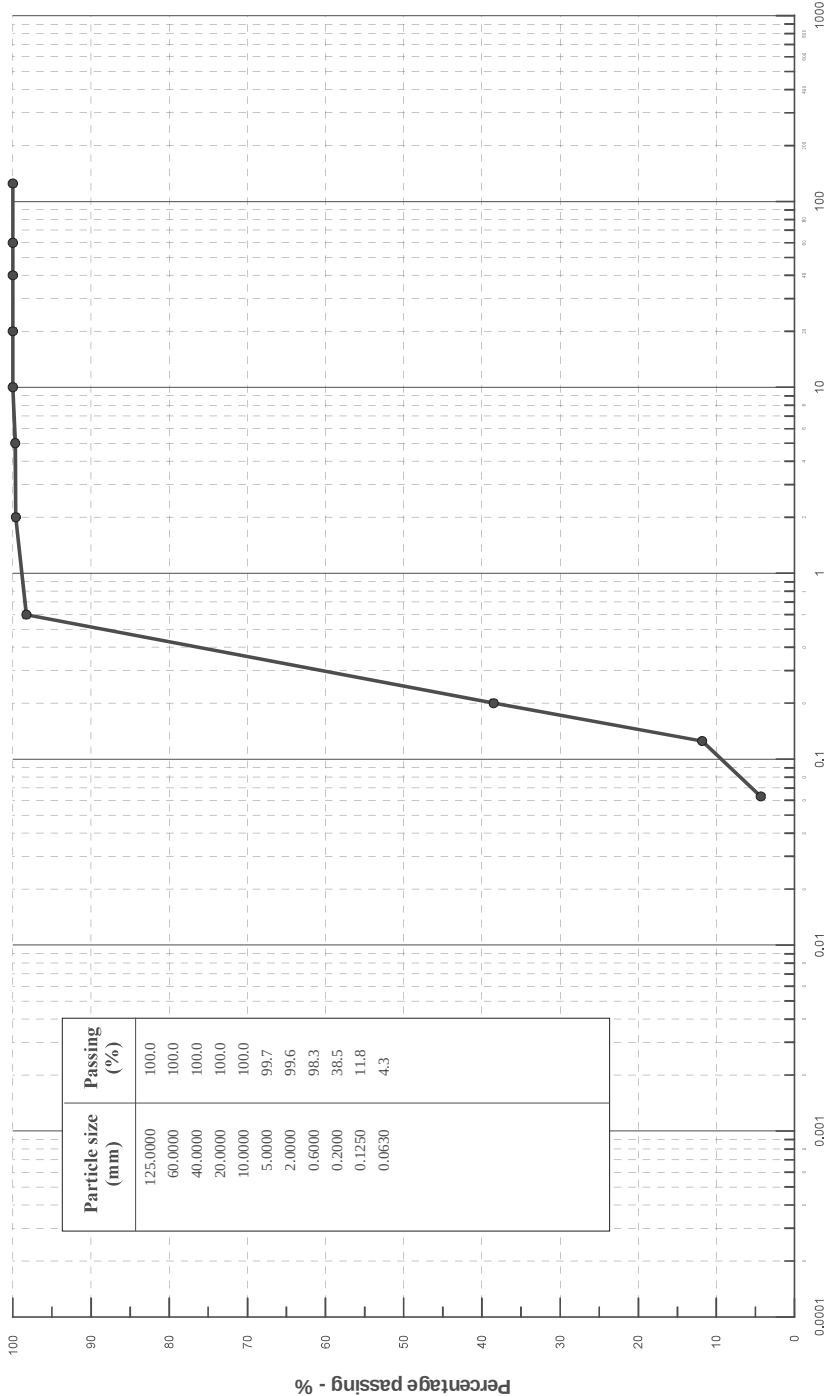
%	SIZE
0.0	Cobbles
0.2	Gravel
95.6	Sand
4.2	Silt and Clay

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

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6127
Site Reference: VGH

Project: Development at Greenhill Road
Location: Middleton
Client: J Walker Homes Limited
Consultant: Trevena Blake & Associates



