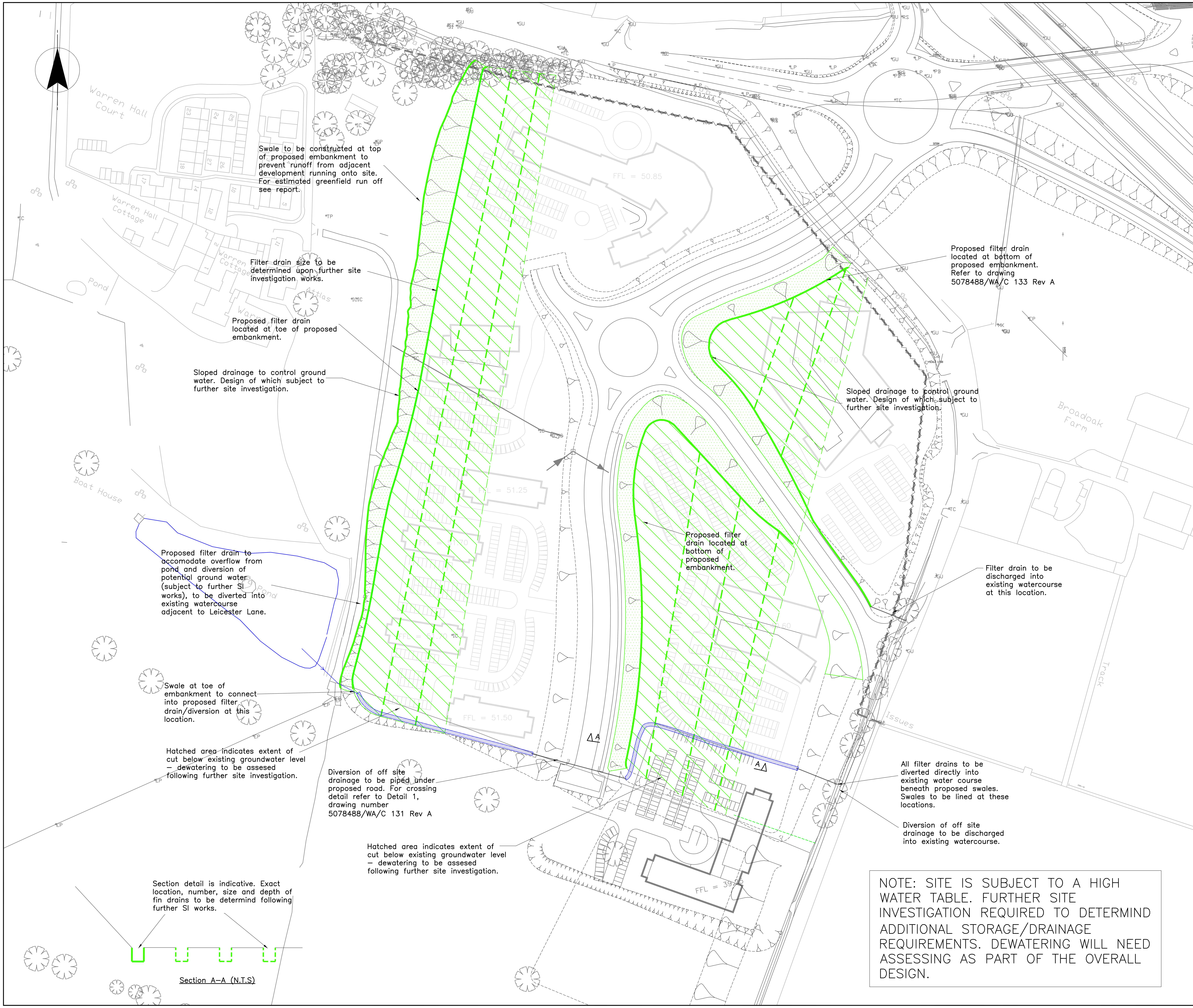
APPENDIX C – HISTORICAL RECORDS

1. Proposed Site Plan Ground Water Identification
2. Borehole records
3. Drilling logs
4. Factual Investigation Report - Ian Farmer, Feb 2008
5. Interpretative Report of Ground Investigation & Development Plateaus - Ian Farmer March 2008
6. Geotechnical Overview Report - Atkins, Sept 2010



NOTE: SITE IS SUBJECT TO A HIGH WATER TABLE. FURTHER SITE INVESTIGATION REQUIRED TO DETERMIND ADDITIONAL STORAGE/DRAINAGE REQUIREMENTS. DEWATERING WILL NEED ASSESSING AS PART OF THE OVERALL DESIGN.

ATKINS

KEY:

- Indicates length of required filter drain.
- Indicates length of filter drain. Number, size and depth all to be confirmed following further S.I. works.

NOTE

Drawing to be read in conjunction with drawing number 5078488/WA/C/120.

Stat	Purpose of Issue	Date	Auth
P	FOR INFORMATION	??.??.??	??

Rev	Description	By	Date	Chk'd	Auth
A	FOR INFORMATION	LMC	??.??.??	??	??

ATKINS
Atkins Limited
Consulting Engineers,
Chadwick House
Birchwood Park
Warrington, Cheshire, England,
WA3 6AE
Tel: (01925) 238000
Fax: (01925) 238500
www.atkinsglobal.com

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Client

WELSH ASSEMBLY GOVERNMENT

Project

WARREN HALL BUSINESS PARK

Title

PROPOSED SITE PLAN
GROUND WATER IDENTIFICATION

Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A1	1000	LMC, Date 13.05.09	ZT, Date 14.05.09	Date

Status	Drawing Number	Rev
P	5078488/WA/C 140	A

Rev A
Drawing Number 5078488/WA/C 140
Status P
DO NOT SCALE
A1
0 10 100

File: 5078488-WA-C Ground Water.dwg Plotted by: flet5005
Date: Jun 09, 2009 - 9:41am

P:\GBWAI\Water\WWWN\Projects\5078488 - Warren Hall\60 - Work processes documentation\64 - Drawings\Generated\5078488-WA-C Ground Water.dwg

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Version 2.0.6

BGS ID: 156701 : BGS Reference: SJ36SW5
British National Grid (27700) : 332300,362050
Report an issue with this borehole

<< < Prev Page 1 of 4 ▼ Next > >>

RECORD OF WELL SHAFT OR BORE 9 SJ 36 SW 5 5

1" N.S. 108
1" O.S. —
Grid Ref. 14SE. 2.

At Boring No.1 at Kinnerton Lodge Higher Kinnerton

Town or Village Higher Kinnerton County Flintshire Six-inch quarter sheet 14 S.E.

Exact site 450 yards N.W. of Kinnerton Lodge House (411 48m) in parish of (A rough sketch-map or a tracing from a map is very desirable)

Level of ground surface above sea-level (O.D.) 188 ft. (57.30m) If well starts below ground surface, state how far ft.

Shaft ft., diameter ft. Bore ft. Diameter of bore: at top ins.; at bottom ins.

Details of permanent lining tubes (internal diameters preferred)

Water struck at depths of (feet)

Rest-level of water below/above top of well feet. Suction at feet. Yield on hours'/days' test gallons per (with pump of capacity g.p.h.); depressing water level to feet below top. Time of recovery hrs. Amount normally pumped daily g.p.h. for hours.

Quality (attach copy of analysis if available)

Sunk by Mr. Robert Roberts for Mr. Date of well 1899

Information from Communicated 1913.

(For Survey use only). GEOLOGICAL CLASSIFICATION.	NATURE OF STRATA (and any additional remarks).	m.	THICKNESS Feet.	THICKNESS Inches.	DEPTH Feet.	DEPTH Inches.	m.
Glacial	Soil	0.30	1	-	1	-	0.30
	Brick soil	2.51	8	3	9	3	2.82
	Light-blue metal	1.93	22	9	32	-	9.75
	Ironstone, light-coloured	0.10		4	9.86 32	4	17.48
	Light-blue metal	7.82	25	8	17.68 58	-	25.30
	Ironstone	0.05		2	17.73 58	2	25.35
	Black metal	1.83	6	-	19.56 64	2	27.18
Lower Coal Measures	Ironstone	0.08		3	19.63 64	5	27.25
	Black shale with ironstone	2.74	9	-	22.38 73	5	30.00
	Light warrant	2.24	7	4	24.61 80	9	32.23
	Blue metal	1.75	5	9	26.37 86	6	33.99
	Grey rock	2.90	9	6	29.26 96	-	36.88
	Blue metal with rock bands	18.59	61	-	47.95 157	-	55.47
	Black shale	5.81 3.66	12	6?	51.51 169 51.66	6	59.13
	Brown warrant	1.22	4	-	52.75 173 51.88	6	60.35

Hope Exchange Station.
Surface c.350 O.D. Bore $40\frac{1}{2}$. R.W.L. 30. (Wyatt). SJ36SW/8

Drift $40\frac{1}{2}$	Marl & gravel ...	20	20
	Coarse & fine gravel ...	$20\frac{1}{2}$	$40\frac{1}{2}$

37. (108/14S.E./5). Kinnerton: Warren Dale, 550 yds. W. of Crab Mill.
Surface c.180 O.D. Bore 120 x 5 in. Lining tubes to 101 x 5 in. R.W.L. at surface. P.W.L. 77. Yield 1,100 g.p.h. (Wyatt, 1938).

Drift on L.C.M. 120	Hard marl ...	34	34
	Soft shale ...	34	68
	Slate rock ...	20	88
	Hard rock & grit ...	32	120

38. (108/14S.E./2). Higher Kinnerton: Kinnerton Lodge, Bore No. 1, 450 yds. N.W. of Lodge. Mineral bore.
Ref. Flint Mem., 1924, p.194. Surface 188 O.D. Bore $173\frac{1}{2}$. (R. Roberts, Buckley; 1899).

Drift: $9\frac{1}{4}$	Soil & brick clay ...	$9\frac{1}{4}$	$9\frac{1}{4}$
L.C.M. $164\frac{1}{4}$	Shales with ironstone ...	$77\frac{1}{4}$	$86\frac{1}{2}$
	Grey rock ...	$9\frac{1}{2}$	96
	Blue metal with rock bands	61	157
	Black shale ...	$12\frac{1}{2}$	$169\frac{1}{2}$
	Brown warrant ...	4	$173\frac{1}{2}$

39. (108/14S.E./3). Higher Kinnerton: Kinnerton Lodge, Bore No. 2, 420 yds. W. of Lodge. Mineral bore.
Ref. Flint Mem., 1924, p.195. Surface 200 O.D. Bore 108. (R. Roberts, Buckley; 1899).

Drift	Clay ...	$6\frac{3}{4}$	$6\frac{3}{4}$
L.C.M.	Shale, rock & ironstone ...	$101\frac{1}{4}$	108

40. (108/14S.E./6). Kinnerton: Crab Mill. Public supply for Flint County Council.
Surface c.100 O.D. Shaft 24 x 4. Bore 24-73 x $8\frac{1}{4}$ in.; 73-95 x $6\frac{1}{2}$ in.; 95-124 x 5 in. Lining tubes to $97\frac{1}{4}$. R.W.L. $2\frac{1}{4}$. P.W.L. 13. Yield 900 g.p.h. (Wyatt, 1937).

Drift on L.C.M. 124	Well ...	24	24
	Shale with bands of ironstone ...	56	80
	Soft black shale ...	12	92
	Hard rock ...	6	98
	Marl or shale ...	26	124

41. (108/14S.E./1). Broughton: Broughton Hall.
Surface c.60 O.D. Bore 180.

Drift, L.M.S.	Details unknown ...	180	180

42. (108/14S.E./4). Lower Kinnerton: Davies' Farm, 550 yds. E.N.E. of Kinnerton Station.
Ref. Flint Mem., 1924, p.195. Surface c.40 O.D. Bore 402. Lining tubes 0-$148\frac{1}{2}$ x 4 in.; $148\frac{1}{2}$-$328\frac{1}{3}$ x $2\frac{1}{2}$ in.; $328\frac{1}{3}$-$333\frac{2}{3}$ x 2 in.; $333\frac{2}{3}$-341 x $1\frac{1}{2}$ in.
R.W.L. Water rises to 20 ft. above surface. Yield 114 g.p.h. Anal. Hardness 9. (Timmins, 1886).

Drift $328\frac{1}{3}$	Very fine clay ...	112	112
	Coarse sand ...	16	128
	Fine red clay ...	$97\frac{1}{2}$	$225\frac{1}{2}$
	Coarse sand ...	$10\frac{1}{2}$	236
	Fine clay ...	2	238
	Red sand with bands of clay	74	312
	Sand & gravel ...	8	320
	Fine red clay		

SJ36/26

(*11938) Wt.30370/0370 10,000 9/30 A.& E.W.Ltd. Gp.685 16

Name and Number of Shaft or Bore given by Geological Survey: SJ 36 SW 9

County: FLINT

Quarter Sheet: 14SE

Water Bore at CRAB MILL KINNERTON

14SE 6.

GEOLOGICAL CLASSIFICATION	DESCRIPTION		THICKNESS		DEPTH (m.)	DEPTH	
	Bore for the Flint County Council 26/9/1937.						
	Made by Messrs Wyatt Bros Wayland Works Whitchurch.						
	Surface c. 100 O.D. (30.48m.)						
	6" map. Flint 14SE						
	1" map. 108						
	Well 24ft. × 4ft. (7.32 × 1.22m.)						
	Bore 24 – 73 × 8¼ in. (7.32 – 22.25 × 0.21 m.)						
	73 – 95 × 6½ in. (22.96 × 0.17m.)						
	95 – 124 × 5 in. (37.80 × 0.13m.) (29.64m.)						
	Lining tubes to 97ft. 3ins.						
	Rest water level 2ft. 3ins. (0.69m.)						
	Water level 13ft. (3.96m.) on pumping 900 galls per hour.						
	From Messrs Wyatts 15/1/1942.	m.				m.		
	Well	7.32	24	0	7.32	24	–
Drift	Red rock ironstone	0.30	1	0	7.62	25	0
or	marl or shale	0.91	3	0	8.53	28	0
	Rock ironstone	0.91	3	0	9.45	31	0
	marl or shale	1.22	4	0	10.67	35	0
Lower Coal	Rock ironstone	0.61	2	0	11.28	37	0
	marl or shale	1.52	5	0	12.80	42	0
Measures (?)	Rock ironstone	0.30	1	0	13.11	43	0
	marl or shale	2.44	8	0	15.54	57	0
	Rock ironstone	1.83	6	0	17.37	57	0
	marl or shale	7.01	23	0	24.38	80	0
	Soft black rock	3.66	12	0	28.04	92	0
	Hard rock	1.83	6	0	29.87	98	0
	marl or shale	7.92	26	0	37.80	124	0

British Geological Survey

SJ36SW/16 3271 6315

SJ 36 8W5 / 1

SUB SOIL SURVEYS LTD
MANCHESTER

BOREHOLE No. 16 (1" 108)
Ref:- 4

EXPLORATORY BORING RECORD

~~3271 6318~~

SITE Hawarden

Site Ref :- 72/149

Boring Method Shell

Ground Level 43.35 O.D

DATE	DEPTH OF CASING BELOW G.L. (m)	WATER LEVEL MORNING & EVENING	DEPTH OF STRATA BELOW G.L.	STRATA (APPROX. SCALE)	NO. OF SAMP	TYPE OF SAMP	PENETRATION OF SAMPLER OR CORE BARREL (metres) FROM	TO	NO. OF BLOWS	CORE RECOVERY
18.8.72			0.1	Sandy topsoil						
	Made Ground		0.8	Firm brown sandy clay with pieces of brick, stones etc. Backfill	1 2 3	D U D	0.3 0.8 1.3	 1.3 	 13 	
	Drift		1.3	Firm brown and grey silty mottled clay with stone incls.	4 5 6	U D U	1.4 1.9 2.0	1.9 2.5	31 28	
	Boulder Clay (with lenses and beds of sand)		3.4	Very stiff and stiff brown siltysandy clay with stone incls. and occ. grey fissures	7 8 9	D D U	2.5 3.2 3.5	 4.0	 42	
	31/1/86		4.3	Very stiff brown sandy clay with stone inclusions and lenses of silty fine/medium sand	10 11 12 13 14	D B X W U	4.0 4.4 4.75 5.1 5.4	 5.05 5.9	 20 24	
			4.8	Compact very silty sand with lenses of clay and occ. pebbles	15 16 17 18	D D U D	5.9 6.8 7.0 7.5	 7.5 	 36 	
			6.7	Firm brown silty clay with numerous lenses of fine/ medium sand.	19 20 21 22	B X B X	8.0 8.45 9.0 9.75	 8.75 10.05	 18 25	
			8.0	Very stiff brown sandy clay with bands of sand and stone inclusions and pieces of grey clayey shale						
18.8.72	9.4	8.8	10.1	Compact brown silty sand with bands of firm brown silty clay						

Samples shown thus: Disturbed D. Undisturbed U. Standard Pen. Test X. Water W. Bulk B.

WATER OBSERVED AT THE FOLLOWING DEPTHS (* - overnight seepage)	DEPTH OF CASING WHEN SEALED (N.S. – NOT SEALED)	ESTIMATED SEEPAGE	WATER ADDED AT FOLLOWING DEPTHS TO ASSIST BORING	WATER LEVEL IN CASED / UNCASED BOREHOLE ON COMPLETION: DATE	WATER LEVEL	DEPTH OF CASING
1. 3.6	4.0	Slow		19.8.72	2.4	
2. 4.2	N.S.	Fast				
3.						
4.						
5.						
6.						

DIA. OF CASING ____ m.m. to depth of ____ metres
____ m.m. to depth of ____ metres
____ m.m. to depth of ____ metres

REMARKS:

British Geological Survey

Institute of Geological Sciences
Industrial Minerals Assessment Unit
BOREHOLE RECORD SHEET
SJ 36 SW/20
3283 6290

Registration Number

6 in. quarter sheet	Accn. no.	Suffix
SJ36SW	210	

Temp. No. 10

Borehole diam. 203mm.

Water struck w 7m in pebbly clay

Remarks: NGR 3283 6290

od = 36m

BROAD OAK FARM HAWARDEN

Classification	Thickness (m)	Lithology
WASTE	9.2	TILL
BEDROCK	0.6+	SILTSTONE

Lithostrat. Code	Description	Thick^{n} (m)	Depth to base (m)	Sample No.
	SOIL	0.3	0.3	
Boulder clay	CLAY, red-brown, sandy, becoming stiff and more clayey at 1m with till fabric. Few pebbles – mostly fine, angular, with much coal; some rounded quartz and red sandstn. Between 7m and 8m the clay has sandy lenses and some laminated silty bands. Below 8m, reverts to till fabric with water in borehole.	8.9	9.2	MoS 517 (3m)
Namurian Holway Formation	SILTSTONE, with thin mudstones. Coal Measure Bedrock. HOLYWELL SHALE	0.6+	9.8	
31/5/84	T.D 9.8m 7/11/79			

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Version 2.0.6

BGS ID: 20262917 : BGS Reference: SJ36SW154
British National Grid (27700) : 332870,362150

Report an issue with this borehole

DRILLING LOG

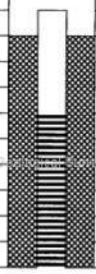
LOG NUMBER 3WB 363

DRAGON DRILLING (WATER & ENERGY) LIMITED
GRAIG LELO INDUSTRIAL ESTATE
CORWEN
LL21 9SD
TEL: 01824 707777

SITE: Crabmill Farm JOB REFERENCE: 1251 SITE BH NUMBER: 1 BGS No: SN17/206 GRID REF: SJ32876215 DATE: 9/11/2017

OPERATION	SIZE (MM)	FROM DEPTH (M)	TO DEPTH (M)	TOTAL
Set up				1
Symmetrix drilling	198	GL	6	6
Open hole drilling	150	6	60	54
Mud drilling				
CFA drilling				
Airlift				2

DEPTH (M)	DESCRIPTION	MATERIAL & DEPTH (M)
0 – 0.5	Soil	
0.5 - 3	Clay	
3 - 6	Fractured sandstone	Solid casing size - 113mm
6 - 60	Mudstone with layers of sandstone	
		Bentonite type – Granules
		Slotted casing size - 113/1mm
		Gravel pack size - 6mm
	Water strike depths – 12m	Glass media size - n/a



PREDICTED DEPTH (M)	ACTUAL DEPTH (M)	WATER STRIKE (MBGL)	LITRES PER MINUTE	SLOTTED (M)	PLAIN (M)	END CAP	GRAVEL/GLASS PACK (MBGL)	BENTONITE (MBGL)
60	60	12	40	60 - 30	30 - GL	yes	60 - 28	28 - GL

DRILLING FOR: Domestic water supply

NAME: Malcolm MacDonald (LEAD DRILLER)

WELSH ASSEMBLY GOVERNMENT

WARREN HALL
BROUGHTON

FACTUAL REPORT ON
GROUND INVESTIGATION

Contract: W08/40274

Date: February 2008

Ian Farmer Associates (1998) Limited
17 Rivington Court, Hardwick Grange, Woolston, Warrington, WA1 4RT
Tel: 01925 855 440
Fax: 01925 855 441

FACTUAL REPORT ON

GROUND INVESTIGATION

carried out at

WARREN BANK INTERCHANGE

BROUGHTON

Prepared for

WELSH ASSEMBLY GOVERNMENT
Unit 7
Ffordd Richard Davies
St Asaph Business Park
St Asaph
LL17 0LJ

Contract No: W08/40274

Date: February 2008

Ian Farmer Associates (1998) Limited
17 Rivington Court, Hardwick Grange, Woolston, Warrington, WA1 4RT
Tel: 01925 855 440
Fax: 01925 855 441

CONTENTS

1.0 INTRODUCTION

1.1 On the instructions of Opus International Consultants (UK) Limited Consulting Engineers to Welsh Assembly Government, a supplementary ground investigation was undertaken to determine ground and groundwater conditions at the site.

1.2 This report has been prepared for the sole use of the Client for the purpose described and no extended duty of care to any third party is implied or offered. Third parties using any information contained within this report do so at their own risk.

1.3 The comments given in this report and the opinions expressed herein are based on the information received, the conditions encountered during site works, and on the results of tests made in the field and laboratory. However, there may be conditions prevailing at the site which have not been disclosed by the investigation and which have not been taken into account in the report.

1.4 The comments on groundwater conditions are based on observations made at the time the site work was carried out. It should be noted that groundwater levels vary owing to seasonal or other effects.

2.0 SITE SETTING

2.1 Site Location

2.1.1 The site is situated in Broughton at Leicester Lane, and may be located by National Grid Reference SJ 327,631. A site location plan is included in Appendix 1, Figures A1.1.

2.2 Site Description

2.2.1 The site at the time of the walkover consisted of a large area of pasture land with occasional large deciduous trees spread across the site. The land was divided into different sized fields by hedge rows.

2.2.2 To the W of the site on plateau B the site was reasonably flat with occasional areas of glacial depressions. The site sloped down at a considerably gradient from Plateau B to the lower laying plateau A.

2.2.3 The site is bound to the N by Mold Road; to the E of the site running along the full length of the site is Leicester Lane with farm land opposite. To the S of the site is a small stream with a small wooded area in the W side of the S boundary. To the W the site is bound by more agricultural land and Kinnerton Lane.

3.0 SITE WORK

3.1 The site work was carried out between 9th and 18th January 2008. The locations of exploratory holes were indicated by the Engineer, and the site works carried out on the basis of the practices set out in BS 10175:2001, ref. 5.1, and BS 5930:1999 ref. 5.2

3.2 Seventeen boreholes, designated BH01 to BH17 were sunk by light cable percussion method, Ten of the boreholes, BH04 to BH10, and BH15 to BH17 were extended by rotary coring techniques. Seventeen boreholes, designated WS01-WS17, were sunk by drive-in window sampler techniques, eighteen boreholes, designated DP01 to DP18 were sunk by dynamic probing methods and fifteen trial pits, designated TP01 to TP15 were excavated by machine, at the positions shown on the site plan, Appendix 1, Figure A1.2. The depths of boreholes and trial pits, descriptions of strata encountered and comments on groundwater conditions are given in the borehole, window sample hole, dynamic probe hole and trial records, Appendix 2, Figures A2.1 and A2.4.

3.3 Representative disturbed and undisturbed samples were taken at the depths shown on the borehole, window sample hole and trial pit records and despatched to the laboratory. Standard (split-barrel and cone) penetration tests, ref.5.2.were carried out in the light cable percussion boreholes in the various strata to assess the relative density or consistency. The values of penetration resistance are given in the borehole records and in greater detail in Appendix 2, Figure A2.7.

3.4 Samples were collected for environmental purposes in amber glass jars and kept in a cool box.

3.5 In-situ Californian Bearing Ratio tests and probing by TRL methods were conducted at all trial pit locations. Results of these tests are presented in Appendix 2, Figure A2.5 and A2.6.

3.6 Perforated standpipes, surrounded by pea shingle and protected by a stopcock cover were installed in thirteen boreholes, BH01 to BH12 and WS10, as detailed in the borehole records and also in Appendix 2, Figure A2.8.

3.7 The ground levels at the borehole locations were determined using traditional survey techniques and plotted on a plan supplied by the Client.

3.8 Gas and groundwater levels were recorded six occasions following site works. Details of this monitoring are presented in Appendix 5.

4.0 LABORATORY TESTS

4.1 Geotechnical Testing

4.1.1 All soil samples were prepared in accordance with BS1377: Part One: 1990 ref. 5.3 and representative sub-samples were taken for testing. The following tests were carried out: The results of the rock testing will be included within the final report.

- 18 No. Moisture content
- 18 No. Plasticity indices
- 1 No. Bulk density
- 14 No. Particle size distribution by wet sieve
- 11 No. Particle size distribution by sedimentation
- 21 No. pH
- 14 No. Water soluble sulphate
- 2 No. Groundwater sulphate
- 3 No. Dry density/moisture content relationship
- 7 No. Californian bearing ratio
- 8 No. Undrained triaxial test without pore water measurement
- 7 No. One dimensional consolidation

4.1.2 The results of these tests are presented in Appendix 3.

4.2 Chemical Testing

4.2.1 The suite of chemical analyses has been based upon the findings of the desk study, the conceptual model and observations on site. The chemical analyses were carried out on fifty six samples of soil, seven samples of leachate and six samples of water. The nature of the analyses is detailed below:

4.2.2 **Soil Suite:**

4.2.2.1 ***Metal Suite*** **-** arsenic, boron (water soluble), cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc.

4.2.2.2 **Volatile Organic Compounds** (VOC) - including: benzene, toluene, ethylbenzene and xylenes (BTEX) and chlorinated solvents

4.2.2.3 **Organic Screen -** total petroleum hydrocarbons (TPH) – alphatic/aromatic split, polyaromatic hydrocarbons (PAH) – USEPA 16 suite, monohydric phenols

4.2.2.4 ***Inorganics Screen*** – pH, sulphate (2:1 extract) and cyanide (free).

4.2.2.5 ***PCBs (as congeners).***

4.2.2.6 WAC Testing.

4.2.3 **Leachate Suite:**

4.2.3.1 ***WAC Testing.***

4.2.4 **Water Suite:**

4.2.4.1 ***Metal Suite*** **-** arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc.

4.2.4.2 **Organic Screen -** total petroleum hydrocarbons (sTPH) – C6-C10, C10-C14 and C15-C36 and polyaromatic hydrocarbons (PAH) – USEPA 16 suite.

4.2.4.3 ***Inorganics Screen*** – pH, sulphate, sulphur, cyanide (total) and hardness.

4.2.5 The results of these tests are shown in Appendix 4.

5.0 REFERENCES

5.1 British Standards Institute: BS 10175 'Code of practice for the investigation of potentially contaminated sites', BSI 2001.

5.2 British Standards Institute: BS 5930 'Code of practice for site investigations', BSi 1999.

5.3 British Standard 1377:1990, Part 9, 'Methods of Test for Soils for Civil Engineering Purposes'.

5.4 Building Research Establishment, Special Digest 1, "Concrete in Aggressive Ground", 3rd Edition, 2005.

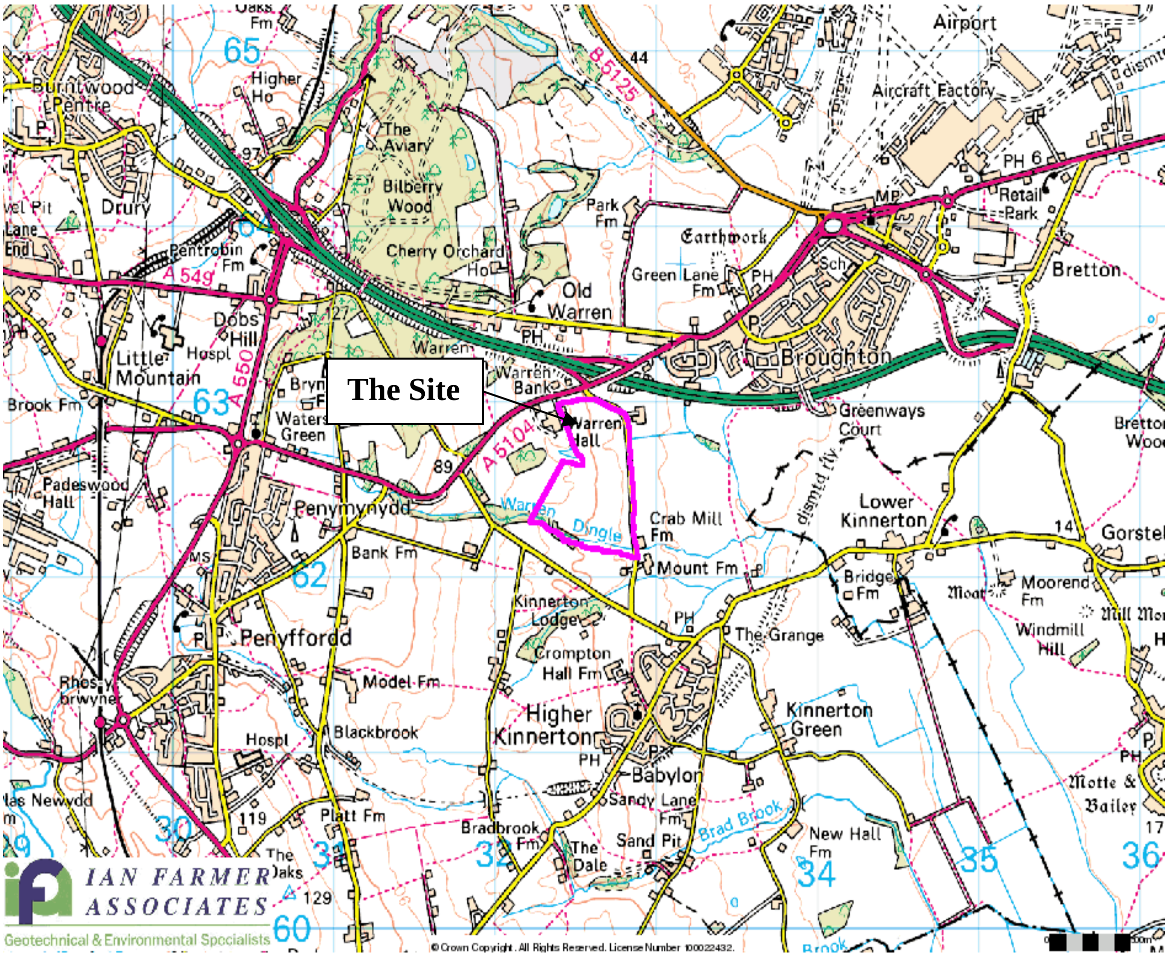
5.5 MCERTS Performance Standard for Laboratories Undertaking Chemical Testing of Soil v2, Feb 2003. British Standards Institute: BS 10175 'Code of practice for the investigation of potentially contaminated sites', BSI 2001.

For and on behalf of Ian Farmer Associates (1998) Limited

C P Bailey	J A Latimer
BSc (Hons) MSc FGS	BSc (Hons) FGS
Principal Engineering Geologist	Director

APPENDIX 1

DRAWINGS



PROJECT: 40274 – Warren Hall

FIGURE No. A1.1. **SCALE: NTS**

TITLE: Site Location Plan

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

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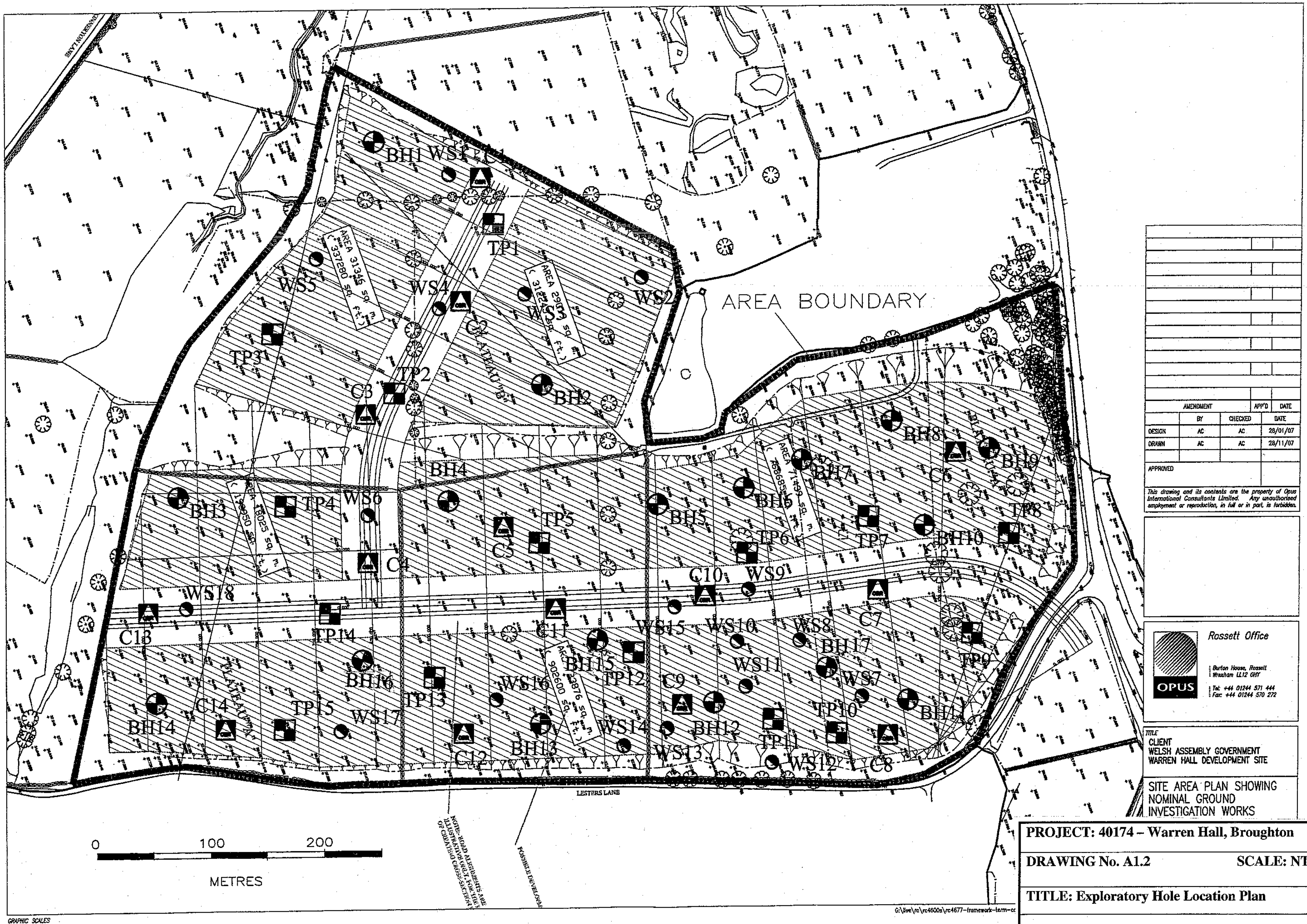

PROJECT: 40174 – Warren Hall, Broughton

DRAWING No. A1.2 **SCALE: NTS**

TITLE: Exploratory Hole Location Plan

IAN FARMER ASSOCIATES

Geotechnical & Environmental Specialists

APPENDIX 2

SITE WORK

APPENDIX 2

GENERAL NOTES ON SITE WORKS

A2.1 SITE WORK

A2.1.1 Rotary Drilling

For exploration within rock rotary drilling methods are employed, where the drill bit is rotated on the bottom of the borehole. This method is occasionally used for drilling within soils. The drilling fluid is transferred from the surface though hollow drilling rods to the bit cooling and lubricating. Drilling fluids commonly comprise clean water, air, foam, mud or polymers which aid the transportation of drill cuttings to the surface and maximise core recovery.

There are two basic types of rotary drilling:

- Open hole where the drill bit cuts all the material within the diameter of the borehole. This technique is sometimes used in soils and weak rocks as a rapid and economical means of making holes for taking soil samples, carrying out insitu soil tests, installing instruments and probing for voids such as mine workings or solution cavities. The only samples recovered are the poor quality drill cuttings.

- Core drilling where an annular bit fixed to the bottom of the core barrel cuts a core, which is recovered within the innermost tube of the core barrel. Coring is normally carried out by triple tube core barrels. At the end of the core run the core barrel assembly is brought to the surface. The core is prevented from dropping out of the barrel by a core catcher made of spring steel. The non-rotating inner barrel contains a removable sample tube or liner. At the end of each coring run the liner is extracted from the barrel and stored in a core box, where it can be photographed, described and tested.

A2.1.2 Light Cable Percussion Boring

For routine soil exploration to depths in excess of 3m, the light cable percussion rig is generally employed for boring through soils and weak rocks. It consists of a powered winch and tripod frame, with running wheels that are permanently attached so that the rig may be towed behind a suitable vehicle. The rig is towed into position and set up using its own winching system.

The locations of services are checked to make sure the borehole is not situated unacceptably near any services. Regardless of the proximity of services, a CAT scan is undertaken at the borehole location and a trial hole dug to 1.20m by hand.

Boreholes are advanced in soil by the percussive action of the cable tool. The force of the cylindrical tool as it is dropped a short distance cuts a plug of cohesive soil that is removed by the tool.

In non-cohesive soils, the borehole is advanced by a ‘shell’, otherwise known as a ‘bailer’ or ‘sand pump’, which incorporates a clack valve. Material is transferred into the shell and retained by the clack valve. The water level in a borehole is maintained above that in the surrounding granular soil to allow for temporary reductions in the head of water as the shell is withdrawn from the borehole. Water should flow from the borehole into the surrounding soil at all times to prevent ‘piping’ and loosening the soil at the base of the hole. The casing is always advanced with the borehole in granular soil so that material is drawn from the base rather than the borehole sides.

Obstructions to boring are overcome by fitting a serrated chiselling ring to the base of the percussion tool. For large obstructions, a heavy chisel with a hardened cutting edge may have to be used.

Disturbed samples are taken in polythene bags, jars or tubs that are sealed against air or water loss.

Undisturbed samples are generally taken in cohesive materials at changes in strata and at one metre intervals to 5 metres then at 1.5 metre intervals to the full depths of the borehole. The general purpose open-tube sampler is suitable for firm to stiff clays, but is often used to retrieve disturbed samples of weak rocks, soft or hard clay and also clayey sand or silts. This has been adopted for routine use, and usually consists of a 100mm internal diameter tube (U100), which is capable of taking soil samples up to 450mm in length. The undisturbed samples are sealed at each end using micro-crystalline wax to prevent drying.

Standard penetration tests are generally carried out in non-cohesive soils but also in stiff clays and soft rocks at frequencies similar to that of undisturbed sampling.

A2.1.3 Drive-in Window Sampler

The drive-in window sampler consists of a series of cylindrical sample tubes, generally varying in diameter from 80mm to 35mm. A cutting shoe is fitted to the bottom of each tube, while a window, representing about a quarter of the circumference, is cut along the length of the tube.

The largest diameter tube is driven into the ground using a small vibrating breaker. The sample tube is extracted by means of a ratchet or hydraulic extraction system.

The borehole is extended by using progressively smaller diameter tubes.

Soil samples are extracted through the window of the tube.

A2.1.4 Dynamic Probing Heavy, DPH

This covers the determination of the resistance of in-situ soil to a 90° cone being driven dynamically, Dynamic Probing can be used to determine presence of variations in strata, however, since samples are not recovered, it should be carried out in conjunction with sampling.

In principle, the test consists of driving a 90° cone of 15cm² cross-sectional area into the ground using a 50kg drop hammer falling a standard height of 500mm. At regular intervals, in order to minimise friction on the shaft, the rods are turned.

The results are recorded as the number of blows of the hammer to drive the cone 100mm, N_{100}, together with the torque to turn the rods.

As an approximate correlation, the resistance determined by the DPH may be related to the SPT ‘N’ value as:

$$\text{‘N’ value} = 2 \times N_{100}$$

A2.2 IN-SITU TESTS

A2.2.1 Standard Penetration Test

The Standard Penetration Test is carried out in accordance with the proposals recommended by BS 1377, Part 9, 1990, ref 5.3**Error! Reference source not found.**.

The standard penetration test, **SPT**, covers the determination of the resistance of soils to the penetration of a split barrel sampler. A 50mm diameter split barrel sampler is driven 450mm into the soil using a 65kg hammer with a 760mm drop. The penetration resistance is expressed as the number of blows required to obtain 300mm penetration below an initial seating drive of 150mm through any disturbed ground at the bottom of the borehole. The number of blows to achieve the standard penetration of 300mm is reported as the 'N' value.

The test is generally carried out in fine soils, however, it may also be carried out in coarse granular soils, weak rocks and glacial tills using the same procedure as for the SPT but with a 50mm diameter, 60° apex solid cone replacing the split spoon sampler, **CPT.**

When attempting the standard penetration test in very dense material or weathered rocks it may be necessary to terminate the test before completion to prevent damage to the equipment. In these circumstances it is important to distinguish how the blow count relates to the penetration of the sampler. This may be achieved in the following manner:

- Where the seating drive has been completed, the test drive is terminated if 50 blows are reached before the full penetration of 300mm is achieved. The penetration for 50 blows is recorded and an approximate N value obtained by linear extrapolation of the number of blows for the partial test drive.

- If the seating drive of 150mm is not achieved within the first 25 blows, the penetration after 25 blows is recorded and the test drive then commenced.

- For tests in soft rocks, the test drive should be terminated after 100 blows where the penetration of 300mm has not been achieved.

The N-value obtained from the Standard Penetration Test may be used to assess the relative density of sands and gravels as follows:

Term	SPT N-Value : Blows/300mm Penetration
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50

A2.2.2 Dynamic Cone Penetrometer, DCP

The dynamic cone penetrometer consists of a 16mm diameter rod with a 20mm diameter, 60° cone of tempered steel at one end. The impact is provided by means of an 8kg sliding hammer falling 575mm. The total weight of the instrument is about 12kg.

The correlation of DCP to California Bearing Ratio, CBR, has been determined to be as below.

The correlation for DCP to SPT 'N' value has been determined on the basis of equivalent energy imparted per unit area of penetrometer. This provides an approximate correlation of

$$\text{'N' value} = \frac{\text{DCP blows for 300mm}}{0.6}$$

A2.2.3 California Bearing Ratio, CBR

The California Bearing Ratio test is used to evaluate the strength of subgrade by measuring the load required to cause a plunger of standard size (50mm diameter) into the ground at a standard rate (1.00mm/min) and comparing the result with a standard material, .

The test is arbitrary in that the results cannot be accurately related to any of the fundamental properties governing soil strength. However, in that the deformation is predominantly shear, the CBR can be regarded as an indirect measurement of shear strength and modulus of subgrade reaction.

Alternative methods of determining the equivalent CBR by cone penetrometer can be undertaken. The Mexicone consists of a 30° cone of 129mm² cross-section that is pushed into the ground at a steady rate. The load is determined through a compression spring that deflects under load and is calibrated to give a direct reading of CBR on a dial. The instrument is best suited in cohesive or fine granular soil, but in gravelly soil it should not be used.

A2.3 SAMPLES

U(x) represents undisturbed 100mm diameter sample with (x) being the number of blows required to obtain sample.

U fail indicates undisturbed sample not recovered

HV represents Hand Vane test with equivalent undrained shear strength

PP represents Pocket Penetrometer test with equivalent undrained shear strength

CBR represents California Bearing Ratio test

B represents large bulk disturbed samples

D represents small disturbed sample

W represents water sample

$\underline{\nabla}$ respresents water strike

$\underline{\blacktriangledown}$ represents level to which water rose

A2.4 DESCRIPTION OF SOILS

A2.4.1 General

The procedures and principles given in Section 6 of BS 5930, ref 5.3 have been used in the soil descriptions contained within this report.

A2.4.2 Predominantly Coarse Soils

A coarse soil (omitting any boulders or cobbles) contains about 65% or more coarse material and is described as a SAND or GRAVEL depending on which of the constituents predominates. The secondary constituents of coarse soils should precede the main soil type e.g. ‘Medium dense brown very gravelly coarse SAND. Gravel is subangular fine and medium of sandstone and mudstone’.

A2.4.3 Deposits containing silt-sized and clay-sized particles

Most soils are mixtures of clay and silt sized particles. Fine soil should be described as either a clay or a silt, depending on the plastic properties. If ambiguous, the term CLAY/SILT should be used.

A2.4.4 Deposits containing mixtures of fine and coarse soil.

The appropriate quantified terms should be used before the principal soil type. It is recommended that the dominant secondary fraction come immediately before the principal soil term. Additional detail can be added in a separate sentence thus, ‘Gravelly very clayey SAND. Gravel (10%) is fine of rounded quartz. Clay is firm’.

The terms ‘silty’ and ‘clayey’ are mutually exclusive as in a coarse soil and based on the plastic properties of the fine fraction.

Table 1 Deposits containing boulder-size and cobble-size particles

Term	Composition
BOULDERS (or COBBLES) with a little finer material	Up to 5% finer material
BOULDERS (or COBBLES) with some finer material	5 to 20% finer material
BOULDERS (or COBBLES) with much finer material	20 to 50% finer material
FINER MATERIAL with many boulders (or cobbles)	50 to 20% boulders (or cobbles)
FINER MATERIAL with some boulders (or Cobbles)	20 to 5% boulders (or cobbles)
FINER MATERIAL with occasional boulders (or cobbles)	up to 5% boulders (or cobbles)

Term	Principal Soil Type	Approximate proportion of secondary constituent
Slightly sandy or gravelly	SAND or	Up to 5%
Sandy or gravelly	GRAVEL	5 to 20%
Very sandy or gravelly		over 20%
	SAND and GRAVEL	about equal proportions

Table 2 Mixtures of coarse and fine fractions.

Term Before	Principal Term	Proportion of secondary Coarse soil	constituent Coarse and/or fine soil
Slightly clayey or silty and/or sandy gravelly	SAND		< 5
Clayey or silty and/or sandy or gravelly	and/or GRAVEL		5 – 20 %
Very clayey or silty and/or sandy or gravelly			20 %
Very sandy or gravelly	SILT or CLAY	< 65%	
Sandy and/or gravelly		35 – 65 %	
Slightly sandy an/or gravelly		<35 %	

For clays the strength scale is used as follows:

Term	Field Identification	Undrained shear strength (KN/m^2)
Very Soft	Exudes between fingers when squeezed in hand	< 20
Soft	Moulded by light finger pressure	20 - 40
Firm	Can be moulded by strong finger pressure	40 - 75
Stiff	Cannot be moulded by finger. Can be indented by thumb.	75 - 150
Very Stiff	Can be indented by thumbnail.	150 - 300
Hard (or very weak mudstone)		> 300

A2.4.5 Man Made Soils

Man made soils (Made Ground or Fill) have been placed by man and can be divided into those composed of natural reworked soils and those composed of man-made materials. Fills are placed in the ground in a controlled manner and soils defined as Made Ground are placed without any engineering control. For example:

'MADE GROUND comprising plastic bags, window frames, garden refuse and newspapers'.

' MADE GROUND dense brown sandy GRAVEL with occasional tiles, wire and glass'.

'Firm yellow brown slightly sandy CLAY with clods (up to 200mm) of firm to stiff orange CLAY (EMBANKMENT FILL)'.

A2.4.6 Organic Soils

Small quantities of dispersed organic matter can have a marked effect on plasticity and hence the engineering properties of the soil. The following quantifying terms are appropriate:

Term	Organic Content	Typical Colour
Slightly organic clay or silt Slightly organic sand	2 - 5 1 – 3	Grey As mineral
Organic clay or silt Organic sand	5 – 10 3 – 5	Dark grey Dark grey
Very organic clay or silt Very organic sand	>10 >5	Black Black

A2.5 GEOLOGICAL LOGGING

A2.5.1 General

The procedures and principles given in Section 6 of BS 5930, ref 5.3. have been used in the rock descriptions contained within this report.

Open hole drilling (OH) was achieved with a tricone rock bit.

A core run is the length of rock drilled from the base of the hole each time the core barrel is run into the hole.

A2.5.2 Fracture State

Various criteria may be used for quantitative description of the Fracture State of rock cores. The standard terms are as follows.

TCR (%)	ratio of core recovered (solid and non intact) to length of core run.
SCR (%)	ratio of solid core recovered to length of core run.
RQD (%)	ratio of solid core pieces longer than 100mm to length of core run.
Fracture Index	a count of the number or spacing of fractures over an arbitrary length of core of similar intensity of fracturing. Commonly reported as either Fracture Index (FI, number of fractures per metre) or as Fracture Spacing (I_f mm).
NR	indicates no core recovery.
NI	indicates intensely fractured rock which is not of sufficient quality to allow an assessment of fracture spacing to be made.

Figure A2.1

Borehole Records

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Site	Borehole Number
Warren Hall Site - Broughton	**BH01**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm to 4.00m		Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		17/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00-0.50	B1					(0.50)	Grass over TOPSOIL: Very soft, brown, sandy clay with some plant material.			
0.20	D2									
0.20	J3									
0.50	D5					0.50	Firm, mottled orange brown, sandy, slightly gravelly CLAY. Gravel is subrounded to subangular, fine and medium including sandstone and siltstone.			
0.50	J6									
0.50-1.00	B4					(0.70)				
1.20-1.65	U7 0.45	1.20	DRY	36 blows		1.20	Firm, grey brown, sandy, slightly gravelly CLAY. Gravel is subrounded to subangular, fine and medium including sandstone and siltstone.			
1.70	D8									
2.00-2.45	SPT N=16	1.70	DRY	3,3/3,4,3,6		(1.80)	Below 2.00m: brown.			
2.00-2.45	D10									
2.00-2.45	B9									
2.50	J11									
3.00-3.45	SPT N=22	3.00	DRY	5,6/5,5,5,7		3.00	Dark blue grey MUDSTONE, recovered as stiff, friable, sandy, gravelly clay.			
3.00	D13									
3.00	J15									
3.00-3.45	B12									
3.00-3.45	D14					(1.50)				
4.00-4.44	SPT 50/290	4.00	DRY	7,10/12,13,14,11			Below 4.00m: recovered as slightly clayey, slightly sandy, angular to subangular, fine to coarse gravel.			
4.00	D17									
4.00-4.44	D16					4.50				
							Complete at 4.50m			

Remarks
Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
1:50	GP

Figure No. 40274.BH01

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Site	Borehole Number
Warren Hall Site - Broughton	BH02

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm to 6.00m		Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		16/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00-1.00	B1					(0.30)	Grass over TOPSOIL: Dark brown, clayey SAND with occasional nodules of clay and plant material.			
0.20	D2					0.30				
0.30	D3						Firm, orange brown, sandy, slightly gravelly CLAY. Gravel is subrounded to subangular, fine and medium including sandstone, siltstone and coal (possible made ground).			
0.30	J4					(0.50)				
0.80	D5					0.80				
0.80	J6					(0.60)	Very dense, orange brown, very clayey SAND and rounded to subrounded, fine to coarse GRAVEL with occasional nodules of clay. Gravel consists of sandstone.		∇1	
1.20-1.64	D8			Water strike(1) at 1.20m, sealed at 3.50m.		1.40				
1.20-1.65	B7					(0.40)	COBBLE/BOULDER of sandstone (driller's description).			
1.20-1.64	SPT 50/290	1.20	1.20	7,11/12,11,12,15		1.80				
2.00-2.45	CPT N=18	2.00	WET	5,3/4,5,4,5			Medium dense, orange brown SAND and rounded to subrounded, fine to coarse GRAVEL. Gravel includes sandstone, siltstone and quartz.			
2.00-2.45	B9					(1.70)				
3.00-3.45	CPT N=15	3.00	WET	2,3/4,3,4,4						
3.00-3.45	B10									
3.50	J12					3.50	Firm, brown, sandy, slightly gravelly CLAY. Gravel is rounded to subrounded, fine and medium including sandstone, siltstone and quartz.			
3.50	D11									
3.80	D13									
3.80	J14									
4.00-4.45	SPT N=18	4.00	DRY	4,5/5,4,5,4			At 4.00m: occasional cobbles.			
4.00-4.45	B15									
4.00-4.45	D16					(1.60)				
4.60	D17									
5.00-5.44	SPT 50/285	4.70	DRY	7,8/11,12,13,14		5.10	Blue grey MUDSTONE, recovered as very stiff, friable, sandy, gravelly clay.			
5.00-5.44	D19									
5.00-5.45	B18									
5.50	D20					(0.90)				
6.00-6.38	CPT 50/225	6.00	DRY	7,9/14,16,20		6.00	At 6.00m: recovered as sandy, angular to subrounded, fine to coarse gravel.			
6.00	D21						Complete at 6.00m			

Remarks
Chiselling from 1.40m to 1.80m for 1.00 hour. Chiselling from 4.60m to 4.90m for 0.75 hours. Water added from 1.20m. Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
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Figure No. 40274.BH02

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Site	Borehole Number
Warren Hall Site - Broughton	**BH03**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm to 5.50m		Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		18/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(0.30)	TOPSOIL (driller's description).			
0.30 0.30-1.20	J1 B2					0.30	Firm, orange brown, occasional mottled orange, brown, grey, sandy, slightly gravelly CLAY. Gravel is subrounded to subangular, fine of sandstone.			
						(1.40)				
1.20-1.65	U3 0.45	1.20	DRY	32 blows						
1.70	D4					1.70	Firm, red brown, sandy, gravelly CLAY. Gravel is rounded to subangular, fine and medium including sandstone, siltstone and quartz.			
2.00-2.45 2.00-2.45 2.00-2.45	SPT N=10 D6 B5	1.70	DRY	2,2/2,3,2,3		(1.10)				
						2.80	Stiff, red brown, sandy, gravelly CLAY. Gravel is rounded to subangular, fine and medium including sandstone, siltstone and quartz.			
3.00-3.45	U7 0.45	3.00	DRY	100 blows						
3.50	D8					(1.70)				
4.00-4.45 4.00-4.45 4.00-4.45	SPT N=28 D10 B9	4.00	DRY	4,5/6,6,6,10			Below 4.00m: slightly gravelly.			
						4.50	Blue grey MUDSTONE, recovered as stiff, friable, sandy, gravelly clay.		1	
5.00	D11					(1.50)			1	
5.50-5.95 5.50-5.82	B12 CPT 50/165	5.50	4.60	Water strike(1) at 5.40m, rose to 4.60m in 20 mins. 9,14/20,22,8						
						6.00				
							Complete at 6.00m			

Remarks
Chiselling from 5.70m to 6.00m for 1.00 hour. Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
1:50	GP

Figure No. 40274.BH03

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Site Warren Hall Site - Broughton				**Borehole Number** BH04
Boring Method Cable percussion with rotary follow on	**Casing Diameter** 150mm to 4.00m	**Ground Level (mOD)**	**Client** Welsh Assembly Government	**Job Number** 40274
	Location	**Dates** 16/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.30) 0.30	TOPSOIL (driller's description).		
0.30 0.30-1.20	J1 B2					(1.10) 1.40	Firm, dark red brown with grey veining, sandy, gravelly CLAY. Gravel is subangular to subrounded, fine and medium including slate, mudstone and coal.		
1.20-1.65 1.20-1.65 1.20-1.65	D4 SPT N=20 B3	1.20	DRY	3,3/3,5,6,6					
2.00-2.45 2.00-2.45 2.00-2.45	D6 SPT N=18 B5	1.70	DRY	2,3/4,4,5,5		(1.60) 3.00	Medium dense, red grey brown, slightly silty, fine SAND. Driller notes bands of sand.		▼1
2.70 3.00-3.45 3.00-3.45 3.00-3.45	W9 D8 SPT N=10 B7	3.00	DRY	2,2/2,3,2,3		(0.80) 3.80	Firm, red brown CLAY with partings of silt.		∇1
4.00-4.45 4.00-4.25 4.00-4.25	B10 D11 SPT 25*/135 50/110	4.00	2.90	Water strike(1) at 3.80m, rose to 2.70m in 20 mins. 13,12/27,23		(0.70) 4.50	Dark blue grey SILTSTONE, recovered as very stiff, gravelly clay.		

Depth (m)	TCR	SCR	RQD	FI	Depth (m) (Thickness)	Description
5.00	83	28	0	NI	(3.50) 8.00	Weak to very weak, dark grey, moderately weathered MUDSTONE, recovered predominately as angular to subangular, fine to coarse gravel and cobble sized fragments with sections. Discontinuities where observed are inclined approx 20 degrees. Planar, smooth, slightly stepped. Some soft clay on discontinuity surfaces.
6.50	67	17	7			Below 7.50m: becoming moderately weak.
8.00	93	67	33	10	(3.00)	Moderately weak to weak, dark grey, moderately weak MUDSTONE, with some angular too subangular, medium to coarse and cobble sized fragments. Discontinuities are sub-horizontal to 20 degrees inclined, planar, smooth to stepped smooth. Below 8.00m: intact mudstone.
9.50						Between 9.50m and 9.65m: soft clay filling. At 9.50m: some soft clay infilling.
10.00						

Remarks
Chiselling from 4.10m to 4.50m for 1.00 hour. Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx) 1:50 | Logged By MV

Figure No. 40274.BH04

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Site	Borehole Number
Warren Hall Site - Broughton	BH04

Machine :	Casing Diameter	Ground Level (mOD)	Client	Job Number
Flush :	150mm to 4.00m		Welsh Assembly Government	40274
Core Dia : 92	**Location**	**Dates**	**Engineer**	**Sheet**
Method : Rotary Open Hole		16/01/2008	Opus International Consultants (UK) Ltd	2/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
	92	42	35	9			(3.00)			
11.00							11.00			
								Complete at 11.00m		

Remarks

Scale (approx)	Logged By
1:50	MV

Figure No. 40274.BH04

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Site	Borehole Number
Warren Hall Site - Broughton	BH05

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable percussion with rotary follow on	150mm to 1.30m		Welsh Assembly Government	40274
	Location	**Dates** 15/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.50)	Grass over brown, sandy, clayey TOPSOIL (driller's description).		
0.40	J1								
0.50-1.20	B2					0.50	Grey brown SANDSTONE, recovered as slightly clayey, very gravelly sand with some cobbles.		
						(0.80)			
1.30-1.35	D3								
1.30-1.35	CPT 25*/20 50/25	1.30	DRY	25/50		1.30	At 1.30m: recovered as grey, slightly clayey, slightly sandy, subangular to subrounded, medium to coarse gravel.		

Depth (m)	TCR	SCR	RQD	FI	Depth (m) (Thickness)	Description
1.50	47	12	7	NI	(1.70)	Moderately strong to strong, light grey brown, fine to medium SANDSTONE, recovered as angular to subangular, medium to coarse gravel and cobble sized fragments.
3.00	87	55	19	NI	3.00 (1.50)	Light grey red brown, weak to moderately weak, sandy SILTSTONE, recovered as angular to subangular, medium to coarse gravel and cobble sized fragments with some weak to very weak intact short intervals of core. Below 3.70m: loose gravel of light grey white siltstone.
4.50	88	70	67	NI	4.50 (0.25)	Moderately weak, dark grey black brown, sandy MUDSTONE, recovered as angular to subangular, medium to coarse gravel and occasional cobble sized fragments.
4.75				7	4.75 (2.31)	Strong to moderately strong to moderately weathered, light grey, dark grey white, silty, fine SANDSTONE. Discontinuities are sub-horizontal axis with planar, rough surfaces coated with soft, brown black, silt and some fine gravels.
6.00	97	75	55	10		
7.06				NI	7.06 (0.44)	Weak to very weak, light grey brown interbedded SILTSTONE and MUDSTONE, recovered as angular to subangular, medium to coarse gravel, cobbles and occasional high weathered short intervals of core.
7.50					7.50	Complete at 7.50m

Remarks
Chiselling from 1.10m to 1.30m for 0.50 hours. Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
1:50	GP

Figure No. 40274.BH05

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Site	Borehole Number
Warren Hall Site - Broughton	**BH06**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable percussion with rotary follow on	150mm to 2.20m		Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		15/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.20) 0.20	Grass over brown TOPSOIL (driller's description).		
0.20-1.20	B2						Firm, orange red, brown, sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine and medium including sandstone and siltstone.		
0.50	J1			Slight Seepage(1) at 0.60m.					∇1
						(1.70)			
1.20-1.65	D4								
1.20-1.65	SPT N=11	1.20	DRY	1,1/2,3,3,3					
1.20-1.65	B3								
						1.90 (0.30) 2.20	Brown SANDSTONE, recovered as slightly sandy, angular to subangular, fine to coarse gravel.		
2.20-2.24	D5								
2.20-2.24	CPT 25*/15 50/20	2.20	DRY	25/50					

Depth (m)	TCR	SCR	RQD	FI	Field Records	Depth (m) (Thickness)	Description
2.50						(0.62) 2.82	Moderately strong to strong, light brown, fine and medium SANDSTONE, recovered as short lengths of intact core with some cobble sized, angular to subangular fragments. Discontinuities are inclined at 30-40 degrees axis with black, silty on discontinuity surfaces.
	60	24	0				Moderately strong to strong, light to dark grey, very sandy SILTSTONE, recovered as angular to subangular, medium to coarse gravel and cobbles with some clay infilling.
4.00							Below 4.00m: becoming yellow brown, highly weathered weak siltstone.
	90	18	0			(4.38)	
5.50				NI			Below 5.50m: becoming dark yellow grey and increasing in sandy content.
	77	19	14				
7.00						7.20 (0.20) 7.40	Dark grey/black, weak to moderately weak MUDSTONE, recovered as gravel.
	77	43	43			(1.10)	Moderately strong to strong, dark grey, very sandy SILTSTONE. Discontinuities are inclined 45-40 degrees including smooth, steeply inclined fractures of 70 degrees, red brown oxide weathering on discontinuity surfaces.
8.50						8.50	Complete at 8.50m

Remarks
Chiselling from 1.90m to 2.20m for 1.00 hour. Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
1:50	GP

Figure No. 40274.BH06

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Site	Borehole Number
Warren Hall Site - Broughton	BH07

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable percussion with rotary follow on	150mm to 4.00m		Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		15/01/2008-16/01/2008	Opus International Consultants (UK) Ltd	1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records
0.25-1.20	B1			
0.50	J2			
1.20-1.65	D4			
1.20-1.65	SPT N=10	1.20	DRY	1,1/2,2,3,3
1.20-1.65	B3			
2.00-2.45	U5 0.45	1.50	DRY	70 blows
2.50	D6			
3.00-3.45	D8			
3.00-3.45	SPT N=22	3.00	DRY	1,2/3,4,5,10
3.00-3.45	B7			
				Water strike(1) at 3.40m, rose to 2.00m in 20 mins.
3.50	D9			
4.00-4.04	D10			
4.00-4.04	CPT 25*/20 50/20	4.00	3.00	25/50

Depth (m)	TCR	SCR	RQD	FI	Field Records
5.00					
5.40-5.55					C11
5.00-6.50	40	20	17		
6.50-8.00	73	0	0		
8.00				NI	
8.00-9.50	57	0	0		
9.50					

Level (mOD)	Depth (m) (Thickness)	Description	Water
	(0.25) 0.25	Grass over clayey TOPSOIL (driller's description).	
	(2.25) 2.50	Firm, orange brown, sandy, slightly gravelly CLAY with occasional pockets of grey, clayey sand and some rootlets. Gravel is subrounded to subangular, fine and medium of sandstone.	▼1
	(0.90) 3.40	Stiff, red brown, sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine and medium including siltstone, sandstone and coal.	∇1
	(0.60) 4.00	Red brown SANDSTONE, recovered as sandy, subangular to subrounded, fine to coarse gravel.	
	(1.45) 5.45	Yellow brown black and grey, moderately weak to moderately strong, fine, silty SANDSTONE, recovered as non intact, angular to subangular, gravel and cobbles sized fragments and occasional sections of intact core.	
	(5.55)	Moderately weak to very weak, highly weathered, dark black grey MUDSTONE, recovered as predominately bands of clay with angular to subangular, fine to coarse gravel and cobble sized fragments with occasional relic laminated structures (at 6.50-6.70m). Discontinuities where observed are sub-horizontal.	

Remarks
Chiselling from 3.60m to 4.00m for 1.00 hour. Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
1:50	GP

Figure No. 40274.BH07

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Site	Borehole Number
Warren Hall Site - Broughton	BH07

Machine :	Casing Diameter	Ground Level (mOD)	Client	Job Number
Flush :	150mm to 4.00m		Welsh Assembly Government	40274
Core Dia : 92	**Location**	**Dates**	**Engineer**	**Sheet**
Method : Rotary Open Hole		15/01/2008-16/01/2008	Opus International Consultants (UK) Ltd	2/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.14-10.19	89	0	0		C12					
10.57-10.66					C13		(5.55)			
11.00							11.00			
								Complete at 11.00m		

Remarks

Scale (approx)	Logged By
1:50	GP

Figure No. 40274.BH07

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Site	Borehole Number
Warren Hall Site - Broughton	BH08

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable percussion with rotary follow on	150mm to 4.00m		Welsh Assembly Government	40274
	Location	**Dates** 15/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-1.00	B1					(0.30)	Grass over TOPSOIL: Brown, very clayey, slightly gravelly SAND with some plant material. Gravel is subrounded, fine including quartz and sandstone.		
0.20	D2					0.30			
0.30	D3						Firm, orange brown, sandy, slightly gravelly CLAY. Gravel is subangular, fine to coarse of siltstone.		
0.30	J4					(1.30)			
1.20-1.65	B5								
1.20-1.65	SPT N=16	1.20	DRY	1,2/3,4,4,5					
1.20-1.65	D6					1.60	Orange brown, silty, fine and medium SAND.		
2.00-2.45	D10					(0.40)			
1.70	J7					2.00	Firm, orange brown, sandy, slightly gravelly CLAY with occasional pockets of sand. Gravel is subangular to subrounded, fine to coarse including sandstone and siltstone.		
1.70	D8								
2.00-2.45	SPT N=13	1.70	DRY	2,2/3,4,3,3					
2.00-2.45	B9					(0.95)			
2.60	D11								
2.60	J12								
3.00-3.45	B14					2.95	Dense, red brown, slightly silty, slightly gravelly, fine and medium SAND. Gravel is subangular to subrounded, fine to coarse including sandstone and quartz.		
2.95	D13								
3.00-3.45	SPT N=46	3.00	WET	3,8/9,11,14,12					
3.00-3.45	D15					(0.75)			
3.70	D16					3.70	Dark blue grey MUDSTONE, recovered as very clayey sand and angular to subangular, fine and medium gravel. Below 4.00m: recovered as very stiff, friable, sandy, gravelly clay.		
4.00-4.39	D17								
4.00-4.39	SPT 50/240	4.00	DRY	8,9/11,13,19,7		(0.75)			
						4.45	Weak to very weak, dark grey green, highly weathered SILTSTONE, recovered as angular to sub-angular, fine to coarse gravel and cobble sized fragments with some sections of intact core. Discontinuities where observed are sub-horizontal to core arises, planar and smooth.		

Depth (m)	TCR	SCR	RQD	FI	Depth (m) (Thickness)	Description
6.00	80	25	24	NI		
7.00				4		
7.50	59	50	41	7	(7.55)	Below 7.50m: very weak to weak, dark grey green siltstone.
9.00	33	3	0	NI		

Remarks
Water added from 3.00m. Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
1:50	GP

Figure No. 40274.BH08

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Site	Borehole Number
Warren Hall Site - Broughton	BH08

Machine :	Casing Diameter	Ground Level (mOD)	Client	Job Number
Flush :	150mm to 4.00m		Welsh Assembly Government	40274
Core Dia : 92	**Location**	**Dates**	**Engineer**	**Sheet**
Method : Rotary Open Hole		15/01/2008	Opus International Consultants (UK) Ltd	2/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.50	65	34	11	NI			(7.55)			
12.00							12.00	Complete at 12.00m		

Remarks	Scale (approx)	Logged By
	1:50	GP
	Figure No. 40274.BH08	

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Site	Borehole Number
Warren Hall Site - Broughton	**BH09**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable percussion with rotary follow on	150mm to 3.00m		Welsh Assembly Government	40274

Location	Dates	Engineer	Sheet
	16/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records
0.20-1.20	B2			
0.50	J1			
1.20-1.65	D4			
1.20-1.65	SPT N=9	1.20	DRY	1,1/2,2,2,3
1.20-1.65	B3			
2.00-2.45	U5 0.45	2.00	DRY	70 blows
2.50	D6			
3.00-3.22	B7			
3.00-3.22	SPT 50/65	3.00	DRY	2,4/50
3.00-3.45	D8			
3.50-3.54	D9			
3.50-3.54	CPT 25*/15 50/20	3.00	DRY	25/50

Depth (m)	TCR	SCR	RQD	FI
4.00	60	21	16	
7.00	68	34	19	NI
8.50	69	21	7	
10.00				

Level (mOD)	Depth (m) (Thickness)	Description
	(0.20) 0.20	Grass over brown clayey TOPSOIL (driller's description).
	(3.00) 3.20	Soft, red brown, sandy, slightly gravelly CLAY. Gravel is subrounded to subangular, fine and medium of sandstone and siltstone. Below 1.20m: firm. Below 2.50m: stiff.
	(0.30) 3.50	Red brown SANDSTONE, recovered as sandy, subangular to angular, fine to coarse gravel.
	(2.25) 5.75	Moderately strong, red brown, fine to medium SANDSTONE, recovered as angular to subangular, medium to coarse gravel and cobble sized fragments with silt coatings on discontinuity surfaces.
	(1.75) 7.50	Moderately strong, red brown, fine to coarse SANDSTONE, recovered as angular to subangular, medium to coarse gravel and cobble sized fragments with clay coatings of discontinuity surfaces.
	(2.50) 10.00	Moderately weak to weak, red brown, highly weathered SILTSTONE, recovered predominately as angular to subangular, medium to coarse gravel and cobbles.

Remarks
Chiselling from 3.20m to 3.50m for 1.00 hour. Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
1:50	GP

Figure No. 40274.BH09

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Site	Borehole Number
Warren Hall Site - Broughton	BH10

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable percussion with rotary follow on	150mm to 4.00m		Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		14/01/2008-15/01/2008	Opus International Consultants (UK) Ltd	1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
0.00-0.50	B1					(0.10) 0.10	Gravel over MADE GROUND: Topsoil (driller's description).
0.20	D2						MADE GROUND: Soft, orange red brown, sandy, gravelly CLAY with some cobbles of subrounded sandstone and some rootlets. Gravel is subangular to subrounded, fine to coarse including sandstone, mudstone and coal.
0.20	J3						
0.50-1.00	B4						
0.60	D5			Water strike(1) at 0.60m, rose to 0.50m in 20 mins, sealed at 0.65m.			
0.60	J6					(1.90)	
1.20-1.65	U7 0.45	1.20	0.65	28 blows			
1.70	D8						
2.00	J11					2.00	Firm in places stiff, red brown, sandy, gravelly CLAY. Gravel is subangular to subrounded, fine to coarse including mudstone and sandstone.
2.00-2.45	SPT N=16	1.70	WET	3,3/3,3,5,5			
2.00-2.45	D10						
2.00-2.45	B9						
2.60	D12					(2.00)	
3.00-3.45	U13 0.45	3.00	DRY	48 blows			
3.50	D14			Water strike(2) at 3.50m, rose to 3.00m in 20 mins.			
3.50	J15						
4.00-4.24	D16						
4.00-4.24	SPT 25*/145 50/95	4.00	WET	8,17/38,12		4.00 (0.45)	Grey SILTSTONE, recovered as angular to subangular, fine to coarse gravel.
						4.45	Very weak to moderately weak, red grey to light blue grey, highly weathered SILTSTONE, recovered predominately as intact sections of core with occasional intervals of angular to subangular fragments of siltstone. Discontinuities are inclined sub-horizontal with surfaces with red brown and black weathering. Recovered discontinuities inclined at 30-40 degrees and 11 degrees.
						(3.05)	
						7.50	Moderately strong to strong, grey blue, silty SANDSTONE. Discontinuities are sub-horizontal and 30-40 degrees. Below 8.00m: red brown, fine sandstone.
						(3.00)	

Depth (m)	TCR	SCR	RQD	FI
4.50	97	75	58	9
5.50				9
6.50				NI
6.90				3
7.50	92	76	57	8
8.50				3
9.00				NI
9.50				

Water: ▼1 ▽1 ▼2 ▽2

Remarks
Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
1:50	MV

Figure No. 40274.BH10

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			Site: Warren Hall Site - Broughton		Borehole Number: **BH10**
Machine : Flush : Core Dia : 92 Method : Rotary Open Hole	Casing Diameter: 150mm to 4.00m	Ground Level (mOD)	Client: Welsh Assembly Government		Job Number: 40274
	Location	Dates: 14/01/2008-15/01/2008	Engineer: Opus International Consultants (UK) Ltd		Sheet: 2/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
				7			(3.00)				
10.50							10.50	Complete at 10.50m			

Remarks	Scale (approx): 1:50	Logged By: MV
	Figure No.: 40274.BH10	

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Site	Borehole Number
Warren Hall Site - Broughton	**BH11**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm to 13.70m		Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		14/01/2008-15/01/2008	Opus International Consultants (UK) Ltd	1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
						(0.40)	TOPSOIL (driller's description).
0.40	J1					0.40	Firm, orange red brown, slightly sandy, gravelly CLAY with some pockets of fine sand.. Gravel is subangular to subrounded, fine to medium including sandstone and coal. Occasional rootlets.
0.40-1.20	B2						
1.20-1.65	U3 0.45	1.20	DRY	78 blows			
						(2.50)	
1.70	D4						
2.00-2.45	SPT N=33	1.70	DRY	3,4/6,7,9,11			Below 2.00m: stiff.
2.00-2.45	B5						
2.00-2.45	D6						
						2.90	Stiff, dark red brown, sandy, gravelly CLAY with occasional cobbles of sandstone. Gravel is subangular to subrounded, fine and medium including sandstone and mudstone.
3.00-3.45	U7 0.45	3.00	DRY	107 blows			
3.50	D8						
						(1.50)	
4.00-4.45	SPT N=39	4.00	DRY	5,6/8,10,10,11			
4.00-4.45	B9						
4.00-4.45	D10						
						4.40	Medium dense, brown, silty, slightly gravelly SAND. Gravel is subangular to subrounded, fine to coarse including sandstone and mudstone.
5.00	D11						
5.50-5.95	SPT N=17	5.50	MOIST	3,4/4,4,5,4			
5.50-5.95	B12						
5.50-5.95	D13						
6.50	D14						
7.00-7.45	SPT N=9	7.00	MOIST	2,1/2,2,2,3		(5.40)	
7.00-7.45	D16						
7.00-7.45	B15						
8.00	D17						
8.50-8.95	SPT N=11	8.50	MOIST	1,2/2,2,3,4			
8.50-8.95	B18						
8.50-8.95	D19						
9.50	D20						
9.80	D21					9.80	Stiff, dark grey brown, sandy, gravelly CLAY.

Remarks
Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
1:50	MV

Figure No. 40274.BH11

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Site	Borehole Number
Warren Hall Site - Broughton	BH11

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm to 13.70m		Welsh Assembly Government	40274

Location	Dates	Engineer	Sheet
	14/01/2008-15/01/2008	Opus International Consultants (UK) Ltd	2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
10.00-10.45	U22 0.45	10.00	DRY	75 blows			Gravel is subangular to subrounded, fine to coarse of sandstone and mudstone.			
10.50	D23									
11.00	D24									
11.50-11.95 11.50-11.95 11.50-11.95	SPT N=19 D26 B25	11.50	DRY	3,4/4,5,5,5		(4.00)	Below 11.50m: some partings of silt.			
12.50	D27									
13.00-13.45	U28 0.45	13.00	DRY	97 blows						
13.50	D29									
13.80	D30					13.80 (0.40)	Stiff, dark grey black, gravelly CLAY. Gravel is subangular to angular, medium to coarse of mudstone (possible weathered mudstone).			
14.00-14.16 14.00-14.45	CPT 25*/120 50/40 B31	13.70	DRY	9,16/50		14.20 (0.30) 14.50	Dark grey black MUDSTONE, recovered as angular to subangular, medium to coarse gravel.			
							Complete at 14.50m			

Remarks
Chiselling from 14.20m to 14.50m for 1.00 hour.

Scale (approx)	Logged By
1:50	MV

Figure No. 40274.BH11

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Site	Borehole Number
Warren Hall Site - Broughton	**BH12**

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm to 7.50m		Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		14/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(0.10) 0.10	Grass over MADE GROUND: topsoil (driller's description).			
0.10-1.20	B2						MADE GROUND: Firm, dark red brown, sandy, gravelly CLAY with some pockets of red brown sand. Gravel is subangular to subrounded, fine and medium of sandstone, mudstone and brick fragments. Occasional rootlets.			
0.50	J1									
1.20-1.65 1.20-1.65 1.20-1.65	SPT N=7 B3 D4	1.20	DRY	1,1/1,2,2,2						
2.00-2.45	U5 0.35	1.50	DRY	55 blows						
2.50	D6					(5.00)				
3.00-3.45 3.00-3.45 3.00-3.45	SPT N=8 D8 B7	3.00	DRY	1,1/1,2,2,3			Below 3.00m: occasional cobbles of sandstone.			
4.00-4.45	U9 0.35	4.00	DRY	70 blows						
4.50	D10									
5.00-5.45 5.00-5.45 5.00-5.45	SPT N=11 B11 D12	4.50	DRY	1,2/2,3,3,3		5.10 (0.50)	Firm, dark grey brown, slightly gravelly CLAY with pockets of laminated light grey silt. Gravel includes mudstone.			
5.50 5.60	D13 D14					5.60	Dark blue grey, thinly laminated MUDSTONE, recovered as clayey, angular to subangular, fine to coarse gravel.			
6.00-6.45	U15 0.45	6.00	DRY	90 blows						
6.50	D16			Slight seepage(1) at 6.50m.		(1.90)			∇1	
7.50-7.57 7.50-7.57	CPT 25*/30 50/35 D17	7.50	DRY	25/50		7.50	Complete at 7.50m			

Remarks
Chiselling from 7.20m to 7.50m for 1.00 hour. Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
1:50	MV

Figure No.
40274.BH12

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IAN FARMER ASSOCIATES

Site	Borehole Number
Warren Hall Site - Broughton	BH13

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm to 4.00m		Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		16/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(0.40) 0.40	TOPSOIL (driller's description).			
0.40 0.40-1.20	J1 B2					(0.80) 1.20	Firm, orange brown, sandy, slightly gravelly CLAY with occasional grey and black horizons. Gravel is subangular to subrounded, fine and medium including sandstone and siltstone (possible made ground).			
1.20-1.65 1.70	U3 0.45 D4	1.20	DRY	81 blows		(0.80) 2.00	Dark blue grey MUDSTONE with occasional nodules of clay, recovered as clayey, slightly sandy, angular to subangular, fine and medium gravel.			
2.00-2.45 2.00-2.45 2.00-2.45	SPT N=24 D6 B5	1.70	DRY	4,5/5,6,6,7		(1.30) 3.30	Dark blue grey MUDSTONE, recovered as stiff, friable, sandy, slightly gravelly CLAY. Gravel is angular to subangular, fine and medium.			
3.00-3.32 3.00-3.32 3.00-3.45	SPT 56/165 D8 B7	3.00	DRY	6,12/17,23,16						
4.00-4.19 4.00-4.45	CPT 25*/85 50/100 B9	4.00	DRY	20,5/34,16		(1.20) 4.50	Dark blue grey MUDSTONE, recovered as slightly clayey, slightly sandy, angular to subangular, fine to coarse gravel.			
							Complete at 4.50m			

Remarks
Chiselling from 4.10m to 4.50m for 1.00 hour. Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
1:50	GP

Figure No. 40274.BH13

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IAN FARMER ASSOCIATES

Site	Borehole Number
Warren Hall Site - Broughton	BH14

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm to 3.00m		Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		18/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(0.20) 0.20	Grass over brown, clayey TOPSOIL (driller's description).			
0.20-1.20	B2						Firm, red brown, mottled orange brown, grey, sandy, slightly gravelly CLAY with some rootlets. Gravel is subrounded to subangular, fine and medium including sandstone and siltstone.			
0.50	J1									
1.20-1.65 1.20-1.65 1.20-1.65	SPT N=10 D4 B3	1.20	DRY	1,2/2,2,3,3		(2.30)				
2.00-2.45	U5 0.45	1.50	DRY	110 blows					1	
2.50	D6			Water strike(1) at 2.50m, rose to 2.25m in 20 mins, sealed at 2.70m.		2.50 (0.20) 2.70	Orange brown SANDSTONE, recovered as sandy, angular to subrounded, fine to coarse gravel.		1	
3.00-3.05 3.00-3.05	CPT 25*/25 50/20 D7	3.00	DRY	25/50		(0.30) 3.00	Grey, fine grained SANDSTONE, recovered as slightly sandy, angular to subangular, fine to coarse gravel.			
							Complete at 3.00m			

Remarks
Chiselling from 2.70m to 3.00m for 1.00 hour. Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
1:50	GP

Figure No. 40274.BH14

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IAN FARMER ASSOCIATES

Site	Borehole Number
Warren Hall Site - Broughton	BH15

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable percussion with rotary follow on	150mm to 4.00m		Welsh Assembly Government	40274

Location	Dates	Engineer	Sheet
	17/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records
0.40	J2			
0.40-1.20	B1			
1.20-1.65	U3 0.45	1.20	DRY	75 blows
1.70	D4			
2.00-2.45	D6			
2.00-2.45	SPT N=32	1.70	DRY	2,4/4,7,10,11
2.00-2.45	B5			
3.00-3.45				B8
2.60	W7			
3.00-3.45				7,10/12,12,12,14
3.00-3.45				SPT N=50
3.00				D9
				Water strike(1) at 3.30m, rose to 2.60m in 20 mins.
4.00-4.45				11,13/15,17,18
4.00-4.37				CPT 50/220
				B10

Core run (m)	TCR	SCR	RQD	FI
3.00-4.75	40	12	0	NI (3.00-5.87)
4.75-6.50	50	37	36	7 (5.87-6.22); 9 (6.22-7.50)
6.50-7.50	89	69	42	
7.50-8.50	82	53	34	9
8.50-9.50	78	30	10	NI

Level (mOD)	Depth (m) (Thickness)	Description	Water
	(0.40) 0.40	TOPSOIL (driller's description).	
	(1.70) 2.10	Firm, orange brown, sandy, slightly gravelly CLAY. Gravel is angular to subrounded, fine and medium including sandstone and siltstone. Between 0.40m and 1.20m: very sandy.	
	(0.90) 3.00	Blue grey MUDSTONE, recovered as very stiff, friable, sandy, gravelly clay. Gravel is angular to subrounded, fine to coarse.	▼1
	(1.10) 4.10	Blue grey brown MUDSTONE, recovered as clayey sand and angular to subrounded, fine and medium gravel.	▽1
	(0.40) 4.50	Grey MUDSTONE, recovered as very stiff, slightly sandy, gravelly clay. Gravel is angular to subangular, fine and medium.	
	(0.50) 5.00	Moderately weak to weak, dark blue grey black MUDSTONE, recovered as angular to subangular, medium to coarse gravel and occasional cobbles. At 5.00m: pocket of soft, black clay.	
	(1.22) 6.22	Moderately weak to weak, light grey MUDSTONE. Discontinuities are sub-horizontal, planar, smooth with soft clay and black staining on surfaces.	
	(2.63) 8.85	Weak to moderately weak, light grey SILTSTONE, recovered as angular, medium to coarse fragments with intervals of intact core where observed discontinuities are sub-horizontal, planar and rough. Below 7.50m: becoming dark grey green. Below 8.85m: becoming dark grey brown.	
	(0.65) 9.50	Dark grey brown, weak to moderately weak SILTSTONE, recovered as angular to subangular, medium to coarse gravel and cobbles with occasional short intervals of intact core. Discontinuity appear sub-horizontal.	

Remarks
Chiselling from 4.10m to 4.50m for 1.00 hour. Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
1:50	GP

Figure No. 40274.BH15

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IAN FARMER ASSOCIATES

Site	Borehole Number
Warren Hall Site - Broughton	BH16

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable percussion with rotary follow on	150mm to 1.70m		Welsh Assembly Government	40274
	Location	**Dates** 17/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
						(0.40) 0.40	TOPSOIL (driller's description).
0.40	J2						Firm, mottled orange brown grey, sandy, slightly gravelly CLAY with some rootlets. Gravel is subangular to subrounded, fine to coarse sandstone and siltstone.
0.40-1.10	B1					(1.50)	
1.20-1.65	U3 0.27	1.20	DRY	83 blows			
1.70	D4					1.90	
2.00-2.21	D6					(0.40)	Orange grey SILTSTONE, recovered as stiff, sandy, gravelly clay. Gravel is angular to subangular, fine to coarse.
2.00-2.21	SPT 50/55	1.70	DRY	7,12/50		2.30	
2.00-2.45	B5					(0.20) 2.50	Grey SILTSTONE, recovered as sandy, angular to subangular, fine to coarse gravel.
						(0.30) 2.80	Weak to very weak, red yellow brown, mottled grey blue SILTSTONE, recovered as subangular to subrounded, medium to coarse gravels and limited intervals of very weak, highly weathered core. Discontinuities are sub-horizontal core arises with heavy, brown staining on surfaces, brown hydrated oxides of FC.
						(3.20)	Moderately weak to weak, yellow orange brown, sandy SILTSTONE, recovered as intervals of intact core, discontinuities are sub-horizontal to core arises, underlying rough with strong weathered stains from re oxides on discontinuity surfaces. Below 4.60m: light grey blue with staining. Below 2.80m: becoming more sandy.
						6.00 (0.40) 6.40	Moderately strong, moderately weathered BRECCIA.
						(0.40) 6.80	Weak, black COAL interlaminated with MUDSTONE.
						(0.65) 7.45	Moderately strong, moderately weathered BRECCIA.
						(1.15) 8.60	Weak to very weak, light grey brown SILTSTONE, recovered as angular to subangular, medium to coarse and occasional intervals of highly weathered core.
							Complete at 8.60m

Depth (m)	TCR	SCR	RQD	FI
2.60	54	0.43	20	8
3.60	75	75	56	8
4.60	92	74	55	8
5.60	100	49	13	NI
6.40	50	0	0	NI
6.60	100	0	0	
6.80	67	67	67	
7.10	70	36	36	NI
7.60	70	23	10	
8.60				

Remarks
Chiselling from 2.30m to 2.50m for 1.00 hour. Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
1:50	GP

Figure No. 40274.BH16

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IAN FARMER ASSOCIATES		Site: Warren Hall Site - Broughton	Borehole Number: **BH17**
Boring Method: Cable percussion with rotary follow on	**Casing Diameter**: 150mm to 13.50m; **Ground Level (mOD)**:	**Client**: Welsh Assembly Government	**Job Number**: 40274
	Location: ; **Dates**: 16/01/2008-17/01/2008	**Engineer**: Opus International Consultants (UK) Ltd	**Sheet**: 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
						(0.40)	Grass over TOPSOIL: Brown, clayey, slightly gravelly SAND with occasional plant material. Gravel is subrounded, fine and medium of sandstone.
0.20	D1						
0.40-1.20	B3					0.40	Firm, orange brown, occasional mottled orange brown and grey, sandy CLAY with occasional plant material.
0.50	J2						
						(1.60)	
1.20-1.65	SPT N=9	1.20	DRY	1,1/2,2,2,3			Below 1.20m: occasional pockets of very clayey, slightly gravelly sand. Gravel is subangular to subrounded, fine and medium of sandstone.
1.20-1.65	B4						
1.20-1.65	D5						
2.00-2.45	SPT N=7	2.00	MOIST	1,1/1,2,2,2		2.00	Loose, brown, silty, slightly gravelly SAND. Gravel is subangular to subrounded, fine to coarse including siltstone and sandstone.
2.00	D6						
2.00-2.45	B7						
2.00-2.45	D8			Water strike(1) at 2.40m, rose to 2.10m in 20 mins, sealed at 8.50m.			At 2.50m: occasional pockets of very soft, sandy clay.
3.00-3.45	SPT N=9	3.00	2.40	1,1/2,2,2,3			At 3.00m: slightly silty, fine to coarse sand.
3.00-3.45	B9						
3.00-3.45	D10						
4.00-4.45	SPT N=10	4.00	3.00	1,1/2,2,3,3			
4.00-4.45	B11						
4.00-4.45	D12						
						(5.80)	
5.00-5.45	SPT N=8	5.00	3.50	1,1/2,2,2,2			
5.00-5.45	D14						
5.00-5.45	B13						
6.00-6.45	SPT N=7	6.00	3.50	1,1/2,1,2,2			
6.00-6.45	D16						
6.00-6.45	B15						
7.50-7.95	SPT N=17	7.50	4.00	1,3/3,4,5,5			
7.50-7.95	B17						
7.50-7.95	D18					7.80	Stiff, brown, sandy, slightly gravelly CLAY. Gravel is subrounded to subangular, fine and medium including sandstone and siltstone.
8.00	D19						
9.00-9.45	U20 0.45	9.00	DRY	75 blows			
9.50	D21					(3.40)	

Remarks
Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
1:50	GP

Figure No. 40274.BH17

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Site	Borehole Number
Warren Hall Site - Broughton	BH17

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable percussion with rotary follow on	150mm to 13.50m		Welsh Assembly Government	40274
	Location	**Dates** 16/01/2008-17/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
10.50-10.95 10.50-10.95 10.50-10.95	B22 SPT N=28 D23	10.50	DRY	3,4/5,7,8,8		(3.40)	
	TCR / SCR / RQD / FI						
11.00 11.20				D24		11.20	Blue grey MUDSTONE, recovered as very stiff, friable, sandy, gravelly clay. Gravel is angular to subangular, fine and medium.
			FI: NI				
12.00-12.44 12.00-12.44 11.90 12.00-12.45	TCR 83, SCR 23	RQD 0		5,7/9,12,15,14 SPT 50/290 D26 B25		(1.60)	
12.80 12.80			FI: 15	D27		12.80	Blue grey MUDSTONE, recovered as slightly clayey, slightly sandy, angular to subangular, fine to coarse gravel.
						(0.70)	
13.50-13.58 13.50-13.58	TCR 76, SCR 57	RQD 41		25/50 CPT 25*/35 50/40 D28		13.50 (0.50)	Red blue grey, moderately weak to very weak, highly weathered SILTSTONE with some intervals of angular to subangular, medium to coarse gravels. Discontinuities are inclined at 25-30 degrees, planar to moderately rough.
14.00						14.00	Moderately strong to strong, dark red brown, moderately weathered, silty SANDSTONE with occasional bands of soft, red brown clay at 14.90m. Discontinuities are inclined 20 degrees, rough, planar and infilled/coated with soft clay.
	TCR 96, SCR 74	RQD 67	FI: 13.5			(2.00)	
15.50							
16.00	TCR 83, SCR 61	RQD 49	FI: NI			16.00 (0.47)	Moderately weak to very weak, dark red, highly weathered SILTSTONE.
16.47			FI: 3			16.47 (0.53)	Moderately strong to strong, grey red brown, silty SANDSTONE. Discontinuities inclined at 30 degrees with soft clay on surfaces.
17.00						17.00	
							Complete at 17.00m

Remarks
Chiselling from 13.10m to 13.50m for 1.00 hour.

Scale (approx)	Logged By
1:50	GP

Figure No. 40274.BH17

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Figure A2.2

Window Sample Hole Records

IAN FARMER ASSOCIATES

Site	Warren Hall Site - Broughton		**Number**	**WS01**
Excavation Method Drive-in Window Sampler	**Dimensions**	**Ground Level (mOD)**	**Client** Welsh Assembly Government	**Job Number** 40274
	Location	**Dates** 17/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
0.00	D1				(0.20)	Grass over TOPSOIL (driller's description).
					0.20	Red brown, very clayey SAND with pockets of light grey silt.
0.50	D2					
					(1.10)	
1.00	D3					
					1.30	
					(0.30)	Stiff, red brown, gravelly CLAY with partings of light grey blue silt. Gravel is angular to subangular, fine and medium including mudstone.
1.50	D4				1.60	Dark red grey brown, very silty SAND.
2.00	D5				(1.00)	
					2.60	
					(0.20)	Firm, red brown, sandy CLAY with partings of grey silt and occasional fine gravel of coal.
2.70	D6				2.80	Red brown, clayey, fine SAND (wet).
3.00	D7					
					(2.20)	
4.00	D8					
4.50	D9					Below 4.50m: very clayey.
					5.00	
5.00	D10					Complete at 5.00m

Remarks
Excavating from 0.00m to 1.00m for 1.00 hour.

Scale (approx)	Logged By
1:50	MV

Figure No. 40274.WS01

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IAN FARMER ASSOCIATES

Site	Number
Warren Hall Site - Broughton	**WS02**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler			Welsh Assembly Government	40274
	Location	**Dates** 16/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Soft, dark brown, clayey, sandy TOPSOIL with rootlets.		
0.20	D1				0.30	Soft, dark brown, sandy CLAY.		
0.50	J2				(0.70)			
0.70	D3							
1.00	D4				1.00	Firm, red brown, sandy CLAY with bands of silt. Occasional rootlets.		
					(1.00)			
1.80-2.00	D5							
					2.00	Dark grey brown, clayey, fine SAND with occasional fine gravel of coal.		
2.50	D6							
					(1.50)			
3.00	D7					At 3.00m: very clayey.		
3.10-3.30	D8							
					3.50	Firm, red brown, gravelly CLAY. Gravel is subangular to angular, fine and medium including mudstone and siltstone.		
3.80-4.00	D9							
					(2.30)			
5.00	D10							
5.80	D11				5.80	At 5.80m: veined grey.		
						Complete at 5.80m		

Remarks
Water level at ground level during drilling.
Window sample hole terminated at 5.80m due to obstruction.
Excavating from 0.00m to 1.00m for 1.00 hour.

Scale (approx)	Logged By
1:50	MV

Figure No. 40274.WS02

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IAN FARMER ASSOCIATES

Site	Number
Warren Hall Site - Broughton	**WS03**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		17/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Soft, dark brown, clayey, sandy TOPSOIL with rootlets.		
0.20	D1				0.30			
					(0.70)	Soft, brown, sandy, gravelly CLAY. Gravel is subangular to angular, medium to coarse including sandstone and siltstone.		
0.70	D2				1.00			
						Complete at 3.00m		

Remarks	Scale (approx)	Logged By
Excavating from 0.00m to 1.20m for 1.00 hour.	1:50	
	Figure No. 40274.WS03	

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			Site: Warren Hall Site - Broughton		Number: **WS04**
Excavation Method: Drive-in Window Sampler	Dimensions	Ground Level (mOD)	Client: Welsh Assembly Government		Job Number: 40274
	Location	Dates: 18/01/2008	Engineer: Opus International Consultants (UK) Ltd		Sheet: 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30) 0.30	Grass over brown, clayey, sandy, slightly gravelly TOPSOIL. Gravel is subangular to subrounded, fine and medium of sandstone.		
0.20	J2							
0.20	D1							
0.30	J4							
0.30	D3							
					(1.30)	Firm, mottled orange grey brown, sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine and medium including sandstone, siltstone and quartz. Below 0.60m: mottled red brown grey, slightly sandy.		
1.30	J6							
1.30	D5				1.60			
1.60	D7				(0.40) 2.00	Orange brown, very clayey SAND.		
					(0.70) 2.70	Red brown, slightly clayey SAND.		
2.30	D8							
2.80	D9				(0.70) 3.40	Soft, dark brown, slightly sandy CLAY.		
3.50	D10				(1.30) 4.70	Firm, light grey blue, mottled red orange brown, slightly sandy, gravelly CLAY with pockets of silt. Gravel is subangular to angular, fine and medium of siltstone. Below 4.10m: dark grey blue.		
4.00	D11							
4.30	D12							
4.70-4.80	D13				(0.30) 5.00	Yellow brown, mottled blue grey SILTSTONE, highly weathered, recovered as stiff, slightly gravelly clay.		
						Complete at 5.00m		

Remarks
Excavating from 0.00m to 1.00m for 1.00 hour.

Scale (approx)	Logged By
1:50	MV

Figure No. 40274.WS04

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IAN FARMER ASSOCIATES

Site	Number
Warren Hall Site - Broughton	**WS05**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		18/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Grass over soft, dark brown, clayey, sandy TOPSOIL with rootlets.		
0.20	D1				0.30	Soft, brown, sandy CLAY.		
0.50	J2				(0.70)			
0.70	D3							
1.00-1.20	D4				1.00 (0.20) 1.20	Soft, light blue grey brown, sandy, gravelly CLAY with some plant material. Gravel is subangular to angular, fine to coarse of sandstone.		
1.50-1.60	D5					Firm, light blue grey, mottled red yellow brown CLAY with partings and fissures of light blue silt.		
2.00	D6					At 2.00m: with pockets of dark grey blue silt and some plant material.		
2.50	D7				(2.70)	Below 2.50m: slightly gravelly, angular to subrounded, fine to coarse of weathered siltstone.		
3.00	D8							
3.50	D9							
3.80-3.90	D10				3.90			
					(0.10) 4.00	Blue grey MUDSTONE, highly weathered, recovered as angular to subangular, medium to coarse gravel.		
						Complete at 4.00m		

Remarks
Water lever at ground lever during drilling.
Excavating from 0.00m to 1.00m for 100 hours.

Scale (approx)	Logged By
1:50	MV

Figure No. 40274.WS05

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IAN FARMER ASSOCIATES

Site	Number
Warren Hall Site - Broughton	**WS06**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		18/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Soft, dark brown, clayey, sandy TOPSOIL with rootlets.		
0.20	D1				0.30			
					(0.70)	Soft, brown, sandy, gravelly CLAY. Gravel is subangular to angular, fine to coarse including sandstone and siltstone.		
0.70	D2							
					1.00			
					(0.20)	Stiff, red brown, sandy CLAY with thin partings and veins of dark blue grey silt and occasional fine gravel of coal.		
					1.20			
						Stiff, red brown, slightly sandy, gravelly CLAY with partings and pockets of grey silt. Gravel is subangular to rounded, fine to coarse including sandstone and quartz.		
1.50	D3							
2.00	D4				(1.60)			
2.50	D5					Below 2.50m: dark grey brown.		
2.80	D6				2.80			
					(0.00)	Dark grey black SILTSTONE, recovered as stiff, sandy, gravelly clay with partings and pockets of orange yellow brown silt. Gravel is subangular to angular, medium to coarse.		
					2.80			
						Complete at 2.90m		

Remarks	Scale (approx)	Logged By
Excavating from 0.00m to 1.00m for 1.00 hour.	1:50	MV
	Figure No.	
	40274.WS06	

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Site	Number
Warren Hall Site - Broughton	WS07

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler			Welsh Assembly Government	40274
	Location	**Dates** 14/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30) 0.30	Soft, dark brown, clayey, sandy TOPSOIL with rootlets.		
0.50	J1				(0.70) 1.00	Soft, dark sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse including sandstone and siltstone.		
1.50	D2					MADE GROUND: Firm, dark red brown, mottled grey, sandy, gravelly CLAY with bands of silt. Gravel is angular to subangular, fine to coarse including sandstone, mudstone, siltstone and some coal.		
2.00	D3				(1.90)			
2.50	D4							
2.75	D5				2.90	Below 2.75m: stiff.		
						Complete at 2.90m		

Remarks
Water level at 0.70m during drilling.
Window sample terminated at 2.90m due to obstruction.
Excavating from 0.00m to 1.00m for 1.00 hour.

Scale (approx)	Logged By
1:50	MV

Figure No. 40274.WS07

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Site	Number
Warren Hall Site - Broughton	WS08

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler			Welsh Assembly Government	40274
	Location	**Dates** 15/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Soft, dark brown, clayey, sandy TOPSOIL with rootlets.		
0.20	D1				0.30			
0.50	J2					Soft, brown, sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse including sandstone and siltstone.		
					(0.70)			
0.70	D3							
1.00-1.10	D4				1.00	Firm, grey brown, sandy, gravelly CLAY with some bands of silt and some cobbles of sandstone. Gravel is subangular to subrounded, medium to coarse including sandstone and mudstone.		
1.40-1.50	D5							
					(2.00)			
2.00	D6							
2.50	D7					Below 2.50m: sandy clay with partings of silt.		
3.00	D8				3.00	Red brown, slightly clayey, fine SAND.		
					(1.00)			
3.50-3.60	D9					below 3.50m: with bands of clay.		
4.00	D10				4.00	Stiff, red brown, gravelly CLAY. Gravel is subangular, medium to coarse of mudstone.		
					(1.00)			
5.00	D11				5.00			
						Complete at 5.00m		

Remarks
Water level at 0.30m during drilling.
Excavating from 0.00m to 1.00m for 1.00 hour.

Scale (approx)	Logged By
1:50	MV

Figure No. 40274.WS08

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Site	Number
Warren Hall Site - Broughton	**WS09**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		16/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Soft, dark brown, clayey, sandy TOPSOIL with rootlets.		
0.20	D1				0.30			
0.50	J2				(0.70)	Soft, brown, sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse including sandstone and siltstone.		
0.70	D3							
1.00	D4				1.00	Firm, dark red brown, sandy, gravelly CLAY with partings light blue grey silt. Gravel is angular to subangular, fine and medium of sandstone and coal. At 1.00m: occasional rootlets.		
1.50	D5							
2.00	D6				(2.00)			
2.50	D7							
3.00	D8				3.00	Weathered SANDSTONE (driller's description).		
					(0.30)			
					3.30			
						Complete at 3.30m		

Remarks	Scale (approx)	Logged By
Water level at ground level during drilling. Excavating from 0.00m to 1.00m for 1.00 hour.	1:50	MV
	Figure No. 40274.WS09	

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Site Warren Hall Site - Broughton				**Number** WS10
Excavation Method Drive-in Window Sampler	**Dimensions**	**Ground Level (mOD)**	**Client** Welsh Assembly Government	**Job Number** 40274
	Location	**Dates** 15/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30) 0.30	MADE GROUND: Soft, dark brown, clayey, sandy TOPSOIL with rootlets.		
0.20	D1							
0.50	J2				(0.70) 1.00	MADE GROUND: Soft, brown, sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse including sandstone and siltstone.		
0.70	D3							
1.00	D4				(0.20) 1.20	MADE GROUND: Brown, sandy, gravelly SILT with occasional pockets of clay. Gravel is angular to subrounded, fine to coarse including sandstone and mudstone.		
1.50	D5				(1.30) 2.50	MADE GROUND: Firm, mottled grey brown, slightly sandy, gravelly CLAY with occasional pockets of silt and some lenses of fine sand. Gravel is subangular to subrounded, fine to coarse including mudstone, siltstone, sandstone and brick.		
2.20	D6							
2.70	D7				(0.50) 3.00	MADE GROUND: Stiff, orange brown, sandy, slightly gravelly CLAY. Gravel is angular to subrounded, fine and medium including sandstone, mudstone, siltstone and coal.		
3.20	D8				(3.00) 6.00	MADE GROUND: Firm, mottled grey brown, very sandy, slightly gravelly CLAY with some plant material. Gravel is subangular to subrounded, fine to coarse including sandstone and mudstone. Organic odour noted. Driller noted saturated bands of sand.		
3.70	D9							
4.50	D10							
5.20	D11							
5.70	D12							
						Complete at 6.00m		

Remarks
Water level at ground level during drilling.
Excavating from 0.00m to 1.00m for 1.00 hour.

Scale (approx) 1:50	**Logged By** TB
Figure No. 40274.WS10	

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Site	Number
Warren Hall Site - Broughton	**WS11**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		14/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	MADE GROUND: Soft, dark brown, clayey, sandy TOPSOIL with rootlets.		
0.20	D1				0.30			
0.50	J2				(0.70)	MADE GROUND: Soft, brown, sandy, slightly gravelly CLAY. Gravel is subangular to angular, medium to coarse including sandstone and siltstone.		
0.70	D3							
1.00-1.10	D4				1.00			
1.50-1.60	D5				(1.00)	MADE GROUND: Firm, dark red brown, grey brown, gravelly CLAY with partings of silt. Gravel is subangular to subrounded, fine to coarse including mudstone and sandstone.		
					2.00			
						Complete at 2.80m		

Remarks
Water level at 0.50m during drilling.
Window sample hole terminated at 2.80m due to obstruction.
Excavating from 0.00m to 1.00m for 1.00 hour.

Scale (approx)	Logged By
1:50	MV

Figure No. 40274.WS11

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Excavation Method	Dimensions	Ground Level (mOD)	Site	Number
Drive-in Window Sampler			Warren Hall Site - Broughton	WS12
			Client Welsh Assembly Government	**Job Number** 40274
	Location	**Dates** 14/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	MADE GROUND: Soft, dark brown, clayey, sandy TOPSOIL with rootlets.		
0.20	D1				0.30			
0.50	J2				(0.70)	MADE GROUND: Soft, brown, sandy, slightly gravelly CLAY. Gravel is angular, medium to coarse including sandstone and siltstone. Below 0.70m: with some cobbles.		
0.70	D3							
1.00	D4				1.00			
					(0.50)	MADE GROUND: Soft, dark grey brown, sandy, gravelly CLAY with partings of dark grey silt. Gravel is subangular to subrounded, medium to coarse including sandstone and fragments of brick.		
1.50	D5				1.50			
2.00	D6				(0.90)	Firm becoming stiff, dark red brown, veined grey, sandy, gravelly CLAY. Gravel is subangular to subrounded, medium to coarse including sandstone. Occasional rootlets.		
2.40	D7				2.40			
						Complete at 2.40m		

Remarks
Water level at 0.30m during drilling.
Window sample hole terminated at 2.40m due to obstruction (possible boulders).
Excavating from 0.00m to 1.00m for 1.00 hour.

Scale (approx)	Logged By
1:50	MV

Figure No. 40274.WS12

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Site	Number
Warren Hall Site - Broughton	**WS13**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		14/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
					(0.30)	MADE GROUND: Soft, dark brown, clayey, sandy TOPSOIL with rootlets.
0.20	D1				0.30	
0.50	J2				(0.70)	MADE GROUND: Soft, brown, sandy, gravelly CLAY. Gravel is subangular to angular, medium to coarse including sandstone and siltstone.
0.70	D3					
1.00-1.10	D4				1.00	MADE GROUND: Stiff, dark red brown, sandy, gravelly CLAY with thin partings and laminations of grey silt. Gravel is angular to subangular, fine to coarse including sandstone and coal.
1.50-1.60	D5					
1.80	D6					
					(2.40)	
2.30	D7					
2.80	D8					
3.30	D10					
3.30	D9				3.40	
					(0.30)	Stiff, grey red brown CLAY (possible weathered sandstone).
					3.70	
3.70	D11					
						Complete at 3.70m

Remarks
Water level at 0.50m during drilling.
Window sample hole terminated at 3.70m due to obstruction (possible rockhead).
Excavating from 0.00m to 1.00m for 1.00 hour.

Scale (approx)	Logged By
1:50	MV

Figure No. 40274.WS13

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			Site Warren Hall Site - Broughton	**Number** **WS14**
Excavation Method Drive-in Window Sampler	**Dimensions**	**Ground Level (mOD)**	**Client** Welsh Assembly Government	**Job Number** 40274
	Location	**Dates** 17/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Soft, dark brown, clayey, sandy TOPSOIL with rootlets.		
0.20	D1				0.30			
					(0.70)	Soft, brown, sandy, slightly gravelly CLAY. Gravel is subangular to angular, medium to coarse including sandstone and siltstone.		
0.70	D2				1.00			
						Complete at 2.40m		

Remarks Excavating from 0.00m to 1.20m for 1.00 hour.	**Scale (approx)** 1:50	**Logged By**
	Figure No. 40274.WS14	

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			Site Warren Hall Site - Broughton	**Number** **WS15**
Excavation Method Drive-in Window Sampler	**Dimensions**	**Ground Level (mOD)**	**Client** Welsh Assembly Government	**Job Number** 40274
	Location	**Dates** 16/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30) 0.30	Grass over MADE GROUND: Topsoil (driller's description).		
0.50 0.50 1.00 1.50	J1 D2 D3 D4				(1.70) 2.00	MADE GROUND: Firm, red grey brown, sandy, gravelly CLAY with occasional cobbles of sandstone and bands of light grey silt. Gravel is subangular to angular, medium to coarse including sandstone and fragments of brick and coal. Occasional rootlets.		
2.00 3.00 3.90	D5 D6 D7				(1.90) 3.90	MADE GROUND: Firm, red grey brown, sandy, gravelly CLAY with bands of light grey silt. Gravel is angular to subangular, fine to coarse including sandstone and coal. At 3.00m: organic odour noted.		
						Complete at 3.90m		

Remarks Window sample hole terminated at 3.90m due to obstruction. Excavating from 0.00m to 1.00m for 1.00 hour.	**Scale (approx)** 1:50	**Logged By** MV
	Figure No. 40274.WS15	

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Site	Number
Warren Hall Site - Broughton	WS16

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		17/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.30	J2					Grass over MADE GROUND: Stiff, dark grey red brown, sandy, gravelly CLAY with pockets and partings of dark grey silt. Gravel is angular to subangular, fine to coarse including mudstone, quartz, coal and brick.		
0.30	D1				(1.00)			
0.80	D3							
1.00	D4				1.00 (0.20) 1.20	Red orange brown, very clayey, gravelly SAND. Gravel is subangular to angular, fine and medium of sandstone.		
1.50	D5					Firm, red brown, sandy, gravelly CLAY. Gravel is subangular to angular, fine and medium including sandstone and siltstone.		
1.60	D6				(1.00)	Below 1.50m: soft.		
					2.20 (0.30) 2.50	Light grey, red brown SILTSTONE.		
2.50	D7							
						Complete at 2.50m		

Remarks	Scale (approx)	Logged By
Window sample hole terminated at 2.50m due to obstruction (possible rockhead). Excavating from 0.00m to 1.00m for 1.00 hour.	1:50	MV
	Figure No. 40274.WS16	

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Site	Number
Warren Hall Site - Broughton	WS17

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		18/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.20	D1				(0.30) 0.30	Grass over soft, dark brown, clayey, sandy TOPSOIL with rootlets.		
0.70	D2				(0.70) 1.00	Soft, brown, sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse including sandstone and siltstone.		
1.00	D3							
1.30	J4							
1.50	D5				(1.00) 2.00	Stiff, dark red brown, sandy, gravelly CLAY with partings of light grey silt. Gravel is subrounded to rounded, fine to coarse including siltstone and coal.		
2.00	D6				(0.40) 2.40	Dark grey to black SILTSTONE, recovered as stiff, sandy, gravelly clay.		
2.40	D7							
						Complete at 2.40m		

Remarks
Window sample hole terminated at 2.40m due to obstruction.
Excavating from 0.00m to 1.00m for 1.00 hour.

Scale (approx)	Logged By
1:50	MV

Figure No. 40274.WS17

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Excavation Method	Dimensions	Ground Level (mOD)	Site	Number
Drive-in Window Sampler			Warren Hall Site - Broughton	WS18
			Client	**Job Number**
			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		18/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Soft, dark brown, clayey, sandy TOPSOIL with rootlets.		
0.20	D1				0.30			
					(0.70)	Soft, brown, sandy CLAY.		
0.70	D2							
					1.00			
						Complete at 2.00m		

Remarks
Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
1:50	

Figure No.
40274.WS18

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Figure A2.3

Dynamic Probe Hole Records

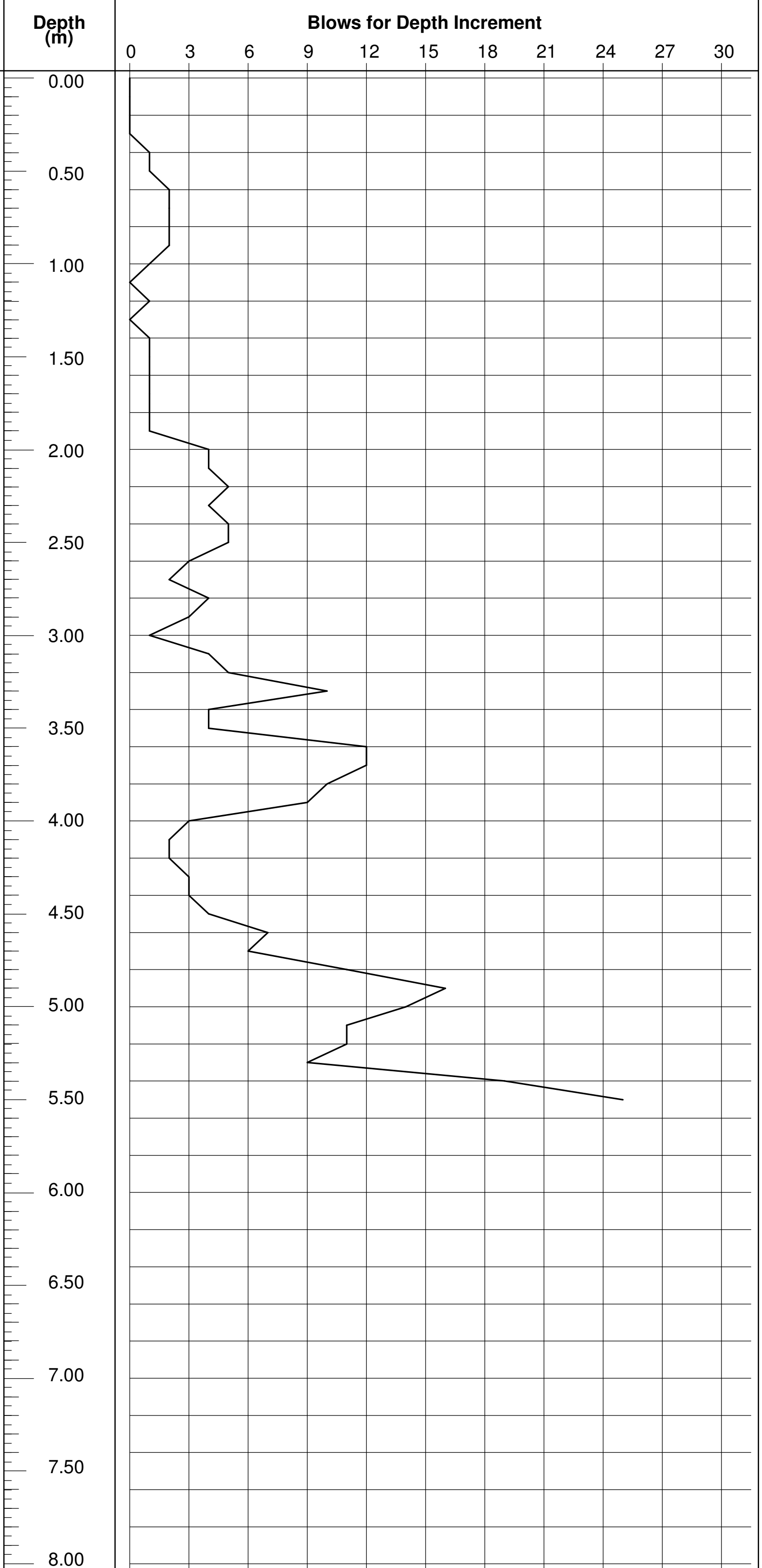
IAN FARMER ASSOCIATES

Site	Probe Number
Warren Hall Site - Broughton	DP01

Method	Cone Dimensions	Ground Level (mOD)	Client	Job Number
Dynamic Probe			Welsh Assembly Government	40274

Location	Dates	Engineer	Sheet
	17/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	0		
0.10-0.20	0		
0.20-0.30	0		
0.30-0.40	0		
0.40-0.50	1		
0.50-0.60	1		
0.60-0.70	2		
0.70-0.80	2		
0.80-0.90	2		
0.90-1.00	2		
1.00-1.10	1		
1.10-1.20	0		
1.20-1.30	1		
1.30-1.40	0		
1.40-1.50	1		
1.50-1.60	1		
1.60-1.70	1		
1.70-1.80	1		
1.80-1.90	1		
1.90-2.00	1		
2.00-2.10	4		
2.10-2.20	4		
2.20-2.30	5		
2.30-2.40	4		
2.40-2.50	5		
2.50-2.60	5		
2.60-2.70	3		
2.70-2.80	2		
2.80-2.90	4		
2.90-3.00	3		
3.00-3.10	1		
3.10-3.20	4		
3.20-3.30	5		
3.30-3.40	10		
3.40-3.50	4		
3.50-3.60	4		
3.60-3.70	12		
3.70-3.80	12		
3.80-3.90	10		
3.90-4.00	9		
4.00-4.10	3		
4.10-4.20	2		
4.20-4.30	2		
4.30-4.40	3		
4.40-4.50	3		
4.50-4.60	4		
4.60-4.70	7		
4.70-4.80	6		
4.80-4.90	11		
4.90-5.00	16		
5.00-5.10	14		
5.10-5.20	11		
5.20-5.30	11		
5.30-5.40	9		
5.40-5.50	19		
5.50-5.60	25		



Remarks	Scale (approx)	Logged By
	1:40	n/a

Figure No. 40274.DP01

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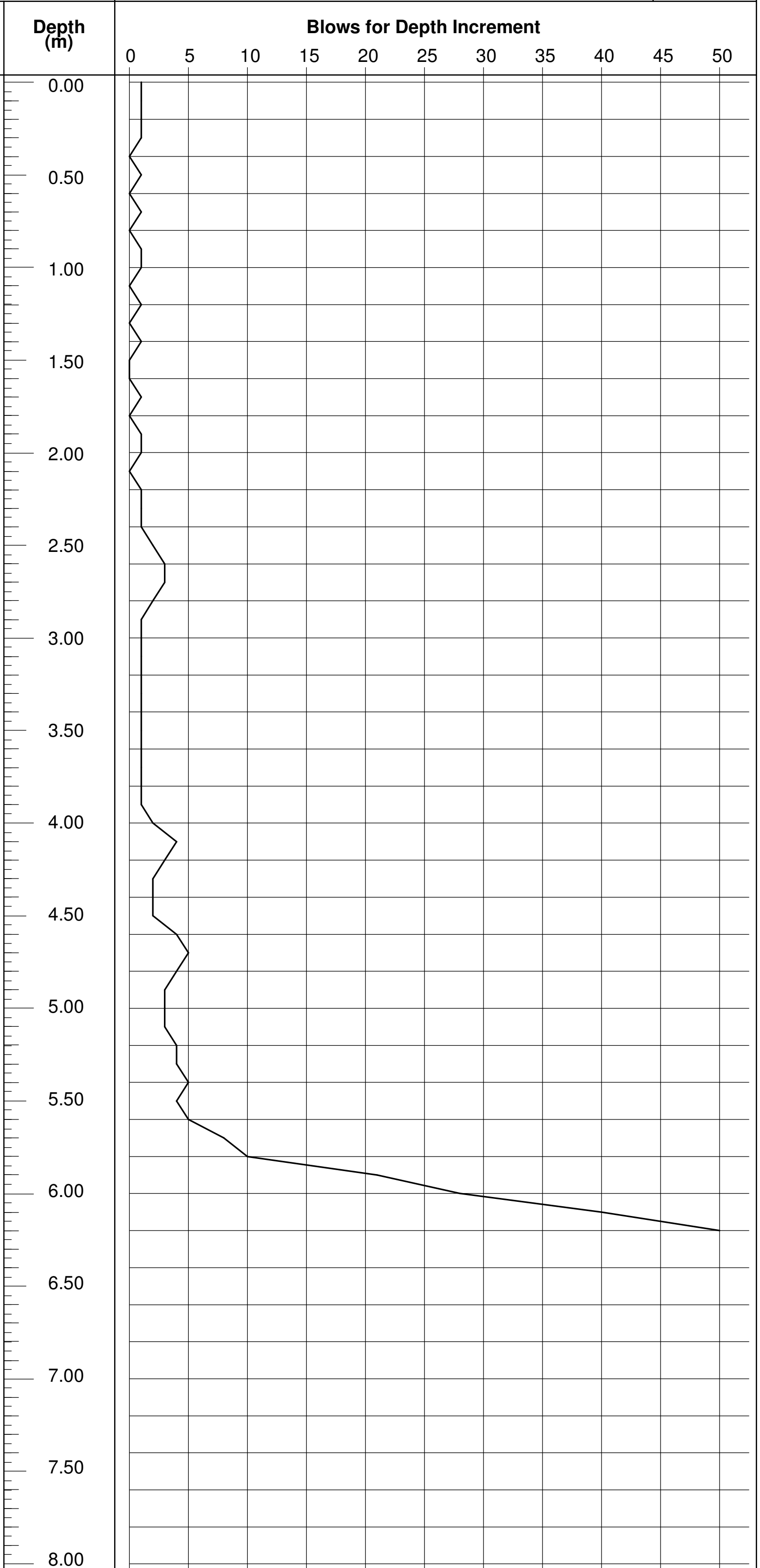
Site Warren Hall Site - Broughton				**Probe Number** DP02
Method Dynamic Probe	**Cone Dimensions**	**Ground Level (mOD)**	**Client** Welsh Assembly Government	**Job Number** 40274
	Location	**Dates** 16/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	1		
0.10-0.20	1		
0.20-0.30	1		
0.30-0.40	1		
0.40-0.50	0		
0.50-0.60	1		
0.60-0.70	0		
0.70-0.80	1		
0.80-0.90	0		
0.90-1.00	1		
1.00-1.10	1		
1.10-1.20	0		
1.20-1.30	1		
1.30-1.40	0		
1.40-1.50	1		
1.50-1.60	0		
1.60-1.70	0		
1.70-1.80	1		
1.80-1.90	0		
1.90-2.00	1		
2.00-2.10	1		
2.10-2.20	0		
2.20-2.30	1		
2.30-2.40	1		
2.40-2.50	1		
2.50-2.60	2		
2.60-2.70	3		
2.70-2.80	3		
2.80-2.90	2		
2.90-3.00	1		
3.00-3.10	1		
3.10-3.20	1		
3.20-3.30	1		
3.30-3.40	1		
3.40-3.50	1		
3.50-3.60	1		
3.60-3.70	1		
3.70-3.80	1		
3.80-3.90	1		
3.90-4.00	1		
4.00-4.10	2		
4.10-4.20	4		
4.20-4.30	3		
4.30-4.40	2		
4.40-4.50	2		
4.50-4.60	2		
4.60-4.70	4		
4.70-4.80	5		
4.80-4.90	4		
4.90-5.00	3		
5.00-5.10	3		
5.10-5.20	3		
5.20-5.30	4		
5.30-5.40	4		
5.40-5.50	5		
5.50-5.60	4		
5.60-5.70	5		
5.70-5.80	8		
5.80-5.90	10		
5.90-6.00	21		
6.00-6.10	28		
6.10-6.20	40		
6.20-6.22	50		



Remarks	**Scale (approx)** 1:40	**Logged By** n/a
	Figure No. 40274.DP02	

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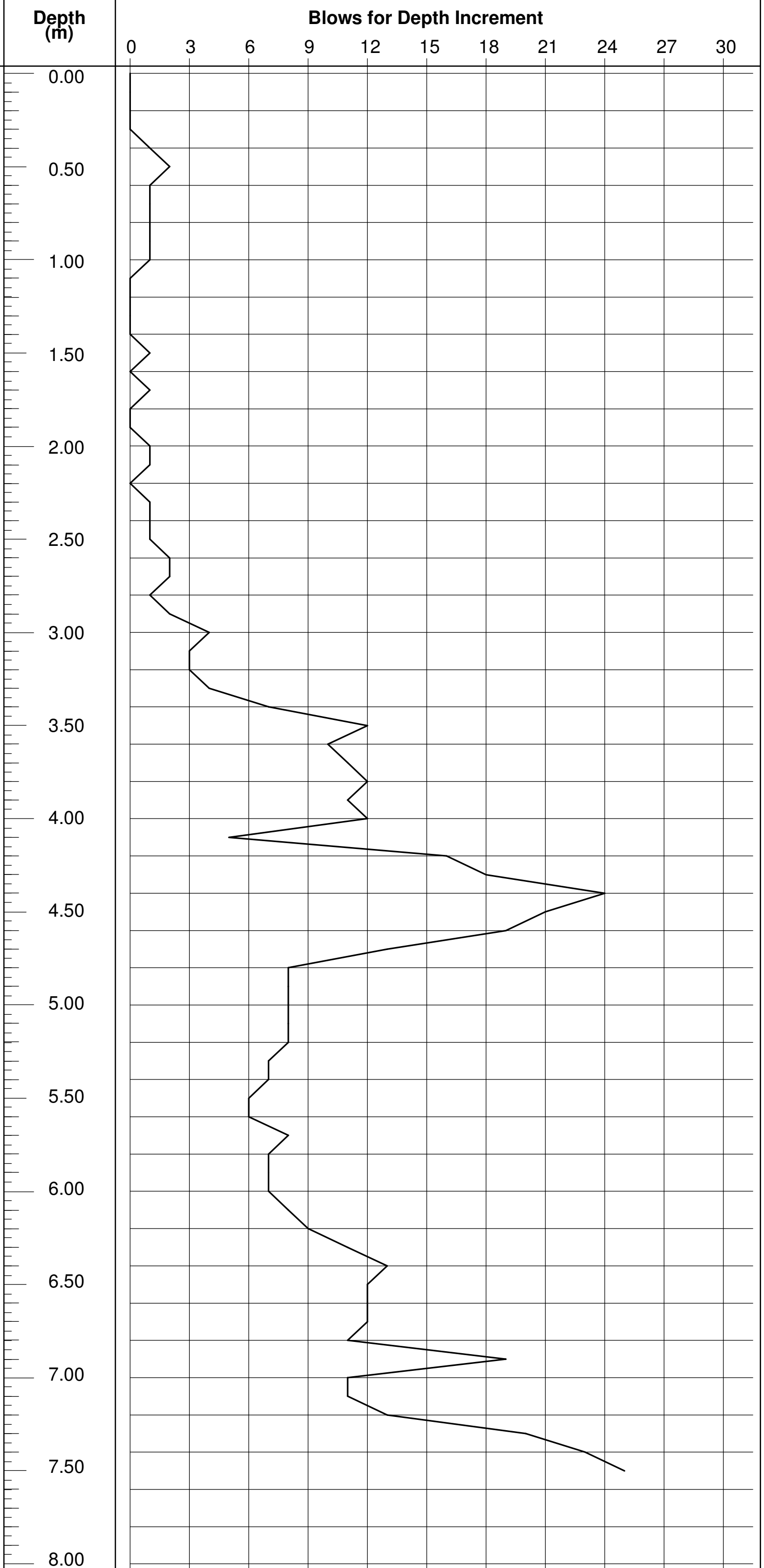
IAN FARMER ASSOCIATES

Site	Probe Number
Warren Hall Site - Broughton	DP03

Method	Cone Dimensions	Ground Level (mOD)	Client	Job Number
Dynamic Probe			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		17/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	0		
0.10-0.20	0		
0.20-0.30	0		
0.30-0.40	0		
0.40-0.50	1		
0.50-0.60	2		
0.60-0.70	1		
0.70-0.80	1		
0.80-0.90	1		
0.90-1.00	1		
1.00-1.10	1		
1.10-1.20	0		
1.20-1.30	0		
1.30-1.40	0		
1.40-1.50	0		
1.50-1.60	1		
1.60-1.70	0		
1.70-1.80	1		
1.80-1.90	0		
1.90-2.00	0		
2.00-2.10	1		
2.10-2.20	1		
2.20-2.30	0		
2.30-2.40	1		
2.40-2.50	1		
2.50-2.60	1		
2.60-2.70	2		
2.70-2.80	2		
2.80-2.90	1		
2.90-3.00	2		
3.00-3.10	4		
3.10-3.20	3		
3.20-3.30	3		
3.30-3.40	4		
3.40-3.50	7		
3.50-3.60	12		
3.60-3.70	10		
3.70-3.80	11		
3.80-3.90	12		
3.90-4.00	11		
4.00-4.10	12		
4.10-4.20	5		
4.20-4.30	16		
4.30-4.40	18		
4.40-4.50	24		
4.50-4.60	21		
4.60-4.70	19		
4.70-4.80	13		
4.80-4.90	8		
4.90-5.00	8		
5.00-5.10	8		
5.10-5.20	8		
5.20-5.30	8		
5.30-5.40	7		
5.40-5.50	7		
5.50-5.60	6		
5.60-5.70	6		
5.70-5.80	8		
5.80-5.90	7		
5.90-6.00	7		
6.00-6.10	7		
6.10-6.20	8		
6.20-6.30	9		
6.30-6.40	11		
6.40-6.50	13		
6.50-6.60	12		
6.60-6.70	12		
6.70-6.80	12		
6.80-6.90	11		
6.90-7.00	19		
7.00-7.10	11		
7.10-7.20	11		
7.20-7.30	13		
7.30-7.40	20		
7.40-7.50	23		
7.50-7.60	25		



Remarks

Scale (approx)	Logged By
1:40	n/a

Figure No.
40274.DP03

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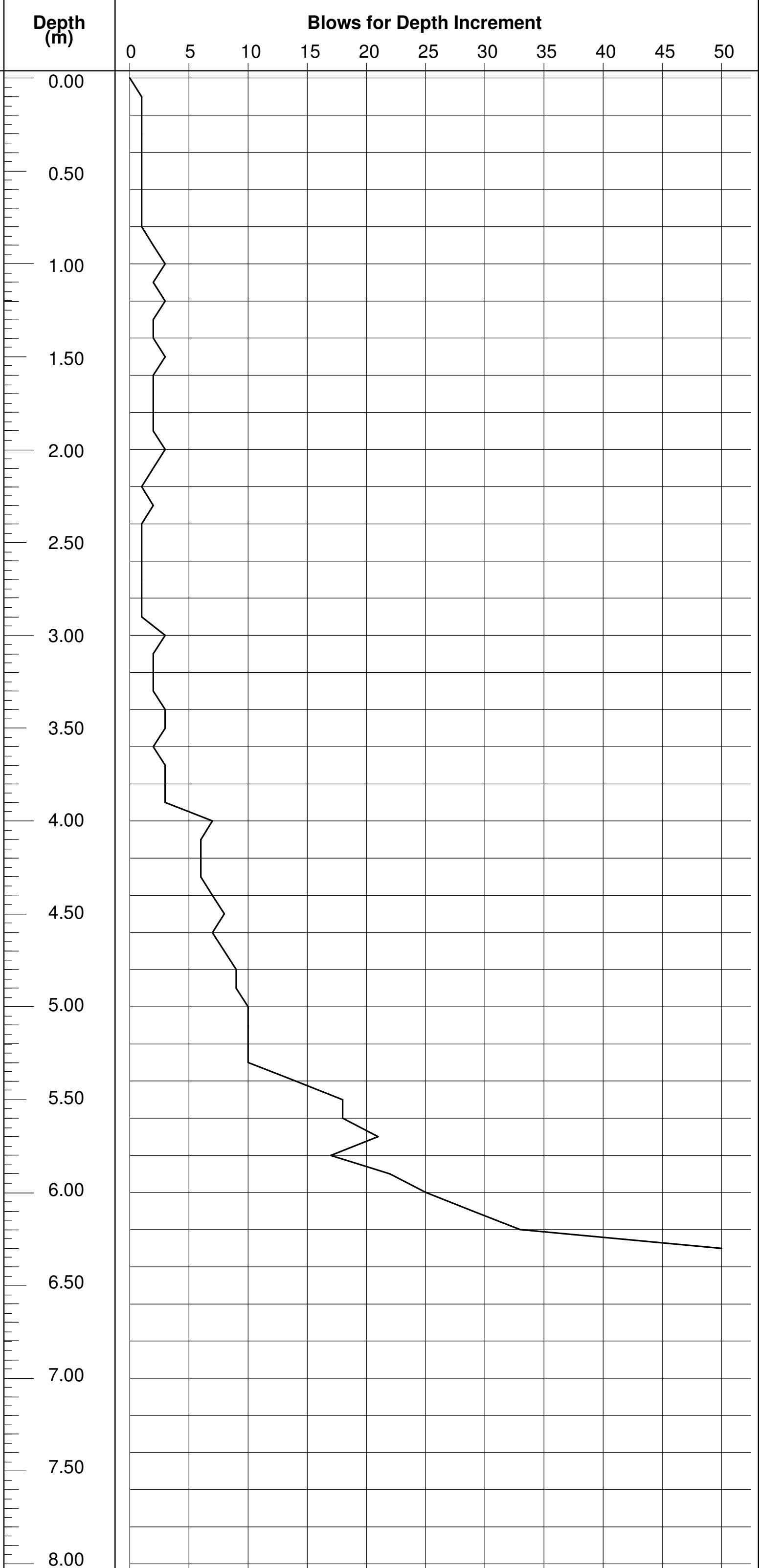
IAN FARMER ASSOCIATES

Site Warren Hall Site - Broughton				**Probe Number** DP04
Method Dynamic Probe	**Cone Dimensions**	**Ground Level (mOD)**	**Client** Welsh Assembly Government	**Job Number** 40274
	Location	**Dates** 18/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	0		
0.10-0.20	1		
0.20-0.30	1		
0.30-0.40	1		
0.40-0.50	1		
0.50-0.60	1		
0.60-0.70	1		
0.70-0.80	1		
0.80-0.90	1		
0.90-1.00	2		
1.00-1.10	3		
1.10-1.20	2		
1.20-1.30	3		
1.30-1.40	2		
1.40-1.50	2		
1.50-1.60	3		
1.60-1.70	2		
1.70-1.80	2		
1.80-1.90	2		
1.90-2.00	2		
2.00-2.10	3		
2.10-2.20	2		
2.20-2.30	1		
2.30-2.40	2		
2.40-2.50	1		
2.50-2.60	1		
2.60-2.70	1		
2.70-2.80	1		
2.80-2.90	1		
2.90-3.00	1		
3.00-3.10	3		
3.10-3.20	2		
3.20-3.30	2		
3.30-3.40	2		
3.40-3.50	3		
3.50-3.60	3		
3.60-3.70	2		
3.70-3.80	3		
3.80-3.90	3		
3.90-4.00	3		
4.00-4.10	7		
4.10-4.20	6		
4.20-4.30	6		
4.30-4.40	6		
4.40-4.50	7		
4.50-4.60	8		
4.60-4.70	7		
4.70-4.80	8		
4.80-4.90	9		
4.90-5.00	9		
5.00-5.10	10		
5.10-5.20	10		
5.20-5.30	10		
5.30-5.40	10		
5.40-5.50	14		
5.50-5.60	18		
5.60-5.70	18		
5.70-5.80	21		
5.80-5.90	17		
5.90-6.00	22		
6.00-6.10	25		
6.10-6.20	29		
6.20-6.30	33		
6.30-6.36	50		



Remarks	**Scale (approx)** 1:40	**Logged By** n/a
	Figure No. 40274.DP04	

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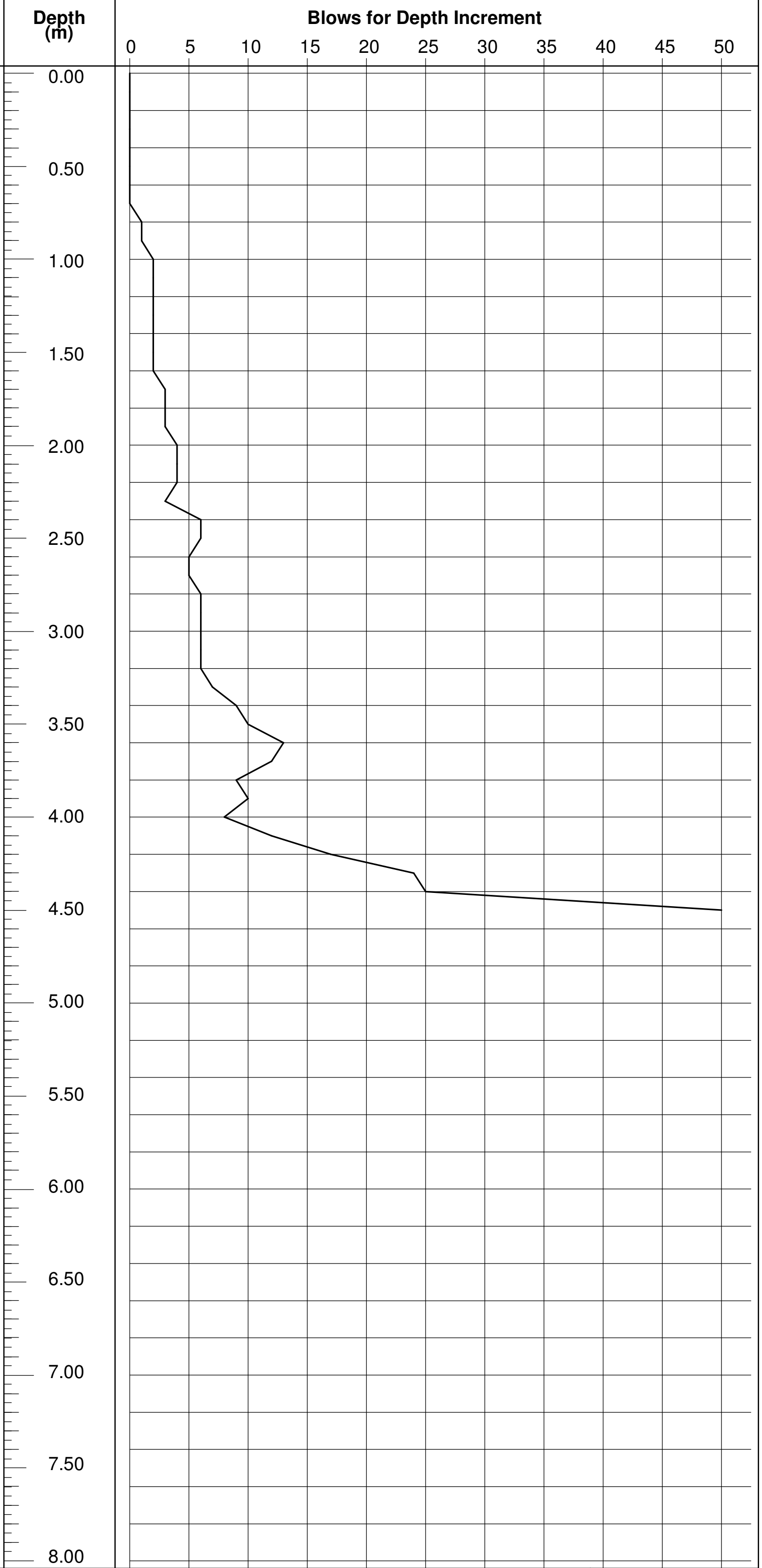
IAN FARMER ASSOCIATES

Site	Probe Number
Warren Hall Site - Broughton	DP05

Method	Cone Dimensions	Ground Level (mOD)	Client	Job Number
Dynamic Probe			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		18/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	0		
0.10-0.20	0		
0.20-0.30	0		
0.30-0.40	0		
0.40-0.50	0		
0.50-0.60	0		
0.60-0.70	0		
0.70-0.80	0		
0.80-0.90	1		
0.90-1.00	1		
1.00-1.10	2		
1.10-1.20	2		
1.20-1.30	2		
1.30-1.40	2		
1.40-1.50	2		
1.50-1.60	2		
1.60-1.70	2		
1.70-1.80	3		
1.80-1.90	3		
1.90-2.00	3		
2.00-2.10	4		
2.10-2.20	4		
2.20-2.30	4		
2.30-2.40	3		
2.40-2.50	6		
2.50-2.60	6		
2.60-2.70	5		
2.70-2.80	5		
2.80-2.90	6		
2.90-3.00	6		
3.00-3.10	6		
3.10-3.20	6		
3.20-3.30	6		
3.30-3.40	7		
3.40-3.50	9		
3.50-3.60	10		
3.60-3.70	13		
3.70-3.80	12		
3.80-3.90	9		
3.90-4.00	10		
4.00-4.10	8		
4.10-4.20	12		
4.20-4.30	17		
4.30-4.40	24		
4.40-4.50	25		
4.50-4.53	50		



Remarks	Scale (approx)	Logged By
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	Figure No.	
	40274.DP05	

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IAN FARMER ASSOCIATES

Site	Probe Number
Warren Hall Site - Broughton	DP06

Method	Cone Dimensions	Ground Level (mOD)	Client	Job Number
Dynamic Probe			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		18/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	0		
0.10-0.20	0		
0.20-0.30	0		
0.30-0.40	0		
0.40-0.50	0		
0.50-0.60	0		
0.60-0.70	1		
0.70-0.80	2		
0.80-0.90	3		
0.90-1.00	2		
1.00-1.10	3		
1.10-1.20	3		
1.20-1.30	2		
1.30-1.40	2		
1.40-1.50	2		
1.50-1.60	2		
1.60-1.70	3		
1.70-1.80	4		
1.80-1.90	5		
1.90-2.00	6		
2.00-2.10	6		
2.10-2.20	6		
2.20-2.30	7		
2.30-2.40	7		
2.40-2.50	10		
2.50-2.60	10		
2.60-2.70	10		
2.70-2.80	10		
2.80-2.90	9		
2.90-3.00	14		
3.00-3.10	15		
3.10-3.20	20		
3.20-3.30	18		
3.30-3.40	18		
3.40-3.50	25		

Remarks	Scale (approx)	Logged By
	1:40	n/a
	Figure No.	
	40274.DP06	

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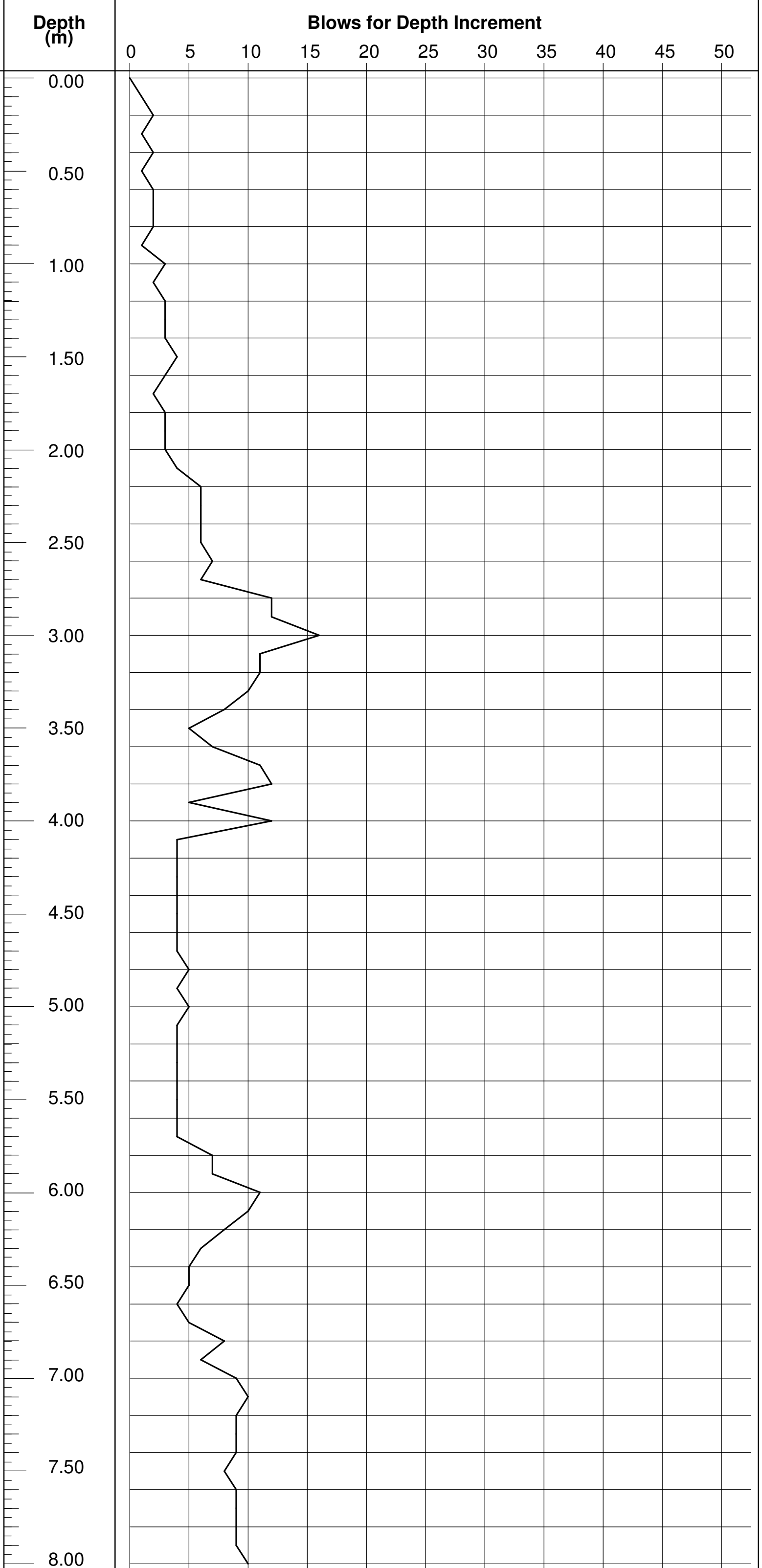
IAN FARMER ASSOCIATES			Site: Warren Hall Site - Broughton	Probe Number: **DP07**
Method Dynamic Probe	**Cone Dimensions**	**Ground Level (mOD)**	**Client** Welsh Assembly Government	**Job Number** 40274
	Location	**Dates** 14/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/2

