

**PROPOSED RESIDENTIAL DEVELOPMENT
46 PARK ROAD, TRINITY,
EDINBURGH**

GEOTECHNICAL REPORT



**Burnbank House,
Pencaitland,
East Lothian
EH34 5HB**

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Prepared for:

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1.0 INTRODUCTION

1.1 General

Geovia Ltd has been commissioned by Cameron Guest House Ltd to undertake a geotechnical investigation at the proposed residential development plot at 46 Park Road, Trinity, Edinburgh to characterise the underlying ground conditions prior to the development of a basement structure to the north of the existing house.

1.2 Purpose and aims of this report

A limited desk study was undertaken in order to make a preliminary assessment of ground conditions at the site. The desk study has considered the following elements:

- The current and former uses of the site and its environs;
- The environmental setting of the site as determined by the geology, hydrogeology, mineral stability and hydrology;

The purpose and aims of the geotechnical ground investigation are as follows:

- To investigate the geotechnical characteristics of the near surface soils at the site with regard to the site's proposed end use;
- To undertake in-situ testing of the soils, and to recover soil samples for subsequent laboratory based geotechnical testing;
- To provide a summary of encountered ground conditions, with regard to the site's proposed end use.

1.3 Scope of works

The scope of works undertaken at the site is as follows:

- Review of available desk study information;
- Drilling of a single cable percussion borehole to 10.25m depth bgl;
- In-situ geotechnical testing of soils;
- Laboratory based testing of soils;
- Provision of a geotechnical factual report.

1.4 Report limitations

Limitations of this study are included in Appendix A.

2.0 DESK STUDY INFORMATION

2.1 General

A site location plan is presented as Figure 1.

2.2 Site location and description

Table 1 – Site details

Site Address:	Proposed basement extension to the existing house at 46 Park Road, Trinity.
National Grid Reference (NGR):	NT 25384 76938
Site description:	<p>The 0.19 hectare site is currently undergoing refurbishment and extension to a single residential property end use.</p> <p>The site comprises a single Victorian age masonry construction residential property within the central eastern section of the site. The remainder of the site is understood to have comprised garden/ soft landscaping areas, although at the time of the site inspection, the external areas had been stripped of vegetation and was undergoing additional development works.</p>

2.3 Site history

Review of the published historical maps has indicated that the site initially underwent development prior to 1877, with no significant change since this time.

2.4 Site geology

The geology of the site has been reviewed from the following published data:

- Open-Geoscience – solid and drift geology, obtained from the BGS website.

Made ground

Given that no previous development is shown to have taken place within the garden/ soft landscaping areas, no made ground soils are anticipated to be present within the subject site boundary. Also, the published geological maps do not indicate the presence of made ground deposits within the site boundary.

Superficial geology

The site is shown to be underlain by Devensian age raised marine deposits and glacial till of greater than 10m thickness.

Solid geology

Published geological maps indicate that the site is underlain by Gullane Formation bedrock strata. Typically, these deposits comprise bands of sandstone, siltstone and mudstone.

2.5 Hydrogeology

The Hydrogeological Map at 1:625,000 scale available via the BGS website indicates the bedrock strata underlying the area to comprise Carboniferous sedimentary rock representing a highly productive aquifer in which flow is dominantly in fissures and other discontinuities.

The superficial glacial till deposits are anticipated to exhibit low permeability characteristics.

The general direction of groundwater flow is anticipated to follow the topography of the site and surrounding area, i.e. in a northerly direction towards the Firth of Forth.

2.6 Hydrology

Water courses

The Firth of Forth coastline lies approximately 120m to the north of the site. The Water of Leith lies approximately 950m to the south east, flowing in a north westerly direction towards outfall at Leith Docks 1.7km to the east.

Flooding

The Flood Extent Map, available on the SEPA website, records the site as lying out with the risk of flooding associated with the Water of Leith. This does not constitute a full flood risk assessment.

2.7 Mineral extraction***Quarrying***

The historical maps show no record of quarrying on the site or in the vicinity of the site.

Mining

The site is not located within an area that requires a Coal Authority Report to be obtained for new developments

3.0 GROUND INVESTIGATION

3.1 Investigation rationale

The scope of works undertaken at the site was instructed by the Engineer. Table 2 summarises the works carried out on site and outlines the rationale behind the investigation technique.

Table 2 – Site investigation rationale

Investigation technique	No.	Depth (m bgl)	Rationale
Cable percussion borehole	1	10.25	To enable visual inspection of soils in-situ, and to permit representative sampling of near surface soils for laboratory testing.
Laboratory based testing (soil)	-	various	Laboratory based geotechnical testing of soils recovered from the borehole, to support visual appraisal of soils made in-situ.
In-situ geotechnical testing	-	various	To develop a strength profile throughout the depth of the superficial deposits.

3.2 Ground investigation fieldwork

The intrusive site investigation works were carried out on the 15th June 2016. All investigative techniques were undertaken in general accordance with BS 5930 (2015) - Code of Practice for Ground Investigation.

An exploratory hole location plan is included as Figure 2. Details of the soils encountered, groundwater strikes and samples taken are included within the exploratory hole log presented in Appendix B.

Cable percussion borehole

A single cable percussion borehole was constructed to 10.25m depth bgl within the northern section of the site.

