Appendix 13.1A

Arklow SI Causeway 2017

INTERIM REPORT

Arklow Sewerage Scheme – Site Investigation

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Client:	Irish Water
Client's Representative:	Arup Byrne Looby
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APPENDICES

Document Control Sheet

Report No.:	16-5027
Project title:	Arklow Sewerage Scheme
Client:	Irish Water
Client's Representative:	Arup Byrne Looby

Revision	Status	Report prepared by:	Report reviewed by:	Report approved by:	Issue date
0	Interim	Andrew Garne		Paul Dunlop BEng PhD CEng MIEI	17th November 2016

The works were conducted in accordance with:

UK Specification for Ground Investigation 2nd Edition, published by ICE Publishing (2012)

British Standards Institute (2010) BS 5930:1999 + A2: 2010, Code of practice for site investigations. Incorporating Amendment Nos. 1 and 2, as partially replaced by:

- BS EN 1997-2:2007: Eurocode 7. Geotechnical design. Ground investigation and testing
- BS EN ISO 22475-1:2006: Geotechnical investigation and testing. Sampling methods and groundwater measurements. Technical principles for execution
- BS EN ISO 14688-1:2002/Amd 1:2013: Geotechnical investigation and testing. Identification and classification of soil. Identification and description
- BS EN ISO 14688-2:2004/Amd 1:2013: Geotechnical investigation and testing. Identification and classification of soil. Principles for a classification
- BS EN ISO 14689-1:2003: Geotechnical investigation and testing. Identification and classification of rock. Identification and description
- BS EN ISO 22476-2:2005/Amd 1:2011: Geotechnical investigation and testing. Field testing. Dynamic probing
- BS EN ISO 22476-3:2005/Amd 1:2011: Geotechnical investigation and testing. Field testing. Standard penetration test

METHODS OF DESCRIBING SOILS AND ROCKS

Soil and rock descriptions are based on the guidance in Section 6 of BS 5930: 1999 + A2: 2010, The Code of Practice for Site Investigation. The amendments revised the Standard to remove text superseded by BS EN ISO 14688-1:2002, BS EN ISO 14688-2:2004 and EN ISO 14689-1:2003 and refers to the relevant standard for each affected subclause. However, the following terms are used in the description of fine-grained soils, where applicable:

- soft to firm: fine-grained soil with consistency description close to the boundary between soft and firm soil (Table 13 of BS5930).
- firm to stiff: fine-grained soil with consistency description close to the boundary between firm and stiff soil (Table 13 of BS5930).

Abbreviations used on exploratory hole logs	
U	Nominal 100mm diameter undisturbed open tube sample
P	Nominal 100mm diameter undisturbed piston sample
B	Bulk disturbed sample
D	Small disturbed sample
W	Water sample
ES / EW	Soil sample for environmental testing / Water sample for environmental testing
SPT	Standard penetration test using a split spoon sampler (small disturbed sample obtained)
SPT (C)	Standard penetration test using 60 degree solid cone
x,x/x,x,x,x	Blows per increment during the standard penetration test. The initial two values relate to the seating drive (150mm) and the remaining four to the 75mm increments of the test length. The length achieved is stated (mm) for any test increment less than 75mm
N=X	SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm)
N=X/Z	Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given test length 'Z' (mm)
V VR	Shear vane test (borehole) Hand vane test (trial pit) Shear strength stated in kPa V: undisturbed vane shear strength VR: remoulded vane shear strength
dd/mm/yy: 1.0 dd/mm/yy: dry	Date & water level at the borehole depth at the end of shift and the start of the following shift
Abbreviations relating to rock core – reference Clause 44.4.4 of BS 5930: 1999	
TCR (%)	Total Core Recovery: Ratio of rock/soil core recovered (both solid and non-intact) to the total length of core run.
SCR (%)	Solid Core Recovery: Ratio of solid core to the total length of core run. Solid core has a full diameter, uninterrupted by natural discontinuities, but not necessarily a full circumference and is measured along the core axis between natural fractures.
RQD (%)	Rock Quality Designation: Ratio of total length of solid core pieces greater than 100mm to the total length of core run.
FI	Fracture Index: Number of natural discontinuities per metre over an indicated length of core of similar intensity of fracturing.
NI	Non Intact: Used where the rock material was recovered fragmented, for example as fine to coarse gravel size particles.
AZCL	Assessed zone of core loss: The estimated depth range where core was not recovered.
DIF	Drilling induced fracture: A fracture of non-geological origin brought about by the rock coring.

Arklow Sewerage Scheme

1 AUTHORITY

On the instructions of Consulting Engineers, Arup Byrne Looby ("the Client's Representative"), acting on the behalf of Irish Water ("the Client"), a ground investigation was undertaken at the above location to provide geotechnical and environmental information for input to the design and construction of a proposed sewerage scheme.

This report details the work carried out both on site and in the geotechnical and chemical testing laboratories; it contains a description of the site and the works undertaken, the exploratory hole logs and the laboratory test results.

All information given in this report is based upon the ground conditions encountered during the site investigation works, and on the results of the laboratory and field tests performed. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations, and water conditions between or below exploratory holes. It should be noted that groundwater levels usually vary due to seasonal and/or other effects and may at times differ to those measured during the investigation.

This report was prepared by Causeway Geotech Ltd for the use of the Client and the Client's Representative in response to particular instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

2 SCOPE

The extent of the investigation, as instructed by the Client's Representative, included boreholes, soil sampling, in-situ and laboratory testing, and the preparation of a factual report on the findings .

3 DESCRIPTION OF SITE

The works were conducted close to the Arklow Marina, between Mill Road and North Quay which lie close to the harbour, on the east side of Arklow Town.

The existing site is presented on the exploratory hole location plans provided by Arup Byrne Looby within the Contract Documents (Drawing Nos. 401 and 402).

4 SITE OPERATIONS

Site operations, which were conducted between 18th August and 21st September 2016, included:

- Nine cable percussion boreholes
- a standpipe installation in two boreholes

The exploratory holes and in situ tests were located as instructed by the Client's Representative, as shown on the exploratory hole location plans.

4.1 Boreholes

9 No boreholes (BH12-16 & BH15A, 15B, 15C, 15d) were put down to completion in minimum 150mm diameter using Dando 1500 light cable percussion soil boring rigs. All boreholes were terminated either at their scheduled completion depths, or else on encountering virtual refusal on obstructions, including large boulders and weathered bedrock.

Hand dug inspection pits were carried out between ground level and 1.2m depth to ensure boreholes were put down at locations clear of services or subsurface obstructions.

Disturbed (bulk and small bag) samples were taken within the encountered strata.

Standard penetration tests were carried out in accordance with EC7 at standard depth intervals using the split spoon sampler (SPT). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The N-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections.

Any water strikes encountered during boring were recorded along with any changes in their levels as the borehole proceeded.

Where water was added to assist with boring, a note has been added to the log to account for same.

Appendix A presents the borehole logs.

4.2 Standpipe installations

A 50mm dimeter groundwater monitoring standpipe was installed in boreholes BH14 and BH15D.

Details of the installations, including the depth range of the response zone, are provided in Appendix A on the individual borehole logs.

5 LABORATORY WORK

Upon their receipt in the laboratory, all disturbed samples were carefully examined and accurately described and their descriptions incorporated into the borehole logs.

5.1 Geotechnical laboratory testing of soils

Laboratory testing of soils comprised:

- **soil classification:** moisture content measurement, Atterberg Limit tests and particle size distribution analysis.
- **compaction:** dry density/moisture content relationship, Moisture Condition Value (MCV) and California Bearing Ratio (CBR) tests
- **soil and water chemistry:** pH and water soluble sulphate content

Laboratory testing of soils samples was carried out in accordance with British Standards Institute (1990) *BS 1377:1990, Methods of test for soils for civil engineering purposes. Parts 1 to 9.*

The test results are presented in Appendix B.

5.2 Environmental laboratory testing of soils

In addition, environmental testing, as specified by the Clients Representative was conducted on selected environmental samples by Chemtest at its laboratory in Newmarket, Suffolk. Results of environmental testing are presented in Appendix C.

6 GROUND CONDITIONS

6.1 General geology of the area

The GSI online mapping for this area shows that the site is underlain by Made Ground, possibly overlying alluvial/marine deposits.

6.2 Ground types encountered during investigation of the site

A summary of the ground types encountered in the exploratory holes is listed below, in approximate stratigraphic order:

- Made Ground (Paved surface): The boreholes encountered tarmacadam, granular fill (Clause 804 or

similar) and concrete down to a maximum depth of 0.96m (BH15).

- Made Ground (fill): reworked clay or granular fill with localised brick fragments was encountered to a maximum depth of 1.2m. It is likely that some of the underlying material is also Made Ground also although no man-made material was observed.
- Alluvial/Marine/Glacial Deposits: Predominantly granular deposits were encountered to a maximum observed depth of 20.5m (BH16). Occasional beds of marine clay/silt were also observed along with possible glacial till within BH14 and BH16.
- Bedrock: No bedrock was encountered.

6.3 Groundwater

Groundwater was encountered during percussion boring through soil as water strikes at depths of between 0.8m and 4.0m. Given the proximity of the sea, it is likely that the groundwater will be tidal.

Details of the individual groundwater strikes, along with any relative changes in levels as works proceeded, are presented on the exploratory hole logs for each location.

Groundwater monitoring standpipes (50mm nominal internal diameter) were installed within BH14 and BH15D to facilitate long-term groundwater monitoring. Details of the response zone depths, seal depths etc are given on the borehole records in Appendix A.

7 REFERENCES

BS 1377: 1990: Methods of test for soils for civil engineering purposes. British Standards Institution.

BS 5930: 2015: Code of practice for ground investigations. British Standards Institution.

BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. British Standards Institution.

BS EN ISO 14688-1: 2002: Geotechnical investigation and testing - Identification and classification of soil - Part 1 Identification and description. British Standards Institution.

Appendix A Borehole Logs

CAUSEWAY GEOTECH	**Project No.:** 16-5027	**Project Name:** Arklow Sewerage Scheme	**Borehole No.:** BH12
	Coordinates: E	**Client:** Irish Water	Sheet 1 of 2
Method: Cable Percussion	N	**Client's Representative:** Arup Byrne Looby	**Scale:** 1:50
Plant: Dando	**Ground Level:** mOD	**Dates:** 13/09/2016 - 15/09/2016	**Driller:** WD
			Logger: TOS

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
						(0.10)		TARMACADAM		
						0.10 (0.20)		MADE GROUND: Clause 804 fill		
						0.30		MADE GROUND: Brown sandy fill with brick fragments.		
						(0.70)				
1.00	B1					1.00				
1.00 - 1.45	SPT (C) N=4			N=4 (1,0/1,1,1,1)		(0.20) 1.20		Loose, purple/brown, slightly gravelly, very clayey SAND with low to medium cobble content. Gravel is fine to coarse, subangular to subrounded. Sand is fine to coarse. Cobbles are 63-160mm, subangular to subrounded.		
1.20	B2							Soft, purple/brown, slightly sandy, gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded.		
						(1.30)				
2.00	D3									
2.00 - 2.45	SPT (C) N=6			N=6 (2,2/1,2,2,1)						
2.50	B4					2.50		Medium dense, brown, gravelly, very clayey SAND. Gravel is fine to medium, subangular to subrounded. Sand is fine to coarse.		
						(0.50)				
3.00	B5					3.00		Loose to medium dense, brown/orange, slightly silty very sandy GRAVEL. Gravel is fine to medium, subangular to rounded. Sand is fine to coarse.		
3.00 - 3.45	SPT (C) N=9			N=9 (2,2/2,3,2,2)					▼	
4.00	B6							*Below 4.0m: Grades to silty gravelly SAND.*		
4.00 - 4.45	SPT (C) N=11			N=11 (3,2/2,3,3,3)		(2.60)				
5.00	B7									
5.00 - 5.45	SPT (C) N=9			N=9 (2,2/3,2,2,2)						
5.10	D8									
5.60	B9					5.60		Loose, light brown/orange silty SAND. Sand is fine to coarse.		
6.00	B10									
6.00 - 6.45	SPT (C) N=4			N=4 (1,2/0,1,1,2)						
7.00	B11									
7.50	B12									
7.50 - 7.95	SPT (C) N=9			N=9 (2,2/2,3,2,2)						
8.50	B13									
9.00	B14							*Medium dense from 9.00m - 10.50m*		
9.00 - 9.45	SPT (C) N=22			N=22 (4,4/5,5,5,7)						
10.00	B15									

Continued on Next Page

Remarks

Water Added		Water Strike - General			
From (m)	To (m)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
2.40	3.90	3.90		20	3.70
6.50	10.00				
10.00	15.00				

Casing Details		Chiselling Details		
To (m)	Diam (mm)	From (m)	To (m)	Time (hh:mm)

CAUSEWAY GEOTECH	**Project No.:** 16-5027	**Project Name:** Arklow Sewerage Scheme	**Borehole No.:** BH12
	Coordinates: E	**Client:** Irish Water	Sheet 2 of 2
Method: Cable Percussion	N	**Client's Representative:** Arup Byrne Looby	**Scale:** 1:50
Plant: Dando	**Ground Level:** mOD	**Dates:** 13/09/2016 - 15/09/2016	**Driller:** WD
			Logger: TOS

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
10.50	B16							*Dense from 10.50m - 15.00m*		
10.50 - 10.95	SPT (C) N=30			N=30 (5,7/7,7,8,8)						
11.00	D17									
12.00	B18									
12.00 - 12.45	SPT (C) N=34			N=34 (8,8/9,10,8,7)		(9.40)				
13.00	B19									
13.50	D20									
13.50 - 13.95	SPT (C) N=39			N=39 (6,8/10,10,10,9)						
14.00	B21					15.00		End of borehole at 15.000m		

Remarks

Water Added		Water Strike - General			
From (m)	To (m)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
2.40	3.90	3.90		20	3.70
6.50	10.00				
10.00	15.00				

Casing Details		Chiselling Details		
To (m)	Diam (mm)	From (m)	To (m)	Time (hh:mm)

CAUSEWAY GEOTECH	**Project No.:** 16-5027	**Project Name:** Arklow Sewerage Scheme	**Borehole No.:** **BH13**
	Coordinates: E	**Client:** Irish Water	Sheet 1 of 2
Method: Cable Percussion	N	**Client's Representative:** Arup Byrne Looby	**Scale:** 1:50
Plant: Dando	**Ground Level:** mOD	**Dates:** 15/09/2016 - 19/09/2016	**Driller:** WD **Logger:** IH

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
						(0.10)		TARMACADAM		
						(0.10)		MADE GROUND: Gravelly fill		
						0.20		Brown, sandy, very gravelly CLAY.		
						(0.80)				
1.00	B1					1.00		Loose, brown, silty sandy GRAVEL with medium cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular, 63-140mm dia.		
1.00 - 1.45	SPT (C) N=7			N=7 (2,2/1,2,2,2)						
1.50	D2					(1.00)				
2.00 - 2.45	SPT (C) N=11			N=11 (2,2/3,2,3,3)		2.00		Firm, brown, slightly sandy, gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded.		
2.40	B3					2.40		Medium dense, dark grey/brown, slightly clayey, gravelly SAND. Gravel is fine to coarse, subangular to subrounded. Sand is fine to coarse.		
						(0.60)				
3.00	B4					3.00		Loose, dark grey/brown, slightly clayey, gravelly SAND with medium cobble content.. Gravel is fine to coarse, subangular to subrounded. Sand is fine to coarse. Cobbles are 63-180mm dia, subrounded.		
3.00 - 3.45	SPT (C) N=8			N=8 (3,2/2,2,2,2)						
						(1.00)				
4.00	B5					4.00		Medium dense, dark grey/brown, slightly clayey, SAND and GRAVEL with low cobble content. Gravel is fine to coarse, subangular to subrounded. Sand is fine to coarse. Cobbles are subangular to subrounded, 63-140mm dia.		
4.00 - 4.45	SPT (C) N=12			N=12 (3,3/3,3,3,3)						
						(1.00)				
5.00	B6					5.00		Medium dense, light brown, gravelly SAND with low cobble content. Gravel is fine to medium, subangular to subrounded. Sand is fine to coarse.		
5.00 - 5.45	SPT (C) N=15			N=15 (3,4/4,4,3,4)						
						(0.70)				
5.70	B7					5.70		Medium dense, orange, slightly silty, gravelly SAND.		
6.50	B8									
6.50 - 6.95	SPT (C) N=18			N=18 (3,3/4,5,5,4)						
7.00	B9									
7.50	D10									
8.00	B11									
8.00 - 8.45	SPT (C) N=22			N=22 (6,6/5,6,7,4)						
8.50	D12									
9.00	B13									
9.50	D14									
9.50 - 9.95	SPT (C) N=16			N=16 (5,5/4,4,4,4)						
10.00	B15									

Continued on Next Page

Remarks

Water Added		Water Strike - General			
From (m)	To (m)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
5.70	15.00				

Casing Details		Chiselling Details		
To (m)	Diam (mm)	From (m)	To (m)	Time (hh:mm)

CAUSEWAY GEOTECH

Project No.: 16-5027	**Project Name:** Arklow Sewerage Scheme	**Borehole No.:** **BH13**
Coordinates: E N	**Client:** Irish Water	Sheet 2 of 2
Method: Cable Percussion	**Client's Representative:** Arup Byrne Looby	**Scale:** 1:50
Plant: Dando	**Ground Level:** mOD	**Driller:** WD
	Dates: 15/09/2016 - 19/09/2016	**Logger:** IH

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
11.00	B16							*Dense from 11.00m to 15.00m.*		
11.00 - 11.45	SPT (C) N=34			N=34 (7,7/7,10,10,7)						
11.50	D17									
12.00	B18									
12.50 - 12.95	SPT (C) N=37			N=37 (10,10/10,12,7,8)		(9.30)				
13.00	B19									
14.00	B20									
14.00 - 14.45	SPT (C) N=41			N=41 (7,7/10,10,7,14)						
14.50	D21									
						15.00		End of borehole at 15.000m		

Remarks

Water Added		Water Strike - General			
From (m)	To (m)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
5.70	15.00				

Casing Details		Chiselling Details		
To (m)	Diam (mm)	From (m)	To (m)	Time (hh:mm)

CAUSEWAY GEOTECH	**Project No.:** 16-5027	**Project Name:** Arklow Sewerage Scheme	**Borehole No.:** BH14
	Coordinates: E	**Client:** Irish Water	Sheet 1 of 2
Method: Cable Percussion	N	**Client's Representative:** Arup Byrne Looby	**Scale:** 1:50
Plant: Dando	**Ground Level:** mOD	**Dates:** 21/09/2016 - 21/09/2016	**Driller:** WD **Logger:** IH

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description
						(0.20)		TARMACADAM
						0.20		MADE GROUND: Brown, sandy, gravelly fill
						(1.00)		
1.00	D1							
1.00 - 1.45	SPT (C) N=5			N=5 (2,1/1,1,1,2)		1.20		
1.20	B2							Loose, light brown, slightly silty sandy GRAVEL with low cobble content. Gravel is fine to coarse, subangular to subrounded. Sand is fine to coarse. Cobbles are subrounded.
1.60	B3					(0.80)		
2.00	B4					2.00		
2.00 - 2.45	SPT (C) N=8			N=8 (2,2/2,2,2,2)				Loose to medium dense, Brown/grey, slightly silty, gravelly SAND with low cobble content. Gravel is fine to coarse, angular to subrounded. Sand is fine to coarse. Cobbles are subangular to subrounded, 63-80mm dia.
3.00	B5					(2.00)		
3.00 - 3.45	SPT (C) N=12			N=12 (3,3/4,2,3,3)				
4.00	B6					4.00		
4.00 - 4.45	SPT (C) N=16			N=16 (4,4/4,4,4,4)				Medium dense, red/brown, slightly silty, very sandy GRAVEL. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse.
5.00	B7							
5.00 - 5.45	SPT (C) N=16			N=16 (4,5/5,4,4,3)				
5.40	B8					(3.00)		
5.90	D9							
6.50 - 6.95	SPT (C) N=14			N=14 (3,4/3,3,4,4)				
7.00	B10					7.00		Medium dense, light yellow/brown, slightly gravelly, fine to medium SAND. Gravel is subangular, fine.
8.00	B11							
8.00 - 8.45	SPT (C) N=22			N=22 (7,7/4,5,7,6)		(2.40)		
8.50	D12							
9.40	B13					9.40		
9.50 - 9.95	SPT (C) N=64			N=64 (4,8/9,11,22,22)				Very stiff, grey/brown, slightly sandy, slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse.
~~10.00~~	D14							

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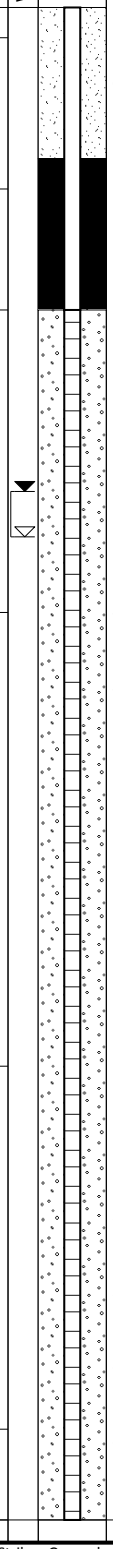
Water / Backfill



Remarks

Water Added		Water Strike - General			
From (m)	To (m)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
		3.50		20	3.20

Casing Details		Chiselling Details		
To (m)	Diam (mm)	From (m)	To (m)	Time (hh:mm)

CAUSEWAY GEOTECH

Project No.: 16-5027	**Project Name:** Arklow Sewerage Scheme	**Borehole No.:** BH14
Coordinates: E N	**Client:** Irish Water	Sheet 2 of 2
Method: Cable Percussion	**Client's Representative:** Arup Byrne Looby	**Scale:** 1:50
Plant: Dando	**Ground Level:** mOD	**Dates:** 21/09/2016 - 21/09/2016	**Driller:** WD / **Logger:** IH

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description
11.00	B15							
11.00 - 11.45	SPT (C) N=37			N=37 (7,8/8,9,10,10)				
11.50	D16							
12.00	B17							
12.50 - 12.95	SPT (C) N=60			N=60 (8,10/10,15,15,20)		(5.60)		
12.80	B18							
13.00	B19							
14.00	D20							
14.00 - 14.45	SPT (C) N=47			N=47 (7,7/10,10,10,17)				
						15.00		End of borehole at 15.000m

Water: Backfill

10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5 19.0 19.5

Remarks

Water Added		Water Strike - General			
From (m)	To (m)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
		3.50		20	3.20

Casing Details		Chiselling Details		
To (m)	Diam (mm)	From (m)	To (m)	Time (hh:mm)

CAUSEWAY GEOTECH	**Project No.:** 16-5027	**Project Name:** Arklow Sewerage Scheme	**Borehole No.:** BH15
	Coordinates: E	**Client:** Irish Water	Sheet 1 of 1
Method: Cable Percussive	N	**Client's Representative:** Arup Byrne Looby	**Scale:** 1:50
Plant: Dando 1500	**Ground Level:** mOD	**Dates:** 29/08/2016 - 29/08/2016	**Driller:** JO'SB
			Logger:

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
						(0.08) 0.08		Tarmacadam surfacing		
						(0.24) 0.32		Very hard CONCRETE (drillers description)		
								Reinforced Concrete.		
						(0.64)		Reinforced CONCRETE with a concrete anchor. (drillers description)		
						0.96		End of borehole at 0.960m		

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5

Remarks

Water Added		Water Strike - General			
From (m)	To (m)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Casing Details		Chiselling Details		
To (m)	Diam (mm)	From (m)	To (m)	Time (hh:mm)

CAUSEWAY GEOTECH

Project No.: 16-5027	**Project Name:** Arklow Sewerage Scheme	**Borehole No.:** BH15A
Coordinates: E N	**Client:** Irish Water	Sheet 1 of 1
Method: Cable Percussive	**Client's Representative:** Arup Byrne Looby	**Scale:** 1:50
Plant: Dando 1500	**Ground Level:** mOD	**Driller:** JO'SB
	Dates: 29/08/2016 - 29/08/2016	**Logger:** IH

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
						(0.08) 0.08		Tarmacadam surfacing (drillers description).		
						(0.20)		Very strong reinforced CONCRETE (drillers description).		
0.28 - 0.96	B1					0.28		Dark grey/brown, slightly sandy, gravelly SILT with medium cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded, fine to coarse. Cobbles are subangular, 63 to 120mm.		
0.28 - 0.96	D2					(0.68)				
0.80	EW3								▼	
						0.96		End of borehole at 0.960m		

Remarks

Water Added		Water Strike - General			
From (m)	To (m)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
		0.80		20	0.80

Casing Details		Chiselling Details		
To (m)	Diam (mm)	From (m)	To (m)	Time (hh:mm)

CAUSEWAY GEOTECH	**Project No.:** 16-5027	**Project Name:** Arklow Sewerage Scheme	**Borehole No.:** BH15B
	Coordinates: E	**Client:** Irish Water	Sheet 1 of 1
Method: Cable Percussive	N	**Client's Representative:** Arup Byrne Looby	**Scale:** 1:50
Plant: Dando 1500	**Ground Level:** mOD	**Dates:** 30/08/2016 - 30/08/2016	**Driller:** JO'SB
			Logger: IH

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
						(0.05) 0.05		Tarmacadam surfacing (drillers description)		
						(0.23) 0.28		Reinforced CONCRETE (drillers description)		
0.28 - 0.41	B1							Light brown, sandy, gravelly SILT with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded, fine to coarse. Cobbles are 63 to 100mm, subangular.		
0.28 - 0.41	D2									
0.41 - 0.96	B3					(0.68)				
0.41 - 0.96	D4									
						0.96		End of borehole at 0.960m		

Remarks

Water Added		Water Strike - General			
From (m)	To (m)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Casing Details		Chiselling Details		
To (m)	Diam (mm)	From (m)	To (m)	Time (hh:mm)

CAUSEWAY GEOTECH

Project No.: 16-5027	**Project Name:** Arklow Sewerage Scheme	**Borehole No.:** BH15C
Coordinates: E N	**Client:** Irish Water	Sheet 1 of 1
Method: Cable Percussive	**Client's Representative:** Arup Byrne Looby	**Scale:** 1:50
Plant: Dando 1500	**Ground Level:** mOD	**Driller:** JO'SB
	Dates: 30/08/2016 - 30/08/2016	**Logger:** IH

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
0.08 - 0.20	B1					(0.08) 0.08		Tarmacadam surfacing (drillers description)		
0.08 - 0.20	D2					(0.12) 0.20		Dark brown, slightly sandy, very gravelly SILT with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular, 63-80mm.		
0.20 - 1.20	B3					(1.00)		Light brown, sandy, gravelly SILT with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular, 63-90mm.		
0.20 - 1.20	D4					1.20		End of borehole at 1.200m		

Remarks

Water Added		Water Strike - General			
From (m)	To (m)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Casing Details		Chiselling Details		
To (m)	Diam (mm)	From (m)	To (m)	Time (hh:mm)

CAUSEWAY GEOTECH	**Project No.:** 16-5027	**Project Name:** Arklow Sewerage Scheme	**Borehole No.:** BH15D
	Coordinates: E	**Client:** Irish Water	Sheet 1 of 3
Method: Cable Percussive	N	**Client's Representative:** Arup Byrne Looby	**Scale:** 1:50
Plant: Dando 1500	**Ground Level:** mOD	**Dates:** 31/08/2016 - 07/09/2016	**Driller:** JO'SB
			Logger: IH

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description
						(0.07)		TARMAC
0.20 - 1.60	B1					(0.13) 0.20		Compacted black, gravelly CLAY. Gravel is fine to medium, rounded (drillers description).
0.20 - 1.60	D2							Brown, silty sandy GRAVEL with medium cobble content. Gravel is fine to coarse, subangular to subrounded. Sand is fine to coarse. Cobbles are subangular.
						(2.40)		
1.60 - 2.60	B3							
1.60 - 2.60	D4							
1.60 - 1.90	SPT (C)			42 (3,4/42 for 150mm)				
2.60 - 4.10	B5					2.60		Loose to medium dense, orange/brown, slightly silty, sandy GRAVEL. Gravel is fine to coarse, subangular to subrounded. Sand is fine to coarse.
2.60 - 4.10	D6							
2.60 - 3.05	SPT (C) N=26			N=26 (3,4/5,6,7,8)				
3.60 - 4.05	SPT (C) N=19			N=19 (3,3/5,4,5,5)				
4.10 - 5.60	B7							
4.10 - 5.60	D8							
4.60 - 5.05	SPT (C) N=18			N=18 (2,4/4,2,5,7)		(4.20)		
5.60 - 6.80	B9							*With shell fragments from 5.60 - 6.80m.*
5.60 - 6.80	D10							
5.60 - 6.05	SPT (C) N=4			N=4 (1,2/1,1,1,1)				
6.60 - 7.05	SPT (C) N=11			N=11 (2,2/3,4,1,3)				
6.80 - 8.50	B11					6.80		Loose to medium dense, light brown, silty SAND. Sand is fine to medium.
6.80 - 8.50	D12							
						(4.00)		
8.50 - 10.00	B13							
8.50 - 10.00	D14							
8.50 - 8.95	SPT (C) N=8			N=8 (2,1/2,2,1,3)				
~~10.00 - 10.80~~	B15							

Continued on Next Page

Remarks

Water Added	
From (m)	To (m)
1.60	

Water Strike - General			
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
4.00		20	3.90

Casing Details	
To (m)	Diam (mm)
10.70	200
20.00	150

Chiselling Details		
From (m)	To (m)	Time (hh:mm)
1.80	1.90	01:30

CAUSEWAY GEOTECH

Project No.: 16-5027	**Project Name:** Arklow Sewerage Scheme	**Borehole No.:** BH15D
Coordinates: E	**Client:** Irish Water	Sheet 2 of 3
Method: Cable Percussive	**Client's Representative:** Arup Byrne Looby	**Scale:** 1:50
Plant: Dando 1500	**Ground Level:** mOD	**Dates:** 31/08/2016 - 07/09/2016	**Driller:** JO'SB
			Logger: IH

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description
10.00 - 10.80	D16							
10.00 - 10.45	SPT (C) N=22			N=22 (4,5/5,5,6,6)				
10.70 - 11.15	U17							
10.70 - 10.70	SPT (C)			40 (0 for 0mm/40 for 0mm)		10.80		
						(0.50)		Hard grey/brown CLAY.
10.80 - 11.30	B18							
10.80 - 11.30	D19					11.30		
11.15 - 11.60	SPT (C) N=23			N=23 (6,6/5,6,4,8)				Medium dense, light brown/orange, slightly silty, very gravelly SAND. Gravel is fine to medium, angular to subangular. Sand is fine to coarse.
11.30 - 12.00	B20					(0.70)		
11.30 - 12.00	D21							
12.00 - 13.50	B22					12.00		
12.00 - 13.50	D23							Dense, dark grey, gravelly SAND with high cobble content Gravel is fine to coarse, subangular to subrounded. Sand is medium to coarse. Cobbles are subangular to subrounded, 63-90mm dia.
12.65 - 13.10	SPT (C) N=40			N=40 (4,7/10,9,12,9)		(1.50)		
13.50 - 15.00	B24					13.50		
13.50 - 15.00	D25							Medium Dense to Dense, dark grey, slightly gravelly SAND with some lenses of firm Clay present. Gravel is fine to medium, subangular to subrounded. Sand is medium to coarse.
14.15 - 14.60	SPT (C) N=31			N=31 (3,6/7,6,10,8)		(1.50)		
15.00 - 16.00	B26					15.00		
15.00 - 16.00	D27							Soft to firm, brown/grey CLAY
16.00 - 16.45	U28							
16.00 - 17.50	B30							
16.00 - 17.50	D31							
16.50 - 16.95	SPTLS29							
16.50 - 16.95	SPT (S) N=8			N=8 (2,2/1,2,3,2)		(3.50)		
17.50 - 18.50	B32							
17.50 - 18.50	D33							
18.00 - 18.45	SPT (S) N=25			N=25 (3,4/5,7,6,7)				*Below 18.0m: Stiff to very stiff.*
18.50 - 20.00	B34					18.50		
18.50 - 20.00	D35							Grey/Brown, slightly clayey, gravelly SAND with low cobble content. Gravel is fine to coarse, subangular to subrounded. Sand is medium to coarse. Cobbles are subangular to subrounded, 63-100mm dia.
						(1.50)		
						20.00		

Continued on Next Page

Water | Backfill

Remarks

Water Added		Water Strike - General			
From (m)	To (m)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
1.60		4.00		20	3.90

Casing Details		Chiselling Details		
To (m)	Diam (mm)	From (m)	To (m)	Time (hh:mm)
10.70	200	1.80	1.90	01:30
20.00	150			

CAUSEWAY GEOTECH

Project No.: 16-5027	**Project Name:** Arklow Sewerage Scheme		**Borehole No.:** BH15D
Coordinates: E	**Client:** Irish Water		Sheet 3 of 3
Method: Cable Percussive	**Client's Representative:** Arup Byrne Looby		**Scale:** 1:50
Plant: Dando 1500	**Ground Level:** mOD	**Dates:** 31/08/2016 - 07/09/2016	**Driller:** JO'SB
N			**Logger:** IH

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
20.00 - 20.08	SPT (C)			25 (31 for 75mm/25 for 0mm)				End of borehole at 20.000m		

20.5 21.0 21.5 22.0 22.5 23.0 23.5 24.0 24.5 25.0 25.5 26.0 26.5 27.0 27.5 28.0 28.5 29.0 29.5

Remarks

Water Added	
From (m)	To (m)
1.60	

Water Strike - General			
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
4.00		20	3.90

Casing Details	
To (m)	Diam (mm)
10.70	200
20.00	150

Chiselling Details		
From (m)	To (m)	Time (hh:mm)
1.80	1.90	01:30

CAUSEWAY GEOTECH

Project No.: 16-5027	**Project Name:** Arklow Sewerage Scheme		**Borehole No.:** **BH16**
Coordinates: E	**Client:** Irish Water		Sheet 1 of 3
Method: Cable Percussion	**Client's Representative:** Arup Byrne Looby		**Scale:** 1:50
Plant: Dando 1500	**Ground Level:** mOD	**Dates:** 18/08/2016 - 25/08/2016	**Driller:** JOSB / **Logger:** AG

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
0.05 - 0.50	B1					(0.05)		Concrete slab.		
0.05 - 0.50	D2							Loose light brown silty slightly silty SAND and GRAVEL with occasional shells and shell fragments. Low cobble content. Gravel angular to subrounded medium to coarse. Cobbles angular sandstone.		
0.50 - 1.20	B3									
0.50 - 1.20	D4									
						(1.95)				
1.20 - 2.00	B5									
1.20 - 2.00	D6									
1.20 - 1.65	SPT (S) N=5			N=5 (1,2/2,1,1,1)						
2.00 - 3.00	B7					2.00				
2.00 - 3.00	D8							Medium dense dark grey brown very silty very gravelly fine SAND with rootlets and organic odour. Gravel subangular to rounded, medium.	▼	
2.00 - 2.45	SPT (S) N=26			N=26 (5,7/5,7,8,6)						
2.10	W9					(1.00)				
3.00 - 4.50	B11					3.00				
3.00 - 4.50	U10							Loose brown silty gravelly fine SAND. Gravel subrounded to rounded fine to medium.		
3.00 - 3.45	SPT (S) N=6			N=6 (2,2/3,1,1,1)						
						(1.50)				
4.00 - 4.45	SPT (S) N=19			N=19 (4,4/5,4,5,5)				*Below 4.0m: Medium dense.*		
4.50 - 5.60	B12					4.50				
4.50 - 5.60	D13							Medium dense, locally very loose, grey and brown silty gravelly fine to coarse SAND with occasional shell fragments. Gravel subangular to rounded fine to coarse, mixed lithologies.		
5.00 - 5.45	SPT (C) N=16			N=16 (5,4/2,5,5,4)						
5.60 - 7.00	B14									
5.60 - 7.00	D15									
						(4.90)				
7.50 - 8.50	B16									
7.50 - 8.50	B17									
7.50 - 7.95	SPT (S) N=19			N=19 (3,5/4,6,5,4)						
8.50 - 9.40	B18									
8.50 - 9.40	D19									
9.00 - 9.45	SPT (S) N=17	9.00	1.90	N=17 (3,4/5,5,4,3) 19-08-2016						
		9.00	2.50	18-08-2016						
9.40 - 10.00	B20					9.40				
9.40 - 10.00	D21							Stiff grey sandy SILT/CLAY		
						(0.60)				
~~10.00 - 10.50~~	B22					10.00				

Continued on Next Page

Remarks

Water Added		Water Strike - General			
From (m)	To (m)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
1.20	2.00	2.20	2.20	20	2.10

Casing Details		Chiselling Details		
To (m)	Diam (mm)	From (m)	To (m)	Time (hh:mm)
10.50	200	0.00	0.05	03:00
20.00	150			

CAUSEWAY GEOTECH	**Project No.:** 16-5027	**Project Name:** Arklow Sewerage Scheme	**Borehole No.:** BH16
	Coordinates: E	**Client:** Irish Water	Sheet 2 of 3
Method: Cable Percussion	N	**Client's Representative:** Arup Byrne Looby	**Scale:** 1:50
Plant: Dando 1500	**Ground Level:** mOD	**Dates:** 18/08/2016 - 25/08/2016	**Driller:** JOSB **Logger:** AG

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
10.00 - 10.50	D23							Medium dense grey and brown slightly silty SAND and GRAVEL. Sand fine to coarse. Gravel angular to subrounded fine to medium.		
10.50 - 11.00	B24					(1.00)				
10.50 - 11.00	D25									
10.50 - 10.95	SPT (C) N=24			N=24 (7,7/6,7,5,6)						
		10.50	0.80	22-08-2016		11.00				
		10.50	2.10	19-08-2016				Very stiff grey brown slightly sandy slightly gravelly CLAY/SILT. Gravel is subangular to subrounded, fine.		
11.00 - 12.50	B26									
11.00 - 12.50	D27									
12.00 - 12.45	SPT (S) N=30			N=30 (5,6/6,7,8,9)						
12.50 - 13.50	B28									
12.50 - 13.50	D29									
13.50 - 14.00	U30									
14.00 - 15.50	B31									
14.00 - 15.50	D32									
		13.50	3.20	22-08-2016		(7.00)				
		16.00	0.00	24-08-2016						
15.50 - 17.00	B33									
15.50 - 17.00	D34									
15.50 - 15.95	SPT (S) N=21			N=21 (5,2/3,5,6,7)						
17.00 - 18.00	B35									
17.00 - 18.00	D36									
17.00 - 17.45	SPT (S) N=49			N=49 (8,7/12,7,14,16)						
18.00 - 19.50	B37					18.00				
18.00 - 19.50	D38							Medium dense to dense grey and brown slightly silty slightly sandy GRAVEL with high cobble content. Gravel subangular to rounded fine to coarse. Cobbles subangular to subrounded mixed lithologies.		
		18.00	2.00	25-08-2016						
		18.00	2.50	24-08-2016						
18.50 - 18.95	SPT (C) N=28			N=28 (6,6/5,6,7,10)		(2.50)				
19.50 - 20.00	B39									
19.50 - 20.00	D40									
19.50 - 19.95	SPT (C) N=45			N=45 (5,5/6,6,8,25)						

Continued on Next Page

Remarks

Water Added		Water Strike - General			
From (m)	To (m)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
1.20	2.00	2.20	2.20	20	2.10

Casing Details		Chiselling Details		
To (m)	Diam (mm)	From (m)	To (m)	Time (hh:mm)
10.50	200	0.00	0.05	03:00
20.00	150			

CAUSEWAY GEOTECH	**Project No.:** 16-5027	**Project Name:** Arklow Sewerage Scheme	**Borehole No.:** BH16
	Coordinates: E	**Client:** Irish Water	Sheet 3 of 3
Method: Cable Percussion	N	**Client's Representative:** Arup Byrne Looby	**Scale:** 1:50
Plant: Dando 1500	**Ground Level:** mOD	**Dates:** 18/08/2016 - 25/08/2016	**Driller:** JOSB **Logger:** AG

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
		20.00	3.50	25-08-2016		20.50		End of borehole at 20.500m		

Remarks

Water Added	
From (m)	To (m)
1.20	2.00

Water Strike - General			
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
2.20	2.20	20	2.10

Casing Details	
To (m)	Diam (mm)
10.50	200
20.00	150

Chiselling Details		
From (m)	To (m)	Time (hh:mm)
0.00	0.05	03:00

Appendix B Geotechnical Laboratory Test Results

LABORATORY REPORT

4043

Contract Number: PSL16/4906

Report Date: 11 November 2016

Client's Reference: 16-5027

Client Name: Causeway Geotech
8 Drumahiskey Road
Ballymoney
Co.Antrim
BT53 7QL

For the attention of: Stephen Watson

Contract Title: Arklow

Date Received: 20/10/2016
Date Commenced: 20/10/2016
Date Completed: 11/11/2016

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:

R Gunson (Director)	A Watkins (Director)	R Berriman (Quality Manager)
D Lambe (Senior Technician)	S Royle (Senior Technician)	W Allen (Senior Technician)

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SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
BH12	2	B	1.20		Dark brown very gravelly very sandy very silty CLAY with some organic material.
BH12	3	D	2.00		Brown very sandy silty GRAVEL.
BH12	5	B	3.00		Brown very sandy slightly silty GRAVEL.
BH12	6	B	4.00		Brown very sandy silty GRAVEL.
BH12	7	B	5.00		Brown gravelly silty SAND.
BH12	12	B	7.50		Brown slightly gravelly silty SAND.
BH12	14	B	9.00		Brown SAND.
BH13	1	B	1.00		Brown sandy slightly clayey silty GRAVEL.
BH13	4	B	3.00		Brown sandy silty GRAVEL.
BH13	5	B	4.00		Brown slightly silty SAND & GRAVEL.
BH13	8	B	6.50		Brown slightly gravelly slightly silty SAND.
BH13	15	B	10.00		Brown slightly gravelly SAND.
BH14	3	B	1.60		Brown sandy slightly silty GRAVEL.
BH14	6	B	4.00		Brown very sandy GRAVEL.
BH14	8	B	5.40		Brown gravelly SAND.
BH14	13	B	9.40		Brown gravelly sandy CLAY.
BH14	15	B	11.00		Brown gravelly sandy CLAY.
BH15D	1	B	0.20	1.60	Brown sandy slightly silty GRAVEL with cobbles.
BH15D	3	B	1.60	2.60	Brown very sandy GRAVEL.

