



Certificate of Analysis

Certificate Number 22-26370

Issued: 23-Dec-22

Client Professional Soils Laboratory Ltd
5/7 Hexthorpe Road
Hexthorpe
DN4 0AR

Our Reference 22-26370

Client Reference PSL22/7849

Order No (not supplied)

Contract Title WIE17469: Project Otter

Description 3 Soil samples.

Date Received 19-Dec-22

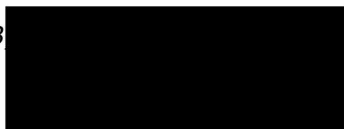
Date Started 19-Dec-22

Date Completed 23-Dec-22

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

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

Approved By



Kirk Bridgewood
General Manager



2139

Summary of Chemical Analysis

Soil Samples

Our Ref 22-26370

Client Ref PSL22/7849

Contract Title WIE17469: Project Otter

Lab No	2101321	2101322	2101323
Sample ID	WBH106	WBH106	WBH106
Depth	1.00	5.00	14.00
Other ID			
Sample Type	B	B	B
Sampling Date	n/s	n/s	n/s
Sampling Time	n/s	n/s	n/s

Test	Method	LOD	Units			
Metals						
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l	< 10	13	14
Inorganics						
pH	DETSC 2008#		pH	11.9	8.0	8.2
Chloride Aqueous Extract	DETSC 2055	1	mg/l	38	24	5.6
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l	1.9	< 1.0	< 1.0
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	190	240	230
Sulphur as S, Total	DETSC 2320	0.01	%	0.16	0.40	0.25
Sulphate as SO4, Total	DETSC 2321#	0.01	%	0.29	0.30	0.22

Information in Support of the Analytical Results

Our Ref 22-26370
 Client Ref PSL22/7849
 Contract WIE17469: Project Otter

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
2101321	WBH106 1.00 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (30 days), Total Sulphur ICP (7 days), Total Sulphate ICP (30 days), Metals ICP Prep (182 days), pH + Conductivity (7 days)	
2101322	WBH106 5.00 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (30 days), Total Sulphur ICP (7 days), Total Sulphate ICP (30 days), Metals ICP Prep (182 days), pH + Conductivity (7 days)	
2101323	WBH106 14.00 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (30 days), Total Sulphur ICP (7 days), Total Sulphate ICP (30 days), Metals ICP Prep (182 days), pH + Conductivity (7 days)	

Key: P-Plastic T-Tub

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

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/- 2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report



LABORATORY REPORT



4043

Contract Number: PSL22/7850

Report Date: 12 January 2023
Client's Reference: WIE17469-WBH107
Client Name: Groundtech Consulting
First Floor
Lloyd House
Orford Court
Greenfold Way
WN7 3XJ

For the attention of: Michael Berry

Contract Title: Project Otter
Date Received: 9/12/2022
Date Commenced: 9/12/2022
Date Completed: 4/1/2023

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)

S Royle
(Laboratory Manager)

L Knight
(Senior Technician)

S Eyre
(Senior Technician)

T Watkins
(Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
e-mail: awatkins@prosoils.co.uk
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SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

4043

PSL
Professional Soils Laboratory

Project Otter

Contract No:

PSL22/7850

Client Ref:

WIE17469

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

[illegible]

SYMBOLS : NP : Non Plastic

*** : Liquid Limit and Plastic Limit Wet Sieved.**



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Project Otter

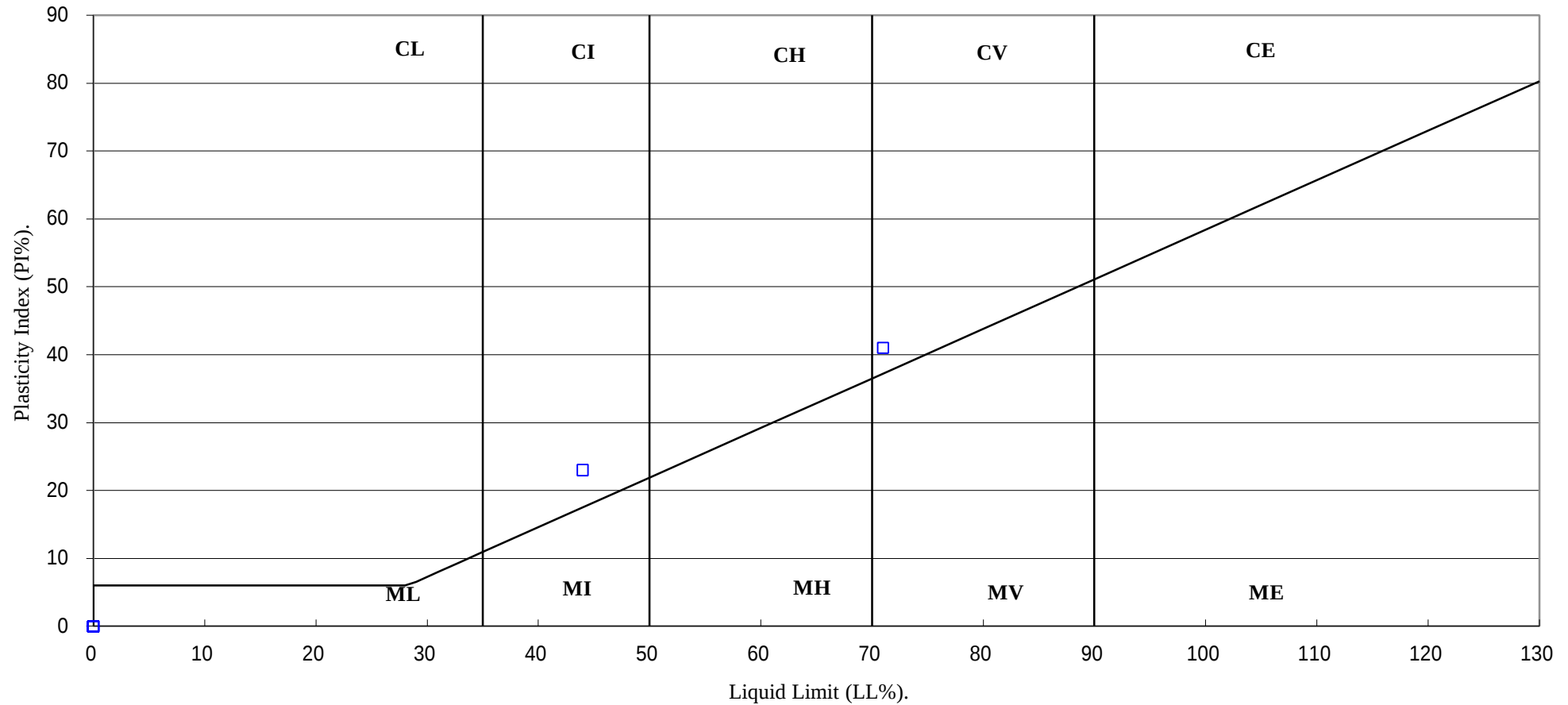
Contract No:

PSL22/7850

Client Ref:

WIE17469

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



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Professional Soils Laboratory

Project Otter

Contract No:

PSL22/7850

Client Ref:

WIE17469

PARTICLE SIZE DISTRIBUTION TEST

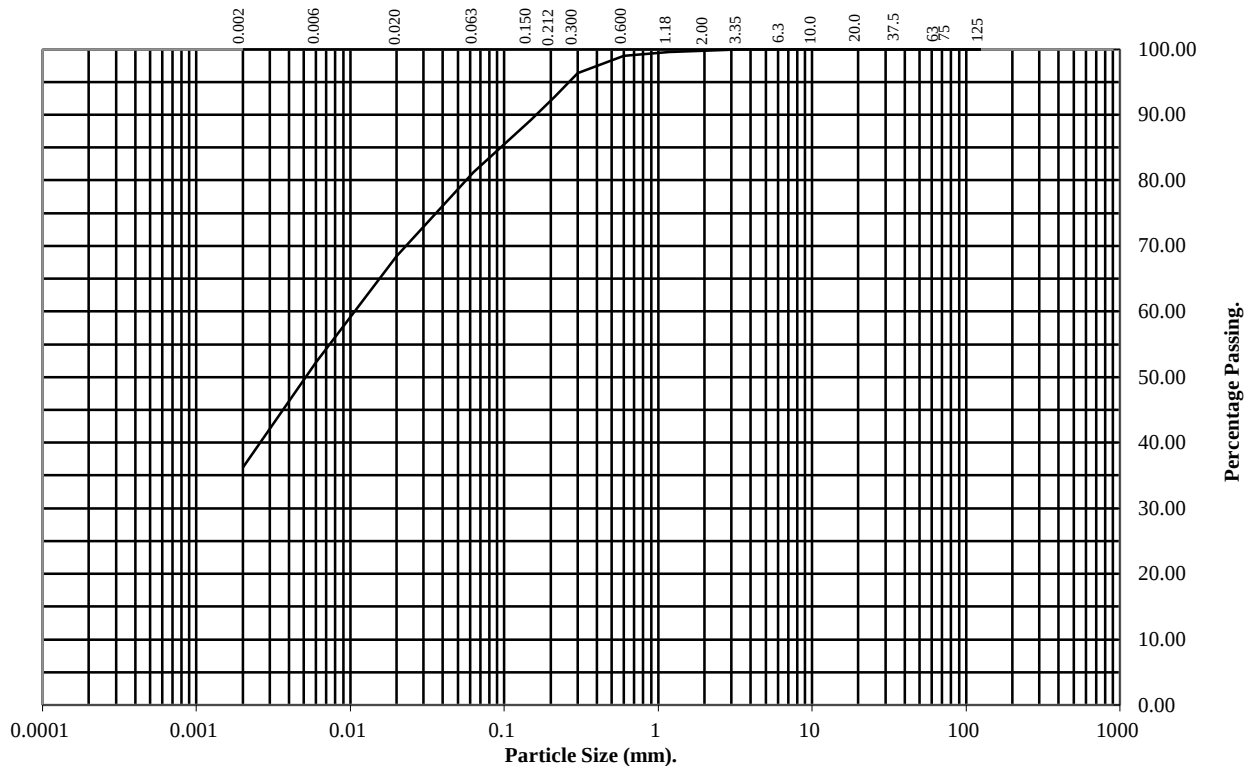
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **WBH107** Top Depth (m): **2.00**

Sample Number: Base Depth(m):

Sample Type: **B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	100
1.18	100
0.6	99
0.3	96
0.212	93
0.15	89
0.063	81

Particle Diameter	Percentage Passing
0.02	68
0.006	52
0.002	36

Soil Fraction	Total Percentage
Cobbles	0
Gravel	0
Sand	19
Silt	45
Clay	36

Remarks:
See Summary of Soil Descriptions



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Professional Soils Laboratory

Project Otter

Contract No:
PSL22/7850
Client Ref:
WIE17469

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number:

WBH107

Top Depth (m):

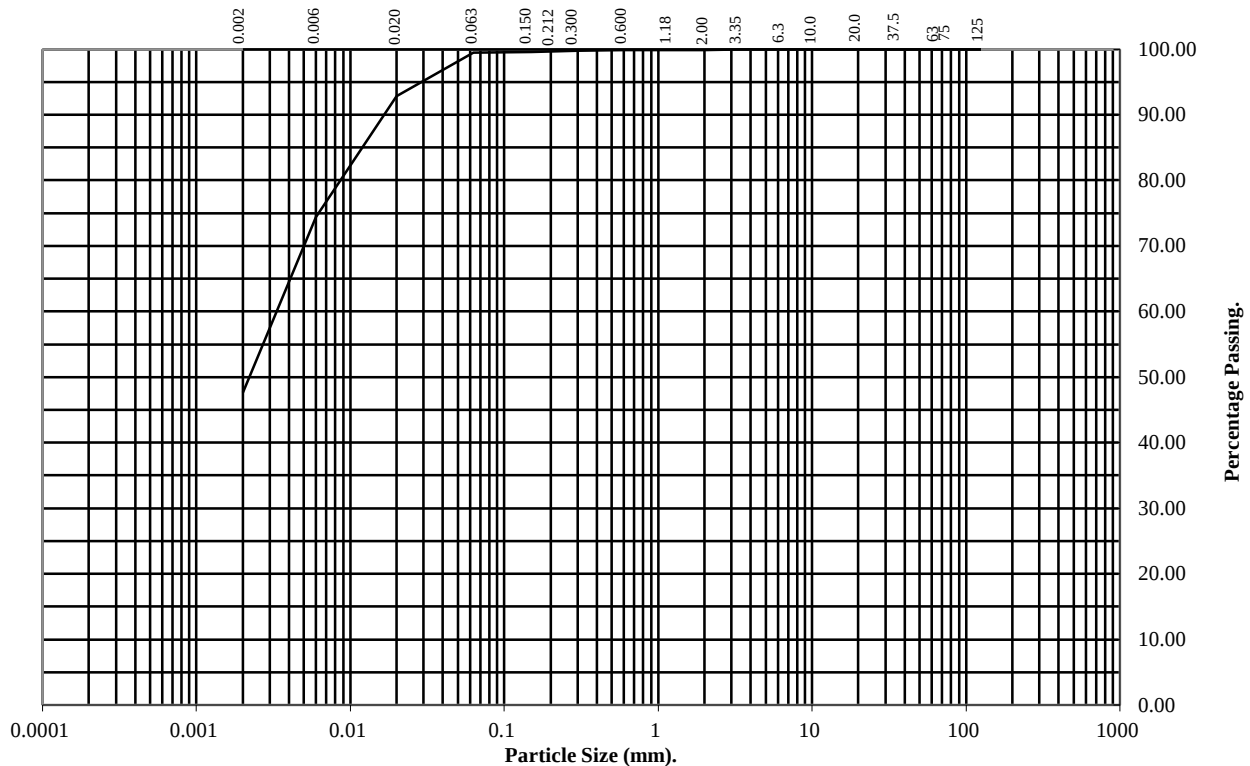
11.00

Sample Number:

Base Depth(m):

Sample Type:

B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	100
1.18	100
0.6	100
0.3	100
0.212	100
0.15	100
0.063	99

Particle Diameter	Percentage Passing
0.02	93
0.006	74
0.002	48

Soil Fraction	Total Percentage
Cobbles	0
Gravel	0
Sand	1
Silt	51
Clay	48

Remarks:

See Summary of Soil Descriptions



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Project Otter

Contract No:
PSL22/7850
Client Ref:
WIE17469

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

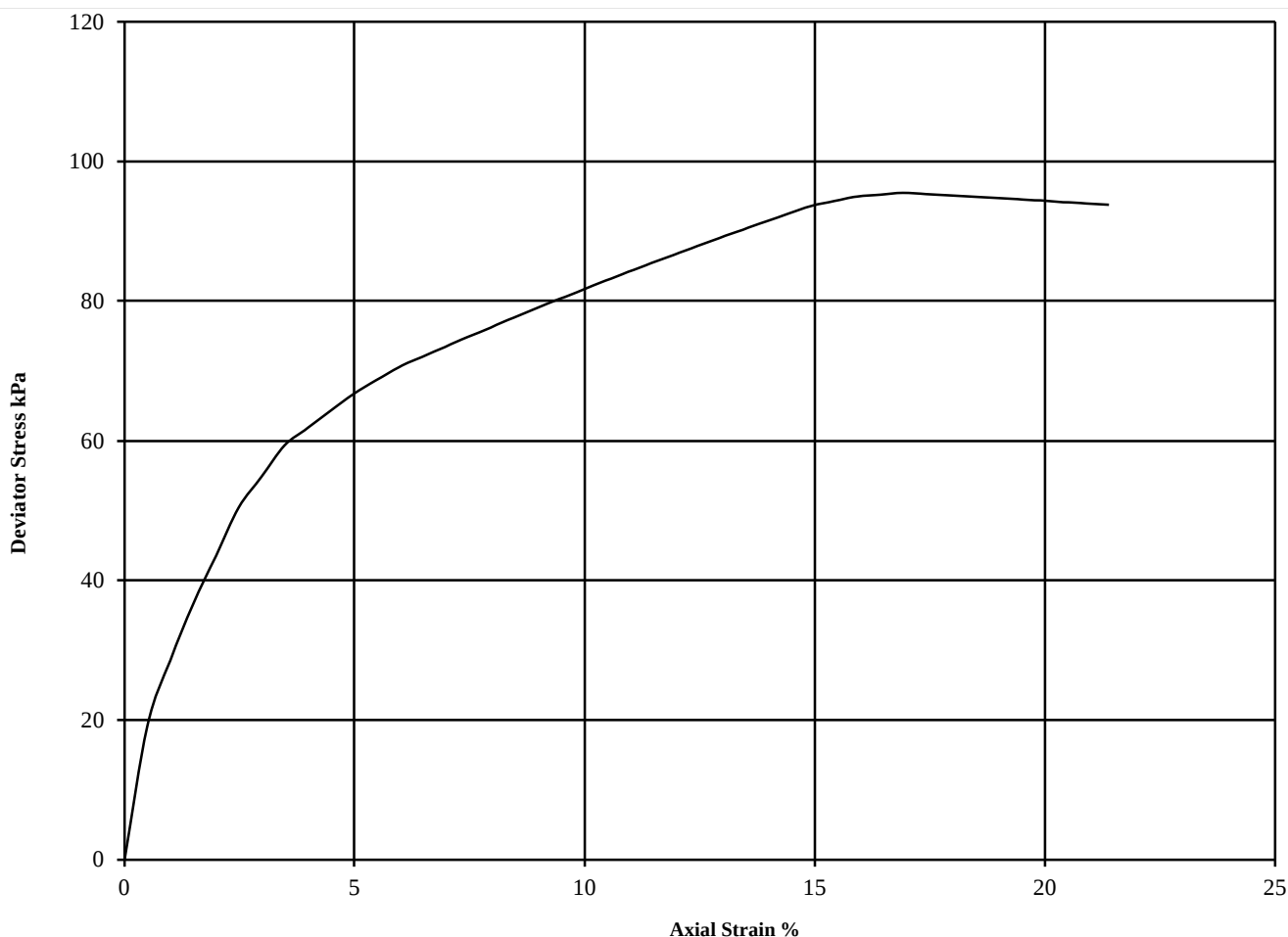
Hole Number: WBH107

Top Depth (m): 2.50

Sample Number:

Base Depth (m):

Sample Type U



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.34 See summary of soil descriptions
				3	$(\frac{1}{2} \sigma_3)_f$	$\frac{1}{2}(\sigma_1 - \sigma_3)_f$			
1	25	1.94	1.55	50	95	48	16.9	Plastic	



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UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

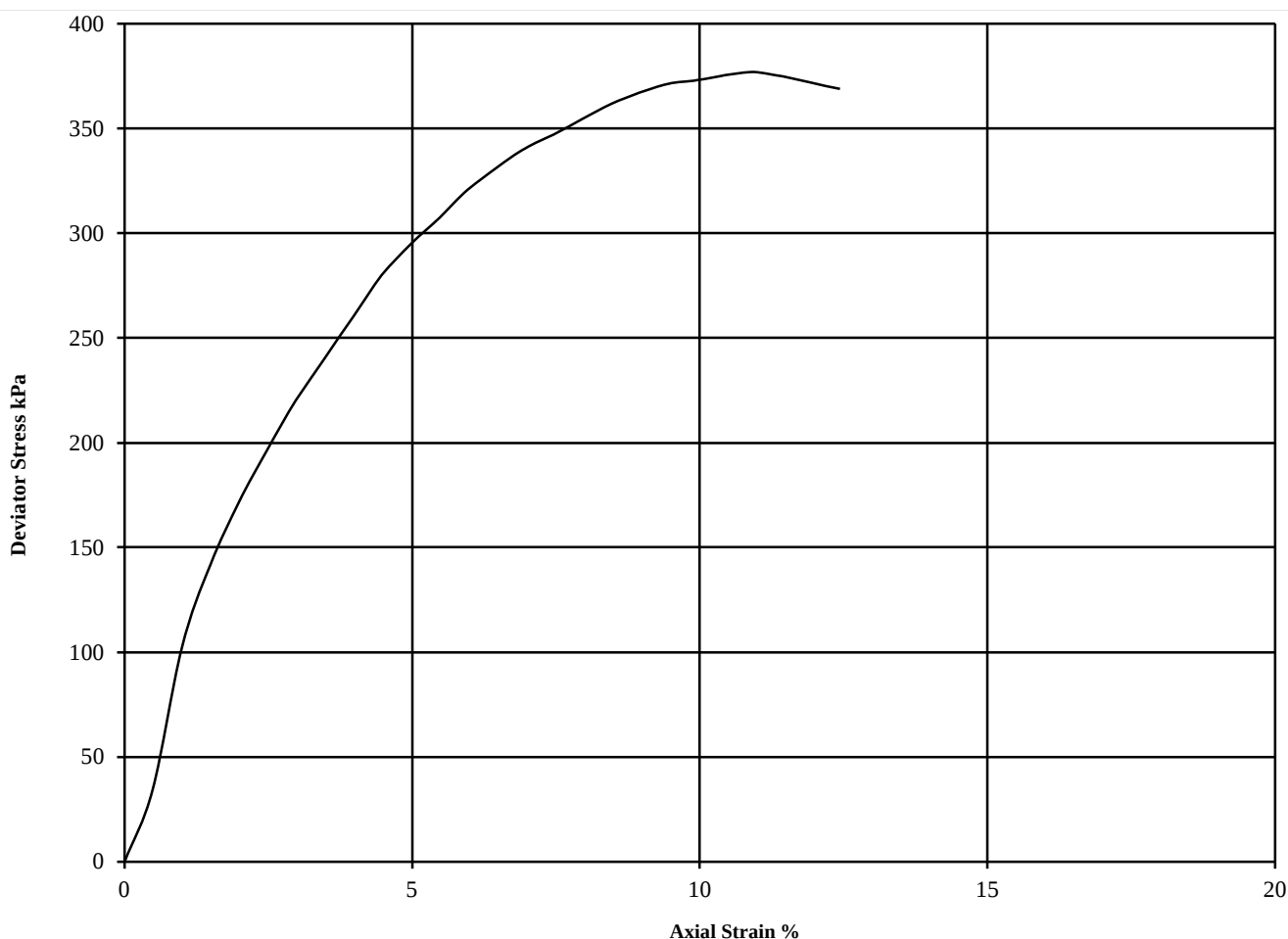
Hole Number: WBH107

Top Depth (m): 10.50

Sample Number:

Base Depth (m):

Sample Type U



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.35 See summary of soil descriptions
					$(\sigma_1 - \sigma_3)_f$	$\frac{1}{2}(\sigma_1 - \sigma_3)_f$			
1	27	1.89	1.49	210	377	188	10.9	Brittle	



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Project Otter

Contract No:

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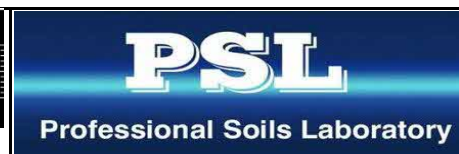
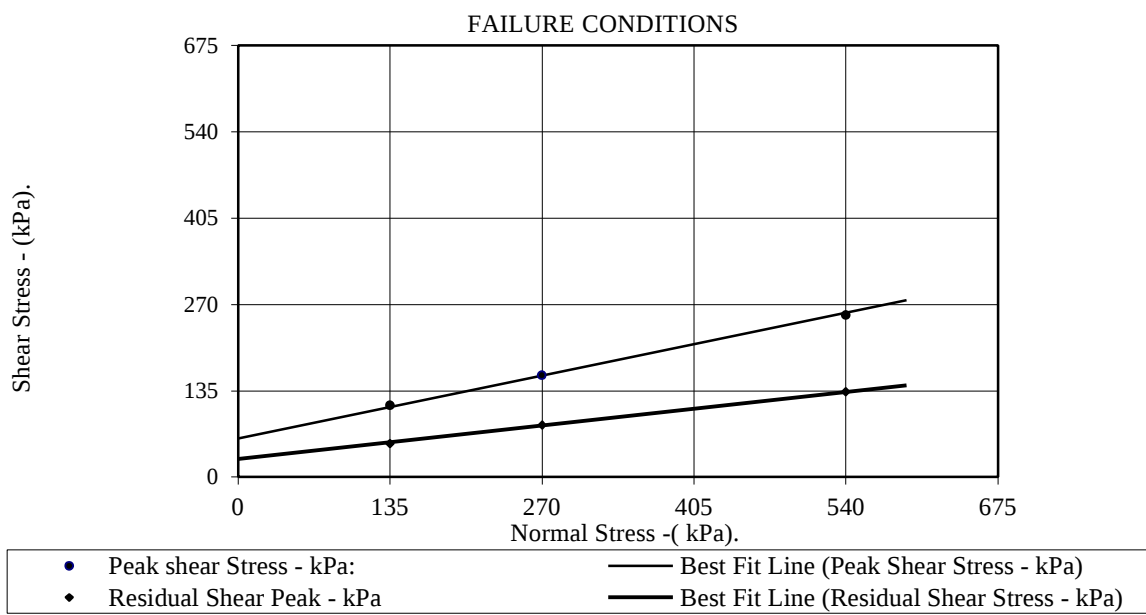
Client Ref:

WIE17469

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377 : 1990 Part 7 Clause 4

Hole Number:	WBH107		Top Depth	13.50	
Sample Number:			Base Depth		
Sample Conditions:	Submerged		Sample Type	U	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Specimen Preparation	Cut and trimmed Undisturbed				
Sample Description:	See summary of soil descriptions				
STAGE			1	2	3
Initial Conditions					
Height - mm:			19.99	19.99	19.99
Length - mm:			60.05	60.05	60.05
Moisture Content - %:			27	27	27
Bulk Density - Mg/m3:			2.01	2.01	2.01
Dry Density - Mg/m3:			1.58	1.58	1.58
Voids Ratio:			0.673	0.673	0.673
Normal Pressure- kPa			135	270	540
Consolidation Stage					
Consolidated Height - mm:			19.17	18.95	18.33
Peak Shear					
Rate of Strain - mm/min			0.041	0.041	0.041
Displacement at peak shear stress - mm			3.00	1.80	1.50
Peak shear Stress - kPa:			112	159	253
Residual Shear					
Rate of Strain - mm/min			0.082	0.082	0.082
Displacement at residual shear stress - mm			30.00	20.00	30.00
Residual shear Stress - kPa:			52	82	133
Final Consolidation Conditions					
Moisture Content - %:			31	30	27
Bulk Density - Mg/m3:			2.10	2.12	2.19
Dry Density - Mg/m3:			1.60	1.64	1.72
Peak Shear					
Angle of Shearing Resistance:(0)			20		
Effective Cohesion - kPa:			60		
Residual Shear					
Angle of Shearing Resistance:(0)			11		
Effective Cohesion - kPa:			28		



Project Otter

Contract No:

PSL22/7850

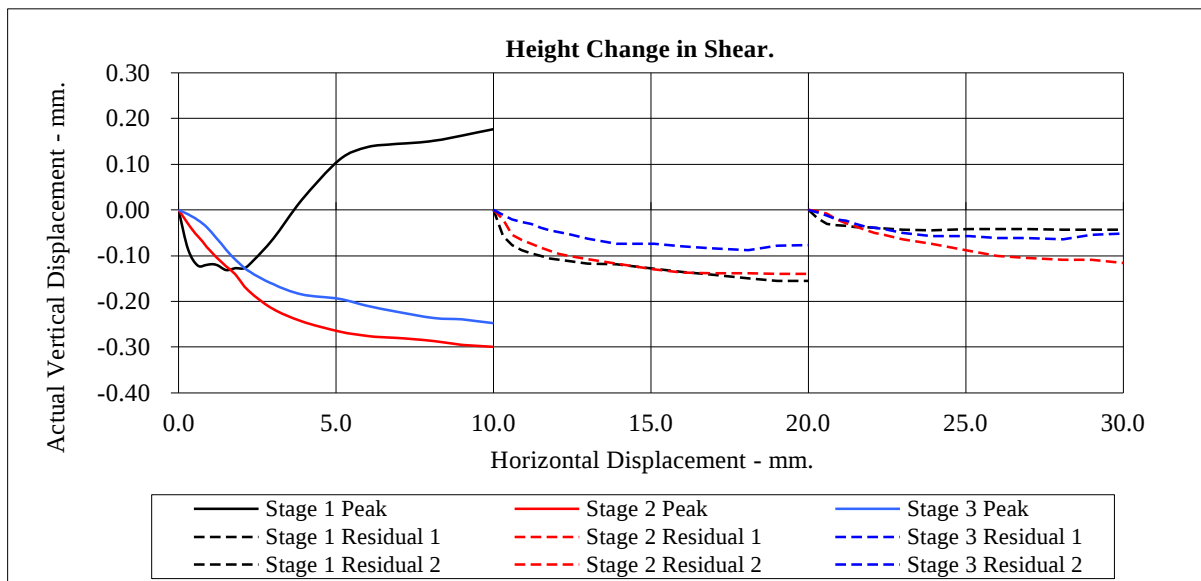
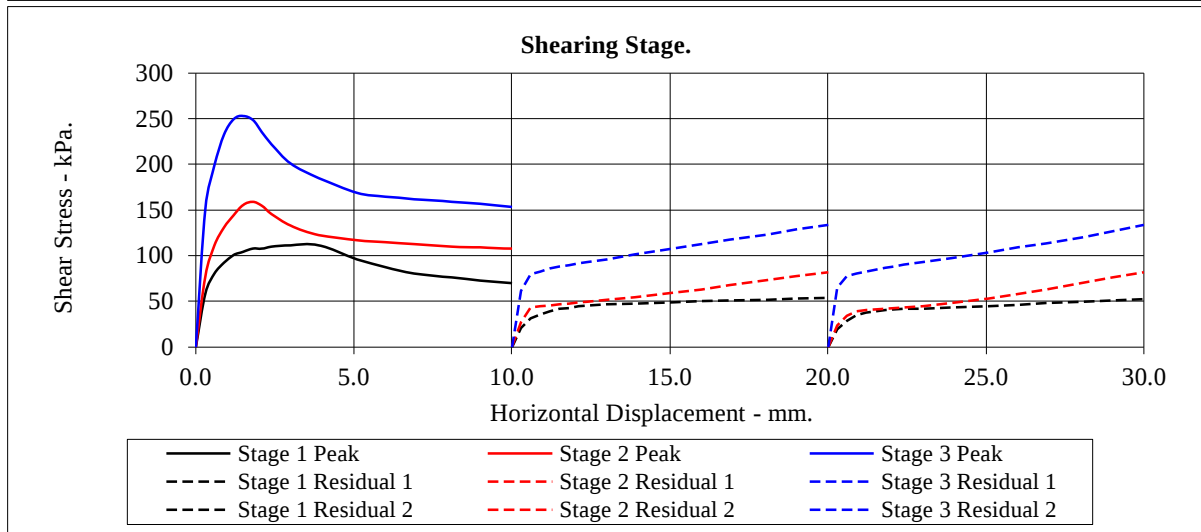
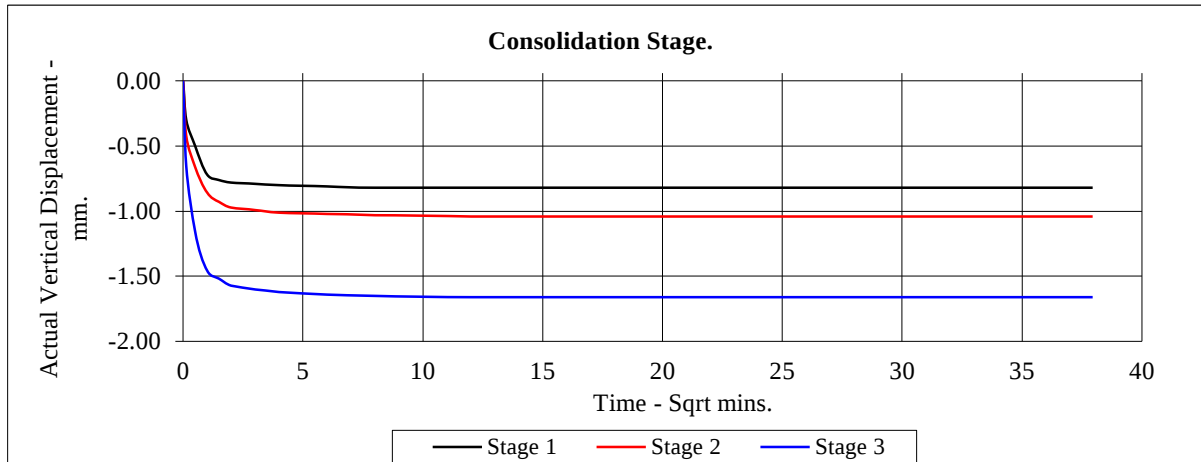
Client Ref:

WIE17469

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377 : 1990 Part 7 Clause 4

Hole Number:	WBH107	Top Depth:	13.50
Sample Number:		Base Depth:	



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Project Otter

Contract No:
PSL22/7850
Client Ref:
WIE17469

PERMEABILITY IN A TRIAXIAL CELL

BS 1377 : Part 6 : 1990: Clause 6

Hole Number: WBH107 Top Depth (m) : 4.50

Sample Number: Base Depth (m) :

Sample Type: U Lift Number:

Date Grid Reference:

Description of Specimen
See summary of soil descriptions
Remarks
Undisturbed

Initial Specimen Conditions		
Height	mm	101.56
Diameter	mm	103.46
Area	mm ²	8406.88
Volume	cm ³	853.80
Mass	g	1666
Dry Mass	g	1276
Bulk Density	Mg/m ³	1.95
Dry Density	Mg/m ³	1.49
Moisture Content	%	31
Voids Ratio	-	0.773
Specific Gravity	Mg/m ³	2.65
(assumed/measured)	-	assumed

Final Specimen Conditions		
Moisture Content	%	32
Bulk Density	Mg/m ³	1.97
Dry Density	Mg/m ³	1.49

Test Setup		
Date Started		23/12/2022
Date Finished		10/01/2023
Top Drain Used		Y
Base Drain Used		Y
Method of Saturation		By back pressure
Direction Of Flow		Vertically Downwards
Saturation Time	Days	1
Consolidation Time	Days	6
Permeability Time	Days	1



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Project Otter

Contract No.

PSL22/7850

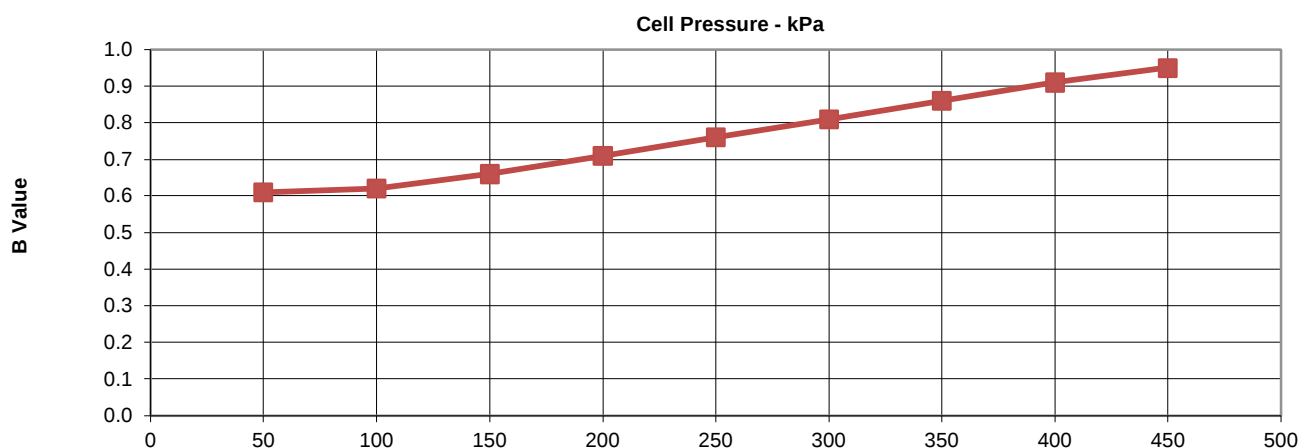
Client Ref

WIE17469

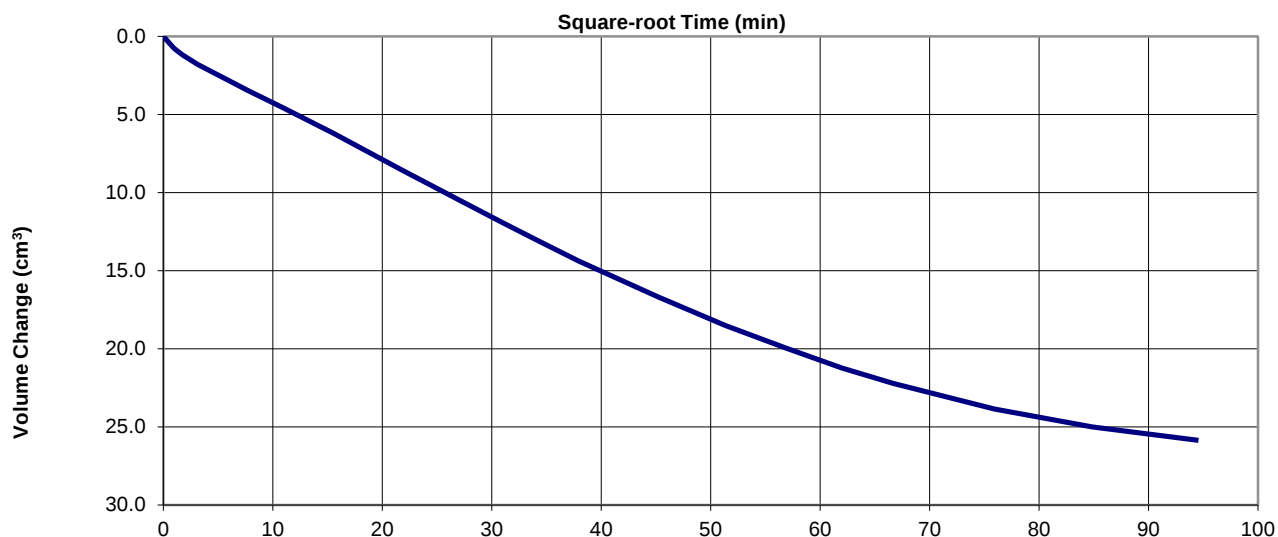
PERMEABILITY IN A TRIAXIAL CELL

BS 1377 : Part 6 : 1990 Clause 6

Specimen Details		
Hole Number		WBH107
Sample Depth	m	4.50
Sample No,		
Grid Reference		
Lift Number		
Saturation		
Cell Pressure Incr.	kPa	50
Back Pressure Incr.	kPa	50
Differential Pressure	kPa	10
Final Cell Pressure	kPa	450
Final B Value	-	0.95



Consolidation		
Effective Pressure	kPa	90
Cell Pressure	kPa	490
Back Pressure	kPa	400
Final PWP	kPa	404
PWP dissipation	%	95



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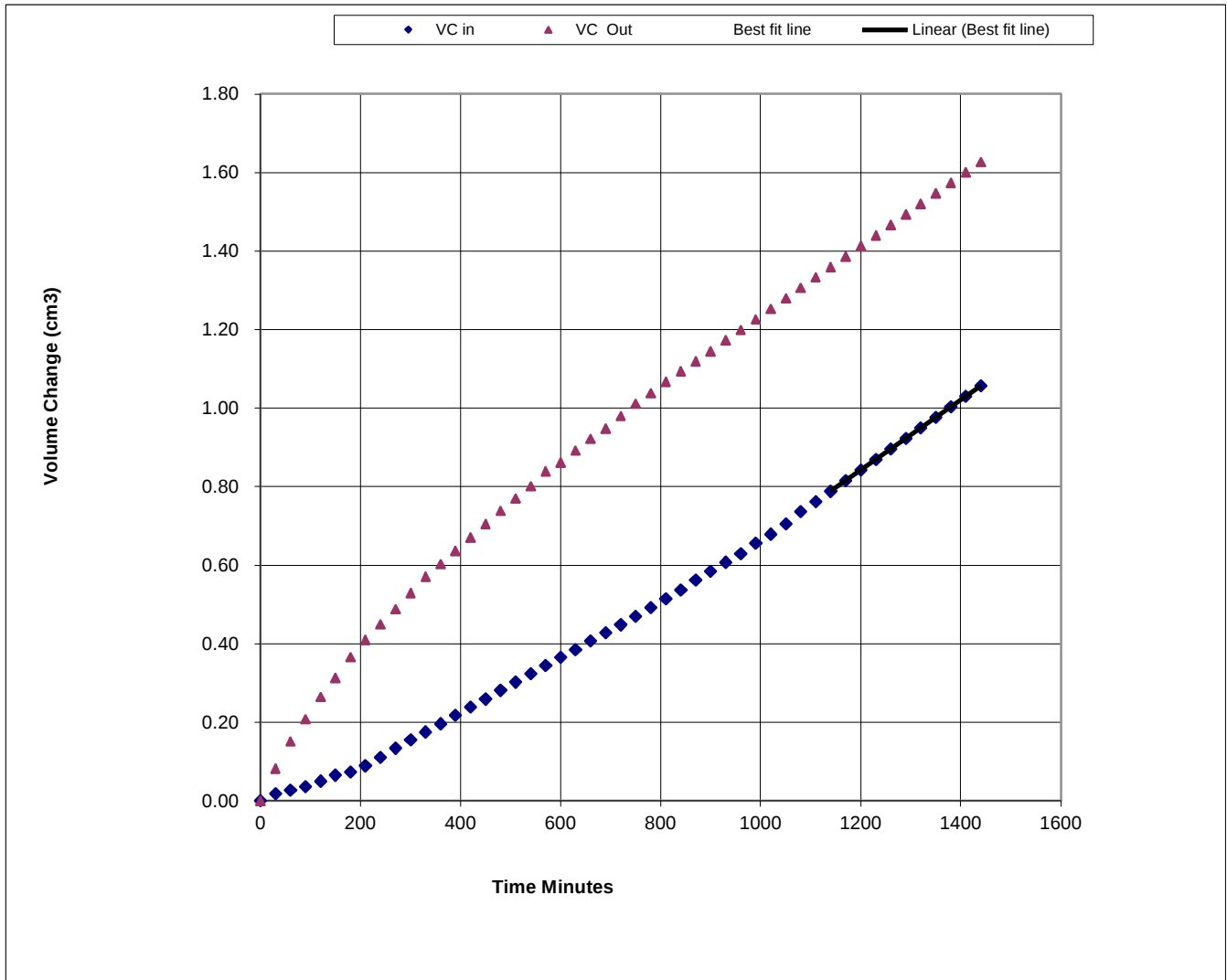
WIE17469

PERMEABILITY IN A TRIAXIAL CELL

BS 1377 : Part 6 : 1990 Clause 6

Specimen Details		
Hole Number		WBH107
Sample Depth	m	4.50
Sample No.		
Grid Reference		
Lift Number		

Permeability Stage



Permeability Stage		
Cell Pressure	kPa	490
Mean Effective Stress	kPa	90
Back Pressure Diff.	kPa	20
Mean Rate of Flow	ml/min	0.0009
Average Temperature	'C	20
Vertical Permeability Kv	m/s	8.9E-11



PSL
Professional Soils Laboratory

Project Otter

Contract No.
PSL22/7850
Client Ref
WIE17469



ANALYTICAL TEST REPORT

Contract no: 117318

Contract name: WIE17469 : Project Otter

Client reference: PSL22/7850

Clients name: Professional Soils Laboratory

Clients address: 5/7 Hexthorpe Road
Doncaster
DN4 0AR

Samples received: 04 January 2023

Analysis started: 04 January 2023

Analysis completed: 10 January 2023

Report issued: 10 January 2023

Key

U	UKAS accredited test
M	MCERTS & UKAS accredited test
\$	Test carried out by an approved subcontractor
I/S	Insufficient sample to carry out test
N/S	Sample not suitable for testing

Approved by:



Abbie Neasham-Bourn
Senior Reporting Administrator

Chemtech Environmental Limited

SOILS

Lab number			117318-1	117318-2
Sample id			WBH107	WBH107
Depth (m)			1.00	19.50
Sample Type			D	U
Date sampled			-	-
Test	Method	Units		
pH	CE004 ^U	units	11.1	9.0
Magnesium (2:1 water soluble)	CE061	mg/l Mg	<1	3.3
Chloride (2:1 water soluble)	CE049 ^U	mg/l Cl	15	4.6
Nitrate (2:1 water soluble)	CE049 ^U	mg/l NO ₃	4.2	<1
Sulphate (2:1 water soluble)	CE061 ^U	mg/l SO ₄	109	510
Sulphate (acid extractable)	CE062 ^U	mg/kg SO ₄	3646	3536
Sulphate (acid extractable)	CE062 ^U	% w/w SO ₄	0.36	0.35
Sulphur (total)	CE119	mg/kg S	1453	3092
Sulphur (total)	CE119	% w/w S	0.15	0.31

Chemtech Environmental Limited

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE004	pH	Based on BS 1377, pH Meter	As received	U	-	units
CE061	Magnesium (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry		1	mg/l Mg
CE049	Chloride (2:1 water soluble)	Aqueous extraction, IC-COND	Dry	U	1	mg/l Cl
CE049	Nitrate (2:1 water soluble)	Aqueous extraction, IC-COND	Dry	U	1	mg/l NO ₃
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	U	10	mg/l SO ₄
CE062	Sulphate (acid extractable)	HCl extract, analysed by ICP-OES	Dry	U	100	mg/kg SO ₄
CE062	Sulphate (acid extractable)	HCl extract, analysed by ICP-OES	Dry	U	0.01	% w/w SO ₄
CE119	Sulphur (total)	Aqua regia digest, analysed by ICP-OES	Dry		100	mg/kg S
CE119	Sulphur (total)	Aqua regia digest, analysed by ICP-OES	Dry		0.01	% w/w S

Chemtech Environmental Limited

DEVIATING SAMPLE INFORMATION

Comments

Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.

For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.

Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
117318-1	WBH107	1.00	Y	All (NSD)
117318-2	WBH107	19.50	Y	All (NSD)

Chemtech Environmental Limited

ADDITIONAL INFORMATION

Notes

Opinions and interpretations expressed herein are outside the UKAS accreditation scope.

Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.

All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.

Methods, procedures and performance data are available on request.

Results reported herein relate only to the material supplied to the laboratory.

This report shall not be reproduced except in full, without prior written approval.

Samples will be disposed of 4 weeks from initial receipt unless otherwise instructed.

For soils and solids, all results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.

Analytical results are inclusive of stones, where applicable.



LABORATORY REPORT



4043

Contract Number: PSL22/7851

Report Date: 18 January 2023
Client's Reference: WIE17469-WBH108
Client Name: Groundtech Consulting
First Floor
Lloyd House
Orford Court
Greenfold Way
WN7 3XJ

For the attention of: Michael Berry

Contract Title: Project Otter
Date Received: 9/12/2022
Date Commenced: 9/12/2022
Date Completed: 9/1/2023

Notes: Opinions and Interpretations are outside the UKAS Accreditation

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Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)

S Royle
(Laboratory Manager)

L Knight
(Senior Technician)

S Eyre
(Senior Technician)

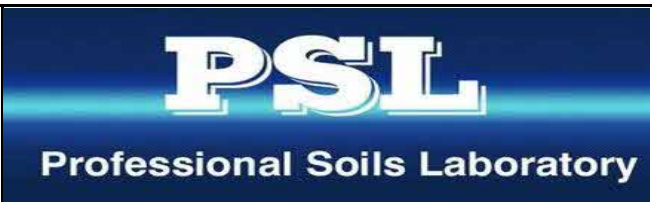
I Watkins
(Senior Technician)

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fax: +44 (0)844 815 6642
e-mail: awatkins@prosoils.co.uk
rberriman@prosoils.co.uk

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SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
WBH108		B	0.50	1.00	MADE GROUND brown mottled grey very sandy very clayey gravel.
WBH108		B	1.50		Brown mottled grey very sandy very clayey GRAVEL.
WBH108		B	6.00		Grey CLAY.
WBH108		U	10.50		Grey CLAY.
WBH108		B	12.50		Grey CLAY.
WBH108		U	13.50		Grey slightly sandy CLAY.
WBH108		U	19.50		Stiff grey slightly sandy CLAY.