Representative disturbed and undisturbed samples were recovered for subsequent laboratory based testing with in-situ geotechnical testing being undertaken throughout the depth of the borehole. Upon completion the borehole was backfilled with arisings and made good.

3.3 Laboratory based geotechnical testing

Soil samples recovered from the trial pits were analysed by MatTest Ltd, a UKAS accredited materials testing laboratory. Copies of the test certificates are presented in Appendix C, and are summarised below.

- Moisture content;
- Shear strength;
- Oedometer consolidation testing;
- Atterberg Limits (Classification); and
- pH and soil sulphate concentrations.

4.0 GROUND CONDITIONS

4.1 General

The ground conditions encountered broadly correlate with those indicated within the desk study phase of research. Table 4 summarises the ground conditions encountered.

Table 4 – Summary of ground conditions

Stratum	General description	Depth to top of strata (m bgl)	Thickness (m)
Glacial till deposits	Firm becoming stiff sandy gravelly clay. Gravel comprising fine to coarse fragments of mixed lithology, including sandstone.	0.0	3.10
Glacial fluvial deposits	Medium dense brownish grey slightly gravelly silty sand.	3.10	3.70
Glacial till deposits	Stiff to very stiff sandy gravelly clay. Gravel is sub-angular to rounded, fine to coarse of mixed lithology, including sandstone. Also including occasional cobbles of sandstone.	3.70	10.25*

* Base not encountered.

4.2 Natural superficial deposits: Glacial deposits

As the vegetation and topsoil has been stripped from the site, the superficial deposits were found to comprise firm to stiff sandy gravelly clay glacial till, with a 0.6m thick band of medium dense gravelly sand at 3.1 – 3.7m depth, overlying further stiff to very stiff sandy gravelly clay glacial till to greater than 10.25m depth bgl.

In-situ testing carried out throughout the depth of the borehole has recorded an 'N' value of 14 within the gravelly sand at 3.20m depth bgl, confirming the medium dense nature of the granular horizon. A further SPT at 7.5m depth has recorded an 'N' value of 37 within the glacial till material.

Laboratory geotechnical test certificates are presented in Appendix C. In summary, the glacial till is confirmed to behave as a low plasticity clay, with moisture content values ranging from 7.3% - 12%. The soil has an exhibited cohesion value of 69.4kPa at 2.20m depth bgl, with a coefficient of volume compressibility (m_v) value of 0.17m²/MN.

Laboratory chemical analysis of the soil samples has also recorded sulphate concentrations of <0.01g/l, with pH levels of 8.4.

4.3 Groundwater

Groundwater was encountered at 3.10m depth bgl, within the granular horizon, rising to 2.90m depth after 20minutes.

FIGURE 1 – SITE LOCATION PLAN

Site: Dunforth House, 46 Park Road, Trinity

Ref: 1606-02

Title: Site location plan

Scale: NTS. Originally drawn at 1:25,000 scale.