UKAS TESTING 4043

PSL Professional Soils Laboratory

Checked / Approved		Date	11/11/16	Contract No:
Arklow				PSL16/4906
				Client Ref:
				16-5027

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
BH15D	7	B	4.10	5.60	Brown sandy slightly silty GRAVEL.
BH15D	13	B	8.50	10.00	Brown slightly gravelly silty SAND.
BH15D	18	B	10.80	11.30	Brown slightly sandy very silty CLAY.
BH15D	24	B	13.50	15.00	Brown gravelly sandy CLAY.
BH15D	28	U	16.00	16.45	Firm brown slightly gravelly sandy very silty CLAY.
BH16	3	B	0.50	1.20	Brown very gravelly slightly silty SAND with cobbles.
BH16	5	B	1.20	2.00	Brown very gravelly silty SAND.
BH16	7	B	2.00	3.00	Brown very gravelly silty SAND.
BH16	11	B	3.00	4.50	Brown slightly gravelly silty SAND.
BH16	14	B	5.60	7.00	Grey slightly gravelly SAND.
BH16	16	B	7.50	8.50	Grey gravelly silty SAND.
BH16	19	D	8.50	9.40	Brown gravelly SAND.
BH16	24	B	10.50	11.00	Brown gravelly SAND.
BH16	28	B	12.50	13.50	Brown slightly gravelly sandy CLAY.

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved		Date	11/11/16
		Arklow			Contract No: PSL16/4906 Client Ref: 16-5027

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
BH12	2	B	1.20		40			88	38	50	47	Very high plasticity CV.
BH12	3	D	2.00		12							
BH12	5	B	3.00		5.0				NP			
BH12	7	B	5.00		16							
BH12	12	B	7.50		21							
BH12	14	B	9.00		22							
BH13	1	B	1.00		10				NP			
BH13	5	B	4.00		11				NP			
BH13	8	B	6.50		14							
BH13	15	B	10.00		16							
BH14	3	B	1.60		4.6				NP			
BH14	6	B	4.00		5.2							
BH14	8	B	5.40		12							
BH14	13	B	9.40		25			42	20	22	82	Intermediate plasticity CI.
BH14	15	B	11.00		23							
BH15D	1	B	0.20	1.60	5.4				NP			
BH15D	3	B	1.60	2.60	9.1							
BH15D	7	B	4.10	5.60	8.2							
BH15D	13	B	8.50	10.00	18							

SYMBOLS : **NP : Non Plastic** *** : Liquid Limit and Plastic Limit Wet Sieved.**

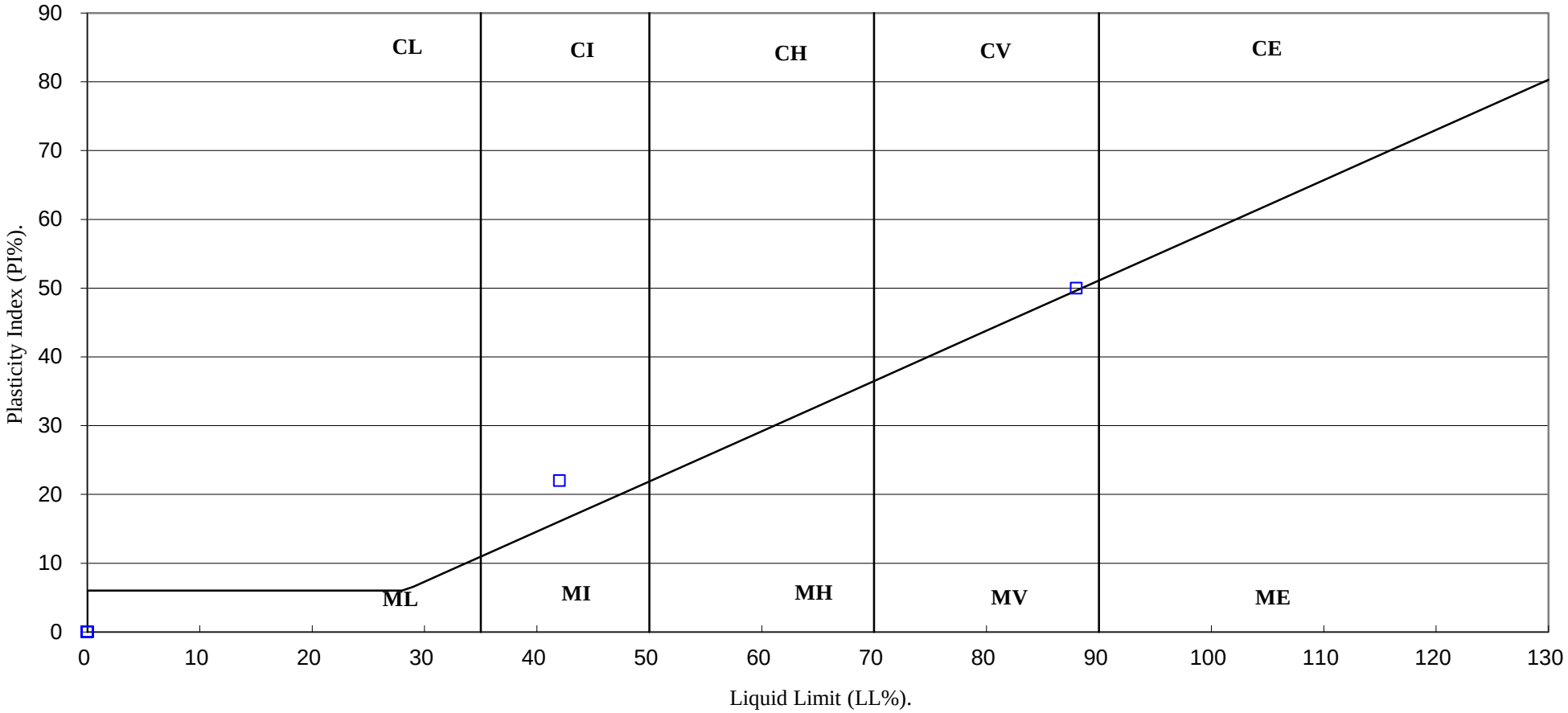
UKAS TESTING 4043

PSL Professional Soils Laboratory

Checked / Approved		Date	11/11/16	Contract No:
Arklow				PSL16/4906
				Client Ref:
				16-5027

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(BS5930 :2015)



UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked /Approved**		**Date**	**11/11/16**	**Contract No:**
			Arklow			**PSL16/4906**
						Client Ref:
						16-5027

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
BH15D	18	B	10.80	11.30	30							
BH15D	24	B	13.50	15.00	8.6							
BH16	3	B	0.50	1.20	9.1				NP			
BH16	5	B	1.20	2.00	16							
BH16	7	B	2.00	3.00	15				NP			
BH16	11	B	3.00	4.50	16							
BH16	14	B	5.60	7.00	16							
BH16	16	B	7.50	8.50	15							
BH16	19	D	8.50	9.40	19							
BH16	24	B	10.50	11.00	8.9							
BH16	28	B	12.50	13.50	24							

SYMBOLS : **NP : Non Plastic** *** : Liquid Limit and Plastic Limit Wet Sieved.**

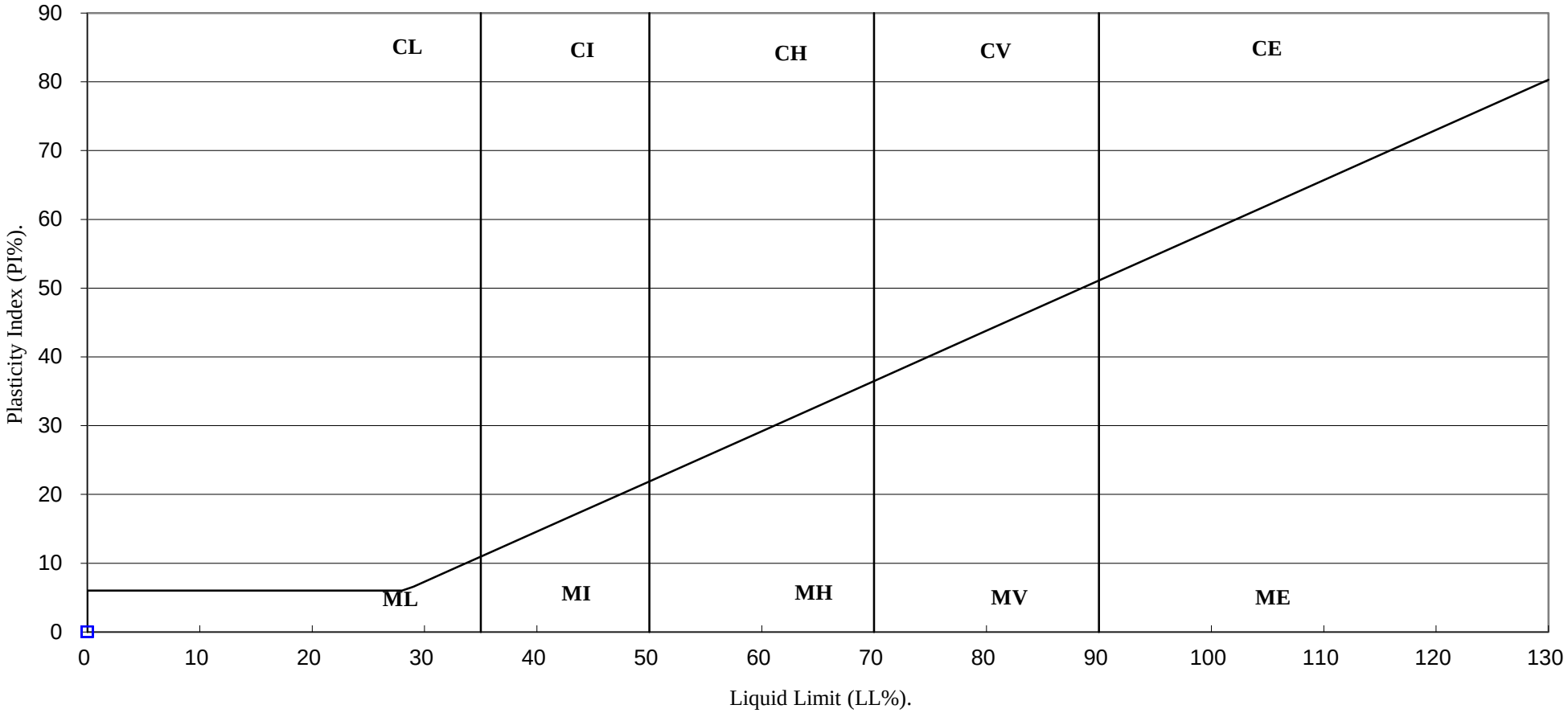
UKAS TESTING 4043

PSL Professional Soils Laboratory

Checked / Approved		Date	11/11/16	Contract No:
Arklow				PSL16/4906
				Client Ref:
				16-5027

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(BS5930 :2015)



UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked /Approved**		**Date**	**11/11/16**	**Contract No:**
			Arklow			**PSL16/4906**
						Client Ref:
						16-5027

PARTICLE SIZE DISTRIBUTION TEST

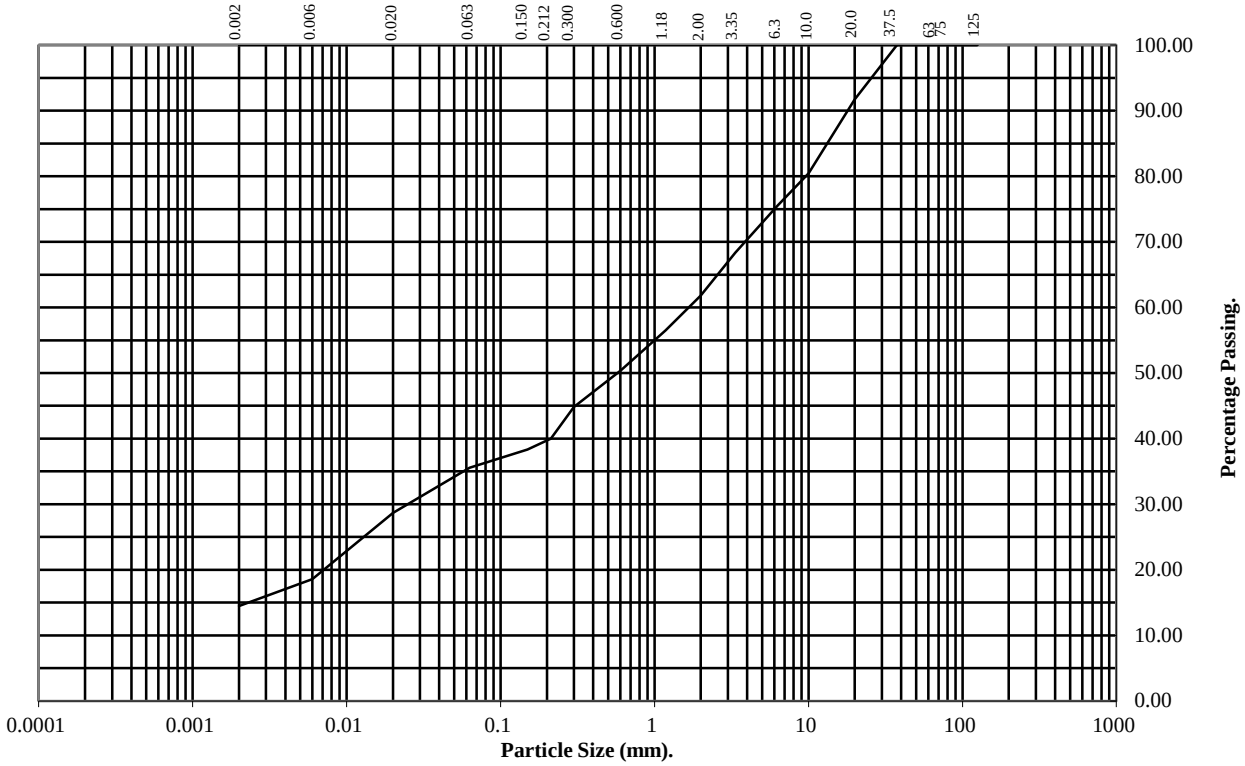
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **BH12** **Top Depth (m):** **1.20**

Sample Number: **2** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	92
10	80
6.3	75
3.35	68
2	62
1.18	57
0.6	50
0.3	45
0.212	40
0.15	38
0.063	36

Particle Diameter	Percentage Passing
0.02	29
0.006	19
0.002	14

Soil Fraction	Total Percentage
Cobbles	0
Gravel	38
Sand	26
Silt	22
Clay	14

Remarks:
See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow		**Client Ref:** 16-5027

PARTICLE SIZE DISTRIBUTION TEST

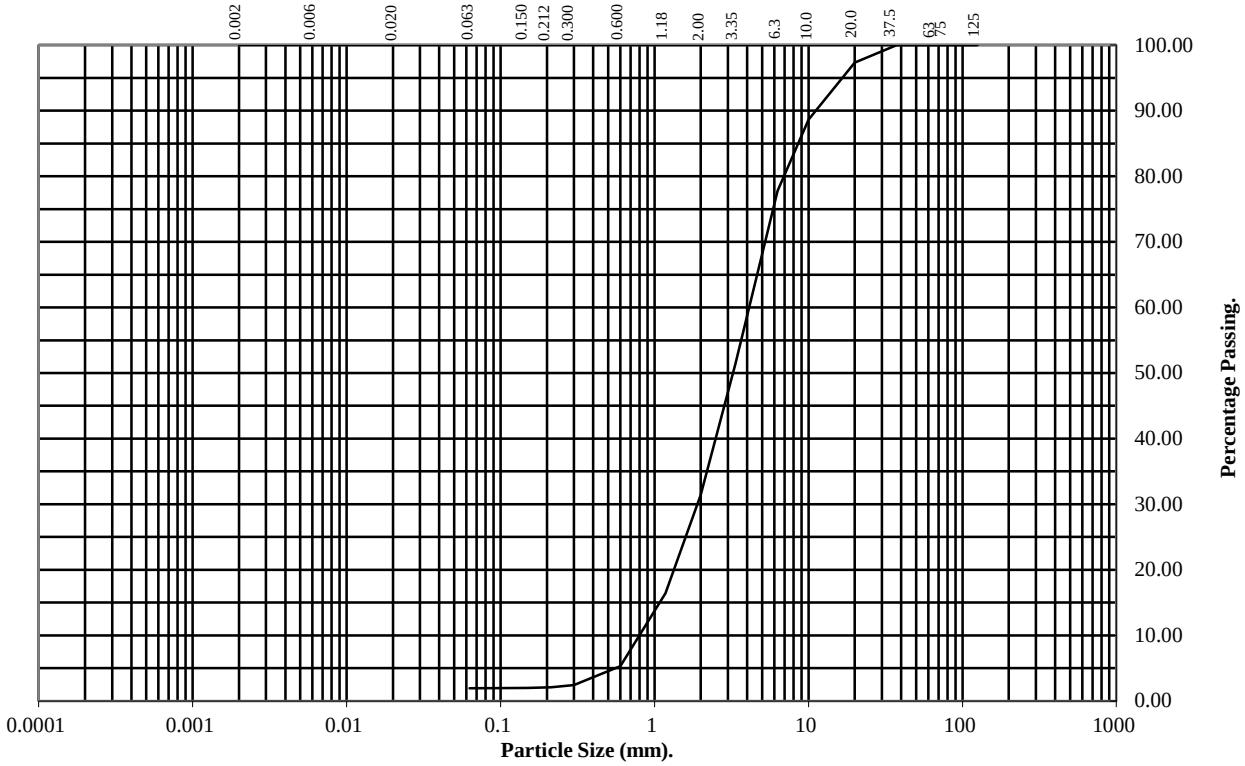
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH12** **Top Depth (m):** **3.00**

Sample Number: **5** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	97
10	89
6.3	78
3.35	51
2	31
1.18	16
0.6	5
0.3	2
0.212	2
0.15	2
0.063	2

Soil Fraction	Total Percentage
Cobbles	0
Gravel	69
Sand	29
Silt/Clay	2

Remarks:

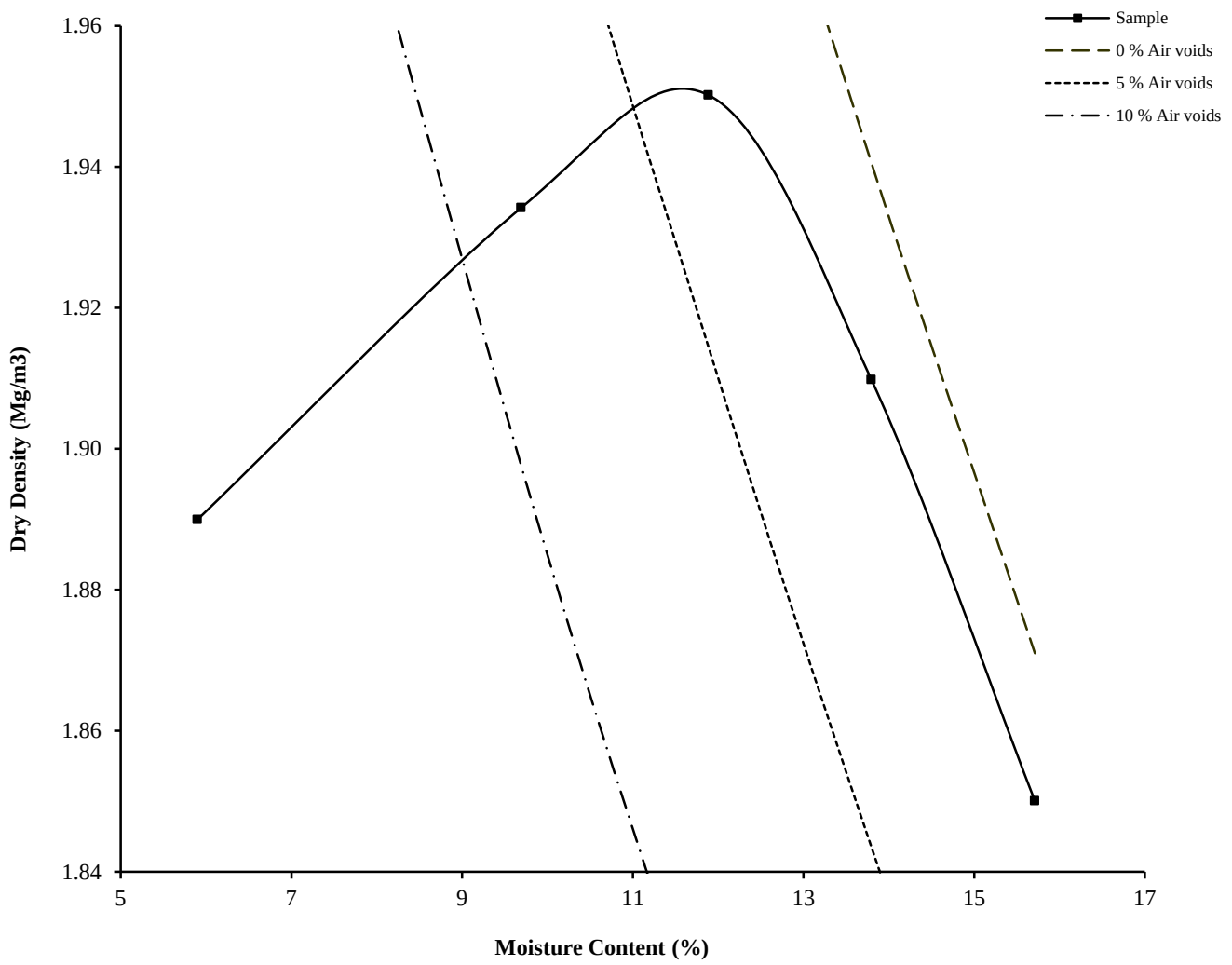
See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** **11/11/16**	**Contract No:** **PSL16/4906**
		Arklow			**Client Ref:** **16-5027**

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : 1990

Hole Number:	**BH12**	**Top Depth (m) :**	**4.00**
Sample Number:	**6**	**Base Depth (m) :**	
Sample Type:	**B**		



Initial Moisture Content:		5.9	Method of Compaction:	2.5Kg Rammer	Separate Samples
Particle Density (Mg/m3):	2.65	Assumed	Material Retained on 37.5 mm Test Sieve (%):		0
Maximum Dry Density (Mg/m3):		1.95	Material Retained on 20.0 mm Test Sieve (%):		2
Optimum Moisture Content (%):		12			
Remarks See summary of soil descriptions					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date**	**11/11/16**	**Contract No.**
		Arklow			**PSL16/4906**
					Client Ref
					16-5027

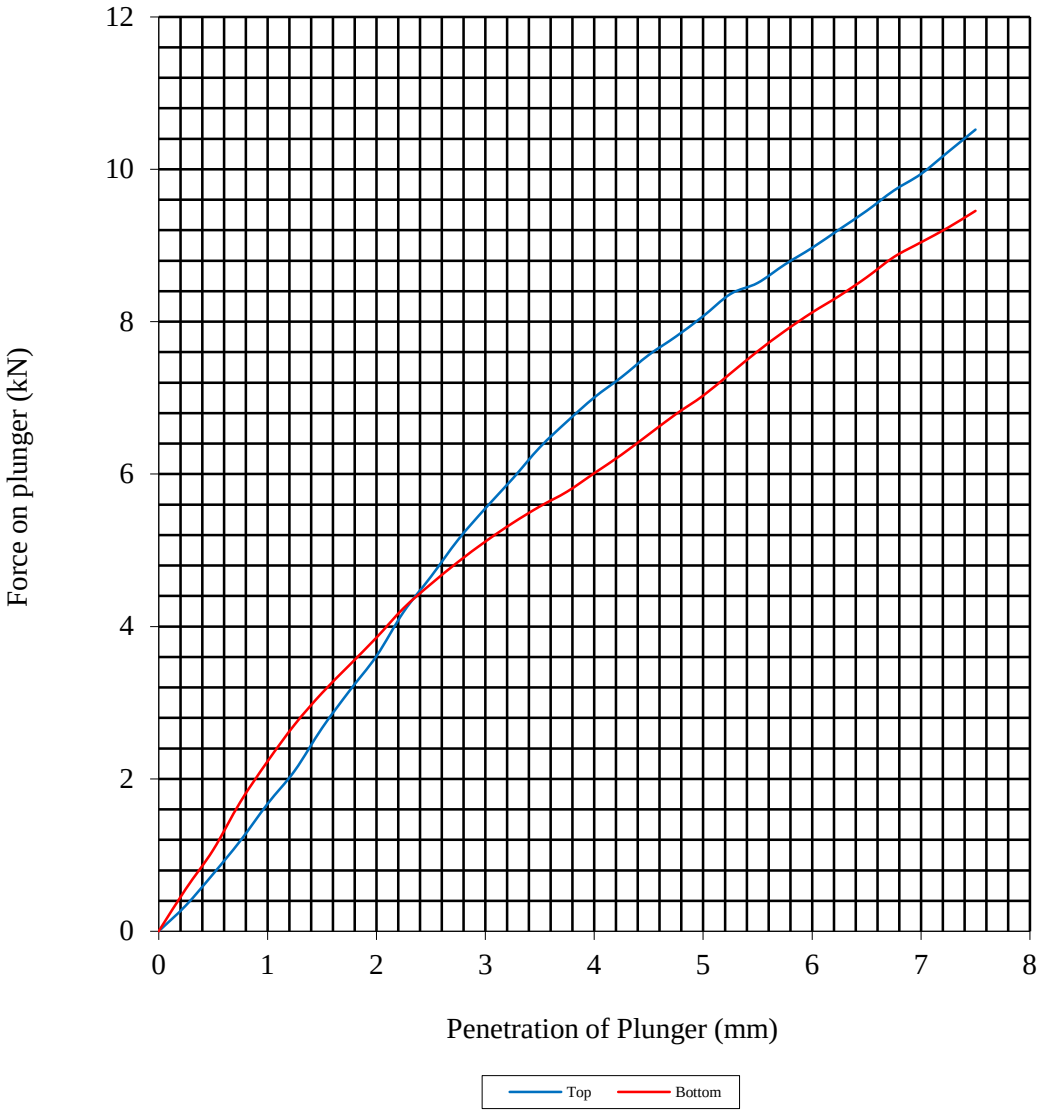
CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number: BH12 **Top Depth (m):** 4.00

Sample Number: 6 **Base Depth (m):**

Sample Type: B



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	5.9	Surcharge Kg:	4.20	Sample Top	5.7	Sample Top	40.4
Bulk Density Mg/m3:	2.00	Soaking Time hrs	0	Sample Bottom	6.1	Sample Bottom	35.1
Dry Density Mg/m3:	1.89	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			0				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved	Date	11/11/16	Contract No: PSL16/4906
		Arklow			Client Ref: 16-5027

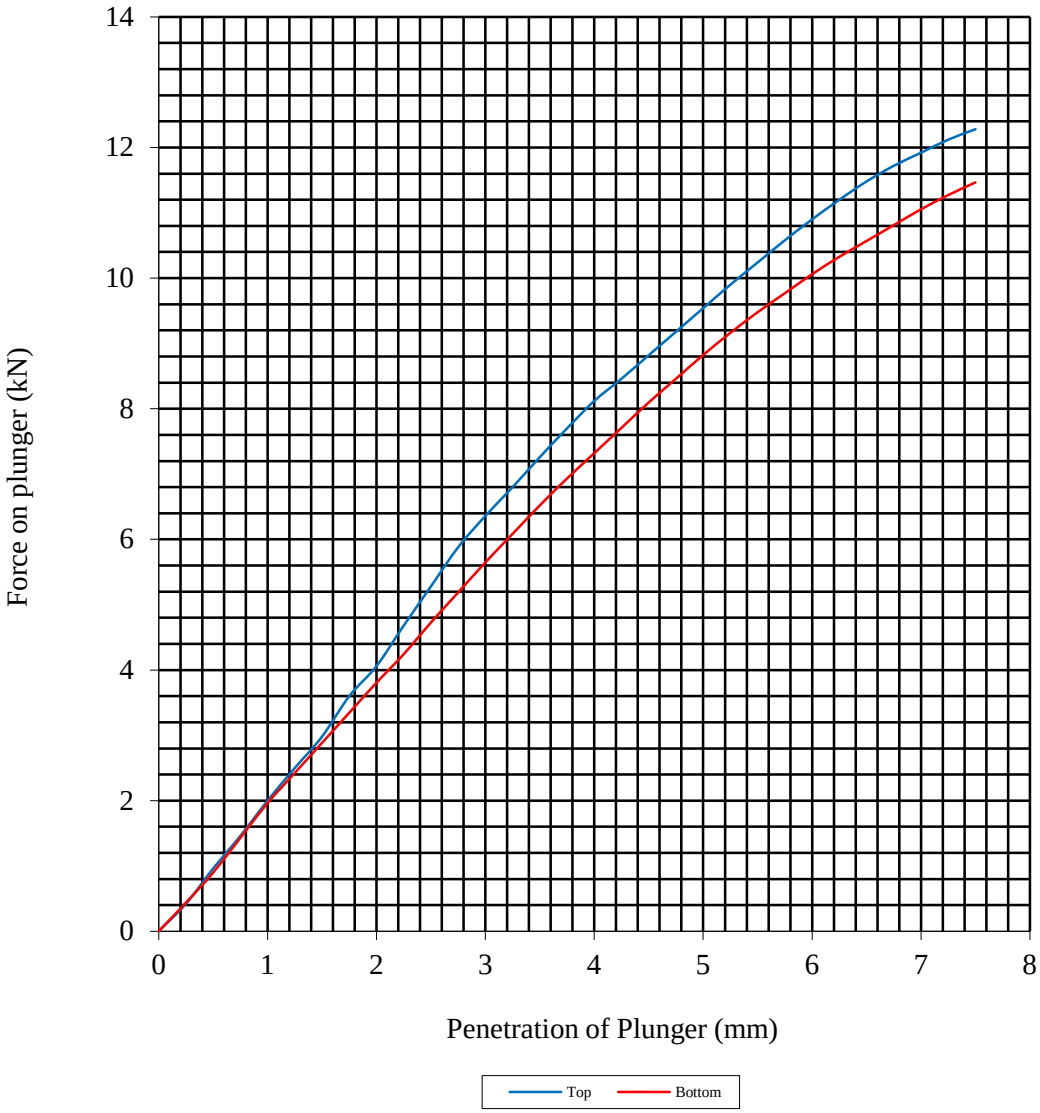
CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number: **BH12** **Top Depth (m):** **4.00**

Sample Number: **6** **Base Depth (m):**

Sample Type: **B**



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	10	Surcharge Kg:	4.20	Sample Top	10	Sample Top	47.7
Bulk Density Mg/m3:	2.13	Soaking Time hrs	0	Sample Bottom	10	Sample Bottom	44.1
Dry Density Mg/m3:	1.94	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			2				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved		Date 11/11/16	Contract No: PSL16/4906
		Arklow			Client Ref: 16-5027

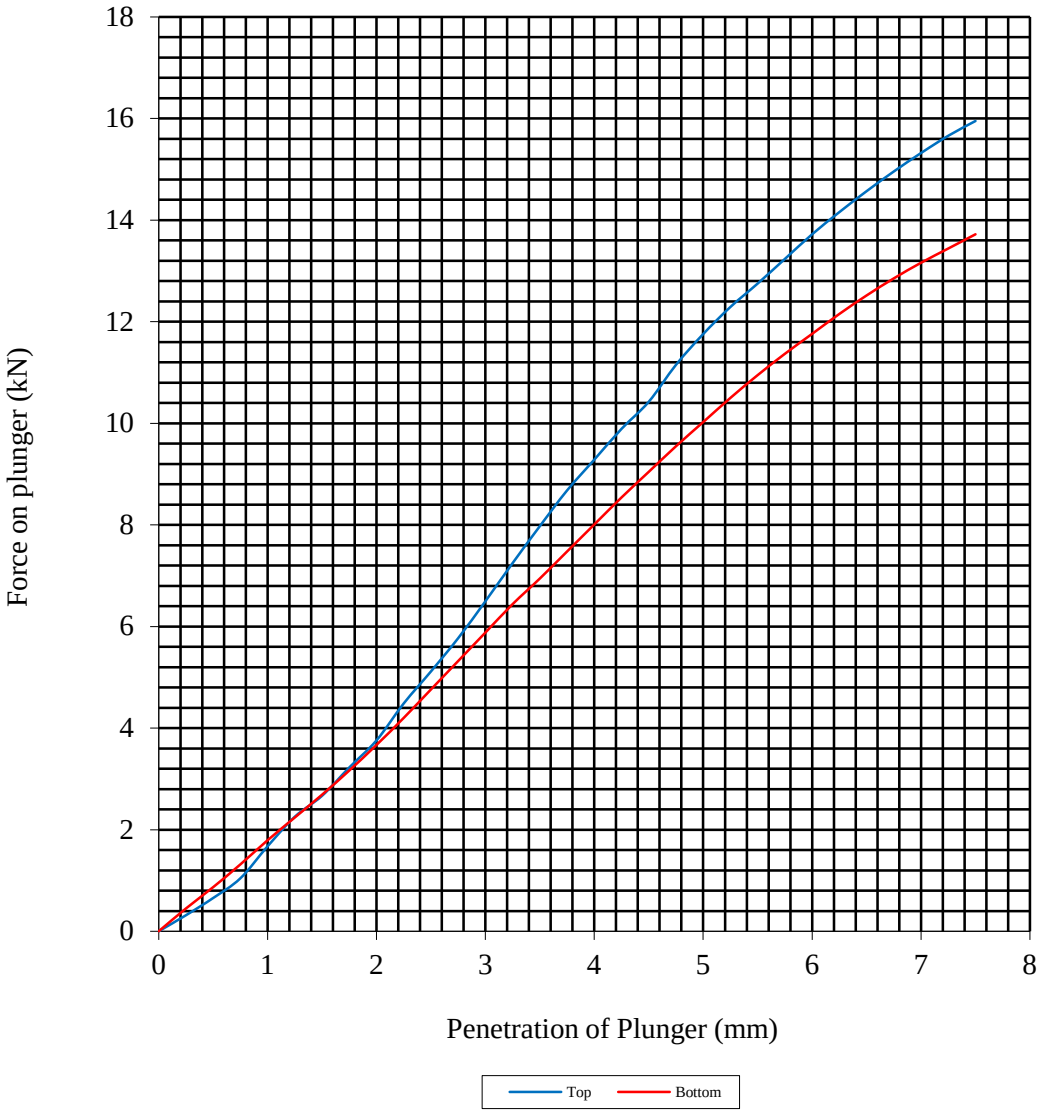
CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number: **BH12** **Top Depth (m):** **4.00**