Project Otter

Contract No:
PSL22/7851
Client Ref:
WIE17469

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

[illegible]

SYMBOLS : NP : Non Plastic

*** : Liquid Limit and Plastic Limit Wet Sieved.**



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Professional Soils Laboratory

Project Otter

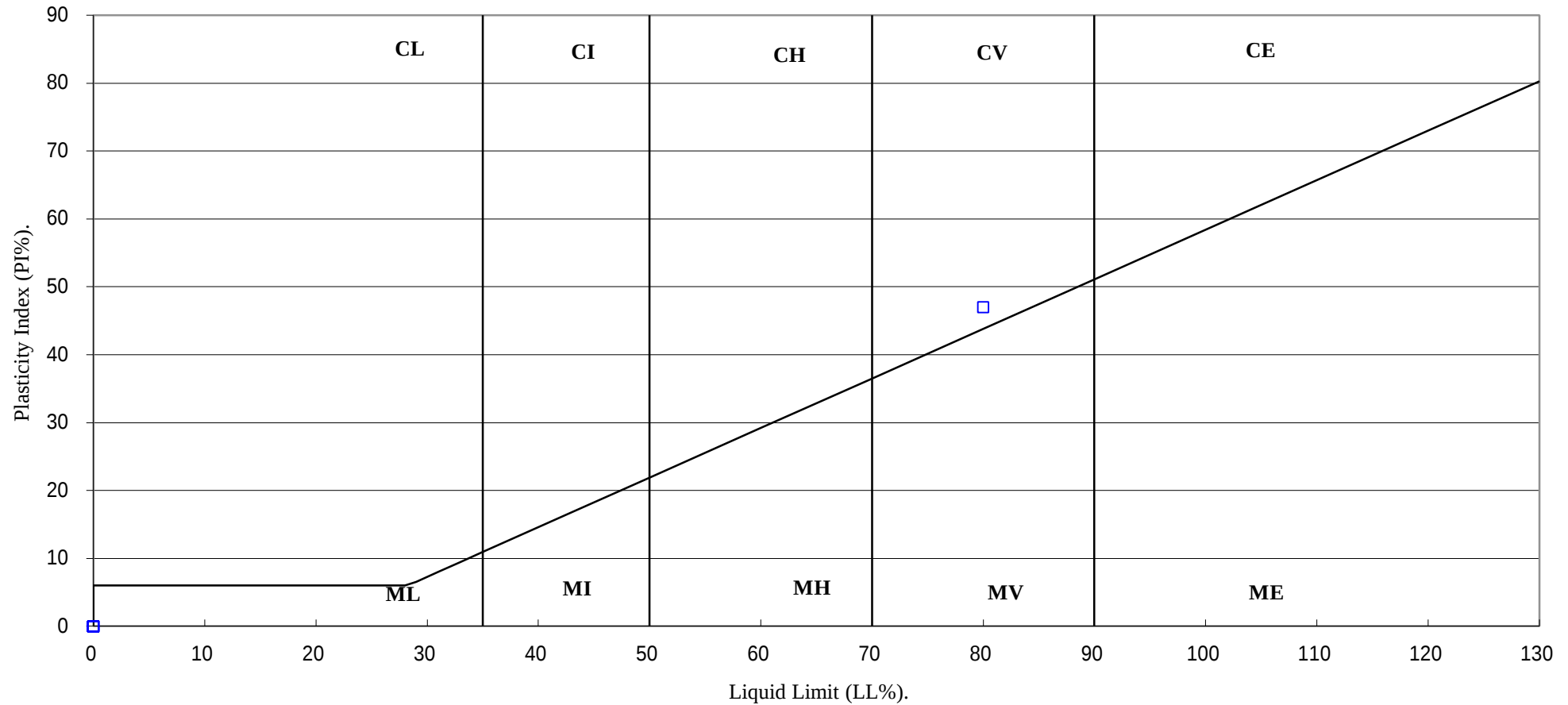
Contract No:

PSL22/7851

Client Ref:

WIE17469

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



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Professional Soils Laboratory

Project Otter

Contract No:

PSL22/7851

Client Ref:

WIE17469

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:

WBH108

Top Depth (m):

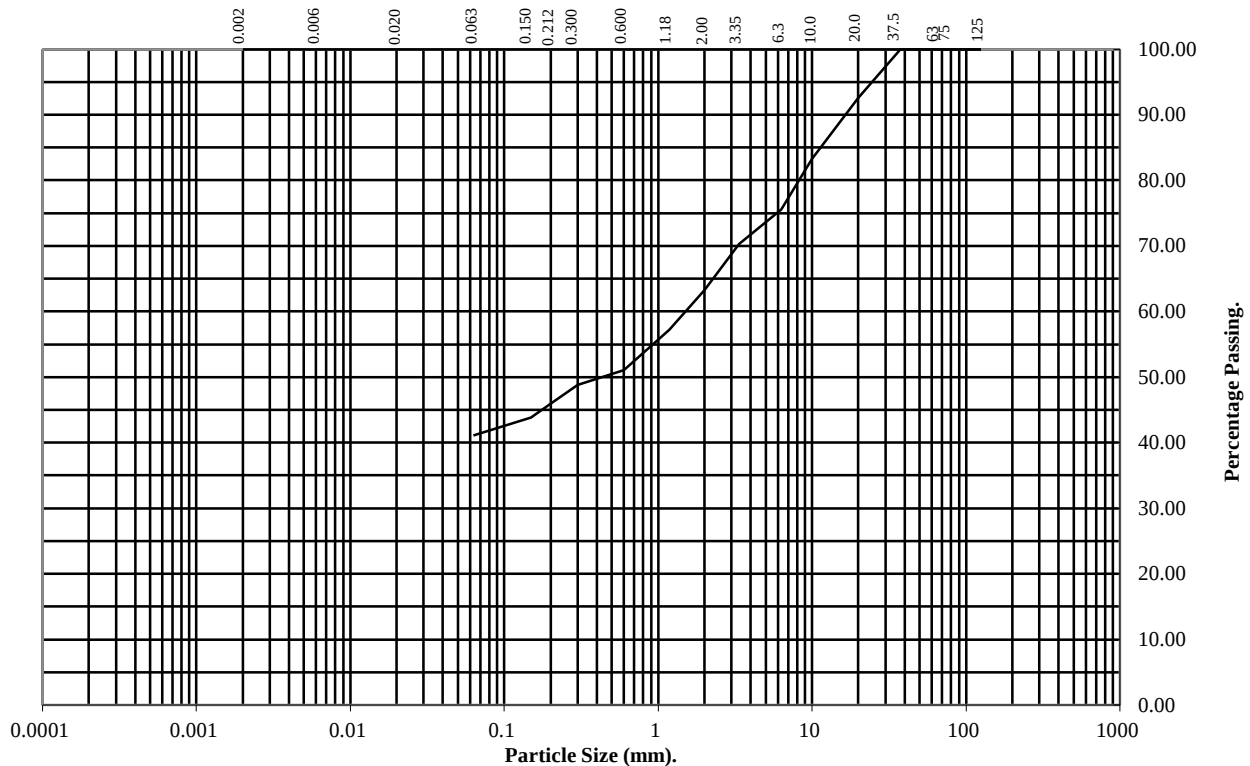
1.50

Sample Number:

Base Depth(m):

Sample Type:

B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	93
10	83
6.3	76
3.35	70
2	63
1.18	57
0.6	51
0.3	49
0.212	46
0.15	44
0.063	41

Soil Fraction	Total Percentage
Cobbles	0
Gravel	37
Sand	22
Silt/Clay	41

Remarks:

See Summary of Soil Descriptions



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Professional Soils Laboratory

Project Otter

Contract No:
PSL22/7851
Client Ref:
WIE17469

PARTICLE SIZE DISTRIBUTION TEST

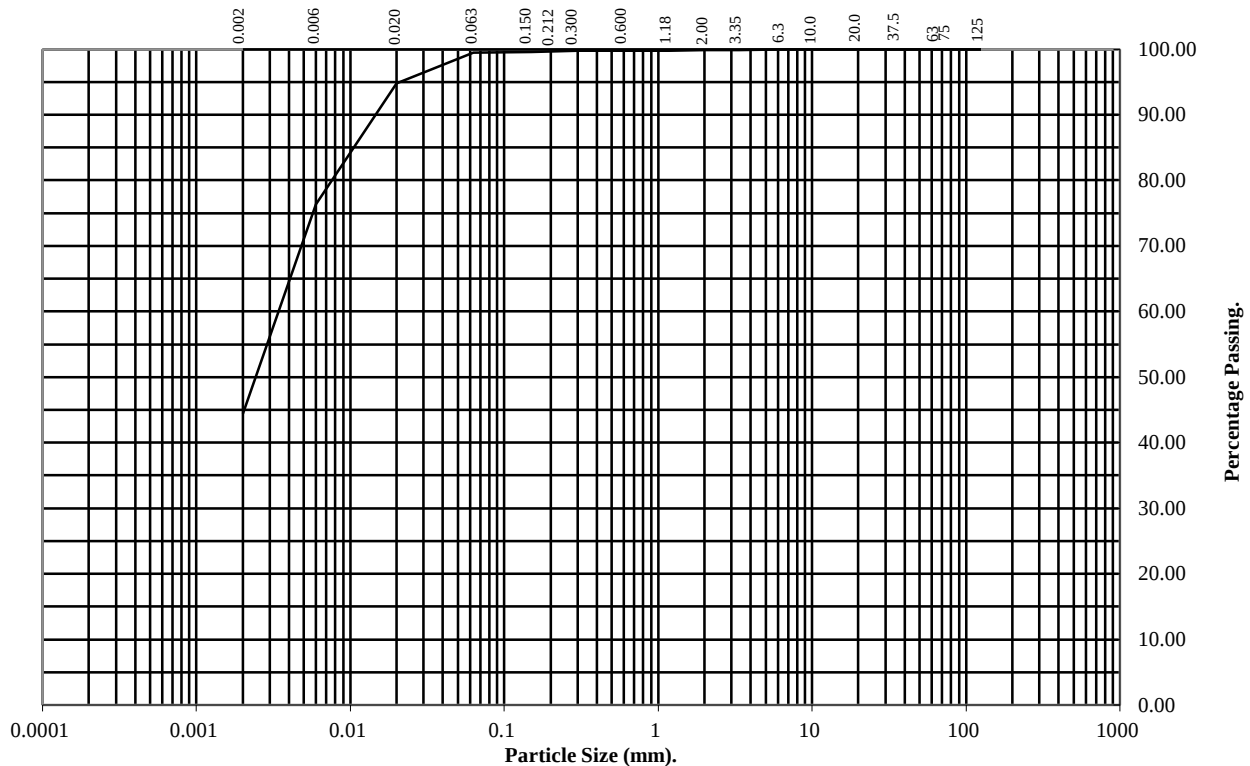
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **WBH108** Top Depth (m): **12.50**

Sample Number: Base Depth(m):

Sample Type: **B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	100
1.18	100
0.6	100
0.3	100
0.212	100
0.15	100
0.063	99

Particle Diameter	Percentage Passing
0.02	95
0.006	76
0.002	44

Soil Fraction	Total Percentage
Cobbles	0
Gravel	0
Sand	1
Silt	55
Clay	44

Remarks:

See Summary of Soil Descriptions



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Project Otter

Contract No:
PSL22/7851
Client Ref:
WIE17469

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number: WBH108

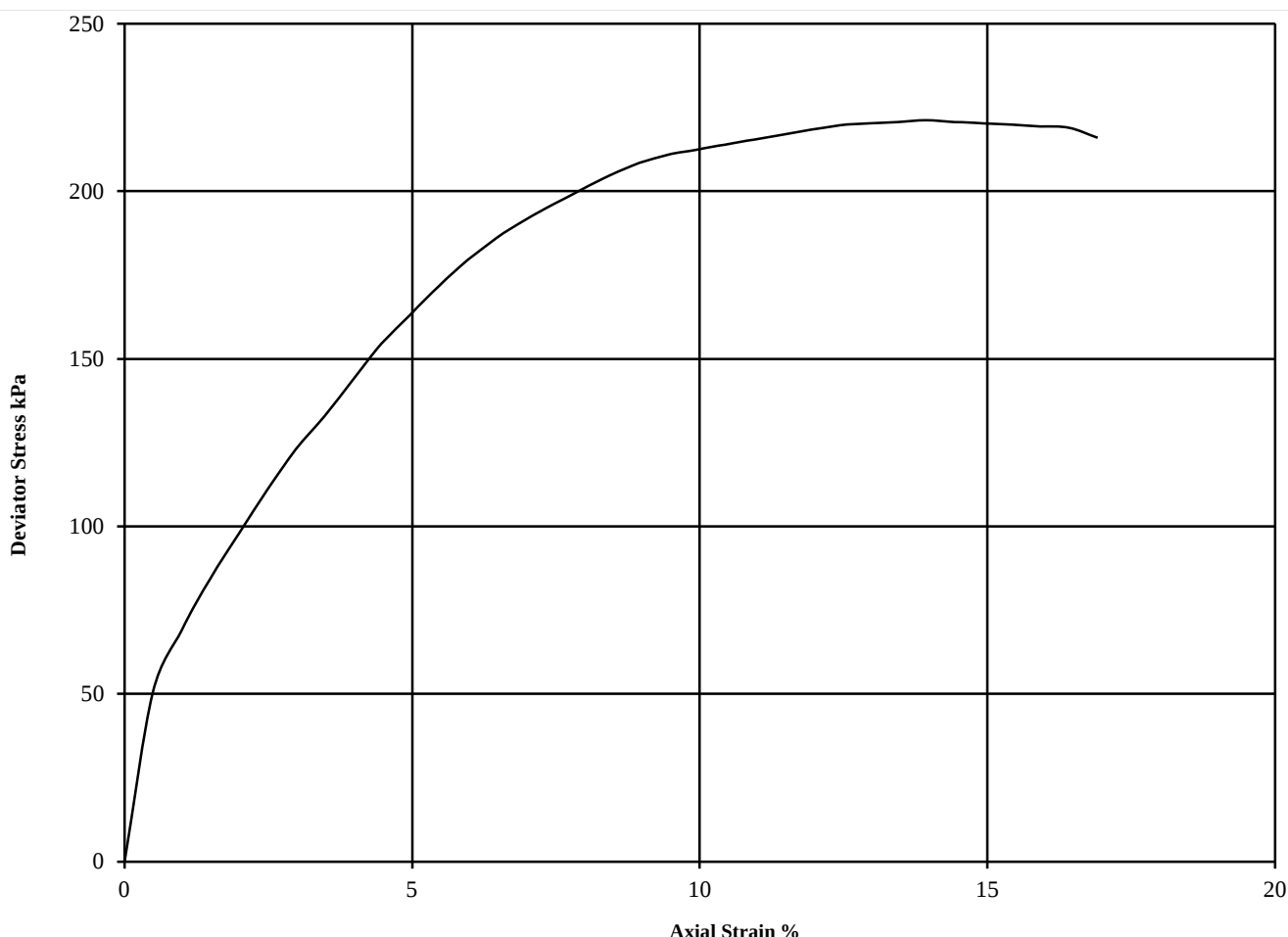
Top Depth (m): 19.50

Sample Number:

Base Depth (m):

Sample Type

U



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.34 See summary of soil descriptions
					$(\sigma_1 - \sigma_3)_f$	$\frac{1}{2}(\sigma_1 - \sigma_3)_f$			
1	26	1.82	1.44	390	221	111	13.9	Brittle	



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Project Otter

Contract No:

PSL22/7851

Client Ref:

WIE17469

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.4 : 1990

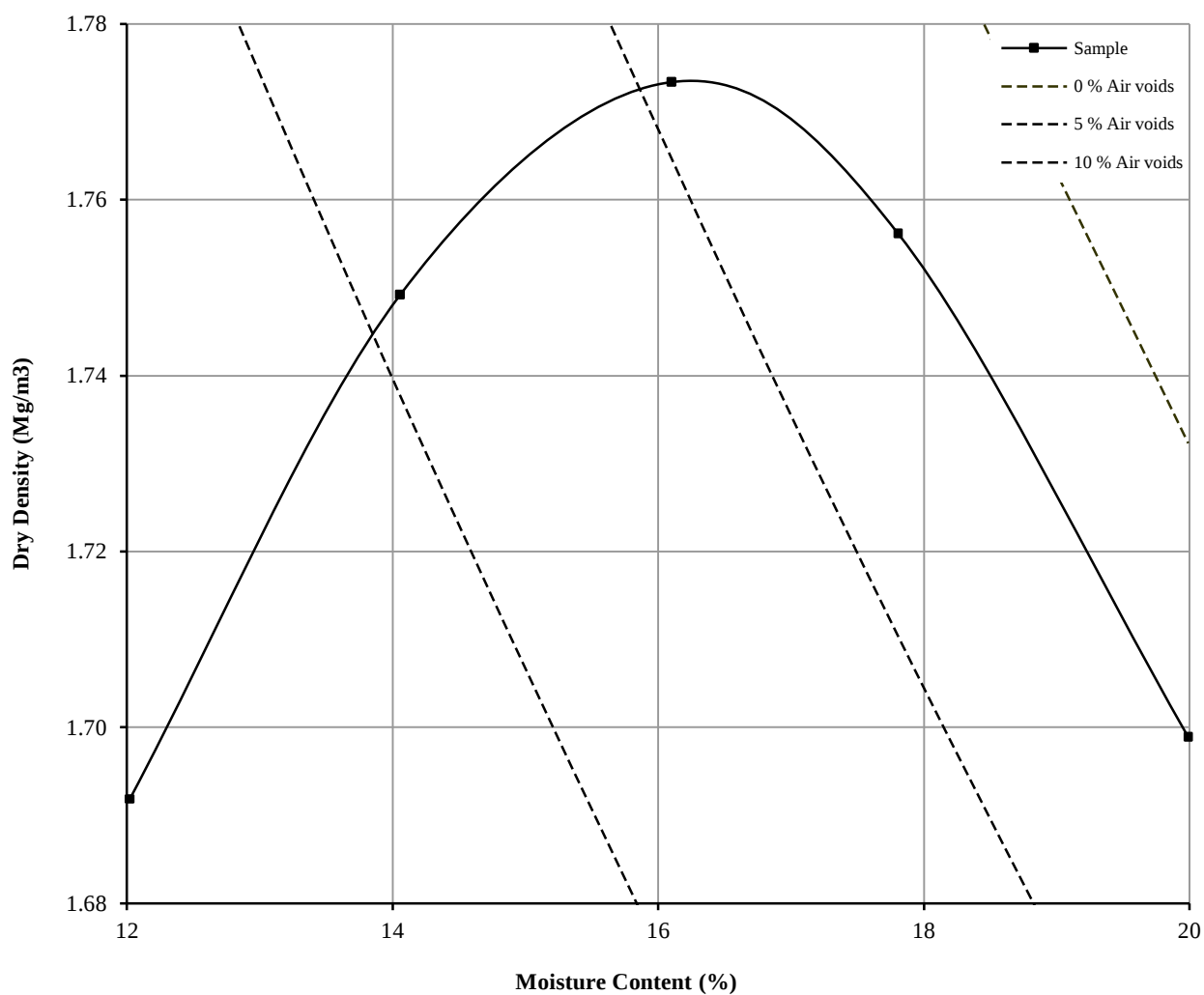
Hole Number: WBH108

Top Depth (m) : 0.50

Sample Number:

Base Depth (m) :

Sample Type: B



Initial Moisture Content:	12	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m3):	2.65	Assumed	Material Retained on 37.5 mm Test Sieve (%):	0
Maximum Dry Density (Mg/m3):	1.77		Material Retained on 20.0 mm Test Sieve (%):	19
Optimum Moisture Content (%):	16			
Remarks See summary of soil descriptions				



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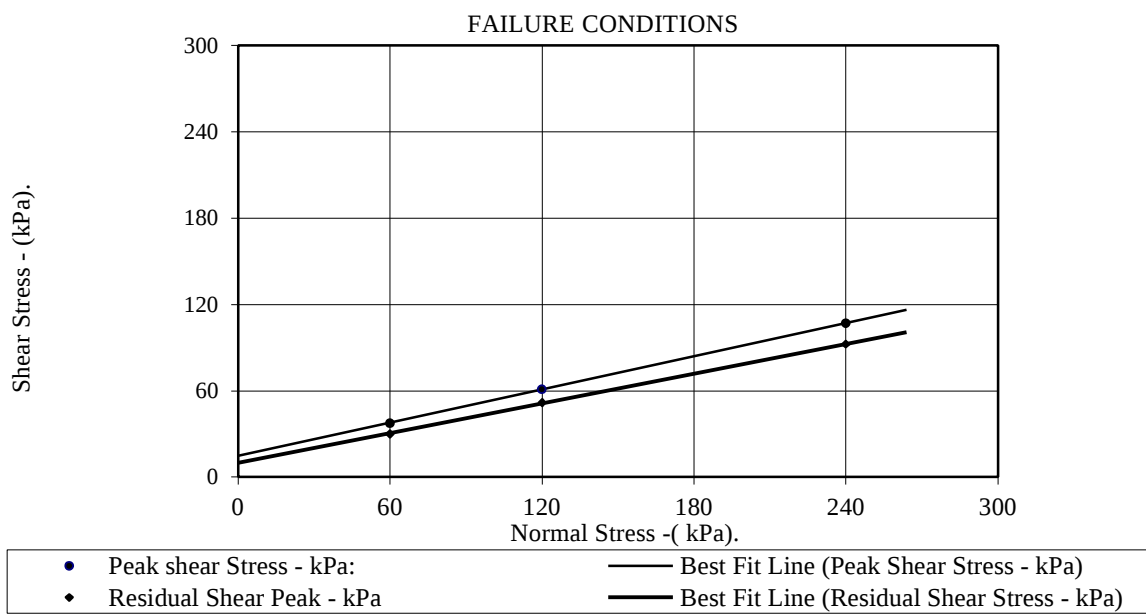
Project Otter

Contract
PSL22/7851
Client Ref
WIE17469

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377 : 1990 Part 7 Clause 4

Hole Number:	WBH108		Top Depth	6.00	
Sample Number:			Base Depth		
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Specimen Preparation	Material tested passing 2mm sieve Remoulded using hand tamped effort				
Sample Description:	See summary of soil descriptions				
STAGE			1	2	3
Initial Conditions					
Height - mm:			19.99	19.99	19.99
Length - mm:			60.05	60.05	60.05
Moisture Content - %:			44	44	44
Bulk Density - Mg/m3:			1.84	1.84	1.84
Dry Density - Mg/m3:			1.28	1.28	1.28
Voids Ratio:			1.077	1.077	1.077
Normal Pressure- kPa			60	120	240
Consolidation Stage					
Consolidated Height - mm:			18.78	18.36	16.89
Peak Shear					
Rate of Strain - mm/min			0.043	0.043	0.043
Displacement at peak shear stress - mm			10.00	10.00	9.00
Peak shear Stress - kPa:			37	61	107
Residual Shear					
Rate of Strain - mm/min			0.086	0.086	0.086
Displacement at residual shear stress - mm			25.10	26.90	30.00
Residual shear Stress - kPa:			30	52	92
Final Consolidation Conditions					
Moisture Content - %:			28	28	27
Bulk Density - Mg/m3:			1.96	2.00	2.18
Dry Density - Mg/m3:			1.52	1.57	1.72
Peak Shear					
Angle of Shearing Resistance:(0)			21		
Effective Cohesion - kPa:			15		
Residual Shear					
Angle of Shearing Resistance:(0)			19		
Effective Cohesion - kPa:			10		



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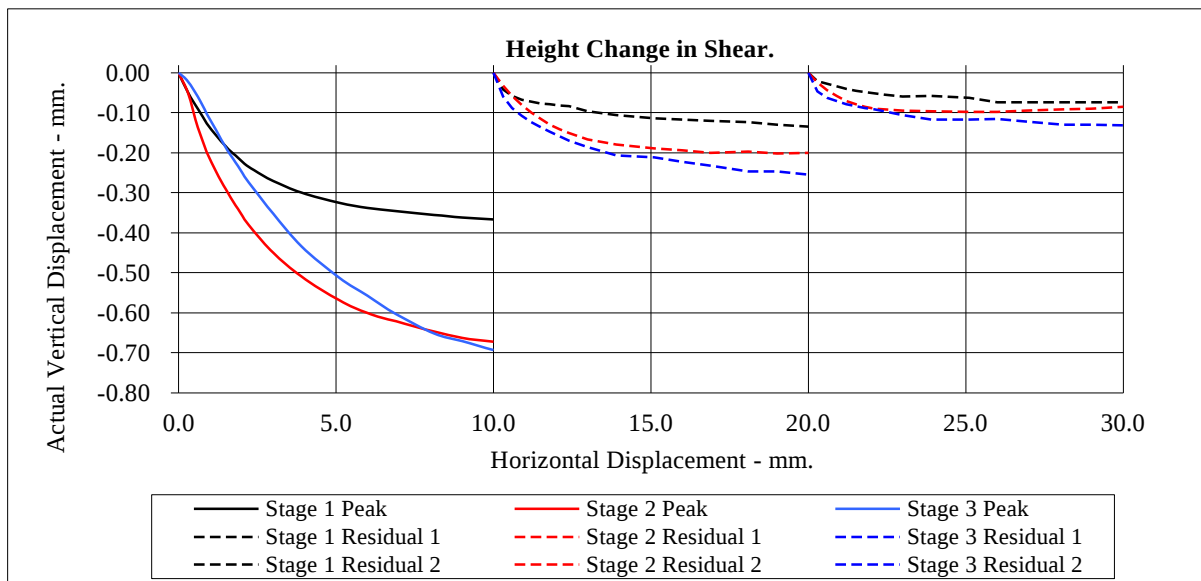
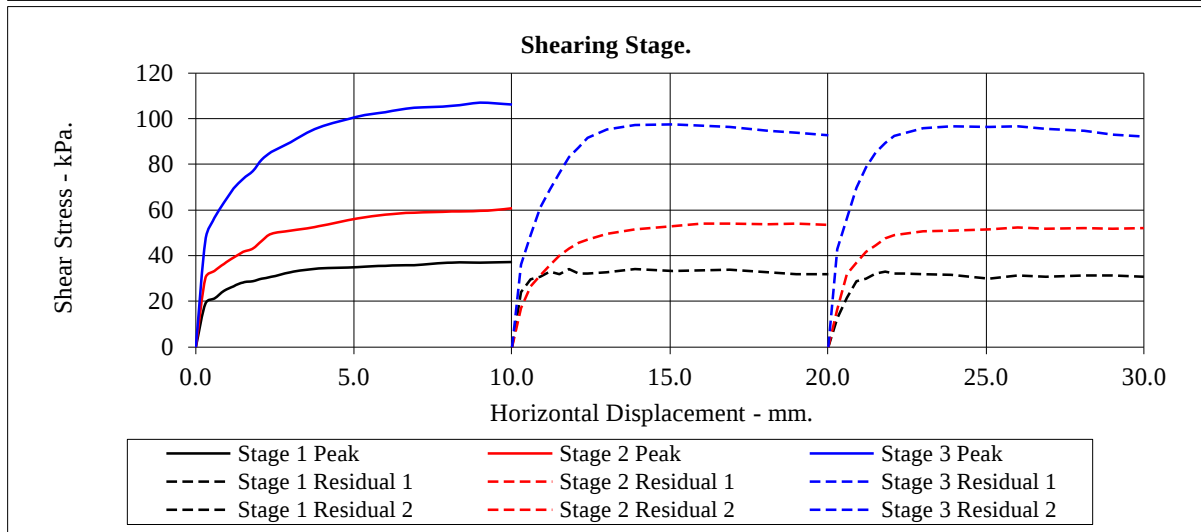
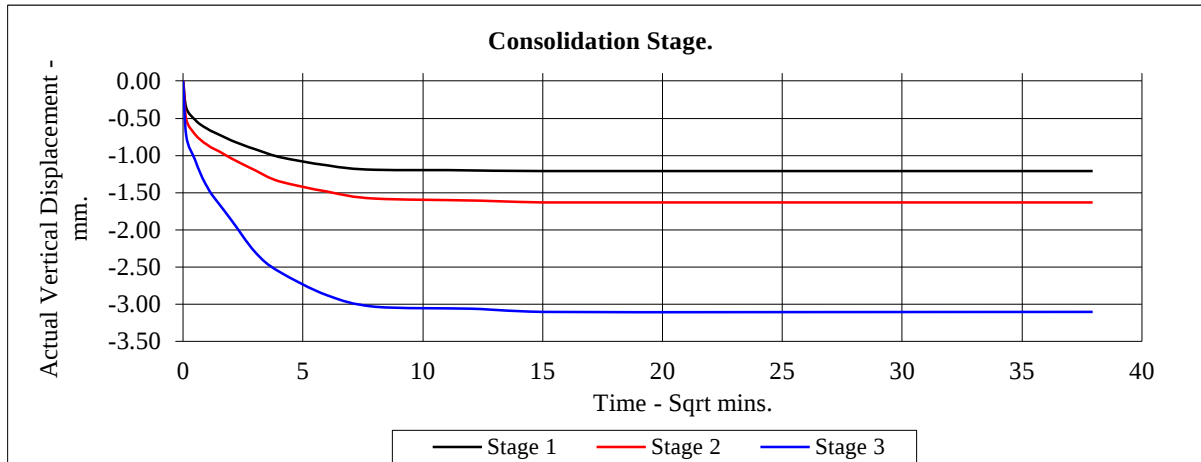
Project Otter

Contract No:
PSL22/7851
Client Ref:
WIE17469

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377 : 1990 Part 7 Clause 4

Hole Number:	WBH108	Top Depth:	6.00
Sample Number:		Base Depth:	



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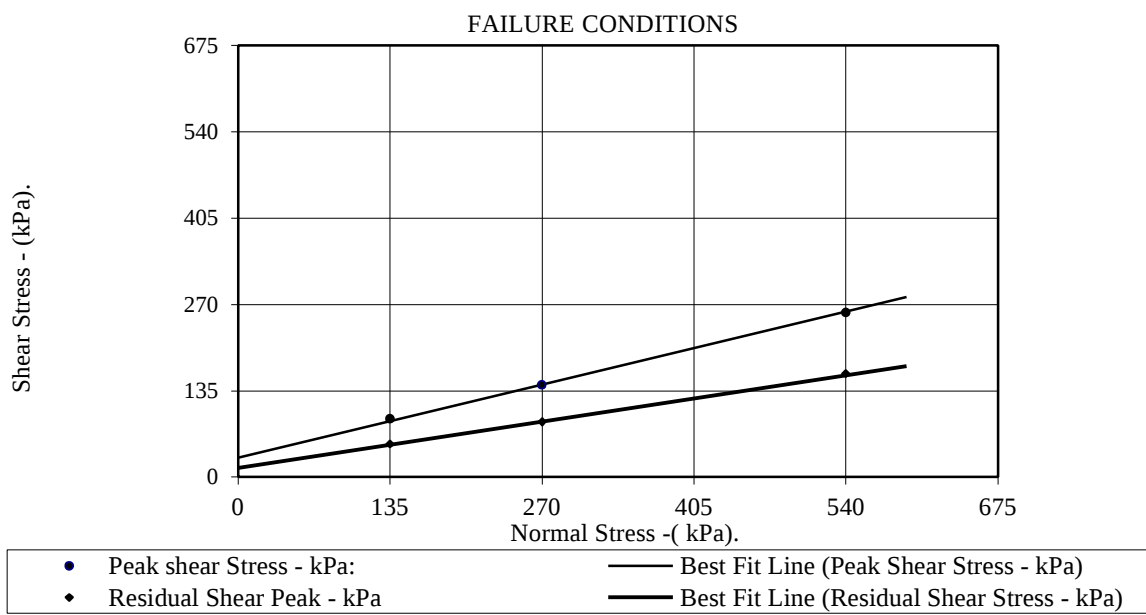
Project Otter