FIGURE 2 – EXPLORATORY HOLE LOCATION PLAN



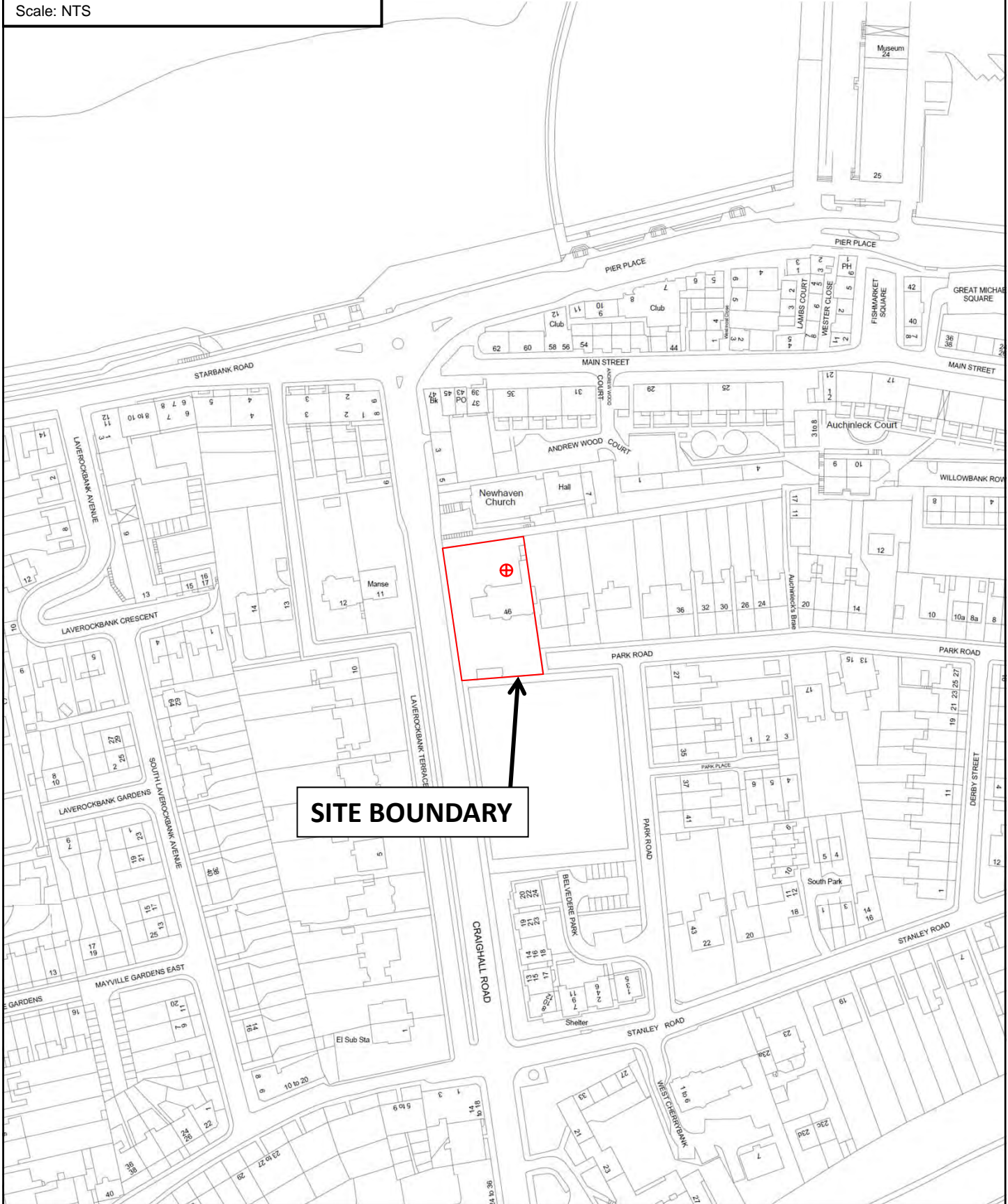
⊕ Borehole position

Site: Dunforth House, 46 Park Road, Trinity

Ref: 1606-02

Title: Exploratory hole location plan

Scale: NTS



APPENDIX A – NOTES ON LIMITATIONS

NOTES ON LIMITATIONS

General

This report has been prepared by Geovia Ltd for the sole use of the client(s) as indicated within the text of this report. Should any additional party seek reliance of the contents of this report then approval from Geovia Ltd must be sought. Geovia Ltd cannot be held liable / responsible for the contents of this report if either it is used for purposes other than which it was commissioned or any additional party/ parties using the report without the express permission of Geovia Ltd.

Phase I Desk Studies / Environmental Audits

Information in this report is gathered from a number of sources including published documentation. Any information gathered from external sources has been accepted and reviewed in good faith and taken to provide true reflection of the site conditions. However, Geovia Ltd cannot be held responsible for any event where such data is inaccurate or does not reflect true site conditions. This would include future changes in site use or additional information that may become available. Should additional information come to light in the future that may change conclusions drawn for the site, Geovia Ltd reserves the right to review this information and if necessary change any existing opinion drawn accordingly.

The opinions within this report are partially formed at the time of the site walkover and therefore it is possible that any sub surface contamination issues are not visible at that time or the report cannot take into account any future contamination issues that may arise after the site walkover has been completed.

Other opinions developed within this study are formed from interpretation of historical data.

Information is not finite for any site and therefore it is possible that environmental liabilities associated with the site or the ground conditions below the site may not have been realised.

The instructed scope of works within the study may not include consultation with relevant Statutory Authorities or environmental regulators and therefore it is possible that geo-environmental issues affecting the site may have been overlooked.

Intrusive Ground Investigations and Geo-environmental Phase II Reports

The investigation has been carried out to provide appropriate information on the ground conditions below the site. The nature of intrusive ground investigation results in only a small proportion of ground being investigated in relation to the overall size of the site. Therefore, it is possible that unforeseen ground conditions exist below the site, including contamination hotspots.

The scope of works for any ground investigation may be limited by financial and/or time constraints. Exploratory locations across any site can also be limited by services, utilities and physical obstructions. This may be particularly relevant for any given targeted ground investigation.

Guidance on the assessment of contaminated land within the UK is under continuous development. The assessments used within this report have been undertaken in general accordance with current assessment frameworks and industry best practise. However, Geovia Ltd cannot be held responsible for any future changes to contaminated land assessment that may alter the findings of this report.

Outline foundation recommendations have been developed from the ground investigation data. However, specific foundation design for any structure should be undertaken by a qualified structural/civil engineer. In the case of abnormal foundations advice and design should be sought from an appropriately qualified ground works contractor.


Groundwater conditions recorded are based on observations made at the time the site works were carried out. Groundwater levels will vary depending upon seasonal and weather related effects.

APPENDIX B – EXPLORATORY HOLE LOG

Progress	Sample Depth	Samples and Tests		Casing Depth	Level (m)	Depth	Description of Strata	Legend	Water Depth	Backfill		
		Type	Result							Symbol	Depth	
15/6 2016							# Firm brown sandy CLAY; sandstone clay.					
	0.50											
	0.80	B					Stiff grey sandy gravelly boulder CLAY. Gravel is sub-angular to sub-rounded, to coarse grained of mixed lithology including sandstone. (GLACIAL TILL).					
	1.20	U (50)		1.20								
	1.80	B										
	2.20	U (62)		2.20								
	2.80	B										
	3.20	SPT=14 T	1.1/2.2.5.5	3.20				Medium dense brownish grey slightly gravelly silty SAND. Gravel is sub-rounded, fine to medium grained of sandstone. (GLACIAL FLUVIAL DEPOSITS).				
	3.70											
	3.80	B						Stiff to very stiff brownish grey sandy gravelly boulder CLAY. Gravel is sub-angular to sub-rounded, fine to coarse grained of mixed lithology including sandstone. Occasional sub-angular to sub-rounded cobbles of sandstone. (GLACIAL TILL).				
	4.20	U (71)		4.20								
	4.80	B										
	5.50	U (78)		5.20								
	5.80	B										
7.00	U (94)		7.00									
7.50	SPT=37 T	10.10/8.9.9.11	7.20									
7.80	B											
8.00	U (77)		7.20									
8.80	B											
9.50	U (89)		7.20									