Sample Number: **6** **Base Depth (m):**

Sample Type: **B**



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	12	Surcharge Kg:	4.20	Sample Top	12	Sample Top	58.8
Bulk Density Mg/m3:	2.18	Soaking Time hrs	0	Sample Bottom	12	Sample Bottom	50.1
Dry Density Mg/m3:	1.95	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			2				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved		Date 11/11/16	Contract No: PSL16/4906
		Arklow			Client Ref: 16-5027

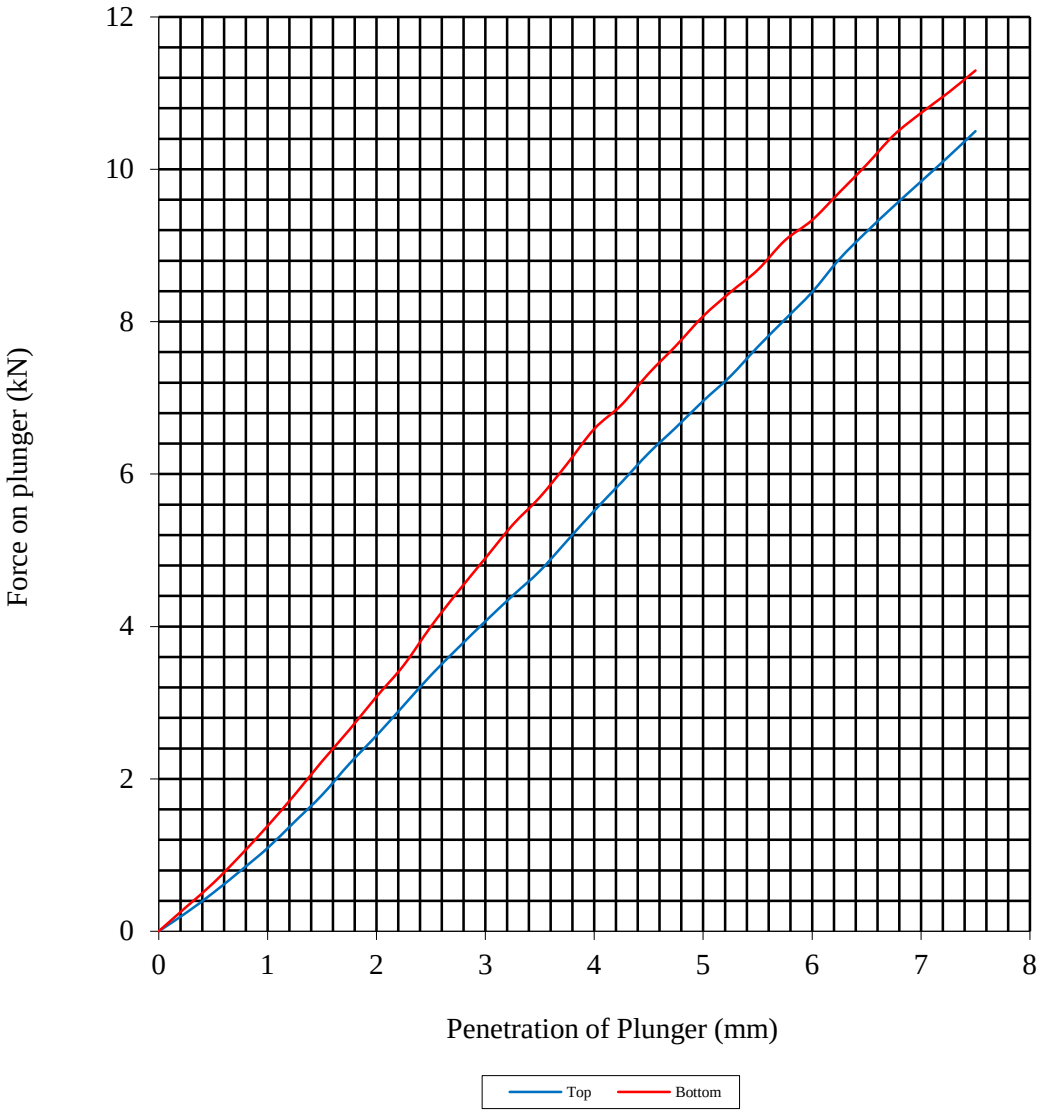
CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number: BH12 **Top Depth (m):** 4.00

Sample Number: 6 **Base Depth (m):**

Sample Type: B



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	14	Surcharge Kg:	4.20	Sample Top	13	Sample Top	34.8
Bulk Density Mg/m3:	2.17	Soaking Time hrs	0	Sample Bottom	14	Sample Bottom	40.4
Dry Density Mg/m3:	1.91	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			2				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved	Date	11/11/16	Contract No: PSL16/4906
		Arklow			Client Ref: 16-5027

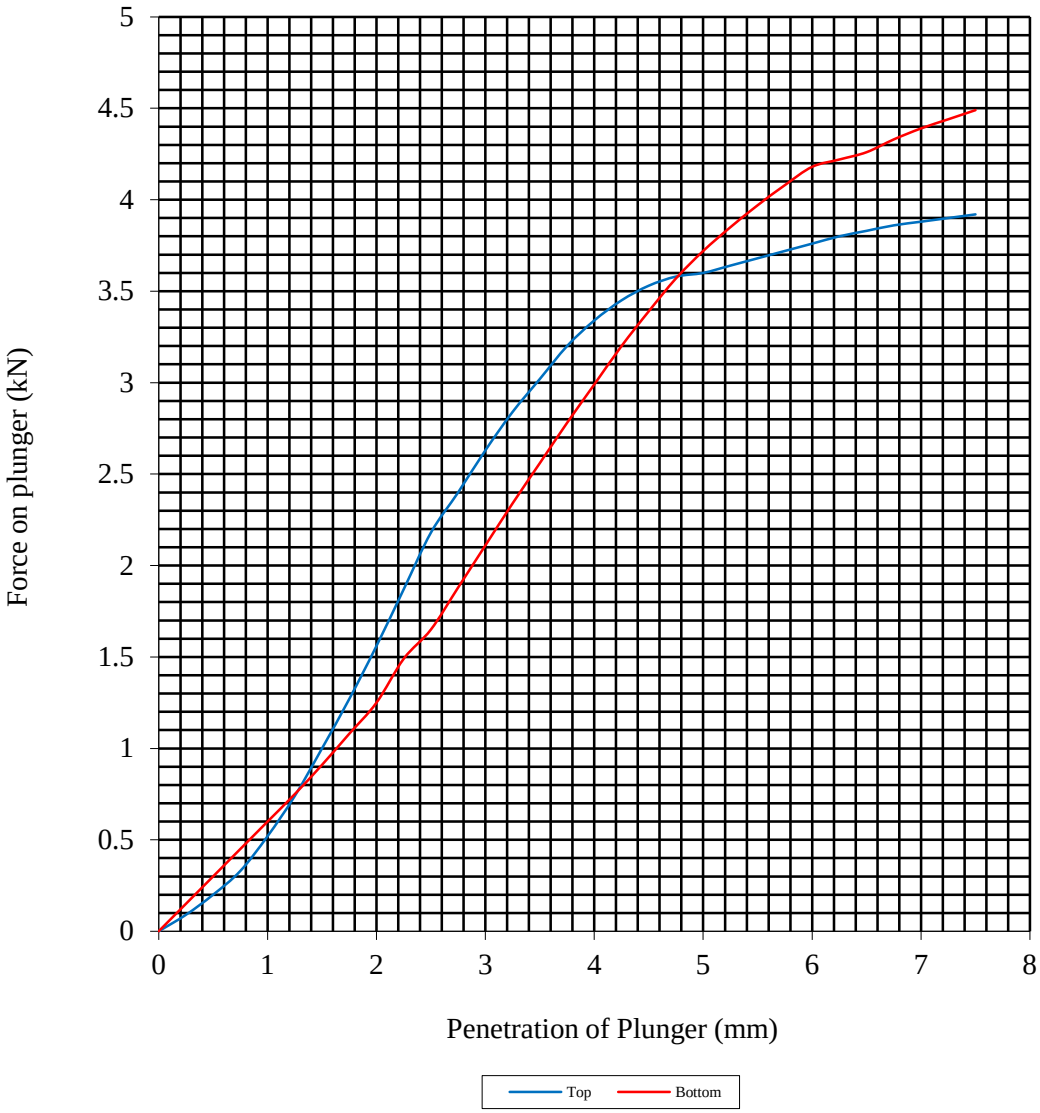
CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number: **BH12** **Top Depth (m):** **4.00**

Sample Number: **6** **Base Depth (m):**

Sample Type: **B**



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	16	Surcharge Kg:	4.20	Sample Top	16	Sample Top	18.0
Bulk Density Mg/m3:	2.14	Soaking Time hrs	0	Sample Bottom	16	Sample Bottom	18.6
Dry Density Mg/m3:	1.85	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			2				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved		Date 11/11/16	Contract No: PSL16/4906
		Arklow			Client Ref: 16-5027

MOISTURE CONDITION VALUE

BS1377 : Part 4 : 1990 Clause 5.4

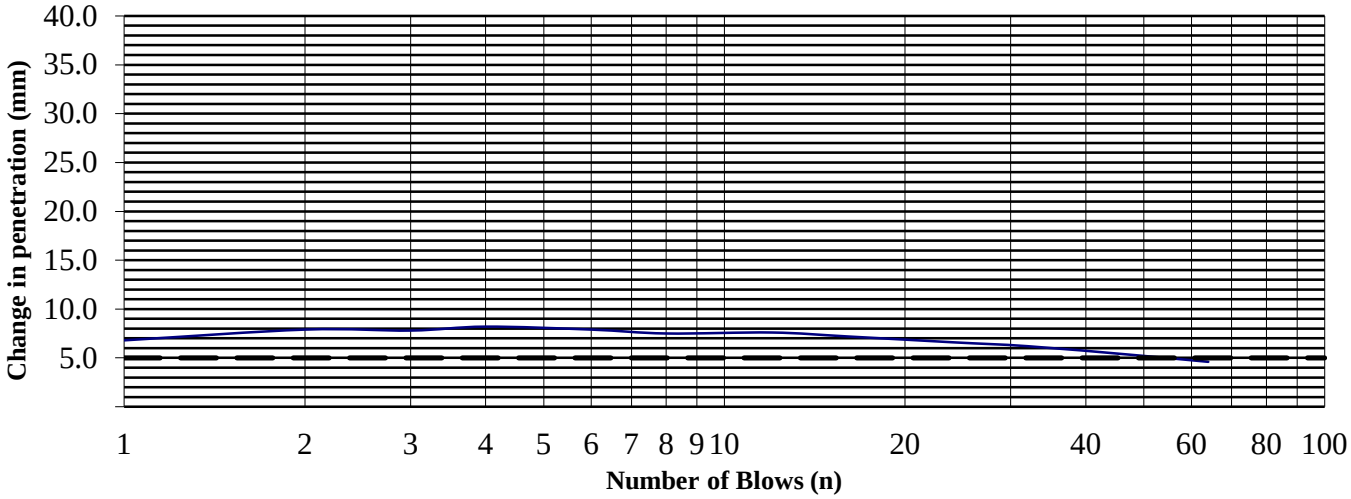
Hole Number: **BH12** **Top Depth (m):** **4.00**

Sample Number: **6** **Base Depth (m):**

Sample Type: **B**

Material Retained on the 20mm BS Test Sieve (%):	2
Interpretation of test curve is by the instection of 5mm change in penetration value	

MCV Determination



Blows (N)	Penetration (mm)	n to 4 n (mm)
1	78.9	6.8
2	75.6	7.9
3	73.4	7.8
4	72.1	8.2
6	69.5	7.9
8	67.7	7.5
12	65.6	7.6
16	63.9	7.2
24	61.6	6.6
32	60.2	6.2
48	58.0	5.3
64	56.7	4.6
96	55.0	
128	54.0	
192	52.7	
256	52.1	

Test Results.

Moisture Content (%)	5.9
MCV	17.9

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date**	**11/11/16**	**Contract No:**
		Arklow			**PSL16/4906**
					Client Ref:
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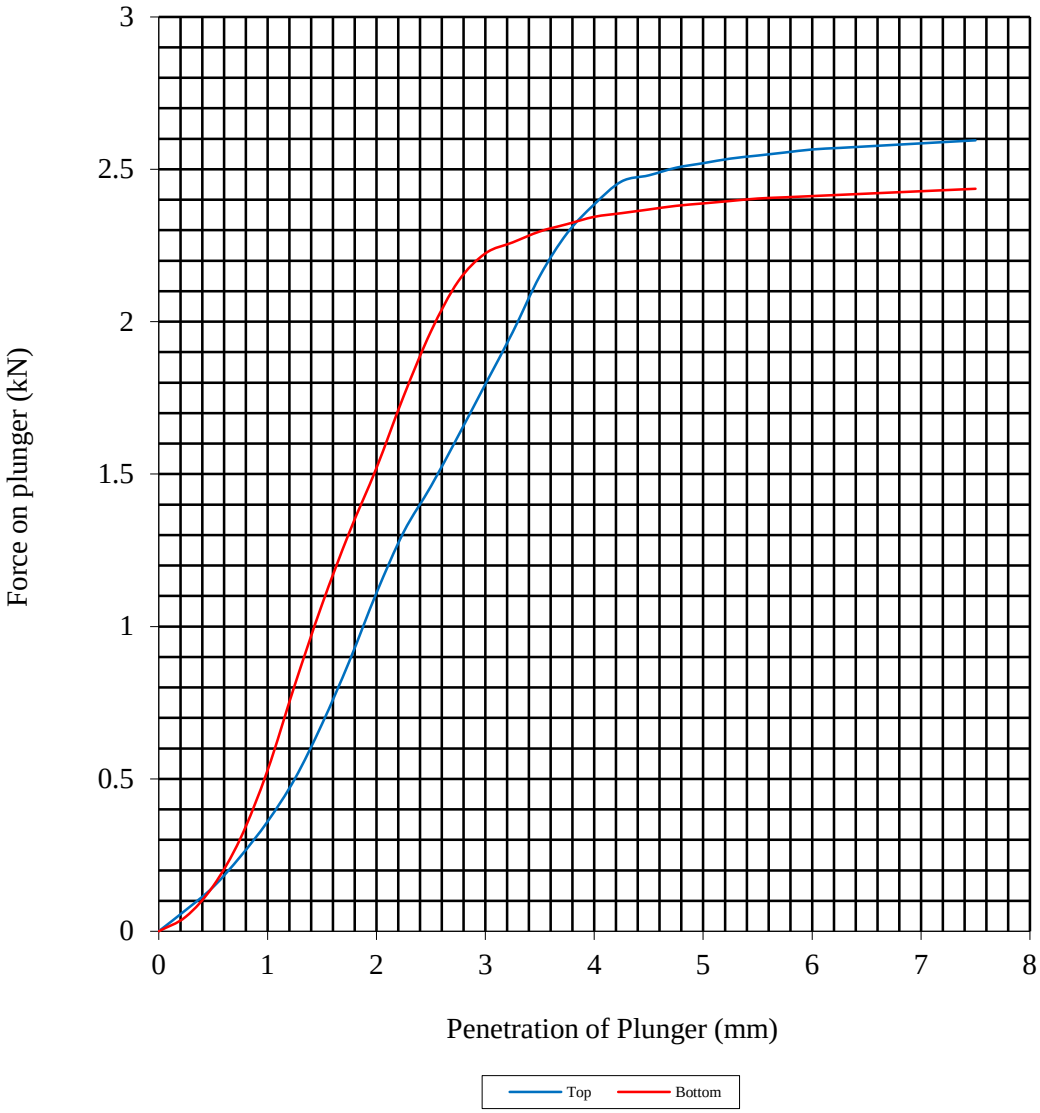
CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number: BH12 **Top Depth (m):** 5.00

Sample Number: 7 **Base Depth (m):**

Sample Type: B



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	16	Surcharge Kg:	4.20	Sample Top	16	Sample Top	12.6
Bulk Density Mg/m3:	1.93	Soaking Time hrs	0	Sample Bottom	16	Sample Bottom	14.9
Dry Density Mg/m3:	1.67	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			1				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved	Date	11/11/16	Contract No: PSL16/4906
		Arklow			Client Ref: 16-5027

PARTICLE SIZE DISTRIBUTION TEST

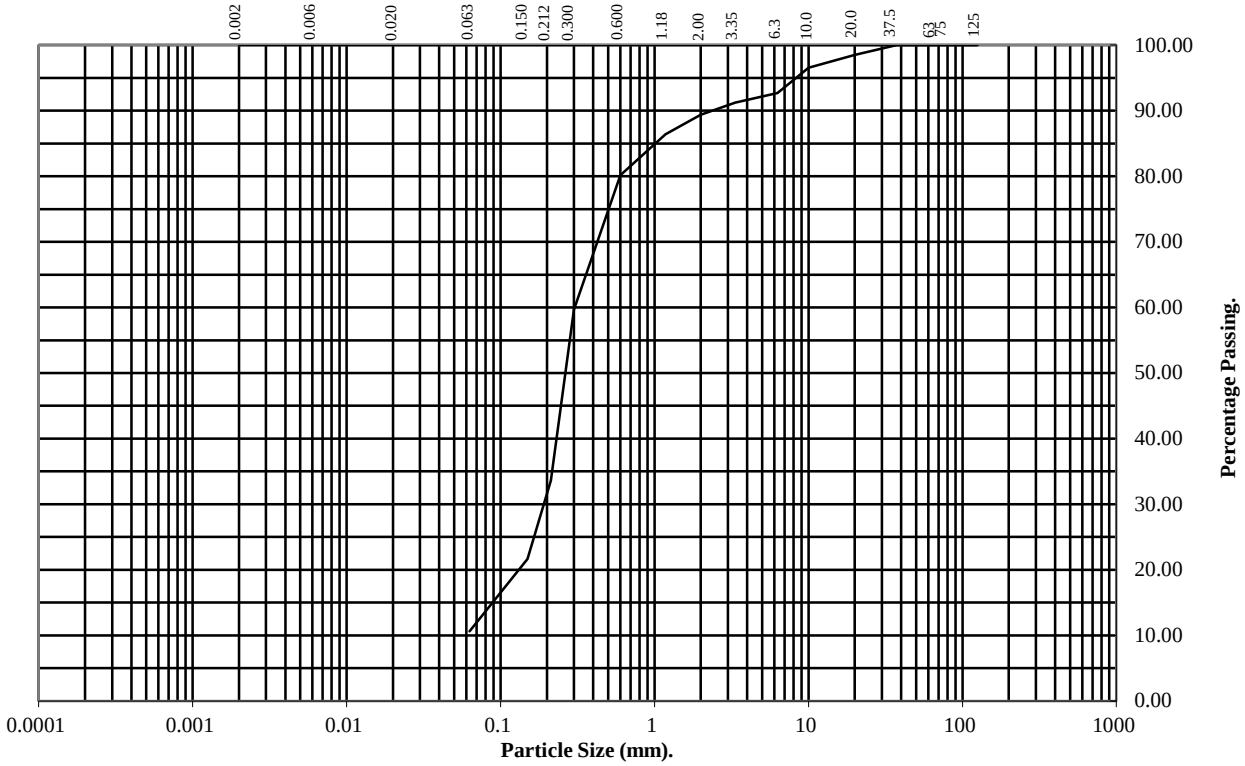
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH12** **Top Depth (m):** **5.00**

Sample Number: **7** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	99
10	97
6.3	93
3.35	91
2	89
1.18	86
0.6	80
0.3	60
0.212	34
0.15	22
0.063	11

Soil Fraction	Total Percentage
Cobbles	0
Gravel	11
Sand	78
Silt/Clay	11

Remarks:

See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow		**Client Ref:** 16-5027

MOISTURE CONDITION VALUE

BS1377 : Part 4 : 1990 Clause 5.4

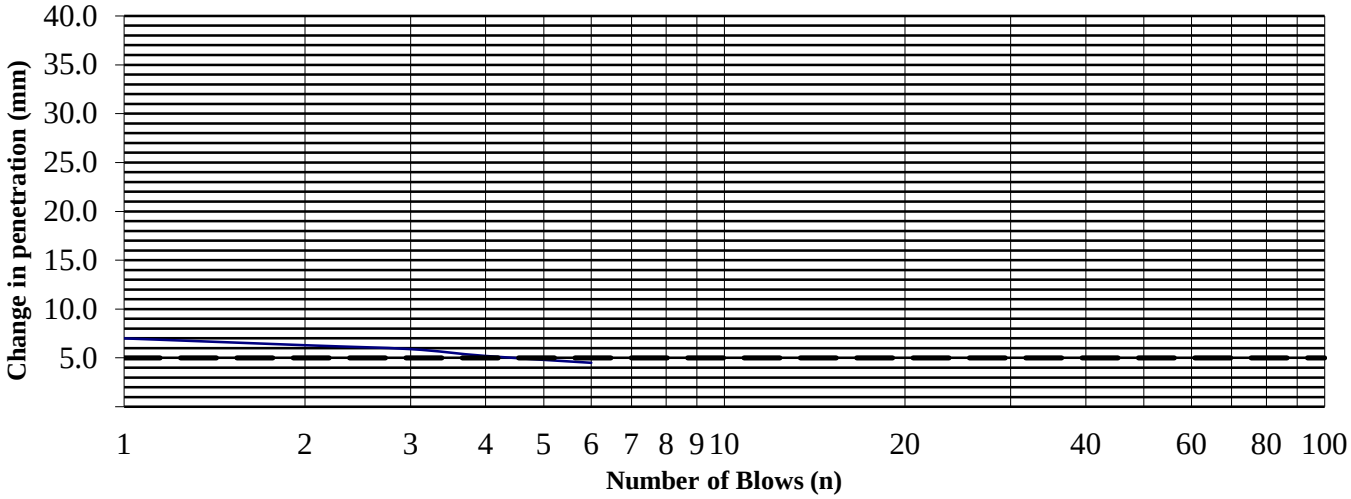
Hole Number: **BH12** **Top Depth (m):** **5.00**

Sample Number: **7** **Base Depth (m):**

Sample Type: **B**

Material Retained on the 20mm BS Test Sieve (%):	1
Interpretation of test curve is by the instection of 5mm change in penetration value	

MCV Determination



Blows (N)	Penetration (mm)	n to 4 n (mm)
1	81.3	7.0
2	78.0	6.3
3	76.0	5.9
4	74.3	5.2
6	72.6	4.5
8	71.7	
12	70.1	
16	69.1	
24	68.1	
32		
48		
64		
96		
128		
192		
256		

Test Results.

Moisture Content (%)	16
MCV	7.0

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date**	**11/11/16**	**Contract No:**
		Arklow			**PSL16/4906**
					Client Ref:
					16-5027

PARTICLE SIZE DISTRIBUTION TEST

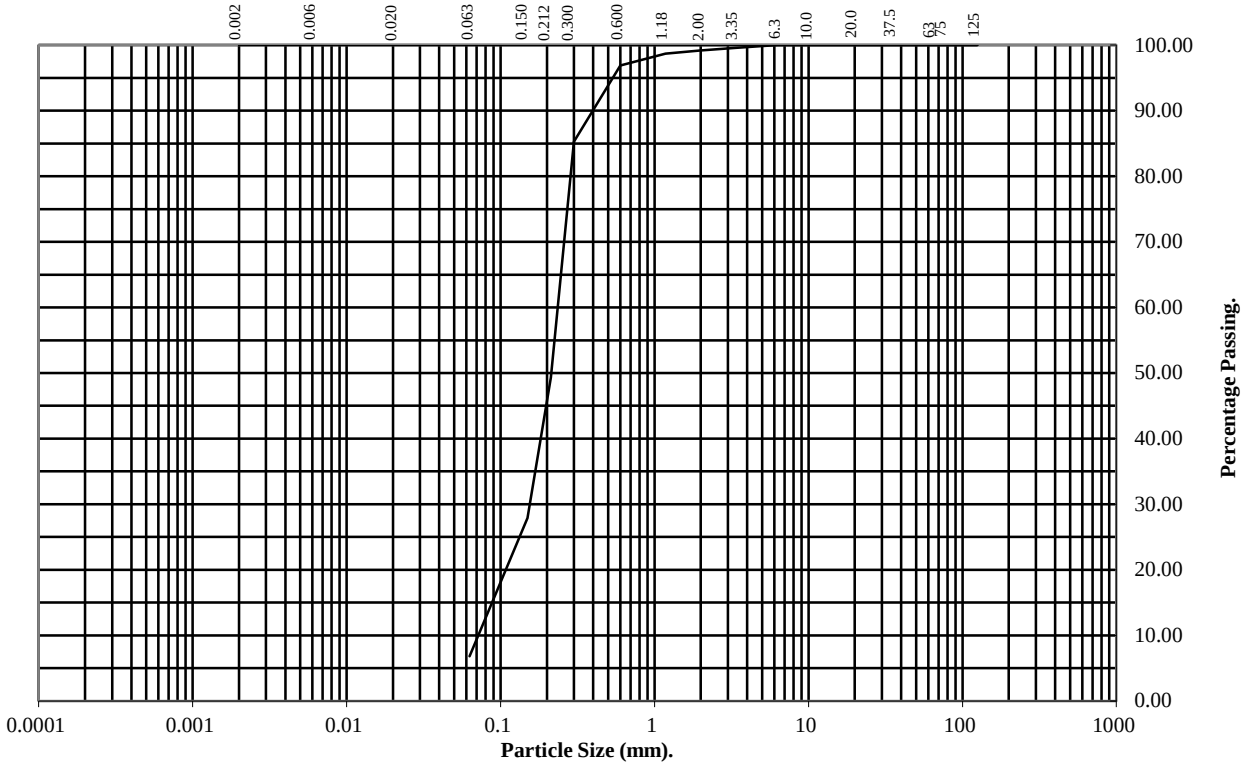
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH12** **Top Depth (m):** **7.50**

Sample Number: **12** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	99
1.18	99
0.6	97
0.3	85
0.212	49
0.15	28
0.063	7

Soil Fraction	Total Percentage
Cobbles	0
Gravel	1
Sand	92
Silt/Clay	7

Remarks:

See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow		**Client Ref:** 16-5027

PARTICLE SIZE DISTRIBUTION TEST

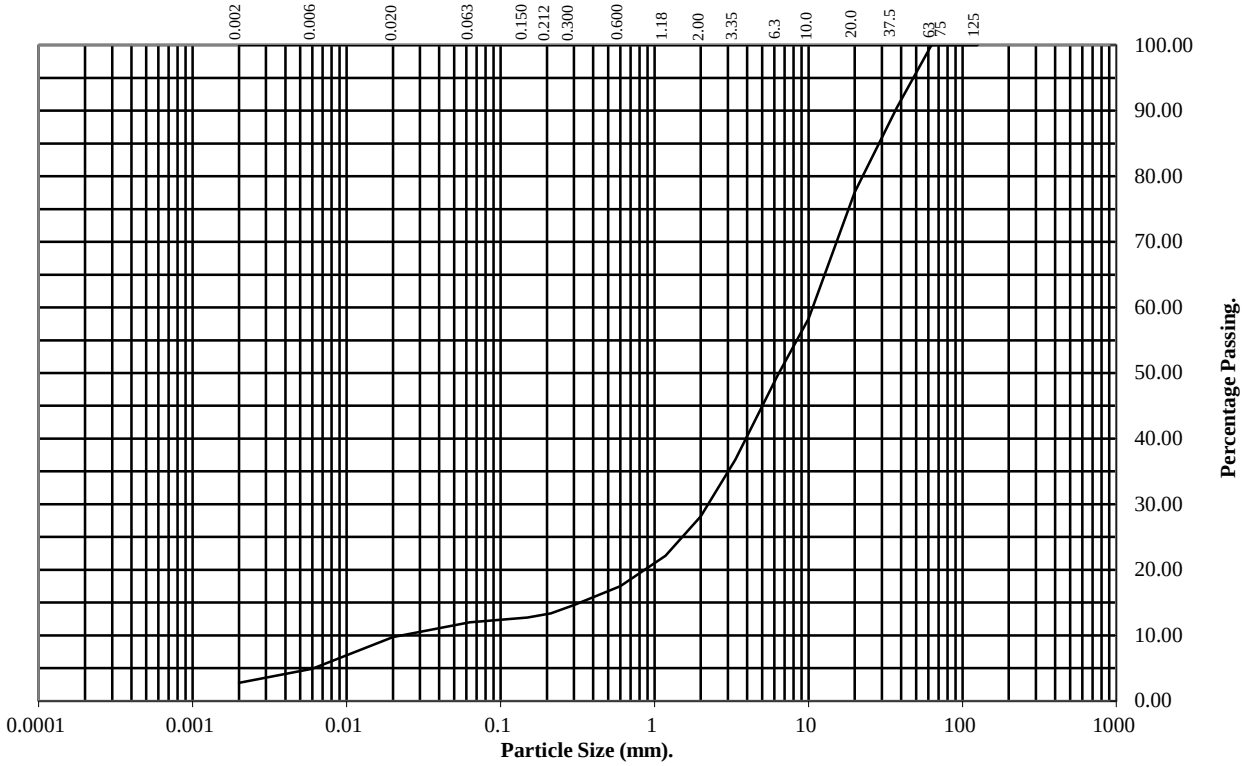
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **BH13** **Top Depth (m):** **1.00**

Sample Number: **1** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	90
20	78
10	58
6.3	50
3.35	37
2	28
1.18	22
0.6	18
0.3	15
0.212	13
0.15	13
0.063	12

Particle Diameter	Percentage Passing
0.02	10
0.006	5
0.002	3

Soil Fraction	Total Percentage
Cobbles	0
Gravel	72
Sand	16
Silt	9
Clay	3

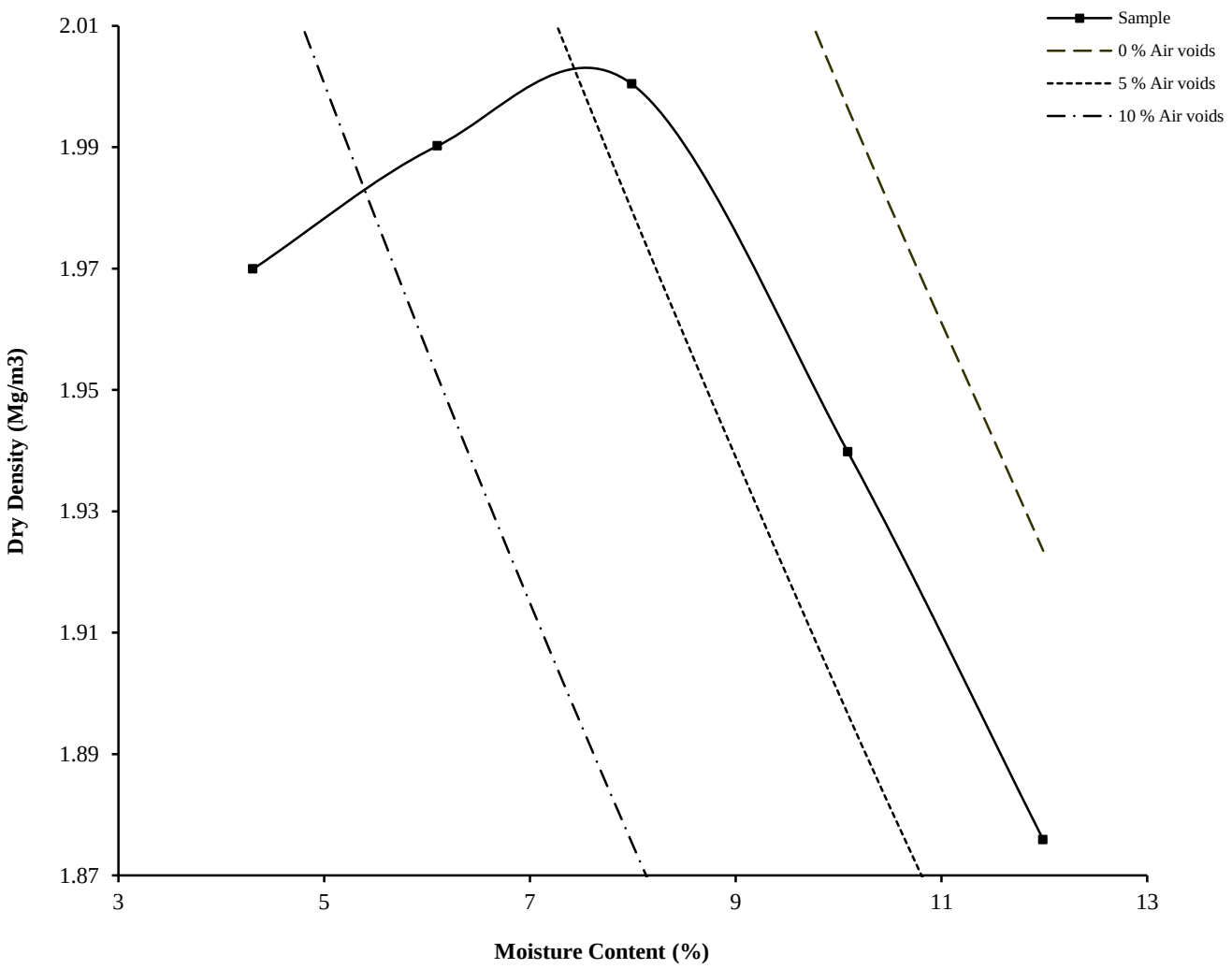
Remarks:
See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow		**Client Ref:** 16-5027

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : 1990

Hole Number:	**BH13**	**Top Depth (m) :**	**3.00**
Sample Number:	**4**	**Base Depth (m) :**	
Sample Type:	**B**		



Initial Moisture Content:		10	Method of Compaction:	2.5Kg Rammer	Separate Samples
Particle Density (Mg/m3):	2.5	Assumed	Material Retained on 37.5 mm Test Sieve (%):		0
Maximum Dry Density (Mg/m3):		2.00	Material Retained on 20.0 mm Test Sieve (%):		6
Optimum Moisture Content (%):		8			
Remarks See summary of soil descriptions					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date**	**11/11/16**	**Contract No.**
		Arklow				**PSL16/4906**
						Client Ref
						16-5027

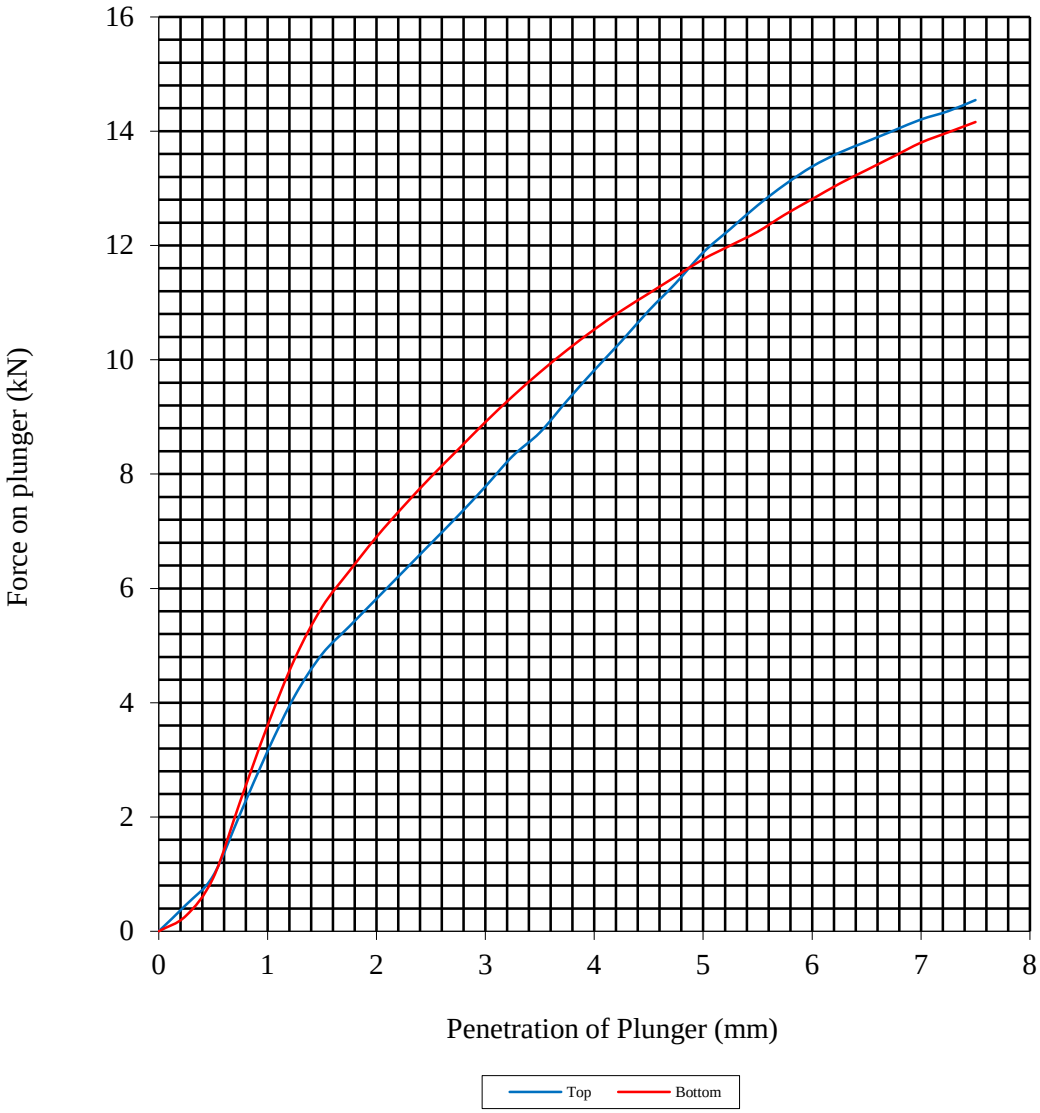
CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number: **BH13** **Top Depth (m):** **3.00**