Contract No:
PSL22/7851
Client Ref:
WIE17469

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377 : 1990 Part 7 Clause 4

Hole Number:	WBH108		Top Depth	13.50	
Sample Number:			Base Depth		
Sample Conditions:	Submerged		Sample Type	U	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Specimen Preparation	Cut and trimmed Undisturbed				
Sample Description:	See summary of soil descriptions				
STAGE			1	2	3
Initial Conditions					
Height - mm:			19.99	19.99	19.99
Length - mm:			60.05	60.05	60.05
Moisture Content - %:			28	28	28
Bulk Density - Mg/m3:			1.92	1.92	1.92
Dry Density - Mg/m3:			1.50	1.50	1.50
Voids Ratio:			0.764	0.764	0.764
Normal Pressure- kPa			135	270	540
Consolidation Stage					
Consolidated Height - mm:			19.17	18.43	17.79
Peak Shear					
Rate of Strain - mm/min			0.045	0.045	0.045
Displacement at peak shear stress - mm			2.10	3.90	3.90
Peak shear Stress - kPa:			91	144	257
Residual Shear					
Rate of Strain - mm/min			0.090	0.090	0.090
Displacement at residual shear stress - mm			30.00	30.00	30.00
Residual shear Stress - kPa:			52	87	162
Final Consolidation Conditions					
Moisture Content - %:			30	28	25
Bulk Density - Mg/m3:			2.01	2.09	2.16
Dry Density - Mg/m3:			1.54	1.63	1.73
Peak Shear					
Angle of Shearing Resistance:(0)			23		
Effective Cohesion - kPa:			30		
Residual Shear					
Angle of Shearing Resistance:(0)			15		
Effective Cohesion - kPa:			14		



Project Otter

Contract No:

PSL22/7851

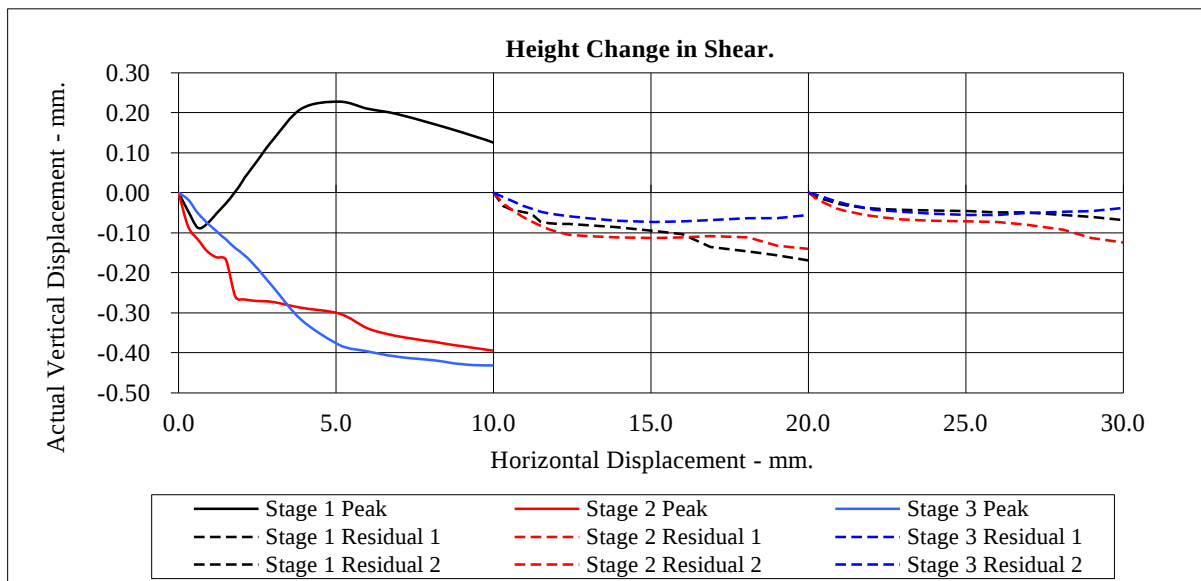
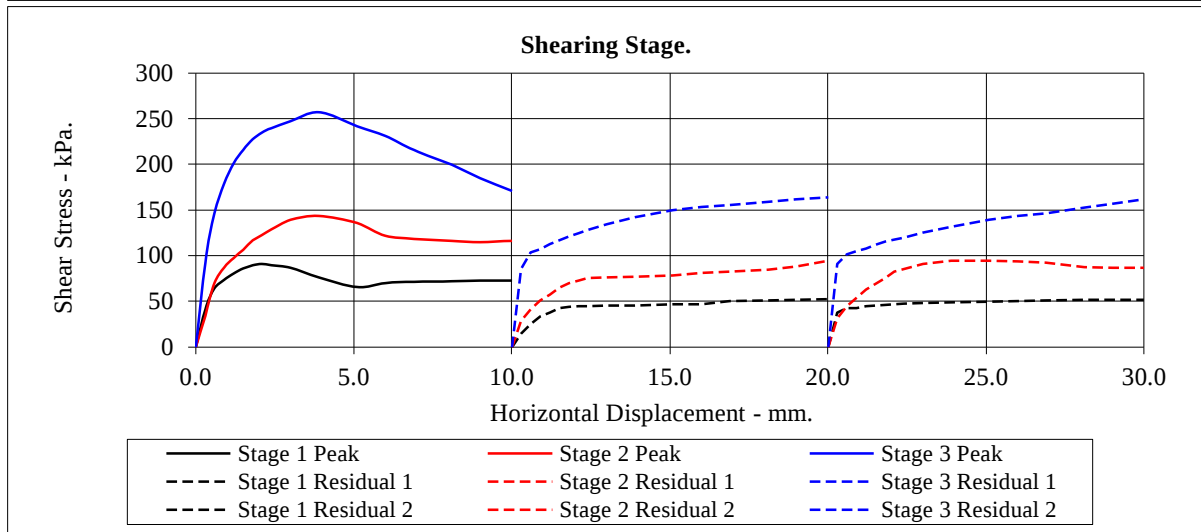
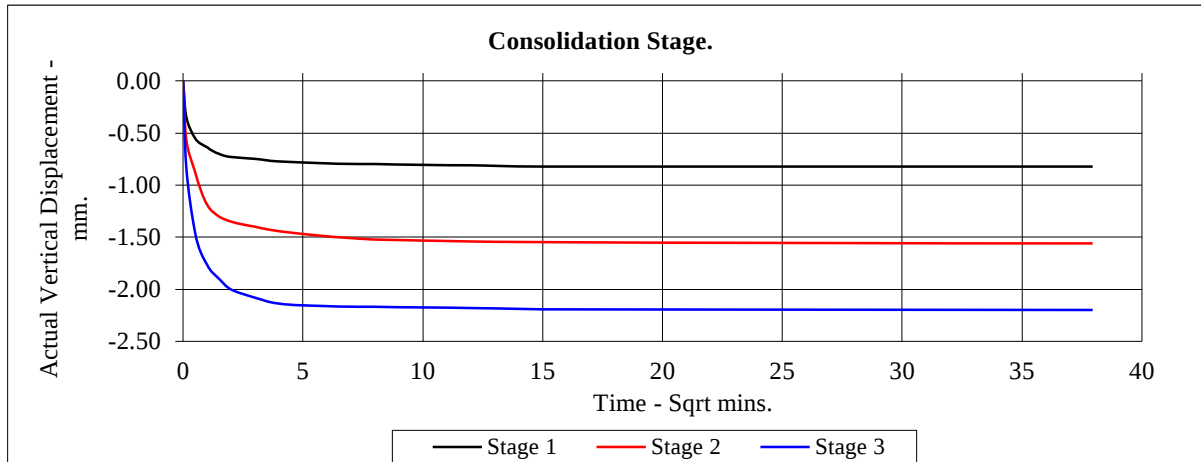
Client Ref:

WIE17469

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377 : 1990 Part 7 Clause 4

Hole Number:	WBH108	Top Depth:	13.50
Sample Number:		Base Depth:	



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Project Otter

Contract No:
PSL22/7851
Client Ref:
WIE17469

PERMEABILITY IN A TRIAXIAL CELL

BS 1377 : Part 6 : 1990: Clause 6

Hole Number: WBH108 Top Depth (m) : 10.50

Sample Number: Base Depth (m) :

Sample Type: U Lift Number:

Date Grid Reference:

Description of Specimen
See summary of soil descriptions
Remarks
Undisturbed

Initial Specimen Conditions		
Height	mm	102.67
Diameter	mm	103.20
Area	mm ²	8364.68
Volume	cm ³	858.80
Mass	g	1669
Dry Mass	g	1296
Bulk Density	Mg/m ³	1.94
Dry Density	Mg/m ³	1.51
Moisture Content	%	29
Voids Ratio	-	0.756
Specific Gravity	Mg/m ³	2.65
(assumed/measured)	-	assumed

Final Specimen Conditions		
Moisture Content	%	28
Bulk Density	Mg/m ³	1.93
Dry Density	Mg/m ³	1.51

Test Setup		
Date Started		23/12/2022
Date Finished		10/01/2023
Top Drain Used		Y
Base Drain Used		Y
Method of Saturation		By back pressure
Direction Of Flow		Vertically Downwards
Saturation Time	Days	1
Consolidation Time	Days	6
Permeability Time	Days	1



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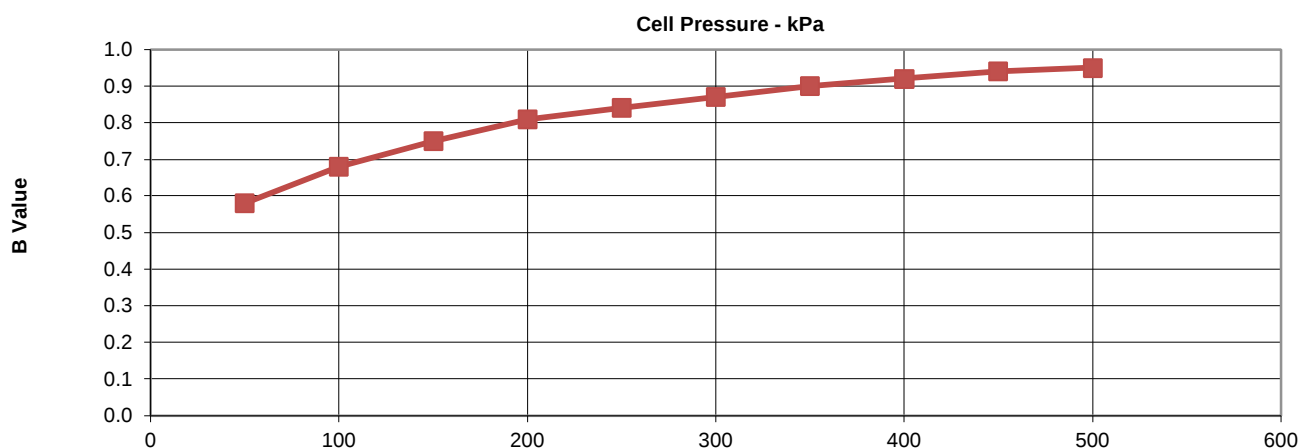
Project Otter

Contract No.
PSL22/7851
Client Ref
WIE17469

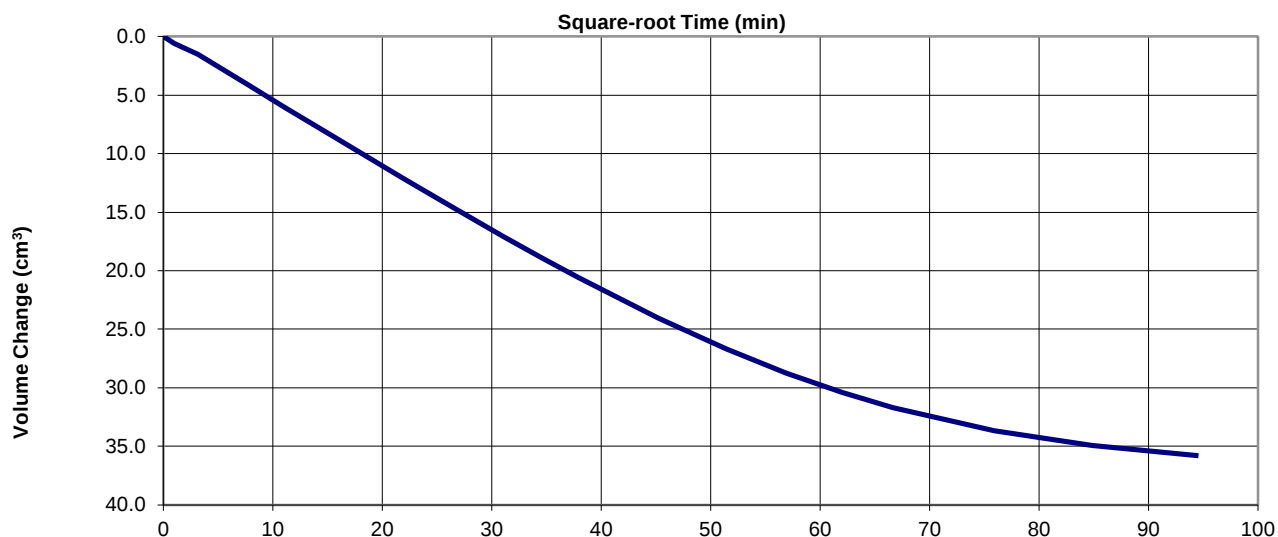
PERMEABILITY IN A TRIAXIAL CELL

BS 1377 : Part 6 : 1990 Clause 6

Specimen Details		
Hole Number		WBH108
Sample Depth	m	10.50
Sample No,		
Grid Reference		
Lift Number		
Saturation		
Cell Pressure Incr.	kPa	50
Back Pressure Incr.	kPa	50
Differential Pressure	kPa	10
Final Cell Pressure	kPa	500
Final B Value	-	0.95



Consolidation		
Effective Pressure	kPa	210
Cell Pressure	kPa	660
Back Pressure	kPa	450
Final PWP	kPa	460
PWP dissipation	%	95



