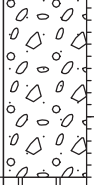
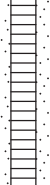
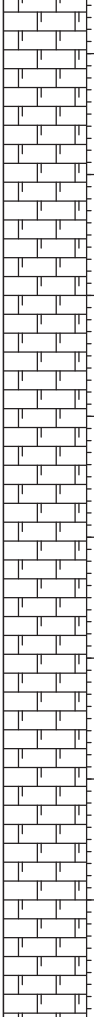
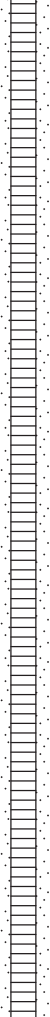


Project:	Broadwater Road, Welwyn Garden City	Project No:	2342.18	Hole ID:	BH415
CABLE PERCUSSION BOREHOLE LOG		Date From / To:	13/10/2014 - 14/10/2014		
		Client:	Spenn Hill Developments Ltd		

DESCRIPTION OF STRATA	LEGEND	WATER	CASING DEPTH / (Diam. mm)	REDUCED LEVEL/ DEPTH (Thickness)	Sample Details			Test Results	Backfill Details
					TYPE	REF	Depth	SPT N Value/Drive mm	
Dense orange brown gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse flint. Rare flint cobbles. (KESGRAVE CATCHMENT SUBGROUP)(BH Continued)			11.50	73.42 11.50	D	7	10.50 - 10.95 10.50 - 10.95	CPT N=42 4,6/8,9,11,14	
Recovered as structureless CHALK composed of cream with rare orange veins slightly gravelly silt. Gravel is angular to subangular fine to medium extremely to very weak low to medium density cream. Rare subrounded coarse gravels and cobbles of rinded flint throughout. Grade Dm. (LEWES NODULAR/ SEAFORD CHALK FORMATION)					D	8	12.00 - 12.45 12.00 - 12.45	CPT N=28 1,2/4,8,11,5	
					D	9	13.50 - 13.95 13.50 - 13.95	SPT N=14 1,2/4,4,3,3	
					D	10	15.00 - 15.45 15.00 - 15.45	SPT N=21 3,4/4,5,6,6	
					D	11	16.50 - 16.95 16.50 - 16.95	SPT N=12 2,2/3,2,4,3	
					D	12	18.00 - 18.45 18.00 - 18.45	SPT N=34 2,3/6,8,9,11	
					D	13	19.50 - 19.95 19.50 - 19.95	SPT N=18 2,2/3,5,6,4	

REMARKS :

1. Engineer verified logged in general accordance to BS 5930:2010.
2. Area CAT scanned prior to excavation.
3. Groundwater encountered at 27.00m bgl.
4. Installed with HDPE standpipe to 30.00m bgl.

CHISELLING			WATER LEVEL OBSERVATIONS					
Depth From	Depth To	Time Taken		Date	Time	Water Strike	Standing Level	Casing Depth
				1	14-10-14		27.00	25.00
BOREHOLE DIAMETER			CASING DIAMETER			DEPTH SEALED		
150mm to 30.00m			150mm to 11.50m					

All measurements in metres unless otherwise stated	10m/page Scale: 1:62.50	Coordinates to National Grid Ground Level to Ordnance Datum		Page 2 of 4	
Plant Used: Dando 2000	Coordinates / Level (mAOD): E: 524101.97 N: 212899.63 Level: 84.92	Logged By: WC		Checked By: WC	Approved By: SS

Project: **Broadwater Road, Welwyn Garden City**

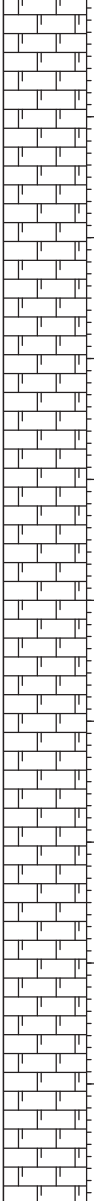
Project No: **2342.18**

Hole ID: **BH415**

CABLE PERCUSSION BOREHOLE LOG

Date From / To:
13/10/2014 - 14/10/2014

Client:
Spenn Hill Developments Ltd

DESCRIPTION OF STRATA	LEGEND	WATER	CASING DEPTH / (Diam. mm)	REDUCED LEVEL/ DEPTH (Thickness)	Sample Details			Test Results	Backfill Details
					TYPE	REF	Depth		
Recovered as structureless CHALK composed of cream with rare orange veins slightly gravelly silt. Gravel is angular to subangular fine to medium extremely to very weak low to medium density cream. Rare subrounded coarse gravels and cobbles of rinded flint throughout. Grade Dm. (LEWES NODULAR/ SEAFORD CHALK FORMATION)(BH Continued)				(18.50)	D	14	21.00 - 21.45 21.00 - 21.45	SPT N=37 4,5/7,8,10,12	
					D	15	22.50 - 22.95 22.50 - 22.95	SPT N=37 4,5/8,12,9,8	
					D	16	24.00 - 24.45 24.00 - 24.45	SPT N=40 5,8/9,9,10,12	
					D	17	25.50 - 25.95 25.50 - 25.95	SPT N=50/275mm (4,7/9,10,15,16/50mm)	
					D	18	27.00 - 27.45 27.00 - 27.45	SPT N=43 5,9/9,12,9,13	
					D	19	28.50 - 28.95 28.50 - 28.95	SPT N=42 5,6/7,9,12,14	
			54.92	30.00	D	20	30.00 - 30.45		

REMARKS :

1. Engineer verified logged in general accordance to BS 5930:2010.
2. Area CAT scanned prior to excavation.
3. Groundwater encountered at 27.00m bgl.
4. Installed with HDPE standpipe to 30.00m bgl.

CHISELLING			WATER LEVEL OBSERVATIONS					
Depth From	Depth To	Time Taken	Date	Time	Water Strike	Standing Level	Casing Depth	
			1	14-10-14		27.00	25.00	
BOREHOLE DIAMETER			CASING DIAMETER			DEPTH SEALED		
150mm to 30.00m			150mm to 11.50m					

All measurements in metres unless otherwise stated

10m/page Scale: 1:62.50

Coordinates to National Grid
Ground Level to Ordnance Datum

Page 3 of 4

Plant Used:
Dando 2000

Coordinates / Level (mAOD):
E: 524101.97 N: 212899.63
Level: 84.92

Logged By:
WC

Checked By:
WC

Approved By:
SS



deltasimons

Hole ID: **BH415**

Client: **Spenn Hill Developments Ltd**

REMARKS : 1. Engineer verified logged in general accordance to BS 5930:2010. 2. Area CAT scanned prior to excavation. 3. Groundwater encountered at 27.00m bgl. 4. Installed with HDPE standpipe to 30.00m bgl.		CHISELLING			WATER LEVEL OBSERVATIONS					
		Depth From	Depth To	Time Taken		Date	Time	Water Strike	Standing Level	Casing Depth
					1	14-10-14		27.00	25.00	
		BOREHOLE DIAMETER			CASING DIAMETER			DEPTH SEALED		
		150mm to 30.00m			150mm to 11.50m					
All measurements in metres unless otherwise stated		10m/page Scale: 1:62.50		Coordinates to National Grid Ground Level to Ordnance Datum				Page 4 of 4		
Plant Used: Dando 2000		Coordinates / Level (mAOD): E: 524101.97 N: 212899.63 Level: 84.92		Logged By: WC		Checked By: WC		Approved By: SS		