Sample Number: **4** **Base Depth (m):**

Sample Type: **B**



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	4.3	Surcharge Kg:	4.20	Sample Top	4.0	Sample Top	59.4
Bulk Density Mg/m3:	2.05	Soaking Time hrs	0	Sample Bottom	4.6	Sample Bottom	60.2
Dry Density Mg/m3:	1.97	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			6				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved		Date	11/11/16	Contract No:
		Arklow				PSL16/4906
						Client Ref:
						16-5027

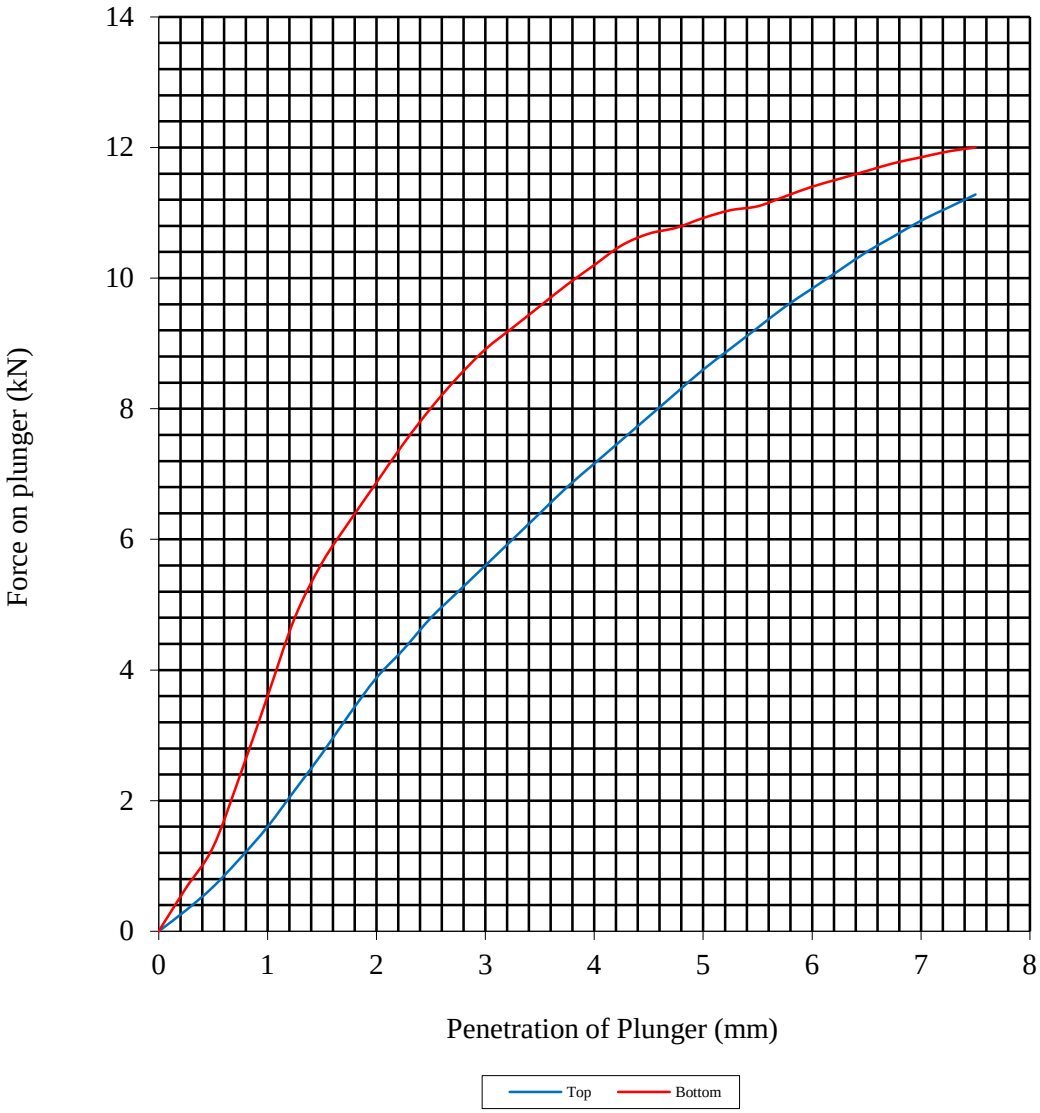
CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number: BH13 **Top Depth (m):** 3.00

Sample Number: 4 **Base Depth (m):**

Sample Type: B



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	6.1	Surcharge Kg:	4.20	Sample Top	6.5	Sample Top	43.0
Bulk Density Mg/m3:	2.11	Soaking Time hrs	0	Sample Bottom	5.7	Sample Bottom	60.7
Dry Density Mg/m3:	1.99	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			6				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved		Date 11/01/16	Contract No: PSL16/4906
		Arklow			Client Ref: 16-5027

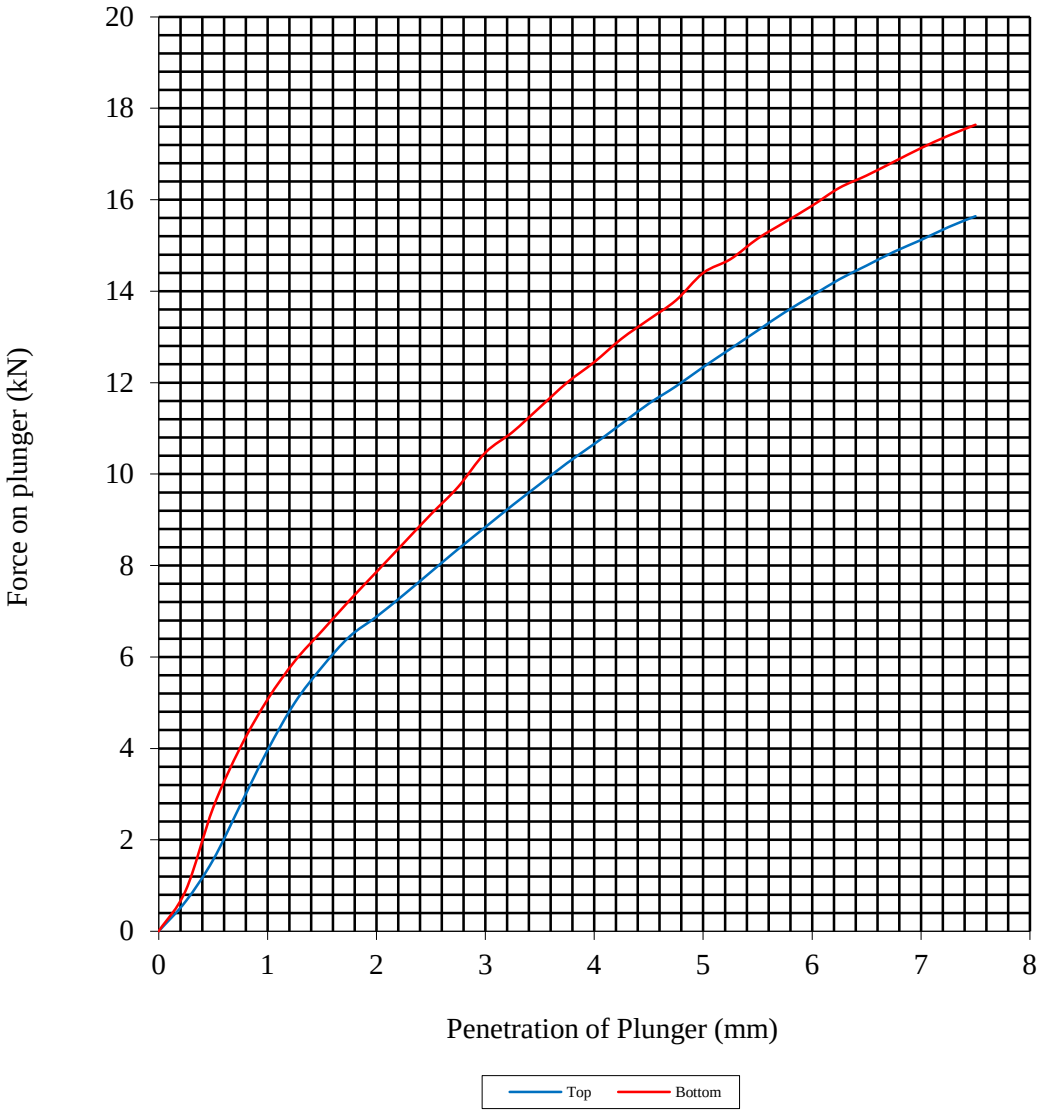
CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number: BH13 **Top Depth (m):** 3.00

Sample Number: 4 **Base Depth (m):**

Sample Type: B



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	8.0	Surcharge Kg:	4.20	Sample Top	8.1	Sample Top	61.7
Bulk Density Mg/m3:	2.16	Soaking Time hrs	0	Sample Bottom	7.8	Sample Bottom	72.0
Dry Density Mg/m3:	2.00	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			6				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved	Date	11/11/16	Contract No:
		Arklow			PSL16/4906
					Client Ref:
					16-5027

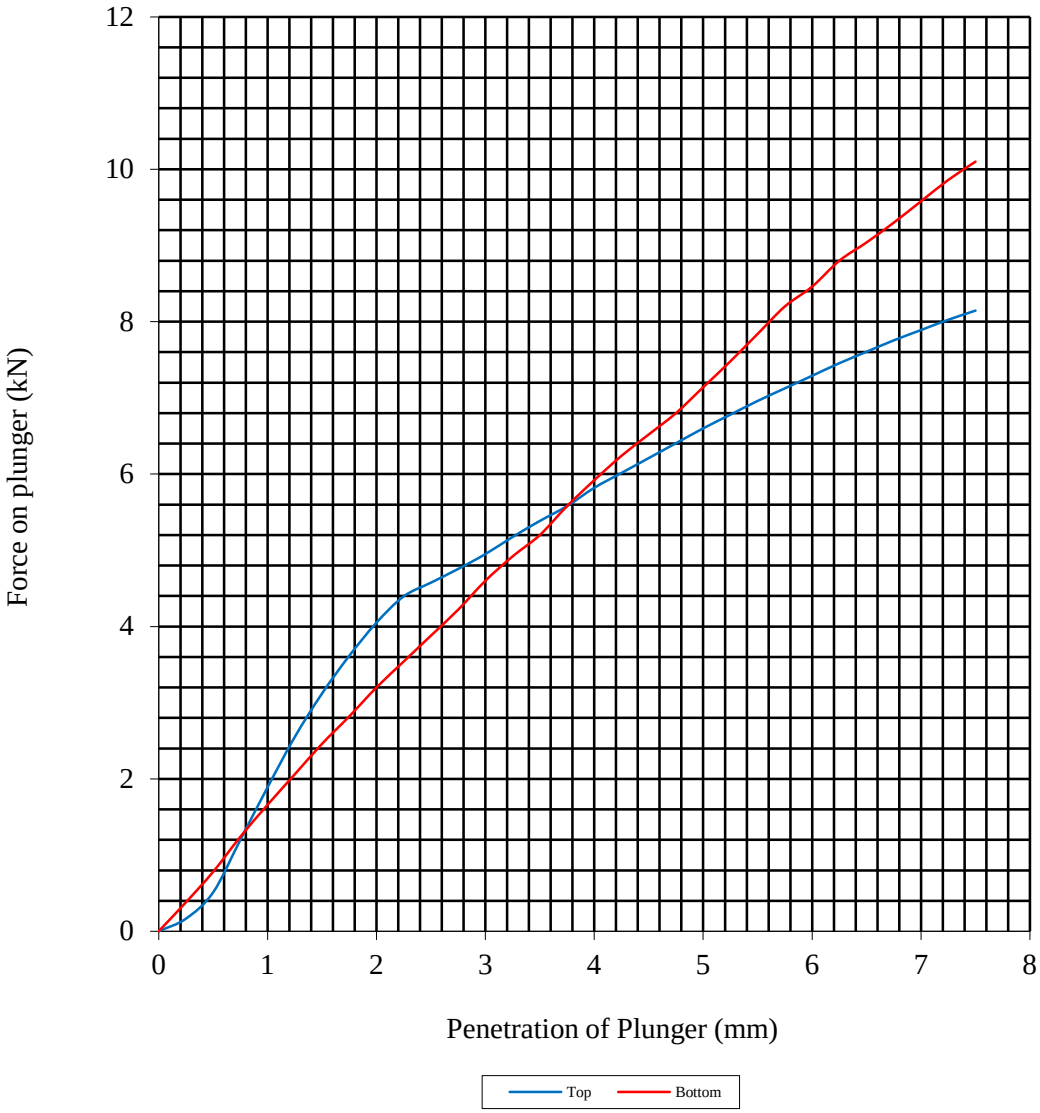
CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number: BH13 **Top Depth (m):** 3.00

Sample Number: 4 **Base Depth (m):**

Sample Type: B



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	10	Surcharge Kg:	4.20	Sample Top	10	Sample Top	34.7
Bulk Density Mg/m3:	2.14	Soaking Time hrs	0	Sample Bottom	10	Sample Bottom	35.7
Dry Density Mg/m3:	1.94	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			6				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved	Date	11/11/16	Contract No: PSL16/4906
		Arklow			Client Ref: 16-5027

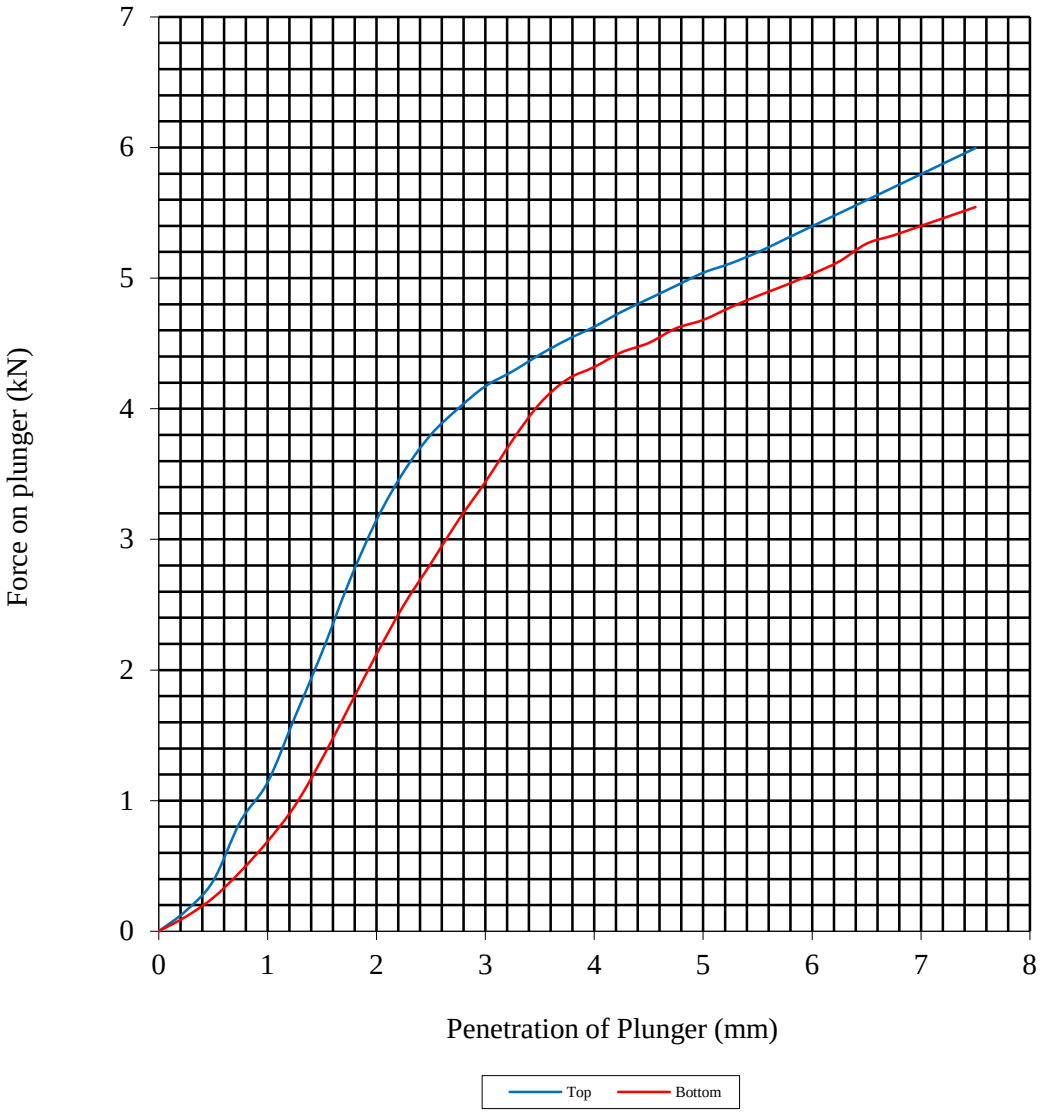
CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number: **BH13** **Top Depth (m):** **3.00**

Sample Number: **4** **Base Depth (m):**

Sample Type: **B**



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	12	Surcharge Kg:	4.20	Sample Top	12	Sample Top	28.8
Bulk Density Mg/m3:	2.10	Soaking Time hrs	0	Sample Bottom	12	Sample Bottom	23.4
Dry Density Mg/m3:	1.88	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			6				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved	Date	11/11/16	Contract No:
		Arklow			PSL16/4906
					Client Ref:
					16-5027

MOISTURE CONDITION VALUE

BS1377 : Part 4 : 1990 Clause 5.4

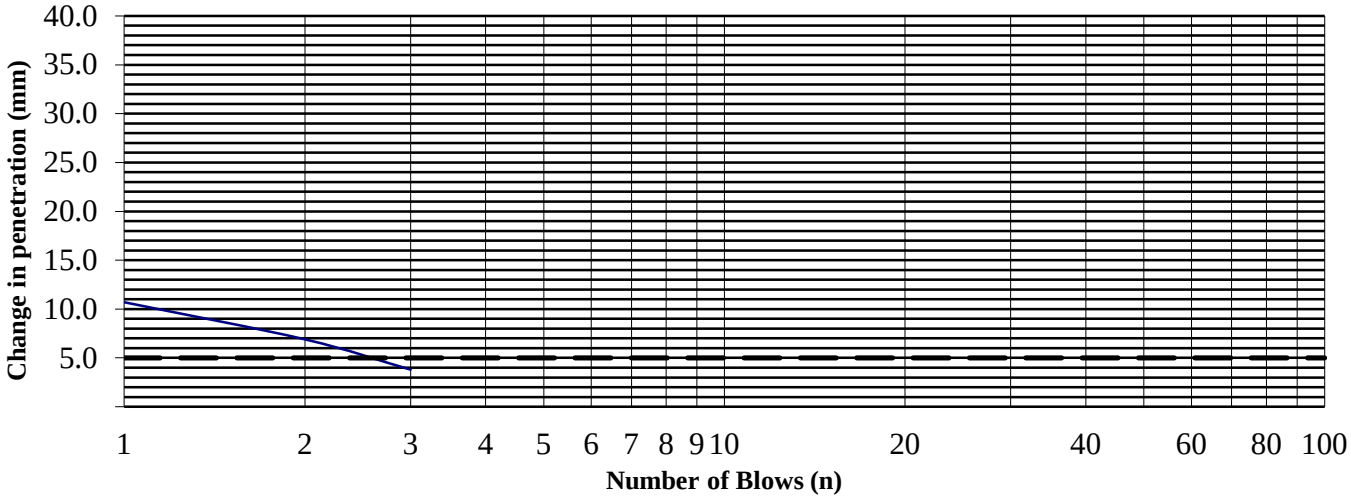
Hole Number: **BH13** **Top Depth (m):** **3.00**

Sample Number: **4** **Base Depth (m):**

Sample Type: **B**

Material Retained on the 20mm BS Test Sieve (%):	6
Interpretation of test curve is by the instection of 5mm change in penetration value	

MCV Determination



Blows (N)	Penetration (mm)	n to 4 n (mm)
1	59.4	10.7
2	53.5	6.9
3	50.1	3.8
4	48.7	
6	47.4	
8	46.6	
12	46.3	
16		
24		
32		
48		
64		
96		
128		
192		
256		

Test Results.

Moisture Content (%)	10
MCV	3.9

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date**	**11/11/16**	**Contract No:**
		Arklow			**PSL16/4906**
					Client Ref:
					16-5027

PARTICLE SIZE DISTRIBUTION TEST

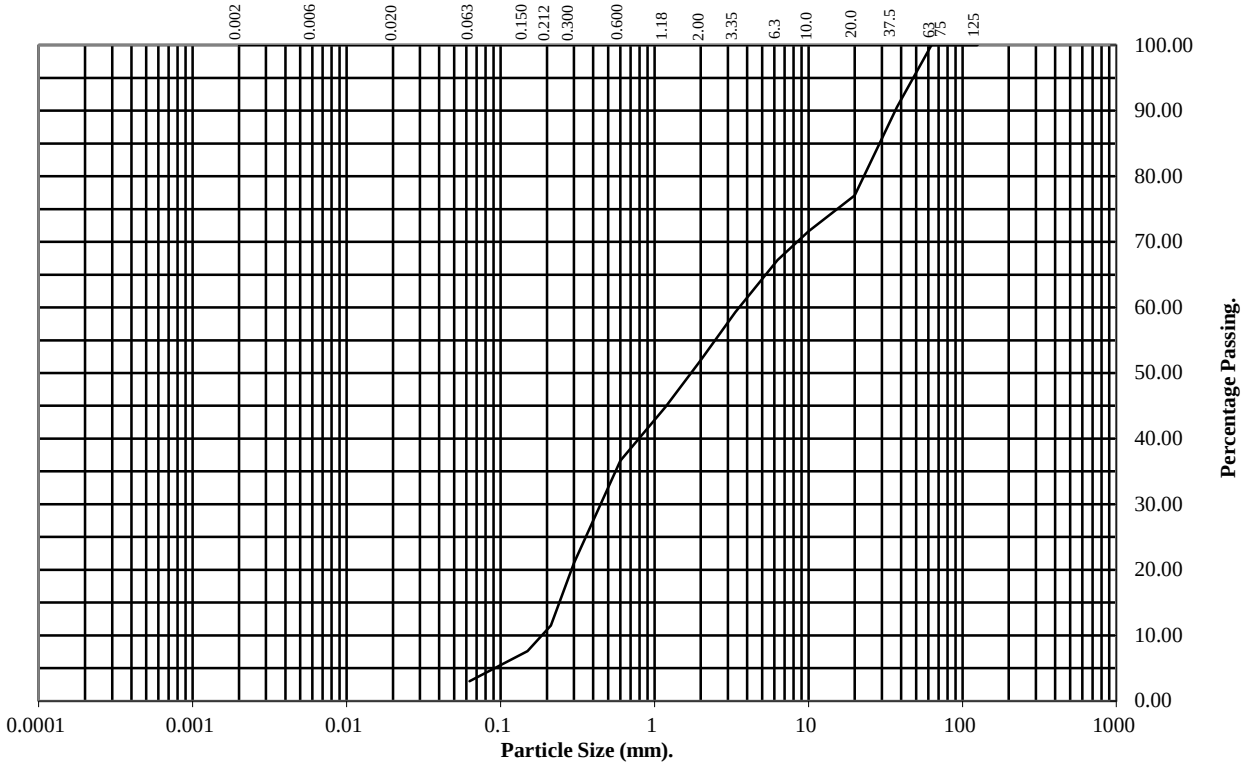
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH13** **Top Depth (m):** **4.00**

Sample Number: **5** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	91
20	77
10	72
6.3	67
3.35	59
2	52
1.18	45
0.6	37
0.3	21
0.212	12
0.15	8
0.063	3

Soil Fraction	Total Percentage
Cobbles	0
Gravel	48
Sand	49
Silt/Clay	3

Remarks:

See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow		**Client Ref:** 16-5027

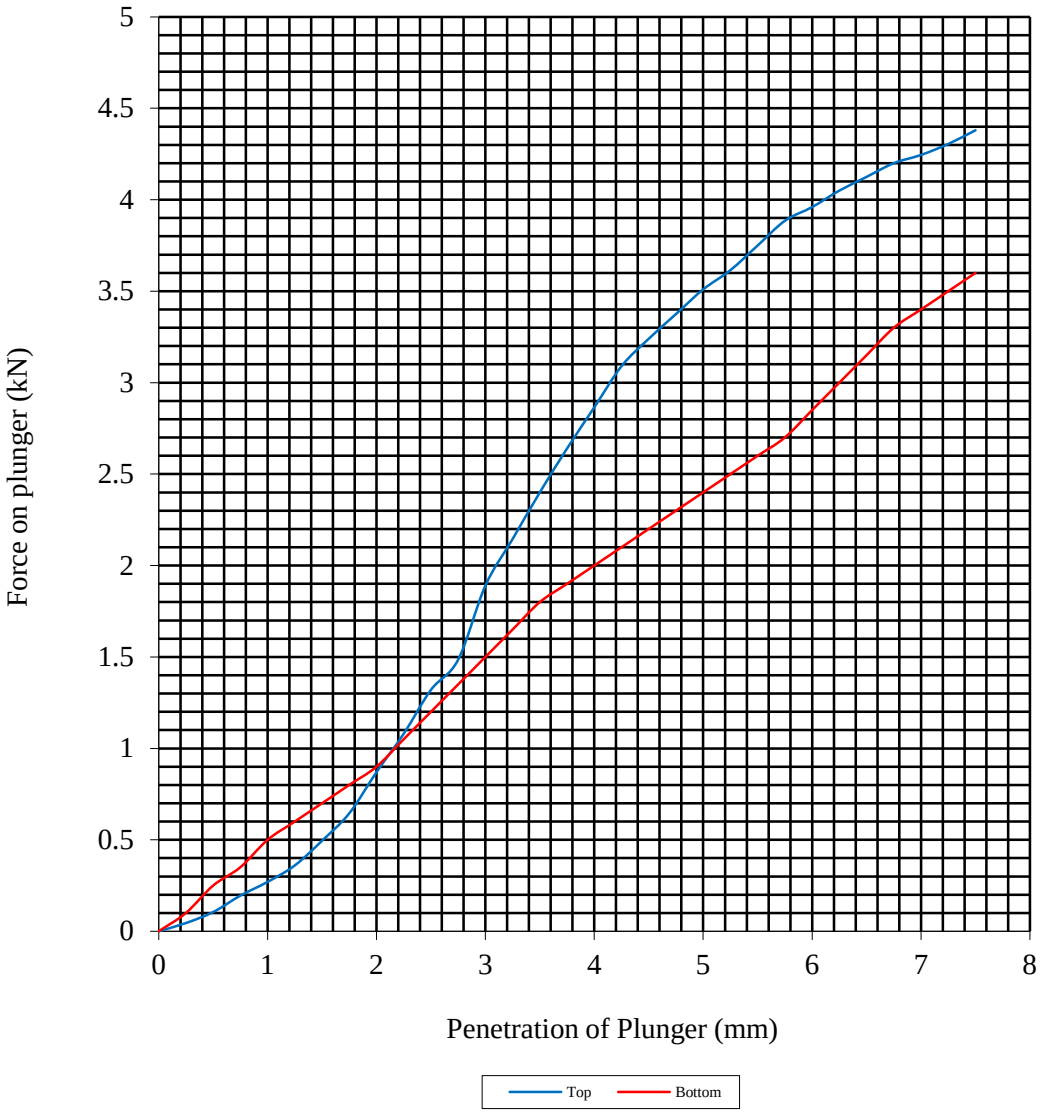
CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number: **BH13** **Top Depth (m):** **4.00**

Sample Number: **5** **Base Depth (m):**

Sample Type: **B**



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	11	Surcharge Kg:	4.20	Sample Top	11	Sample Top	17.6
Bulk Density Mg/m3:	2.11	Soaking Time hrs	0	Sample Bottom	12	Sample Bottom	12.0
Dry Density Mg/m3:	1.90	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			23				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved		Date 11/11/16	Contract No: PSL16/4906
		Arklow			Client Ref: 16-5027

MOISTURE CONDITION VALUE

BS1377 : Part 4 : 1990 Clause 5.4

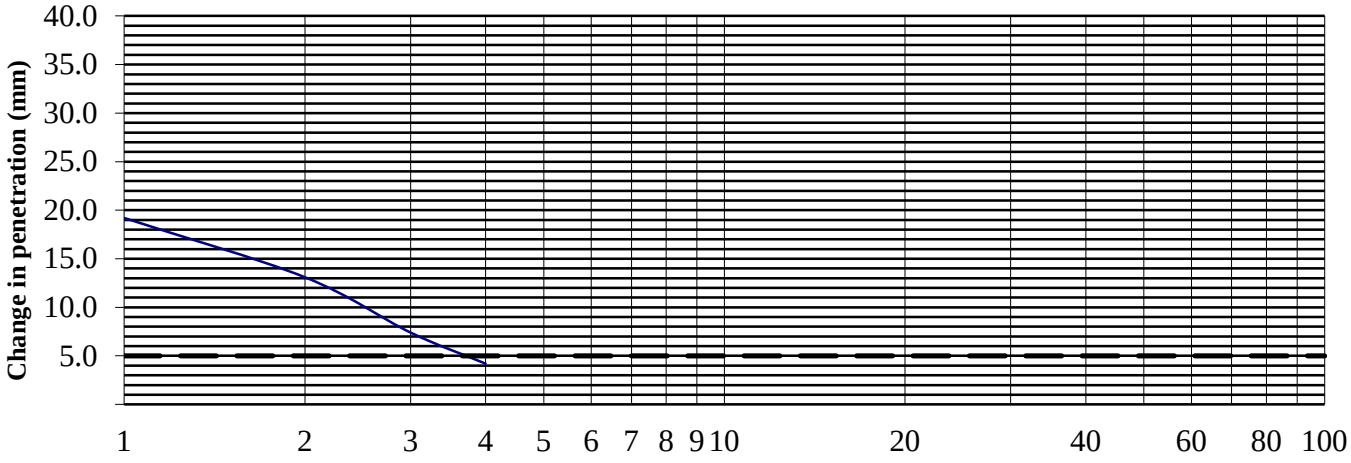
Hole Number: **BH13** **Top Depth (m):** **4.00**

Sample Number: **5** **Base Depth (m):**

Sample Type: **B**

Material Retained on the 20mm BS Test Sieve (%):	23
Interpretation of test curve is by the instection of 5mm change in penetration value	

MCV Determination



Blows (N)	Penetration (mm)	n to 4 n (mm)
1	89.4	19.2
2	79.6	13.1
3	73.6	7.4
4	70.2	4.2
6	67.1	
8	66.5	
12	66.2	
16	66.0	
24		
32		
48		
64		
96		
128		
192		
256		

Test Results.