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	0		
0.10-0.20	1		
0.20-0.30	2		
0.30-0.40	1		
0.40-0.50	2		
0.50-0.60	1		
0.60-0.70	2		
0.70-0.80	2		
0.80-0.90	2		
0.90-1.00	1		
1.00-1.10	3		
1.10-1.20	2		
1.20-1.30	3		
1.30-1.40	3		
1.40-1.50	3		
1.50-1.60	4		
1.60-1.70	3		
1.70-1.80	2		
1.80-1.90	3		
1.90-2.00	3		
2.00-2.10	3		
2.10-2.20	4		
2.20-2.30	6		
2.30-2.40	6		
2.40-2.50	6		
2.50-2.60	6		
2.60-2.70	7		
2.70-2.80	6		
2.80-2.90	12		
2.90-3.00	12		
3.00-3.10	16		
3.10-3.20	11		
3.20-3.30	11		
3.30-3.40	10		
3.40-3.50	8		
3.50-3.60	5		
3.60-3.70	7		
3.70-3.80	11		
3.80-3.90	12		
3.90-4.00	5		
4.00-4.10	12		
4.10-4.20	4		
4.20-4.30	4		
4.30-4.40	4		
4.40-4.50	4		
4.50-4.60	4		
4.60-4.70	4		
4.70-4.80	4		
4.80-4.90	5		
4.90-5.00	4		
5.00-5.10	5		
5.10-5.20	4		
5.20-5.30	4		
5.30-5.40	4		
5.40-5.50	4		
5.50-5.60	4		
5.60-5.70	4		
5.70-5.80	4		
5.80-5.90	7		
5.90-6.00	7		
6.00-6.10	11		
6.10-6.20	10		
6.20-6.30	8		
6.30-6.40	6		
6.40-6.50	5		
6.50-6.60	5		
6.60-6.70	4		
6.70-6.80	5		
6.80-6.90	8		
6.90-7.00	6		
7.00-7.10	9		
7.10-7.20	10		
7.20-7.30	9		
7.30-7.40	9		
7.40-7.50	9		
7.50-7.60	8		
7.60-7.70	9		
7.70-7.80	9		
7.80-7.90	9		
7.90-8.00	9		



Remarks	**Scale (approx)**	**Logged By**
	1:40	n/a
	Figure No. 40274.DP07	

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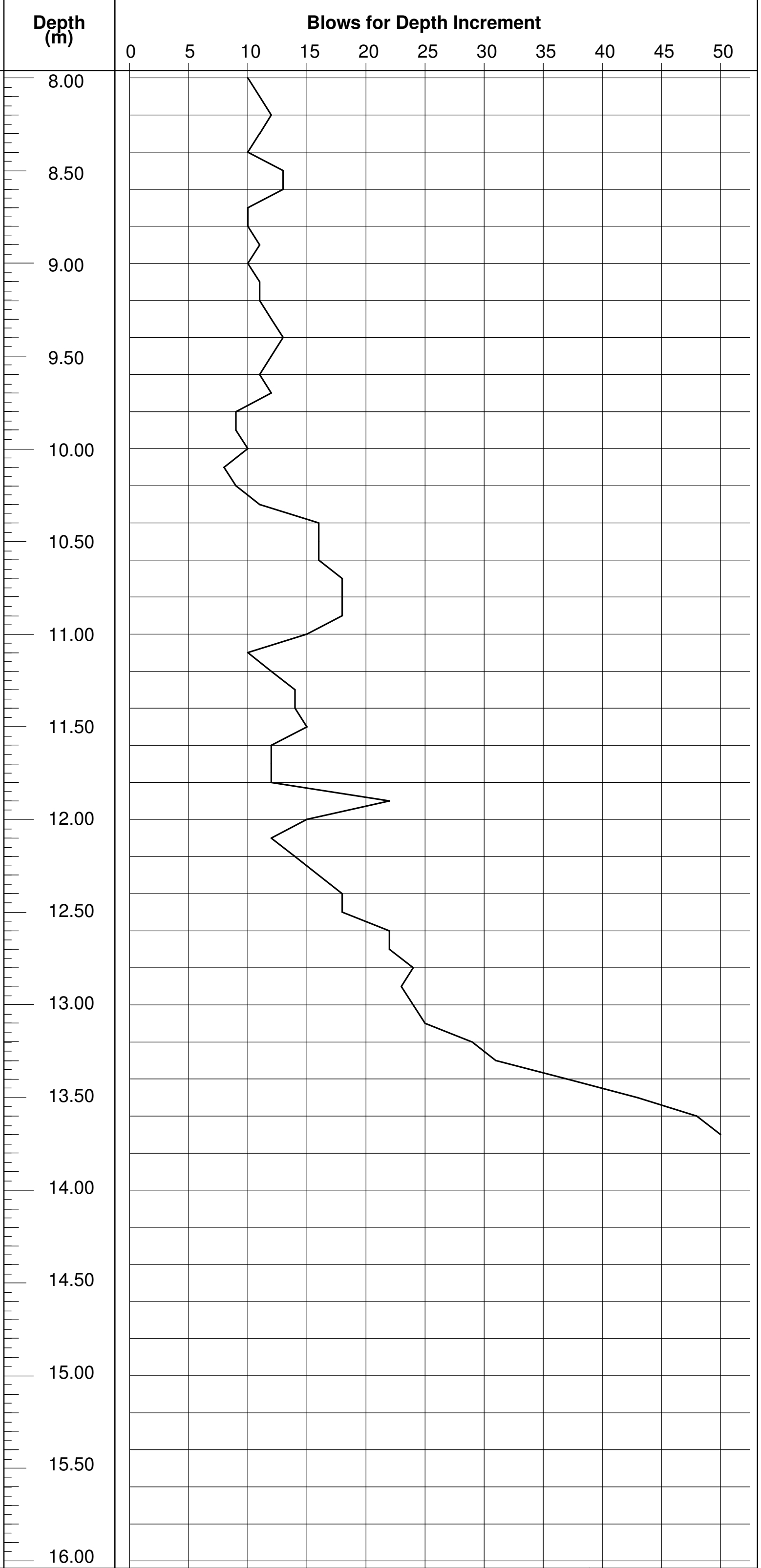
IAN FARMER ASSOCIATES

Site	Probe Number
Warren Hall Site - Broughton	DP07

Method	Cone Dimensions	Ground Level (mOD)	Client	Job Number
Dynamic Probe			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		14/01/2008	Opus International Consultants (UK) Ltd	2/2

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
8.00-8.10	10		
8.10-8.20	11		
8.20-8.30	12		
8.30-8.40	11		
8.40-8.50	10		
8.50-8.60	13		
8.60-8.70	13		
8.70-8.80	10		
8.80-8.90	10		
8.90-9.00	11		
9.00-9.10	10		
9.10-9.20	11		
9.20-9.30	11		
9.30-9.40	12		
9.40-9.50	13		
9.50-9.60	12		
9.60-9.70	11		
9.70-9.80	12		
9.80-9.90	9		
9.90-10.00	9		
10.00-10.10	10		
10.10-10.20	8		
10.20-10.30	9		
10.30-10.40	11		
10.40-10.50	16		
10.50-10.60	16		
10.60-10.70	16		
10.70-10.80	18		
10.80-10.90	18		
10.90-11.00	18		
11.00-11.10	15		
11.10-11.20	10		
11.20-11.30	12		
11.30-11.40	14		
11.40-11.50	14		
11.50-11.60	15		
11.60-11.70	12		
11.70-11.80	12		
11.80-11.90	12		
11.90-12.00	22		
12.00-12.10	15		
12.10-12.20	12		
12.20-12.30	14		
12.30-12.40	16		
12.40-12.50	18		
12.50-12.60	18		
12.60-12.70	22		
12.70-12.80	22		
12.80-12.90	24		
12.90-13.00	23		
13.00-13.10	24		
13.10-13.20	25		
13.20-13.30	29		
13.30-13.40	31		
13.40-13.50	37		
13.50-13.60	43		
13.60-13.70	48		
13.70-13.76	50		



Remarks	Scale (approx)	Logged By
	1:40	n/a
	Figure No.	
	40274.DP07	

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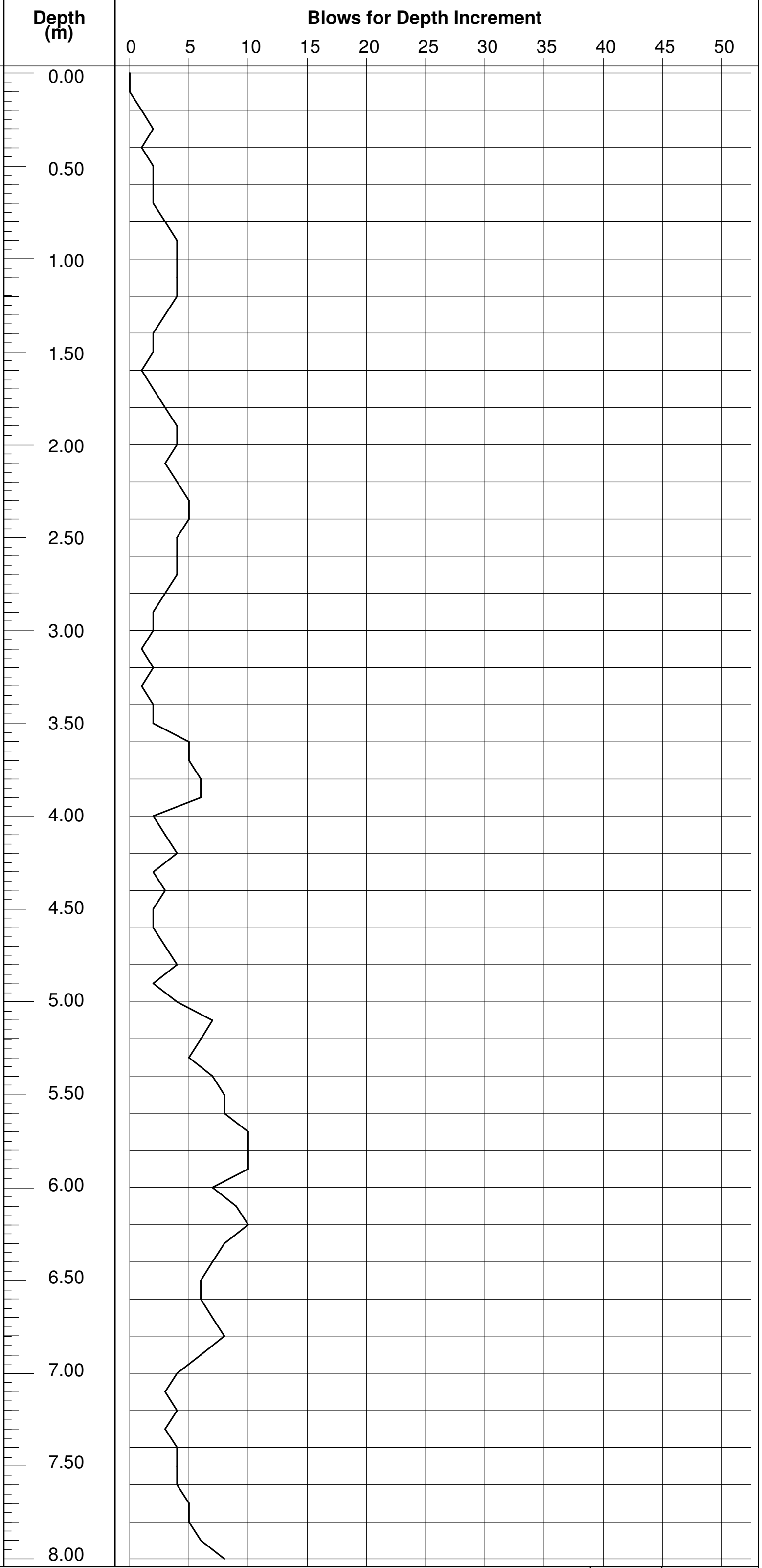
IAN FARMER ASSOCIATES

			Site Warren Hall Site - Broughton	**Probe Number** **DP08**
Method Dynamic Probe	**Cone Dimensions**	**Ground Level (mOD)**	**Client** Welsh Assembly Government	**Job Number** 40274
	Location	**Dates** 15/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/2

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	0		
0.10-0.20	0		
0.20-0.30	1		
0.30-0.40	2		
0.40-0.50	1		
0.50-0.60	2		
0.60-0.70	2		
0.70-0.80	2		
0.80-0.90	3		
0.90-1.00	4		
1.00-1.10	4		
1.10-1.20	4		
1.20-1.30	4		
1.30-1.40	3		
1.40-1.50	2		
1.50-1.60	2		
1.60-1.70	1		
1.70-1.80	2		
1.80-1.90	3		
1.90-2.00	4		
2.00-2.10	4		
2.10-2.20	3		
2.20-2.30	4		
2.30-2.40	5		
2.40-2.50	5		
2.50-2.60	4		
2.60-2.70	4		
2.70-2.80	4		
2.80-2.90	3		
2.90-3.00	2		
3.00-3.10	2		
3.10-3.20	1		
3.20-3.30	2		
3.30-3.40	1		
3.40-3.50	2		
3.50-3.60	2		
3.60-3.70	5		
3.70-3.80	5		
3.80-3.90	6		
3.90-4.00	6		
4.00-4.10	2		
4.10-4.20	3		
4.20-4.30	4		
4.30-4.40	2		
4.40-4.50	3		
4.50-4.60	2		
4.60-4.70	2		
4.70-4.80	3		
4.80-4.90	4		
4.90-5.00	2		
5.00-5.10	4		
5.10-5.20	7		
5.20-5.30	6		
5.30-5.40	5		
5.40-5.50	7		
5.50-5.60	8		
5.60-5.70	8		
5.70-5.80	10		
5.80-5.90	10		
5.90-6.00	10		
6.00-6.10	7		
6.10-6.20	9		
6.20-6.30	10		
6.30-6.40	8		
6.40-6.50	7		
6.50-6.60	6		
6.60-6.70	6		
6.70-6.80	7		
6.80-6.90	8		
6.90-7.00	6		
7.00-7.10	4		
7.10-7.20	3		
7.20-7.30	4		
7.30-7.40	3		
7.40-7.50	4		
7.50-7.60	4		
7.60-7.70	4		
7.70-7.80	5		
7.80-7.90	5		
7.90-8.00	6		



Remarks	**Scale (approx)** 1:40	**Logged By** n/a
	Figure No. 40274.DP08	

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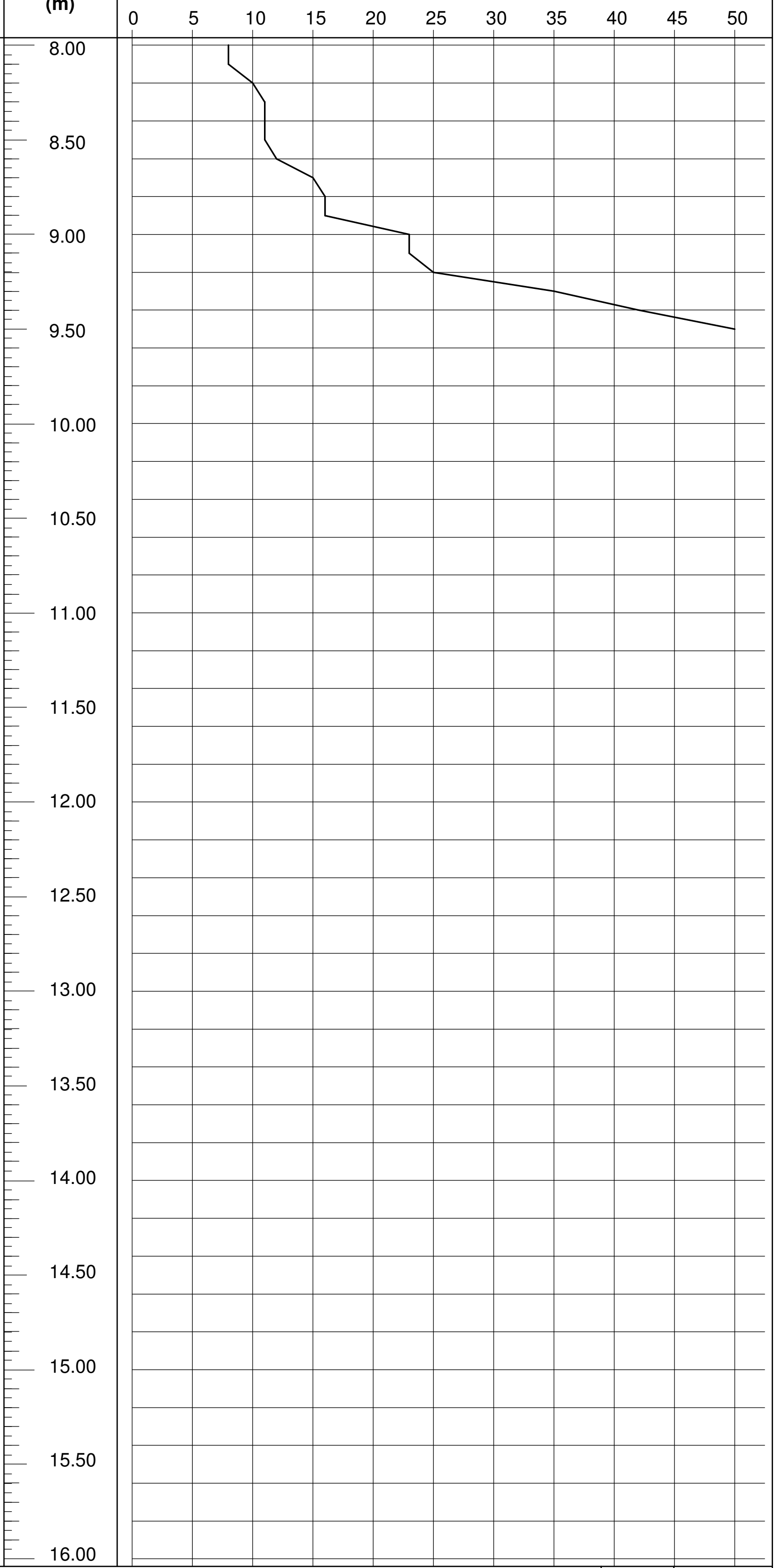
IAN FARMER ASSOCIATES			Site: Warren Hall Site - Broughton	Probe Number: **DP08**
Method Dynamic Probe	**Cone Dimensions**	**Ground Level (mOD)**	**Client** Welsh Assembly Government	**Job Number** 40274
	Location	**Dates** 15/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 2/2

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
8.00-8.10	8		
8.10-8.20	8		
8.20-8.30	10		
8.30-8.40	11		
8.40-8.50	11		
8.50-8.60	11		
8.60-8.70	12		
8.70-8.80	15		
8.80-8.90	16		
8.90-9.00	16		
9.00-9.10	23		
9.10-9.20	23		
9.20-9.30	25		
9.30-9.40	35		
9.40-9.50	42		
9.50-9.57	50		

Depth (m) — **Blows for Depth Increment**



Remarks	**Scale (approx)**	**Logged By**
	1:40	n/a
	Figure No. 40274.DP08	

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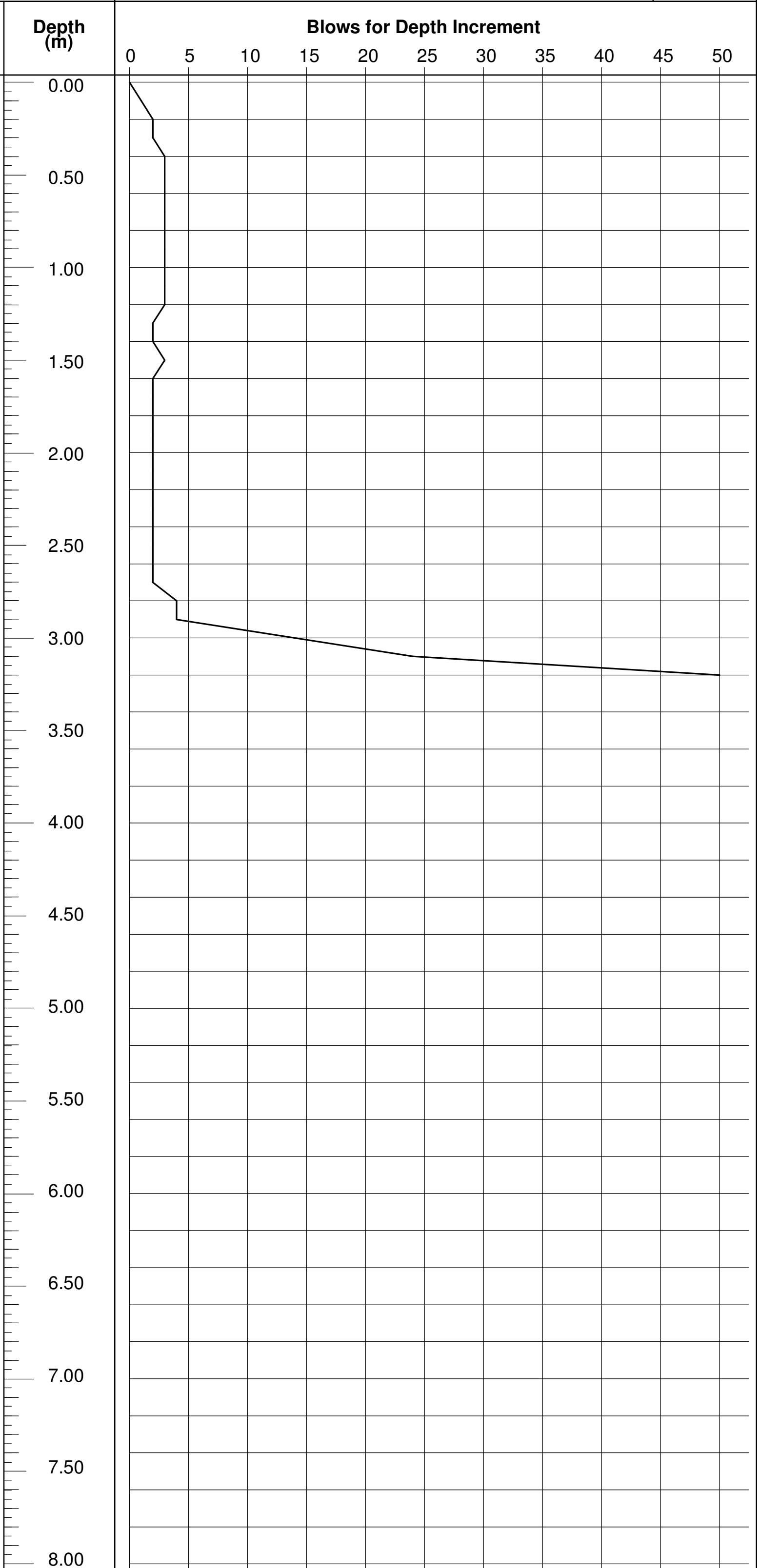
IAN FARMER ASSOCIATES

Site	Probe Number
Warren Hall Site - Broughton	DP09

Method	Cone Dimensions	Ground Level (mOD)	Client	Job Number
Dynamic Probe			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		16/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	0		
0.10-0.20	1		
0.20-0.30	2		
0.30-0.40	2		
0.40-0.50	3		
0.50-0.60	3		
0.60-0.70	3		
0.70-0.80	3		
0.80-0.90	3		
0.90-1.00	3		
1.00-1.10	3		
1.10-1.20	3		
1.20-1.30	3		
1.30-1.40	2		
1.40-1.50	2		
1.50-1.60	3		
1.60-1.70	2		
1.70-1.80	2		
1.80-1.90	2		
1.90-2.00	2		
2.00-2.10	2		
2.10-2.20	2		
2.20-2.30	2		
2.30-2.40	2		
2.40-2.50	2		
2.50-2.60	2		
2.60-2.70	2		
2.70-2.80	2		
2.80-2.90	4		
2.90-3.00	4		
3.00-3.10	14		
3.10-3.20	24		
3.20-3.21	50		



Remarks	Scale (approx)	Logged By
	1:40	n/a
	Figure No.	
	40274.DP09	

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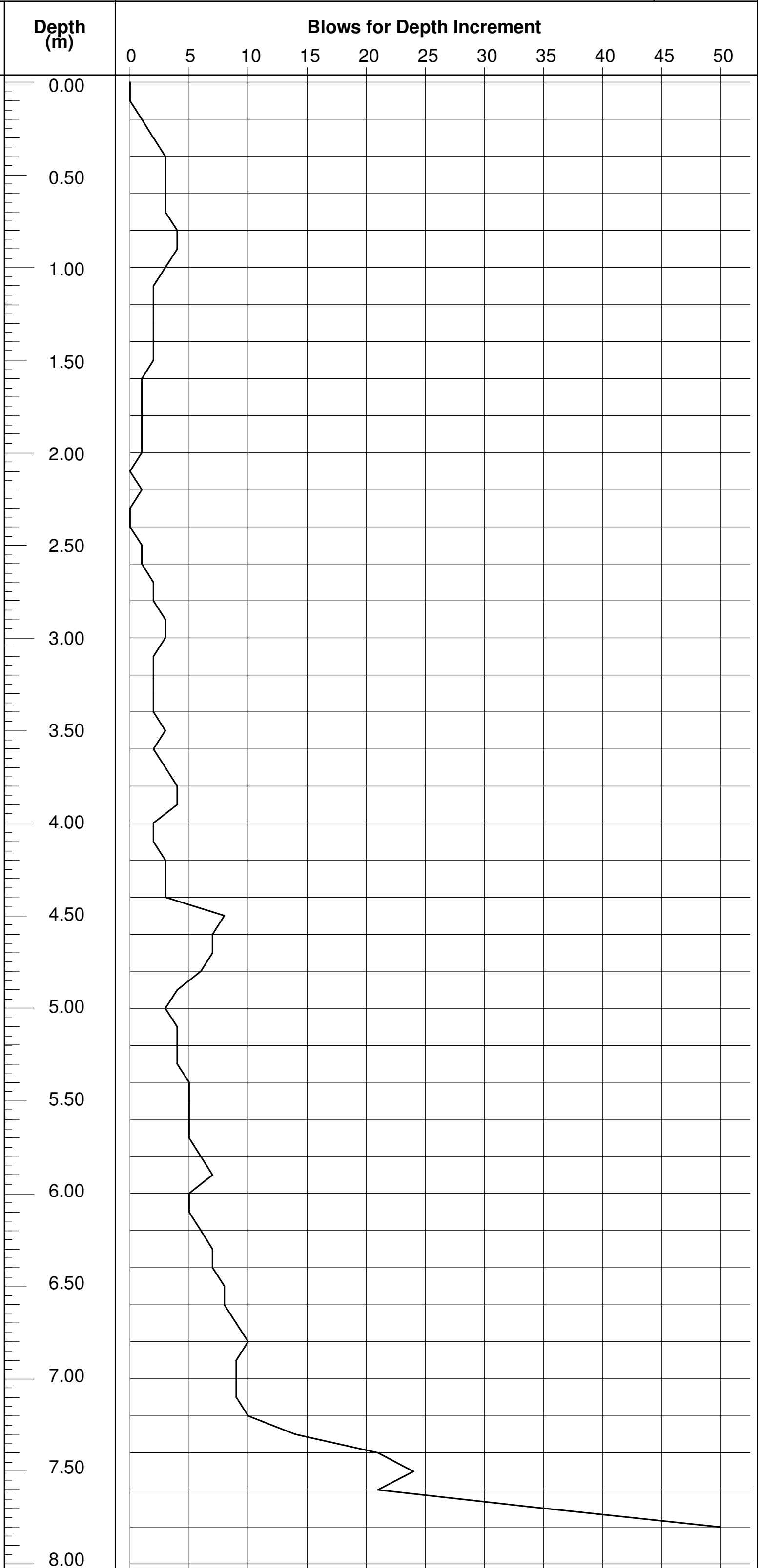
IAN FARMER ASSOCIATES			Site: Warren Hall Site - Broughton	Probe Number: DP10
Method: Dynamic Probe	Cone Dimensions:	Ground Level (mOD):	Client: Welsh Assembly Government	Job Number: 40274
	Location:	Dates: 15/01/2008	Engineer: Opus International Consultants (UK) Ltd	Sheet: 1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	0		
0.10-0.20	0		
0.20-0.30	1		
0.30-0.40	2		
0.40-0.50	3		
0.50-0.60	3		
0.60-0.70	3		
0.70-0.80	3		
0.80-0.90	4		
0.90-1.00	4		
1.00-1.10	3		
1.10-1.20	2		
1.20-1.30	2		
1.30-1.40	2		
1.40-1.50	2		
1.50-1.60	2		
1.60-1.70	1		
1.70-1.80	1		
1.80-1.90	1		
1.90-2.00	1		
2.00-2.10	1		
2.10-2.20	0		
2.20-2.30	1		
2.30-2.40	0		
2.40-2.50	0		
2.50-2.60	1		
2.60-2.70	1		
2.70-2.80	2		
2.80-2.90	2		
2.90-3.00	3		
3.00-3.10	3		
3.10-3.20	2		
3.20-3.30	2		
3.30-3.40	2		
3.40-3.50	2		
3.50-3.60	3		
3.60-3.70	2		
3.70-3.80	3		
3.80-3.90	4		
3.90-4.00	4		
4.00-4.10	2		
4.10-4.20	2		
4.20-4.30	3		
4.30-4.40	3		
4.40-4.50	3		
4.50-4.60	8		
4.60-4.70	7		
4.70-4.80	7		
4.80-4.90	6		
4.90-5.00	4		
5.00-5.10	3		
5.10-5.20	4		
5.20-5.30	4		
5.30-5.40	4		
5.40-5.50	5		
5.50-5.60	5		
5.60-5.70	5		
5.70-5.80	5		
5.80-5.90	6		
5.90-6.00	7		
6.00-6.10	5		
6.10-6.20	5		
6.20-6.30	6		
6.30-6.40	7		
6.40-6.50	7		
6.50-6.60	8		
6.60-6.70	8		
6.70-6.80	9		
6.80-6.90	10		
6.90-7.00	9		
7.00-7.10	9		
7.10-7.20	9		
7.20-7.30	10		
7.30-7.40	14		
7.40-7.50	21		
7.50-7.60	24		
7.60-7.70	21		
7.70-7.80	35		
7.80-7.82	50		



Remarks	Scale (approx)	Logged By
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	Figure No.	
	40274.DP10	

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IAN FARMER ASSOCIATES

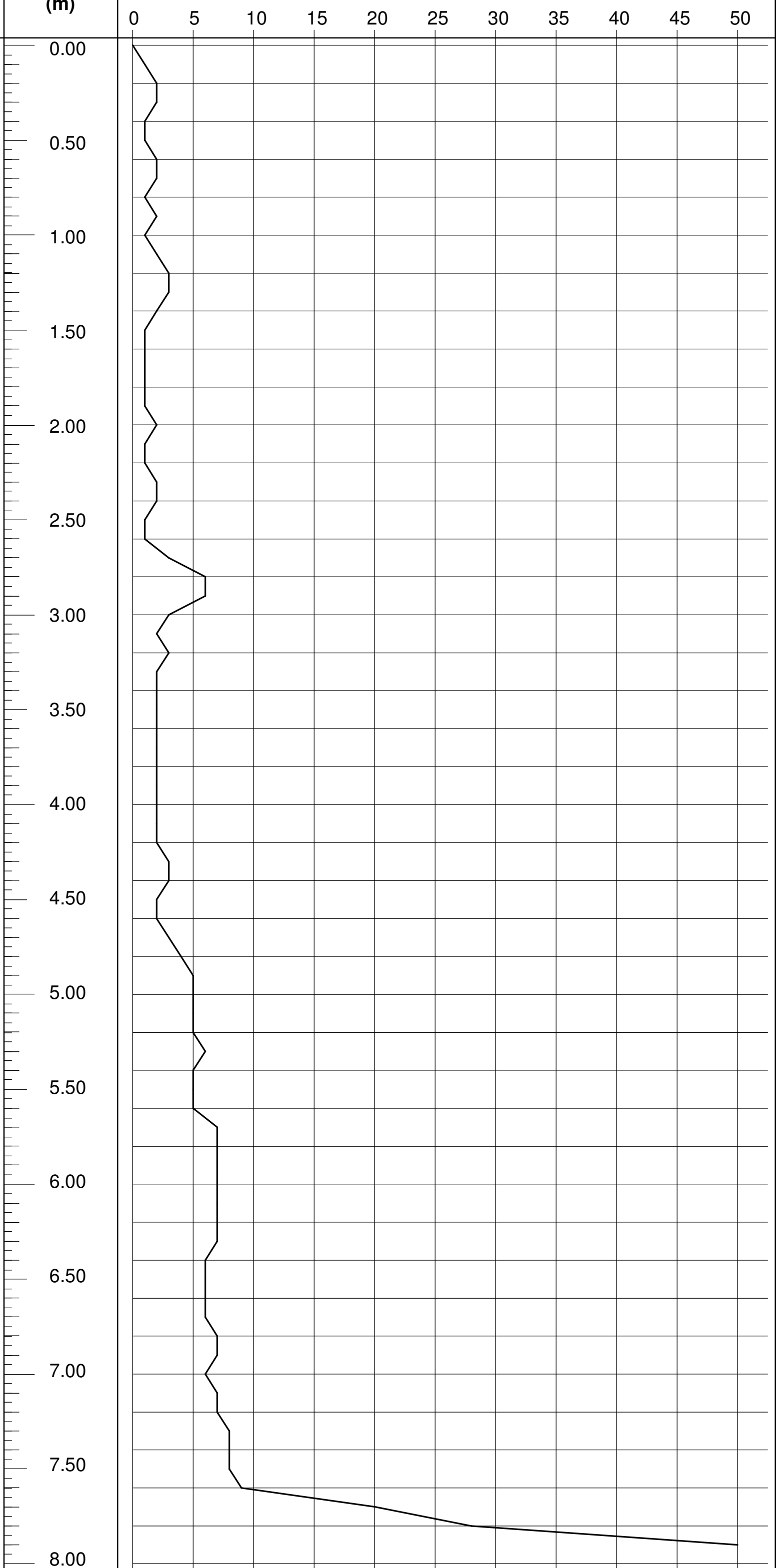
Site	Probe Number
Warren Hall Site - Broughton	DP11

Method	Cone Dimensions	Ground Level (mOD)	Client	Job Number
Dynamic Probe			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		14/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	0		
0.10-0.20	1		
0.20-0.30	2		
0.30-0.40	2		
0.40-0.50	1		
0.50-0.60	1		
0.60-0.70	2		
0.70-0.80	2		
0.80-0.90	1		
0.90-1.00	2		
1.00-1.10	1		
1.10-1.20	2		
1.20-1.30	3		
1.30-1.40	3		
1.40-1.50	2		
1.50-1.60	1		
1.60-1.70	1		
1.70-1.80	1		
1.80-1.90	1		
1.90-2.00	1		
2.00-2.10	2		
2.10-2.20	1		
2.20-2.30	1		
2.30-2.40	2		
2.40-2.50	2		
2.50-2.60	1		
2.60-2.70	1		
2.70-2.80	3		
2.80-2.90	6		
2.90-3.00	6		
3.00-3.10	3		
3.10-3.20	2		
3.20-3.30	3		
3.30-3.40	2		
3.40-3.50	2		
3.50-3.60	2		
3.60-3.70	2		
3.70-3.80	2		
3.80-3.90	2		
3.90-4.00	2		
4.00-4.10	2		
4.10-4.20	2		
4.20-4.30	2		
4.30-4.40	3		
4.40-4.50	3		
4.50-4.60	2		
4.60-4.70	2		
4.70-4.80	3		
4.80-4.90	4		
4.90-5.00	5		
5.00-5.10	5		
5.10-5.20	5		
5.20-5.30	5		
5.30-5.40	6		
5.40-5.50	5		
5.50-5.60	5		
5.60-5.70	5		
5.70-5.80	7		
5.80-5.90	7		
5.90-6.00	7		
6.00-6.10	7		
6.10-6.20	7		
6.20-6.30	7		
6.30-6.40	7		
6.40-6.50	6		
6.50-6.60	6		
6.60-6.70	6		
6.70-6.80	6		
6.80-6.90	7		
6.90-7.00	7		
7.00-7.10	6		
7.10-7.20	7		
7.20-7.30	7		
7.30-7.40	8		
7.40-7.50	8		
7.50-7.60	8		
7.60-7.70	9		
7.70-7.80	20		
7.80-7.90	28		
7.90-7.97	50		

Depth (m)

Blows for Depth Increment



Remarks	Scale (approx)	Logged By
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	Figure No.	
	40274.DP11	

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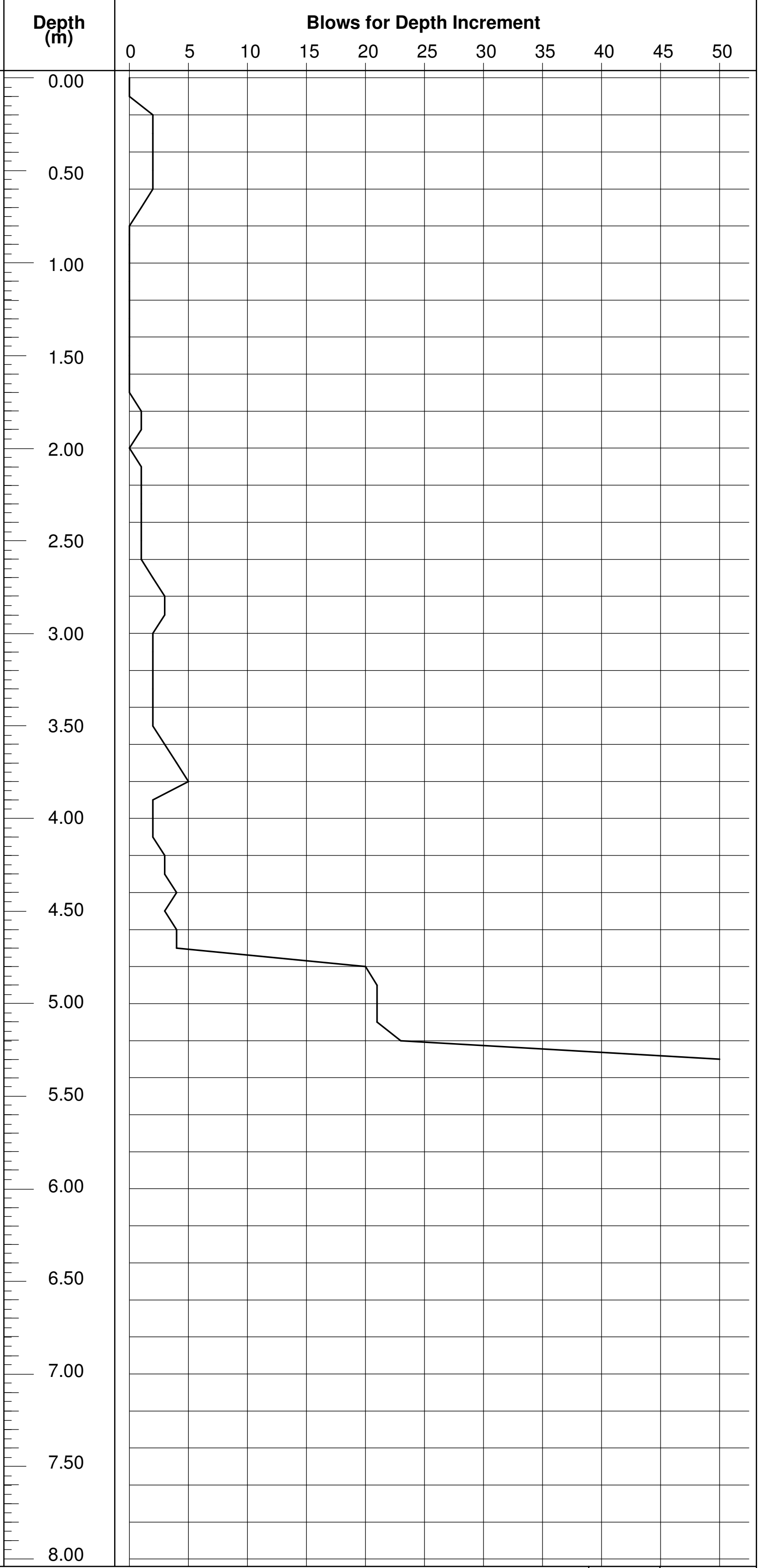
IAN FARMER ASSOCIATES

Site	Probe Number
Warren Hall Site - Broughton	**DP12**

Method	Cone Dimensions	Ground Level (mOD)	Client	Job Number
Dynamic Probe			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		14/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	0		
0.10-0.20	0		
0.20-0.30	2		
0.30-0.40	2		
0.40-0.50	2		
0.50-0.60	2		
0.60-0.70	2		
0.70-0.80	1		
0.80-0.90	0		
0.90-1.00	0		
1.00-1.10	0		
1.10-1.20	0		
1.20-1.30	0		
1.30-1.40	0		
1.40-1.50	0		
1.50-1.60	0		
1.60-1.70	0		
1.70-1.80	0		
1.80-1.90	1		
1.90-2.00	1		
2.00-2.10	0		
2.10-2.20	1		
2.20-2.30	1		
2.30-2.40	1		
2.40-2.50	1		
2.50-2.60	1		
2.60-2.70	1		
2.70-2.80	2		
2.80-2.90	3		
2.90-3.00	3		
3.00-3.10	2		
3.10-3.20	2		
3.20-3.30	2		
3.30-3.40	2		
3.40-3.50	2		
3.50-3.60	2		
3.60-3.70	3		
3.70-3.80	4		
3.80-3.90	5		
3.90-4.00	2		
4.00-4.10	2		
4.10-4.20	2		
4.20-4.30	3		
4.30-4.40	3		
4.40-4.50	4		
4.50-4.60	3		
4.60-4.70	4		
4.70-4.80	4		
4.80-4.90	20		
4.90-5.00	21		
5.00-5.10	21		
5.10-5.20	21		
5.20-5.30	23		
5.30-5.33	50		



Remarks	Scale (approx)	Logged By
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	Figure No.	
	40274.DP12	

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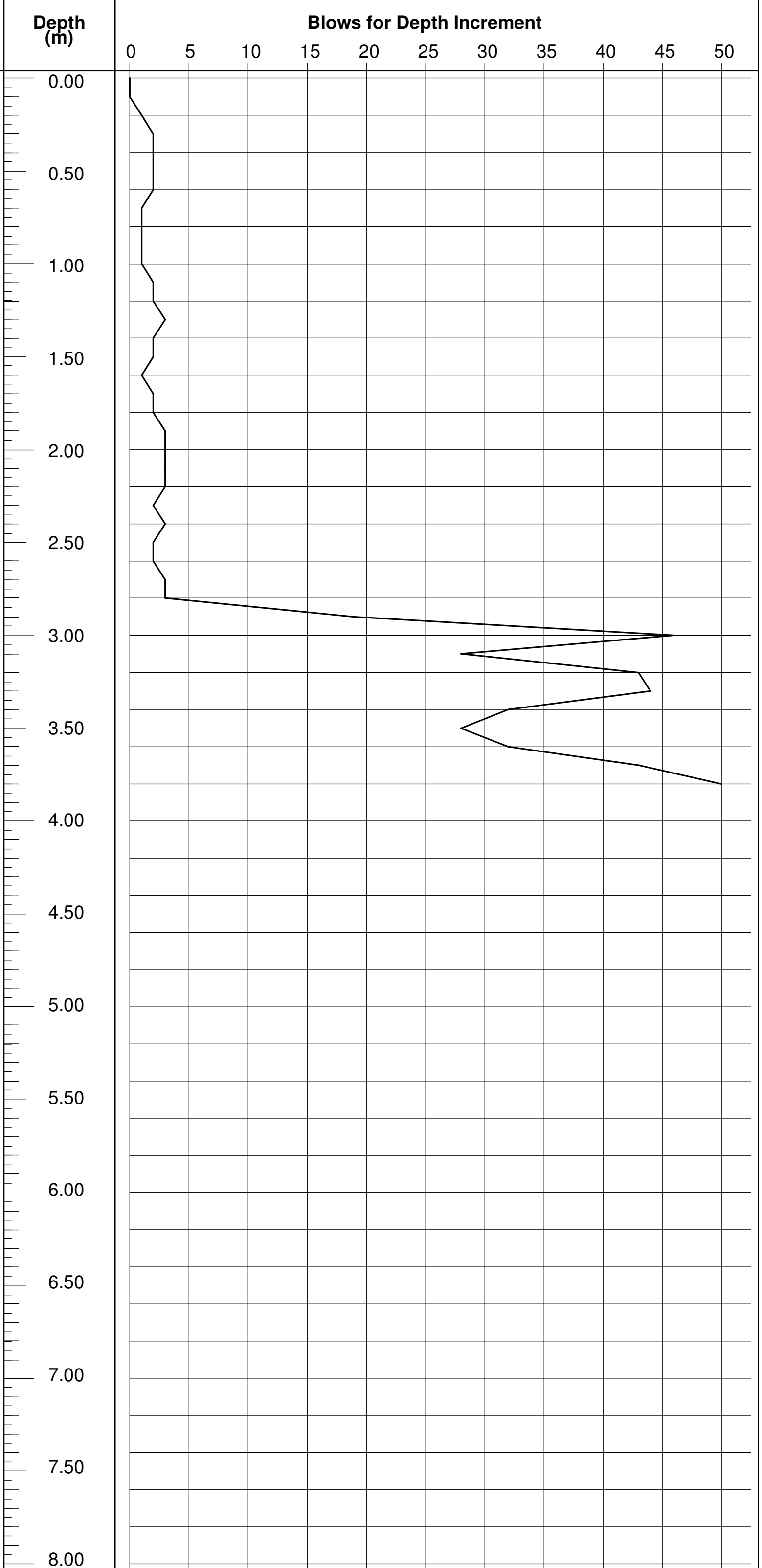
IAN FARMER ASSOCIATES

Site	Probe Number
Warren Hall Site - Broughton	DP13

Method	Cone Dimensions	Ground Level (mOD)	Client	Job Number
Dynamic Probe			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		14/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	0		
0.10-0.20	0		
0.20-0.30	1		
0.30-0.40	2		
0.40-0.50	2		
0.50-0.60	2		
0.60-0.70	2		
0.70-0.80	1		
0.80-0.90	1		
0.90-1.00	1		
1.00-1.10	1		
1.10-1.20	2		
1.20-1.30	2		
1.30-1.40	3		
1.40-1.50	2		
1.50-1.60	2		
1.60-1.70	1		
1.70-1.80	2		
1.80-1.90	2		
1.90-2.00	3		
2.00-2.10	3		
2.10-2.20	3		
2.20-2.30	3		
2.30-2.40	2		
2.40-2.50	3		
2.50-2.60	2		
2.60-2.70	2		
2.70-2.80	3		
2.80-2.90	3		
2.90-3.00	19		
3.00-3.10	46		
3.10-3.20	28		
3.20-3.30	43		
3.30-3.40	44		
3.40-3.50	32		
3.50-3.60	28		
3.60-3.70	32		
3.70-3.80	43		
3.80-3.82	50		



Remarks

Scale (approx)	Logged By
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Figure No. 40274.DP13

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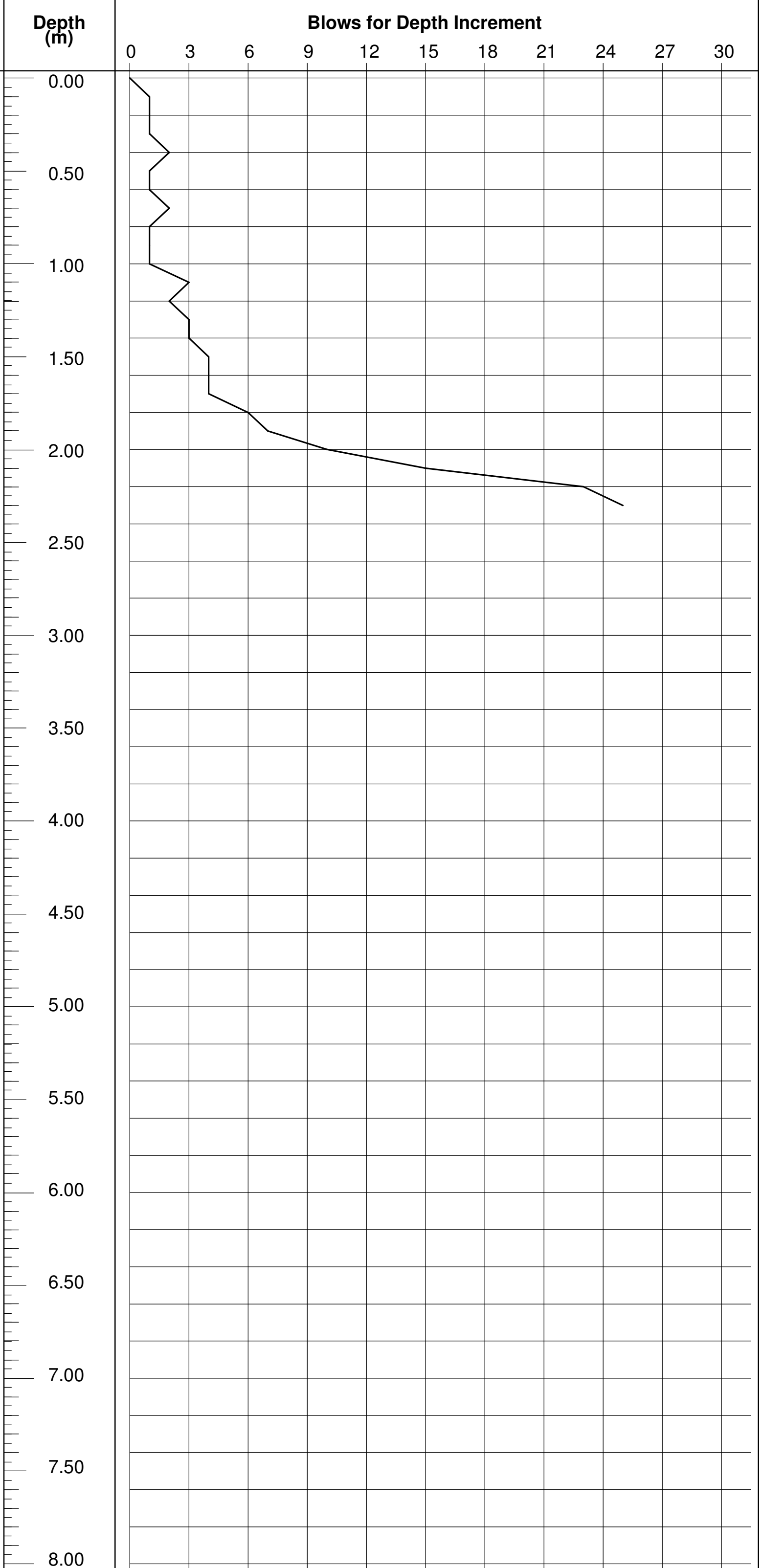
IAN FARMER ASSOCIATES

Site Warren Hall Site - Broughton				**Probe Number** DP14
Method Dynamic Probe	**Cone Dimensions**	**Ground Level (mOD)**	**Client** Welsh Assembly Government	**Job Number** 40274
	Location	**Dates** 17/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	0		
0.10-0.20	1		
0.20-0.30	1		
0.30-0.40	1		
0.40-0.50	2		
0.50-0.60	1		
0.60-0.70	1		
0.70-0.80	2		
0.80-0.90	1		
0.90-1.00	1		
1.00-1.10	1		
1.10-1.20	3		
1.20-1.30	2		
1.30-1.40	3		
1.40-1.50	3		
1.50-1.60	4		
1.60-1.70	4		
1.70-1.80	4		
1.80-1.90	6		
1.90-2.00	7		
2.00-2.10	10		
2.10-2.20	15		
2.20-2.30	23		
2.30-2.40	25		



Remarks	**Scale (approx)** 1:40	**Logged By** n/a
	Figure No. 40274.DP14	

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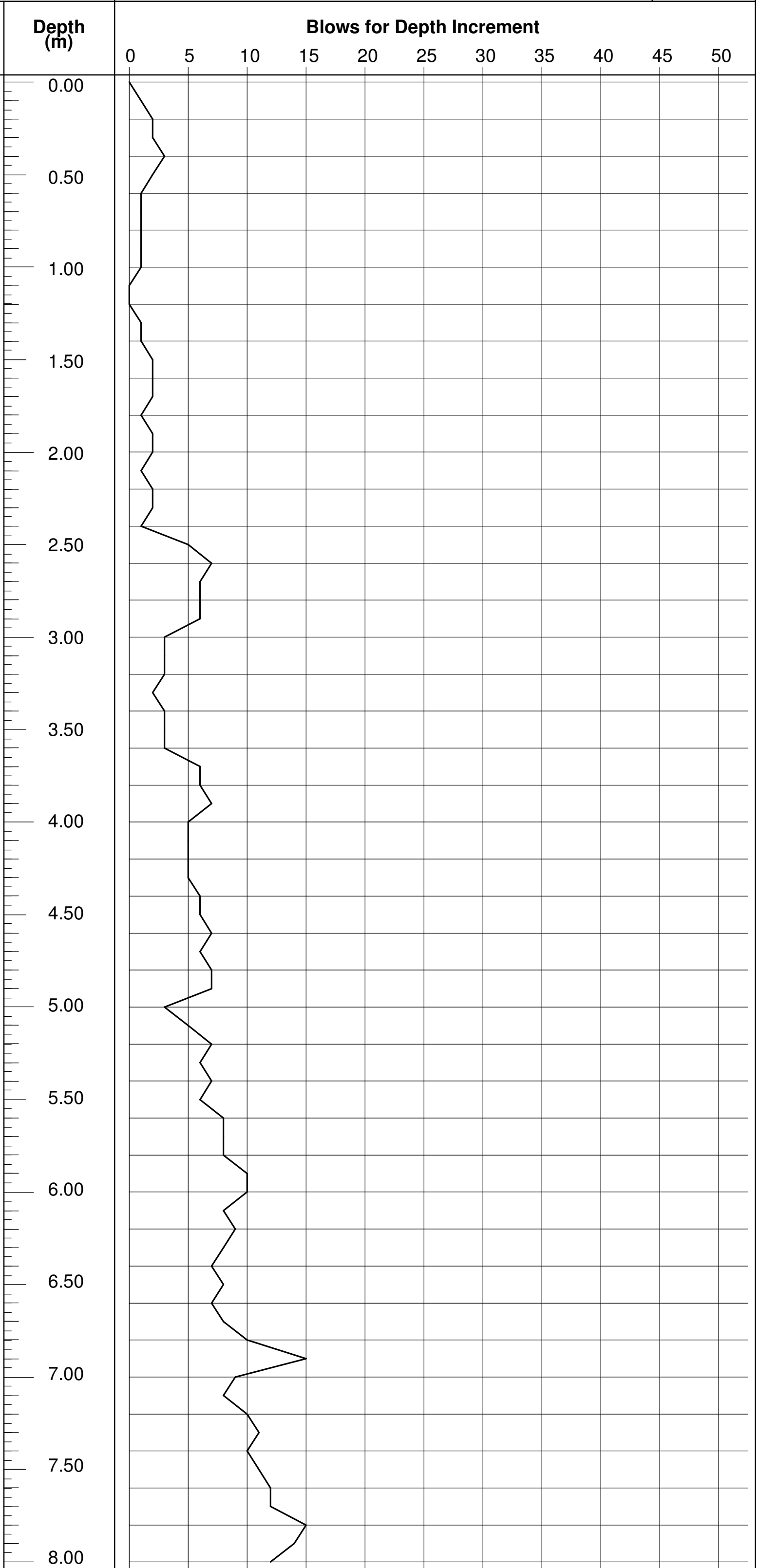
IAN FARMER ASSOCIATES

Site	Probe Number
Warren Hall Site - Broughton	**DP15**

Method	Cone Dimensions	Ground Level (mOD)	Client	Job Number
Dynamic Probe			Welsh Assembly Government	40274

Location	Dates	Engineer	Sheet
	16/01/2008	Opus International Consultants (UK) Ltd	1/2

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	0		
0.10-0.20	1		
0.20-0.30	2		
0.30-0.40	2		
0.40-0.50	3		
0.50-0.60	2		
0.60-0.70	1		
0.70-0.80	1		
0.80-0.90	1		
0.90-1.00	1		
1.00-1.10	1		
1.10-1.20	0		
1.20-1.30	0		
1.30-1.40	1		
1.40-1.50	1		
1.50-1.60	2		
1.60-1.70	2		
1.70-1.80	2		
1.80-1.90	1		
1.90-2.00	2		
2.00-2.10	2		
2.10-2.20	1		
2.20-2.30	2		
2.30-2.40	2		
2.40-2.50	1		
2.50-2.60	5		
2.60-2.70	7		
2.70-2.80	6		
2.80-2.90	6		
2.90-3.00	6		
3.00-3.10	3		
3.10-3.20	3		
3.20-3.30	3		
3.30-3.40	2		
3.40-3.50	3		
3.50-3.60	3		
3.60-3.70	3		
3.70-3.80	6		
3.80-3.90	6		
3.90-4.00	7		
4.00-4.10	5		
4.10-4.20	5		
4.20-4.30	5		
4.30-4.40	5		
4.40-4.50	6		
4.50-4.60	6		
4.60-4.70	7		
4.70-4.80	6		
4.80-4.90	7		
4.90-5.00	7		
5.00-5.10	3		
5.10-5.20	5		
5.20-5.30	7		
5.30-5.40	6		
5.40-5.50	7		
5.50-5.60	6		
5.60-5.70	8		
5.70-5.80	8		
5.80-5.90	8		
5.90-6.00	10		
6.00-6.10	10		
6.10-6.20	8		
6.20-6.30	9		
6.30-6.40	8		
6.40-6.50	7		
6.50-6.60	8		
6.60-6.70	7		
6.70-6.80	8		
6.80-6.90	10		
6.90-7.00	15		
7.00-7.10	9		
7.10-7.20	8		
7.20-7.30	10		
7.30-7.40	11		
7.40-7.50	10		
7.50-7.60	11		
7.60-7.70	12		
7.70-7.80	12		
7.80-7.90	15		
7.90-8.00	14		



Remarks	Scale (approx)	Logged By
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Figure No. 40274.DP15

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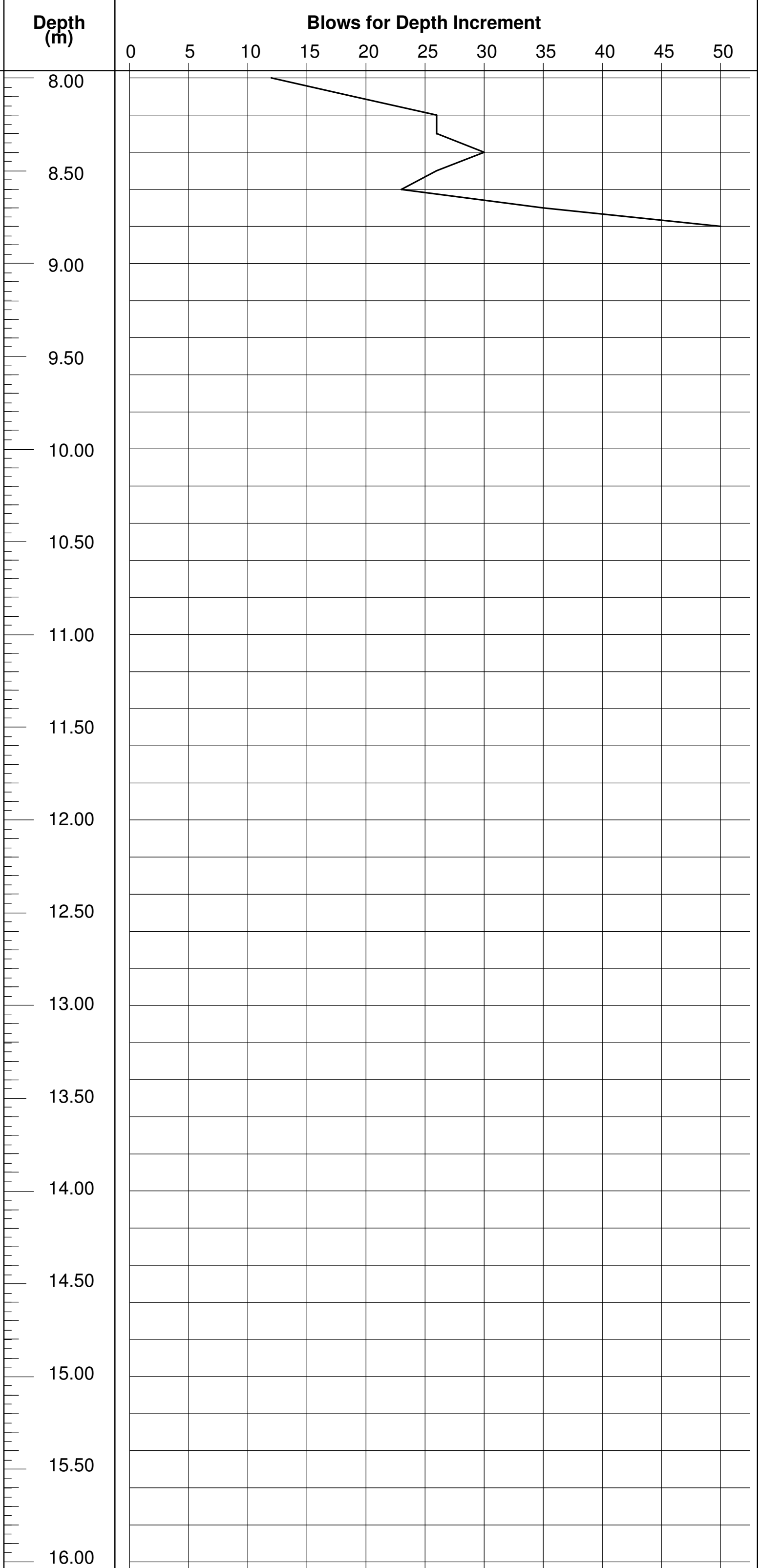
IAN FARMER ASSOCIATES

Site	Probe Number
Warren Hall Site - Broughton	DP15

Method	Cone Dimensions	Ground Level (mOD)	Client	Job Number
Dynamic Probe			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		16/01/2008	Opus International Consultants (UK) Ltd	2/2

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
8.00-8.10	12		
8.10-8.20	19		
8.20-8.30	26		
8.30-8.40	26		
8.40-8.50	30		
8.50-8.60	26		
8.60-8.70	23		
8.70-8.80	35		
8.80-8.86	50		



Remarks	Scale (approx)	Logged By
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	Figure No.	
	40274.DP15	

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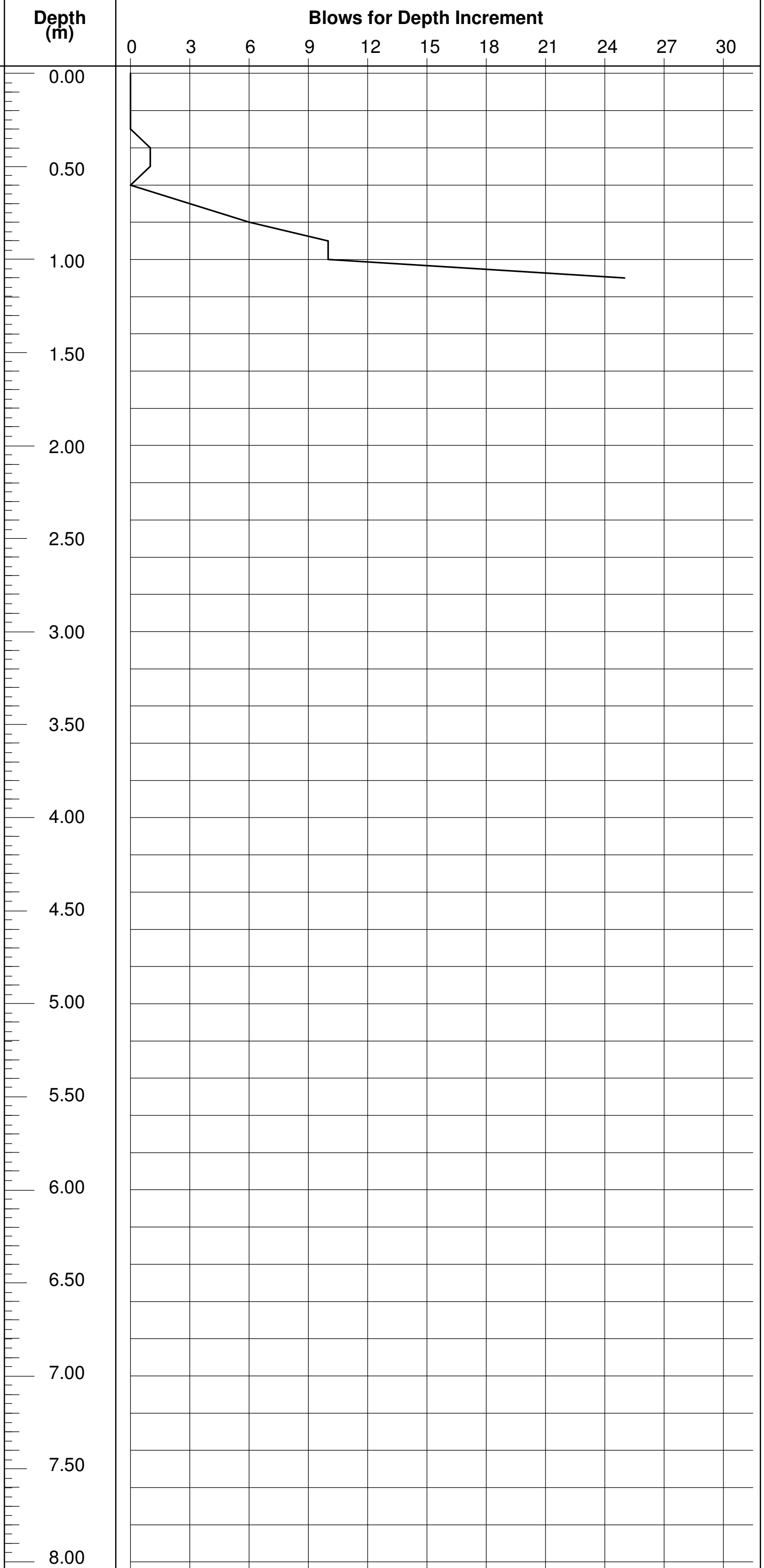
IAN FARMER ASSOCIATES

Site	Probe Number
Warren Hall Site - Broughton	DP16

Method	Cone Dimensions	Ground Level (mOD)	Client	Job Number
Dynamic Probe			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		17/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	0		
0.10-0.20	0		
0.20-0.30	0		
0.30-0.40	0		
0.40-0.50	1		
0.50-0.60	1		
0.60-0.70	0		
0.70-0.80	3		
0.80-0.90	6		
0.90-1.00	10		
1.00-1.10	10		
1.10-1.20	25		



Remarks	Scale (approx)	Logged By
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	Figure No.	
	40274.DP16	

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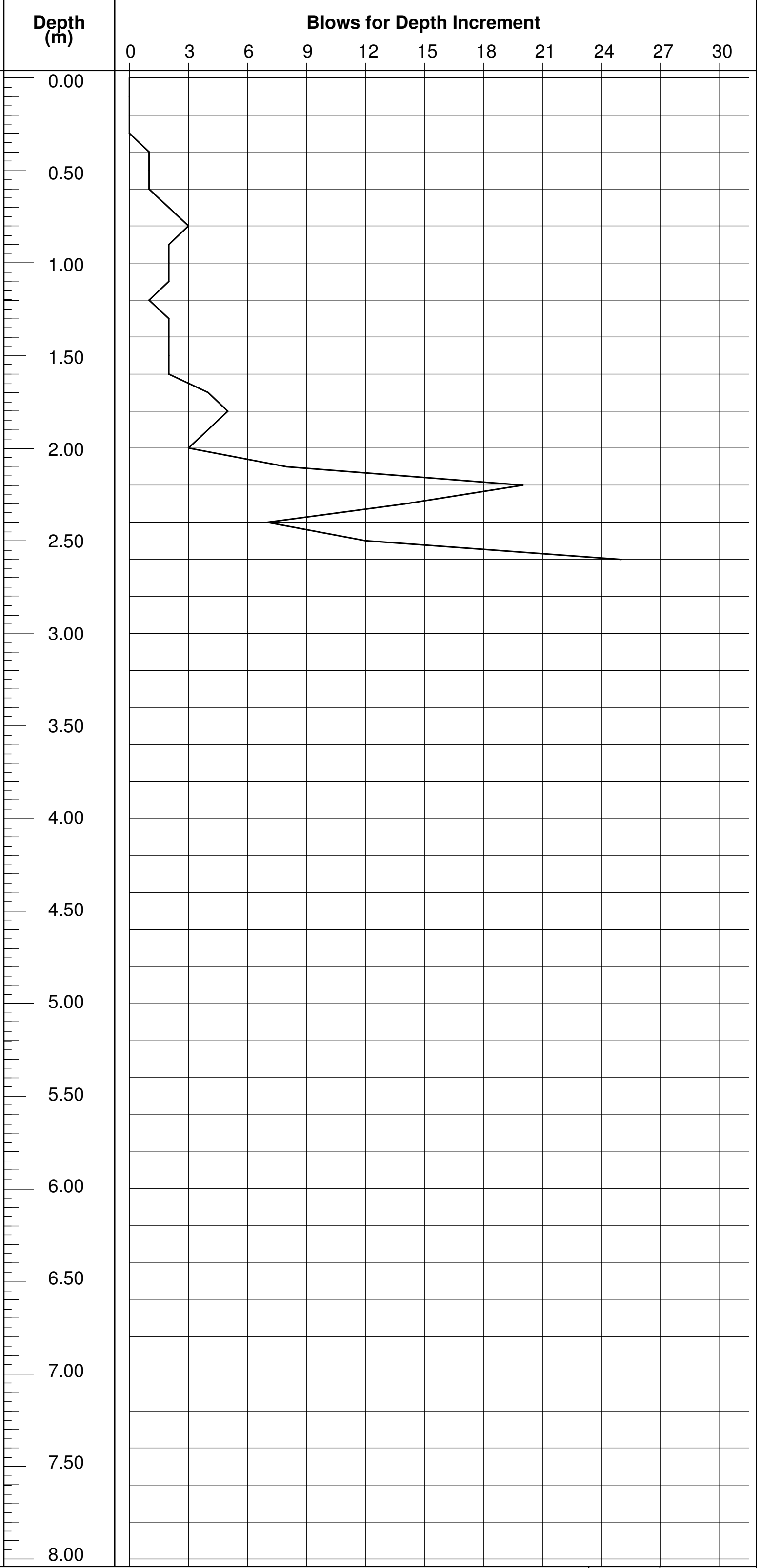
IAN FARMER ASSOCIATES

Site Warren Hall Site - Broughton				**Probe Number** DP17
Method Dynamic Probe	**Cone Dimensions**	**Ground Level (mOD)**	**Client** Welsh Assembly Government	**Job Number** 40274
	Location	**Dates** 18/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	0		
0.10-0.20	0		
0.20-0.30	0		
0.30-0.40	0		
0.40-0.50	1		
0.50-0.60	1		
0.60-0.70	1		
0.70-0.80	2		
0.80-0.90	3		
0.90-1.00	2		
1.00-1.10	2		
1.10-1.20	2		
1.20-1.30	1		
1.30-1.40	2		
1.40-1.50	2		
1.50-1.60	2		
1.60-1.70	2		
1.70-1.80	4		
1.80-1.90	5		
1.90-2.00	4		
2.00-2.10	3		
2.10-2.20	8		
2.20-2.30	20		
2.30-2.40	14		
2.40-2.50	7		
2.50-2.60	12		
2.60-2.70	25		



Remarks	Scale (approx)	Logged By
	1:40	n/a
	Figure No. 40274.DP17	

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IAN FARMER ASSOCIATES

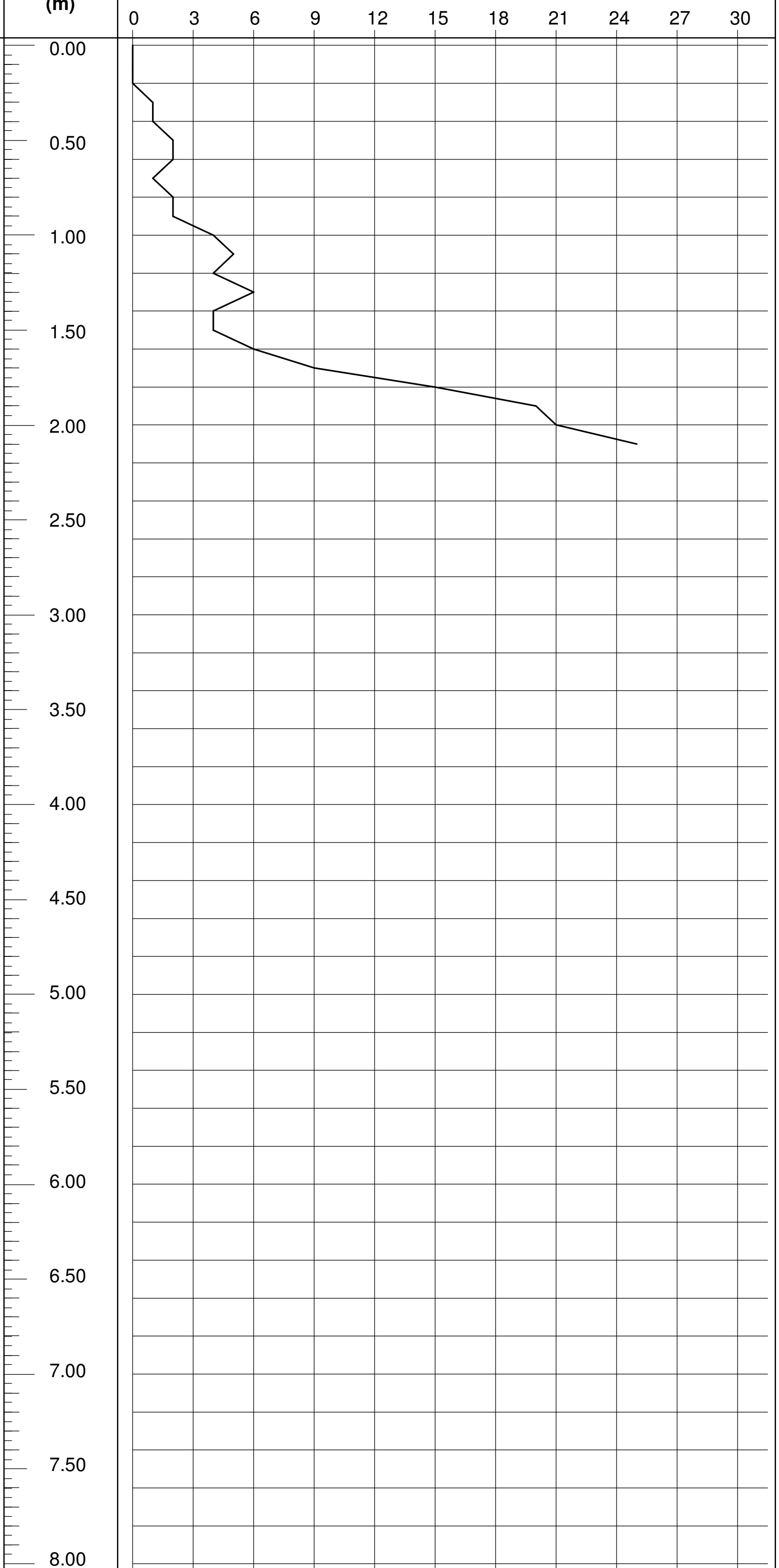
Site	Probe Number
Warren Hall Site - Broughton	DP18

Method	Cone Dimensions	Ground Level (mOD)	Client	Job Number
Dynamic Probe			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		18/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)
0.00-0.10	0		
0.10-0.20	0		
0.20-0.30	0		
0.30-0.40	1		
0.40-0.50	1		
0.50-0.60	2		
0.60-0.70	2		
0.70-0.80	1		
0.80-0.90	2		
0.90-1.00	2		
1.00-1.10	4		
1.10-1.20	5		
1.20-1.30	4		
1.30-1.40	6		
1.40-1.50	4		
1.50-1.60	4		
1.60-1.70	6		
1.70-1.80	9		
1.80-1.90	15		
1.90-2.00	20		
2.00-2.10	21		
2.10-2.20	25		

Depth (m)

Blows for Depth Increment



Remarks

Scale (approx)	Logged By
1:40	n/a

Figure No.

40274.DP18

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Figure A2.4

Trial Pit Records

IAN FARMER ASSOCIATES

Site	Trial Pit Number
Warren Hall Site - Broughton	TP01

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
JCB 3CX	2.70m x 0.60m x 4.00m		Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		16/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.20 0.20 0.20 0.30 0.30 0.30	J3 D2 B1 J6 D5 B4				(0.20) 0.20	Grass over brown, clayey, sandy TOPSOIL with some plant material.		
1.30 1.30 1.40	D8 B7 D9				(1.90) 2.10	Firm, red brown, occasionally mottled grey orange, sandy, slightly gravelly CLAY with occasional rootlets. Gravel is rounded to angular, fine to coarse including siltstone and sandstone. At 1.40m: occasional pockets of silty sand (sample D9).		1
2.10 2.10	D11 B10		seepage(1) at 2.10m.		(0.70) 2.80	Brown, very silty SAND.		
2.80 2.80	D13 B12				(1.00) 3.80	Firm, brown, slightly sandy CLAY with occasional pockets of silt.		
3.80 3.80	D15 B14				(0.20) 4.00	Firm, blue brown, sandy, slightly gravelly CLAY with occasional pockets of silty sand. Gravel is subangular to subrounded, fine and medium including sandstone and quartz.		
						Complete at 4.00m		

Plan

Remarks

Seepage at 2.10m.
Slight spalling between 2.50m and 3.00m.

Scale (approx)	Logged By	Figure No.
1:50	GP	40274.TP01

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IAN FARMER ASSOCIATES

Site	Trial Pit Number
Warren Hall Site - Broughton	TP01X

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
JCB 3CX	3.50m x 0.70m x 4.40m		Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		18/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30) 0.30	Soft, dark brown TOPSOIL with some rootlets.		
0.30	D2							
0.30	B1				(0.20) 0.50	Soft in places firm, dark red brown, gravelly CLAY. Gravel is angular to subangular, fine to coarse including siltstone and mudstone.		
0.80	D4				(0.40)			
0.80	B3				0.90	Firm, light red , dark grey, mottled brown, gravelly CLAY. Gravel is angular to subangular, fine to coarse including siltstone, quartz and mudstone.		
					(1.00)	Firm in places stiff, dark red, brown, mottled blue grey CLAY with some cobbles of quartz and sandstone and some rootlets.		
1.50	D6							
1.50	B5							1
			Water strike(1) at 1.80m.		1.90	Dark red, brown, gravelly CLAY with some cobbles of siltstone. Gravel is angular to subangular, fine to coarse including siltstone, mudstone and coal.		
2.50	D8		Water strike(2) at 2.50m.					2
2.50	B7							
					(2.50)			
3.50	D10							
3.50	B9							
					4.40	At 4.40m: obstruction (possible rockhead encountered).		
						Complete at 4.40m		

Plan

Remarks

Groundwater located at 1.80m and 2.50m.
Trial pit remained stable throughout excavation.
Trial pit terminated at 4.40m due to obstruction - possible rockhead.

Scale (approx)	Logged By	Figure No.
1:50	MV	40274.TP01X

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IAN FARMER ASSOCIATES

Site	Trial Pit Number
Warren Hall Site - Broughton	TP02

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
JCB 3CX	2.70m x 0.60m x 3.00m		Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		16/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Grass over brown, very clayey, sandy TOPSOIL with some nodules of clay and some rootlets.		
0.20 0.20 0.20 0.30 0.30 0.30	J3 D2 B1 B4 D5 J6				(0.60) 0.80	Soft in places firm, orange brown, sandy, slightly gravelly CLAY. Gravel is rounded to subrounded, fine and medium including sandstone and quartz.		
0.90 0.90	D8 B7				(0.40) 1.20	Firm in places stiff, red brown, sandy, slightly gravelly CLAY. Gravel is rounded to subrounded, fine to coarse including sandstone and siltstone.		
1.20 1.20	D10 B9				(0.70) 1.90	Red brown SANDSTONE, recovered as very clayey sand and subangular to subrounded, fine to coarse gravel.		
1.90 1.90	B11 D12				(0.30) 2.20	Light grey SANDSTONE, recovered as sand and angular to subrounded, fine to coarse gravel.		
2.20 2.20	B13 D14				(0.80) 3.00	Red brown SANDSTONE, recovered as sandy, angular to subangular, fine to coarse gravel. Between 2.50m and 3.00m: slow progress (20 minutes).		
3.00 3.00	D16 B15					Complete at 3.00m		

Plan

Remarks

Trial pit remained dry throughout excavation.
Slight spalling between 1.20m and 2.00m.

Scale (approx)	Logged By	Figure No.
1:50	GP	40274.TP02

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IAN FARMER ASSOCIATES

Site	Trial Pit Number
Warren Hall Site - Broughton	TP03

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
JCB 3CX	3.00m x 0.60m x 3.50m		Welsh Assembly Government	40274

Location	Dates	Engineer	Sheet
	16/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30) 0.30	Grass over MADE GROUND: Brown, very clayey, sandy, slightly gravelly TOPSOIL. Gravel is rounded to subrounded, fine to coarse of sandstone.		
0.20	J3							
0.20	D2							
0.20	B1							
0.30	J6				(0.60) 0.90	MADE GROUND: Firm in places stiff, mottled orange brown, sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse including sandstone, siltstone and coal.		
0.30	D5							
0.30	B4							
0.90	D8				(1.00) 1.90	Firm, dark blue, grey, slightly sandy CLAY.		
0.90	B7							
					(0.40) 2.30	Dark blue SILTSTONE/MUDSTONE, recovered as sandy, gravelly CLAY. Gravel is angular to subangular, fine and medium including siltstone and mudstone.		∇1
2.30	D10		trickle(1) at 2.30m.		(0.60) 2.90	Very weak, dark grey blue MUDSTONE, recovered as clayey sand and angular to subangular, fine to coarse, tabular gravel.		
2.30	B9							
2.90	D12				(0.60) 3.50	Dark grey blue MUDSTONE/SILTSTONE, recovered as clayey, sandy, angular to subangular, fine to coarse, tabular gravel.		
2.90	B11							
3.50	B13							
3.50	D14							
						Complete at 3.50m		

Plan

Remarks

Groundwater located at 2.30m.
Slight spalling between 1.50m and 2.50m.

Scale (approx)	Logged By	Figure No.
1:50	GP	40274.TP03

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IAN FARMER ASSOCIATES

Site	Trial Pit Number
Warren Hall Site - Broughton	**TP04**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
JCB 3CX	3.00m x 0.60m x 4.00m		Welsh Assembly Government	40274
	Location	**Dates** 16/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Grass over brown, very clayey, sandy, slightly gravelly TOPSOIL with rootlets. Gravel is rounded to subrounded, fine to coarse of sandstone.		
0.20 0.20 0.20 0.30 0.30 0.30	D2 J3 B1 B4 D5 J6					Firm, mottled orange, grey, brown, sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine and medium including sandstone, siltstone and coal (possible made ground).		
1.30 1.30 1.30	J9 D8 B7				(2.10)			
					2.30	Below 2.20m: silty and red brown.		
2.30 2.30 2.30 2.40 2.40	B10 D11 J12 B13 D14				(0.10) 2.40	Red brown, very clayey SAND and angular to rounded, fine to coarse GRAVEL with some nodules of clay. Gravel includes sandstone and siltstone (possible made ground).		
3.40 3.40	D16 B15				(1.60)	Stiff, red brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse including sandstone, siltstone and quartz.		
					4.00			
						Complete at 4.00m		

Plan

Remarks

Trial pit remained dry and stable throughout excavation.

Scale (approx)	Logged By	Figure No.
1:50	GP	40274.TP04

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Site	Warren Hall Site - Broughton	**Trial Pit Number**	**TP05**
Excavation Method JCB 3CX	**Dimensions** 3.00m x 0.60m x 4.00m	**Ground Level (mOD)**	**Client** Welsh Assembly Government
Job Number 40274	**Location**	**Dates** 15/01/2008	**Engineer** Opus International Consultants (UK) Ltd
Sheet 1/1			

Depth (m)	Sample / Tests	Water Depth (m)	Field Records
0.20	J3		
0.20	D2		
0.20	B1		
0.30	J6		
0.30	D5		
0.30	B4		
1.30	J9		
1.30	D8		
1.30	B7		
1.80	D11		
1.80	B10		
2.70	D13		
2.70	B12		
3.20	D15		
3.20	B14		

Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
	(0.20) 0.20	Grass over brown, clayey, sandy, slightly gravelly TOPSOIL with occasional plant material. Gravel is rounded to angular, fine and medium including siltstone and sandstone.		
	(1.60) 1.80	Orange brown, clayey SAND and rounded to subrounded, fine to coarse GRAVEL with occasional nodules of clay. Gravel includes sandstone and quartz (possible made ground). Below 1.30m: some nodules of clay. At 1.80m: occasional cobbles.		
	(0.90) 2.70	Stiff, blue grey, slightly sandy, slightly gravelly CLAY with occasional cobbles. Gravel is subrounded to subangular, fine to coarse including sandstone and quartz. At 2.30m: some cobbles of sandstone and boulders of sandstone (upto 0.50m).		
	(0.50) 3.20	Stiff, light orange, brown, sandy, slightly gravelly SILT with occasional cobbles. Gravel is subrounded to angular, fine and medium of sandstone.		
	(0.80) 4.00	Firm in places stiff, blue grey, slightly sandy, slightly gravelly CLAY. Gravel is subrounded to subangular, fine and medium of sandstone.		
		Complete at 4.00m		

Plan

Remarks

Trial pit remained dry throughout excavation.
Slight spalling between 1.00m and 3.00m.

Scale (approx)	Logged By	Figure No.
1:50	GP	40274.TP05

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IAN FARMER ASSOCIATES			Site: Warren Hall Site - Broughton	Trial Pit Number: TP06
Excavation Method JCB 3CX	**Dimensions** 3.40m x 0.70m x 1.40m	**Ground Level (mOD)**	**Client** Welsh Assembly Government	**Job Number** 40274
	Location	**Dates** 18/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Soft, dark brown TOPSOIL with rootlets.		
0.50 0.50	D2 B1				(0.80) 1.00	Soft in places firm, red brown, sandy, gravelly CLAY with some cobbles. Gravel is angular to subangular, fine to coarse including siltstone and sandstone.		∇1
1.40 1.40	D4 B3		slight seepage(1) at 1.00m.		(0.40) 1.40	Firm in places stiff, light blue grey, gravelly SILT with some cobbles. Gravel is angular to subangular, fine to coarse of siltstone. At 1.40m: obstruction (rockhead encountered).		
						Complete at 1.40m		

Plan

Remarks

At 1.00m: slight seepage (broken land drain).
Trial pit remained stable throughout excavation.
Trial pit terminated at 1.40m due to obstruction.

Scale (approx)	Logged By	Figure No.
1:50	MV	40274.TP06

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IAN FARMER ASSOCIATES	Site: Warren Hall Site - Broughton	Trial Pit Number: **TP07**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
JCB 3CX	3.50m x 0.70m x 3.00m		Welsh Assembly Government	40274
	Location	**Dates** 18/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30) 0.30	Soft, dark brown, sandy, gravelly TOPSOIL with rootlets.		
					(0.60) 0.90	Soft, light red brown, sandy, gravelly SILT. Gravel is angular to subangular, fine to coarse including siltstone, sandstone and mudstone.		
0.80 0.80	D2 B1							
			slight seepage(1) at 1.30m.			Firm, becoming stiff, dark red, brown, sandy, gravelly SILT. Gravel is angular to subrounded, fine to coarse including siltstone, sandstone and mudstone.		∇1
1.50 1.50	D4 B3				(1.50) 2.40			
2.50 2.50	D6 B5				(0.60) 3.00	Firm in places stiff, dark red, brown, sandy, gravelly SILT. Gravel is angular to subangular, fine to coarse including siltstone, sandstone and mudstone.		
3.00 3.00	B7 D8					At 3.00m: obstruction (rockhead encountered).		
						Complete at 3.00m		

Plan

Remarks

At 1.30m: slight seepage.
Trial pit remained stable throughout excavation.
Trial pit terminated at 3.00m due to obstruction.

Scale (approx)	Logged By	Figure No.
1:50	MV	40274.TP07

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Site	Trial Pit Number
Warren Hall Site - Broughton	TP08

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
JCB 3CX	3.00m x 0.60m x 3.50m		Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		15/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests
0.20	J3
0.20	D2
0.20	B1
0.40	J6
0.40	D5
0.40	B4
1.20	J9
1.20	D8
1.20	B7
2.00	D11
2.00	B10
2.40	D13
2.40	B12
3.40	D15
3.40	B14

Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
			(0.20) 0.20	MADE GROUND: Brown, clayey, sandy, gravelly TOPSOIL with some plant material. Gravel is subrounded to subangular, fine to coarse including sandstone and slag.		
			(1.30) 1.50	MADE GROUND: Orange brown, very clayey, slightly gravelly SAND with some nodules of clay and silt. Gravel is subrounded to subangular, fine and medium including ash and sandstone.		
			(0.90) 2.40	Soft in places firm, orange brown, sandy, slightly gravelly CLAY. Gravel is angular to subrounded, fine and medium including chert, flint, siltstone and sandstone. At 1.90m: occasional nodules of stiff clay.		
			(1.00) 3.40	Firm, red brown, sandy, slightly gravelly CLAY. Gravel is rounded to subrounded, fine to coarse including sandstone, siltstone and coal. Below 3.00m: very sandy.		
			(0.10) 3.50	Red, purple, brown SILTSTONE, recovered as slightly clayey sand and angular to subangular, fine to coarse gravel. At 3.50m: light grey.		
				Complete at 3.50m		

Plan

Remarks

Trial pit remained dry and stable throughout excavation.

Scale (approx)	Logged By	Figure No.
1:50	GP	40274.TP08

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IAN FARMER ASSOCIATES

Site	Trial Pit Number
Warren Hall Site - Broughton	**TP09**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
JCB 3CX	3.50m x 0.70m x 3.50m		Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		18/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30) 0.30	Soft, dark brown, sandy, gravelly TOPSOIL with rootlets.		
0.50 0.50	D2 B1				(0.80) 1.10	Soft in places firm, light red, brown, sandy, gravelly SILT. Gravel is angular to subangular, fine to coarse including siltstone, sandstone and mudstone.		
1.10 1.10 2.00 2.00	D4 B3 D6 B5				(1.90) 3.00	Firm, dark red, brown, sandy, gravelly SILT with occasional small fragments of coal.		
3.00 3.00	D8 B7				(0.50) 3.50	Red brown, clayey SAND.		
						Complete at 3.50m		

Plan

Remarks

Groundwater located between 1.00m and 1.10m.
Slight spalling between 0.00m and 3.00m.

Scale (approx)	Logged By	Figure No.
1:50	MV	40274.TP09

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IAN FARMER ASSOCIATES

Excavation Method	Dimensions	Ground Level (mOD)	Site	Trial Pit Number
JCB 3CX	3.30m x 0.70m x 4.50m		Warren Hall Site - Broughton	TP10
	Location	**Dates** 18/01/2008	**Client** Welsh Assembly Government	**Job Number** 40274
			Engineer Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.50) 0.50	Soft, dark brown, slightly gravelly TOPSOIL with rootlets.		
0.50 0.50	D2 B1				(0.40) 0.90	Soft in places firm, dark grey, brown, sandy, gravelly CLAY. Gravel is angular to subangular, fine to coarse of mudstone.		
0.90 0.90 0.90	J5 D4 B3				(0.60) 1.50	Firm in places stiff, red, orange, brown, mottled blue grey, gravelly CLAY. Gravel is angular to subangular, fine to coarse including siltstone, sandstone and mudstone.		
1.50 1.50	D7 B6					Red brown, sandy SILT with fragments of coal and rootlets.		
2.50 2.50	D9 B8		Water strike(1) at 2.50m.		(2.50)	Below 2.60m: with nodules of stiff, brown clay.		∇1
3.50 3.50	D11 B10				4.00			
4.50 4.50	B12 D13				(0.50) 4.50	Stiff, dark red, blue, brown, gravelly CLAY with some cobbles of mudstone. Gravel is angular to subangular, fine to coarse of siltstone.		
						Complete at 4.50m		

Plan

Remarks

Groundwater located at 2.50m.
Trial pit remained stable throughout excavation.

Scale (approx)	Logged By	Figure No.
1:50	MV	40274.TP10

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IAN FARMER ASSOCIATES

Site	Trial Pit Number
Warren Hall Site - Broughton	TP11

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
JCB 3CX	3.40m x 0.70m x 4.00m		Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		18/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.60)	Soft, dark brown, slightly gravelly TOPSOIL with rootlets.		
0.60	D2				0.60	Soft in places firm, light grey, red brown, gravelly CLAY. Gravel is angular to subangular, fine to coarse including mudstone and coal.		
0.60	B1				(0.40)			
1.00	J5				1.00	Firm, dark red brown, gravelly CLAY. Gravel is angular to subangular, fine to coarse including mudstone and coal.		
1.00	D4							
1.00	B3				(0.90)			
					1.90	Firm, dark black, blue grey, gravelly CLAY. Gravel is angular to subangular, fine to coarse including siltstone, quartz and mudstone.		
2.00	D7							
2.00	B6				(2.00)			
3.00	D9							
3.00	B8							
3.50	D11							
3.50	B10							
					3.90	Stiff, dark red, blue grey, sandy, gravelly CLAY with some cobbles of siltstone. Gravel is angular to subangular, fine to coarse including mudstone and siltstone.		
4.00	B12				(0.10)			
4.00	D13				4.00	Complete at 4.00m		

Plan

Remarks

Trial pit remained dry throughout excavation.
Slight spalling between 0.00m and 2.00m.

Scale (approx)	Logged By	Figure No.
1:50	MV	40274.TP11

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Excavation Method	Dimensions	Ground Level (mOD)	Site	Trial Pit Number
JCb 3CX	2.70m x 0.60m x 3.50m		Warren Hall Site - Broughton	TP12
			Client	**Job Number**
			Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		15/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30) 0.30	MADE GROUND: Brown, very clayey, sandy TOPSOIL with some plant material.		
0.20 0.20 0.20 0.50 0.50 0.50	D2 J3 B1 B4 D5 J6					MADE GROUND: Firm in places, orange brown, sandy, slightly gravelly CLAY with occasional localised pockets of clayey sand. Gravel is rounded to subangular, fine to coarse including sandstone, siltstone, coal and ash.		
					(1.80)			
1.50 1.50 1.50 1.50	D10a D8 J9 B7					At 1.50m: pocket of silty sand (sample D10a).		
					2.10			
2.20 2.20	B11 D12				(0.60)	Grey, very clayey SAND and angular to subangular, fine to coarse GRAVEL. Gravel includes siltstone and shale. At 2.50m: dark blue, grey with occasional cobbles.		
					2.70			
2.70 2.70	B13 D14				(0.80)	Dark blue grey SILTSTONE, recovered as clayey, sandy, angular, fine to coarse, tabular gravel of siltstone. Between 3.00m and 3.50m: slow progress (30 minutes).		
3.50 3.50	B15 D16				3.50			
						Complete at 3.50m		

Plan

Remarks

Trial pit remained dry and stable throughout excavation.

Scale (approx)	Logged By	Figure No.
1:50	GP	40274.TP12

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			Site Warren Hall Site - Broughton	**Trial Pit Number** **TP13**
Excavation Method JCb 3CX	**Dimensions** 2.50m x 0.60m x 1.20m	**Ground Level (mOD)**	**Client** Welsh Assembly Government	**Job Number** 40274
	Location	**Dates** 15/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.20	J3				(0.30) 0.30	Brown, very clayey, sandy, slightly gravelly TOPSOIL with occasional nodules of clay and occasional plant material. Gravel is subrounded to subangular, fine and medium of sandstone.		
0.20	D2							
0.20	B1							
0.30	J6				(0.40) 0.70	Firm, orange brown, sandy, slightly gravelly CLAY with occasional plant material. Gravel is rounded to subrounded, fine and medium including sandstone and quartz.		
0.30	D5							
0.30	B4							
0.70	D8				(0.50) 1.20	Orange brown SANDSTONE, recovered as slightly clayey, very sandy, angular to subangular, fine to coarse gravel with occasional cobbles and boulders. Gravel consists of sandstone. Between 0.80m and 1.20m: slow progress (20 minutes).		
0.70	B7							
						Complete at 1.20m		

Plan

Remarks

Trial pit remained dry and stable throughout excavation.

Scale (approx)	Logged By	Figure No.
1:50	GP	40274.TP13

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Site	Trial Pit Number
Warren Hall Site - Broughton	**TP14**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
JCB 3CX	2.50m x 0.60m x 3.50m		Welsh Assembly Government	40274
	Location	**Dates**	**Engineer**	**Sheet**
		16/01/2008	Opus International Consultants (UK) Ltd	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records
0.20	D2		
0.20	J3		
0.20	B1		
0.30	B4		
0.30	D5		
0.30	J6		
0.70	D8		
0.70	B7		
1.00	D10		
1.00	B9		
1.80	D11		
1.90	B12		
1.90	D13		
2.80	B14		
2.80	D15		
3.50	B16		
3.50	D17		

Level (mOD)	Depth (m) (Thickness)	Description
	(0.20) 0.20	Grass over brown, very clayey, sandy TOPSOIL with some plant material.
	(0.50) 0.70	Firm, mottled orange, brown, grey, sandy, slightly gravelly CLAY with rootlets and occasional small pockets of black silt. Gravel is subangular to subrounded, fine and medium of sandstone.
	(0.30) 1.00	Rock object, recovered as orange, dark grey, clayey, sandy, angular to subangular, fine to coarse gravel of sandstone.
	(0.80) 1.80	Orange brown, very clayey SAND and subangular to subrounded, fine to coarse gravel. Gravel includes sandstone and siltstone.
	(0.10) 1.90	Very weak, dark blue, grey SILTSTONE, recovered slightly sandy, angular to subangular, fine and medium gravel of siltstone.
	(1.60) 3.50	Grey, slightly clayey SAND and subangular to subrounded, fine to coarse GRAVEL with occasional nodules of clay/silt and occasional cobbles. Gravel includes sandstone and siltstone. At 2.80m: orange brown. At 3.10m: grey/cream.

Complete at 3.50m

Plan

Remarks

Trial pit remained dry and stable throughout excavation.

Scale (approx)	Logged By	Figure No.
1:50	GP	40274.TP14

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			Site Warren Hall Site - Broughton	**Trial Pit Number** **TP15**
Excavation Method JCB 3CX	**Dimensions** 2.70m x 0.60m x 4.00m	**Ground Level (mOD)**	**Client** Welsh Assembly Government	**Job Number** 40274
	Location	**Dates** 15/01/2008	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Grass over brown, very clayey, sandy, slightly gravelly TOPSOIL with occasional plant material. Gravel is subrounded to subangular, fine to coarse including sandstone, clinker and ash.		
0.20 0.20 0.20 0.30 0.30 0.30	D2 J3 B1 B4 D5 J6				(0.40) 0.60	Soft, orange brown, sandy, slightly gravelly CLAY. Gravel is subrounded to subangular, fine to coarse of sandstone.		
0.60 0.60	D8 B7				(1.00) 1.60	Soft, orange brown, mottled blue grey, slightly sandy, slightly gravelly CLAY with occasional rootlets. Gravel is rounded to subrounded, fine and medium of sandstone. Below 1.00m: occasional cobbles.		
1.60 1.60	D10 B9				(0.60) 2.20	Stiff, mottled dark blue grey/orange brown, sandy, gravelly CLAY. Gravel is angular to subrounded, fine to coarse including sandstone and siltstone. At 2.00m: occasional boulders.		
2.20 2.20	B11 D12				(0.50) 2.70	Light brown, very clayey, very gravelly SAND. Gravel is angular to subangular, fine to coarse including siltstone and sandstone.		
2.70 2.70	B13 D14				(0.30) 3.00	Light brown, very clayey SAND and angular to subangular, fine to coarse GRAVEL. Gravel consists of siltstone and sandstone.		
3.00 3.00	B15 D16				(1.00) 4.00	Blue grey, very clayey SAND and angular to subangular, fine to coarse GRAVEL. Gravel consists of siltstone and sandstone.		
4.00 4.00	B17 D18					Complete at 4.00m		

Plan

Remarks

Trial pit remained dry throughout excavation.
Slight spalling between 3.00m and 3.50m.

Scale (approx)	**Logged By**	**Figure No.**
1:50	GP	40274.TP15

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Figure A2.5

In-Situ Californian Bearing Ratio Test Results

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Tel. 0191 4166375 Fax. 0191 4191578 Email. lab@ifawashington.co.uk Internet.www.ianfarmerassociates.co.uk

TEST CERTIFICATE

IN-SITU PENETRATION TEST - CALIFORNIA BEARING RATIO AND MOISTURE CONTENT

BS 1377: Part 9 :1990: Clause 4.3 and BS 1377 : Part2 : 1990 : Clause 3.2

Job Number : 40674

Client : Ian Farmer Associates

Address : 17 Rivington Court,
Warrington,
Cheshire,
WA1 4RT

Site : Warren Hall

Requested By : Client

Test Location : C1

Test Depth : 0.30m

Reaction Load Inadequate : No

Report Number : C1@0.30/icbr

Sample Number : C1@0.30

Date Tested : 15/1/08

Date Received : 15/1/08

Sampled By : I.Henley for IFA

Sampled At : Site

Groundwater Level : Unknown

Test Number : C1

Weather Condition : Rainy

Presence of particles > 20mm : No

Sample Description : Brown sandy CLAY

California Bearing Ratio	14
Moisture Content Beneath the Test Area (%)	19

Comments : Graph showing applied force and penetration relationship attached.
CBR test is outside our scope of UKAS accreditation.

Checked By : V. Williamson **Date :** 23/1/08

V.Williamson Assistant Laboratory Manager

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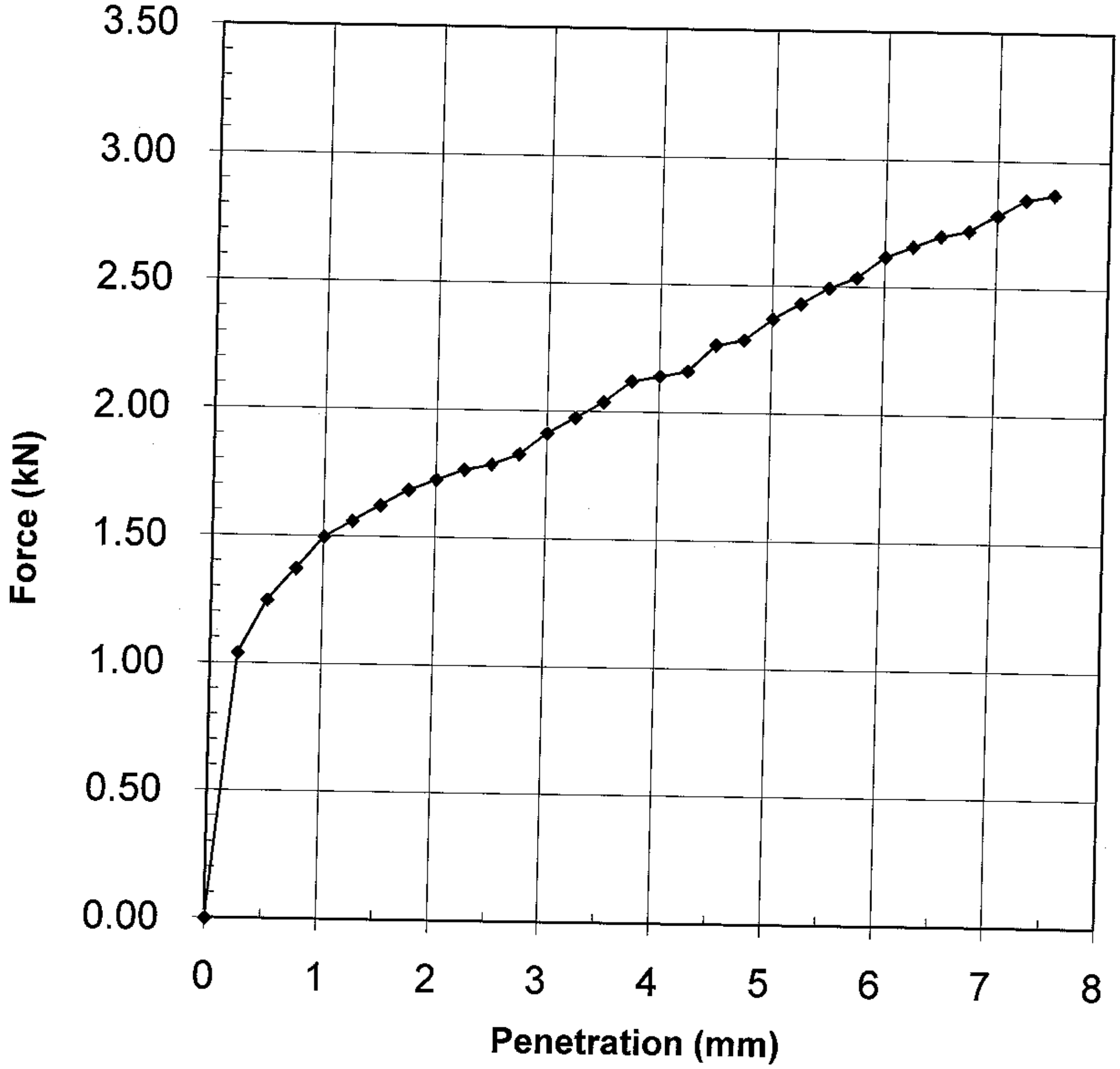
Newcastle Upon Tyne
NE 3RH
Tel: 0191 261 2473
Fax: 0191 222 1856

Insitu CBR
BS1377:Part 9:1990



PROJECT NAME :	Warren Hall	PROJECT NO :	40674

SAMPLE DETAILS BELOW			CBR VALUE		
TRIAL PIT	DEPTH (m)	MOISTURE CONTENT (%)	Penetration	2.5mm	5.0mm
C1	0.30	19	Force (kN) Value	1.79 14	2.37 12
			CBR	14	

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TEST CERTIFICATE

IN-SITU PENETRATION TEST - CALIFORNIA BEARING RATIO AND MOISTURE CONTENT

BS 1377: Part 9 :1990: Clause 4.3 and BS 1377 : Part2 : 1990 : Clause 3.2

Job Number : 40674

Client : Ian Farmer Associates

Address : 17 Rivington Court,
Warrington,
Cheshire,
WA1 4RT

Site : Warren Hall

Requested By : Client

Test Location : C2

Test Depth : 0.30m

Reaction Load Inadequate : No

Report Number : C2@0.30/icbr

Sample Number : C2@0.30

Date Tested : 15/1/08

Date Received : 15/1/08

Sampled By : I.Henley for IFA

Sampled At : Site

Groundwater Level : Unknown

Test Number : C2

Weather Condition : Rainy

Presence of particles > 20mm : No

Sample Description : Brown slightly sandy CLAY

California Bearing Ratio	12
Moisture Content Beneath the Test Area (%)	24

Comments : Graph showing applied force and penetration relationship attached.
CBR test is outside our scope of UKAS accreditation.

Checked By : V.Williamson Assistant Laboratory Manager

Date : 23/1/08

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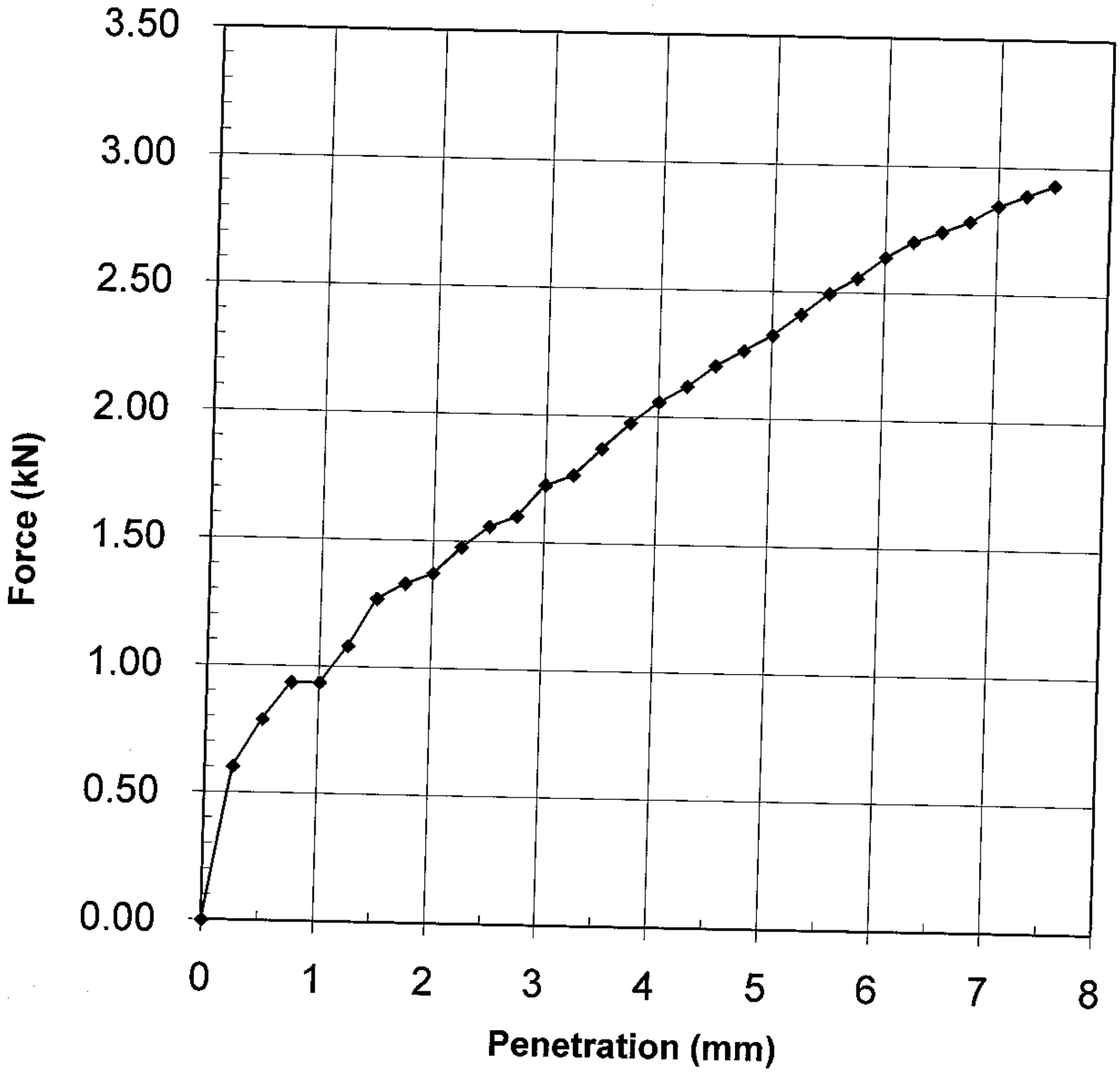

PROJECT NAME :	Warren Hall	PROJECT NO :	40674

SAMPLE DETAILS BELOW			CBR VALUE		
TRIAL PIT	DEPTH (m)	MOISTURE CONTENT (%)	Penetration	2.5mm	5.0mm
C2	0.30	24	Force (kN) Value	1.56 12	2.33 12
			CBR	12	

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BS 1377: Part 9 :1990: Clause 4.3 and BS 1377 : Part2 : 1990 : Clause 3.2

Job Number : 40674

Client : Ian Farmer Associates

Address : 17 Rivington Court,
Warrington,
Cheshire,
WA1 4RT

Site : Warren Hall

Requested By : Client

Test Location : C3

Test Depth : 0.30m

Reaction Load Inadequate : No

Report Number : C3@0.30/icbr

Sample Number : C3@0.30

Date Tested : 15/1/08

Date Received : 15/1/08

Sampled By : I.Henley for IFA

Sampled At : Site

Groundwater Level : Unknown

Test Number : C3

Weather Condition : Rainy

Presence of particles > 20mm : No

Sample Description : Brown CLAY

California Bearing Ratio	9.8
Moisture Content Beneath the Test Area (%)	26

Comments : Graph showing applied force and penetration relationship attached.
CBR test is outside our scope of UKAS accreditation.

Checked By : V.Williamson Assistant Laboratory Manager

Date : 23/1/08

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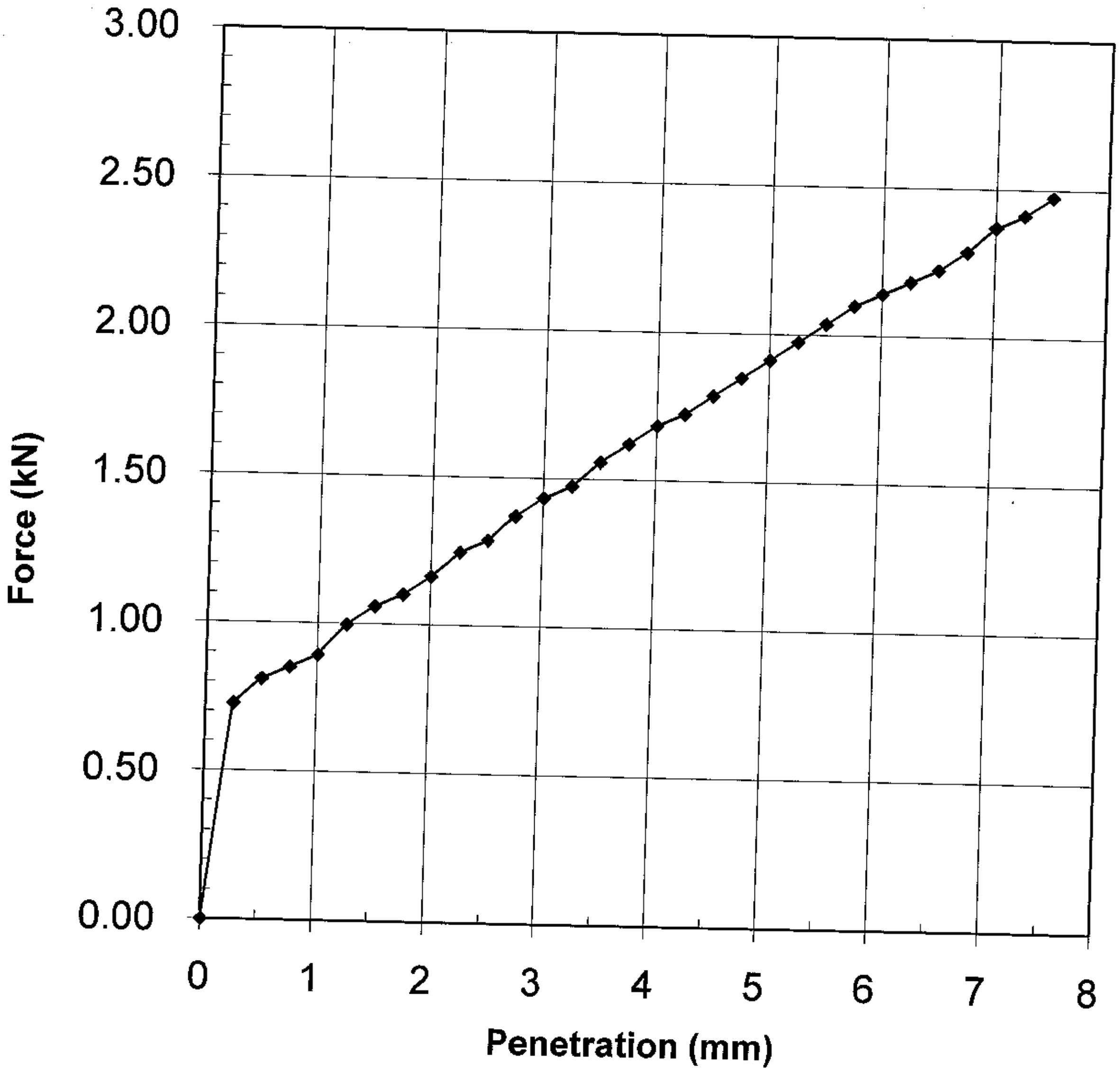
Insitu CBR
BS1377:Part 9:1990



PROJECT NAME :	Warren Hall	PROJECT NO :	40674

SAMPLE DETAILS BELOW			CBR VALUE		
TRIAL PIT	DEPTH (m)	MOISTURE CONTENT (%)	Penetration	2.5mm	5.0mm
C3	0.30	26	Force (kN) Value	1.29 9.8	1.91 9.6
			CBR	9.8	

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BS 1377: Part 9 :1990: Clause 4.3 and BS 1377 : Part2 : 1990 : Clause 3.2

Job Number : 40674

Client : Ian Farmer Associates

Address : 17 Rivington Court,
Warrington,
Cheshire,
WA1 4RT

Site : Warren Hall

Requested By : Client

Test Location : C4

Test Depth : 0.30m

Reaction Load Inadequate : No

Sample Description : Brown CLAY

Report Number : C4@0.30/icbr

Sample Number : C4@0.30

Date Tested : 15/1/08

Date Received : 15/1/08

Sampled By : I.Henley for IFA

Sampled At : Site

Groundwater Level : Unknown

Test Number : C4

Weather Condition : Rainy

Presence of particles > 20mm : No

California Bearing Ratio	9.1
Moisture Content Beneath the Test Area (%)	21

Comments : Graph showing applied force and penetration relationship attached.
CBR test is outside our scope of UKAS accreditation.

Checked By : V.Williamson Assistant Laboratory Manager

Date : 23/1/08

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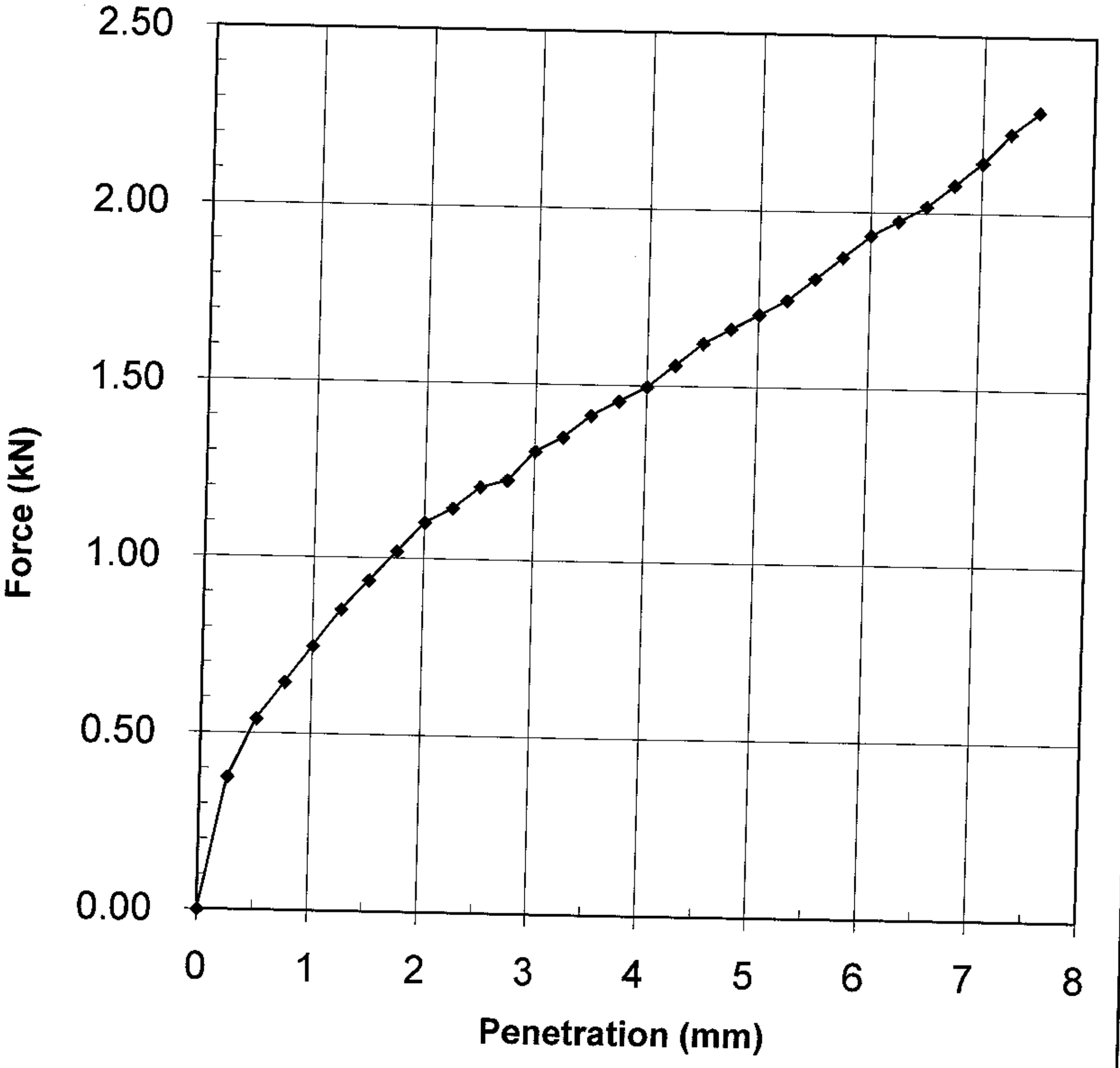
Insitu CBR
BS1377:Part 9:1990



PROJECT NAME :	Warren Hall	PROJECT NO :	40674

SAMPLE DETAILS BELOW			CBR VALUE		
TRIAL PIT	DEPTH (m)	MOISTURE CONTENT (%)	Penetration	2.5mm	5.0mm
C4	0.30	21	Force (kN) Value	1.21 9.1	1.70 8.5
			CBR	9.1	

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BS 1377: Part 9 :1990: Clause 4.3 and BS 1377 : Part2 : 1990 : Clause 3.2

Job Number : 40674

Client : Ian Farmer Associates

Address : 17 Rivington Court,
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Cheshire,
WA1 4RT

Site : Warren Hall

Requested By : Client

Test Location : C5

Test Depth : 0.30m

Reaction Load Inadequate : No

Report Number : C5@0.30/icbr

Sample Number : C5@0.30

Date Tested : 15/1/08

Date Received : 15/1/08

Sampled By : I.Henley for IFA

Sampled At : Site

Groundwater Level : Unknown

Test Number : C5

Weather Condition : Rainy

Presence of particles > 20mm : No

Sample Description : Brown slightly sandy slightly gravelly CLAY

California Bearing Ratio	9.8
Moisture Content Beneath the Test Area (%)	16

Comments : Graph showing applied force and penetration relationship attached.
CBR test is outside our scope of UKAS accreditation.

Checked By :

Date : 23/1/08

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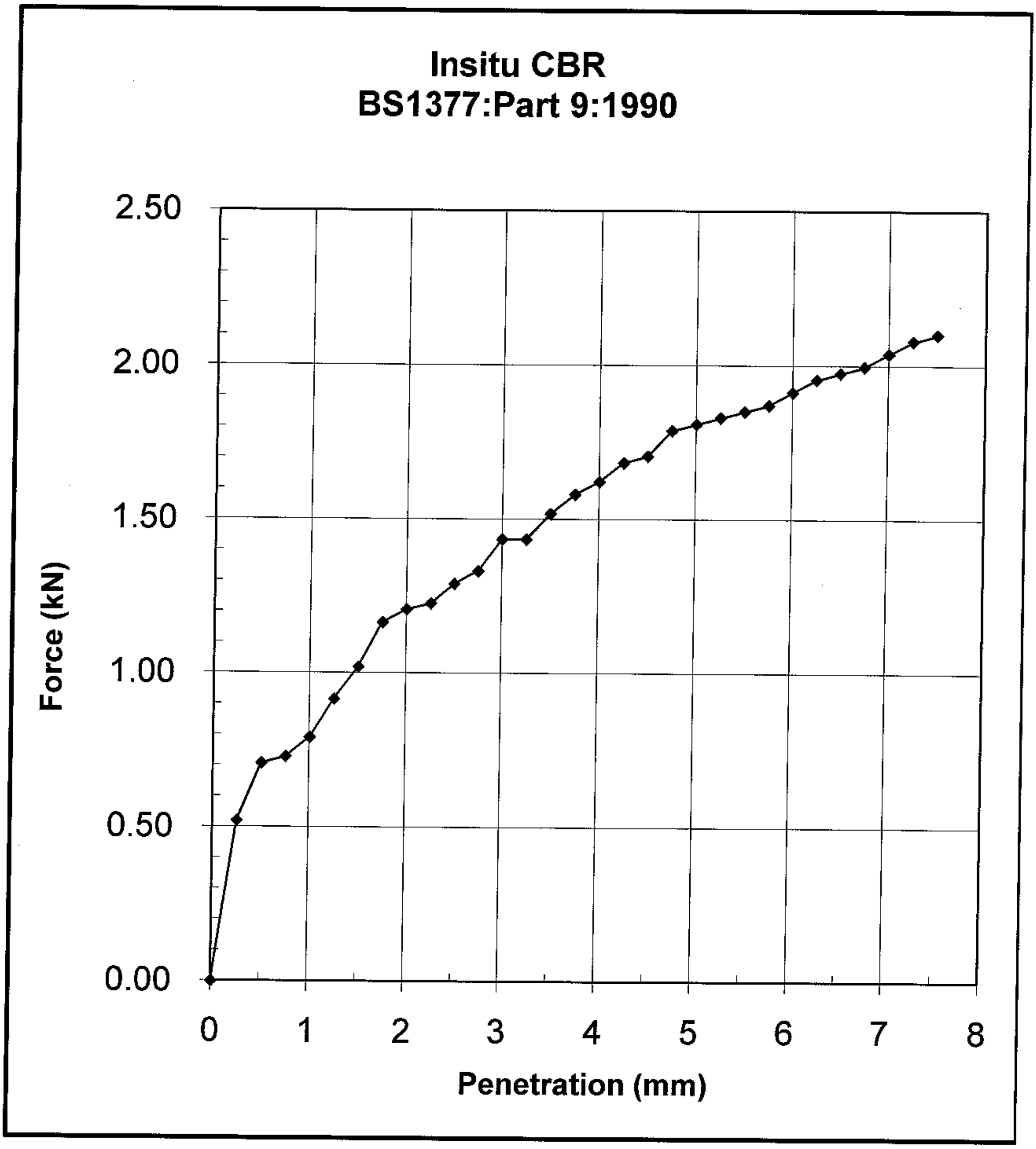

PROJECT NAME :	Warren Hall	PROJECT NO :	40674

SAMPLE DETAILS BELOW			CBR VALUE		
TRIAL PIT	DEPTH (m)	MOISTURE CONTENT (%)	Penetration	2.5mm	5.0mm
C5	0.30	16	Force (kN)	1.29	1.81
			Value	9.8	9.0
			CBR	9.8	

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IN-SITU PENETRATION TEST - CALIFORNIA BEARING RATIO AND MOISTURE CONTENT

BS 1377: Part 9 :1990: Clause 4.3 and BS 1377 : Part2 : 1990 : Clause 3.2

Job Number : 40674

Report Number : C6@0.30/icbr

Client : Ian Farmer Associates

Sample Number : C6@0.30

Address : 17 Rivington Court,
Warrington,
Cheshire,
WA1 4RT

Date Tested : 15/1/08

Date Received : 15/1/08

Sampled By : I.Henley for IFA

Site : Warren Hall

Sampled At : Site

Requested By : Client

Groundwater Level : Unknown

Test Location : C6

Test Number : C6

Test Depth : 0.30m

Weather Condition : Rainy

Reaction Load Inadequate : No

Presence of particles > 20mm : No

Sample Description : Brown slightly gravelly clayey SAND

California Bearing Ratio	13
Moisture Content Beneath the Test Area (%)	30

Comments : Graph showing applied force and penetration relationship attached.
CBR test is outside our scope of UKAS accreditation.

Checked By : [signature] **Date :** 23/1/08
V.Williamson Assistant Laboratory Manager

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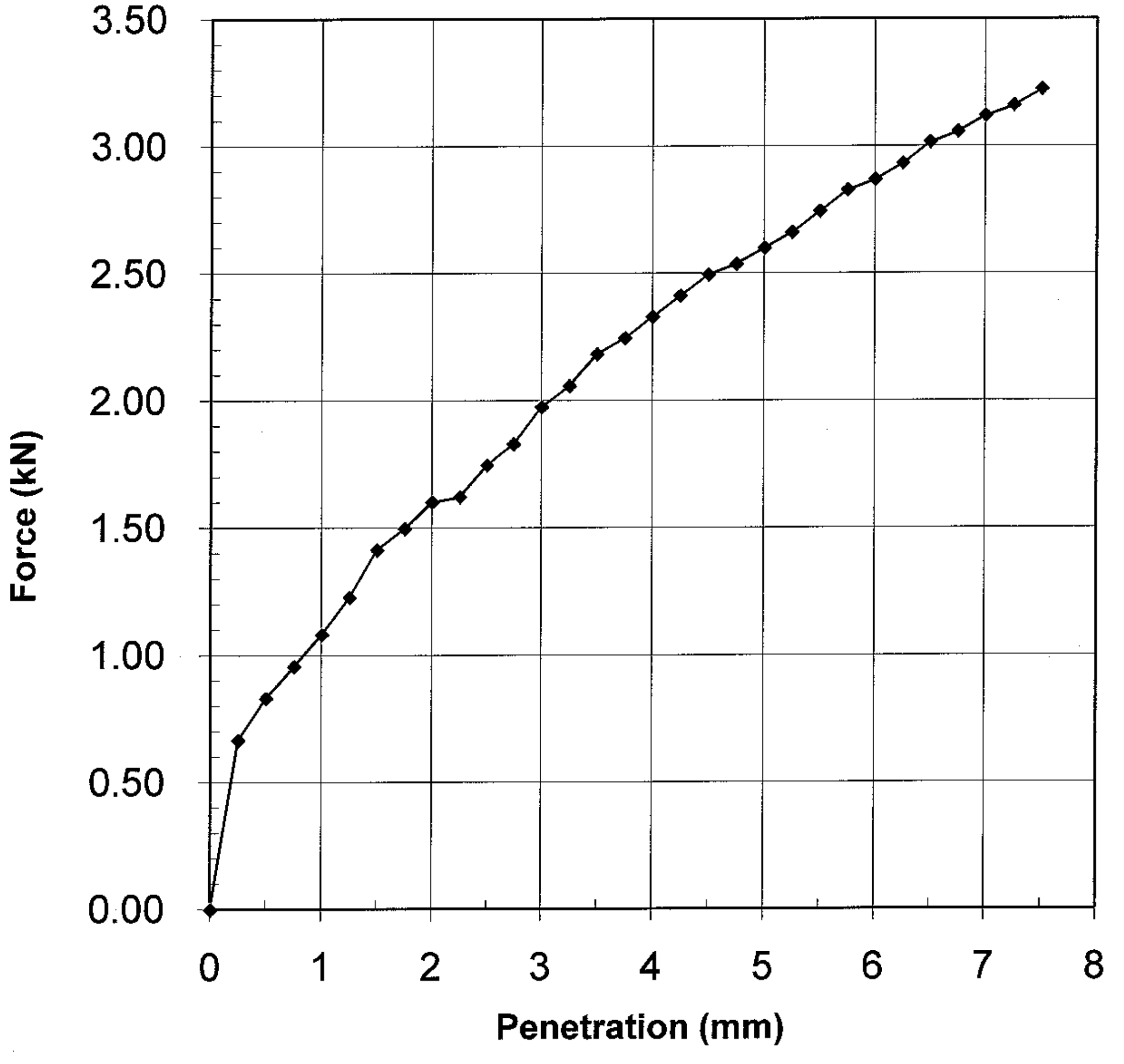

PROJECT NAME :	Warren Hall	PROJECT NO :	40674

SAMPLE DETAILS BELOW			CBR VALUE		
TRIAL PIT	DEPTH (m)	MOISTURE CONTENT (%)	Penetration	2.5mm	5.0mm
C6	0.30	30	Force (kN)	1.75	2.60
			Value	13	13
			CBR	13	

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TEST CERTIFICATE

IN-SITU PENETRATION TEST - CALIFORNIA BEARING RATIO AND MOISTURE CONTENT

BS 1377: Part 9 :1990: Clause 4.3 and BS 1377 : Part2 : 1990 : Clause 3.2

Job Number : 40674

Report Number : C7@0.30/icbr

Client : Ian Farmer Associates

Sample Number : C7@0.30

Address : 17 Rivington Court,
Warrington,
Cheshire,
WA1 4RT

Date Tested : 15/1/08

Date Received : 15/1/08

Sampled By : I.Henley for IFA

Site : Warren Hall

Sampled At : Site

Requested By : Client

Groundwater Level : Unknown

Test Location : C7

Test Number : C7

Test Depth : 0.30m

Weather Condition : Rainy

Reaction Load Inadequate : No

Presence of particles > 20mm : No

Sample Description : Brown slightly gravelly clayey SAND

California Bearing Ratio	30
Moisture Content Beneath the Test Area (%)	19

Comments : Graph showing applied force and penetration relationship attached.
CBR test is outside our scope of UKAS accreditation.

Checked By : V. Williamson

V.Williamson Assistant Laboratory Manager

Date : 23/1/08

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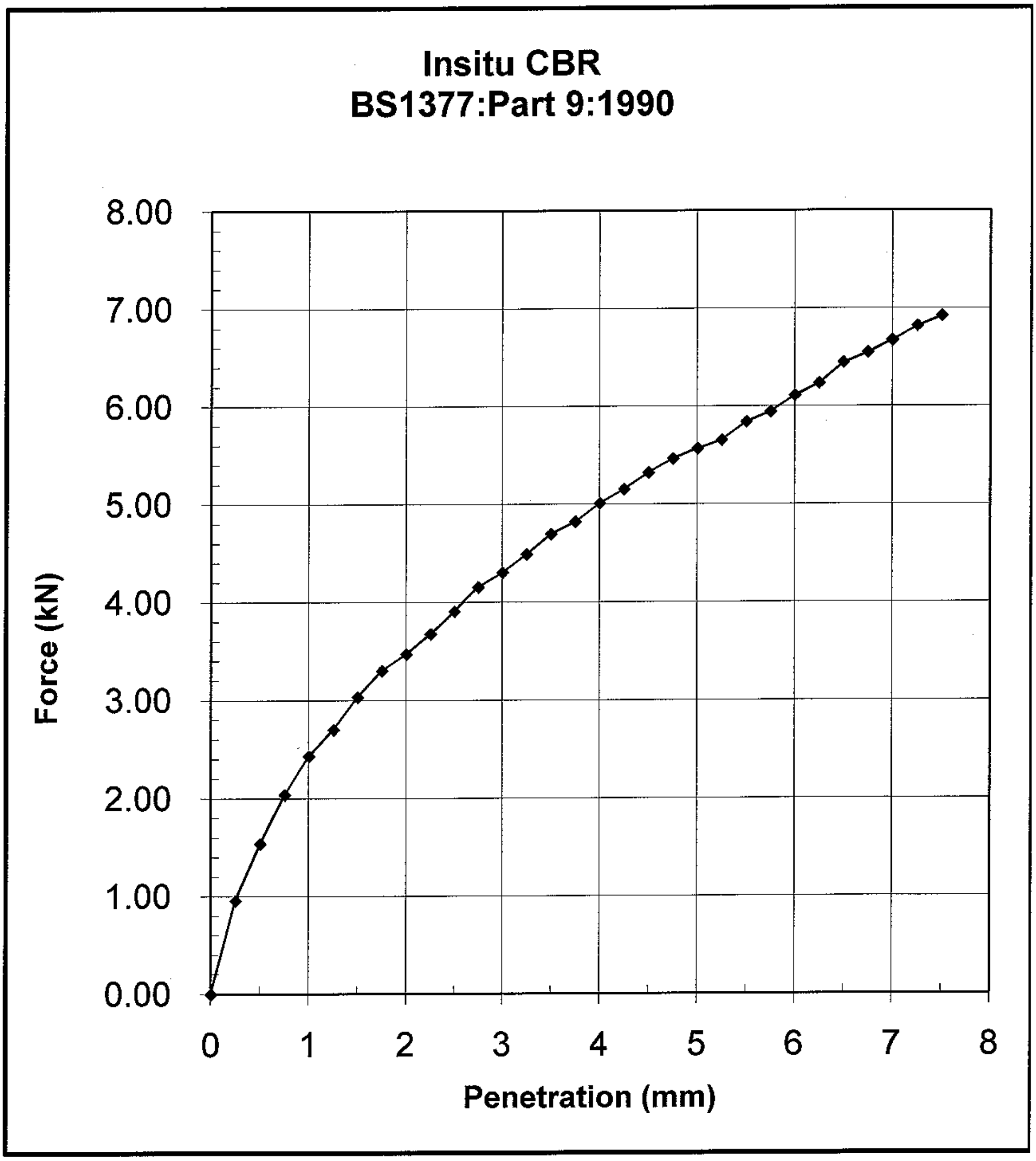

PROJECT NAME :	Warren Hall	PROJECT NO :	40674

SAMPLE DETAILS BELOW			CBR VALUE		
TRIAL PIT	DEPTH (m)	MOISTURE CONTENT (%)	Penetration	2.5mm	5.0mm
C7	0.30	19	Force (kN)	3.91	5.57
			Value	30	28
			CBR	30	

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TEST CERTIFICATE

IN-SITU PENETRATION TEST - CALIFORNIA BEARING RATIO AND MOISTURE CONTENT

BS 1377: Part 9 :1990: Clause 4.3 and BS 1377 : Part2 : 1990 : Clause 3.2

Job Number : 40674

Report Number : C8@0.30/icbr

Client : Ian Farmer Associates

Sample Number : C8@0.30

Address : 17 Rivington Court,
Warrington,
Cheshire,
WA1 4RT

Date Tested : 15/1/08

Date Received : 15/1/08

Sampled By : I.Henley for IFA

Site : Warren Hall

Sampled At : Site

Requested By : Client

Groundwater Level : Unknown

Test Location : C8

Test Number : C8

Test Depth : 0.30m

Weather Condition : Rainy

Reaction Load Inadequate : No

Presence of particles > 20mm : No

Sample Description : Brown slightly gravelly clayey SAND

California Bearing Ratio	8.7
Moisture Content Beneath the Test Area (%)	20

Comments : Graph showing applied force and penetration relationship attached.
CBR test is outside our scope of UKAS accreditation.

Checked By : V. Williamson

Date : 23/1/08

V.Williamson Assistant Laboratory Manager

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Registered Office: Unit 1, Bamburgh Court, TVTE, Gateshead, Tyne & Wear, NE11 0TX
Offices in: Coventry (02476) 456565. Harpenden, Herts. (01582) 460018. Truro (01872) 261775.
Warrington (01925) 855440. Newcastle upon Tyne (0191) 4828500. Motherwell (01698) 230231.

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UKAS TESTING
1464

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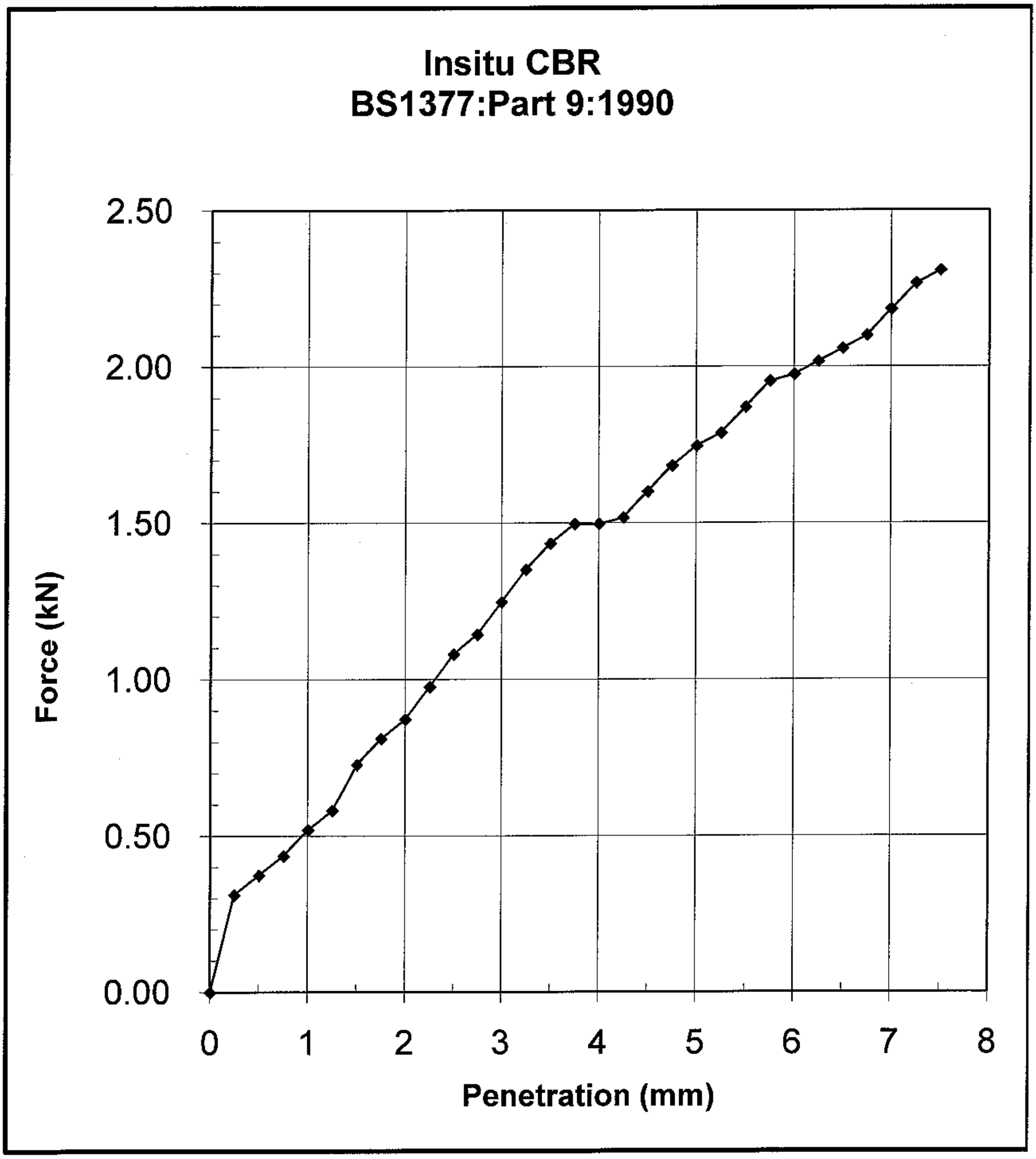
11-12 Skinnerburn Road
Newcastle Upon Tyne
NE 3RH
Tel: 0191 261 2473
Fax: 0191 222 1856



PROJECT NAME :	Warren Hall	PROJECT NO :	40674

SAMPLE DETAILS BELOW			CBR VALUE		
TRIAL PIT	DEPTH (m)	MOISTURE CONTENT (%)	Penetration	2.5mm	5.0mm
C8	0.30	20	Force (kN)	1.08	1.75
			Value	8.2	8.7
			CBR	8.7	

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Geotechnical & Environmental Specialists

14 Faraday Close, District 15, Pattinson North Industrial Estate, Washington, Tyne & Wear, NE38 8QJ.
Tel. 0191 4166375 Fax. 0191 4191578 Email. lab@ifawashington.co.uk Internet.www.ianfarmerassociates.co.uk

TEST CERTIFICATE

IN-SITU PENETRATION TEST - CALIFORNIA BEARING RATIO AND MOISTURE CONTENT

BS 1377: Part 9 :1990: Clause 4.3 and BS 1377 : Part2 : 1990 : Clause 3.2

Job Number : 40674

Client : Ian Farmer Associates

Address : 17 Rivington Court,
Warrington,
Cheshire,
WA1 4RT

Site : Warren Hall

Requested By : Client

Test Location : C9

Test Depth : 0.30m

Reaction Load Inadequate : No

Report Number : C9@0.30/icbr

Sample Number : C9@0.30

Date Tested : 15/1/08

Date Received : 15/1/08

Sampled By : I.Henley for IFA

Sampled At : Site

Groundwater Level : Unknown

Test Number : C9

Weather Condition : Rainy

Presence of particles > 20mm : No

Sample Description : Brown slightly gravelly CLAY

California Bearing Ratio	19
Moisture Content Beneath the Test Area (%)	25

Comments : Graph showing applied force and penetration relationship attached.
CBR test is outside our scope of UKAS accreditation.