Flush			Chiselling			Water Added		Ground-water				Diam	To Depth		Location:
Returns	Type	To Depth	From	To	Time(hr)	From	To	Struck	Rose To	Time(mins)	Cut Off		Boring	Casing	
			6.60 10.10	6.70 10.25	0.5 1			3.10	2.90	20	3.80				Orientation: Vertical


Remarks: # Description based on drillers records.						Equipment: Dando 2000				Method: Inspection Pit to 1.20m Percussion to 10.25m		Borehole No: 1	
												Contract No: 2121	

Driller MK	Originator LH	BOREHOLE RECORD Scale 1:50											Part Fig. No.
Chk & App SG	Status Final	46 PARK ROAD, TRINITY											Sheet 1 of 2

Progress	Sample Depth	Samples and Tests		Casing Depth	Level (m)	Depth	Description of Strata	Legend	Water Depth	Backfill	
		Type	Result							Symbol	Depth
						10.25	END OF BOREHOLE				10.25

Flush			Chiselling			Water Added		Ground-water				Diam	To Depth		Location:
Returns	Type	To Depth	From	To	Time(hr)	From	To	Struck	Rose To	Time(mins)	Cut Off		Boring	Casing	
			6.60 10.10	6.70 10.25	0.5 1										Orientation: Vertical

Remarks: # Description based on drillers records.						Equipment: Dando 2000				Method: Inspection Pit to 1.20m Percussion to 10.25m		Borehole No: 1	
												Contract No: 2121	

Driller MK	Originator LH	BOREHOLE RECORD Scale 1:50											Part Fig. No.
Chk & App SG	Status Final	46 PARK ROAD, TRINITY											Sheet 2 of 2

APPENDIX C – LABORATORY GEOTECHNICAL TEST RESULTS

LABORATORY TEST CERTIFICATE

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

Certificate No : 16/712 - 01
To : Robin Wilson
Client : Geovia Limited
124 West Savile Terrace
Edinburgh
EH9 3EJ

Tel: 0141 774 4032
Fax: 0141 774 3552

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

Dear Sirs,

LABORATORY TESTING OF SOIL

Introduction

We refer to samples taken from Park Road, Trinity and delivered to our laboratory on 11th July 2016.

Material & Source

Sample Reference : See Report Plates
Sampled By : Client
Sampling Certificate : Not Supplied
Location : See Report Plates
Description : See Page 2
Date Sampled : 15th June 2016
Date Tested : 11th June 2016 Onwards
Source : Park Road, Trinity

Test Results;

As Detailed On Page 2 to Page 8 inclusive

Comments;

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
All remaining samples for this project will be disposed of 28 days after issue of this test certificate

Remarks;

Approved for Issue

T McLelland (Director)