Moisture Content (%)	11
MCV	5.8

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date**	**11/01/16**	**Contract No:**
		Arklow			**PSL16/4906**
					Client Ref:
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PARTICLE SIZE DISTRIBUTION TEST

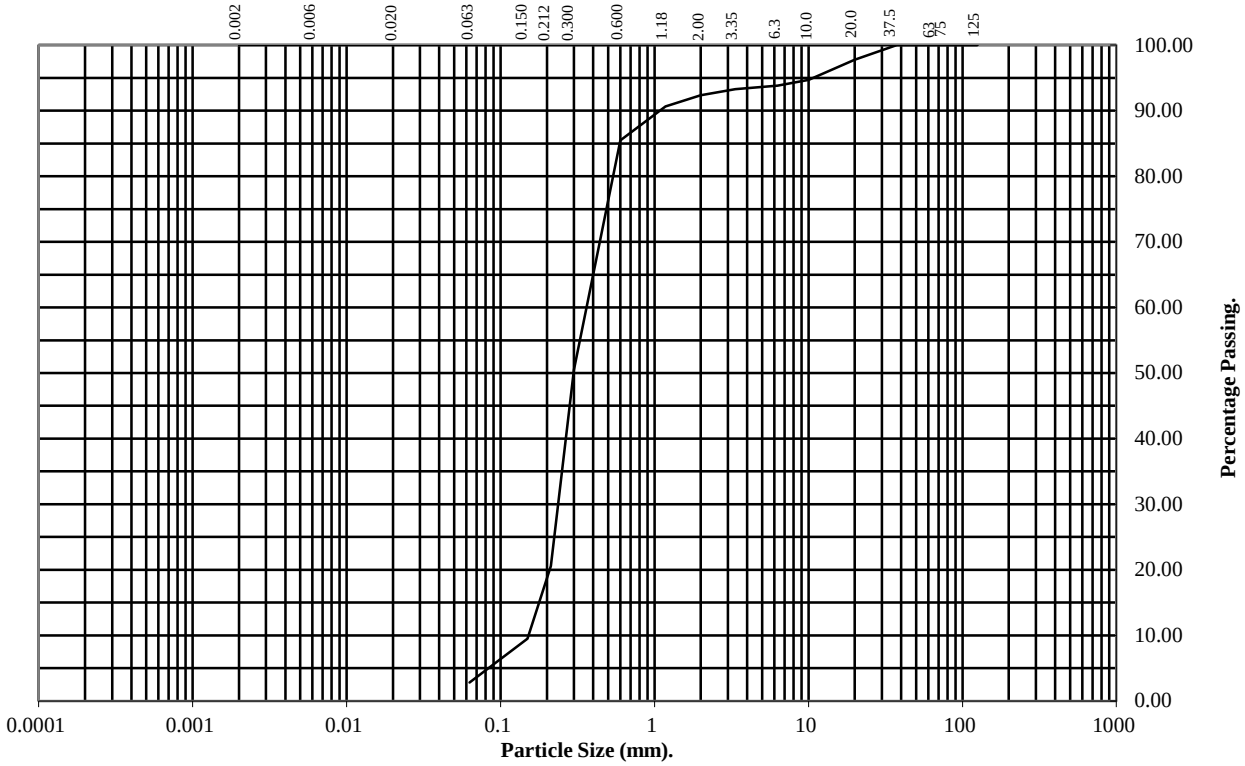
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH13** **Top Depth (m):** **6.50**

Sample Number: **8** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	98
10	95
6.3	94
3.35	93
2	92
1.18	91
0.6	85
0.3	50
0.212	21
0.15	9
0.063	3

Soil Fraction	Total Percentage
Cobbles	0
Gravel	8
Sand	89
Silt/Clay	3

Remarks:

See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow		**Client Ref:** 16-5027

PARTICLE SIZE DISTRIBUTION TEST

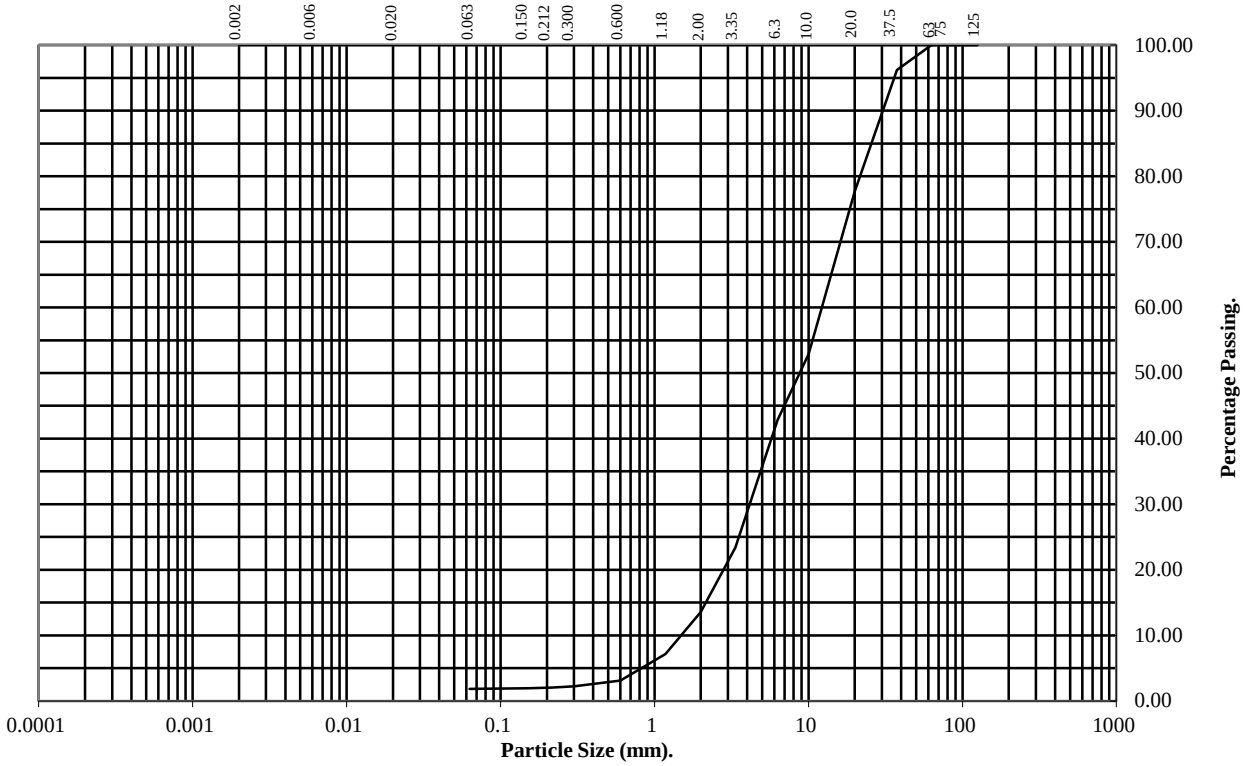
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH14** **Top Depth (m):** **1.60**

Sample Number: **3** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	96
20	78
10	53
6.3	43
3.35	23
2	14
1.18	7
0.6	3
0.3	2
0.212	2
0.15	2
0.063	2

Soil Fraction	Total Percentage
Cobbles	0
Gravel	86
Sand	12
Silt/Clay	2

Remarks:

See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow		**Client Ref:** 16-5027

PARTICLE SIZE DISTRIBUTION TEST

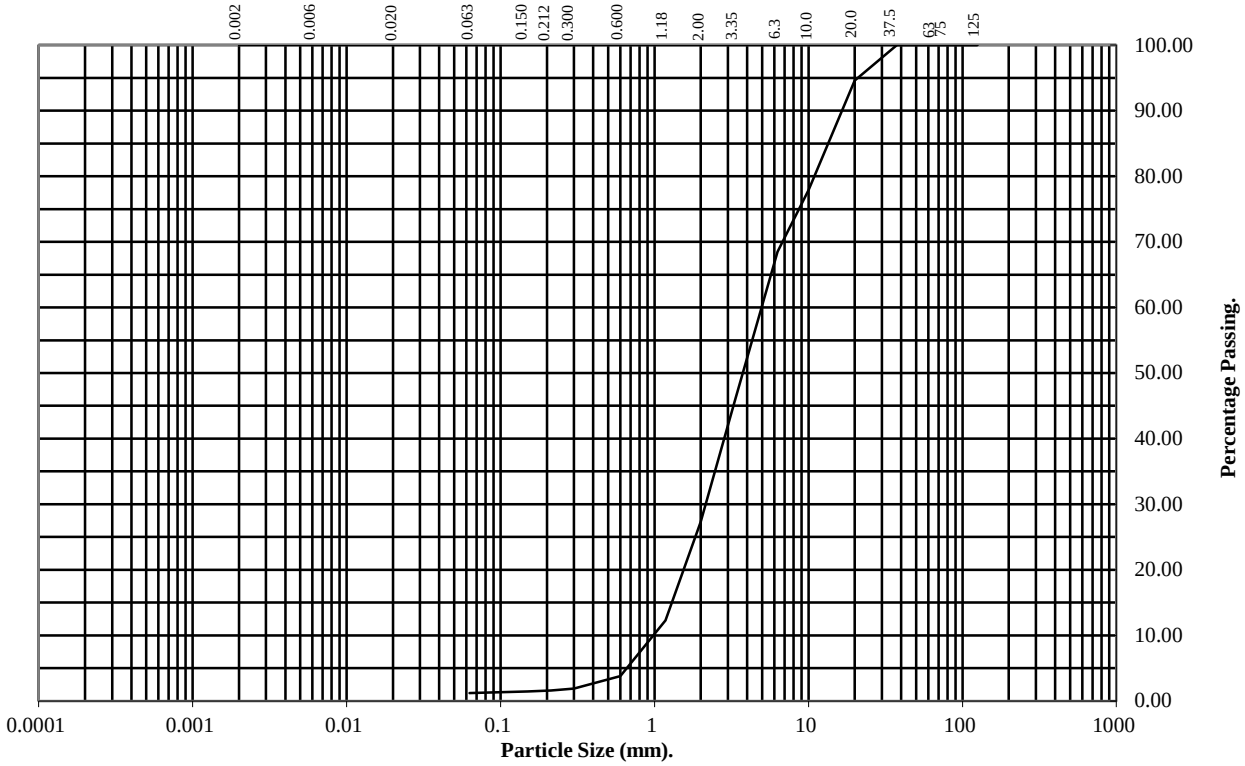
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH14** **Top Depth (m):** **4.00**

Sample Number: **6** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	95
10	78
6.3	69
3.35	46
2	27
1.18	12
0.6	4
0.3	2
0.212	2
0.15	1
0.063	1

Soil Fraction	Total Percentage
Cobbles	0
Gravel	73
Sand	26
Silt/Clay	1

Remarks:

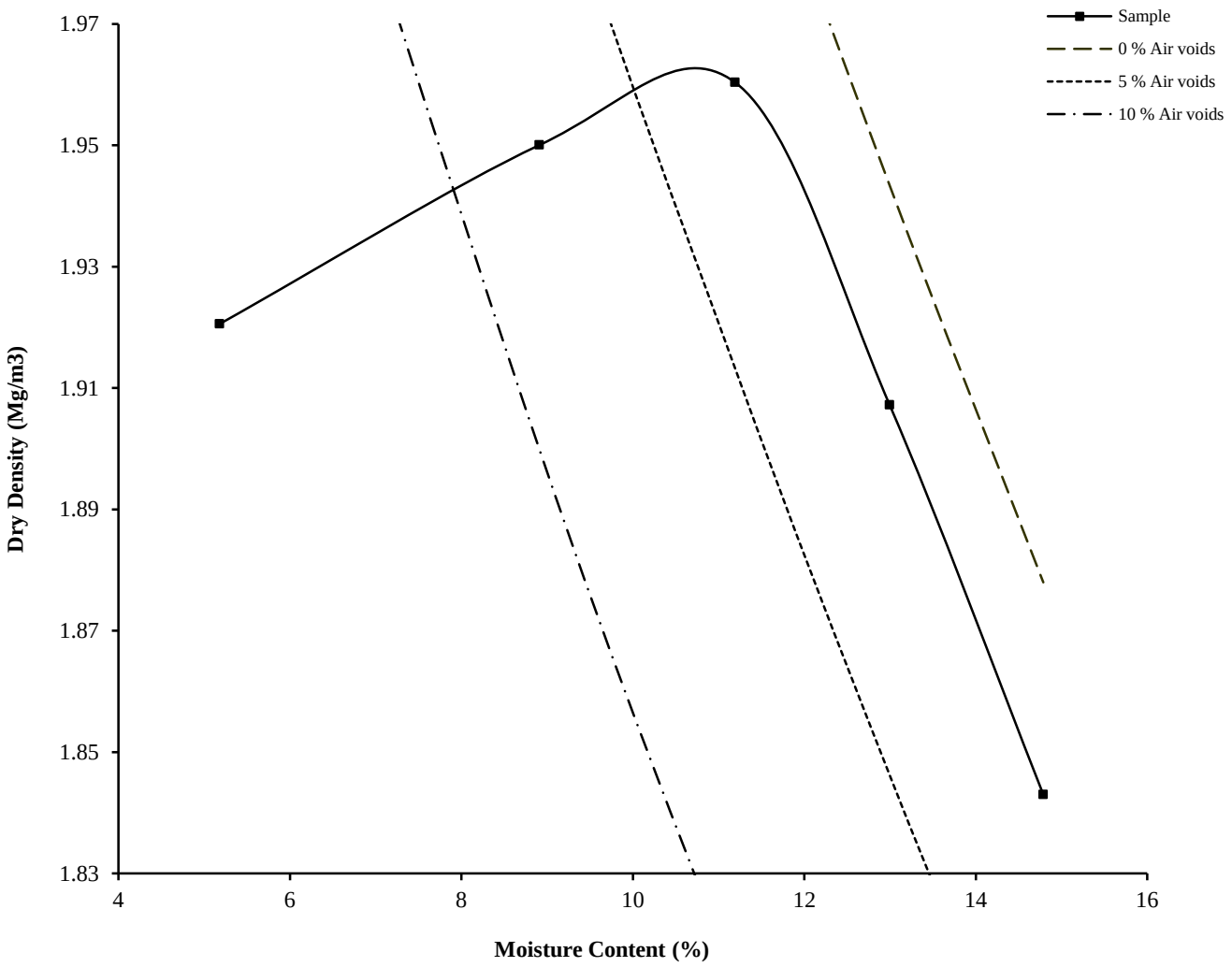
See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow		**Client Ref:** 16-5027

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : 1990

Hole Number:	**BH14**	**Top Depth (m) :**	**4.00**
Sample Number:	**6**	**Base Depth (m) :**	
Sample Type:	**B**		



Initial Moisture Content:		5.2	Method of Compaction:	2.5Kg Rammer	Separate Samples
Particle Density (Mg/m3):	2.6	Assumed	Material Retained on 37.5 mm Test Sieve (%):		0
Maximum Dry Density (Mg/m3):		1.96	Material Retained on 20.0 mm Test Sieve (%):		5
Optimum Moisture Content (%):		11			
Remarks See summary of soil descriptions					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 11/11/16	**Contract No.**
		Arklow			**PSL16/4906**
					Client Ref
					16-5027

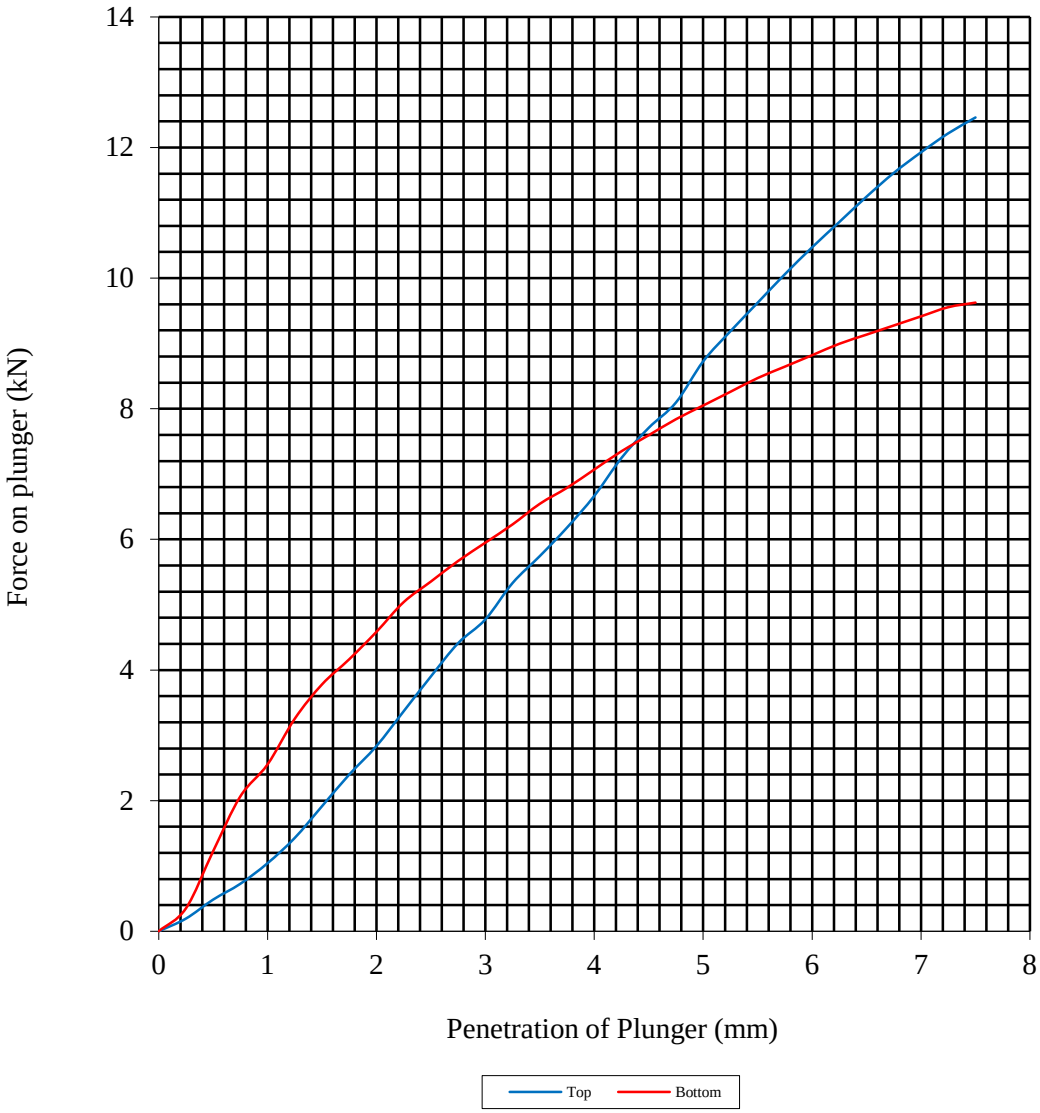
CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number: **BH14** **Top Depth (m):** **4.00**

Sample Number: **6** **Base Depth (m):**

Sample Type: **B**



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	5.2	Surcharge Kg:	4.20	Sample Top	5.0	Sample Top	43.6
Bulk Density Mg/m3:	2.02	Soaking Time hrs	0	Sample Bottom	5.4	Sample Bottom	40.6
Dry Density Mg/m3:	1.92	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			5				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved		Date 11/11/16	Contract No: PSL16/4906
		Arklow			Client Ref: 16-5027

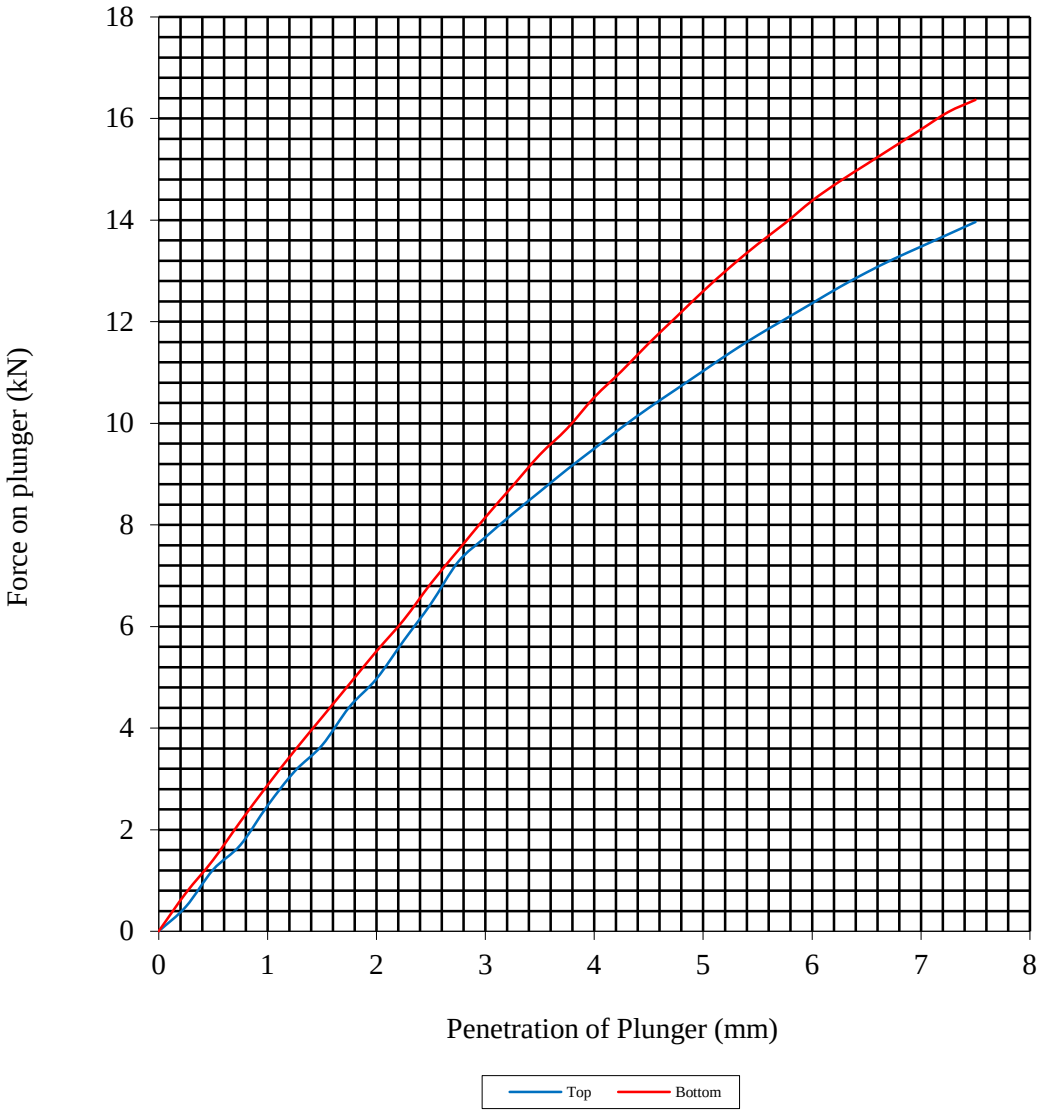
CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number: BH14 **Top Depth (m):** 4.00

Sample Number: 6 **Base Depth (m):**

Sample Type: B



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	8.9	Surcharge Kg:	4.20	Sample Top	8.6	Sample Top	55.1
Bulk Density Mg/m3:	2.12	Soaking Time hrs	0	Sample Bottom	9.2	Sample Bottom	63.0
Dry Density Mg/m3:	1.95	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			5				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved		Date 11/11/16	Contract No: PSL16/4906
		Arklow			Client Ref: 16-5027

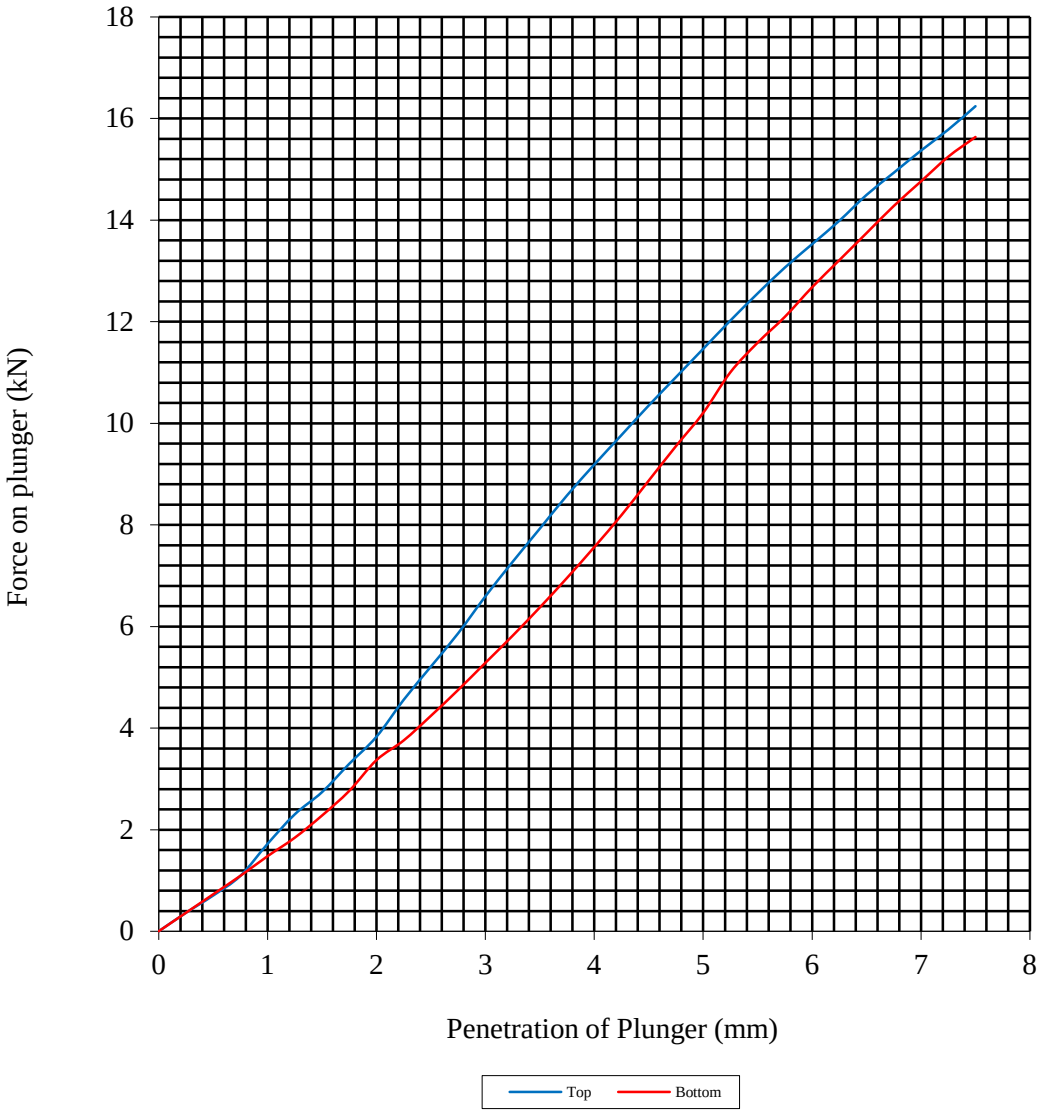
CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number: BH14 **Top Depth (m):** 4.00

Sample Number: 6 **Base Depth (m):**

Sample Type: B



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	11	Surcharge Kg:	4.20	Sample Top	11	Sample Top	57.3
Bulk Density Mg/m3:	2.18	Soaking Time hrs	0	Sample Bottom	11	Sample Bottom	51.0
Dry Density Mg/m3:	1.96	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			5				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved		Date 11/11/16	Contract No: PSL16/4906
		Arklow			Client Ref: 16-5027

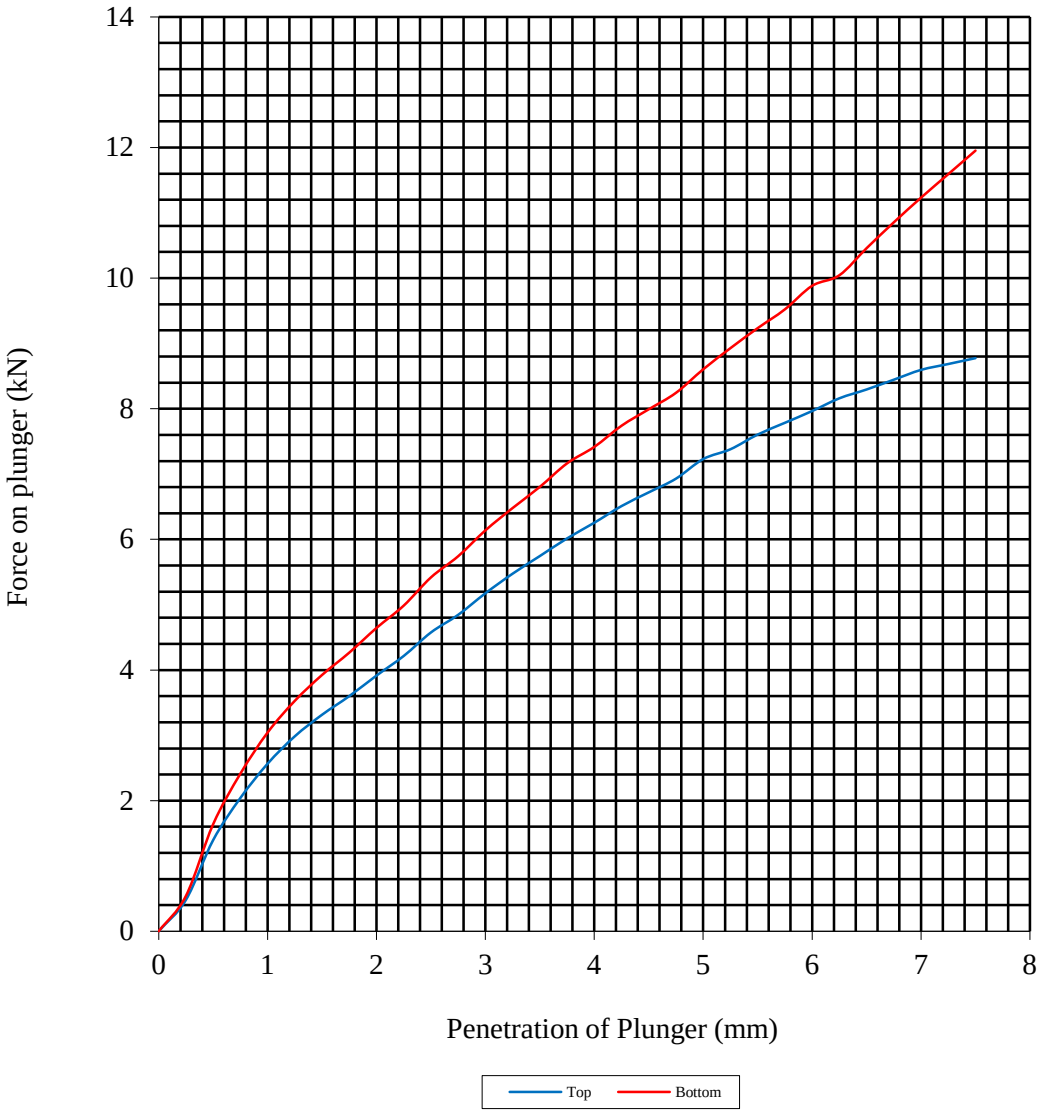
CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number: **BH14** **Top Depth (m):** **4.00**

Sample Number: **6** **Base Depth (m):**

Sample Type: **B**



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	13	Surcharge Kg:	4.20	Sample Top	13	Sample Top	36.2
Bulk Density Mg/m3:	2.16	Soaking Time hrs	0	Sample Bottom	13	Sample Bottom	43.0
Dry Density Mg/m3:	1.91	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			5				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved		Date 11/11/16	Contract No: PSL16/4906
		Arklow			Client Ref: 16-5027

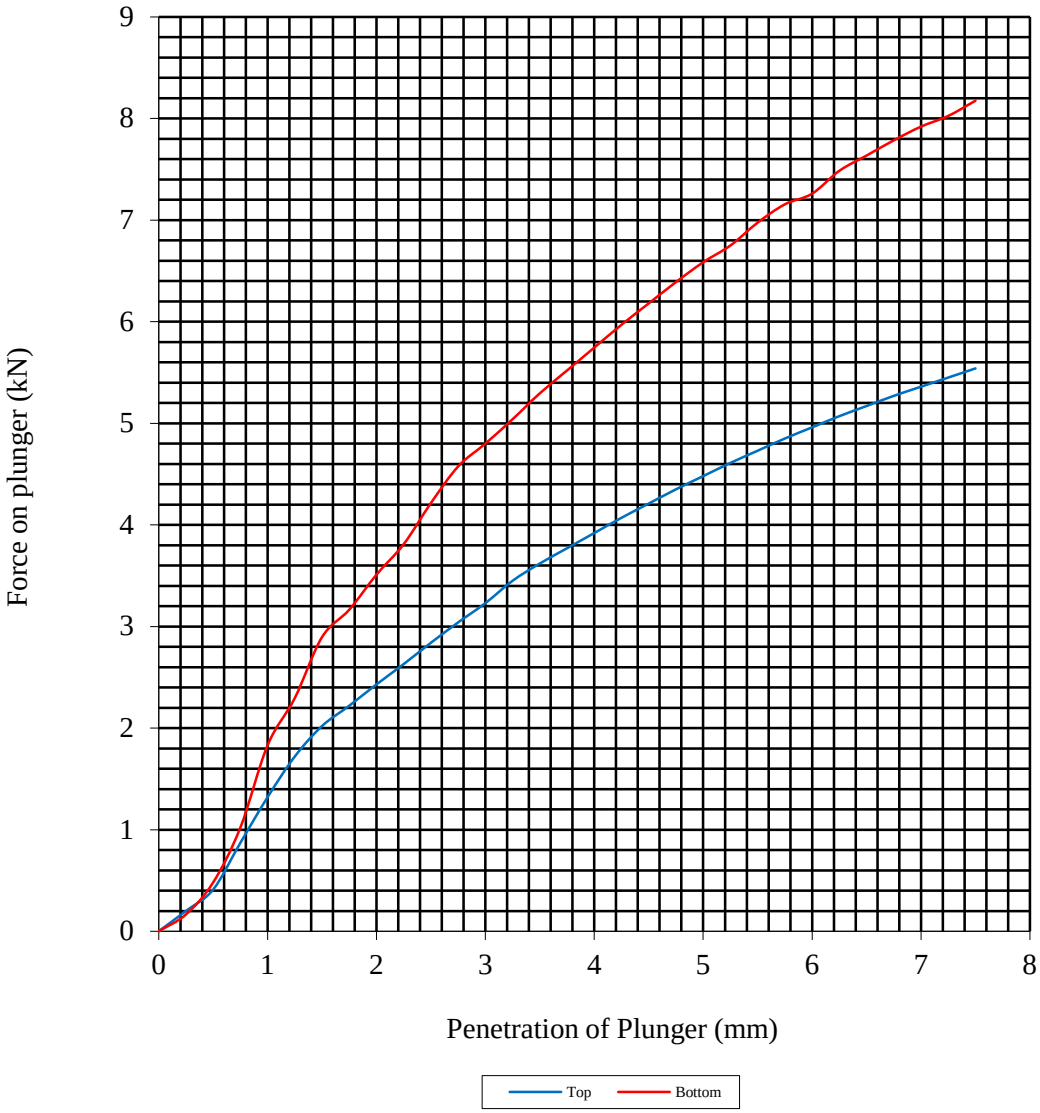
CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number: **BH14** **Top Depth (m):** **4.00**

Sample Number: **6** **Base Depth (m):**

Sample Type: **B**



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	15	Surcharge Kg:	4.20	Sample Top	15	Sample Top	22.4
Bulk Density Mg/m3:	2.12	Soaking Time hrs	0	Sample Bottom	15	Sample Bottom	32.9
Dry Density Mg/m3:	1.84	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			5				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved		Date	Contract No:
		Arklow			PSL16/4906
					Client Ref:
					16-5027

MOISTURE CONDITION VALUE

BS1377 : Part 4 : 1990 Clause 5.4

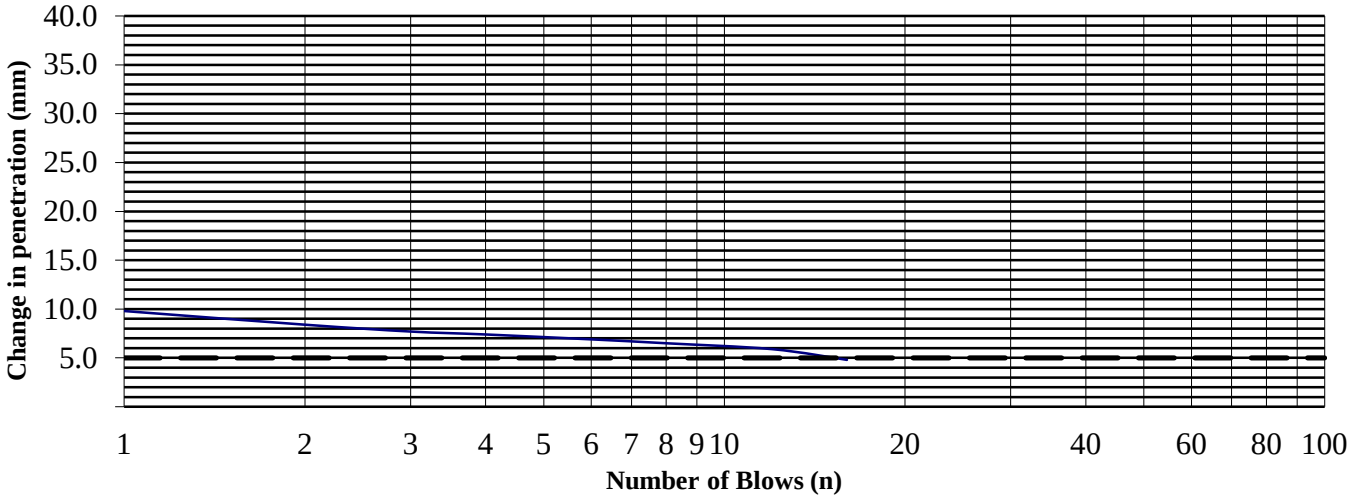
Hole Number: **BH14** **Top Depth (m):** **4.00**

Sample Number: **6** **Base Depth (m):**

Sample Type: **B**

Material Retained on the 20mm BS Test Sieve (%):	5
Interpretation of test curve is by the instection of 5mm change in penetration value	

MCV Determination



Blows (N)	Penetration (mm)	n to 4 n (mm)
1	84.0	9.8
2	79.2	8.4
3	76.0	7.7
4	74.2	7.4
6	72.0	6.9
8	70.8	6.5
12	68.3	5.9
16	66.8	4.8
24	65.1	
32	64.3	
48	62.4	
64	62.0	
96		
128		
192		
256		

Test Results.

Moisture Content (%)	5.7
MCV	11.8

UKAS TESTING 4043	PSL Professional Soils Laboratory	Checked / Approved		Date	11/11/16	Contract No:
		Arklow				PSL16/4906
						Client Ref:
						16-5027

PARTICLE SIZE DISTRIBUTION TEST

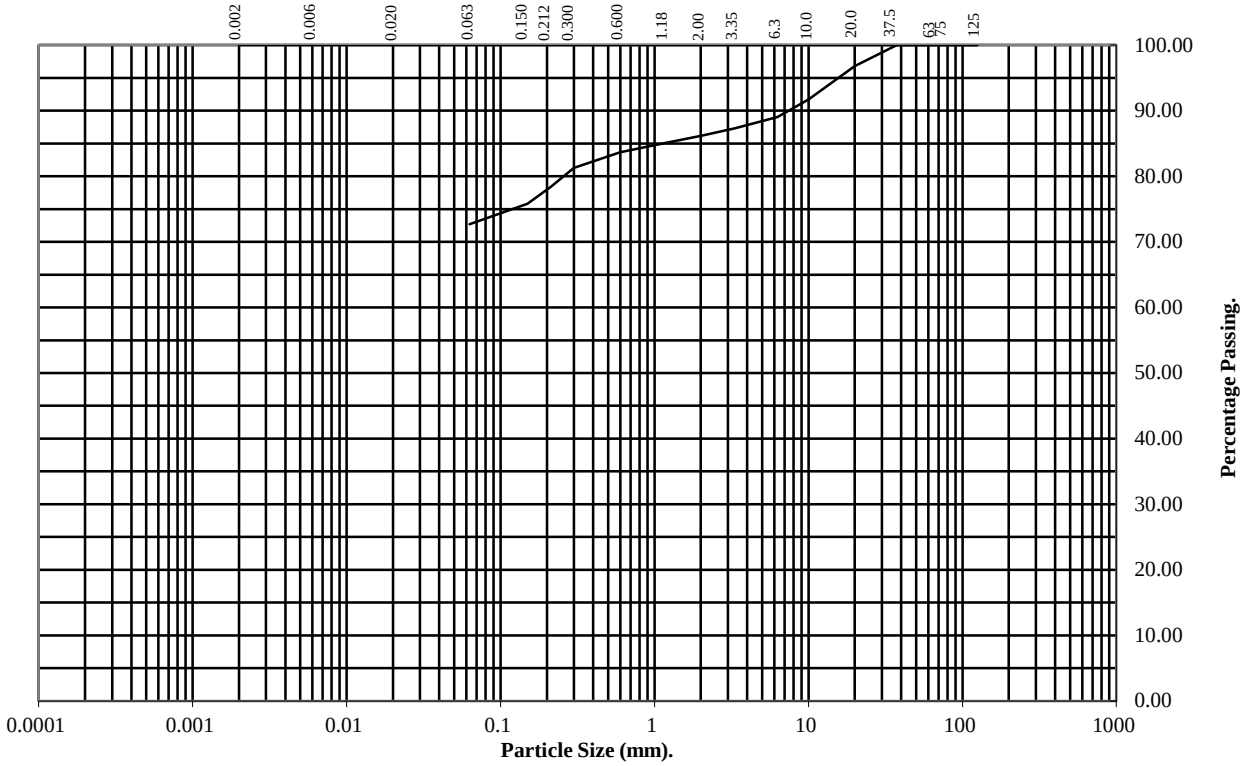
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH14** **Top Depth (m):** **9.40**

Sample Number: **13** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	97
10	92
6.3	89
3.35	87
2	86
1.18	85
0.6	84
0.3	81
0.212	78
0.15	76
0.063	73

Soil Fraction	Total Percentage
Cobbles	0
Gravel	14
Sand	13
Silt/Clay	73

Remarks:

See summary of soil descriptions.