Checked By : [signature] **Date :** 23/1/08

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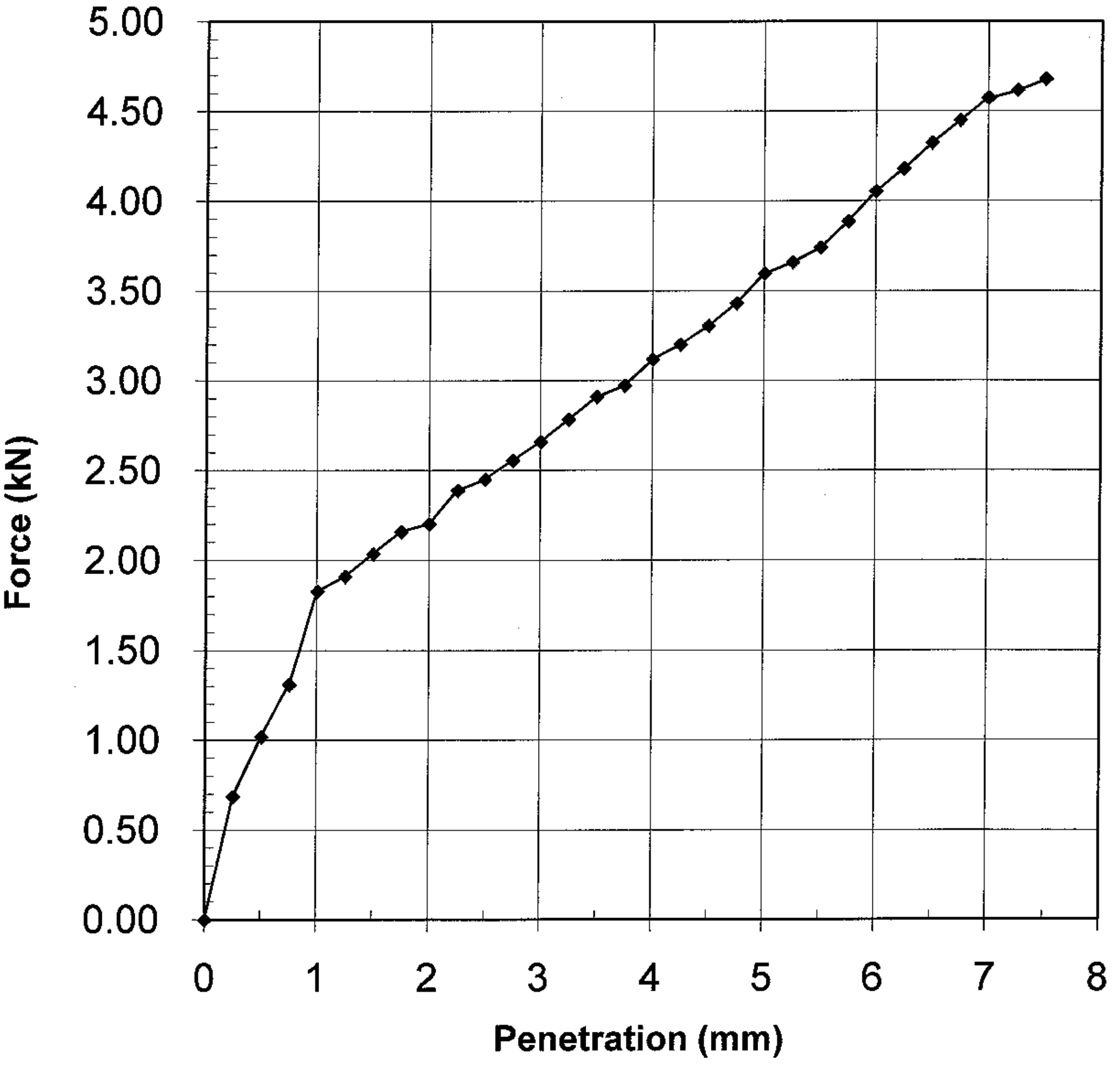
Newcastle Upon Tyne
NE 3RH
Tel: 0191 261 2473
Fax: 0191 222 1856

Insitu CBR
BS1377:Part 9:1990



PROJECT NAME :	Warren Hall	PROJECT NO :	40674

SAMPLE DETAILS BELOW			CBR VALUE		
TRIAL PIT	DEPTH (m)	MOISTURE CONTENT (%)	Penetration	2.5mm	5.0mm
C9	0.30	25	Force (kN)	2.45	3.60
			Value	19	18
			CBR	19	

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Geotechnical & Environmental Specialists
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IN-SITU PENETRATION TEST - CALIFORNIA BEARING RATIO AND MOISTURE CONTENT

BS 1377: Part 9 :1990: Clause 4.3 and BS 1377 : Part2 : 1990 : Clause 3.2

Job Number : 40674

Client : Ian Farmer Associates

Address : 17 Rivington Court,
Warrington,
Cheshire,
WA1 4RT

Site : Warren Hall

Requested By : Client

Test Location : C10

Test Depth : 0.30m

Reaction Load Inadequate : No

Report Number : C10@0.30/icbr

Sample Number : C10@0.30

Date Tested : 15/1/08

Date Received : 15/1/08

Sampled By : I.Henley for IFA

Sampled At : Site

Groundwater Level : Unknown

Test Number : C10

Weather Condition : Rainy

Presence of particles > 20mm : No

Sample Description : Brown CLAY

California Bearing Ratio	18
Moisture Content Beneath the Test Area (%)	21

Comments : Graph showing applied force and penetration relationship attached.
CBR test is outside our scope of UKAS accreditation.

Checked By : V. Williamson **Date :** 23/1/08
V.Williamson Assistant Laboratory Manager

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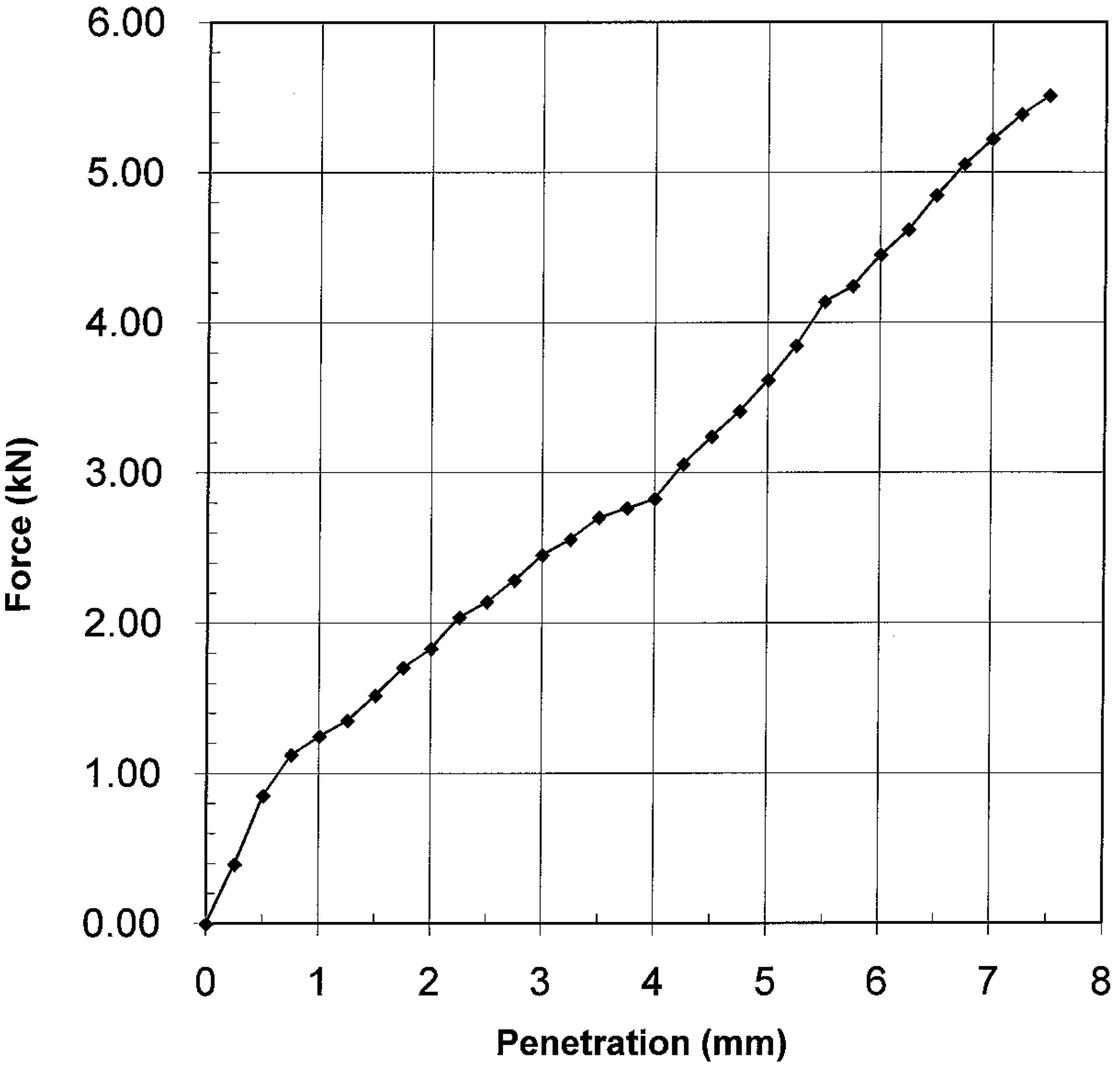
Newcastle Upon Tyne
NE 3RH
Tel: 0191 261 2473
Fax: 0191 222 1856

Insitu CBR
BS1377:Part 9:1990



PROJECT NAME :	Warren Hall	PROJECT NO :	40674

SAMPLE DETAILS BELOW			CBR VALUE		
TRIAL PIT	DEPTH (m)	MOISTURE CONTENT (%)	Penetration	2.5mm	5.0mm
C10	0.30	21	Force (kN)	2.14	3.62
			Value	16	18
			CBR	18	

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Geotechnical & Environmental Specialists
14 Faraday Close, District 15, Pattinson North Industrial Estate, Washington, Tyne & Wear, NE38 8QJ.
Tel. 0191 4166375 Fax. 0191 4191578 Email. lab@ifawashington.co.uk Internet.www.ianfarmerassociates.co.uk

TEST CERTIFICATE

IN-SITU PENETRATION TEST - CALIFORNIA BEARING RATIO AND MOISTURE CONTENT

BS 1377: Part 9 :1990: Clause 4.3 and BS 1377 : Part2 : 1990 : Clause 3.2

Job Number : 40674

Report Number : C11@0.30/icbr

Client : Ian Farmer Associates

Sample Number : C11@0.30

Address : 17 Rivington Court,
Warrington,
Cheshire,
WA1 4RT

Date Tested : 15/1/08

Date Received : 15/1/08

Sampled By : I.Henley for IFA

Site : Warren Hall

Sampled At : Site

Requested By : Client

Groundwater Level : Unknown

Test Location : C11

Test Number : C11

Test Depth : 0.30m

Weather Condition : Rainy

Reaction Load Inadequate : No

Presence of particles > 20mm : No

Sample Description : Brown slightly sandy CLAY

California Bearing Ratio	13
Moisture Content Beneath the Test Area (%)	19

Comments : Graph showing applied force and penetration relationship attached.
CBR test is outside our scope of UKAS accreditation.

Checked By : V.Williamson Assistant Laboratory Manager

Date : 23/1/08

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11-12 Skinnerburn Road
Newcastle Upon Tyne
NE 3RH
Tel: 0191 261 2473
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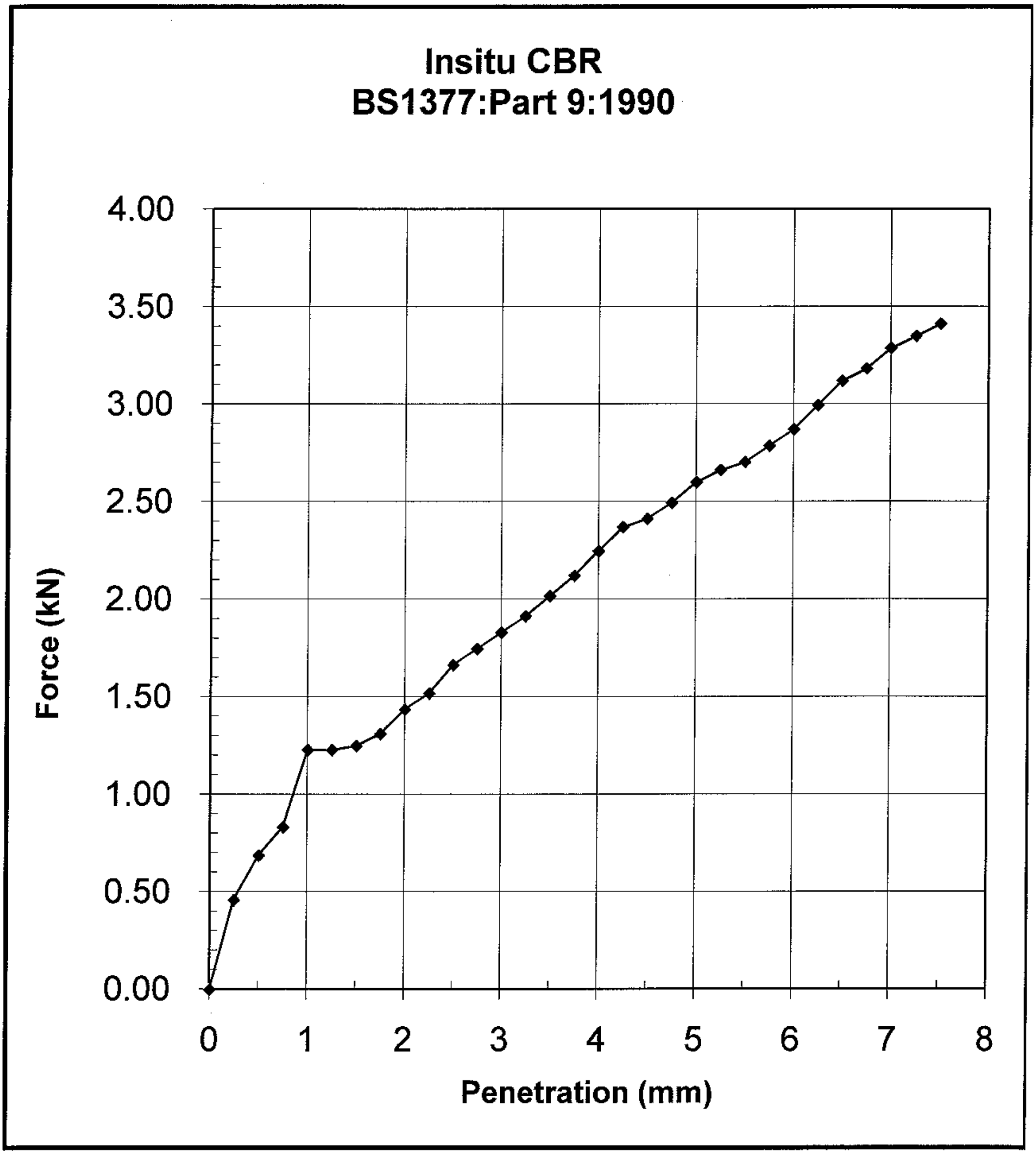

PROJECT NAME :	Warren Hall	PROJECT NO :	40674

SAMPLE DETAILS BELOW			CBR VALUE		
TRIAL PIT	DEPTH (m)	MOISTURE CONTENT (%)	Penetration	2.5mm	5.0mm
C11	0.30	19	Force (kN)	1.66	2.60
			Value	13	13
			CBR	13	

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TEST CERTIFICATE

IN-SITU PENETRATION TEST - CALIFORNIA BEARING RATIO AND MOISTURE CONTENT

BS 1377: Part 9 :1990: Clause 4.3 and BS 1377 : Part2 : 1990 : Clause 3.2

Job Number : 40674

Report Number : C12@0.30/icbr

Client : Ian Farmer Associates

Sample Number : C12@0.30

Address : 17 Rivington Court,
Warrington,
Cheshire,
WA1 4RT

Date Tested : 15/1/08

Date Received : 15/1/08

Sampled By : I.Henley for IFA

Site : Warren Hall

Sampled At : Site

Requested By : Client

Groundwater Level : Unknown

Test Location : C12

Test Number : C12

Test Depth : 0.30m

Weather Condition : Rainy

Reaction Load Inadequate : No

Presence of particles > 20mm : No

Sample Description : Brown slightly sandy CLAY

California Bearing Ratio	7.4
Moisture Content Beneath the Test Area (%)	19

Comments : Graph showing applied force and penetration relationship attached.
CBR test is outside our scope of UKAS accreditation.

Checked By : V. Williamson **Date :** 23/1/08

V.Williamson Assistant Laboratory Manager

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IAN FARMER ASSOCIATES
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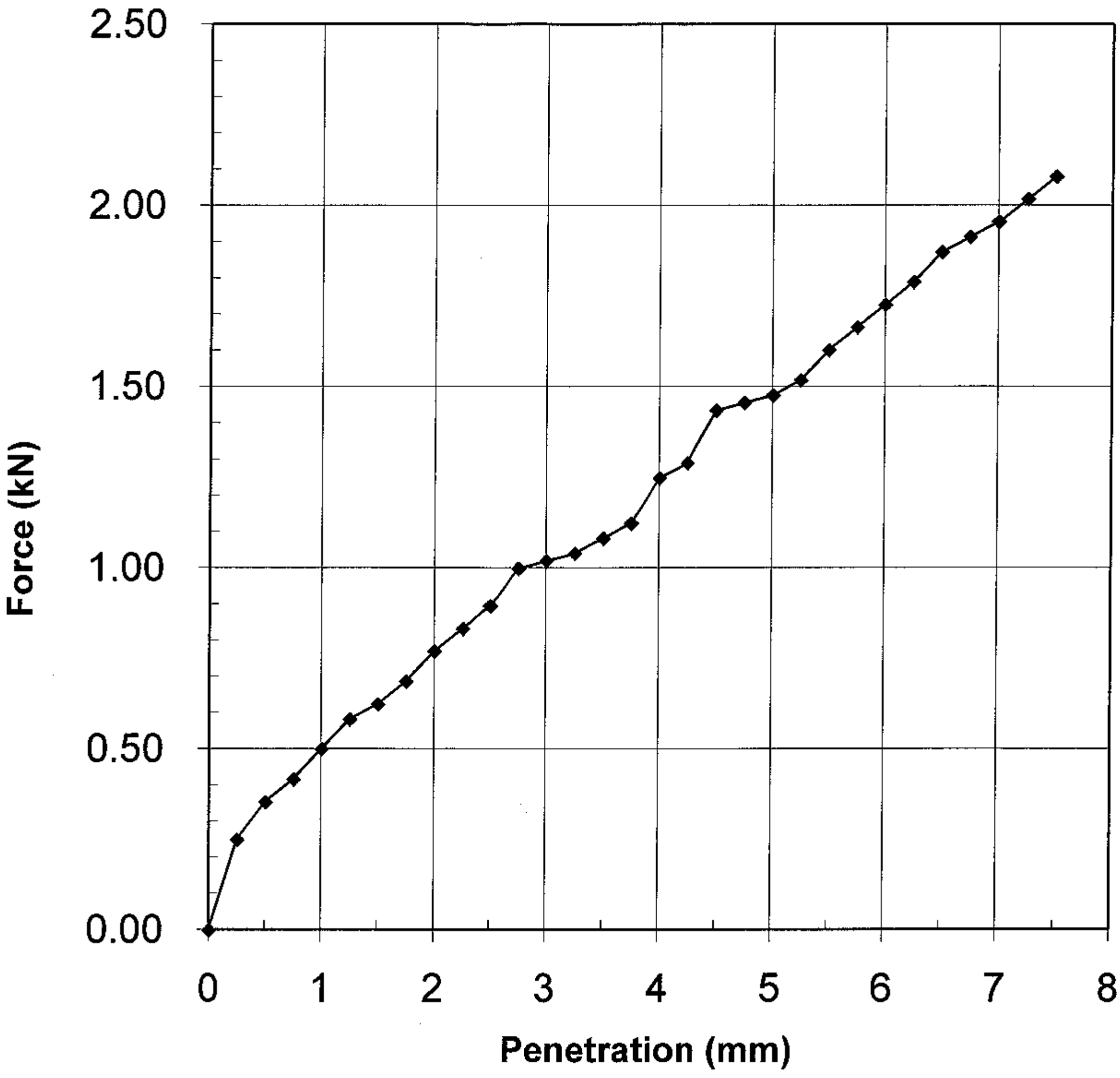
Newcastle Upon Tyne
NE 3RH
Tel: 0191 261 2473
Fax: 0191 222 1856

Insitu CBR
BS1377:Part 9:1990



PROJECT NAME :	Warren Hall	PROJECT NO :	40674

SAMPLE DETAILS BELOW			CBR VALUE		
TRIAL PIT	DEPTH (m)	MOISTURE CONTENT (%)	Penetration	2.5mm	5.0mm
C12	0.30	19	Force (kN)	0.89	1.48
			Value	6.8	7.4
			CBR	7.4	

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TEST CERTIFICATE

IN-SITU PENETRATION TEST - CALIFORNIA BEARING RATIO AND MOISTURE CONTENT

BS 1377: Part 9 :1990: Clause 4.3 and BS 1377 : Part2 : 1990 : Clause 3.2

Job Number : 40674

Report Number : C13@0.30/icbr

Client : Ian Farmer Associates

Sample Number : C13@0.30

Address : 17 Rivington Court,
Warrington,
Cheshire,
WA1 4RT

Date Tested : 15/1/08

Date Received : 15/1/08

Sampled By : I.Henley for IFA

Site : Warren Hall

Sampled At : Site

Requested By : Client

Groundwater Level : Unknown

Test Location : C13

Test Number : C13

Test Depth : 0.30m

Weather Condition : Rainy

Reaction Load Inadequate : No

Presence of particles > 20mm : No

Sample Description : Brown slightly sandy CLAY

California Bearing Ratio	12
Moisture Content Beneath the Test Area (%)	20

Comments : Graph showing applied force and penetration relationship attached.
CBR test is outside our scope of UKAS accreditation.

Checked By : [signature]

Date : 23/1/08

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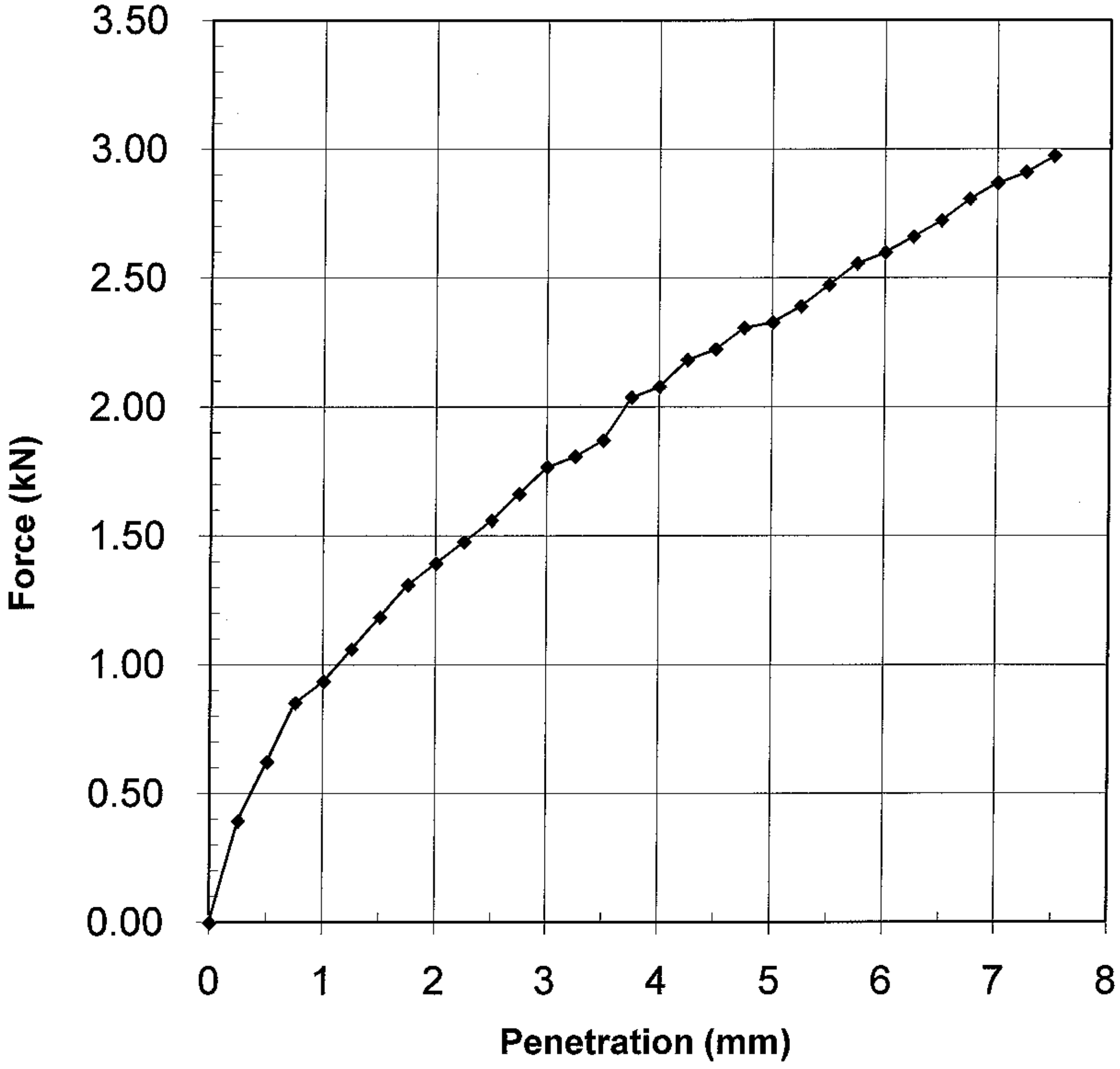
Insitu CBR
BS1377:Part 9:1990



PROJECT NAME :	Warren Hall	PROJECT NO :	40674

SAMPLE DETAILS BELOW			CBR VALUE		
TRIAL PIT	DEPTH (m)	MOISTURE CONTENT (%)	Penetration	2.5mm	5.0mm
C13	0.30	20	Force (kN)	1.56	2.33
			Value	12	12
			CBR	12	

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Geotechnical & Environmental Specialists
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TEST CERTIFICATE

IN-SITU PENETRATION TEST - CALIFORNIA BEARING RATIO AND MOISTURE CONTENT

BS 1377: Part 9 :1990: Clause 4.3 and BS 1377 : Part2 : 1990 : Clause 3.2

Job Number : 40674

Report Number : C14@0.30/icbr

Client : Ian Farmer Associates

Sample Number : C14 @0.30

Address : 17 Rivington Court, Warrington, Cheshire, WA1 4RT

Date Tested : 15/1/08

Date Received : 15/1/08

Sampled By : I.Henley for IFA

Site : Warren Hall

Sampled At : Site

Requested By : Client

Groundwater Level : Unknown

Test Location : C14

Test Number : C14

Test Depth : 0.30m

Weather Condition : Rainy

Reaction Load Inadequate : No

Presence of particles > 20mm : No

Sample Description : Brown CLAY

California Bearing Ratio	12
Moisture Content Beneath the Test Area (%)	25

Comments : Graph showing applied force and penetration relationship attached.
CBR test is outside our scope of UKAS accreditation.

Checked By : [signature] **Date :** 23/1/08

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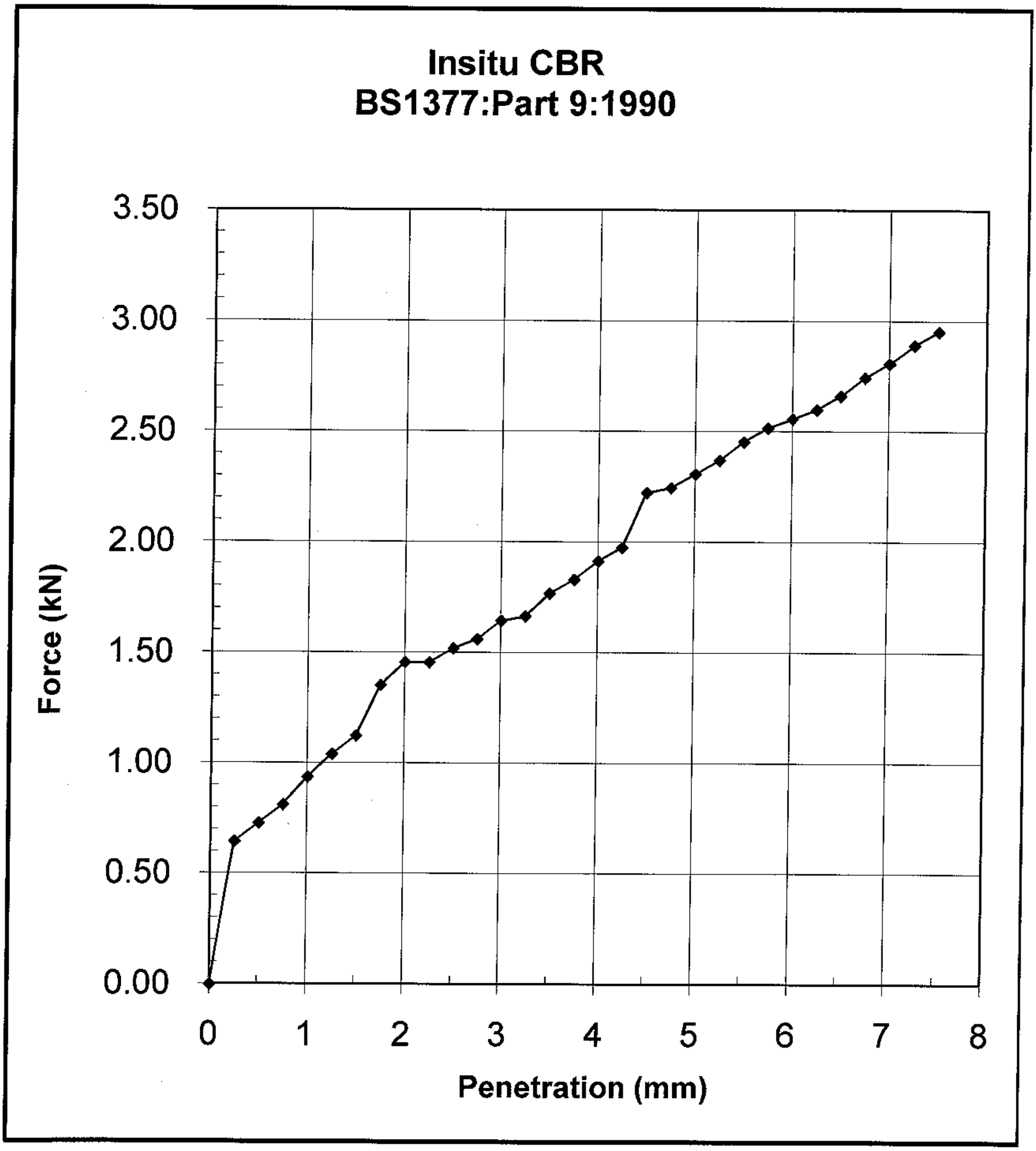

PROJECT NAME :	Warren Hall	PROJECT NO :	40674

SAMPLE DETAILS BELOW			CBR VALUE		
TRIAL PIT	DEPTH (m)	MOISTURE CONTENT (%)	Penetration	2.5mm	5.0mm
C14	0.30	25	Force (kN) Value	1.52 11	2.31 12
			CBR	12	

Figure A2.6

SPT Summary Table

IAN FARMER ASSOCIATES

Standard Penetration Test Results

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Engineer : Opus International Consultants (UK) Ltd

Job Number 40274

Sheet 1 / 2

Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
BH01	2.00	2.15	2.45	SPT	3	3	3	4	3	6	N=16	
BH01	3.00	3.15	3.45	SPT	5	6	5	5	5	7	N=22	
BH01	4.00	4.15	4.44	SPT	7	10	12	13	14	11	50/290mm	
BH02	1.20	1.35	1.64	SPT	7	11	12	11	12	15	50/290mm	
BH02	2.00	2.15	2.45	CPT	5	3	4	5	4	5	N=18	
BH02	3.00	3.15	3.45	CPT	2	3	4	3	4	4	N=15	
BH02	4.00	4.15	4.45	SPT	4	5	5	4	5	4	N=18	
BH02	5.00	5.15	5.44	SPT	7	8	11	12	13	14	50/285mm	
BH02	6.00	6.15	6.38	CPT	7	9	14	16	20		50/225mm	
BH03	2.00	2.15	2.45	SPT	2	2	2	3	2	3	N=10	
BH03	4.00	4.15	4.45	SPT	4	5	6	6	6	10	N=28	
BH03	5.50	5.65	5.82	CPT	9	14	20	22	8		50/165mm	
BH04	1.20	1.35	1.65	SPT	3	3	3	5	6	6	N=20	
BH04	2.00	2.15	2.45	SPT	2	3	4	4	5	5	N=18	
BH04	3.00	3.15	3.45	SPT	2	2	2	3	2	3	N=10	
BH04	4.00	4.14	4.25	SPT	13	12	27	23			25*/135mm 50/110mm	
BH05	1.30	1.32	1.35	CPT	25		50				25*/20mm 50/25mm	
BH06	1.20	1.35	1.65	SPT	1	1	2	3	3	3	N=11	
BH06	2.20	2.22	2.24	CPT	25		50				25*/15mm 50/20mm	
BH07	1.20	1.35	1.65	SPT	1	1	2	2	3	3	N=10	
BH07	3.00	3.15	3.45	SPT	1	2	3	4	5	10	N=22	
BH07	4.00	4.02	4.04	CPT	25		50				25*/20mm 50/20mm	
BH08	1.20	1.35	1.65	SPT	1	2	3	4	4	5	N=16	
BH08	2.00	2.15	2.45	SPT	2	2	3	4	3	3	N=13	
BH08	3.00	3.15	3.45	SPT	3	8	9	11	14	12	N=46	
BH08	4.00	4.15	4.39	SPT	8	9	11	13	19	7	50/240mm	
BH09	1.20	1.35	1.65	SPT	1	1	2	2	2	3	N=9	
BH09	3.00	3.15	3.22	SPT	2	4	50				50/65mm	
BH09	3.50	3.52	3.54	CPT	25		50				25*/15mm 50/20mm	
BH10	2.00	2.15	2.45	SPT	3	3	3	3	5	5	N=16	
BH10	4.00	4.15	4.24	SPT	8	17	38	12			25*/145mm 50/95mm	
BH11	2.00	2.15	2.45	SPT	3	4	6	7	9	11	N=33	
BH11	4.00	4.15	4.45	SPT	5	6	8	10	10	11	N=39	
BH11	5.50	5.65	5.95	SPT	3	4	4	4	5	4	N=17	
BH11	7.00	7.15	7.45	SPT	2	1	2	2	2	3	N=9	
BH11	8.50	8.65	8.95	SPT	1	2	2	2	3	4	N=11	
BH11	11.50	11.65	11.95	SPT	3	4	4	5	5	5	N=19	
BH11	14.00	14.12	14.16	CPT	9	16	50				25*/120mm 50/40mm	
BH12	1.20	1.35	1.65	SPT	1	1	1	2	2	2	N=7	

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IAN FARMER ASSOCIATES

Standard Penetration Test Results

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Engineer : Opus International Consultants (UK) Ltd

Job Number 40274

Sheet 2 / 2

Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
BH12	3.00	3.15	3.45	SPT	1	1	1	2	2	3	N=8	
BH12	5.00	5.15	5.45	SPT	1	2	2	3	3	3	N=11	
BH12	7.50	7.53	7.57	CPT	25		50				25*/30mm 50/35mm	
BH13	2.00	2.15	2.45	SPT	4	5	5	6	6	7	N=24	
BH13	3.00	3.15	3.32	SPT	6	12	17	23	16		56/165mm	
BH13	4.00	4.09	4.19	CPT	20	5	34	16			25*/85mm 50/100mm	
BH14	1.20	1.35	1.65	SPT	1	2	2	2	3	3	N=10	
BH14	3.00	3.03	3.05	CPT	25		50				25*/25mm 50/20mm	
BH15	2.00	2.15	2.45	SPT	2	4	4	7	10	11	N=32	
BH15	3.00	3.15	3.45	SPT	7	10	12	12	12	14	N=50	
BH15	4.00	4.15	4.37	CPT	11	13	15	17	18		50/220mm	
BH16	2.00	2.15	2.21	SPT	7	12	50				50/55mm	
BH17	1.20	1.35	1.65	SPT	1	1	2	2	2	3	N=9	
BH17	2.00	2.15	2.45	SPT	1	1	1	2	2	2	N=7	
BH17	3.00	3.15	3.45	SPT	1	1	2	2	2	3	N=9	
BH17	4.00	4.15	4.45	SPT	1	1	2	2	3	3	N=10	
BH17	5.00	5.15	5.45	SPT	1	1	2	2	2	2	N=8	
BH17	6.00	6.15	6.45	SPT	1	1	2	1	2	2	N=7	
BH17	7.50	7.65	7.95	SPT	1	3	3	4	5	5	N=17	
BH17	10.50	10.65	10.95	SPT	3	4	5	7	8	8	N=28	
BH17	12.00	12.15	12.44	SPT	5	7	9	12	15	14	50/290mm	
BH17	13.50	13.54	13.58	CPT	25		50				25*/35mm 50/40mm	

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Figure A2.7

Instrumentation Details

IAN FARMER ASSOCIATES

Site	Borehole Number
Warren Hall Site - Broughton	BH01

Installation Type	Dimensions		Client	Job Number
			Welsh Assembly Government	40274
	Location	Ground Level (mOD)	Engineer	Sheet
			Opus International Consultants (UK) Ltd	1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
				0.30	Concrete
				3.00	Cement/Bentonite Grout
				3.50	Slotted Standpipe
				4.45	Cement/Bentonite Seal

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)
					5 min	10 min	15 min	20 min	

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	

Remarks

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IAN FARMER ASSOCIATES

Site	Borehole Number
Warren Hall Site - Broughton	BH02

Installation Type	Dimensions		Client	Job Number
			Welsh Assembly Government	40274
	Location	**Ground Level (mOD)**	**Engineer**	**Sheet**
			Opus International Consultants (UK) Ltd	1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
				0.20	Concrete
					Cement/Bentonite Grout
				1.00	
	▽1				
					Slotted Standpipe
				3.00	
					Cement/Bentonite Seal
				4.00	
					General Backfill
				6.00	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)
		1.20							3.50

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	

Remarks

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IAN FARMER ASSOCIATES

Site	Borehole Number
Warren Hall Site - Broughton	BH03

Installation Type	Dimensions	Client	Job Number
		Welsh Assembly Government	40274

Location	Ground Level (mOD)	Engineer	Sheet
		Opus International Consultants (UK) Ltd	1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
				0.20	Concrete
				1.50	Cement/Bentonite Grout
	▼1 ▽1			6.00	Slotted Standpipe

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	10 min	15 min	20 min	Depth Sealed (m)
		5.40	4.70		5.00	4.80	4.70	4.60	

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	

Remarks

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IAN FARMER ASSOCIATES

Site	Borehole Number
Warren Hall Site - Broughton	BH10
Client	**Job Number**
Welsh Assembly Government	40274
Engineer	**Sheet**
Opus International Consultants (UK) Ltd	1/1

Installation Type

Dimensions

Location

Ground Level (mOD)

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
				0.30	Concrete
	▼1 ▽1				Cement/Bentonite Grout
	▼2 ▽2			2.50	Slotted Standpipe
				4.00	Gravel Filter
				4.45	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	10 min	15 min	20 min	Depth Sealed (m)
		0.60			0.50	0.50	0.50	0.50	0.65
		3.50	3.00		3.40	3.20	3.10	3.00	

Groundwater Observations During Drilling

Date	Start of Shift Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	End of Shift Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A] Time	Depth (m)	Level (mOD)	Remarks

Remarks

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IAN FARMER ASSOCIATES

Installation Type	Dimensions		Site	Borehole Number
			Warren Hall Site - Broughton	**BH11**
			Client	**Job Number**
			Welsh Assembly Government	40274
	Location	**Ground Level (mOD)**	**Engineer**	**Sheet**
			Opus International Consultants (UK) Ltd	1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
				0.30	Concrete
				4.50	Cement/Bentonite Grout
				7.50	Slotted Standpipe
				8.50	Cement/Bentonite Seal
				14.50	General Backfill

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	10 min	15 min	20 min	Depth Sealed (m)

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	

Remarks

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IAN FARMER ASSOCIATES

Site	Borehole Number
Warren Hall Site - Broughton	BH12

Installation Type	Dimensions	Client	Job Number
		Welsh Assembly Government	40274

Location	Ground Level (mOD)	Engineer	Sheet
		Opus International Consultants (UK) Ltd	1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
				0.30	Concrete
				1.00	Cement/Bentonite Grout
				5.00	Slotted Standpipe
	∇1			7.50	Cement/Bentonite Seal

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)
		6.50		Slight seepage					

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	

Remarks

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IAN FARMER ASSOCIATES

Site	Borehole Number
Warren Hall Site - Broughton	BH13

Installation Type	Dimensions	Client	Job Number
		Welsh Assembly Government	40274

Location	Ground Level (mOD)	Engineer	Sheet
		Opus International Consultants (UK) Ltd	1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
				0.20	Concrete
				1.50	Cement/Bentonite Grout
				4.00	Slotted Standpipe
				4.50	Cement/Bentonite Seal

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	10 min	15 min	20 min	Depth Sealed (m)

Groundwater Observations During Drilling

Date	Start of Shift Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	End of Shift Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A] Time	Depth (m)	Level (mOD)	Remarks

Remarks

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IAN FARMER ASSOCIATES

Site	Borehole Number
Warren Hall Site - Broughton	BH14

Installation Type	Dimensions		Client	Job Number
			Welsh Assembly Government	40274
	Location	Ground Level (mOD)	Engineer	Sheet
			Opus International Consultants (UK) Ltd	1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
				0.20	Concrete
				1.00	Cement/Bentonite Grout
	▼1 ∇1			2.50	Slotted Standpipe
				3.00	Cement/Bentonite Seal

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	10 min	15 min	20 min	Depth Sealed (m)
		2.50	2.00		2.40	2.30	2.25	2.25	2.70

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	

Remarks

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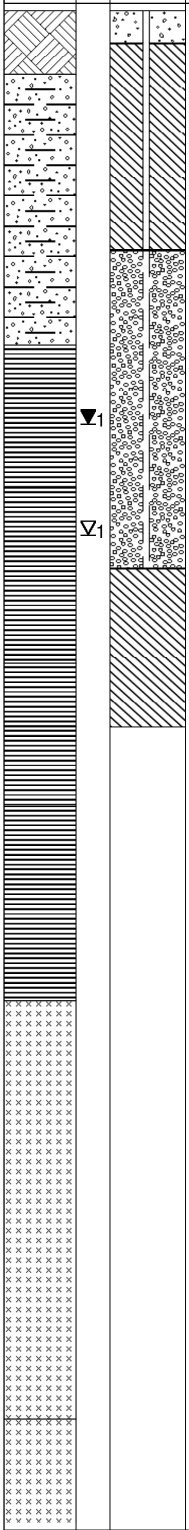
IAN FARMER ASSOCIATES

Site	Borehole Number
Warren Hall Site - Broughton	BH15

Installation Type	Dimensions	Client	Job Number
		Welsh Assembly Government	40274

Location	Ground Level (mOD)	Engineer	Sheet
		Opus International Consultants (UK) Ltd	1/1



Depth (m)	Description
0.20	Concrete
	Cement/Bentonite Grout
1.50	
	Slotted Standpipe
3.50	
	Cement/Bentonite Seal
4.50	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	10 min	15 min	20 min	Depth Sealed (m)
		3.30	3.00		2.90	2.70	2.60	2.60	

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	

Remarks

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IAN FARMER ASSOCIATES

Site	Borehole Number
Warren Hall Site - Broughton	BH16

Installation Type	Dimensions		Client	Job Number
			Welsh Assembly Government	40274
	Location	**Ground Level (mOD)**	**Engineer**	**Sheet**
			Opus International Consultants (UK) Ltd	1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
				0.20	Concrete
				0.30	Cement/Bentonite Grout
					Slotted Standpipe
				6.00	
					Cement/Bentonite Seal
				8.60	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)
					5 min	10 min	15 min	20 min	

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	

Remarks

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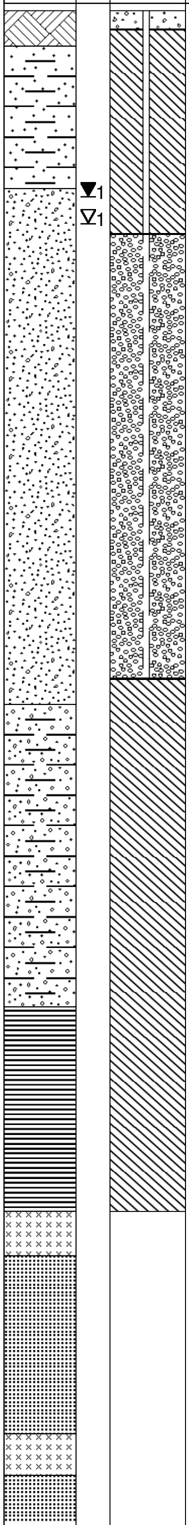
		Site Warren Hall Site - Broughton	**Borehole Number** **BH17**
Installation Type	**Dimensions**	**Client** Welsh Assembly Government	**Job Number** 40274
	Location / **Ground Level (mOD)**	**Engineer** Opus International Consultants (UK) Ltd	**Sheet** 1/1



Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
				0.20	Concrete
					Cement/Bentonite Grout
				2.50	
					Slotted Standpipe
				7.50	
					Cement/Bentonite Seal
				13.50	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	10 min	15 min	20 min	Depth Sealed (m)
		2.40	2.30		2.20	2.10	2.10	2.10	8.50

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	

Remarks

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APPENDIX 3

LABORATORY TESTS

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

14 Faraday Close, District 15, Pattinson North Industrial Estate, Washington, Tyne & Wear, NE38 8QJ.
Tel. 0191 4166375 Fax. 0191 4191578 Email. lab@ifawashington.co.uk Internet.www.ianfarmerassociates.co.uk

Ian Farmer Associates (1998) Ltd
17 Rivington Court
Warrington
Cheshire
WA1 4RT

F.A.O. Mr A Latimer

TEST REPORT - 40274/1

Site :	Warren Hall Site - Broughton
Job Number :	40274
Originating Client :	Welsh Assembly Government
Originating Reference :	40274
Date Sampled :	Not Given
Date Scheduled :	22.01.08
Date Testing Started :	24/1/08
Date Testing Finished :	31/1/08
Remarks :	• First Report for above Job Number • Samples will be disposed of 28 days after the report is issue unless otherwise agreed • This report may contain results from tests which are not included within the scope of the UKAS accreditation. Please see final sheet for details.

Authorised By: J.M. Jones

Position : Senior Materials Engineer Date : 31/1/08

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Warrington (01925) 855440. Newcastle upon Tyne (0191) 4828500. Motherwell (01698) 230231.

constructionline
AGS ASSOCIATION OF GEOTECHNICAL & GEOENVIRONMENTAL SPECIALISTS
UKAS 1464

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274

DETERMINATION OF MOISTURE CONTENT

Borehole/ Trial Pit	Depth (m)	Sample	Moisture Content %	Description
TP05	1.80	D11	15	Brown slightly sandy slightly gravelly CLAY
TP06	0.50	D2	18	Brown CLAY / SAND
TP08	2.00	D11	16	Brown sandy CLAY

Method of Preparation : BS 1377:PART 1:1990:7.3.3 Preparation of samples for classification tests

Method of Test : BS 1377:PART 2:1990:3.2 Determination of oven dried moisture content

Remarks :

IAN FARMER ASSOCIATES

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274

DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY AND LIQUIDITY INDEX

Borehole/ Trial Pit	Depth (m)	Sample	Natural / Sieved	Natural Moisture Content %	Sample Passing 425µm Sieve		Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Class	Description / Remarks
					Percentage %	Moisture Content %						
TP05	1.80	D11	Natural	15	82	18	38	20	18	-0.11	CI	Brown slightly sandy slightly gravelly CLAY
TP06	0.50	D2	Natural	18	85	20		NP				Brown CLAY / SAND
TP08	2.00	D11	Natural	16	95	17	23	13	10	0.40	CL	Brown sandy CLAY

Method of Preparation : BS 1377:PART 1:1990:7.4 Preparation of samples for classification tests BS 1377:PART 2:1990:4.2 & 5.2 Sample preparations

Method of Test : BS 1377:PART 2:1990:3.2 Determination of moisture content 4.3 Determination of the liquid limit 5.3 Determination of the plastic limit and plasticity index

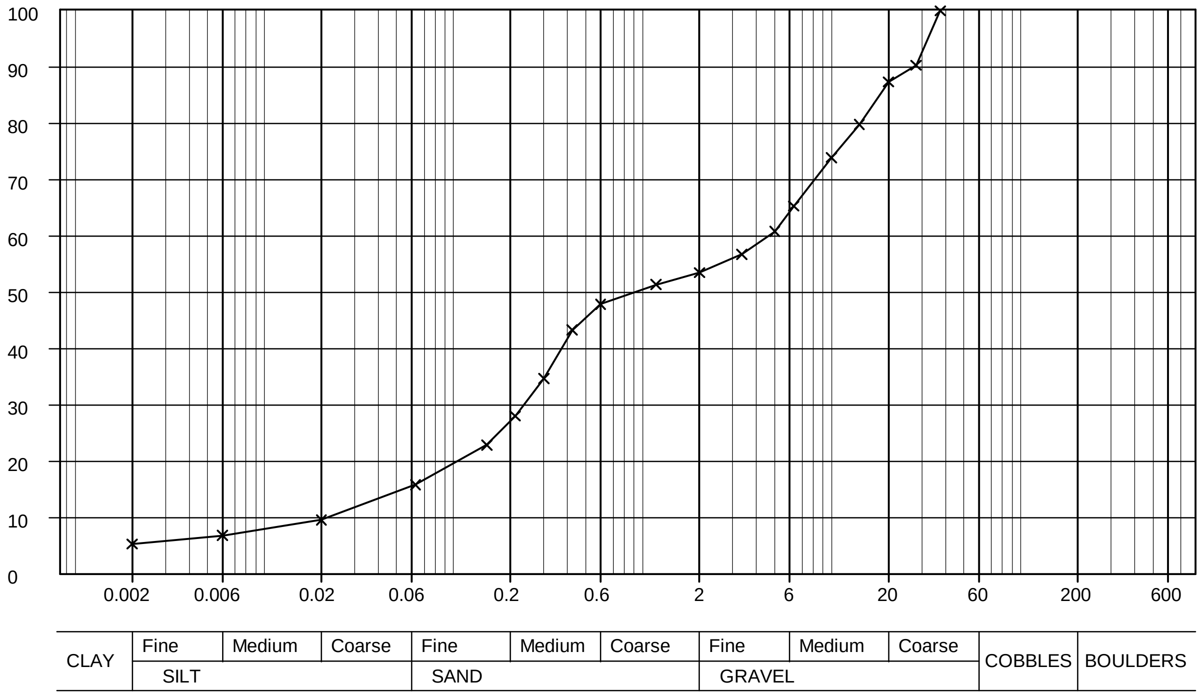
IAN FARMER ASSOCIATES

Laboratory Test Report - 40274/1

Site : Warren Hall Site - Broughton	**Job Number** 40274
Client : Welsh Assembly Government	**Page** 4 / 13

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
TP05	0.30	B4	Pipette	Brown gravelly CLAY / SAND



Sieve / Particle Size	% Passing
200 mm	100
150 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	90
20 mm	87
14 mm	80
10 mm	74
6.3 mm	65
5 mm	61
3.35 mm	57
2 mm	54
1.18 mm	51
600 µm	48
425 µm	43
300 µm	35
212 µm	28
150 µm	23
63 µm	16
20 µm	10
6 µm	7
2 µm	5

Grading Analysis	
D85	18.1 mm
D60	4.5 mm
D10	20.0 µm
Uniformity Coefficient	226.2

Particle Proportions	
Cobbles + Boulders	0%
Gravel	46%
Sand	38%
Silt	10%
Clay	5%

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with washing dispersant, Oven Dried at 105 - 110℃

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274

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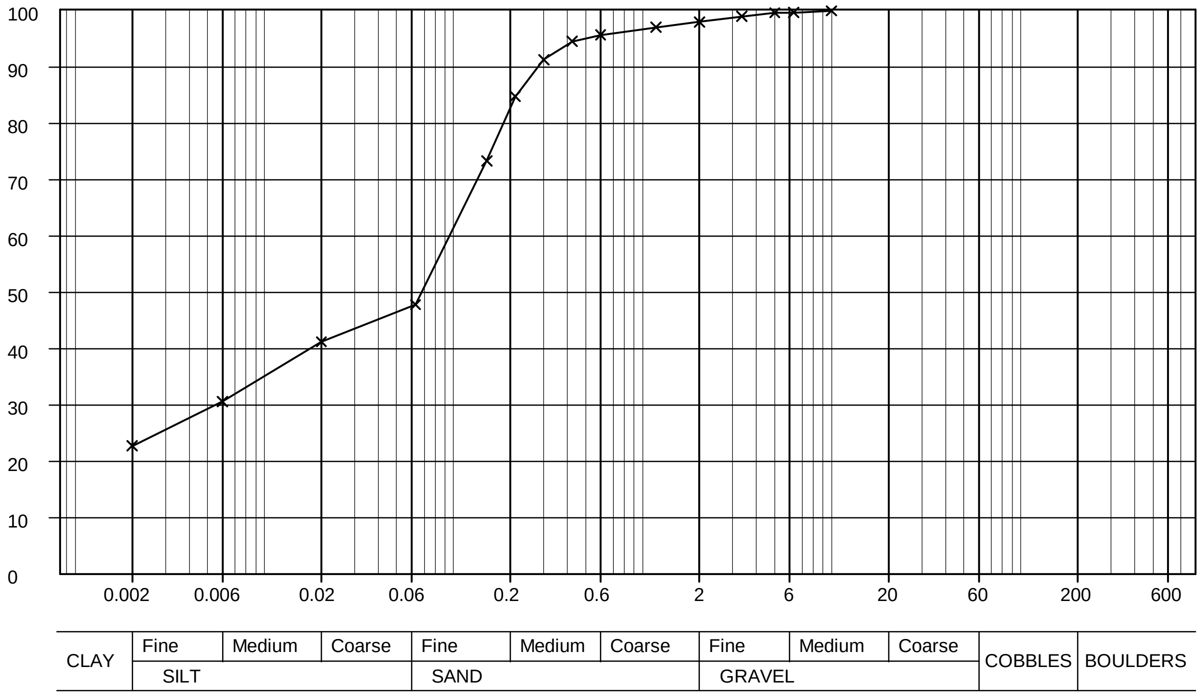
DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
TP08	2.00	D11	Pipette	Brown sandy CLAY



Sieve / Particle Size	% Passing
200 mm	100
150 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	100
10 mm	100
6.3 mm	100
5 mm	100
3.35 mm	99
2 mm	98
1.18 mm	97
600 µm	96
425 µm	95
300 µm	91
212 µm	85
150 µm	73
63 µm	48
20 µm	41
6 µm	31
2 µm	23

Grading Analysis	
D85	200.0 µm
D60	100.0 µm
D10	-
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	0%
Gravel	2%
Sand	50%
Silt	25%
Clay	23%

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with washing dispersant, Oven Dried at 105 - 110℃

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

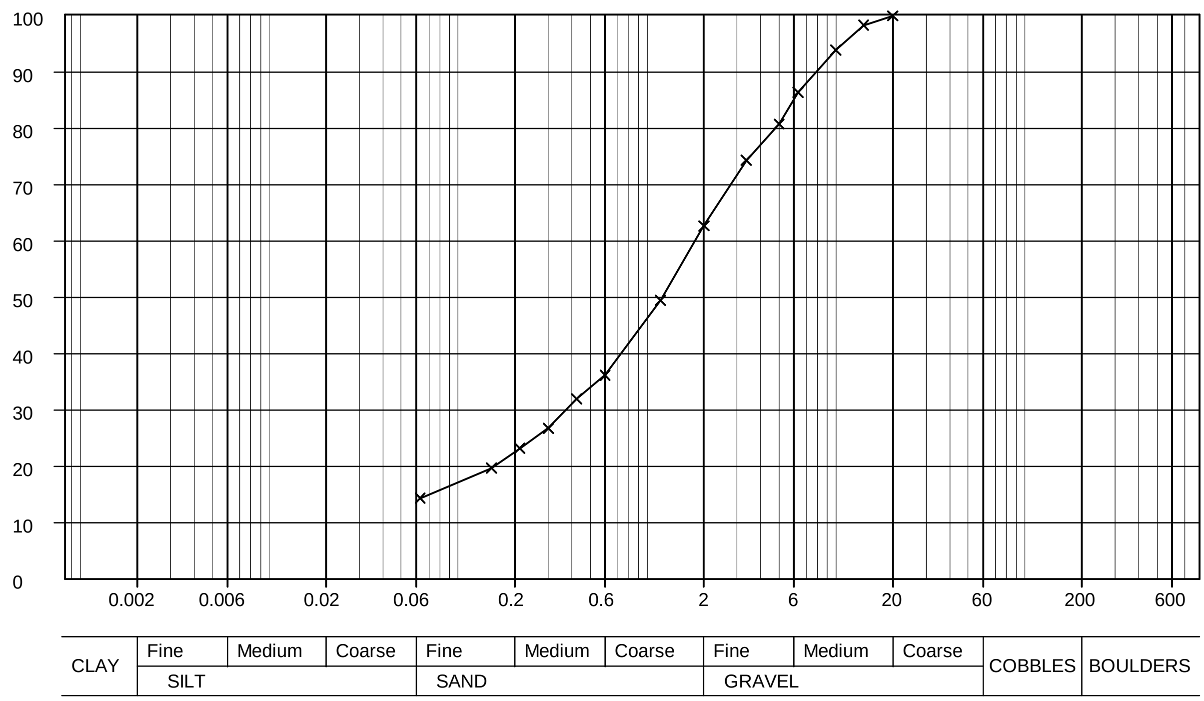
Laboratory Test Report - 40274/1

IAN FARMER ASSOCIATES

Site : Warren Hall Site - Broughton	**Job Number**	40274
Client : Welsh Assembly Government	**Page**	6 / 13

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
TP12	2.20	B11	N/A	Brown slightly sandy gravelly CLAY



Sieve / Particle Size	% Passing
200 mm	100
150 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	98
10 mm	94
6.3 mm	86
5 mm	81
3.35 mm	74
2 mm	63
1.18 mm	50
600 µm	36
425 µm	32
300 µm	27
212 µm	23
150 µm	20
63 µm	14

Grading Analysis	
D85	6.0 mm
D60	1.8 mm
D10	-
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	0%
Gravel	37%
Sand	48%
Silt/Clay	15%

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with washing dispersant, Oven Dried at 105 - 110℃

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

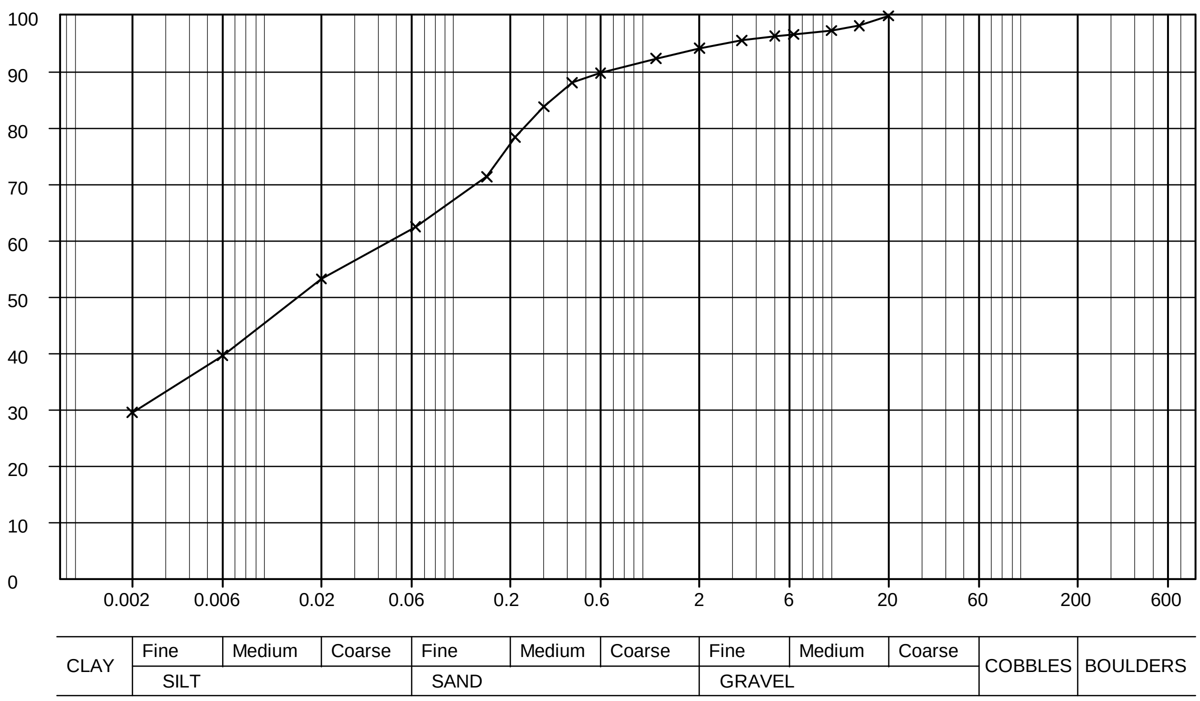
IAN FARMER ASSOCIATES

Laboratory Test Report - 40274/1

Site	: Warren Hall Site - Broughton	**Job Number** 40274
Client	: Welsh Assembly Government	**Page** 7 / 13

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
TP13	0.30	B4	Pipette	Brown sandy slightly gravelly CLAY



Sieve / Particle Size	% Passing
200 mm	100
150 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	98
10 mm	97
6.3 mm	97
5 mm	96
3.35 mm	96
2 mm	94
1.18 mm	92
600 µm	90
425 µm	88
300 µm	84
212 µm	79
150 µm	71
63 µm	63
20 µm	53
6 µm	40
2 µm	30

Grading Analysis	
D85	300.0 µm
D60	0.0 µm
D10	-
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	0%
Gravel	6%
Sand	32%
Silt	33%
Clay	30%

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with washing dispersant, Oven Dried at 105 - 110℃

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274

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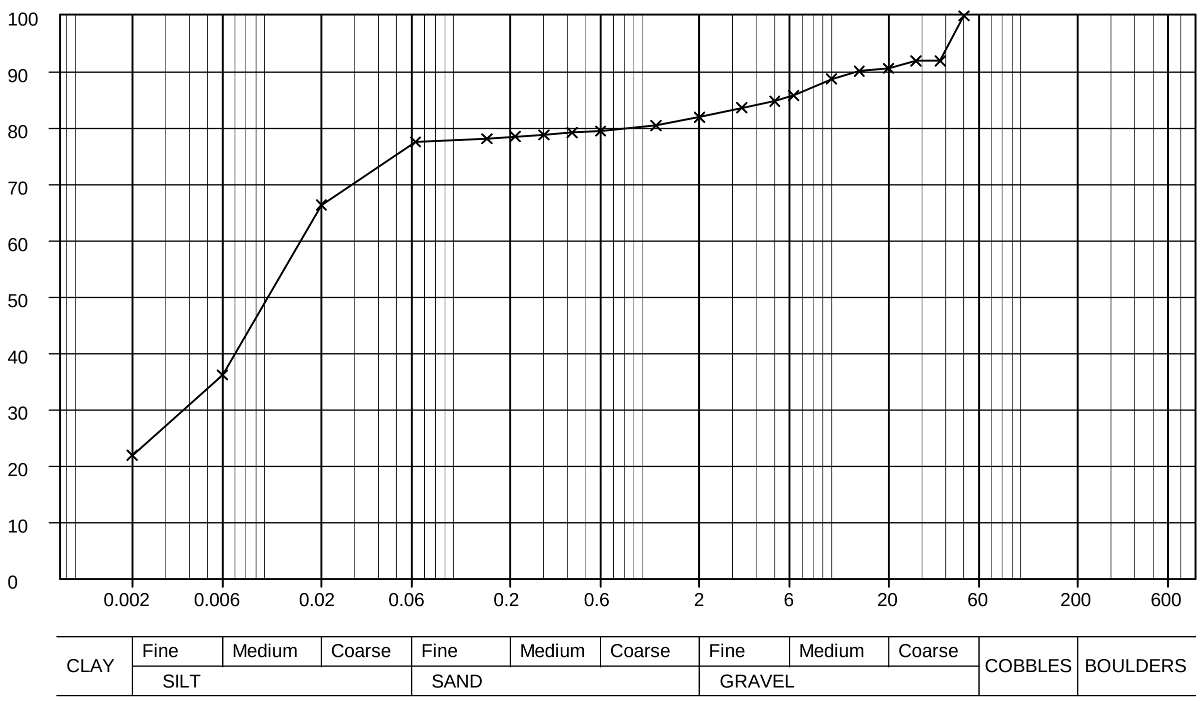
DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
TP15	2.70	B13	Pipette	Brown slightly sandy gravelly CLAY



Sieve / Particle Size	% Passing
200 mm	100
150 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	92
28 mm	92
20 mm	91
14 mm	90
10 mm	89
6.3 mm	86
5 mm	85
3.35 mm	84
2 mm	82
1.18 mm	81
600 µm	80
425 µm	79
300 µm	79
212 µm	79
150 µm	78
63 µm	78
20 µm	66
6 µm	36
2 µm	22

Grading Analysis	
D85	5.0 mm
D60	0.0 µm
D10	-
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	0%
Gravel	18%
Sand	5%
Silt	55%
Clay	22%

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with washing dispersant, Oven Dried at 105 - 110℃

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274

DETERMINATION OF THE pH VALUE AND THE SULPHATE CONTENT OF SOIL AND GROUNDWATER

Borehole/ Trial Pit	Depth (m)	Sample	Concentration of Soluble Sulphate			Percentage of sample passing 2mm Sieve %	pH	Description / Remarks
			Soil		Groundwater g /l			
			Total S04 %	S04 in 2:1 water:soil g /l				
TP05	0.30	D5		<0.1		25	7.4	Brown gravelly CLAY / SAND
TP06	0.50	D2		<0.1		56	4.8	Brown CLAY / SAND
TP08	0.40	D5		0.1		47	6.9	Brown sandy slightly gravelly CLAY
TP12	0.20	B1		0.1		49	6.8	Brown sandy CLAY
TP13	0.30	D5		0.1		27	7.1	Brown sandy CLAY
TP15	0.60	B7		<0.1		100	8.2	Brown slightly sandy CLAY

Method of Preparation : BS 1377:PART 1:1990:7.5 Preparation of soil for chemical tests BS 1377:PART 3:1990:5.2, 5.3, 5.4 & 9.4

Method of Test : BS 1377:PART 3:1990:5 Determination of the sulphate content of soil and ground water BS 1377:PART 3:1990:9 Determination of the pH value

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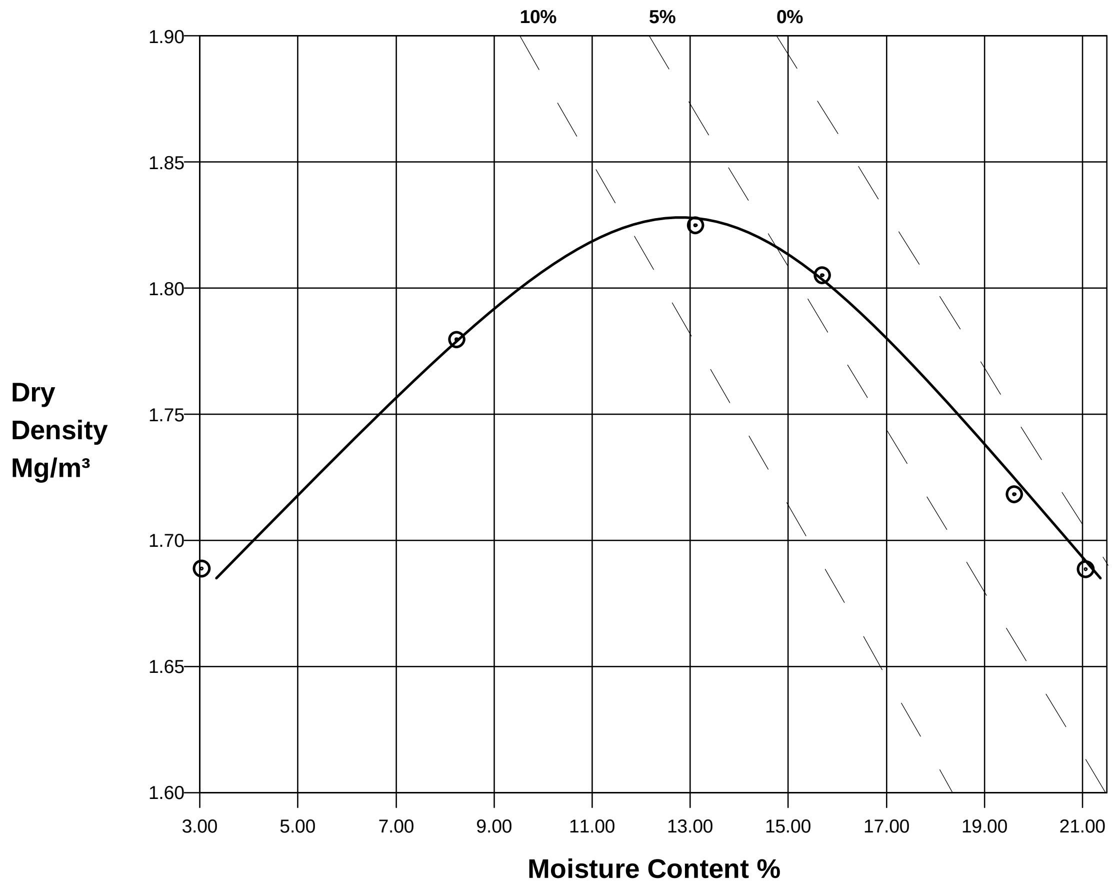
Laboratory Test Report - 40274/1

Site : Warren Hall Site - Broughton	**Job Number** 40274
Client : Welsh Assembly Government	**Page** 10 / 13

DETERMINATION OF DRY DENSITY/MOISTURE CONTENT RELATIONSHIP

Borehole / Trial Pit	Depth (m)	Sample	Description
TP15	0.60	B7	Brown slightly sandy CLAY

Percentage retained 37.5 mm	0 %	**Max size of cohesive lumps**	20 mm
Percentage retained 20.0 mm	0 %	**Single or separate samples**	Single
Grading Zone	1	**Particle density**	2.65 Assumed
Mould Type	1 Litre/proctor	**Method of compaction**	2.5kg Rammer
MAX DRY DENSITY	1.83 Mg/m³	**OPTIMUM MOISTURE CONTENT**	13 %



Method of Preparation : BS 1377:PART 1:7.6, BS 1377:PART 4:1990:3.2 Preparation of samples for compaction tests

Method of Test : BS 1377:PART 4:1990:3.4/3.4 Determination using 2.5 kg rammer or 3.5/3.6 Determination using 4.5kg rammer: PART 2:1990:8.2 Determination of particle density

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274/1

Site	: Warren Hall Site - Broughton	**Job Number** 40274
Client	: Welsh Assembly Government	**Page** 11 / 13

DETERMINATION OF CALIFORNIA BEARING RATIO (CBR)

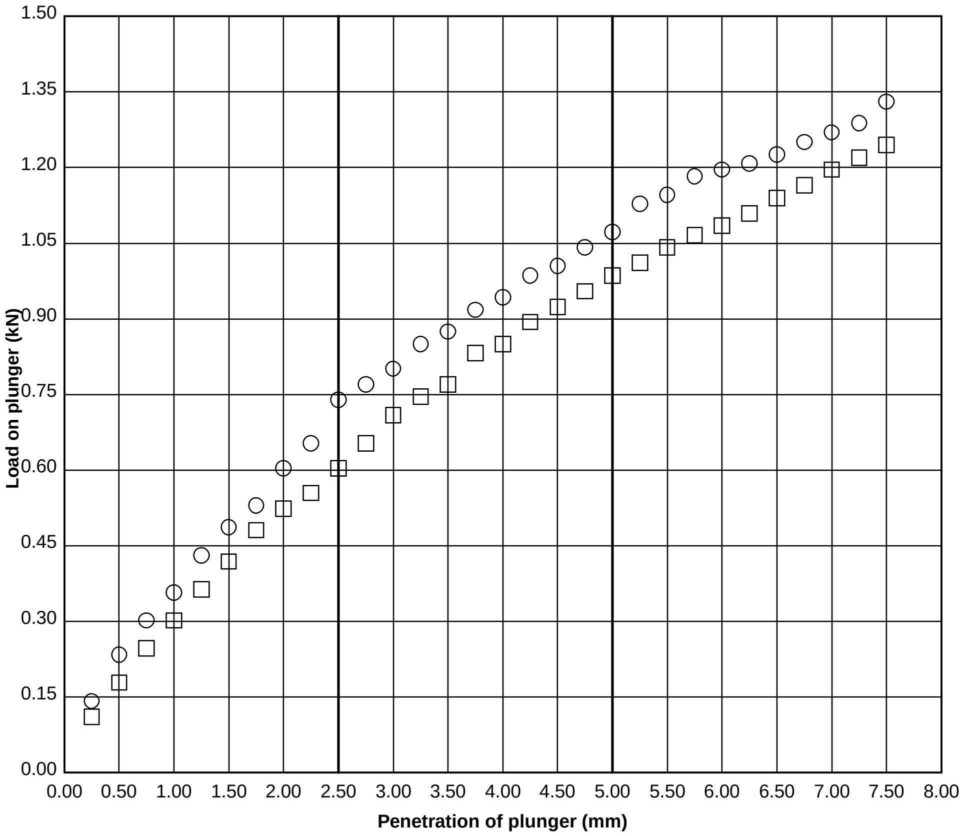
Borehole / Trial Pit	Depth (m)	Sample	% Passing 20 mm Sieve	Description
TP13	0.70	B7	99 %	Brown sandy CLAY

Moisture Content %	
Bulk Density Mg/m³	0.00
Dry Density Mg/m³	0.00
Soaked Test	No

Test on	□ TOP	
Moisture Content %	18	
Surcharge weight kg		
Penetration mm	2.5	5.0
Force kN	0.60	0.99
Corrected CBR %	4.6	4.9

Test on	○ BOTTOM	
Moisture Content %	15	
Surcharge weight kg		
Penetration mm	2.5	5.0
Force kN	0.74	1.1
Corrected CBR %	5.6	5.4

Test on	TOP	BOTTOM
Reported CBR %	4.9	5.6
Mean CBR %	5.2	



Method of Preparation : The specimen was prepared by Dynamic compression using a 2.5 kg Rammer
BS 1377:PART 1:1990:7.6.1 General 1990:7.6.5 California bearing ratio test BS 1377:PART 4:1990:7.2 Preparation of test sample

Method of Test : BS 1377:PART 4:1990:7.4 Penetration test procedure

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274/1

Site : Warren Hall Site - Broughton		**Job Number** 40274
Client : Welsh Assembly Government		**Page** 12 / 13

DETERMINATION OF CALIFORNIA BEARING RATIO (CBR)

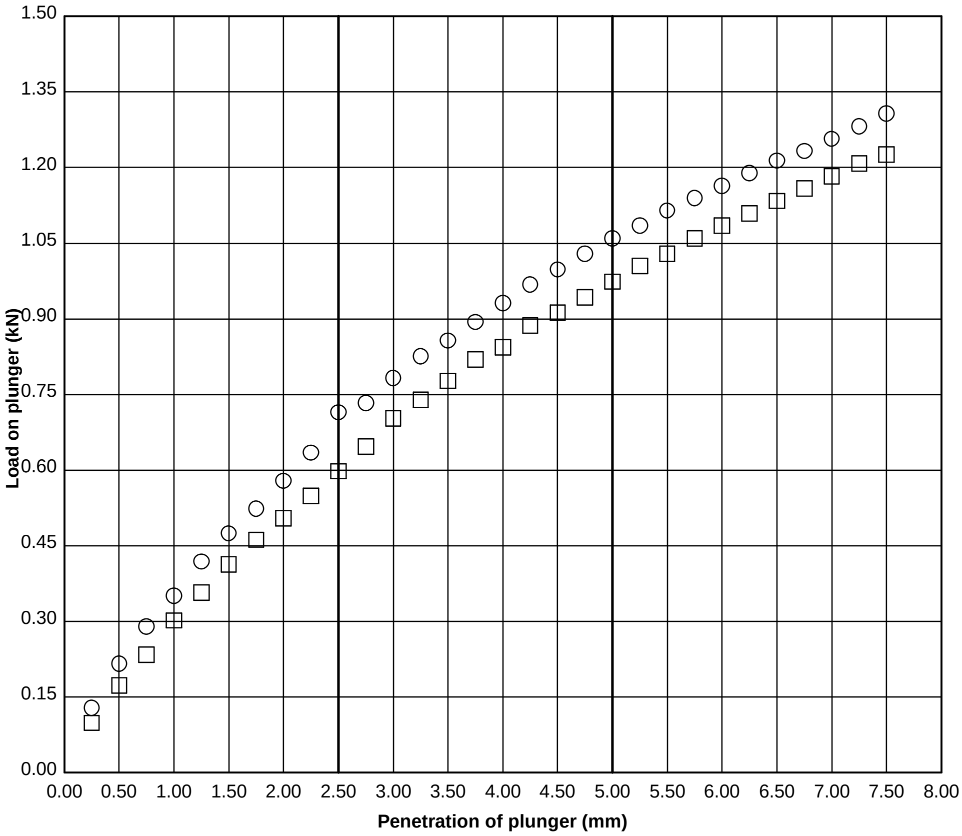
Borehole / Trial Pit	Depth (m)	Sample	% Passing 20 mm Sieve	Description
TP15	0.60	B7	99 %	Brown slightly sandy CLAY

Moisture Content %	
Bulk Density Mg/m³	2.11
Dry Density Mg/m³	1.78
Soaked Test	No

Test on	□ TOP	
Moisture Content %	19	
Surcharge weight kg	4.40	
Penetration mm	2.5	5.0
Force kN	0.60	0.97
Corrected CBR %	4.5	4.9

Test on	○ BOTTOM	
Moisture Content %	18	
Surcharge weight kg	4.40	
Penetration mm	2.5	5.0
Force kN	0.71	1.1
Corrected CBR %	5.4	5.3

Test on	TOP	BOTTOM
Reported CBR %	4.9	5.4
Mean CBR %	5.2	



Method of Preparation : The specimen was prepared by Dynamic compression using a 2.5 kg Rammer
BS 1377:PART 1:1990:7.6.1 General 1990:7.6.5 California bearing ratio test BS 1377:PART 4:1990:7.2 Preparation of test sample

Method of Test : BS 1377:PART 4:1990:7.4 Penetration test procedure

Remarks :

IAN FARMER ASSOCIATES

Geotechnical & Environmental Specialists

Test Report : **40274/1**

Site : Warren Hall Site - Broughton
Job Number : 40274
Originating Client : Welsh Assembly Government

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Date of Issue : 31/1/08

14 Faraday Close, District 15, Pattinson North Industrial Estate, Washington, Tyne & Wear, NE38 8QJ.
Tel. 0191 4166375 Fax. 0191 4191578 Email. lab@ifawashington.co.uk Internet.www.ianfarmerassociates.co.uk

Ian Farmer Associates (1998) Ltd
17 Rivington Court
Warrington
Cheshire
WA1 4RT

F.A.O. Mr A Latimer

TEST REPORT - 40274A/1

Site :	Warren Hall, Broughton, Chester
Job Number :	40274A
Originating Client :	OPUS
Originating Reference :	40274A
Date Sampled :	Not Given
Date Scheduled :	16.01.08
Date Testing Started :	4/2/08
Date Testing Finished :	8/2/08

Remarks :
- First Report for above Job Number
- Samples will be disposed of 28 days after the report is issue unless otherwise agreed
- This report may contain results from tests which are not included within the scope of the UKAS accreditation. Please see final sheet for details.

Authorised By: J.M. Jones

Position : Senior Materials Engineer Date : 8/2/08

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Registered Office: Unit 1, Bamburgh Court, TVTE, Gateshead, Tyne & Wear, NE11 0TX
Offices in: Coventry (02476) 456565. Harpenden, Herts. (01582) 460018. Truro (01827) 261775
Warrington (01925) 855440. Newcastle upon Tyne (0191) 4828500. Motherwell (01698) 230231.

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Laboratory Test Report - 40274A/1

Site : Warren Hall, Broughton, Chester

Client : OPUS

Job Number 40274A

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DETERMINATION OF MOISTURE CONTENT

Borehole/ Trial Pit	Depth (m)	Sample	Moisture Content %	Description
TP07	1.50	D4	16	Brown slightly sandy gravelly CLAY
TP10	2.50	D9	19	Brown slightly sandy slightly gravelly CLAY

Method of Preparation : BS 1377:PART 1:1990:7.3.3 Preparation of samples for classification tests

Method of Test : BS 1377:PART 2:1990:3.2 Determination of oven dried moisture content

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274A/1

Site : Warren Hall, Broughton, Chester

Client : OPUS

Job Number 40274A

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DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY AND LIQUIDITY INDEX

Borehole/ Trial Pit	Depth (m)	Sample	Natural / Sieved	Natural Moisture Content %	Sample Passing 425µm Sieve		Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Class	Description / Remarks
					Percentage %	Moisture Content %						
TP07	1.50	D4	Natural	16	95	17	29	16	13	0.08	CL	Brown slightly sandy gravelly CLAY
TP10	2.50	D9	Natural	19	84	22	30	16	14	0.43	CL	Brown slightly sandy slightly gravelly CLAY

Method of Preparation : BS 1377:PART 1:1990:7.4 Preparation of samples for classification tests BS 1377:PART 2:1990:4.2 & 5.2 Sample preparations

Method of Test : BS 1377:PART 2:1990:3.2 Determination of moisture content 4.3 Determination of the liquid limit 5.3 Determination of the plastic limit and plasticity index

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274A/1

Site : Warren Hall, Broughton, Chester

Client : OPUS

Job Number 40274A

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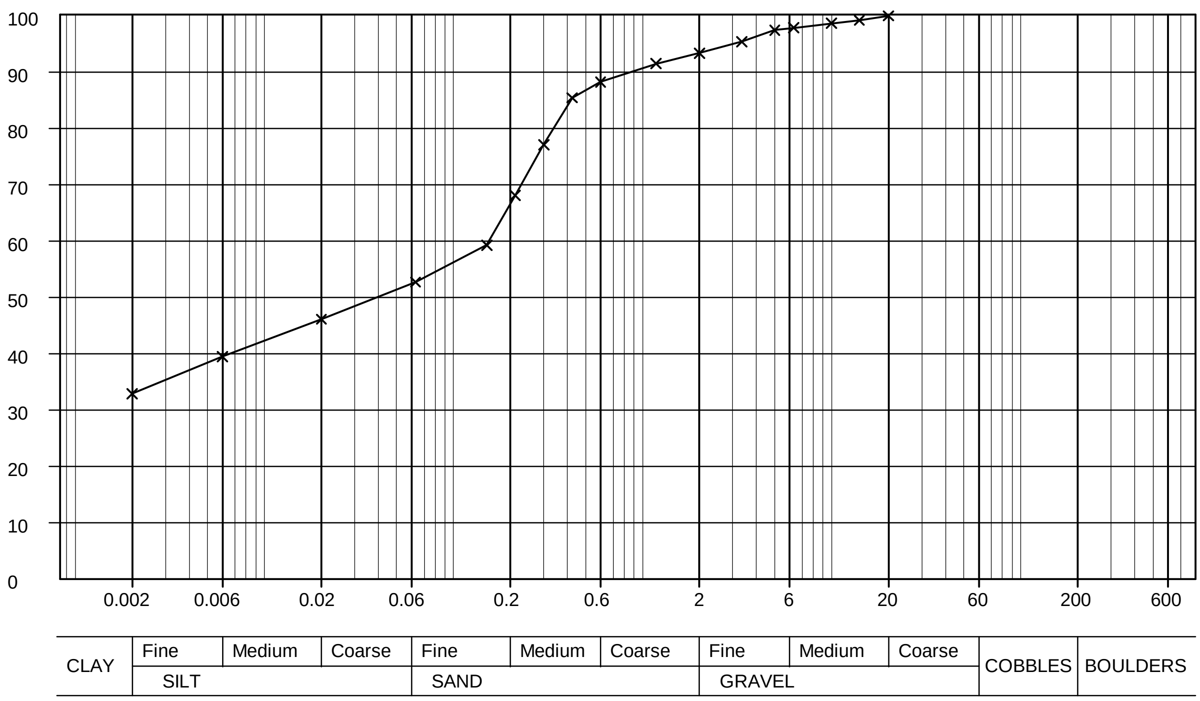
DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
TP09	1.10	B3	Pipette	Brown sandy CLAY



Sieve / Particle Size	% Passing
200 mm	100
150 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	99
10 mm	99
6.3 mm	98
5 mm	97
3.35 mm	95
2 mm	93
1.18 mm	92
600 µm	88
425 µm	85
300 µm	77
212 µm	68
150 µm	59
63 µm	53
20 µm	46
6 µm	40
2 µm	33

Grading Analysis	
D85	400.0 µm
D60	200.0 µm
D10	-
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	0%
Gravel	7%
Sand	41%
Silt	19%
Clay	33%

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with washing dispersant, Oven Dried at 105 - 110℃

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274A/1

Site : Warren Hall, Broughton, Chester

Client : OPUS

Job Number 40274A

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DETERMINATION OF THE pH VALUE AND THE SULPHATE CONTENT OF SOIL AND GROUNDWATER

Borehole/ Trial Pit	Depth (m)	Sample	Concentration of Soluble Sulphate			Percentage of sample passing 2mm Sieve %	pH	Description / Remarks
			Soil		Groundwater g /l			
			Total S04 %	S04 in 2:1 water:soil g /l				
TP11	1.00	D4		0.1		96	7.6	Brown slightly gravelly CLAY

Method of Preparation : BS 1377:PART 1:1990:7.5 Preparation of soil for chemical tests BS 1377:PART 3:1990:5.2, 5.3, 5.4 & 9.4

Method of Test : BS 1377:PART 3:1990:5 Determination of the sulphate content of soil and ground water BS 1377:PART 3:1990:9 Determination of the pH value

IAN FARMER ASSOCIATES

Geotechnical & Environmental Specialists

Test Report : **40274A/1**

Site : Warren Hall, Broughton, Chester
Job Number : 40274A
Originating Client : OPUS

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Date of Issue : 8/2/08

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

14 Faraday Close, District 15, Pattinson North Industrial Estate, Washington, Tyne & Wear, NE38 8QJ.
Tel. 0191 4166375 Fax. 0191 4191578 Email. lab@ifawashington.co.uk Internet.www.ianfarmerassociates.co.uk

Ian Farmer Associates (1998) Ltd
17 Rivington Court
Warrington
Cheshire
WA1 4RT

F.A.O. Mr A Latimer

TEST REPORT - 40274C/1

Site :	Warren Hall Site - Broughton
Job Number :	40274C
Originating Client :	Welsh Assembly Government
Originating Reference :	40274C
Date Sampled :	Not Given
Date Scheduled :	25.01.08
Date Testing Started :	1/2/08
Date Testing Finished :	20/2/08
Remarks :	• First Report for above Job Number • Samples will be disposed of 28 days after the report is issue unless otherwise agreed • This report may contain results from tests which are not included within the scope of the UKAS accreditation. Please see final sheet for details.

Authorised By: J.M. Jones

Position : Senior Materials Engineer Date : 20/2/08

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UKAS 1464

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Laboratory Test Report - 40274C/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274C

DETERMINATION OF MOISTURE CONTENT

Borehole/ Trial Pit	Depth (m)	Sample	Moisture Content %	Description
BH02	5.00	D17	8.5	Brown sandy gravelly CLAY
BH03	3.00	U7	15	Brown slightly gravelly CLAY
BH04	3.00	B7	27	Brown silty clayey SAND
BH06	1.20	D4	16	Brown slightly sandy slightly gravelly CLAY
BH07	2.00	U5	27	Brown slightly sandy slightly gravelly SAND

Method of Preparation : BS 1377:PART 1:1990:7.3.3 Preparation of samples for classification tests

Method of Test : BS 1377:PART 2:1990:3.2 Determination of oven dried moisture content

Remarks :

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Laboratory Test Report - 40274C/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274C

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DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY AND LIQUIDITY INDEX

Borehole/ Trial Pit	Depth (m)	Sample	Natural / Sieved	Natural Moisture Content %	Sample Passing 425µm Sieve		Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Class	Description / Remarks
					Percentage %	Moisture Content %						
BH02	5.00	D17	Natural	8.5	80	9.4	24	14	10	-0.46	CL	Brown sandy gravelly CLAY
BH03	3.00	U7	Natural	15	92	15	24	14	10	0.10	CL	Brown slightly gravelly CLAY
BH04	3.00	B7	Natural	27	72	36	24	15	9	2.33	CL	Brown silty clayey SAND
BH06	1.20	D4	Natural	16	98	16	24	14	10	0.20	CL	Brown slightly sandy slightly gravelly CLAY
BH07	2.00	U5	Natural	27	94	29		NP				Brown slightly sandy slightly gravelly SAND

Method of Preparation : BS 1377:PART 1:1990:7.4 Preparation of samples for classification tests BS 1377:PART 2:1990:4.2 & 5.2 Sample preparations

Method of Test : BS 1377:PART 2:1990:3.2 Determination of moisture content 4.3 Determination of the liquid limit 5.3 Determination of the plastic limit and plasticity index

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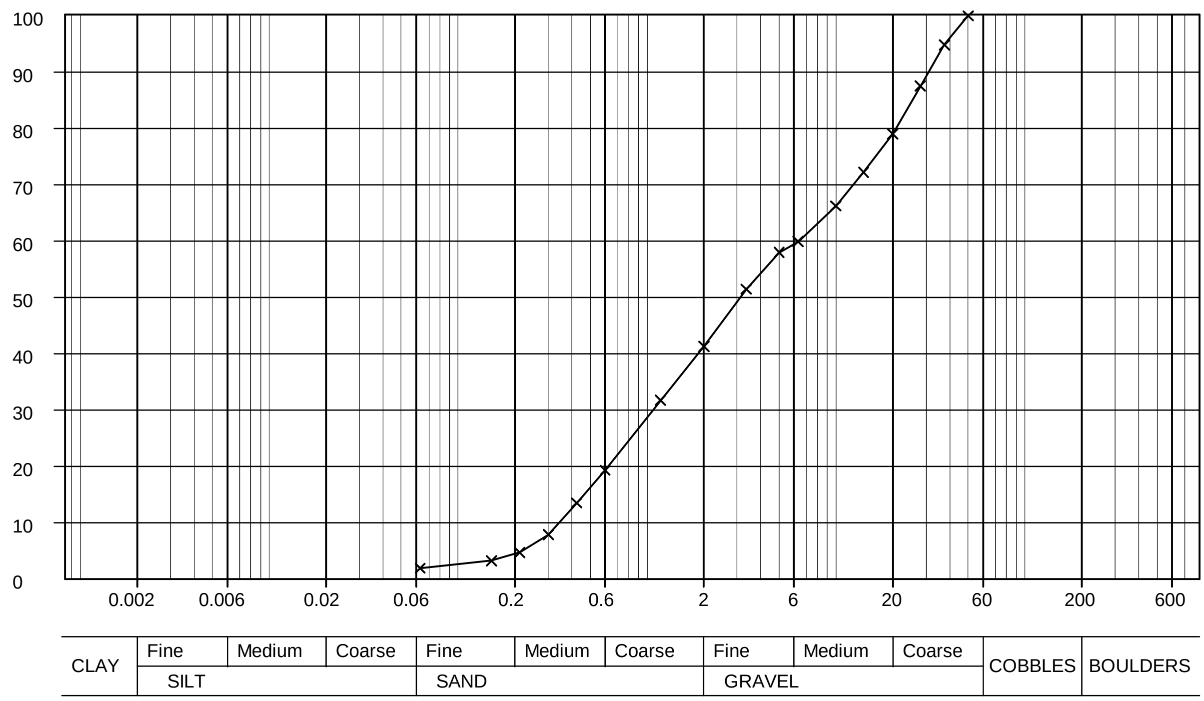
Laboratory Test Report - 40274C/1

Site	: Warren Hall Site - Broughton	**Job Number** 40274C
Client	: Welsh Assembly Government	**Page** 4 / 29

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
BH02	2.00	B9	N/A	Brown sandy GRAVEL



Sieve / Particle Size	% Passing
200 mm	100
150 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	95
28 mm	88
20 mm	79
14 mm	72
10 mm	66
6.3 mm	60
5 mm	58
3.35 mm	51
2 mm	41
1.18 mm	32
600 µm	19
425 µm	14
300 µm	8
212 µm	5
150 µm	3
63 µm	2

Grading Analysis	
D85	25.0 mm
D60	6.3 mm
D10	337.0 µm
Uniformity Coefficient	18.7

Particle Proportions	
Cobbles + Boulders	0%
Gravel	59%
Sand	39%
Silt/Clay	2%

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with washing dispersant, Oven Dried at 105 - 110℃

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

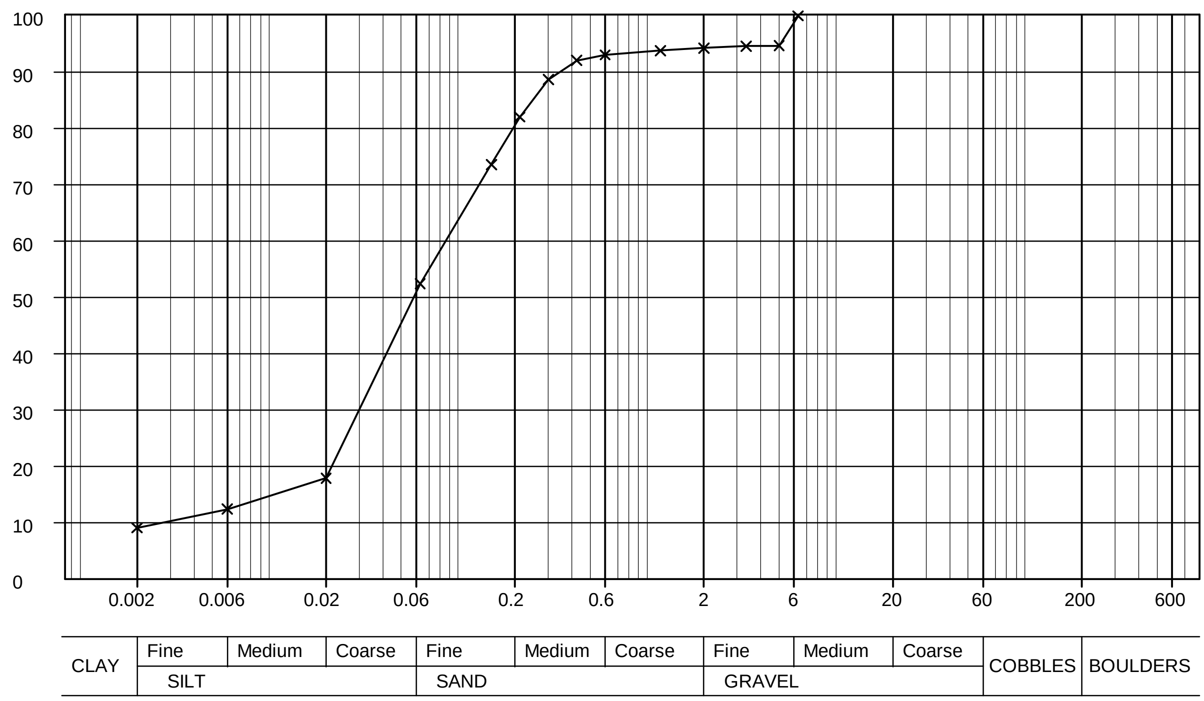
Remarks :

IAN FARMER ASSOCIATES	**Laboratory Test Report - 40274C/1**

Site	: Warren Hall Site - Broughton	**Job Number** 40274C
Client	: Welsh Assembly Government	**Page** 5 / 29

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
BH03	2.00	B5	Pipette	Brown sandy CLAY



Sieve / Particle Size	% Passing
200 mm	100
150 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	100
10 mm	100
6.3 mm	100
5 mm	95
3.35 mm	95
2 mm	94
1.18 mm	94
600 µm	93
425 µm	92
300 µm	89
212 µm	82
150 µm	74
63 µm	52
20 µm	18
6 µm	12
2 µm	9

Grading Analysis	
D85	200.0 µm
D60	100.0 µm
D10	3.0 µm
Uniformity Coefficient	29.8

Particle Proportions	
Cobbles + Boulders	0%
Gravel	6%
Sand	43%
Silt	42%
Clay	9%

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with washing dispersant, Oven Dried at 105 - 110℃

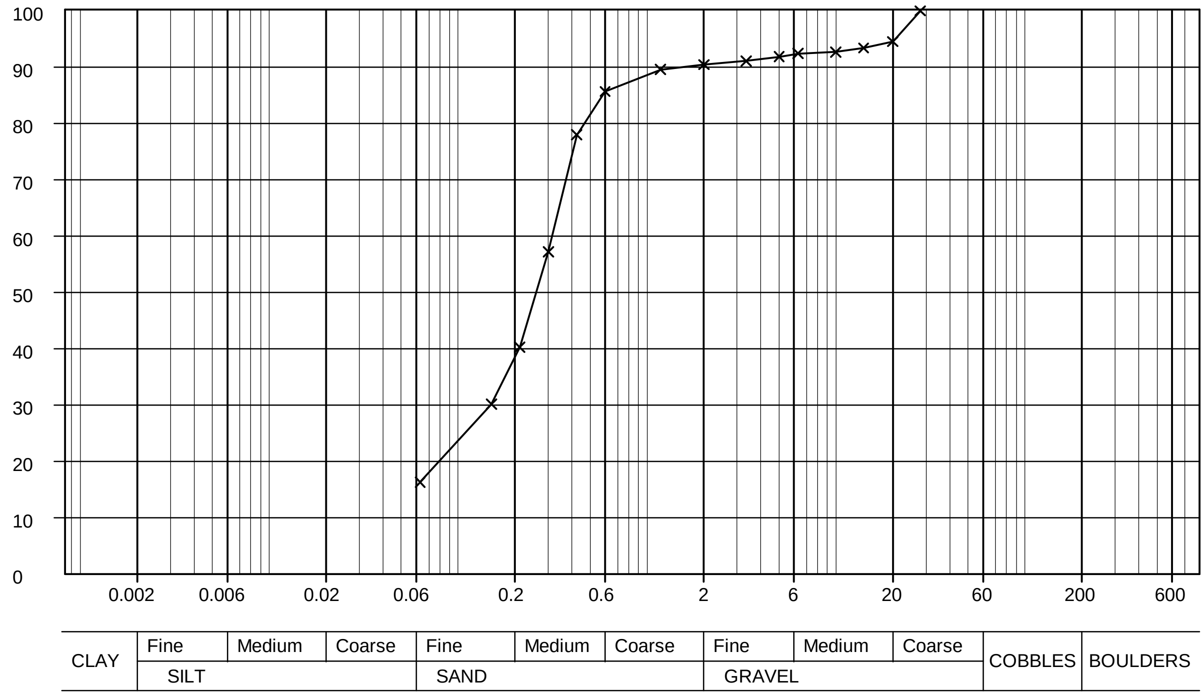
Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

Site : Warren Hall Site - Broughton		**Job Number** 40274C
Client : Welsh Assembly Government		**Page** 6 / 29

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
BH04	2.00	B5	N/A	Brown SAND



Sieve / Particle Size	% Passing
200 mm	100
150 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	95
14 mm	93
10 mm	93
6.3 mm	92
5 mm	92
3.35 mm	91
2 mm	90
1.18 mm	90
600 µm	86
425 µm	78
300 µm	57
212 µm	40
150 µm	30
63 µm	16

Grading Analysis	
D85	600.0 µm
D60	300.0 µm
D10	-
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	0%
Gravel	10%
Sand	74%
Silt/Clay	16%

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with washing dispersant, Oven Dried at 105 - 110℃

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274C/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274C

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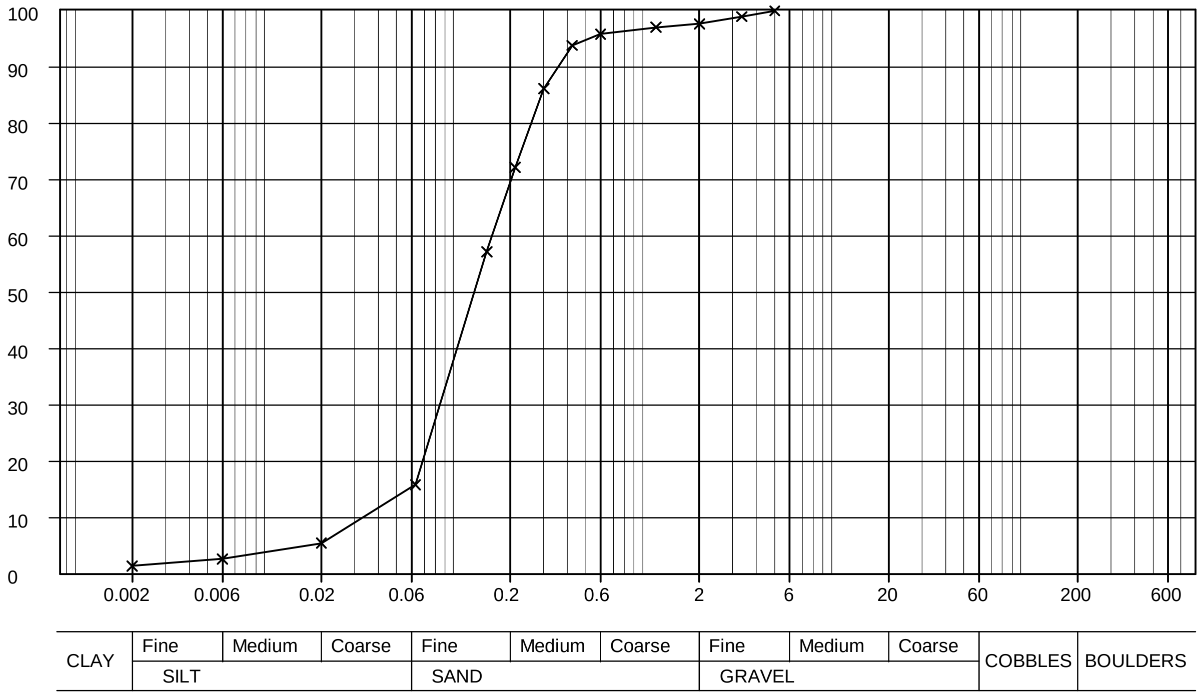
DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
BH04	3.00	B7	Pipette	Brown silty clayey SAND



Sieve / Particle Size	% Passing
200 mm	100
150 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	100
10 mm	100
6.3 mm	100
5 mm	100
3.35 mm	99
2 mm	98
1.18 mm	97
600 µm	96
425 µm	94
300 µm	86
212 µm	72
150 µm	57
63 µm	16
20 µm	5
6 µm	3
2 µm	1

Grading Analysis	
D85	300.0 µm
D60	200.0 µm
D10	34.0 µm
Uniformity Coefficient	4.8

Particle Proportions	
Cobbles + Boulders	0%
Gravel	2%
Sand	82%
Silt	14%
Clay	1%

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with no dispersant used, Oven Dried at 105 - 110℃

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

Laboratory Test Report - 40274C/1

IAN FARMER ASSOCIATES

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274C

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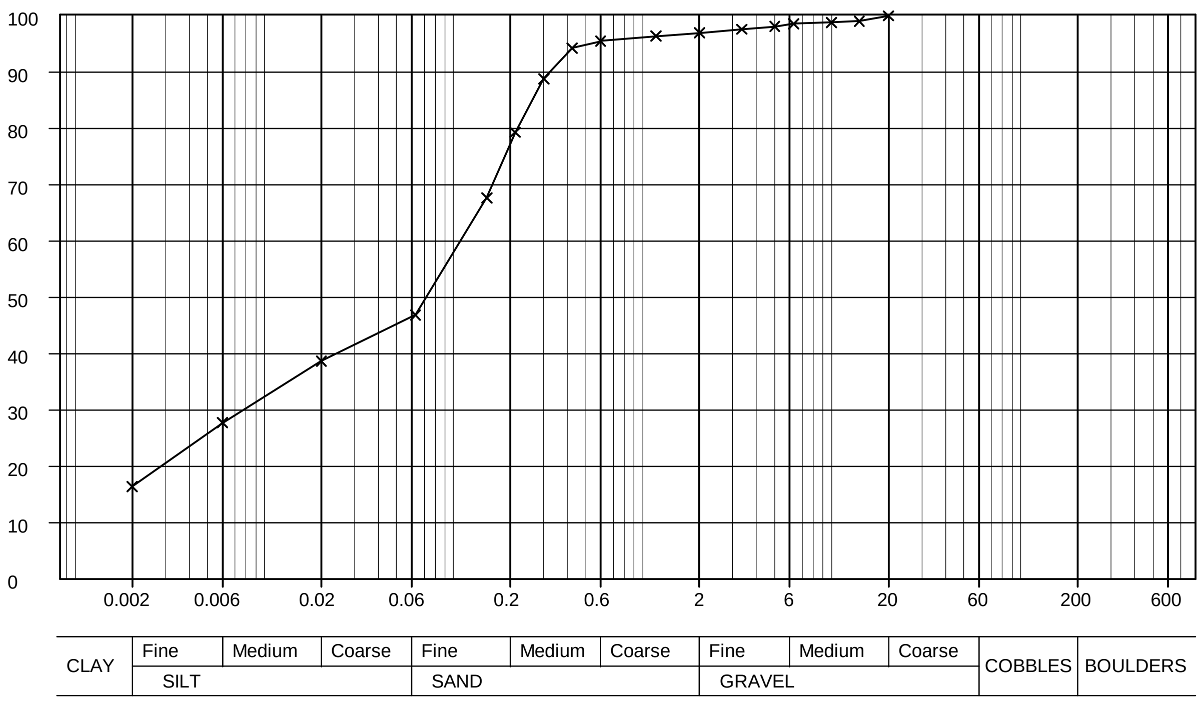
DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
BH06	0.20	B2	Pipette	Brown sandy CLAY



Sieve / Particle Size	% Passing
200 mm	100
150 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	99
10 mm	99
6.3 mm	99
5 mm	98
3.35 mm	98
2 mm	97
1.18 mm	96
600 µm	96
425 µm	94
300 µm	89
212 µm	79
150 µm	68
63 µm	47
20 µm	39
6 µm	28
2 µm	16

Grading Analysis	
D85	300.0 µm
D60	100.0 µm
D10	-
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	0%
Gravel	3%
Sand	50%
Silt	30%
Clay	16%

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with washing dispersant, Oven Dried at 105 - 110℃

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274C/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274C

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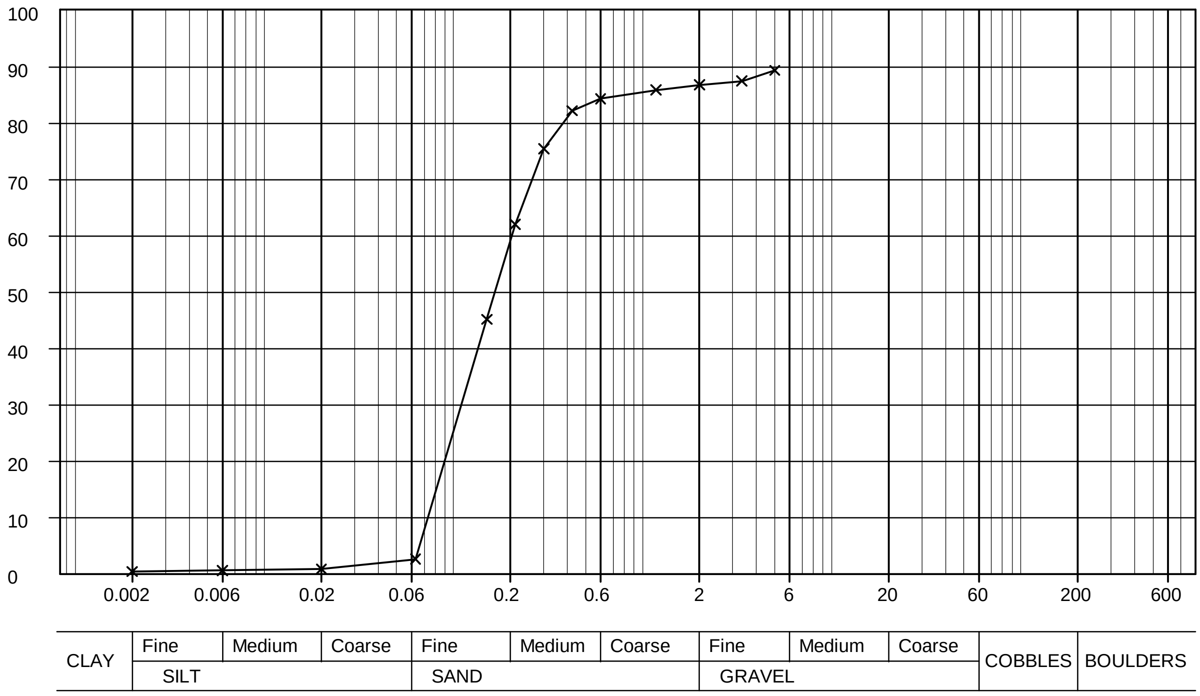
DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
BH06	1.20	D4	Pipette	Brown slightly sandy slightly gravelly CLAY



Sieve / Particle Size	% Passing
5 mm	89
3.35 mm	88
2 mm	87
1.18 mm	86
600 µm	84
425 µm	82
300 µm	75
212 µm	62
150 µm	45
63 µm	3
20 µm	1
6 µm	1
2 µm	0

Grading Analysis	
D85	800.0 µm
D60	200.0 µm
D10	73.0 µm
Uniformity Coefficient	2.8

Particle Proportions	
Cobbles + Boulders	0%
Gravel	13%
Sand	84%
Silt	2%
Clay	0%

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with no dispersant used, Oven Dried at 105 - 110℃

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274C/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274C

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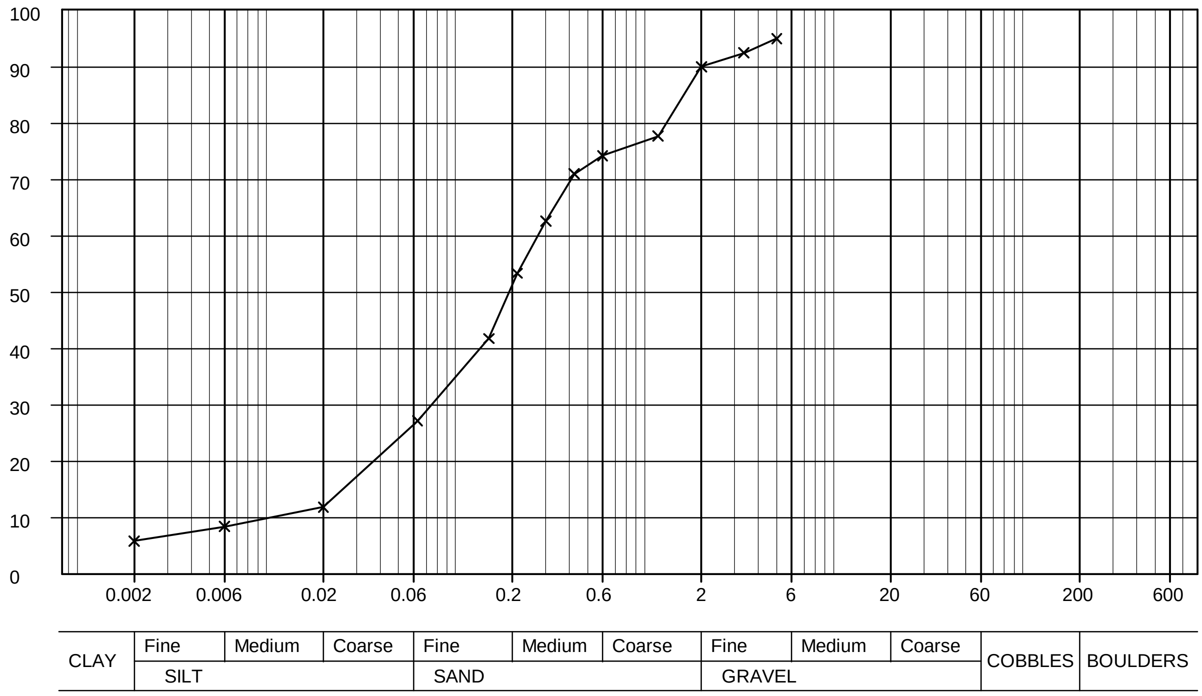
DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
BH07	3.00	D8	Pipette	Brown slightly sandy slightly gravelly CLAY



Sieve / Particle Size	% Passing
5 mm	95
3.35 mm	93
2 mm	90
1.18 mm	78
600 µm	74
425 µm	71
300 µm	63
212 µm	53
150 µm	42
63 µm	27
20 µm	12
6 µm	8
2 µm	6

Grading Analysis	
D85	1.6 mm
D60	300.0 µm
D10	11.0 µm
Uniformity Coefficient	24.6

Particle Proportions	
Cobbles + Boulders	0%
Gravel	10%
Sand	64%
Silt	21%
Clay	6%

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with no dispersant used, Oven Dried at 105 - 110℃

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274C/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274C

DETERMINATION OF THE pH VALUE AND THE SULPHATE CONTENT OF SOIL AND GROUNDWATER

Borehole/ Trial Pit	Depth (m)	Sample	Concentration of Soluble Sulphate			Percentage of sample passing 2mm Sieve %	pH	Description / Remarks
			Soil		Groundwater g /l			
			Total S04 %	S04 in 2:1 water:soil g /l				
BH02	0.20	D2		<0.1		51	6.1	Brown slightly sandy slightly gravelly CLAY
BH03	1.70	D4		0.1		50	7.2	Brown sandy CLAY
BH04	2.70	W9			0.04		8.2	
BH05	1.30	D3		0.1		98	7.2	Brown gravelly SAND
BH06	1.20	D4		0.4		96	7.2	Brown slightly sandy slightly gravelly CLAY
BH06	2.20	D5		0.1		46	7.1	Brown slightly sandy slightly gravelly CLAY
BH07	1.20	D4		0.4		66	7.0	Brown slightly sandy slightly gravelly CLAY

Method of Preparation : BS 1377:PART 1:1990:7.5 Preparation of soil for chemical tests BS 1377:PART 3:1990:5.2, 5.3, 5.4 & 9.4

Method of Test : BS 1377:PART 3:1990:5 Determination of the sulphate content of soil and ground water BS 1377:PART 3:1990:9 Determination of the pH value

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Laboratory Test Report - 40274C/1

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Client : Welsh Assembly Government		**Page** 12 / 29

DETERMINATION OF CALIFORNIA BEARING RATIO (CBR)

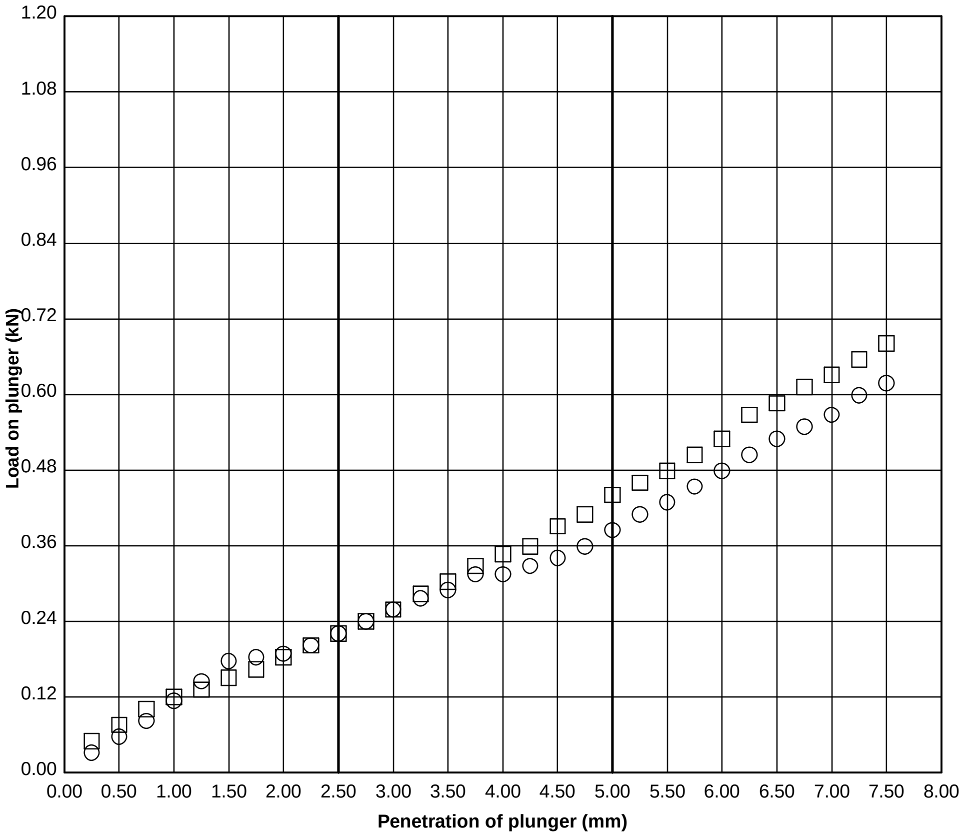
Borehole / Trial Pit	Depth (m)	Sample	% Passing 20 mm Sieve	Description
BH03	0.30	B2	100 %	Brown sandy CLAY

Moisture Content %	
Bulk Density Mg/m³	2.15
Dry Density Mg/m³	2.15
Soaked Test	No

Test on	□ TOP	
Moisture Content %	14	
Surcharge weight kg	4.40	
Penetration mm	2.5	5.0
Force kN	0.22	0.44
Corrected CBR %	1.7	2.2

Test on	○ BOTTOM	
Moisture Content %	13	
Surcharge weight kg	4.40	
Penetration mm	2.5	5.0
Force kN	0.22	0.38
Corrected CBR %	1.7	1.9

Test on	TOP	BOTTOM
Reported CBR %	2.2	1.9
Mean CBR %	2.0	



Method of Preparation : The specimen was prepared by Dynamic compression using a 2.5 kg Rammer
BS 1377:PART 1:1990:7.6.1 General 1990:7.6.5 California bearing ratio test BS 1377:PART 4:1990:7.2 Preparation of test sample

Method of Test : BS 1377:PART 4:1990:7.4 Penetration test procedure

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274C/1

Site : Warren Hall Site - Broughton		**Job Number** 40274C
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DETERMINATION OF CALIFORNIA BEARING RATIO (CBR)

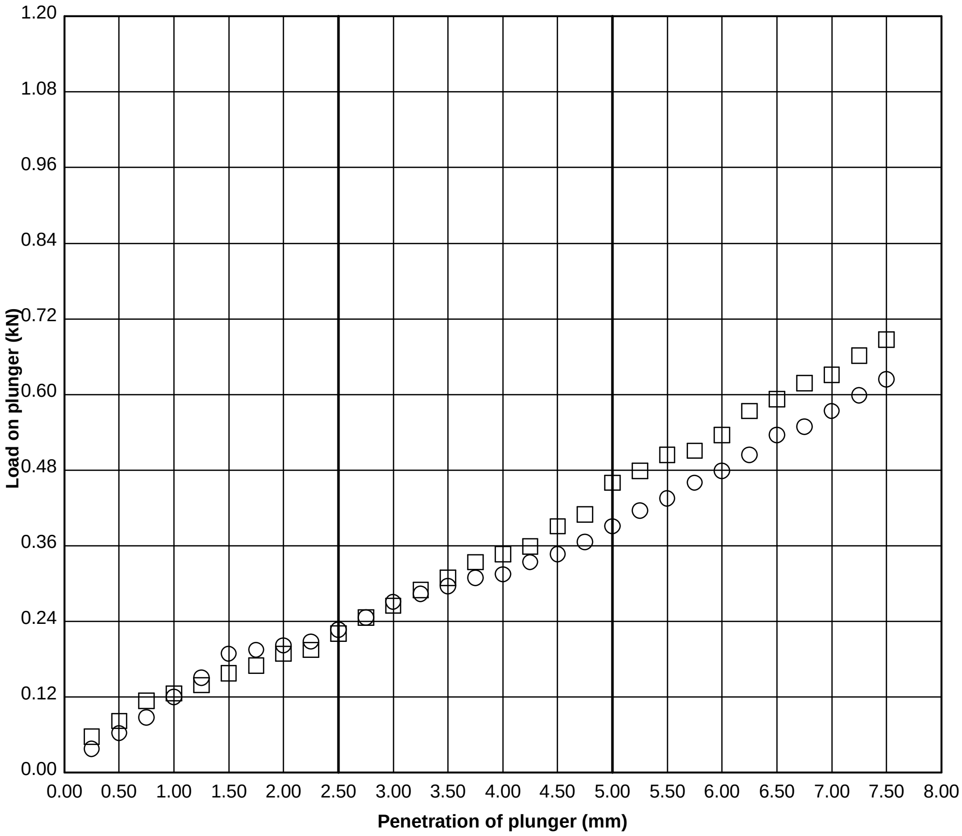
Borehole / Trial Pit	Depth (m)	Sample	% Passing 20 mm Sieve	Description
BH04	1.20	B3	100 %	Brown SAND

Moisture Content %	
Bulk Density Mg/m³	2.15
Dry Density Mg/m³	1.90
Soaked Test	No

Test on	□ TOP	
Moisture Content %	13	
Surcharge weight kg	4.40	
Penetration mm	2.5	5.0
Force kN	0.22	0.46
Corrected CBR %	1.7	2.3

Test on	○ BOTTOM	
Moisture Content %	13	
Surcharge weight kg	4.40	
Penetration mm	2.5	5.0
Force kN	0.23	0.39
Corrected CBR %	1.7	2.0

Test on	TOP	BOTTOM
Reported CBR %	2.3	2.0
Mean CBR %	2.2	



Method of Preparation : The specimen was prepared by Dynamic compression using a 2.5 kg Rammer
BS 1377:PART 1:1990:7.6.1 General 1990:7.6.5 California bearing ratio test BS 1377:PART 4:1990:7.2 Preparation of test sample

Method of Test : BS 1377:PART 4:1990:7.4 Penetration test procedure

Remarks :

Site	: Warren Hall Site - Broughton	**Job Number** 40274C
Client	: Welsh Assembly Government	**Page** 14 / 29

DETERMINATION OF CALIFORNIA BEARING RATIO (CBR)

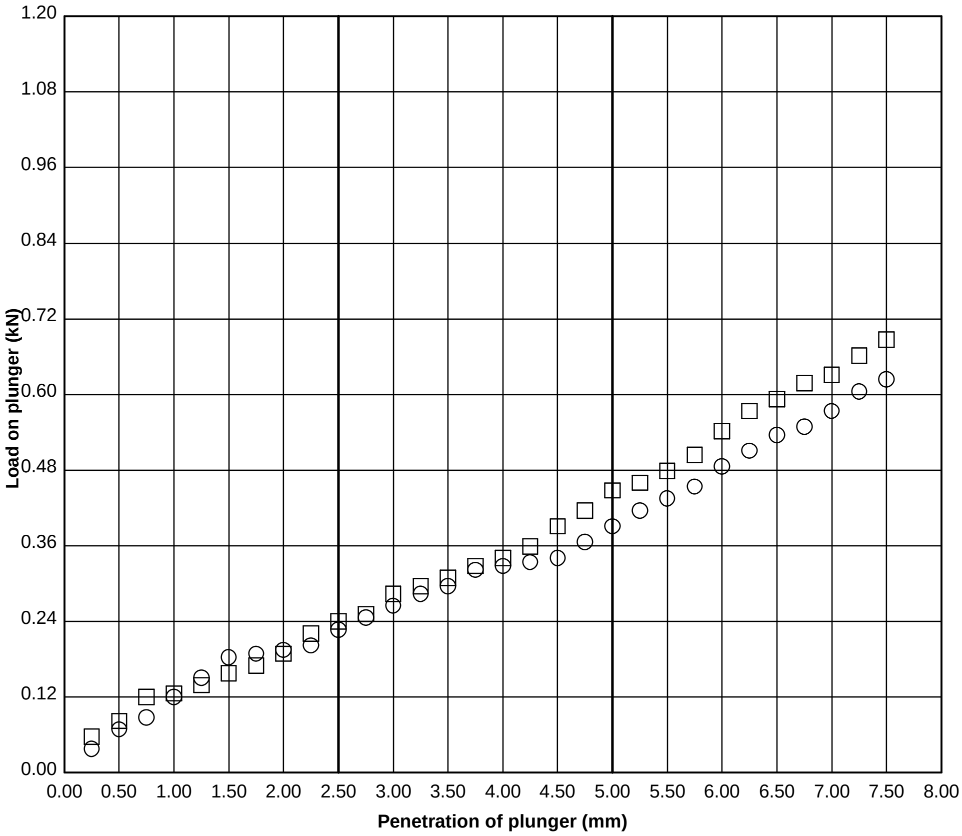
Borehole / Trial Pit	Depth (m)	Sample	% Passing 20 mm Sieve	Description
BH05	0.50	B2	100 %	Brown gravelly SAND

Moisture Content %	
Bulk Density Mg/m³	2.15
Dry Density Mg/m³	2.15
Soaked Test	No

Test on	□ TOP	
Moisture Content %	13	
Surcharge weight kg	4.40	
Penetration mm	2.5	5.0
Force kN	0.24	0.45
Corrected CBR %	1.8	2.2

Test on	○ BOTTOM	
Moisture Content %	13	
Surcharge weight kg	4.40	
Penetration mm	2.5	5.0
Force kN	0.23	0.39
Corrected CBR %	1.7	2.0

Test on	TOP	BOTTOM
Reported CBR %	2.2	2.0
Mean CBR %	2.1	



Method of Preparation : The specimen was prepared by Dynamic compression using a 2.5 kg Rammer
BS 1377:PART 1:1990:7.6.1 General 1990:7.6.5 California bearing ratio test BS 1377:PART 4:1990:7.2 Preparation of test sample

Method of Test : BS 1377:PART 4:1990:7.4 Penetration test procedure

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274C/1

Site	: Warren Hall Site - Broughton	**Job Number** 40274C
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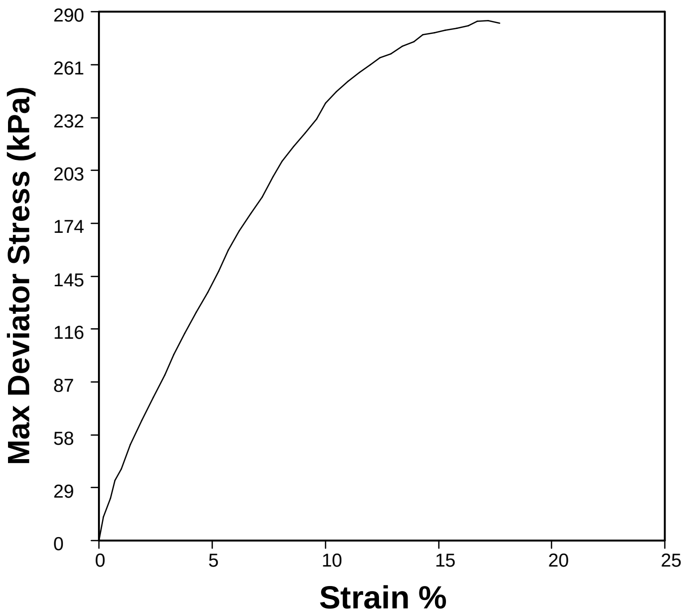
DETERMINATION OF MOISTURE CONTENT, DENSITY AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE (DEFINITIVE METHOD)

Borehole / Trial Pit	Depth (m)	Sample	Description
BH03	3.00	U7	Brown slightly gravelly CLAY

Initial Specimen		
Length of Sample (mm)	450	
Depth from top of sample (mm)	50	
Condition of Sample:	Undisturbed	
Orientation:	Vertical	

Test Type	Single Stage
Length of Specimen (mm)	209.1
Diameter of Specimen (mm)	101.5
Moisture Content (%)	15
Bulk Density (Mg/m³)	2.34
Dry Density (Mg/m³)	2.04
Membrane Thickness (mm)	0.3
Membrane Type	Latex
Rate of Strain (%/min)	1.91

Test Results	
Measured Cell Pressure (kPa)	60
Strain at Failure (%)	17.2
Membrane Correction (kPa)	1.0
Corrected Deviator Stress (kPa)	284
Shear Stress (kPa)	**142**
Mode of Failure (B/P/C)	**Plastic**



Method of Preparation : BS 1377:PT1:1990:7.4.2 Moisture Content, BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or BS 1377:PT1:1990 :7.7.5.2 Preparation of disturbed samples for testing.

Method of Test : BS 1377:PT2:1990:3.2 Determination of moisture content, BS 1377:PT2:1990:7.2 Determination of density by linear measurement and BS1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (definitive method)

Remarks : Membrane Type: Latex

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Laboratory Test Report - 40274C/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274C

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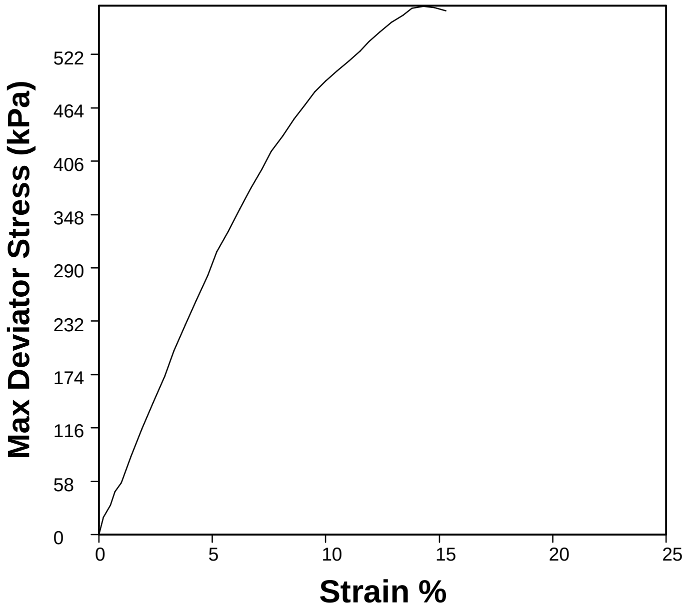
DETERMINATION OF MOISTURE CONTENT, DENSITY AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE (DEFINITIVE METHOD)

Borehole / Trial Pit	Depth (m)	Sample	Description
BH07	2.00	U5	Brown slightly sandy slightly gravelly SAND

Initial Specimen	**Length of Sample (mm)**	450
	Depth from top of sample (mm)	50
	Condition of Sample:	Undisturbed
	Orientation:	Vertical
Test Type		Single Stage
Length of Specimen (mm)		209.6
Diameter of Specimen (mm)		101.1
Moisture Content (%)		17
Bulk Density (Mg/m³)		2.27
Dry Density (Mg/m³)		1.93
Membrane Thickness (mm)		0.36
Membrane Type		Latex
Rate of Strain (%/min)		1.91
Test Results	**Measured Cell Pressure (kPa)**	40
	Strain at Failure (%)	14.3
	Membrane Correction (kPa)	1.1
	Corrected Deviator Stress (kPa)	573
	Shear Stress (kPa)	**287**
	Mode of Failure (B/P/C)	**Plastic**



Method of Preparation : BS 1377:PT1:1990:7.4.2 Moisture Content, BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or BS 1377:PT1:1990 :7.7.5.2 Preparation of disturbed samples for testing.