Project: **Broadwater Road, Welwyn Garden City**

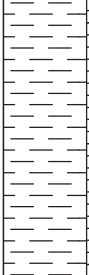
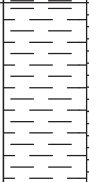
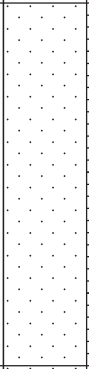
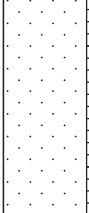
Project No: **2342.18**

Hole ID: **BH416**

CABLE PERCUSSION BOREHOLE LOG

Date From / To:
21/10/2014 - 22/10/2014

Client:
Spenn Hill Developments Ltd

DESCRIPTION OF STRATA	LEGEND	WATER	CASING DEPTH / (Diam. mm)	REDUCED LEVEL/ DEPTH (Thickness)	Sample Details			Test Results	Backfill Details
					TYPE	REF	Depth		
MADE GROUND: Dark brown sandy slightly gravelly clay. Gravel is angular to rounded fine to coarse flint and rare brick. Sand is fine to coarse. Abundant rootlets in top 200mm.				(0.60) 83.72 0.60	D	1	0.50		
Stiff orangey brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse flint. Sand is fine to coarse. (LOWESTOFT FORMATION)				(2.50)	D	2	1.00		
					U	1	1.50 - 1.95	U=90/225mm	
					D	3	1.95 - 20.50		
					B	1	2.50 - 2.95 2.50 - 2.95	CPT N=30 3,4/4,7,9,10	
Stiff brown slightly sandy CLAY. Sand is fine to medium. (LOWESTOFT FORMATION)				(1.50)	D	4	3.10		
					U	2	3.50 - 3.95	U=79/450mm	
					D	5	3.95 - 4.05		
Dense orangey brown fine to coarse SAND. Rare subangular fine to medium flint gravel. (LOWESTOFT FORMATION)				(3.00)	D	6	4.50 - 4.95 4.50 - 4.95	SPT N=31 3,4/4,6,9,12	
					B	2	6.00 - 6.45 6.00 - 6.45	CPT N=45 5,7/8,10,13,14	
					B	3	7.50 - 7.95 7.50 - 7.95	CPT N=28 4,5/6,6,7,9	
Medium dense to dense yellowy brown fine to medium SAND. Rare subangular fine to coarse flint gravel. (KESGRAVE CATCHMENT SUBGROUP)				(1.80)	D	7	9.00 - 9.45 9.00 - 9.45	SPT N=41 4,4/6,9,12,14	
				74.92 9.40					

REMARKS :

1. Engineer verified logged in general accordance to BS 5930:2010.
2. Area CAT scanned prior to excavation.
3. Borehole remained dry on completion.
4. Installed with HDPE standpipe to 13.50m bgl.

CHISELLING			WATER LEVEL OBSERVATIONS				
Depth From	Depth To	Time Taken	Date	Time	Water Strike	Standing Level	Casing Depth
NO CHISELLING UNDERTAKEN:			NO WATER ENCOUNTERED:				
BOREHOLE DIAMETER			CASING DIAMETER		DEPTH SEALED		
150mm to 13.40m			150mm to 12.60m				