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Project Otter

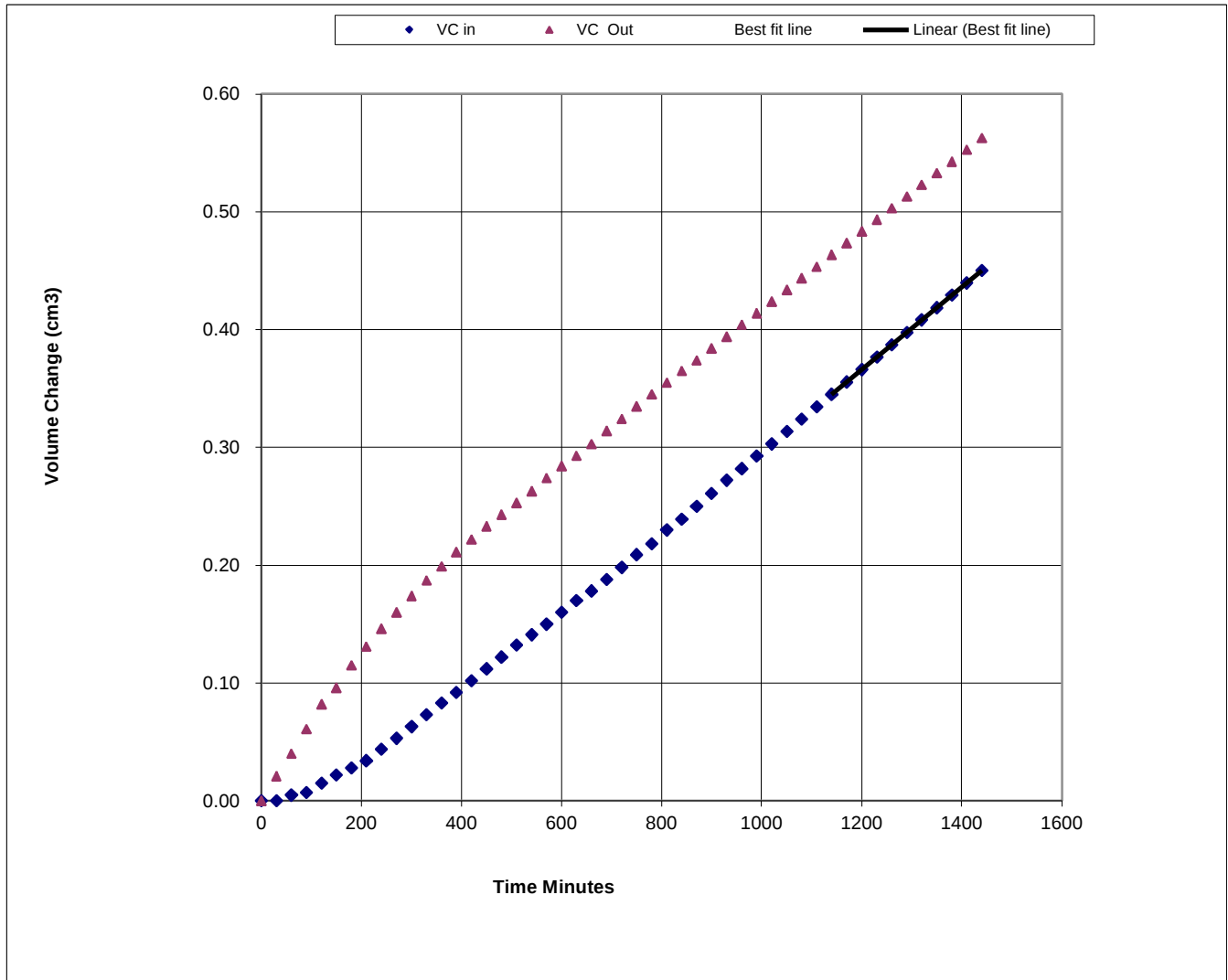
Contract No.
PSL22/7851
Client Ref
WIE17469

PERMEABILITY IN A TRIAXIAL CELL

BS 1377 : Part 6 : 1990 Clause 6

Specimen Details		
Hole Number		WBH108
Sample Depth	m	10.50
Sample No.		
Grid Reference		
Lift Number		

Permeability Stage



Permeability Stage		
Cell Pressure	kPa	660
Mean Effective Stress	kPa	210
Back Pressure Diff.	kPa	20
Mean Rate of Flow	ml/min	0.0003
Average Temperature	'C	20
Vertical Permeability Kv	m/s	3.3E-11



PSL
Professional Soils Laboratory

Project Otter

Contract No.
PSL22/7851
Client Ref
WIE17469



ANALYTICAL TEST REPORT

Contract no: 117329

Contract name: WIE17469: Project Otter

Client reference: PSL22/7851

Clients name: Professional Soils Laboratory

Clients address: 5/7 Hexthorpe Road
Doncaster
DN4 0AR

Samples received: 05 January 2023

Analysis started: 05 January 2023

Analysis completed: 12 January 2023

Report issued: 12 January 2023

Key

U	UKAS accredited test
M	MCERTS & UKAS accredited test
\$	Test carried out by an approved subcontractor
I/S	Insufficient sample to carry out test
N/S	Sample not suitable for testing
NAD	No Asbestos Detected

Approved by:



Abbie Neasham-Bourn
Senior Reporting Administrator

Chemtech Environmental Limited

SOILS

Lab number			117329-1
Sample id			WBH108
Depth (m)			4.50
Sample Type			B
Date sampled			-
Test	Method	Units	
pH	CE004 ^U	units	8.1
Magnesium (2:1 water soluble)	CE061	mg/l Mg	11
Chloride (2:1 water soluble)	CE049 ^U	mg/l Cl	210
Nitrate (2:1 water soluble)	CE049 ^U	mg/l NO ₃	<1
Sulphate (2:1 water soluble)	CE061 ^U	mg/l SO ₄	663
Sulphate (acid extractable)	CE062 ^U	mg/kg SO ₄	2529
Sulphate (acid extractable)	CE062 ^U	% w/w SO ₄	0.25
Sulphur (total)	CE119	mg/kg S	2272
Sulphur (total)	CE119	% w/w S	0.23
Total Organic Carbon (TOC)	CE197	% w/w C	5.0
Estimate of OMC (calculated from TOC)	CE197	% w/w	8.5

Chemtech Environmental Limited

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE004	pH	Based on BS 1377, pH Meter	As received	U	-	units
CE061	Magnesium (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry		1	mg/l Mg
CE049	Chloride (2:1 water soluble)	Aqueous extraction, IC-COND	Dry	U	1	mg/l Cl
CE049	Nitrate (2:1 water soluble)	Aqueous extraction, IC-COND	Dry	U	1	mg/l NO ₃
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	U	10	mg/l SO ₄
CE062	Sulphate (acid extractable)	HCl extract, analysed by ICP-OES	Dry	U	100	mg/kg SO ₄
CE062	Sulphate (acid extractable)	HCl extract, analysed by ICP-OES	Dry	U	0.01	% w/w SO ₄
CE119	Sulphur (total)	Aqua regia digest, analysed by ICP-OES	Dry		100	mg/kg S
CE119	Sulphur (total)	Aqua regia digest, analysed by ICP-OES	Dry		0.01	% w/w S
CE197	Total Organic Carbon (TOC)	Carbon Analyser	Dry		0.1	% w/w C
CE197	Estimate of OMC (calculated from TOC)	Calculation from Total Organic Carbon	Dry		0.1	% w/w

Chemtech Environmental Limited

DEVIATING SAMPLE INFORMATION

Comments

Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.

For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.

Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
117329-1	WBH108	4.50	Y	All (NSD)

Chemtech Environmental Limited

ADDITIONAL INFORMATION

Notes

Opinions and interpretations expressed herein are outside the UKAS accreditation scope.

Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.

All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.

Methods, procedures and performance data are available on request.

Results reported herein relate only to the material supplied to the laboratory.

This report shall not be reproduced except in full, without prior written approval.

Samples will be disposed of 4 weeks from initial receipt unless otherwise instructed.

For soils and solids, all results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.

Analytical results are inclusive of stones, where applicable.



LABORATORY REPORT



4043

Contract Number: PSL22/7852

Report Date: 13 January 2023
Client's Reference: WIE17469-WBH109
Client Name: Groundtech Consulting
First Floor
Lloyd House
Orford Court
Greenfold Way
WN7 3XJ

For the attention of: Michael Berry

Contract Title: Project Otter
Date Received: 9/12/2022
Date Commenced: 9/12/2022
Date Completed: 12/1/2023

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)

S Royle
(Laboratory Manager)

L Knight
(Senior Technician)

S Eyre
(Senior Technician)


T Watkins
(Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
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e-mail: awatkins@prosoils.co.uk
rberriman@prosoils.co.uk

Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

4043

PSL
Professional Soils Laboratory

Project Otter

Contract No:

PSL22/7852

Client Ref:

WIE17469

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

[illegible]

SYMBOLS : NP : Non Plastic

*** : Liquid Limit and Plastic Limit Wet Sieved.**



4043

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Project Otter

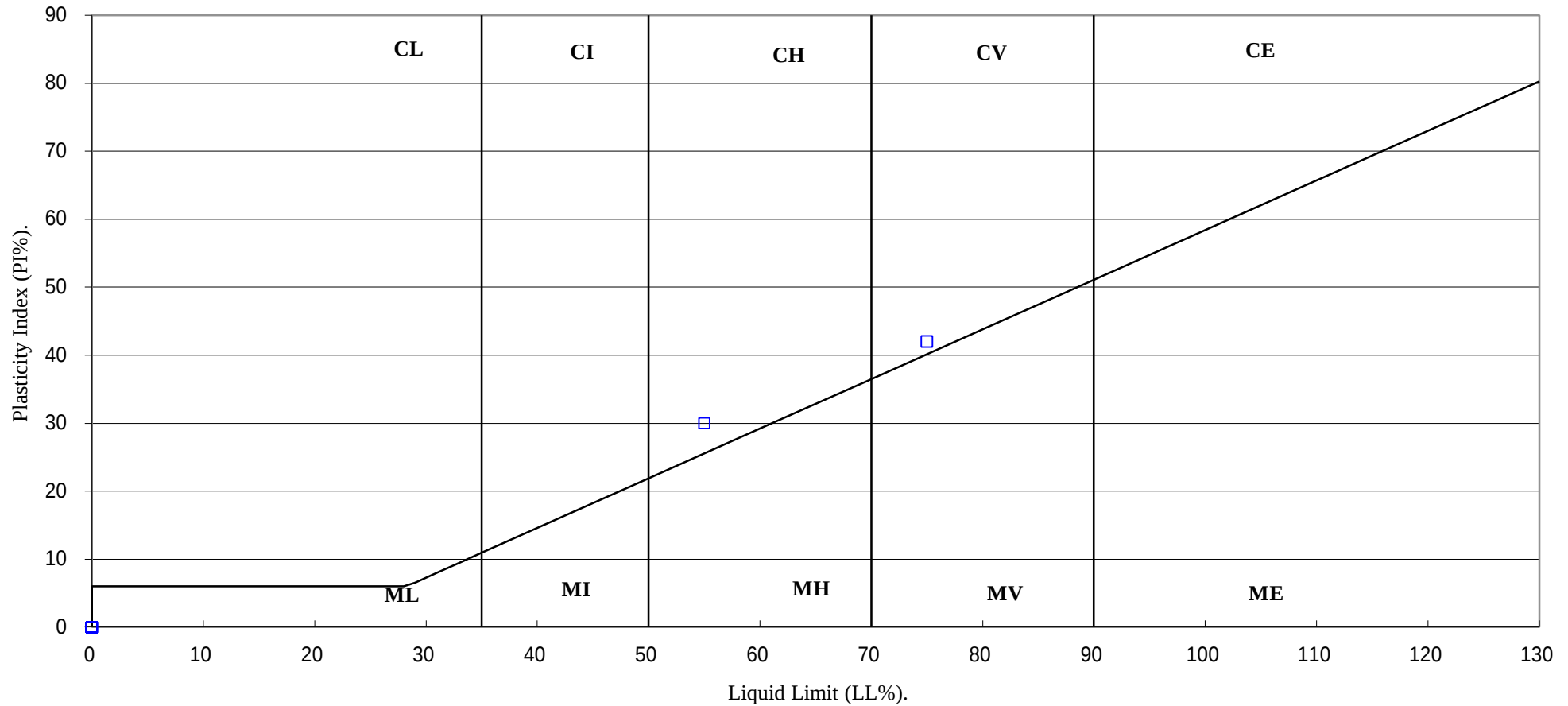
Contract No:

PSL22/7852

Client Ref:

WIE17469

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



4043

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Project Otter

Contract No:

PSL22/7852

Client Ref:

WIE17469

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number:

WBH109

Top Depth (m):

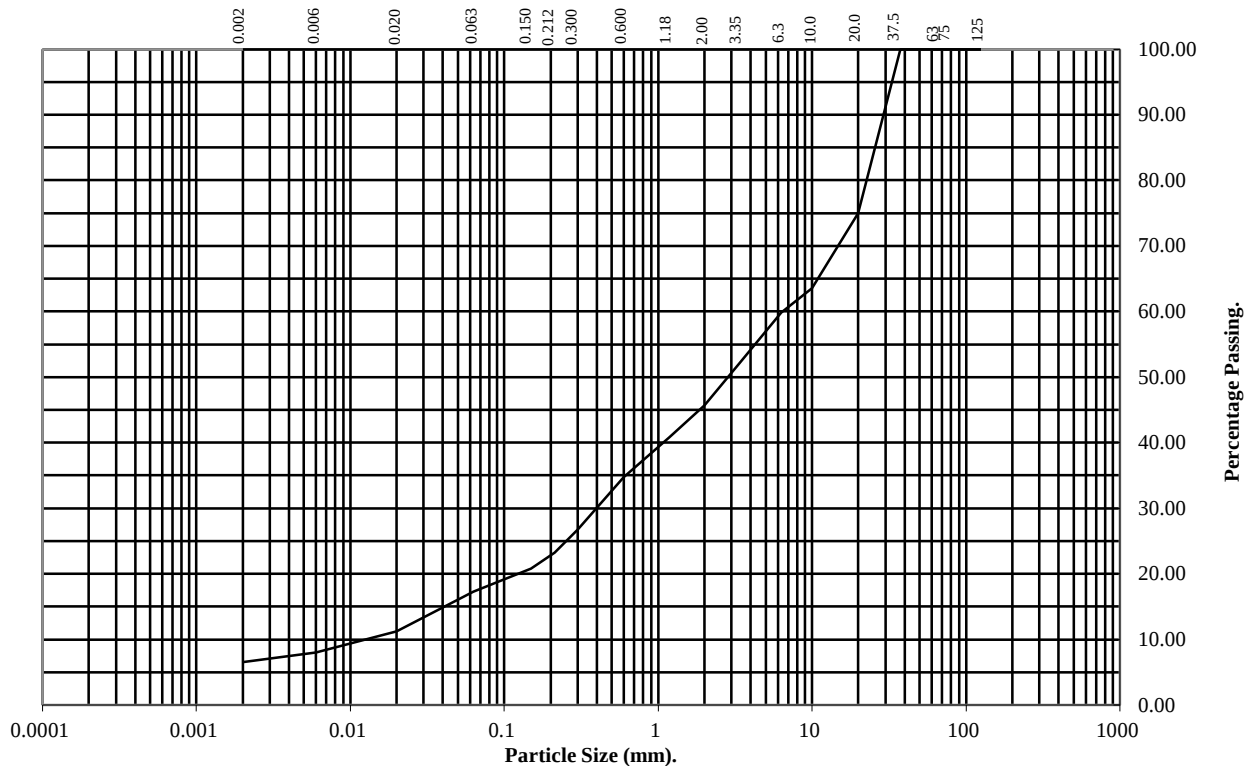
1.50

Sample Number:

Base Depth(m):

Sample Type:

D



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	75
10	64
6.3	60
3.35	52
2	46
1.18	41
0.6	35
0.3	27
0.212	23
0.15	21
0.063	17

Particle Diameter	Percentage Passing
0.02	11
0.006	8
0.002	7

Soil Fraction	Total Percentage
Cobbles	0
Gravel	54
Sand	29
Silt	10
Clay	7

Remarks:

See Summary of Soil Descriptions



PSL
Professional Soils Laboratory

Project Otter

Contract No:
PSL22/7852
Client Ref:
WIE17469

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number:

WBH109

Top Depth (m):