Method of Test : BS 1377:PT2:1990:3.2 Determination of moisture content, BS 1377:PT2:1990:7.2 Determination of density by linear measurement and BS1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (definitive method)

Remarks : Membrane Type: Latex

IAN FARMER ASSOCIATES

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ONE-DIMENSIONAL CONSOLIDATION TEST

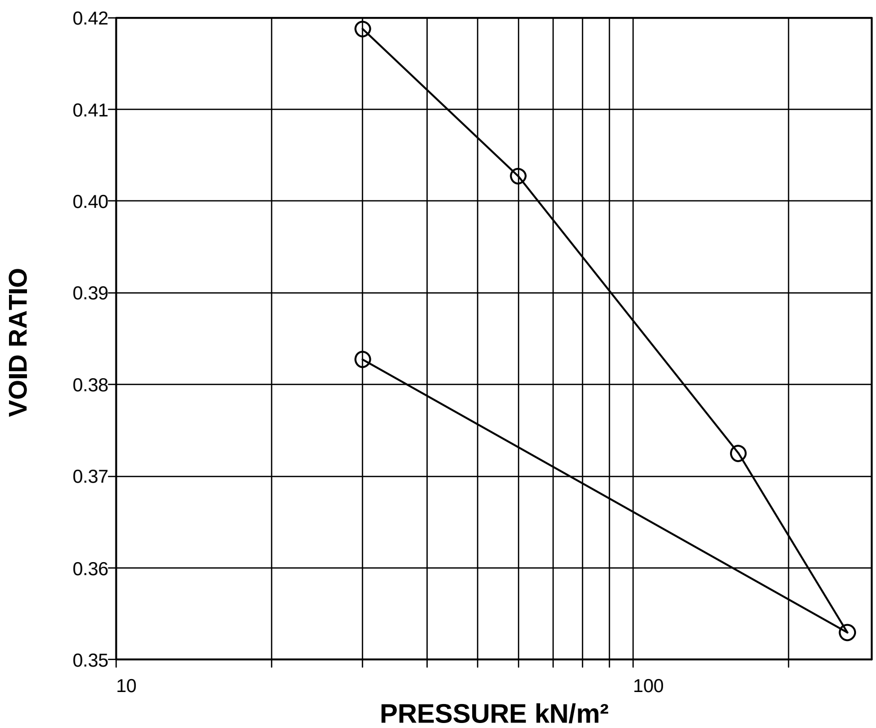
Borehole / Trial Pit	Depth (m)	Sample	Description
BH03	3.00	U7	Brown slightly gravelly CLAY

Initial Specimen

Length of Sample (mm)	450
Depth from top of sample (mm)	50
Condition of Sample:	Undisturbed
Orientation:	Vertical

Diameter (mm)	75.00
Particle Density (Mg/m³)	2.65 (Assumed)
Swelling Pressure (kN/m²)	
Lab Temp (℃)	19

	Inital	Final
Height (mm)	19.00	18.72
Wet Weight (g)	179.10	180.38
Moisture Content (%)	14	8.66
Bulk Density (Mg/m³)	2.13	2.18
Dry Density (Mg/m³)	1.86	2.01
Void Ratio	0.425	0.318
Degree of Saturation (%)	89.79	72.17



Pressure kN/m²	Mv m²/MN	Cv m²/year	Void Ratio
30	0.07	103	0.419
60	0.19	29	0.403
160	0.10	57	0.372
260	0.07	57	0.353
30	0.04	43	0.383

Pressure kN/m²	Mv m²/MN	Cv m²/year	Void Ratio

Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

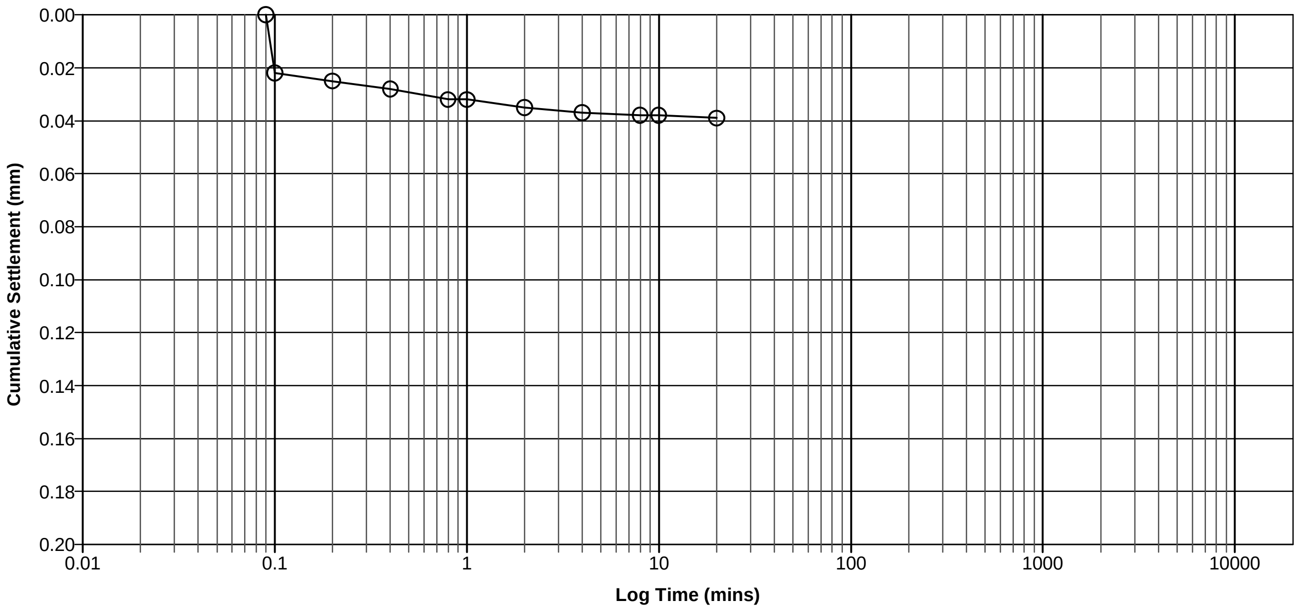
IAN FARMER ASSOCIATES

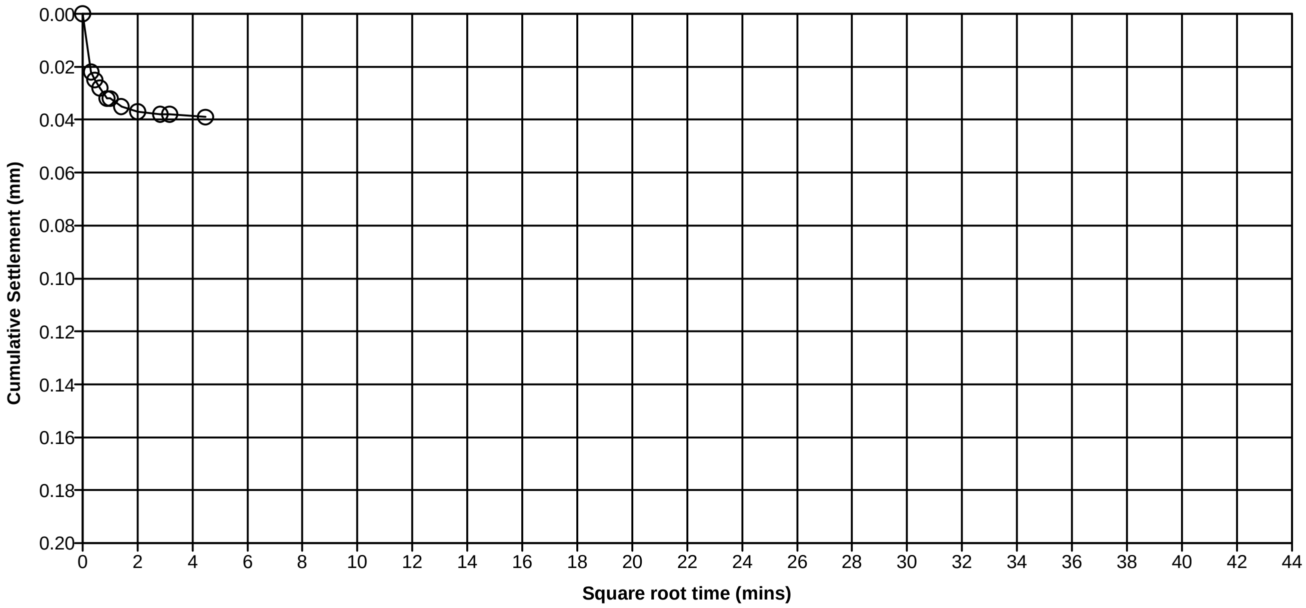
Laboratory Test Report - 40274C/1

Site : Warren Hall Site - Broughton	**Job Number** 40274C
Client : Welsh Assembly Government	**Page** 18 / 29

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH03	3.00	U7	1	Brown slightly gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

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Site : Warren Hall Site - Broughton	**Job Number** 40274C
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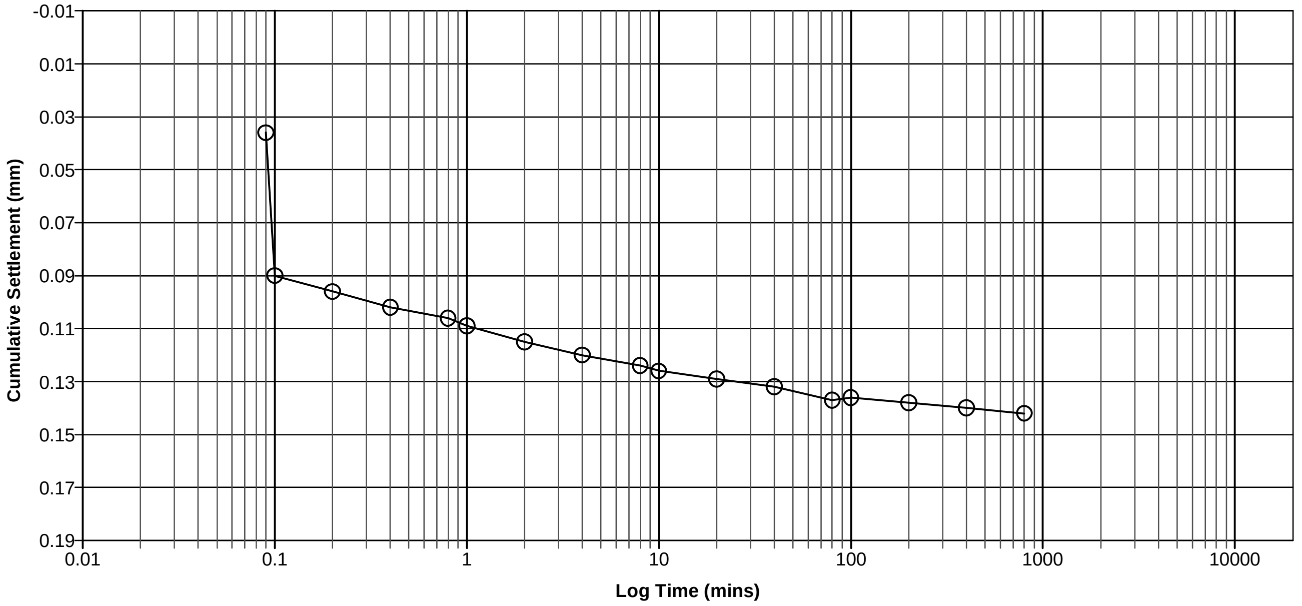
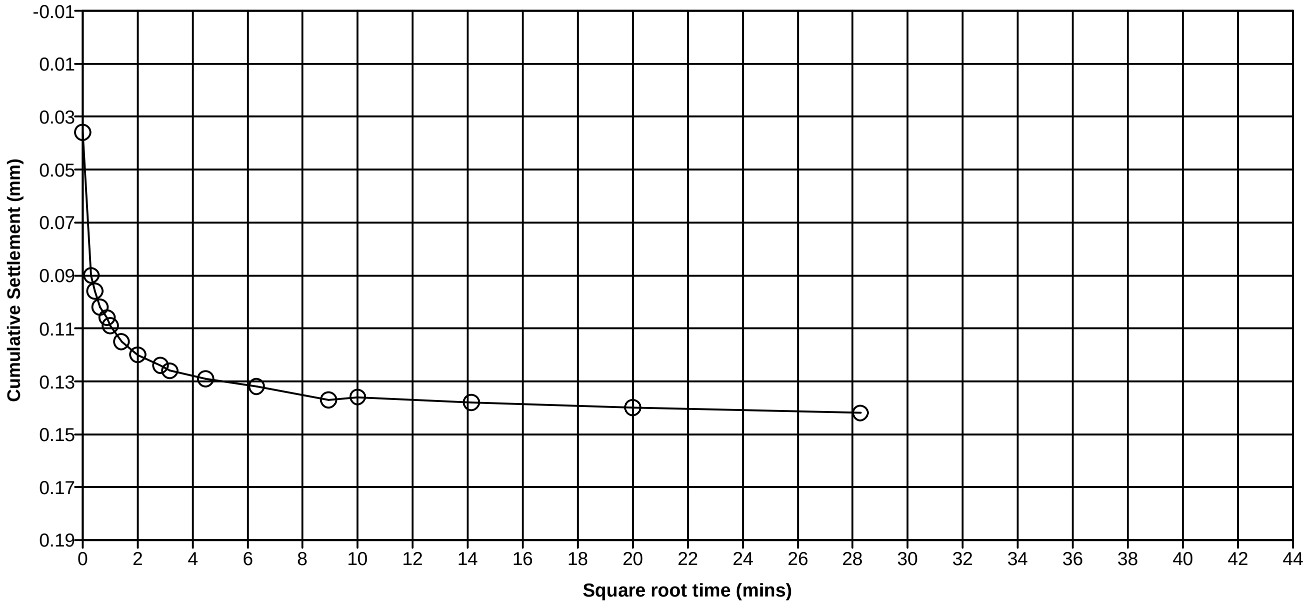
ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH03	3.00	U7	2	Brown slightly gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

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Laboratory Test Report - 40274C/1

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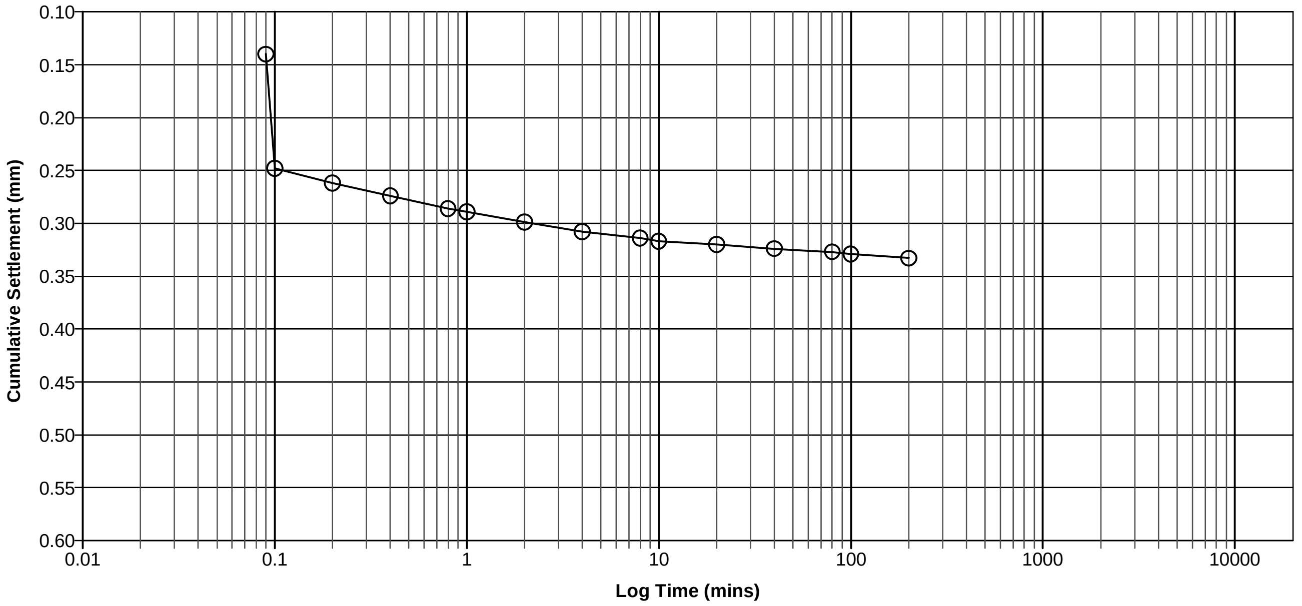
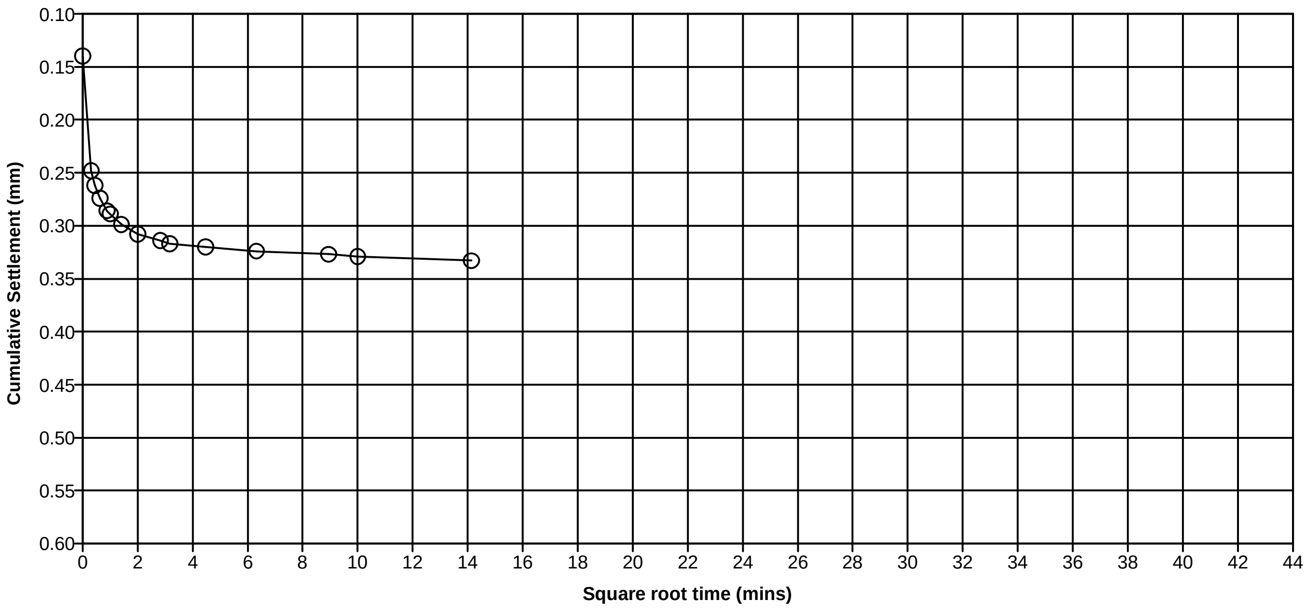
ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH03	3.00	U7	3	Brown slightly gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

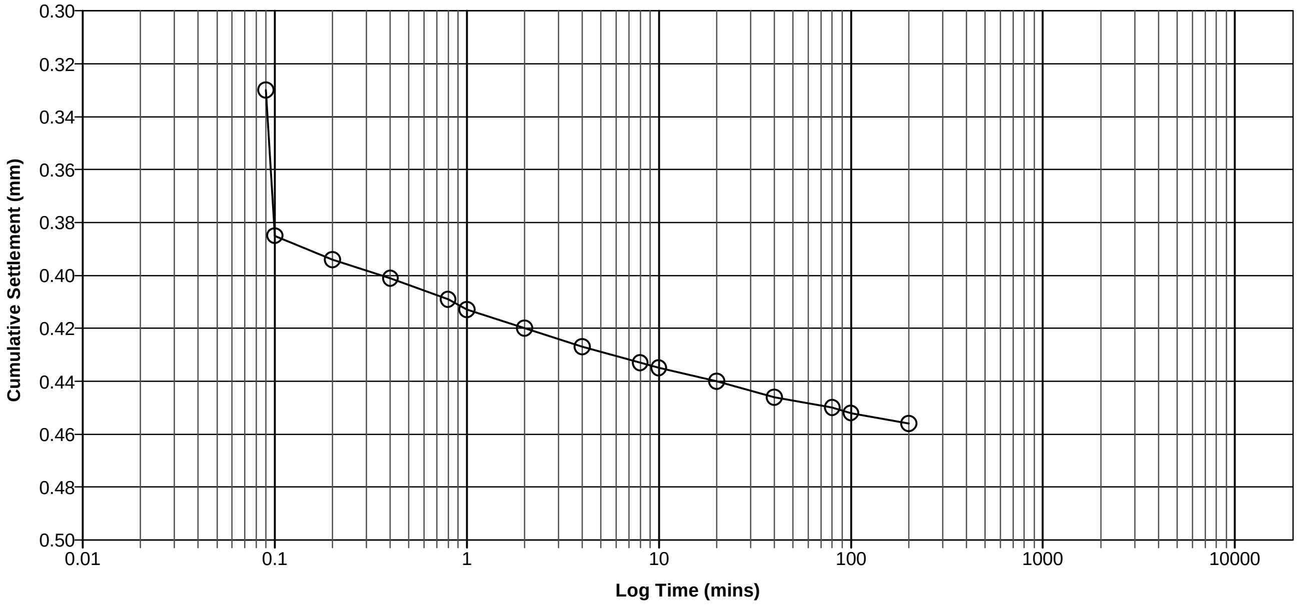
Method of Test : BS 1377:PART 5:1990:3.5

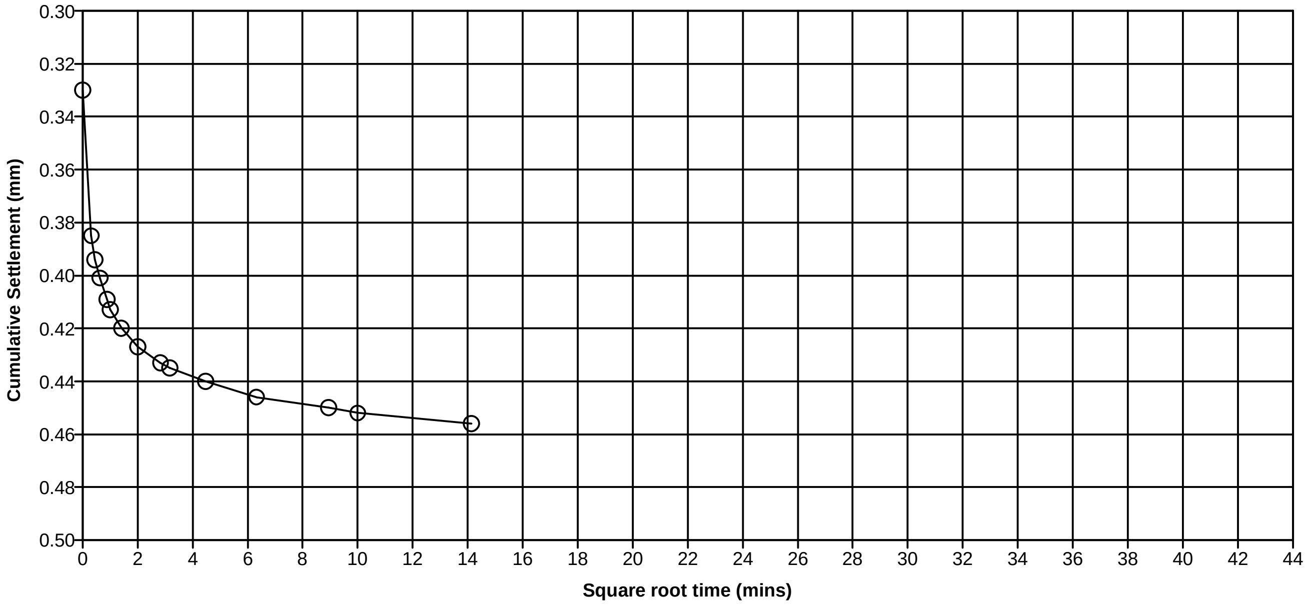
Remarks :

Site	: Warren Hall Site - Broughton	**Job Number**	40274C
Client	: Welsh Assembly Government	**Page**	21 / 29

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH03	3.00	U7	4	Brown slightly gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274C/1

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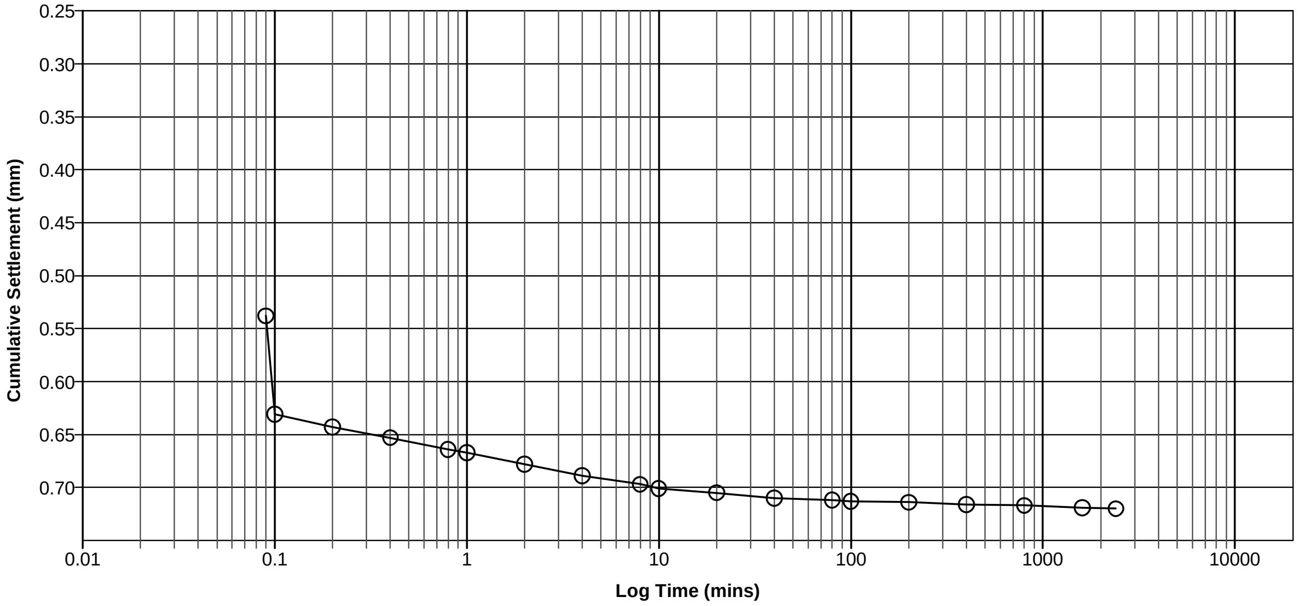
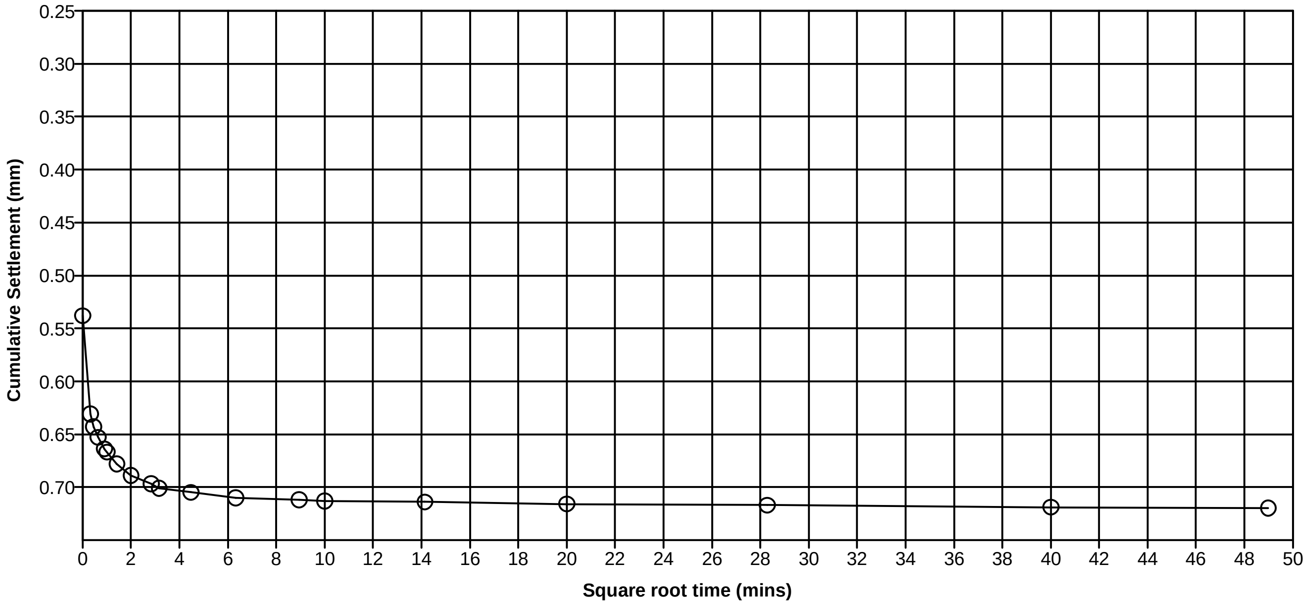
ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH03	3.00	U7	5	Brown slightly gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274C/1

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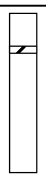
ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Description
BH07	2.00	U5	Brown slightly sandy slightly gravelly SAND

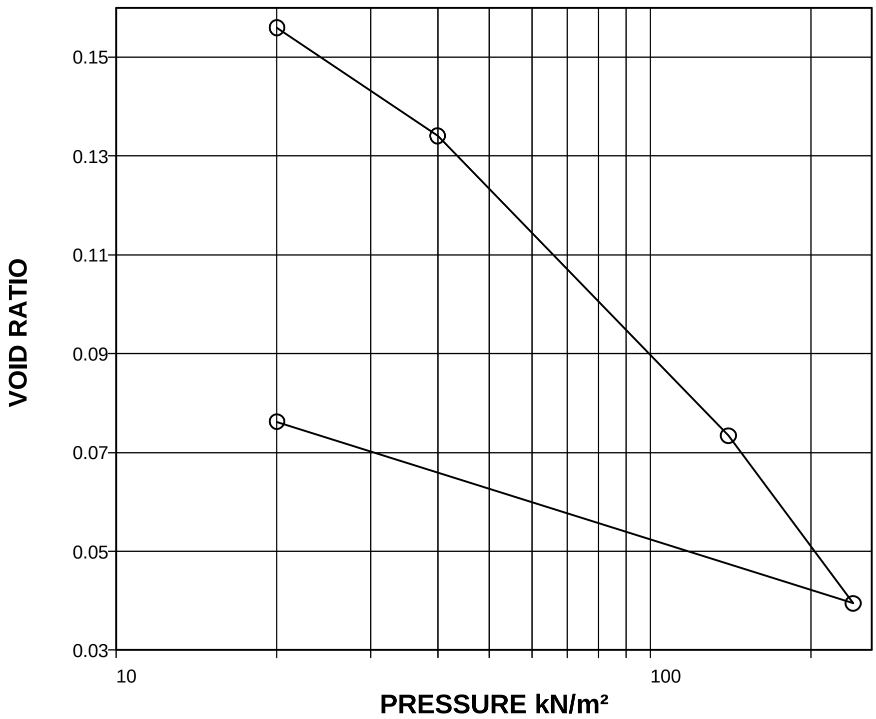
Initial Specimen



Length of Sample (mm)	450
Depth from top of sample (mm)	50
Condition of Sample:	Undisturbed
Orientation:	Vertical

Diameter (mm)	75.00
Particle Density (Mg/m³)	2.65 (Assumed)
Swelling Pressure (kN/m²)	
Lab Temp (℃)	19

	Inital	Final
Height (mm)	19.00	17.89
Wet Weight (g)	207.94	206.60
Moisture Content (%)	14	6.49
Bulk Density (Mg/m³)	2.48	2.61
Dry Density (Mg/m³)	2.17	2.45
Void Ratio	0.221	0.082
Degree of Saturation (%)	171.47	209.74



Pressure kN/m²	Mv m²/MN	Cv m²/year	Void Ratio
20	1.3	24	0.156
40	0.46	38	0.134
140	0.25	89	0.073
240	0.14	148	0.039
20	0.06	112	0.076

Pressure kN/m²	Mv m²/MN	Cv m²/year	Void Ratio

Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

IAN FARMER ASSOCIATES	Laboratory Test Report - 40274C/1

Site : Warren Hall Site - Broughton		**Job Number** 40274C
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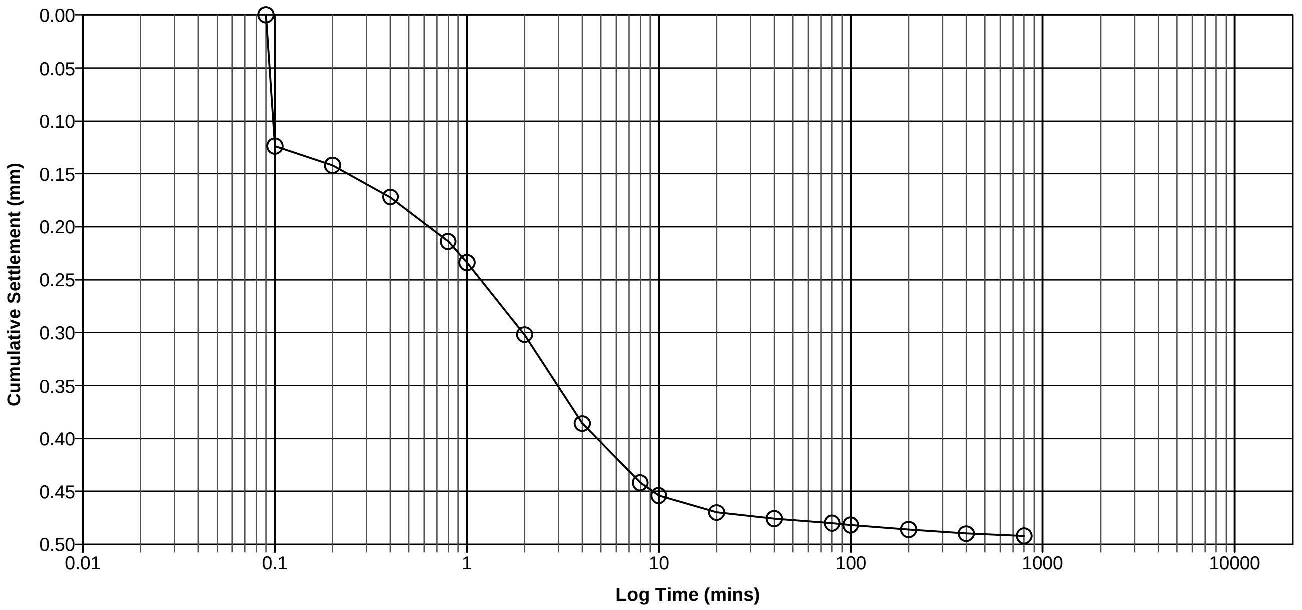
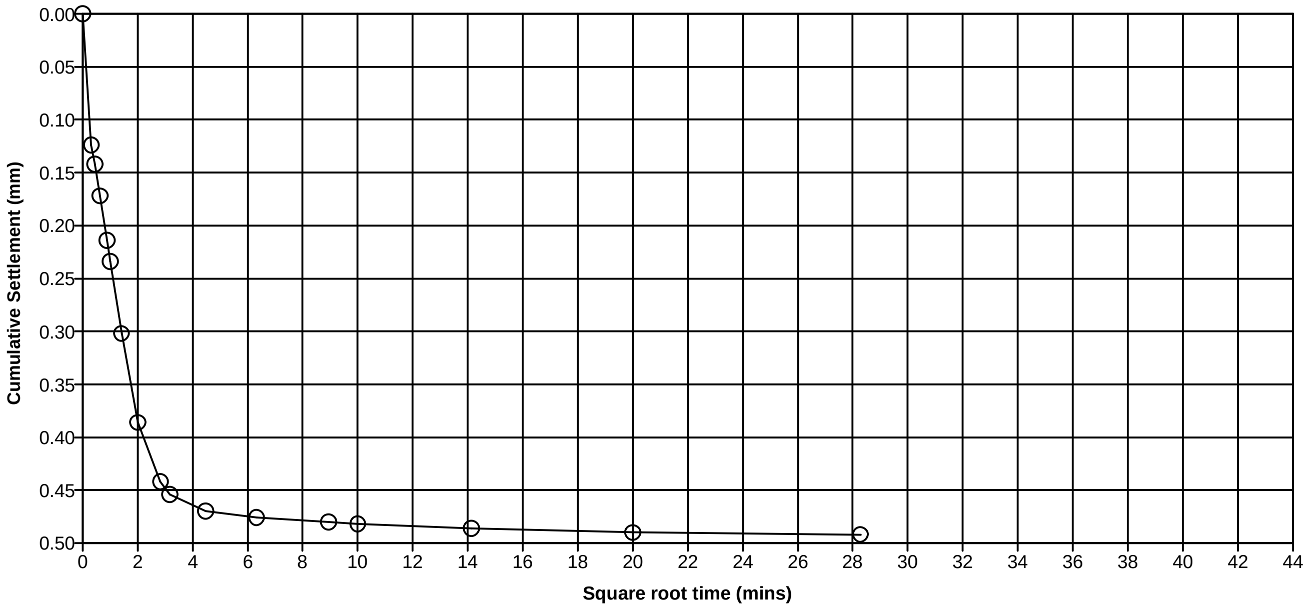
ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH07	2.00	U5	1	Brown slightly sandy slightly gravelly SAND





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

IAN FARMER ASSOCIATES	Laboratory Test Report - 40274C/1

Site	: Warren Hall Site - Broughton	**Job Number** 40274C
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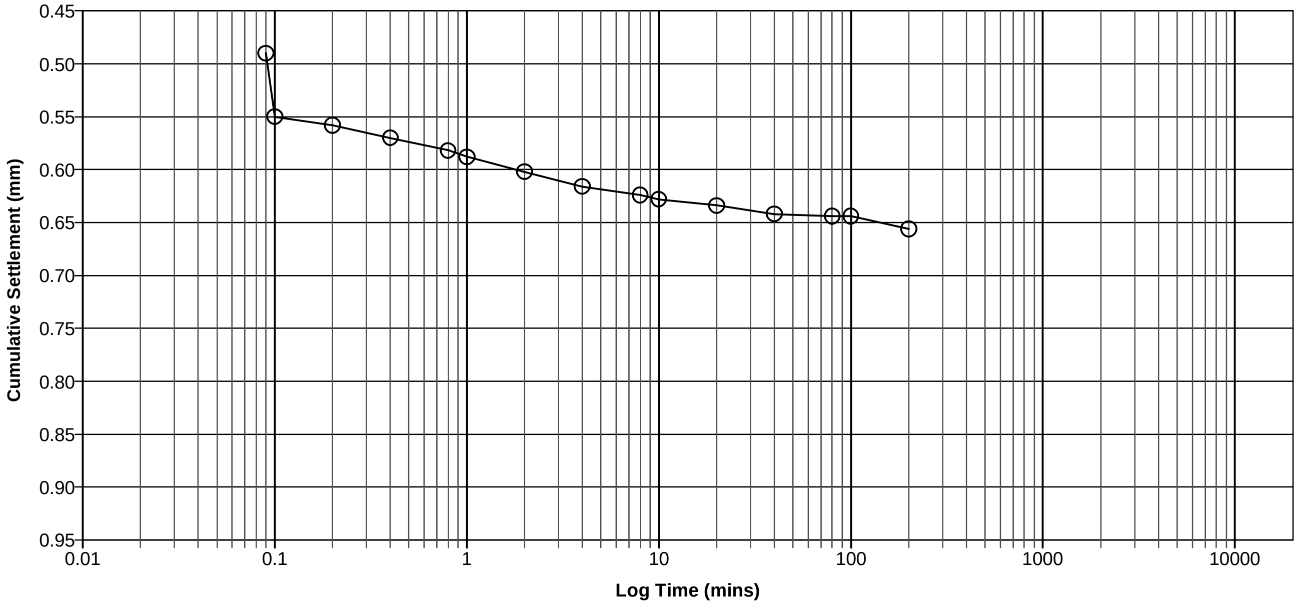
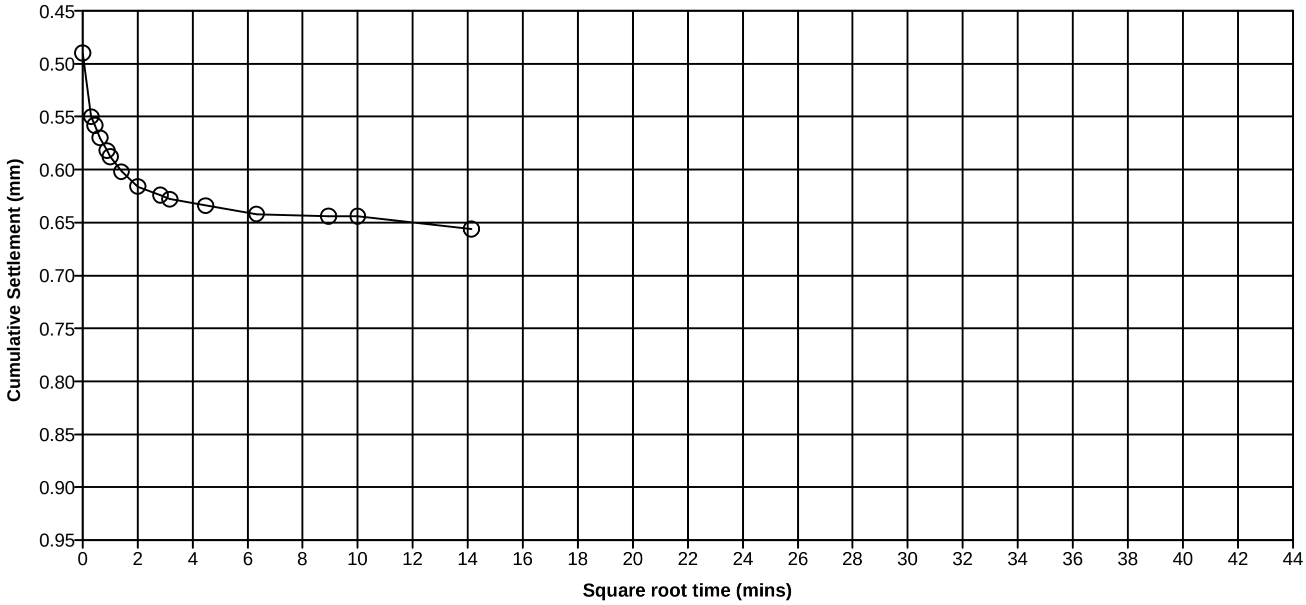
ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH07	2.00	U5	2	Brown slightly sandy slightly gravelly SAND





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

IAN FARMER ASSOCIATES

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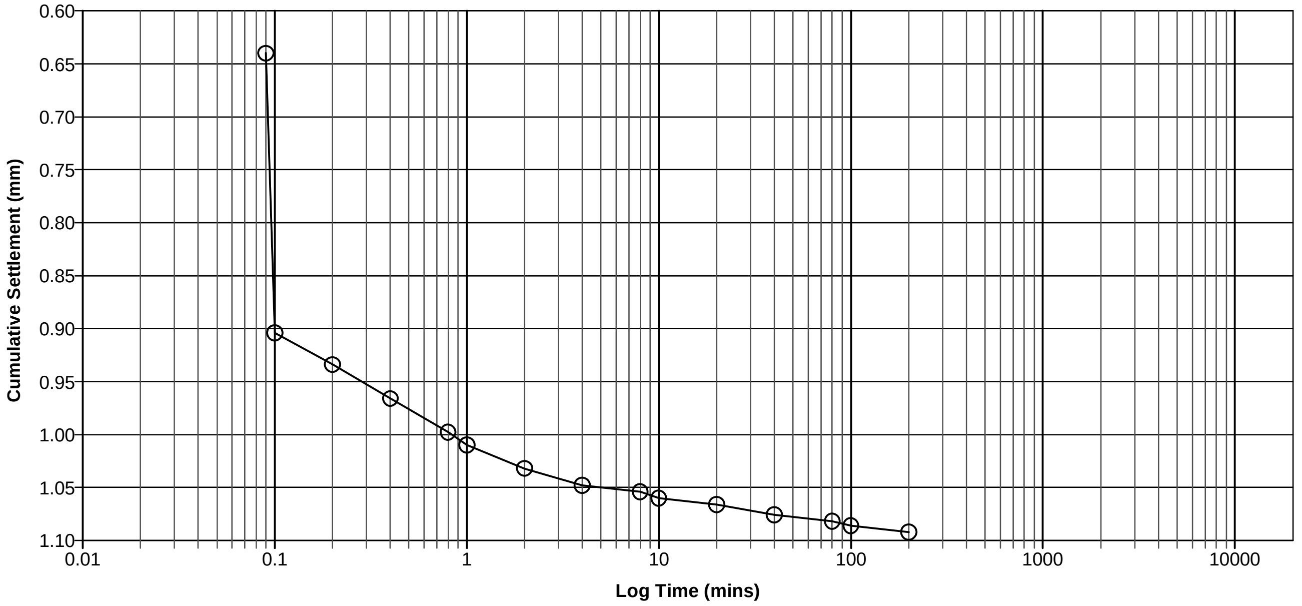
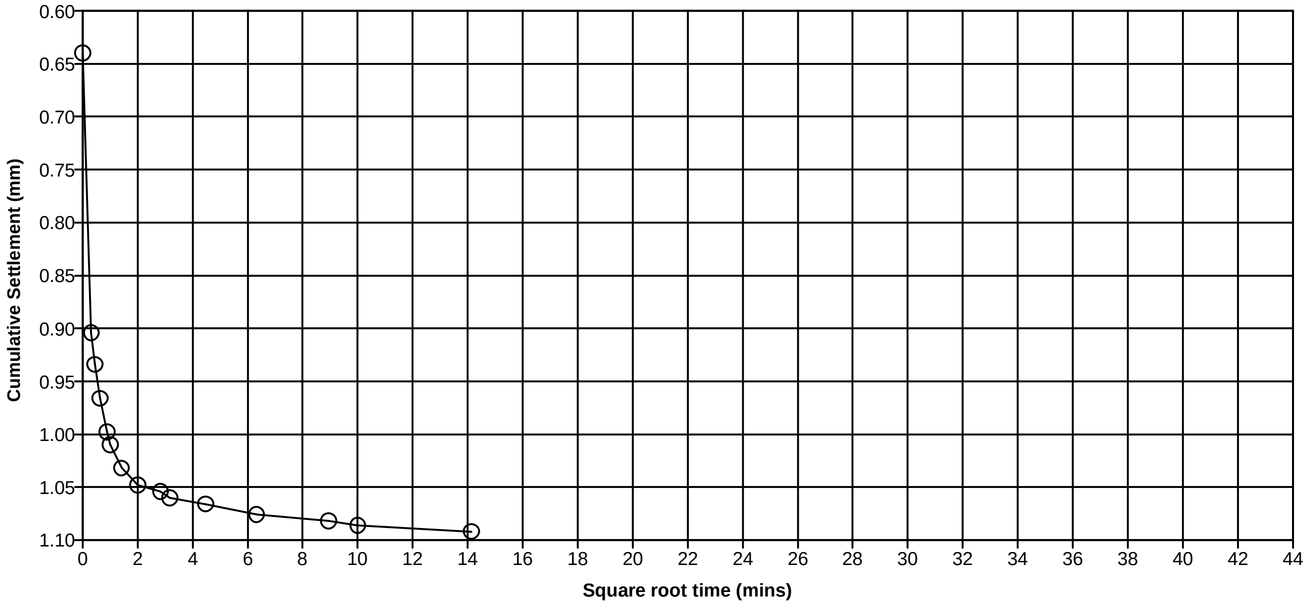
ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH07	2.00	U5	3	Brown slightly sandy slightly gravelly SAND





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

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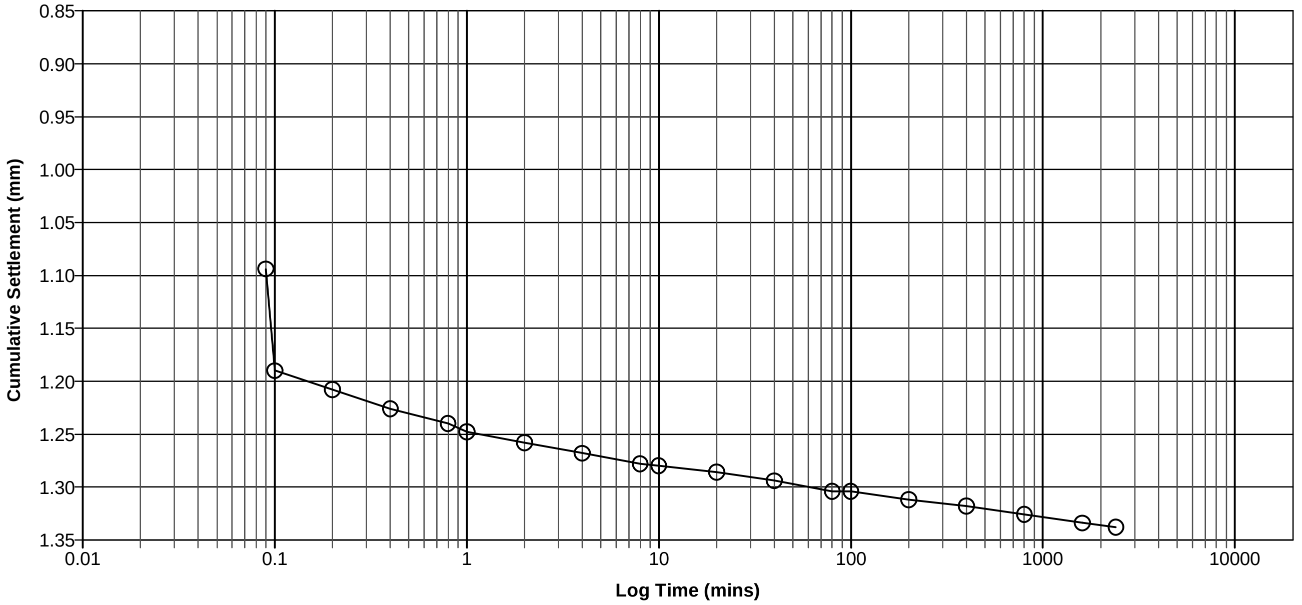
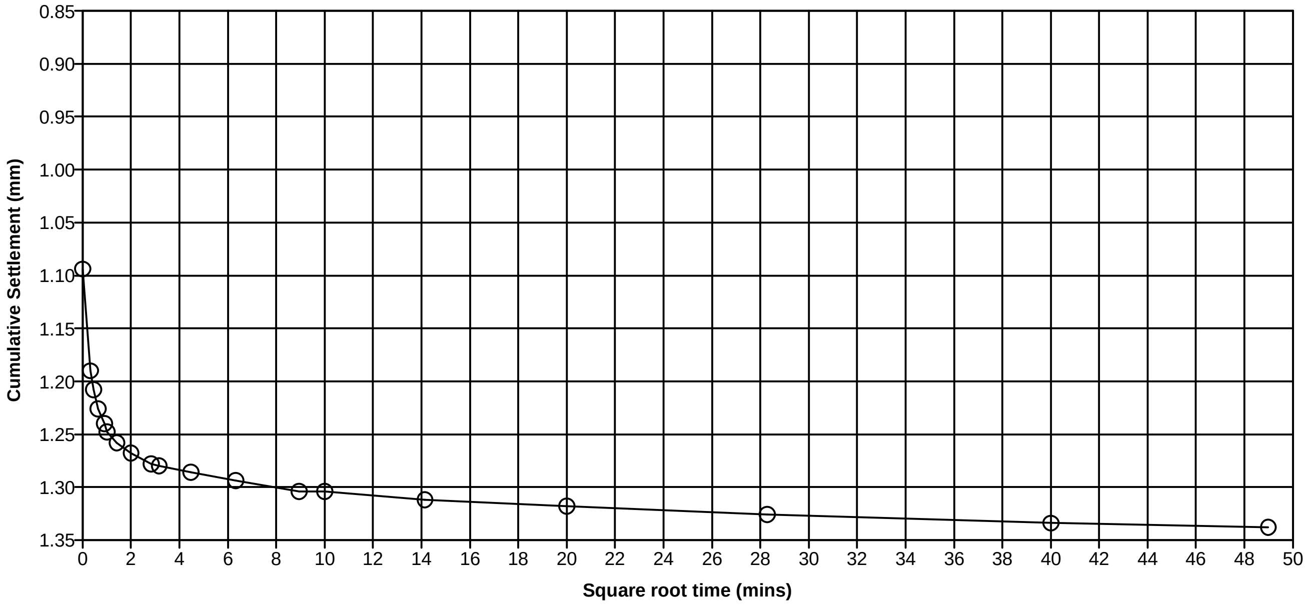
Laboratory Test Report - 40274C/1

Site : Warren Hall Site - Broughton	**Job Number** 40274C
Client : Welsh Assembly Government	**Page** 27 / 29

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH07	2.00	U5	4	Brown slightly sandy slightly gravelly SAND





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

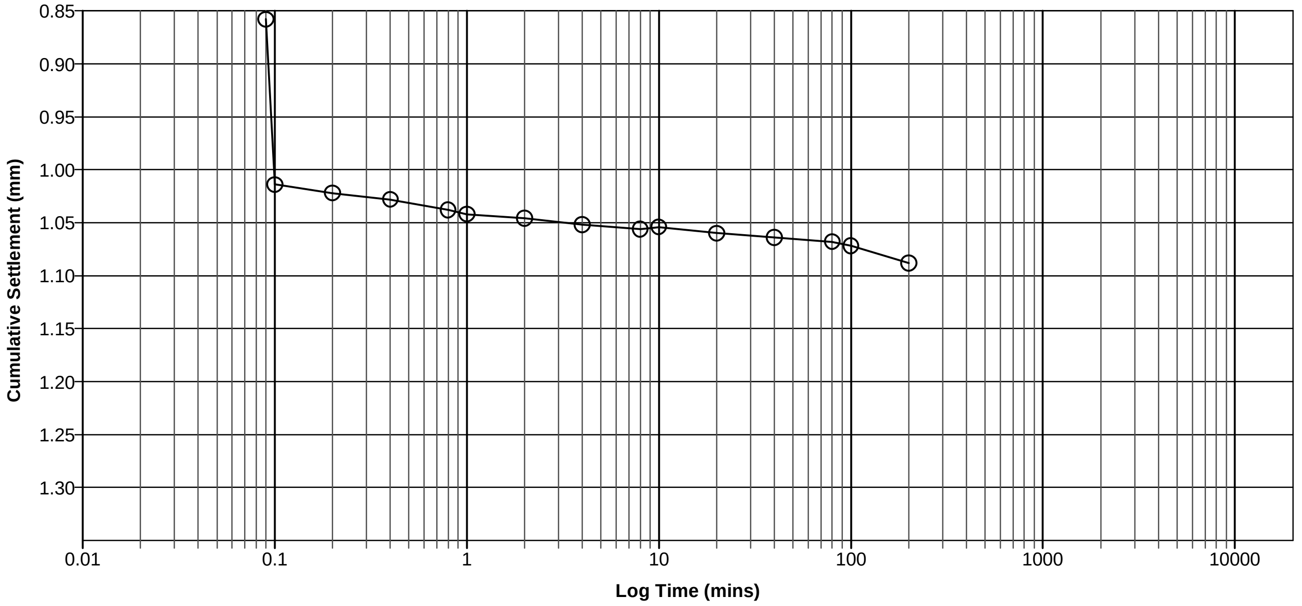
Remarks :

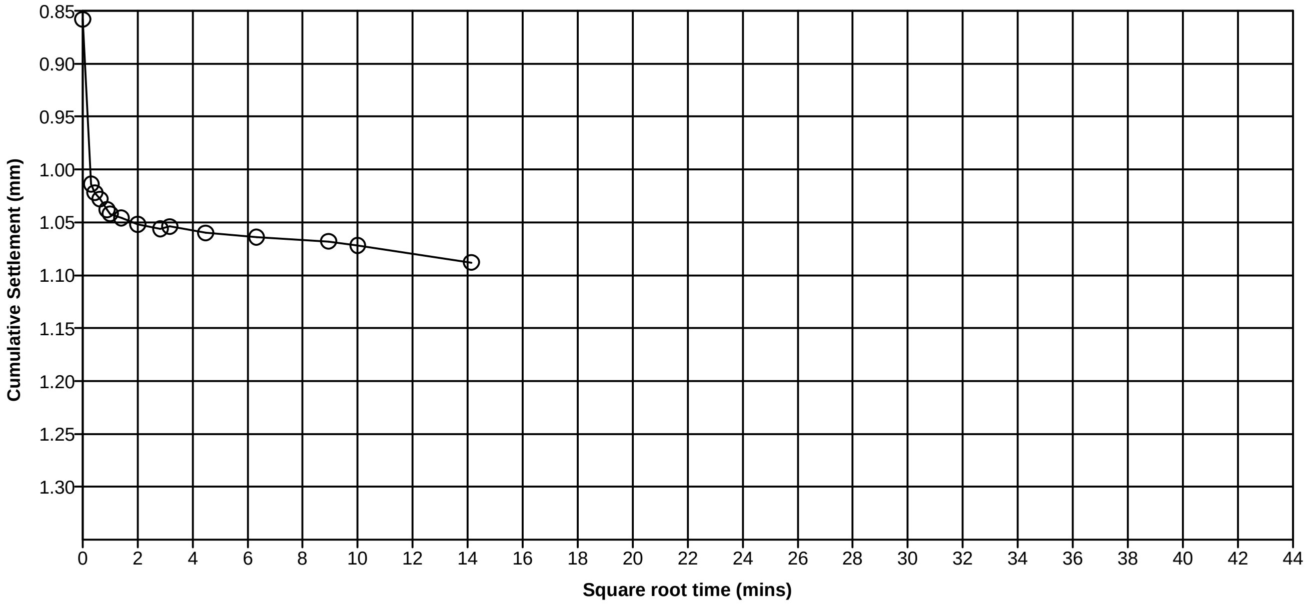
Laboratory Test Report - 40274C/1

Site	: Warren Hall Site - Broughton	**Job Number** 40274C
Client	: Welsh Assembly Government	**Page** 28 / 29

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH07	2.00	U5	5	Brown slightly sandy slightly gravelly SAND





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

Test Report : **40274C/1**

Site :	Warren Hall Site - Broughton
Job Number :	40274C
Originating Client :	Welsh Assembly Government

All opinions and interpretations contained within this report are outside of our Scope of Accreditation.

The following tests contained within this report are not UKAS Accredited.
One - Dimensional Consolidation

Date of Issue : 20/2/08

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

14 Faraday Close, District 15, Pattinson North Industrial Estate, Washington, Tyne & Wear, NE38 8QJ.
Tel. 0191 4166375 Fax. 0191 4191578 Email. lab@ifawashington.co.uk Internet.www.ianfarmerassociates.co.uk

Ian Farmer Associates (1998) Ltd
17 Rivington Court
Warrington
Cheshire
WA1 4RT

F.A.O. Mr A Latimer

TEST REPORT - 40274D/1

Site :	Warren Hall Site - Broughton
Job Number :	40274D
Originating Client :	Welsh Assembly Government
Originating Reference :	40274D
Date Sampled :	Not Given
Date Scheduled :	25.01.08
Date Testing Started :	3/2/08
Date Testing Finished :	19/2/08
Remarks :	• First Report for above Job Number • Samples will be disposed of 28 days after the report is issue unless otherwise agreed • This report may contain results from tests which are not included within the scope of the UKAS accreditation. Please see final sheet for details.

Authorised By: J.M. Jones

Position : Senior Materials Engineer Date : 19/2/08

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Warrington (01925) 855440. Newcastle upon Tyne (0191) 4828500. Motherwell (01698) 230231.

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AGS ASSOCIATION OF GEOTECHNICAL & GEOENVIRONMENTAL SPECIALISTS
UKAS 1464

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Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274D

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DETERMINATION OF MOISTURE CONTENT

Borehole/ Trial Pit	Depth (m)	Sample	Moisture Content %	Description
BH09	2.00	U5	15	Brown sandy CLAY
BH10	3.00	U13	17	Brown sandy CLAY
BH11	1.70	D4	16	Brown slightly gravelly CLAY
BH12	5.50	D13	40	Brown CLAY
BH13	0.40	B2	16	Brown slightly gravelly CLAY

Method of Preparation : BS 1377:PART 1:1990:7.3.3 Preparation of samples for classification tests

Method of Test : BS 1377:PART 2:1990:3.2 Determination of oven dried moisture content

Remarks :

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274D

DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY AND LIQUIDITY INDEX

Borehole/ Trial Pit	Depth (m)	Sample	Natural / Sieved	Natural Moisture Content %	Sample Passing 425µm Sieve		Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Class	Description / Remarks
					Percentage %	Moisture Content %						
BH09	2.00	U5	Natural	15	96	15	24	14	10	0.10	CL	Brown sandy CLAY
BH10	3.00	U13	Natural	17	90	18	24	17	7	0.14	CL	Brown sandy CLAY
BH11	1.70	D4	Natural	16	94	17	31	18	13	-0.08	CL	Brown slightly gravelly CLAY
BH12	5.50	D13	Natural	40	95	42	65	36	29	0.21	MH	Brown CLAY
BH13	0.40	B2	Natural	16	74	20	35	18	17	0.12	CL/CI	Brown slightly gravelly CLAY

Method of Preparation : BS 1377:PART 1:1990:7.4 Preparation of samples for classification tests BS 1377:PART 2:1990:4.2 & 5.2 Sample preparations

Method of Test : BS 1377:PART 2:1990:3.2 Determination of moisture content 4.3 Determination of the liquid limit 5.3 Determination of the plastic limit and plasticity index

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Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274D

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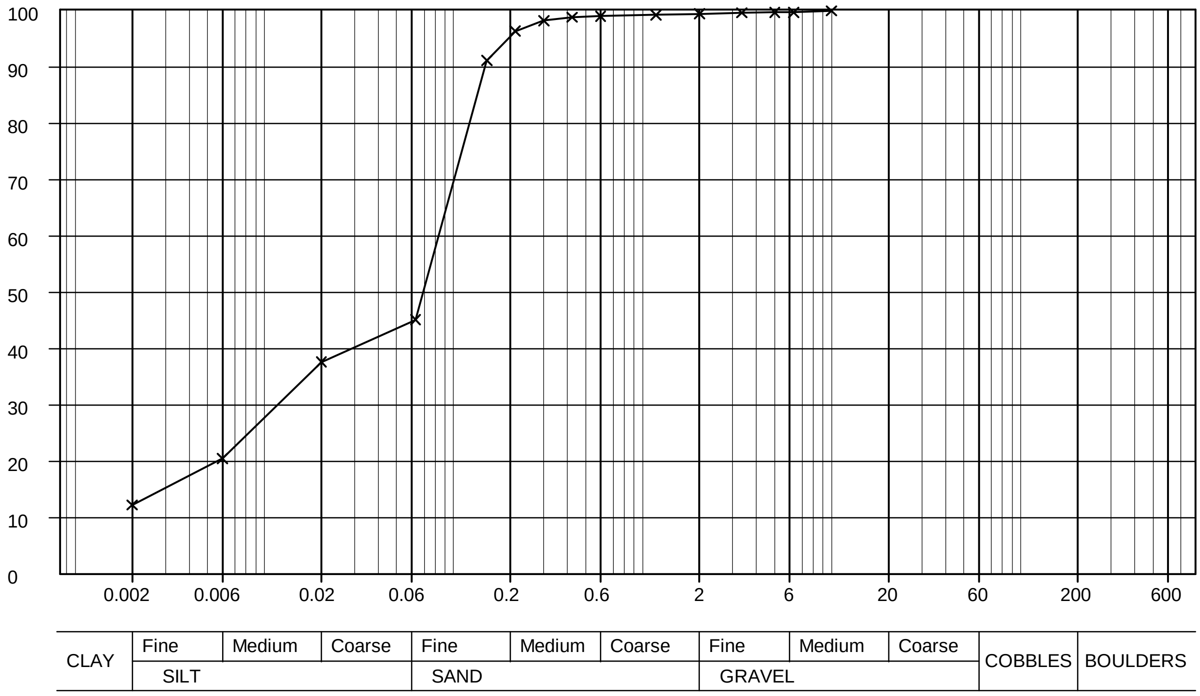
DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
BH11	5.50	B12	Pipette	Brown SILT / CLAY



Sieve / Particle Size	% Passing
200 mm	100
150 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	100
10 mm	100
6.3 mm	100
5 mm	100
3.35 mm	100
2 mm	99
1.18 mm	99
600 µm	99
425 µm	99
300 µm	98
212 µm	96
150 µm	91
63 µm	45
20 µm	38
6 µm	21
2 µm	12

Grading Analysis	
D85	100.0 µm
D60	100.0 µm
D10	-
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	0%
Gravel	1%
Sand	55%
Silt	33%
Clay	12%

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with washing dispersant, Oven Dried at 105 - 110°C

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274D

DETERMINATION OF THE pH VALUE AND THE SULPHATE CONTENT OF SOIL AND GROUNDWATER

Borehole/ Trial Pit	Depth (m)	Sample	Concentration of Soluble Sulphate			Percentage of sample passing 2mm Sieve %	pH	Description / Remarks
			Soil		Groundwater g /l			
			Total S04 %	S04 in 2:1 water:soil g /l				
BH09	0.20	B2		0.1		96	7.2	Brown slightly sandy slightly gravelly CLAY
BH09	2.50	D6		0.1		91	7.4	Brown sandy CLAY / SILT
BH10	0.60	D5		0.1		85	7.4	Brown sandy CLAY
BH11	4.00	D10		0.1		84	7.3	Brown sandy CLAY
BH12	0.10	B2		0.1		53	7.4	Brown slightly gravelly SILT / CLAY
BH13	1.70	D4		0.1		93	7.4	Brown SILT / CLAY

Method of Preparation : BS 1377:PART 1:1990:7.5 Preparation of soil for chemical tests BS 1377:PART 3:1990:5.2, 5.3, 5.4 & 9.4

Method of Test : BS 1377:PART 3:1990:5 Determination of the sulphate content of soil and ground water BS 1377:PART 3:1990:9 Determination of the pH value

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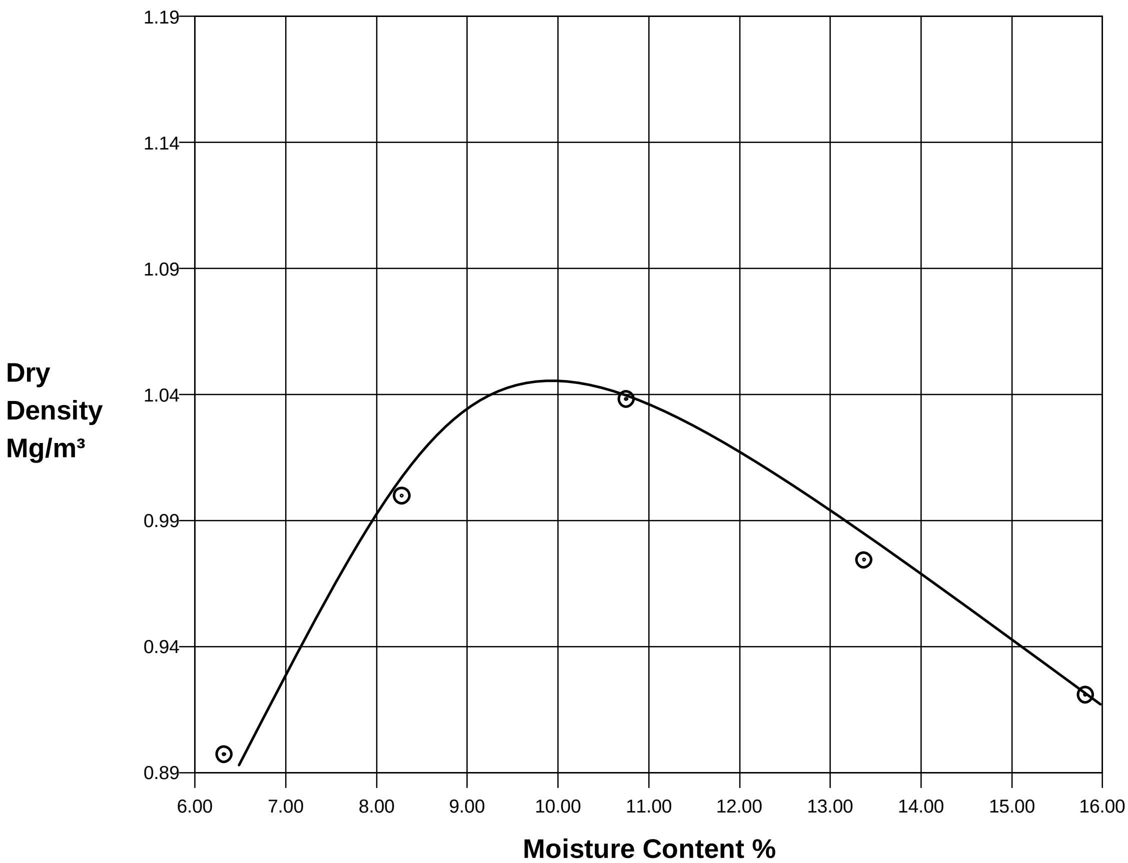
Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton		**Job Number** 40274D
Client : Welsh Assembly Government		**Page** 6 / 37

DETERMINATION OF DRY DENSITY/MOISTURE CONTENT RELATIONSHIP

Borehole / Trial Pit	Depth (m)	Sample	Description
BH10	0.50	B4	Brown slightly sandy slightly gravelly CLAY

Percentage retained 37.5 mm	0 %	**Max size of cohesive lumps**	20 mm
Percentage retained 20.0 mm	2 %	**Single or separate samples**	Single
Grading Zone	2	**Particle density**	2.65 Assumed
Mould Type	1 Litre/proctor	**Method of compaction**	2.5kg Rammer
MAX DRY DENSITY	1.05 **Mg/m³**	**OPTIMUM MOISTURE CONTENT**	9.9 **%**



Method of Preparation : BS 1377:PART 1:7.6, BS 1377:PART 4:1990:3.2 Preparation of samples for compaction tests

Method of Test : BS 1377:PART 4:1990:3.4/3.4 Determination using 2.5 kg rammer or 3.5/3.6 Determination using 4.5kg rammer: PART 2:1990:8.2 Determination of particle density

Remarks :

IAN FARMER ASSOCIATES

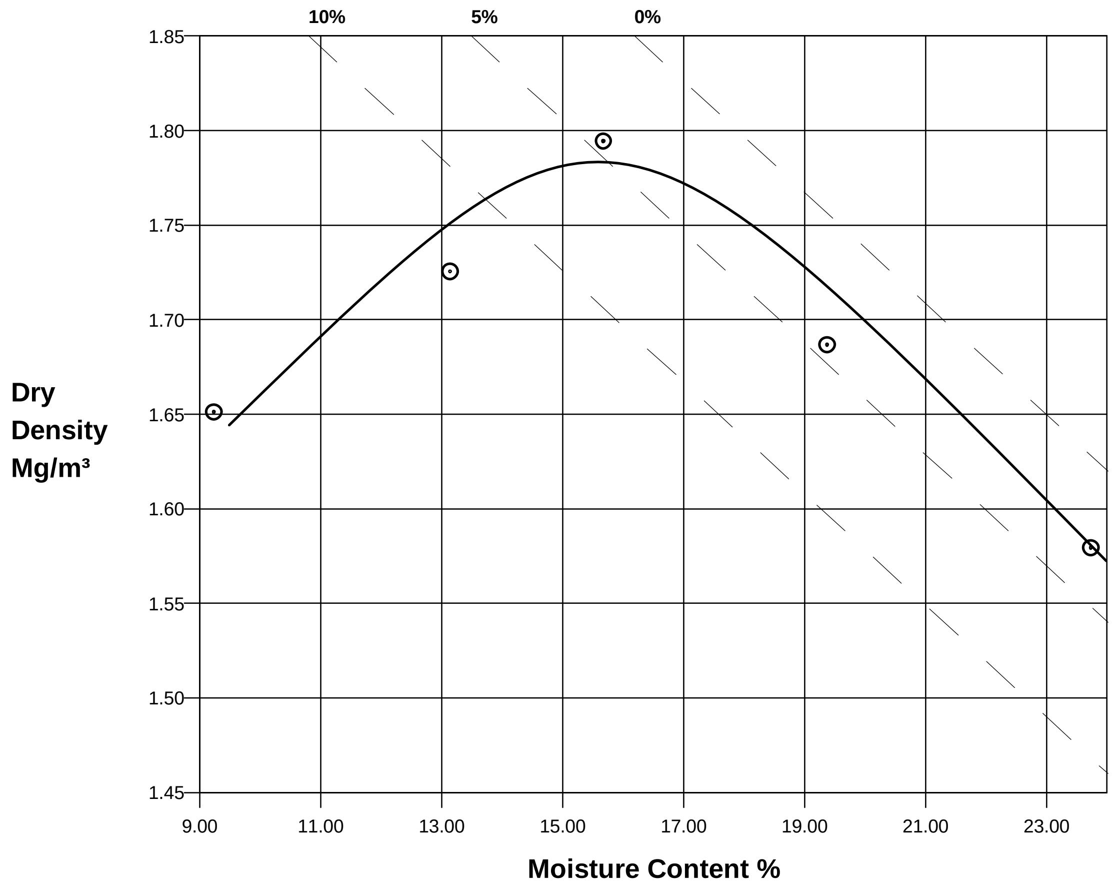
Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton		**Job Number** 40274D
Client : Welsh Assembly Government		**Page** 7 / 37

DETERMINATION OF DRY DENSITY/MOISTURE CONTENT RELATIONSHIP

Borehole / Trial Pit	Depth (m)	Sample	Description
BH12	1.20	B3	Brown slightly gravelly CLAY

Percentage retained 37.5 mm	0 %	**Max size of cohesive lumps**	20 mm
Percentage retained 20.0 mm	4 %	**Single or separate samples**	Single
Grading Zone	2	**Particle density**	2.65 Assumed
Mould Type	1 Litre/proctor	**Method of compaction**	2.5kg Rammer
MAX DRY DENSITY	1.84 Mg/m³	**OPTIMUM MOISTURE CONTENT**	16 %



Method of Preparation : BS 1377:PART 1:7.6, BS 1377:PART 4:1990:3.2 Preparation of samples for compaction tests

Method of Test : BS 1377:PART 4:1990:3.4/3.4 Determination using 2.5 kg rammer or 3.5/3.6 Determination using 4.5kg rammer: PART 2:1990:8.2 Determination of particle density

Remarks :

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274D

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DETERMINATION OF CALIFORNIA BEARING RATIO (CBR)

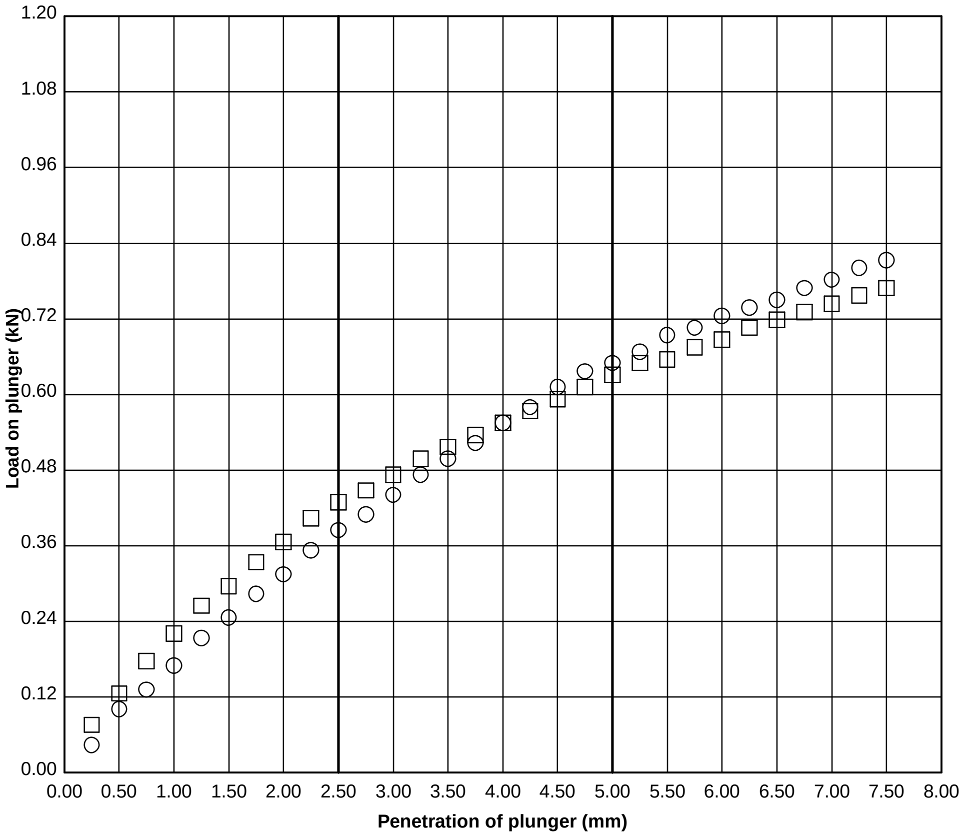
Borehole / Trial Pit	Depth (m)	Sample	% Passing 20 mm Sieve	Description
BH13	0.40	B2	99 %	Brown slightly gravelly CLAY

Moisture Content %	
Bulk Density Mg/m³	2.08
Dry Density Mg/m³	1.75
Soaked Test	No

Test on	□ TOP	
Moisture Content %	19	
Surcharge weight kg		
Penetration mm	2.5	5.0
Force kN	0.43	0.63
Corrected CBR %	3.2	3.2

Test on	○ BOTTOM	
Moisture Content %	19	
Surcharge weight kg		
Penetration mm	2.5	5.0
Force kN	0.38	0.65
Corrected CBR %	2.9	3.2

Test on	TOP	BOTTOM
Reported CBR %	3.2	3.2
Mean CBR %	3.2	



Method of Preparation : The specimen was prepared by Dynamic compression using a 2.5 kg Rammer
BS 1377:PART 1:1990:7.6.1 General 1990:7.6.5 California bearing ratio test BS 1377:PART 4:1990:7.2 Preparation of test sample

Method of Test : BS 1377:PART 4:1990:7.4 Penetration test procedure

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274D

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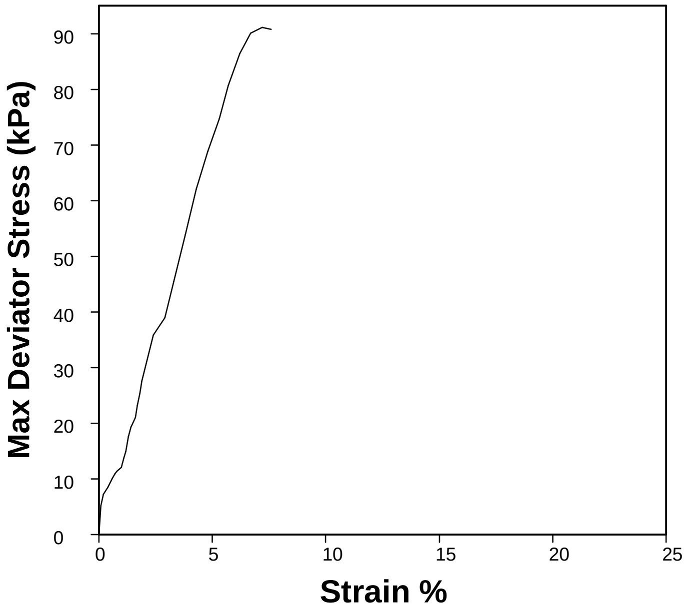
DETERMINATION OF MOISTURE CONTENT, DENSITY AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE (DEFINITIVE METHOD)

Borehole / Trial Pit	Depth (m)	Sample	Description
BH10	3.00	U13	Brown sandy CLAY

Initial Specimen		
Length of Sample (mm)		450
Depth from top of sample (mm)		50
Condition of Sample:		Undisturbed
Orientation:		Vertical

Test Type	Single Stage
Length of Specimen (mm)	209.2
Diameter of Specimen (mm)	101.5
Moisture Content (%)	13
Bulk Density (Mg/m³)	2.27
Dry Density (Mg/m³)	2.00
Membrane Thickness (mm)	0.4
Membrane Type	Latex
Rate of Strain (%/min)	1.91

Test Results	
Measured Cell Pressure (kPa)	40
Strain at Failure (%)	7.2
Membrane Correction (kPa)	0.6
Corrected Deviator Stress (kPa)	90
Shear Stress (kPa)	**45**
Mode of Failure (B/P/C)	**Plastic**



Method of Preparation : BS 1377:PT1:1990:7.4.2 Moisture Content, BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or BS 1377:PT1:1990 :7.7.5.2 Preparation of disturbed samples for testing.

Method of Test : BS 1377:PT2:1990:3.2 Determination of moisture content, BS 1377:PT2:1990:7.2 Determination of density by linear measurement and BS1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (definitive method)

Remarks : Membrane Type: Latex

IAN FARMER ASSOCIATES

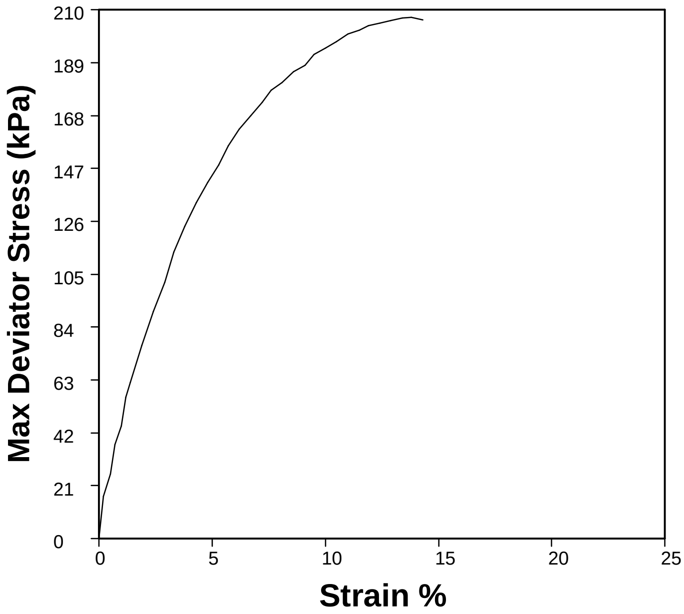
Laboratory Test Report - 40274D/1

Site	: Warren Hall Site - Broughton	**Job Number** 40274D
Client	: Welsh Assembly Government	**Page** 10 / 37

DETERMINATION OF MOISTURE CONTENT, DENSITY AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE (DEFINITIVE METHOD)

Borehole / Trial Pit	Depth (m)	Sample	Description
BH11	1.20	U3	Brown slightly gravelly CLAY

Initial Specimen	**Length of Sample (mm)**	450
	Depth from top of sample (mm)	50
	Condition of Sample:	Undisturbed
	Orientation:	Vertical
Test Type		Single Stage
Length of Specimen (mm)		209.4
Diameter of Specimen (mm)		101.1
Moisture Content (%)		15
Bulk Density (Mg/m³)		2.23
Dry Density (Mg/m³)		1.94
Membrane Thickness (mm)		0.41
Membrane Type		Latex
Rate of Strain (%/min)		1.91
Test Results	**Measured Cell Pressure (kPa)**	25
	Strain at Failure (%)	13.8
	Membrane Correction (kPa)	1.2
	Corrected Deviator Stress (kPa)	206
	Shear Stress (kPa)	**103**
	Mode of Failure (B/P/C)	**Plastic**



Method of Preparation : BS 1377:PT1:1990:7.4.2 Moisture Content, BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or BS 1377:PT1:1990 :7.7.5.2 Preparation of disturbed samples for testing.

Method of Test : BS 1377:PT2:1990:3.2 Determination of moisture content, BS 1377:PT2:1990:7.2 Determination of density by linear measurement and BS1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (definitive method)

Remarks : Membrane Type: Latex

IAN FARMER ASSOCIATES	**Laboratory Test Report - 40274D/1**

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274D

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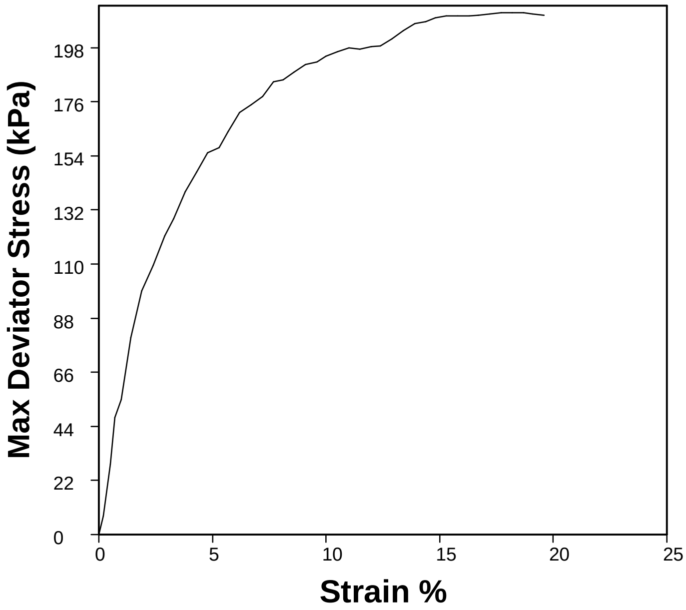
DETERMINATION OF MOISTURE CONTENT, DENSITY AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE (DEFINITIVE METHOD)

Borehole / Trial Pit	Depth (m)	Sample	Description
BH11	10.00	U22	Brown slightly gravelly CLAY

Initial Specimen	Length of Sample (mm)	450
	Depth from top of sample (mm)	50
	Condition of Sample:	Undisturbed
	Orientation:	Vertical
Test Type		Single Stage
Length of Specimen (mm)		209
Diameter of Specimen (mm)		101.7
Moisture Content (%)		77
Bulk Density (Mg/m³)		2.29
Dry Density (Mg/m³)		1.29
Membrane Thickness (mm)		0.34
Membrane Type		latex
Rate of Strain (%/min)		1.44
Test Results	Measured Cell Pressure (kPa)	200
	Strain at Failure (%)	17.7
	Membrane Correction (kPa)	1.2
	Corrected Deviator Stress (kPa)	211
	Shear Stress (kPa)	**106**
	Mode of Failure (B/P/C)	**Brittle**



Method of Preparation : BS 1377:PT1:1990:7.4.2 Moisture Content, BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or BS 1377:PT1:1990 :7.7.5.2 Preparation of disturbed samples for testing.

Method of Test : BS 1377:PT2:1990:3.2 Determination of moisture content, BS 1377:PT2:1990:7.2 Determination of density by linear measurement and BS1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (definitive method)

Remarks : Membrane Type: latex

Site	: Warren Hall Site - Broughton	**Job Number**	40274D
Client	: Welsh Assembly Government	**Page**	12 / 37

DETERMINATION OF MOISTURE CONTENT, DENSITY AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE (DEFINITIVE METHOD)

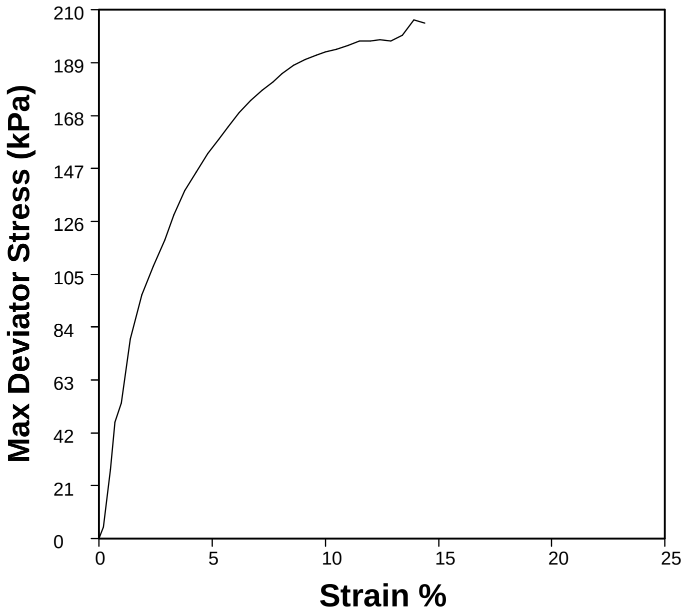
Borehole / Trial Pit	Depth (m)	Sample	Description
BH13	1.20	U3	Brown CLAY

Initial Specimen

Length of Sample (mm)	450
Depth from top of sample (mm)	50
Condition of Sample:	Undisturbed
Orientation:	Vertical
Test Type	Single Stage
Length of Specimen (mm)	209
Diameter of Specimen (mm)	101.3
Moisture Content (%)	17
Bulk Density (Mg/m³)	2.17
Dry Density (Mg/m³)	1.85
Membrane Thickness (mm)	0.34
Membrane Type	latex
Rate of Strain (%/min)	1.44

Test Results

Measured Cell Pressure (kPa)	25
Strain at Failure (%)	13.9
Membrane Correction (kPa)	1.0
Corrected Deviator Stress (kPa)	205
Shear Stress (kPa)	**102**
Mode of Failure (B/P/C)	**Brittle**



Method of Preparation : BS 1377:PT1:1990:7.4.2 Moisture Content, BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or BS 1377:PT1:1990 :7.7.5.2 Preparation of disturbed samples for testing.

Method of Test : BS 1377:PT2:1990:3.2 Determination of moisture content, BS 1377:PT2:1990:7.2 Determination of density by linear measurement and BS1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (definitive method)

Remarks : Membrane Type: latex

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Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton	**Job Number** 40274D
Client : Welsh Assembly Government	**Page** 13 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

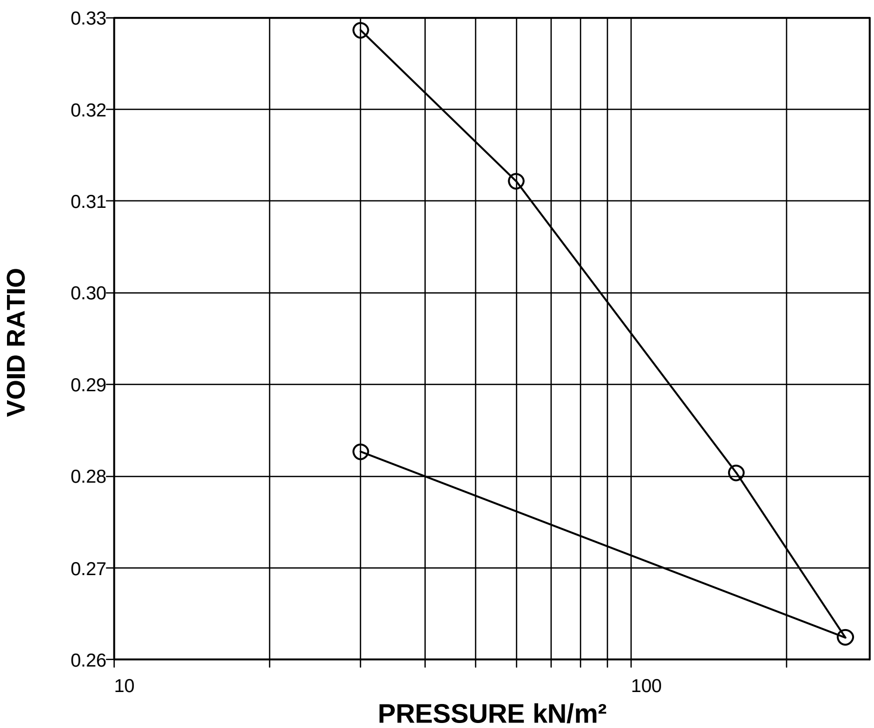
Borehole / Trial Pit	Depth (m)	Sample	Description
BH09	2.00	U5	Brown sandy CLAY

Initial Specimen

Length of Sample (mm)	450
Depth from top of sample (mm)	50
Condition of Sample:	Undisturbed
Orientation:	Vertical

Diameter (mm)	75.00
Particle Density (Mg/m³)	2.65 (Assumed)
Swelling Pressure (kN/m²)	
Lab Temp (℃)	19

	Inital	Final
Height (mm)	19.00	18.38
Wet Weight (g)	184.45	182.74
Moisture Content (%)	14	7.49
Bulk Density (Mg/m³)	2.20	2.25
Dry Density (Mg/m³)	1.93	2.09
Void Ratio	0.373	0.268
Degree of Saturation (%)	100.17	74.06



Pressure kN/m²	Mv m²/MN	Cv m²/year	Void Ratio
30	0.55	6.5	0.329
60	0.21	7.5	0.312
160	0.12	24	0.280
260	0.07	18	0.262
30	0.03	36	0.283

Pressure kN/m²	Mv m²/MN	Cv m²/year	Void Ratio

Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

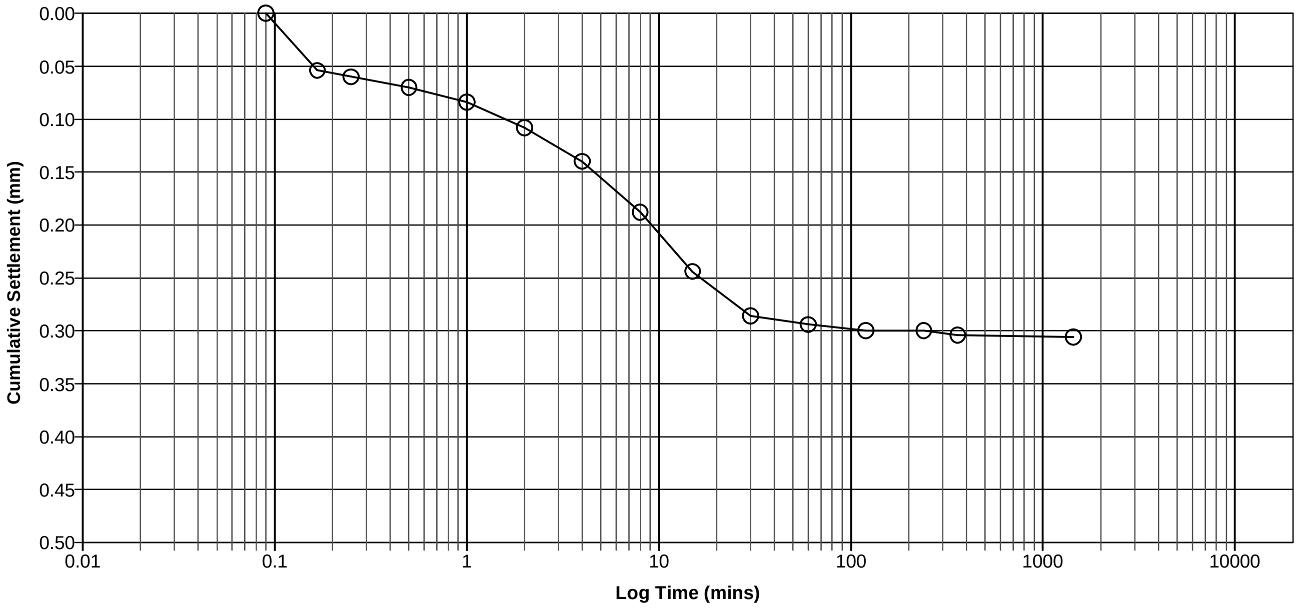
IAN FARMER ASSOCIATES

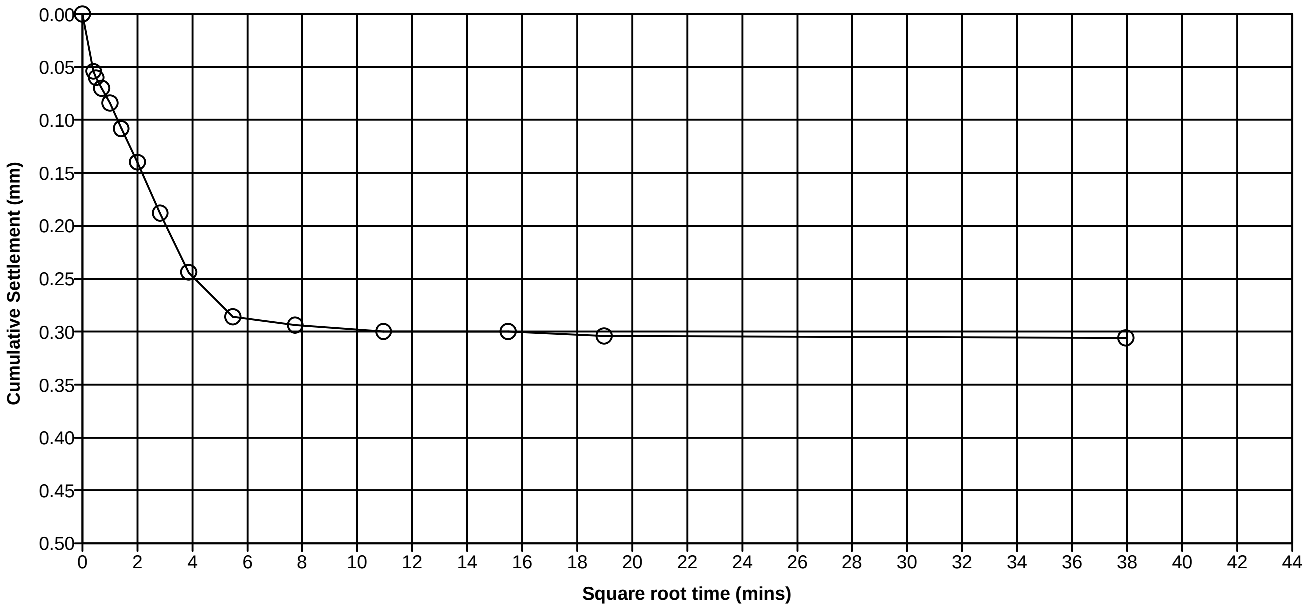
Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton		**Job Number** 40274D
Client : Welsh Assembly Government		**Page** 14 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH09	2.00	U5	1	Brown sandy CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

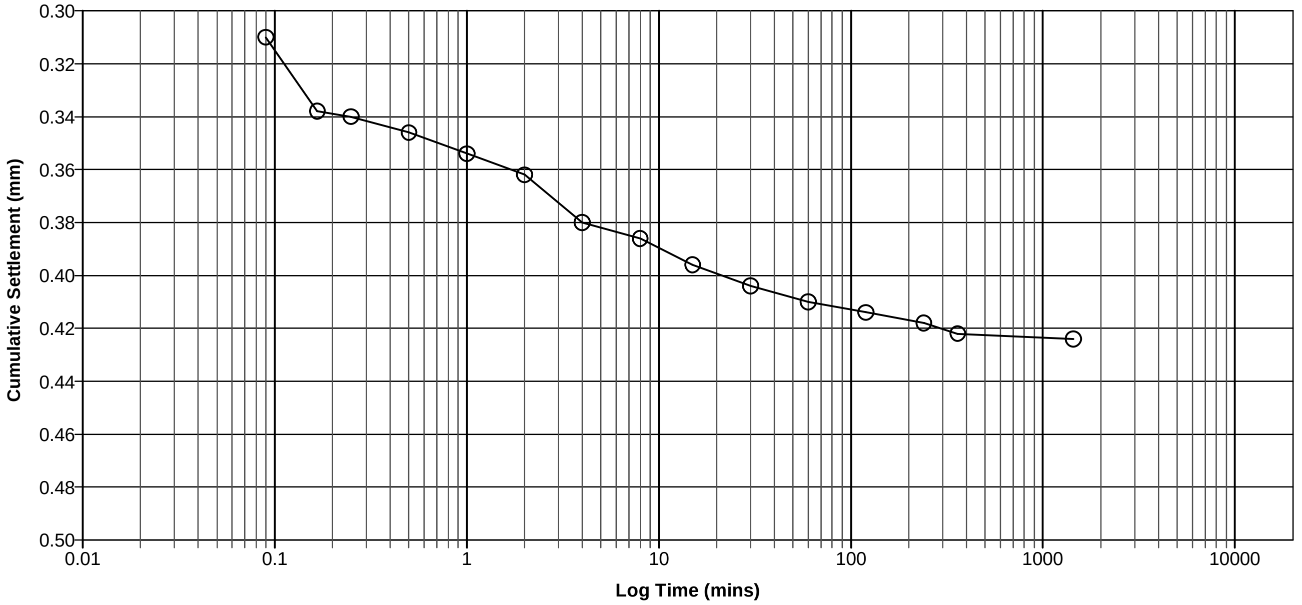
Method of Test : BS 1377:PART 5:1990:3.5

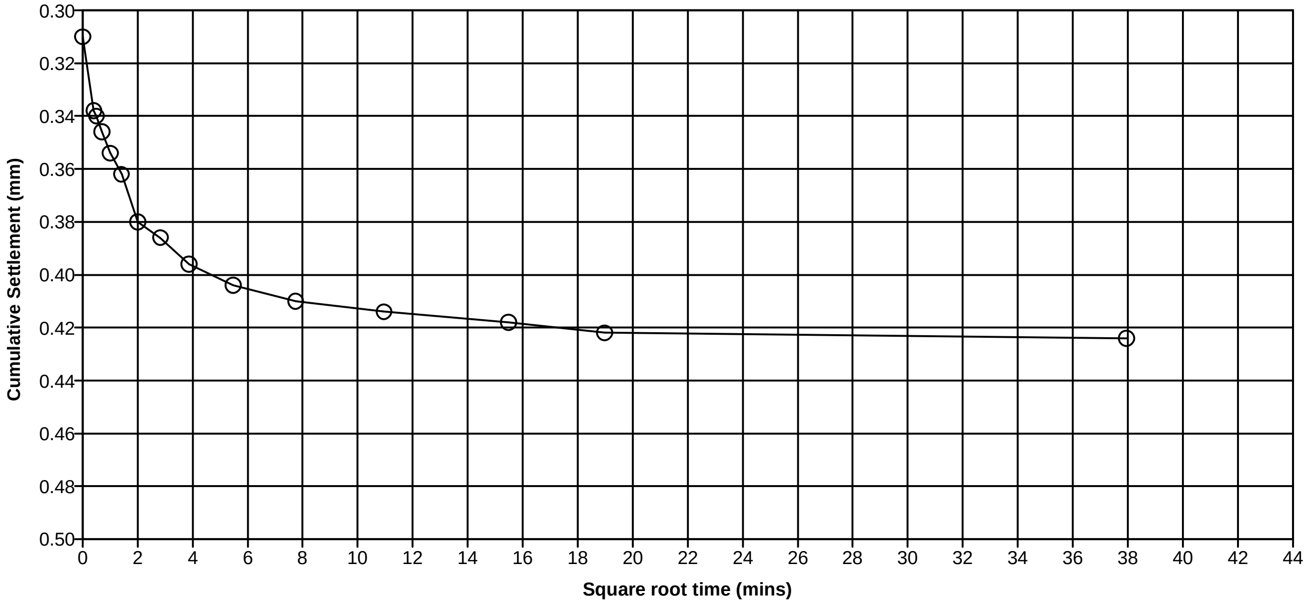
Remarks :

Site : Warren Hall Site - Broughton		**Job Number** 40274D
Client : Welsh Assembly Government		**Page** 15 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH09	2.00	U5	2	Brown sandy CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274D/1

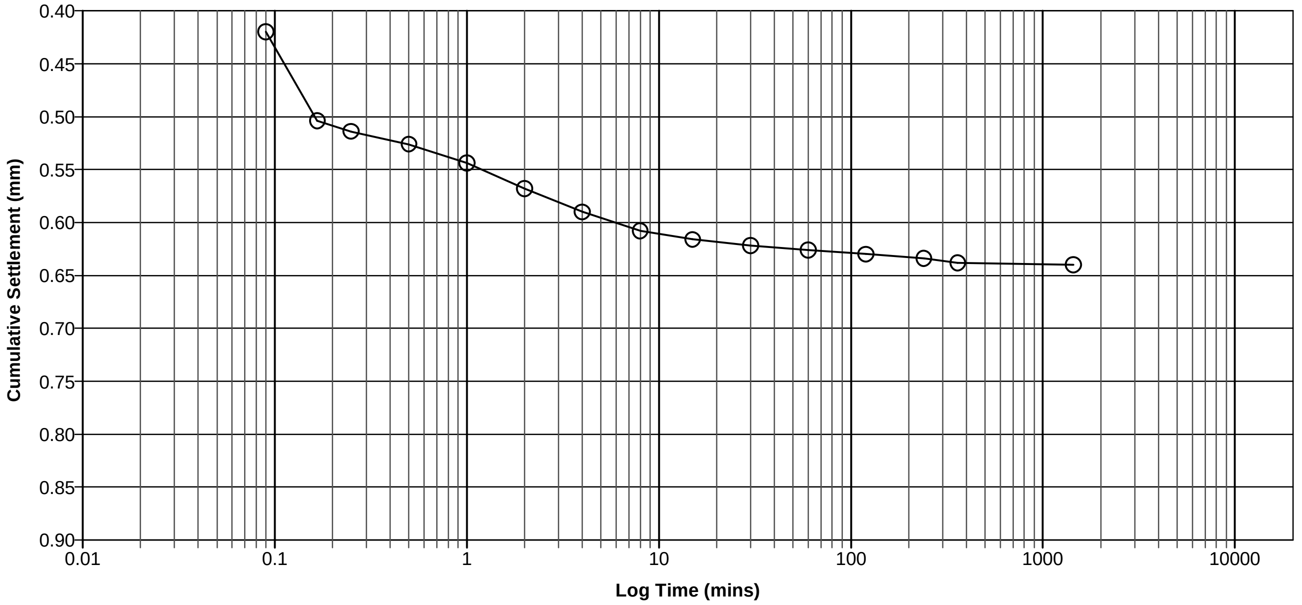
Site : Warren Hall Site - Broughton

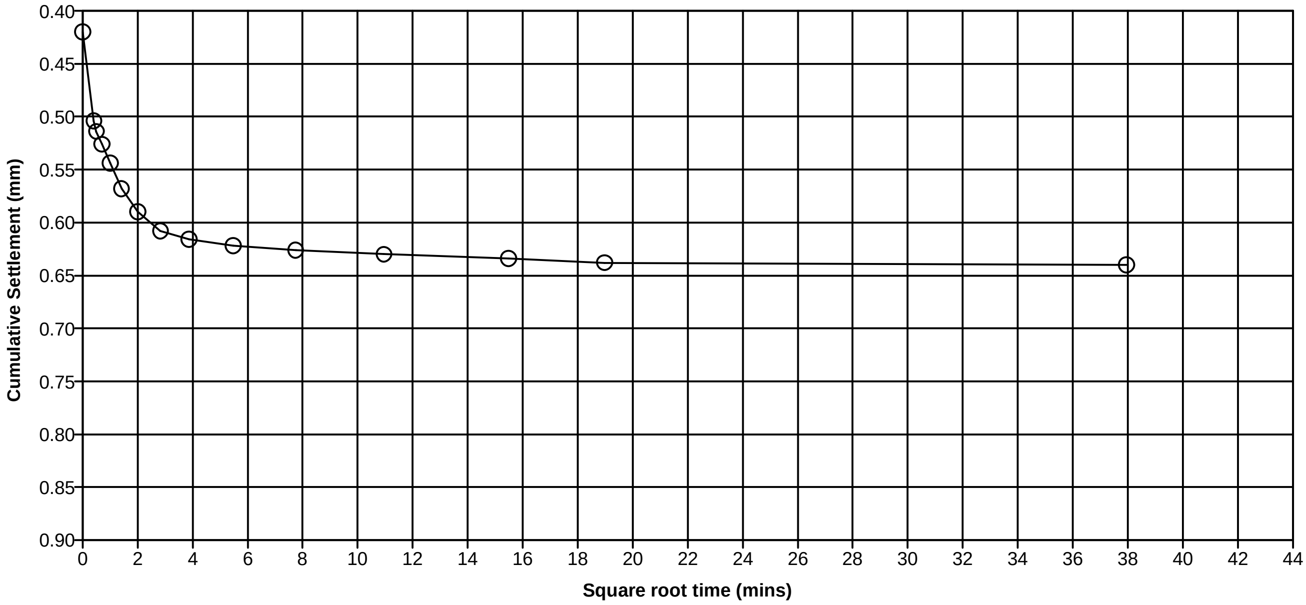
Client : Welsh Assembly Government

Job Number 40274D

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH09	2.00	U5	3	Brown sandy CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274D

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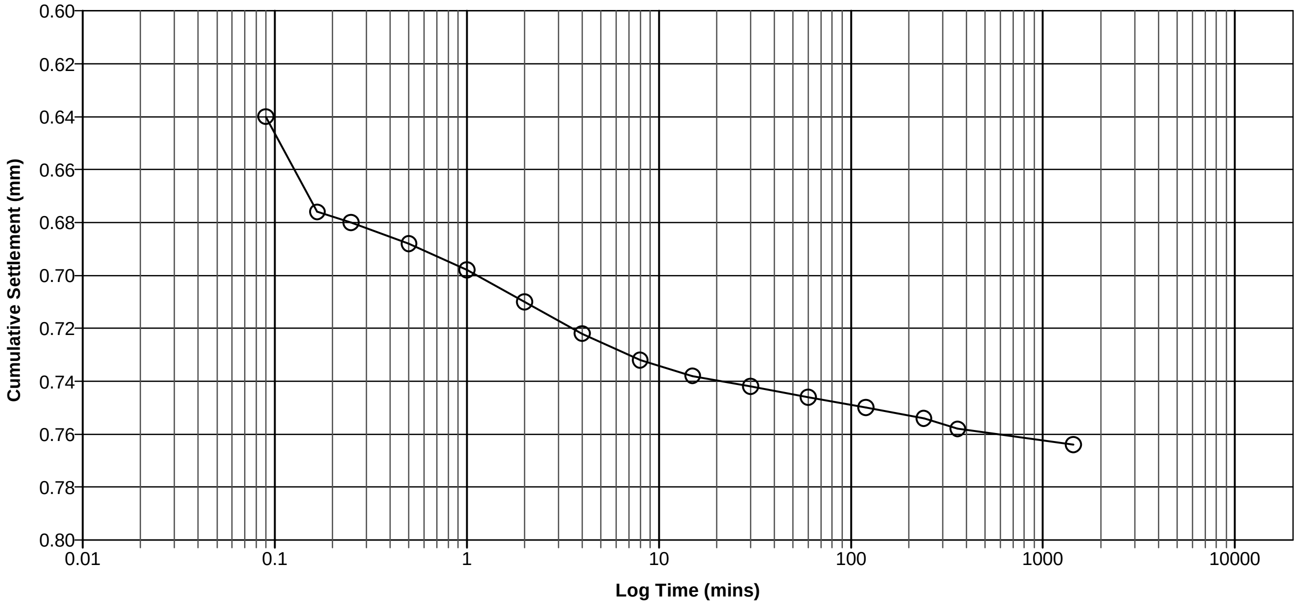
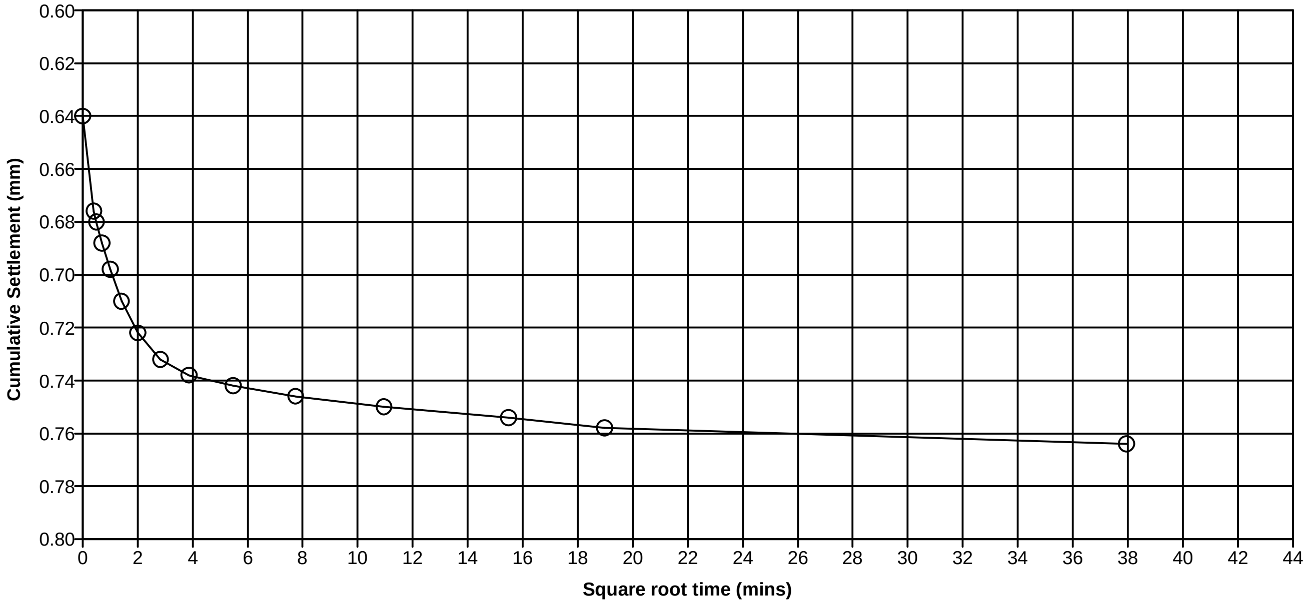
ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH09	2.00	U5	4	Brown sandy CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

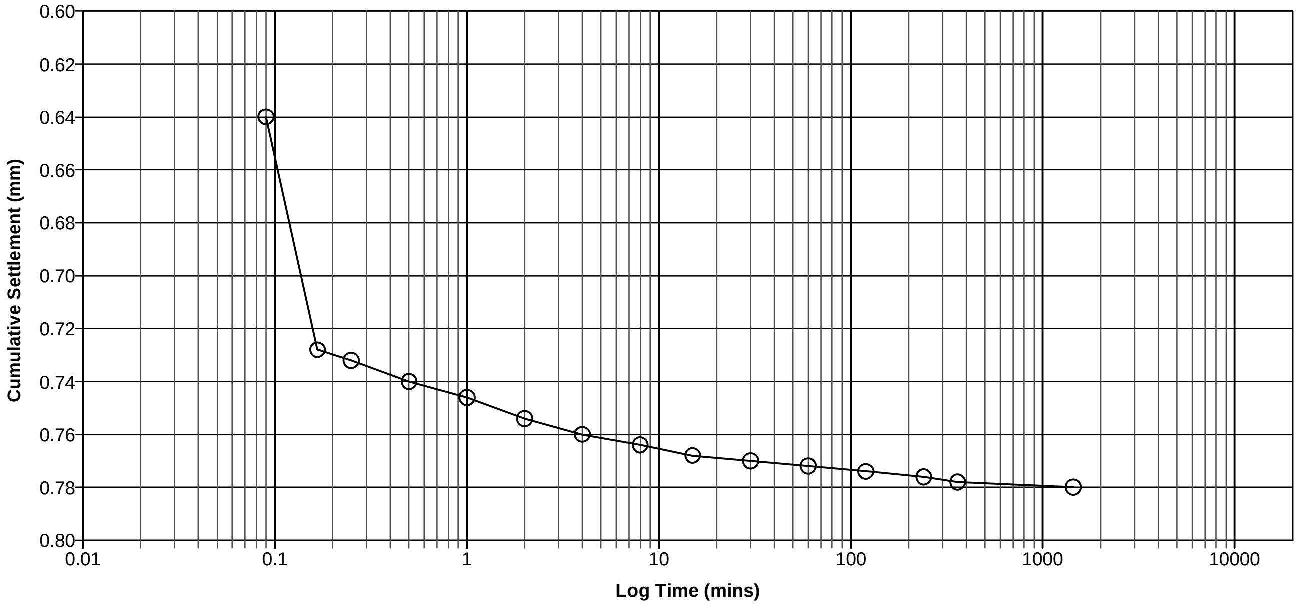
IAN FARMER ASSOCIATES

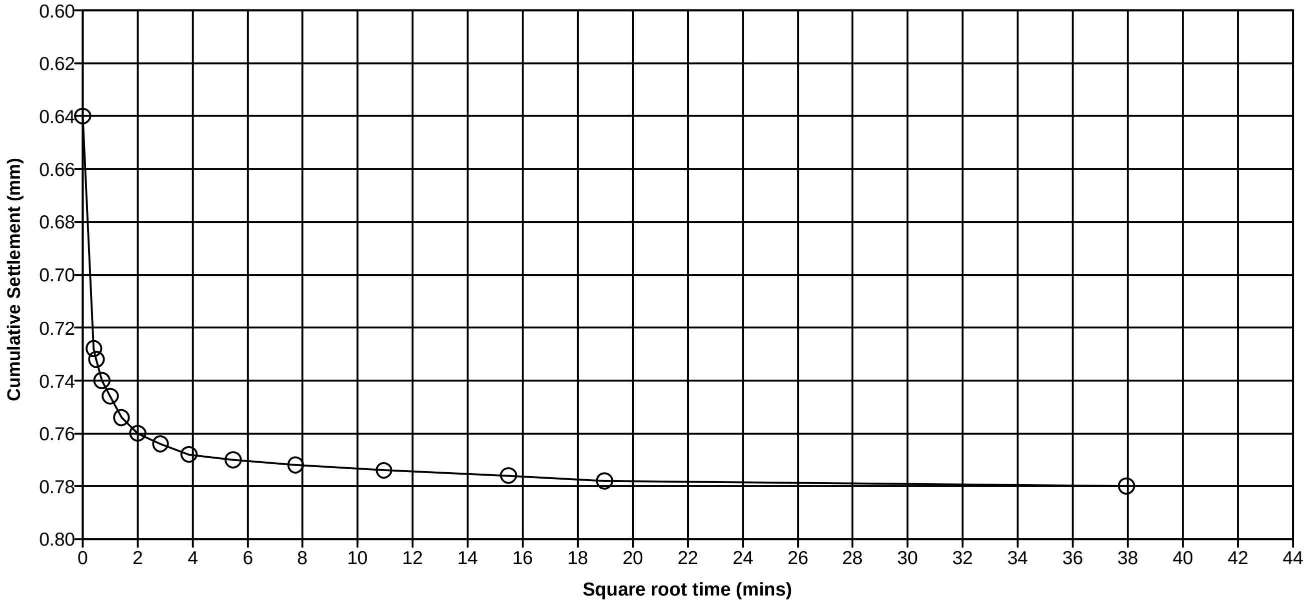
Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton		**Job Number** 40274D
Client : Welsh Assembly Government		**Page** 18 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH09	2.00	U5	5	Brown sandy CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274D/1

Site	: Warren Hall Site - Broughton	**Job Number** 40274D
Client	: Welsh Assembly Government	**Page** 19 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

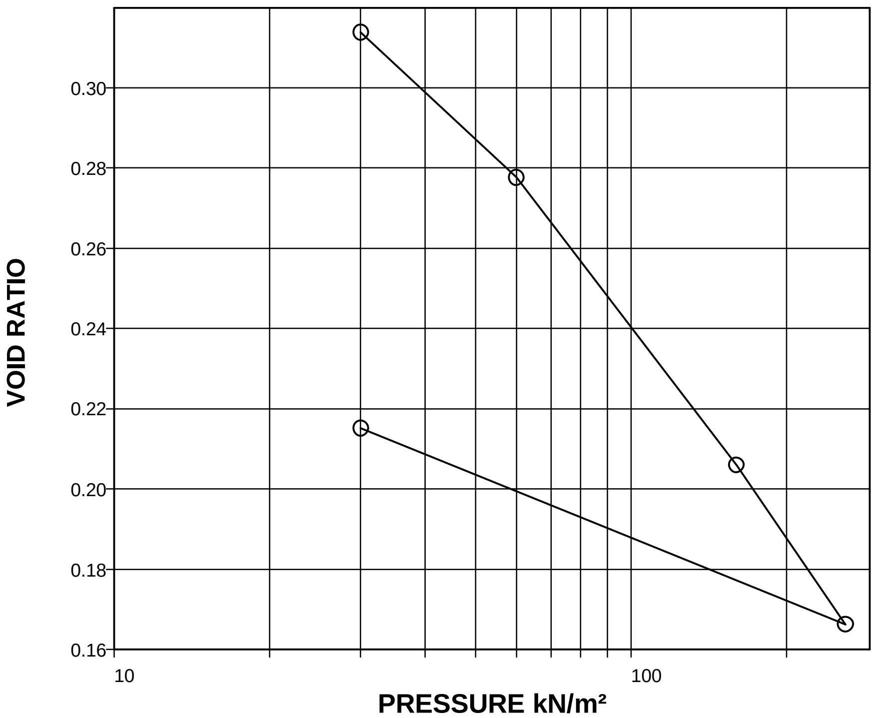
Borehole / Trial Pit	Depth (m)	Sample	Description
BH10	3.00	U13	Brown sandy CLAY

Initial Specimen

Length of Sample (mm)	450
Depth from top of sample (mm)	50
Condition of Sample:	Undisturbed
Orientation:	Vertical

Diameter (mm)	75.00
Particle Density (Mg/m³)	2.65 (Assumed)
Swelling Pressure (kN/m²)	
Lab Temp (℃)	19

	Inital	Final
Height (mm)	19.00	18.00
Wet Weight (g)	186.58	186.27
Moisture Content (%)	14	8.30
Bulk Density (Mg/m³)	2.22	2.34
Dry Density (Mg/m³)	1.94	2.16
Void Ratio	0.366	0.227
Degree of Saturation (%)	104.26	96.89



Pressure kN/m²	Mv m²/MN	Cv m²/year	Void Ratio
30	0.56	18	0.314
60	0.40	32	0.278
160	0.28	67	0.206
260	0.14	38	0.166
30	0.07	72	0.215

Pressure kN/m²	Mv m²/MN	Cv m²/year	Void Ratio

Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

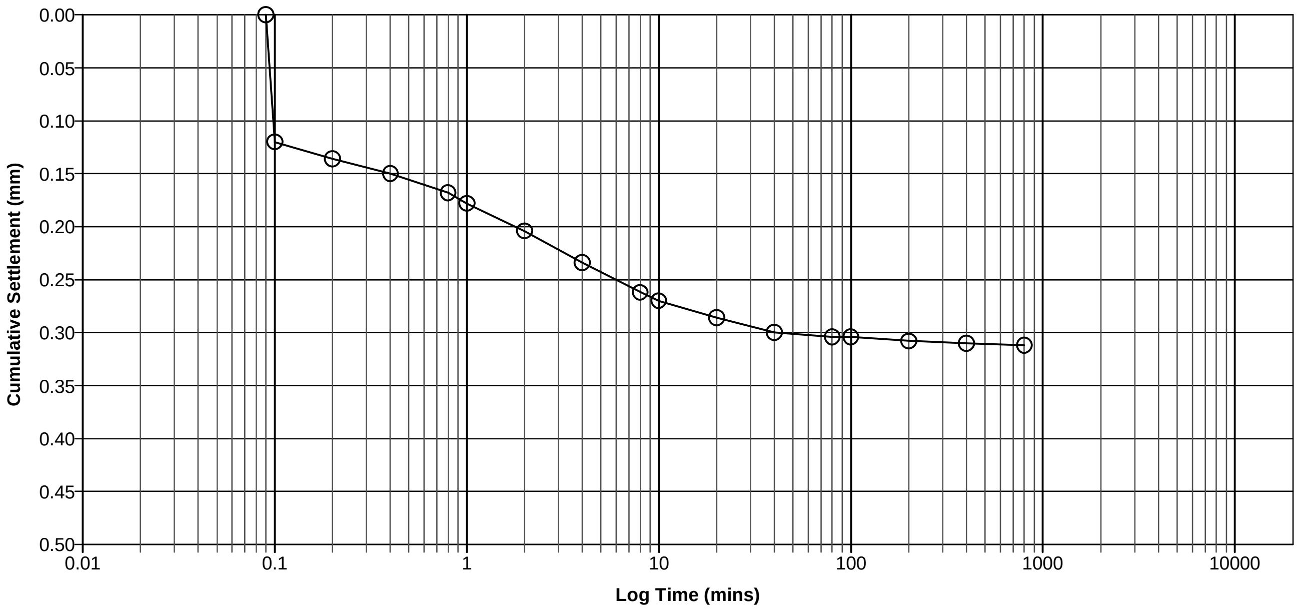
IAN FARMER ASSOCIATES

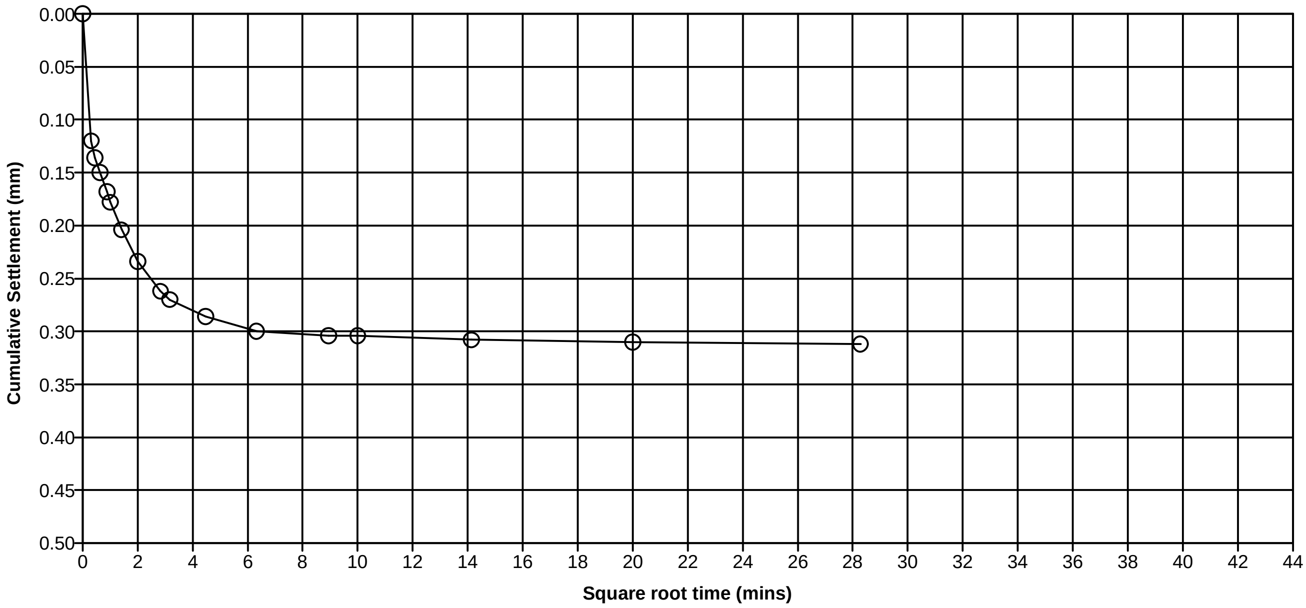
Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton	**Job Number** 40274D
Client : Welsh Assembly Government	**Page** 20 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH10	3.00	U13	1	Brown sandy CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

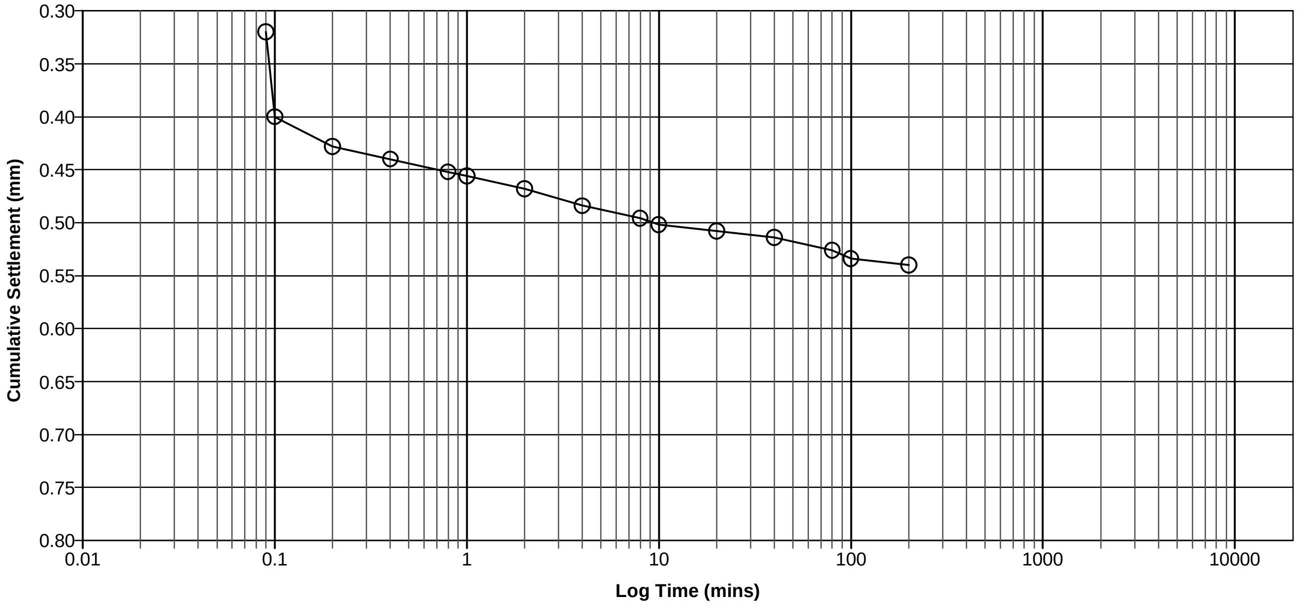
IAN FARMER ASSOCIATES

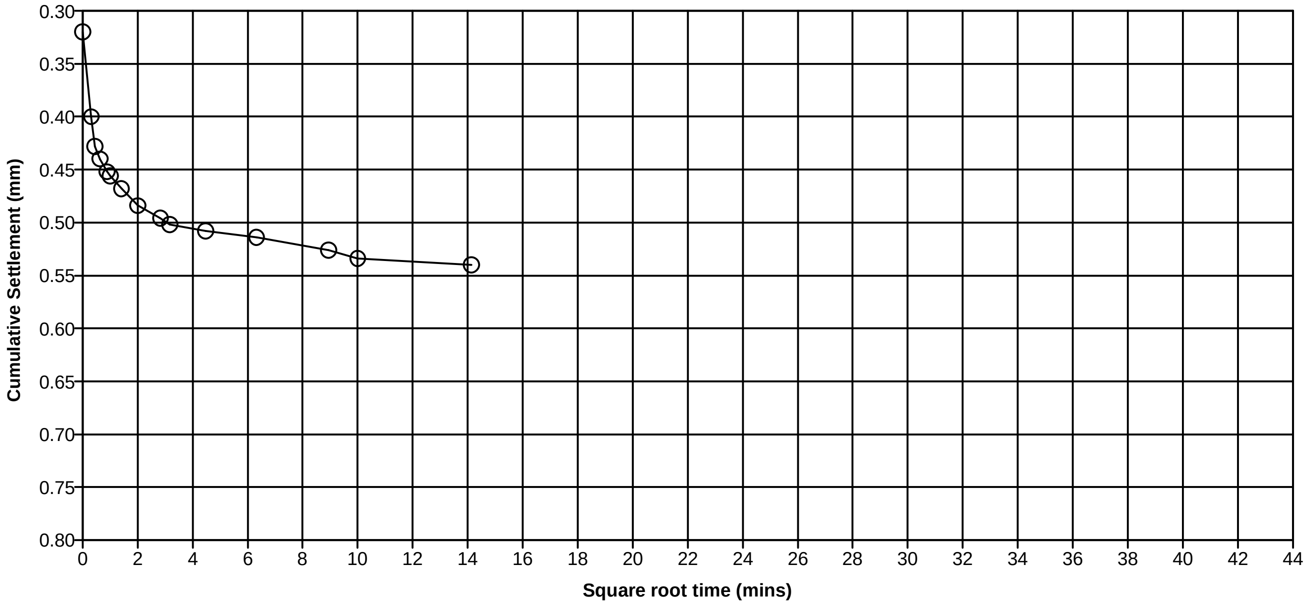
Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton	**Job Number** 40274D
Client : Welsh Assembly Government	**Page** 21 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH10	3.00	U13	2	Brown sandy CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

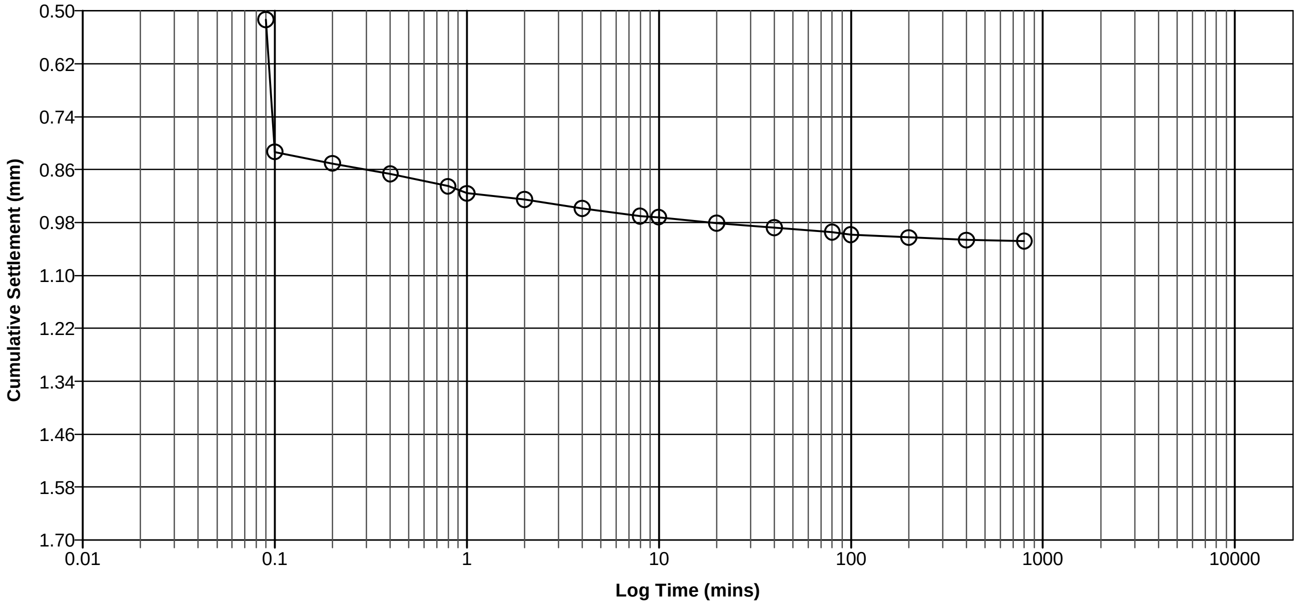
Remarks :

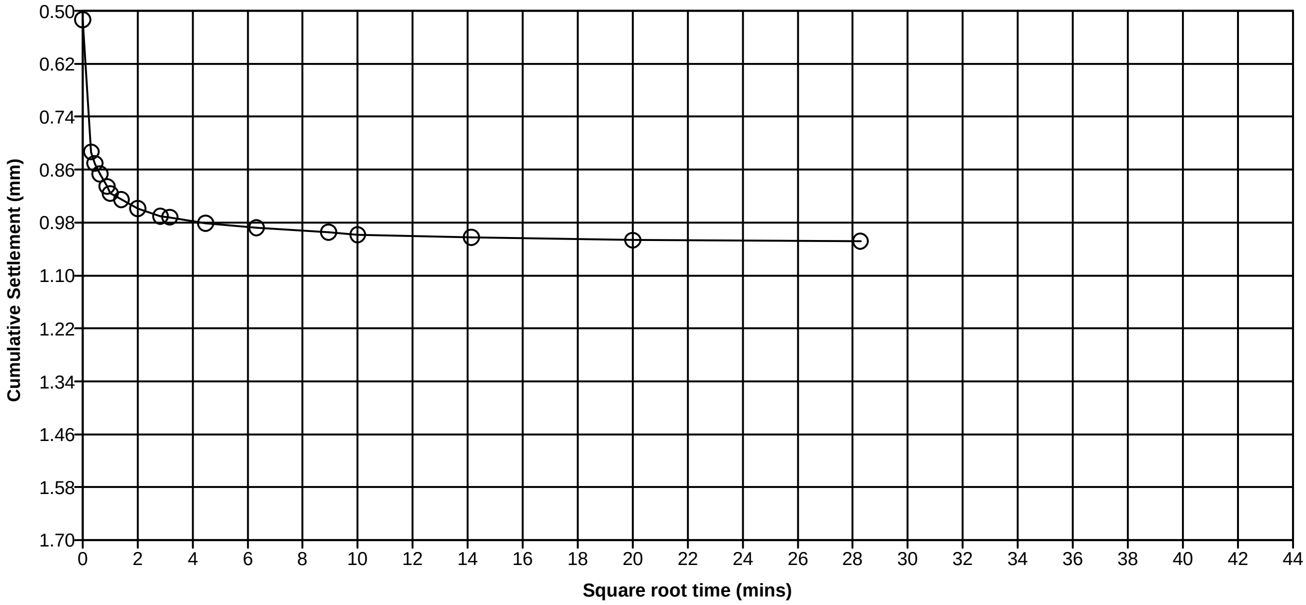
IAN FARMER ASSOCIATES	**Laboratory Test Report - 40274D/1**

Site : Warren Hall Site - Broughton		**Job Number** 40274D
Client : Welsh Assembly Government		**Page** 22 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH10	3.00	U13	3	Brown sandy CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

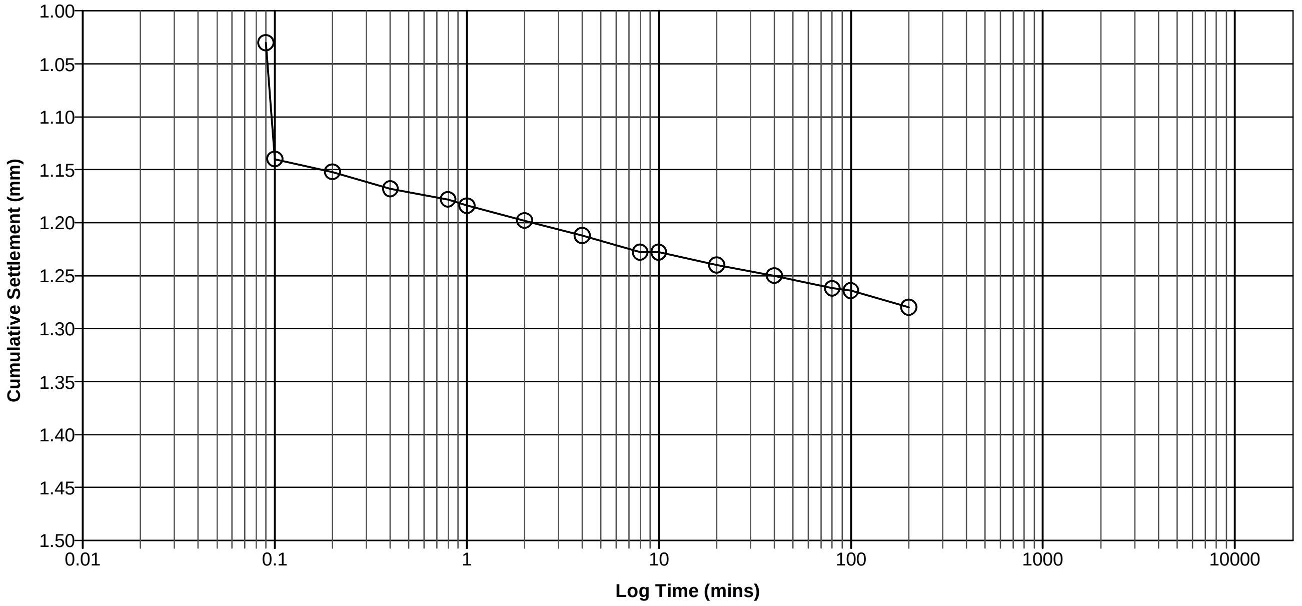
IAN FARMER ASSOCIATES

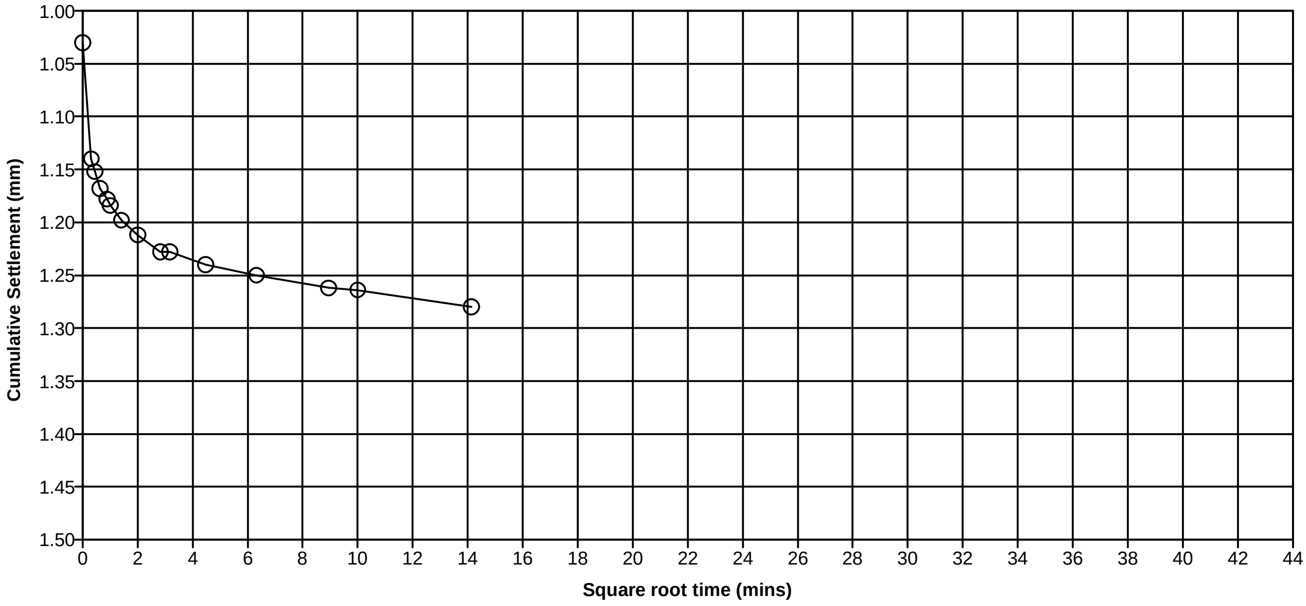
Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton	**Job Number** 40274D
Client : Welsh Assembly Government	**Page** 23 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH10	3.00	U13	4	Brown sandy CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

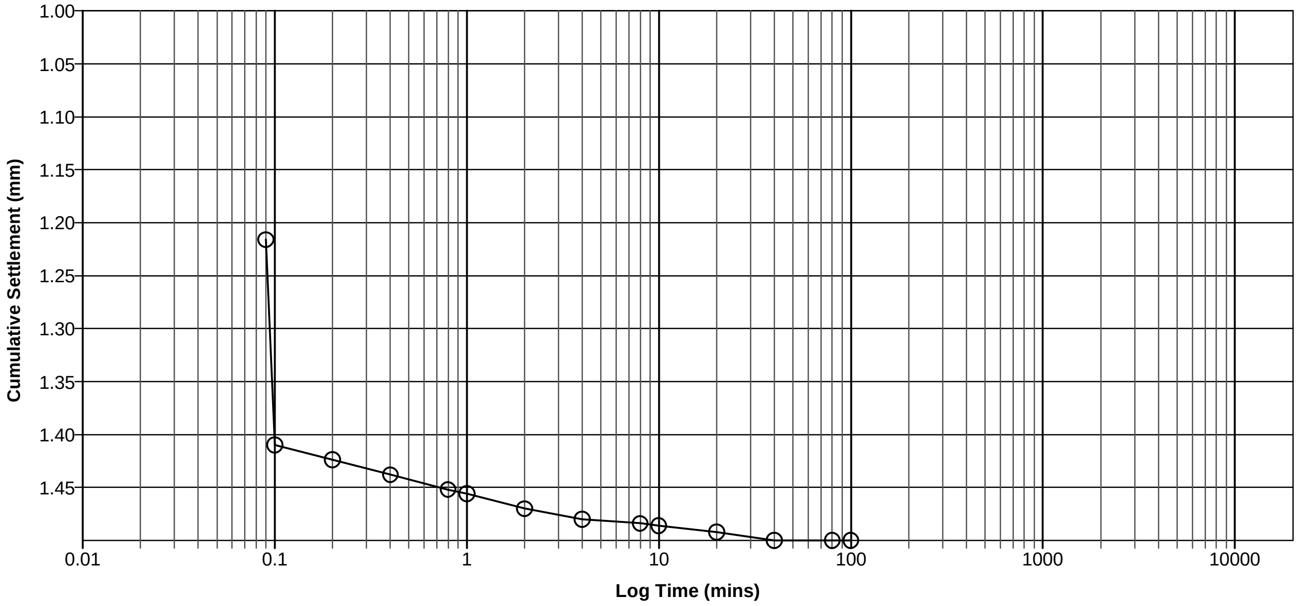
Method of Test : BS 1377:PART 5:1990:3.5

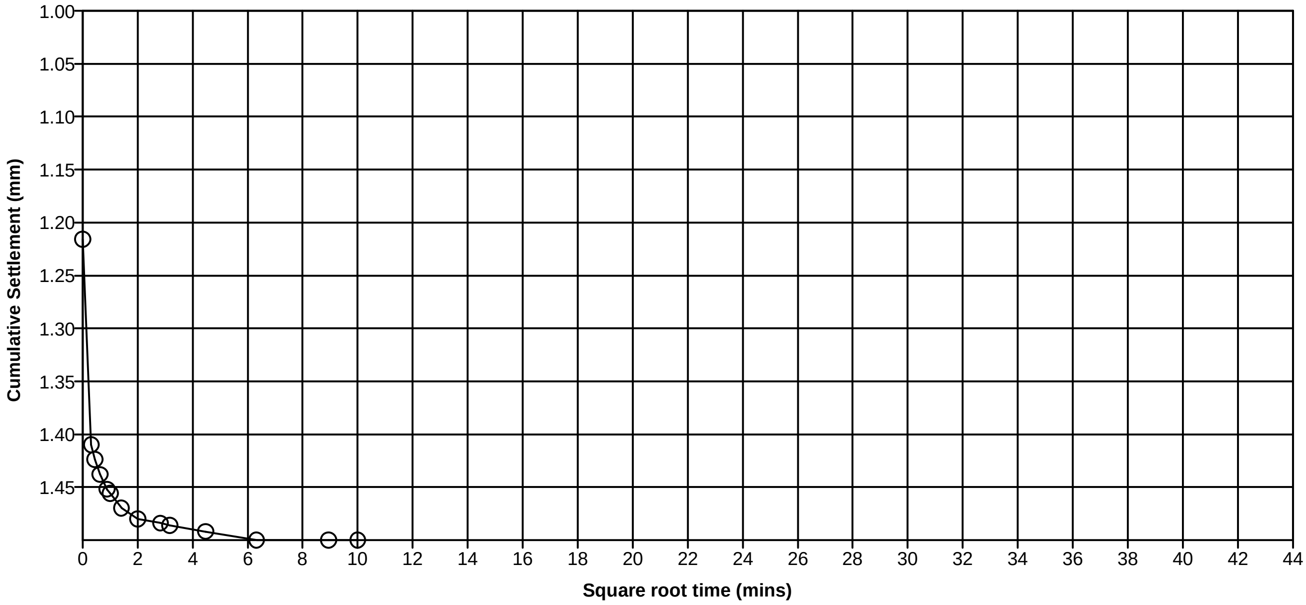
Remarks :

Site	: Warren Hall Site - Broughton	**Job Number** 40274D
Client	: Welsh Assembly Government	**Page** 24 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH10	3.00	U13	5	Brown sandy CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274D

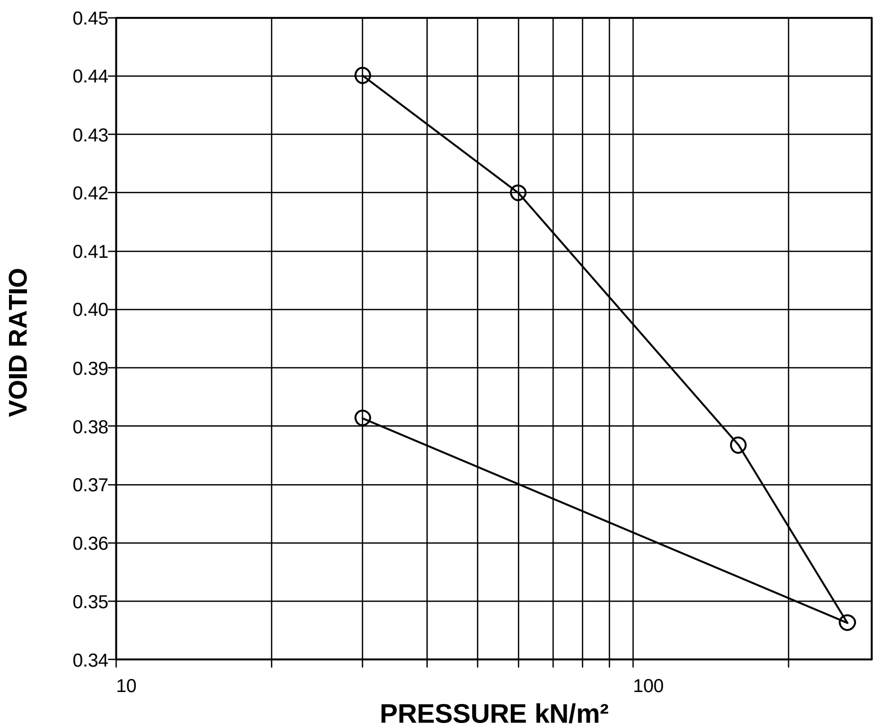
ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Description
BH11	1.20	U3	Brown slightly gravelly CLAY

Initial Specimen		
Length of Sample (mm)	450
Depth from top of sample (mm)	50
Condition of Sample:	Undisturbed
Orientation:	Vertical

Diameter (mm)	75.00
Particle Density (Mg/m³)	2.65 (Assumed)
Swelling Pressure (kN/m²)	
Lab Temp (°C)	19

	Inital	Final
Height (mm)	19.00	18.57
Wet Weight (g)	177.41	178.06
Moisture Content (%)	15	9.24
Bulk Density (Mg/m³)	2.11	2.17
Dry Density (Mg/m³)	1.83	1.99
Void Ratio	0.448	0.332
Degree of Saturation (%)	91.09	73.75



Pressure kN/m²	Mv m²/MN	Cv m²/year	Void Ratio
30	0.09	42	0.440
60	0.21	14	0.420
160	0.14	34	0.377
260	0.10	20	0.346
30	0.04	12	0.381

Pressure kN/m²	Mv m²/MN	Cv m²/year	Void Ratio

Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

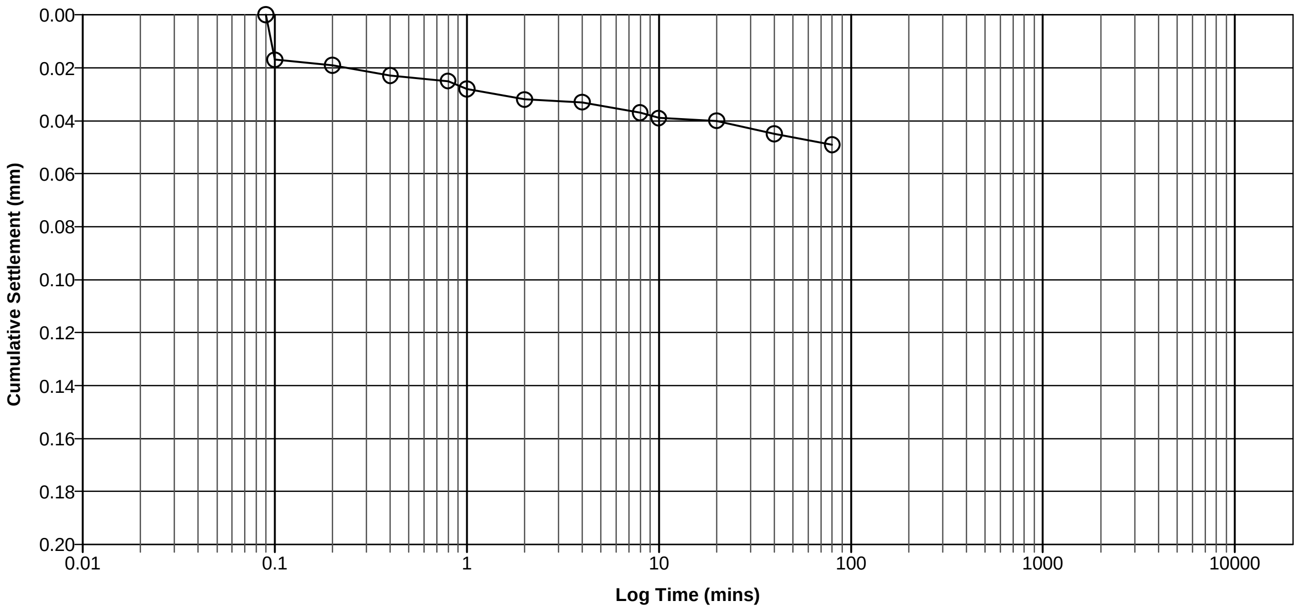
IAN FARMER ASSOCIATES

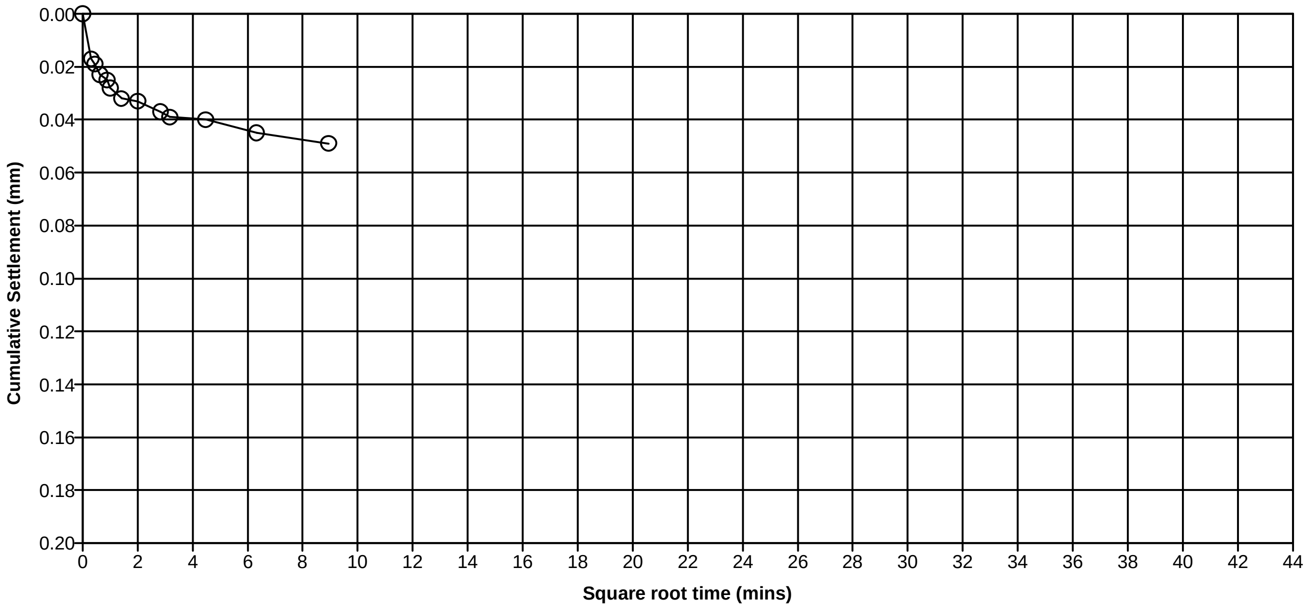
Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton	**Job Number** 40274D
Client : Welsh Assembly Government	**Page** 26 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH11	1.20	U3	1	Brown slightly gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