All measurements in metres unless otherwise stated

10m/page Scale: 1:62.50

Coordinates to National Grid
Ground Level to Ordnance Datum

Page 1 of 2

Plant Used:
Dando 2000

Coordinates / Level (mAOD):
E: 524065.76 N: 213041.5
Level: 84.32

Logged By:
WC

Checked By:
WC

Approved By:
SS

Project: **Broadwater Road, Welwyn Garden City**

Project No: **2342.18**

Hole ID: **BH416**

CABLE PERCUSSION BOREHOLE LOG

Date From / To:
21/10/2014 - 22/10/2014

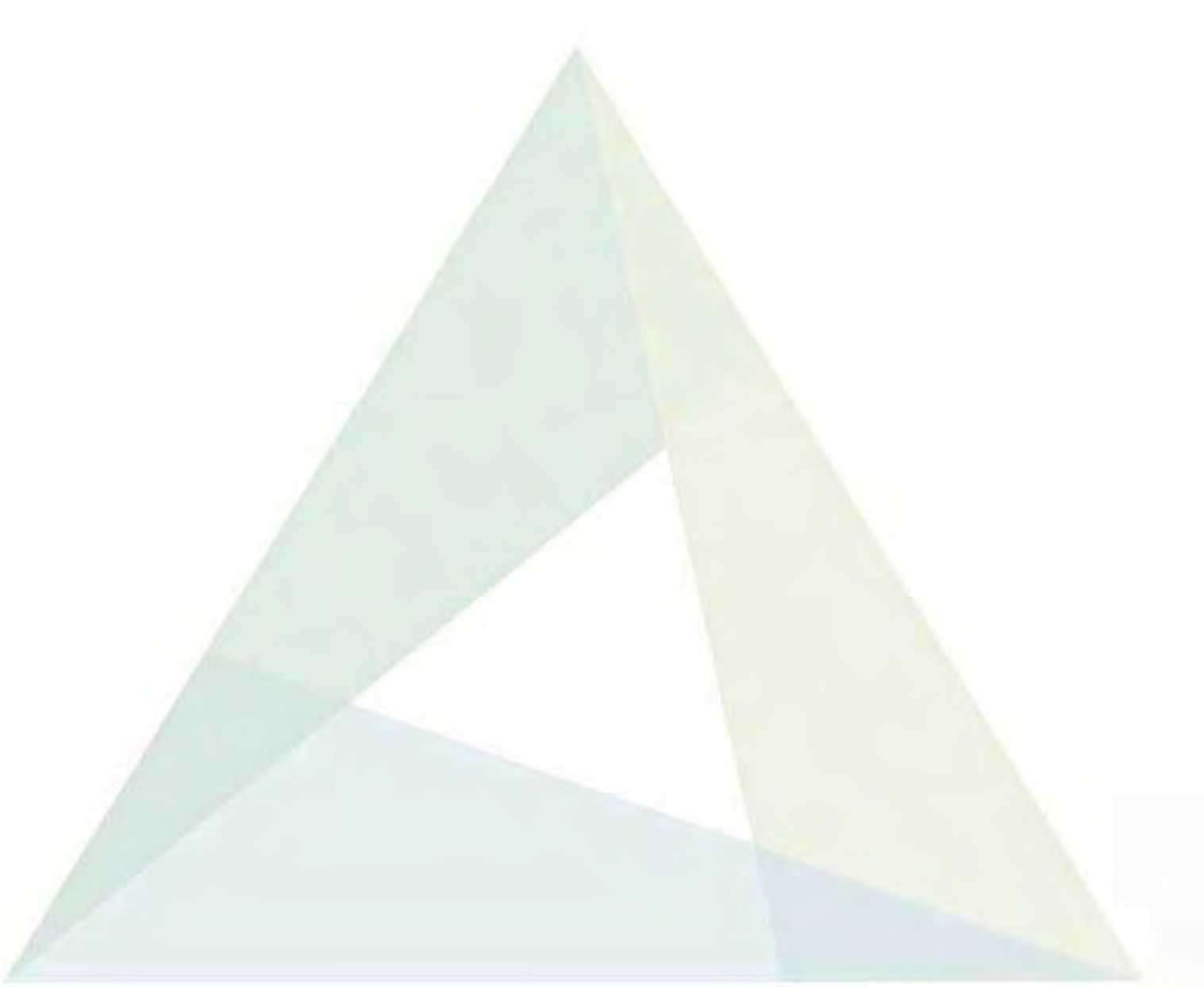
Client:
Spenn Hill Developments Ltd

DESCRIPTION OF STRATA	LEGEND	WATER	CASING DEPTH / (Diam. mm)	REDUCED LEVEL/ DEPTH (Thickness)	Sample Details			Test Results	Backfill Details
					TYPE	REF	Depth	SPT N Value/Drive mm	
Medium dense orangey brown sandy angular to subrounded fine to coarse flint GRAVEL. Sand is fine to coarse. Rare flint cobbles.(KESGRAVE CATCHMENT SUBGROUP)(BH Continued)				(3.20)	B	4	10.50 - 10.95 10.50 - 10.95	CPT N=28 3,4/4,6,8,10	
No recovery pushing flint cobble.			12.60	71.72 12.60	D	8	12.00 - 12.45 12.00 - 12.45	CPT N=22 4,5/4,6,6,6	
				(0.80)					
				70.92 13.40					
Borehole terminated due to difficult conditions at 13.40m bgl.									

REMARKS :

1. Engineer verified logged in general accordance to BS 5930:2010.
2. Area CAT scanned prior to excavation.
3. Borehole remained dry on completion.
4. Installed with HDPE standpipe to 13.50m bgl.

CHISELLING			WATER LEVEL OBSERVATIONS					
Depth From	Depth To	Time Taken	Date	Time	Water Strike	Standing Level	Casing Depth	
NO CHISELLING UNDERTAKEN:					NO WATER ENCOUNTERED:			
BOREHOLE DIAMETER			CASING DIAMETER			DEPTH SEALED		
150mm to 13.40m			150mm to 12.60m					



SPT Calibration Report

Hammer Energy Measurement Report

Type of Hammer SPT HAMMER
 Client SI DRILLING
 Test No EQU938
 Test Depth (m) 6.95
 Date of Test 23 December 2013
 Valid until 23 December 2014
 Hammer ID EQU438

Mass of the hammer $m = 63.5\text{kg}$
 Falling height $h = 0.76\text{m}$
 $E_{\text{theor}} = m \times g \times h = 473\text{J}$
 Characteristics of the instrumented rod
 Diameter $d_r = 0.052\text{ m}$
 Length of the instrumented rod 0.558 m
 Area $A = 11.61\text{ cm}^2$
 Modulus $E_s = 206843\text{ MPa}$

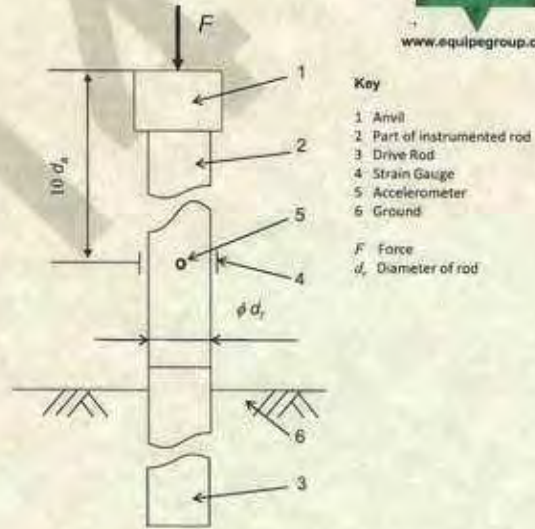
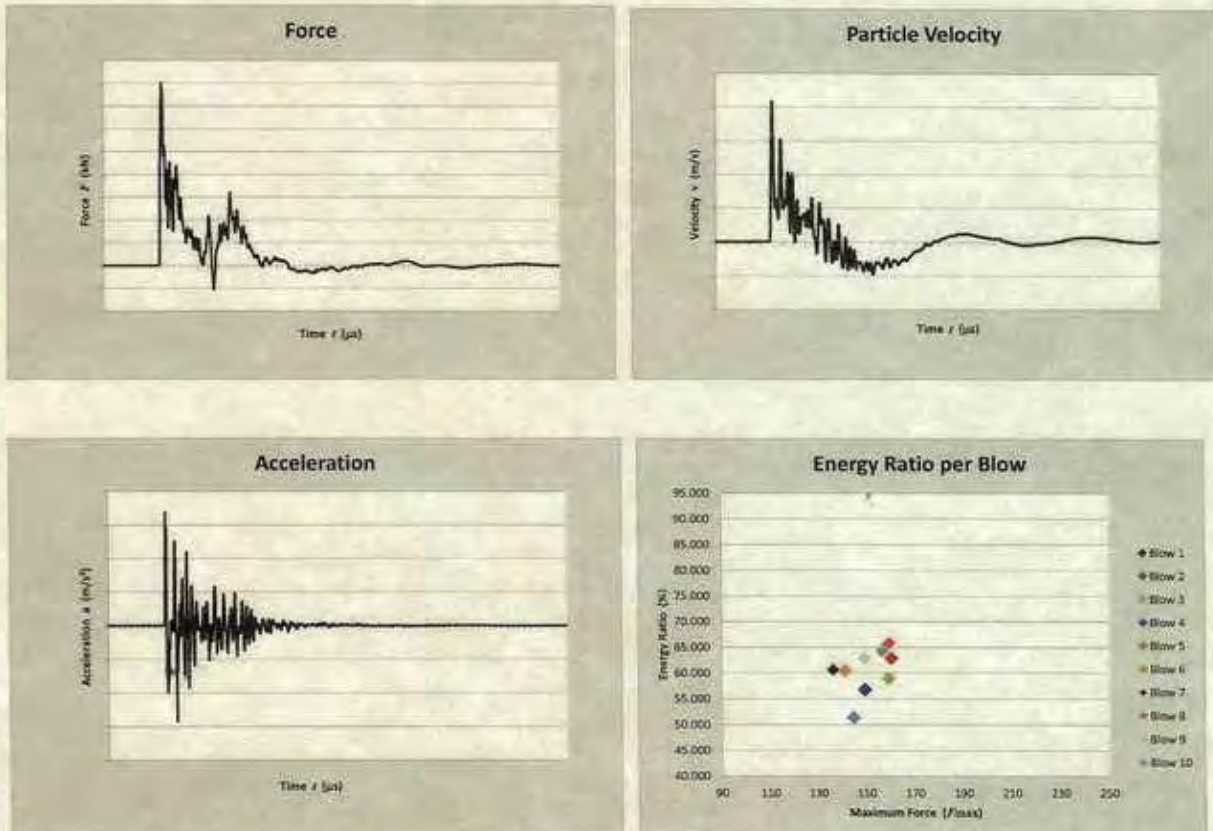


Fig. B.1 and B.2 BS EN ISO 22476-3 : 2005 + A1 : 2011



Observations:
 1.