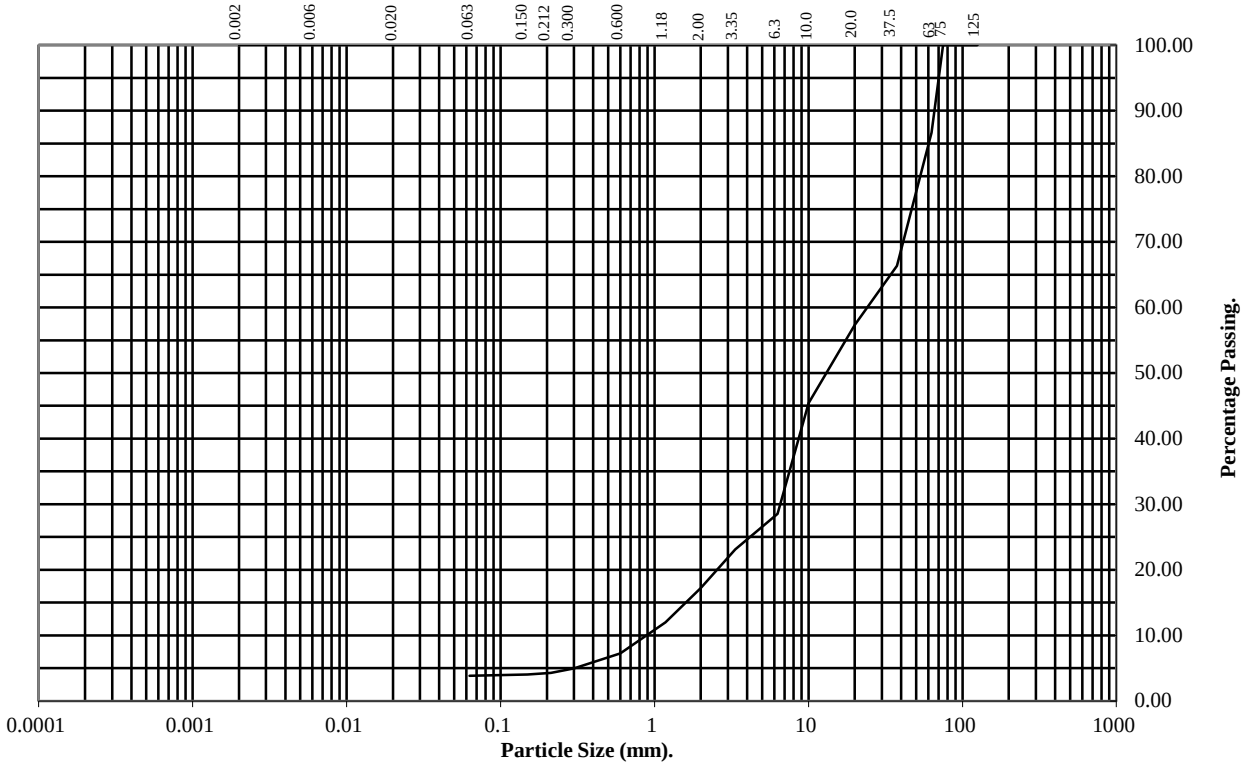
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow		**Client Ref:** 16-5027

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH15D**	**Top Depth (m):**	**0.20**
Sample Number:	**1**	**Base Depth(m):**	**1.60**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	87
37.5	66
20	57
10	45
6.3	29
3.35	23
2	17
1.18	12
0.6	7
0.3	5
0.212	4
0.15	4
0.063	4

Soil Fraction	Total Percentage
Cobbles	13
Gravel	70
Sand	13
Silt/Clay	4

Remarks:

See summary of soil descriptions.

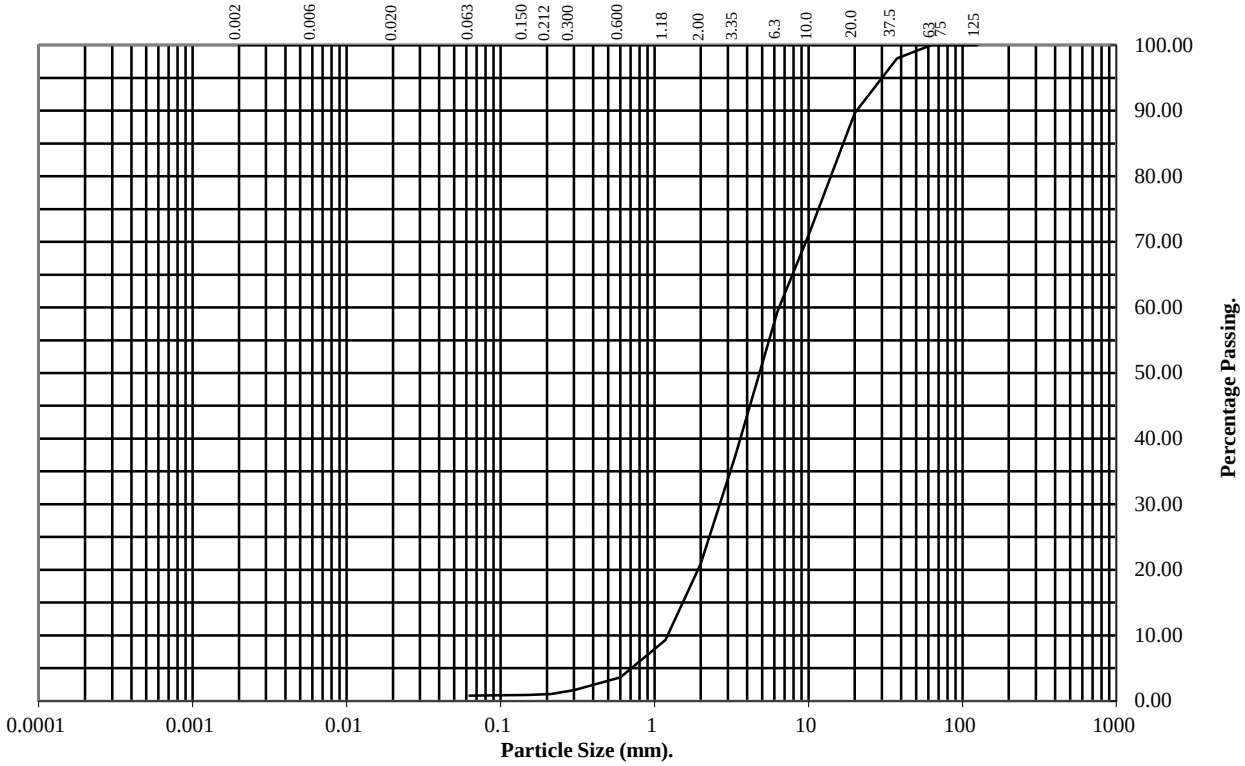
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow			**Client Ref:** 16-5027

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH15D**	**Top Depth (m):**	**1.60**
Sample Number:	**3**	**Base Depth(m):**	**2.60**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	98
20	90
10	71
6.3	59
3.35	37
2	21
1.18	9
0.6	4
0.3	2
0.212	1
0.15	1
0.063	1

Soil Fraction	Total Percentage
Cobbles	0
Gravel	79
Sand	20
Silt/Clay	1

Remarks:

See summary of soil descriptions.

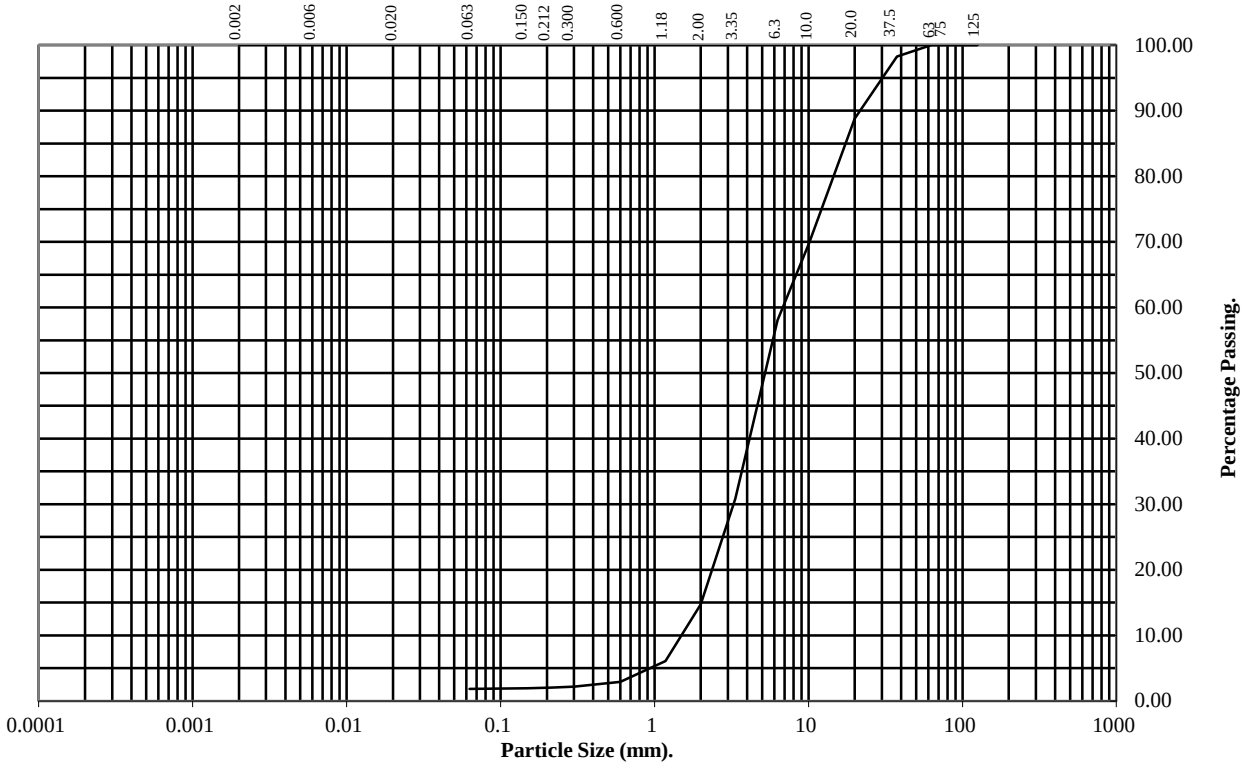
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date**	**11/11/16**	**Contract No:**
		Arklow				**PSL16/4906**
						Client Ref:
						16-5027

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH15D**	**Top Depth (m):**	**4.10**
Sample Number:	**7**	**Base Depth(m):**	**5.60**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	98
20	89
10	70
6.3	58
3.35	31
2	15
1.18	6
0.6	3
0.3	2
0.212	2
0.15	2
0.063	2

Soil Fraction	Total Percentage
Cobbles	0
Gravel	85
Sand	13
Silt/Clay	2

Remarks:

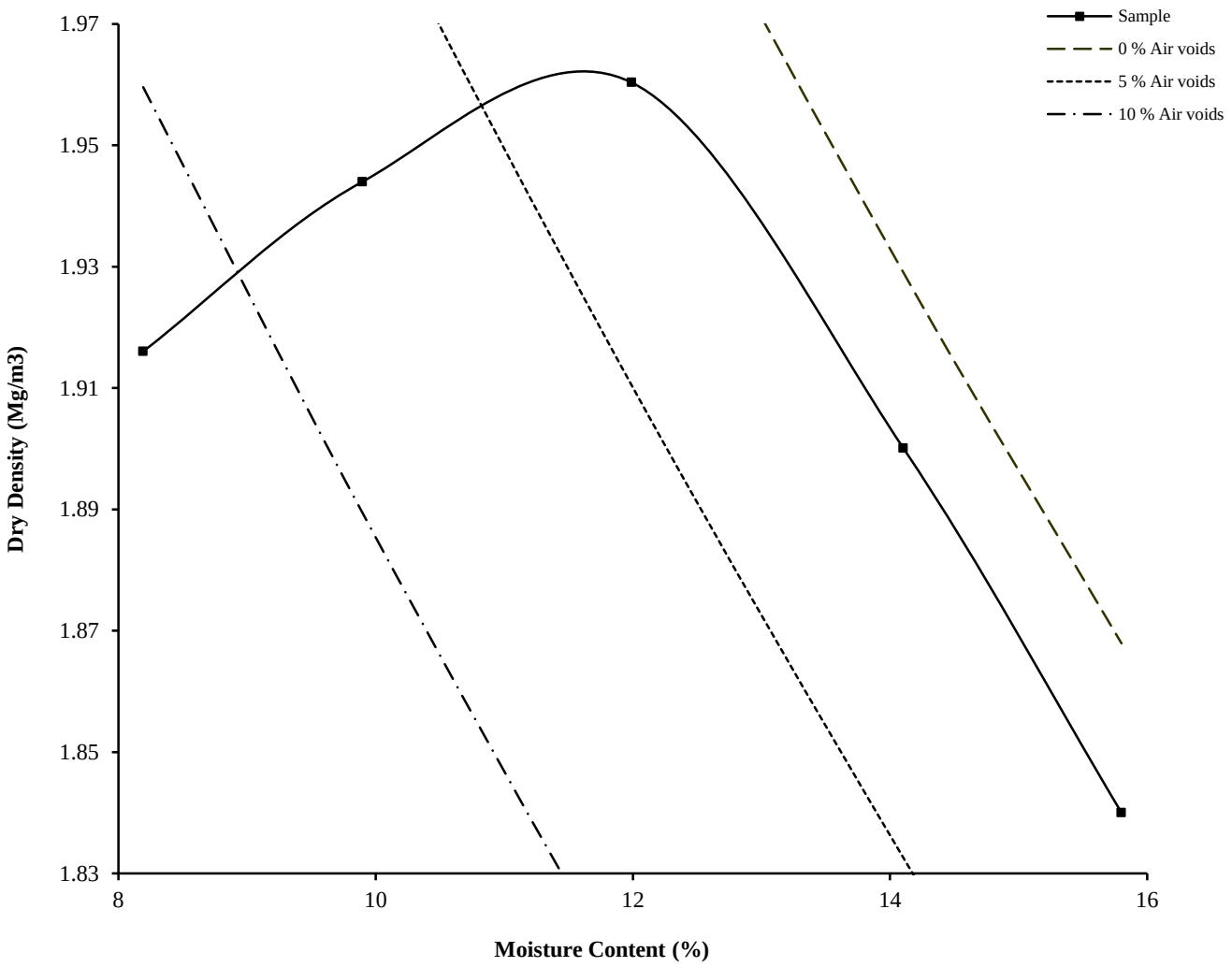
See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow			**Client Ref:** 16-5027

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : 1990

Hole Number:	**BH15D**	**Top Depth (m) :**	**4.10**
Sample Number:	**7**	**Base Depth (m) :**	**5.60**
Sample Type:	**B**		



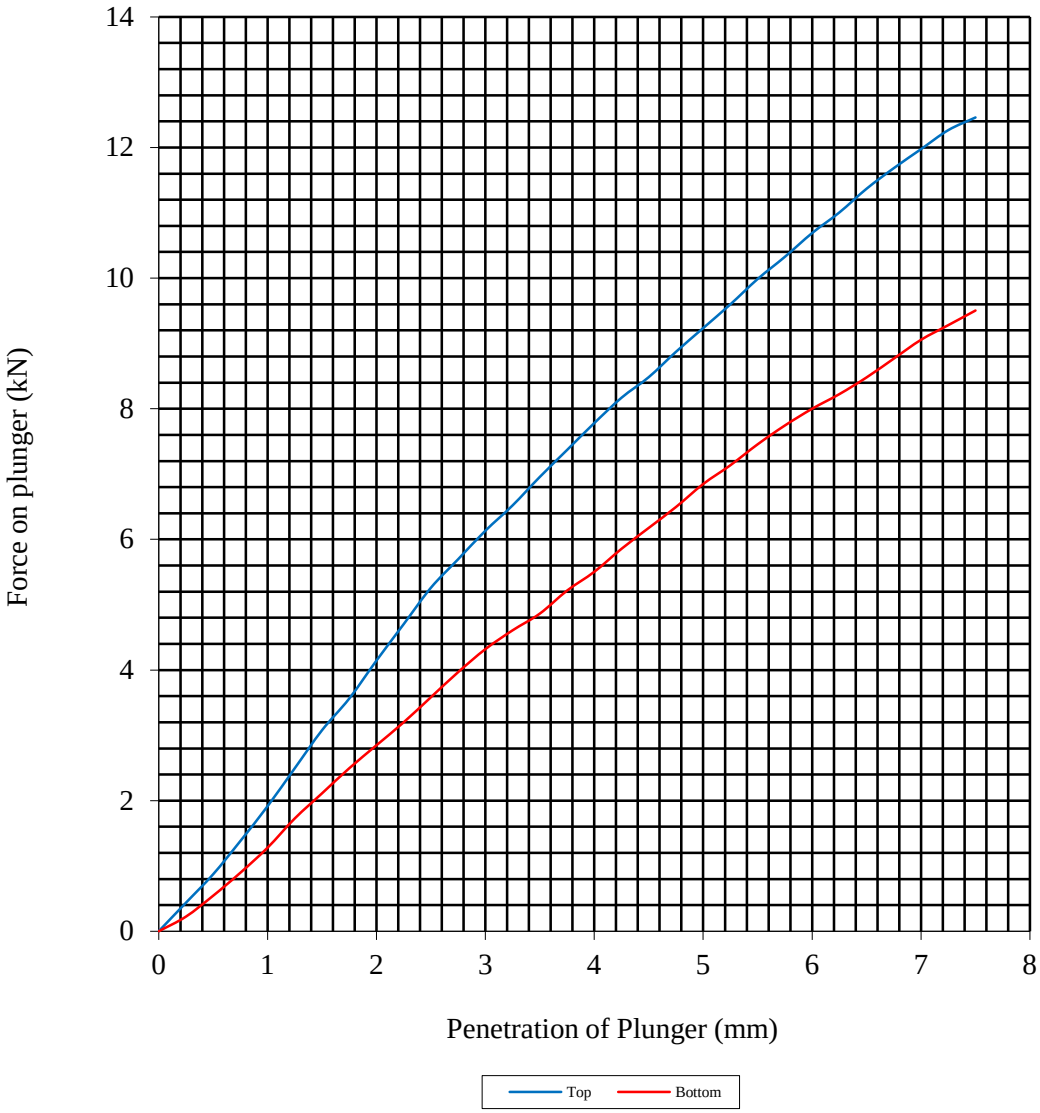
Initial Moisture Content:		8.2	Method of Compaction:	2.5Kg Rammer	Separate Samples
Particle Density (Mg/m3):	2.65	Assumed	Material Retained on 37.5 mm Test Sieve (%):		2
Maximum Dry Density (Mg/m3):		1.96	Material Retained on 20.0 mm Test Sieve (%):		9
Optimum Moisture Content (%):		12			
Remarks See summary of soil descriptions					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 11/11/16	**Contract No.**
		Arklow			**PSL16/4906**
					Client Ref
					16-5027

CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number:	**BH15D**	**Top Depth (m):**	**5.60**
Sample Number:	**9**	**Base Depth (m):**	**6.80**
Sample Type:	**B**		



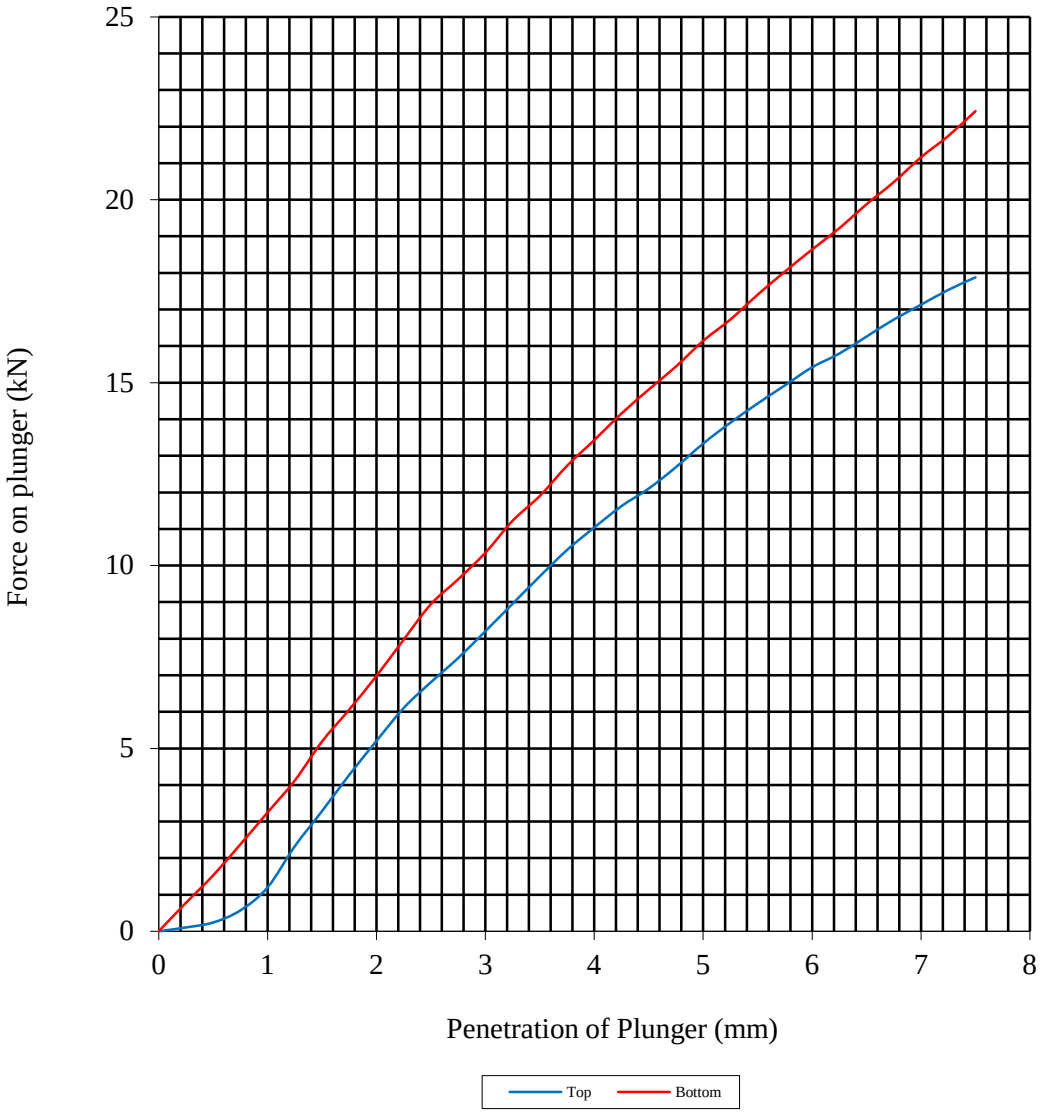
Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	5.2	Surcharge Kg:	4.20	Sample Top	5.2	Sample Top	46.2
Bulk Density Mg/m3:	2.00	Soaking Time hrs	0	Sample Bottom	5.3	Sample Bottom	34.2
Dry Density Mg/m3:	1.90	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			12				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date**	**11/11/16**	**Contract No:**
		Arklow				**PSL16/4906**
						Client Ref:
						16-5027

CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number:	**BH15D**	**Top Depth (m):**	**4.10**
Sample Number:	**7**	**Base Depth (m):**	**5.60**
Sample Type:	**B**		



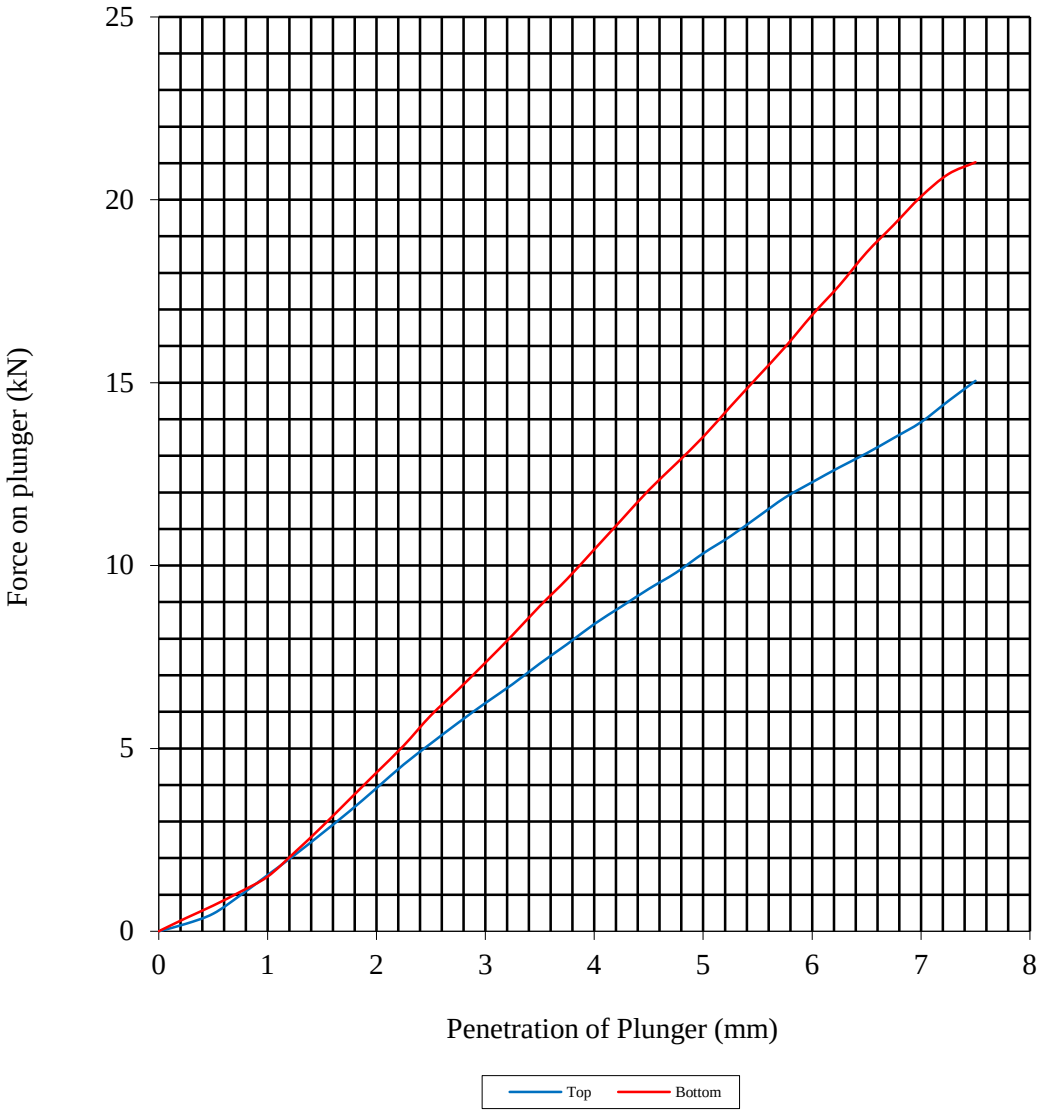
Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	10	Surcharge Kg:	4.20	Sample Top	10	Sample Top	66.7
Bulk Density Mg/m3:	2.13	Soaking Time hrs	0	Sample Bottom	10	Sample Bottom	80.7
Dry Density Mg/m3:	1.94	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			11				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date**	**11/11/16**	**Contract No:**
		Arklow				**PSL16/4906**
						Client Ref:
						16-5027

CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number:	**BH15D**	**Top Depth (m):**	**4.10**
Sample Number:	**7**	**Base Depth (m):**	**5.60**
Sample Type:	**B**		



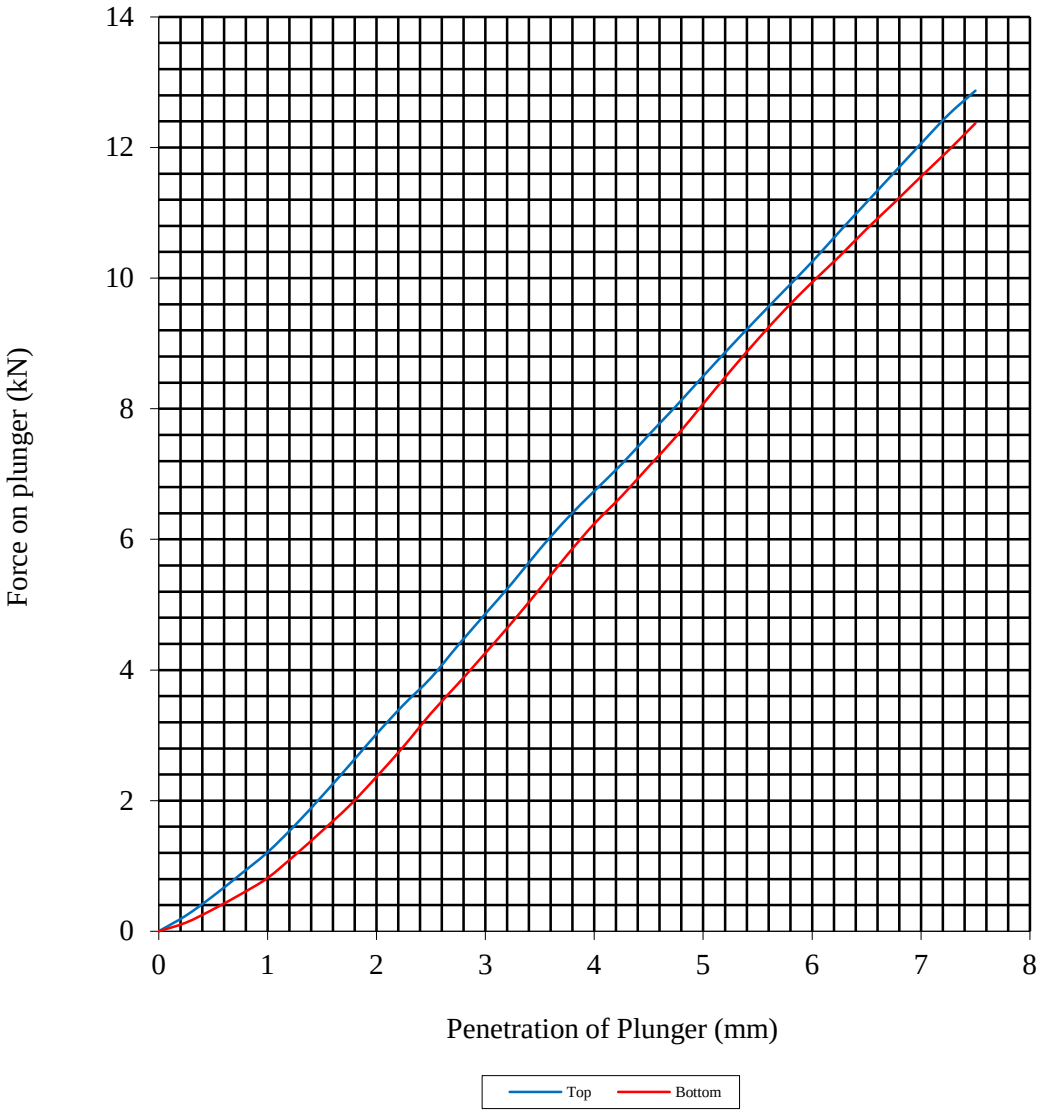
Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	12	Surcharge Kg:	4.20	Sample Top	12	Sample Top	51.7
Bulk Density Mg/m3:	2.20	Soaking Time hrs	0	Sample Bottom	12	Sample Bottom	67.6
Dry Density Mg/m3:	1.96	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			11				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date**	**11/11/16**	**Contract No:**
		Arklow				**PSL16/4906**
						Client Ref:
						16-5027

CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number:	**BH15D**	**Top Depth (m):**	**4.10**
Sample Number:	**7**	**Base Depth (m):**	**5.60**
Sample Type:	**B**		



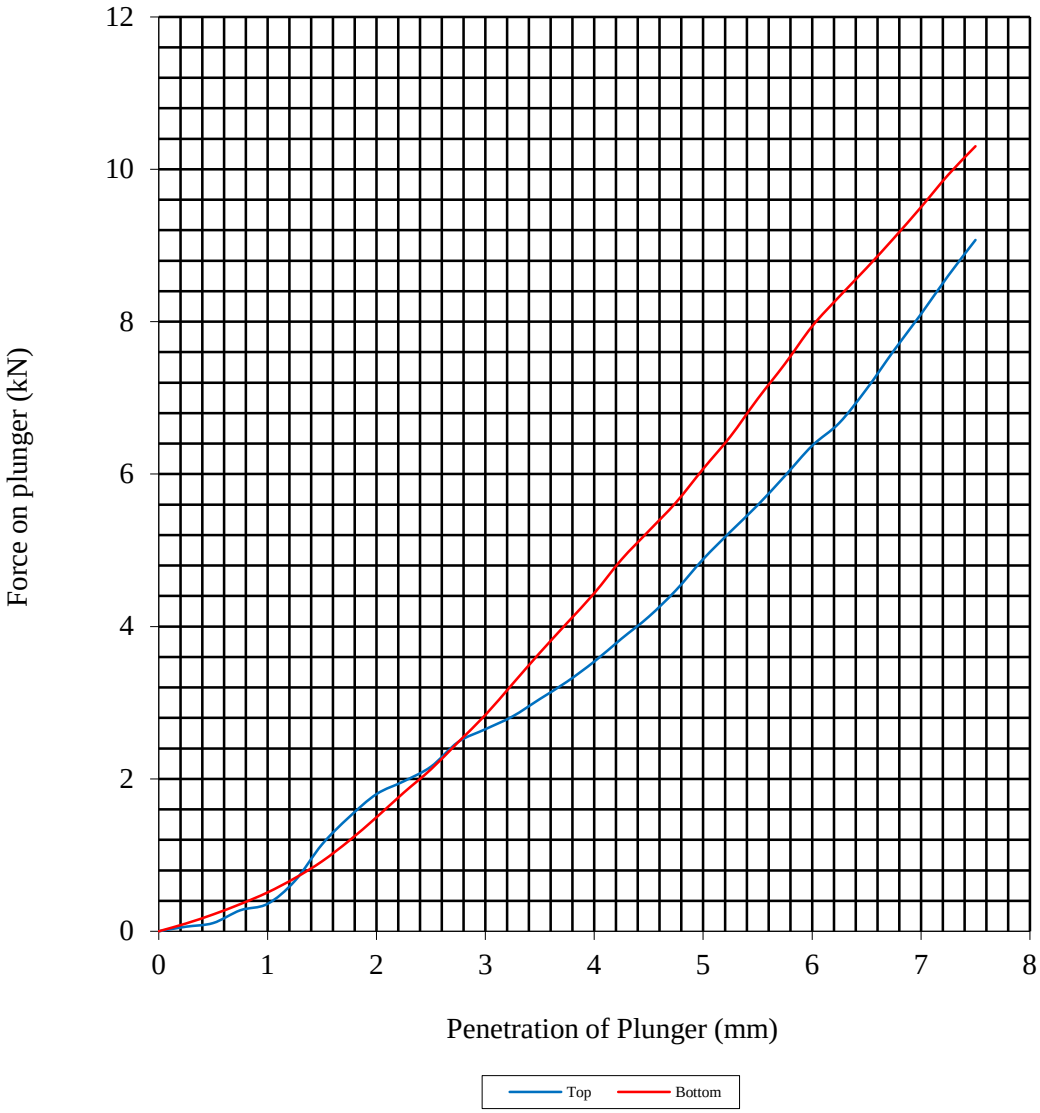
Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	14	Surcharge Kg:	4.20	Sample Top	14	Sample Top	42.5
Bulk Density Mg/m3:	2.17	Soaking Time hrs	0	Sample Bottom	14	Sample Bottom	40.4
Dry Density Mg/m3:	1.90	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			S				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow			**Client Ref:** 16-5027

CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number:	**BH15D**	**Top Depth (m):**	**4.10**
Sample Number:	**7**	**Base Depth (m):**	**5.60**
Sample Type:	**B**		



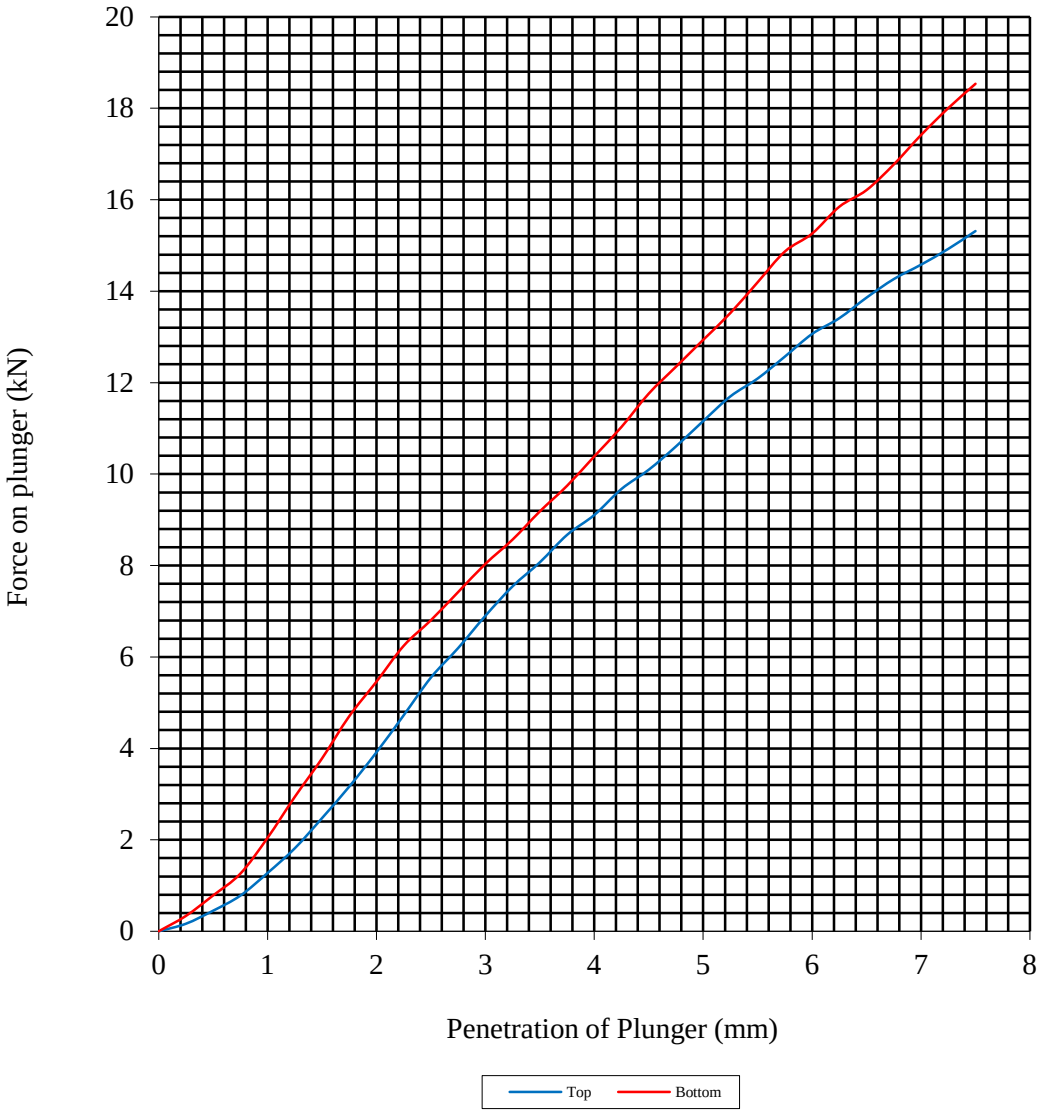
Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	16	Surcharge Kg:	4.20	Sample Top	16	Sample Top	24.4
Bulk Density Mg/m3:	2.13	Soaking Time hrs	0	Sample Bottom	16	Sample Bottom	30.3
Dry Density Mg/m3:	1.84	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			11				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow			**Client Ref:** 16-5027

CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number:	**BH15D**	**Top Depth (m):**	**4.10**
Sample Number:	**7**	**Base Depth (m):**	**5.60**
Sample Type:	**B**		



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	8.2	Surcharge Kg:	4.20	Sample Top	7.9	Sample Top	55.8
Bulk Density Mg/m3:	2.07	Soaking Time hrs	0	Sample Bottom	8.5	Sample Bottom	64.7
Dry Density Mg/m3:	1.92	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			11				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow			**Client Ref:** 16-5027

MOISTURE CONDITION VALUE

BS1377 : Part 4 : 1990 Clause 5.4

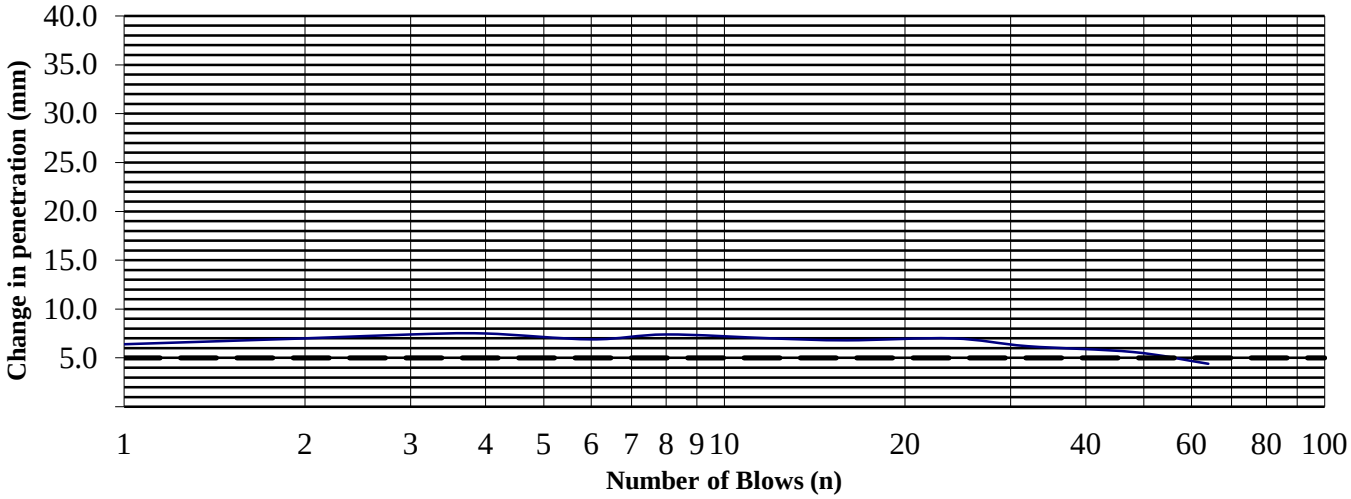
Hole Number: **BH15D** **Top Depth (m):** **4.10**

Sample Number: **7** **Base Depth (m):**

Sample Type: **B**

Material Retained on the 20mm BS Test Sieve (%):	11
Interpretation of test curve is by the instection of 5mm change in penetration value	

MCV Determination



Blows (N)	Penetration (mm)	n to 4 n (mm)
1	83.7	6.4
2	80.6	7.0
3	78.8	7.4
4	77.3	7.5
6	75.1	6.9
8	73.6	7.4
12	71.4	7.0
16	69.8	6.8
24	68.2	7.0
32	66.2	6.2
48	64.4	5.6
64	63.0	4.4
96	61.2	
128	60.0	
192	58.8	
256	58.6	

Test Results.