BH No: WS07
Sample: D2
Depth: 3.50m

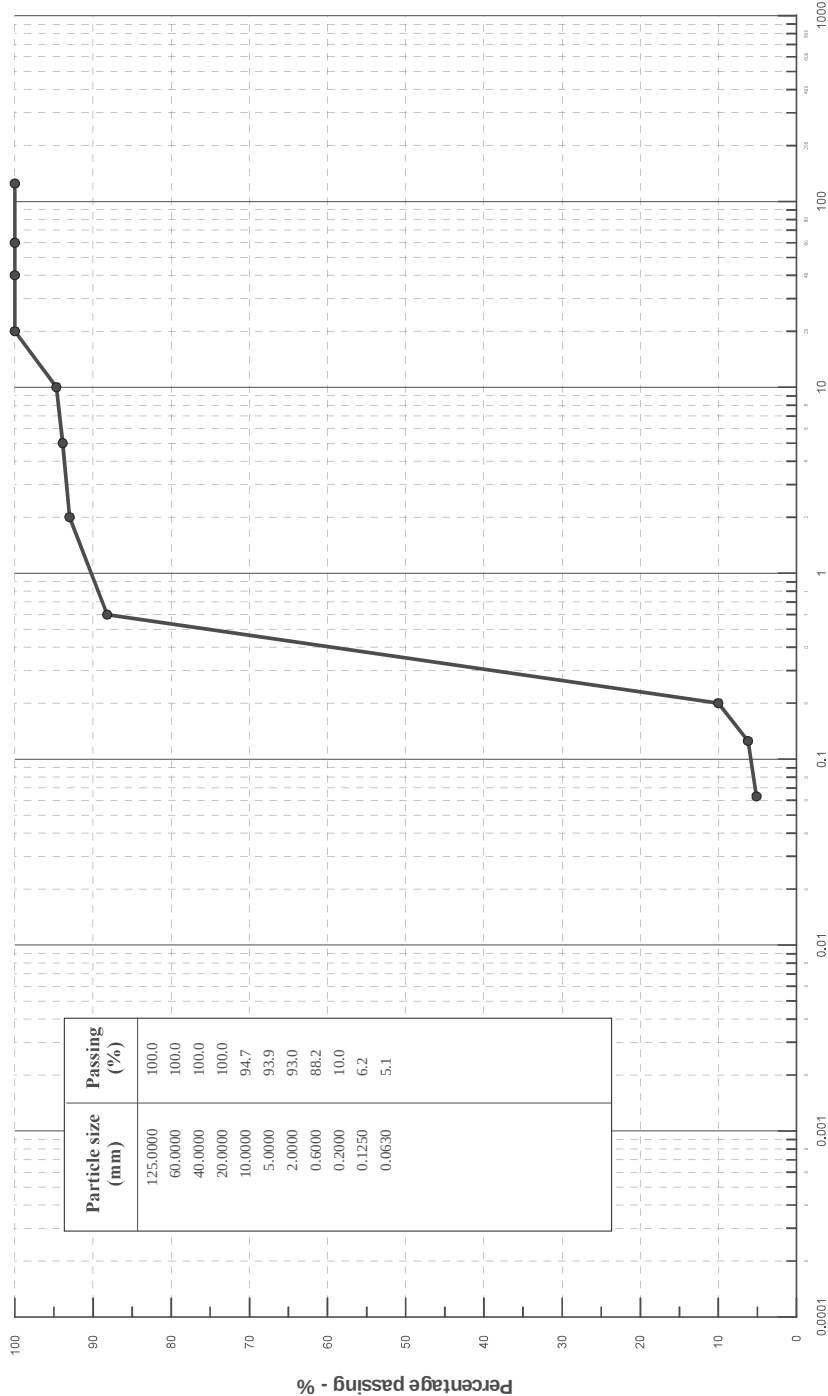
%	SIZE
0.0	Cobbles
0.4	Gravel
95.3	Sand
4.3	Silt and Clay

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

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6127
Site Reference: VGH

Project: Development at Greenhill Road
Location: Middleton
Client: J Walker Homes Limited
Consultant: Trevena Blake & Associates