$E_{\text{meas}} = 0.281\text{ kN-m}$
 $E_{\text{theor}} = 0.473\text{ kN-m}$

$$\text{Energy Ratio} = \frac{E_{\text{meas}}}{(E_s)} = \frac{E_{\text{meas}}}{E_{\text{theor}}} = 59.30\%$$

Equipe SPT Analyzer Operators:

KS

Prepared by:

Checked by:

Date

09/01/2014

SPT Calibration Report

Hammer Energy Measurement Report

Type of Hammer SPT HAMMER
 Client SI DRILLING
 Test No EQU936_1
 Test Depth (m) 6.80
 Date of Test 23 December 2013
 Valid until 23 December 2014
 Hammer ID EQU756

Mass of the hammer $m = 63.5\text{kg}$
 Falling height $h = 0.76\text{m}$
 $E_{\text{theor}} = m \times g \times h = 473\text{J}$

Characteristics of the instrumented rod

Diameter $d_r = 0.052\text{ m}$
 Length of the instrumented rod 0.558 m
 Area $A = 11.61\text{ cm}^2$
 Modulus $E_s = 206843\text{ MPa}$

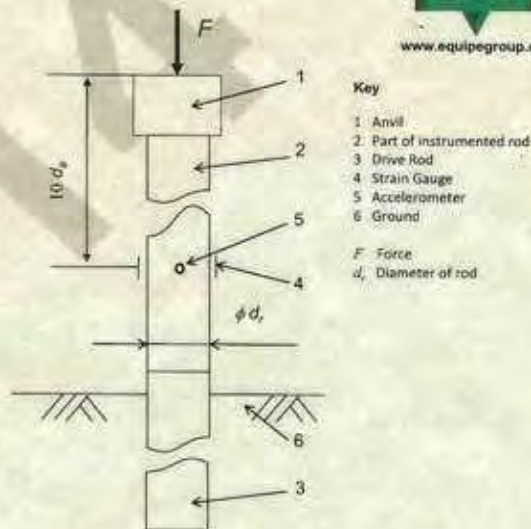
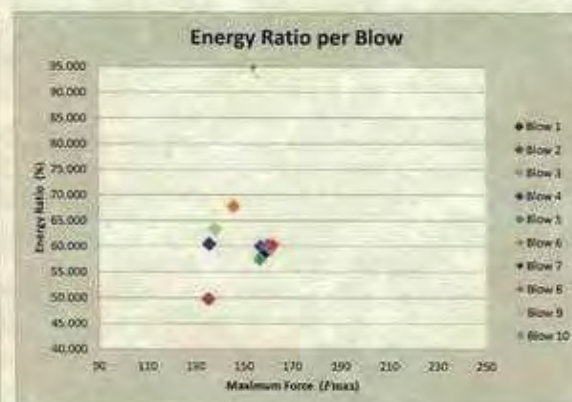
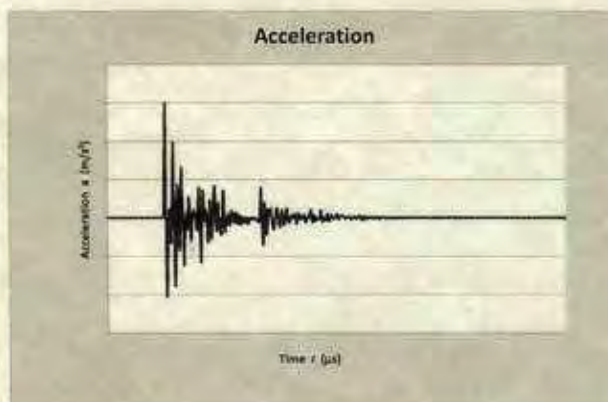
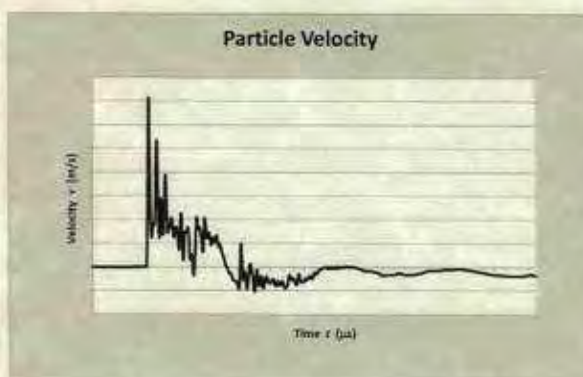


Fig. B.1 and B.2 BS EN ISO 22476-3: 2005 + A1: 2011



Observations:
 1.

$E_{\text{meas}} = 0.281\text{ kN-m}$
 $E_{\text{theor}} = 0.473\text{ kN-m}$

Energy Ratio = $\frac{E_{\text{meas}}}{E_{\text{theor}}} = 59.45\%$

Equipe SPT Analyzer Operators:

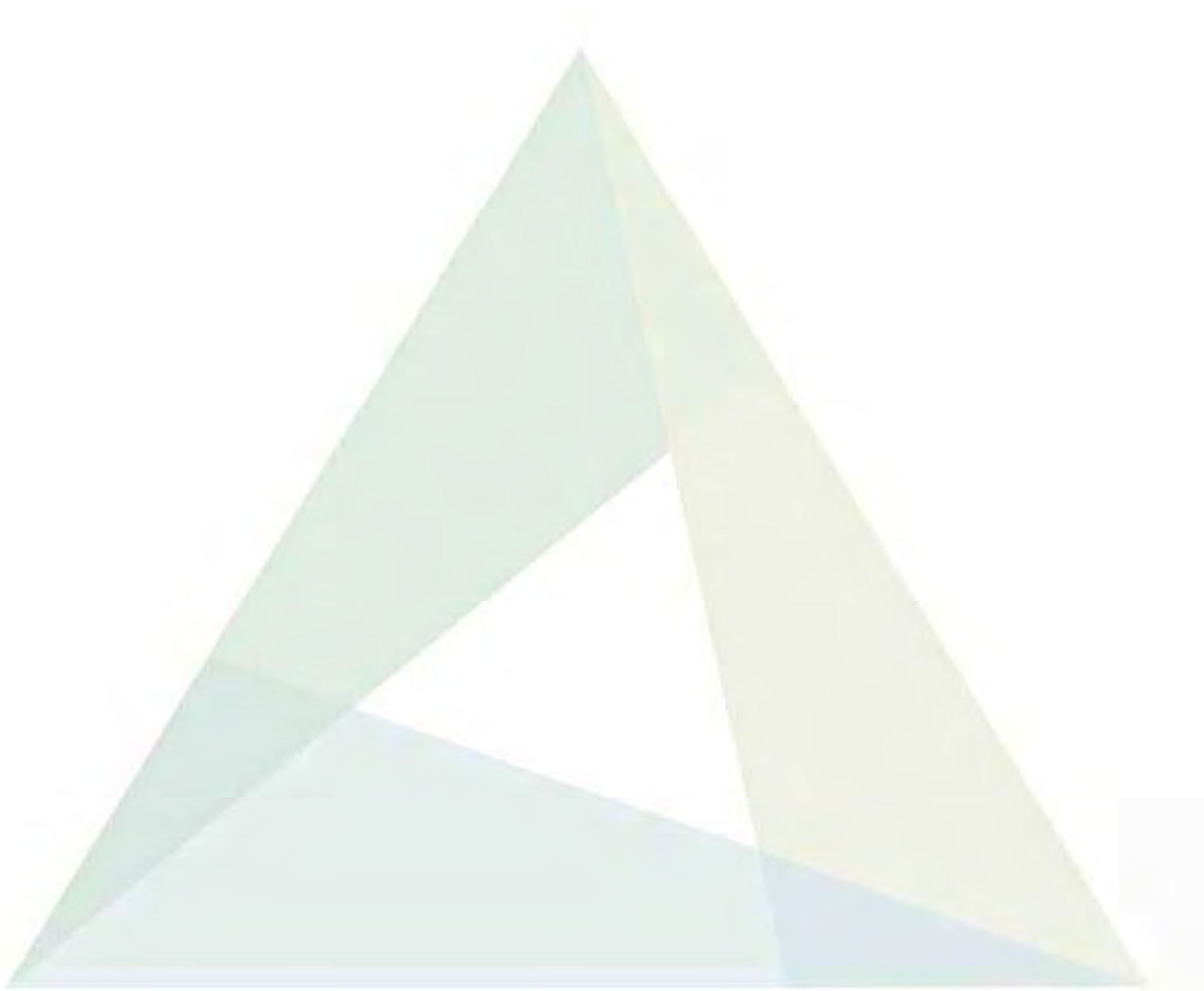
KS

Prepared by:

Checked by:

Date

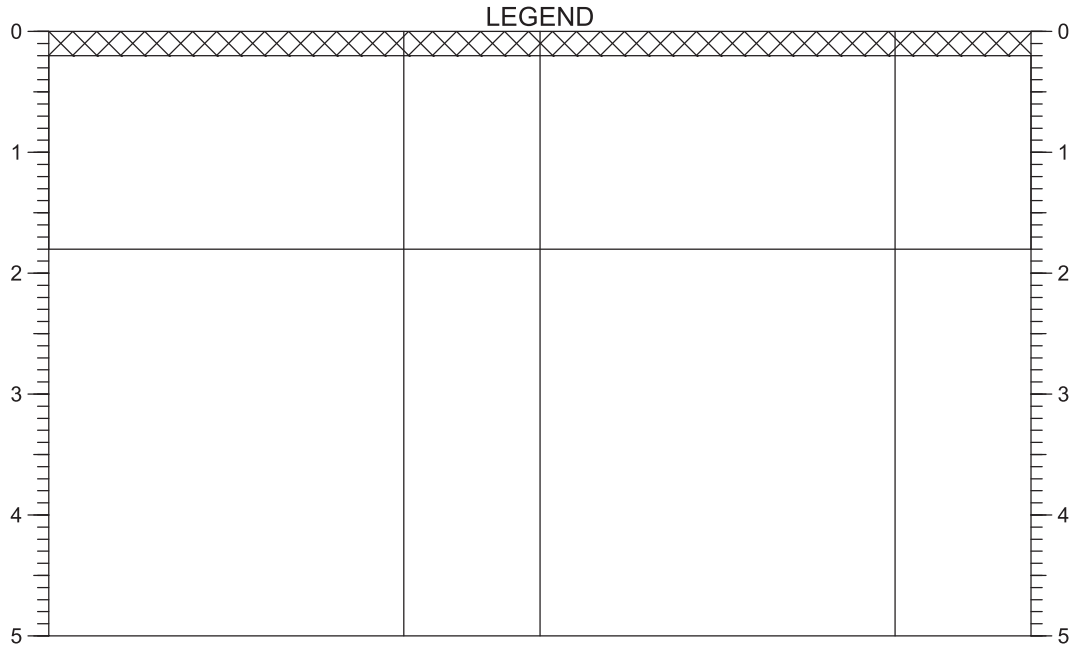
09/01/2014



Delta-Simons
3 Henley Office Park, Doddington Road,
Lincoln, LN6 3QR
Tel: +44 (0) 870 0400 012
Fax: +44 (0) 1522 698393
Email: info@deltasimons.com

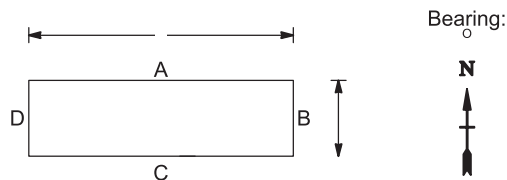


Project:	Broadwater Road, Welwyn Garden City	Project No:	2342.18	Hole ID:	TP401
TRIAL PIT LOG		Date:	09/10/2014	Client:	Spenn Hill Developments Ltd



STRATA			SAMPLES		TESTS	
Depth	No	DESCRIPTION	Depth	No	Depth	Results
84.26	0.20	MADE GROUND: Reinforced concrete.				
		VOID. Service corridor.				
(1.60)						
82.66	1.80	Trial pit terminated at 1.80m due to difficult excavation through gravels.				

Shoring/Support:
Stability:



REMARKS :

1. Engineer verified logged in general accordance to BS 5930:2010.
2. Area CAT scanned prior to excavation.
3. Trial pit remained dry on completion.
4. Backfilled with arisings.

All measurements in metres
unless otherwise stated

5m/page Scale: 1:62.5

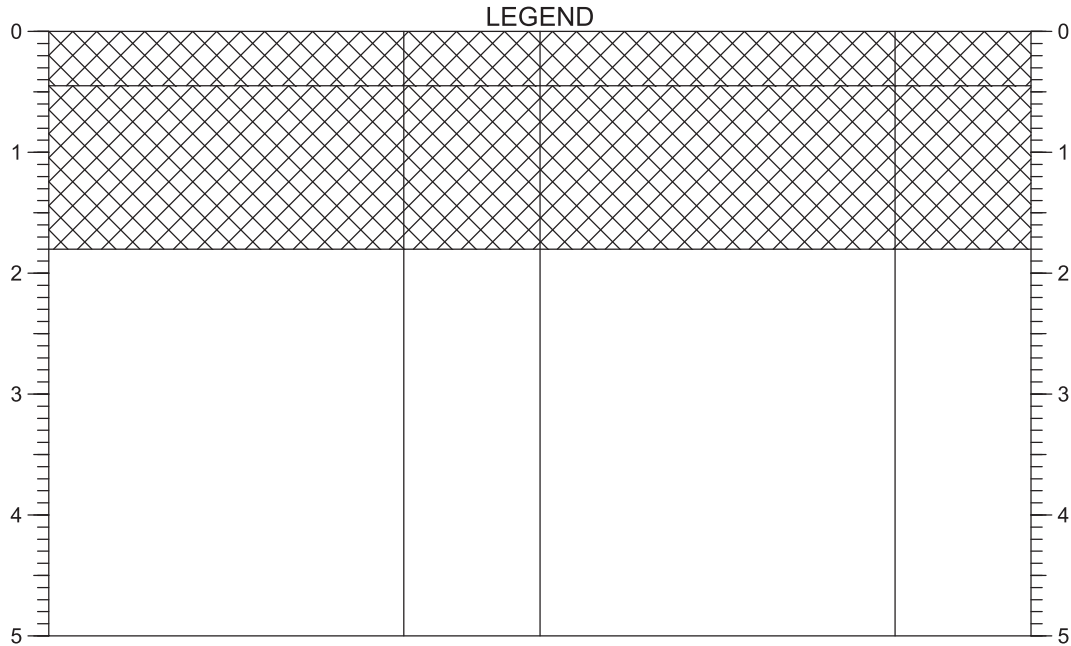
Coordinates to National Grid
Ground Level to Ordnance Datum

Plant Used:	JCB 3CX	Coordinates / Level (mAOD):	E: 524102.75 N: 212642.01 Level: 84.46	Logged By:	WC	Checked By:	WC	Approved By:	SS
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Delta-Simons
3 Henley Office Park, Doddington Road,
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Fax: +44 (0) 1522 698393
Email: info@deltasimons.com