Date 01/08/2016



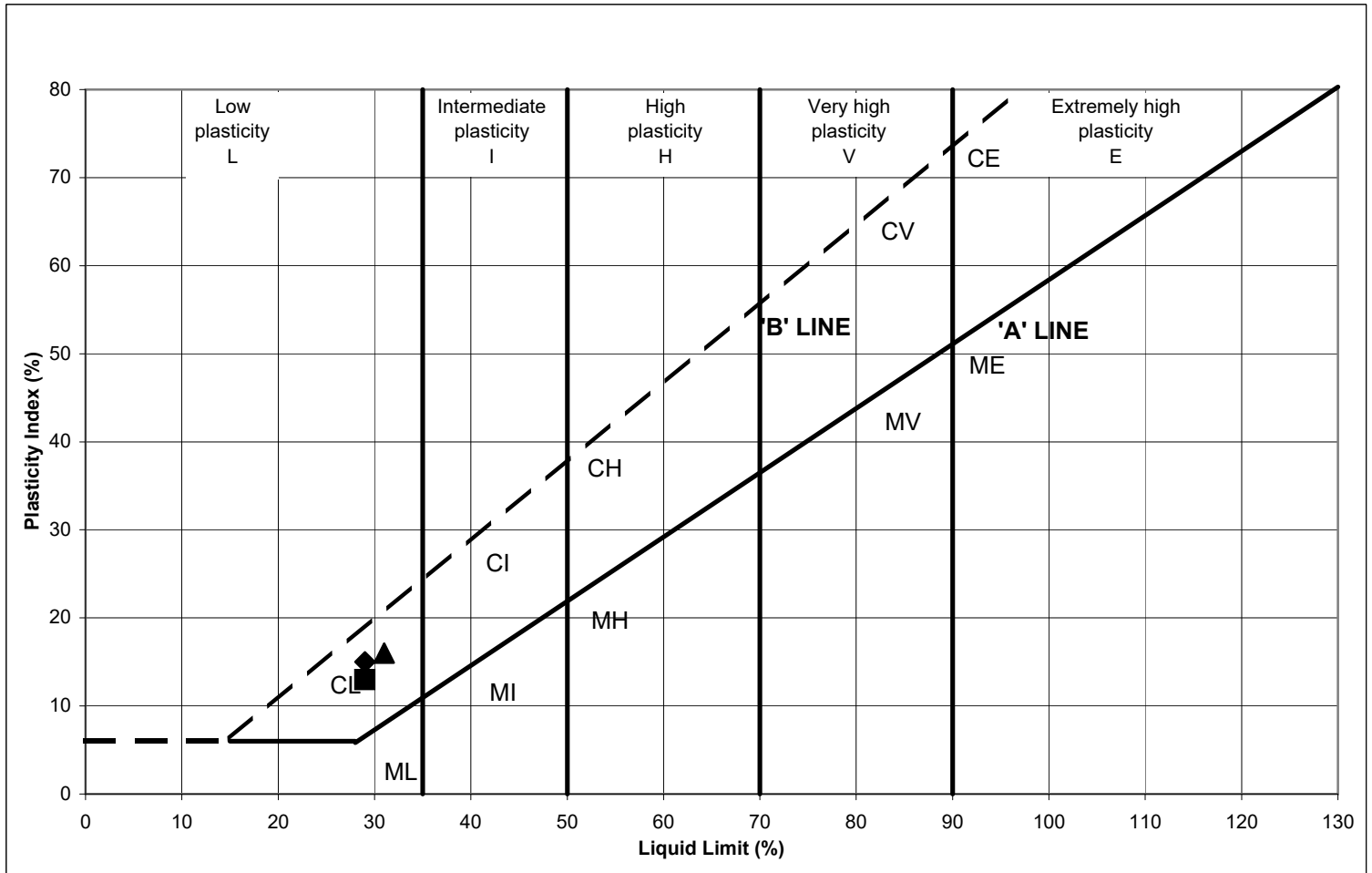
BOREHOLE	SAMPLE	DEPTH (m)	SAMPLE DESCRIPTION
BH01	U	1.20	Brown gravelly sandy CLAY. Gravel is fine to coarse.
BH01	U	2.20	Dark brown gravelly sandy CLAY. Gravel is fine to coarse.
BH01	T	3.20	Dark grey gravelly sandy CLAY. Gravel is fine to medium.
BH01	U	4.20	Dark grey gravelly sandy CLAY. Gravel is fine to coarse.

SUMMARY OF SAMPLE DESCRIPTIONS

BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)
BH01	U	1.20	7.3
BH01	U	2.20	12
BH01	U	4.20	10

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

SUMMARY OF MOISTURE CONTENT TEST RESULTS