Moisture Content (%)	8
MCV	17.4

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date**	**11/11/16**	**Contract No:**
		Arklow			**PSL16/4906**
					Client Ref:
					16-5027

MOISTURE CONDITION VALUE

BS1377 : Part 4 : 1990 Clause 5.4

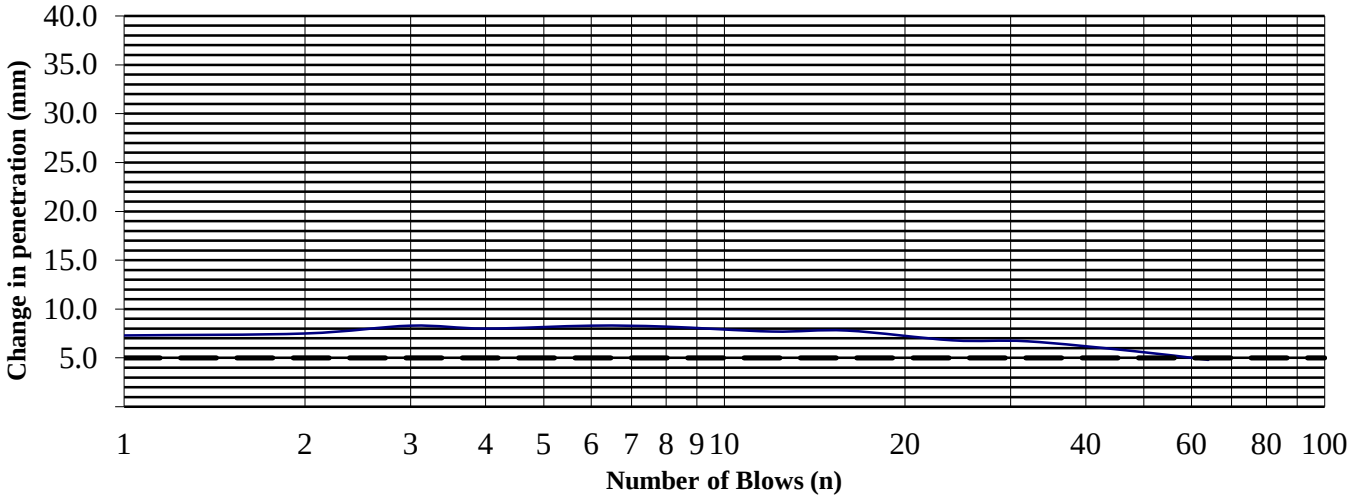
Hole Number: **BH15D** **Top Depth (m):** **5.60**

Sample Number: **9** **Base Depth (m):**

Sample Type: **B**

Material Retained on the 20mm BS Test Sieve (%):	12
Interpretation of test curve is by the instection of 5mm change in penetration value	

MCV Determination



Blows (N)	Penetration (mm)	n to 4 n (mm)
1	84.1	7.3
2	80.6	7.5
3	78.6	8.3
4	76.8	8.0
6	74.6	8.3
8	73.1	8.2
12	70.3	7.7
16	68.8	7.8
24	66.3	6.8
32	64.9	6.7
48	62.6	5.7
64	61.0	4.8
96	59.5	
128	58.2	
192	56.9	
256	56.2	

Test Results.

Moisture Content (%)	5.2
MCV	18.1

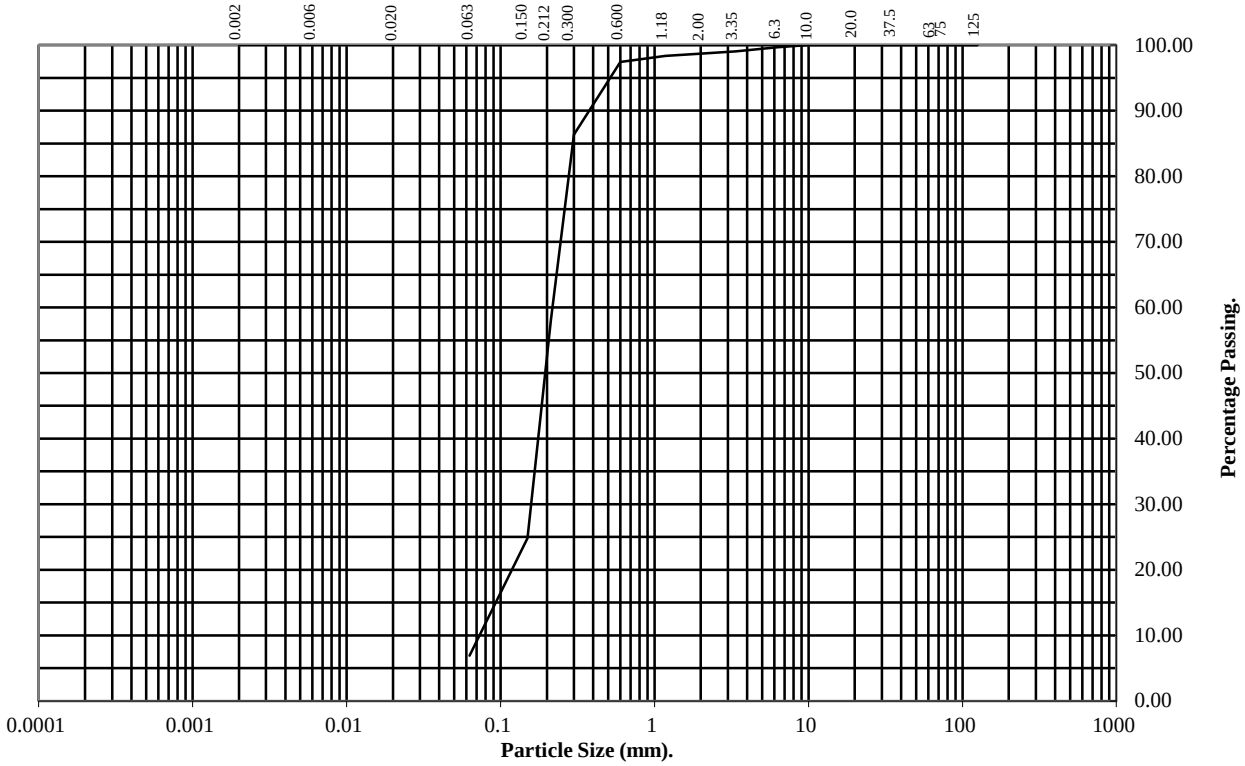
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date**	**11/11/16**	**Contract No:**
		Arklow			**PSL16/4906**
					Client Ref:
					16-5027

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH15D**	**Top Depth (m):**	**8.50**
Sample Number:	**13**	**Base Depth(m):**	**10.00**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	99
2	99
1.18	98
0.6	97
0.3	86
0.212	58
0.15	25
0.063	7

Soil Fraction	Total Percentage
Cobbles	0
Gravel	1
Sand	92
Silt/Clay	7

Remarks:

See summary of soil descriptions.

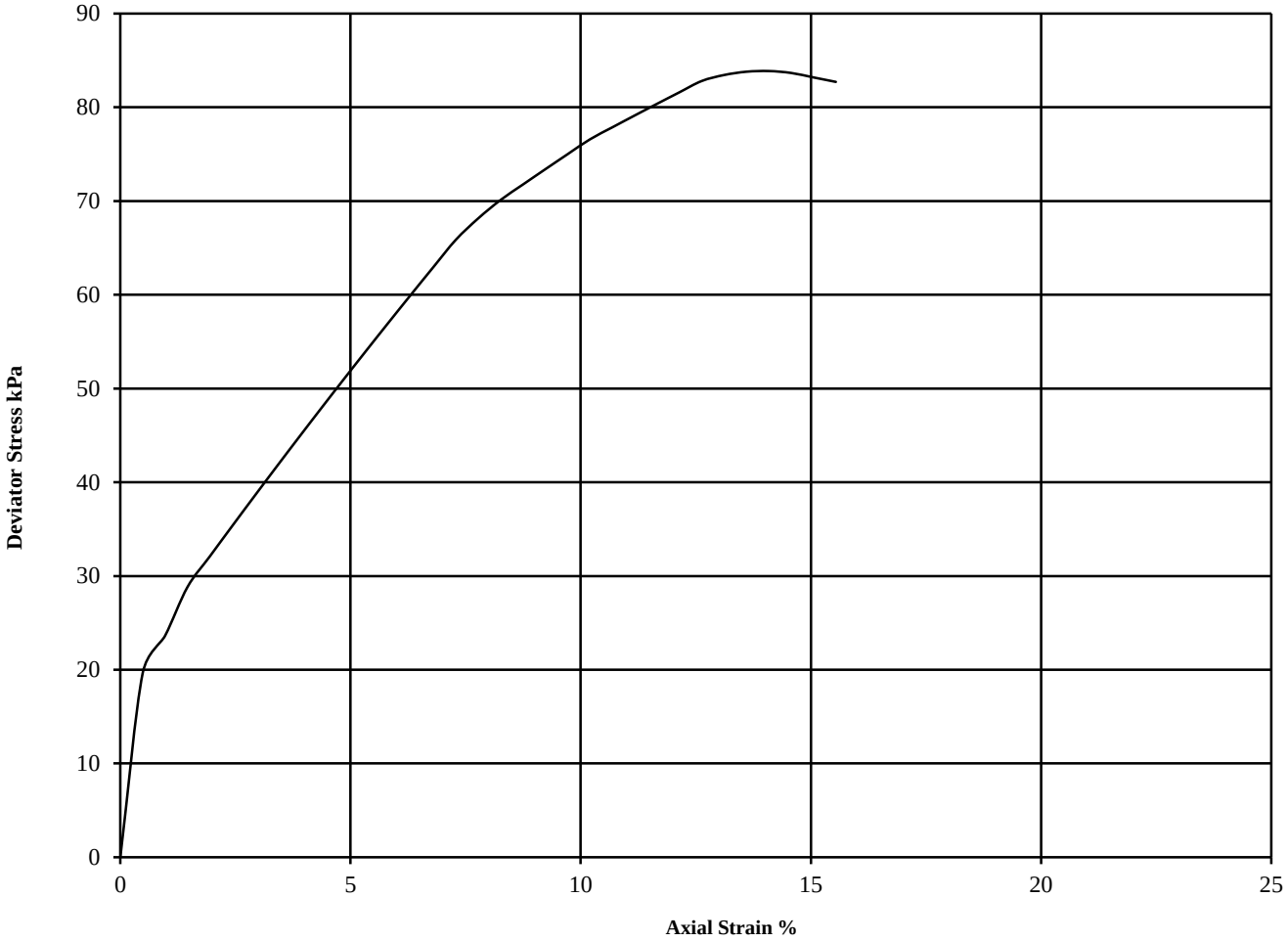
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow			**Client Ref:** 16-5027

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number:	**BH15D**	**Top Depth (m):**	**16.00**
Sample Number:	**28**	**Base Depth (m):**	**16.45**
Sample Type	**U**		



Diameter (mm):		102.0	Height (mm):		210.0	Test:	UU Single Stage		Remarks
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa) θ_3	Corr. Max. Deviator Stress (kPa) $(\theta_1-\theta_3)_f$	Shear Strength Cu (kPa) $^1/_2(\theta_1-\theta_3)_f$	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
1	27	2.01	1.58	320	84	42	14.1	Plastic	See summary of soil descriptions.

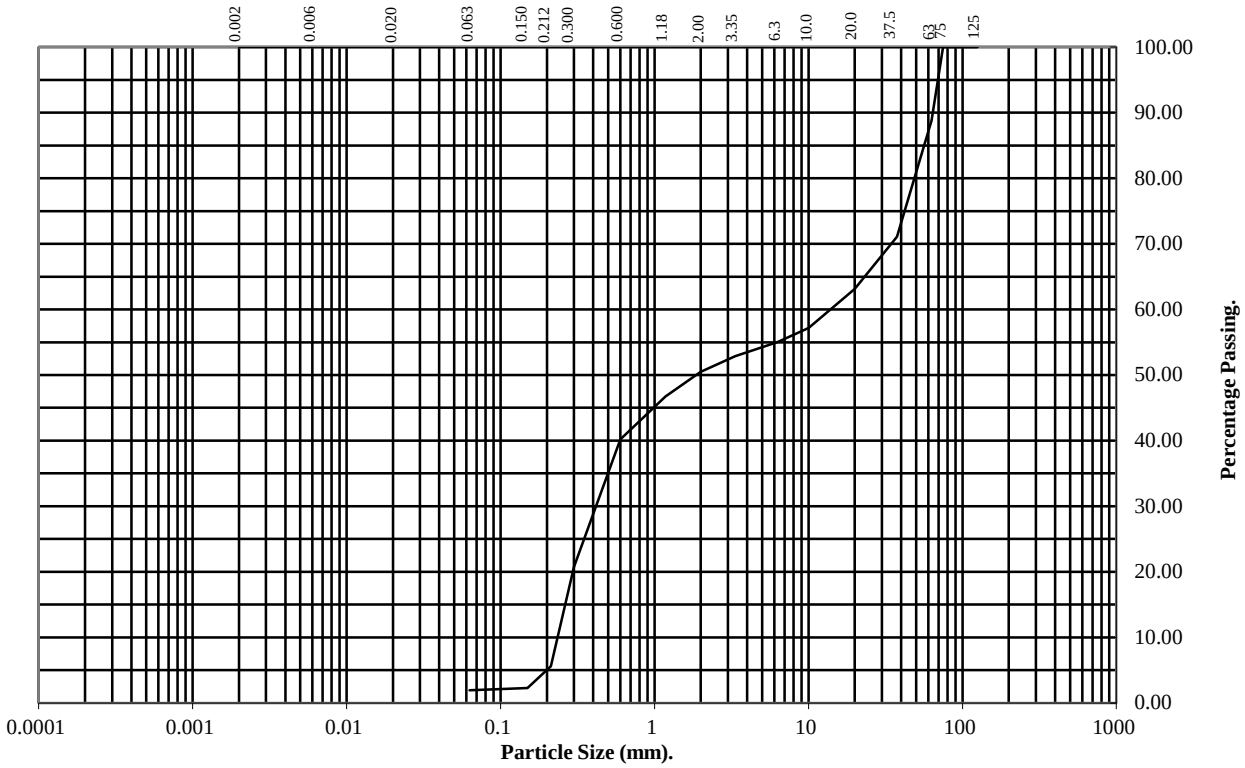
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 11/11/16	**Contract No:**
		Arklow			**PSL16/4906**
					Client Ref:
					16-5027

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH16**	**Top Depth (m):**	**0.50**
Sample Number:	**3**	**Base Depth(m):**	**1.20**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	89
37.5	71
20	63
10	57
6.3	55
3.35	53
2	50
1.18	47
0.6	40
0.3	21
0.212	6
0.15	2
0.063	2

Soil Fraction	Total Percentage
Cobbles	11
Gravel	39
Sand	48
Silt/Clay	2

Remarks:

See summary of soil descriptions.

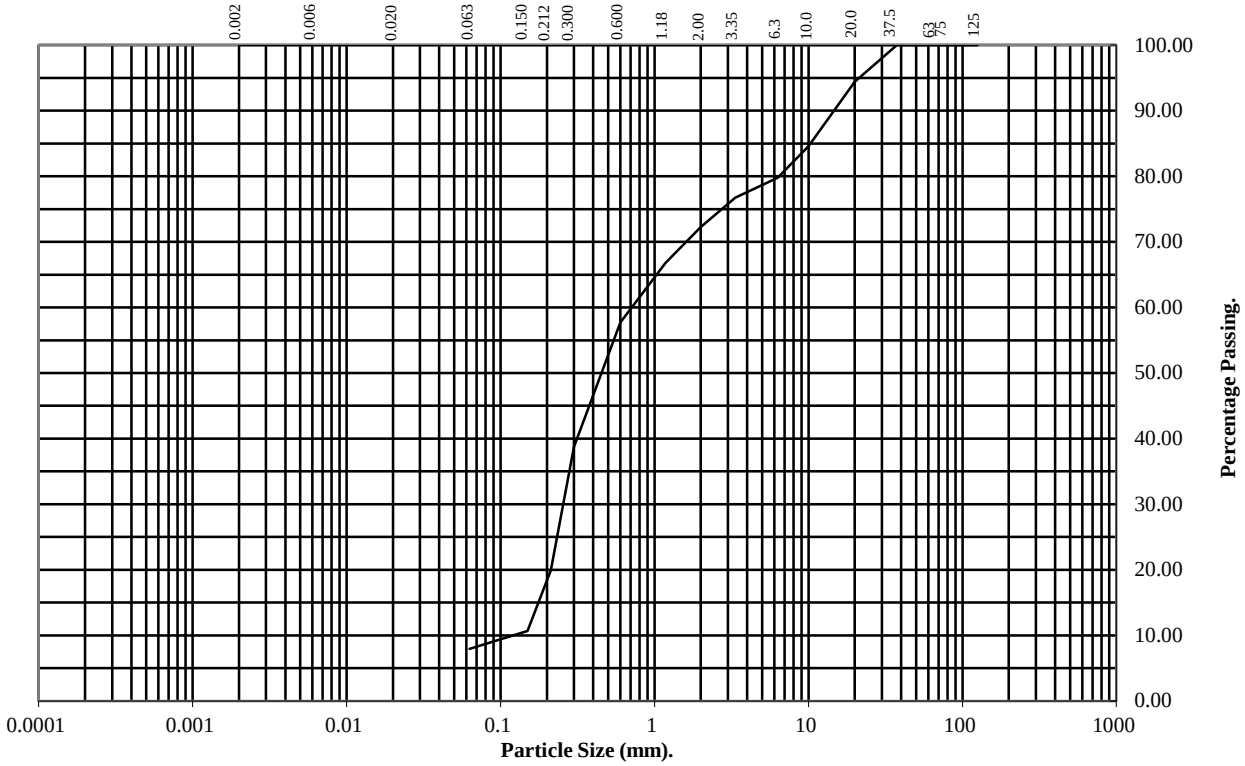
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow			**Client Ref:** 16-5027

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH16**	**Top Depth (m):**	**2.00**
Sample Number:	**7**	**Base Depth(m):**	**3.00**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	94
10	85
6.3	80
3.35	77
2	72
1.18	67
0.6	58
0.3	39
0.212	20
0.15	11
0.063	8

Soil Fraction	Total Percentage
Cobbles	0
Gravel	28
Sand	64
Silt/Clay	8

Remarks:

See summary of soil descriptions.

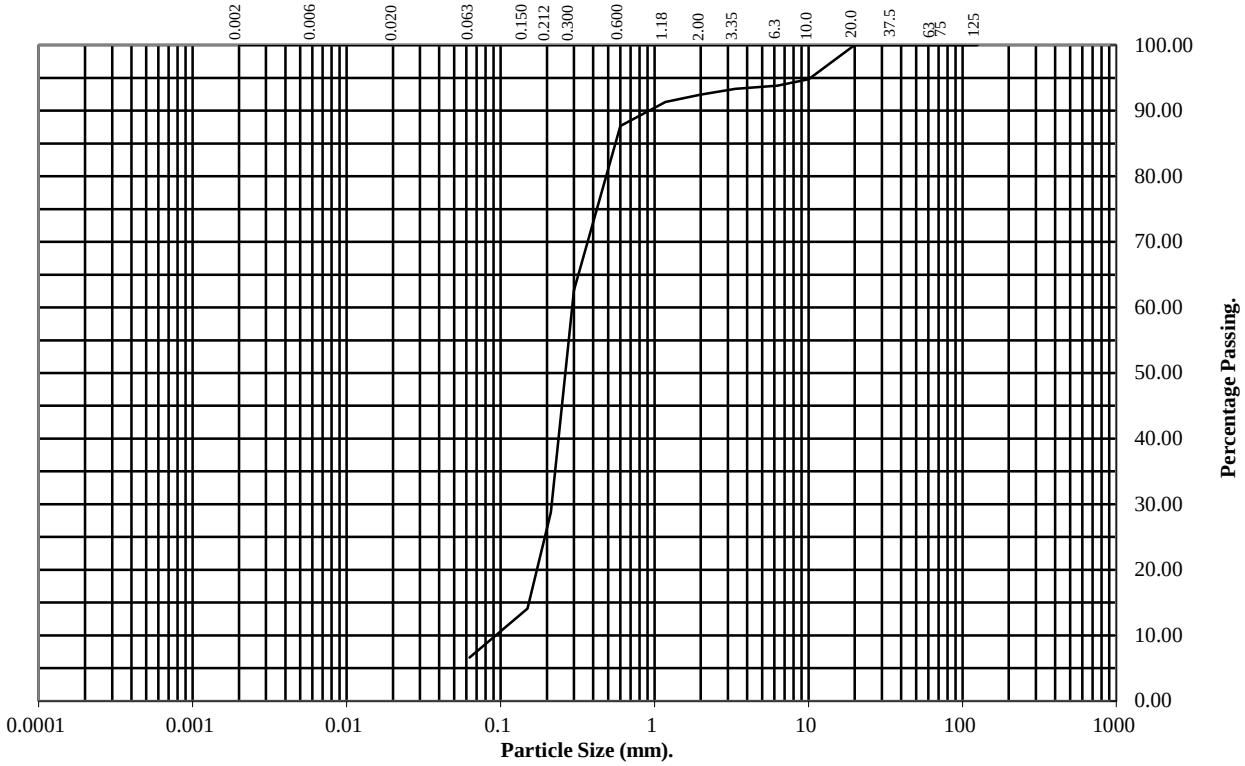
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow			**Client Ref:** 16-5027

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:	**BH16**	**Top Depth (m):**	**3.00**
Sample Number:	**11**	**Base Depth(m):**	**4.50**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	95
6.3	94
3.35	93
2	92
1.18	91
0.6	88
0.3	63
0.212	29
0.15	14
0.063	7

Soil Fraction	Total Percentage
Cobbles	0
Gravel	8
Sand	85
Silt/Clay	7

Remarks:

See summary of soil descriptions.

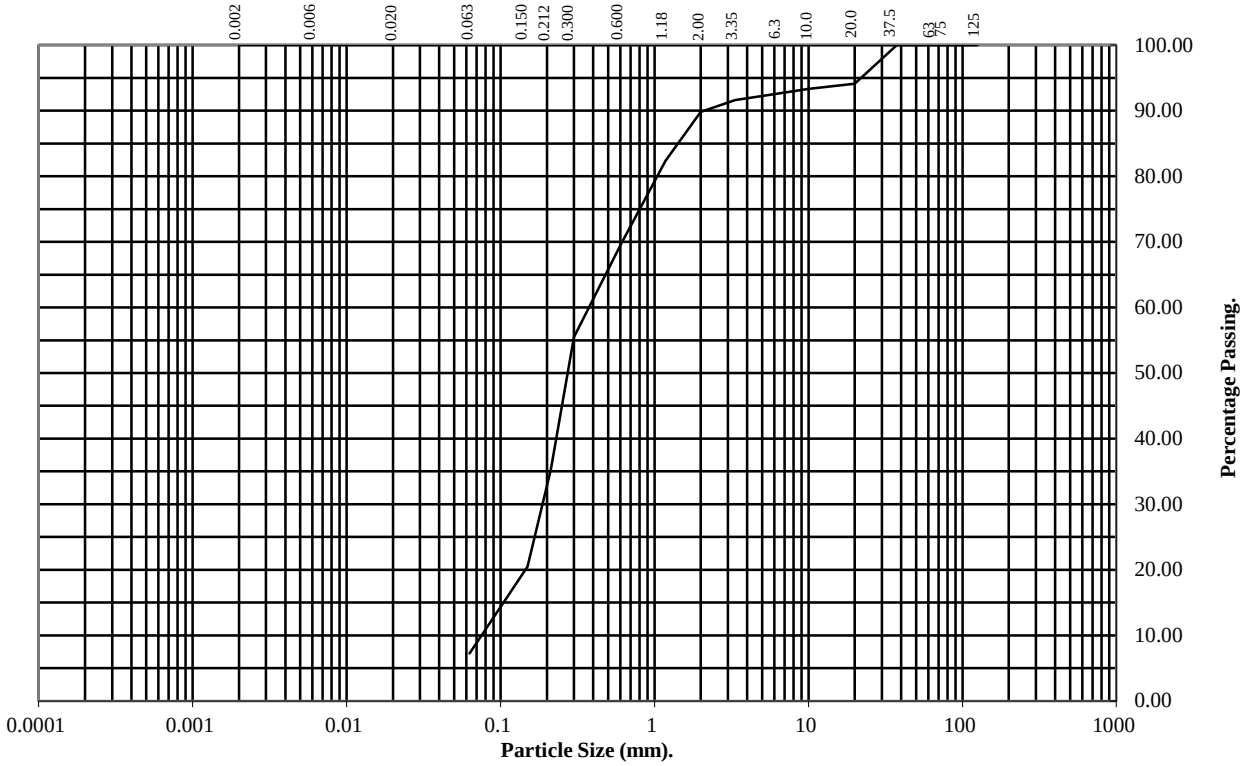
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date**	**11/11/16**	**Contract No:**
		Arklow				**PSL16/4906**
						Client Ref:
						16-5027

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number:	**BH16**	**Top Depth (m):**	**7.50**
Sample Number:	**16**	**Base Depth(m):**	**8.50**
Sample Type:	**B**		



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	94
10	93
6.3	93
3.35	92
2	90
1.18	82
0.6	69
0.3	55
0.212	35
0.15	20
0.063	7

Soil Fraction	Total Percentage
Cobbles	0
Gravel	10
Sand	83
Silt/Clay	7

Remarks:

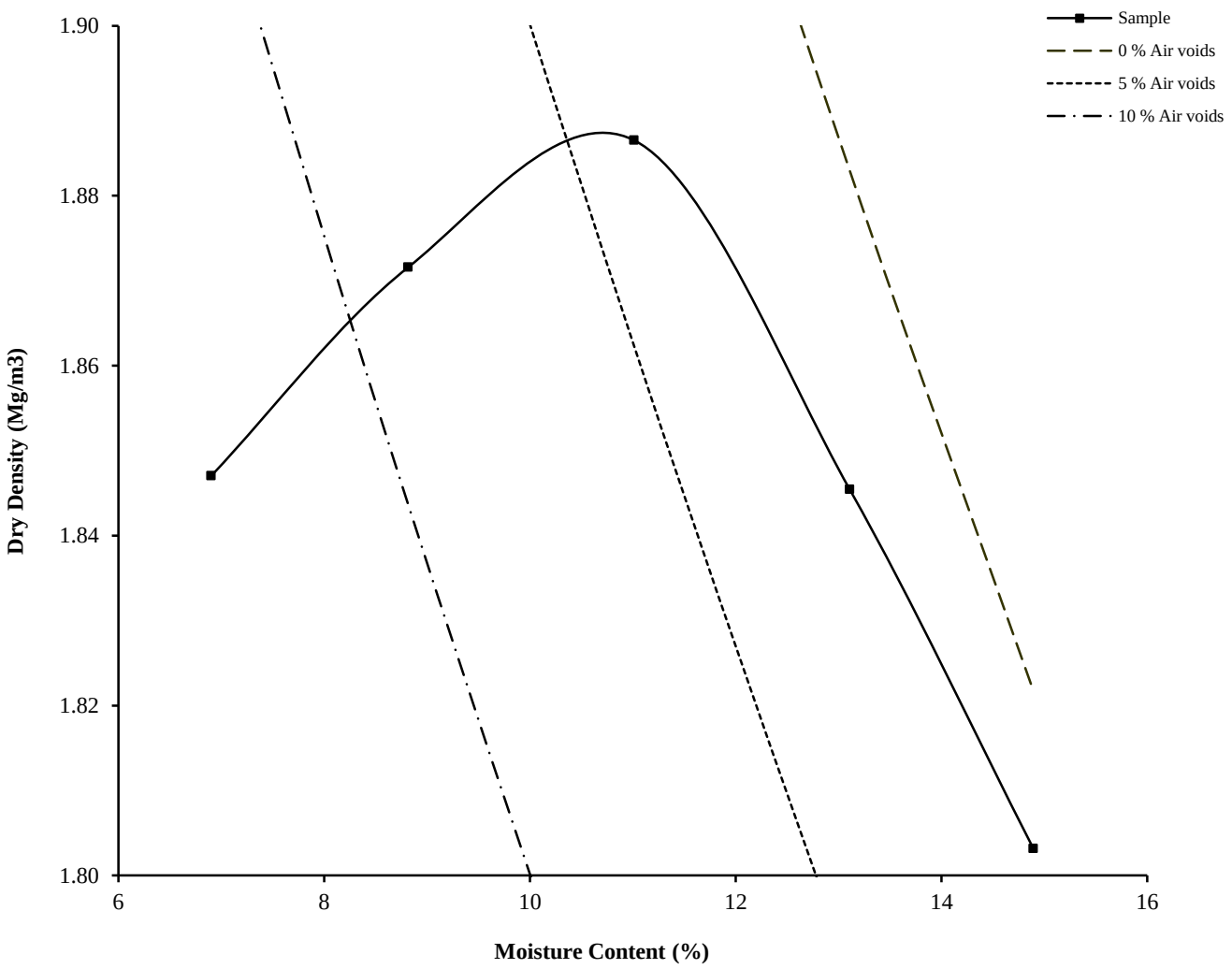
See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow			**Client Ref:** 16-5027

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : 1990

Hole Number:	**BH16**	**Top Depth (m) :**	**7.50**
Sample Number:	**16**	**Base Depth (m) :**	**8.50**
Sample Type:	**B**		



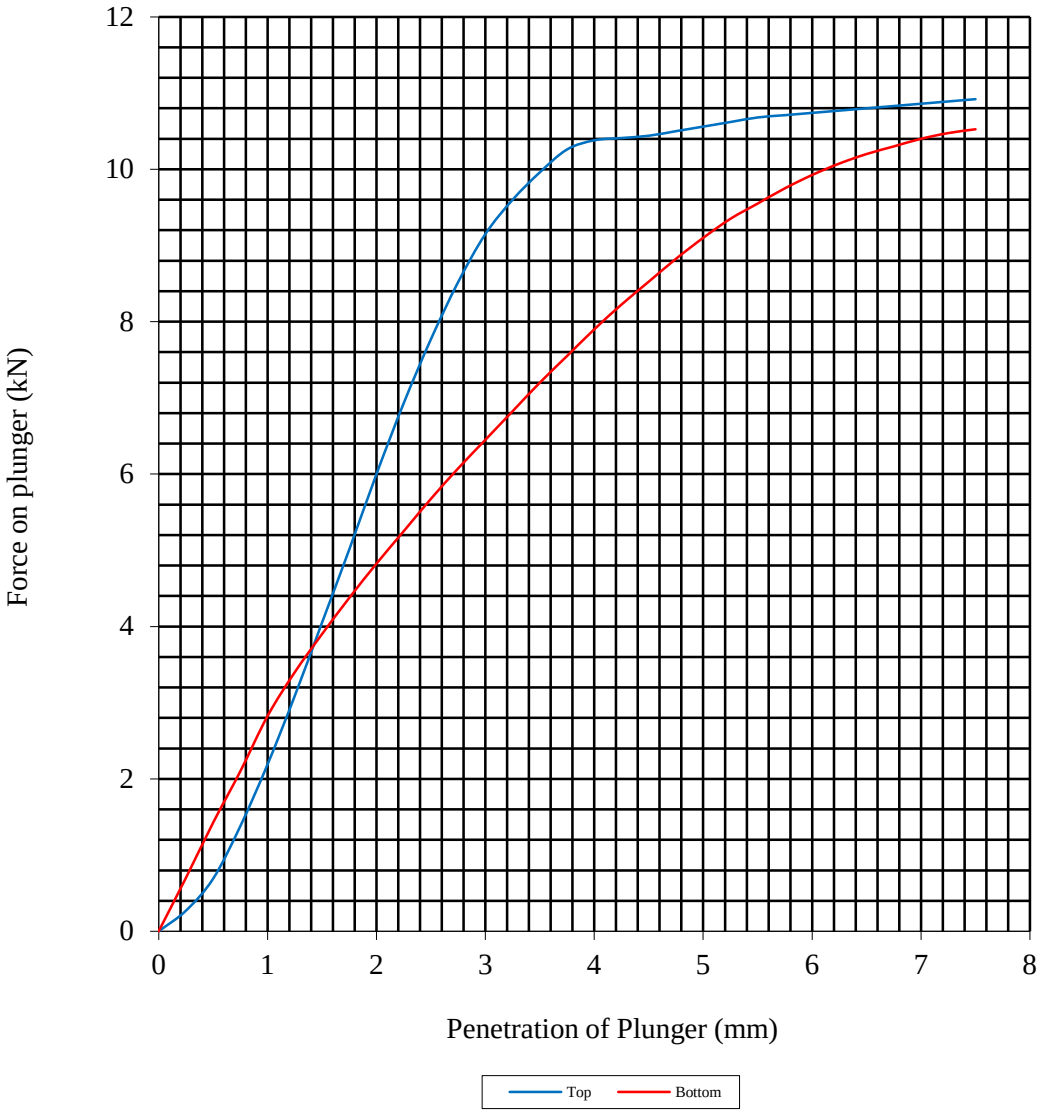
Initial Moisture Content:		15	Method of Compaction:	2.5Kg Rammer	Separate Samples
Particle Density (Mg/m3):	2.5	Assumed	Material Retained on 37.5 mm Test Sieve (%):		0
Maximum Dry Density (Mg/m3):		1.89	Material Retained on 20.0 mm Test Sieve (%):		6
Optimum Moisture Content (%):		11			
Remarks See summary of soil descriptions					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 11/11/16	**Contract No.**
		Arklow			**PSL16/4906**
					Client Ref
					16-5027

CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number:	**BH16**	**Top Depth (m):**	**7.50**
Sample Number:	**16**	**Base Depth (m):**	**8.50**
Sample Type:	**B**		



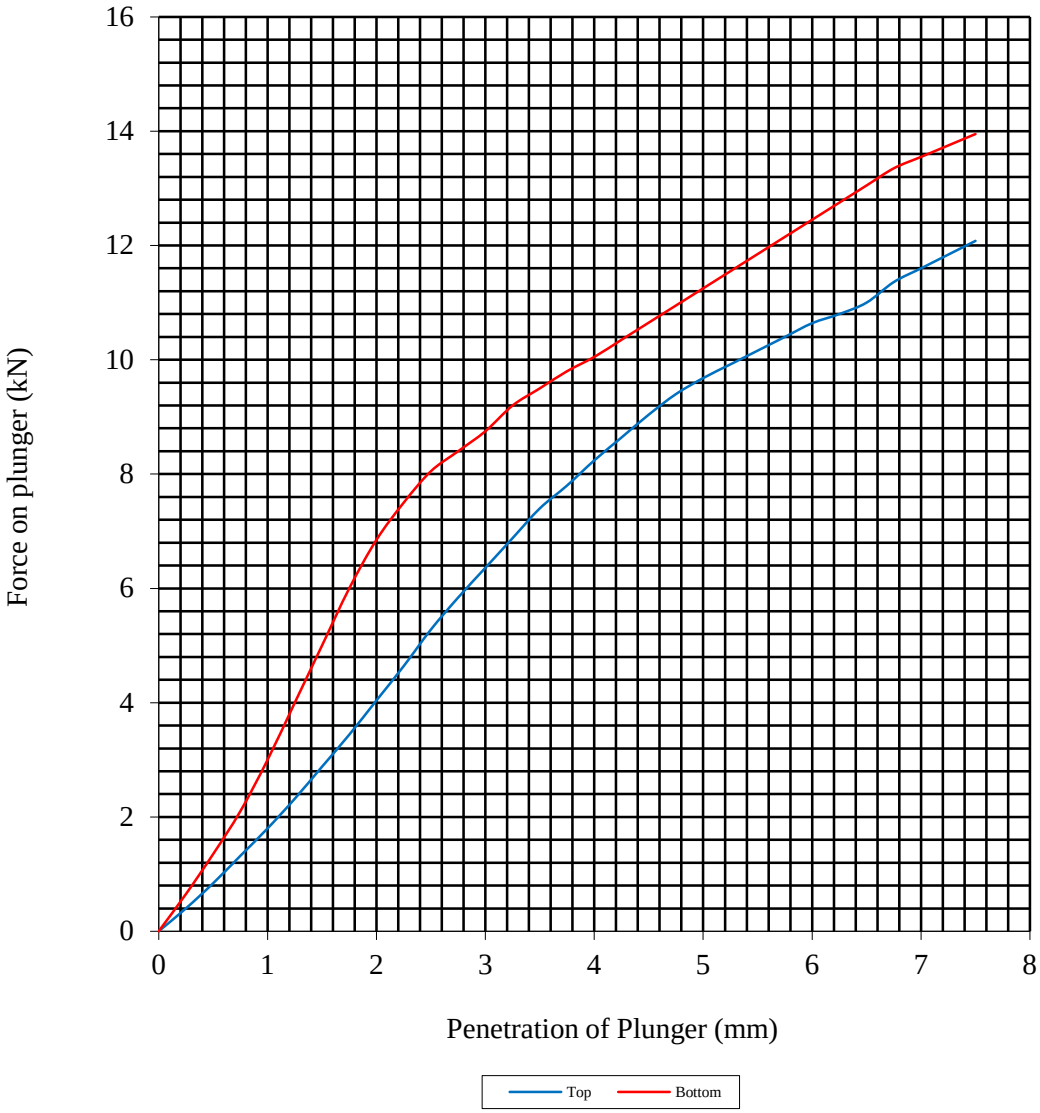
Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	6.9	Surcharge Kg:	4.20	Sample Top	6.7	Sample Top	58.9
Bulk Density Mg/m3:	1.97	Soaking Time hrs	0	Sample Bottom	7.1	Sample Bottom	45.5
Dry Density Mg/m3:	1.85	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			6				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow		**Client Ref:** 16-5027

CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number:	**BH16**	**Top Depth (m):**	**7.50**
Sample Number:	**16**	**Base Depth (m):**	**8.50**
Sample Type:	**B**		



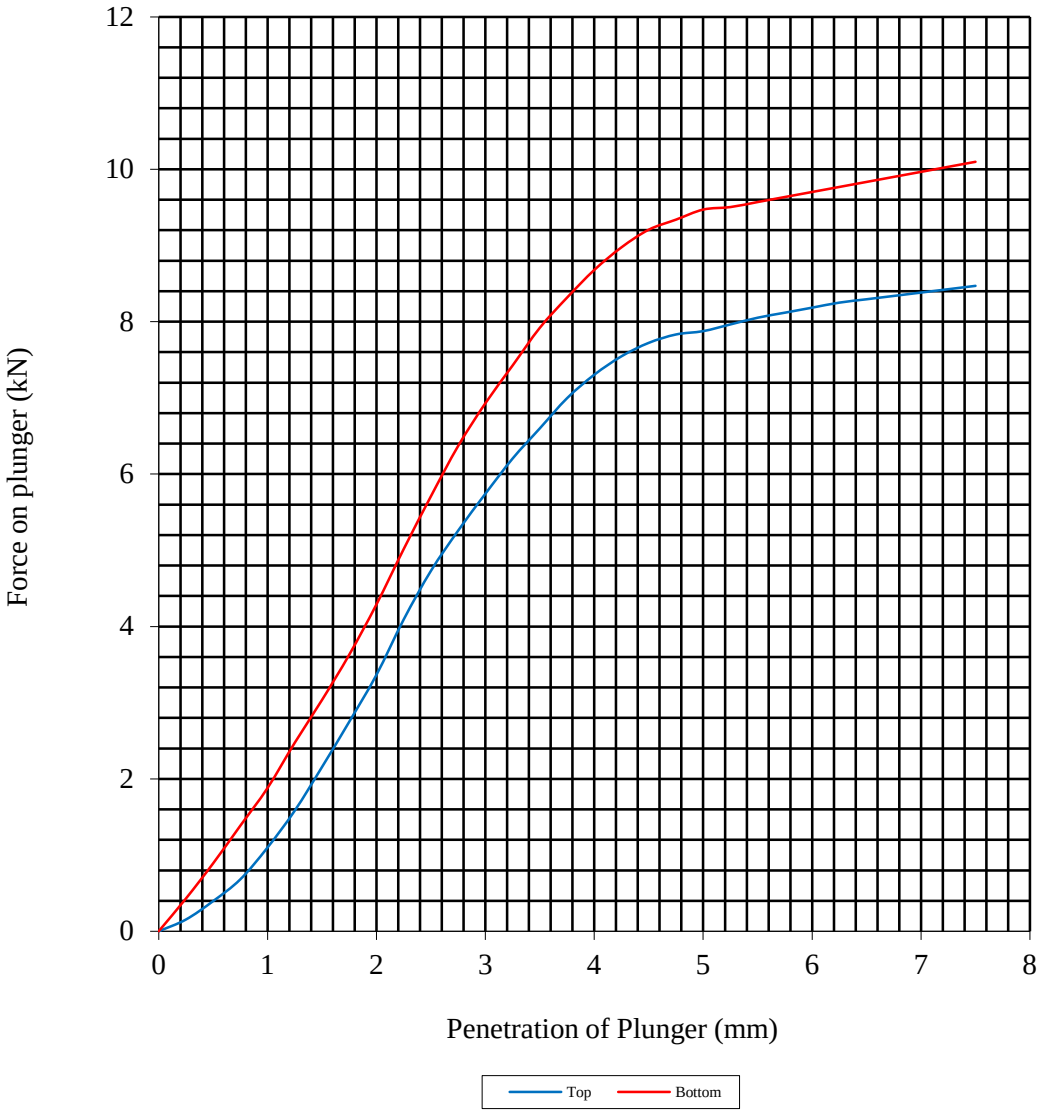
Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	8.8	Surcharge Kg:	4.20	Sample Top	8.7	Sample Top	48.4
Bulk Density Mg/m3:	2.03	Soaking Time hrs	0	Sample Bottom	8.9	Sample Bottom	61.0
Dry Density Mg/m3:	1.87	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			6				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date**	**11/11/16**	**Contract No:**
		Arklow				**PSL16/4906**
						Client Ref:
						16-5027

CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number:	**BH16**	**Top Depth (m):**	**7.50**
Sample Number:	**16**	**Base Depth (m):**	**8.50**
Sample Type:	**B**		



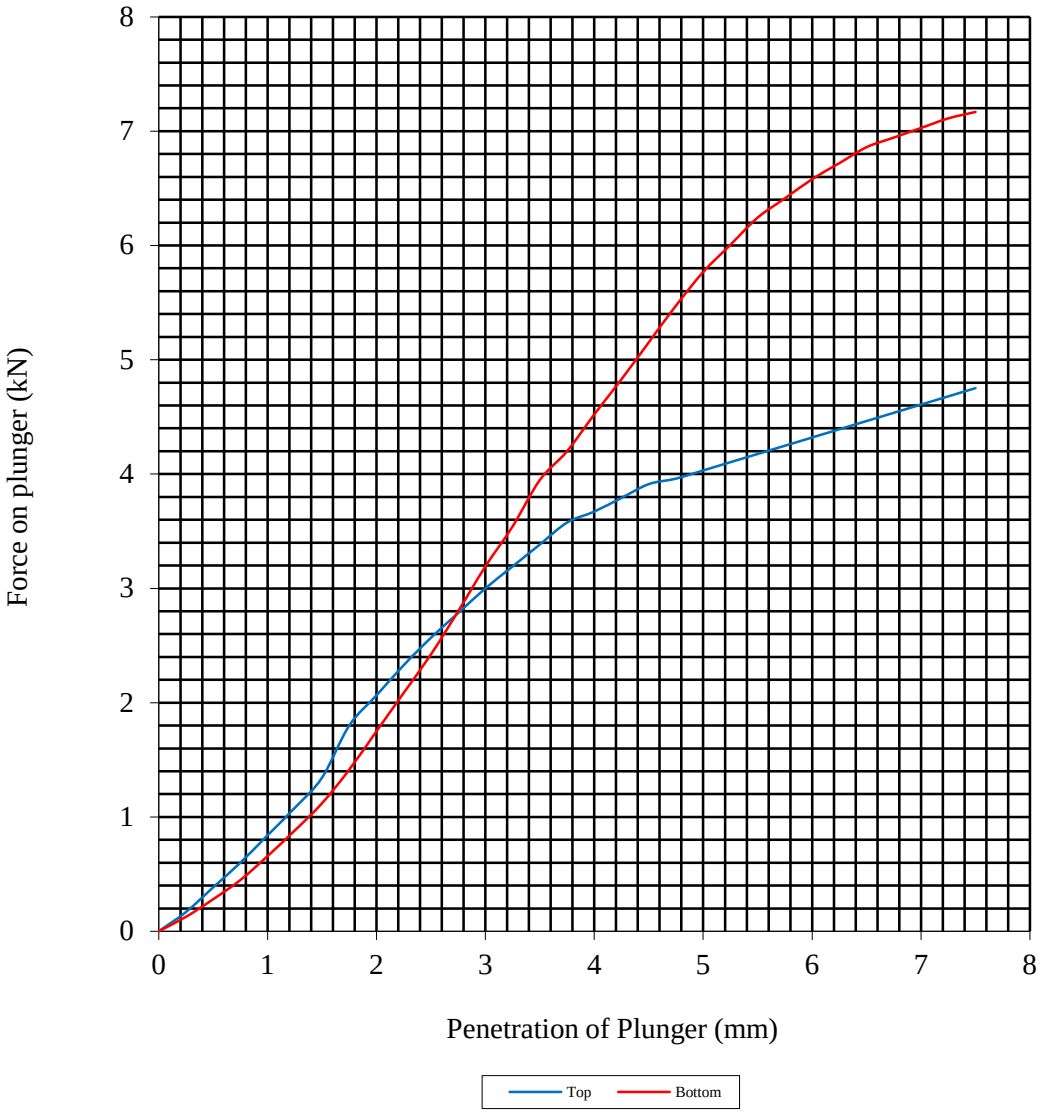
Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	11	Surcharge Kg:	4.20	Sample Top	11	Sample Top	39.4
Bulk Density Mg/m3:	2.10	Soaking Time hrs	0	Sample Bottom	11	Sample Bottom	47.4
Dry Density Mg/m3:	1.89	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			6				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date**	**11/11/16**	**Contract No:**
		Arklow			**PSL16/4906**
					Client Ref:
					16-5027

CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number:	**BH16**	**Top Depth (m):**	**7.50**
Sample Number:	**16**	**Base Depth (m):**	**8.50**
Sample Type:	**B**		



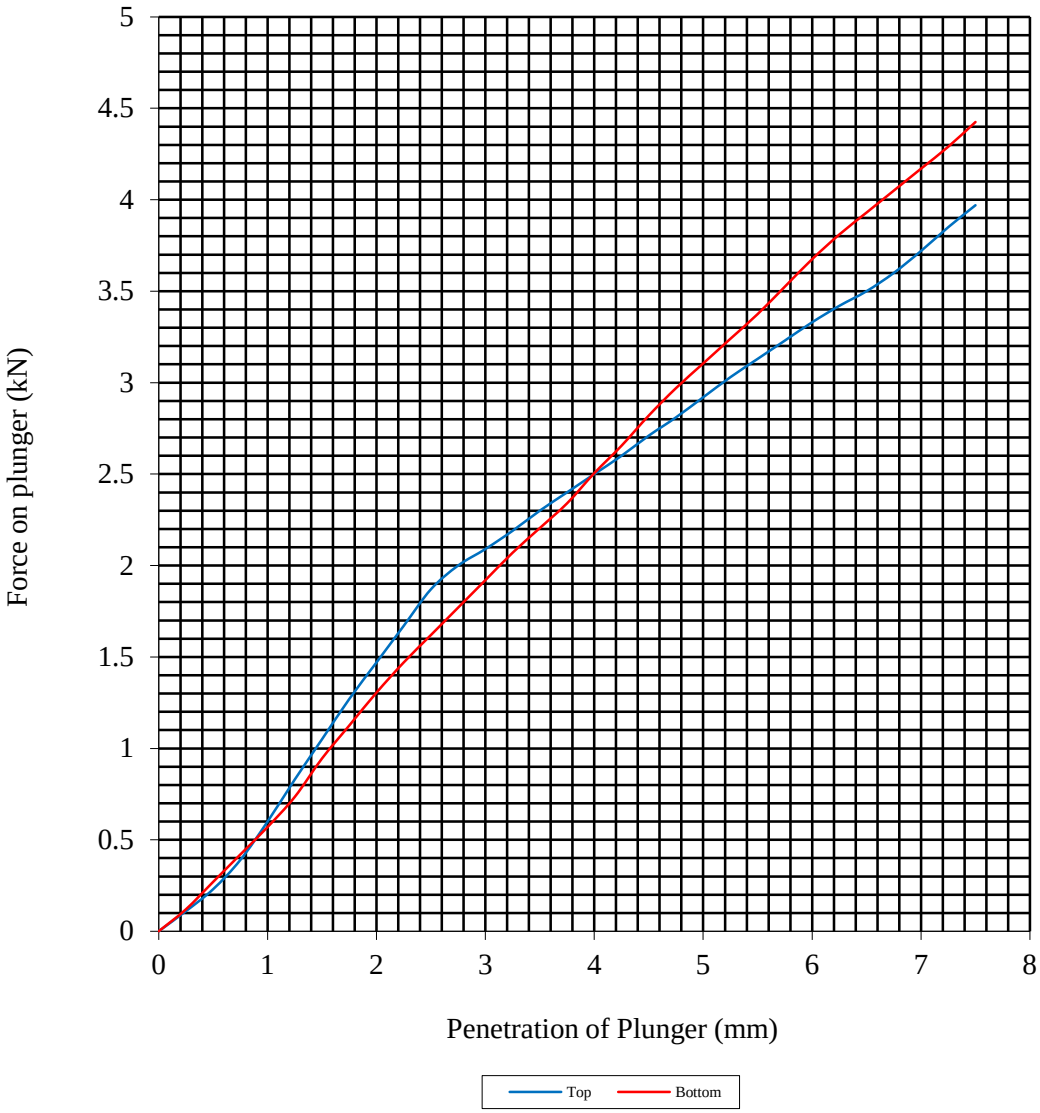
Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	13	Surcharge Kg:	4.20	Sample Top	14	Sample Top	20.2
Bulk Density Mg/m3:	2.09	Soaking Time hrs	0	Sample Bottom	13	Sample Bottom	28.8
Dry Density Mg/m3:	1.85	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			6				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date**	**11/11/16**	**Contract No:**
		Arklow				**PSL16/4906**
						Client Ref:
						16-5027

CALIFORNIA BEARING RATIO TEST

BS 1377 : Part 4 : 1990

Hole Number:	**BH16**	**Top Depth (m):**	**7.50**
Sample Number:	**16**	**Base Depth (m):**	**8.50**
Sample Type:	**B**		



Initial Sample Conditions		Sample Preparation		Final Moisture Content %		C.B.R. Value %	
Moisture Content:	15	Surcharge Kg:	4.20	Sample Top	15	Sample Top	14.6
Bulk Density Mg/m3:	2.06	Soaking Time hrs	0	Sample Bottom	15	Sample Bottom	15.5
Dry Density Mg/m3:	1.80	Swelling mm:	0.00	Remarks: See summary of soil descriptions.			
Percentage retained on 20mm BS test sieve:			6				
Compaction Conditions		2.5kg Rammer					

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** 11/11/16	**Contract No:** PSL16/4906
		Arklow			**Client Ref:** 16-5027

MOISTURE CONDITION VALUE

BS1377 : Part 4 : 1990 Clause 5.4

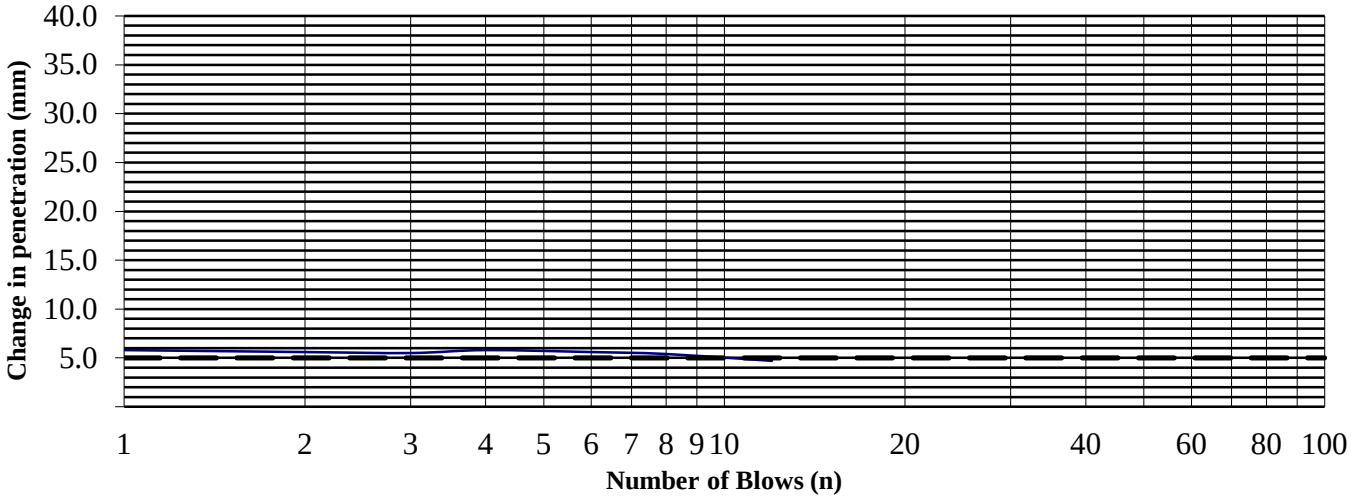
Hole Number: **BH16** **Top Depth (m):** **7.50**

Sample Number: **16** **Base Depth (m):** **8.50**

Sample Type: **B**

Material Retained on the 20mm BS Test Sieve (%):	6
Interpretation of test curve is by the instection of 5mm change in penetration value	

MCV Determination



Blows (N)	Penetration (mm)	n to 4 n (mm)
1	79.5	5.8
2	76.5	5.6
3	74.8	5.5
4	73.7	5.8
6	71.9	5.6
8	70.9	5.4
12	69.3	4.7
16	67.9	
24	66.3	
32	65.5	
48	64.6	
64		
96		
128		
192		
256		

Test Results.

Moisture Content (%)	15
MCV	10.4

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date**	**11/11/16**	**Contract No:**
		Arklow			**PSL16/4906**
					Client Ref:
					16-5027

Derwentside Environmental Testing Services

Certificate of Analysis

Certificate Number 16-82225

31-Oct-16

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

Our Reference 16-82225

Client Reference PSL16/4906

Order No (not supplied)

Contract Title Arklow

Description 1 Soil sample, 2 Water samples.

Date Received 26-Oct-16

Date Started 26-Oct-16

Date Completed 31-Oct-16

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

Notes Opinions and interpretations are outside the scope of UKAS 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. Observations and interpretations are outside the scope of ISO 17025. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Rob Brown
Business Manager

UKAS TESTING
2139

Summary of Chemical Analysis
Soil Samples

Our Ref 16-82225
Client Ref PSL16/4906
Contract Title Arklow

Lab No	1073971
Sample ID	BH15D
Depth	2.60
Other ID	
Sample Type	SOIL
Sampling Date	n/s
Sampling Time	n/s

Test	Method	LOD	Units	
Inorganics				
pH	DETSC 2008#			8.3
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	300

Key: # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis
Water Samples

Our Ref 16-82225
Client Ref PSL16/4906
Contract Title Arklow

			Lab No	1073970	1073972
			Sample ID	BH15A	BH16
			Depth	0.80	2.10
			Other ID		
			Sample Type	WATER	WATER
			Sampling Date	n/s	n/s
			Sampling Time	n/s	n/s
Test	**Method**	**LOD**	**Units**		
Inorganics					
pH	DETSC 2008			9.2	7.3
Sulphate as SO4	DETSC 2055	0.1	mg/l	380	160

Key: n/s -not supplied.

Information in Support of the Analytical Results

Our Ref 16-82225
Client Ref PSL16/4906
Contract Arklow

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1073970	BH15A 0.80 WATER		PB 1L	Sample date+time not supplied, Anions (30 days), pH/Cond/TDS (7 days)	
1073971	BH15D 2.60 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
1073972	BH16 2.10 WATER		PB 1L	Sample date+time not supplied, Anions (30 days), pH/Cond/TDS (7 days)	

Key: P-Plastic B-Bottle 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

Appendix C Environmental Laboratory Test Results

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

UKAS TESTING
2183

Final Report

Report No.:	16-25458-1
Initial Date of Issue:	31-Oct-2016
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Andy Garne Brian Mooney Colm Hurley Darren O'Mahony Ian Holley Lucy Peaker Mark Nyhan Matthew Gilbert Neil Haggan Paul Dunlop Paul McNamara Stephen Franey Stephen Watson
Project	16-5027 Arklow

Quotation No.:		**Date Received:**	20-Oct-2016
Order No.:		**Date Instructed:**	20-Oct-2016
No. of Samples:	6		
Turnaround (Wkdays):	7	**Results Due:**	28-Oct-2016
Date Approved:	31-Oct-2016		

Approved By:

Details: Glynn Harvey, Laboratory Manager

Results - 2 Stage WAC

Project: 16-5027 Arklow

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	16-25458								
Chemtest Sample ID:	367620								
Sample Ref:	BH12						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:									
Top Depth(m):	1.0								
Bottom Depth(m):									
Sampling Date:	19-Oct-2016								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			2.4	3	5	6
Loss On Ignition	2610	U	%			1.9	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			62	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			92	100	--	--
pH	2010	U				8.0	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.022	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.0022	0.0034	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.020	0.029	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	0.00026	0.00044	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	0.0096	< 0.050	0.083	0.5	10	70
Copper	1450	U	0.0034	0.0036	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	0.00065	< 0.0010	0.0056	0.01	0.2	2
Molybdenum	1450	U	0.0069	0.0081	< 0.050	0.079	0.5	10	30
Nickel	1450	U	0.0013	0.0017	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	0.0034	< 0.010	0.029	0.5	10	50
Antimony	1450	U	0.0018	0.0015	< 0.010	0.015	0.06	0.7	5
Selenium	1450	U	0.0020	0.0049	< 0.010	0.045	0.1	0.5	7
Zinc	1450	U	0.030	0.031	< 0.50	< 0.50	4	50	200
Chloride	1220	U	37	4.5	74	88	800	15000	25000
Fluoride	1220	U	0.59	0.37	1.2	4.0	10	150	500
Sulphate	1220	U	1500	1400	3000	14000	1000	20000	50000
Total Dissolved Solids	1020	N	1500	1400	3000	14000	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	10	6.3	< 50	68	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	10

Leachate Test Information	
Leachant volume 1st extract/l	0.330
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.231

Results - 2 Stage WAC

Project: 16-5027 Arklow

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	16-25458								
Chemtest Sample ID:	367621								
Sample Ref:	BH13								
Sample ID:									
Top Depth(m):	1.0								
Bottom Depth(m):									
Sampling Date:	19-Oct-2016						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.46	3	5	6
Loss On Ignition	2610	U	%			2.7	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				9.5	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.064	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.0091	0.015	< 0.050	0.14	0.5	2	25
Barium	1450	U	0.022	0.011	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	0.011	0.0036	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0096	0.0046	< 0.050	< 0.050	2	50	100
Mercury	1450	U	0.00058	< 0.00050	0.0012	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.013	0.0031	< 0.050	< 0.050	0.5	10	30
Nickel	1450	U	0.0011	< 0.0010	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	0.0032	0.0013	< 0.010	0.016	0.5	10	50
Antimony	1450	U	0.0020	0.0012	< 0.010	0.013	0.06	0.7	5
Selenium	1450	U	0.0042	0.0015	< 0.010	0.019	0.1	0.5	7
Zinc	1450	U	0.0092	0.0028	< 0.50	< 0.50	4	50	200
Chloride	1220	U	11	2.1	22	33	800	15000	25000
Fluoride	1220	U	0.39	0.23	< 1.0	2.5	10	150	500
Sulphate	1220	U	140	28	270	430	1000	20000	50000
Total Dissolved Solids	1020	N	420	93	840	1400	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	10	9.2	< 50	93	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	11

Leachate Test Information	
Leachant volume 1st extract/l	0.329
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.239

Results - 2 Stage WAC

Project: 16-5027 Arklow

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	16-25458						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Chemtest Sample ID:	367622								
Sample Ref:	BH15D								
Sample ID:									
Top Depth(m):	0.2								
Bottom Depth(m):									
Sampling Date:	19-Oct-2016								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.52	3	5	6
Loss On Ignition	2610	U	%			0.95	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			110	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			2.5	100	--	--
pH	2010	U				8.1	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.0090	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.0035	0.0025	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.025	0.019	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0053	0.0023	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.019	0.0093	< 0.050	0.11	0.5	10	30
Nickel	1450	U	0.0010	< 0.0010	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.5	10	50
Antimony	1450	U	0.012	0.0082	0.024	0.087	0.06	0.7	5
Selenium	1450	U	0.0011	< 0.0010	< 0.010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.023	0.0044	< 0.50	< 0.50	4	50	200
Chloride	1220	U	13	1.7	26	33	800	15000	25000
Fluoride	1220	U	0.56	0.64	1.1	6.3	10	150	500
Sulphate	1220	U	1200	130	2300	2800	1000	20000	50000
Total Dissolved Solids	1020	N	1200	240	2400	3800	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	11	7.0	< 50	76	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	7.5

Leachate Test Information	
Leachant volume 1st extract/l	0.336
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.252

Results - 2 Stage WAC

Project: 16-5027 Arklow

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	16-25458								
Chemtest Sample ID:	367623								
Sample Ref:	BH15D								
Sample ID:									
Top Depth(m):	1.6								
Bottom Depth(m):									
Sampling Date:	19-Oct-2016						Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.44	3	5	6
Loss On Ignition	2610	U	%			1.3	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			50	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				10.8	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.018	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.0030	0.0025	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.087	0.030	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	0.0034	0.0036	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.025	0.0078	< 0.050	< 0.050	2	50	100
Mercury	1450	U	0.00096	0.00084	0.0019	0.0086	0.01	0.2	2
Molybdenum	1450	U	0.061	0.019	0.12	0.25	0.5	10	30
Nickel	1450	U	0.0023	< 0.0010	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	0.0019	< 0.0010	< 0.010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.06	0.7	5
Selenium	1450	U	0.0029	0.0011	< 0.010	0.014	0.1	0.5	7
Zinc	1450	U	0.0017	< 0.0010	< 0.50	< 0.50	4	50	200
Chloride	1220	U	240	41	480	700	800	15000	25000
Fluoride	1220	U	0.70	0.19	1.4	2.6	10	150	500
Sulphate	1220	U	23	29	46	280	1000	20000	50000
Total Dissolved Solids	1020	N	1200	620	2400	7000	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	7.6	6.2	< 50	64	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	6.3

Leachate Test Information	
Leachant volume 1st extract/l	0.338
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.253

Results - 2 Stage WAC

Project: 16-5027 Arklow

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	16-25458								
Chemtest Sample ID:	367624								
Sample Ref:	BH16						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:									
Top Depth(m):	0.5								
Bottom Depth(m):									
Sampling Date:	19-Oct-2016								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.32	3	5	6
Loss On Ignition	2610	U	%			0.89	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			17	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				9.9	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.036	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.0027	0.0054	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.018	0.015	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	0.0031	0.0028	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0047	0.014	< 0.050	< 0.050	2	50	100
Mercury	1450	U	0.00098	< 0.00050	0.0019	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0072	0.0024	< 0.050	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	0.016	< 0.010	0.14	0.5	10	50
Antimony	1450	U	0.0017	0.0012	< 0.010	0.013	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.0017	0.017	< 0.50	< 0.50	4	50	200
Chloride	1220	U	7.4	2.8	15	35	800	15000	25000
Fluoride	1220	U	0.32	0.19	< 1.0	2.1	10	150	500
Sulphate	1220	U	15	2.8	30	46	1000	20000	50000
Total Dissolved Solids	1020	N	100	41	200	500	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	13	8.9	< 50	95	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	12

Leachate Test Information	
Leachant volume 1st extract/l	0.325
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.262

Results - 2 Stage WAC

Project: 16-5027 Arklow

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	16-25458								
Chemtest Sample ID:	367625								
Sample Ref:	BH14						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:									
Top Depth(m):	1.0								
Bottom Depth(m):									
Sampling Date:	19-Oct-2016								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.57	3	5	6
Loss On Ignition	2610	U	%			1.9	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			190	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			4.8	100	--	--
pH	2010	U				4.8	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			< 0.0020	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
Arsenic	1450	U	0.0044	0.0020	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.024	0.030	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	0.052	0.065	0.10	0.63	0.04	1	5
Chromium	1450	U	0.0028	0.0019	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.59	0.74	1.2	0.86	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	30
Nickel	1450	U	0.053	0.068	0.11	0.66	0.4	10	40
Lead	1450	U	0.081	0.089	0.16	0.88	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	0.0012	< 0.010	0.010	0.1	0.5	7
Zinc	1450	U	16	21	32	200	4	50	200
Chloride	1220	U	14	2.2	28	39	800	15000	25000
Fluoride	1220	U	2.4	0.85	4.8	11	10	150	500
Sulphate	1220	U	2100	1100	4300	13000	1000	20000	50000
Total Dissolved Solids	1020	N	1900	1100	3800	12000	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	10	5.9	< 50	65	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	9.9

Leachate Test Information	
Leachant volume 1st extract/l	0.331
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.254

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Test Methods

SOP	Title	Accreditation	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	UKAS accredited	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids in Waters
1220	Anions, Alkalinity & Ammonium in Waters	UKAS accredited	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1450	Metals in Waters by ICP-MS	UKAS accredited	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	UKAS accredited	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	UKAS accredited	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	UKAS accreditedMCERTS accredited	pH	pH Meter
2015	Acid Neutralisation Capacity		Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)		Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2610	Loss on Ignition	UKAS accreditedMCERTS accredited	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	UKAS accreditedMCERTS accredited	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	UKAS accreditedMCERTS accredited*	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	UKAS accreditedMCERTS accredited	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	UKAS accreditedMCERTS accredited*	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	UKAS accreditedMCERTS accredited	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS

Report Information

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T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.co.uk

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

UKAS TESTING
2183

Final Report

Report No.:	16-25460-1
Initial Date of Issue:	26-Oct-2016
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Andy Garne Colm Hurley Darren O'Mahony Matthew Gilbert Neil Haggan Paul McNamara Stephen Franey Stephen Watson Brian Mooney Lucy Peaker Ian Holley Mark Nyhan Paul Dunlop
Project	16-5027 Arklow

Quotation No.:		**Date Received:**	20-Oct-2016
Order No.:		**Date Instructed:**	20-Oct-2016
No. of Samples:	6		
Turnaround (Wkdays):	5	**Results Due:**	26-Oct-2016
Date Approved:	26-Oct-2016		

Approved By:

Details: Glynn Harvey, Laboratory Manager

Chemtest
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Results - Soil

Project: 16-5027 Arklow

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		16-25460	16-25460	16-25460	16-25460	16-25460	16-25460
Quotation No.:			**Chemtest Sample ID.:**		367632	367633	367634	367635	367636	367637
Order No.:			Client Location ID.:		BH12	BH13	BH15D	BH15D	BH16	BH14
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		1.0	1.0	0.2	1.6	0.5	1.0
			Date Sampled:		19-Oct-2016	19-Oct-2016	19-Oct-2016	19-Oct-2016	19-Oct-2016	19-Oct-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
Moisture	N	2030	%	0.020	15	7.7	6.5	6.4	12	9.5
pH	U	2010		N/A	7.5	8.9	8.2	10.8	9.0	5.0
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	1.8	0.87	0.42	0.58	< 0.010	2.5
Arsenic	U	2450	mg/kg	1.0	230	25	80	110	18	500
Cadmium	U	2450	mg/kg	0.10	1.2	0.20	0.33	0.54	0.37	1.4
Chromium	U	2450	mg/kg	1.0	15	28	17	19	8.2	13
Copper	U	2450	mg/kg	0.50	530	51	300	250	87	710
Mercury	U	2450	mg/kg	0.10	1.7	0.12	0.11	0.10	< 0.10	0.68
Nickel	U	2450	mg/kg	0.50	16	33	15	18	8.4	12
Lead	U	2450	mg/kg	0.50	900	54	380	420	66	1600
Selenium	U	2450	mg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Zinc	U	2450	mg/kg	0.50	570	94	240	230	170	680
Mineral Oil	N	2670	mg/kg	10	< 10	< 10	< 10	< 10	< 10	< 10
TPH >C6-C10	N	2670	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH >C10-C21	N	2670	mg/kg	1.0	21	< 1.0	9.9	6.5	< 1.0	36
TPH >C21-C40	N	2670	mg/kg	1.0	34	< 1.0	18	12	< 1.0	20
Total TPH >C6-C40	U	2670	mg/kg	10	54	< 10	28	19	< 10	56
Naphthalene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.29
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.47
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	1.1
Fluorene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	1.1
Phenanthrene	U	2700	mg/kg	0.10	2.5	0.28	< 0.10	0.86	< 0.10	5.0
Anthracene	U	2700	mg/kg	0.10	0.80	< 0.10	< 0.10	0.49	< 0.10	1.4
Fluoranthene	U	2700	mg/kg	0.10	7.1	0.35	0.39	2.9	0.43	4.4
Pyrene	U	2700	mg/kg	0.10	6.9	0.35	0.32	2.6	0.50	3.7
Benzo[a]anthracene	U	2700	mg/kg	0.10	3.4	< 0.10	< 0.10	1.9	< 0.10	1.3
Chrysene	U	2700	mg/kg	0.10	4.7	< 0.10	< 0.10	2.3	< 0.10	1.7
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	4.5	< 0.10	< 0.10	2.1	< 0.10	1.5
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	2.3	< 0.10	< 0.10	1.1	< 0.10	0.82
Benzo[a]pyrene	U	2700	mg/kg	0.10	2.5	< 0.10	< 0.10	1.3	< 0.10	0.96
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	1.6	< 0.10	< 0.10	0.53	< 0.10	0.53
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	0.27	< 0.10	< 0.10	0.12	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	1.6	< 0.10	< 0.10	0.68	< 0.10	0.61
Coronene	N	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	6.6
Total Of 17 PAH's	N	2700	mg/kg	2.0	38	< 2.0	< 2.0	17	< 2.0	32

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