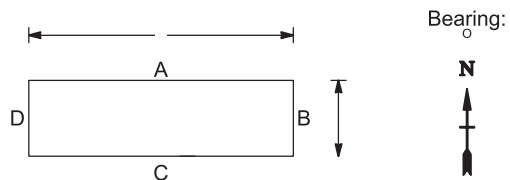


Project:	Broadwater Road, Welwyn Garden City	Project No:	2342.18	Hole ID:	TP401a
TRIAL PIT LOG		Date:	21/10/2014	Client:	Spenn Hill Developments Ltd



STRATA			SAMPLES		TESTS	
Depth	No	DESCRIPTION	Depth	No	Depth	Results
84.44	0.45	MADE GROUND: Reinforced concrete.				
(1.35)		MADE GROUND: Orange brown sandy gravelly clay. Gravel is subangular to subrounded fine to coarse flint and rare brick. Sand is fine to coarse. Rare brick cobbles.				
83.09	1.80	Trial pit terminated at 1.80m bgl due to difficult excavation through gravels.				

Shoring/Support:
Stability:



REMARKS :

1. Engineer verified logged in general accordance to BS 5930:2010.
2. Area CAT scanned prior to excavation.
3. Trial pit remained dry on completion.
4. Backfilled with arisings.

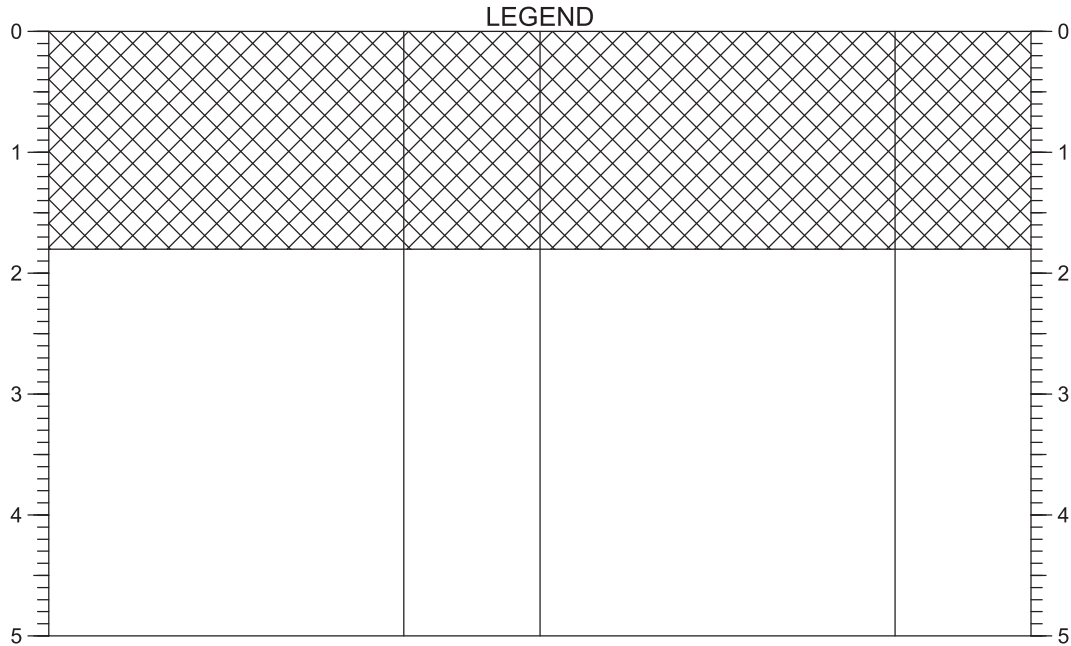
All measurements in metres
unless otherwise stated

5m/page Scale: 1:62.5

Coordinates to National Grid
Ground Level to Ordnance Datum

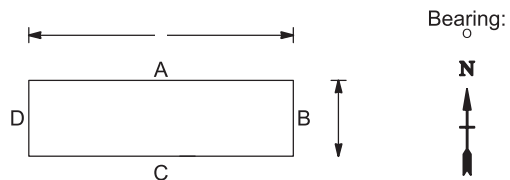
Plant Used:	JCB 3CX	Coordinates / Level (mAOD):	E: 524110.81 N: 212639.54 Level: 84.89	Logged By:	WC	Checked By:	WC	Approved By:	SS
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Project:	Broadwater Road, Welwyn Garden City	Project No:	2342.18	Hole ID:	TP402
TRIAL PIT LOG		Date:	21/10/2014	Client:	Spenn Hill Developments Ltd



STRATA			SAMPLES		TESTS	
Depth	No	DESCRIPTION	Depth	No	Depth	Results
(1.80)		MADE GROUND: Brownish grey sandy gravel. Gravel is angular to subrounded fine to coarse brick, concrete and flint. Sand is fine to coarse. Abundant brick and concrete cobbles.				
82.66	1.80	Trial pit terminated at 1.80m bgl due to difficult excavation through gravels.				

Shoring/Support:
Stability:



REMARKS :

1. Engineer verified logged in general accordance to BS 5930:2010.
2. Area CAT scanned prior to excavation.
3. Trial pit remained dry on completion.
4. Backfilled with arisings.

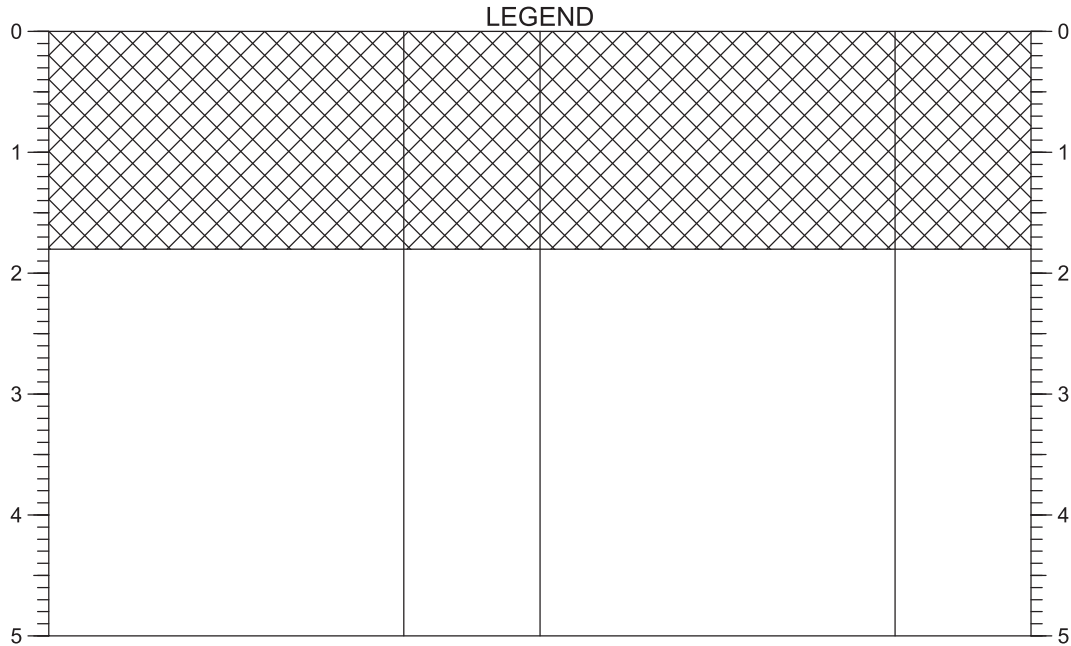
All measurements in metres
unless otherwise stated