Symbol	Borehole	Sample	Depth	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing 0.425mm Sieve	Remarks
■	BH01	U	1.20	7.3	29	16	13	70	Clay with low plasticity
◆	BH01	U	2.20	12	29	14	15	58	Clay with low plasticity
▲	BH01	U	4.20	10	31	15	16	60	Clay with low plasticity
●									
□									
◇									
△									
○									
×									
*									

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

SUMMARY OF ATTERBERG LIMITS TEST RESULTS

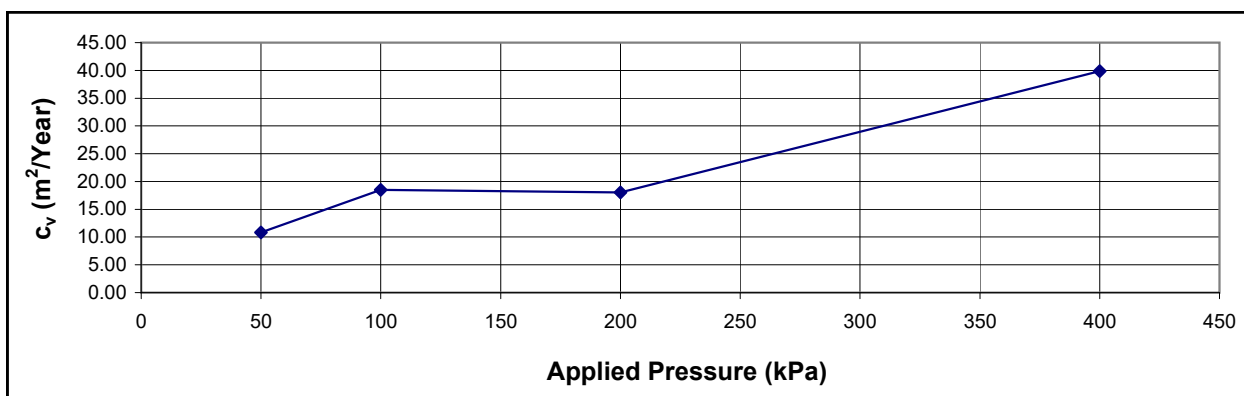
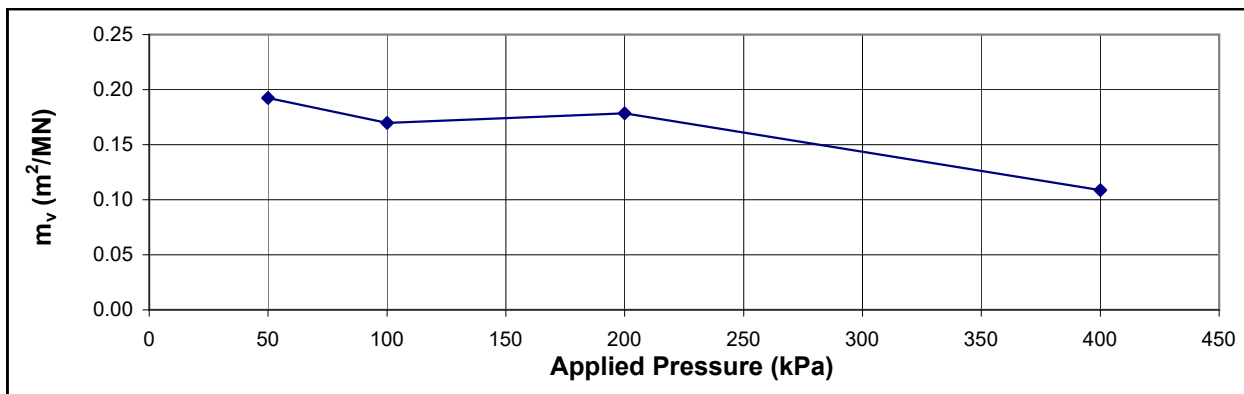
BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m ³)	DRY DENSITY (Mg/m ³)
BH01	U	4.20	12	2.09	1.88