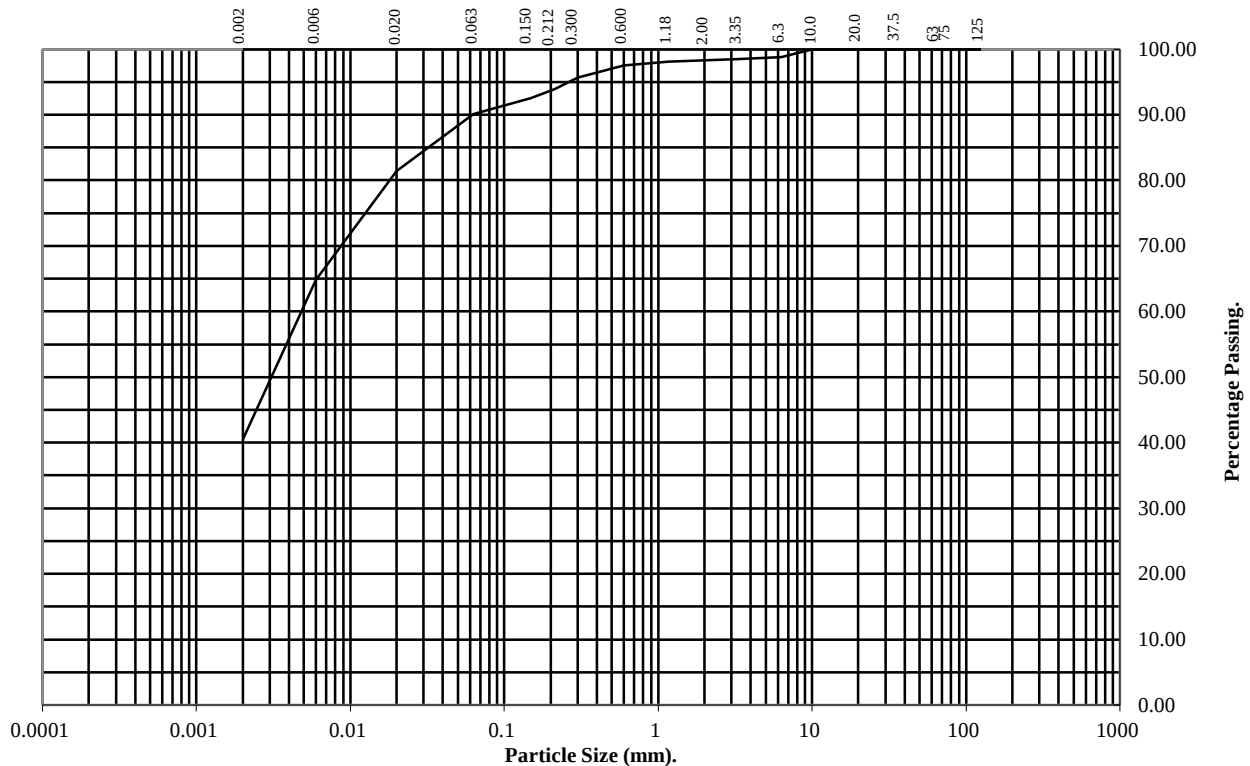
7.00

Sample Number:

Base Depth(m):

Sample Type:

B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	99
3.35	98
2	98
1.18	98
0.6	98
0.3	96
0.212	94
0.15	93
0.063	90

Particle Diameter	Percentage Passing
0.02	81
0.006	65
0.002	41

Soil Fraction	Total Percentage
Cobbles	0
Gravel	2
Sand	8
Silt	49
Clay	41

Remarks:

See Summary of Soil Descriptions



PSL
Professional Soils Laboratory

Project Otter

Contract No:
PSL22/7852
Client Ref:
WIE17469

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

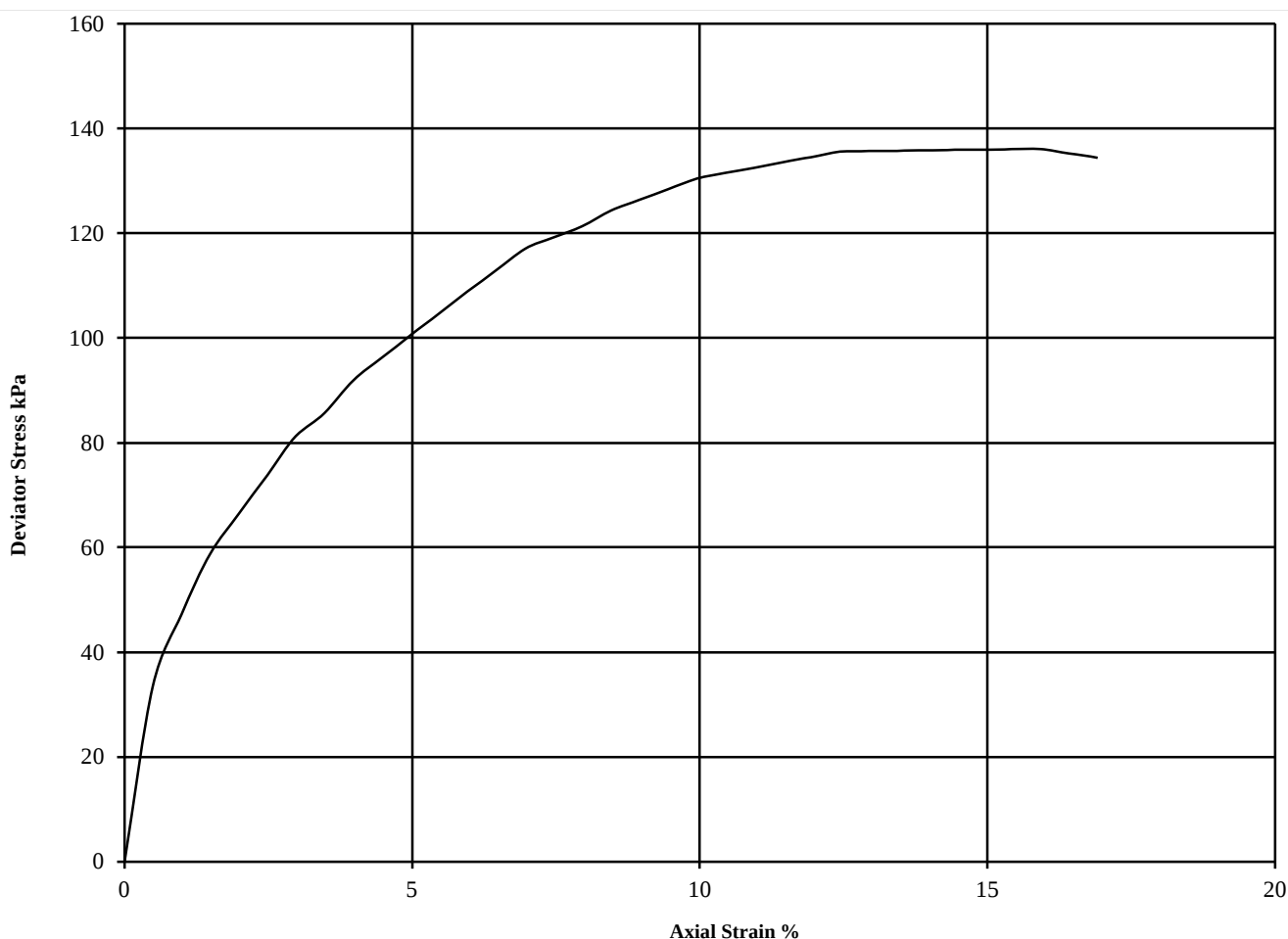
Hole Number: WBH109

Top Depth (m): 6.00

Sample Number:

Base Depth (m):

Sample Type U



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.34 See summary of soil descriptions
					$(\sigma_1 - \sigma_3)_f$	$\frac{1}{2}(\sigma_1 - \sigma_3)_f$			
1	26	1.99	1.58	120	136	68	15.9	Plastic	



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Professional Soils Laboratory

Project Otter

Contract No:

PSL22/7852

Client Ref:

WIE17469

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number: WBH109

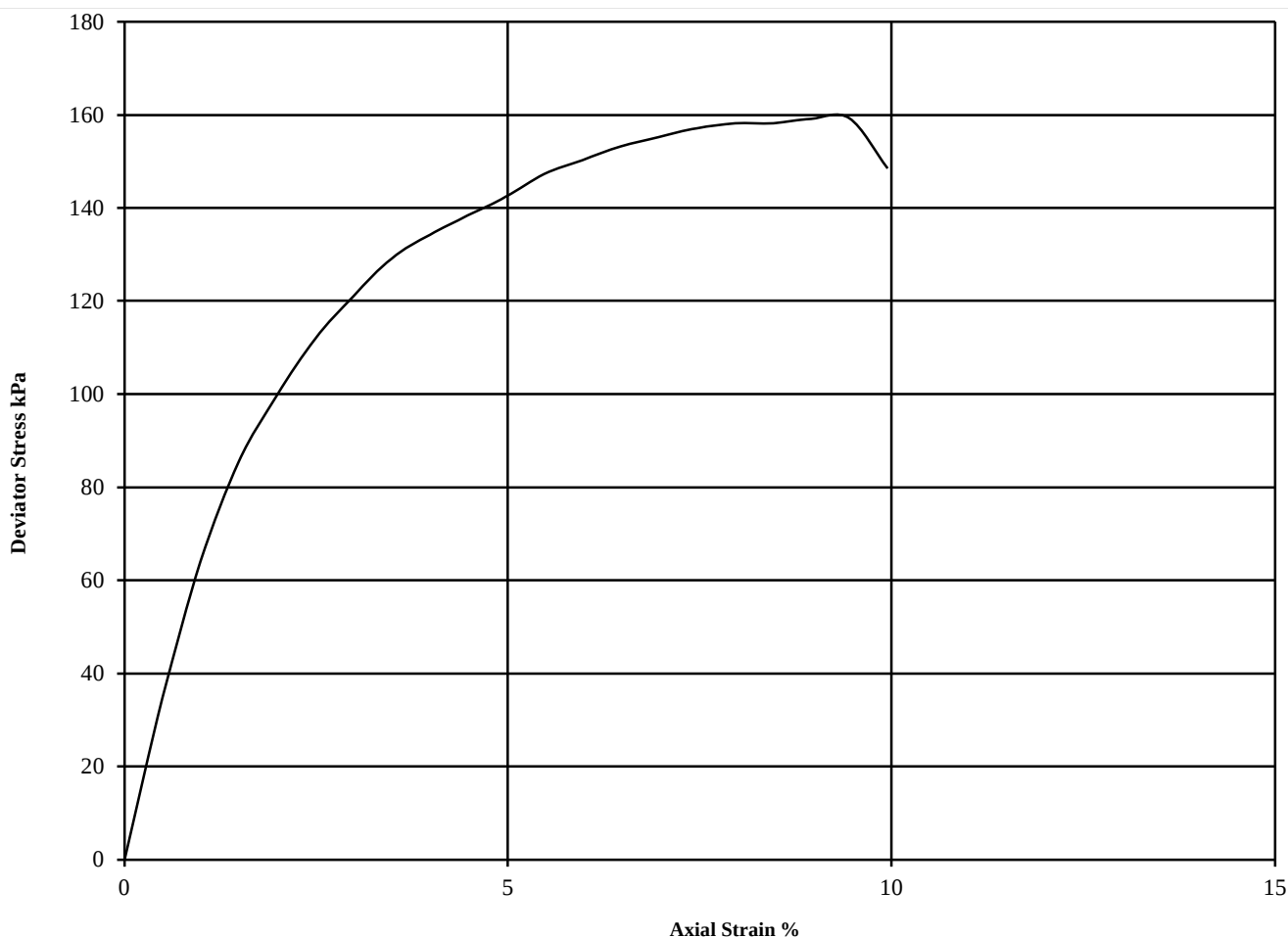
Top Depth (m): 9.00

Sample Number:

Base Depth (m):

Sample Type

U



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.35 See summary of soil descriptions
					$\frac{1}{2}(\sigma_1 - \sigma_3)_f$	$\frac{1}{2}(\sigma_1 - \sigma_3)_f$			
1	29	1.88	1.46	180	159	80	9.5	Brittle	



PSL
Professional Soils Laboratory

Project Otter

Contract No:

PSL22/7852

Client Ref:

WIE17469

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number: WBH109

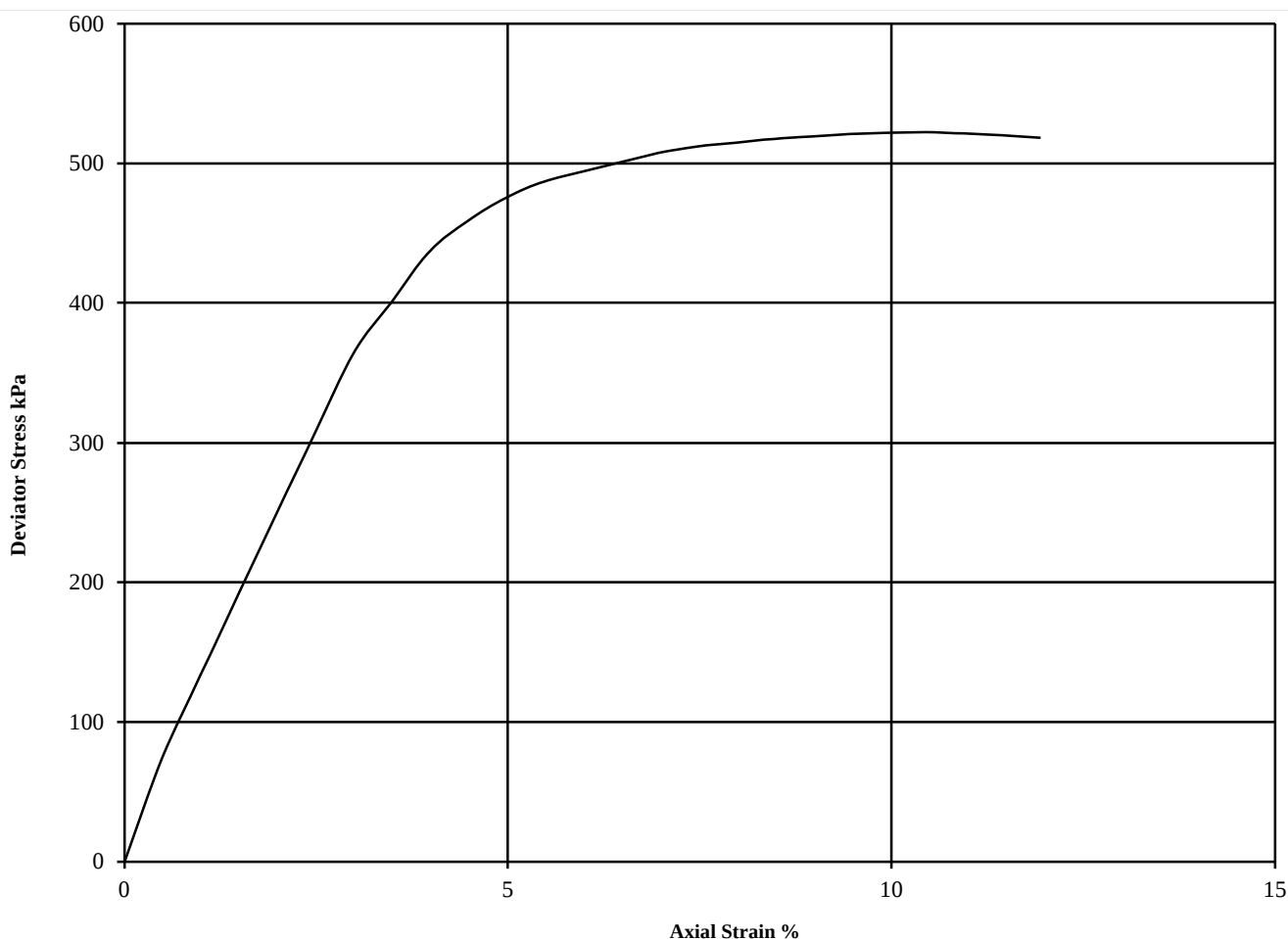
Top Depth (m): 24.00

Sample Number:

Base Depth (m):

Sample Type

U



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.35 See summary of soil descriptions
					$(\sigma_1 - \sigma_3)_f$	$\frac{1}{2}(\sigma_1 - \sigma_3)_f$			
1	27	1.93	1.52	480	522	261	10.4	Brittle	



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