BH No: WS08
Sample: D2
Depth: 1.80m

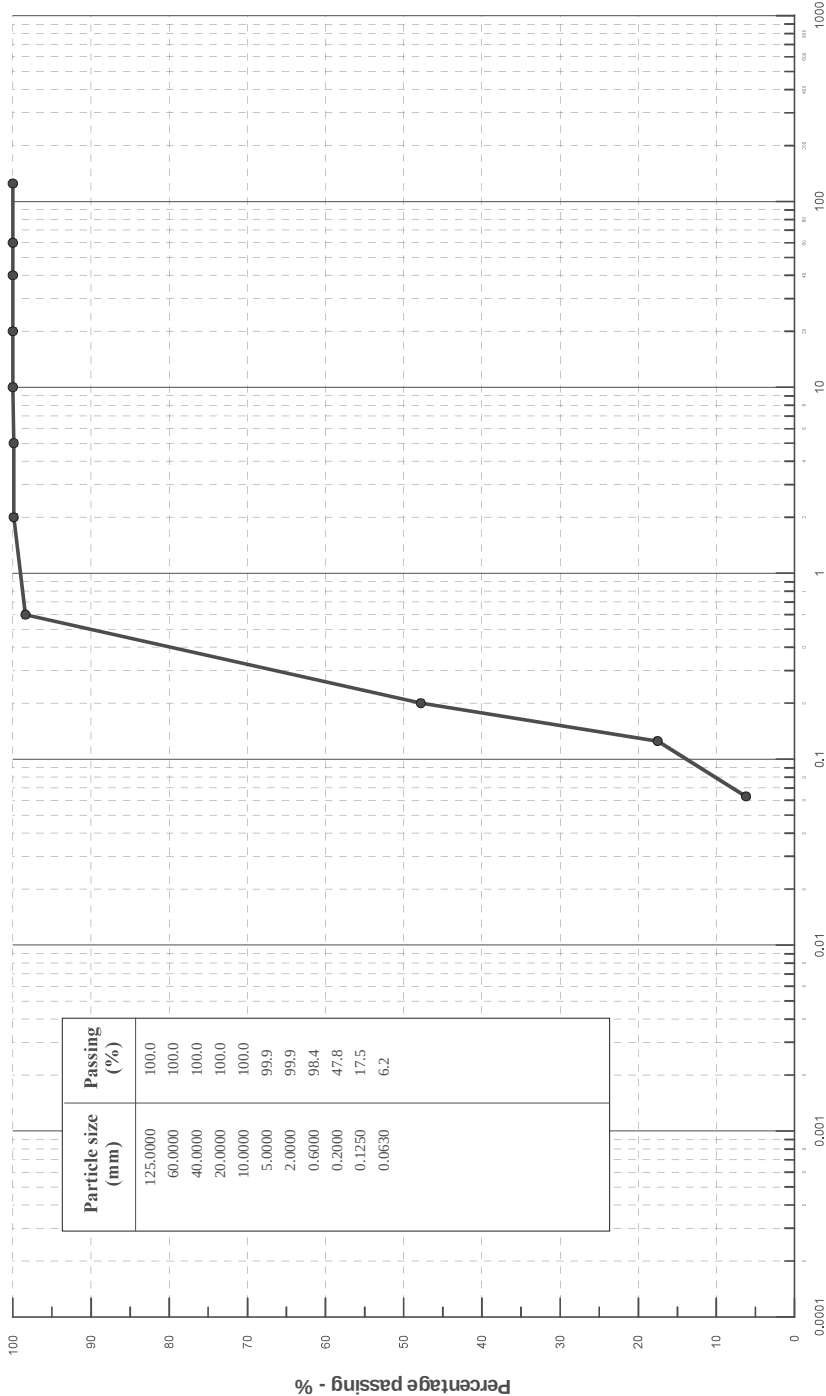
%	SIZE
0.0	Cobbles
7.0	Gravel
88.0	Sand
5.1	Silt and Clay

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

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6127
Site Reference: VGH

Project: Development at Greenhill Road
Location: Middleton
Client: J Walker Homes Limited
Consultant: Trevena Blake & Associates