SAMPLE DIAMETER (mm)	SAMPLE HEIGHT (mm)	PARTICLE DENSITY (Mg/m ³)	INITIAL VOIDS RATIO	DEGREE OF SATURATION (%)	SWELLING PRESSURE (kPa)
74.91	19.86	2.40	0.278	99	

The value detailed for Particle Density is an assumed value

PRESSURE (kPa)	SAMPLE HEIGHT (mm)	VOIDS RATIO	m _v (m ² /MN)	C _v (m ² /Year)	C _{sec}
0	19.86	0.278			
50	19.67	0.266	0.19	10.84	
100	19.50	0.255	0.17	18.51	
200	19.15	0.233	0.18	18.03	
400	18.74	0.206	0.11	39.84	
100	18.94	0.219			

m_v indicates values of coefficient of volume compressibility, c_v indicates values of coefficient of consolidation

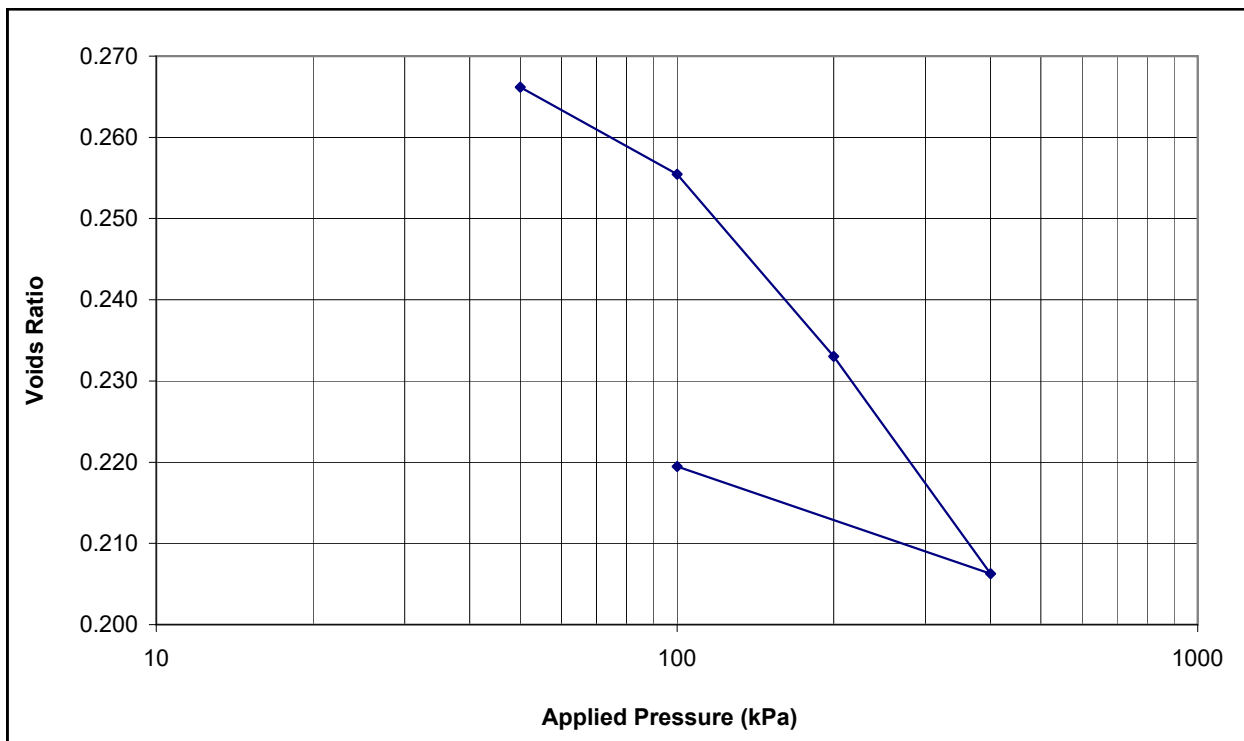
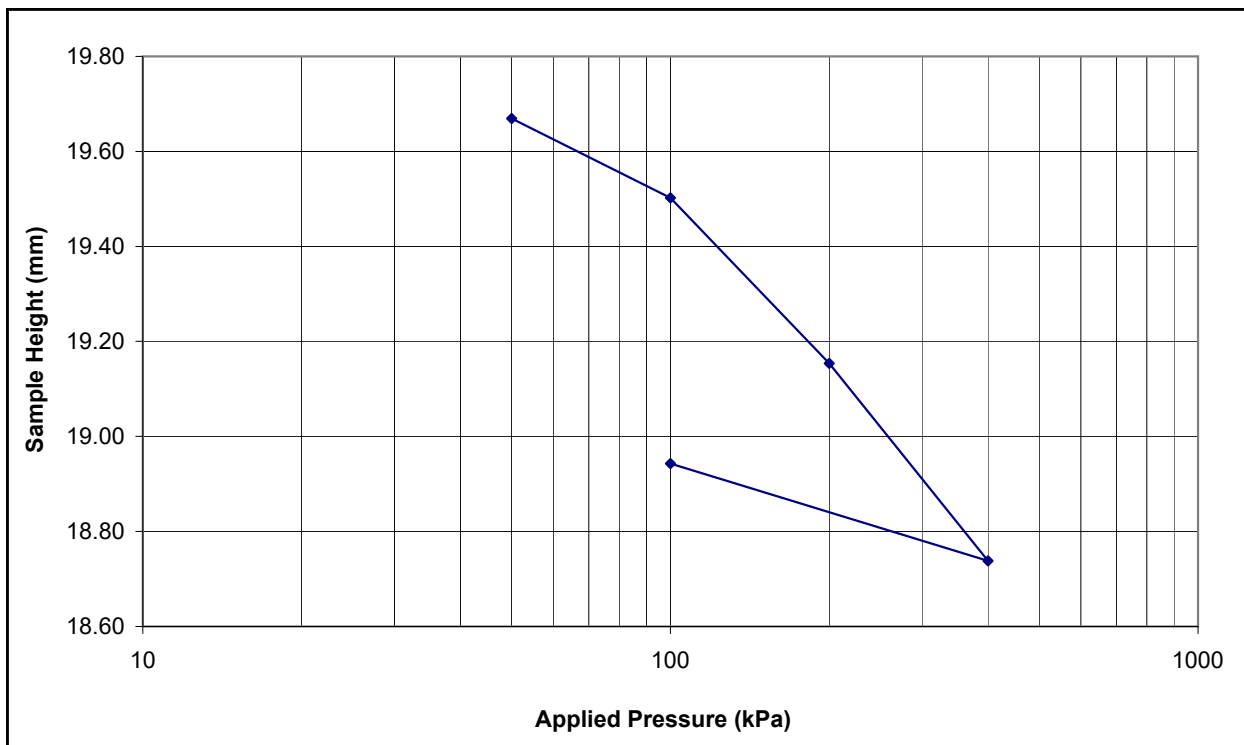