5m/page Scale: 1:62.5

Coordinates to National Grid
Ground Level to Ordnance Datum

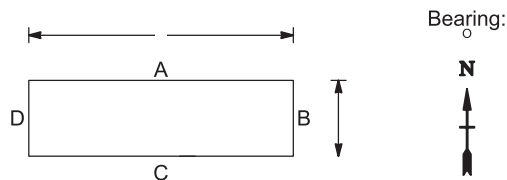
Plant Used:	JCB 3CX	Coordinates / Level (mAOD):	E: 524197.53 N: 212743.84 Level: 84.46	Logged By:	WC	Checked By:	WC	Approved By:	SS
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Project:	Broadwater Road, Welwyn Garden City	Project No:	2342.18	Hole ID:	TP403
TRIAL PIT LOG		Date:	21/10/2014	Client:	Spenn Hill Developments Ltd



STRATA			SAMPLES		TESTS	
Depth	No	DESCRIPTION	Depth	No	Depth	Results
(1.80)		MADE GROUND: Brownish grey sandy gravel. Gravel is angular to subrounded fine to coarse brick, concrete and flint. Sand is fine to coarse. Abundant brick and concrete cobbles. Suspected basement access.				
83.25	1.80	Trial pit terminated at 1.80m bgl due to difficult excavation through gravels.				

Shoring/Support:
Stability:



REMARKS :

1. Engineer verified logged in general accordance to BS 5930:2010.
2. Area CAT scanned prior to excavation.
3. Trial pit remained dry on completion.
4. Backfilled with arisings.

All measurements in metres
unless otherwise stated

5m/page Scale: 1:62.5

Coordinates to National Grid
Ground Level to Ordnance Datum

Plant Used:	JCB 3CX	Coordinates / Level (mAOD):	E: 524096.26 N: 212681.44 Level: 85.05	Logged By:	WC	Checked By:	WC	Approved By:	SS
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Project: **Broadwater Road, Welwyn Garden City**

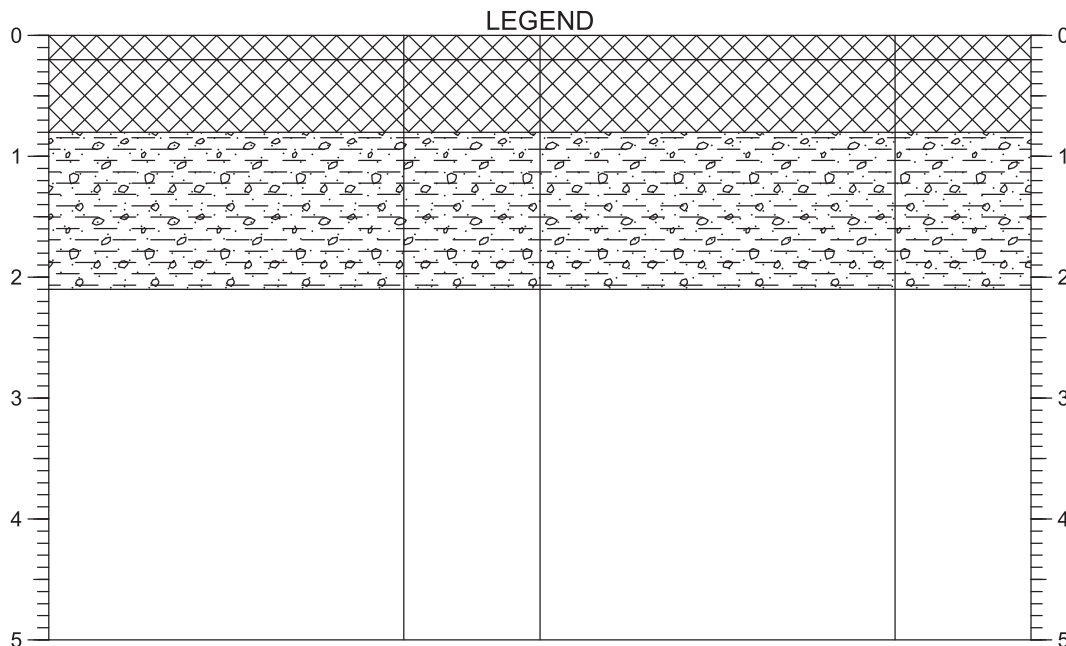
Project No: **2342.18**

Hole ID: **TP405**

TRIAL PIT LOG

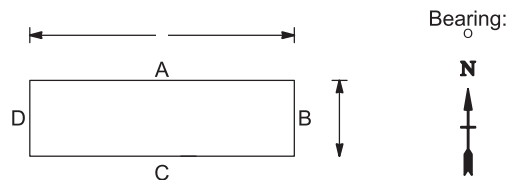
Date: **21/10/2014**

Client: **Spenn Hill Developments Ltd**



STRATA			SAMPLES		TESTS	
Depth	No	DESCRIPTION	Depth	No	Depth	Results
83.68	0.20	MADE GROUND: Dark brown slightly sandy gravelly clay. Gravel is angular to rounded fine to coarse of mixed lithologies including flint, brick and concrete. Abundant roolets within top 200mm	0.50	B1		
(0.60)						
83.08	0.80					
(1.30)		MADE GROUND: Brown slightly sandy gravelly clay. Gravel is angular to rounded fine to coarse of mixed lithologies including flint, brick and concrete. Rare fragments of pottery.	1.00	B2		
		Orange brown sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse flint. Sand is fine to coarse. (LOWESTOFT FORMATION).	1.50	B3		
81.78	2.10	Trial pit terminated at 2.10m bgl due to difficult escavation through gravels.				

Shoring/Support:
Stability:



REMARKS :

1. Engineer verified logged in general accordance to BS 5930:2010.
2. Area CAT scanned prior to excavation.
3. Trial pit remained dry on completion.
4. Backfilled with arisings.