BH No: WS09
Sample: D2
Depth: 1.90m

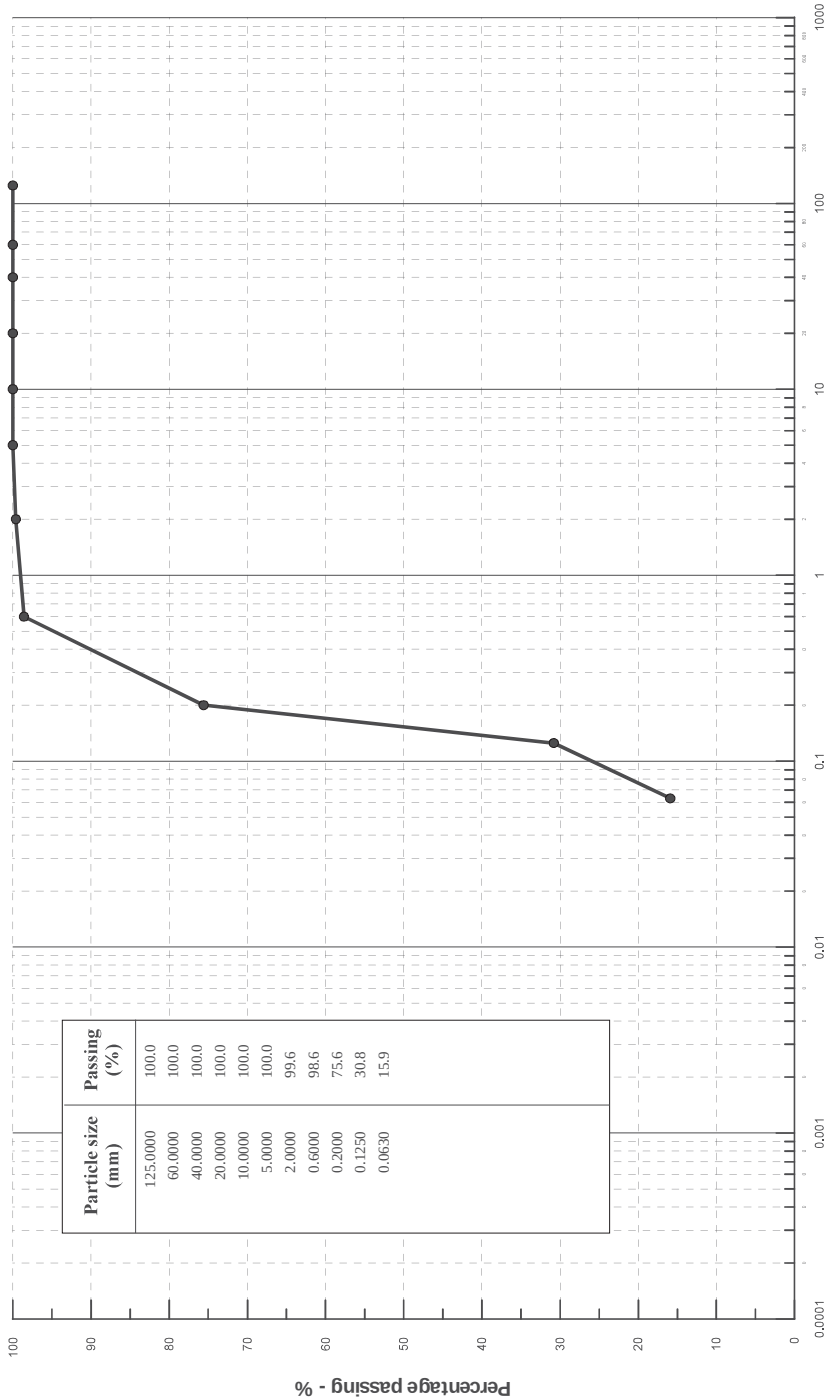
%	SIZE
0.0	Cobbles
0.1	Gravel
93.7	Sand
6.2	Silt and Clay

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

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6127
Site Reference: VGH

Project: Development at Greenhill Road
Location: Middleton
Client: J Walker Homes Limited
Consultant: Trevena Blake & Associates



BH No: WS09
Sample: D3
Depth: 2.80m

%	SIZE
0.0	Cobbles
0.4	Gravel
83.7	Sand
15.9	Silt and Clay

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

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6127
Site Reference: VGH

Project: Development at Greenhill Road
Location: Middleton
Client: J Walker Homes Limited
Consultant: Trevena Blake & Associates