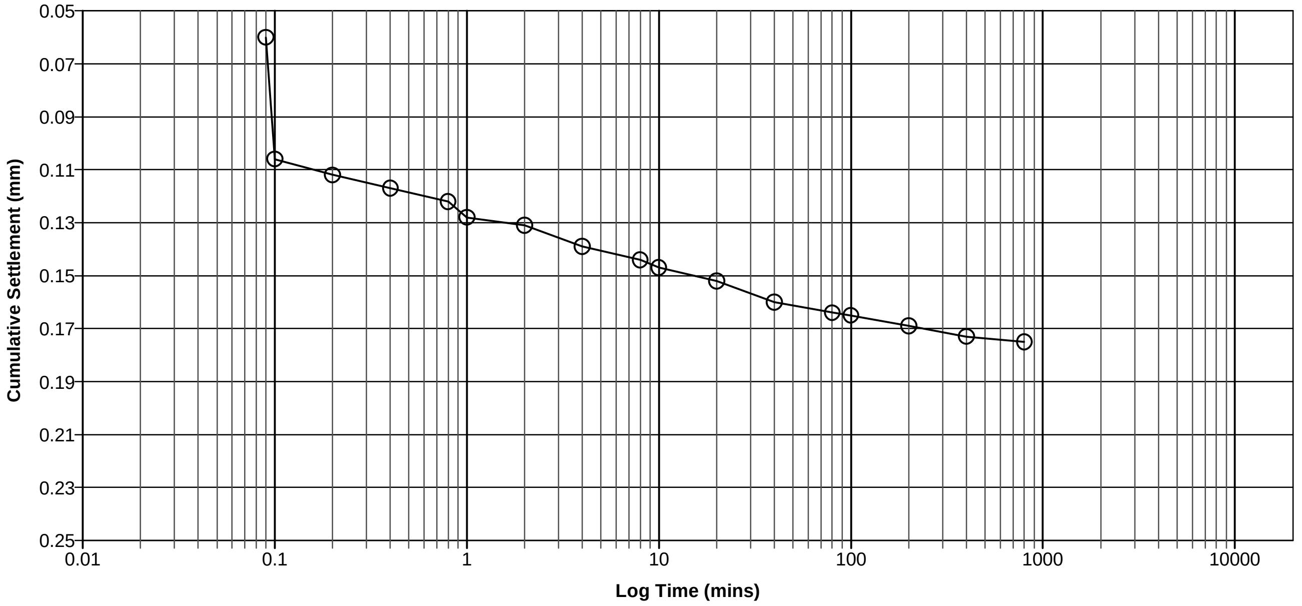
IAN FARMER ASSOCIATES

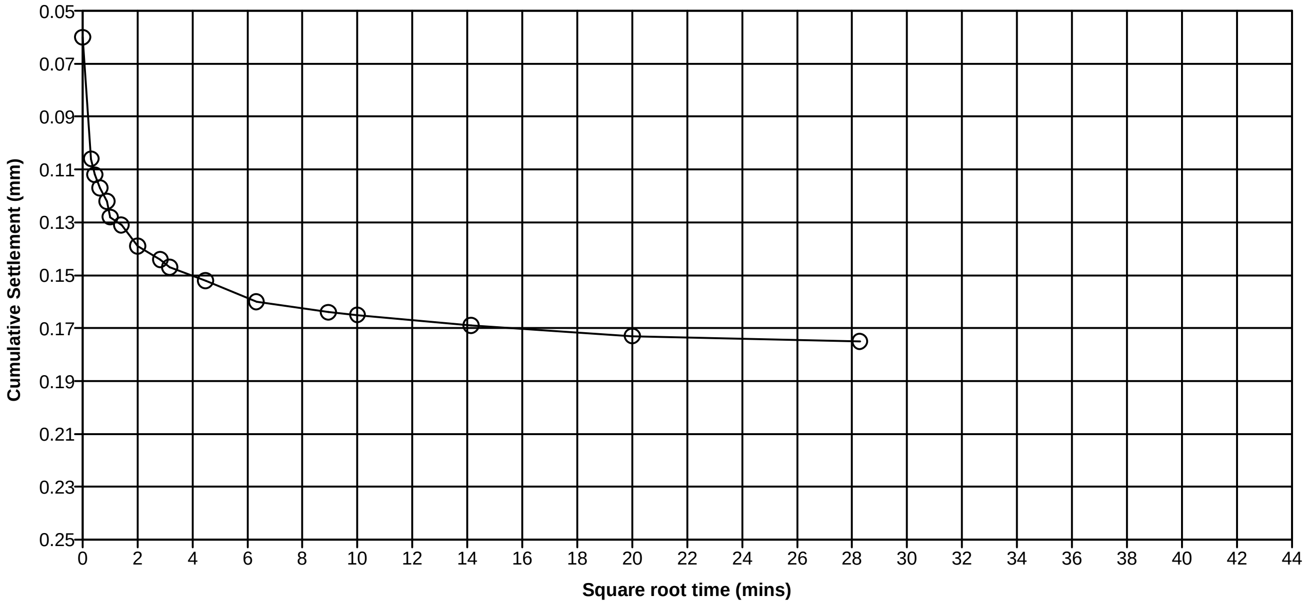
Laboratory Test Report - 40274D/1

Site	: Warren Hall Site - Broughton	**Job Number** 40274D
Client	: Welsh Assembly Government	**Page** 27 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH11	1.20	U3	2	Brown slightly gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

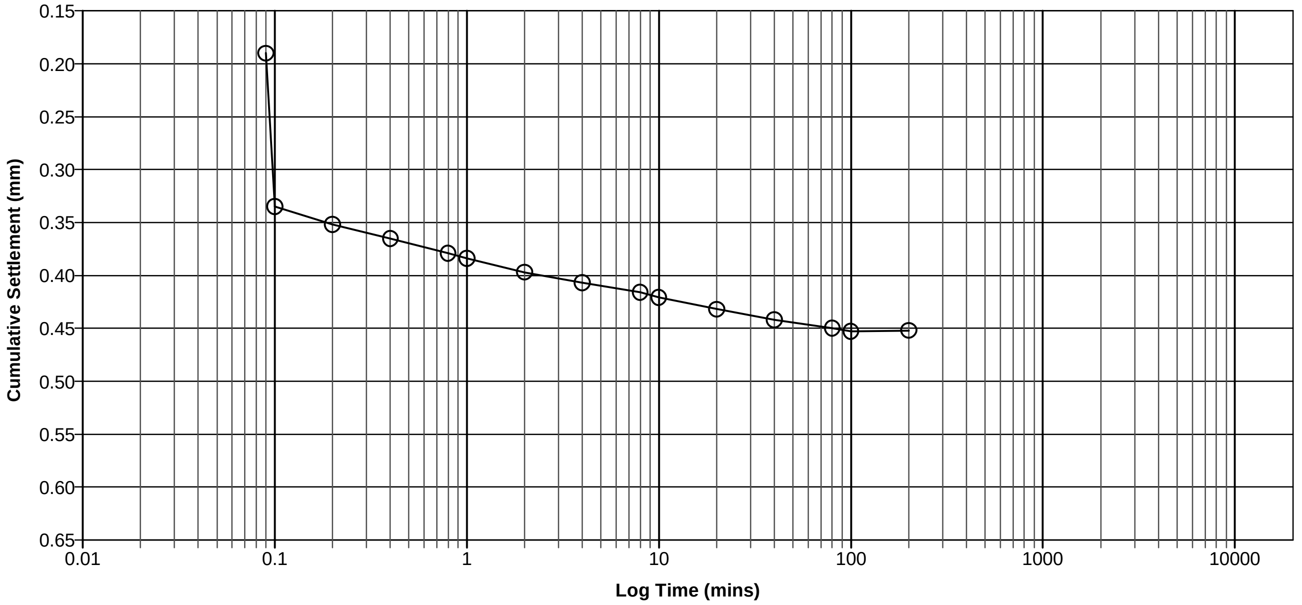
IAN FARMER ASSOCIATES

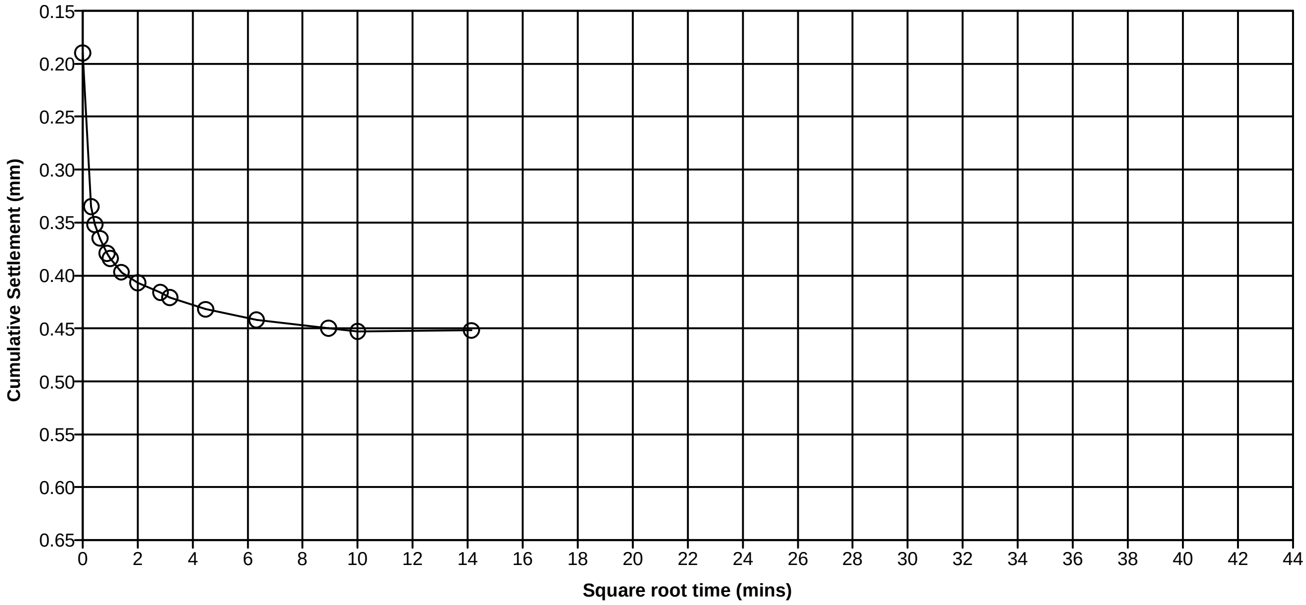
Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton	**Job Number** 40274D
Client : Welsh Assembly Government	**Page** 28 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH11	1.20	U3	3	Brown slightly gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274D/1

Site	: Warren Hall Site - Broughton	**Job Number** 40274D
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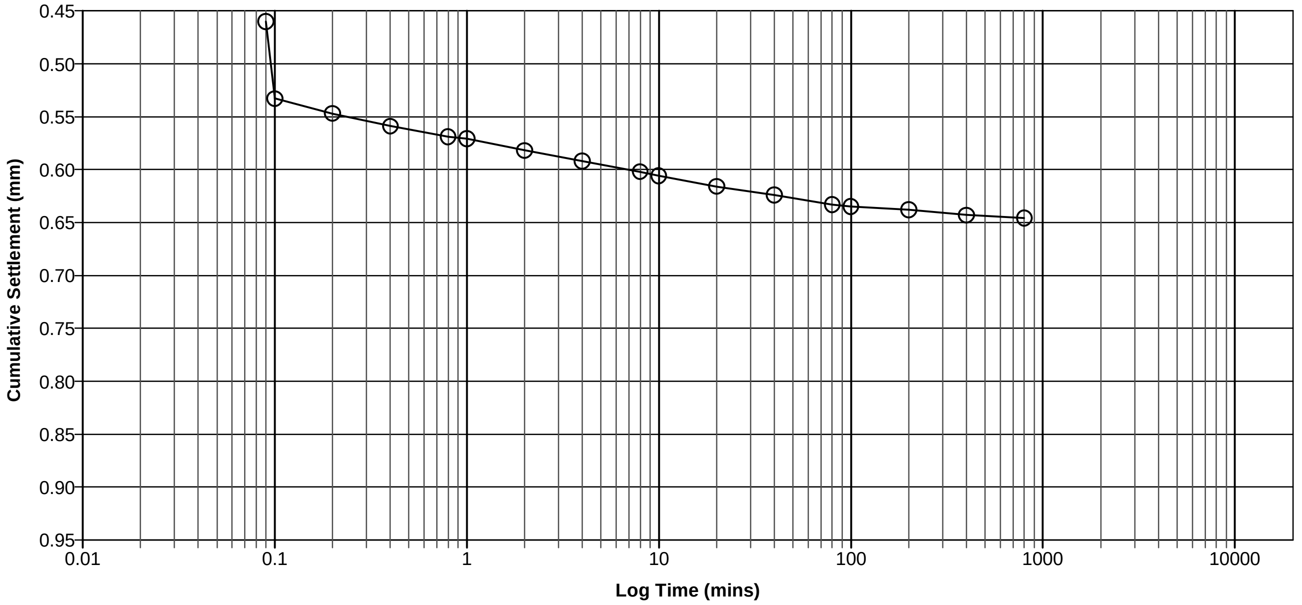
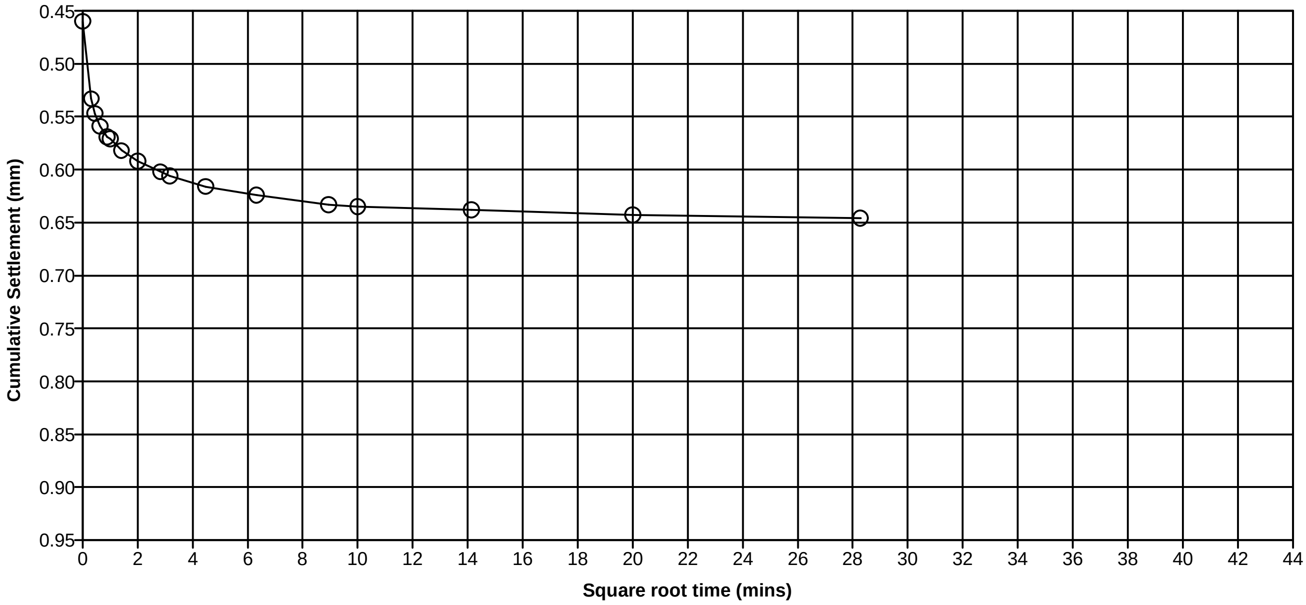
ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH11	1.20	U3	4	Brown slightly gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

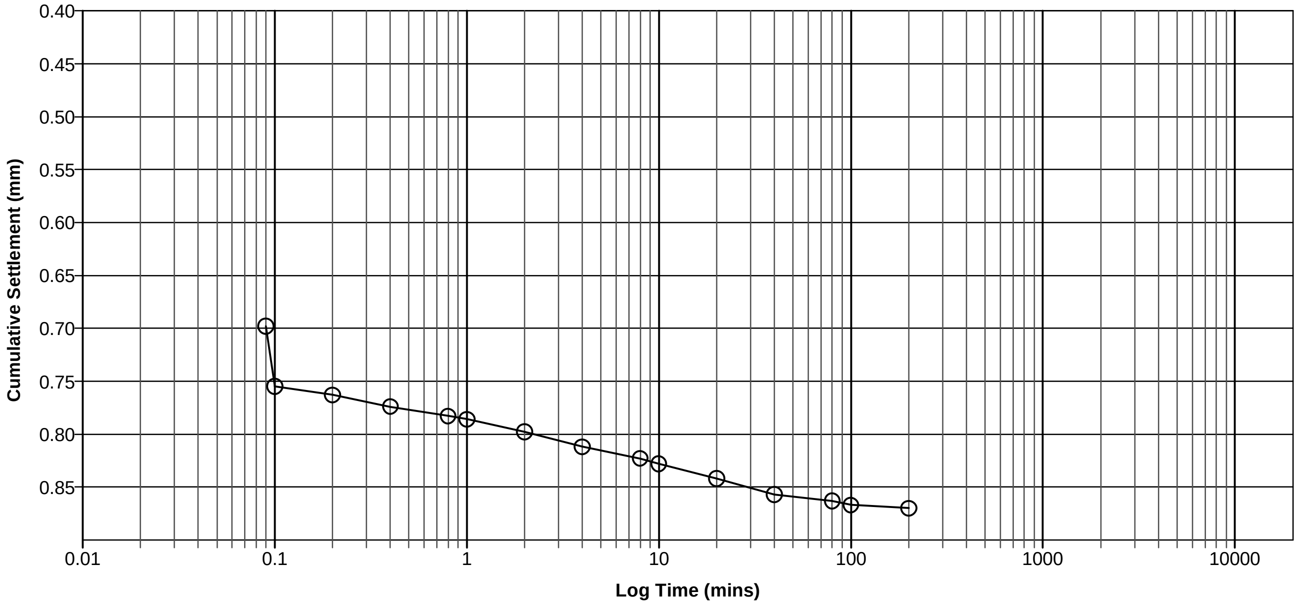
IAN FARMER ASSOCIATES

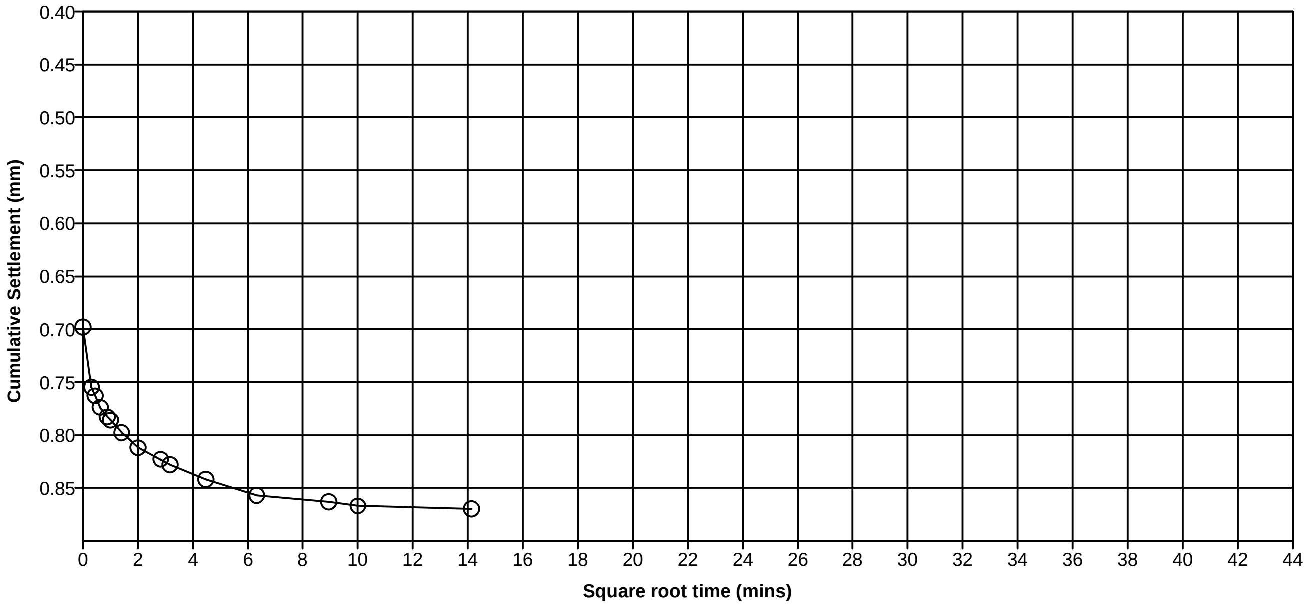
Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton		**Job Number** 40274D
Client : Welsh Assembly Government		**Page** 30 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH11	1.20	U3	5	Brown slightly gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

Site : Warren Hall Site - Broughton		**Job Number** 40274D
Client : Welsh Assembly Government		**Page** 31 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

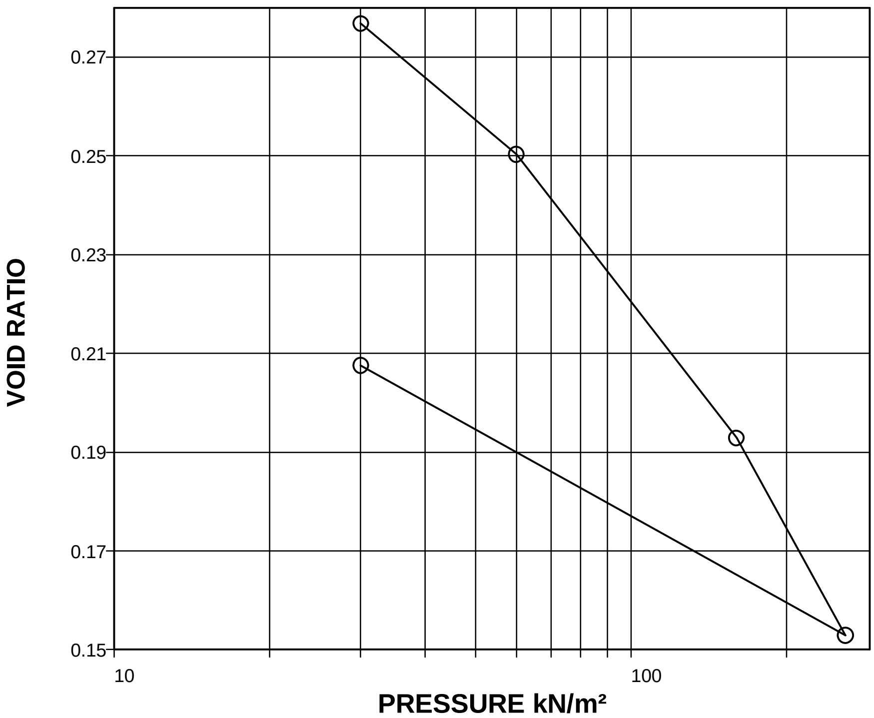
Borehole / Trial Pit	Depth (m)	Sample	Description
BH11	3.00	U7	Brown sandy gravelly CLAY

Initial Specimen

Length of Sample (mm)	450
Depth from top of sample (mm)	50
Condition of Sample:	Undisturbed
Orientation:	Vertical

Diameter (mm)	75.00
Particle Density (Mg/m³)	2.65 (Assumed)
Swelling Pressure (kN/m²)	
Lab Temp (℃)	19

	Inital	Final
Height (mm)	19.00	18.31
Wet Weight (g)	187.98	189.46
Moisture Content (%)	11	6.44
Bulk Density (Mg/m³)	2.24	2.34
Dry Density (Mg/m³)	2.03	2.20
Void Ratio	0.305	0.205
Degree of Saturation (%)	91.23	83.25



Pressure kN/m²	Mv m²/MN	Cv m²/year	Void Ratio
30	0.34	49	0.277
60	0.33	36	0.250
160	0.22	66	0.193
260	0.15	44	0.153
30	0.09	80	0.208

Pressure kN/m²	Mv m²/MN	Cv m²/year	Void Ratio

Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

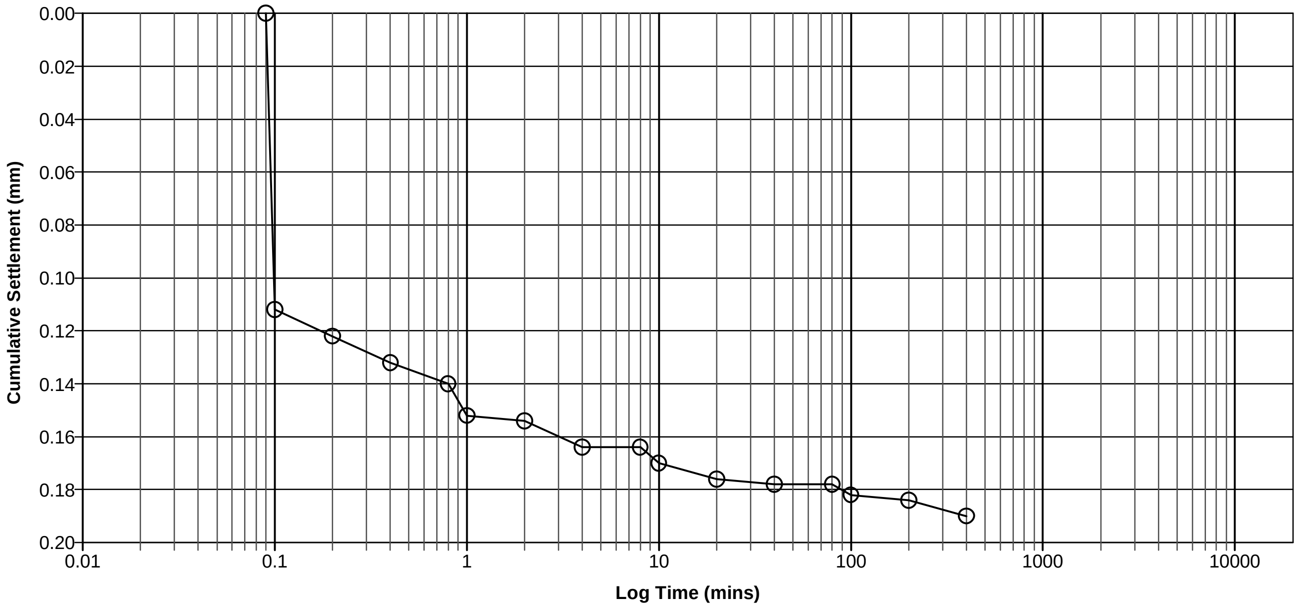
IAN FARMER ASSOCIATES

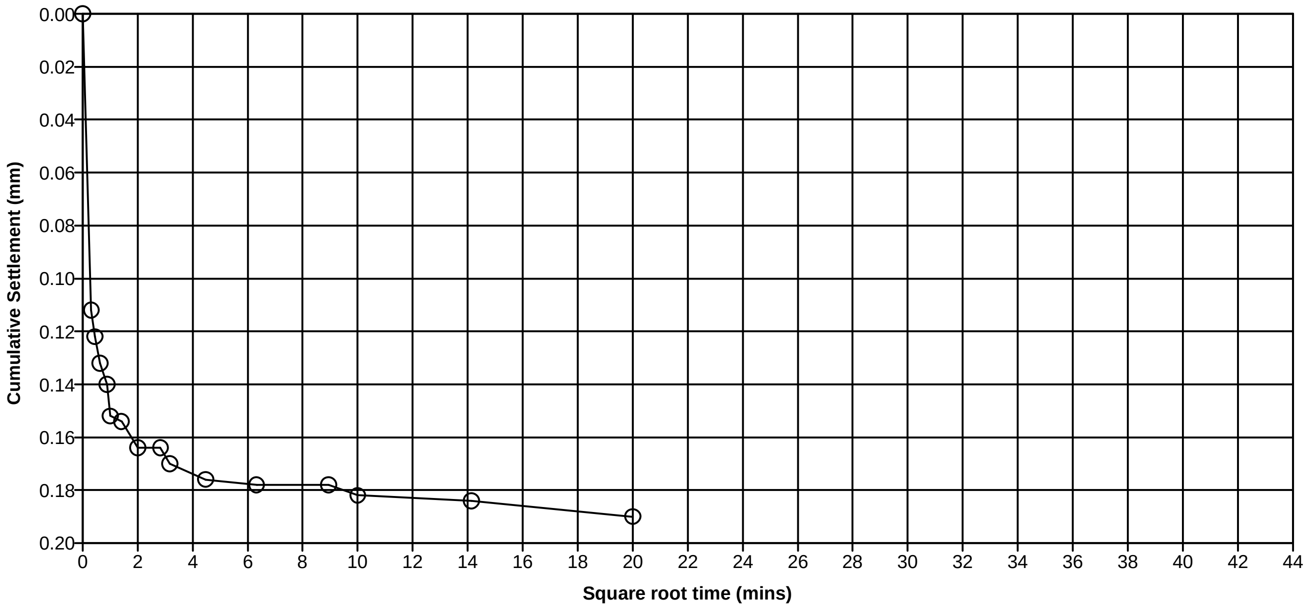
Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton	**Job Number** 40274D
Client : Welsh Assembly Government	**Page** 32 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH11	3.00	U7	1	Brown sandy gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

IAN FARMER ASSOCIATES	Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton

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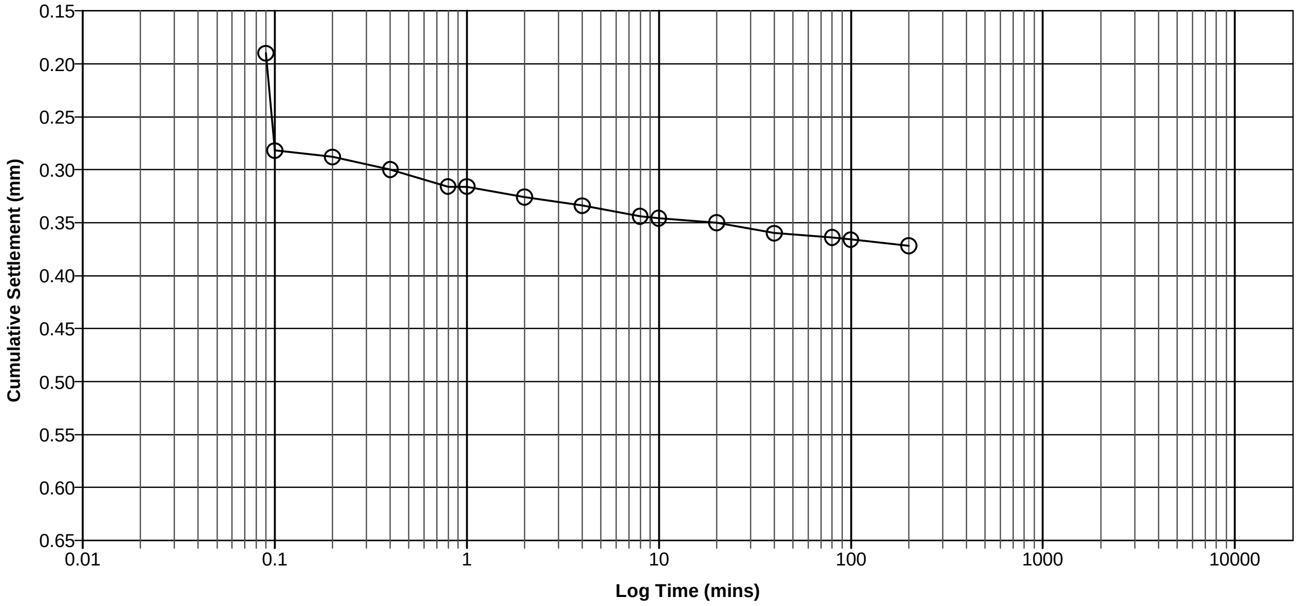
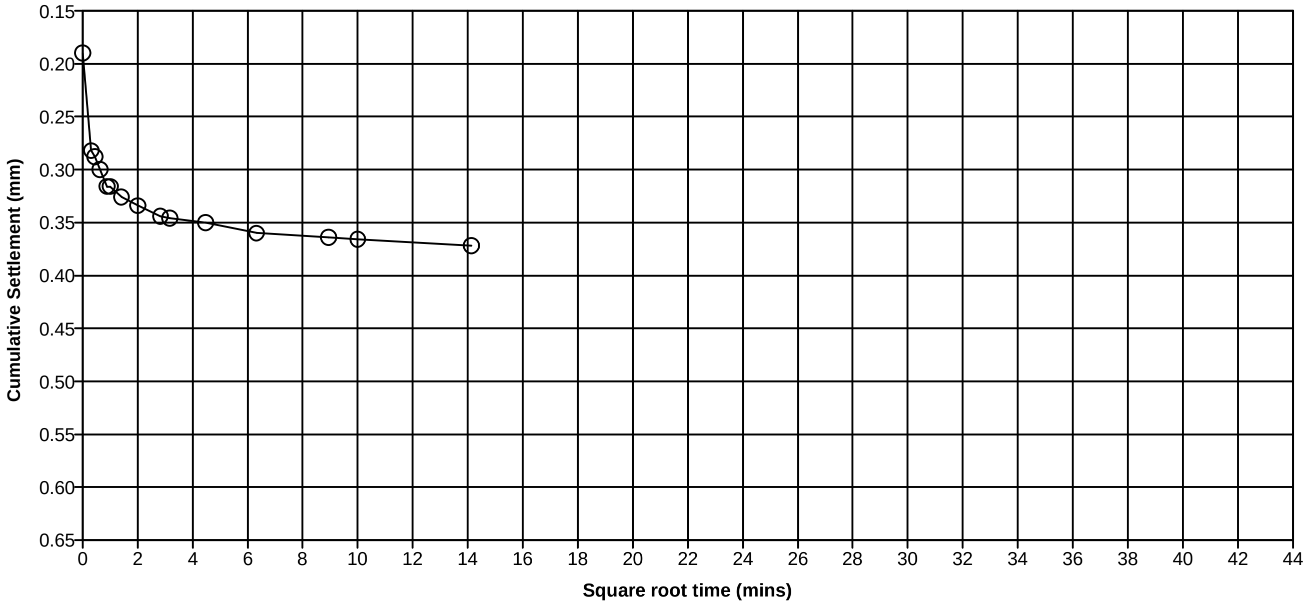
ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH11	3.00	U7	2	Brown sandy gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

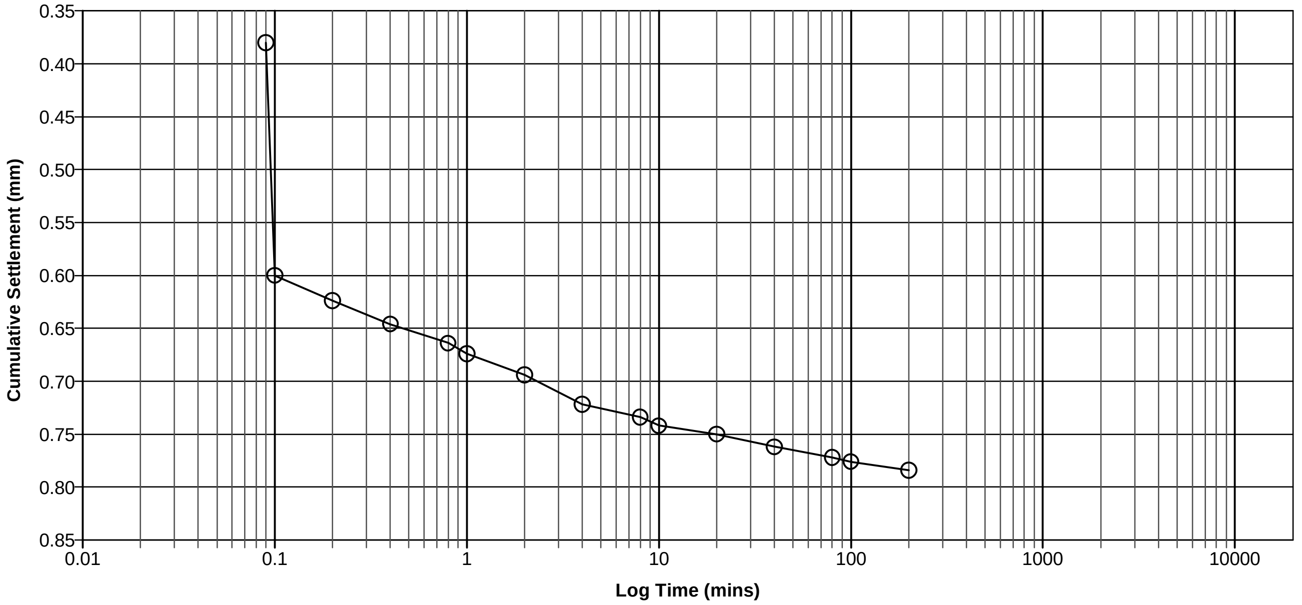
IAN FARMER ASSOCIATES

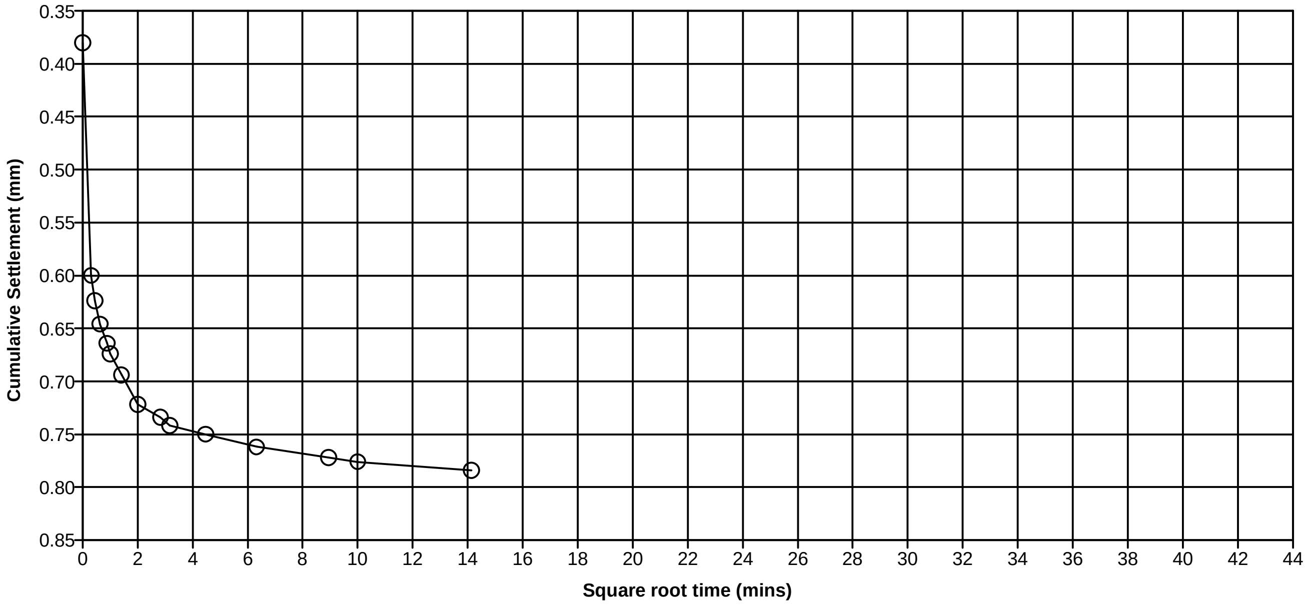
Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton		**Job Number** 40274D
Client : Welsh Assembly Government		**Page** 34 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH11	3.00	U7	3	Brown sandy gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274D

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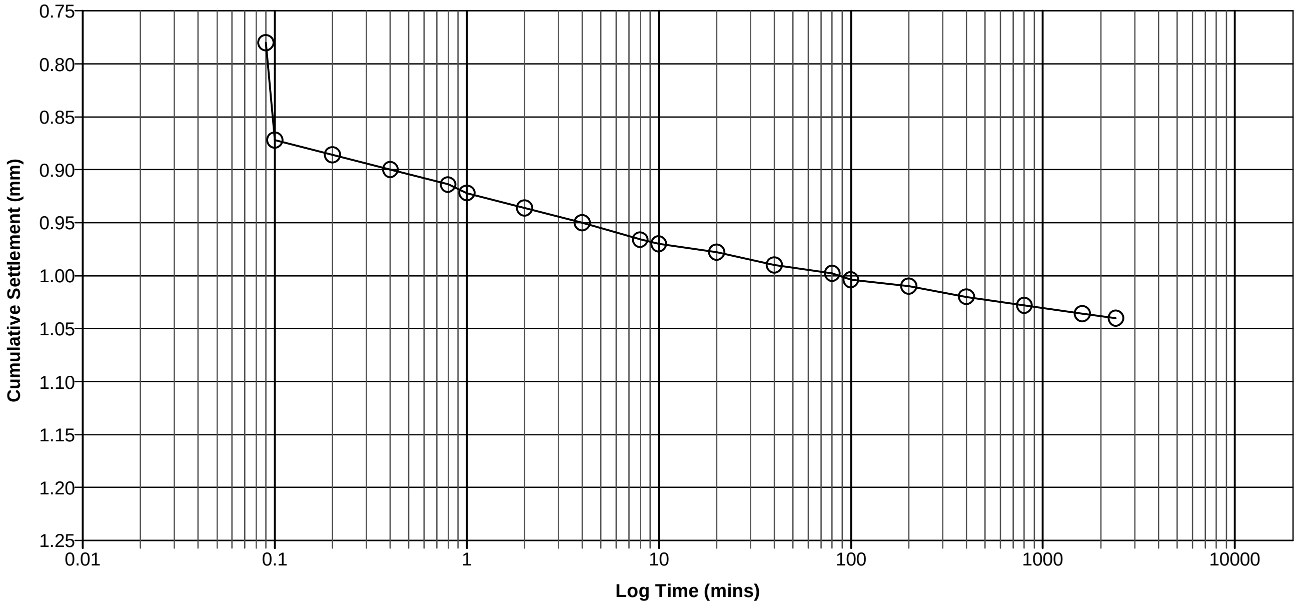
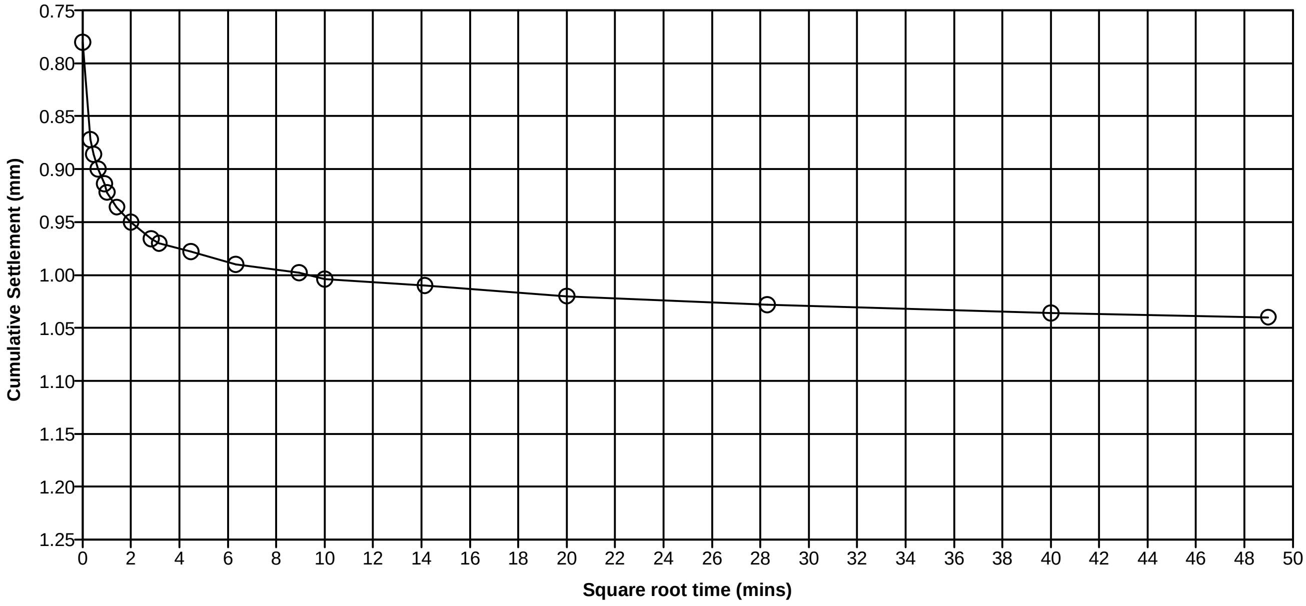
ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH11	3.00	U7	4	Brown sandy gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

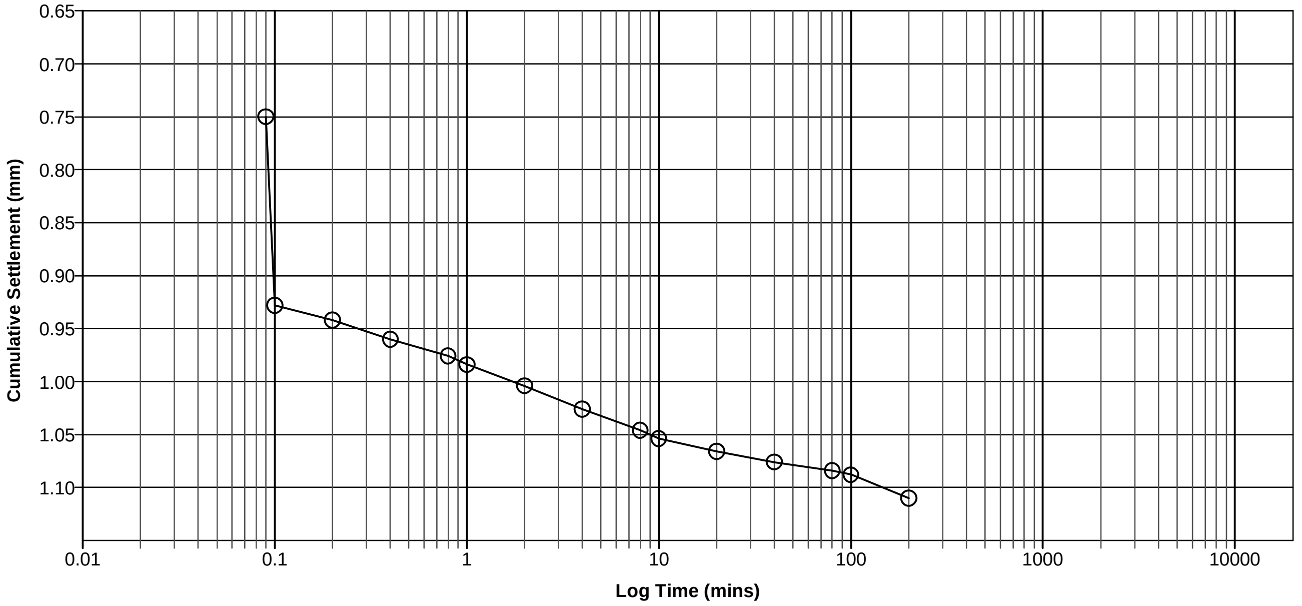
IAN FARMER ASSOCIATES

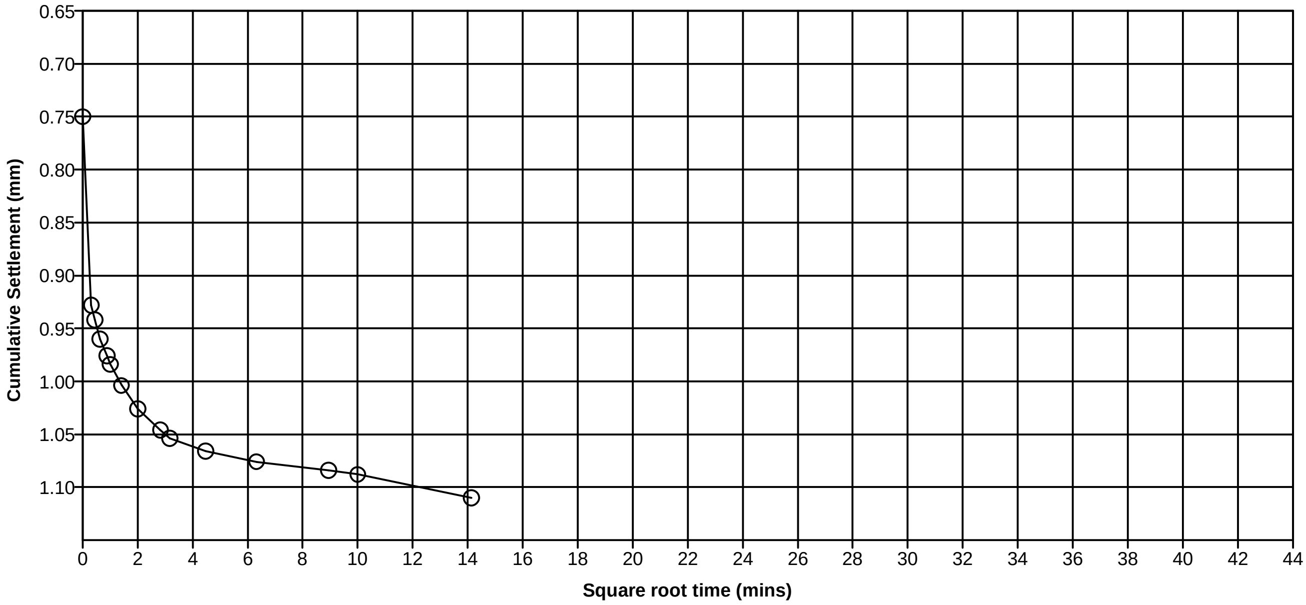
Laboratory Test Report - 40274D/1

Site : Warren Hall Site - Broughton	**Job Number** 40274D
Client : Welsh Assembly Government	**Page** 36 / 37

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH11	3.00	U7	5	Brown sandy gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

Test Report : **40274D/1**

Site : Warren Hall Site - Broughton
Job Number : 40274D
Originating Client : Welsh Assembly Government

All opinions and interpretations contained within this report are outside of our Scope of Accreditation.

The following tests contained within this report are not UKAS Accredited.
One - Dimensional Consolidation

Date of Issue : 19/2/08

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

14 Faraday Close, District 15, Pattinson North Industrial Estate, Washington, Tyne & Wear, NE38 8QJ.
Tel. 0191 4166375 Fax. 0191 4191578 Email. lab@ifawashington.co.uk Internet.www.ianfarmerassociates.co.uk

Ian Farmer Associates (1998) Ltd
17 Rivington Court
Warrington
Cheshire
WA1 4RT

F.A.O. Mr A Latimer

TEST REPORT - 40274E/1

Site :	Warren Hall Site - Broughton
Job Number :	40274E
Originating Client :	Welsh Assembly Government
Originating Reference :	40274E
Date Sampled :	Not Given
Date Scheduled :	25.01.08
Date Testing Started :	1/2/08
Date Testing Finished :	19/2/08
Remarks :	• First Report for above Job Number • Samples will be disposed of 28 days after the report is issue unless otherwise agreed • This report may contain results from tests which are not included within the scope of the UKAS accreditation. Please see final sheet for details.

Authorised By: J.M. Jones

Position : Senior Materials Engineer Date : 19/2/08

Ian Farmer Associates (1998) Limited. Registered in England and Wales No. 3661447
Registered Office: Unit 1, Bamburgh Court, TVTE, Gateshead, Tyne & Wear, NE11 0TX
Offices in: Coventry (02476) 456565. Harpenden, Herts. (01582) 460018. Truro (01827) 261775
Warrington (01925) 855440. Newcastle upon Tyne (0191) 4828500. Motherwell (01698) 230231.

AGS ASSOCIATION OF GEOTECHNICAL & GEOENVIRONMENTAL SPECIALISTS

UKAS 1464

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274E/1

Site : Warren Hall Site - Broughton	**Job Number** 40274E
Client : Welsh Assembly Government	**Page** 2 / 15

DETERMINATION OF MOISTURE CONTENT

Borehole/ Trial Pit	Depth (m)	Sample	Moisture Content %	Description
BH14	1.20	B3	15	Brown slightly sandy CLAY
BH16	1.20	U3	22	Brown slightly gravelly CLAY
BH17	1.20	D5	22	Brown slightly sandy CLAY

Method of Preparation : BS 1377:PART 1:1990:7.3.3 Preparation of samples for classification tests

Method of Test : BS 1377:PART 2:1990:3.2 Determination of oven dried moisture content

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274E/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274E

DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY AND LIQUIDITY INDEX

Borehole/ Trial Pit	Depth (m)	Sample	Natural / Sieved	Natural Moisture Content %	Sample Passing 425µm Sieve		Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Class	Description / Remarks
					Percentage %	Moisture Content %						
BH14	1.20	B3	Natural	15	95	16	25	15	10	0.10	CL	Brown slightly sandy CLAY
BH16	1.20	U3	Natural	22	94	23	40	22	18	0.06	CI	Brown slightly gravelly CLAY
BH17	1.20	D5	Natural	22	79	27	23	15	8	1.50	CL	Brown slightly sandy CLAY

Method of Preparation : BS 1377:PART 1:1990:7.4 Preparation of samples for classification tests BS 1377:PART 2:1990:4.2 & 5.2 Sample preparations

Method of Test : BS 1377:PART 2:1990:3.2 Determination of moisture content 4.3 Determination of the liquid limit 5.3 Determination of the plastic limit and plasticity index

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Laboratory Test Report - 40274E/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274E

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DETERMINATION OF MOISTURE CONTENT / BULK DENSITY / DRY DENSITY

Borehole/ Trial Pit	Depth (m)	Sample	Moisture Content %	Bulk Density (Mg/m^3)	Dry Density (Mg/m^3)	Description / Remarks
BH16	1.20	U3	18	1.9	1.60	Brown slightly gravelly CLAY

Method of Preparation : BS 1377:PART 1:1990:8.2,8.3,8.4

Method of Test : BS 1377:PART 2:1990:7 Determination of Density

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274E/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274E

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DETERMINATION OF THE pH VALUE AND THE SULPHATE CONTENT OF SOIL AND GROUNDWATER

Borehole/ Trial Pit	Depth (m)	Sample	Concentration of Soluble Sulphate			Percentage of sample passing 2mm Sieve %	pH	Description / Remarks
			Soil		Groundwater g /l			
			Total S04 %	S04 in 2:1 water:soil g /l				
BH15	2.60	W9			0.07		8.2	
BH17	3.00	B9		0.2		94	6.8	Brown SAND

Method of Preparation : BS 1377:PART 1:1990:7.5 Preparation of soil for chemical tests BS 1377:PART 3:1990:5.2, 5.3, 5.4 & 9.4

Method of Test : BS 1377:PART 3:1990:5 Determination of the sulphate content of soil and ground water BS 1377:PART 3:1990:9 Determination of the pH value

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Laboratory Test Report - 40274E/1

Site	: Warren Hall Site - Broughton	**Job Number** 40274E
Client	: Welsh Assembly Government	**Page** 6 / 15

DETERMINATION OF CALIFORNIA BEARING RATIO (CBR)

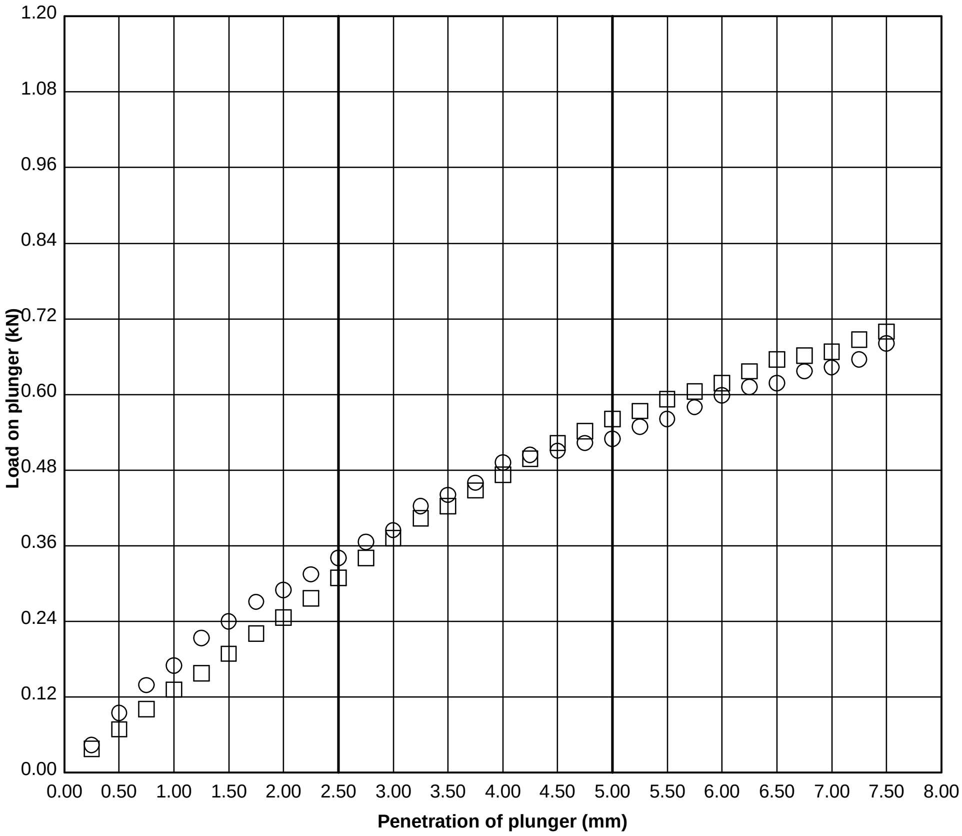
Borehole / Trial Pit	Depth (m)	Sample	% Passing 20 mm Sieve	Description
BH14	1.20	B3	97 %	Brown slightly sandy CLAY

Moisture Content %	
Bulk Density Mg/m³	2.09
Dry Density Mg/m³	1.79
Soaked Test	No

Test on	□ TOP	
Moisture Content %	17	
Surcharge weight kg		
Penetration mm	2.5	5.0
Force kN	0.31	0.56
Corrected CBR %	2.3	2.8

Test on	○ BOTTOM	
Moisture Content %	16	
Surcharge weight kg		
Penetration mm	2.5	5.0
Force kN	0.34	0.53
Corrected CBR %	2.6	2.7

Test on	TOP	BOTTOM
Reported CBR %	2.8	2.7
Mean CBR %	2.8	



Method of Preparation : The specimen was prepared by Dynamic compression using a 2.5 kg Rammer
BS 1377:PART 1:1990:7.6.1 General 1990:7.6.5 California bearing ratio test BS 1377:PART 4:1990:7.2 Preparation of test sample

Method of Test : BS 1377:PART 4:1990:7.4 Penetration test procedure

Remarks :

IAN FARMER ASSOCIATES

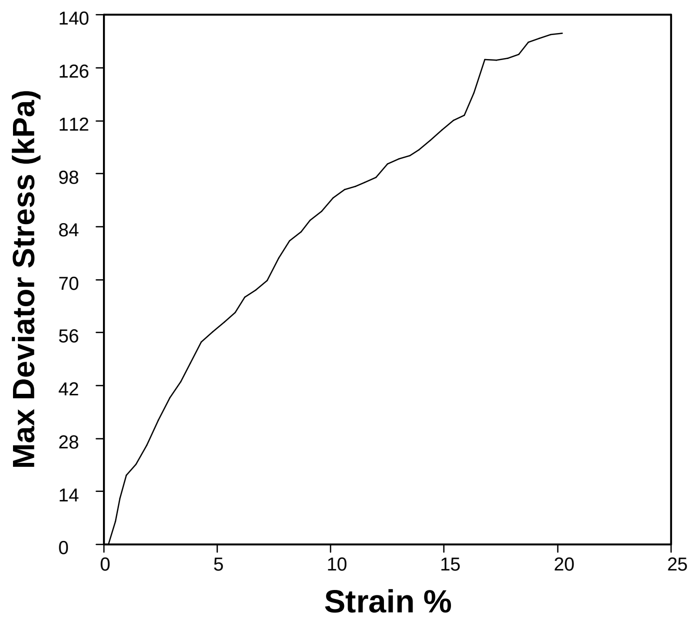
Laboratory Test Report - 40274E/1

Site : Warren Hall Site - Broughton	**Job Number** 40274E
Client : Welsh Assembly Government	**Page** 7 / 15

DETERMINATION OF MOISTURE CONTENT, DENSITY AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE (DEFINITIVE METHOD)

Borehole / Trial Pit	Depth (m)	Sample	Description
BH14	2.00	U5	Brown GRAVEL

Initial Specimen	**Length of Sample (mm)**	450
	Depth from top of sample (mm)	50
	Condition of Sample:	Undisturbed
	Orientation:	Vertical
Test Type		Single Stage
Length of Specimen (mm)		208
Diameter of Specimen (mm)		101.2
Moisture Content (%)		15
Bulk Density (Mg/m³)		2.22
Dry Density (Mg/m³)		1.93
Membrane Thickness (mm)		0.32
Membrane Type		latex
Rate of Strain (%/min)		1.44
Test Results	**Measured Cell Pressure (kPa)**	40
	Strain at Failure (%)	20.2
	Membrane Correction (kPa)	1.2
	Corrected Deviator Stress (kPa)	134
	Shear Stress (kPa)	**67**
	Mode of Failure (B/P/C)	**Compound**



Method of Preparation : BS 1377:PT1:1990:7.4.2 Moisture Content, BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or BS 1377:PT1:1990 :7.7.5.2 Preparation of disturbed samples for testing.

Method of Test : BS 1377:PT2:1990:3.2 Determination of moisture content, BS 1377:PT2:1990:7.2 Determination of density by linear measurement and BS1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (definitive method)

Remarks : Membrane Type: latex

IAN FARMER ASSOCIATES

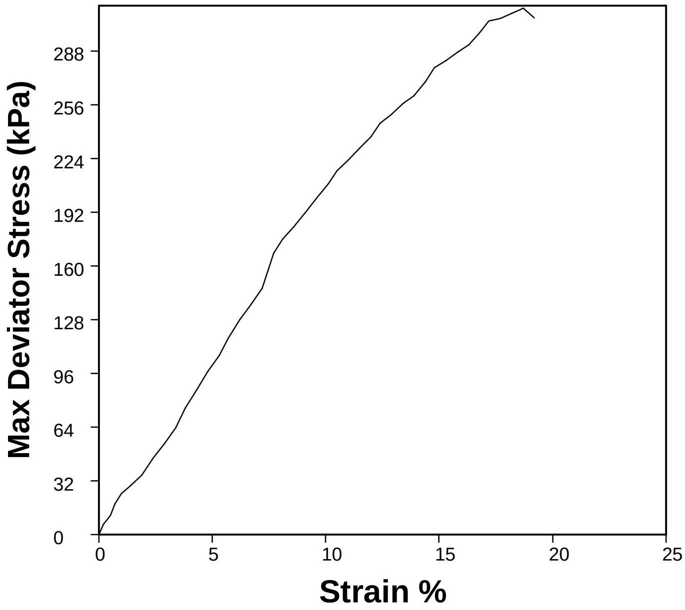
Laboratory Test Report - 40274E/1

Site : Warren Hall Site - Broughton	**Job Number**	40274E
Client : Welsh Assembly Government	**Page**	8 / 15

DETERMINATION OF MOISTURE CONTENT, DENSITY AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE (DEFINITIVE METHOD)

Borehole / Trial Pit	Depth (m)	Sample	Description
BH17	9.00	U20	Brown sandy CLAY

Initial Specimen		
Length of Sample (mm)		450
Depth from top of sample (mm)		50
Condition of Sample:		Undisturbed
Orientation:		Vertical
Test Type		Single Stage
Length of Specimen (mm)		208.9
Diameter of Specimen (mm)		101.2
Moisture Content (%)		12
Bulk Density (Mg/m³)		2.31
Dry Density (Mg/m³)		2.05
Membrane Thickness (mm)		0.31
Membrane Type		latex
Rate of Strain (%/min)		1.91
Test Results	Measured Cell Pressure (kPa)	180
	Strain at Failure (%)	18.7
	Membrane Correction (kPa)	1.1
	Corrected Deviator Stress (kPa)	312
	Shear Stress (kPa)	**156**
	Mode of Failure (B/P/C)	**Brittle**



Method of Preparation : BS 1377:PT1:1990:7.4.2 Moisture Content, BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or BS 1377:PT1:1990 :7.7.5.2 Preparation of disturbed samples for testing.

Method of Test : BS 1377:PT2:1990:3.2 Determination of moisture content, BS 1377:PT2:1990:7.2 Determination of density by linear measurement and BS1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (definitive method)

Remarks : Membrane Type: latex

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Laboratory Test Report - 40274E/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274E

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ONE-DIMENSIONAL CONSOLIDATION TEST

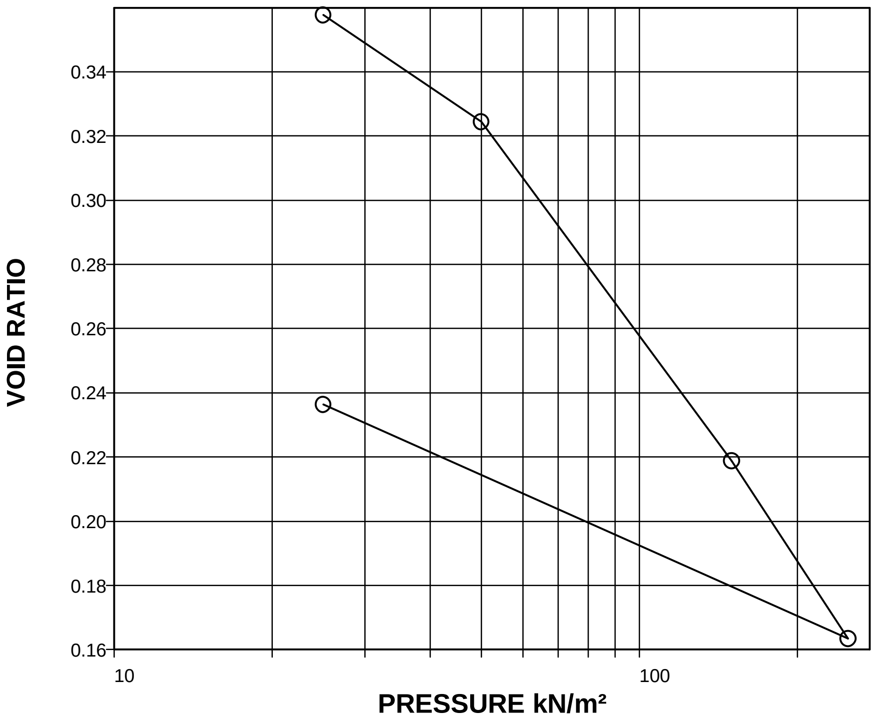
Borehole / Trial Pit	Depth (m)	Sample	Description
BH15	1.20	U3	Brown sandy slightly gravelly CLAY

Initial Specimen

Length of Sample (mm)	450
Depth from top of sample (mm)	50
Condition of Sample:	Undisturbed
Orientation:	Vertical

Diameter (mm)	75.00
Particle Density (Mg/m³)	2.65 (Assumed)
Swelling Pressure (kN/m²)	
Lab Temp (℃)	19

	Inital	Final
Height (mm)	19.00	17.86
Wet Weight (g)	181.51	181.41
Moisture Content (%)	15	13
Bulk Density (Mg/m³)	2.16	2.30
Dry Density (Mg/m³)	1.88	2.03
Void Ratio	0.410	0.305
Degree of Saturation (%)	97.60	116.25



Pressure kN/m²	Mv m²/MN	Cv m²/year	Void Ratio
25	0.70	6.1	0.358
50	0.49	5.0	0.324
150	0.38	8.1	0.219
250	0.17	6.4	0.164
25	0.11	6.6	0.236

Pressure kN/m²	Mv m²/MN	Cv m²/year	Void Ratio

Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

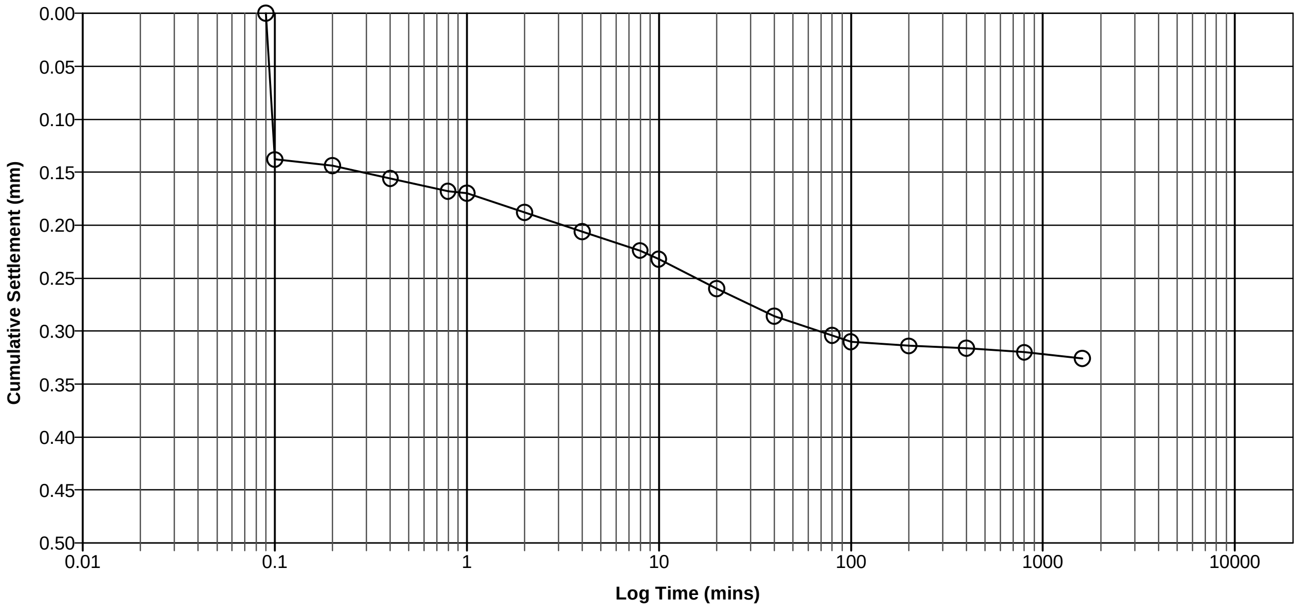
IAN FARMER ASSOCIATES

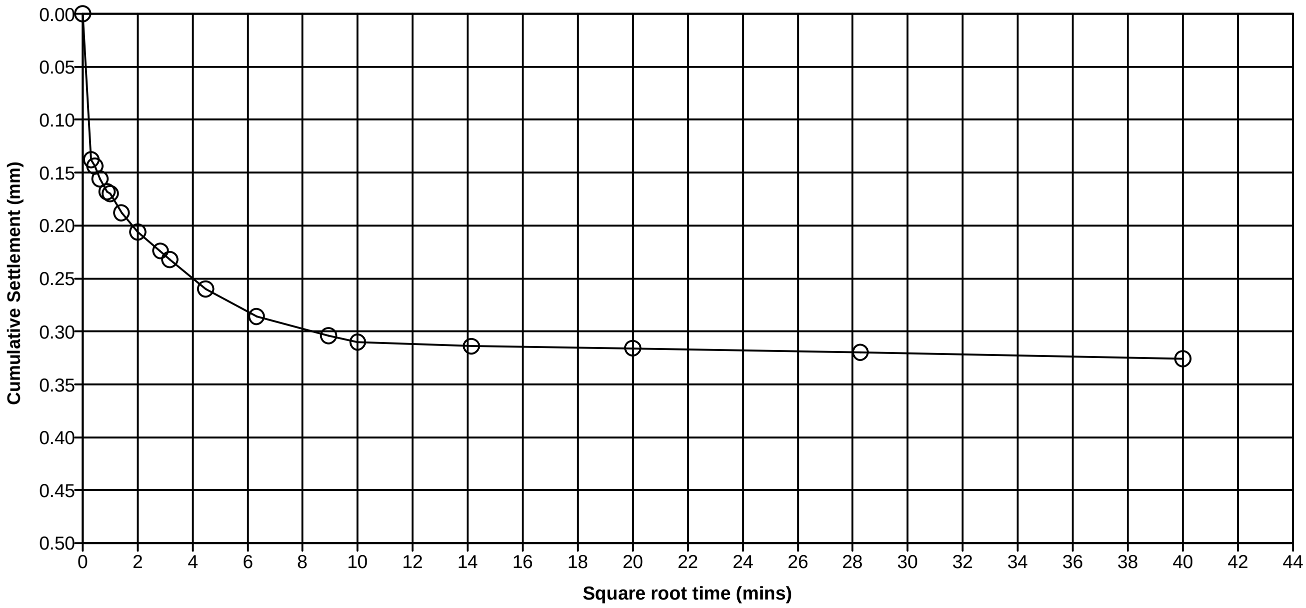
Laboratory Test Report - 40274E/1

Site : Warren Hall Site - Broughton	**Job Number** 40274E
Client : Welsh Assembly Government	**Page** 10 / 15

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH15	1.20	U3	1	Brown sandy slightly gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

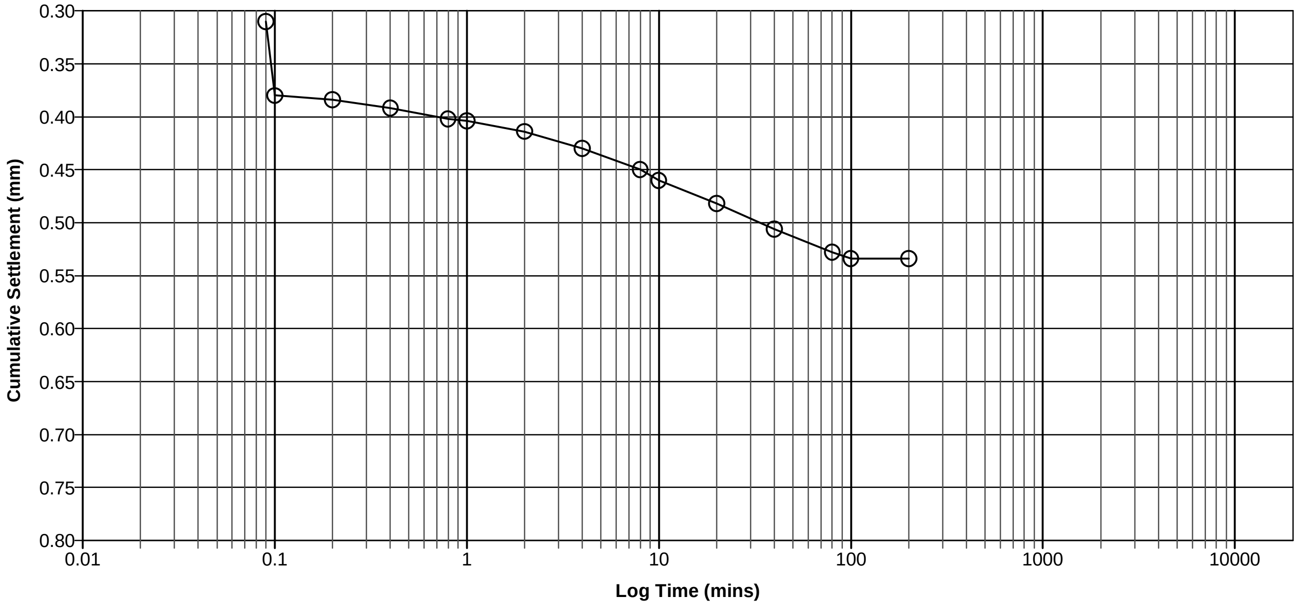
IAN FARMER ASSOCIATES

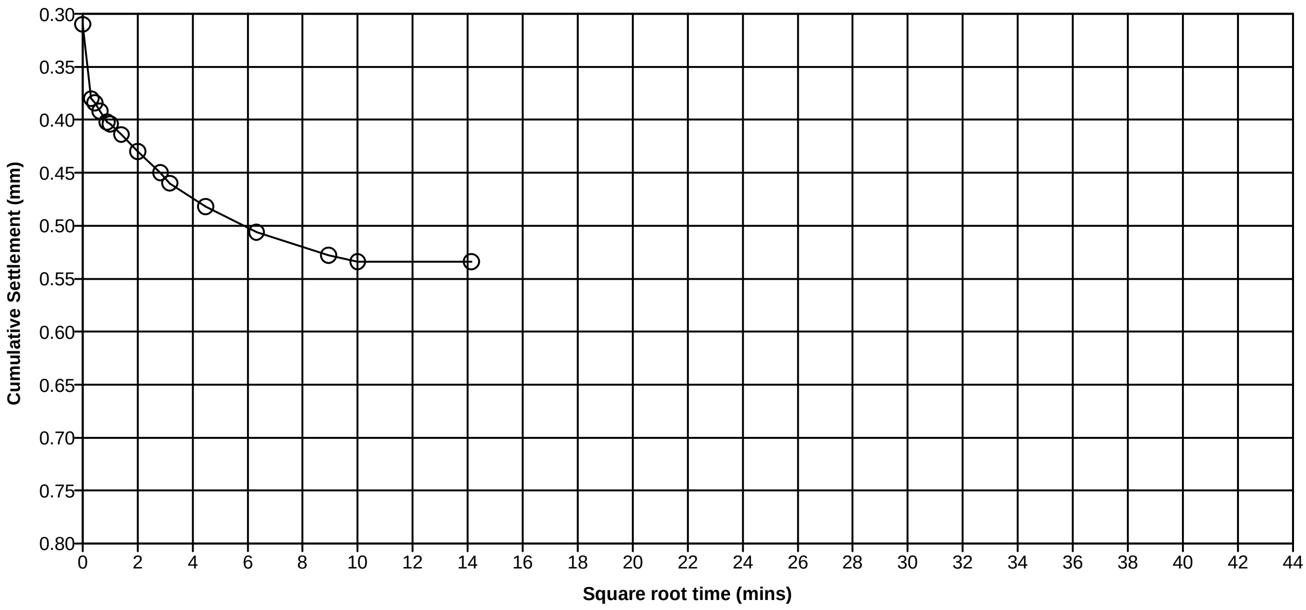
Laboratory Test Report - 40274E/1

Site : Warren Hall Site - Broughton		**Job Number** 40274E
Client : Welsh Assembly Government		**Page** 11 / 15

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH15	1.20	U3	2	Brown sandy slightly gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 40274E/1

Site : Warren Hall Site - Broughton

Client : Welsh Assembly Government

Job Number 40274E

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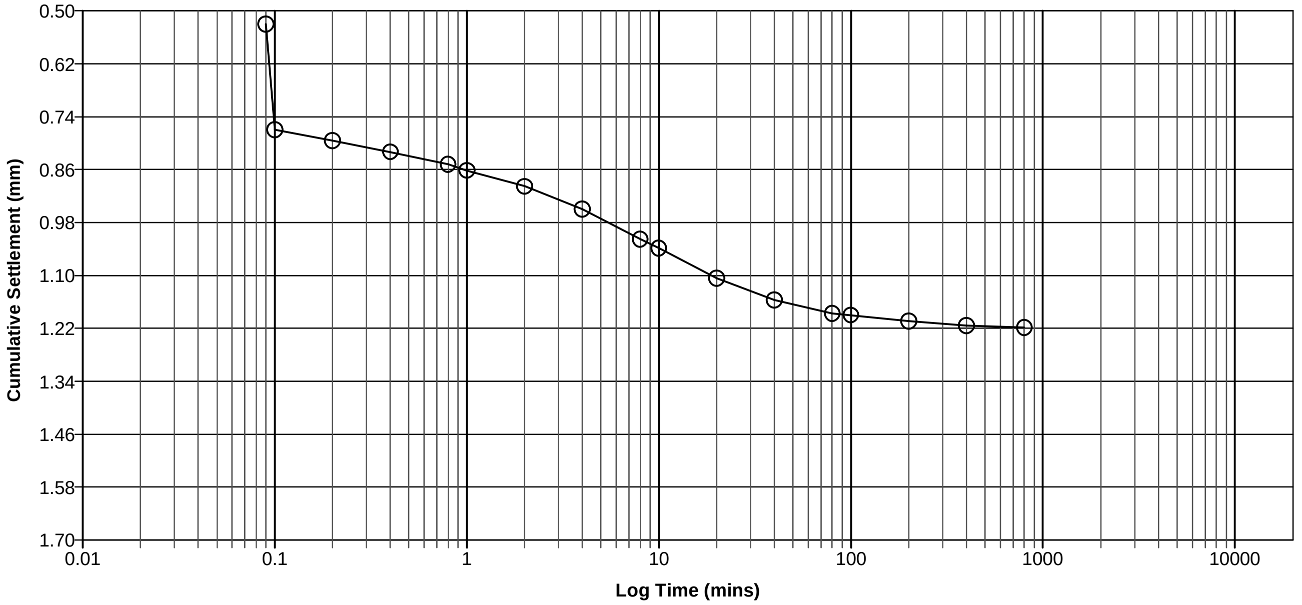
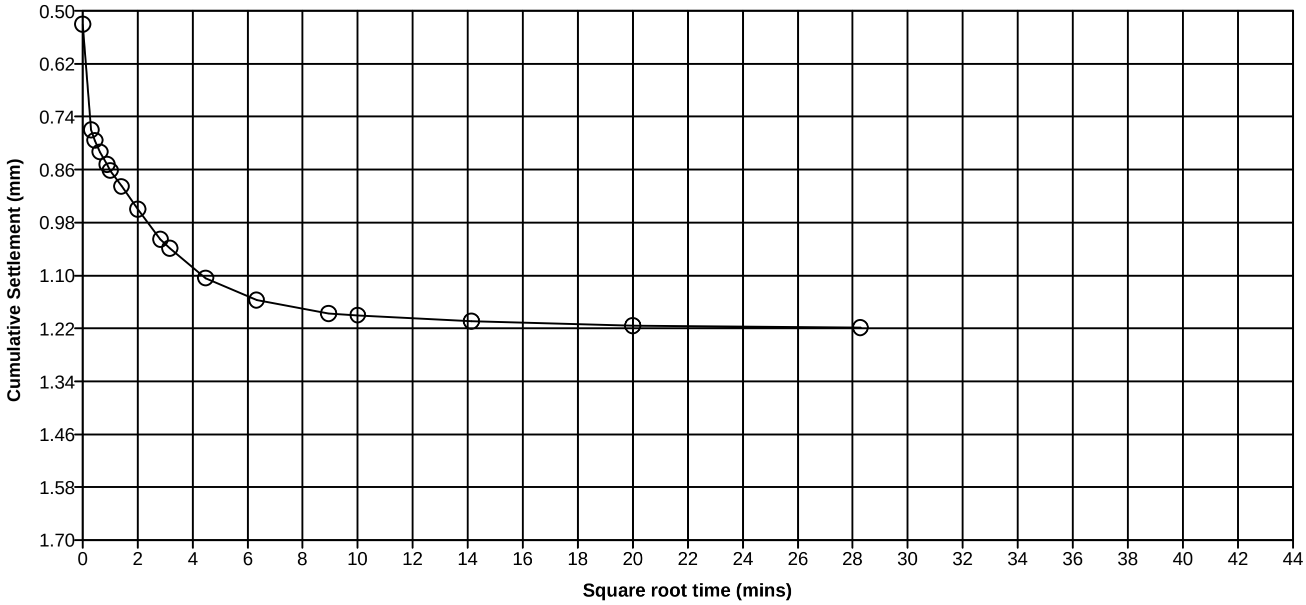
ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH15	1.20	U3	3	Brown sandy slightly gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

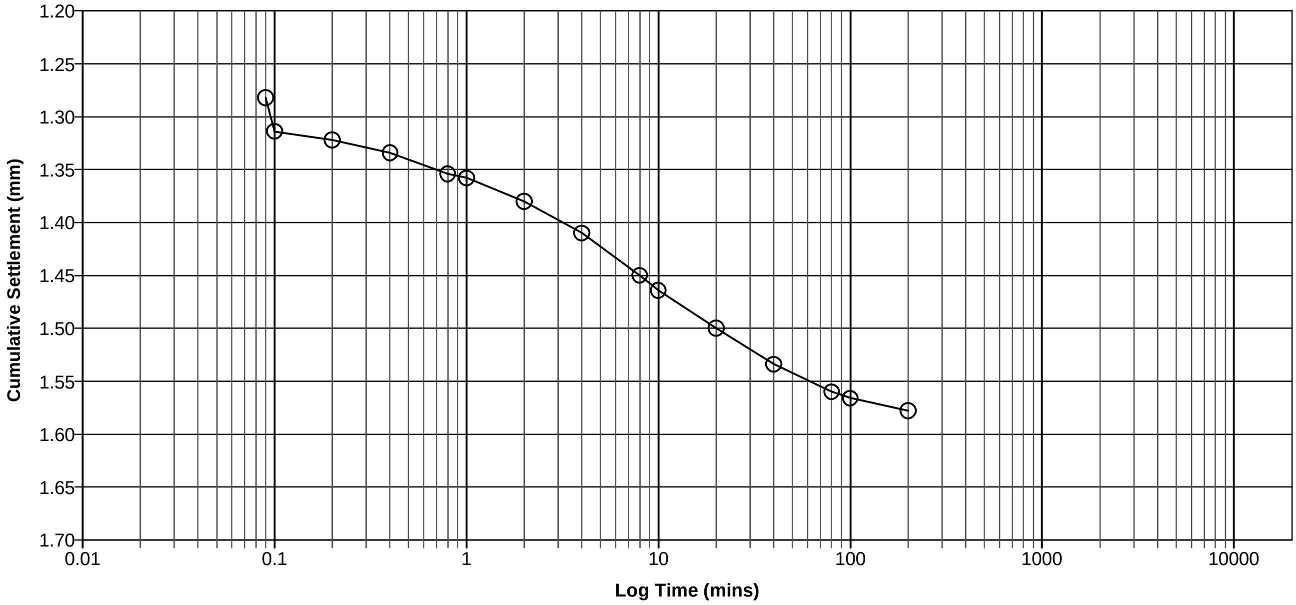
IAN FARMER ASSOCIATES

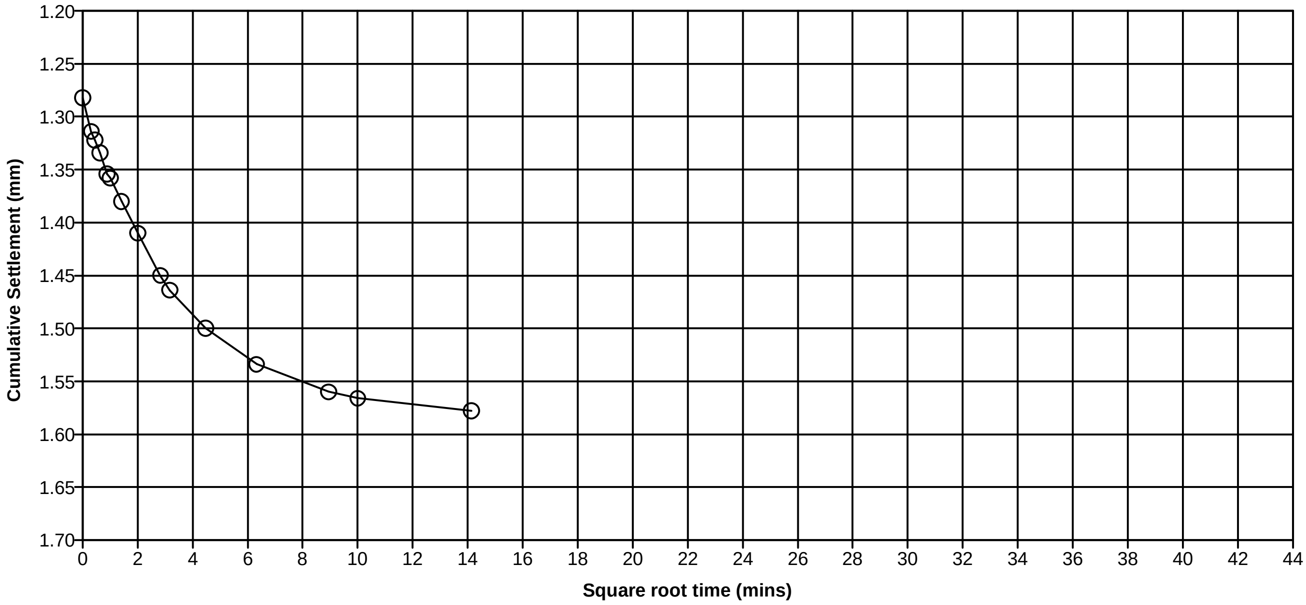
Laboratory Test Report - 40274E/1

Site	: Warren Hall Site - Broughton	**Job Number** 40274E
Client	: Welsh Assembly Government	**Page** 13 / 15

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH15	1.20	U3	4	Brown sandy slightly gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

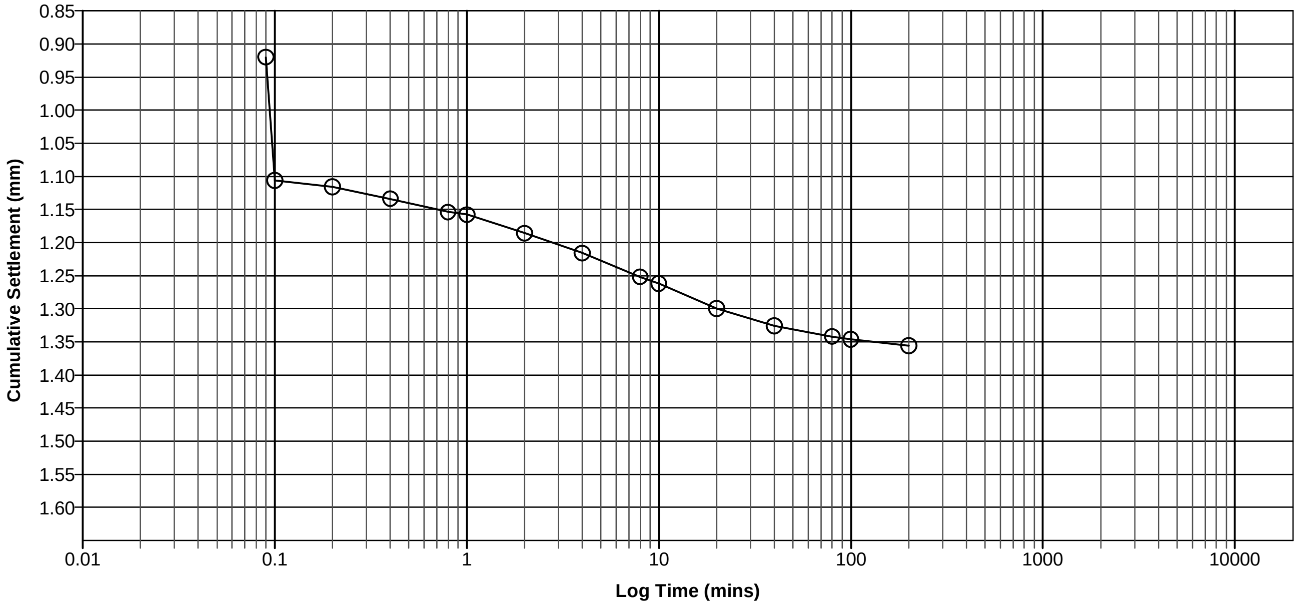
Remarks :

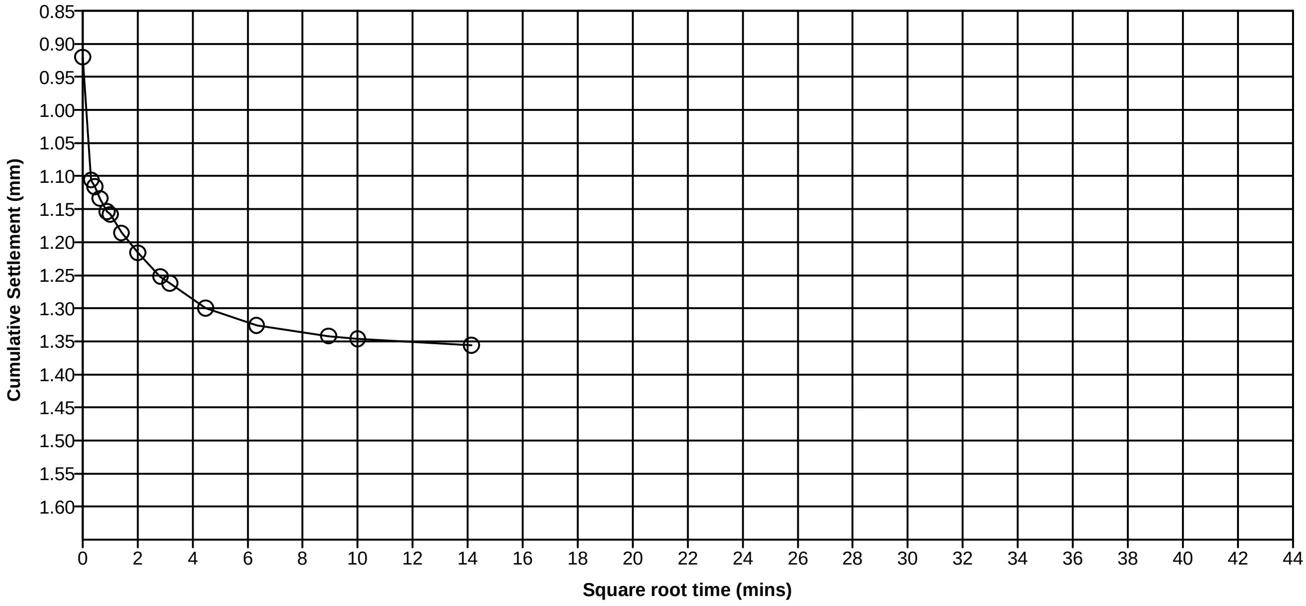
IAN FARMER ASSOCIATES	Laboratory Test Report - 40274E/1

Site : Warren Hall Site - Broughton	**Job Number** 40274E
Client : Welsh Assembly Government	**Page** 14 / 15

ONE-DIMENSIONAL CONSOLIDATION TEST

Borehole / Trial Pit	Depth (m)	Sample	Stage	Description
BH15	1.20	U3	5	Brown sandy slightly gravelly CLAY





Method of Preparation : BS 1377:PART 5:1990:3.3, 3.4

Method of Test : BS 1377:PART 5:1990:3.5

Remarks :

IAN FARMER ASSOCIATES

Geotechnical & Environmental Specialists

Test Report : **40274E/1**

Site : Warren Hall Site - Broughton
Job Number : 40274E
Originating Client : Welsh Assembly Government

All opinions and interpretations contained within this report are outside of our Scope of Accreditation.

The following tests contained within this report are not UKAS Accredited.
One - Dimensional Consolidation

Date of Issue : 19/2/08

APPENDIX 4

CHEMICAL TESTS

Certificate of Analysis

2139

Certificate Number: 08-17171

Date: 14/02/2008

Client:	Ian Farmer Associates 17 Rivington Court Hardwick Grange Woolston Warrington Cheshire WA1 4RT
Our Reference:	08-17171
Client Reference:	40274
Contract Title:	Warren Hall
Description:	28 soil samples
Date Received:	05/02/2008
Date Started:	05/02/2008
Date Completed:	14/02/2008
Test Procedures:	Identified by prefix DETSn, details available upon request.
Notes:	Observations and interpretations are outside the scope of UKAS accreditation * denotes test not included in laboratory scope of accreditation # denotes test that holds MCERT accreditation $ denotes tests completed by approved subcontractors I/S denotes insufficient sample to carry out test N/S denotes that the sample is not suitable for testing Solid samples will be disposed 1 month and liquids 2 weeks after the date of issue of this test certificate
Approved By:	
Authorised Signatories:	Rob Brown Business Manager

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

Sample Details

Sample ID	Depth	DETS Ref	Matrix Description	Date Sampled	Time Sampled	Preservation	Analysis Complete
WS01	0.50	116583	Loose brown orange grey clayey SAND (silty)	Not Provided	Not Provided	None	14/02/2008
WS02	0.50	116584	Firm brown orange CLAY	Not Provided	Not Provided	None	14/02/2008
WS02	1.00	116585	Soft brown slightly sandy CLAY	Not Provided	Not Provided	None	14/02/2008
WS03	0.70	116586	Firm dark brown / grey sandy gravelly CLAY	Not Provided	Not Provided	None	14/02/2008
WS04	0.30	116587	Firm brown orange grey slightly gravelly CLAY (made ground contains coal)	Not Provided	Not Provided	None	14/02/2008
WS04	1.30	116588	Firm brown grey CLAY	Not Provided	Not Provided	None	14/02/2008
WS05	0.50	116589	Soft light brown grey slightly gravelly CLAY	Not Provided	Not Provided	None	14/02/2008
WS05	1.50	116590	Firm light brown grey CLAY	Not Provided	Not Provided	None	14/02/2008
WS06	0.70	116591	Firm dark brown sandy gravelly CLAY	Not Provided	Not Provided	None	14/02/2008
WS06	1.50	116592	Firm brown red slightly gravelly CLAY (made ground contains coal)	Not Provided	Not Provided	None	14/02/2008
WS07	0.50	116593	Firm light brown red grey gravelly CLAY	Not Provided	Not Provided	None	14/02/2008
WS07	1.50	116594	Firm dark brown black grey sandy CLAY	Not Provided	Not Provided	None	14/02/2008
WS08	0.70	116595	Loose brown SAND (silty)	Not Provided	Not Provided	None	14/02/2008
WS09	0.50	116596	Firm dark brown red slightly sandy gravelly CLAY	Not Provided	Not Provided	None	14/02/2008
WS09	1.00	116597	Firm brown sandy gravelly CLAY	Not Provided	Not Provided	None	14/02/2008
WS10	1.50	116598	Firm brown grey slightly gravelly CLAY (made ground contains brick)	Not Provided	Not Provided	None	14/02/2008
WS10	2.70	116599	Firm brown orange sandy gravelly CLAy (made ground contains coal)	Not Provided	Not Provided	None	14/02/2008
WS11	0.50	116600	Firm dark brown grey sandy gravelly CLAY (occasional rootlets)	Not Provided	Not Provided	None	14/02/2008
WS11	1.50	116601	Firm brown grey gravelly sandy CLAY (silty)	Not Provided	Not Provided	None	14/02/2008
WS12	0.50	116602	Firm dark brown redish sandy gravelly CLAY	Not Provided	Not Provided	None	14/02/2008
WS12	1.00	116603	Soft brown grey slightly gravelly sandy CLAY	Not Provided	Not Provided	None	14/02/2008
WS13	0.50	116604	Stiff brown grey gravelly sandy CLAY	Not Provided	Not Provided	None	14/02/2008
WS15	0.50	116605	Soft brown grey sandy gravelly CLAY (occasional rootlets)	Not Provided	Not Provided	None	14/02/2008
WS15	2.00	116606	Firm dark brown sandy gravelly CLAY	Not Provided	Not Provided	None	14/02/2008
WS16	0.30	116607	Firm brown grey gravelly sandy CLAY	Not Provided	Not Provided	None	14/02/2008
WS17	1.00	116608	Very soft brown orange grey sandy CLAY	Not Provided	Not Provided	None	14/02/2008
WS17	1.30	116609	Stiff brown grey slighty gravelly sandy CLAY	Not Provided	Not Provided	None	14/02/2008
TP5	1.50	116610	Firm brown gravelly sandy CLAY	Not Provided	Not Provided	None	14/02/2008

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

Sample Details

Sample ID	Depth	DETS Ref	Matrix Description	Date Sampled	Time Sampled	Preservation	Analysis Complete

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	116583	116584	116585	116586
		Sample Ref	WS01	WS02	WS02	WS03
		Depth	0.50	0.50	1.00	0.70
		Other Ref				
		Sample Type	D	J	D	D
Test	**Units**	**DETSxx**				
Arsenic	mg/kg	DETS 042#	6	9	8	4
Cadmium	mg/kg	DETS 042	0.4	0.7	0.8	0.5
Chromium	mg/kg	DETS 042	14	25	24	15
Copper	mg/kg	DETS 042	17	11	19	10
Lead	mg/kg	DETS 042	63	23	23	19
Mercury	mg/kg	DETS 081*	< 0.3	< 0.3	< 0.3	< 0.3
Nickel	mg/kg	DETS 042	12	18	24	14
Selenium	mg/kg	DETS 042	< 0.3	0.3	< 0.3	< 0.3
Zinc	mg/kg	DETS 042#	27	45	47	32
Boron (water soluble)	mg/kg	DETS 020#	0.3	0.5	0.2	1.6
Cyanide free	mg/kg	DETS 067#	< 0.1	< 0.1	< 0.1	< 0.1
pH		DETS 008#	8.2	8.0	8.3	8.2
Aliphatic C5-C6	mg/kg	DETS 072*				
Aliphatic C6-C8	mg/kg	DETS 072*				
Aliphatic C8-C10	mg/kg	DETS 072*				
Aliphatic C10-C12	mg/kg	DETS 072*				
Aliphatic C12-C16	mg/kg	DETS 072*				
Aliphatic C16-C21	mg/kg	DETS 072*				
Aliphatic C21-C35	mg/kg	DETS 072*				
Aromatic C5-C7	mg/kg	DETS 072*				
Aromatic C7-C8	mg/kg	DETS 072*				
Aromatic C8-C10	mg/kg	DETS 072*				
Aromatic C10-C12	mg/kg	DETS 072*				
Aromatic C12-C16	mg/kg	DETS 072*				
Aromatic C16-C21	mg/kg	DETS 072*				
Aromatic C21-C35	mg/kg	DETS 072*				
Aliphatic C5-C35	mg/kg	DETS 072*				
Aromatic C5-C35	mg/kg	DETS 072*				
TPH Ali/Aro	mg/kg	DETS 072*				

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

Test	Units	Lab No. / Sample Ref / Depth / Other Ref / Sample Type / DETSxx	116583	116584	116585	116586
		Sample Ref	WS01	WS02	WS02	WS03
		Depth	0.50	0.50	1.00	0.70
		Other Ref				
		Sample Type	D	J	D	D
Acenaphthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Acenapthylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(g,h,i)perylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Dibenzo(a,h)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Napthalene	mg/kg	DETS 050	0.3	0.3	0.3	0.3
Phenanthrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
PAH	mg/kg	DETS 050	< 5.0	< 5.0	< 5.0	< 5.0
Benzene	mg/kg	DETS 062#				
Ethylbenzene	mg/kg	DETS 062#				
Toluene	mg/kg	DETS 062#				
Xylene	mg/kg	DETS 062#				
Phenol - Monohydric	mg/kg	DETS 067#				
PCB	mg/kg	DETS 052*				
2,4,4'-Trichlorobiphenyl PCB 28	mg/kg	DETS 052*				
2,2',5,5'-Tetrachlorobiphenyl PCB 52	mg/kg	DETS 052*				
2,2',4,5,5'-Pentachlorobiphenyl PCB 101	mg/kg	DETS 052*				
2,3',4,4',5-Pentachlorobiphenyl PCB 118	mg/kg	DETS 052*				
2,2',4,4',5,5'-Hexachlorobiphenyl PCB 153	mg/kg	DETS 052*				
2,2',3,4,4',5'-Hexachlorobiphenyl PCB 138	mg/kg	DETS 052*				
2,2',3,4,4',5,5'-Heptachlorobiphenyl PCB 180	mg/kg	DETS 052*				
Total VOC's	mg/kg	DETS 068*				
1,2-dichloropropane	mg/kg	DETS 068*				
Dibromomethane	mg/kg	DETS 068*				
Bromodichloromethane	mg/kg	DETS 068*				
cis-1,3-dichloropropene	mg/kg	DETS 068*				
Toluene	mg/kg	DETS 068*				
trans-1,3-dichloropropene	mg/kg	DETS 068*				
1,1,2-trichloroethane	mg/kg	DETS 068*				
Tetrachloroethylene	mg/kg	DETS 068*				
1,3-dichloropropane	mg/kg	DETS 068*				
Dibromochloromethane	mg/kg	DETS 068*				
1,2-dibromoethane	mg/kg	DETS 068*				
Chlorobenzene	mg/kg	DETS 068*				
Ethylbenzene+1,1,1,2-tetrachloroethane	mg/kg	DETS 068*				
m+p-Xylene	mg/kg	DETS 068*				

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	116583	116584	116585	116586
		Sample Ref	WS01	WS02	WS02	WS03
		Depth	0.50	0.50	1.00	0.70
		Other Ref				
		Sample Type	D	J	D	D
Test	**Units**	**DETSxx**				
o-Xylene	mg/kg	DETS 068*				
Styrene	mg/kg	DETS 068*				
Bromoform	mg/kg	DETS 068*				
Isopropylbenzene	mg/kg	DETS 068*				
Bromobenzene	mg/kg	DETS 068*				
1,2,3-trichloropropane	mg/kg	DETS 068*				
n-propylbenzene	mg/kg	DETS 068*				
2-chlorotoluene	mg/kg	DETS 068*				
1,3,5-trimethylbenzene	mg/kg	DETS 068*				
4-chlorotoluene	mg/kg	DETS 068*				
Tert-butylbenzene	mg/kg	DETS 068*				
1,2,4-trimethylbenzene	mg/kg	DETS 068*				
sec-butylbenzene	mg/kg	DETS 068*				
1,3-dichlorobenzene+p-isopropyltoluene	mg/kg	DETS 068*				
1,4-dichlorobenzene	mg/kg	DETS 068*				
n-butylbenzene	mg/kg	DETS 068*				
1,2-dichlorobenzene	mg/kg	DETS 068*				
1,2-dibromo-3-chloropropane	mg/kg	DETS 068*				
1,2,4-trichlorobenzene	mg/kg	DETS 068*				
Hexachlorobutadiene	mg/kg	DETS 068*				
Naphthalene	mg/kg	DETS 068*				
1,2,3-trichlorobenzene	mg/kg	DETS 068*				
Trichloroethylene	mg/kg	DETS 068*				
Methylene Chloride	mg/kg	DETS 068*				
1,1 Dichloroethylene	mg/kg	DETS 068*				
1,2-dichloroethane	mg/kg	DETS 068*				
Benzene	mg/kg	DETS 068*				
Carbon tetrachloride + 1,1-dichloropropene	mg/kg	DETS 068*				
1,1,1-trichloroethane	mg/kg	DETS 068*				
Chloroform	mg/kg	DETS 068*				
Bromochloromethane	mg/kg	DETS 068*				
2,2-dichlororopane+1,2-dichloroethylene	mg/kg	DETS 068*				
1,1-dichloroethane	mg/kg	DETS 068*				
Trans-1,2-dichloroethylene	mg/kg	DETS 068*				

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

Test	Units	DETSxx	116587	116588	116589	116590
		Lab No.	116587	116588	116589	116590
		Sample Ref	WS04	WS04	WS05	WS05
		Depth	0.30	1.30	0.50	1.50
		Other Ref				
		Sample Type	J	J	J	D
Arsenic	mg/kg	DETS 042#	8	10	3	1
Cadmium	mg/kg	DETS 042	0.8	0.9	1.0	0.8
Chromium	mg/kg	DETS 042	24	37	27	32
Copper	mg/kg	DETS 042	9	23	10	7
Lead	mg/kg	DETS 042	16	16	11	4
Mercury	mg/kg	DETS 081*	< 0.3	< 0.3	< 0.3	< 0.3
Nickel	mg/kg	DETS 042	17	42	34	46
Selenium	mg/kg	DETS 042	< 0.3	< 0.3	< 0.3	< 0.3
Zinc	mg/kg	DETS 042#	43	64	55	64
Boron (water soluble)	mg/kg	DETS 020#	1.1	1.4	1.0	1.0
Cyanide free	mg/kg	DETS 067#	< 0.1	< 0.1	< 0.1	< 0.1
pH		DETS 008#	8.2	8.3	8.5	8.5
Aliphatic C5-C6	mg/kg	DETS 072*				
Aliphatic C6-C8	mg/kg	DETS 072*				
Aliphatic C8-C10	mg/kg	DETS 072*				
Aliphatic C10-C12	mg/kg	DETS 072*				
Aliphatic C12-C16	mg/kg	DETS 072*				
Aliphatic C16-C21	mg/kg	DETS 072*				
Aliphatic C21-C35	mg/kg	DETS 072*				
Aromatic C5-C7	mg/kg	DETS 072*				
Aromatic C7-C8	mg/kg	DETS 072*				
Aromatic C8-C10	mg/kg	DETS 072*				
Aromatic C10-C12	mg/kg	DETS 072*				
Aromatic C12-C16	mg/kg	DETS 072*				
Aromatic C16-C21	mg/kg	DETS 072*				
Aromatic C21-C35	mg/kg	DETS 072*				
Aliphatic C5-C35	mg/kg	DETS 072*				
Aromatic C5-C35	mg/kg	DETS 072*				
TPH Ali/Aro	mg/kg	DETS 072*				

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	116587	116588	116589	116590
		Sample Ref	WS04	WS04	WS05	WS05
		Depth	0.30	1.30	0.50	1.50
		Other Ref				
		Sample Type	J	J	J	D
Test	**Units**	**DETSxx**				
Acenaphthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Acenapthylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(g,h,i)perylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Dibenzo(a,h)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Napthalene	mg/kg	DETS 050	0.3	0.3	0.3	0.3
Phenanthrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
PAH	mg/kg	DETS 050	< 5.0	< 5.0	< 5.0	< 5.0
Benzene	mg/kg	DETS 062#				
Ethylbenzene	mg/kg	DETS 062#				
Toluene	mg/kg	DETS 062#				
Xylene	mg/kg	DETS 062#				
Phenol - Monohydric	mg/kg	DETS 067#				
PCB	mg/kg	DETS 052*				
2,4,4'-Trichlorobiphenyl PCB 28	mg/kg	DETS 052*				
2,2',5,5'-Tetrachlorobiphenyl PCB 52	mg/kg	DETS 052*				
2,2',4,5,5'-Pentachlorobiphenyl PCB 101	mg/kg	DETS 052*				
2,3',4,4',5-Pentachlorobiphenyl PCB 118	mg/kg	DETS 052*				
2,2',4,4',5,5'-Hexachlorobiphenyl PCB 153	mg/kg	DETS 052*				
2,2',3,4,4',5'-Hexachlorobiphenyl PCB 138	mg/kg	DETS 052*				
2,2',3,4,4',5,5'-Heptachlorobiphenyl PCB 180	mg/kg	DETS 052*				
Total VOC's	mg/kg	DETS 068*				
1,2-dichloropropane	mg/kg	DETS 068*				
Dibromomethane	mg/kg	DETS 068*				
Bromodichloromethane	mg/kg	DETS 068*				
cis-1,3-dichloropropene	mg/kg	DETS 068*				
Toluene	mg/kg	DETS 068*				
trans-1,3-dichloropropene	mg/kg	DETS 068*				
1,1,2-trichloroethane	mg/kg	DETS 068*				
Tetrachloroethylene	mg/kg	DETS 068*				
1,3-dichloropropane	mg/kg	DETS 068*				
Dibromochloromethane	mg/kg	DETS 068*				
1,2-dibromoethane	mg/kg	DETS 068*				
Chlorobenzene	mg/kg	DETS 068*				
Ethylbenzene+1,1,1,2-tetrachloroethane	mg/kg	DETS 068*				
m+p-Xylene	mg/kg	DETS 068*				

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	116587	116588	116589	116590
		Sample Ref	WS04	WS04	WS05	WS05
		Depth	0.30	1.30	0.50	1.50
		Other Ref				
		Sample Type	J	J	J	D
Test	**Units**	**DETSxx**				
o-Xylene	mg/kg	DETS 068*				
Styrene	mg/kg	DETS 068*				
Bromoform	mg/kg	DETS 068*				
Isopropylbenzene	mg/kg	DETS 068*				
Bromobenzene	mg/kg	DETS 068*				
1,2,3-trichloropropane	mg/kg	DETS 068*				
n-propylbenzene	mg/kg	DETS 068*				
2-chlorotoluene	mg/kg	DETS 068*				
1,3,5-trimethylbenzene	mg/kg	DETS 068*				
4-chlorotoluene	mg/kg	DETS 068*				
Tert-butylbenzene	mg/kg	DETS 068*				
1,2,4-trimethylbenzene	mg/kg	DETS 068*				
sec-butylbenzene	mg/kg	DETS 068*				
1,3-dichlorobenzene+p-isopropyltoluene	mg/kg	DETS 068*				
1,4-dichlorobenzene	mg/kg	DETS 068*				
n-butylbenzene	mg/kg	DETS 068*				
1,2-dichlorobenzene	mg/kg	DETS 068*				
1,2-dibromo-3-chloropropane	mg/kg	DETS 068*				
1,2,4-trichlorobenzene	mg/kg	DETS 068*				
Hexachlorobutadiene	mg/kg	DETS 068*				
Naphthalene	mg/kg	DETS 068*				
1,2,3-trichlorobenzene	mg/kg	DETS 068*				
Trichloroethylene	mg/kg	DETS 068*				
Methylene Chloride	mg/kg	DETS 068*				
1,1 Dichloroethylene	mg/kg	DETS 068*				
1,2-dichloroethane	mg/kg	DETS 068*				
Benzene	mg/kg	DETS 068*				
Carbon tetrachloride + 1,1-dichloropropene	mg/kg	DETS 068*				
1,1,1-trichloroethane	mg/kg	DETS 068*				
Chloroform	mg/kg	DETS 068*				
Bromochloromethane	mg/kg	DETS 068*				
2,2-dichlororopane+1,2-dichloroethylene	mg/kg	DETS 068*				
1,1-dichloroethane	mg/kg	DETS 068*				
Trans-1,2-dichloroethylene	mg/kg	DETS 068*				

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

Test	Units	DETSxx	116591	116592	116593	116594
		Lab No.	116591	116592	116593	116594
		Sample Ref	WS06	WS06	WS07	WS07
		Depth	0.70	1.50	0.50	1.50
		Other Ref				
		Sample Type	D	D	J	D
Arsenic	mg/kg	DETS 042#	8	7	8	5
Cadmium	mg/kg	DETS 042	0.7	0.6	0.6	0.5
Chromium	mg/kg	DETS 042	14	22	20	23
Copper	mg/kg	DETS 042	14	19	20	27
Lead	mg/kg	DETS 042	69	12	12	12
Mercury	mg/kg	DETS 081*	< 0.3	< 0.3	< 0.3	< 0.3
Nickel	mg/kg	DETS 042	14	27	15	35
Selenium	mg/kg	DETS 042	< 0.3	< 0.3	< 0.3	< 0.3
Zinc	mg/kg	DETS 042#	65	43	31	40
Boron (water soluble)	mg/kg	DETS 020#	0.8	0.6	0.7	0.8
Cyanide free	mg/kg	DETS 067#	< 0.1	< 0.1	< 0.1	< 0.1
pH		DETS 008#	8.4	8.3	8.1	8.2
Aliphatic C5-C6	mg/kg	DETS 072*				
Aliphatic C6-C8	mg/kg	DETS 072*				
Aliphatic C8-C10	mg/kg	DETS 072*				
Aliphatic C10-C12	mg/kg	DETS 072*				
Aliphatic C12-C16	mg/kg	DETS 072*				
Aliphatic C16-C21	mg/kg	DETS 072*				
Aliphatic C21-C35	mg/kg	DETS 072*				
Aromatic C5-C7	mg/kg	DETS 072*				
Aromatic C7-C8	mg/kg	DETS 072*				
Aromatic C8-C10	mg/kg	DETS 072*				
Aromatic C10-C12	mg/kg	DETS 072*				
Aromatic C12-C16	mg/kg	DETS 072*				
Aromatic C16-C21	mg/kg	DETS 072*				
Aromatic C21-C35	mg/kg	DETS 072*				
Aliphatic C5-C35	mg/kg	DETS 072*				
Aromatic C5-C35	mg/kg	DETS 072*				
TPH Ali/Aro	mg/kg	DETS 072*				

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	116591	116592	116593	116594
		Sample Ref	WS06	WS06	WS07	WS07
		Depth	0.70	1.50	0.50	1.50
		Other Ref				
		Sample Type	D	D	J	D
Test	**Units**	**DETSxx**				
Acenaphthene	mg/kg	DETS 050	0.1	< 0.1	< 0.1	< 0.1
Acenapthylene	mg/kg	DETS 050	0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	DETS 050	0.3	< 0.1	< 0.1	0.1
Benzo(a)anthracene	mg/kg	DETS 050	1.3	< 0.1	< 0.1	0.3
Benzo(a)pyrene	mg/kg	DETS 050	1.6	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	DETS 050	2.3	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	DETS 050	0.7	< 0.1	< 0.1	< 0.1
Benzo(g,h,i)perylene	mg/kg	DETS 050	1.3	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	DETS 050	1.3	< 0.1	< 0.1	0.2
Dibenzo(a,h)anthracene	mg/kg	DETS 050	0.7	< 0.1	0.4	< 0.1
Fluoranthene	mg/kg	DETS 050	2.5	< 0.1	< 0.1	0.3
Fluorene	mg/kg	DETS 050	0.2	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	1.6	< 0.1	< 0.1	< 0.1
Napthalene	mg/kg	DETS 050	0.4	0.3	0.3	0.3
Phenanthrene	mg/kg	DETS 050	1.0	< 0.1	< 0.1	0.1
Pyrene	mg/kg	DETS 050	2.1	< 0.1	< 0.1	0.3
PAH	mg/kg	DETS 050	18	< 5.0	< 5.0	< 5.0
Benzene	mg/kg	DETS 062#				
Ethylbenzene	mg/kg	DETS 062#				
Toluene	mg/kg	DETS 062#				
Xylene	mg/kg	DETS 062#				
Phenol - Monohydric	mg/kg	DETS 067#				
PCB	mg/kg	DETS 052*				
2,4,4'-Trichlorobiphenyl PCB 28	mg/kg	DETS 052*				
2,2',5,5'-Tetrachlorobiphenyl PCB 52	mg/kg	DETS 052*				
2,2',4,5,5'-Pentachlorobiphenyl PCB 101	mg/kg	DETS 052*				
2,3',4,4',5-Pentachlorobiphenyl PCB 118	mg/kg	DETS 052*				
2,2',4,4',5,5'-Hexachlorobiphenyl PCB 153	mg/kg	DETS 052*				
2,2',3,4,4',5'-Hexachlorobiphenyl PCB 138	mg/kg	DETS 052*				
2,2',3,4,4',5,5'-Heptachlorobiphenyl PCB 180	mg/kg	DETS 052*				
Total VOC's	mg/kg	DETS 068*				
1,2-dichloropropane	mg/kg	DETS 068*				
Dibromomethane	mg/kg	DETS 068*				
Bromodichloromethane	mg/kg	DETS 068*				
cis-1,3-dichloropropene	mg/kg	DETS 068*				
Toluene	mg/kg	DETS 068*				
trans-1,3-dichloropropene	mg/kg	DETS 068*				
1,1,2-trichloroethane	mg/kg	DETS 068*				
Tetrachloroethylene	mg/kg	DETS 068*				
1,3-dichloropropane	mg/kg	DETS 068*				
Dibromochloromethane	mg/kg	DETS 068*				
1,2-dibromoethane	mg/kg	DETS 068*				
Chlorobenzene	mg/kg	DETS 068*				
Ethylbenzene+1,1,1,2-tetrachloroethane	mg/kg	DETS 068*				
m+p-Xylene	mg/kg	DETS 068*				

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	116591	116592	116593	116594
		Sample Ref	WS06	WS06	WS07	WS07
		Depth	0.70	1.50	0.50	1.50
		Other Ref				
		Sample Type	D	D	J	D
Test	Units	DETSxx				
o-Xylene	mg/kg	DETS 068*				
Styrene	mg/kg	DETS 068*				
Bromoform	mg/kg	DETS 068*				
Isopropylbenzene	mg/kg	DETS 068*				
Bromobenzene	mg/kg	DETS 068*				
1,2,3-trichloropropane	mg/kg	DETS 068*				
n-propylbenzene	mg/kg	DETS 068*				
2-chlorotoluene	mg/kg	DETS 068*				
1,3,5-trimethylbenzene	mg/kg	DETS 068*				
4-chlorotoluene	mg/kg	DETS 068*				
Tert-butylbenzene	mg/kg	DETS 068*				
1,2,4-trimethylbenzene	mg/kg	DETS 068*				
sec-butylbenzene	mg/kg	DETS 068*				
1,3-dichlorobenzene+p-isopropyltoluene	mg/kg	DETS 068*				
1,4-dichlorobenzene	mg/kg	DETS 068*				
n-butylbenzene	mg/kg	DETS 068*				
1,2-dichlorobenzene	mg/kg	DETS 068*				
1,2-dibromo-3-chloropropane	mg/kg	DETS 068*				
1,2,4-trichlorobenzene	mg/kg	DETS 068*				
Hexachlorobutadiene	mg/kg	DETS 068*				
Naphthalene	mg/kg	DETS 068*				
1,2,3-trichlorobenzene	mg/kg	DETS 068*				
Trichloroethylene	mg/kg	DETS 068*				
Methylene Chloride	mg/kg	DETS 068*				
1,1 Dichloroethylene	mg/kg	DETS 068*				
1,2-dichloroethane	mg/kg	DETS 068*				
Benzene	mg/kg	DETS 068*				
Carbon tetrachloride + 1,1-dichloropropene	mg/kg	DETS 068*				
1,1,1-trichloroethane	mg/kg	DETS 068*				
Chloroform	mg/kg	DETS 068*				
Bromochloromethane	mg/kg	DETS 068*				
2,2-dichlororopane+1,2-dichloroethylene	mg/kg	DETS 068*				
1,1-dichloroethane	mg/kg	DETS 068*				
Trans-1,2-dichloroethylene	mg/kg	DETS 068*				

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	116595	116596	116597	116598
		Sample Ref	WS08	WS09	WS09	WS10
		Depth	0.70	0.50	1.00	1.50
		Other Ref				
		Sample Type	J	J	D	D
Test	**Units**	**DETSxx**				
Arsenic	mg/kg	DETS 042#	4	7	8	7
Cadmium	mg/kg	DETS 042	0.4	0.7	0.6	0.7
Chromium	mg/kg	DETS 042	12	26	19	24
Copper	mg/kg	DETS 042	11	19	13	18
Lead	mg/kg	DETS 042	20	21	29	18
Mercury	mg/kg	DETS 081*	< 0.3	< 0.3	< 0.3	< 0.3
Nickel	mg/kg	DETS 042	13	28	14	26
Selenium	mg/kg	DETS 042	< 0.3	< 0.3	< 0.3	< 0.3
Zinc	mg/kg	DETS 042#	27	52	40	51
Boron (water soluble)	mg/kg	DETS 020#	0.6	1.7	1.0	1.9
Cyanide free	mg/kg	DETS 067#	< 0.1	< 0.1	< 0.1	< 0.1
pH		DETS 008#	8.0	8.4	8.0	8.3
Aliphatic C5-C6	mg/kg	DETS 072*				< 0.01
Aliphatic C6-C8	mg/kg	DETS 072*				< 0.01
Aliphatic C8-C10	mg/kg	DETS 072*				< 0.01
Aliphatic C10-C12	mg/kg	DETS 072*				< 0.1
Aliphatic C12-C16	mg/kg	DETS 072*				< 0.1
Aliphatic C16-C21	mg/kg	DETS 072*				< 0.1
Aliphatic C21-C35	mg/kg	DETS 072*				< 0.1
Aromatic C5-C7	mg/kg	DETS 072*				< 0.01
Aromatic C7-C8	mg/kg	DETS 072*				< 0.01
Aromatic C8-C10	mg/kg	DETS 072*				< 0.01
Aromatic C10-C12	mg/kg	DETS 072*				< 0.1
Aromatic C12-C16	mg/kg	DETS 072*				< 0.1
Aromatic C16-C21	mg/kg	DETS 072*				< 0.1
Aromatic C21-C35	mg/kg	DETS 072*				< 0.1
Aliphatic C5-C35	mg/kg	DETS 072*				< 0.1
Aromatic C5-C35	mg/kg	DETS 072*				< 0.1
TPH Ali/Aro	mg/kg	DETS 072*				< 0.1

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	116595	116596	116597	116598
		Sample Ref	WS08	WS09	WS09	WS10
		Depth	0.70	0.50	1.00	1.50
		Other Ref				
		Sample Type	J	J	D	D
Test	**Units**	**DETSxx**				
Acenaphthene	mg/kg	DETS 050	< 0.1	< 0.1	0.4	0.9
Acenapthylene	mg/kg	DETS 050	< 0.1	< 0.1	0.2	0.4
Anthracene	mg/kg	DETS 050	0.2	< 0.1	0.6	1.2
Benzo(a)anthracene	mg/kg	DETS 050	1.3	< 0.1	2.3	2.0
Benzo(a)pyrene	mg/kg	DETS 050	0.1	< 0.1	2.7	1.7
Benzo(b)fluoranthene	mg/kg	DETS 050	0.2	< 0.1	2.7	3.3
Benzo(k)fluoranthene	mg/kg	DETS 050	0.3	< 0.1	2.1	1.0
Benzo(g,h,i)perylene	mg/kg	DETS 050	0.3	< 0.1	1.7	1.3
Chrysene	mg/kg	DETS 050	1.2	< 0.1	1.6	1.5
Dibenzo(a,h)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	7.3	4.4
Fluoranthene	mg/kg	DETS 050	0.4	< 0.1	2.5	3.0
Fluorene	mg/kg	DETS 050	0.1	< 0.1	0.5	0.9
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	2.5	1.7
Napthalene	mg/kg	DETS 050	0.3	0.3	0.4	0.7
Phenanthrene	mg/kg	DETS 050	0.2	< 0.1	2.0	2.7
Pyrene	mg/kg	DETS 050	0.5	< 0.1	2.0	2.4
PAH	mg/kg	DETS 050	5.1	< 5.0	31	29
Benzene	mg/kg	DETS 062#				< 0.01
Ethylbenzene	mg/kg	DETS 062#				< 0.01
Toluene	mg/kg	DETS 062#				< 0.01
Xylene	mg/kg	DETS 062#				< 0.01
Phenol - Monohydric	mg/kg	DETS 067#				
PCB	mg/kg	DETS 052*				< 0.01
2,4,4'-Trichlorobiphenyl PCB 28	mg/kg	DETS 052*				< 0.01
2,2',5,5'-Tetrachlorobiphenyl PCB 52	mg/kg	DETS 052*				< 0.01
2,2',4,5,5'-Pentachlorobiphenyl PCB 101	mg/kg	DETS 052*				< 0.01
2,3',4,4',5-Pentachlorobiphenyl PCB 118	mg/kg	DETS 052*				< 0.01
2,2',4,4',5,5'-Hexachlorobiphenyl PCB 153	mg/kg	DETS 052*				< 0.01
2,2',3,4,4',5'-Hexachlorobiphenyl PCB 138	mg/kg	DETS 052*				< 0.01
2,2',3,4,4',5,5'-Heptachlorobiphenyl PCB 180	mg/kg	DETS 052*				< 0.01
Total VOC's	mg/kg	DETS 068*				< 0.01
1,2-dichloropropane	mg/kg	DETS 068*				< 0.01
Dibromomethane	mg/kg	DETS 068*				< 0.01
Bromodichloromethane	mg/kg	DETS 068*				< 0.01
cis-1,3-dichloropropene	mg/kg	DETS 068*				< 0.01
Toluene	mg/kg	DETS 068*				< 0.01
trans-1,3-dichloropropene	mg/kg	DETS 068*				< 0.01
1,1,2-trichloroethane	mg/kg	DETS 068*				< 0.01
Tetrachloroethylene	mg/kg	DETS 068*				< 0.01
1,3-dichloropropane	mg/kg	DETS 068*				< 0.01
Dibromochloromethane	mg/kg	DETS 068*				< 0.01
1,2-dibromoethane	mg/kg	DETS 068*				< 0.01
Chlorobenzene	mg/kg	DETS 068*				< 0.01
Ethylbenzene+1,1,1,2-tetrachloroethane	mg/kg	DETS 068*				< 0.01
m+p-Xylene	mg/kg	DETS 068*				< 0.01

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	116595	116596	116597	116598
		Sample Ref	WS08	WS09	WS09	WS10
		Depth	0.70	0.50	1.00	1.50
		Other Ref				
		Sample Type	J	J	D	D
Test	**Units**	**DETSxx**				
o-Xylene	mg/kg	DETS 068*				< 0.01
Styrene	mg/kg	DETS 068*				< 0.01
Bromoform	mg/kg	DETS 068*				< 0.01
Isopropylbenzene	mg/kg	DETS 068*				< 0.01
Bromobenzene	mg/kg	DETS 068*				< 0.01
1,2,3-trichloropropane	mg/kg	DETS 068*				< 0.01
n-propylbenzene	mg/kg	DETS 068*				< 0.01
2-chlorotoluene	mg/kg	DETS 068*				< 0.01
1,3,5-trimethylbenzene	mg/kg	DETS 068*				< 0.01
4-chlorotoluene	mg/kg	DETS 068*				< 0.01
Tert-butylbenzene	mg/kg	DETS 068*				< 0.01
1,2,4-trimethylbenzene	mg/kg	DETS 068*				< 0.01
sec-butylbenzene	mg/kg	DETS 068*				< 0.01
1,3-dichlorobenzene+p-isopropyltoluene	mg/kg	DETS 068*				< 0.01
1,4-dichlorobenzene	mg/kg	DETS 068*				< 0.01
n-butylbenzene	mg/kg	DETS 068*				< 0.01
1,2-dichlorobenzene	mg/kg	DETS 068*				< 0.01
1,2-dibromo-3-chloropropane	mg/kg	DETS 068*				< 0.01
1,2,4-trichlorobenzene	mg/kg	DETS 068*				< 0.01
Hexachlorobutadiene	mg/kg	DETS 068*				< 0.01
Naphthalene	mg/kg	DETS 068*				< 0.01
1,2,3-trichlorobenzene	mg/kg	DETS 068*				< 0.01
Trichloroethylene	mg/kg	DETS 068*				< 0.01
Methylene Chloride	mg/kg	DETS 068*				< 0.01
1,1 Dichloroethylene	mg/kg	DETS 068*				< 0.01
1,2-dichloroethane	mg/kg	DETS 068*				< 0.01
Benzene	mg/kg	DETS 068*				< 0.01
Carbon tetrachloride + 1,1-dichloropropene	mg/kg	DETS 068*				< 0.01
1,1,1-trichloroethane	mg/kg	DETS 068*				< 0.01
Chloroform	mg/kg	DETS 068*				< 0.01
Bromochloromethane	mg/kg	DETS 068*				< 0.01
2,2-dichlororopane+1,2-dichloroethylene	mg/kg	DETS 068*				< 0.01
1,1-dichloroethane	mg/kg	DETS 068*				< 0.01
Trans-1,2-dichloroethylene	mg/kg	DETS 068*				< 0.01

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	116599	116600	116601	116602
		Sample Ref	WS10	WS11	WS11	WS12
		Depth	2.70	0.50	1.50	0.50
		Other Ref				
		Sample Type	D	D	D	J
Test	**Units**	**DETSxx**				
Arsenic	mg/kg	DETS 042#	7	8	5	8
Cadmium	mg/kg	DETS 042	0.6	0.7	0.5	0.7
Chromium	mg/kg	DETS 042	21	22	17	16
Copper	mg/kg	DETS 042	20	29	14	24
Lead	mg/kg	DETS 042	17	24	19	31
Mercury	mg/kg	DETS 081*	< 0.3	< 0.3	< 0.3	< 0.3
Nickel	mg/kg	DETS 042	20	26	19	20
Selenium	mg/kg	DETS 042	< 0.3	< 0.3	< 0.3	0.4
Zinc	mg/kg	DETS 042#	36	38	34	39
Boron (water soluble)	mg/kg	DETS 020#	0.8	1.1	1.1	1.0
Cyanide free	mg/kg	DETS 067#	< 0.1	< 0.1		
pH		DETS 008#	8.3	7.9		
Aliphatic C5-C6	mg/kg	DETS 072*		< 0.01		
Aliphatic C6-C8	mg/kg	DETS 072*		< 0.01		
Aliphatic C8-C10	mg/kg	DETS 072*		< 0.01		
Aliphatic C10-C12	mg/kg	DETS 072*		< 0.1		
Aliphatic C12-C16	mg/kg	DETS 072*		< 0.1		
Aliphatic C16-C21	mg/kg	DETS 072*		< 0.1		
Aliphatic C21-C35	mg/kg	DETS 072*		< 0.1		
Aromatic C5-C7	mg/kg	DETS 072*		< 0.01		
Aromatic C7-C8	mg/kg	DETS 072*		< 0.01		
Aromatic C8-C10	mg/kg	DETS 072*		< 0.01		
Aromatic C10-C12	mg/kg	DETS 072*		< 0.1		
Aromatic C12-C16	mg/kg	DETS 072*		< 0.1		
Aromatic C16-C21	mg/kg	DETS 072*		< 0.1		
Aromatic C21-C35	mg/kg	DETS 072*		< 0.1		
Aliphatic C5-C35	mg/kg	DETS 072*		< 0.1		
Aromatic C5-C35	mg/kg	DETS 072*		< 0.1		
TPH Ali/Aro	mg/kg	DETS 072*		< 0.1		

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

Test	Units	Lab No. / Sample Ref / Depth / Other Ref / Sample Type / DETSxx	116599	116600	116601	116602
		Sample Ref	WS10	WS11	WS11	WS12
		Depth	2.70	0.50	1.50	0.50
		Other Ref				
		Sample Type	D	D	D	J
Acenaphthene	mg/kg	DETS 050	0.1	< 0.1	0.3	0.2
Acenapthylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	DETS 050	0.4	0.7	0.5	0.5
Benzo(a)pyrene	mg/kg	DETS 050	0.7	1.2	0.9	1.2
Benzo(b)fluoranthene	mg/kg	DETS 050	0.6	0.9	< 0.1	1.3
Benzo(k)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(g,h,i)perylene	mg/kg	DETS 050	0.2	0.4	0.3	0.5
Chrysene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Dibenzo(a,h)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	0.2	0.7	1.0	0.8
Napthalene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
PAH	mg/kg	DETS 050	< 5.0	< 5.0	< 5.0	< 5.0
Benzene	mg/kg	DETS 062#		< 0.01		
Ethylbenzene	mg/kg	DETS 062#		< 0.01		
Toluene	mg/kg	DETS 062#		< 0.01		
Xylene	mg/kg	DETS 062#		< 0.01		
Phenol - Monohydric	mg/kg	DETS 067#			< 0.3	< 0.3
PCB	mg/kg	DETS 052*		< 0.01		
2,4,4'-Trichlorobiphenyl PCB 28	mg/kg	DETS 052*		< 0.01		
2,2',5,5'-Tetrachlorobiphenyl PCB 52	mg/kg	DETS 052*		< 0.01		
2,2',4,5,5'-Pentachlorobiphenyl PCB 101	mg/kg	DETS 052*		< 0.01		
2,3',4,4',5-Pentachlorobiphenyl PCB 118	mg/kg	DETS 052*		< 0.01		
2,2',4,4',5,5'-Hexachlorobiphenyl PCB 153	mg/kg	DETS 052*		< 0.01		
2,2',3,4,4',5'-Hexachlorobiphenyl PCB 138	mg/kg	DETS 052*		< 0.01		
2,2',3,4,4',5,5'-Heptachlorobiphenyl PCB 180	mg/kg	DETS 052*		< 0.01		
Total VOC's	mg/kg	DETS 068*		< 0.01		
1,2-dichloropropane	mg/kg	DETS 068*		< 0.01		
Dibromomethane	mg/kg	DETS 068*		< 0.01		
Bromodichloromethane	mg/kg	DETS 068*		< 0.01		
cis-1,3-dichloropropene	mg/kg	DETS 068*		< 0.01		
Toluene	mg/kg	DETS 068*		< 0.01		
trans-1,3-dichloropropene	mg/kg	DETS 068*		< 0.01		
1,1,2-trichloroethane	mg/kg	DETS 068*		< 0.01		
Tetrachloroethylene	mg/kg	DETS 068*		< 0.01		
1,3-dichloropropane	mg/kg	DETS 068*		< 0.01		
Dibromochloromethane	mg/kg	DETS 068*		< 0.01		
1,2-dibromoethane	mg/kg	DETS 068*		< 0.01		
Chlorobenzene	mg/kg	DETS 068*		< 0.01		
Ethylbenzene+1,1,1,2-tetrachloroethane	mg/kg	DETS 068*		< 0.01		
m+p-Xylene	mg/kg	DETS 068*		< 0.01		

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	116599	116600	116601	116602
		Sample Ref	WS10	WS11	WS11	WS12
		Depth	2.70	0.50	1.50	0.50
		Other Ref				
		Sample Type	D	D	D	J
Test	**Units**	**DETSxx**				
o-Xylene	mg/kg	DETS 068*		< 0.01		
Styrene	mg/kg	DETS 068*		< 0.01		
Bromoform	mg/kg	DETS 068*		< 0.01		
Isopropylbenzene	mg/kg	DETS 068*		< 0.01		
Bromobenzene	mg/kg	DETS 068*		< 0.01		
1,2,3-trichloropropane	mg/kg	DETS 068*		< 0.01		
n-propylbenzene	mg/kg	DETS 068*		< 0.01		
2-chlorotoluene	mg/kg	DETS 068*		< 0.01		
1,3,5-trimethylbenzene	mg/kg	DETS 068*		< 0.01		
4-chlorotoluene	mg/kg	DETS 068*		< 0.01		
Tert-butylbenzene	mg/kg	DETS 068*		< 0.01		
1,2,4-trimethylbenzene	mg/kg	DETS 068*		< 0.01		
sec-butylbenzene	mg/kg	DETS 068*		< 0.01		
1,3-dichlorobenzene+p-isopropyltoluene	mg/kg	DETS 068*		< 0.01		
1,4-dichlorobenzene	mg/kg	DETS 068*		< 0.01		
n-butylbenzene	mg/kg	DETS 068*		< 0.01		
1,2-dichlorobenzene	mg/kg	DETS 068*		< 0.01		
1,2-dibromo-3-chloropropane	mg/kg	DETS 068*		< 0.01		
1,2,4-trichlorobenzene	mg/kg	DETS 068*		< 0.01		
Hexachlorobutadiene	mg/kg	DETS 068*		< 0.01		
Naphthalene	mg/kg	DETS 068*		< 0.01		
1,2,3-trichlorobenzene	mg/kg	DETS 068*		< 0.01		
Trichloroethylene	mg/kg	DETS 068*		< 0.01		
Methylene Chloride	mg/kg	DETS 068*		< 0.01		
1,1 Dichloroethylene	mg/kg	DETS 068*		< 0.01		
1,2-dichloroethane	mg/kg	DETS 068*		< 0.01		
Benzene	mg/kg	DETS 068*		< 0.01		
Carbon tetrachloride + 1,1-dichloropropene	mg/kg	DETS 068*		< 0.01		
1,1,1-trichloroethane	mg/kg	DETS 068*		< 0.01		
Chloroform	mg/kg	DETS 068*		< 0.01		
Bromochloromethane	mg/kg	DETS 068*		< 0.01		
2,2-dichlororopane+1,2-dichloroethylene	mg/kg	DETS 068*		< 0.01		
1,1-dichloroethane	mg/kg	DETS 068*		< 0.01		
Trans-1,2-dichloroethylene	mg/kg	DETS 068*		< 0.01		

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	116603	116604	116605	116606
		Sample Ref	WS12	WS13	WS15	WS15
		Depth	1.00	0.50	0.50	2.00
		Other Ref				
		Sample Type	D	D	D	D
Test	**Units**	**DETSxx**				
Arsenic	mg/kg	DETS 042#	7	5	6	4
Cadmium	mg/kg	DETS 042	0.6	0.5	0.7	0.5
Chromium	mg/kg	DETS 042	15	17	17	15
Copper	mg/kg	DETS 042	19	19	20	10
Lead	mg/kg	DETS 042	25	15	28	16
Mercury	mg/kg	DETS 081*	< 0.3	< 0.3	< 0.3	< 0.3
Nickel	mg/kg	DETS 042	19	21	21	15
Selenium	mg/kg	DETS 042	< 0.3	< 0.3	< 0.3	< 0.3
Zinc	mg/kg	DETS 042#	42	35	43	31
Boron (water soluble)	mg/kg	DETS 020#	0.8	1.1	1.0	1.3
Cyanide free	mg/kg	DETS 067#				
pH		DETS 008#				
Aliphatic C5-C6	mg/kg	DETS 072*	< 0.01	< 0.01	< 0.01	
Aliphatic C6-C8	mg/kg	DETS 072*	< 0.01	< 0.01	< 0.01	
Aliphatic C8-C10	mg/kg	DETS 072*	< 0.01	< 0.01	< 0.01	
Aliphatic C10-C12	mg/kg	DETS 072*	< 0.1	< 0.1	< 0.1	
Aliphatic C12-C16	mg/kg	DETS 072*	< 0.1	< 0.1	< 0.1	
Aliphatic C16-C21	mg/kg	DETS 072*	< 0.1	< 0.1	< 0.1	
Aliphatic C21-C35	mg/kg	DETS 072*	< 0.1	< 0.1	< 0.1	
Aromatic C5-C7	mg/kg	DETS 072*	< 0.01	< 0.01	< 0.01	
Aromatic C7-C8	mg/kg	DETS 072*	< 0.01	< 0.01	< 0.01	
Aromatic C8-C10	mg/kg	DETS 072*	< 0.01	< 0.01	< 0.01	
Aromatic C10-C12	mg/kg	DETS 072*	< 0.1	< 0.1	< 0.1	
Aromatic C12-C16	mg/kg	DETS 072*	< 0.1	< 0.1	< 0.1	
Aromatic C16-C21	mg/kg	DETS 072*	< 0.1	< 0.1	< 0.1	
Aromatic C21-C35	mg/kg	DETS 072*	< 0.1	< 0.1	< 0.1	
Aliphatic C5-C35	mg/kg	DETS 072*	< 0.1	< 0.1	< 0.1	
Aromatic C5-C35	mg/kg	DETS 072*	< 0.1	< 0.1	< 0.1	
TPH Ali/Aro	mg/kg	DETS 072*	< 0.1	< 0.1	< 0.1	

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	116603	116604	116605	116606
		Sample Ref	WS12	WS13	WS15	WS15
		Depth	1.00	0.50	0.50	2.00
		Other Ref				
		Sample Type	D	D	D	D
Test	**Units**	**DETSxx**				
Acenaphthene	mg/kg	DETS 050	< 0.1	< 0.1	0.2	< 0.1
Acenapthylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	DETS 050	0.4	0.7	0.6	0.8
Benzo(a)pyrene	mg/kg	DETS 050	1.1	1.1	1.3	2.1
Benzo(b)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	1.1	< 0.1
Benzo(k)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(g,h,i)perylene	mg/kg	DETS 050	0.2	0.3	0.4	0.7
Chrysene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Dibenzo(a,h)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	0.6	0.5	0.9	1.3
Napthalene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
PAH	mg/kg	DETS 050	< 5.0	< 5.0	< 5.0	5.0
Benzene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	
Ethylbenzene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	
Toluene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	
Xylene	mg/kg	DETS 062#	< 0.01	< 0.01	< 0.01	
Phenol - Monohydric	mg/kg	DETS 067#	< 0.3	< 0.3	< 0.3	< 0.3
PCB	mg/kg	DETS 052*	< 0.01	< 0.01	< 0.01	
2,4,4'-Trichlorobiphenyl PCB 28	mg/kg	DETS 052*	< 0.01	< 0.01	< 0.01	
2,2',5,5'-Tetrachlorobiphenyl PCB 52	mg/kg	DETS 052*	< 0.01	< 0.01	< 0.01	
2,2',4,5,5'-Pentachlorobiphenyl PCB 101	mg/kg	DETS 052*	< 0.01	< 0.01	< 0.01	
2,3',4,4',5-Pentachlorobiphenyl PCB 118	mg/kg	DETS 052*	< 0.01	< 0.01	< 0.01	
2,2',4,4',5,5'-Hexachlorobiphenyl PCB 153	mg/kg	DETS 052*	< 0.01	< 0.01	< 0.01	
2,2',3,4,4',5'-Hexachlorobiphenyl PCB 138	mg/kg	DETS 052*	< 0.01	< 0.01	< 0.01	
2,2',3,4,4',5,5'-Heptachlorobiphenyl PCB 180	mg/kg	DETS 052*	< 0.01	< 0.01	< 0.01	
Total VOC's	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
1,2-dichloropropane	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Dibromomethane	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Bromodichloromethane	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
cis-1,3-dichloropropene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Toluene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
trans-1,3-dichloropropene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
1,1,2-trichloroethane	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Tetrachloroethylene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
1,3-dichloropropane	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Dibromochloromethane	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
1,2-dibromoethane	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Chlorobenzene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Ethylbenzene+1,1,1,2-tetrachloroethane	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
m+p-Xylene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	116603	116604	116605	116606
		Sample Ref	WS12	WS13	WS15	WS15
		Depth	1.00	0.50	0.50	2.00
		Other Ref				
		Sample Type	D	D	D	D
Test	**Units**	**DETSxx**				
o-Xylene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Styrene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Bromoform	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Isopropylbenzene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Bromobenzene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
1,2,3-trichloropropane	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
n-propylbenzene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
2-chlorotoluene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
1,3,5-trimethylbenzene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
4-chlorotoluene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Tert-butylbenzene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
1,2,4-trimethylbenzene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
sec-butylbenzene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
1,3-dichlorobenzene+p-isopropyltoluene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
1,4-dichlorobenzene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
n-butylbenzene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
1,2-dichlorobenzene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
1,2-dibromo-3-chloropropane	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
1,2,4-trichlorobenzene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Hexachlorobutadiene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Naphthalene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
1,2,3-trichlorobenzene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Trichloroethylene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Methylene Chloride	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
1,1 Dichloroethylene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
1,2-dichloroethane	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Benzene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Carbon tetrachloride + 1,1-dichloropropene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
1,1,1-trichloroethane	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Chloroform	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Bromochloromethane	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
2,2-dichlororopane+1,2-dichloroethylene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
1,1-dichloroethane	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	
Trans-1,2-dichloroethylene	mg/kg	DETS 068*	< 0.01	< 0.01	< 0.01	

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	116607	116608	116609	116610
		Sample Ref	WS16	WS17	WS17	TP5
		Depth	0.30	1.00	1.30	1.50
		Other Ref				
		Sample Type	J	D	D	J
Test	**Units**	**DETSxx**				
Arsenic	mg/kg	DETS 042#	9	7	6	
Cadmium	mg/kg	DETS 042	0.9	0.7	0.7	
Chromium	mg/kg	DETS 042	22	19	18	
Copper	mg/kg	DETS 042	32	18	20	
Lead	mg/kg	DETS 042	12	17	19	
Mercury	mg/kg	DETS 081*	< 0.3	< 0.3	< 0.3	
Nickel	mg/kg	DETS 042	38	23	25	
Selenium	mg/kg	DETS 042	< 0.3	< 0.3	< 0.3	
Zinc	mg/kg	DETS 042#	61	43	46	
Boron (water soluble)	mg/kg	DETS 020#	0.7	0.8	0.8	
Cyanide free	mg/kg	DETS 067#				
pH		DETS 008#				
Aliphatic C5-C6	mg/kg	DETS 072*	< 0.01			< 0.01
Aliphatic C6-C8	mg/kg	DETS 072*	< 0.01			< 0.01
Aliphatic C8-C10	mg/kg	DETS 072*	< 0.01			< 0.01
Aliphatic C10-C12	mg/kg	DETS 072*	< 0.1			< 0.1
Aliphatic C12-C16	mg/kg	DETS 072*	< 0.1			< 0.1
Aliphatic C16-C21	mg/kg	DETS 072*	< 0.1			< 0.1
Aliphatic C21-C35	mg/kg	DETS 072*	< 0.1			< 0.1
Aromatic C5-C7	mg/kg	DETS 072*	< 0.01			< 0.01
Aromatic C7-C8	mg/kg	DETS 072*	< 0.01			< 0.01
Aromatic C8-C10	mg/kg	DETS 072*	< 0.01			< 0.01
Aromatic C10-C12	mg/kg	DETS 072*	< 0.1			< 0.1
Aromatic C12-C16	mg/kg	DETS 072*	< 0.1			< 0.1
Aromatic C16-C21	mg/kg	DETS 072*	< 0.1			< 0.1
Aromatic C21-C35	mg/kg	DETS 072*	< 0.1			< 0.1
Aliphatic C5-C35	mg/kg	DETS 072*	< 0.1			< 0.1
Aromatic C5-C35	mg/kg	DETS 072*	< 0.1			< 0.1
TPH Ali/Aro	mg/kg	DETS 072*	< 0.1			< 0.1

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

Test	Units	DETSxx	116607	116608	116609	116610
		Sample Ref	WS16	WS17	WS17	TP5
		Depth	0.30	1.00	1.30	1.50
		Other Ref				
		Sample Type	J	D	D	J
Acenaphthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	
Acenapthylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	
Anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	
Benzo(a)anthracene	mg/kg	DETS 050	0.7	0.7	0.4	
Benzo(a)pyrene	mg/kg	DETS 050	1.6	1.6	1.2	
Benzo(b)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	
Benzo(k)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	
Benzo(g,h,i)perylene	mg/kg	DETS 050	0.6	0.6	0.3	
Chrysene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	
Dibenzo(a,h)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	
Fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	
Fluorene	mg/kg	DETS 050	0.1	< 0.1	< 0.1	
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	0.8	0.9	0.6	
Napthalene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	
Phenanthrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	
Pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	
PAH	mg/kg	DETS 050	< 5.0	< 5.0	< 5.0	
Benzene	mg/kg	DETS 062#	< 0.01			< 0.01
Ethylbenzene	mg/kg	DETS 062#	< 0.01			< 0.01
Toluene	mg/kg	DETS 062#	< 0.01			< 0.01
Xylene	mg/kg	DETS 062#	< 0.01			< 0.01
Phenol - Monohydric	mg/kg	DETS 067#	< 0.3	< 0.3	< 0.3	
PCB	mg/kg	DETS 052*	< 0.01			< 0.01
2,4,4'-Trichlorobiphenyl PCB 28	mg/kg	DETS 052*	< 0.01			< 0.01
2,2',5,5'-Tetrachlorobiphenyl PCB 52	mg/kg	DETS 052*	< 0.01			< 0.01
2,2',4,5,5'-Pentachlorobiphenyl PCB 101	mg/kg	DETS 052*	< 0.01			< 0.01
2,3',4,4',5-Pentachlorobiphenyl PCB 118	mg/kg	DETS 052*	< 0.01			< 0.01
2,2',4,4',5,5'-Hexachlorobiphenyl PCB 153	mg/kg	DETS 052*	< 0.01			< 0.01
2,2',3,4,4',5'-Hexachlorobiphenyl PCB 138	mg/kg	DETS 052*	< 0.01			< 0.01
2,2',3,4,4',5,5'-Heptachlorobiphenyl PCB 180	mg/kg	DETS 052*	< 0.01			< 0.01
Total VOC's	mg/kg	DETS 068*	< 0.01			< 0.01
1,2-dichloropropane	mg/kg	DETS 068*	< 0.01			< 0.01
Dibromomethane	mg/kg	DETS 068*	< 0.01			< 0.01
Bromodichloromethane	mg/kg	DETS 068*	< 0.01			< 0.01
cis-1,3-dichloropropene	mg/kg	DETS 068*	< 0.01			< 0.01
Toluene	mg/kg	DETS 068*	< 0.01			< 0.01
trans-1,3-dichloropropene	mg/kg	DETS 068*	< 0.01			< 0.01
1,1,2-trichloroethane	mg/kg	DETS 068*	< 0.01			< 0.01
Tetrachloroethylene	mg/kg	DETS 068*	< 0.01			< 0.01
1,3-dichloropropane	mg/kg	DETS 068*	< 0.01			< 0.01
Dibromochloromethane	mg/kg	DETS 068*	< 0.01			< 0.01
1,2-dibromoethane	mg/kg	DETS 068*	< 0.01			< 0.01
Chlorobenzene	mg/kg	DETS 068*	< 0.01			< 0.01
Ethylbenzene+1,1,1,2-tetrachloroethane	mg/kg	DETS 068*	< 0.01			< 0.01
m+p-Xylene	mg/kg	DETS 068*	< 0.01			< 0.01

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17171
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	116607	116608	116609	116610
		Sample Ref	WS16	WS17	WS17	TP5
		Depth	0.30	1.00	1.30	1.50
		Other Ref				
		Sample Type	J	D	D	J
Test	**Units**	**DETSxx**				
o-Xylene	mg/kg	DETS 068*	< 0.01			< 0.01
Styrene	mg/kg	DETS 068*	< 0.01			< 0.01
Bromoform	mg/kg	DETS 068*	< 0.01			< 0.01
Isopropylbenzene	mg/kg	DETS 068*	< 0.01			< 0.01
Bromobenzene	mg/kg	DETS 068*	< 0.01			< 0.01
1,2,3-trichloropropane	mg/kg	DETS 068*	< 0.01			< 0.01
n-propylbenzene	mg/kg	DETS 068*	< 0.01			< 0.01
2-chlorotoluene	mg/kg	DETS 068*	< 0.01			< 0.01
1,3,5-trimethylbenzene	mg/kg	DETS 068*	< 0.01			< 0.01
4-chlorotoluene	mg/kg	DETS 068*	< 0.01			< 0.01
Tert-butylbenzene	mg/kg	DETS 068*	< 0.01			< 0.01
1,2,4-trimethylbenzene	mg/kg	DETS 068*	< 0.01			< 0.01
sec-butylbenzene	mg/kg	DETS 068*	< 0.01			< 0.01
1,3-dichlorobenzene+p-isopropyltoluene	mg/kg	DETS 068*	< 0.01			< 0.01
1,4-dichlorobenzene	mg/kg	DETS 068*	< 0.01			< 0.01
n-butylbenzene	mg/kg	DETS 068*	< 0.01			< 0.01
1,2-dichlorobenzene	mg/kg	DETS 068*	< 0.01			< 0.01
1,2-dibromo-3-chloropropane	mg/kg	DETS 068*	< 0.01			< 0.01
1,2,4-trichlorobenzene	mg/kg	DETS 068*	< 0.01			< 0.01
Hexachlorobutadiene	mg/kg	DETS 068*	< 0.01			< 0.01
Naphthalene	mg/kg	DETS 068*	< 0.01			< 0.01
1,2,3-trichlorobenzene	mg/kg	DETS 068*	< 0.01			< 0.01
Trichloroethylene	mg/kg	DETS 068*	< 0.01			< 0.01
Methylene Chloride	mg/kg	DETS 068*	< 0.01			< 0.01
1,1 Dichloroethylene	mg/kg	DETS 068*	< 0.01			< 0.01
1,2-dichloroethane	mg/kg	DETS 068*	< 0.01			< 0.01
Benzene	mg/kg	DETS 068*	< 0.01			< 0.01
Carbon tetrachloride + 1,1-dichloropropene	mg/kg	DETS 068*	< 0.01			< 0.01
1,1,1-trichloroethane	mg/kg	DETS 068*	< 0.01			< 0.01
Chloroform	mg/kg	DETS 068*	< 0.01			< 0.01
Bromochloromethane	mg/kg	DETS 068*	< 0.01			< 0.01
2,2-dichlororopane+1,2-dichloroethylene	mg/kg	DETS 068*	< 0.01			< 0.01
1,1-dichloroethane	mg/kg	DETS 068*	< 0.01			< 0.01
Trans-1,2-dichloroethylene	mg/kg	DETS 068*	< 0.01			< 0.01

Appendix A - Details of Analysis

Method details are shown only for those determinants listed in Annex A of the MCERTS standard. Anything not included on this list falls outside the scope of MCERTS.
No Recovery Factors are used in the determination of results. Results reported assume 100% recovery
Full method statements are available on request.