Tested in a temperature controlled room at 20 +/- 2°C

Tested in accordance with BS 1377: Part 5: 1990: Clause 3

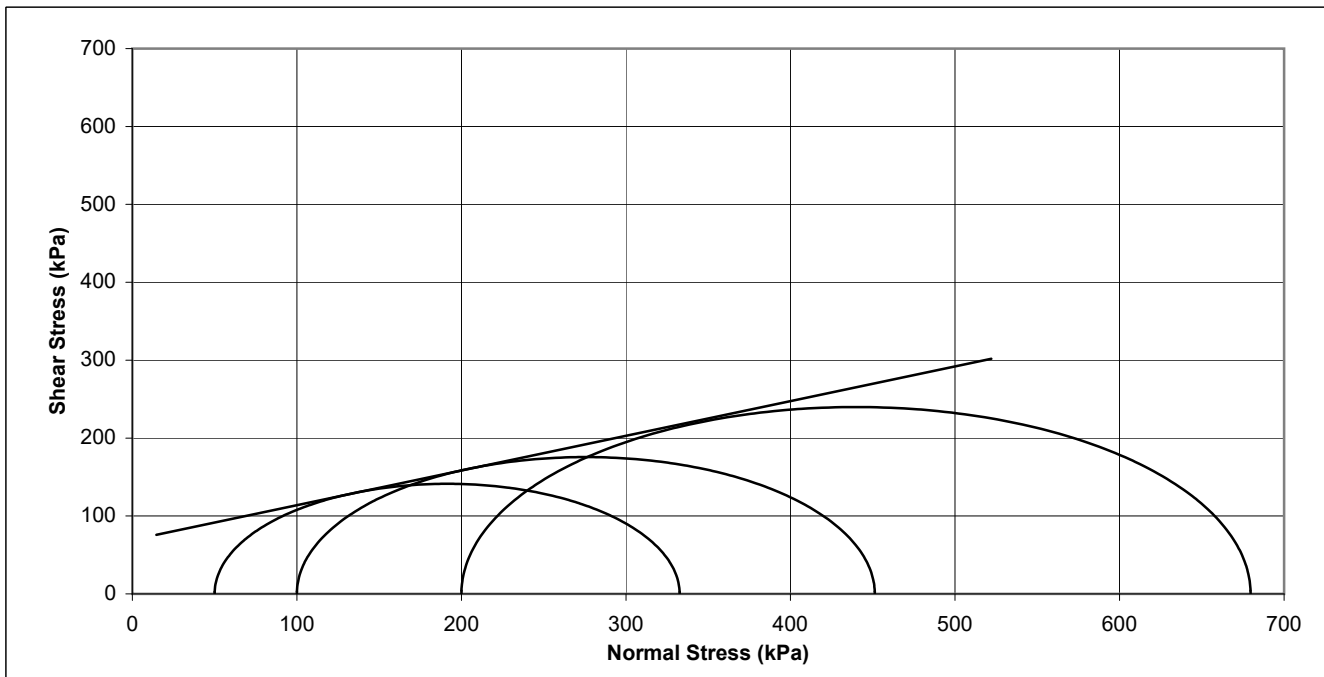
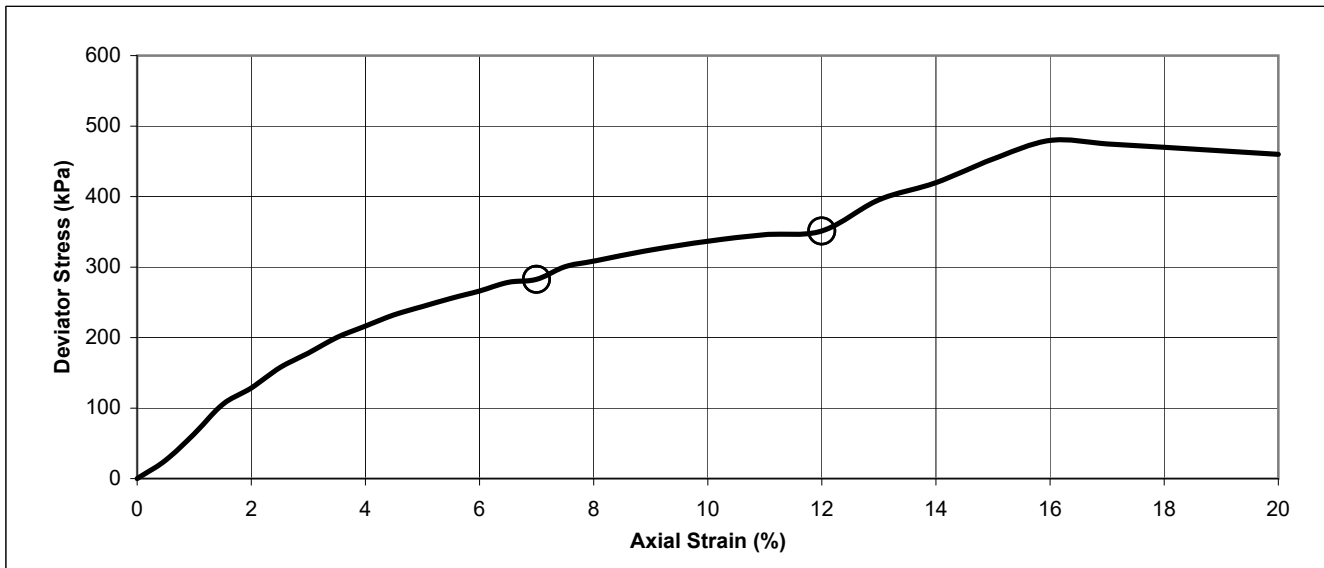
ONE DIMENSIONAL CONSOLIDATION TEST RESULTS

BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m ³)	DRY DENSITY (Mg/m ³)
BH01	U	4.20	12	2.09	1.88



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

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



Failure Conditions			
Cell pressure	kPa	50	100
Membrane correction	kPa	0.3	0.5
Strain at failure	%	7.0	12.0
Failure Type		Intermediate	Intermediate
Corrected deviator stress	kPa	283	351
Undrained shear stress	kPa	141	176

Cohesion	kPa	69.4	Friction Angle	°	24.0
----------	-----	------	----------------	---	------

Initial Conditions					Borehole	BH01	
Sample length	mm	205.29	Rate of strain	%/min			2.0
Sample diameter	mm	103.38	Bulk Density	Mg/m ³			2.27
Membrane type	Latex		Dry Density	Mg/m ³			2.06
Membrane thickness	mm	0.20	Moisture Content	%	10	Depth (m)	2.20

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

DETERMINATION OF MULTI STAGE UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

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

BOREHOLE	SAMPLE	DEPTH (m)	SPECIMEN § ORIENTATION	PREPARATION METHOD *	BS TEST METHODS *	SAMPLE PASSING 2mm SIEVE (%)	TOTAL SULPHATE (% SO ₃)	2:1 WATER SOLUBLE SULPHATE (g/l SO ₃)	pH VALUE
BH01	U	1.20	N/A	5.3 / 9.4	5.5 / 9.5	88	-	<0.01	8.4
BH01	T	3.20	N/A	5.3 / 9.4	5.5 / 9.5	87	-	<0.01	8.4

All tests performed on fraction of sample passing 2mm sieve
NOTE: To convert sulphate results from SO₃ to SO₄ multiply by 1.2

§ Specimen orientation :

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

* Tested in accordance with the following clauses
of BS 1377: Part 3: 1990:

5.2	Acid extract method	9.4	Preparation of pH test specimen
5.3	Water extract method	9.5	Determination of the pH value
5.5	Gravimetric method of analysis		

SUMMARY OF SULPHATE & pH TEST RESULTS