BH No: WS10
Sample: D3
Depth: 2.20m

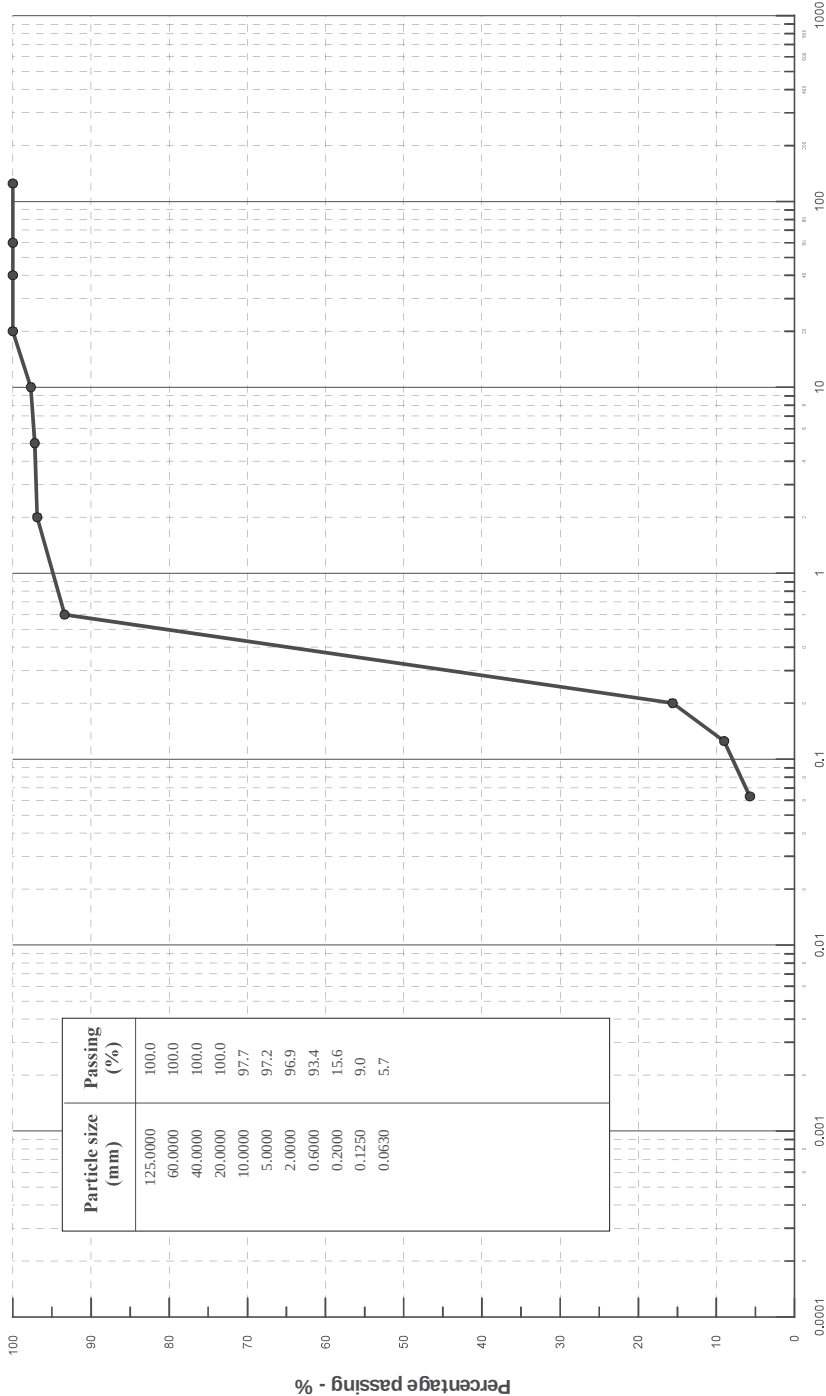
%	SIZE
0.0	Cobbles
16.1	Gravel
59.8	Sand
24.1	Silt and Clay

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

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6127
Site Reference: VGH

Project: Development at Greenhill Road
Location: Middleton
Client: J Walker Homes Limited
Consultant: Trevena Blake & Associates