Method	Name of Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETS 002	Organic Matter	%	0.01	Air Dried	No	Yes	No
DETS 003	Loss on Ignition	%	0.01	Air Dried	No	Yes	Yes
DETS 004	Total Sulphate	%	0.01	Air Dried	No	Yes	Yes
DETS 075	Total Sulphate	%	0.01	Air Dried	No	Yes	Yes
DETS 004	Water Soluble Sulphate	g/l	0.01	Air Dried	No	Yes	Yes
DETS 076	Water Soluble Sulphate	g/l	0.01	Air Dried	No	Yes	Yes
DETS 006	Chloride	mg/kg	0.01	Air Dried	No	Yes	Yes
DETS 008	pH	pH Units	0.10	Air Dried	No	Yes	Yes
DETS 042	Selenium	mg/kg	0.30	Air Dried	No	Yes	No
DETS 055	Ammonia	mg/kg	0.02	Air Dried	No	No	No
DETS 020	Boron (Water Soluble)	mg/kg	0.20	Air Dried	No	Yes	Yes
DETS 024	Sulphide	mg/kg	10.00	Air Dried	No	Yes	Yes
DETS 042	Antimony	mg/kg	1.00	Air Dried	No	No	No
DETS 042	Arsenic	mg/kg	1.00	Air Dried	No	Yes	Yes
DETS 042	Barium	mg/kg	1.00	Air Dried	No	No	No
DET S 042	Beryllium	mg/kg	1.00	Air Dried	No	No	No
DETS 042	Cadmium	mg/kg	0.20	Air Dried	No	Yes	No

Appendix A - Details of Analysis

Method details are shown only for those determinants listed in Annex A of the MCERTS standard. Anything not included on this list falls outside the scope of MCERTS.
No Recovery Factors are used in the determination of results. Results reported assume 100% recovery
Full method statements are available on request.

Method	Name of Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETS 042	Cobalt	mg/kg	0.20	Air Dried	No	No	No
DETS 042	Copper	mg/kg	1.00	Air Dried	No	Yes	No
DETS 042	Chromium	mg/kg	1.00	Air Dried	No	Yes	No
DETS 042	Iron	mg/kg	1.00	Air Dried	No	No	No
DETS 042	Lead	mg/kg	1.00	Air Dried	No	Yes	No
DETS 042	Manganese	mg/kg	1.00	Air Dried	No	No	No
DETS 081	Mercury	mg/kg	0.30	Air Dried	No	No	No
DETS 042	Molybdenum	mg/kg	1.00	Air Dried	No	No	No
DETS 042	Nickel	mg/kg	1.00	Air Dried	No	Yes	No
DETS 042	Thallium	mg/kg	1.00	Air Dried	No	No	No
DETS 042	Vanadium	mg/kg	1.00	Air Dried	No	No	No
DETS 042	Zinc	mg/kg	1.00	Air Dried	No	Yes	Yes
DETS 049	Sulphur (Free)	mg/kg	0.50	As Received	No	Yes	Yes
DETS 050	PAH	mg/kg	0.10	As Received	No	Yes	No
DETS 051	TPH (C10 - C40)	mg/kg	20.00	As Received	No	Yes	Yes

Appendix A - Details of Analysis

Method details are shown only for those determinants listed in Annex A of the MCERTS standard. Anything not included on this list falls outside the scope of MCERTS.
No Recovery Factors are used in the determination of results. Results reported assume 100% recovery
Full method statements are available on request.

Method	Name of Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETS 052	PCB	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Benzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Toluene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Ethylbenzne	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 067	Phenol - Monohydric	mg/kg	0.3	Air Dried	No	Yes	Yes
DETS 067	Easily Liberatable Cyanide	mg/kg	0.1	Air Dried	No	Yes	Yes
DETS 067	Complex Cyanide	mg/kg	0.30	Air Dried	No	Yes	No
DETS 067	Total Cyanide	mg/kg	0.40	Air Dried	No	Yes	Yes
DETS 067	Thiocyanate	mg/kg	0.6	Air Dried	No	Yes	Yes
DETS 068	VOC	mg/kg	0.01	As Received	No	No	No

Certificate of Analysis

Date: 12/02/2008

2139

Certificate Number: 08-17051

Client:	Ian Farmer Associates 17 Rivington Court Hardwick Grange Woolston Warrington Cheshire WA1 4RT
Our Reference:	08-17051
Client Reference:	40274
Contract Title:	Warren Hall
Description:	21 soil samples
Date Received:	30/01/2008
Date Started:	30/01/2008
Date Completed:	12/02/2008
Test Procedures:	Identified by prefix DETSn, details available upon request.
Notes:	Observations and interpretations are outside the scope of UKAS accreditation * denotes test not included in laboratory scope of accreditation # denotes test that holds MCERT accreditation $ denotes tests completed by approved subcontractors I/S denotes insufficient sample to carry out test N/S denotes that the sample is not suitable for testing Solid samples will be disposed 1 month and liquids 2 weeks after the date of issue of this test certificate
Approved By:	
Authorised Signatories:	Rob Brown Business Manager

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	115726	115727	115728	115729
		Sample Ref	TP01	TP02	TP03	TP03
		Depth	0.30	0.30	0.30	0.90
		Other Ref				
		Sample Type				
Test	**Units**	**DETSxx**				
Arsenic	mg/kg	DETS 042#	6	6	6	44
Cadmium	mg/kg	DETS 042	1.1	1.2	1.3	1.9
Chromium	mg/kg	DETS 042	18	17	16	13
Copper	mg/kg	DETS 042	15	9	12	19
Lead	mg/kg	DETS 042	23	27	21	59
Mercury	mg/kg	DETS 081*	< 0.3	< 0.3	< 0.3	< 0.3
Nickel	mg/kg	DETS 042	24	11	15	3
Selenium	mg/kg	DETS 042	< 0.3	< 0.3	< 0.3	< 0.3
Zinc	mg/kg	DETS 042#	39	30	32	13
Boron (water soluble)	mg/kg	DETS 020#	< 0.2	< 0.2	0.3	0.5
Cyanide free	mg/kg	DETS 067#	< 0.1	< 0.1	< 0.1	< 0.1
Sulphate Aqueous Extract as SO4	g/l	DETS 076#	0.02	0.02	< 0.01	0.05
pH		DETS 008#	8.6	8.5	8.6	6.3
Aliphatic C5-C6	mg/kg	DETS 072*			< 0.01	
Aliphatic C6-C8	mg/kg	DETS 072*			< 0.01	
Aliphatic C8-C10	mg/kg	DETS 072*			< 0.01	
Aliphatic C10-C12	mg/kg	DETS 072*			< 0.1	
Aliphatic C12-C16	mg/kg	DETS 072*			< 0.1	
Aliphatic C16-C21	mg/kg	DETS 072*			< 0.1	
Aliphatic C21-C35	mg/kg	DETS 072*			< 0.1	
Aromatic C5-C7	mg/kg	DETS 072*			< 0.01	
Aromatic C7-C8	mg/kg	DETS 072*			< 0.01	
Aromatic C8-C10	mg/kg	DETS 072*			< 0.01	
Aromatic C10-C12	mg/kg	DETS 072*			< 0.1	
Aromatic C12-C16	mg/kg	DETS 072*			< 0.1	
Aromatic C16-C21	mg/kg	DETS 072*			< 0.1	
Aromatic C21-C35	mg/kg	DETS 072*			< 0.1	
Aliphatic C5-C35	mg/kg	DETS 072*			< 0.1	
Aromatic C5-C35	mg/kg	DETS 072*			< 0.1	
TPH Ali/Aro	mg/kg	DETS 072*			< 0.1	

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	115726	115727	115728	115729
		Sample Ref	TP01	TP02	TP03	TP03
		Depth	0.30	0.30	0.30	0.90
		Other Ref				
		Sample Type				
Test	**Units**	**DETSxx**				
Acenaphthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Acenapthylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(g,h,i)perylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Dibenzo(a,h)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Napthalene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
PAH	mg/kg	DETS 050	< 5.0	< 5.0	< 5.0	< 5.0
Benzene	mg/kg	DETS 062#			< 0.01	
Ethylbenzene	mg/kg	DETS 062#			< 0.01	
Toluene	mg/kg	DETS 062#			< 0.01	
Xylene	mg/kg	DETS 062#			< 0.01	
Phenol - Monohydric	mg/kg	DETS 067#	< 0.3	< 0.3	< 0.3	< 0.3
PCB	mg/kg	DETS 052*			< 0.01	
2,2',4,4',5,5'-Hexachlorobiphenyl PCB 153	mg/kg	DETS 052*			< 0.01	
2,3',4,4',5-Pentachlorobiphenyl PCB 118	mg/kg	DETS 052*			< 0.01	
2,2',3,4,4',5,5'-Heptachlorobiphenyl PCB 180	mg/kg	DETS 052*			< 0.01	
2,2',3,4,4',5'-Hexachlorobiphenyl PCB 138	mg/kg	DETS 052*			< 0.01	
2,2',4,5,5'-Pentachlorobiphenyl PCB 101	mg/kg	DETS 052*			< 0.01	
2,4,4'-Trichlorobiphenyl PCB 28	mg/kg	DETS 052*			< 0.01	
2,2',5,5'-Tetrachlorobiphenyl PCB 52	mg/kg	DETS 052*			< 0.01	
Total VOC's	mg/kg	DETS 068*			< 0.01	
1,2-dichloropropane	mg/kg	DETS 068*			< 0.01	
Dibromomethane	mg/kg	DETS 068*			< 0.01	
Bromodichloromethane	mg/kg	DETS 068*			< 0.01	
cis-1,3-dichloropropene	mg/kg	DETS 068*			< 0.01	
Toluene	mg/kg	DETS 068*			< 0.01	
trans-1,3-dichloropropene	mg/kg	DETS 068*			< 0.01	
1,1,2-trichloroethane	mg/kg	DETS 068*			< 0.01	
Tetrachloroethylene	mg/kg	DETS 068*			< 0.01	
1,3-dichloropropane	mg/kg	DETS 068*			< 0.01	
Dibromochloromethane	mg/kg	DETS 068*			< 0.01	
1,2-dibromoethane	mg/kg	DETS 068*			< 0.01	
Chlorobenzene	mg/kg	DETS 068*			< 0.01	
Ethylbenzene+1,1,1,2-tetrachloroethane	mg/kg	DETS 068*			< 0.01	
m+p-Xylene	mg/kg	DETS 068*			< 0.01	

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	115726	115727	115728	115729
		Sample Ref	TP01	TP02	TP03	TP03
		Depth	0.30	0.30	0.30	0.90
		Other Ref				
		Sample Type				
Test	**Units**	**DETSxx**				
o-Xylene	mg/kg	DETS 068*			< 0.01	
Styrene	mg/kg	DETS 068*			< 0.01	
Bromoform	mg/kg	DETS 068*			< 0.01	
Isopropylbenzene	mg/kg	DETS 068*			< 0.01	
Bromobenzene	mg/kg	DETS 068*			< 0.01	
1,2,3-trichloropropane	mg/kg	DETS 068*			< 0.01	
n-propylbenzene	mg/kg	DETS 068*			< 0.01	
2-chlorotoluene	mg/kg	DETS 068*			< 0.01	
1,3,5-trimethylbenzene	mg/kg	DETS 068*			< 0.01	
4-chlorotoluene	mg/kg	DETS 068*			< 0.01	
Tert-butylbenzene	mg/kg	DETS 068*			< 0.01	
1,2,4-trimethylbenzene	mg/kg	DETS 068*			< 0.01	
sec-butylbenzene	mg/kg	DETS 068*			< 0.01	
1,3-dichlorobenzene+p-isopropyltoluene	mg/kg	DETS 068*			< 0.01	
1,4-dichlorobenzene	mg/kg	DETS 068*			< 0.01	
n-butylbenzene	mg/kg	DETS 068*			< 0.01	
1,2-dichlorobenzene	mg/kg	DETS 068*			< 0.01	
1,2-dibromo-3-chloropropane	mg/kg	DETS 068*			< 0.01	
1,2,4-trichlorobenzene	mg/kg	DETS 068*			< 0.01	
Hexachlorobutadiene	mg/kg	DETS 068*			< 0.01	
Naphthalene	mg/kg	DETS 068*			< 0.01	
1,2,3-trichlorobenzene	mg/kg	DETS 068*			< 0.01	
Trichloroethylene	mg/kg	DETS 068*			< 0.01	
Chloroform	mg/kg	DETS 068*			< 0.01	
Bromochloromethane	mg/kg	DETS 068*			< 0.01	
2,2-dichlororopane+1,2-dichloroethylene	mg/kg	DETS 068*			< 0.01	
1,1-dichloroethane	mg/kg	DETS 068*			< 0.01	
1,2-dichloroethane	mg/kg	DETS 068*			< 0.01	
Benzene	mg/kg	DETS 068*			< 0.01	
Carbon tetrachloride + 1,1-dichloropropene	mg/kg	DETS 068*			< 0.01	
Trans-1,2-dichloroethylene	mg/kg	DETS 068*			< 0.01	
Methylene Chloride	mg/kg	DETS 068*			< 0.01	
1,1 Dichloroethylene	mg/kg	DETS 068*			< 0.01	
1,1,1-trichloroethane	mg/kg	DETS 068*			< 0.01	

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	115730	115731	115732	115733
		Sample Ref	TP04	TP05	TP05	TP06
		Depth	0.30	0.30	1.80	0.50
		Other Ref				
		Sample Type				
Test	**Units**	**DETSxx**				
Arsenic	mg/kg	DETS 042#	5	6	9	6
Cadmium	mg/kg	DETS 042	0.8	1.5	1.5	0.8
Chromium	mg/kg	DETS 042	14	13	17	12
Copper	mg/kg	DETS 042	17	11	27	13
Lead	mg/kg	DETS 042	13	22	56	38
Mercury	mg/kg	DETS 081*	< 0.3	< 0.3	< 0.3	< 0.3
Nickel	mg/kg	DETS 042	12	19	25	11
Selenium	mg/kg	DETS 042	< 0.3	< 0.3	< 0.3	< 0.3
Zinc	mg/kg	DETS 042#	24	32	61	38
Boron (water soluble)	mg/kg	DETS 020#	1.6	0.8	0.5	1.1
Cyanide free	mg/kg	DETS 067#	< 0.1	0.1	< 0.1	< 0.1
Sulphate Aqueous Extract as SO4	g/l	DETS 076#	0.01	0.01	0.01	0.05
pH		DETS 008#	8.1	7.4	7.7	6.7
Aliphatic C5-C6	mg/kg	DETS 072*				
Aliphatic C6-C8	mg/kg	DETS 072*				
Aliphatic C8-C10	mg/kg	DETS 072*				
Aliphatic C10-C12	mg/kg	DETS 072*				
Aliphatic C12-C16	mg/kg	DETS 072*				
Aliphatic C16-C21	mg/kg	DETS 072*				
Aliphatic C21-C35	mg/kg	DETS 072*				
Aromatic C5-C7	mg/kg	DETS 072*				
Aromatic C7-C8	mg/kg	DETS 072*				
Aromatic C8-C10	mg/kg	DETS 072*				
Aromatic C10-C12	mg/kg	DETS 072*				
Aromatic C12-C16	mg/kg	DETS 072*				
Aromatic C16-C21	mg/kg	DETS 072*				
Aromatic C21-C35	mg/kg	DETS 072*				
Aliphatic C5-C35	mg/kg	DETS 072*				
Aromatic C5-C35	mg/kg	DETS 072*				
TPH Ali/Aro	mg/kg	DETS 072*				

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	115730	115731	115732	115733
		Sample Ref	TP04	TP05	TP05	TP06
		Depth	0.30	0.30	1.80	0.50
		Other Ref				
		Sample Type				
Test	**Units**	**DETSxx**				
Acenaphthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Acenapthylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(g,h,i)perylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Dibenzo(a,h)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	DETS 050	0.1	0.1	0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Napthalene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
PAH	mg/kg	DETS 050	< 5.0	< 5.0	< 5.0	< 5.0
Benzene	mg/kg	DETS 062#				
Ethylbenzene	mg/kg	DETS 062#				
Toluene	mg/kg	DETS 062#				
Xylene	mg/kg	DETS 062#				
Phenol - Monohydric	mg/kg	DETS 067#	< 0.3	< 0.3	< 0.3	< 0.3
PCB	mg/kg	DETS 052*				
2,2',4,4',5,5'-Hexachlorobiphenyl PCB 153	mg/kg	DETS 052*				
2,3',4,4',5-Pentachlorobiphenyl PCB 118	mg/kg	DETS 052*				
2,2',3,4,4',5,5'-Heptachlorobiphenyl PCB 180	mg/kg	DETS 052*				
2,2',3,4,4',5'-Hexachlorobiphenyl PCB 138	mg/kg	DETS 052*				
2,2',4,5,5'-Pentachlorobiphenyl PCB 101	mg/kg	DETS 052*				
2,4,4'-Trichlorobiphenyl PCB 28	mg/kg	DETS 052*				
2,2',5,5'-Tetrachlorobiphenyl PCB 52	mg/kg	DETS 052*				
Total VOC's	mg/kg	DETS 068*				
1,2-dichloropropane	mg/kg	DETS 068*				
Dibromomethane	mg/kg	DETS 068*				
Bromodichloromethane	mg/kg	DETS 068*				
cis-1,3-dichloropropene	mg/kg	DETS 068*				
Toluene	mg/kg	DETS 068*				
trans-1,3-dichloropropene	mg/kg	DETS 068*				
1,1,2-trichloroethane	mg/kg	DETS 068*				
Tetrachloroethylene	mg/kg	DETS 068*				
1,3-dichloropropane	mg/kg	DETS 068*				
Dibromochloromethane	mg/kg	DETS 068*				
1,2-dibromoethane	mg/kg	DETS 068*				
Chlorobenzene	mg/kg	DETS 068*				
Ethylbenzene+1,1,1,2-tetrachloroethane	mg/kg	DETS 068*				
m+p-Xylene	mg/kg	DETS 068*				

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	115730	115731	115732	115733
		Sample Ref	TP04	TP05	TP05	TP06
		Depth	0.30	0.30	1.80	0.50
		Other Ref				
		Sample Type				
Test	**Units**	**DETSxx**				
o-Xylene	mg/kg	DETS 068*				
Styrene	mg/kg	DETS 068*				
Bromoform	mg/kg	DETS 068*				
Isopropylbenzene	mg/kg	DETS 068*				
Bromobenzene	mg/kg	DETS 068*				
1,2,3-trichloropropane	mg/kg	DETS 068*				
n-propylbenzene	mg/kg	DETS 068*				
2-chlorotoluene	mg/kg	DETS 068*				
1,3,5-trimethylbenzene	mg/kg	DETS 068*				
4-chlorotoluene	mg/kg	DETS 068*				
Tert-butylbenzene	mg/kg	DETS 068*				
1,2,4-trimethylbenzene	mg/kg	DETS 068*				
sec-butylbenzene	mg/kg	DETS 068*				
1,3-dichlorobenzene+p-isopropyltoluene	mg/kg	DETS 068*				
1,4-dichlorobenzene	mg/kg	DETS 068*				
n-butylbenzene	mg/kg	DETS 068*				
1,2-dichlorobenzene	mg/kg	DETS 068*				
1,2-dibromo-3-chloropropane	mg/kg	DETS 068*				
1,2,4-trichlorobenzene	mg/kg	DETS 068*				
Hexachlorobutadiene	mg/kg	DETS 068*				
Naphthalene	mg/kg	DETS 068*				
1,2,3-trichlorobenzene	mg/kg	DETS 068*				
Trichloroethylene	mg/kg	DETS 068*				
Chloroform	mg/kg	DETS 068*				
Bromochloromethane	mg/kg	DETS 068*				
2,2-dichlororopane+1,2-dichloroethylene	mg/kg	DETS 068*				
1,1-dichloroethane	mg/kg	DETS 068*				
1,2-dichloroethane	mg/kg	DETS 068*				
Benzene	mg/kg	DETS 068*				
Carbon tetrachloride + 1,1-dichloropropene	mg/kg	DETS 068*				
Trans-1,2-dichloroethylene	mg/kg	DETS 068*				
Methylene Chloride	mg/kg	DETS 068*				
1,1 Dichloroethylene	mg/kg	DETS 068*				
1,1,1-trichloroethane	mg/kg	DETS 068*				

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	115734	115735	115736	115737
		Sample Ref	TP07	TP08	TP08	TP09
		Depth	0.80	0.40	1.20	0.50
		Other Ref				
		Sample Type				
Test	**Units**	**DETSxx**				
Arsenic	mg/kg	DETS 042#	5	5	6	5
Cadmium	mg/kg	DETS 042	0.9	1.1	0.9	0.8
Chromium	mg/kg	DETS 042	14	13	13	13
Copper	mg/kg	DETS 042	12	12	14	11
Lead	mg/kg	DETS 042	13	19	15	21
Mercury	mg/kg	DETS 081*	< 0.3	< 0.3	< 0.3	< 0.3
Nickel	mg/kg	DETS 042	14	9	14	10
Selenium	mg/kg	DETS 042	< 0.3	< 0.3	< 0.3	< 0.3
Zinc	mg/kg	DETS 042#	27	27	27	29
Boron (water soluble)	mg/kg	DETS 020#	0.9	0.8	2.0	0.9
Cyanide free	mg/kg	DETS 067#	< 0.1	< 0.1	< 0.1	0.1
Sulphate Aqueous Extract as SO4	g/l	DETS 076#	0.02	0.02	0.04	0.02
pH		DETS 008#	7.9	7.0	7.0	7.4
Aliphatic C5-C6	mg/kg	DETS 072*		< 0.01		
Aliphatic C6-C8	mg/kg	DETS 072*		< 0.01		
Aliphatic C8-C10	mg/kg	DETS 072*		< 0.01		
Aliphatic C10-C12	mg/kg	DETS 072*		< 0.1		
Aliphatic C12-C16	mg/kg	DETS 072*		< 0.1		
Aliphatic C16-C21	mg/kg	DETS 072*		< 0.1		
Aliphatic C21-C35	mg/kg	DETS 072*		< 0.1		
Aromatic C5-C7	mg/kg	DETS 072*		< 0.01		
Aromatic C7-C8	mg/kg	DETS 072*		< 0.01		
Aromatic C8-C10	mg/kg	DETS 072*		< 0.01		
Aromatic C10-C12	mg/kg	DETS 072*		< 0.1		
Aromatic C12-C16	mg/kg	DETS 072*		< 0.1		
Aromatic C16-C21	mg/kg	DETS 072*		< 0.1		
Aromatic C21-C35	mg/kg	DETS 072*		< 0.1		
Aliphatic C5-C35	mg/kg	DETS 072*		< 0.1		
Aromatic C5-C35	mg/kg	DETS 072*		< 0.1		
TPH Ali/Aro	mg/kg	DETS 072*		< 0.1		

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	115734	115735	115736	115737
		Sample Ref	TP07	TP08	TP08	TP09
		Depth	0.80	0.40	1.20	0.50
		Other Ref				
		Sample Type				
Test	**Units**	**DETSxx**				
Acenaphthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Acenapthylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	0.1
Benzo(a)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	0.5
Benzo(a)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	1.0
Benzo(b)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	0.5
Benzo(k)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	0.9
Benzo(g,h,i)perylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	0.2
Chrysene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	0.4
Dibenzo(a,h)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	4.2
Fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	0.6
Fluorene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	0.8
Napthalene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	0.2
Phenanthrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	0.2
Pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	0.5
PAH	mg/kg	DETS 050	< 5.0	< 5.0	< 5.0	10
Benzene	mg/kg	DETS 062#		< 0.01		
Ethylbenzene	mg/kg	DETS 062#		< 0.01		
Toluene	mg/kg	DETS 062#		< 0.01		
Xylene	mg/kg	DETS 062#		< 0.01		
Phenol - Monohydric	mg/kg	DETS 067#	< 0.3	< 0.3	< 0.3	< 0.3
PCB	mg/kg	DETS 052*		< 0.01		
2,2',4,4',5,5'-Hexachlorobiphenyl PCB 153	mg/kg	DETS 052*		< 0.01		
2,3',4,4',5-Pentachlorobiphenyl PCB 118	mg/kg	DETS 052*		< 0.01		
2,2',3,4,4',5,5'-Heptachlorobiphenyl PCB 180	mg/kg	DETS 052*		< 0.01		
2,2',3,4,4',5'-Hexachlorobiphenyl PCB 138	mg/kg	DETS 052*		< 0.01		
2,2',4,5,5'-Pentachlorobiphenyl PCB 101	mg/kg	DETS 052*		< 0.01		
2,4,4'-Trichlorobiphenyl PCB 28	mg/kg	DETS 052*		< 0.01		
2,2',5,5'-Tetrachlorobiphenyl PCB 52	mg/kg	DETS 052*		< 0.01		
Total VOC's	mg/kg	DETS 068*		< 0.01		
1,2-dichloropropane	mg/kg	DETS 068*		< 0.01		
Dibromomethane	mg/kg	DETS 068*		< 0.01		
Bromodichloromethane	mg/kg	DETS 068*		< 0.01		
cis-1,3-dichloropropene	mg/kg	DETS 068*		< 0.01		
Toluene	mg/kg	DETS 068*		< 0.01		
trans-1,3-dichloropropene	mg/kg	DETS 068*		< 0.01		
1,1,2-trichloroethane	mg/kg	DETS 068*		< 0.01		
Tetrachloroethylene	mg/kg	DETS 068*		< 0.01		
1,3-dichloropropane	mg/kg	DETS 068*		< 0.01		
Dibromochloromethane	mg/kg	DETS 068*		< 0.01		
1,2-dibromoethane	mg/kg	DETS 068*		< 0.01		
Chlorobenzene	mg/kg	DETS 068*		< 0.01		
Ethylbenzene+1,1,1,2-tetrachloroethane	mg/kg	DETS 068*		< 0.01		
m+p-Xylene	mg/kg	DETS 068*		< 0.01		

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	115734	115735	115736	115737
		Sample Ref	TP07	TP08	TP08	TP09
		Depth	0.80	0.40	1.20	0.50
		Other Ref				
		Sample Type				
Test	**Units**	**DETSxx**				
o-Xylene	mg/kg	DETS 068*		< 0.01		
Styrene	mg/kg	DETS 068*		< 0.01		
Bromoform	mg/kg	DETS 068*		< 0.01		
Isopropylbenzene	mg/kg	DETS 068*		< 0.01		
Bromobenzene	mg/kg	DETS 068*		< 0.01		
1,2,3-trichloropropane	mg/kg	DETS 068*		< 0.01		
n-propylbenzene	mg/kg	DETS 068*		< 0.01		
2-chlorotoluene	mg/kg	DETS 068*		< 0.01		
1,3,5-trimethylbenzene	mg/kg	DETS 068*		< 0.01		
4-chlorotoluene	mg/kg	DETS 068*		< 0.01		
Tert-butylbenzene	mg/kg	DETS 068*		< 0.01		
1,2,4-trimethylbenzene	mg/kg	DETS 068*		< 0.01		
sec-butylbenzene	mg/kg	DETS 068*		< 0.01		
1,3-dichlorobenzene+p-isopropyltoluene	mg/kg	DETS 068*		< 0.01		
1,4-dichlorobenzene	mg/kg	DETS 068*		< 0.01		
n-butylbenzene	mg/kg	DETS 068*		< 0.01		
1,2-dichlorobenzene	mg/kg	DETS 068*		< 0.01		
1,2-dibromo-3-chloropropane	mg/kg	DETS 068*		< 0.01		
1,2,4-trichlorobenzene	mg/kg	DETS 068*		< 0.01		
Hexachlorobutadiene	mg/kg	DETS 068*		< 0.01		
Naphthalene	mg/kg	DETS 068*		< 0.01		
1,2,3-trichlorobenzene	mg/kg	DETS 068*		< 0.01		
Trichloroethylene	mg/kg	DETS 068*		< 0.01		
Chloroform	mg/kg	DETS 068*		< 0.01		
Bromochloromethane	mg/kg	DETS 068*		< 0.01		
2,2-dichlororopane+1,2-dichloroethylene	mg/kg	DETS 068*		< 0.01		
1,1-dichloroethane	mg/kg	DETS 068*		< 0.01		
1,2-dichloroethane	mg/kg	DETS 068*		< 0.01		
Benzene	mg/kg	DETS 068*		< 0.01		
Carbon tetrachloride + 1,1-dichloropropene	mg/kg	DETS 068*		< 0.01		
Trans-1,2-dichloroethylene	mg/kg	DETS 068*		< 0.01		
Methylene Chloride	mg/kg	DETS 068*		< 0.01		
1,1 Dichloroethylene	mg/kg	DETS 068*		< 0.01		
1,1,1-trichloroethane	mg/kg	DETS 068*		< 0.01		

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	115738	115739	115740	115741
		Sample Ref	TP10	TP10	TP11	TP12
		Depth	0.50	1.50	0.60	0.50
		Other Ref				
		Sample Type				
Test	**Units**	**DETSxx**				
Arsenic	mg/kg	DETS 042#	5	6	8	6
Cadmium	mg/kg	DETS 042	1.0	1.8	1.1	1.0
Chromium	mg/kg	DETS 042	13	13	14	17
Copper	mg/kg	DETS 042	10	13	38	15
Lead	mg/kg	DETS 042	37	19	30	12
Mercury	mg/kg	DETS 081*	< 0.3	< 0.3	< 0.3	< 0.3
Nickel	mg/kg	DETS 042	11	18	20	18
Selenium	mg/kg	DETS 042	< 0.3	< 0.3	0.6	< 0.3
Zinc	mg/kg	DETS 042#	34	31	27	31
Boron (water soluble)	mg/kg	DETS 020#	1.0	0.8	1.0	0.9
Cyanide free	mg/kg	DETS 067#	0.3	< 0.1	< 0.1	< 0.1
Sulphate Aqueous Extract as SO4	g/l	DETS 076#	0.01	0.02	0.33	0.01
pH		DETS 008#	7.2	7.7	6.5	8.2
Aliphatic C5-C6	mg/kg	DETS 072*				< 0.01
Aliphatic C6-C8	mg/kg	DETS 072*				< 0.01
Aliphatic C8-C10	mg/kg	DETS 072*				< 0.01
Aliphatic C10-C12	mg/kg	DETS 072*				< 0.1
Aliphatic C12-C16	mg/kg	DETS 072*				< 0.1
Aliphatic C16-C21	mg/kg	DETS 072*				22
Aliphatic C21-C35	mg/kg	DETS 072*				< 0.1
Aromatic C5-C7	mg/kg	DETS 072*				< 0.01
Aromatic C7-C8	mg/kg	DETS 072*				< 0.01
Aromatic C8-C10	mg/kg	DETS 072*				< 0.01
Aromatic C10-C12	mg/kg	DETS 072*				< 0.1
Aromatic C12-C16	mg/kg	DETS 072*				< 0.1
Aromatic C16-C21	mg/kg	DETS 072*				< 0.1
Aromatic C21-C35	mg/kg	DETS 072*				< 0.1
Aliphatic C5-C35	mg/kg	DETS 072*				22
Aromatic C5-C35	mg/kg	DETS 072*				< 0.1
TPH Ali/Aro	mg/kg	DETS 072*				22

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	115738	115739	115740	115741
		Sample Ref	TP10	TP10	TP11	TP12
		Depth	0.50	1.50	0.60	0.50
		Other Ref				
		Sample Type				
Test	**Units**	**DETSxx**				
Acenaphthene	mg/kg	DETS 050	0.1	0.1	< 0.1	< 0.1
Acenapthylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	DETS 050	0.4	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(g,h,i)perylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Dibenzo(a,h)anthracene	mg/kg	DETS 050	1.5	0.5	< 0.1	< 0.1
Fluoranthene	mg/kg	DETS 050	0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	0.3	< 0.1	< 0.1	< 0.1
Napthalene	mg/kg	DETS 050	0.2	0.2	< 0.1	< 0.1
Phenanthrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
PAH	mg/kg	DETS 050	< 5.0	< 5.0	< 5.0	< 5.0
Benzene	mg/kg	DETS 062#				
Ethylbenzene	mg/kg	DETS 062#				
Toluene	mg/kg	DETS 062#				
Xylene	mg/kg	DETS 062#				
Phenol - Monohydric	mg/kg	DETS 067#	< 0.3	< 0.3	< 0.3	< 0.3
PCB	mg/kg	DETS 052*				< 0.01
2,2',4,4',5,5'-Hexachlorobiphenyl PCB 153	mg/kg	DETS 052*				< 0.01
2,3',4,4',5-Pentachlorobiphenyl PCB 118	mg/kg	DETS 052*				< 0.01
2,2',3,4,4',5,5'-Heptachlorobiphenyl PCB 180	mg/kg	DETS 052*				< 0.01
2,2',3,4,4',5'-Hexachlorobiphenyl PCB 138	mg/kg	DETS 052*				< 0.01
2,2',4,5,5'-Pentachlorobiphenyl PCB 101	mg/kg	DETS 052*				< 0.01
2,4,4'-Trichlorobiphenyl PCB 28	mg/kg	DETS 052*				< 0.01
2,2',5,5'-Tetrachlorobiphenyl PCB 52	mg/kg	DETS 052*				< 0.01
Total VOC's	mg/kg	DETS 068*				< 0.01
1,2-dichloropropane	mg/kg	DETS 068*				< 0.01
Dibromomethane	mg/kg	DETS 068*				< 0.01
Bromodichloromethane	mg/kg	DETS 068*				< 0.01
cis-1,3-dichloropropene	mg/kg	DETS 068*				< 0.01
Toluene	mg/kg	DETS 068*				< 0.01
trans-1,3-dichloropropene	mg/kg	DETS 068*				< 0.01
1,1,2-trichloroethane	mg/kg	DETS 068*				< 0.01
Tetrachloroethylene	mg/kg	DETS 068*				< 0.01
1,3-dichloropropane	mg/kg	DETS 068*				< 0.01
Dibromochloromethane	mg/kg	DETS 068*				< 0.01
1,2-dibromoethane	mg/kg	DETS 068*				< 0.01
Chlorobenzene	mg/kg	DETS 068*				< 0.01
Ethylbenzene+1,1,1,2-tetrachloroethane	mg/kg	DETS 068*				< 0.01
m+p-Xylene	mg/kg	DETS 068*				< 0.01

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	115738	115739	115740	115741
		Sample Ref	TP10	TP10	TP11	TP12
		Depth	0.50	1.50	0.60	0.50
		Other Ref				
		Sample Type				
Test	**Units**	**DETSxx**				
o-Xylene	mg/kg	DETS 068*				< 0.01
Styrene	mg/kg	DETS 068*				< 0.01
Bromoform	mg/kg	DETS 068*				< 0.01
Isopropylbenzene	mg/kg	DETS 068*				< 0.01
Bromobenzene	mg/kg	DETS 068*				< 0.01
1,2,3-trichloropropane	mg/kg	DETS 068*				< 0.01
n-propylbenzene	mg/kg	DETS 068*				< 0.01
2-chlorotoluene	mg/kg	DETS 068*				< 0.01
1,3,5-trimethylbenzene	mg/kg	DETS 068*				< 0.01
4-chlorotoluene	mg/kg	DETS 068*				< 0.01
Tert-butylbenzene	mg/kg	DETS 068*				< 0.01
1,2,4-trimethylbenzene	mg/kg	DETS 068*				< 0.01
sec-butylbenzene	mg/kg	DETS 068*				< 0.01
1,3-dichlorobenzene+p-isopropyltoluene	mg/kg	DETS 068*				< 0.01
1,4-dichlorobenzene	mg/kg	DETS 068*				< 0.01
n-butylbenzene	mg/kg	DETS 068*				< 0.01
1,2-dichlorobenzene	mg/kg	DETS 068*				< 0.01
1,2-dibromo-3-chloropropane	mg/kg	DETS 068*				< 0.01
1,2,4-trichlorobenzene	mg/kg	DETS 068*				< 0.01
Hexachlorobutadiene	mg/kg	DETS 068*				< 0.01
Naphthalene	mg/kg	DETS 068*				< 0.01
1,2,3-trichlorobenzene	mg/kg	DETS 068*				< 0.01
Trichloroethylene	mg/kg	DETS 068*				< 0.01
Chloroform	mg/kg	DETS 068*				< 0.01
Bromochloromethane	mg/kg	DETS 068*				< 0.01
2,2-dichlororopane+1,2-dichloroethylene	mg/kg	DETS 068*				< 0.01
1,1-dichloroethane	mg/kg	DETS 068*				< 0.01
1,2-dichloroethane	mg/kg	DETS 068*				< 0.01
Benzene	mg/kg	DETS 068*				< 0.01
Carbon tetrachloride + 1,1-dichloropropene	mg/kg	DETS 068*				< 0.01
Trans-1,2-dichloroethylene	mg/kg	DETS 068*				< 0.01
Methylene Chloride	mg/kg	DETS 068*				< 0.01
1,1 Dichloroethylene	mg/kg	DETS 068*				< 0.01
1,1,1-trichloroethane	mg/kg	DETS 068*				< 0.01

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	115742	115743	115744	115745
		Sample Ref	TP12	TP13	TP13	TP15
		Depth	2.20	0.20	0.30	0.20
		Other Ref				
		Sample Type				
Test	**Units**	**DETSxx**				
Arsenic	mg/kg	DETS 042#	28	9	6	8
Cadmium	mg/kg	DETS 042	1.3	0.6	0.5	0.9
Chromium	mg/kg	DETS 042	23	17	19	17
Copper	mg/kg	DETS 042	48	14	15	12
Lead	mg/kg	DETS 042	57	41	16	43
Mercury	mg/kg	DETS 081*	< 0.3	< 0.3	< 0.3	< 0.3
Nickel	mg/kg	DETS 042	44	12	14	15
Selenium	mg/kg	DETS 042	< 0.3	< 0.3	< 0.3	< 0.3
Zinc	mg/kg	DETS 042#	120	47	32	60
Boron (water soluble)	mg/kg	DETS 020#	0.8	1.3	0.7	1.0
Cyanide free	mg/kg	DETS 067#	< 0.1	0.3	< 0.1	0.2
Sulphate Aqueous Extract as SO4	g/l	DETS 076#	0.03	0.02	0.01	0.02
pH		DETS 008#	8.3	7.9	8.1	8.0
Aliphatic C5-C6	mg/kg	DETS 072*				
Aliphatic C6-C8	mg/kg	DETS 072*				
Aliphatic C8-C10	mg/kg	DETS 072*				
Aliphatic C10-C12	mg/kg	DETS 072*				
Aliphatic C12-C16	mg/kg	DETS 072*				
Aliphatic C16-C21	mg/kg	DETS 072*				
Aliphatic C21-C35	mg/kg	DETS 072*				
Aromatic C5-C7	mg/kg	DETS 072*				
Aromatic C7-C8	mg/kg	DETS 072*				
Aromatic C8-C10	mg/kg	DETS 072*				
Aromatic C10-C12	mg/kg	DETS 072*				
Aromatic C12-C16	mg/kg	DETS 072*				
Aromatic C16-C21	mg/kg	DETS 072*				
Aromatic C21-C35	mg/kg	DETS 072*				
Aliphatic C5-C35	mg/kg	DETS 072*				
Aromatic C5-C35	mg/kg	DETS 072*				
TPH Ali/Aro	mg/kg	DETS 072*				

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	115742	115743	115744	115745
		Sample Ref	TP12	TP13	TP13	TP15
		Depth	2.20	0.20	0.30	0.20
		Other Ref				
		Sample Type				
Test	**Units**	**DETSxx**				
Acenaphthene	mg/kg	DETS 050	0.1	< 0.1	< 0.1	< 0.1
Acenapthylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(g,h,i)perylene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Dibenzo(a,h)anthracene	mg/kg	DETS 050	< 0.1	0.4	< 0.1	< 0.1
Fluoranthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	DETS 050	0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Napthalene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
Pyrene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1	< 0.1
PAH	mg/kg	DETS 050	< 5.0	< 5.0	< 5.0	< 5.0
Benzene	mg/kg	DETS 062#				
Ethylbenzene	mg/kg	DETS 062#				
Toluene	mg/kg	DETS 062#				
Xylene	mg/kg	DETS 062#				
Phenol - Monohydric	mg/kg	DETS 067#	< 0.3	< 0.3	< 0.3	< 0.3
PCB	mg/kg	DETS 052*				
2,2',4,4',5,5'-Hexachlorobiphenyl PCB 153	mg/kg	DETS 052*				
2,3',4,4',5-Pentachlorobiphenyl PCB 118	mg/kg	DETS 052*				
2,2',3,4,4',5,5'-Heptachlorobiphenyl PCB 180	mg/kg	DETS 052*				
2,2',3,4,4',5'-Hexachlorobiphenyl PCB 138	mg/kg	DETS 052*				
2,2',4,5,5'-Pentachlorobiphenyl PCB 101	mg/kg	DETS 052*				
2,4,4'-Trichlorobiphenyl PCB 28	mg/kg	DETS 052*				
2,2',5,5'-Tetrachlorobiphenyl PCB 52	mg/kg	DETS 052*				
Total VOC's	mg/kg	DETS 068*				
1,2-dichloropropane	mg/kg	DETS 068*				
Dibromomethane	mg/kg	DETS 068*				
Bromodichloromethane	mg/kg	DETS 068*				
cis-1,3-dichloropropene	mg/kg	DETS 068*				
Toluene	mg/kg	DETS 068*				
trans-1,3-dichloropropene	mg/kg	DETS 068*				
1,1,2-trichloroethane	mg/kg	DETS 068*				
Tetrachloroethylene	mg/kg	DETS 068*				
1,3-dichloropropane	mg/kg	DETS 068*				
Dibromochloromethane	mg/kg	DETS 068*				
1,2-dibromoethane	mg/kg	DETS 068*				
Chlorobenzene	mg/kg	DETS 068*				
Ethylbenzene+1,1,1,2-tetrachloroethane	mg/kg	DETS 068*				
m+p-Xylene	mg/kg	DETS 068*				

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	115742	115743	115744	115745
		Sample Ref	TP12	TP13	TP13	TP15
		Depth	2.20	0.20	0.30	0.20
		Other Ref				
		Sample Type				
Test	**Units**	**DETSxx**				
o-Xylene	mg/kg	DETS 068*				
Styrene	mg/kg	DETS 068*				
Bromoform	mg/kg	DETS 068*				
Isopropylbenzene	mg/kg	DETS 068*				
Bromobenzene	mg/kg	DETS 068*				
1,2,3-trichloropropane	mg/kg	DETS 068*				
n-propylbenzene	mg/kg	DETS 068*				
2-chlorotoluene	mg/kg	DETS 068*				
1,3,5-trimethylbenzene	mg/kg	DETS 068*				
4-chlorotoluene	mg/kg	DETS 068*				
Tert-butylbenzene	mg/kg	DETS 068*				
1,2,4-trimethylbenzene	mg/kg	DETS 068*				
sec-butylbenzene	mg/kg	DETS 068*				
1,3-dichlorobenzene+p-isopropyltoluene	mg/kg	DETS 068*				
1,4-dichlorobenzene	mg/kg	DETS 068*				
n-butylbenzene	mg/kg	DETS 068*				
1,2-dichlorobenzene	mg/kg	DETS 068*				
1,2-dibromo-3-chloropropane	mg/kg	DETS 068*				
1,2,4-trichlorobenzene	mg/kg	DETS 068*				
Hexachlorobutadiene	mg/kg	DETS 068*				
Naphthalene	mg/kg	DETS 068*				
1,2,3-trichlorobenzene	mg/kg	DETS 068*				
Trichloroethylene	mg/kg	DETS 068*				
Chloroform	mg/kg	DETS 068*				
Bromochloromethane	mg/kg	DETS 068*				
2,2-dichlororopane+1,2-dichloroethylene	mg/kg	DETS 068*				
1,1-dichloroethane	mg/kg	DETS 068*				
1,2-dichloroethane	mg/kg	DETS 068*				
Benzene	mg/kg	DETS 068*				
Carbon tetrachloride + 1,1-dichloropropene	mg/kg	DETS 068*				
Trans-1,2-dichloroethylene	mg/kg	DETS 068*				
Methylene Chloride	mg/kg	DETS 068*				
1,1 Dichloroethylene	mg/kg	DETS 068*				
1,1,1-trichloroethane	mg/kg	DETS 068*				

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051

Client Ref: 40274

Contract Title: Warren Hall

		Lab No.	115746
		Sample Ref	TP15
		Depth	0.30
		Other Ref	
		Sample Type	
Test	**Units**	**DETSxx**	
Arsenic	mg/kg	DETS 042#	7
Cadmium	mg/kg	DETS 042	0.9
Chromium	mg/kg	DETS 042	19
Copper	mg/kg	DETS 042	14
Lead	mg/kg	DETS 042	18
Mercury	mg/kg	DETS 081*	< 0.3
Nickel	mg/kg	DETS 042	20
Selenium	mg/kg	DETS 042	< 0.3
Zinc	mg/kg	DETS 042#	51
Boron (water soluble)	mg/kg	DETS 020#	0.5
Cyanide free	mg/kg	DETS 067#	< 0.1
Sulphate Aqueous Extract as SO4	g/l	DETS 076#	0.01
pH		DETS 008#	8.4
Aliphatic C5-C6	mg/kg	DETS 072*	
Aliphatic C6-C8	mg/kg	DETS 072*	
Aliphatic C8-C10	mg/kg	DETS 072*	
Aliphatic C10-C12	mg/kg	DETS 072*	
Aliphatic C12-C16	mg/kg	DETS 072*	
Aliphatic C16-C21	mg/kg	DETS 072*	
Aliphatic C21-C35	mg/kg	DETS 072*	
Aromatic C5-C7	mg/kg	DETS 072*	
Aromatic C7-C8	mg/kg	DETS 072*	
Aromatic C8-C10	mg/kg	DETS 072*	
Aromatic C10-C12	mg/kg	DETS 072*	
Aromatic C12-C16	mg/kg	DETS 072*	
Aromatic C16-C21	mg/kg	DETS 072*	
Aromatic C21-C35	mg/kg	DETS 072*	
Aliphatic C5-C35	mg/kg	DETS 072*	
Aromatic C5-C35	mg/kg	DETS 072*	
TPH Ali/Aro	mg/kg	DETS 072*	

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	115746
		Sample Ref	TP15
		Depth	0.30
		Other Ref	
		Sample Type	
Test	**Units**	**DETSxx**	
Acenaphthene	mg/kg	DETS 050	< 0.1
Acenapthylene	mg/kg	DETS 050	< 0.1
Anthracene	mg/kg	DETS 050	< 0.1
Benzo(a)anthracene	mg/kg	DETS 050	< 0.1
Benzo(a)pyrene	mg/kg	DETS 050	< 0.1
Benzo(b)fluoranthene	mg/kg	DETS 050	< 0.1
Benzo(k)fluoranthene	mg/kg	DETS 050	< 0.1
Benzo(g,h,i)perylene	mg/kg	DETS 050	< 0.1
Chrysene	mg/kg	DETS 050	< 0.1
Dibenzo(a,h)anthracene	mg/kg	DETS 050	< 0.1
Fluoranthene	mg/kg	DETS 050	< 0.1
Fluorene	mg/kg	DETS 050	0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	< 0.1
Napthalene	mg/kg	DETS 050	0.1
Phenanthrene	mg/kg	DETS 050	< 0.1
Pyrene	mg/kg	DETS 050	< 0.1
PAH	mg/kg	DETS 050	< 5.0
Benzene	mg/kg	DETS 062#	
Ethylbenzene	mg/kg	DETS 062#	
Toluene	mg/kg	DETS 062#	
Xylene	mg/kg	DETS 062#	
Phenol - Monohydric	mg/kg	DETS 067#	< 0.3
PCB	mg/kg	DETS 052*	
2,2',4,4',5,5'-Hexachlorobiphenyl PCB 153	mg/kg	DETS 052*	
2,3',4,4',5-Pentachlorobiphenyl PCB 118	mg/kg	DETS 052*	
2,2',3,4,4',5,5'-Heptachlorobiphenyl PCB 180	mg/kg	DETS 052*	
2,2',3,4,4',5'-Hexachlorobiphenyl PCB 138	mg/kg	DETS 052*	
2,2',4,5,5'-Pentachlorobiphenyl PCB 101	mg/kg	DETS 052*	
2,4,4'-Trichlorobiphenyl PCB 28	mg/kg	DETS 052*	
2,2',5,5'-Tetrachlorobiphenyl PCB 52	mg/kg	DETS 052*	
Total VOC's	mg/kg	DETS 068*	
1,2-dichloropropane	mg/kg	DETS 068*	
Dibromomethane	mg/kg	DETS 068*	
Bromodichloromethane	mg/kg	DETS 068*	
cis-1,3-dichloropropene	mg/kg	DETS 068*	
Toluene	mg/kg	DETS 068*	
trans-1,3-dichloropropene	mg/kg	DETS 068*	
1,1,2-trichloroethane	mg/kg	DETS 068*	
Tetrachloroethylene	mg/kg	DETS 068*	
1,3-dichloropropane	mg/kg	DETS 068*	
Dibromochloromethane	mg/kg	DETS 068*	
1,2-dibromoethane	mg/kg	DETS 068*	
Chlorobenzene	mg/kg	DETS 068*	
Ethylbenzene+1,1,1,2-tetrachloroethane	mg/kg	DETS 068*	
m+p-Xylene	mg/kg	DETS 068*	

Summary of Chemical Analysis
Soil Samples

Our Ref: 08-17051
Client Ref: 40274
Contract Title: Warren Hall

		Lab No.	115746
		Sample Ref	TP15
		Depth	0.30
		Other Ref	
		Sample Type	
Test	**Units**	**DETSxx**	
o-Xylene	mg/kg	DETS 068*	
Styrene	mg/kg	DETS 068*	
Bromoform	mg/kg	DETS 068*	
Isopropylbenzene	mg/kg	DETS 068*	
Bromobenzene	mg/kg	DETS 068*	
1,2,3-trichloropropane	mg/kg	DETS 068*	
n-propylbenzene	mg/kg	DETS 068*	
2-chlorotoluene	mg/kg	DETS 068*	
1,3,5-trimethylbenzene	mg/kg	DETS 068*	
4-chlorotoluene	mg/kg	DETS 068*	
Tert-butylbenzene	mg/kg	DETS 068*	
1,2,4-trimethylbenzene	mg/kg	DETS 068*	
sec-butylbenzene	mg/kg	DETS 068*	
1,3-dichlorobenzene+p-isopropyltoluene	mg/kg	DETS 068*	
1,4-dichlorobenzene	mg/kg	DETS 068*	
n-butylbenzene	mg/kg	DETS 068*	
1,2-dichlorobenzene	mg/kg	DETS 068*	
1,2-dibromo-3-chloropropane	mg/kg	DETS 068*	
1,2,4-trichlorobenzene	mg/kg	DETS 068*	
Hexachlorobutadiene	mg/kg	DETS 068*	
Naphthalene	mg/kg	DETS 068*	
1,2,3-trichlorobenzene	mg/kg	DETS 068*	
Trichloroethylene	mg/kg	DETS 068*	
Chloroform	mg/kg	DETS 068*	
Bromochloromethane	mg/kg	DETS 068*	
2,2-dichlororopane+1,2-dichloroethylene	mg/kg	DETS 068*	
1,1-dichloroethane	mg/kg	DETS 068*	
1,2-dichloroethane	mg/kg	DETS 068*	
Benzene	mg/kg	DETS 068*	
Carbon tetrachloride + 1,1-dichloropropene	mg/kg	DETS 068*	
Trans-1,2-dichloroethylene	mg/kg	DETS 068*	
Methylene Chloride	mg/kg	DETS 068*	
1,1 Dichloroethylene	mg/kg	DETS 068*	
1,1,1-trichloroethane	mg/kg	DETS 068*	

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CERTIFICATE OF ANALYSIS

Certificate Number : 08-17123_M01

Client Reference :	40274	13/02/2008
Our Reference :	08-17123	
Clients Name :	Ian Farmer Associates	
Clients Address:	17 Rivington Court Hardwick Grange Woolston Warrington Cheshire	
Contract Title :	Warren Hall	
Description :	7 Soil Samples, 7 Leachate Samples	
Date Received :	04/02/2008	
Date Commenced :	04/02/2008	
Date Completed :	13/02/2008	
Test Procedures :	Identified by Prefix DETSn , Details available upon request.	
Notes :	* Denotes test not included in laboratory scope of accreditation Observations and Interpretations are Outside the UKAS Accreditation Scope Samples will be disposed of 1 month after the date of issue of test certificate.	

Approved By:

Authorised Signatories	R Bennett Director	R Brown Business Manager	M Hopgood Technical Manager	

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 received by the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Certificate of Analysis

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Date: 19/02/2008

Certificate Number: 08-17279

Client:	Ian Farmer Associates 17 Rivington Court Hardwick Grange Woolston Warrington Cheshire WA1 4RT
Our Reference:	08-17279
Client Reference:	40274
Contract Title:	Warren Hall
Description:	6 water samples
Date Received:	08/02/2008
Date Started:	08/02/2008
Date Completed:	19/02/2008
Test Procedures:	Identified by prefix DETSn, details available upon request.
Notes:	Observations and interpretations are outside the scope of UKAS accreditation * denotes test not included in laboratory scope of accreditation # denotes test that holds MCERT accreditation $ denotes tests completed by approved subcontractors I/S denotes insufficient sample to carry out test N/S denotes that the sample is not suitable for testing Solid samples will be disposed 1 month and liquids 2 weeks after the date of issue of this test certificate
Approved By:	R. Bennett
Authorised Signatories:	Richard Bennett Director

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Summary of Chemical Analysis
Water Samples

Our Ref: 08-17279
Client Ref: 40274
Contract Title: Warren Hall

Test	Units	Lab No.	117200	117201	117202	117203	117204	117205
		Sample Ref	BH02	BH03	BH04	BH09	BH11	BH13
		Depth						
		Other Ref						
		Sample Type						
		DETSxx						
Arsenic Dissolved	ug/l	DETS 010	< 1	< 1	< 1	< 1	< 1	< 1
Cadmium Dissolved	ug/l	DETS 042	< 2	< 2	< 2	< 2	< 2	< 2
Chromium Dissolved	ug/l	DETS 042	< 10	< 10	< 10	< 10	< 10	< 10
Copper Dissolved	ug/l	DETS 042	2	4	2	3	2	2
Lead Dissolved	ug/l	DETS 042	< 5	< 5	< 5	< 5	< 5	< 5
Mercury Dissolved	ug/l	DETS 078*	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel Dissolved	ug/l	DETS 042	< 10	< 10	< 10	< 10	< 10	< 10
Selenium Dissolved	ug/l	DETS 017	< 3	< 3	< 3	< 3	< 3	< 3
Zinc Dissolved	ug/l	DETS 042	15	16	79	42	18	33
Sulphate	mg/l	DETS 055	150	78	89	49	64	130
Boron	ug/l	DETS 020	< 100	< 100	< 100	< 100	< 100	< 100
Cyanide total	ug/l	DETS 067	< 40	< 40	< 40	< 40	< 40	< 40
Hardness	mg/l	DETS 043*	360	290	330	310	470	370
Sulphur (free)	ug/l	DETS 049	< 90	< 90	< 90	< 90	< 90	< 90
pH		DETS 008	7.5	7.5	7.4	7.4	7.4	7.5
Acenaphthene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenapthylene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(g,h,i)perylene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenzo(a,h)anthracene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	0.02	< 0.01	< 0.01
Fluorene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-c,d)pyrene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Napthalene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01	0.01	< 0.01
Phenanthrene	ug/l	DETS 074*	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	ug/l	DETS 074*	< 0.01	0.02	0.02	0.07	0.01	0.05
PAH	ug/l	DETS 074*	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
PRO (C6-C10)	ug/l	DETS 062*	< 1	< 1	< 1	< 1	< 1	< 1
TPH (C10-C14)	ug/l	DETS 051	< 10	< 10	< 10	< 10	< 10	< 10
TPH (C15-C36)	ug/l	DETS 051	11	< 10	18	87	10	10
TPH (C10-C40)	ug/l	DETS 051	11	< 10	18	87	10	10

APPENDIX 5

GAS AND GROUNDWATER MONITORING

Gas and Groundwater Monitoring Results

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

Contract Number:	*W08 40274*
Contract Name:	*Warren Hall Site, Broughton*
Date:	*1st February 2008*

Background Readings:								
O_2% v/v	*19.3*	CO_2% v/v	*0.0*	CH_4% v/v	*0.0*	H_2S ppm	*0.0*	
Weather Conditions:				*Snowing*				
Ground Conditions (dry / wet etc)				*Wet*				
Atmospheric Pressure (Start)				*990mb*				
Atmospheric Pressure (Finish)				*990mb*				

Hole No:	VOC ppm	O_2% v/v Steady	CO_2%v/v Steady	$CH_{4\%}$ v/v Peak	$CH_{4\%}$ v/v Steady	LEL Steady	H²S ppm Steady	Gas flow Rate (l/hr) Range	Depth to base of well mBGL	SWL mBGL
BH01		*20.3*	*0.6*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*3.40*	*1.00*
BH02		*18.0*	*3.9*	*0.0*	*0.0*	*0.0*	*0.0*	*0.4*	*3.20*	*0.70*
BH03		*20.4*	*0.4*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*5.70*	*2.00*
BH04		*20.8*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*12.0*	*2.40*
BH05		*20.8*	*0.1*	*0.0*	*0.0*	*0.0*	*0.0*	*-0.2*	*7.90*	*1.70*
BH06		*Installation damaged*								
BH07		*19.7*	*1.5*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*10.90*	*1.70*
BH08		*19.7*	*0.5*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*11.90*	*2.40*
BH09		*20.9*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*10.40*	*3.00*
BH10		*21.3*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*3.90*	*0.40*
BH11		*21.2*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*6.70*	*1.00*
BH12		*5.0*	*4.1*	*0.0*	*0.0*	>>>>	*0.0*	*0.3*	*4.60*	*1.00*
BH13										
BH14										
BH15										
BH16										
BH17										

Remarks:

>>>> = Flow above detection limit of 30 l/hr, <<< = Negative flow greater than -10 l/hr.

Readings Taken By:	*CR*
Checked By:	

Gas and Groundwater Monitoring Results

Geotechnical & Environmental Specialists

Contract Number:	*W08 40274*
Contract Name:	*Warren Hall Site, Broughton*
Date:	*1st February 2008*

Background Readings:								
O_2% v/v	*19.3*	CO_2% v/v	*0.0*	CH_4% v/v	*0.0*	H_2S ppm	*0.0*	
Weather Conditions:								
Ground Conditions (dry / wet etc)								
Atmospheric Pressure (Start)								
Atmospheric Pressure (Finish)								

Hole No:	VOC ppm	O_2% v/v	CO_2%v/v	$CH_{4\%}$ v/v		LEL	H²S ppm	Gas flow Rate (l/hr)	Depth to base of well	SWL
		Steady	Steady	Peak	Steady	Steady	Steady	Range	mBGL	mBGL
BH13		*19.6*	*0.7*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*3.80*	*1.00*
BH14		*FLOODED*								
BH15		*FLOODED*								
BH16		*21.3*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*6.0*	*1.00*
BH17		*FLOODED*								

Remarks: Installation damaged

>>>> = Flow above detection limit of 30 l/hr, <<< = Negative flow greater than -10 l/hr.

Readings Taken By:	*CR*
Checked By:	

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

Gas and Groundwater Monitoring Results

Contract Number:	*W08 40274*
Contract Name:	*Warren Hall Site, Broughton*
Date:	*15th February 2008*

Background Readings:		
O_2% v/v	*21.5*	
CO_2% v/v	*0.0*	
CH_4% v/v	*0.0*	
H_2S ppm	*0.0*	
Weather Conditions:	*Cloudy*	
Ground Conditions (dry / wet etc)	*Wet*	
Atmospheric Pressure (Start)	*1035mb*	
Atmospheric Pressure (Finish)	*1038mb*	

Hole No:	VOC ppm	O_2% v/v Steady	CO_2%v/v Steady	$CH_{4\%}$ v/v Peak	$CH_{4\%}$ v/v Steady	LEL Steady	H²S ppm Steady	Gas flow Rate (l/hr) Range	Depth to base of well mBGL	SWL mBGL
BH01		*21.4*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*3.40*	*1.00*
BH02		*22.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*	*3.20*	*1.00*
BH03		*21.3*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*5.70*	*1.60*
BH04		*22.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*12.0*	*2.00*
BH05		*21.6*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.2*	*7.90*	*1.40*
BH06		*Installation damaged*								
BH07		*20.4*	*1.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*10.90*	*1.50*
BH08		*20.3*	*0.3*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*11.90*	*2.70*
BH09		*21.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*10.40*	*3.50*
BH10		*22.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*3.90*	*0.40*
BH11		*21.5*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*6.70*	*2.00*
BH12		*21.8*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*4.60*	*2.30*
BH13		*20.2*	*0.6*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*3.80*	*2.00*
BH14		*22.1*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*2.20*	*0.30*
BH15		*21.5*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*10.0*	*1.00*
BH16		*21.4*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*6.0*	*0.80*
BH17		*21.9*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*7.80*	*0.30*

Remarks:

>>>> = Flow above detection limit of 30 l/hr, <<< = Negative flow greater than -10 l/hr.

Readings Taken By:	
Checked By:	

WELSH ASSEMBLY GOVERNMENT

WARREN HALL,
BROUGHTON

INTERPRETATIVE REPORT ON GROUND INVESTIGATION: DEVELOPMENT PLATEAUS

Contract: W08/40274-3

Date: March 2008

Ian Farmer Associates (1998) Limited

17 Rivington Court, Warrington, Cheshire, WA1 4RT

Tel: 01925 855 440

Fax: 01925 855 441

INTERPRETATIVE REPORT ON GROUND INVESTIGATION:

DEVELOPMENT PLATEAUS

carried out at

WARREN HALL,

BROUGHTON

Prepared for

WELSH ASSEMBLY .
Unit 7
Ffordd Richard Davies
St Asaph Business Park
St Asaph
LL17 0LJ

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17 Rivington Court, Warrington, Cheshire, WA1 4RT
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Fax: 01925 855 441

EXECUTIVE SUMMARY

On the instructions of Opus Consulting Engineers, on behalf of Welsh Assembly Government, an interpretative report has been prepared to discuss the geotechnical and contamination issues relating to the Warren Hall development area.

The site comprises an area of agricultural grazing land of about 34 hectares with topography falling towards the east.

Site preparation proposals comprise large-scale cut and fill earthworks. Office construction is planned for the development platforms created.

Geological records and a series of ground investigations have established the ground conditions as clay with subordinate sand and gravel overlying a sequence of interbedded mudstone, siltstone and sandstone. The boundary between the soil and rock generally falls towards the east, mirroring the overall topography. An area of deeper soil strata towards the northeast corner of the site may indicate a buried channel type feature.

The maximum height cuttings on Plateau A will generally require excavation of about 3 or 4m of clay and about 5 or 6m of rock. Excavation on Plateau B will generally be in soils with occasional bedrock.

Groundwater flows are expected from cut faces where the boundary between soil and rock is encountered and as seepages within soils.

Excavated materials will be suitable for use as Type 1 / 2 general fill or Type 6 / 7 structural fill.

Embankment areas should be prepared by the removal of topsoil and the placement of a granular drainage layer on the exposed formation.

Embankments up to 6m in height are anticipated. The estimated total and differential settlements below embankments are not likely to be of sufficient magnitude to affect the development programme or require post construction monitoring.

Preliminary design of shallow spread foundations may anticipate bearing capacities of about 100kN/m^2 in clay and properly engineered embankment fill. Significantly higher bearing capacities will be available in rock. Foundations may require extending by trench fill where strata types vary laterally.

Preliminary design of roads may be based on a CBR of 5% in natural strata and 2% on embankment fill.

Concrete at shallow depths may be designed on the basis of DS-1.

For the purposes of the contamination risk assessment, the results of the soil

analyses have been compared to the CLEA SGVs where available, or alternatively, Generic Assessment Criteria (GAC), determined by LQM and CIEH in accordance with current legislation and guidance.

The investigations have not indicated the presence of contamination that would pose a significant risk to site users or the water environment.

In the absence of a contamination source it is considered that systematic remediation, validation and reporting is not required as part of this development.

Methane has been detected in concentrations that may require gas protection measures in buildings. Additional monitoring is required to clarify the gas regime and any gas protection measures.

CONTENTS

1.0 INTRODUCTION

1.1 It is understood that it is proposed carry out a ground re-modelling exercise at the site to provide two sensibly level platform areas for future office building development.

1.2 On the instructions of Opus International (UK) Ltd., Consulting Engineers to the Welsh Assembly Government, an interpretative report has been prepared based upon the findings of the desk study, intrusive investigations and laboratory testing. The interpretative report has been prepared to provide conclusions and recommendations for the design and construction of the proposed works.

1.3 This report has been prepared for the sole use of the Client for the purpose described and no extended duty of care to any third party is implied or offered. Third parties using any information contained within this report do so at their own risk.

1.4 The comments given in this report and the opinions expressed herein are based on the information received, the conditions encountered during site works, and on the results of tests made in the field and laboratory. However, there may be conditions prevailing at the site which have not been disclosed by the investigation and which have not been taken into account in the report.

1.5 The comments on groundwater conditions are based on observations made at the time the site work was carried out. It should be noted that groundwater levels vary owing to seasonal or other effects.

2.0 EXISTING INFORMATION

2.1 This report is based upon the following information:

- Ian Farmer Associates (1998) Ltd. Warren Hall, Broughton. Factual report on Ground Investigation. Reference W08/40274. February 2008.
- Ian Farmer Associates (1998) Ltd. Warren Hall, Broughton. Report on Phase 1 Desk Study. Reference W07/40274-1. February 2008.
- Exploration Associates Ltd. Warren Hall – Highway Infrastructure. Factual Report on Ground Investigation. Reference 125001. April 1995.
- Stats Ltd. Warren Hall Park, Broughton. Report on Ground Investigation. Reference M1459. July 1989.

2.2 Relevant information from the above reports has been summarised within this current report.

2.3 The full information used as the basis for the conclusions and recommendations made in this report should be read in conjunction with this report.

3.0 SITE SETTING

3.1 Site Location

3.1.1 The site is situated immediately to the southwest of Broughton, Flintshire, and may be located by National Grid reference SJ 327 631. A site location plan is included in Appendix 1, Figure A1.1.

3.2 Site Description

3.2.1 The site comprises an area, elongated from north to south, extending to some 34 hectares. The overall length of the site is some 800m with a maximum width of about 500m, towards the southern end, and an average width of about 300m.

3.2.2 The site is bounded to the northwest by the A5104 trunk road, immediately adjacent to the Warren Bank Interchange, to the northeast and east by Lesters Lane and to the south and west by adjoining agricultural grazing land.

3.2.3 At the time of the investigation the site comprised agricultural grazing land with occasional mature deciduous trees. The site area was split into fields by hedgerows. The general fall of ground across the site was from west to east.

3.2.4 For the purposes of development the site has been subdivided into Plateau A and Plateau B.

3.2.5 Plateau A occupies the northern and eastern parts of the site, adjacent to Lesters Lane. Plateau A is approximately rectangular in shape, elongated from north to south, with approximate dimensions of 800m by 300m.

3.2.6 The elevations across Plateau A ranged from about 65mAOD at the northwest corner to about 37mAOD along the eastern side of the area. The overall gradients vary across the area. The northern part of Plateau A falls towards the east with gradients of about 1 in 20, the central area about 1 in 15 and the southern area about 1 in 40.

3.2.7 Plateau B occupies an approximately rectangular area to the west of the southern and central part of Plateau A. Plateau B has approximate dimensions of about 300m, north to south, and 200m west to east.

3.2.8 The elevations across Plateau B ranged form about 63mAOD around the northwest corner to about 50mAOD towards the southeast corner.

3.2.9 A site plan is included in Appendix 1, Figure A1.2.

3.3 Geological Setting

3.3.1 Details of the geology underlying the site have been obtained from the British Geological Survey map, Sheet No. 108, ‘Flint’, solid and drift edition, 1:50,000 scale, published 1999.

3.3.2 The geological map indicates the site to be underlain by superficial deposits of stoney clay till and glaciofluvial deposits, undifferentiated, sand and gravel which lay to the south of the site. The map also indicates made ground on top of natural ground at the centre of the site.

3.3.3 The superficial deposits are underlain by Arnsbergian to Kinderscoutian Marsdenian grey mudstones with marine bands and thin sandstones of Namurian Upper Carboniferous (Silesian).

3.4 Hydrogeological Setting

3.4.1 The site hydrogeological setting has been presented in the Phase 1 Desk Study and the classification may be summarised as strata of a minor aquifer overlain by soils of high leaching potential.

3.5 Hydrological Setting

3.5.1 The site hydrological setting has been presented in the Phase 1 Desk Study and the classification may be summarised as a small surface water stream, Warren Dingle, along the southern edge of the site. There are no surface water abstractions within 1km of the site.

3.6 Radon

3.6.1 The radon classification has been presented in the Phase 1 Desk Study.

3.6.2 The information obtained was contradictory and therefore it is unlikely that a single level of radon risk can be determined for the site as a whole.

3.7 Environmental setting

3.7.1 The site environmental setting has been presented in the Phase 1 Desk Study.

3.7.2 The desk study did not reveal any significant risks arising from the environmental setting of the site with the exception of the possible presence of made ground of unknown origin.

3.7.3 The desk study noted a potential risk if made ground was present at the site and contained elevated concentrations of contamination.

3.8 Geological Constraints

3.8.1 Recorded geological constraints on the development of the site have been presented in the Phase 1 Desk Study.

3.8.2 The desk study did not reveal any significant risks arising from geological constraints with respect to the development of the site.

3.9 Site History

3.9.1 The history of the site, based on readily available historical maps has been presented in the Phase 1 desk study.

3.9.2 The historical maps indicated that the site has remained as agricultural land for the last 140 years.

3.9.3 The desk study did not reveal any significant risks arising from the site history with respect to the development of the site.

4.0 SITE WORK

4.1 Three ground investigations have been carried out relating to the general site area.

4.2 The most recent site work site work was carried out between 9th and 18th January 2008 by Ian Farmer Associates and comprised the following:

- Seventeen cable percussion boreholes designated BH01 to BH17
- Ten boreholes, BH04 to BH10, and BH15 to BH17 extended by rotary coring techniques
- Seventeen window sampler boreholes, designated WS01-WS17
- Monitoring standpipes installed in thirteen boreholes, BH01 to BH12 and WS10
- Eighteen dynamic probes, designated DP01 to DP18
- Fifteen machine excavated trial pits, designated TP01 to TP15
- In-situ Californian Bearing Ratio tests and probing by TRL methods at all trial pit locations
- Gas and groundwater levels recorded on six occasions following site works

4.3 The exploratory holes carried out under this current investigation were divided between the development areas as follows:

- Plateau A: BH3 to BH17, WS6 to WS17, DP6 to DP17 and TP4 to TP15
- Plateau B: BH1, BH2, WS1 to WS5, DP1 to DP5 and TP1 to TP3

4.4 In 1995 a ground investigation was carried out by Exploration Associates comprising the following:

- Twelve cable percussion boreholes designated BH1 to BH12
- Monitoring standpipes installed in five boreholes
- Twenty seven machine excavated trial pits, designated TP1 to TP27
- In-situ Californian Bearing Ratio tests

4.5 The ground investigation carried out by Exploration Associates was not coincident with the subject area of the current investigation. The investigation was carried out around the main junction area, to the north of the site, and southwards along the eastern edge of Plateau A. The investigation was carried out immediately adjacent to Lesters Lane. The exploratory holes approximately relate to the current plateau areas as follows:

- Eastern edge of Plateau A: Trial pits TP1 to 14 including TP11A and CBR tests C1 to C11. Records have not been received for trial pits TP1, 2, 11A and 12.

4.6 In 1989 a ground investigation was carried out by Stats Ltd. comprising the following:

- Nine cable percussion boreholes designated BH1, BH3 to BH8, BH4a and BH5a
- Eighteen machine excavated trial pits, designated TP01 to TP18

4.7 The ground investigation carried out by Stats Ltd. extended to a greater area than the subject area of the current investigation. The exploratory holes approximately relate to the current plateau areas as follows:

- Plateau A: Boreholes BH1, 3, 5 and 5a and trial pits TP1 to 6
- Plateau B: Boreholes BH4, 4a and 6 and trial pits TP5, 8 and 9

4.8 In order to maintain clarity within this report any references to exploratory holes carried out under the current investigation will have no prefix, exploratory holes carried out by Exploration Associates will have the prefix “E” and exploratory holes carried out by Stats Ltd. will have the prefix “S”.

5.0 LABORATORY TESTS

5.1 Geotechnical Testing

5.1.1 Geotechnical testing has been carried out as part of each of the ground investigations listed in Section 2.1 above. The range of tests carried out are indicated in the table below:

Geotechnical test	IFA	Ex. Ass	Stats
Natural moisture content	Yes	Yes	Yes
Plasticity indices	Yes	Yes	Yes
Bulk Density	Yes	Yes	Yes
Particle size distribution	Yes	Yes	Yes
Undrained triaxial compression	Yes	Yes	Yes
Oedometer consolidation	Yes	Yes	Yes
Dry density / moisture content relationship	Yes	Yes	Yes
California Bearing Ratio (CBR)	Yes	Yes	Yes
MCV	No	Yes	No
pH value	Yes	Yes	Yes
Total sulphate content	No	Yes	No
Water soluble sulphate content	Yes	No	Yes
Groundwater sulphate content	Yes	No	Yes

5.2 Chemical Testing

5.2.1 Chemical testing was carried out as part of the current investigation.

5.2.2 An analytical testing suite of commonly occurring contaminants was carried out on fifty-six samples of soil, seven samples of leachate and six samples of water.

5.2.3 Chemical testing was not carried out as part of the previous investigations.

6.0 GROUND CONDITIONS ENCOUNTERED

6.1 Previous Investigations

6.1.1 The investigation carried out by Stats in 1989 encountered the sequence and indicative thicknesses of strata, within the current site area, summarised below:

Strata Encountered	Depth Encountered (m)		Strata Thickness (m)
	From	To	
Top soil	0	0.20 – 0.30	0.20 – 0.30
Firm and stiff CLAY	Absent – 0.30	1.60 – 6.00	1.35 – 5.10
SAND with gravel	Locally present with thicknesses up to 2.70m		
Mudstone / sandstone bedrock	0.80 – 6.00		Not proved

6.1.2 The investigation carried out by Exploration Associates in 1995 encountered the sequence and indicative thicknesses of strata, along the eastern edge of the current Plateau A, summarised below:

Strata Encountered	Depth Encountered (m)		Strata Thickness (m)
	From	To	
Top soil	0	0.15 - 0.40	0.15 – 0.40
Made ground	0.15	2.10	1.95
Firm and stiff CLAY	0.15 – 0.40	0.80 – 3.40	0.50 – 1.80
SAND with gravel	Locally present with thicknesses up to 2.30m		
Mudstone / sandstone bedrock	0.80 – 2.10		Not proved

6.2 Current Investigation

6.2.1 The current investigation encountered the sequence and indicative thicknesses of strata are indicated on the nominal cross sections in Appendix 1 and summarised below:

Strata Encountered	Depth Encountered (m)		Strata Thickness (m)
	From	To	
Top soil	0	0.20 – 0.60	0.20 – 0.60
Made ground	0 – 0.30	1.50 – 2.50	0.60 – 2.00
Firm and stiff CLAY	0.20 – 0.50	0.70 – 5.80	0.40 – 4.20
SAND / GRAVEL	Locally present with proved thicknesses up to 5.80m		
Mudstone / sandstone bedrock	0.50 – 14.20		Not proved

6.2.2 The investigations have proved a mantle of drift deposits across the site overlying bedrock.

6.2.3 The drift deposits do not appear to show systematic variation in thickness across the site although a channel, represented by substantially deeper drift deposits, may be present extending from the centre of the site towards the northeast corner.

6.3 Topsoil

6.3.1 Topsoil was encountered throughout the site areas as a thin veneer with thicknesses between 0.15m and 0.60m.

6.4 Made ground

6.4.1 Made ground was encountered locally across the site.

6.4.2 Across Plateau A made ground appeared to be present towards the northeast and east central areas and absent from the northwest and southern areas.

6.4.3 Across Plateau B made ground was only encountered in TP3, on the southern part of the area, as a thin layer beneath topsoil.

6.4.4 Made ground predominantly comprised clay with secondary gravel. Made ground comprised sand in TP8. The made ground appears to comprise reworked locally won materials.

6.5 Clay

6.5.1 The majority of the soil strata encountered across the site comprised clay.

6.5.2 The clay encountered may generally be described as brown slightly sandy, slightly gravely clay. Cobbles were locally noted.

6.5.3 The consistency of the clay was variously described as soft, firm and stiff. Soft clay appeared to be present either directly beneath topsoil or adjacent to granular deposits or rock.

6.6 Sand / Gravel

6.6.1 Sand and gravel was encountered across the site generally interbedded as layers within the clay.

6.6.2 The distribution of granular strata across the site did not appear to be systematic either laterally or vertically.

6.6.3 The greatest thicknesses of granular strata, in excess of 5m, were encountered in BH11 and BH17 towards the northeast corner of the site.

6.7 Bedrock

6.7.1 Rock was encountered across the site. Rock variably comprised sandstone, siltstone and mudstone. The depth to rockhead varied across the site from 0.50m to 14.20m. The average thickness of drift deposits, based on the proved rockhead depths was about 3.50m.

6.7.2 The elevation of the rockhead falls across the site towards the east.

6.7.3 The rock head elevations across the southern part of Plateau A fall from about 50mAOD to about 38mAOD adjacent to Lesters Lane. Beneath the northern part of Plateau A the rockhead levels fall from about 55mAOD to about 28mAOD adjacent to Lesters Lane.

6.7.4 There appears to be a channel type feature, in the rockhead profile, that extends from the central part of Plateau A towards the northeast corner of the site.

6.7.5 The rockhead beneath Plateau B appears to undulate between elevations of about 55mAOD increasing to about 58mAOD adjacent to the western boundary.

6.8 Groundwater

6.8.1 Groundwater was encountered as seepages within drift deposits at depths between about 0.50m and 2.50m. Typically these seepages occurred from sand or silt layers.

6.8.2 Groundwater was encountered at the boundary between drift deposits and bedrock at depths between 2.50m and 6.50m. The groundwater encountered at this boundary generally had a slight pressure head of up to about 1m when encountered during drilling.

6.8.3 Groundwater depths monitored subsequent to fieldworks varied between about 0.40m and 2.70m.

7.0 ASSESSMENT OF STRATA CONDITIONS

7.1 Assessment of Strata Conditions

7.1.1 The soil strata encountered on site were principally cohesive in nature and contained differing proportions of secondary constituents varying in size from sand to cobbles. Sand and gravel, with local variations in grading, were also encountered. Bedrock lies beneath drift deposits. The material types are similar across both Plateau A and B and are therefore discussed together below.

7.1.2 Plasticity indices indicate that the clay strata are predominantly low plasticity. Locally clay of intermediate plasticity and silt of high plasticity were encountered. Natural moisture contents were generally about the plastic limit.

7.1.3 Laboratory measurements of bulk densities of the clay typically ranged from about 2.1 to 2.4Mg/m^3 with dry densities typically from about 1.8 to 2.1Mg/m^3.

7.1.4 Laboratory measurements of undrained shear strength, Cu, ranged from 45kN/m^2 to 287kN/m^2 with an overall mean of 126kN/m^2. These values correspond to consistencies of firm, stiff and very stiff. The Cu values do not indicate any systematic variation between strength and depth.

7.1.5 Work undertaken by Stroud, ref. 12.8 determined a relationship between SPT ‘N’ values and the undrained shear strengths of many over-consolidated clays. Further work by Stroud and Butler, ref. 12.9, in which data was analysed from sites covering a wide range of glacial deposits, confirmed there to be a correlation between the ‘N’ value, plasticity index and undrained shear strength.

7.1.6 The relationship was of the form:

$$Cu = F_1 \times N$$

where Cu = Undrained shear strength

F_1 = Factor

7.1.7 It was determined by Stroud that F_1 varied between 4kN/m² for material of high plasticity and 6kN/m² for material of low plasticity. It is considered that for the strata encountered on this site a value of F_1 = 5kN/m² would be appropriate.

7.1.8 SPT'N' values obtained in cohesive strata across the site ranged from 7 to 39 with an average of 16.

7.1.9 On this basis a range of Cu values between 35kN/m^2 and 195kN/m^2 with an average of 80kN/m^2 may be derived from the SPT data.

7.1.10 SPT'N' values obtained in granular strata across the site ranged from 7 to >50 indicating with a mean, for tests reaching full penetration, of 15. These values indicate relative densities in the range loose, medium dense, dense and very dense.

7.1.11 SPT 'N' values obtained in bedrock ranged from 22 to 50 blows for 20mm penetration corresponding to an extrapolated SPT 'N' values of 750. The overall average of SPT'N' values within bedrock was 245.

7.1.12 CIRIA Report 143 indicates that a relationship exists between SPT'N' value and unconfined compressive strength, $\sigma_{c,}$ of weak rocks. The relationship is acknowledged to be conservative and is therefore of the form:

$$\sigma_c > 10 \text{ x 'N' } (\text{kN/m}^2)$$

7.1.13 On this basis the strengths derived from SPT'N' values within the bedrock range from 0.22MPa to 7.5MPa corresponding to very weak, weak and moderately weak. The strength values vary with lithology and with depth of penetration into the rock.

7.1.14 Direct measurement of uniaxial compressive strength (UCS), carried out on samples recovered by coring, yielded results between 0.80MPa and 67MPa with an average of 30MPa. It should be noted that within the rock strata encountered typically only the most competent materials, with the fewest fractures, are suitable for UCS testing and therefore these values are likely to represent an upper bound value for the strata encountered.

7.1.15 Measurement of the strength of rock was also made by the point load test. The point load test derives a strength value, Is50(MPa), that may be approximately related to UCS by the following:

$$\text{UCS} = \text{Is50 x 24}$$

7.1.16 On this basis the UCS values derived from point load testing ranged from 1.2MPa to 57.6MPa. This range of values is similar to that derived from direct measurement of UCS.

8.0 ENGINEERING DISCUSSION AND RECOMMENDATIONS

8.1 Development Proposals

8.1.1 It is understood that it is proposed carry out a ground re-modelling exercise at the site to provide two development areas for future office building development.

8.1.2 The ground re-modelling will comprise relatively large scale cut and fill earthworks to produce a near level ground profile across Plateau A and a lesser degree of cut for the western site area to produce a similar area of near level ground, at a slightly higher elevation, that will constitute Plateau B.

8.1.3 The illustrative sections, provided by the Engineer, imply the possible excavation of materials to an approximate maximum depth of 9m along the western area of Plateau A and material excavation to depths of 2 to 3m across Plateau B.

8.1.4 It is proposed to re-use the excavated materials as embankment fill to raise the site levels along the eastern boundary by up to 6m so providing a near earthwork balance.

8.2 Earthworks: Cuttings

8.2.1 Earthworks will comprise the removal of material from the west side of Area A and the whole of Area B.

8.2.2 Excavation to depths of about 9m may be required along the west side of Plateau A. This would require the removal of between 3 and 4m of clay, locally with sand bands, and about 5 or 6m of bedrock. The bedrock comprised an interbedded sequence of mudstone, siltstone and sandstone.

8.2.3 Significant cut slopes will be formed along the western side of Plateau A. Along much of this cut the boundary between the drift deposits and the underlying bedrock will be exposed. Observations on groundwater during drilling and monitoring indicate that a spring line should be anticipated along this soil / bedrock boundary. In addition the exposure of sand or gravel layers within the soil strata may give rise to seepages from the soil slope.

8.2.4 Preliminary design of the cutting along the west side of Plateau A may be based on a slope of gradient 1 vertical to 1.5 horizontal within the bedrock and a gradient of 1 vertical to 2.5 horizontal within the overlying soil. The incorporation of a bench along the level of the soil / rock boundary would permit the incorporation of drainage measures to manage water from the spring line and permit access for maintenance of the soil slope. Additional drainage measures may be required within the soil slope to manage local seepages.

8.2.5 Excavation to depths of about 2 to 3m across Plateau B would predominantly require the removal of soil strata comprising clay, locally with significant sand layers. The excavation will locally encounter bedrock.

8.2.6 Preliminary design of cuttings around Plateau B may be based on a gradient of gradient of 1 vertical to 2. Drainage measures may be required within the soil slopes to manage local seepages.

8.2.7 Inspection of slopes should be carried out during excavation to ensure that design measures achieve adequate factors of safety with respect to local strata conditions.

8.2.8 Excavation of soil strata should be achievable by standard plant. The excavation of rock is likely to require the use of heavy duty ripping equipment and / or hydraulic breakers. The difficulty of rock excavation will increase with depth below rock head.

8.3 Earthworks: Re-use or export of materials

8.3.1 Particle size analysis of the soil strata indicate that the cohesive strata are suitable for use as Class 2, general cohesive fill, or Class 7, selected cohesive fill and that the granular strata are suitable for use as Class 1, general granular fill, or Class 6, selected granular fill.

8.3.2 Made ground, where locally encountered, generally comprised reworked clay and will therefore likely be suitable for use as Class 2 fill.

8.3.3 It is considered that sandstone will be suitable for use as Class 1 fill and may be suitable for use as Class 6 fill. The use of sandstone as Class 6 fill is likely to require crushing.

8.3.4 It is considered that mudstone will be suitable for use as Class 2 fill. The use of mudstone as Class 7 fill would require stabilisation by the addition of lime or cement.

8.3.5 Leachate testing of soil samples for waste acceptance criteria indicates that they would fall within the classification of “inert waste”.

8.4 Earthworks: Embankments

8.4.1 The preparation of the formation for embankments will require the removal of topsoil, typically encountered to about 0.30m depth. Any areas of soft, organic or otherwise deleterious material should also be removed.

8.4.2 Cross sections provided by the Engineer indicate maximum embankment heights up to about 6m along the eastern side of Plateau A.

8.4.3 It is considered that the preliminary design of embankments may be based on gradients of 1 vertical to 2 horizontal.

8.4.4 Assuming an average thickness of 3m of compressible clay strata the total maximum settlements beneath embankments will be along the eastern edge of the site and are likely to be in the order of 100mm. It is anticipated that approximately 50% of this settlement will occur during embankment construction.

8.4.5 The rate of consolidation will be dependent on the length of the drainage paths allowing the release of excess pore water pressure from the clay.

8.4.6 It is recommended that a layer of granular material be placed immediately above formation level to minimise the length of drainage paths and therefore the rate that consolidation settlement will occur.

8.4.7 Based on the presence of this drainage blanket at the base of the embankment maximum times for 90% of consolidation settlement to occur are estimated to be in the range 1 to 3 months.

8.4.8 The magnitude of settlement will reduce pro-rata with reduction of embankment thickness assuming a constant thickness of compressible strata.

8.4.9 The total settlements may approach the differential settlement in areas where the embankment is underlain by laterally adjacent cohesive and granular strata.

8.4.10 The post construction settlements indicated above are not considered to be of sufficient magnitudes to require the installation of post construction settlement monitoring.

8.5 Foundation Design

8.5.1 The results of laboratory tests indicate the clay strata may be considered to be of low and, locally, medium plasticity. Although the proposed buildings are not likely to be residential the classification system used by the National House Building Council, ref 12.10 and other published data, refs 12.11 and 12.12 provides a useful indication of minimum foundation depths. Based on these sources the clay is of low and medium volume change potential. Changes in moisture content may result in moderate changes in volume, seasonal changes being exacerbated by the presence of trees. Outside the zone of influence of proposed trees it is considered that a minimum depth of 0.90m should be applied to foundations within clay or clay fill.

8.5.2 The foundations across the site will encounter a variety of strata at shallow depth.

8.5.3 Foundation excavations along the western side of Plateau A will generally encounter bedrock. These strata will provide adequate bearing capacity for the use of shallow spread foundations.

8.5.4 Foundation excavations along the central part of Plateau A will predominantly encounter firm and stiff clay. Preliminary design of shallow spread foundations up to 1m in width may be based on an allowable bearing capacity of $100kN/m^2$. This would provide an adequate factor of safety against shear failure and limit consolidation settlements to the order of 20mm.

8.5.5 Foundation excavations along the eastern part of Plateau A will encounter embankment fill at shallow depths. The bearing capacity of this fill will be dictated by the method of emplacement. Laboratory compaction tests have indicated that maximum dry densities of about $1.8Mg/m^3$ are achievable at moisture contents about 15%. These values approach the in-situ values for the clay and suggest that similar bearing capacities should be achievable within the embankment fill as those indicated above for the in-situ clay.

8.5.6 Foundations spanning the boundary between bedrock and clay, may encounter some differential settlement. In this case it is recommended that the foundations are extended through clay to bear on the underlying bedrock.

8.5.7 If buildings are located close to the top of the embankment crest then detailed slope analysis should be carried out to determine the effect of building loads on slope stability.

8.5.8 The strata encountered at foundation depths on Plateau B will be bedrock, clay or sand. The bearing capacities indicated above may also be used for preliminary design of foundations in this area.

8.5.9 Piles may be considered in areas where high column loads are anticipated and the underlying strata are clay or embankment fill. Guidelines for the design of piles are given in Appendix 5.

8.5.10 The carrying capacity of piles depends not only on their size and the ground conditions but also on their method of installation. Therefore, it is recommended that specialist Piling Contractors be contacted as to the suitability and carrying capacity of their piles in the ground conditions pertaining to the site.

8.6 Excavations

8.6.1 On the basis of observations on site, together with the results of in-situ and laboratory tests, it is considered that excavations to less than 0.90m should stand unsupported in the short term. Side support for safety purposes should of course be provided to all excavations in excess of 0.90m deep in accordance with Health and Safety Regulations.

8.6.2 Groundwater seepages should be expected in shallow excavations for foundations or services. It is also possible that perched groundwater could be present in the strata overlying the clay. It is considered that this could be dealt with by pumping from sumps or diversion drainage.

8.6.3 Groundwater flows could be expected in excavations taken through the soil / bedrock boundary.

8.7 Road and Hard Standing Design

8.7.1 The structural design of a road or hard standing is based on the strength of the subgrade, which is assessed on the California Bearing Ratio, **CBR**, scale.

8.7.2 In situ CBR tests have recorded values in the range 7.4% to 19% for clay formation and 8.7% to 30% for sand formation.

8.7.3 Laboratory CBR tests have recorded values in the range 2.0% to 5.2% for clay.

8.7.4 In practice, the correlation given by the Highways Agency, ref. 12.13, also provides guidance figures for equilibrium CBR values for varying construction conditions.

8.7.5 It is considered that for formations prepared in natural soil strata a CBR value of about 5% may be adopted for preliminary design. Where formations are prepared in suitably compacted embankment fill a CBR value of 2% may be adopted for preliminary design.

8.7.6 Any areas of soft or deleterious material should be excavated and replaced with a properly compacted selected material.

8.8 Chemical Attack on Buried Concrete

8.8.1 The results of chemical tests indicate sulphate concentrations in the soil of between <0.1g/l and 0.4g/l as a 2:1 water/soil extract with pH values in the range of 4.8 to 8.2

8.8.2 The results of chemical tests indicate sulphate concentrations in groundwater of 0.04g/l and 0.07g/l with pH values of 8.2.

8.8.3 In accordance with the guidelines given in BRE Special Digest 1, ref. 12.14, the Aggressive Chemical Environment for Concrete (ACEC) classification for the site is AC-3z. Consequently buried concrete should conform to Design Sulphate Class DS-1.

8.8.4 It is recommended that for conventional shallow foundations, the groundwater should be regarded as mobile.

9.0 ENVIRONMENTAL RISK ASSESSMENT IN RELATION TO PROPOSED DEVELOPMENT

9.1 Contaminated Land

9.1.1 The statutory definition of contaminated land is defined in the Environmental Protection Act 1990, ref 12.15, which was introduced by the Environment Act 1995, ref 12.16;

- 'Land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that –
- significant harm is being caused or there is a significant possibility of such harm being caused; or
- significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused.'

9.2 Risk Assessment

9.2.1 The definition of contaminated land is based on the principles of risk assessment. Risk is defined as a combination of:

- The probability, or frequency of exposure to a substance with the potential to cause harm, and:
- The seriousness of the consequence.

9.3 Pollutant Linkage

9.3.1 The basis of an environmental risk assessment involves identifying a 'source' of contamination, a 'pathway' along which the contamination may migrate and a 'receptor' at risk from the contamination.

9.3.2 Current legislation defines the various elements of the pollution linkage as:

- A contaminant is a substance which is in or under the ground and which has the potential to cause harm or to cause pollution of controlled waters.
- A pathway is one or more routes through which a receptor is being exposed to, or affected by, a contaminant, or could be so affected.
- A receptor is either a living organism, an ecological system, a piece of land or property, or controlled water.

9.3.3 A pollutant linkage indicates that all three elements have been identified. The site can only be defined as 'Contaminated Land' if a pollutant linkage exists and the contamination meets the criteria in Section 9.1.1 above.

9.3.4 The guidance proposes a four-stage approach for the assessment of contamination and the associated risks. The four stages are listed below:

- Hazard Identification
- Hazard Assessment
- Risk Estimation
- Risk Evaluation

9.3.5 The hazard identification and hazard assessment have been based upon the Phase 1 Desk Study and formed the conceptual site model, detailed in our report, reference 40274-1, dated February 2008.

9.3.6 The risk assessment and evaluation stages are presented in this phase 2 interpretive report, after an intrusive ground investigation has taken place.

9.4 Risk Estimation - Humans

9.4.1 The proposed development consists of office / commercial buildings with associated access roads and car park areas. The risk assessment has therefore been based on guidelines for commercial / industrial. Should the proposed end-use of the site be changed in the future then further risk assessment may be required, particularly should a more sensitive end-use be envisaged.

9.4.2 The results of the soil analyses have been compared to the CLEA SGVs where available, or alternatively, Generic Assessment Criteria (GAC), determined by LQM and CIEH in accordance with current legislation and guidance, as detailed in their publication, ref.12.20.

9.4.3 The guidance values used within this contamination assessment have been tabulated and are detailed within Appendix 6.

9.4.4 The results of chemical analyses have been processed in accordance with recommendations set out in CLR 7, ref 12.17 and CLR 10, ref. 12.19. Where the concentrations determined on site are at or below the respective Guidance Level, they are considered not to pose a risk and are removed from further consideration, unless otherwise stated.

9.4.5 The results of the contamination testing carried out on soils were all below their respective guidance values and are therefore not considered to pose a significant risk to the proposed development.

9.5 Risk Assessment - Controlled Waters

9.5.1 The site is located on a minor aquifer and a surface watercourse forms the southern site boundary.

9.5.2 An initial assessment of the risk to controlled waters has been conducted on the basis of the leachate and groundwater test results. The leachate and groundwater results have been screened against the freshwater Environmental Quality Standards (EQS), ref. 12.21.

9.5.3 The analytical test results were all below their respective available EQS guidelines.

9.5.4 The presence of very slightly elevated values of TPH in the range C15 to C40 was noted in BH4 and BH9. This occurrence does not appear to be consistent with the rest of the analytical test data and may be due to minor local oil / diesel spillage from agricultural plant or investigation plant.

9.5.5 Given the ground conditions encountered at the site and the results of this contamination assessment, it is considered unlikely that further assessment of the risks to controlled waters may be required.

9.6 Summary of Risk Evaluation

9.6.1 The analytical test data generally confirms the desk study and is consistent with the site history as agricultural / greenfield land with made ground predominantly comprising reworked soils.

9.6.2 In the absence of a significant source of contamination the risks to potential receptors are considered very low.

10.0 MANAGEMENT OF CONTAMINATION

10.1 General

10.1.1 The results of laboratory tests, analysis of the data, together with consideration of the site conceptual model and exposure model for the proposed development, suggest that a formal remediation strategy is not required as part of this development.

10.1.2 In the absence of a formal remediation strategy there is no requirement for remediation validation monitoring or reporting.

10.2 Management of Unidentified Sources of Contamination

10.2.1 There is the possibility that other sources of contamination may be present on the site, which were not detected during the investigation. Should such contamination be identified or suspected during the site clearance or ground works, these should be dealt with accordingly. A number of options are available for handling this material, which include:

- The removal from site and disposal to a suitably licensed tip of all material suspected of being contaminated. The material would need to be classified prior to disposal.

- Short-term storage of the suspected material while undertaking verification testing for potential contamination. The storage area should be a contained area to ensure that contamination does not migrate and affect other areas of the site. Depending upon the amounts of material under consideration, this could be either a skip or a lined area.

- Having a suitably experienced environmental engineer either on-call or with a watching brief for the visual and olfactory assessment of the material, and sampling for verification purposes.

10.3 Consultation

10.3.1 During the development of large site, consultation may be required for a number of reasons with a number of regulatory Authorities. The following provides an indication as to the most likely Authorities with which consultation may be required.

- **Local Authority.** There may be a planning condition regarding contamination and consultation will be required with a designated Contaminated Land Officer within the Environmental Health Department. The Local Authority is generally concerned with human health risks.

- **Environment Agency.** Where development may affect the local groundwater and / or surface water regime, where a site is within a groundwater protection zone or has been designated as a special site, the Environment Agency is likely to be involved to ensure that controlled waters are protected.

10.3.2 Based on the results of any consultation, there may be specific conditions imposed by one or more of the Authorities.

10.4 Risk Management During Site Works

10.4.1 During ground works, some simple measures may have to be put in place to mitigate the risk of contamination affecting the site workers and the environs. The majority of the proposed measures represent good practice for the construction industry and include:

- Informing the site workers of the contamination on site and the potential health effects from exposure.
- Where appropriate, the provision of suitable PPE for workers who may be potentially impacted by working in areas of the contamination.
- Ensuring good hygiene is enforced on site and washing facilities are maintained on the site. Workers are discouraged from smoking, eating or drinking without washing their hands first.
- Dust monitoring, and if necessary, suppression measures should be put into practice where contamination is becoming airborne.

10.4.2 Where contaminated materials are being removed from the site they should be disposed of at a suitably licensed landfill, with a 'duty of care' system in place and maintained throughout the disposal operations.

10.4.3 Current regulations relating to the landfill disposal of contaminated soils and excavated waste must be in accordance with the EC Landfill Directive, 1999/31/EC. Excavation wastes are now classified in accordance with the European Waste Catalogue, ref 12.22.

11.0 RECOMMENDATIONS IN RELATION TO GAS GENERATION

11.1 Assessment of Gas Emission

11.1.1 Gas standpipes were installed within the boreholes to monitor for gas emissions from either natural, landfill or coal mining sources.

11.1.2 Across the majority of the site the gas concentrations and flow rates were not sufficient to indicate that specific gas protection measures would be required in commercial buildings.

11.1.3 BH11, located at the northeast corner of the site, recorded methane concentrations up to 16% by volume allied to a flow rate of 1.8l/hr on 25th February 2008. A subsequent visit recorded a concentration of 2.3% by volume with negligible flow rate.

11.1.4 It is considered that the methane in BH11 may either be a confined source, within the sand or may be generating at another location and migrating through the sand.

11.1.5 Additional monitoring is required to determine the gas regime and the potential risk to the site.

11.1.6 Notes on potential gas protection measures are provided in Appendix 4.

11.1.7 It is recommended that further gas monitoring will be required to confirm the amount and flow of gas before the design is finalised. This monitoring may be carried out at a time between completion of earthworks and start of building.

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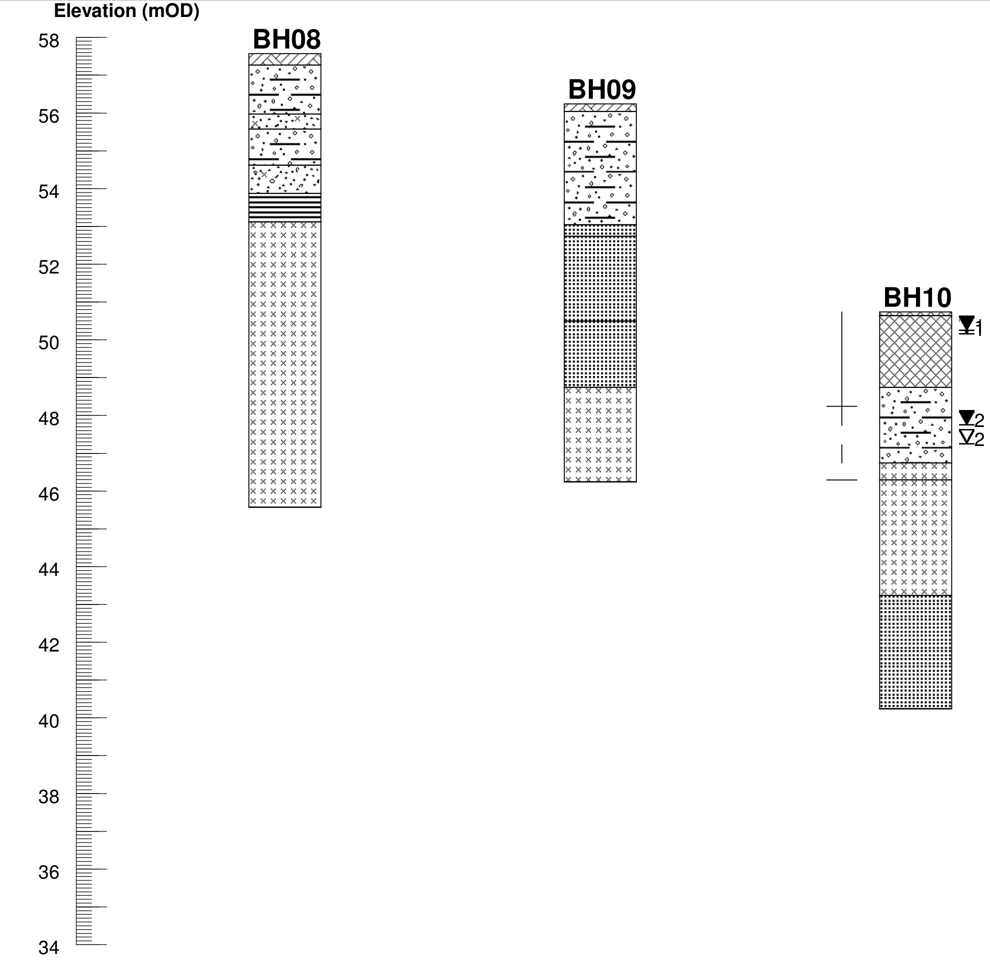
For and on behalf of Ian Farmer Associates (1998) Limited

T J Downes	J A Latimer
BSc (Hons) MSc FGS	BSc (Hons) FGS
Technical Manager	Director

APPENDIX 1

DRAWINGS



Key

- Groundwater Strike
- Strike Rise Level
- Highest recorded piezo level
- Piezometer Tip
- Slotted Standpipe
- TOPSOIL
- MADE GROUND
- Sandy gravelly CLAY
- Sandy gravelly SILT
- Clayey SAND
- Silty SAND
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- SILTSTONE
- SANDSTONE

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Site Warren Hall Site - Broughton			
Title Nominal Section			
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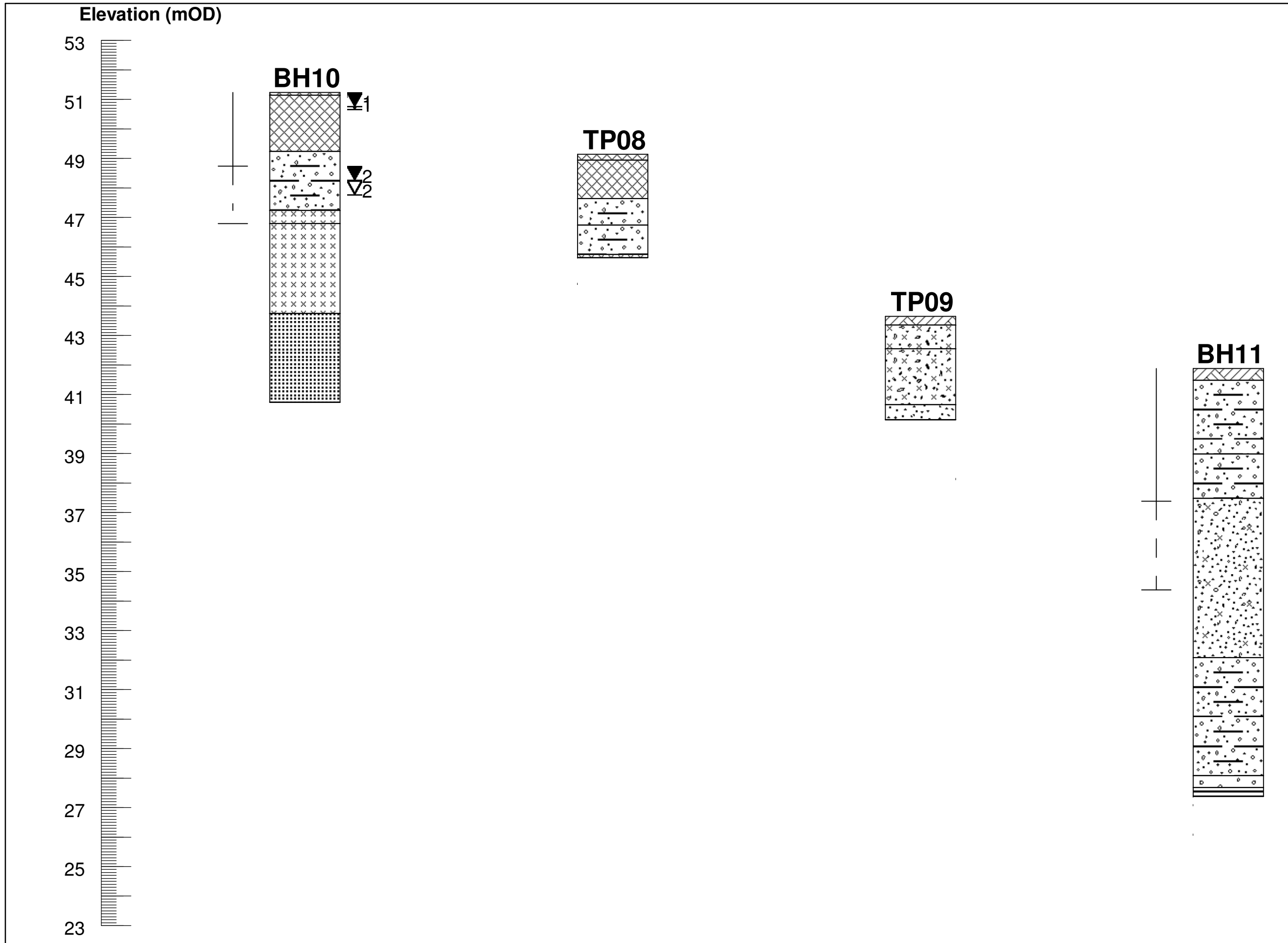

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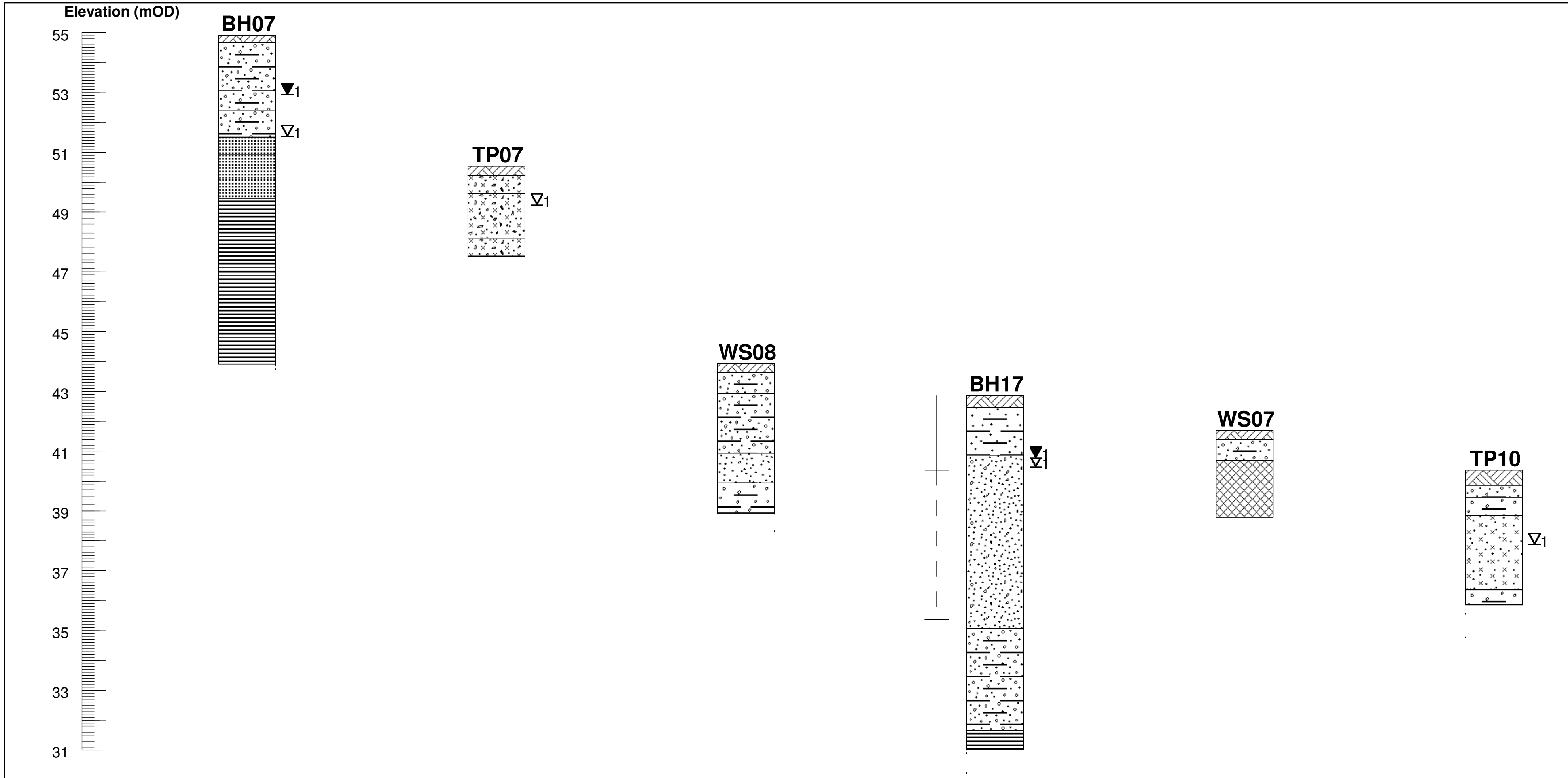

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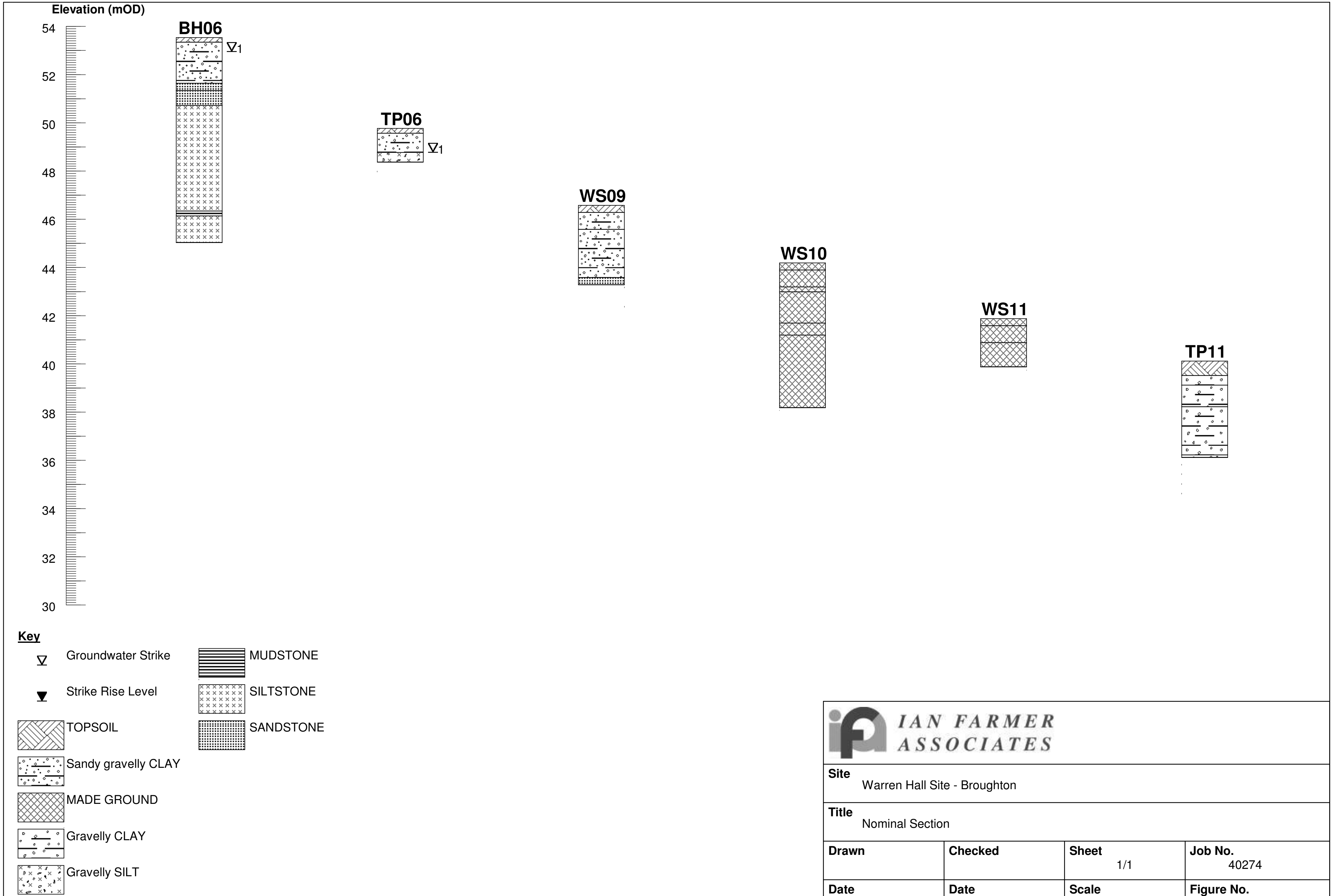

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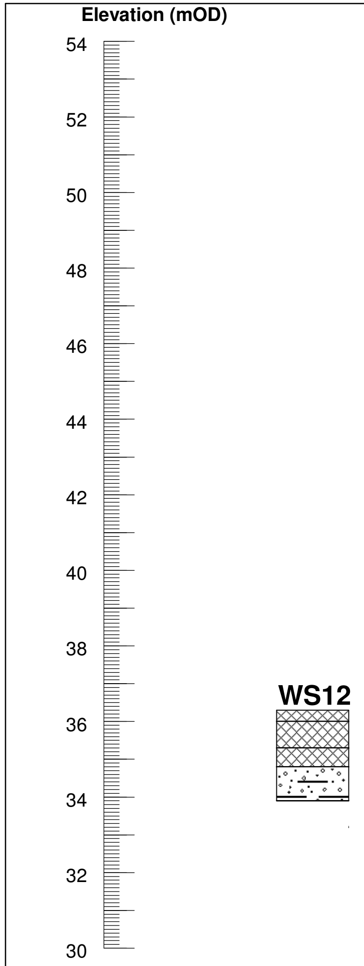

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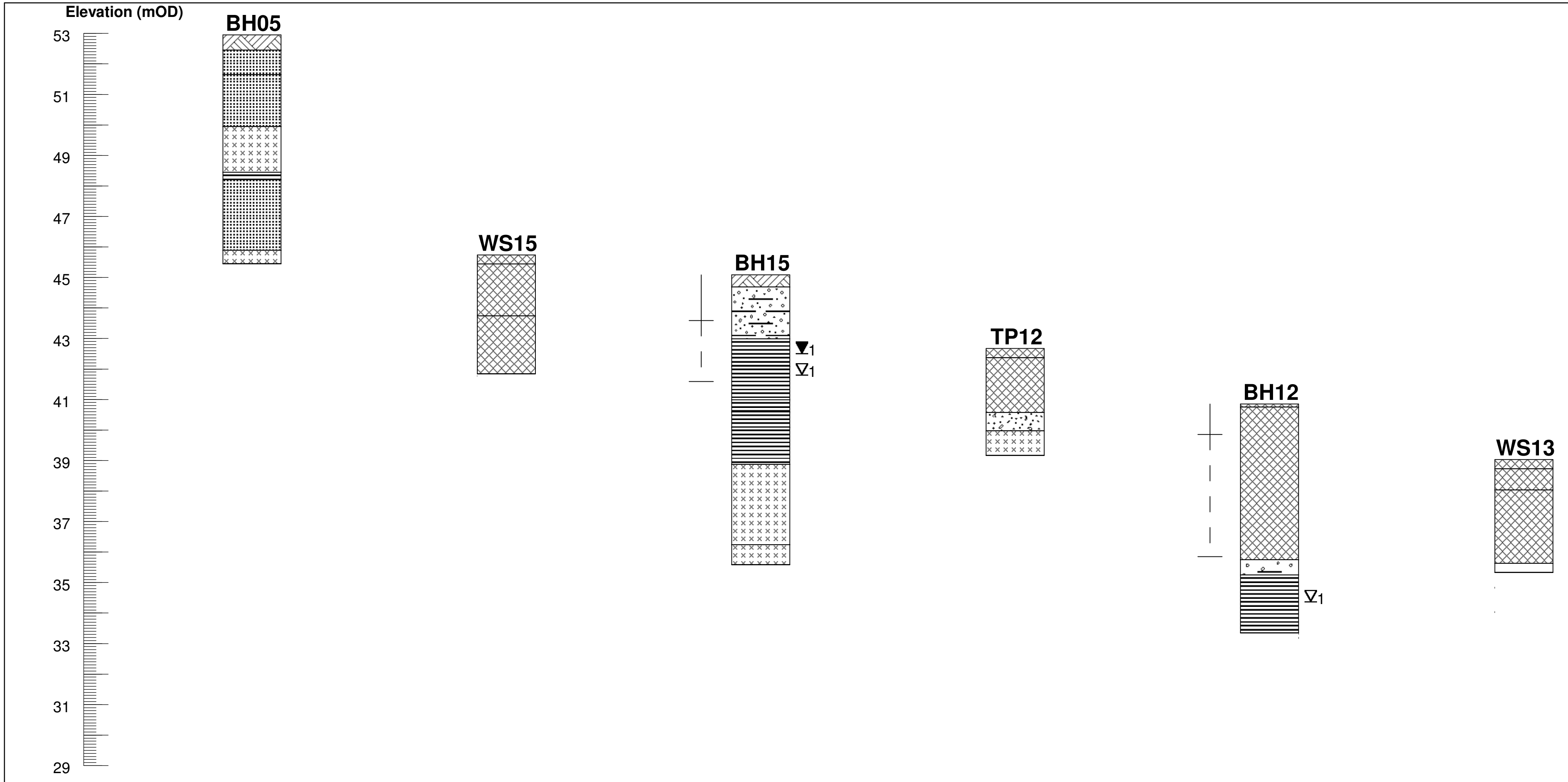

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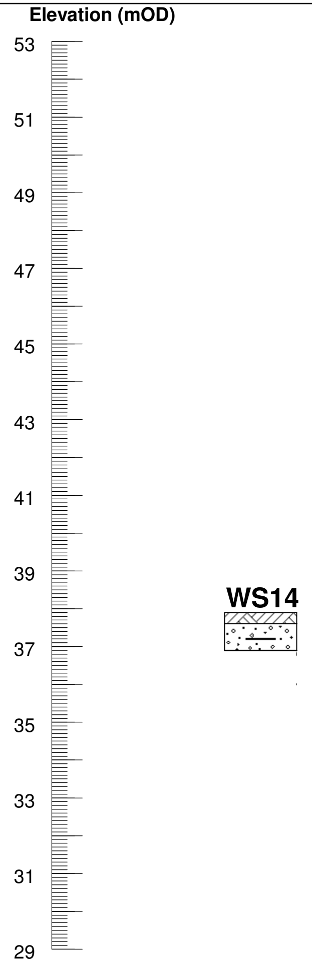

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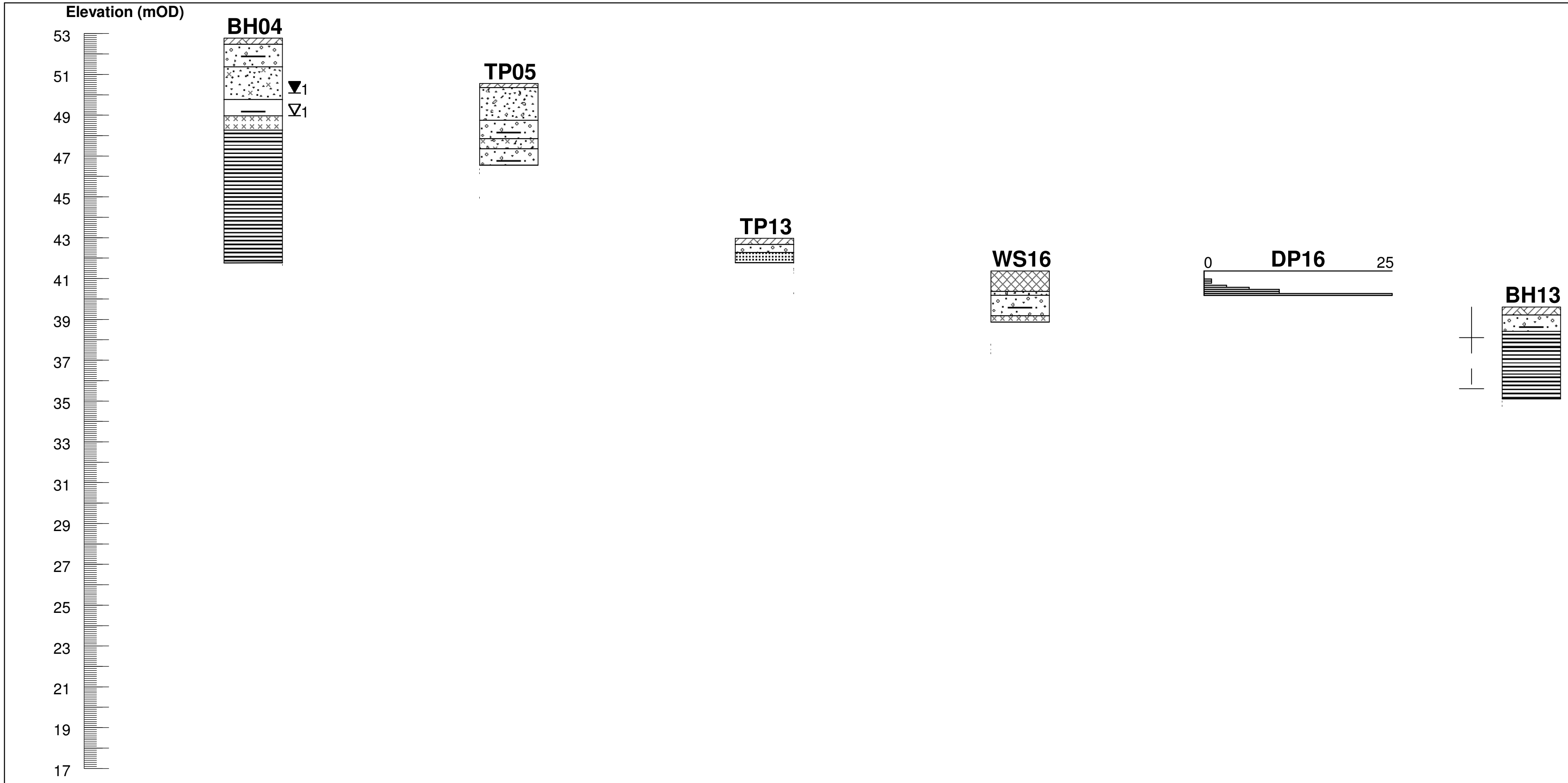

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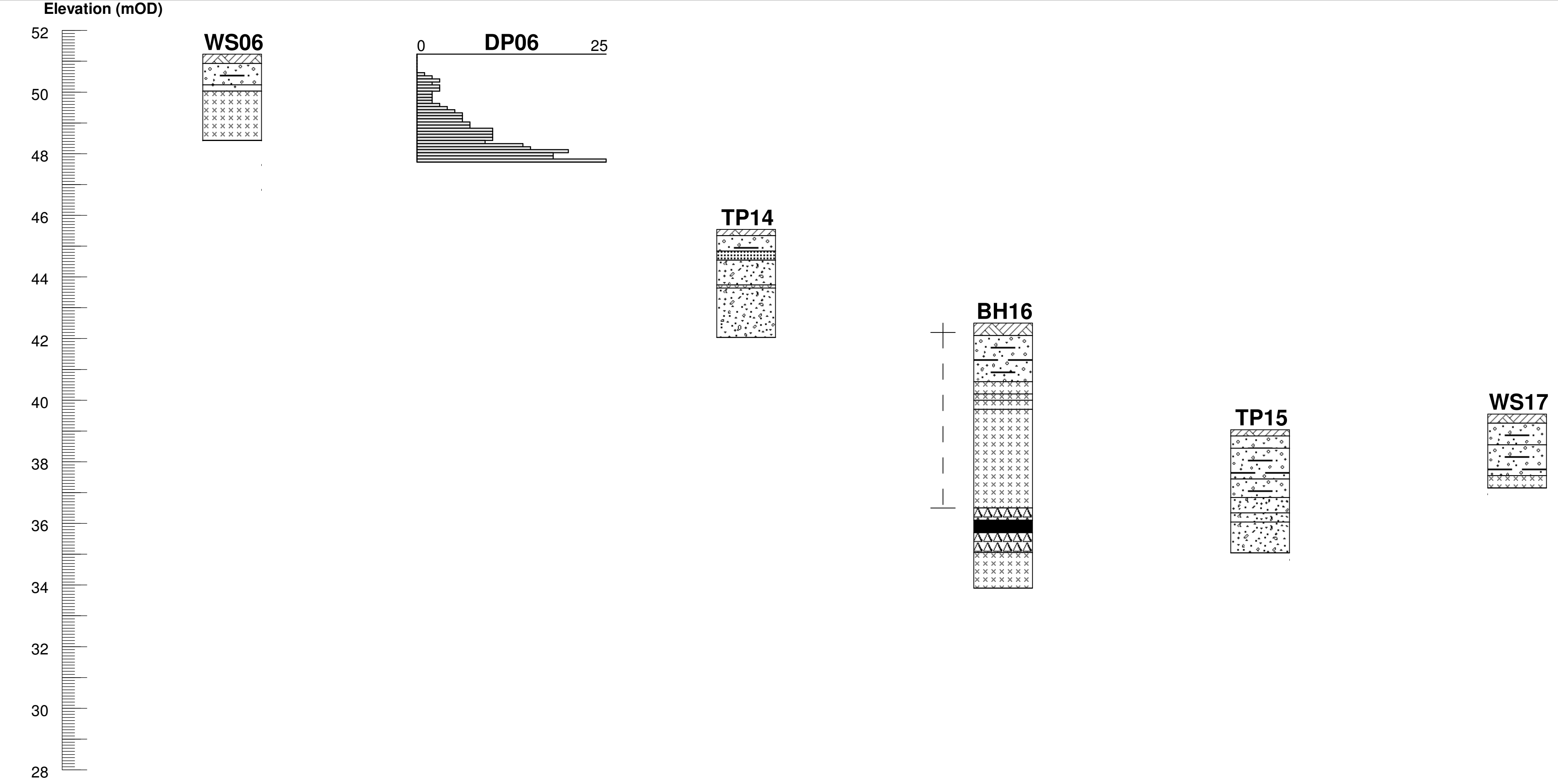

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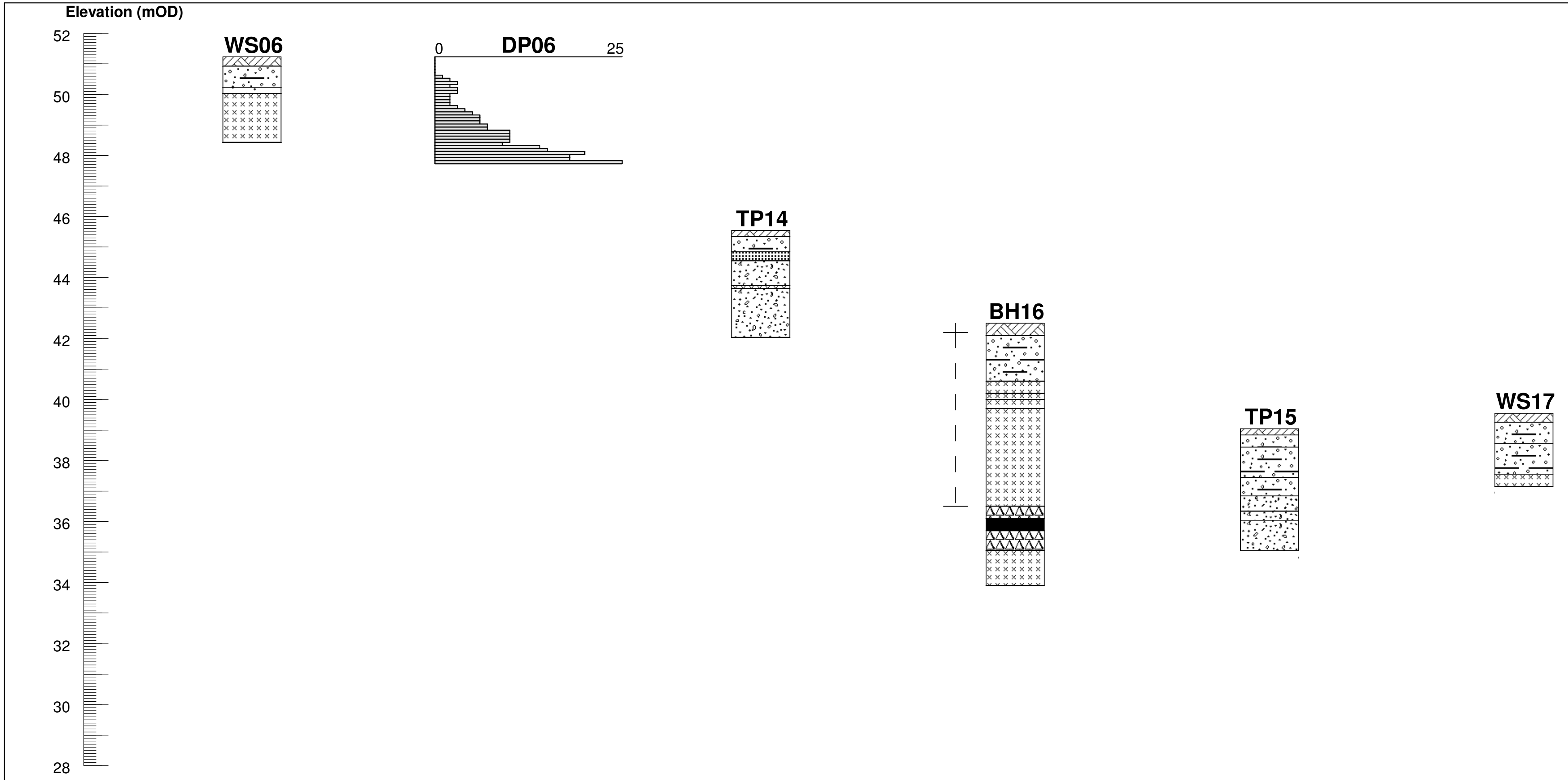

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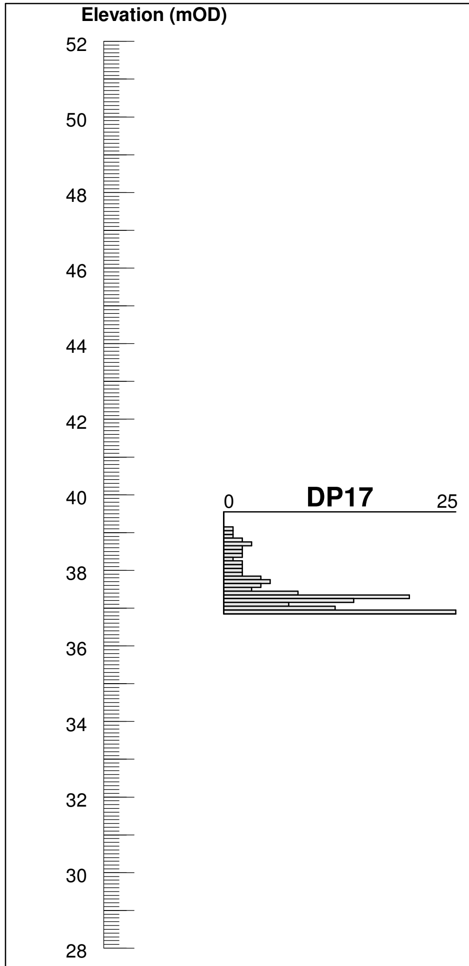

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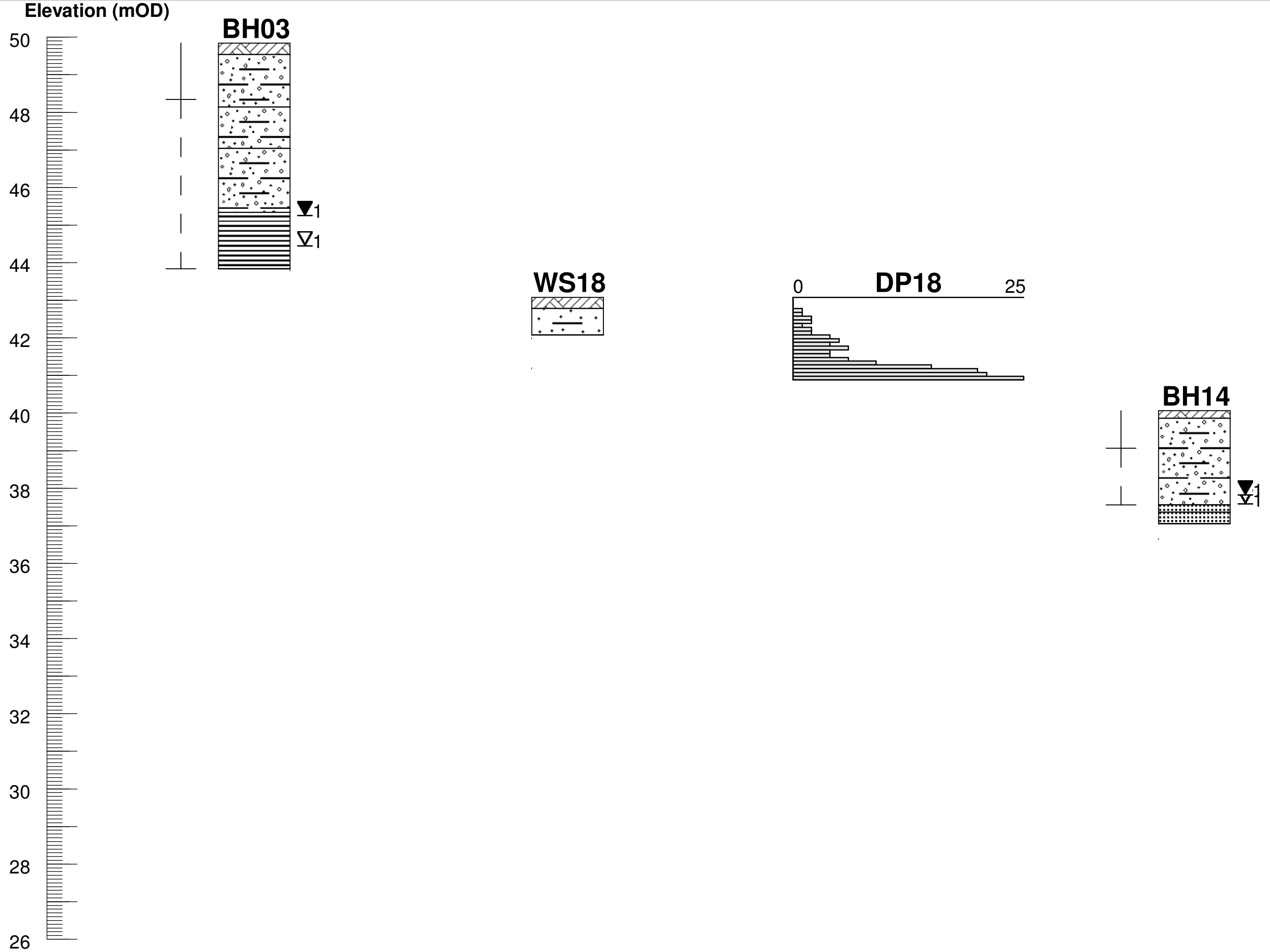

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Date 12/03/2008	**Date**	**Scale** 1:200[V]	**Figure No.** 40274.1

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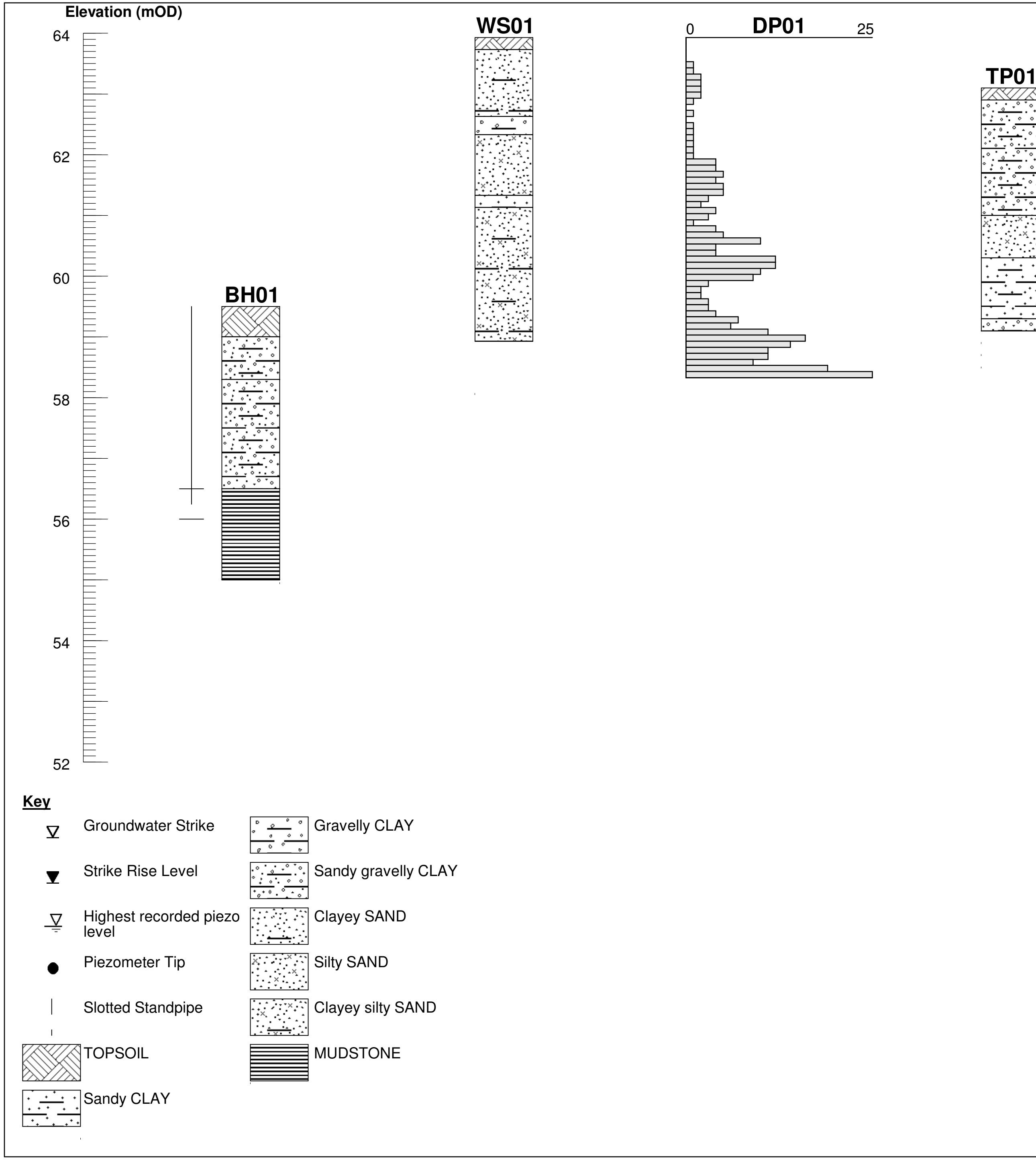

IAN FARMER ASSOCIATES

Site Warren Hall Site - Broughton

Title Nominal Section

Drawn	Checked	Sheet	Job No.
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Date	**Date**	**Scale**	**Figure No.**
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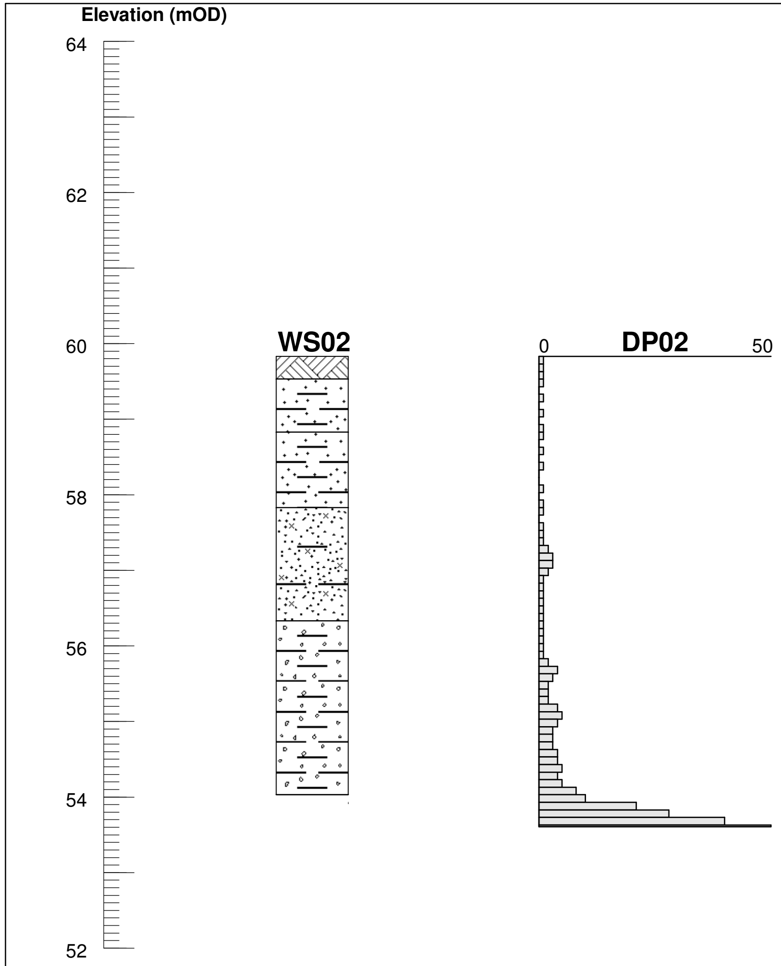

Key

Groundwater Strike

Strike Rise Level

TOPSOIL

Sandy CLAY

Gravelly CLAY

Clayey silty SAND

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Site			
Warren Hall Site - Broughton			
Title Nominal Section			
Drawn	**Checked**	**Sheet** 1/1	**Job No.** 40274
Date 12/03/2008	**Date**	**Scale** 1:100[V]	**Figure No.** 40274.1

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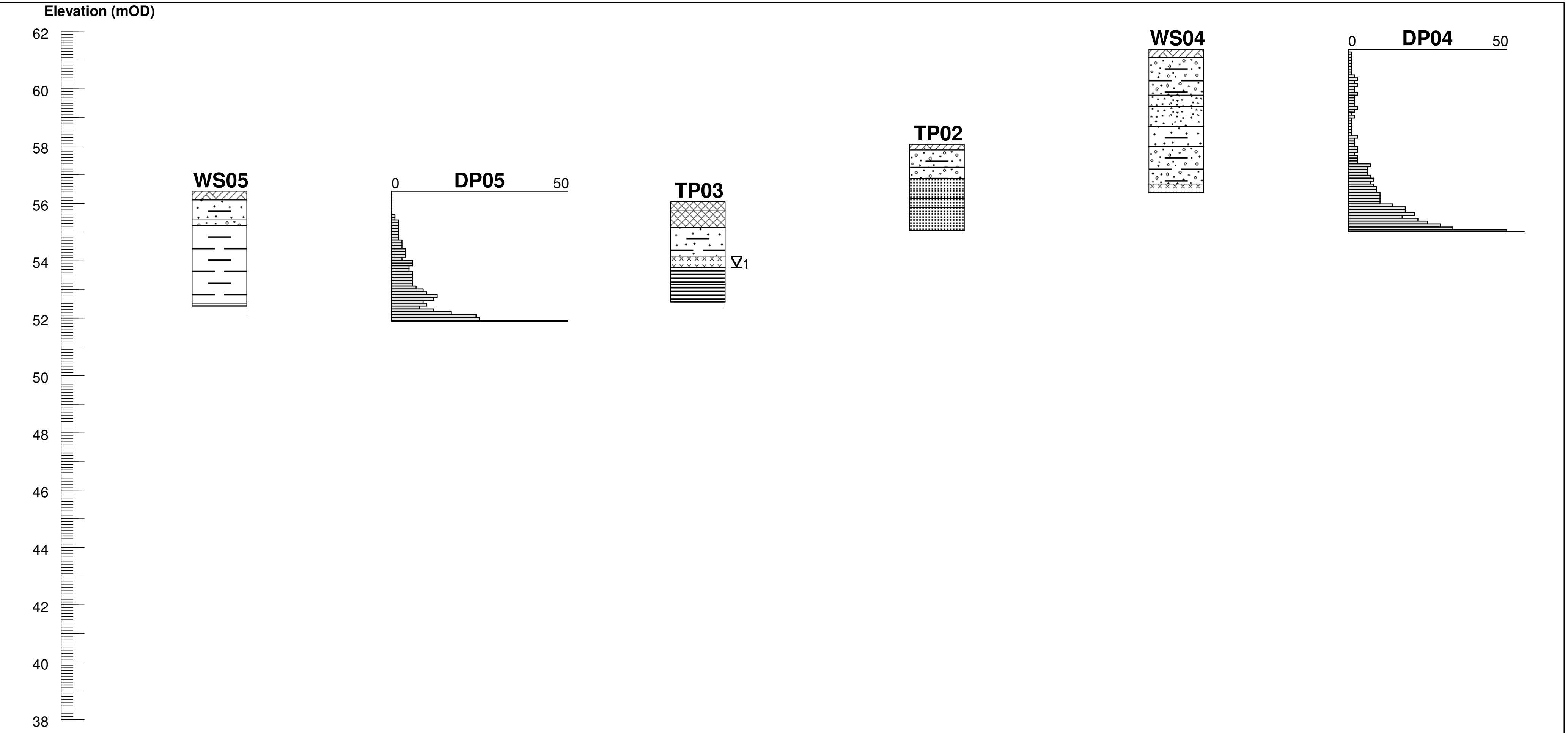

Key

∇	Groundwater Strike		Clayey SAND
▼	Strike Rise Level		MUDSTONE
	TOPSOIL		SILTSTONE
	CLAY		SANDSTONE
	MADE GROUND		
	Sandy CLAY		
	Sandy gravelly CLAY		

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Site Warren Hall Site - Broughton			
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Drawn	**Checked**	**Sheet** 1/1	**Job No.** 40274
Date 12/03/2008	**Date**	**Scale** 1:200[V]	**Figure No.** 40274.1

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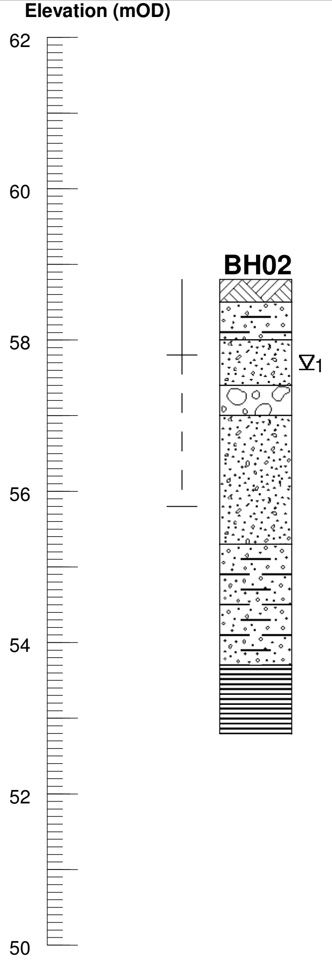

Key

Groundwater Strike

Strike Rise Level

Highest recorded piezo level

Piezometer Tip

Slotted Standpipe

TOPSOIL

Sandy gravelly CLAY

SAND and GRAVEL

COBBLES and BOULDERS

MUDSTONE

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Site Warren Hall Site - Broughton			
Title Nominal Section			
Drawn	**Checked**	**Sheet** 1/1	**Job No.** 40274
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APPENDIX 2

DESIGN CONSIDERATIONS

APPENDIX 2

GUIDELINES FOR THE DESIGN OF PILES

FIRST APPROXIMATION OF WORKING LOAD

A2.1 GENERAL

The ultimate carrying capacity, Qu, of a particular pile is taken as the sum of the ultimate shaft friction resistance, Qs, and the ultimate end bearing resistance, Qb. This may be expressed as follows:-

$$Qu = Qs + Qb$$

$$= f.As + q.Ab$$

where f = unit shaft resistance

As = embedded surface area of pile

q = unit end bearing resistance

Ab = effective cross-sectional area of pile base

A2.2 COHESIVE SOILS

A2.2.1 Shaft Resistance

The ultimate shaft resistance, f, for piles in both compression or tension in cohesive soils is determined by applying a factor to the undrained shear strength, Cs, which exists in the soils along the embedded length of the pile, and is given by:-

$$f = \alpha.Cs$$

Where α is an adhesion factor, which for straight-shafted bored piles may be taken as 0.45 to 0.60.