BH No: WS12
Sample: D2
Depth: 1.70m

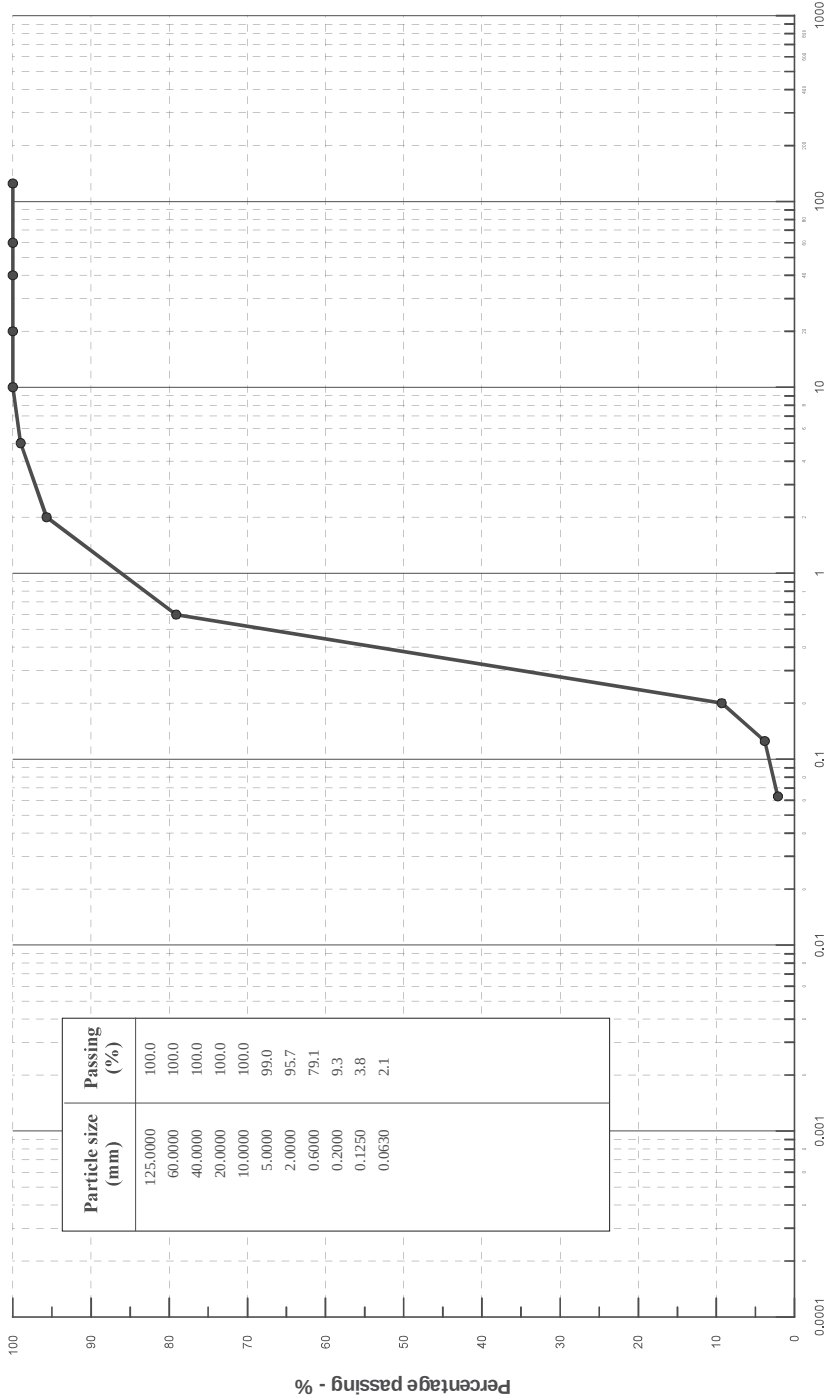
%	SIZE
0.0	Cobbles
3.1	Gravel
91.2	Sand
5.7	Silt and Clay

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

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6127
Site Reference: VGH

Project: Development at Greenhill Road
Location: Middleton
Client: J Walker Homes Limited
Consultant: Trevena Blake & Associates



BH No: WS12
Sample: D3
Depth: 3.40m

%	SIZE
0.0	Cobbles
4.3	Gravel
93.5	Sand
2.1	Silt and Clay

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