Ultimate unit shaft friction should not exceed 100kN/m².

A2.2.2 End Bearing

For piles terminating in cohesive soils, the ultimate unit end bearing resistance q, is given by:-

$$q = Nc.Cb$$

where Cb is the undrained shear strength at the base of the pile

and Nc is a bearing capacity factor

The value of Nc for a cohesive material is variable, depending on the depth of the penetration of the pile into the bearing stratum. Generally, Nc could be taken to have a value of 9, except in the case of large diameter short piles where a lesser value should be used.

A2.3 COHESIONLESS SOILS

A2.3.1 Shaft Resistance

For piles driven in cohesionless soils the ultimate unit shaft resistance, f, may be calculated using the following method, which gives:-

$$f = 0.5\gamma' (D+d)\, Ks \tan \delta$$

where γ = average effective unit weight of soil surrounding the pile

D = depth to the pile toe or to the base of the granular stratum whichever is the lesser

d = depth to the top of the granular stratum

δ = angle of friction between pile and soil (see below)

Ks = a coefficient (see below)

VALUES OF Ks AND δ

Pile Type	**δ**	**Ks**		
		Relative Density		**Tension Piles**
		Low	**High**	
Steel	20°	0.5	1.5	0.5
Concrete	0.75ϕ	1.0	2.0	0.5

The value of ϕ may be interpreted from standard penetration tests, using published figures.

For bored and cast-in-place piles, $\delta = 22°$ and $Ks = 1$ should be used to allow for loosening of the soil during boring.

It has been found that the ultimate unit shaft resistance does not exceed 100kN/m² and therefore this value should not be exceeded in design.

A2.3.2 End Bearing

The unit ultimate end bearing resistance (q) of piles in cohesionless soils may be calculated as follows:-

$$q = \gamma'.D.Nq$$

where γ' = average effective unit weight of soil surrounding the pile

D = depth to pile toe

Nq = bearing capacity factor

Values for Nq, where piles penetrate the bearing stratum by more than five diameters, are given in published figures. In addition, the ultimate unit base resistance should not exceed a value of 11,000kN/m². For bored and cast-in-place piles the value of Nq used should correspond to loose soil conditions.

A2.4 FACTORS OF SAFETY

A2.4.1 Cohesive and Non-cohesive Soils

For cohesive and non-cohesive soils a factor of safety of 3 may be used to obtain the allowable or safe carrying capacity of piles from the ultimate carrying capacity.

APPENDIX 3

CONTAMINATION ASSESSMENT

APPENDIX 3

GENERAL NOTES ON CONTAMINATION ASSESSMENT

A3.1 STATUTORY FRAMEWORK AND DEFINITIONS

A3.1.1 The statutory definition of contaminated land is defined in the Environmental Protection Act 1990, ref 12.15, which was introduced by the Environment Act 1995, ref 12.16;

'Land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that –

(a) significant harm is being caused or there is a significant possibility of such harm being caused; or

(b) pollution of controlled waters is being, or is likely to be, caused.'

A3.1.2 The UK guidance on the assessment of contaminated has developed as a direct result of the introduction of these two Acts. The technical guidance supporting the new legislation has been summarised in a number of key documents collectively known as the Contaminated Land Reports (CLRs), a proposed series of twelve documents. Seven were originally published in March 1994, four more were published in April 2002, while the last remaining guidance document, CLR 11, ref 12.4 was published in 2004.

A3.1.3 In establishing whether a site fulfils the statutory definition of 'contaminated land' it is necessary to identify, whether a pollutant linkage exists in respect of the land in question and whether the pollutant linkage:

- is resulting in significant harm being caused to the receptor in the pollutant linkage,
- presents a significant possibility of significant harm being caused to that receptor,
- is resulting in the pollution of the controlled waters which constitute the receptor, or
- is likely to result in such pollution.

A3.1.4 A *'pollutant linkage'* may be defined as the link between a contaminant *'source'* and a *'receptor'* by means of a *'pathway'*.

A3.2 ASSESSMENT METHODOLOGY

A3.2.1 The guidance proposes a four-stage assessment process for identifying potential pollutant linkages on a site. These stages are set out in the table below:

No.	Process	Description
1	Hazard Identification	Establishing contaminant sources, pathways and receptors (the conceptual model).
2	Hazard Assessment	Analysing the potential for unacceptable risks (what linkages could be present, what could be the effects).
3	Risk Estimation	Trying to establish the magnitude and probability of the possible consequences (what degree of harm might result and to what receptors, and how likely is it).
4	Risk Evaluation	Deciding whether the risk is unacceptable.

A3.2.2 Stages 1 and 2 develop a *'conceptual model'* based upon information collated from desk based studies, and frequently a walkover of the site. The walkover survey should be conducted in general accordance with CLR 2, ref 12.2. The formation of a conceptual model is an iterative process and as such, it should be updated and refined throughout each stage of the project to reflect any additional information obtained.

A3.2.3 The extent of the desk studies and enquiries to be conducted should be in general accordance with CLR 3, ref 12.1. The information from these enquiries is presented in a desk study report with recommendations, if necessary, for further work based upon the conceptual model. CLR 8, ref. 12.23, together with specific DoE 'Industry Profiles' provides guidance on the nature of contaminants relating to specific industrial processes.

A3.2.4 If potential pollutant linkages are identified within the conceptual model, a Phase 2 site investigation and report will be recommended. The investigation should be planned in general accordance with CLR 4, ref 12.5. The number of exploratory holes and samples collected for analysis should be consistent with the size of the site and the level of risk envisaged. This will enable a contamination risk assessment to be conducted, at which point the conceptual model can be updated and relevant pollutant linkages can be identified.

A3.2.5 A two-stage investigation may be more appropriate where time constraints are less of an issue. The first stage investigation being conducted as an initial assessment for the presence of potential sources, a second being a more refined investigation to delineate wherever possible the extent of the identified contamination.

A3.2.6 All site works should be in general accordance with the British Standards, BS 5930:1999, ref. 12.7 and BS 10175:2001, ref 12.6.

A3.2.7 The generic contamination risk assessment screens the results of the chemical analysis against generic guidance values. Soils will be compared with the available Soil Guideline Values (SGVs) as published by the Department of Environment Food and Rural Affairs (DEFRA) and The Environment Agency (EA), and developed using the Contaminated Land Exposure Assessment (CLEA) Model.

A3.2.8 Where there are no currently available SGVs for specific soil contaminants, the results of the soil analyses will be compared to Generic Assessment Criteria (GAC), determined by LQM and CIEH in accordance with current legislation and guidance.

A3.2.9 Chemical laboratory test results are processed as follows. A statistical analysis of the results is conducted, as detailed in CLR 7, ref 12.17. Individual concentrations are compared to the selected guideline values to identify concentrations of contaminants that are above the selected screening criteria.

A3.2.10 The mean value test is applied to determine whether the mean characteristics of the selected soil unit present a significant possibility of significant harm to human health. The significance of the data is further tested using the maximum value test. This determines whether the highest recorded contaminant concentrations are from the same statistical distribution or whether they may represent a 'hot spot'.

A3.2.11 Where the risk estimation identifies significant concentrations of one or more contaminants, a further risk evaluation needs to be undertaken.

A3.2.12 The risk evaluation will address the potential pollutant linkages between an identified source of contamination and the likely receptors both on and off site.

A3.2.13 The potential receptors include:

1) Humans – current site occupants, construction workers, future site users and neighbouring site users.

2) Controlled Waters – surface water and groundwater resources

3) Plants – current and future site vegetation

4) Building materials

A3.2.14 The potential hazards to be considered in relation to contamination are:

a) Ingestion and inhalation.

b) Uptake of contaminants via cultivated vegetables.

c) Dermal contact

d) Phytotoxicity (the prevention or inhibition of plant growth)

e) Contamination of water resources

f) Chemical attack on building materials and services

g) Fire and explosion

A3.2.15 Dependent on the outcome of the initial, generic contamination risk assessment, further detailed assessment of the identified risks may be required.

A3.3 Generic Guideline values used in contamination risk assessment

		Assessment Criteria	Residential with plant uptake			Residential w/o plant uptake			Commercial / Industrial		
			1% SOM	2.5% SOM	5% SOM	1% SOM	2.5% SOM	5% SOM	1% SOM	2.5% SOM	5% SOM
PAH	Benzo(a)pyrene (BaP)	LQM CIEH GAC	1.12	1.08	1.09	1.3	1.31	1.32	29.7	29.7	29.9
	Dibenzo(a,h)anthracene	LQM CIEH GAC	1.14	1.13	1.1	1.3	1.34	1.32	29.7	29.7	29.9
	Fluorene	LQM CIEH GAC	38.4	91.4	184	2770	2640	2700	59000	59400	59500
	Napthalene	LQM CIEH GAC	3.47	8.47	17	6.94	17.1	33.7	290	720	1440
	Napthalene	CLEA SGV 19 (DRAFT)	7	17	34	7	17	34	290	720	1400
	Chlorobenzene	LQM CIEH GAC	10.6	24.8	50	32.9	79.3	155	140000	143000	143000
	1,2-dichloroethane (DCA)	LQM CIEH GAC	0.00791	0.0172	0.0328	0.0118	0.0256	0.0486	0.536	1.16	2.2
	Hexachlorobutadiene (HCBD)	LQM CIEH GAC	0.00422	0.0103	0.0206	0.0496	0.12	0.23	1.98	4.72	8.77
	Tetrachloroethane (PCA)	LQM CIEH GAC	0.562	1.25	2.38	3.6	8.05	15.3	150	332	620
	Tetrachloroethene (PCE)	LQM CIEH GAC	1.01	2.32	4.5	1.46	3.39	6.58	63.1	146	283
	1,1,1-Trichloroethane (TCA)	LQM CIEH GAC	11.7	27.2	53.1	12.9	29.8	57.9	552	1280	2490
	Trichloroethene (TCE)	LQM CIEH GAC	0.134	0.308	0.598	0.15	0.346	0.673	6.42	14.8	28.8
	Trichloromethane	LQM CIEH GAC	0.888	1.99	3.86	1.72	3.91	7.52	79.4	180	345
	Vinyl Chloride	LQM CIEH GAC	0.000953	0.00184	0.00329	0.00129	0.00248	0.00447	0.0587	0.113	0.203
	Atrazine	LQM CIEH GAC	0.0204	0.0489	0.0984	7.04	6.86	7.03	152	157	157
	Phenol	CLEA SGV 8	78	150	280	21900	34400	37300	21900	43000	78100
Metals	Arsenic	CLEA SGV 1	20			20			500		
	Cadmium	CLEA SGV 3	1 (pH 6)	2 (pH 7)	8 (pH 8)	30			1400		
	Chromium	CLEA SGV 4	130			200			5000		
	Inorganic Mercury	CLEA SGV 5	8			15			480		
	Nickel	CLEA SGV 7	50			75			5000		
	Selenium	CLEA SGV 9	35			260			8000		
	Lead	CLEA SGV 10	450			450			750		
	Beryllium	LQM CIEH GAC	12.1			84.9			1950		
	Copper	LQM CIEH GAC	111			2080			45700		
	Vanadium	LQM CIEH GAC	140			150			4250		
	Zinc	LQM CIEH GAC	330			8250			188000		

A3.3 Generic Guidance Values Used Within Contamination Risk Assessment

	Aliphatic EC 5-6	LQM CIEH GAC	2.11	3.72	6.38	2.11	3.72	6.39	95.3	168	288
	Aliphatic EC C6-8	LQM CIEH GAC	5.37	11.9	22.7	5.37	11.9	22.7	242	535	1020
	Aliphatic EC >8-10	LQM CIEH GAC	1.46	3.55	7	1.46	3.56	7.05	65.9	160	317
	Aliphatic EC >10-12	LQM CIEH GAC	8.53	20.8	40.1	8.6	21.2	41.7	29900	30600	30400
	Aliphatic EC >12-16	LQM CIEH GAC	40.7	93.4	163	42.1	101	187	29900	30600	30400
	Aliphatic EC >16-35	LQM CIEH GAC	16400	16400	16300	27600	27600	26800	617000	631000	627000
	Aliphatic EC >35-44	LQM CIEH GAC	16400	16400	16300	27600	27600	26800	617000	631000	627000
TPHCWG	Aromatic 5-7 (Benzene)	LQM CIEH GAC	0.575	1.33	2.57	0.613	1.41	2.75	26.9	26.9	121
	Aromatic EC >7-8 (Toluene)	LQM CIEH GAC	0.624	1.46	2.85	0.694	1.63	3.18	30.4	30.4	139
	Aromatic EC >8-10	LQM CIEH GAC	1.09	2.67	5.3	2.39	5.88	11.6	107	107	513
	Aromatic EC >10-12	LQM CIEH GAC	1.94	4.76	9.44	14.2	34.1	63.9	625	625	2600
	Aromatic EC >12-16	LQM CIEH GAC	2.19	5.39	10.7	72.7	152	235	12200	12500	12400
	Aromatic EC >16-21	LQM CIEH GAC	115	132	133	291	336	362	9190	9400	9350
	Aromatic EC >21-35	LQM CIEH GAC	157	161	157	417	417	404	9250	9460	9410
	Aromatic EC >35-44	LQM CIEH GAC	157	161	157	417	417	404	9250	9460	9410
	Aliphatic & Aromatic EC >44-70	LQM CIEH GAC	174	179	174	417	417	404	9250	9460	9410
	Benzene	CLEA SGV 12 (DRAFT)	0.024	0.056	0.109	0.038	0.087	0.168	1.66	3.8	7.32
BTEX	Toluene	CLEA SGV 15	3	7	14	3	8	15	150	350	680
	Ethylbenzene	CLEA SGV 16	9	21	41	16	41	80	4800		
	Xylenes	CLEA SGV 18 (DRAFT)	6	15	30	8	19	38	340	825	1650

APPENDIX 4

GAS GENERATION

APPENDIX 4

GENERAL NOTES ON GAS GENERATION

A4.1 GENERAL

A4.1.1 In the past, a series of guidance documents were published by CIRIA, ref.12.28, providing advice on hazards associated with methane. This earlier guidance has been consolidated in CIRIA Document C659, ref. 12.29 to provide a risk based approach to gas contaminated land. It is recommended that guidance in C659 is adopted to provide a consistent approach in dealing with ground gas contamination.

A4.1.2 This guidance is based on a similar approach to that for dealing with contaminated soil. The presence of hazardous gases could be deemed to be the 'source' in a 'pollutant linkage' that could lead to the conclusion that significant harm is or could be caused to people, buildings or the environment. In such circumstances the land could be deemed 'contaminated', ref. 12.15.

A4.1.3 A developer must therefore undertake a gas risk assessment, sufficient to demonstrate to the local authority that the proposals mitigate any hazards associated with ground gas. The authority enforces compliance with Approved Document Part C of the Building Regulations, ref. 12.30.

A4.2 APPROACH

A4.2.1 A flow chart detailing the approach to assessing a site is given in CIRIA document C659, Figure 1.1. This may be summarised as follows.

- Carry out Phase 1 desk study, including initial conceptual model
- Assess site, potential presence of gas / potential unacceptable risk / identify further action, if necessary
- Monitor site
- Assessment of Risk
- Recommendations / remediation
- Validation

A4.3 POLLUTANT LINKAGE ASSESSMENT

A4.3.1 A pollutant linkage assessment is presented in Appendix 3 of the Phase 1 Desk Study Report.

A4.3.2 Using the risk model in the desk study, the pollutant linkage can be identified and a preliminary estimate of risk undertaken. If there is no significant pollutant linkage identified there is no risk. If there is a very low risk, it is likely that no further assessment is required. If further assessment is necessary, then gas monitoring is required.

A4.4 SITE MONITORING

A4.4.1 For sites with low generation potential, giving consistently low concentrations of soil gas under the worst-case conditions, a limited programme of monitoring would be appropriate. Where high or variable concentrations are anticipated or recorded, an extended programme of monitoring would be appropriate. The following guideline has been proposed, ref. 12.32.

		Generation potential of source				
		Very low	**Low**	**Moderate**	**High**	**Very high**
Sensitivity of development	Low (Commercial)	4/1	6/2	6/3	12/6	12/12
	Moderate (Flats)	6/2	6/3	9/6	12/12	24/24
	High (Residential with gardens)	6/3[3]	9/6	12/6	24/12	24/24

Notes

1. First number is minimum number of readings and second number is minimum period in months, for example 4/1 – Four sets of readings over 1 month.

2. At least two sets of readings must be at low and falling atmospheric pressure (but not restricted to periods below <1000mb) known as worst case conditions (see Boyle and Witherington, 2006).

3. The frequency and period stated are considered to represent typical minimum requirements. Depending on specific circumstances fewer or additional readings may be required (e.g. any such variation subject to site specific justification). The NHBC guidance is also recommending these periods/frequency of monitoring (Boyle and Witherington, 2006)

4. Historical data can be used as part of the data set.

5. Not all sites will require gas monitoring however, this would need to be confirmed with demonstrable evidence.

6. Placing high sensitivity end use on a high hazard site is not normally acceptable unless the source is removed or treated to reduce its gassing potential. Under such circumstances long-term monitoring may not be appropriate or required.

A4.4.2 Before taking any readings, zero the instrument, record atmospheric pressure and temperature.

A4.4.3 Gas flow should be recorded, giving the range of pressures, ensuring positive or negative flow is recorded.

A4.4.4 Record gas levels, recording peak and steady. Where steady state not obtained within 3 minutes, record change in concentration, where concentrations are decreasing, always recode peak value. For very high concentrations, record for longer period of up to 10 minutes.

A4.5 ASSESSMENT OF RISK AND RECOMMENDATIONS

A4.5.1 The main method of characterising a site is the method described by Wilson and Card, ref. 12.33 and is termed Situation A. This can be used for all types of development except conventional low-rise housing with suspended ground floor and ventilated underfloor void.

A4.5.2 Low rise housing, Situation B, was developed by Boyle and Witherington, ref. 12.34 and was developed for the NHBC for classifying gassing sites for houses with suspended ground floor slab with ventilated void.

A4.6 SITUATION A

A4.6.1 This system proposed by Wilson and Card, ref. 12.33 was originally developed in CIRIA Report 149, ref. 12.24.

A4.6.2 The method uses both gas concentrations and borehole flow rate for methane and carbon dioxide to define a Characteristic Situation for a site.

A4.6.3 Gas Screening Value (litre/hr) = borehole flow rate (litre/hr) x gas concentration (%). The GSV is determined for methane and carbon dioxide and the worst case adopted. The Characteristic Situation can then be determined from the table below. The GSV can be exceeded if the conceptual model indicates it is safe to do so, and other factors may lead to a change in the Characteristic Situation.

Characteristic Situation	Risk Classification	Gas screening value (CH_4 or CO_2(1/hr)[1]	Additional factors	Typical source of generation
1	Very low risk	<0.07	Typically methane ≤1% and/or carbon dioxide ≤5%. Otherwise consider increase to Situation 2	Natural soils with low organic content "Typical" Made Ground
2	Low risk	<0.7	Borehole air flow rate not to exceed 70l/hr. Otherwise consider increase to Characteristic Situation 3	Natural soil, high peat/organic content. "Typical" Made Ground
3	Moderate risk	<3.5		Old landfill, inert waste, mineworking flooded
4	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protective measures	Mineworking – susceptible to flooding, completed landfill (WMP 26B criteria)
5	High risk	<70		Mineworking unflooded inactive with shallow workings near surface
6	Very high risk	>70		Recent landfill site

1. Site characterisation should be based on gas monitoring of concentrations and borehole flow rates for the minimum periods defined in A7.4.1

2. Source of gas and generation potential/performance must be identified.

3. If there is no detectable flow use the limit of detection of the instrument.

A4.6.4 The Characteristic Situation can be used to define the scope of gas protective measures required.

Characteristic situation	Residential building (Not low-rise traditional housing)		Office/commercial/industrial development	
	Number of levels of protection	**Typical scope of protective measures**	**Number of levels of protection**	**Typical scope of protective measures**
1	None	No special precautions	None	No special precautions
2	2	a) Reinforced concrete cast in situ floor slab (suspended non-suspended or raft) with at least 1200g DPM and underfloor venting b) Beam and block or pre-cast concrete and 2000g DPM / reinforced gas membrane and underfloor venting All joints and penetrations sealed	1 to 2	a) Reinforced concrete cast in-situ floor slab (suspended non-suspended or raft) with at least 1200g DPM b) Beam and block or pre cast concrete slab and minimum 2000g DPM/reinforced gas membrane c) Possibly underfloor venting or pressurisation in combination with a) and b) depending on use All joints and penetrations sealed
3	2	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space	1 to 2	All types of floor slab as above. All joints and penetrations sealed. Minimum 2000g/reinforced gas proof membrane and passively ventilated underfloor sub-space or positively pressurised underfloor sub-space
4	3	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated underfloor subspace or positively pressurised underfloor sub-space, oversite capping or blinding and in ground venting layer	2 to 3	All types of floor slab as above. All joints and penetration sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space with monitoring facility

Characteristic situation	Residential building (Not low-rise traditional housing)		Office/commercial/industrial development	
5	4	Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and ventilated or positively pressurised underfloor sub-space, oversite capping and in ground venting wells or barriers	3 to 4	Reinforced concrete cast in-situ floor slab (suspended, non-suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space with monitoring facility. In ground venting wells or barriers
6	5	Not suitable unless gas regime is reduced first and quantitative risk assessment carried out to assess design of protection measures in conjunction with foundation design	4 to 5	Reinforced concrete cast in-situ floor slab (suspended, non-suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and actively ventilated or positively pressurised underfloor sub-space with monitoring facility, with monitoring. In ground venting wells and reduction of gas regime.

1. Typical scope of protective measures may be rationalised for specific developments on the basis of quantitative risk assessments.

2. Note the type of protection is given for illustration purposes only. Information on the detailing and construction of passive protection measures is given in BR414, ref. 12.31.

3. In all cases there should be minimum penetration of ground slabs by services and minimum number of confined spaces such as cupboards above the ground slab. Any confined spaces should be ventilated.

4. Foundation design must minimise differential settlement particularly between structural elements and ground-bearing slabs.

5. Commercial buildings with basement car parks, provided with ventilation in accordance with the Building Regulations, may not require gas protection for characteristic situations 3 and 4.

6. Floor slabs should provide an acceptable formation on which to lay the gas membrane. If a block beam floor is used it should be well detailed so it has no voids in it that membranes have to span, and all holes for service penetrations should be filled. The minimum density of the blocks should be $600kg/m^3$ and the top surface should have a 4:1 sand cement grout brushed into all joints before placing any membrane (this is also good practice to stabilise the floor and should be carried out regardless of the need for gas membrane).

7. The gas-resistant membrane can also act as the damp-proof membrane.

Warren Hall

Geotechnical Overview Report

September 2010

Plan Design Enable

Warren Hall

Geotechnical Overview Report

September 2010

Notice

This document and its contents have been prepared and are intended solely for The Welsh Assembly Government's information and use in relation to the redevelopment of the site at Warren Hall by cut and fill methods for commercial end use.

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Drawings and Figures

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1. Introduction

The Welsh Assembly Government intends to develop a sloping site at Warren Hall, Broughton, to the south of Chester by cut and fill methods for use as a business park. Atkins has been instructed to prepare a Geotechnical Overview Report based on the available information to date. The Welsh Assembly Government has owned the site for a number of years and several ground investigations have been undertaken by various companies at different times on and adjacent to the site. An earthworks contract was begun during February 2010. This contract was terminated before the majority of the earthworks were complete due to poor ground and weather conditions.

Involvement in the Warren Hall scheme and adjacent Warren Bank Interchange improvements has resulted in Atkins gaining a considerable understanding of the ground conditions in the area. On both schemes, the ground conditions have been challenging: the Warren Bank Interchange scheme necessitated ground treatment beneath new embankments in the form of vibro-stone columns and at the Warren Hall site, high groundwater levels have caused problems with excavations and in the re-use of the excavated materials.

This report covers the ground conditions over the whole site, and focuses particularly upon the Phase 1 area where the earthworks contract was begun.

The purpose of this report is to provide an overview of the geotechnical conditions at the site and provide recommendations for further work.

2. Available Information

The following information has been used in the preparation of this report:

1. Atkins' local knowledge from surrounding sites and from ongoing involvement in the site
2. BGS Geological Maps and Memoirs
3. Exploration Associates 1975 Report for proposed Hawarden Bypass
4. Stats Ltd (SL) July 1989 "Proposed Development at Warren Hall Report on Ground Investigation". Report Reference M 1459
5. Exploration Associates (EA) April 1995 "Warren Hall: Highway Infrastructure Factual Report on Ground Investigation". Report Reference 125001
6. D. Nichol, 2001 "Geo-Engineering along the A55 North Wales Coast Road", , Q.J.Eng Geol **34**, 51-64.
7. Ian Farmers Associates (IFA) February 2008 "Warren Hall, Broughton Factual Report on Ground Investigation". Report Reference W08/40274
8. Ian Farmer Associates (IFA) February 2008. "Warren Hall, Broughton" Desk Study. Report Reference W07/40274-1
9. Ian Farmer Associates (IFA) April 2008. "Warren Hall, Broughton: Interpretative Report on Ground Investigation: Development Plateaus". Report Reference W07/40274-3
10. Opus International Consultants (Uk) Ltd (OIC) July 2008 "Geo-Environmental Ground Investigation for the Warren Hall Development, Broughton, Flintshire, North Wales" Appraisal Report of Ian Farmer's Desk Study, Factual and Interpretative Reports. Reference RC4677/39/WJG/AC/LP.

Plus the following information for the Phase 1 area only:

11. Atkins Ltd. (AL) October 2009: 3 no. Trial Pits excavated for additional confirmation of ground conditions beneath proposed Lesters Lane embankment for Warren Bank Interchange scheme. (Presented in Appendix A)
12. Jacobs Engineering (JE) January 2010: 10 no. Trial Pits excavated under the direction of Atkins for assessment of the materials for reuse in proposed earthworks. (Presented in Appendix A)
13. Examination of cut areas between February and April 2010

3. The Site

3.1 Description and Site History

The site is located at the approximate National Grid Reference SJ326 628, approximately 1.5km to the south west of Broughton, Flintshire, and adjacent to Warren Bank Interchange, where the A5104 meets the A55 trunk road. The interchange is currently under redevelopment, with Atkins as designer.

The site is bounded by the A5104 to the north and by Lesters Lane to the east. To the west lies Warren Hall, Warren Farm, an associated pond and the south eastern corner of Gravelhole Wood. A small watercourse and an associated small valley feature, Warren Dingle, forms the southern site boundary.

The site comprises an east facing grassed slope which falls from about 65m AOD in the west to around 35m AOD at Lesters Lane in the east.

At the time of writing this report, some cut and fill operations described in Section 6 had commenced and the north easterly part of the site had been stripped of topsoil. Some broken land drains are visible in some of the cut faces. A large mound of spoil is present on the southern part of the site, comprising materials won from the cut area. .

Historical maps obtained for a previous desk study (reference 8) indicate that the site has been open fields since the Ordnance Survey First Edition map of 1879. A sewerage tank and bed, which are currently present approximately in the middle of the site, are first indicated on a map dated 1967.

Landfill areas have been identified by the desk study (reference 8) at the northern end of the site. The waste material is likely to comprise excavated natural materials from the construction of the A55.

3.2 Proposed Designs

Development proposals to date have divided the site into two development platforms: Plateau A to the east and Plateau B to the west (see appended drawing 20082593/sm/01). Design development by Atkins to date has concentrated on the Phase 1 area (northern end) of Plateau A. The Phase 1 area is shown on the appended drawing 5078488/PL/007.

Phase 1 is divided in to areas of proposed cut (“Cut Area 1” – “Cut area 4”) and fill (“Fill Area 1”).

There have been various revisions of the proposed cut and fill design. Current proposals indicate cut depths of up to around 6m below existing site levels.

4. Published Geology

The British Geological Survey (BGS) Map (Sheet 108 Flint 1:50,000, solid, 1972 and 1:63,360, drift, 1965) shows the site to be underlain by glacial drift which overlies Lower Carboniferous Holywell Shales. Glacial sand and gravel is shown adjacent to the site to the west. Approximately 50m to the west of the site, rocks of the Namurian Halkyn Formation outcrop, comprising Cefyn-y-fedw sandstone with chert beds. The more recent geological map (dated 1999) was reported by the desk study (reference 8) to show "made ground onto natural ground at the centre of the site".

The BGS 1:10,000 map SJ 36 SW (1986) (Figure 1) shows a geological fault running almost north- south through the site at the eastern end of the Warren Farm pond. The fault downthrows to the east. West of the fault, Holywell Shales are shown with bands of Gwespyr Sandstone. East of the fault, "*md*" " is shown, which is assumed to be notation for mudstone, however this is not confirmed on the map legend. Made ground and glacial sand and gravel are shown at the north eastern end of the site. A report from the construction of the Hawarden Bypass (dated 1975) suggests that the rockhead surface is irregular, with dips and hollows infilled with glacial materials.

5. Ground Conditions

The ground conditions at the Warren Hall site indicated by the available ground investigation are discussed below. In January 2010 additional trial pits and earthworks testing were undertaken in the Phase 1 Area associated with the earthworks contract. In the light of this information, a revised interpretation of the ground conditions at the site has been possible. The available ground investigation comprises:

- Stats Ltd (SL) July 1989,
- Exploration Associates (EA) April 1995 (for realignment of Lesters Lane and the redesign of A55/A5104 junction)
- Ian Farmers Associates (IFA) February 2008
- Atkins Ltd (AL) October 2009
- Jacobs Engineering (JE) January 2010

The locations of all of the investigation points are shown on the appended drawing no 20082593/sm/01.

5.1 Topsoil

Topsoil was encountered in all locations and was between 0.2m and 0.6m in thickness.

5.2 Made Ground & Infilled Hollows

Made ground was encountered in many of the boreholes and trial pits, and can be broadly divided into 3 areas:

- Northern end of site (A55 trunk road construction material)
- Central area up to eastern boundary (Infilled hollow)
- Isolated patches in south west and west (possible infilled ponds/kettle holes)

At the northern end of the site, and just beyond the site boundary (EA BH1-3, EA TP15&16, IFA BH10, IFA TP8, AL TP1-3, SL BH1, SL TP1, and TPF1/02) the made ground comprises reworked glacial materials with organic matter, occasional pieces of wood, brick and coal. Where cohesive, the materials were described as soft and firm. The SL boreholes were logged as natural ground, but it is considered that the soft mixed strata in SL TP1 and organic inclusions in SL BH1 may be indicative of made ground. This made ground was encountered to between 0.97m and 2.6m bgl within the site and up to 4.55m bgl in the EA boreholes which are just to the north east of the site boundary. The EA report (reference 5) speculated that that these materials were associated with the construction of the A55 Trunk Road (1976 - 1984). The location of this material is consistent with the area of landfill identified by the desk study (reference 8).

Within the central area of the site, and eastwards up to the site boundary with Lesters Lane (IFA BH12, IFA WS7,10-13,15&16, IFA TP12, SL BH3, SL TP2) made ground was encountered to between 1.0m and in excess of 6.0m bgl. The made ground comprised reworked glacial materials with occasional brick, coal and ash fragments. The SL boreholes were logged as natural ground, but it is considered that the decaying vegetation in TP2 and organic inclusions, timber fragments and plant remains in BH3 may be indicative of made ground. Where cohesive, the materials were described as soft, firm and stiff. The IFA report (reference 9) notes that this area appears to be coincident with a valley type feature in the bedrock contours, which may imply historic excavation and backfilling, or the historic backfilling of a drainage feature.

Close to the southern boundary of the site, made ground was encountered in IFA TP3 and possibly in SL BH6 (logged as natural) comprising firm and stiff glacial clay with organic matter to 0.9m and 1.0m bgl. It is suspected that this may represent a small infilled pond, kettle hole or other small infilled hollow.

A similar feature is observed close to the western site boundary (SL BH4). Although this was logged as natural ground, it is considered that stiff, firm and very soft deposits with organic matter, peat and brown-black mottling may represent an infilled hollow. This material may be natural or made ground.

It is possible that some of the infilled hollows, particularly the features at the south and western boundaries of the site are natural glacial features. During the construction of the adjacent A55, it was observed that "Numerous periglacial kettle holes and subdued hollows on the surface of the till plain contained soft laminated clay, peat and inwash materials characterised by high moisture contents " (D. Nichol, 2001, reference 6).

5.3 Glacial Till

The glacial till was encountered directly below the topsoil or made ground.

The glacial materials encountered are highly variable and intermixed. Brown, red-brown and orange sand, silt, and clay, with varying proportions of gravel and cobbles are present across the site. Materials were described as varying from very soft to very stiff and loose to dense.

There appears to be no consistency between adjacent exploratory holes and it is therefore not possible to plot a coherent cross section. These mixed soil types may be a result of the glacial depositional environment or may be due to periglacial processes such as solifluction. Periglacial features such as kettle holes have been reported in the area (D Nichol, 2001, reference 6).

5.4 Bedrock

The depth to rockhead varies considerably across the site.

Bedrock was encountered at between 0.5m bgl (IFA BH5) and 14.2m bgl (IFA BH11) and was not encountered in all exploratory hole positions. In terms of ordnance datum, the shallowest proven rockhead is at 63.12m AOD (SL TP09) and the deepest proven is 27.68m AOD (IFA BH11).

Generally, rockhead is deepest in the north eastern corner of the site and shallowest at the south eastern boundary and western boundary adjacent to Warren Hall.

The bedrock is variable, comprising alternating sequences of sandstone, mudstone and siltstone, with breccia and 0.4m thickness of coal noted in one hole (IFA BH16). Lateral as well as vertical (stratigraphic) variation in bedrock type is likely.

5.5 Groundwater

During the ground investigation fieldworks, groundwater was noted in the majority of the exploratory holes. The Exploration Associates, Ian Farmer Associates and Atkins investigations were all carried out during the winter (January 1995, 2008 and 2010, respectively) and the Stats Ltd investigation was carried out in the summer (May-June 1989), however, even in the summer months significant groundwater was observed.

Groundwater was encountered:

- Associated with gravelly/ sandy/ silty horizons within the glacial till,
- As “running sand” horizons within the glacial till,
- At the interface of the bedrock and the glacial deposits,
- As seepages observed from joints/beds within bedrock,
- Within the bedrock, and
- Within made ground.

Groundwater was encountered at a wide variety of depths, from around 1.00m below ground level (bgl) to around 6.25m bgl, and small rises were usually recorded in boreholes over a 20 minute monitoring period following a water strike of between around 0.2m and 2.4m, indicating some artesian pressure.

Exploration Associates reported one monitoring visit in March 1995 where water levels of 6.38m bgl (35.55 mAOD) and 4.82m bgl (34.8 mAOD) were reported in BHs EA BH3 and EA BH4, respectively.

Limited groundwater monitoring data (2 no visits undertaken during February 2008) of pipes installed into the IFA boreholes showed standing water levels between 0.3m and 3.5m bgl. Some of the standpipes were recorded as “flooded”.

Groundwater was also observed during Atkins’ visits to the site as seepages from the cut faces in the glacial materials of the Phase 1 Area. Water was also observed flowing from the many land drains which had been disturbed during the cutting works. It is likely that the land drains collect surface water runoff and groundwater.

The currently proposed cut levels are below the monitored groundwater levels in many parts of the site.

5.6 Laboratory Testing

Geotechnical testing has been carried out by Exploration Associates, Ian Farmer Associates and Stats Ltd. comprising:

- Moisture content
- Plasticity Index
- Bulk Density
- Particle Size Distribution
- pH and sulphate

- CBR
- Dry density/ Moisture content relationship
- Undrained Shear Strength (Triaxial)
- One dimensional consolidation
- MCV
- Insitu CBRs

In early 2010, Atkins noted that the geotechnical laboratory testing which was undertaken following the various historical site investigations included very little testing required to carry out an earthworks assessment. Hence, in January 2010, a trial pit investigation within Phase 1 was undertaken prior to the 2010 Earthworks Contract (described in Section 6) to obtain samples for earthworks testing. Nine samples were submitted for testing, comprising:

- 2.5kg Compaction tests with MCV at each of the moisture contents used (Earthworks Relationship Testing)

These samples, plus an additional five samples were also variously tested for:

- Natural moisture content
- Moisture content,
- Atterberg Limits,
- Particle size distribution,
- Shearbox
- MCV (1 point)

6. 2010 Earthworks Contract: Phase 1 Area

6.1 Introduction

In August 2009 The Welsh Assembly Government appointed Alun Griffiths Ltd. as contractor for the Warren Bank Interchange improvement works. As this site is adjacent to the Warren Hall site, a subsequent order was raised for Alun Griffiths Ltd. in February 2010 to construct some initial earthworks at Phase 1 of the Warren Hall development. The weather during this period was particularly cold with snow and prolonged periods of freezing conditions.

6.2 Siteworks

During the earthworks contract, Cut Areas 1, 2 and 4 and Fill Area 1 (shown on drawing 5078488/PL/007) were stripped of topsoil and cutting commenced. During the cutting operation, groundwater was encountered above the final cut levels. Land drains were also encountered which fed water into the excavation, initially as a fast flow, reducing over time. Increased flow was observed from the land drains during wet weather. The problems with the groundwater resulted in the earthworks operation being abandoned.

Details of the encountered water levels in Cut Area 1 are shown in the appended drawing 20082593/sm/01. It should be noted that plant including dumper trucks had difficulty moving across the areas of cut and where topsoil had been stripped. A rock starter layer was installed in

Fill Area 1 to assist with plant movement. The thickness of the layer needed to support plant and machinery was determined by Alun Griffiths Ltd. by site trial.

Prior to the site works soil samples were taken from a number of trial pits within the areas of proposed cut. The samples underwent geotechnical laboratory testing as described in section 5.6. Following this a basic earthworks specification was prepared. The specification is further discussed in section 6.3 and is included within Appendix C. The trial pit logs are included in Appendix A. The locations of the trial pits are shown on the appended drawing 20082593/sm/01.

The material encountered in the trial pits was wet. MCV results (an indication of the moisture content) were all less than 8, the lower limit stated for Class 2 General Cohesive Fill in the earthworks specification. Shallow groundwater was also encountered within additional trial pits undertaken by the Contractor near the western site boundary (at the top of the existing slope) in Cut Area 2. However these trial pits were not witnessed by Atkins staff.

Wet material was encountered during the subsequent earthworks and the material excavated from the areas of cut was placed in a stockpile of unsuitable material, the location of which is shown on drawing 5078488/PL/007. No filling of site won material took place.

During a site visit by Atkins staff in April 2010 hand dug pits were excavated in cut areas up to around 0.6m in depth, at which point groundwater was encountered. This is deeper than was noted during the cutting operations. This suggests that there is a seasonal variation in groundwater level, which would be expected. The groundwater levels during the summer months are not known. Hand dug excavations were also made in the stockpile of unsuitable material to around 0.3m depth. The material appeared to have a dried “crust” and although no groundwater seepage was encountered, the material below 0.3m appeared to have a higher moisture content.

6.3 Earthworks Specification and Advance Testing

The basic earthworks Specification prepared for the Warren Hall Enabling Cut and Fill at Phase 1 comprises an Appendix 6/1 (Issue A) (including Table 6/1), Appendix 6/2 and Appendix 6/3 which are included in Appendix C of this report The specification is general accordance with the Highways Agency Specification for Highway Works. The specification was produced based upon earthworks relationship testing which was undertaken on samples recovered from trial pits dug in January 2010 prior to the earthworks contract. Four samples were recovered from Cut Area 1, six samples from Cut Area 2 and four samples from Fill Area 1. The testing is described in Section 5.6, and reproduced in Appendix B.

The samples were described as silty clayey sand, sandy clay, silty sand, sandy silt, gravelly sandy clay, very sandy gravel and very silty sand. Particle size distribution tests (8 no.), which included sedimentations by pipette method (7 no.) show the fines content of the material to range between 20 and 50%. The testing indicates that the majority of the fines comprises silt. Of the 7 no Atterberg limit tests, 3 no. samples were described as “non plastic” despite being described in the laboratory as “sandy clay”. This, again, appears to be due to a high percentage of silt within the fines. The high silt content and well graded nature renders the material highly moisture susceptible and the behaviour of the material will change with small variations in the moisture content.

The classes of material included within the Specification are Class 1A, 1B and 1C General Granular Fill and Class 2A, 2B and 2C General Cohesive Fill. The acceptable limits for these materials are given within Table 6/1. The grading tests indicate that the material is most likely to classify as a class 2A fill providing that the moisture content of the material is acceptable. Acceptability limits of MCV for Class 2C material is given in the specification as between 8 and 12.

MCV tests results (9 no) were between0 and 7.6 with a mean average of 3.5.

To confirm that the material is acceptable for filling during the works the specification requires acceptability testing. However material that was likely to be acceptable was not encountered during the works due to the high moisture content and no filling of general fill was carried out prior to the cancellation of the earthworks contract. Therefore no acceptability testing was undertaken.

7. Future Site Enabling Works and Dewatering for Phase 1 Area

The site is affected by high groundwater levels and the ground conditions predominantly comprising variable, moisture susceptible glacial materials. The proposed construction must include provision to control the groundwater both in the temporary and permanent condition. It is also necessary to maximise the quantities of site won material that is suitable for re-use at the site. As the suitability of the material is dependent on the moisture content, the control of the groundwater and the suitability of site won material are therefore strongly linked.

In view of the difficulties with the high groundwater and ground conditions at this site it is considered that enabling works should be undertaken in advance of the main earthworks to trial and implement suitable measures to address the groundwater and ground conditions issues.

It is suggested that enabling works are undertaken initially within the Phase 1 area with the intention that once a suitable strategy is developed it could subsequently be implemented in other areas of the site.

7.1 Soils

To maximise the re-use of the materials at the site, the groundwater will need to be controlled. Dewatering is discussed further at Section 7.3 below.

Following dewatering, the soils may still have higher than acceptable moisture contents and additional measures may be required to maximise the suitability for re-use. It is recommended that the enabling works would include trials to determine suitable earthworks methods. These may include:

- Undertaking the earthworks during the summer months
- Spreading
- Stockpiling
- Lime modification

These are discussed in more detail below.

Earthworks at the site should be undertaken during the summer months when the moisture content of materials is lower and avoiding periods of heavy rainfall. An earthworks strategy should be developed to ensure management of surface water during the works and to prevent deterioration of the soil.

Soils could be spread prior to compaction to allow drying. Soils with a higher sand content will dry more quickly than those with a higher clay content. The amount of moisture content reduction will also be affected by the weather conditions, the length of time that the soils are left to dry and the layer thickness.

If an acceptable moisture content cannot be achieved by excavation and placement during dry weather, stockpiling involving double handling of the material may be required. Stockpiling of unsuitable material was undertaken during the 2010 Earthworks Contract. It is recommended that this stockpile is sampled to determine the level of drainage which has occurred. During the site visit by Atkins staff on 19th March 2010 the crust of the stockpile appeared to have dried, however, on inspection using a spade to excavate a small pit, the material below approximately 300mm appeared to have a higher moisture content. Sampling of this stockpile is recommended to determine the moisture content profile through the stockpile to assess the level of drainage which has occurred.

A capillary break layer beneath the stockpile, possibly supplemented by additional layers of granular material within the fill would also aid drainage. If the existing stockpile contains material which has not drained to an acceptable moisture content, a site trial could be conducted incorporating granular layers within a stockpile.

As an alternative, lime modification could be used to reduce the moisture content prior to compaction. This would involve mixing of imported lime with the wet soils prior to compaction. Suitability testing of the materials would be necessary before site operations could commence. The lime is mixed with the material by rotavation and therefore modification is generally only suitable for materials with a maximum particle size around 75mm. Sieve tests (8 no) taken from the AL January 2010 trial pits show no material in excess of 75mm. Sieve tests from the EA 1995 investigation (13 no) show only one test with particles in excess of 75mm (4% of sample from TP16 at 2m depth, a sample of made ground from beyond the site boundaries to the north east). Examination of the exploratory hole records indicates cobbles sized fragments (>60mm) in made ground in 3 no positions at the northern and eastern end of the site. Cobbles and boulders (>200mm) are noted in 5 no. positions in the glacial materials in the central and eastern parts of the site. Further assessment of grading would be required if the feasibility of lime modification is to be considered.

7.2 Rock

The rockhead profile beneath the site appears to be highly variable and would probably be jagged in appearance beneath the glacial deposits, with both lateral and vertical variation in rock type. It is likely that the rock encountered in Phase 1 will be suitable for re-use if the filling takes place in dry conditions. If filling is undertaken in wet weather the mudstone and siltstone lithologies may breakdown during placement. It should be noted that any coal encountered will not be suitable for re-use. However, from the available borehole logs, coal was encountered in only IFA BH16 which is outside the Phase 1 area, in the southern part of the site and at depth (6.4m – 6.8m bgl).

7.3 Dewatering

The proposed cut platforms are likely to be below the current groundwater levels and therefore de-watering is required in the temporary and permanent case.

7.3.1 Temporary Dewatering

An assessment of a temporary sacrificial dewatering system should be undertaken to determine the number of stages of dewatering required, the peak and steady state flows and the spacing of the dewatering trenches. In previous correspondence between Atkins and the WAG, Atkins proposed to carry out calculations following the methods set out in CIRIA 515 Groundwater Control or the NAFAC Manual as appropriate. The calculations would provide flow and drawdown predictions in uniform ground conditions for a range of possible permeabilities. Atkins proposed to use the results to consider drainage solutions.

It is likely that the temporary drainage will comprise a series of filter drains running approximately north-south across the site. The spacing and depth of the drains would be determined by calculation. Water in these drains could then flow into east-west collection drains, to allow outfall.

Further modelling would be needed to assess the quantity and flow rates of water in order to evaluate the capacity and storage requirements of the drainage elements.

7.3.2 Permanent Drainage

An outline design for the requirements of a permanent drainage system should be undertaken following a similar method to that used for the temporary requirement. This work would estimate the flow rates in steady state conditions and estimate the number and depths of trenches required to achieve a drawdown below finished ground level.

A site investigation including pumping tests has not been undertaken on the site. In light of this our estimation of the dewatering requirement would rely on the limited existing ground investigation information and the information gathered during the recent earthworks contract. Therefore initial calculations would include broad assumptions and should be verified with a site trial.

Permanent drainage is likely to use similar methods to the temporary drainage system.

7.4 Estimation of Reuse of Materials

A table considering the possible suitability for re-use of the site won soils is given as Table 7.1, below. Suitability estimates are provided depending upon the earthworks and drainage strategy adopted. These percentages are very rough estimates and should be confirmed by the trials proposed as part of the enabling works.

Table 7.1: Suitability for re-use and Earthworks/Drainage Strategy

Earthworks/Drainage Strategy	% Acceptability of Site Won Soils as Class 1 or 2 Fill
No drainage and works undertaken in winter	0
Drainage, works undertaken in summer avoiding periods of heavy rainfall, good earthworks practice, no additional measures	40
Drainage, works undertaken in summer avoiding periods of heavy rainfall, good earthworks practice, spreading and stockpiling	60
Drainage, works undertaken in summer avoiding periods of heavy rainfall, good earthworks practice, lime modification	80

Notes

1. *It is estimated that approximately 5 – 20% of the site won materials will comprise rock, although this should be confirmed by more detailed geological modelling. This material is not included within the figures given above.*
2. *The percentages of rock and soil are based on the cut levels shown in drawings 1000_40000_contour.dwg, 500_40000_mcl4_xsect.dxf, 500_40000_mcl4_xsect_01.dxf, 500_40000_mcl4_xsect_02.dxf, 31/08/2010*
3. *These percentages are very rough estimates and should be confirmed by trails as proposed in this report.*

8. Conclusions and Recommendations

The existing ground investigation information indicates that the ground conditions across the site are highly variable and moisture susceptible, and groundwater level is close to the surface. During the 2010 earthworks contract it was demonstrated that undertaking cut and fill operations during wet weather was not feasibile.

We have the following recommendations with regard to future cut and fill earthworks on the site:

- It is recommended that a temporary and permanent dewatering strategy is developed.
- Measures to maximise the suitability of site won fill materials should be considered and an earthworks strategy should be developed.
- Prior to any significant earthworks at the site enabling works should be carried out. The enabling works should comprise:
  - Trials and installation of a temporary drainage system to allow the future earthworks to be undertaken.
  - Trials to confirm the feasibility of the earthworks strategy. This may involve several of the measures stated at Section 7.1 above.

The enabling works should be undertaken in the Phase 1 area of the site initially, with the intention that an approach could subsequently be developed for the rest of the Warren Hall site.

ATKINS

Key

+ SB01	Stats Ltd (1989)
+ ET03/EB01	Exploration Associates (1995)
+ BH01	Ian Farmer Associates (2008)
2009/TP1	Atkins (2009)
TPC1/01	Jacobs Engineering (2010)
15.650	Level in m AOD at top of exploratory hole
× 46.482	Level of groundwater seepage encountered during 2009/2010 Earthworks contract
	Site Boundary
	Plateau A
	Plateau B
	Phase 1 Area
	Areas of landfill identified by Envirocheck Report (indicative only)
	Cut Areas
	Fill Area

Stat	Purpose of Issue	Date	Auth
D	Draft for comment	09.09.10	HJ

Rev	Description	By	Date	Chk'd	Auth

Atkins Limited

Chadwick House
Birchwood Park
Warrington, Cheshire,
England,
WA3 6AE

Tel: (01925) 238000
Fax: (01925) 238500
www.atkinsglobal.com

Client

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WELSH ASSEMBLY GOVERNMENT

Project

WARREN HALL

Title

EXPLORATORY HOLE
LOCATION PLAN

Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A0	1:2000	SM Date 09/09/10	CK Date 09/09/10	HJ Date 09/09/10

Status	Drawing Number	Rev
F	20082593/SM/32992	

Rev

Drawing Number 20082593/SM/32992

Status P

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File: Exploratory Hole Location Plan Rev A.dwg

Date: Sep 27, 2010 - 2:52pm

Plotted by: mdie9895

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Local Grid

Notes:-

1. Some tree positions are estimated and are therefore to be verified by contractor on site. All trees to be surveyed by qualified bat specialist before removal.
2. Trees not affected by the works are to remain and shall be fenced off for protection.
3. Extent of earthworks to be completed is governed by the volume of the fill areas shown. Excavation therefore needs to be undertaken progressively in tandem with the deposition of fill material.
4. Maximum depth of topsoil storage heap to be 2m.
5. Haul routes between cut and fill areas to be kept to a minimum. Contractor to protect service crossings. (Refer to Drg 5078488/PL/006 for service details)
6. Contractor to establish survey control points based upon those being used for the Warren Bank Interchange upgrading works.
7. Contractor to clearly define / fence off service corridors.
8. Contractor to establish safe site access off Leicester Lane and to deploy suitable controls for safe passage. (Designers Risk Assessment refers)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS

CONSTRUCTION

MAINTENANCE/CLEANING

USE

DECOMMISSIONING/DEMOLITION

Stat	Bwriad Cyhoeddi/Purpose of Issue	Dyddiad/ Date	Awd/ Auth

Cyw/ Rev	Disgrifiad/Description		Dyddiad/ Date	Gwir/ Chk'd	Awd/ Auth
A	Legend revised to accommodate amended route of 11kV cable	DMA	02.02.10	HJ	HJ

Atkins Limited
Llys Llywelyn (Uned 7)
Parc Busnes Llanelwy
Ffordd Richard Davies
Llanelwy
Sir Ddinbych, LL17 0LJ
Ffôn: (01745) 585351
Ffacs: (01745) 583323
www.atkinsglobal.com

©

Cleient/Client
LLYWODRAETH CYNULLIAD CYMRU
WELSH ASSEMBLY GOVERNMENT

Cynllun/Project
WARREN HALL DEVELOPMENT
PHASE 1
SITE PREPARATION

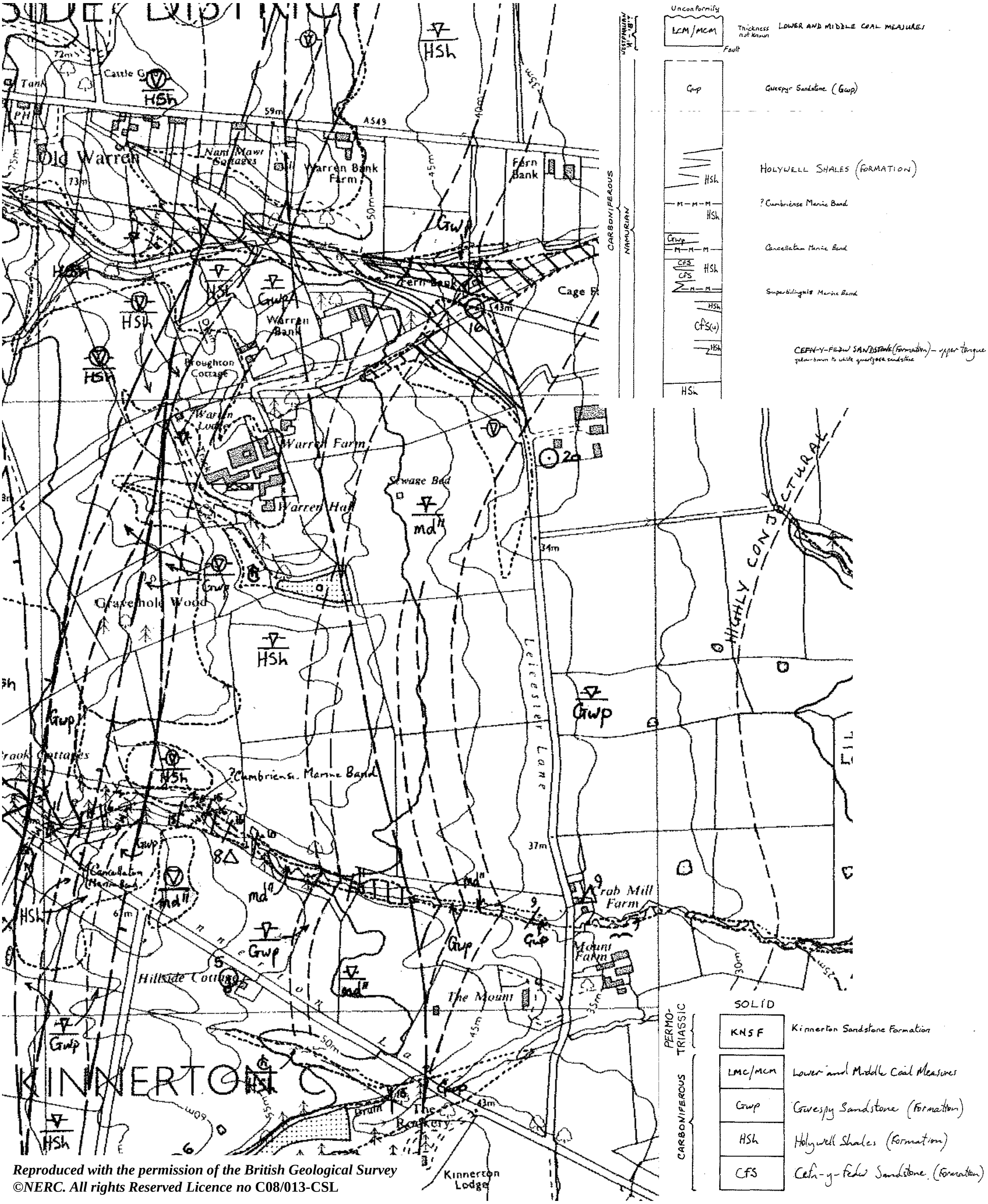
Teitl Llunlad/Drawing Title
EARTHWORKS KEY PLAN

Taflen/Sheet	Graddfa/Scale	Darluniwyd/Drawn	Gwiriwyd/Checked	Awd/Auth
A0	1:500	PS/DMA 02.02.10	HJ 02.02.10	HJ 03.02.10

Statws/Status	Rhif Llunlad/Drawing Number	Cyw/Rev
C	5078488/PL/007	A

Ffeil/File: PL007 Key Plan.dwg new.dwg Dyddiad/Date: Jun 24, 2010 - 2:06pm Argraffwyd gan/Plotted by: SMIT1402

P:\GBLLC\HandT\TSol\BX\Projects\NWTRA - St. Asaph Jobs\5078488 NWTRA Warren Hall Infrastructure JONE6882\Drawings\Current Working DPL007 Key Plan.dwg new.dwg



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ATKINS

Extract From 1:10,000 Geological Map

Figure 1

Client: Welsh Assembly Government	**Project: Warren Hall**	**Project No: 5078488.106**

Appendix A
Additional Trial Pitting Records

Atkins Ltd 2009
Jacobs Engineering 2010

Trial Pit Record

Project: A55 Warren Bank Interchange	**Trial Pit No:** TP 101
Proj. No.	**Ground Level:**
Client: NWTRA	

Hand Vane Tests		**Strata**	
Depth (m)	**Results (kN/m^2)**	**Description**	**Depth to base (m)**
		Grass over brown silty fine and medium sand with rootlets (TOPSOIL)	0.30
		MADE GROUND: Orange-brown silty fine and medium sand with some sub-angular to rounded fine to coarse gravel of sandstone, siltstone. (irregular base, locally to 0.7m)	0.60
0.60 1.00	90, 110, 120 95, 100, 110	MADE GROUND: Stiff brown occasionally mottled grey very sandy (fine and medium) silty Clay with some angular to rounded fine to coarse gravel of sandstone, siltstone, brick fragments and occasional sub-angular to rounded cobbles of sandstone, siltstone. (irregular base, locally to 1.6m)	1.50
		Stiff dark purplish-brown occasionally mottled grey slightly sandy (fine) silty CLAY with some sub-angular to rounded fine to coarse gravel of sandstone, siltstone, mudstone, coal. At 1.80m rounded cobble of siltstone	2.50
		Trial pit complete at 2.50m depth	

Excavation	**Groundwater**
Easy excavatability to 2m, moderately easy below. Pit sides stable.	None encountered.

Remarks

CAT scan undertaken before excavation commenced to check no services present.

No hand vane tests possible on excavated spoil below 1.2m depth; hindered by relatively small 'lump size' and gravel content.

Pit dimensions 0.9m x 2.5m

Logged by M Woolrich

ATKINS	Trial Pit Photographs : TP101		TP101
	Client: Welsh Assembly Government	Project: Warren Hall	Project No: 5078488.106

Trial Pit Record

ATKINS

Project: A55 Warren Bank Interchange	**Trial Pit No:** TP 102
Proj. No.	**Ground Level:**
Client: NWTRA	

Hand Vane Tests		**Strata**	
Depth (m)	**Results (kN/m^2)**	**Description**	**Depth to base (m)**
		Grass over dark brown silty fine and medium sand with rootlets (TOPSOIL)	0.30
		MADE GROUND: Orange-brown and dark brown slightly clayey very silty fine and medium sand with some sub-angular to sub-rounded fine to coarse gravel of sandstone, siltstone. Below 0.7m locally clayey	1.20
1.20	55, 60, 65	Intermixed brown very clayey fine and medium SAND and firm greyish-brown very (fine and medium) sandy CLAY. A little sub-angular to rounded fine to coarse gravel of sandstone, siltstone (possible Made Ground).	1.60
		Firm, locally stiff, brown mottled dark purplish-brown and occasionally grey sandy (fine) CLAY with some sub-angular to rounded fine to coarse gravel of sandstone, siltstone, mudstone. Some pockets (up to 0.3m x 0.5m x 0.6m) of brown clayey fine and medium sand (possible Made Ground). (irregular base, locally to 2.6m)	2.50
2.50 3.00	65, 68, 70 80, 88, 90	Stiff dark brown, locally purplish-brown, occasionally mottled grey slightly sandy (fine) silty CLAY with some sub-angular to rounded fine to coarse gravel of sandstone, siltstone, mudstone.	3.20
		Trial pit complete at 3.2m depth	

Excavation	**Groundwater**
Easy excavatability. Pit sides stable.	Damp at 2.2m depth. Seepage at 2.6m depth where sand pocket locally deepens.

Remarks

CAT scan undertaken before excavation commenced to check no services present.
Hand vane tests not possible between 1.6m and 2.5m depth; hindered by relatively small 'lump size' and sand and gravel content.Tests undertaken on excavated spoil 'disturbed clay lumps' at 1.2m, 2.5m and 3m, consequently probably under-estimates.
Pit dimensions 0.9m x 2.5m

Land drain (dry) encountered at 0.6m depth. Logged by M Woolrich

Trial Pit Record

ATKINS

Project:	**A55 Warren Bank Interchange**	**Trial Pit No:**	**TP 103**
Proj. No.		**Ground Level:**	
Client:	**NWTRA**		

Hand Vane Tests		**Strata**	
Depth (m)	**Results (kN/m^2)**	**Description**	**Depth to base (m)**
		Grass over dark brown silty fine and medium sand with rootlets (TOPSOIL)	0.30
		MADE GROUND: Grey clayey silty fine and medium Sand with much angular to sub-rounded fine to coarse gravel, and occasional cobbles of sandstone, siltstone. Angular, blocky sandstone cobbles/small boulders ('Old stone drain') in one end of pit.	0.70
		MADE GROUND: Orange-brown clayey fine to coarse Sand with some angular to sub-rounded fine to medium gravel of sandstone, siltstone. Locally intermixed with light brown silty sand.	1.10
		MADE GROUND: Grey clayey fine and medium Sand with some pockets (up to 0.2m x 0.3m x 0.5m) of firm brown and grey very sandy (fine and medium) clay.	1.70
		Probable MADE GROUND: Firm dark grey slightly sandy Clay with a little sub-angular to subrounded fine and medium gravel of siltstone, mudstone and some rootlets, organic material. below 1.9m intermixed with firm brown sandy (fine and medium) clay.	2.10
		Stiff, locally firm, dark brown slightly sandy (fine) silty CLAY with some sub-angular to rounded fine to coarse gravel of sandstone, siltstone, mudstone.	2.60
		Trial pit complete at 2.60m depth	

Excavation	**Groundwater**
Easy excavatability. Pit sides stable.	None encountered.

Remarks

CAT scan undertaken before excavation commenced to check no services present.
Hand vane tests not possible below 1.7m depth; hindered by relatively small 'lump size' and sand and gravel content.

Pit dimensions 0.9m x 3.3m (pit extended away from 'stone drain' encountered at 0.3m depth).

Logged by M Woolrich

Jacobs
Unit 1
Whitegate Industrial Estate
Wrexham
LL13 8UG

Tel 01978 358895
Fax 01978 310240

Trial Pit Logging Sheet

Site: ASS WARREN BANK.

Pit Number: TPC1/01.

Client ALUN GRIFFITHS. Date 26/1/10

Operators JE

Depth (m)	Thickness (m)	Material Description	Samples
0 - 0.18		Topsoil with grass over	—
0.18 - 1.0		Orange brown/brown slightly gravelly	TPC1/01
		Silty SAND	S1
1.0 - 1.4		Redish brown/brown silty/clayey SAND	
		occ lumps grey & brown clay.	S2.
		water ~~[illegible]~~ encountered @ 1.0m.	
		(moderate flow)	

Jacobs
Unit 1
Whitegate Industrial Estate
Wrexham
LL13 8UG

Tel 01978 358895
Fax 01978 310240

Trial Pit Logging Sheet

Site: ASS WARREN BANK.
Pit Number: TPC1/02
Client ALUN GRIFFITHS. Date 27/1/10
Operators JE

Depth (m)	Thickness (m)	Material Description	Samples
—	—	Topsoil stripped approx 0.20m	—
0 – 1.0		Light brown/orange brown Slightly gravelly	
		Sandy CLAY – becoming reddish brown	TPC1/02
		in colour after 0.4m.	S1.
1.0 – 2.7		Reddish brown Slightly gravelley silty	S2.
end.		SAND becoming wetter with depth.	(1 – 1.5m)
			S3.
		Land drain @ 1.0m. water entering	(1.5 – 2.7m)
		at Various Points from 1.0m down.	
		(running Sands).	

Jacobs
Unit 1
Whitegate Industrial Estate
Wrexham
LL13 8UG

Tel 01978 358895
Fax 01978 310240

Trial Pit Logging Sheet

Site: A55 WARREN BANK. Pit Number: TPF1/01

Client ALUN GRIFFITHS. Date 27/1/10 Operators JE

Depth (m)	Thickness (m)	Material Description	Samples
0 - 0·24		Topsoil with grass over	—
0·24 - 1·50		Brown/orange brown/light grey Slightly	TPF1/01
end.		gravelly very silty SAND	S1
		Land drain encountered @ 1·20m.	

Jacobs
Unit 1
Whitegate Industrial Estate
Wrexham
LL13 8UG

Tel 01978 358895
Fax 01978 310240

Trial Pit Logging Sheet

Site: A55 WARREN BANK.

Pit Number: TPF1/02.

Client ALUN GRIFFITHS.

Date 27/1/10

Operators JE

Depth (m)	Thickness (m)	Material Description	Samples
0·-0·2		Topsoil with grass over.	—
0·2-0·55		m.g. Brown/orange brown some light grey	—
		Slightly gravelley Sandy CLAY.	
0·55-1·9.		m.g. Firm redish brown/brown with some	
		light to dark grey Slightly gravelley	—
		Sandy CLAY - occ brick + coal fragment	
		Shear vane @ 0·7m. 50, 55, 56 kpa	
1·9.		Rock HEAD - weathered SILTSTONE	—
		No Samples taken.	
		No water encountered.	

Jacobs
Unit 1
Whitegate Industrial Estate
Wrexham
LL13 8UG

Tel 01978 358895
Fax 01978 310240

Trial Pit Logging Sheet

Site: A55 WARREN BANK.

Pit Number: TPF1/04

Client ALUN GRIFFITHS.

Date 27/1/10

Operators JE

Depth (m)	Thickness (m)	Material Description	Samples
0-0.28		Topsoil with grass over	
0.28-0.5		light brown/orange brown slightly gravelly	—
		silty SAND.	
0.5-2.0		Firm ~~Rough~~ occ stiff lumps reddish brown/	TPF1/04
		brown/orange brown Slightly gravelly Slightly Si.	
		Sandy CLAY occ coal fragments.	
		becomes wetter with depth.	
		Shear vane : 1.0m 90,70,100	
		1.35m 40,38,58.	
		No water encountered.	

Jacobs
Unit 1
Whitegate Industrial Estate
Wrexham
LL13 8UG

Tel 01978 358895
Fax 01978 310240

Trial Pit Logging Sheet

Site: A55 WARREN BANK.

Pit Number: TPC2101

Client ALUN GRIFFITHS.

Date 27/1/10

Operators JE

Depth (m)	Thickness (m)	Material Description	Samples
0 – 0·2		Topsoil with grass over	—
0·2 – 1·4m		Firm redish brown/brown Slighty	TPC2101. S1
		gravelly Sandy/Very Sandy CLAY	
1·4m		ROCK HEAD – SANDSTONE.	S2*.
		Slight water Seapage @ 1·4m on top	*Few lumps ~~[illegible]~~
		of rock.	of stone for identification
			if reqd.

Jacobs
Unit 1
Whitegate Industrial Estate
Wrexham
LL13 8UG

Tel 01978 358895
Fax 01978 310240

Trial Pit Logging Sheet

Site: A55 WARREN BANK.

Pit Number: TPC2/02.

Client ALUN GRIFFITHS.

Date 27/1/10

Operators JE

Depth (m)	Thickness (m)	Material Description	Samples
0 – 0·21		Top soil with grass over	—
			TPC2/02
0·21 – 2·3		Brown / reddish brown very Clayey SAND/	S1
		Sandy CLAY	
2·3 – 3·1		Brown slightly gravelly very silty SAND/	S2
end.		Sandy SILT	
		No water	

Jacobs
Unit 1
Whitegate Industrial Estate
Wrexham
LL13 8UG

Tel 01978 358895
Fax 01978 310240

Trial Pit Logging Sheet

Site: ASS WARREN BANK.
Pit Number: TPC2/03
Client ALUN GRIFFITHS. Date 27/1/10
Operators JE

Depth (m)	Thickness (m)	Material Description	Samples
0 - 0·21		Topsoil with grass over	—
0·21 - 2·3 ~~0-2~~		Redish brown/brown patches of grey	TPC2/03
		Very Clayey SAND / ~~Ver~~ Sandy CLAY	S1
End.			
		water @ 1·65m	

Jacobs
Unit 1
Whitegate Industrial Estate
Wrexham
LL13 8UG

Tel 01978 358895
Fax 01978 310240

Trial Pit Logging Sheet

Site: ASS WARREN BANK.

Pit Number: TPC2/04.

Client ALUN GRIFFITHS.

Date 1/10

Operators JE

Depth (m)	Thickness (m)	Material Description	Samples
0-0.2		Topsoil with grass over.	
0.2-2.3		Firm Redish brown/brown Slightly gravelly	TPC2/04
		Slightly Sandy CLAY - becomes more	S1.
		gravels after 1.6m.	
		Shear vane @ app 1.0m 50,42,46KPa	
2.3-3.1		Brown silty/clayey Very Sandy GRAVEL	S2.
end.			
		Water encountered @ 1.6m. Slight flow	

Jacobs
Unit 1
Whitegate Industrial Estate
Wrexham
LL13 8UG

Tel 01978 358895
Fax 01978 310240

Trial Pit Logging Sheet

Site: ASS WARREN BANK.

Pit Number: TPF1103

Client ALUN GRIFFITHS. Date 27/1/10

Operators JE

Depth (m)	Thickness (m)	Material Description	Samples
0.0-0.2		Topsoil with grass over	—
0.2-0.4		Light grey/brown silty SAND	—
0.4-1.8		Firm reddish brown/brown/orange brown	TPF1103
		Slightly gravelly Slightly Sandy CLAY	S1
		Shear Vane @ 1.5m 50,45,50	
1.8-2.1		Brown Slightly gravelly Silty SAND	S2.
end.			

Appendix B
Geotechnical laboratory Testing

Earthworks Suitability Testing 2010

celtest
independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 4th February 2010
Test Report Ref.: STR 207358

Contract: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Particle Size Distribution (PSD) sedimentation by pipette method to **BS 1377: Part 2: 1990: clause 9.4.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC1/01-S2 1.0-1.4**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test.:	**03/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**~~BS 812: Pt. 102/BS EN 932-1~~/Unknown** (Delete as appropriate)
Sampled By:	**Client**
Soil Description:	**Silty Clayey Sand**
Were any unrepresentative lumps present?	**No**

COMMENTS/DEPARTURE FROM SPECIFIED PROCEDURE:

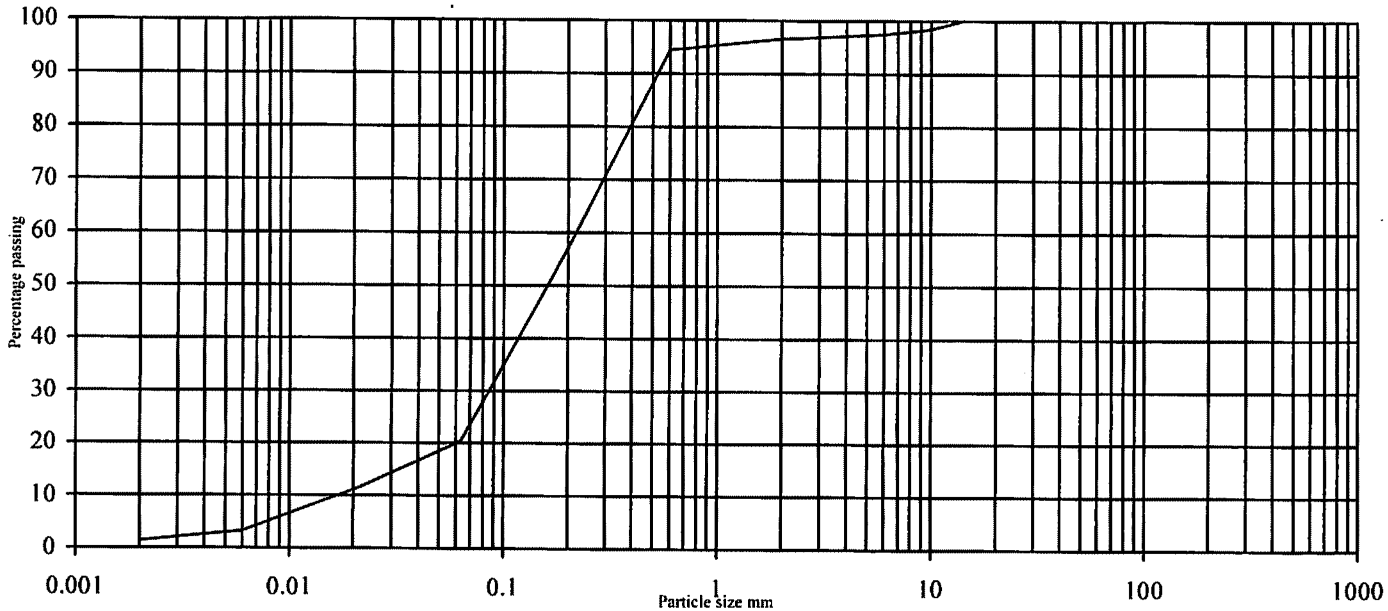
RESULTS:

SEE ATTACHED

PARTICLE SIZE	
(mm)	% pass
200	100
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	100
10	98.5
6.3	97.6
5	97.3
2	96.6
0.6	94.5
0.212	59.0
0.063	20.4
0.0212	11.5
0.006	3.3
0.002	1.4

Preparation : No pre-treatement used

PARTICLE PROPORTIONS	
Cobbles %	0
Gravel %	3.4
Sand %	76.2
Silt %	19.0
Clay %	1.4



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

G.Ll Evans - Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: STR 207360

Contract.: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) of a sample at its natural moisture content in accordance with **BS 1377 : Part 4 : 1990 Test 5.4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC1/01-S2 1.00-1.40**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Silty Clayey Sand**
Target Specification:	**N/A**

RESULTS:

Interpretation of test results: Directly from graph

Moisture Condition Value (MCV) = 1.8

Moisture Content (%) = 16.9

% Particles >20mm removed prior to initial sample = 0

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

For material requiring more than 256 blows the Moisture Condition Value should be reported as "more than 18".

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE
Contract: A55 Warrens Bank

Date: 4th February 2010
Test Report Ref.: 207361

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Dry Density and Moisture Content Relationship of soil passing 20mm sieve 2.5kg Rammer Method in accordance with BS 1377: 4: 1990 Clause 3.3

SAMPLE DETAILS:

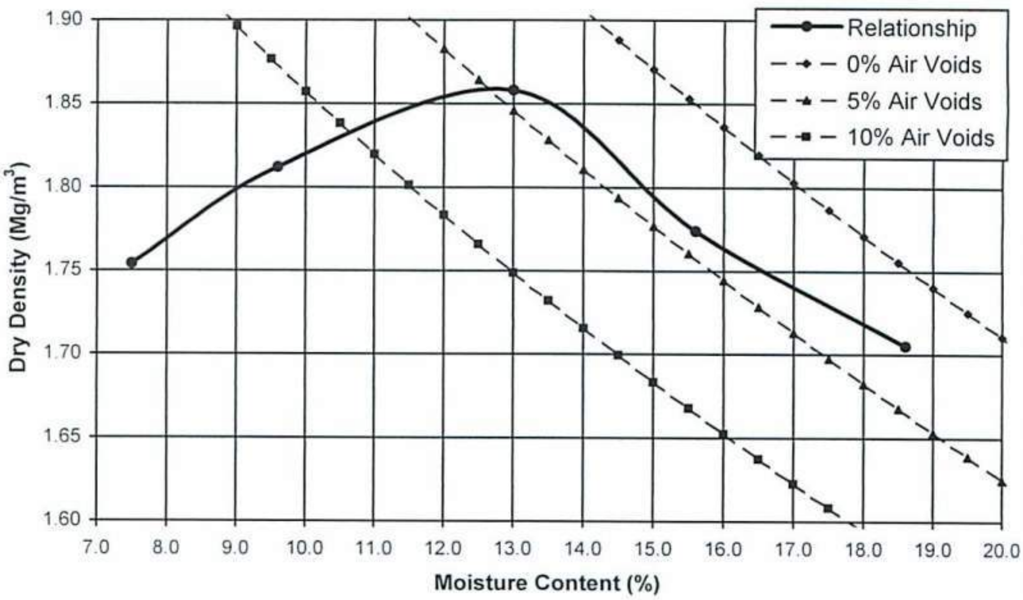
Certificate of sampling received	**No**	Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC1/01-S2 1.00-1.40**	Date and Time of Sampling	**Unknown**
Date of Receipt at Lab:	**01/02/2010**	Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**	Name of Source:	**Unknown**
Method of Sampling:	**Unknown**	Sampled By:	**Client**
Soil Description:	**Silty Clayey Sand**	Type of Sample:	**Silty Clayey Sand**

RESULTS: Were any unrepresentative lumps present? No

Sample Preparation Procedure: 3.2.4.1
Sample Preparation Method: Single
Particle Density: 2.60 Mg/m^3 (Assumed)
Amount of sample retained on 37.5mm test siev 0%
Amount of sample retained on 20mm test sieve: 0%

Moisture Content (%)	Dry Density Mg/m^3
7.5	1.75
9.6	1.81
13.0	1.86
15.6	1.77
18.6	1.71

Optimum Moisture Content (%)	Maximum Dry Density Mg/m^3
13	**1.86**



Comments/Departure from specified procedures:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: 207362

Page 1

Contract:: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) moisture content relation of a soil in accordance with **BS 1377: Part 4: 1990 Test 5.5**

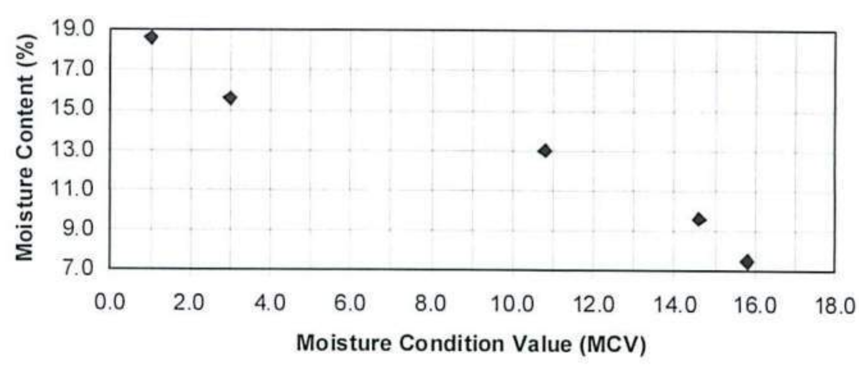
SAMPLE DETAILS:

Certificate of Sampling Received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC1/01-S2 1.00-1.40**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Silty Clayey Sand**
Were any unrepresentative lumps present?	**No**

RESULTS:

Gravel Content >20mm = 0%

Moisture Content (%)	Moisture Condition Value (MCV)
7.5	15.8
9.6	14.6
13.0	10.8
15.6	3.0
18.6	1.0



COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: STR 207364

Contract.: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Content of Soils - DEFINITIVE OVEN - DRYING METHOD. In accordance with **BS 1377 : Part 2 : 1990 : clause 3.2**

SAMPLE DETAILS:

Certificate of Sampling Received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC1/02-S1 0.00-1.00**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Clay**
Were any unrepresentative lumps present?	**No**

RESULTS:

Moisture Content (%) = 20.9

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

.

None

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 4th February 2010
Test Report Ref.: STR 207365

Contract.: A55 Warren Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Plastic Limit, Liquid Limit, and Plasticity Index of sample in accordance with **BS 1377:Part 2:1990 Clause 5.3, Clause 4.3, and Clause 5.4.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC1/02/S1 0.00-1.00**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**01/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Clay**
Target Specification:	**N/A**

RESULTS:

History of sample:		~~Natural state~~/After wet sieving
% Materials passing 425μm	=	**96.3**
Plastic Limit	=	**Non Plastic**
Liquid Limit	=	**22**
Plasticity Index	=	**N/A**

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: STR 207366

Contract.: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) of a sample at its natural moisture content in accordance with **BS 1377 : Part 4 : 1990 Test 5.4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC1/02-S1 0.00-1.00**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Clay**
Target Specification:	**N/A**

RESULTS:

Interpretation of test results: Directly from graph

Moisture Condition Value (MCV) = 6.5

Moisture Content (%) = 20.9

% Particles >20mm removed prior to initial sample = 0

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

For material requiring more than 256 blows the Moisture Condition Value should be reported as "more than 18".

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE
Contract: A55 Warrens Bank

Date: 4th February 2010
Test Report Ref.: 207367

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Dry Density and Moisture Content Relationship of soil passing 20mm sieve 2.5kg Rammer Method in accordance with BS 1377: 4: 1990 Clause 3.3

SAMPLE DETAILS:

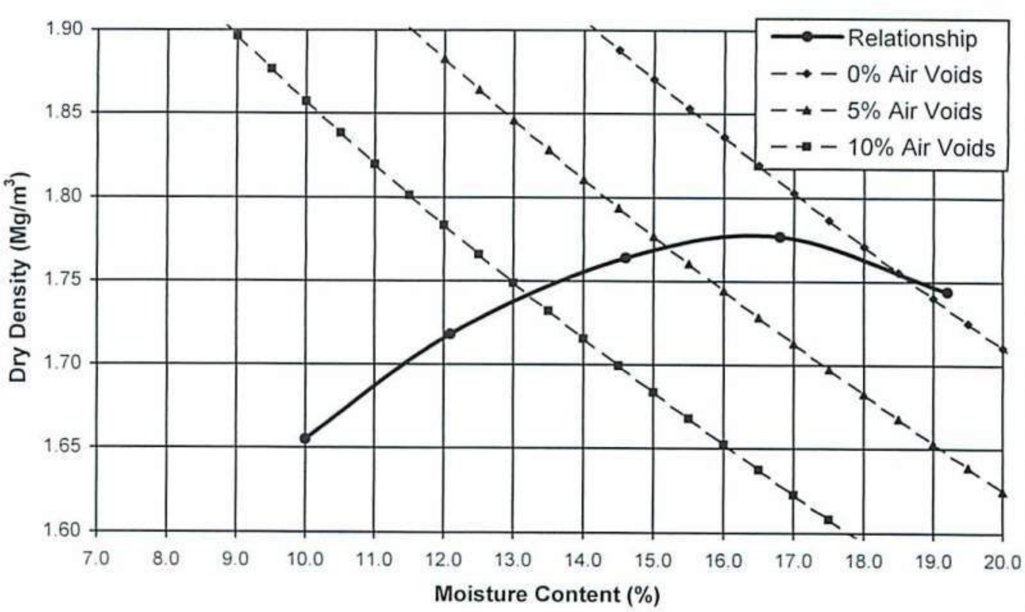
Certificate of sampling received	**No**	Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC1/02-S1 0.00-1.00**	Date and Time of Sampling	**Unknown**
Date of Receipt at Lab:	**01/02/2010**	Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**	Name of Source:	**Unknown**
Method of Sampling:	**Unknown**	Sampled By:	**Client**
Soil Description:	**Sandy Clay**	Type of Sample:	**Sandy Clay**

RESULTS: Were any unrepresentative lumps present? No

Sample Preparation Procedure: 3.2.4.1
Sample Preparation Method: Single
Particle Density: 2.60 Mg/m^3 (Assumed)
Amount of sample retained on 37.5mm test siev 0%
Amount of sample retained on 20mm test sieve: 0%

Moisture Content (%)	Dry Density Mg/m^3
10.0	1.66
12.1	1.72
14.6	1.76
16.8	1.78
19.2	1.74

Optimum Moisture Content (%)	**Maximum Dry Density Mg/m^3**
17	**1.78**



Comments/Departure from specified procedures:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81
UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: 207368

Contract:: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) moisture content relation of a soil in accordance with **BS 1377: Part 4: 1990 Test 5.5**

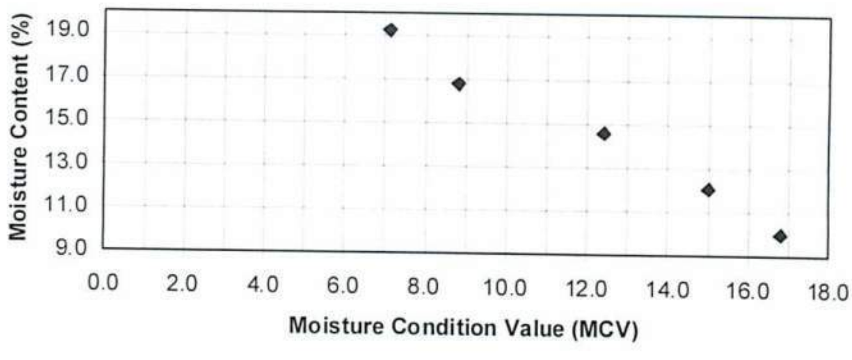
SAMPLE DETAILS:

Certificate of Sampling Received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC1/02-S1 0.00-1.00**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Clay**
Were any unrepresentative lumps present?	**No**

RESULTS:

Gravel Content >20mm = 0%

Moisture Content (%)	Moisture Condition Value (MCV)
10.0	16.8
12.1	15.0
14.6	12.4
16.8	8.8
19.2	7.1



COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81
UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 4th February 2010
Test Report Ref.: STR 207369

Contract: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Particle Size Distribution (PSD) sedimentation by pipette method to **BS 1377: Part 2: 1990: clause 9.4.**

SAMPLE DETAILS:

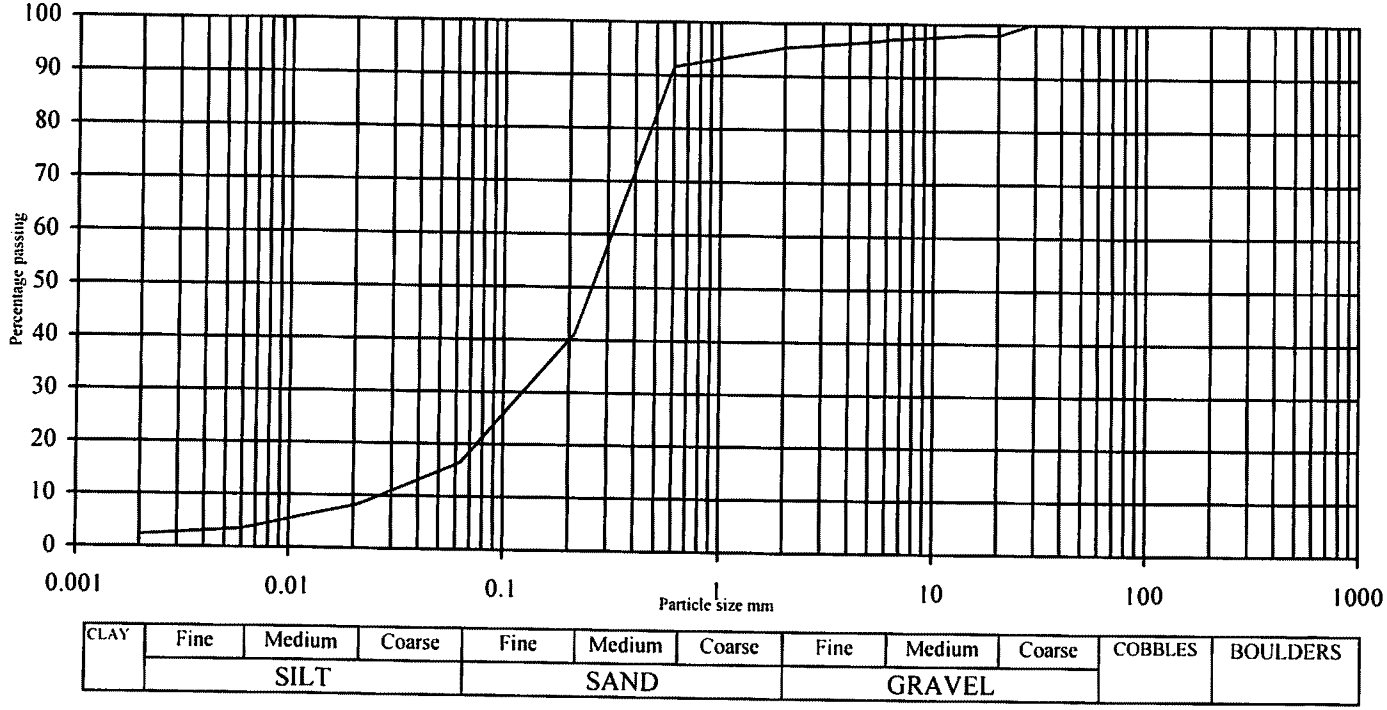
Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC1/02-S2 1.00-1.50**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test.:	**03/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**~~BS 812: Pt. 102/BS EN 932-1~~/Unknown** (Delete as appropriate)
Sampled By:	**Client**
Soil Description:	**Silty Sand**
Were any unrepresentative lumps present?	**No**

COMMENTS/DEPARTURE FROM SPECIFIED PROCEDURE:

RESULTS:

SEE ATTACHED

PARTICLE SIZE	
(mm)	% pass
200	100
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	98
14	98
10	97.6
6.3	97.1
5	96.6
2	95.4
0.6	91.6
0.212	41.2
0.063	16.5
0.0212	8.4
0.006	3.5
0.002	2.3



Preparation : No pre-treatement used

PARTICLE PROPORTIONS	
Cobbles %	0
Gravel %	4.6
Sand %	78.9
Silt %	14.2
Clay %	2.3

G Ll Evans - Laboratory Manager

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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: STR 207370

Contract.: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) of a sample at its natural moisture content in accordance with **BS 1377 : Part 4 : 1990 Test 5.4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC1/02-S2 1.00-1.50**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Silty Sand**
Target Specification:	**N/A**

RESULTS:

Interpretation of test results: Directly from graph

Moisture Condition Value (MCV) = 2.4

Moisture Content (%) = 17.0

% Particles >20mm removed prior to initial sample = 2

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

For material requiring more than 256 blows the Moisture Condition Value should be reported as "more than 18".

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE
Contract: A55 Warrens Bank

Date: 4th February 2010
Test Report Ref.: 207371

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Dry Density and Moisture Content Relationship of soil passing 20mm sieve 2.5kg Rammer Method in accordance with BS 1377: 4: 1990 Clause 3.3

SAMPLE DETAILS:

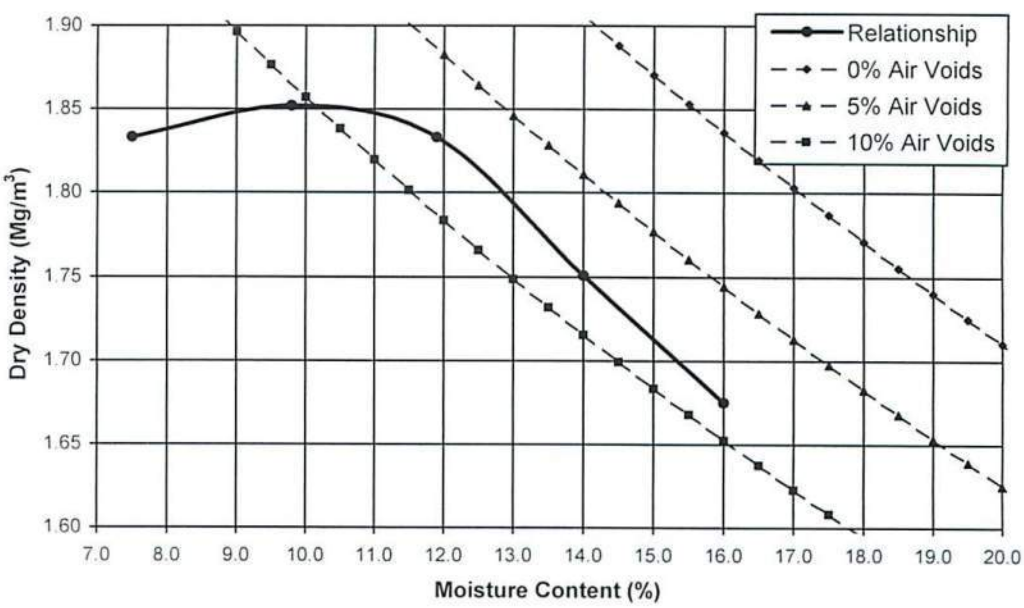
Certificate of sampling received	**No**	Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC1/02-S2 1.00-1.50**	Date and Time of Sampling	**Unknown**
Date of Receipt at Lab:	**01/02/2010**	Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**	Name of Source:	**Unknown**
Method of Sampling:	**Unknown**	Sampled By:	**Client**
Soil Description:	**Silty Sand**	Type of Sample:	**Silty Sand**

RESULTS: Were any unrepresentative lumps present? No

Sample Preparation Procedure: 3.2.4.2
Sample Preparation Method: Single
Particle Density: 2.60 Mg/m^3 (Assumed)
Amount of sample retained on 37.5mm test siev 0%
Amount of sample retained on 20mm test sieve: 2%

Moisture Content (%)	Dry Density Mg/m^3
7.5	1.83
9.8	1.85
11.9	1.83
14.0	1.75
16.0	1.68

Optimum Moisture Content (%)	Maximum Dry Density Mg/m^3
9.8	**1.85**



Comments/Departure from specified procedures:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81
UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: 207372

Contract:: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) moisture content relation of a soil in accordance with **BS 1377: Part 4: 1990 Test 5.5**

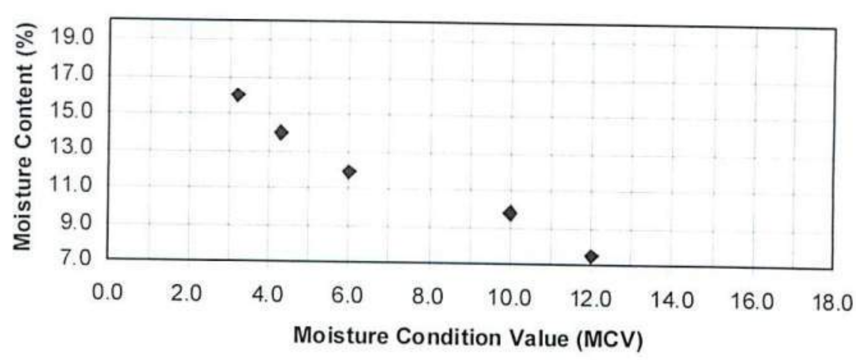
SAMPLE DETAILS:

Certificate of Sampling Received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC1/02-S2 1.00-1.50**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Silty Sand**
Were any unrepresentative lumps present?	**No**

RESULTS:

Gravel Content >20mm = 2%

Moisture Content (%)	Moisture Condition Value (MCV)
7.5	12.0
9.8	10.0
11.9	6.0
14.0	4.3
16.0	3.2



COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 4th February 2010
Test Report Ref.: STR 207374

Contract.: A55 Warren Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Plastic Limit, Liquid Limit, and Plasticity Index of sample in accordance with **BS 1377:Part 2:1990 Clause 5.3, Clause 4.3, and Clause 5.4.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/01/S1 0.20-1.40**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**01/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Clay**
Target Specification:	**N/A**

RESULTS:

History of sample:		~~Natural state~~/After wet sieving
% Materials passing 425μm	=	**92.8**
Plastic Limit	=	**14**
Liquid Limit	=	**22**
Plasticity Index	=	**8**

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(/) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81
UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: STR 207375

Contract.: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Content of Soils - DEFINITIVE OVEN - DRYING METHOD. In accordance with **BS 1377 : Part 2 : 1990 : clause 3.2**

SAMPLE DETAILS:

Certificate of Sampling Received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/01-S1 0.20-1.40**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Clay**
Were any unrepresentative lumps present?	**No**

RESULTS:

Moisture Content (%) = 15.1

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

.
None

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

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independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: STR 207376

Contract.: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Content of Soils - DEFINITIVE OVEN - DRYING METHOD. In accordance with **BS 1377 : Part 2 : 1990 : clause 3.2**

SAMPLE DETAILS:

Certificate of Sampling Received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/02-S1 0.21-2.30**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Clay**
Were any unrepresentative lumps present?	**No**

RESULTS:

Moisture Content (%) = 16.5

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

None

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 4th February 2010
Test Report Ref.: STR 207377

Contract.: A55 Warren Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Plastic Limit, Liquid Limit, and Plasticity Index of sample in accordance with **BS 1377:Part 2:1990 Clause 5.3, Clause 4.3, and Clause 5.4.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/02/S1 0.21-2.30**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**01/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Clay**
Target Specification:	**N/A**

RESULTS:

History of sample:		~~Natural state~~/After wet sieving
% Materials passing 425μm	=	**94.2**
Plastic Limit	=	**Non Plastic**
Liquid Limit	=	**22**
Plasticity Index	=	**N/A**

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81
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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 4th February 2010
Test Report Ref.: STR 207378

Contract: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Particle Size Distribution (PSD) sedimentation by pipette method to **BS 1377: Part 2: 1990: clause 9.4.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/02-S1 0.21-2.30**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test.:	**03/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**~~BS 812: Pt. 102/BS EN 932-1~~/Unknown** (Delete as appropriate)
Sampled By:	**Client**
Soil Description:	**Sandy Clay**
Were any unrepresentative lumps present?	**No**

COMMENTS/DEPARTURE FROM SPECIFIED PROCEDURE:

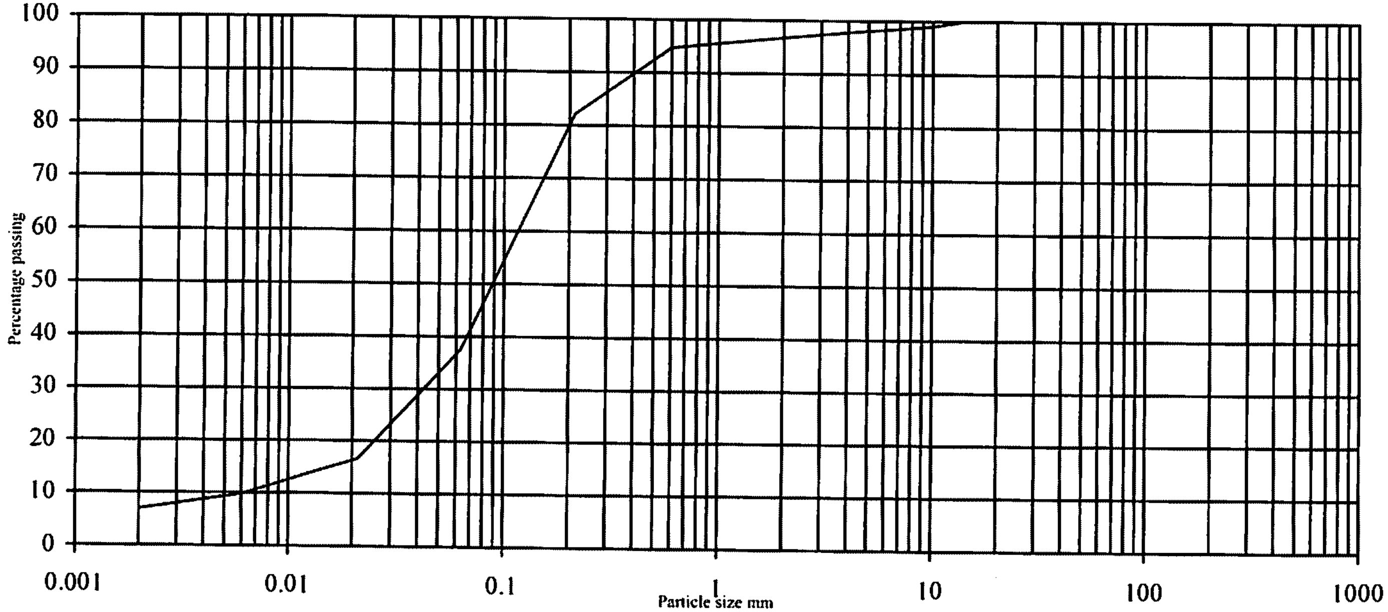
RESULTS:

SEE ATTACHED

PARTICLE SIZE	
(mm)	% pass
200	100
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	100
10	99.1
6.3	98.4
5	98.2
2	96.8
0.6	94.7
0.212	82.1
0.063	37.6
0.0212	16.6
0.006	9.8
0.002	6.9

Preparation : No pre-treatement used

PARTICLE PROPORTIONS	
Cobbles %	0
Gravel %	3.2
Sand %	59.2
Silt %	30.7
Clay %	6.9



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

G.Ll Evans - Laboratory Manager

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independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: STR 207379

Contract.: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) of a sample at its natural moisture content in accordance with **BS 1377 : Part 4 : 1990 Test 5.4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/02-S1 0.21-2.30**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Clay**
Target Specification:	**N/A**

RESULTS:

Interpretation of test results: Directly from graph

Moisture Condition Value (MCV) = 4.0

Moisture Content (%) = 16.5

% Particles >20mm removed prior to initial sample = 0

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

For material requiring more than 256 blows the Moisture Condition Value should be reported as "more than 18".

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE
Contract: A55 Warrens Bank

Date: 4th February 2010
Test Report Ref.: 207380

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Dry Density and Moisture Content Relationship of soil passing 20mm sieve 2.5kg Rammer Method in accordance with BS 1377: 4: 1990 Clause 3.3

SAMPLE DETAILS:

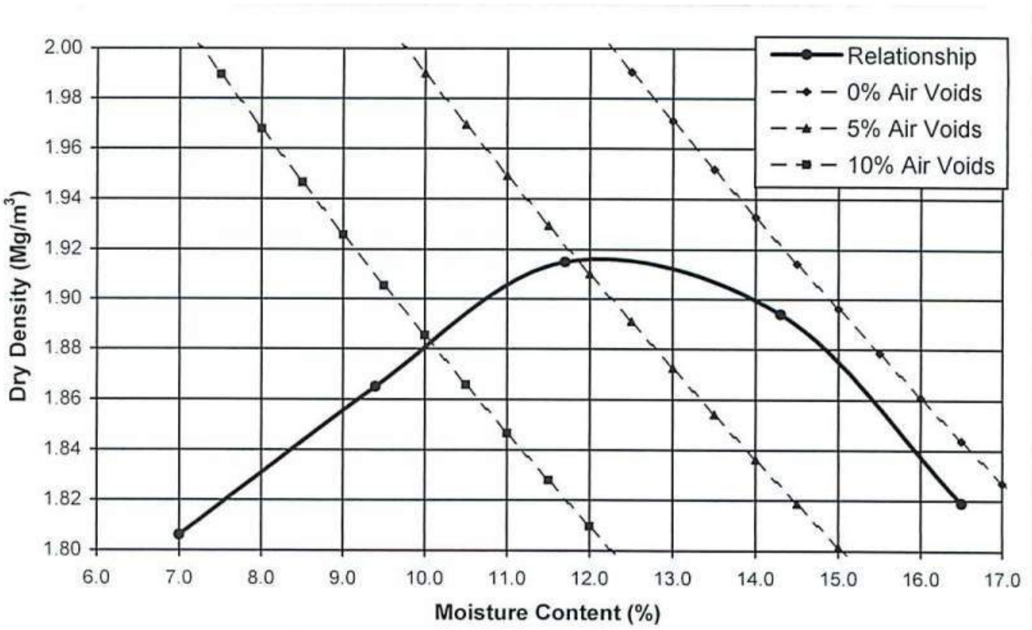
Certificate of sampling received	**No**	Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/02-S1 0.21-2.30**	Date and Time of Sampling	**Unknown**
Date of Receipt at Lab:	**01/02/2010**	Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**	Name of Source:	**Unknown**
Method of Sampling:	**Unknown**	Sampled By:	**Client**
Soil Description:	**Sandy Clay**	Type of Sample:	**Sandy Clay**

RESULTS: Were any unrepresentative lumps present? No

Sample Preparation Procedure: 3.2.4.1
Sample Preparation Method: Single
Particle Density: 2.65 Mg/m^3 (Assumed)
Amount of sample retained on 37.5mm test siev 0%
Amount of sample retained on 20mm test sieve: 0%

Moisture Content (%)	Dry Density Mg/m^3
7.0	1.81
9.4	1.87
11.7	1.92
14.3	1.89
16.5	1.82

Optimum Moisture Content (%)	**Maximum Dry Density Mg/m^3**
12	**1.92**



Comments/Departure from specified procedures:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: 207381

Contract:: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) moisture content relation of a soil in accordance with **BS 1377: Part 4: 1990 Test 5.5**

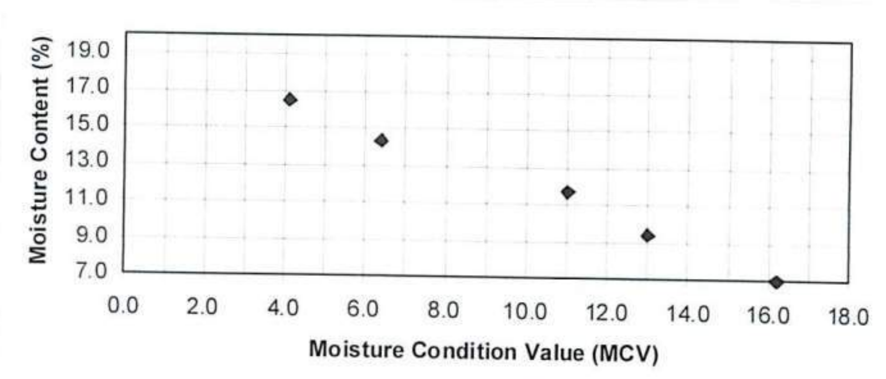
SAMPLE DETAILS:

Certificate of Sampling Received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/02-S1 0.21-2.30**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Clay**
Were any unrepresentative lumps present?	**No**

RESULTS:

Gravel Content >20mm = 0%

Moisture Content (%)	Moisture Condition Value (MCV)
7.0	16.2
9.4	13.0
11.7	11.0
14.3	6.4
16.5	4.1



COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81
UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 4th February 2010
Test Report Ref.: STR 207382

Contract: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Particle Size Distribution (PSD) sedimentation by pipette method to **BS 1377: Part 2: 1990: clause 9.4.**

SAMPLE DETAILS:

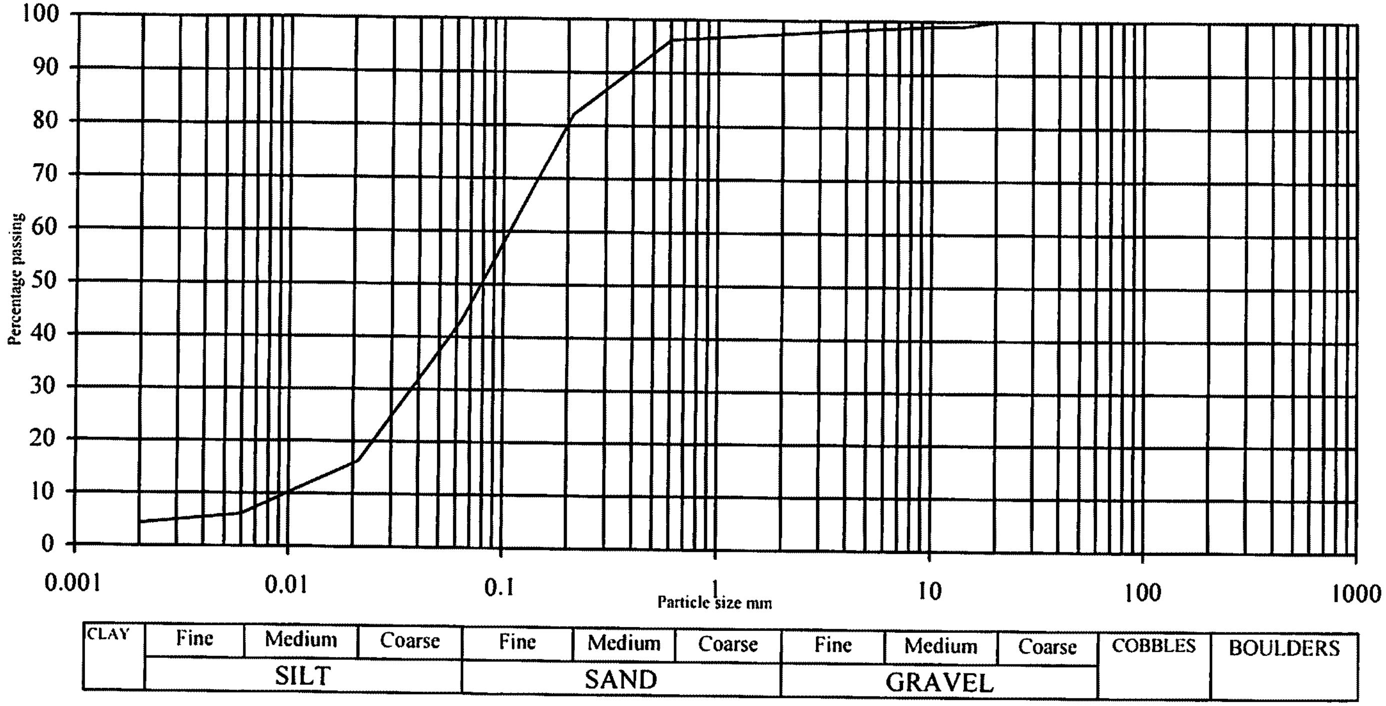
Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/02-S2 2.30-3.10**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test.:	**03/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**~~BS 812: Pt. 102/BS EN 932-1~~/Unknown** (Delete as appropriate)
Sampled By:	**Client**
Soil Description:	**Sandy Silt**
Were any unrepresentative lumps present?	**No**

COMMENTS/DEPARTURE FROM SPECIFIED PROCEDURE:

RESULTS:

SEE ATTACHED

PARTICLE SIZE	
(mm)	% pass
200	100
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	99.1
10	99.0
6.3	98.6
5	98.4
2	97.5
0.6	96.2
0.212	82.1
0.063	43.1
0.0212	16.3
0.006	6.1
0.002	4.3



Preparation : No pre-treatement used

PARTICLE PROPORTIONS	
Cobbles %	0
Gravel %	2.5
Sand %	54.4
Silt %	38.8
Clay %	4.3

G.Ll Evans - Laboratory Manager

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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: STR 207384

Contract.: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) of a sample at its natural moisture content in accordance with **BS 1377 : Part 4 : 1990 Test 5.4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/02-S2 2.30-3.10**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Silt**
Target Specification:	**N/A**

RESULTS:

Interpretation of test results: Directly from graph

Moisture Condition Value (MCV) = 3.4

Moisture Content (%) = 16.4

% Particles >20mm removed prior to initial sample = 0

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

For material requiring more than 256 blows the Moisture Condition Value should be reported as "more than 18".

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE
Contract: A55 Warrens Bank

Date: 4th February 2010
Test Report Ref.: 207385

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Dry Density and Moisture Content Relationship of soil passing 20mm sieve 2.5kg Rammer Method in accordance with BS 1377: 4: 1990 Clause 3.3

SAMPLE DETAILS:

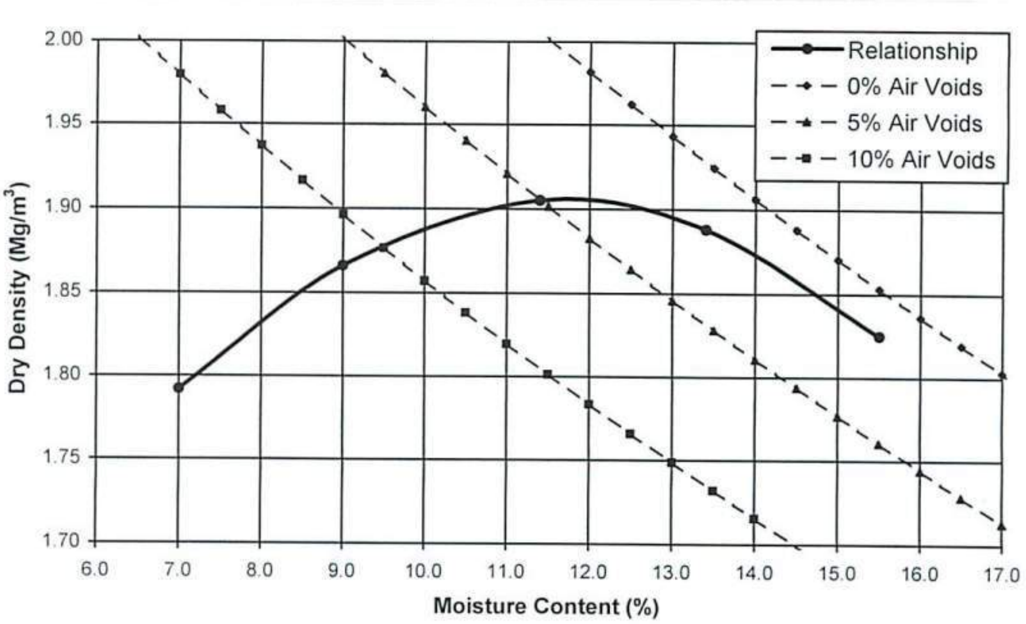
Certificate of sampling received	**No**	Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/02-S2 2.30-3.10**	Date and Time of Sampling	**Unknown**
Date of Receipt at Lab:	**01/02/2010**	Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**	Name of Source:	**Unknown**
Method of Sampling:	**Unknown**	Sampled By:	**Client**
Soil Description:	**Sandy Silt**	Type of Sample:	**Sandy Silt**

RESULTS: Were any unrepresentative lumps present? No

Sample Preparation Procedure:	3.2.4.1
Sample Preparation Method:	Single
Particle Density:	2.60 Mg/m^3 (Assumed)
Amount of sample retained on 37.5mm test siev	0%
Amount of sample retained on 20mm test sieve:	0%

Moisture Content (%)	Dry Density Mg/m^3
7.0	1.79
9.0	1.87
11.4	1.91
13.4	1.89
15.5	1.83

Optimum Moisture Content (%)	**Maximum Dry Density Mg/m^3**
12	**1.91**



Comments/Departure from specified procedures:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

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independent materials testing — diamond core drilling & sawing
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
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Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: 207386

Page 1

Contract:: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) moisture content relation of a soil in accordance with **BS 1377: Part 4: 1990 Test 5.5**

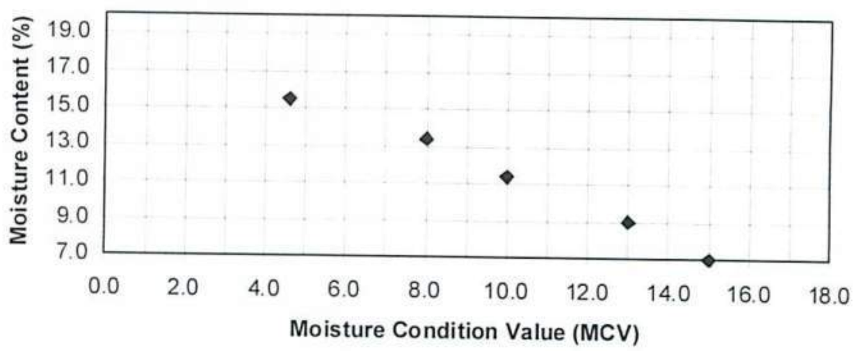
SAMPLE DETAILS:

Certificate of Sampling Received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/02-S2 2.30-3.10**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Silt**
Were any unrepresentative lumps present?	**No**

RESULTS:

Gravel Content >20mm = 0%

Moisture Content (%)	Moisture Condition Value (MCV)
7.0	15.0
9.0	13.0
11.4	10.0
13.4	8.0
15.5	4.6



COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: STR 207393

Contract.: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Content of Soils - DEFINITIVE OVEN - DRYING METHOD. In accordance with **BS 1377 : Part 2 : 1990 : clause 3.2**

SAMPLE DETAILS:

Certificate of Sampling Received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/04-S1 0.20-2.30**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Gravelly Sandy Clay**
Were any unrepresentative lumps present?	**No**

RESULTS:

Moisture Content (%) = 16.7

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

None

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(/) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81
UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 4th February 2010
Test Report Ref.: STR 207394

Contract.: A55 Warren Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Plastic Limit, Liquid Limit, and Plasticity Index of sample in accordance with **BS 1377:Part 2:1990 Clause 5.3, Clause 4.3, and Clause 5.4.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/04/S1 0.20-2.30**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**01/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Gravelly Sandy Clay**
Target Specification:	**N/A**

RESULTS:

History of sample:		~~Natural state~~/After wet sieving
% Materials passing 425μm	=	**92.7**
Plastic Limit	=	**13**
Liquid Limit	=	**23**
Plasticity Index	=	**10**

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: STR 207395

Contract.: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) of a sample at its natural moisture content in accordance with **BS 1377 : Part 4 : 1990 Test 5.4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/04-S1 0.20-2.30**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Gravelly Sandy Clay**
Target Specification:	**N/A**

RESULTS:

Interpretation of test results: Directly from graph

Moisture Condition Value (MCV) **= 3.4**

Moisture Content (%) **= 16.7**

% Particles >20mm removed prior to initial sample = 0

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

For material requiring more than 256 blows the Moisture Condition Value should be reported as "more than 18".

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

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independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE
Contract: A55 Warrens Bank

Date: 4th February 2010
Test Report Ref.: 207397

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Dry Density and Moisture Content Relationship of soil passing 20mm sieve 2.5kg Rammer Method in accordance with BS 1377: 4: 1990 Clause 3.3

SAMPLE DETAILS:

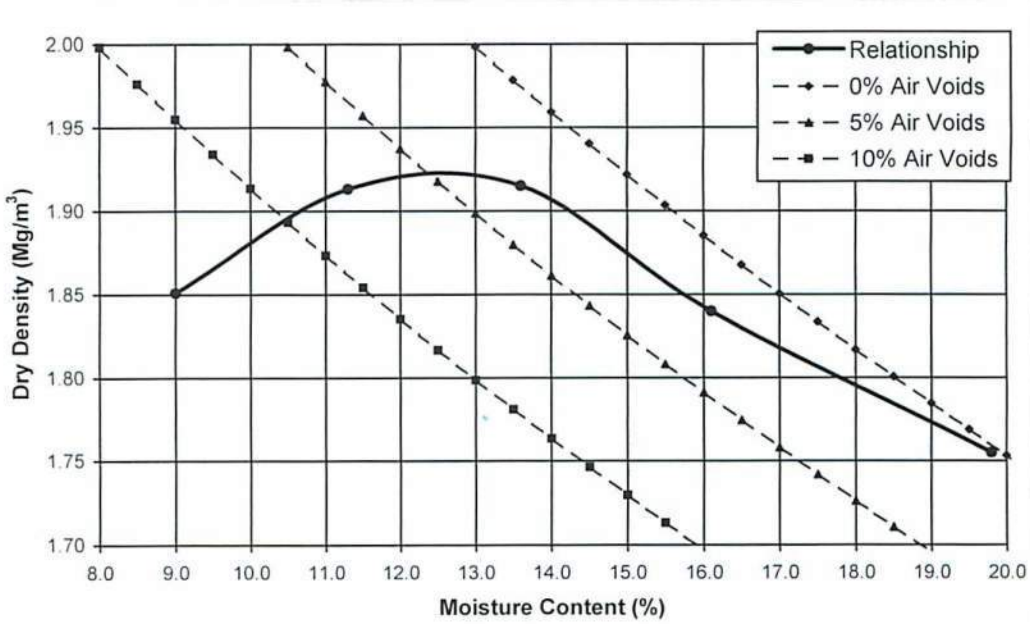
Certificate of sampling received	**No**	Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/04-S1 0.20-2.30**	Date and Time of Sampling	**Unknown**
Date of Receipt at Lab:	**01/02/2010**	Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**	Name of Source:	**Unknown**
Method of Sampling:	**Unknown**	Sampled By:	**Client**
Soil Description:	**Gravelly Sandy Clay**	Type of Sample:	**Gravelly Sandy Clay**

RESULTS: Were any unrepresentative lumps present? No

Sample Preparation Procedure: 3.2.4.1
Sample Preparation Method: Single
Particle Density: 2.70 Mg/m^3 (Assumed)
Amount of sample retained on 37.5mm test siev 0%
Amount of sample retained on 20mm test sieve: 0%

Moisture Content (%)	Dry Density Mg/m^3
9.0	1.85
11.3	1.91
13.6	1.92
16.1	1.84
19.8	1.76

Optimum Moisture Content (%)	**Maximum Dry Density Mg/m^3**
13	**1.92**



Comments/Departure from specified procedures:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
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V.A.T. No. 352-5034-81
UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: 207396

Contract:: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) moisture content relation of a soil in accordance with **BS 1377: Part 4: 1990 Test 5.5**

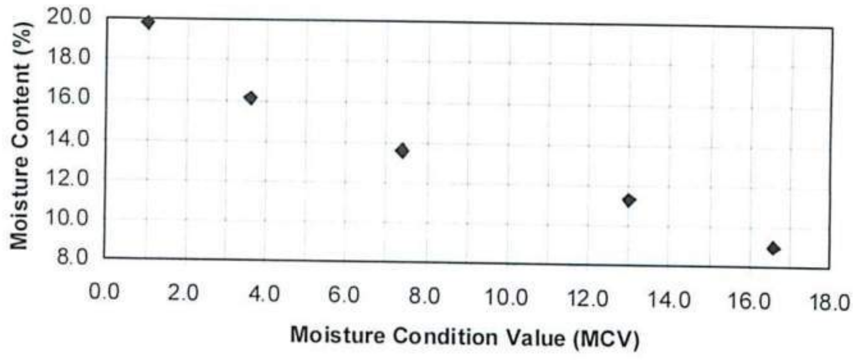
SAMPLE DETAILS:

Certificate of Sampling Received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/04-S1 0.20-2.30**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Gravelly Sandy Clay**
Were any unrepresentative lumps present?	**No**

RESULTS:

Gravel Content >20mm = 0%

Moisture Content (%)	Moisture Condition Value (MCV)
9.0	16.6
11.3	13.0
13.6	7.4
16.1	3.6
19.8	1.0



COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

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independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: STR 207387

Contract.: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Content of Soils - DEFINITIVE OVEN - DRYING METHOD. In accordance with **BS 1377 : Part 2 : 1990 : clause 3.2**

SAMPLE DETAILS:

Certificate of Sampling Received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/03-S1 0.21-2.30**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Clay**
Were any unrepresentative lumps present?	**No**

RESULTS:

Moisture Content (%) = 18.1

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

None

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(/) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 4th February 2010
Test Report Ref.: STR 207388

Contract.: A55 Warren Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Plastic Limit, Liquid Limit, and Plasticity Index of sample in accordance with **BS 1377:Part 2:1990 Clause 5.3, Clause 4.3, and Clause 5.4.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/03/S1 0.21-2.30**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**01/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Clay**
Target Specification:	**N/A**

RESULTS:

History of sample:		~~Natural state~~/After wet sieving
% Materials passing 425μm	=	**88.4**
Plastic Limit	=	**Non Plastic**
Liquid Limit	=	**21**
Plasticity Index	=	**N/A**

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

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Fax: 01248 351563
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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 4th February 2010
Test Report Ref.: STR 207389

Contract: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Particle Size Distribution (PSD) sedimentation by pipette method to **BS 1377: Part 2: 1990: clause 9.4.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/03-S1 0.21-2.30**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test.:	**03/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**~~BS 812: Pt. 102/BS EN 932-1/~~Unknown** (Delete as appropriate)
Sampled By:	**Client**
Soil Description:	**Sandy Clay**
Were any unrepresentative lumps present?	**No**

COMMENTS/DEPARTURE FROM SPECIFIED PROCEDURE:

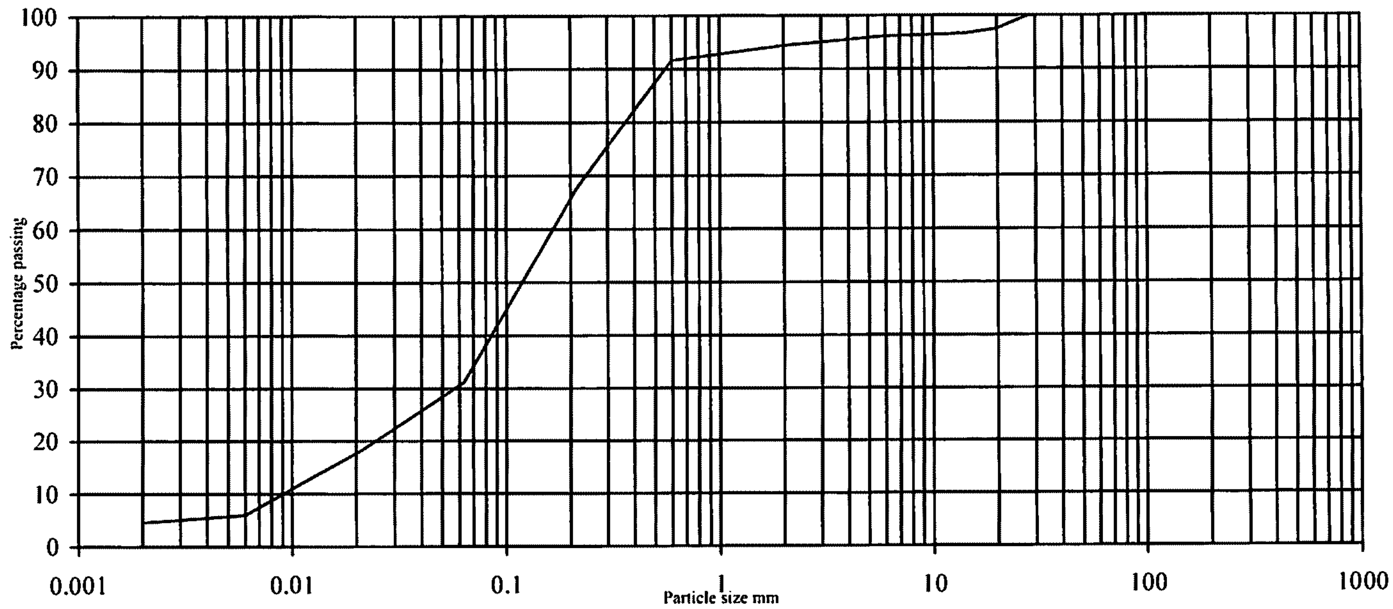
RESULTS:

SEE ATTACHED

PARTICLE SIZE	
(mm)	% pass
200	100
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	97.5
14	96.6
10	96.4
6.3	96.2
5	95.9
2	94.4
0.6	91.6
0.212	67.5
0.063	31.2
0.0212	18.3
0.006	6.0
0.002	4.6

Preparation : No pre-treatement used

PARTICLE PROPORTIONS	
Cobbles %	0
Gravel %	5.6
Sand %	63.2
Silt %	26.6
Clay %	4.6



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

G.Ll Evans - Laboratory Manager

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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

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e-mail: postmaster@celtest.com
Web: www.celtest.com
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V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: STR 207390

Contract.: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) of a sample at its natural moisture content in accordance with **BS 1377 : Part 4 : 1990 Test 5.4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/03-S1 0.21-2.30**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Clay**
Target Specification:	**N/A**

RESULTS:

Interpretation of test results: Directly from graph

Moisture Condition Value (MCV) = 2.1

Moisture Content (%) = 18.1

% Particles >20mm removed prior to initial sample = 2.5

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

For material requiring more than 256 blows the Moisture Condition Value should be reported as "more than 18".

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

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independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

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e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE
Contract: A55 Warrens Bank

Date: 4th February 2010
Test Report Ref.: 207391

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Dry Density and Moisture Content Relationship of soil passing 20mm sieve 2.5kg Rammer Method in accordance with BS 1377: 4: 1990 Clause 3.3

SAMPLE DETAILS:

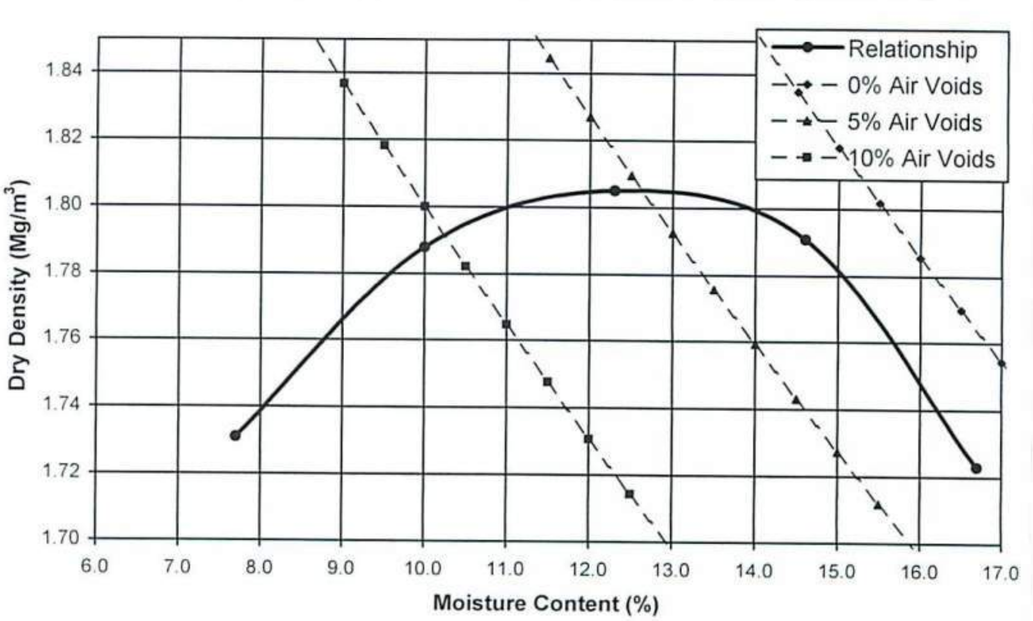
Certificate of sampling received	**No**	Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/03-S1 0.21-2.30**	Date and Time of Sampling	**Unknown**
Date of Receipt at Lab:	**01/02/2010**	Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**	Name of Source:	**Unknown**
Method of Sampling:	**Unknown**	Sampled By:	**Client**
Soil Description:	**Sandy Clay**	Type of Sample:	**Sandy Clay**

RESULTS: Were any unrepresentative lumps present? No

Sample Preparation Procedure: 3.2.4.2
Sample Preparation Method: Single
Particle Density: 2.50 Mg/m^3 (Assumed)
Amount of sample retained on 37.5mm test siev 0%
Amount of sample retained on 20mm test sieve: 3%

Moisture Content (%)	Dry Density Mg/m^3
7.7	1.73
10.0	1.79
12.3	1.81
14.6	1.79
16.7	1.72

Optimum Moisture Content (%)	Maximum Dry Density Mg/m^3
12	**1.81**



Comments/Departure from specified procedures:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

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independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: 207392

Contract:: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) moisture content relation of a soil in accordance with **BS 1377: Part 4: 1990 Test 5.5**

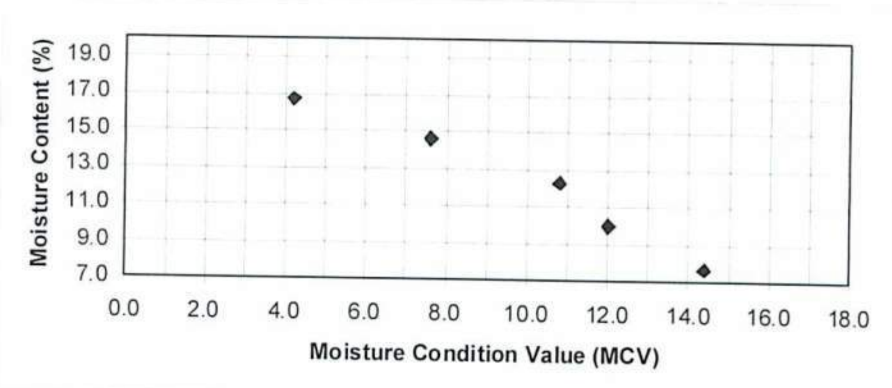
SAMPLE DETAILS:

Certificate of Sampling Received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/03-S1 0.21-2.30**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Clay**
Were any unrepresentative lumps present?	**No**

RESULTS:

Gravel Content >20mm = 2.5%

Moisture Content (%)	Moisture Condition Value (MCV)
7.7	14.4
10.0	12.0
12.3	10.8
14.6	7.6
16.7	4.2



COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

( ) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81
UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE
Contract: A55 Warren Bank

Date: 3rd February 2010
Test Report Ref.: STR 207398

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Particle Size Distribution (PSD) of a soil sample-washing and sieving method in accordance with BS 1377-2: 1990 clause 9.2

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S30235**
Client Ref. No:	**TPC2/04-S2 2.30-3.10**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Soil Description	**Very Sandy Gravel**
Target Specification:	**N/A**
Departure from Specified Procedure:	**N/A**

RESULTS: See Attached

No unrepresentative lumps were present

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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com

Registered in Wales and England 1533370
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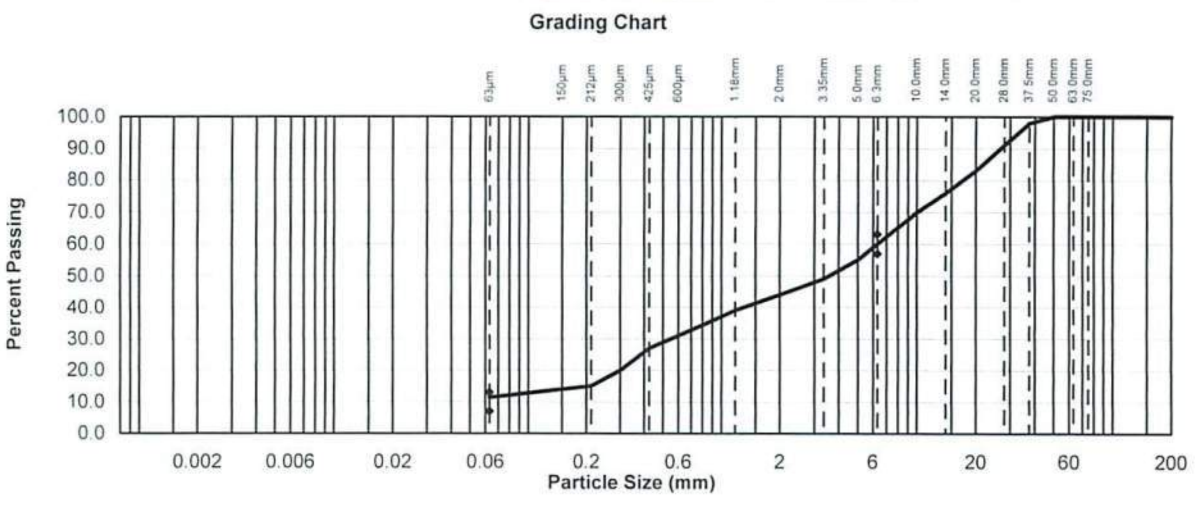
MATERIAL DESCRIPTION	
BS TEST SIEVE NOMINAL APERTURE SIZE	CUMULATIVE PERCENTAGE PASSING
200.0 mm	100
125.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	98
28.0 mm	91
20.0 mm	83
14.0 mm	76
10.0 mm	70
6.3 mm	60
5.0 mm	55
3.35 mm	49
2.0 mm	44
1.18 mm	39
0.600 mm	31
0.425 mm	27
0.300 mm	20
0.212 mm	15
0.150 mm	14
0.063 mm	11.4



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

Comments:

Coefficient of Uniformity = 100

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: STR 207399

Contract.: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) of a sample at its natural moisture content in accordance with **BS 1377 : Part 4 : 1990 Test 5.4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/04-S2 2.30-3.10**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Very Sandy Gravel**
Target Specification:	**N/A**

RESULTS:

Interpretation of test results: Directly from graph

Moisture Condition Value (MCV) = 7.6

Moisture Content (%) = 8.5

% Particles >20mm removed prior to initial sample = 17

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

For material requiring more than 256 blows the Moisture Condition Value should be reported as "more than 18".

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

celtest
independent materials testing — diamond core drilling & sawing
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81
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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE
Contract.: A55 Warrens Bank

Date: 4th February 2010
Test Report Ref.: 207400

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Dry Density and Moisture Content Relationship of soil passing 20mm sieve - Vibrating Hammer Method in accordance with BS 1377: 4: 1990 Clause 3.7

SAMPLE DETAILS:

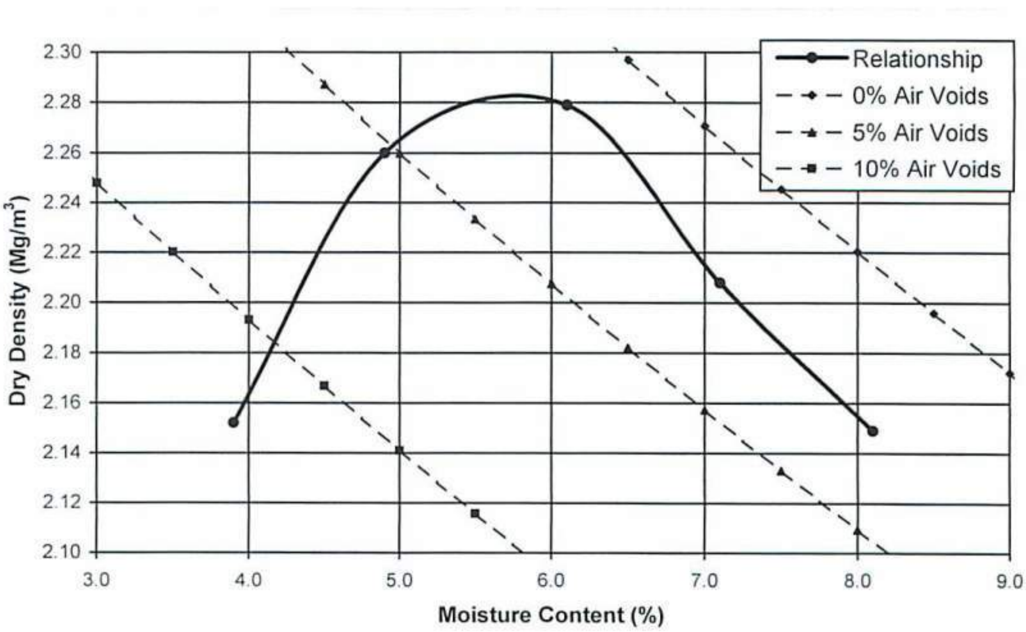
Certificate of sampling received	**No**	Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/04-S2 2.30-3.10**	Date and Time of Sampling	**Unknown**
Date of Receipt at Lab:	**01/02/2010**	Date of Start of Test:	**02/02/2010**
Sampling Location:	**Unknown**	Name of Source:	**Unknown**
Method of Sampling:	**Unknown**	Sampled By:	**Client**
Soil Description:	**Very Sandy Gravel**	Type of Sample:	**Very Sandy Gravel**

RESULTS: Were any unrepresentative lumps present? No

Sample Preparation Procedure:	3.2.5.2	
Sample Preparation Method:	Single	
Particle Density:	2.70	Mg/m^3 (Assumed)
Amount of sample retained on 37.5mm test siev	2%	
Amount of sample retained on 20mm test sieve:	17%	

Moisture Content (%)	Dry Density Mg/m^3
3.9	2.15
4.9	2.26
6.1	2.28
7.1	2.21
8.1	2.15

Optimum Moisture Content (%)	Maximum Dry Density Mg/m^3
5.8	**2.28**



Comments/Departure from specified procedures:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

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independent materials testing — diamond core drilling & sawing
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81
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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: 207401

Contract:: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) moisture content relation of a soil in accordance with **BS 1377: Part 4: 1990 Test 5.5**

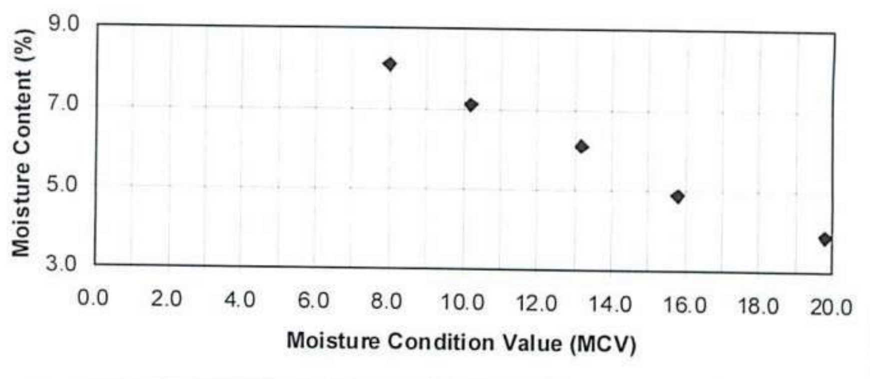
SAMPLE DETAILS:

Certificate of Sampling Received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/04-S2 2.30-3.10**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Very Sandy Gravel**
Were any unrepresentative lumps present?	**No**

RESULTS:

Gravel Content >20mm = 17%

Moisture Content (%)	Moisture Condition Value (MCV)
3.9	19.8
4.9	15.8
6.1	13.2
7.1	10.2
8.1	8.0



COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
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V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 4th February 2010
Test Report Ref.: STR 207402

Contract: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Particle Size Distribution (PSD) sedimentation by pipette method to **BS 1377: Part 2: 1990: clause 9.4.**

SAMPLE DETAILS:

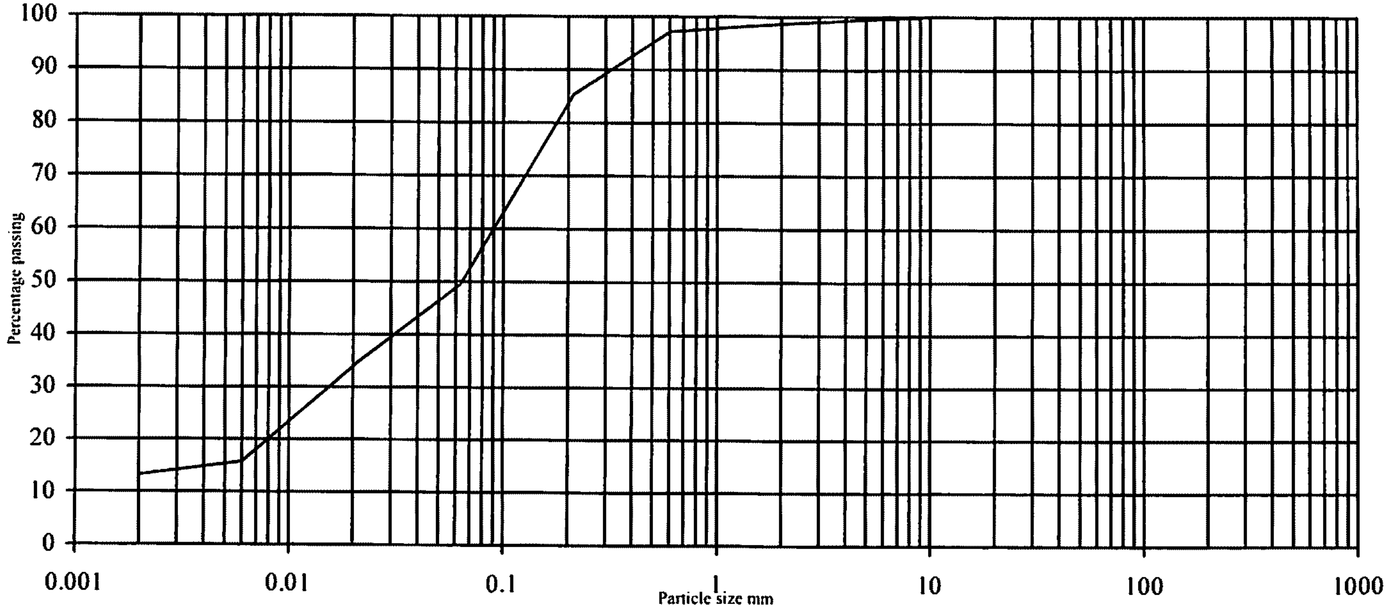
Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPF1/01-S1 0.24-1.50**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test.:	**03/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**~~BS 812: Pt. 102/BS EN 932-1~~/Unknown** (Delete as appropriate)
Sampled By:	**Client**
Soil Description:	**Very Silty Sand**
Were any unrepresentative lumps present?	**No**

COMMENTS/DEPARTURE FROM SPECIFIED PROCEDURE:

RESULTS:

SEE ATTACHED

PARTICLE SIZE	
(mm)	% pass
200	100
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	100
10	100.0
6.3	99.7
5	99.6
2	98.7
0.6	97.2
0.212	85.3
0.063	49.6
0.0212	34.8
0.006	15.8
0.002	13.2



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

Preparation : No pre-treatement used

PARTICLE PROPORTIONS	
Cobbles %	0
Gravel %	1.3
Sand %	49.1
Silt %	36.4
Clay %	13.2

G.Ll Evans - Laboratory Manager

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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
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e-mail: postmaster@celtest.com
Web: www.celtest.com
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V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: STR 207404

Contract.: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) of a sample at its natural moisture content in accordance with **BS 1377 : Part 4 : 1990 Test 5.4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPF1/01-S1 0.24-1.50**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Very Silty Sand**
Target Specification:	**N/A**

RESULTS:

Interpretation of test results: Directly from graph

Moisture Condition Value (MCV) = 0

Moisture Content (%) = 21.1

% Particles >20mm removed prior to initial sample = 0

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

For material requiring more than 256 blows the Moisture Condition Value should be reported as "more than 18".

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

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independent materials testing — diamond core drilling & sawing
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
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UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE
Contract: A55 Warrens Bank

Date: 4th February 2010
Test Report Ref.: 207405

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Dry Density and Moisture Content Relationship of soil passing 20mm sieve 2.5kg Rammer Method in accordance with BS 1377: 4: 1990 Clause 3.3

SAMPLE DETAILS:

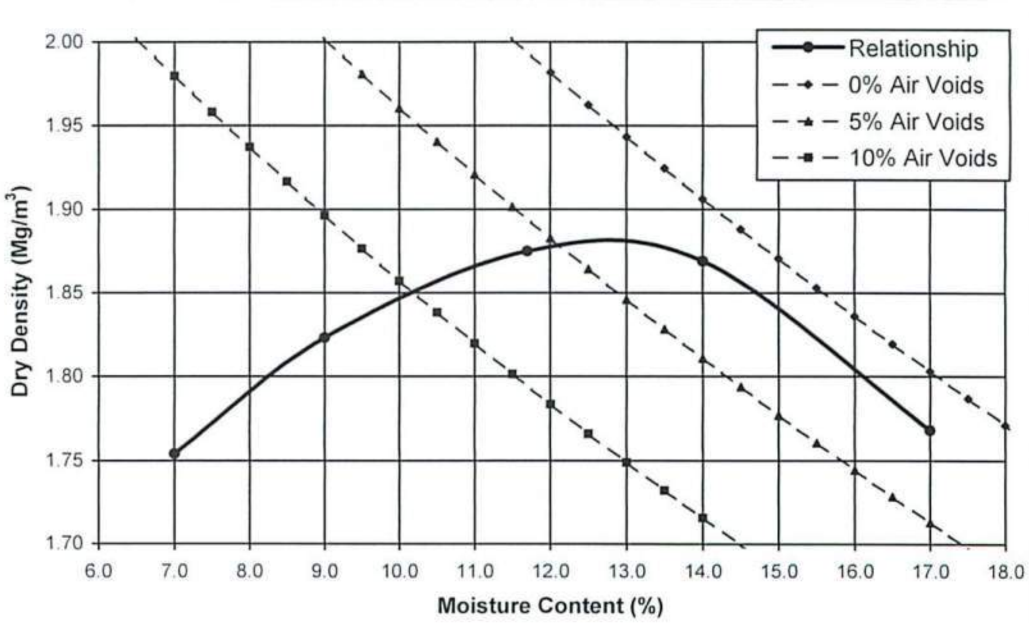
Certificate of sampling received	**No**	Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPF1/01-S1 0.24-1.50**	Date and Time of Sampling	**Unknown**
Date of Receipt at Lab:	**01/02/2010**	Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**	Name of Source:	**Unknown**
Method of Sampling:	**Unknown**	Sampled By:	**Client**
Soil Description:	**Very Silty Sand**	Type of Sample:	**Very Silty Sand**

RESULTS: Were any unrepresentative lumps present? No

Sample Preparation Procedure: 3.2.4.1
Sample Preparation Method: Single
Particle Density: 2.60 Mg/m^3 (Assumed)
Amount of sample retained on 37.5mm test siev 0%
Amount of sample retained on 20mm test sieve: 0%

Moisture Content (%)	Dry Density Mg/m^3
7.0	1.75
9.0	1.82
11.7	1.88
14.0	1.87
17.0	1.77

Optimum Moisture Content (%)	**Maximum Dry Density Mg/m^3**
13	**1.88**



Comments/Departure from specified procedures:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

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e-mail: postmaster@celtest.com
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V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: 207406

Contract:: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Condition Value (MCV) moisture content relation of a soil in accordance with **BS 1377: Part 4: 1990 Test 5.5**

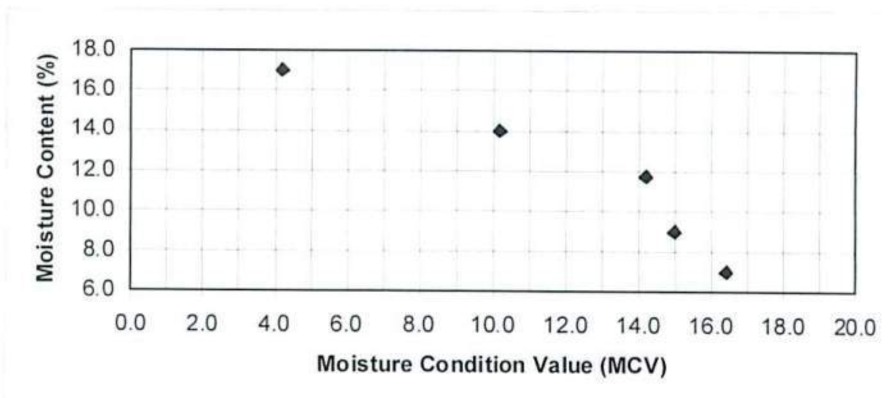
SAMPLE DETAILS:

Certificate of Sampling Received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPF1/01-S1 0.24-1.50**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**03/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Very Silty Sand**
Were any unrepresentative lumps present?	**No**

RESULTS:

Gravel Content >20mm = 0%

Moisture Content (%)	Moisture Condition Value (MCV)
7.0	16.4
9.0	15.0
11.7	14.2
14.0	10.2
17.0	4.2



COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

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Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
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V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: STR 207407

Contract.: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Content of Soils - DEFINITIVE OVEN - DRYING METHOD. In accordance with **BS 1377 : Part 2 : 1990 : clause 3.2**

SAMPLE DETAILS:

Certificate of Sampling Received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPF1/03-S1 0.40-1.80**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Gravelly Sandy Clay**
Were any unrepresentative lumps present?	**No**

RESULTS:

Moisture Content (%) = 14.6

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

None

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 4th February 2010
Test Report Ref.: STR 207408

Contract.: A55 Warren Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Plastic Limit, Liquid Limit, and Plasticity Index of sample in accordance with **BS 1377:Part 2:1990 Clause 5.3, Clause 4.3, and Clause 5.4.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPF1/03/S1 0.40-1.80**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**01/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Gravelly Sandy Clay**
Target Specification:	**N/A**

RESULTS:

History of sample:		~~Natural state~~/After wet sieving
% Materials passing 425μm	=	**89.8**
Plastic Limit	=	**15**
Liquid Limit	=	**28**
Plasticity Index	=	**13**

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

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independent materials testing — diamond core drilling & sawing
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81
UKAS TESTING 0494

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 4th February 2010
Test Report Ref.: STR 207409

Contract: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Particle Size Distribution (PSD) sedimentation by pipette method to **BS 1377: Part 2: 1990: clause 9.4.**

SAMPLE DETAILS:

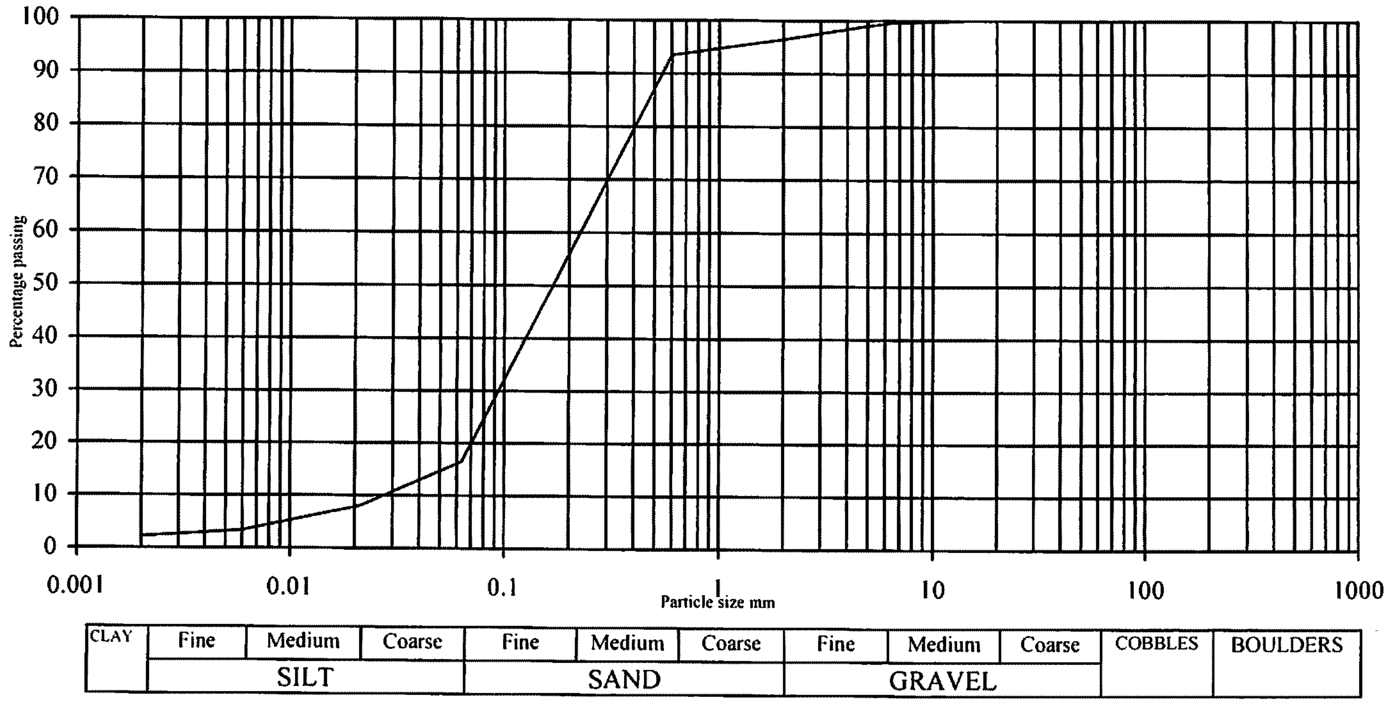
Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPF1/03-S2 1.80-2.10**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test.:	**03/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**~~BS 812: Pt. 102/BS EN 932-1~~/Unknown** (Delete as appropriate)
Sampled By:	**Client**
Soil Description:	**Silty Sand**
Were any unrepresentative lumps present?	**No**

COMMENTS/DEPARTURE FROM SPECIFIED PROCEDURE:

RESULTS:

SEE ATTACHED

PARTICLE SIZE	
(mm)	% pass
200	100
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	100
10	99.9
6.3	99.6
5	99.1
2	96.5
0.6	93.5
0.212	57.9
0.063	16.5
0.0212	8.1
0.006	3.4
0.002	2.2



Preparation : No pre-treatement used

PARTICLE PROPORTIONS	
Cobbles %	0
Gravel %	3.5
Sand %	80.0
Silt %	14.3
Clay %	2.2

G.Ll Evans - Laboratory Manager

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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 5th February 2010
Test Report Ref.: STR 207411

Contract.: A55 Warrens Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Moisture Content of Soils - DEFINITIVE OVEN - DRYING METHOD. In accordance with **BS 1377 : Part 2 : 1990 : clause 3.2**

SAMPLE DETAILS:

Certificate of Sampling Received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPF1/04-S1 0.50-2.00**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Clay**
Were any unrepresentative lumps present?	**No**

RESULTS:

Moisture Content (%) = 16.5

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

.
None

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE

Date: 4th February 2010
Test Report Ref.: STR 207412

Contract.: A55 Warren Bank

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Plastic Limit, Liquid Limit, and Plasticity Index of sample in accordance with **BS 1377:Part 2:1990 Clause 5.3, Clause 4.3, and Clause 5.4.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPF1/04/S1 0.50-2.00**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test:	**01/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Clay**
Target Specification:	**N/A**

RESULTS:

History of sample:		~~Natural state~~/After wet sieving
% Materials passing 425µm	=	**98.9**
Plastic Limit	=	**13**
Liquid Limit	=	**22**
Plasticity Index	=	**9**

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE:

( ) E. R. Goulden
Technical Manager
Approved Signatories

( ) E. N. Jones
Soils Laboratory Manager

(✓) G. LL. Evans
Laboratory Manager

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independent materials testing — diamond core drilling & sawing

Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE
Contract: A55 Warrens Bank

Date: 9th February 2010
Test Report Ref.: STR 207359

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Shear Strength by Direct Shear (Small Shear Box). In accordance with **BS 1377 : Part 7 1990 : Clause 4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC1/01-S2 1.00-1.40**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test.:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Silty Clayey Sand**
Target Specification:	**N/A**

TEST RESULTS:

See Attached

( ) E. R. Goulden, Technical Manager - ( ) E. N. Jones, Soils Laboratory Manager –
(✓) G. LL. Evans, Laboratory Manager Approved Signatories

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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

CONSOLIDATED DRAINED SHEARBOX TEST.

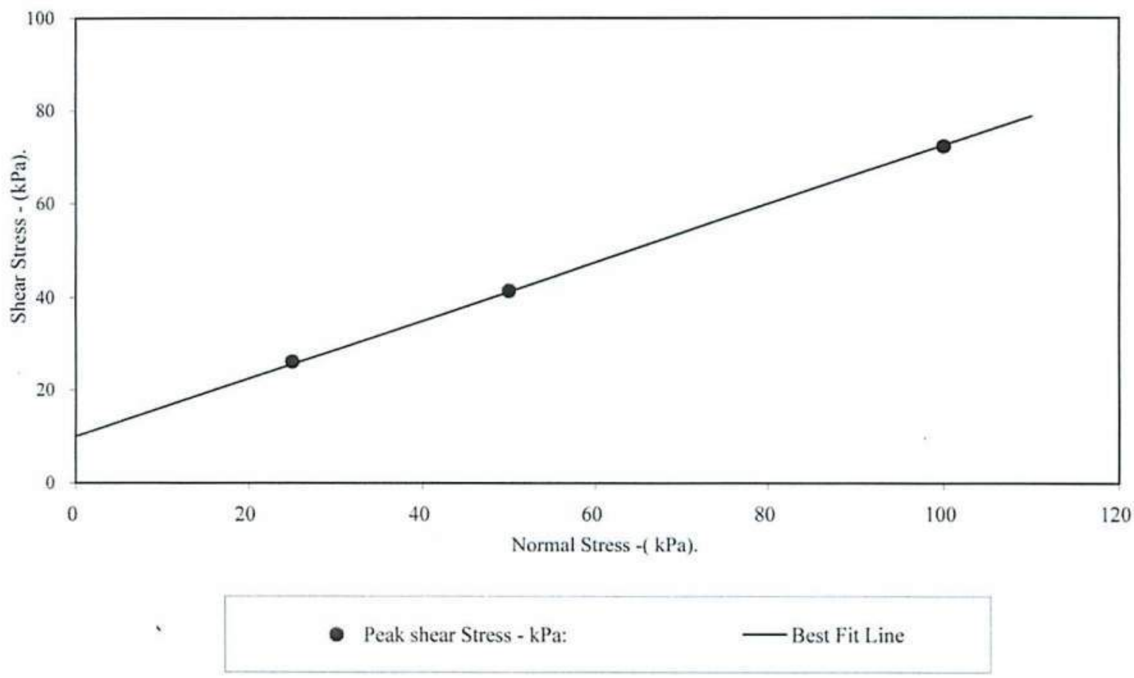
BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPC1/01 S2 Depth (m): 1.00-1.40

Sample Type:	Remoulded (Light Tamping) Material above 2mm removed.		
Particle Density - Mg/m3:	2.65 (Assumed)		
Specimen Tested:	Submerged		
Sample Description: **Reddish brown silty clayey SAND (fine-medium).**			
STAGE	**1**	**2**	**3**
Initial Conditions			
Height - mm:	23.70	23.70	23.70
Length - mm:	60.00	60.00	60.00
Moisture Content - %:	14	14	14
Bulk Density - Mg/m3:	2.15	2.16	2.17
Dry Density - Mg/m3:	1.89	1.90	1.90
Voids Ratio:	0.4045	0.3978	0.3933
Normal Pressure- kPa	25	50	100
Consolidation			
Consolidated Height - mm:	23.66	23.55	23.44
Shear			
Rate of Strain (mm/min)	0.010	0.010	0.010
Strain at peak shear stress (%)	2.81	2.95	2.99
Peak shear Stress - kPa:	26	41	72

PEAK	
Angle of Shearing Resistance:(θ)	**32.0**
Effective Cohesion - kPa:	**10**

FAILURE CONDITIONS



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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

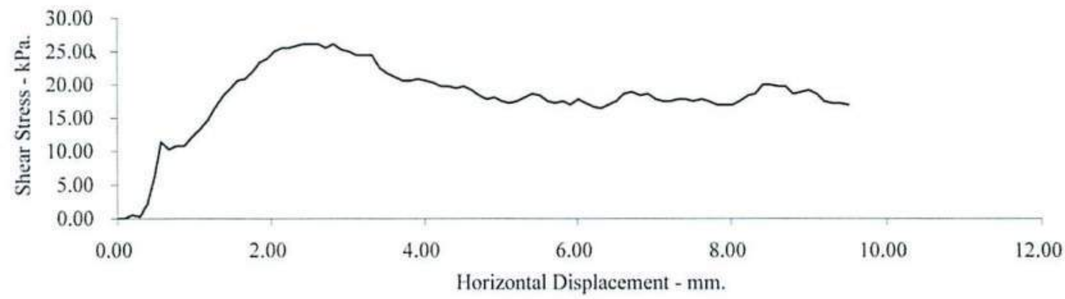
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

CONSOLIDATED DRAINED SHEARBOX TEST.

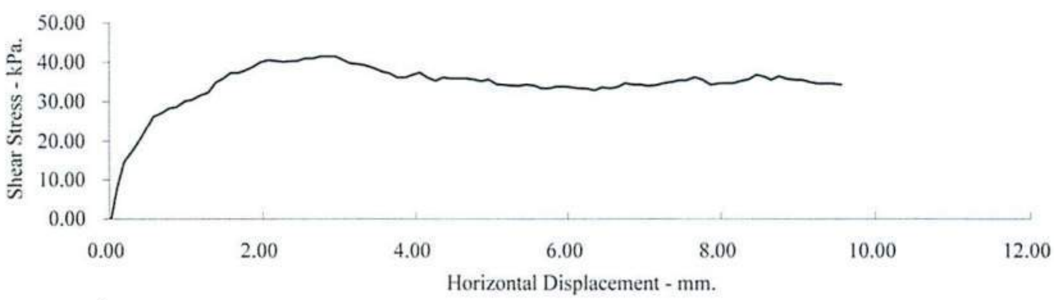
BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPC1/01 S2 Depth (m): 1.00-1.40

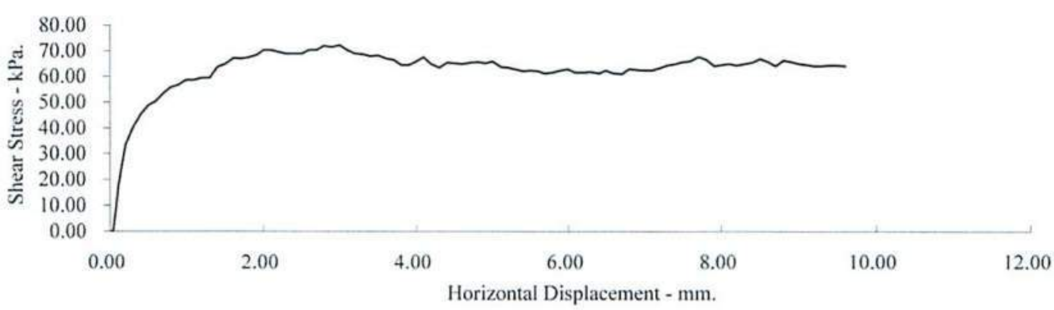
SHEARING STAGE 1.



SHEARING STAGE 2.



SHEARING STAGE 3.



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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
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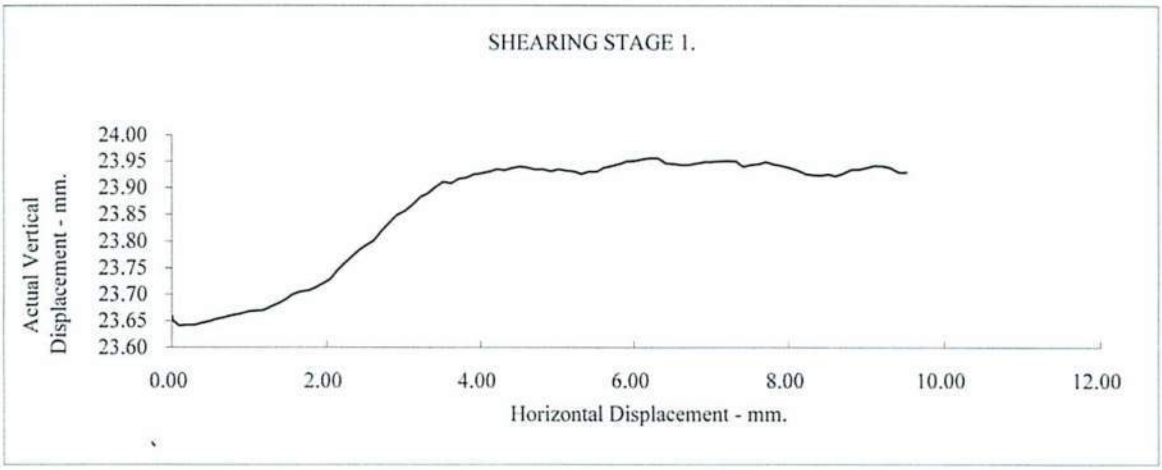
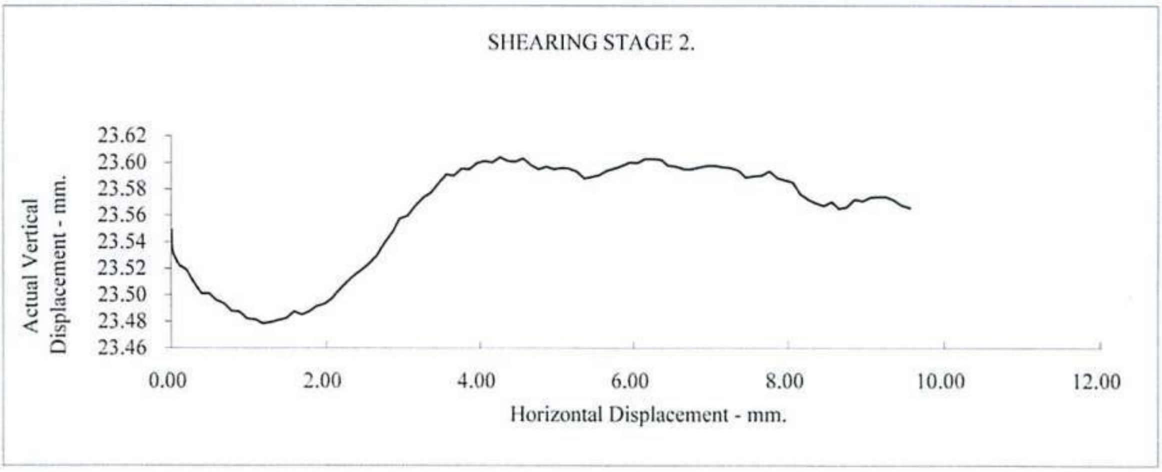
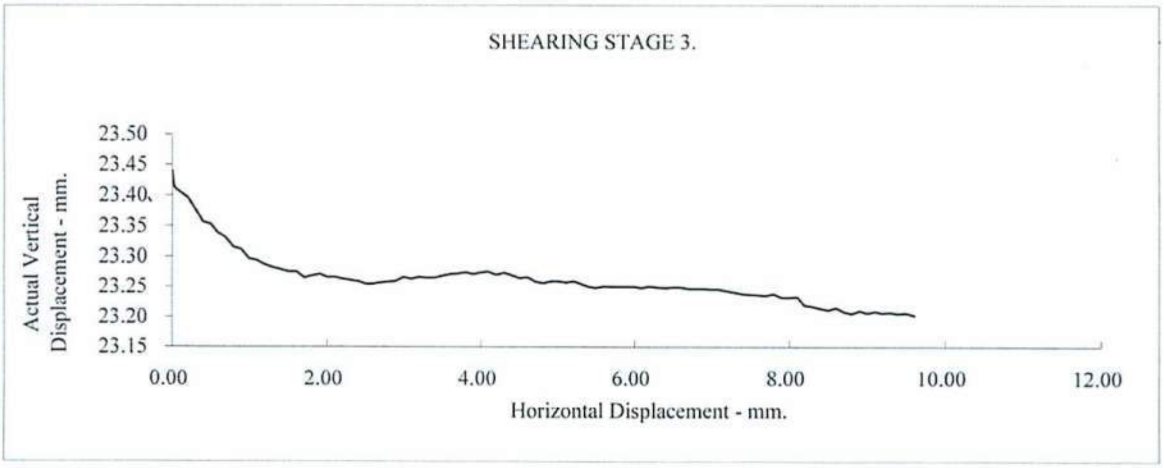
CONSOLIDATED DRAINED SHEARBOX TEST.

BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPC1/01 S2 Depth (m): 1.00-1.40







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Llandegai
Bangor
Gwynedd
LL57 4LH

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e-mail: postmaster@celtest.com
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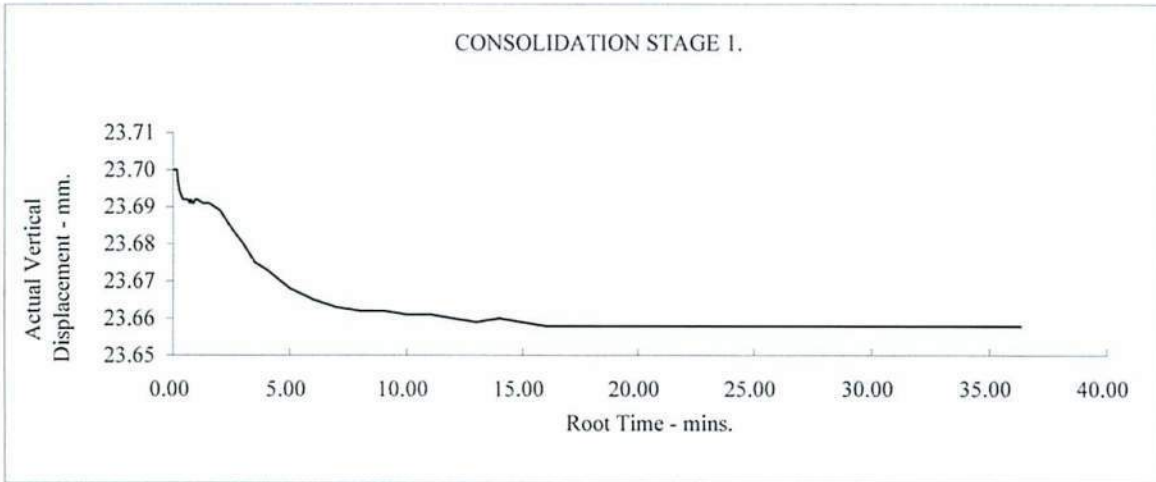
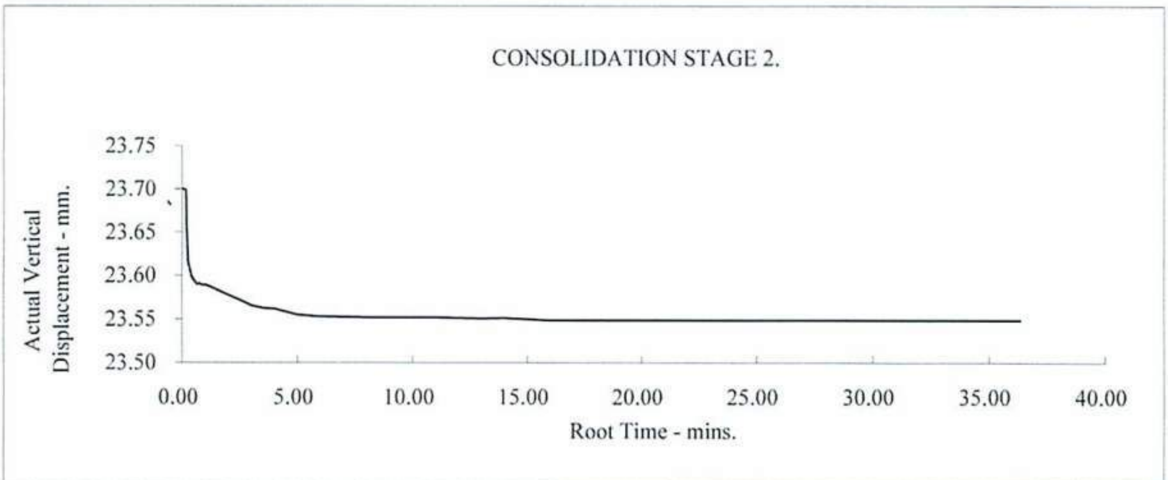
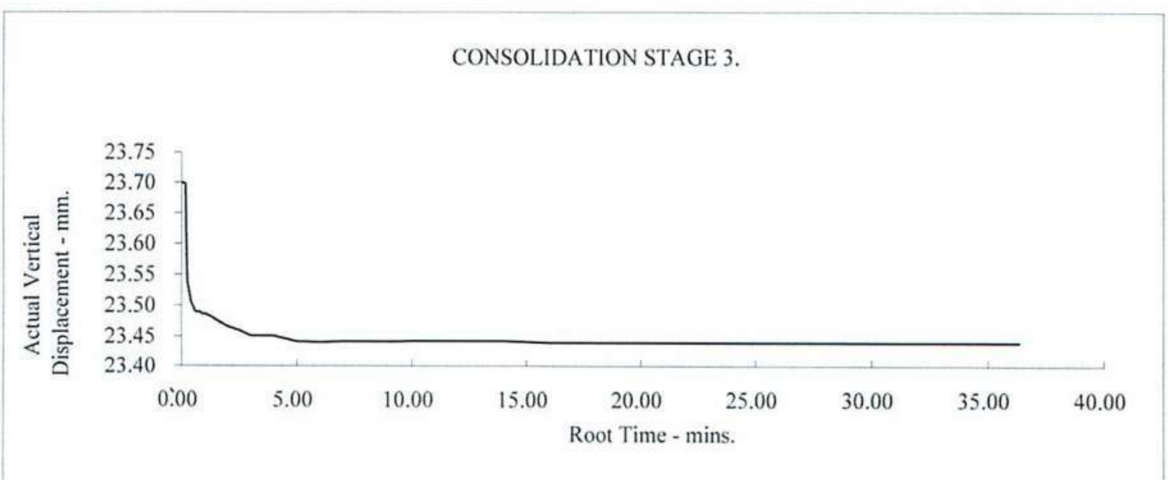
CONSOLIDATED DRAINED SHEARBOX TEST.

BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPC1/01 S2 Depth (m): 1.00-1.40







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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
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V.A.T. No. 352-5034-81

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE
Contract: A55 Warrens Bank

Date: 9th February 2010
Test Report Ref.: STR 207373

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Shear Strength by Direct Shear (Small Shear Box). In accordance with **BS 1377 : Part 7 1990 : Clause 4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC1/02-S3 1.50-2.70**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test.:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Silty Sand**
Target Specification:	**N/A**

TEST RESULTS:

See Attached

( ) E. R. Goulden, Technical Manager - ( ) E. N. Jones, Soils Laboratory Manager –
(✓) G. LL. Evans, Laboratory Manager Approved Signatories

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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
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e-mail: postmaster@celtest.com
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CONSOLIDATED DRAINED SHEARBOX TEST.

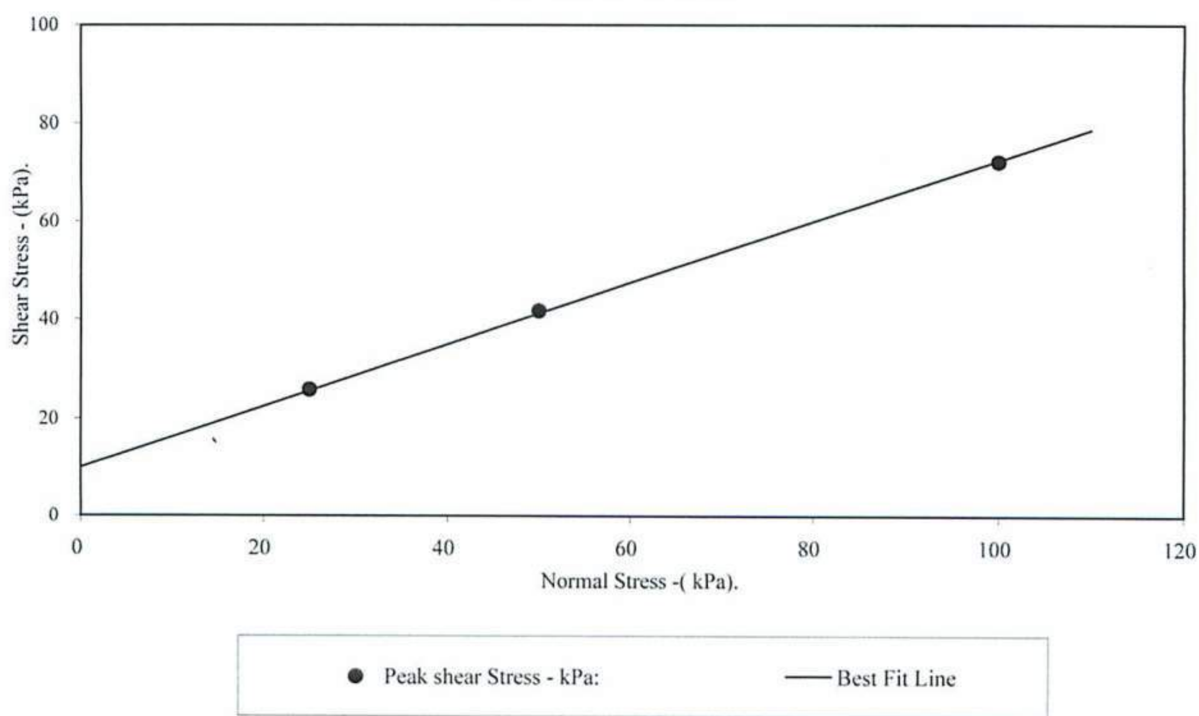
BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPC1/02 S3 Depth (m): 1.50-2.70

Sample Type:	Remoulded (Light Tamping) Material above 2mm removed.		
Particle Density - Mg/m3:	2.65 (Assumed)		
Specimen Tested:	Submerged		
Sample Description: **Reddish brown silty clayey SAND.**			
STAGE	**1**	**2**	**3**
Initial Conditions			
Height - mm:	23.70	23.70	23.70
Length - mm:	60.00	60.00	60.00
Moisture Content - %:	17	17	17
Bulk Density - Mg/m3:	2.13	2.14	2.16
Dry Density - Mg/m3:	1.82	1.82	1.84
Voids Ratio:	0.4564	0.4523	0.4381
Normal Pressure- kPa	25	50	100
Consolidation			
Consolidated Height - mm:	23.67	23.62	23.57
Shear			
Rate of Strain (mm/min)	0.010	0.010	0.010
Strain at peak shear stress (%)	1.91	2.96	2.80
Peak shear Stress - kPa:	26	42	72

PEAK	
Angle of Shearing Resistance:(~~θ~~)	**32.0**
Effective Cohesion - kPa:	**10**

FAILURE CONDITIONS



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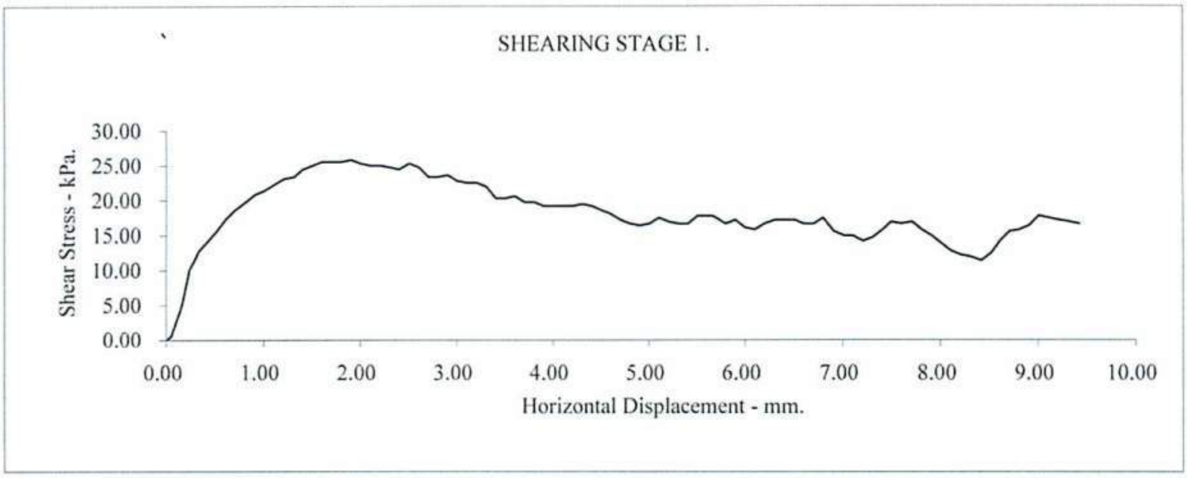
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

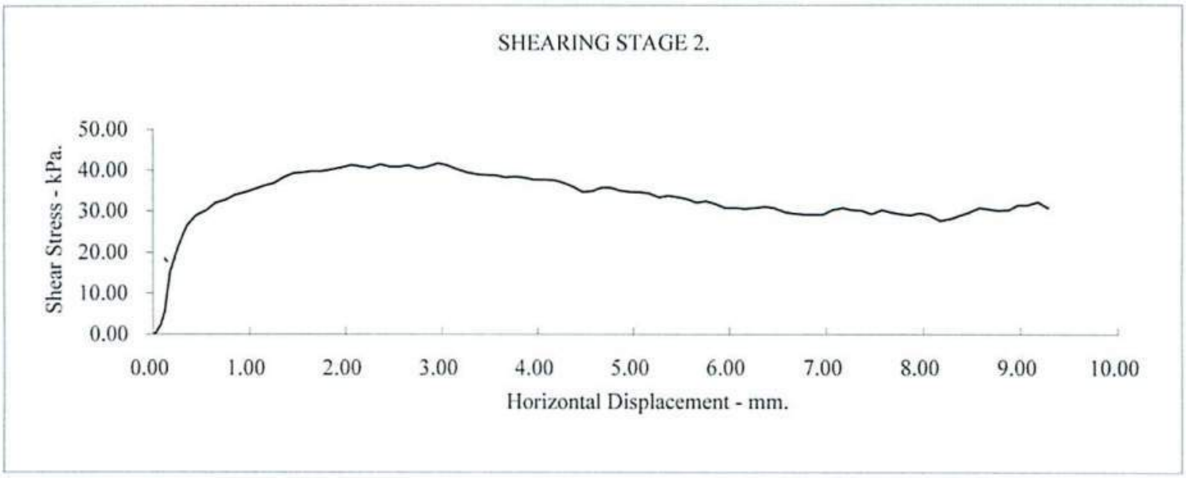
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

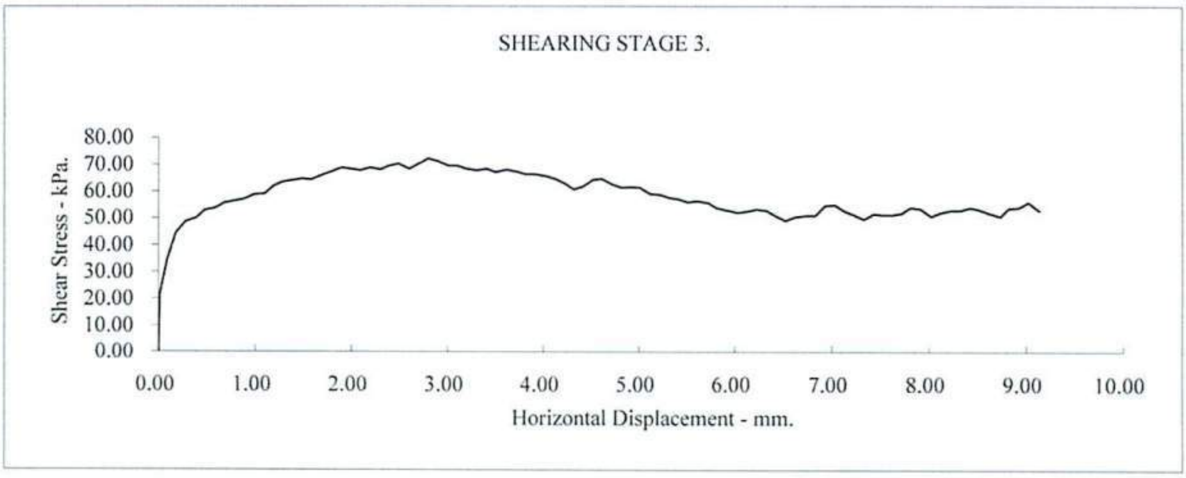
CONSOLIDATED DRAINED SHEARBOX TEST.

BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPC1/02 S3 Depth (m): 1.50-2.70







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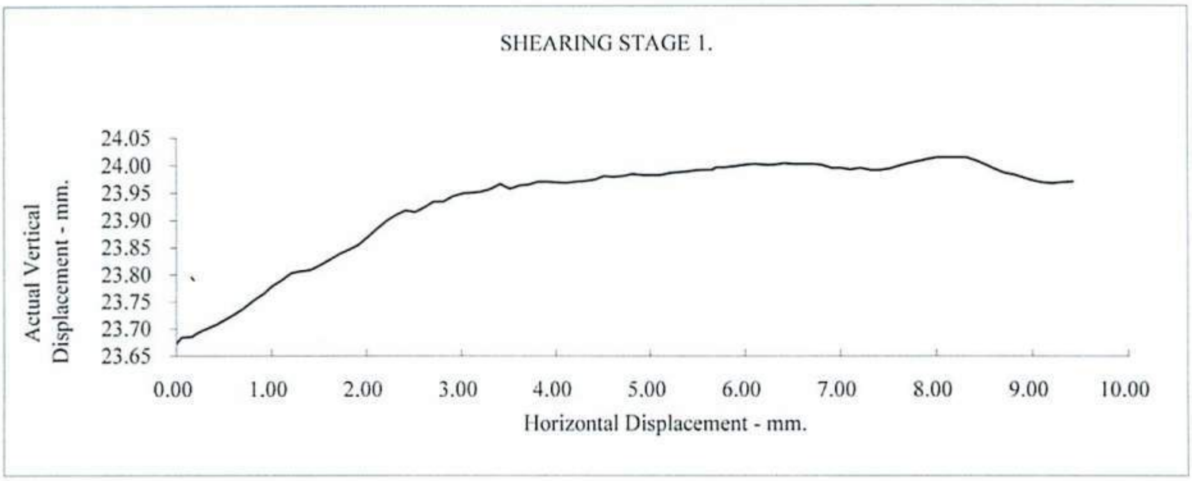
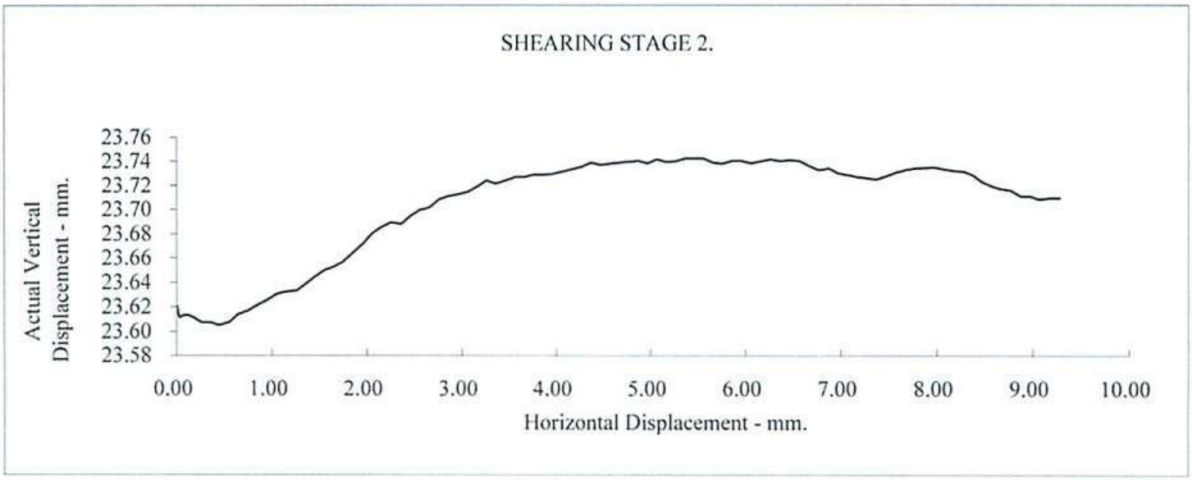
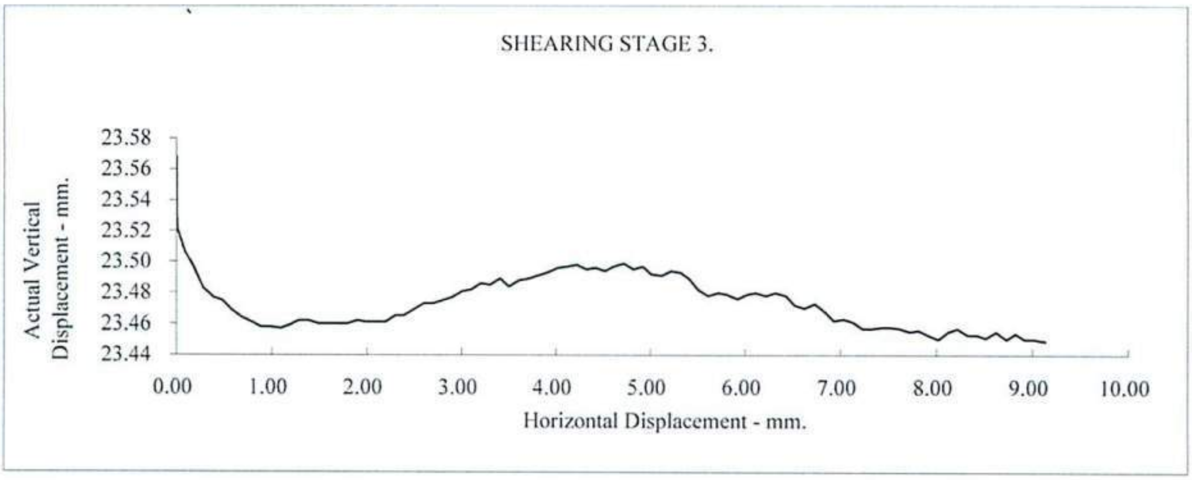
CONSOLIDATED DRAINED SHEARBOX TEST.

BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPC1/02 S3 Depth (m): 1.50-2.70







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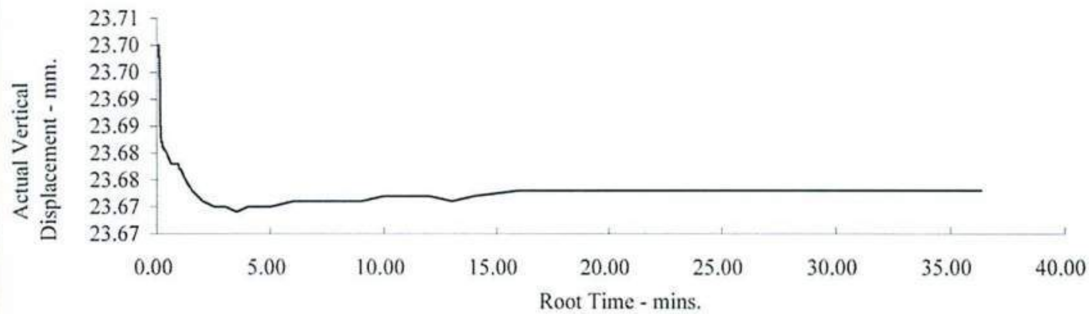
CONSOLIDATED DRAINED SHEARBOX TEST.

BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPC1/02 S3 Depth (m): 1.50-2.70

CONSOLIDATION STAGE 1.



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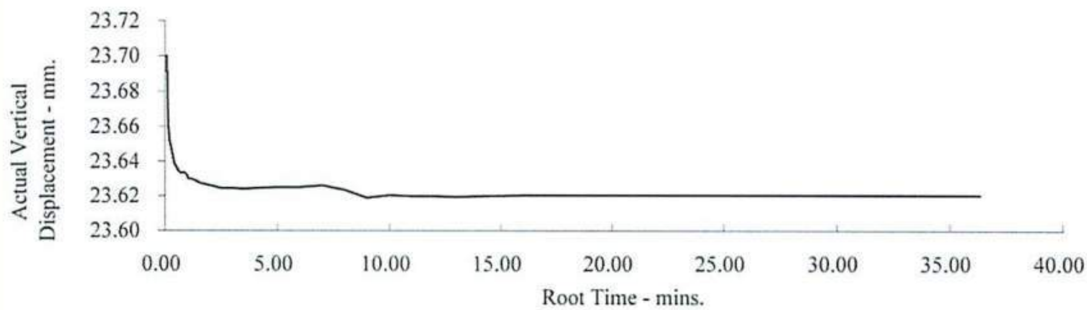
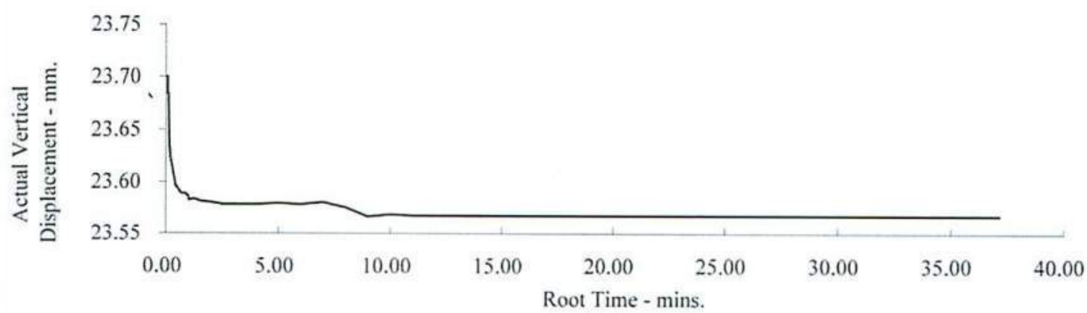


CONSOLIDATION STAGE 3.



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Bangor
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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE
Contract: A55 Warrens Bank

Date: 9th February 2010
Test Report Ref.: STR 207383

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Shear Strength by Direct Shear (Small Shear Box). In accordance with **BS 1377 : Part 7 1990 : Clause 4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPC2/02-S2 2.30-3.10**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test.:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Sandy Silt**
Target Specification:	**N/A**

TEST RESULTS:

See Attached

( ) E. R. Goulden, Technical Manager - ( ) E. N. Jones, Soils Laboratory Manager –
(✓) G. LL. Evans, Laboratory Manager Approved Signatories

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Llandegai
Bangor
Gwynedd
LL57 4LH

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CONSOLIDATED DRAINED SHEARBOX TEST.

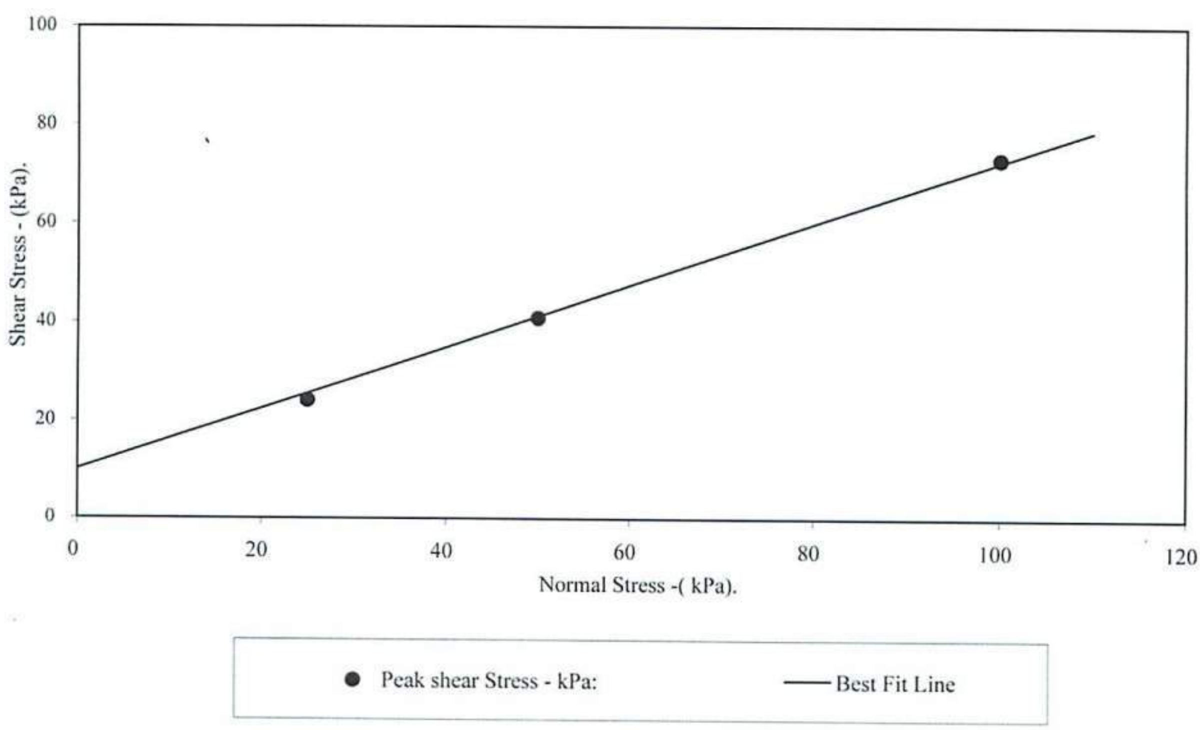
BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPC2/02 S2 Depth (m): 2.30-3.10

Sample Type:	Remoulded (Light Tamping) Material above 2mm removed.		
Particle Density - Mg/m3:	2.65 (Assumed)		
Specimen Tested:	Submerged		
Sample Description: **Brown silty clayey SAND (fine-medium).**			
STAGE	**1**	**2**	**3**
Initial Conditions			
Height - mm:	23.70	23.70	23.70
Length - mm:	60.00	60.00	60.00
Moisture Content - %:	14	14	14
Bulk Density - Mg/m3:	2.10	2.11	2.12
Dry Density - Mg/m3:	1.84	1.85	1.85
Voids Ratio:	0.4421	0.4360	0.4292
Normal Pressure- kPa	25	50	100
Consolidation			
Consolidated Height - mm:	23.67	23.62	23.57
Shear			
Rate of Strain (mm/min)	0.010	0.010	0.010
Strain at peak shear stress (%)	1.95	3.60	3.65
Peak shear Stress - kPa:	24	41	73

PEAK	
Angle of Shearing Resistance:~~(θ)~~	**32.0**
Effective Cohesion - kPa:	**10**

FAILURE CONDITIONS



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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
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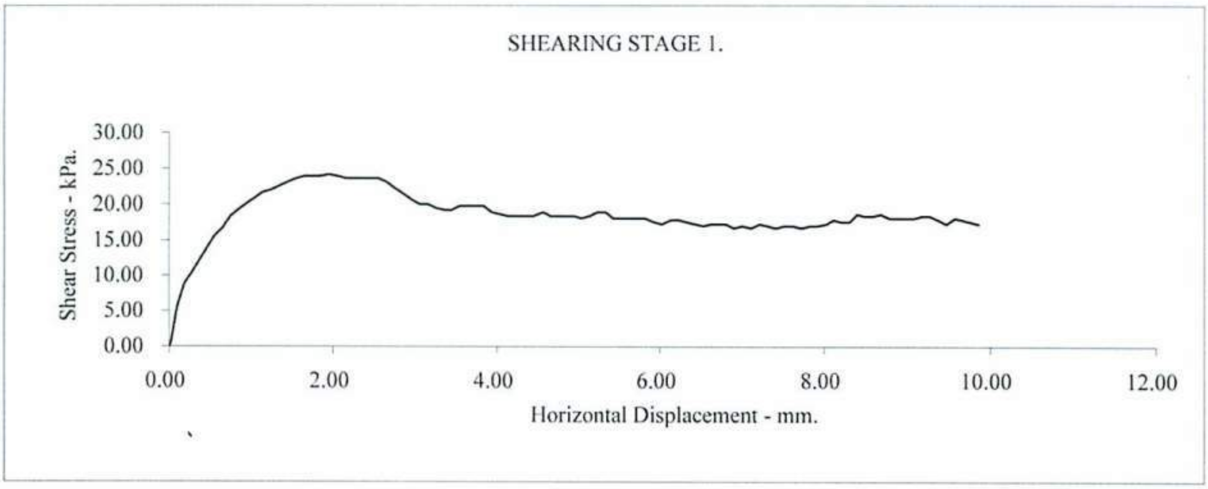
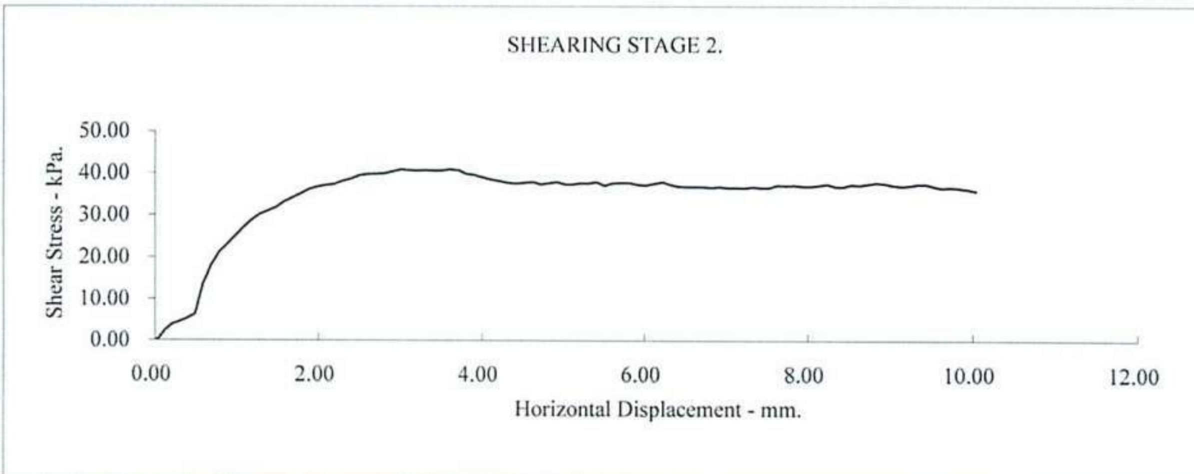
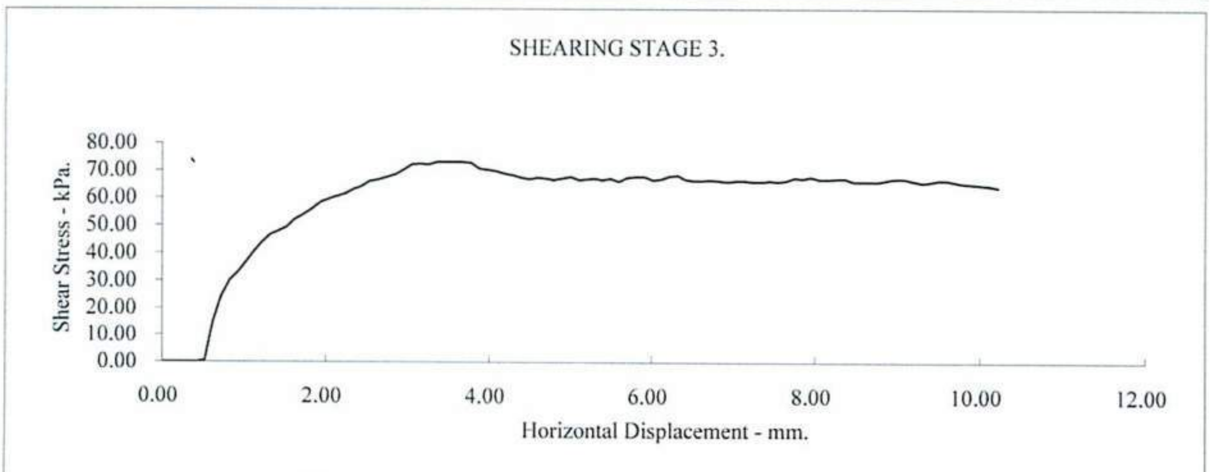
CONSOLIDATED DRAINED SHEARBOX TEST.

BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPC2/02 S2 Depth (m): 2.30-3.10







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Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

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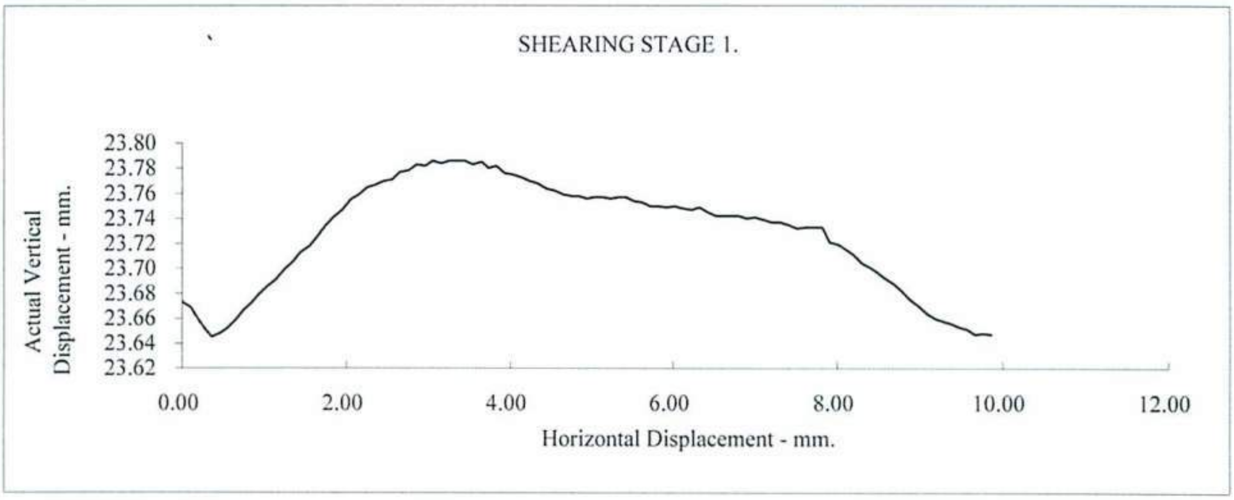
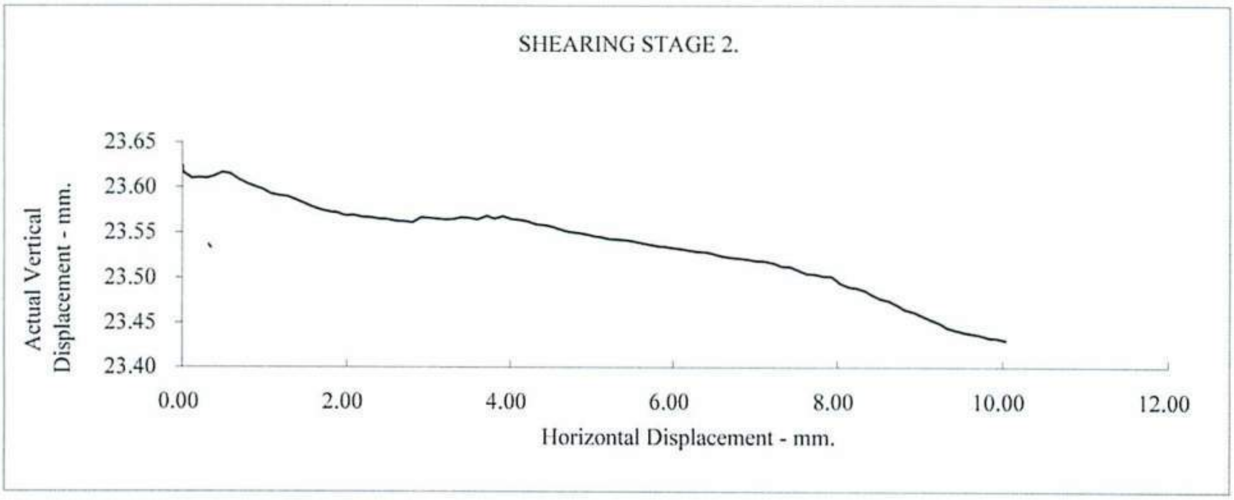
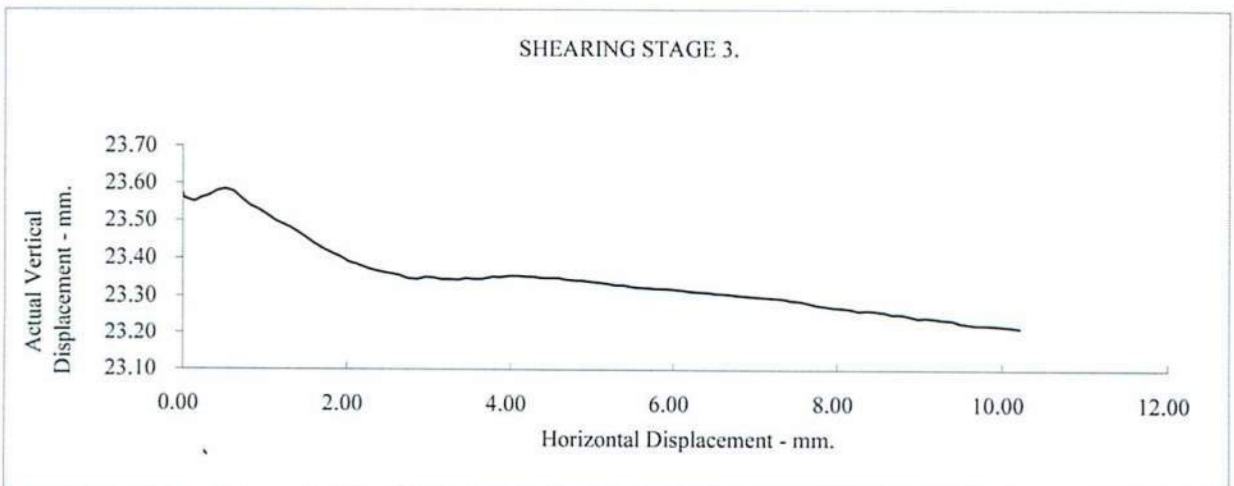
CONSOLIDATED DRAINED SHEARBOX TEST.

BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPC2/02 S2 Depth (m): 2.30-3.10







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Bangor
Gwynedd
LL57 4LH

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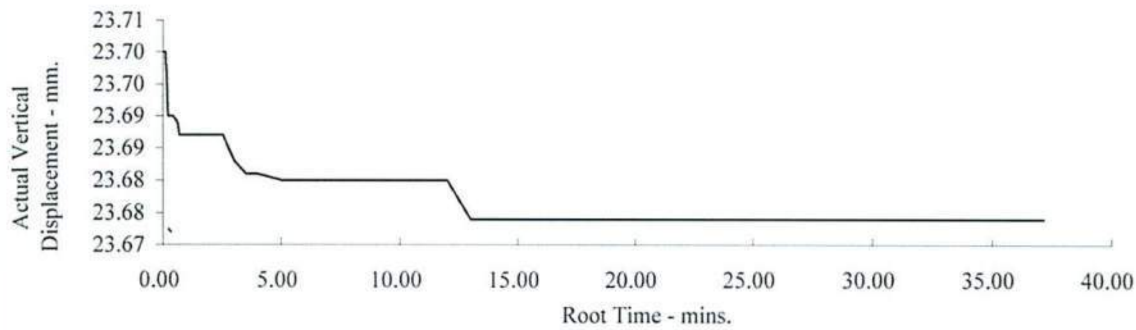
CONSOLIDATED DRAINED SHEARBOX TEST.

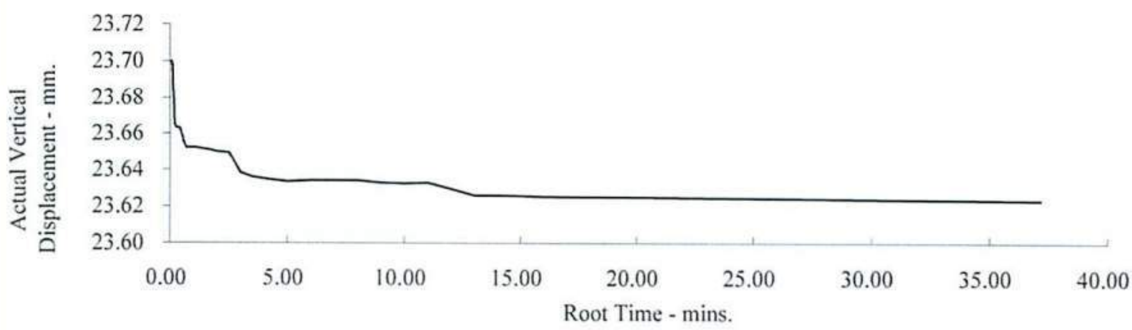
BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPC2/02 S2 Depth (m): 2.30-3.10

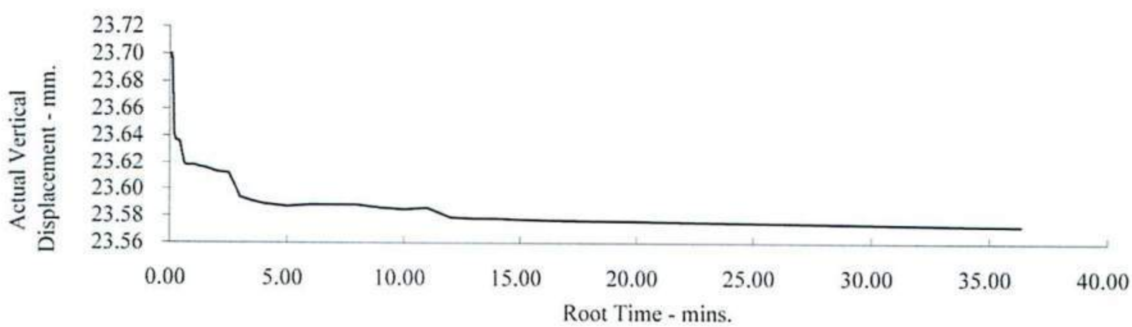
CONSOLIDATION STAGE 1.



CONSOLIDATION STAGE 2.



CONSOLIDATION STAGE 3.



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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
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V.A.T. No. 352-5034-81

Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE
Contract: A55 Warrens Bank

Date: 9th February 2010
Test Report Ref.: STR 207403

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Shear Strength by Direct Shear (Small Shear Box). In accordance with **BS 1377 : Part 7 1990 : Clause 4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPF1/01-S1 0.24-1.50**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test.:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Very Silty Sand**
Target Specification:	**N/A**

TEST RESULTS:

See Attached

( ) E. R. Goulden, Technical Manager - ( ) E. N. Jones, Soils Laboratory Manager –
(✓) G. LL. Evans, Laboratory Manager Approved Signatories

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Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

CONSOLIDATED DRAINED SHEARBOX TEST.

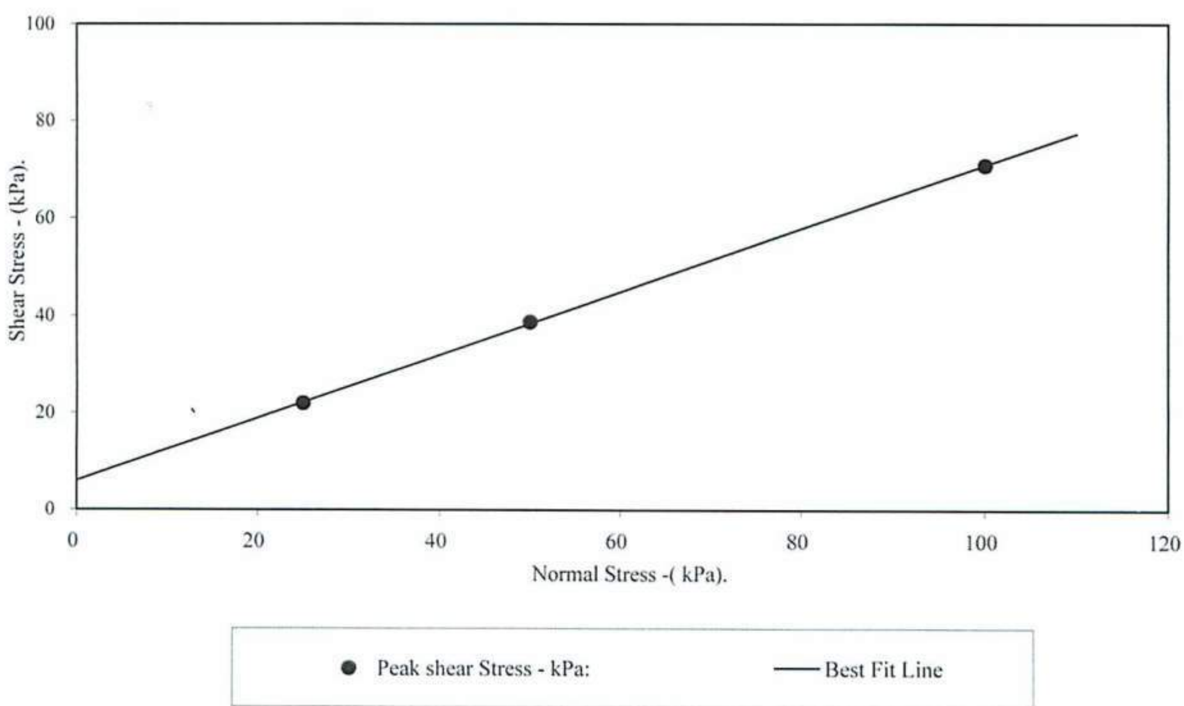
BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPF1/01 S1 Depth (m): 0.24-1.50

Sample Type:	Remoulded (Light Tamping) Material above 2mm removed.		
Particle Density - Mg/m3:	2.65 (Assumed)		
Specimen Tested:	Submerged		
Sample Description: **Brown silty sandy (fine-medium) CLAY.**			
STAGE	**1**	**2**	**3**
Initial Conditions			
Height - mm:	23.70	23.70	23.70
Length - mm:	60.00	60.00	60.00
Moisture Content - %:	19	19	19
Bulk Density - Mg/m3:	2.15	2.13	2.10
Dry Density - Mg/m3:	1.80	1.79	1.76
Voids Ratio:	0.4714	0.4831	0.5043
Normal Pressure- kPa	25	50	100
Consolidation			
Consolidated Height - mm:	23.48	23.00	22.52
Shear			
Rate of Strain (mm/min)	0.010	0.010	0.010
Strain at peak shear stress (%)	6.15	5.68	4.32
Peak shear Stress - kPa:	22	39	71

PEAK	
Angle of Shearing Resistance:(~~θ~~)	**33.0**
Effective Cohesion - kPa:	**6**

FAILURE CONDITIONS



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Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

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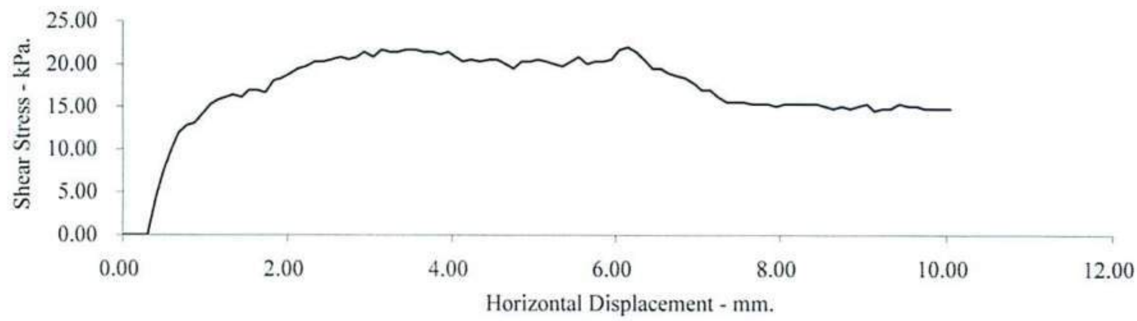
CONSOLIDATED DRAINED SHEARBOX TEST.

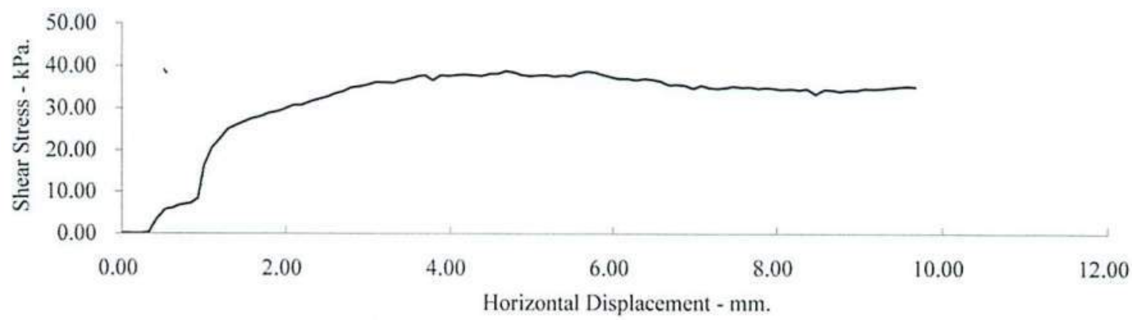
BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPF1/01 S1 Depth (m): 0.24-1.50

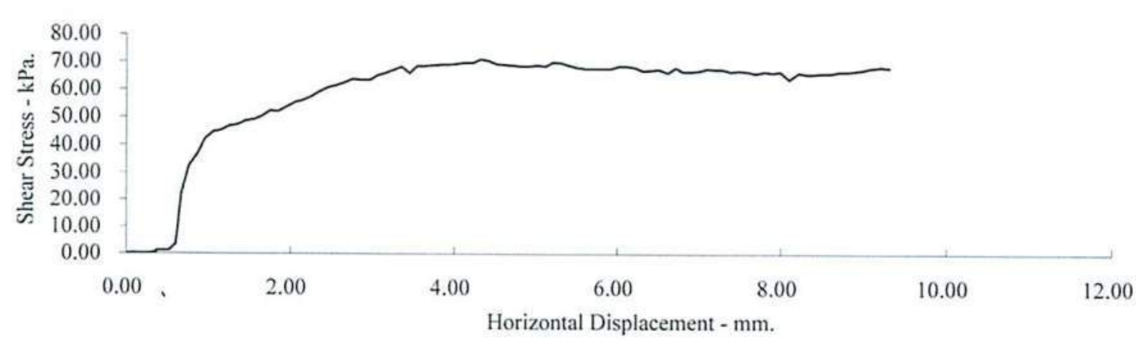
SHEARING STAGE 1.



SHEARING STAGE 2.



SHEARING STAGE 3.



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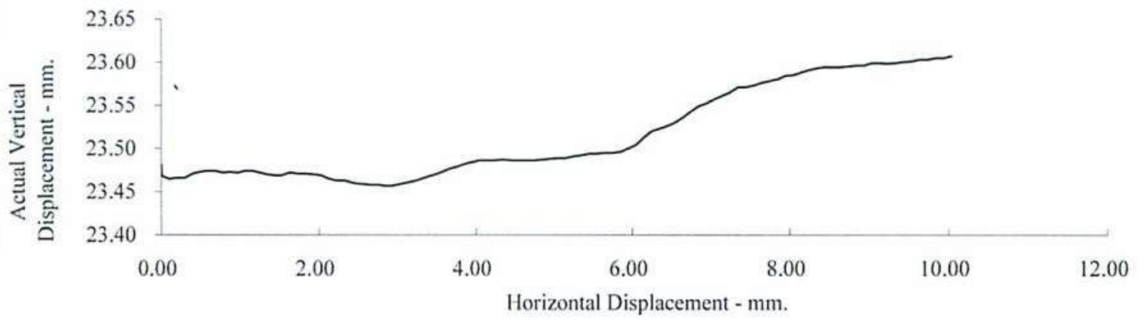
CONSOLIDATED DRAINED SHEARBOX TEST.

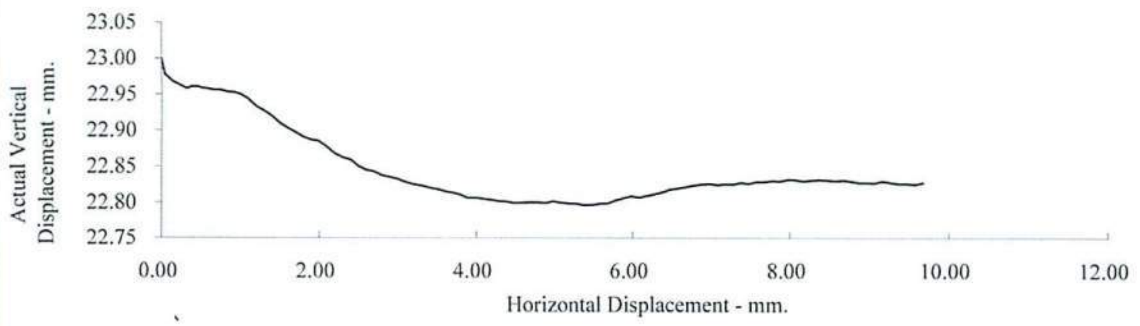
BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPF1/01 S1 Depth (m): 0.24-1.50

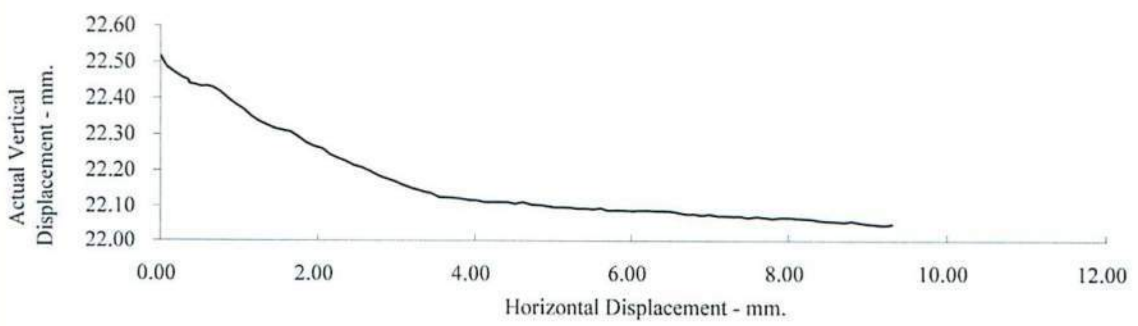
SHEARING STAGE 1.



SHEARING STAGE 2.



SHEARING STAGE 3.



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Llandegai
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Gwynedd
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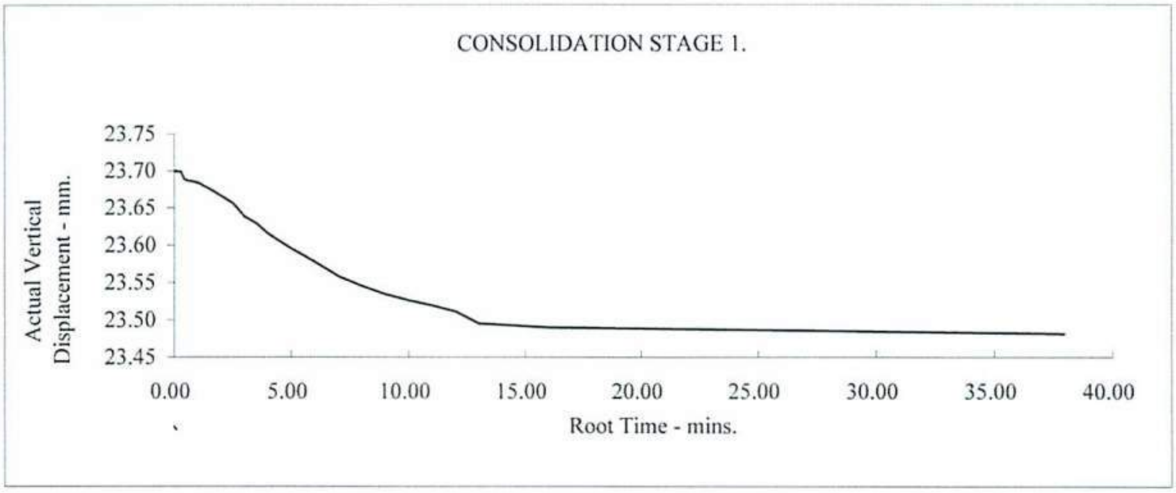
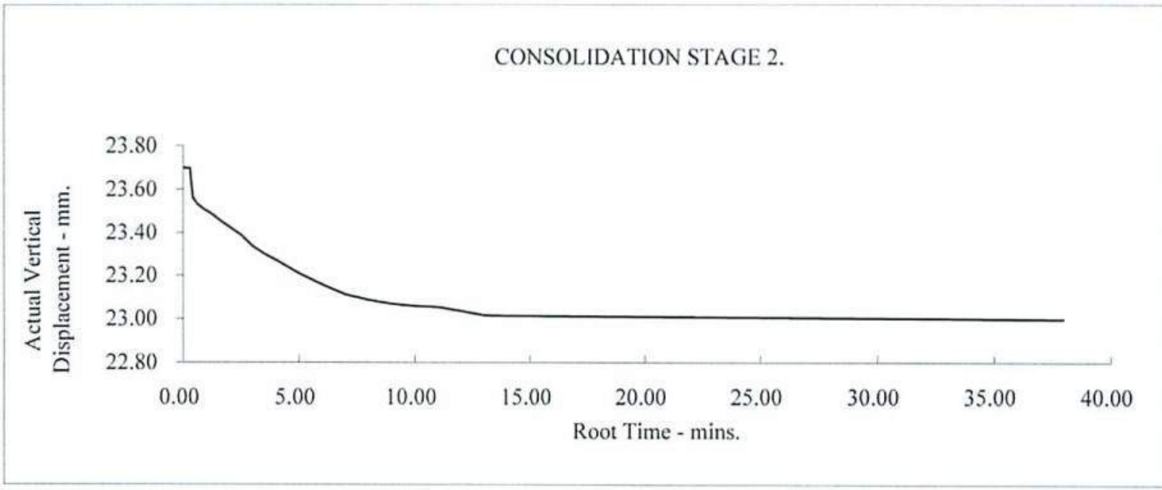
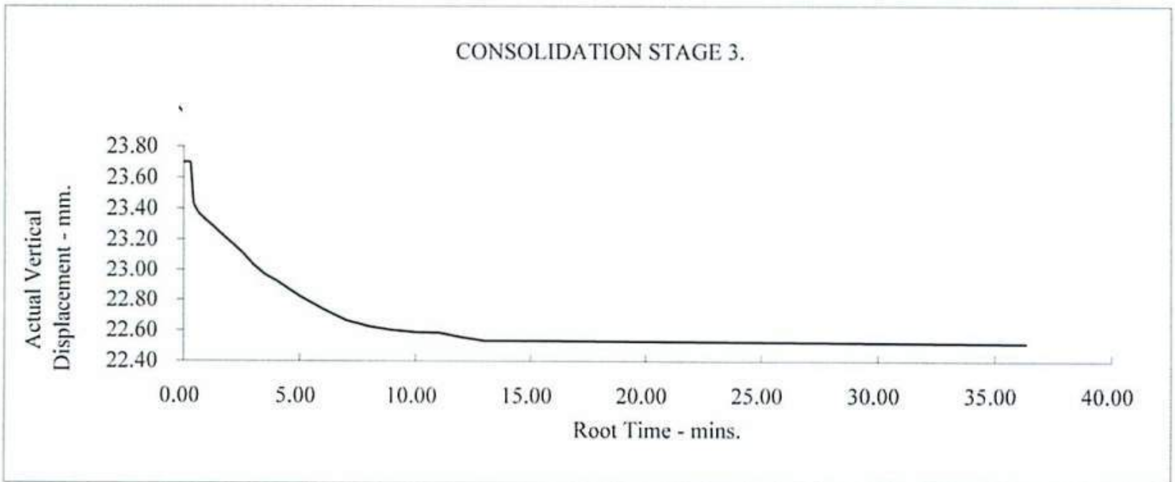
CONSOLIDATED DRAINED SHEARBOX TEST.

BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPF1/01 S1 Depth (m): 0.24-1.50







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Trefelin
Llandegai
Bangor
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Atkins,
Chadwick House,
Birchwood Park,
Risley,
Warrington.
WA3 6AE
Contract: A55 Warrens Bank

Date: 9th February 2010
Test Report Ref.: STR 207410

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Shear Strength by Direct Shear (Small Shear Box). In accordance with **BS 1377 : Part 7 1990 : Clause 4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S30235**
Client Ref. No:	**TPF1/03-S2 1.80-2.10**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**01/02/2010**
Date of Start of Test.:	**02/02/2010**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Disturbed Bulk Sample**
Sampled By:	**Client**
Material Description:	**Silty Sand**
Target Specification:	**N/A**

TEST RESULTS:

See Attached

( ) E. R. Goulden, Technical Manager - ( ) E. N. Jones, Soils Laboratory Manager –
(✓) G. LL. Evans, Laboratory Manager Approved Signatories

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Llandegai
Bangor
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LL57 4LH

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CONSOLIDATED DRAINED SHEARBOX TEST.

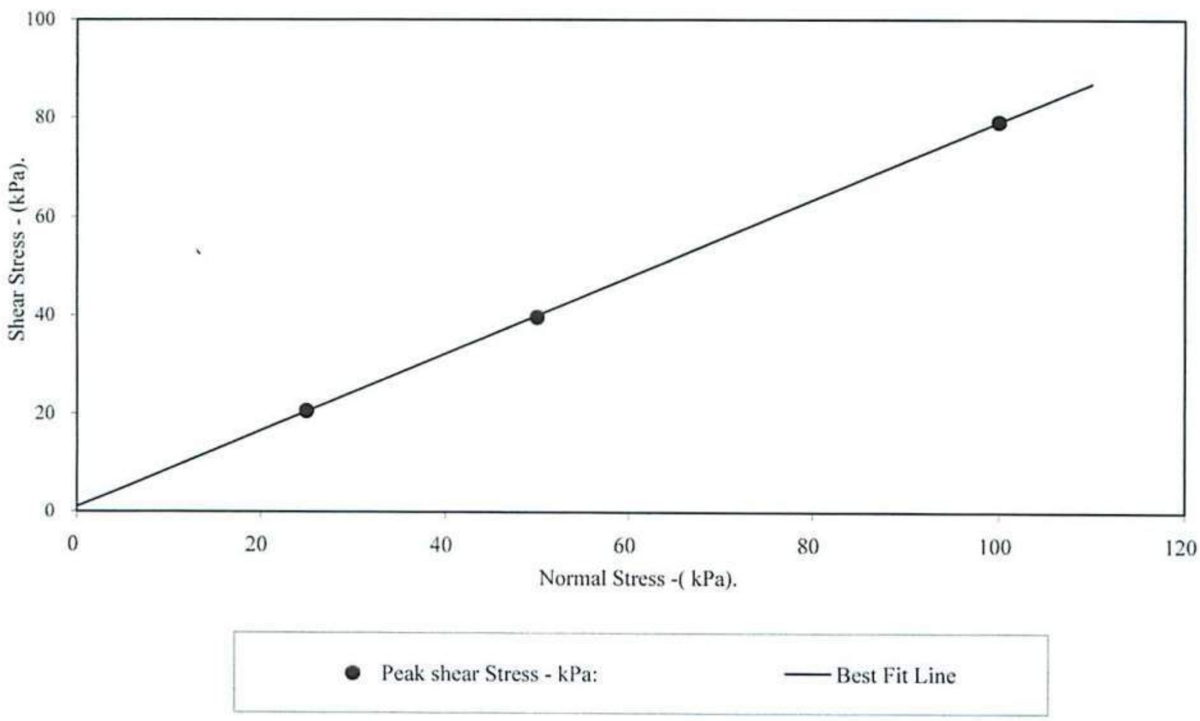
BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPF1/03 S2 Depth (m): 1.80-2.10

Sample Type:	Remoulded (Light Tamping) Material above 2mm removed.		
Particle Density - Mg/m3:	2.65 (Assumed)		
Specimen Tested:	Submerged		
Sample Description: **Brown silty clayey SAND (fine-medium).**			
STAGE	**1**	**2**	**3**
Initial Conditions			
Height - mm:	23.70	23.70	23.70
Length - mm:	60.00	60.00	60.00
Moisture Content - %:	19	19	19
Bulk Density - Mg/m3:	2.14	2.11	2.08
Dry Density - Mg/m3:	1.80	1.78	1.75
Voids Ratio:	0.4762	0.4928	0.5172
Normal Pressure- kPa	25	50	100
Consolidation			
Consolidated Height - mm:	23.62	23.61	23.59
Shear			
Rate of Strain (mm/min)	0.010	0.010	0.010
Strain at peak shear stress (%)	6.10	4.17	4.18
Peak shear Stress - kPa:	21	40	79

PEAK	
Angle of Shearing Resistance:(θ)	**38.0**
Effective Cohesion - kPa:	1

FAILURE CONDITIONS



celtest
independent materials testing — diamond core drilling & sawing

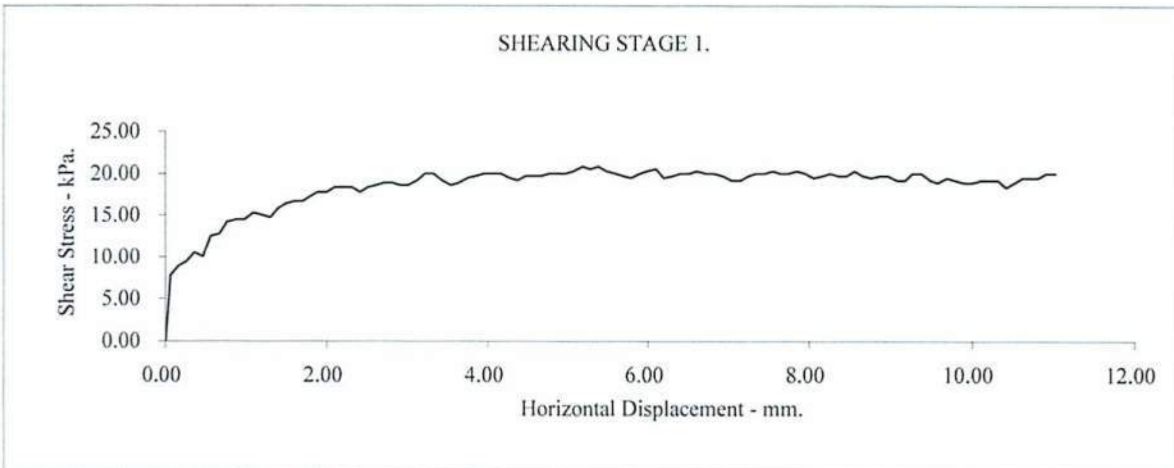
Celtest Company Ltd
Trefelin
Llandegai
Bangor
Gwynedd
LL57 4LH

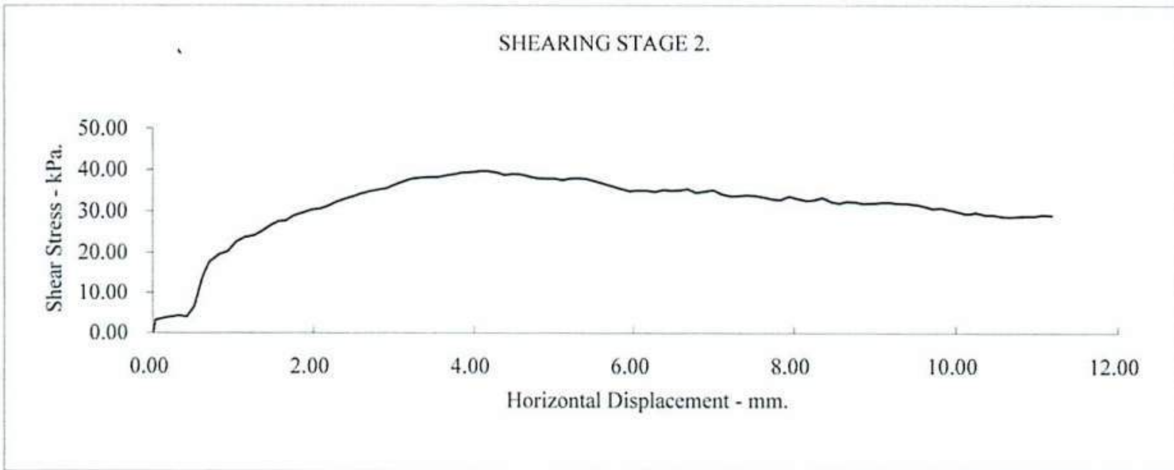
Tel: 01248 355269
Fax: 01248 351563
e-mail: postmaster@celtest.com
Web: www.celtest.com
Registered in Wales and England 1533370
V.A.T. No. 352-5034-81

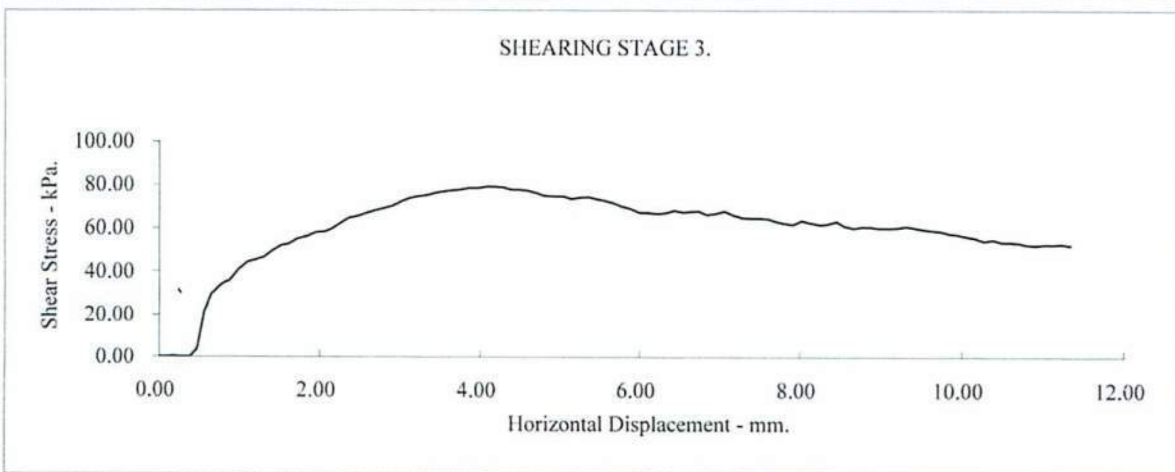
CONSOLIDATED DRAINED SHEARBOX TEST.

BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPF1/03 S2 Depth (m): 1.80-2.10







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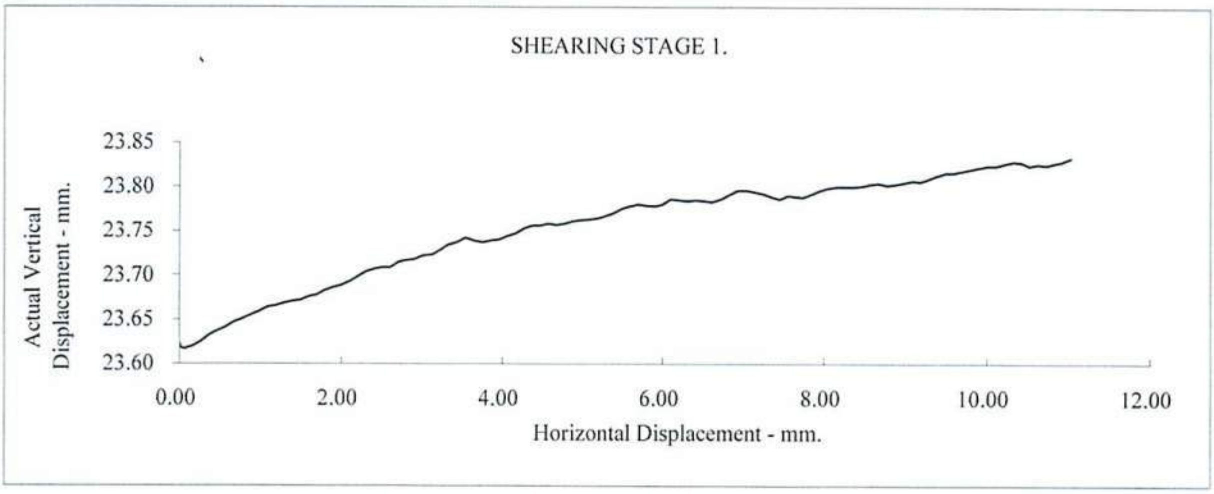
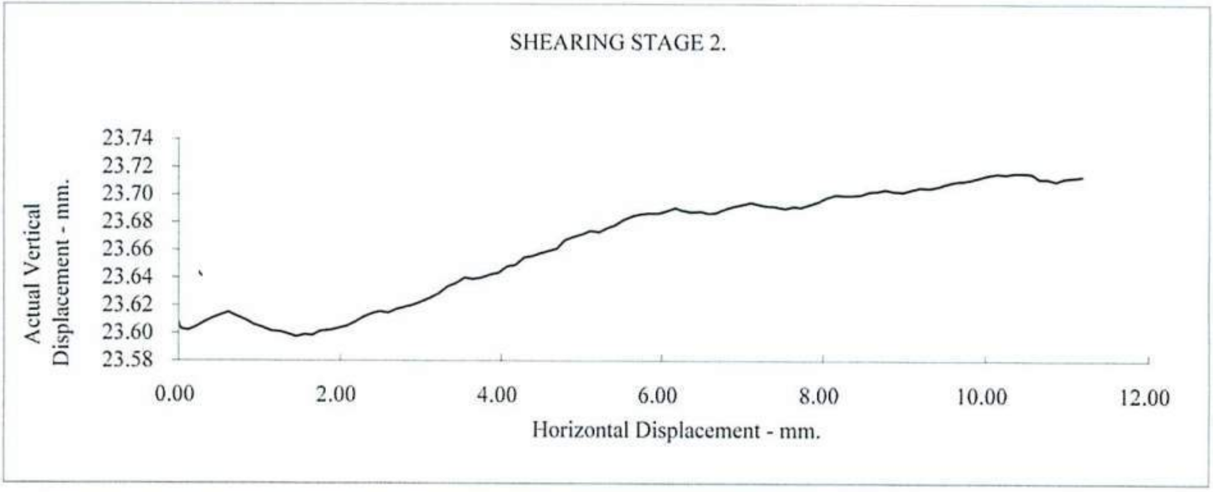
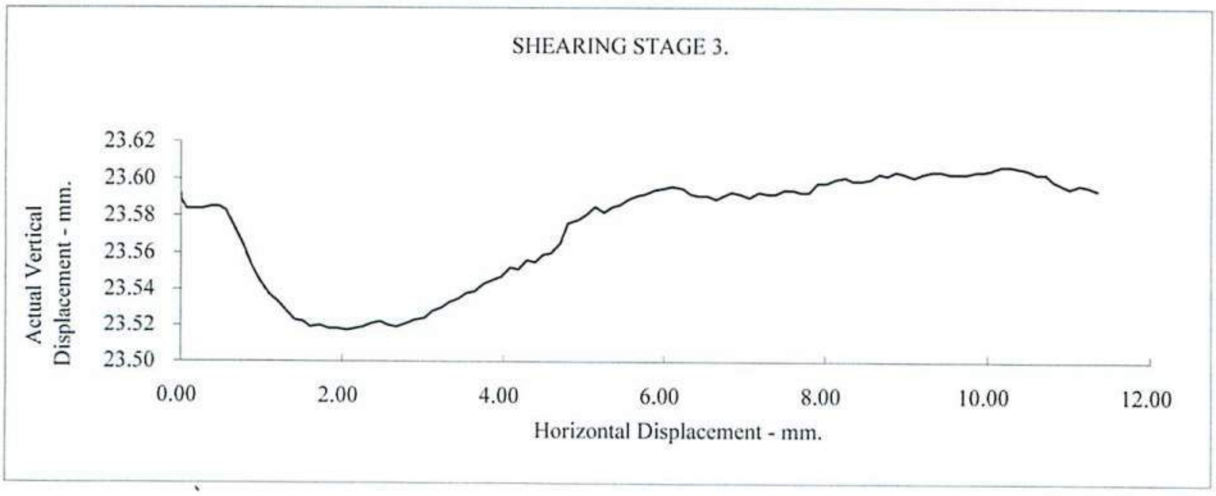
CONSOLIDATED DRAINED SHEARBOX TEST.

BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPF1/03 S2 Depth (m): 1.80-2.10







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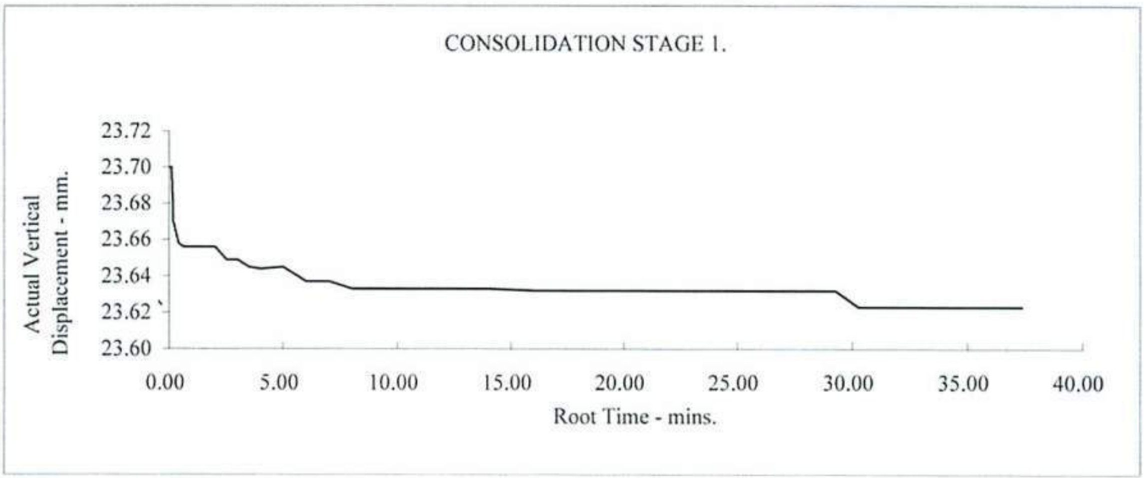
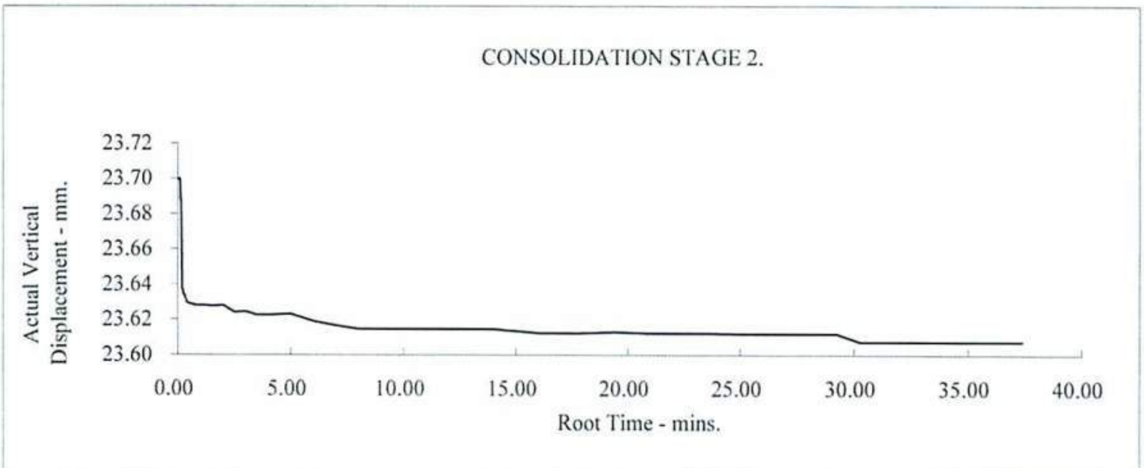
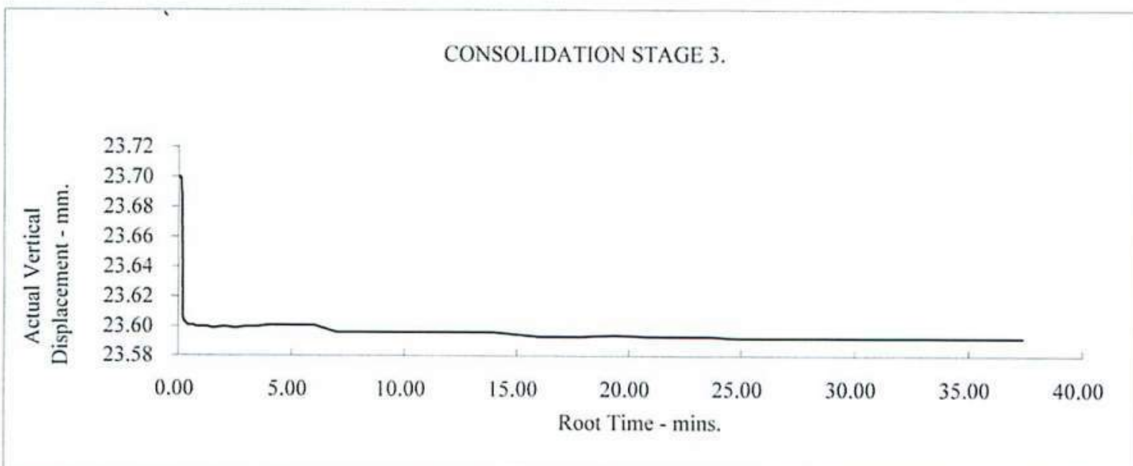
CONSOLIDATED DRAINED SHEARBOX TEST.

BS1377:Part 7:4.5 :1990.

Borehole/Sample Number: TPF1/03 S2 Depth (m): 1.80-2.10







Appendix C
Earthworks Specification

CLIENT: Welsh Assembly Government

PROJECT: Warrenhall Enabling Works Cut and Fill Design

Report Title: Appendix 6/1

Issue: A

Status: Final

A	27/1/10	Final	JDW	PC	PC
Issue	Date	Status	Written by	Reviewed by	Authorised

1. This Specification has been prepared for the purpose of the Warrenhall enabling works. The earthworks shall be carried out in accordance with the current Highways Agency Specification for Highways Works. At the time of writing this specification some ground investigation works are being carried out. This specification may be amended after completion of the ground investigation.

2. Acceptable Limits for Fills

The Contractor shall be responsible for the testing, classification and determination of the acceptability of the proposed earthwork materials.

The permitted classes of construction materials are defined in the following tables:

- Table 6/1 Classification and Compaction Requirements
- Table 6/2 Grading Requirements

Embankments shall be constructed of Class 1/Class 2 General Fill unless otherwise indicated on the drawings.

Class 4 materials shall be used as fill to landscape areas. Class 5 materials shall be used for topsoil.

2. Requirements for Determining Acceptability

General

The Contractor shall carry out all necessary testing as detailed at the Manual of Contract Documents for Highways Works Notes for Guidance on the Specification for Highways Works Volume 2 Table NG 1/1 Typical Testing Details and Table 6/1 to demonstrate the proposed materials meet the requirements of the Specification. The classification and confirmation of acceptability of earthworks materials shall be carried out by the Contractor at excavation for on-site materials and at the point of deposition for imported materials.

Trial pit locations for classification purposes of site won material shall be spread across the area of intended excavation to give representative samples of the proposed fill for testing.

Source approval testing is required for all fill materials. To obtain source approval the Contractor shall carry out a full range of the tests detailed in Table NG 1/1 Typical Testing Details and Table 6/1 for the Class of fill on at least 3 representative samples to demonstrate compliance.

Following source approval, acceptability testing shall carried out at the frequencies given in Subsequent testing shall be at the frequencies given in Table NG 1/1 Typical Testing Details.

If, in the opinion of the Designer, the material at the time of excavation or compaction is not of the previously determined classification or has become unacceptable the Designer may require the Contractor to repeat the classification and acceptability tests given in Table 6/1. The rate of further testing required shall be sufficient to ensure the correct classification of materials taking into account the variations in their properties.

Two copies of all test results and their interpretation to Material Class shall be submitted to the Designer within 3 days of the tests being completed.

3. Rendering Unacceptable Material Acceptable

It is not anticipated that treatment by lime modification/improvement to render soft/weak cohesive materials acceptable will be undertaken for this scheme. If the Contractor proposes lime modification/improvement he shall submit details of his proposals to the Designer for approval prior to incorporating such materials into the Works.

Nuclear density meters calibrated for the various materials on site may be used in place of sand replacement tests, subject to sand replacement tests and laboratory moisture content determinations at a ratio of 1 for every 10 results obtained from nuclear density readings.

Compliance and acceptability tests must be completed prior to covering.

4. Requirements for Groundwater Lowering or Other Treatment

Construction areas shall be kept free of groundwater, infiltration and the effects of weather, and all reasonable measures shall be taken to ensure that the sub-grade is protected.

5. Permitted Use of Rapid Assessment Procedure for Material Acceptability

Where moisture content is specified as the method of material classification and control, the Contractor may use a “rapid” method as an alternative to the BS1377: Part 2 method provided that such “rapid” methods are weekly calibrated against conventional BS methods using drying ovens. The contractor shall submit details of the proposed calibration method to the Designer for review prior to start of the earthworks.

Routine site testing of MCV may use the rapid moisture content assessment procedure of BS 1377 Part 4 where a pre-calibrated repeatable standard can be reliably established and regularly checked. Rapid methods shall not be used for lime modified or lime stabilised materials.

TABLE 6/1: Acceptable Earthworks Materials : Classification and Compaction Requirements (See footnotes)

Class			General Material Description	Typical Use	Permitted Constituents (All subject to requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612
						Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits		
								Lower	Upper	
General Granular Fill	1	A	Well graded granular material	General Fill	Any material or combination of materials.	(i) grading	BS1377: Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 2
						(ii) uniformity coefficient	see Note 5	10	-	
						(iii) moisture content	BS1377: Part 2	App 6/1	App 6/1	
						(iv) Moisture Condition Value (MCV)	Clause 632	App 6/1	App 6/1	
	1	B	Uniformly graded granular material	General Fill	Any material or combination of materials.	(i) grading	BS1377: Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 3
						(ii) uniformity coefficient	see Note 5	10	-	
						(iii) mc	BS1377: Part 2	App 6/1	App 6/1	
						(iv) Moisture Condition Value (MCV)	Clause 632	App 6/1	App 6/1	
	1	C	Coarse granular material	General Fill	Any material or combination of materials.	(i) grading	BS 1377: Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 5
						(ii) effective angle of friction (φ') and effective cohesion (c')	Clause 636	∅' = 35°	-	
						(ii) uniformity coefficient	see Note 5	5	-	
						(iii) Los Angeles coefficent	Clause 635	-	50	
General Cohesive Fill	2	A	Wet cohesive material	General Fill	Any material or combination of materials.	(i) grading	BS 1377: Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 1 except: for materials with liquid limit greater than 50, determined by BS 1377: Part 2, only tamping or grid rollers shall be used.
						(ii) plastic limit (PL)	BS 1377: Part 2	-	-	
						(iii) moisture content	BS 1377: Part 2	OMC - 2%	OMC + 2%	
						(iv) Moisture Condition Value (MCV)	Clause 632	7	12	
						(v) Undrained shear strength of remoulded material	Clause 633	App 6/1	App 6/1	
	2	B	Dry cohesive material	General Fill	Any material or combination of materials.	(i) grading	BS 1377: Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 2
						(ii) plastic limit (PL)	BS 1377: Part 2	-	-	
						(iii) moisture content	BS 1377: Part 2	OMC - 2%	OMC + 2%	
						(iv) Moisture Condition Value (MCV)	Clause 632	7	12	
						(vi) Undrained shear strength of remoulded material	Clause 633	App 6/1	App 6/1	
	2	C	Stony cohesive material	General Fill	Any material or combination of materials.	(i) grading	BS 1377: Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 2
						(ii) plastic limit (PL)	BS 1377: Part 2	-	-	
						(ii) moisture content	BS 1377: Part 2	App 6/1	App 6/1	
						(iii) Moisture Condition Value (MCV)	Clause 632	App 6/1	-	
						(v) undrained shear strength of remoulded material	Clause 633	App 6/1	-	

TABLE 6/1: Acceptable Earthworks Materials : Classification and Compaction Requirements (See footnotes)

Class			General Material Description	Typical Use	Permitted Constituents (All subject to requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612
						Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits		
								Lower	Upper	
General Cohesive Fill	2	D	Silty Cohesive Material	General Fill	Any material or combination of materials.	(i) grading	BS 1377: Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 3
						(ii) moisture content	BS 1377: Part 2	App 6/1	App 6/1	
						(iii) Moisture Condition Value (MCV)	Clause 632	App 6/1	App 6/1	
						(iv) undrained shear strength of remoulded material	Clause 633	App 6/1	App 6/1	
Landscape Fill	4		Various	Fill to landscape areas	Any material or combination of materials excluding peat, topsoil and organic soils	(i) grading	BS1377: Part 2	See Note 7	See Note 7	See Clause 620
						(ii) Moisture content	BS 1377: Part 2	-	-	
						(iii) Moisture Condition Value (MCV)	Clause 632	5	18	
Topsoil	5	A	Topsoil, or turf existing on site	Topsoiling	Topsoil or turf designated as Class 5A in the Contract	(i) grading	Clause 618	-	Clause 618	-
	5	B	Imported Topsoil	Topsoiling	Material complying with BS 3882	-	-	-	-	-
	5	C	Imported turf	Turfing	Material complying with BS 3969	-	-	-	-	-

TABLE 6/1: Acceptable Earthworks Materials : Classification and Compaction Requirements (See footnotes)

Footnotes to Table 6/1:

1 App = Appendix

2 Tab = Table

3 Where in the Acceptable Limits column reference is made to App 6/1, only those properties having limits ascribed to them in Appendix 6/1 shall apply. Where Appendix 6/1 gives limits for other properties not listed in this Table such limits shall also apply.

4 Where BS 1377: Part 2 is specified for mc, this shall mean BS 1377: Part 2 or BS 812: Part 3 as appropriate

5 Uniformity coefficient is defined as the ratio of the particle diameters D60 to D10 on the particle-size distribution curve, where:
D60 =particle diameter at which 60% of the soil by weight is finer
D10 =particle diameter at which 10% of the soil by weight is finer

6 Determination of moisture content shall be made from that part of the material passing the 20mm BS Sieve.

7 Class 4, 4A and 4P materials shall be of such size that it can be deposited in horizontal layers each not exceeding 450mm loose depth. Isolation boulders may be incorporated provided that the specified compaction is achieved. Class 4B consists of cobbles and boulders.

8 Subject to the tolerances given in Clause 616, Class 6F material used within 450mm of the designed final road surface shall not be frost susceptible as defined in the test method and procedure of the Transport and Road Research Laboratory Supplementary Report.

9 Where determination of the optimum moisture content of granular soils is required and the grading of the material places it in Zone 'X' as defined in BS1377 Part 4 Figure 1, then the omc shall be determined where > 35% of the material passes the 37.5mm BS sieve using a CBR mould. The procedures for soils susceptible to crushing during compaction shall be applied to all relevant soils.

10 Where undrained shear strength is specified as the method of material classification and control, the Contractor may use a hand vane provided that it is initially calibrated against the unconsolidated undrained shear strength laboratory triaxial test to BS 1377: Part 7, clause 8 on 110mm nominal diameter samples, and the Moisture Condition Value (MCV) test in accordance with BS1377: Part 4. The Contractor shall submit details of his proposed hand vane calibration method to the Designer for acceptance prior to the start of earthworks.

11 Landscape fill Class 4P shall generally be in a condition that permits it to be transported, deposited, trafficked and shaped by earthworking plant and which will permanently maintain the required earthwork contours.

12 Where note 12 is referred to in Table 6/1 the moisture content shall lie in the range necessary to achieve 95% of maximum dry density to BS1377 with the compactive effort specified on omc-dry density relationship as defined by BS1377 Part 4.

13 For all fills where MCV and shear strength acceptability limits are provided the MCV compliance criteria shall be used to control the acceptability of the fill material unless agreed otherwise with the Designer.

14 For Class 2 Fill should testing indicate that the effective angle of friction and cohesion is lower than that specified the Designer shall be consulted who will undertake a detailed slope stability analysis to determine whether the material is acceptable and if any additional measures are required.

CLIENT: Welsh Assembly Government

PROJECT: Warrenhall Enabling Works Cut and Fill Design

Report Title: Appendix 6/2 Requirements for Dealing with Class U1B and U2 Unacceptable Material

Issue: **A**

Status: Construction

A	27/1/10	Review	JDW	PC	PC
Issue	Date	Status	Written by	Reviewed by	Authorised

1. This Specification has been prepared for the purpose of the Warrenhall enabling works. The earthworks shall be carried out in accordance with the current Highways Agency Specification for Highways Works. At the time of writing this specification some ground investigation works are being carried out. This specification may be amended after completion of the ground investigation.

2. Drawing References

There is no available evidence of any Class U1B or U2 material present at the site.

3. Disposal Requirements

Where contaminated materials are encountered, the materials to be disposed of, disposal methods and disposal sites to be used shall be agreed with the Local Authority and the Designer.

4. Known Hazardous Materials

There is no available evidence of contaminated materials being present at the site. Should any information become available during the site works that contaminated materials are present then the information should be provided to the Designer who may specify testing, carry out a risk assessment and determine the required action.

5. Methods of Excavation, Precautions and Requirements for Handling.

Records

The Contractor shall maintain adequate records of the works which shall include, but not be limited to:

- records to establish the volume of materials excavated,
- location of the source of any re-useable stockpiled materials excavated from site
- testing records relating to the re-used materials
- location where stockpiled materials are re-used
- where appropriate the classification of any waste generated
- where appropriate the disposal methods undertaken.

The Contractor shall provide instruction and training to the appropriate workers to enable them to identify visual evidence contamination.

Testing

The Designer will specify the testing to be undertaken by the Contractor. All contamination test results shall be submitted to the Designer initially for comment.

Stockpiling / Movement of Materials

The Contractor is responsible for the provision of all necessary waste management licences and permits for stockpiling and movement of waste on and off site.

Requirements for stockpiling and movements of materials shall be agreed with the Designer.

6. Special requirements for dealing with leachate and contaminated water.

Should any leachate or contaminated water be encountered the Designer shall be informed who may specify testing, carry out a risk assessment and determine the required action.

7. Requirements for special drainage and for sealing exposed surfaces of contaminated materials

Not Used

8. Test Methods to be used for Chemical Analysis

Not Used

CLIENT: Welsh Assembly Government

PROJECT: Warrenhall Enabling Works Cut and Fill Design

Report Title: Requirements for Excavation, Deposition, Compaction (Other than Dynamic Compaction)

Issue: **A**

Status: Final

A	27/1/10	Review	JDW	PC	PC
Issue	Date	Status	Written by	Reviewed by	Authorised

1. This Specification has been prepared for the purpose of the Warrenhall enabling works. The earthworks shall be carried out in accordance with the current Highways Agency Specification for Highways Works. At the time of writing this specification some ground investigation works are being carried out. This specification may be amended after completion of the ground investigation.

2. Drawing Numbers

Earthworks requirements are shown on the scheme drawings.

3. Blasting

No blasting is required as part of the proposed works.

4. Cutting Faces

(a) The extent of excavations remaining to be backfilled that undercut the toes of cuttings and embankments shall not exceed the limits shown on Drawing 5078488/PL/007.

(b) The tops and bottoms of embankments and cuttings shall be rounded to minimum of 3 metres radius over a length of 1.5 metres.

(c) **Temporary ditches** shall be provided within 2.0m of the toe of all cuttings immediately upon completion of excavation to facilitate drainage of water. Ditches shall be maintained until permanent drainage measures are constructed at the slope toe.

5. **Watercourses**

There are no known watercourses that require modification or filling.

6. **Embankment Construction**

(a) Fills of more than 2 metres in height shall not at any stage of construction have side slopes steeper than those indicated for the final earthworks outline. Side slopes of fills less than 2 metres height shall not exceed 1(v) to 1.5(h) at any stage.

(b) Surcharging of embankments other than as specified in the Contract is not permitted.

(c) Where erodable materials are deposited within 1 metre of the earthwork outline, slopes steeper than 10 degrees shall be covered as soon as possible with topsoil.

(d) All embankments shall be overfilled by 300mm to provide a protective layer. This layer shall be Class 2 General fill and shall be placed and compacted in accordance with the specification.

(e) Weather protection

The Contractor's particular attention is drawn to Clause 608 (Construction of Fills) of the Specification for Highway Works. The works shall be protected against weather in accordance with the relevant sub-clauses.

(f) Soft spots

All areas of embankment foundations shall be proof-rolled prior to fill placement. The proof-rolling shall consist of at least one pass of a smooth-wheeled vibratory roller having a minimum mass per metre roll width of 2100 kg, or other suitable method agreed with the Designer.

Soft spots shall be excavated and backfilled as agreed with the Designer. Soft spots in embankment foundations shall be defined as areas where the soil does not meet the minimum assumed shear strength requirements (assume Cu = 50kPa unless specified on the earthworks drawings). The extent of soft spots shall be determined by inspection during proof-rolling. Soft spot shall be identified by inspection and should be identifiable by the fact that the soil does not support the roller weight during proof-rolling without excessive deformation. Hand vane testing shall also be carried out if necessary.

Records of the foundation inspections carried out, and any remedial measures necessary including the location and depth of any soft spots encountered, shall be made available to the Designer.

<u>Cohesive/granular fill interfaces</u>

Cohesive/granular fill interfaces shall be constructed such that drainage of the interface is towards the edge of the embankment. The slope of the interface shall be such that any water drains to the outside of the embankment. No pockets of granular material shall be formed within cohesive material.

<u>Landscape Fill</u>

Landscape fill used shall be as specified at Appendix 6/1 and shall be compacted in accordance with Clause 620. The Contractor shall ensure that adequate compaction shall be undertaken to ensure the stability of the fill slopes. It is anticipated that compaction will be undertaken using tracked dowsers although compaction plant (rollers) may be required for some areas. The Contractor shall determine the compaction required for each area of earthworks and will depend on the proposed fill height and slope angle, and the nature of the fill to be used. Compaction shall be undertaken in layers not exceeding 450mm loose depth.

7. **Compaction**

i. General:

(a) Requirements of compaction shall comply with Clause 612.

ii. Method Compaction:

(a) Extra compaction in the top 600mm (below the protective layer) for Class 1 and 2 fill over the full width of the embankments to Clause 612.10 is required.

(b) The frequency of field dry density testing shall be as set out in Appendix 1/5.

iii. End Product Compaction

(a) Nuclear surface density gauge (NDG) calibrated for the materials on site may be used for measuring field dry density/moisture content in place of sand replacement tests (SRT). The gauge shall be calibrated in accordance with BS 1377: Part 9.

8. Not used.

9. **Benching**

Where embankments are to be constructed on ground with a slope steeper than one (vertical) in five (horizontal), such slope being measured at right angles across the width of the embankment.

ii. Fill material in areas of benching shall be carefully placed and compacted to ensure that no voids occur at the upright steps of the benching.

iii. Placing and compaction of the fill material shall continue to a level above an adjacent bench before material is placed upon that bench.

iv. Four additional passes of the roller shall be made on the area within two metres each side of the upright face immediately following the compaction of the first layer of fill material on each bench.

v. Details for benching shall be agreed with the Designer.

10. Not Used

11. Not required at this stage.

12 to 15. Not Used

Atkins Limited
Chadwick House
Birchwood Park
Warrington
WA3 6AE

Tel: +44 (0)1925 238000
Fax: +44 (0)1925 238500

info@atkinsglobal.com
www.atkinsglobal.com