All measurements in metres
unless otherwise stated

5m/page Scale: 1:62.5

Coordinates to National Grid
Ground Level to Ordnance Datum

Plant Used: **JCB 3CX**

Coordinates / Level (mAOD):
E: 524110.92 N: 213053.28
Level: 83.88

Logged By: **WC**

Checked By: **WC**

Approved By: **SS**

Project: **Broadwater Road, Welwyn Garden City**

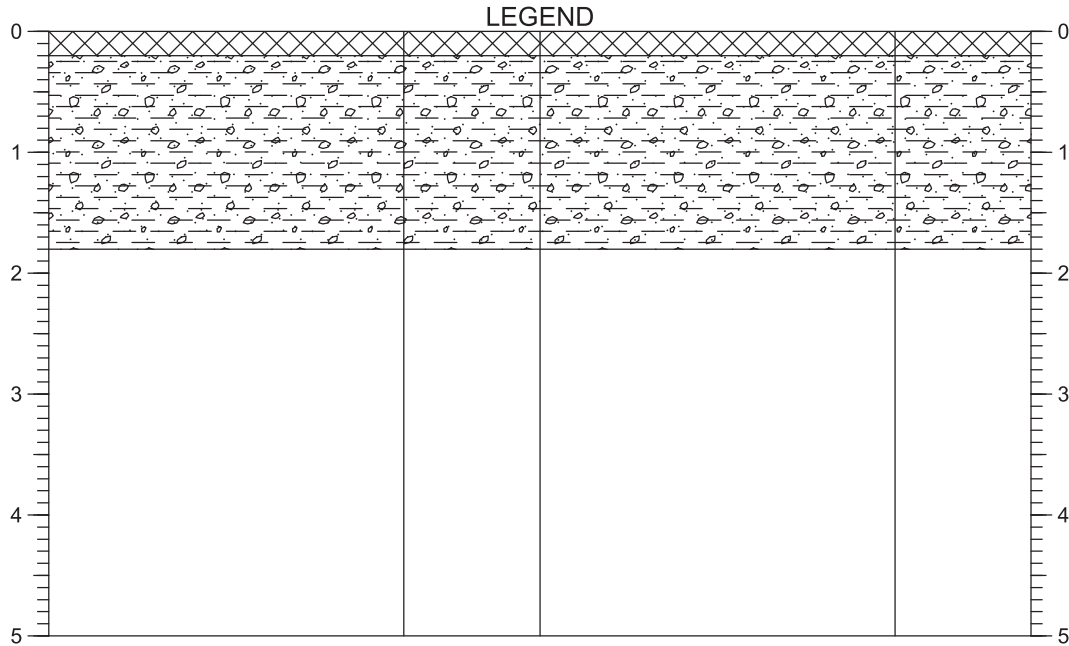
Project No: **2342.18**

Hole ID: **TP406**

TRIAL PIT LOG

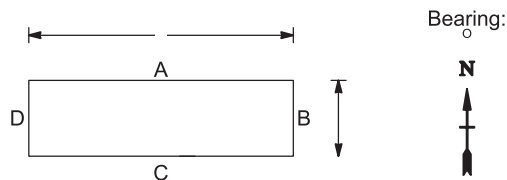
Date: **21/10/2014**

Client: **Spenn Hill Developments Ltd**



STRATA			SAMPLES		TESTS	
Depth	No	DESCRIPTION	Depth	No	Depth	Results
83.41	0.20	MADE GROUND: Dark brown slightly sandy gravelly clay. Gravel is angular to rounded fine to coarse of mixed lithologies including flint, brick and concrete. Abundant roolets within top 200mm Orange brown sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse flint. Sand is fine to coarse. (LOWESTOFT FORMATION).	0.50	B1		
(1.60)			1.00	B2		
			1.50	B3		
81.81	1.80					
		Trial pit terminated at 1.80m bgl due to difficult excavation through gravels.				

Shoring/Support:
Stability:



REMARKS :

1. Engineer verified logged in general accordance to BS 5930:2010.
2. Area CAT scanned prior to excavation.
3. Trial pit remained dry on completion.
4. Backfilled with arisings.

All measurements in metres
unless otherwise stated

5m/page Scale: 1:62.5

Coordinates to National Grid
Ground Level to Ordnance Datum

Plant Used: **JCB 3CX**

Coordinates / Level (mAOD):
E: 524077.54 N: 213067.26
Level: 83.61

Logged By: **WC**

Checked By: **WC**

Approved By: **SS**

Project: **Broadwater Road, Welwyn Garden City**

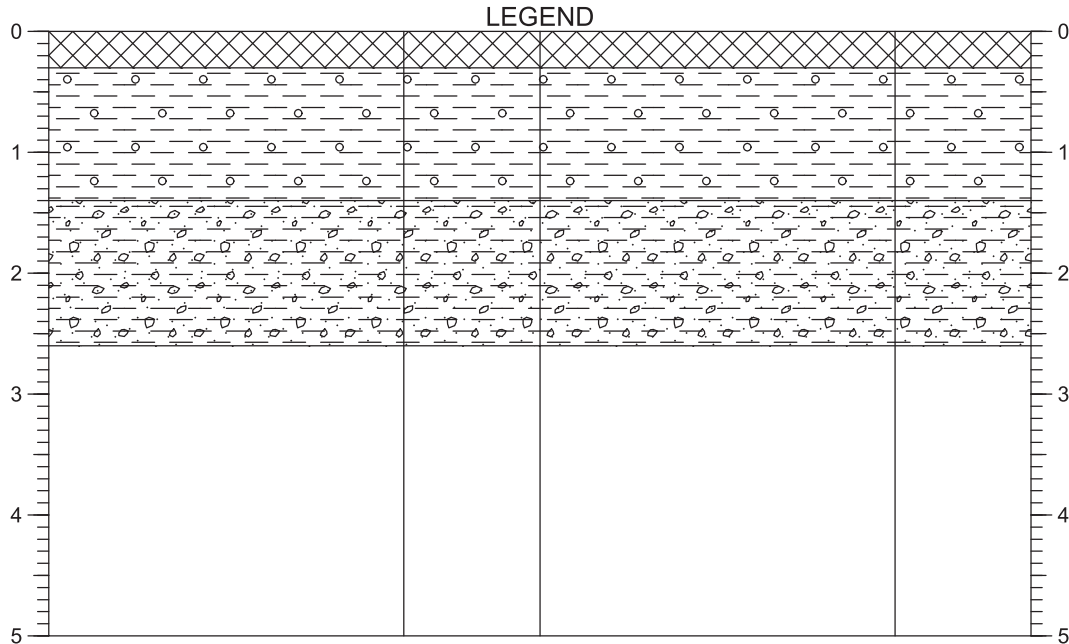
Project No: **2342.18**

Hole ID: **TP407**

TRIAL PIT LOG

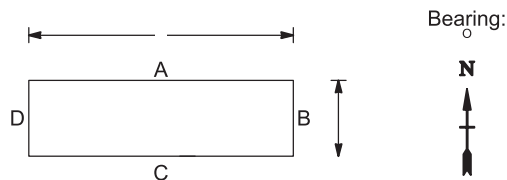
Date: **21/10/2014**

Client: **Spn Hill Developments Ltd**



STRATA			SAMPLES		TESTS	
Depth	No	DESCRIPTION	Depth	No	Depth	Results
84.1	0.30	MADE GROUND: Dark brown slightly sandy gravelly slightly organic clay. Gravel is angular to rounded fine to coarse of mixed lithologies including flint brick and concrete. Abundant rootlets within top 200mm. Brown slightly sandy gravelly CLAY. Gravel is angular to rounded fine to coarse flint.	0.50	B1		
(1.10)			1.00	B2		
83	1.40		1.50	B3		
(1.20)		Orange brown sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse flint. Sand is fine to coarse. (LOWESTOFT FORMATION).				
81.8	2.60	Trial pit terminated at 2.60m bgl due to difficult excavation through gravels.				

Shoring/Support:
Stability:



REMARKS :

1. Engineer verified logged in general accordance to BS 5930:2010.
2. Area CAT scanned prior to excavation.
3. Trial pit remained dry on completion.
4. Backfilled with arisings.

All measurements in metres
unless otherwise stated

5m/page Scale: 1:62.5

Coordinates to National Grid
Ground Level to Ordnance Datum

Plant Used: **JCB 3CX**

Coordinates / Level (mAOD):
E: 524052.62 N: 213018.48
Level: 84.4

Logged By: **WC**

Checked By: **WC**

Approved By: **SS**

Project: **Broadwater Road, Welwyn Garden City**

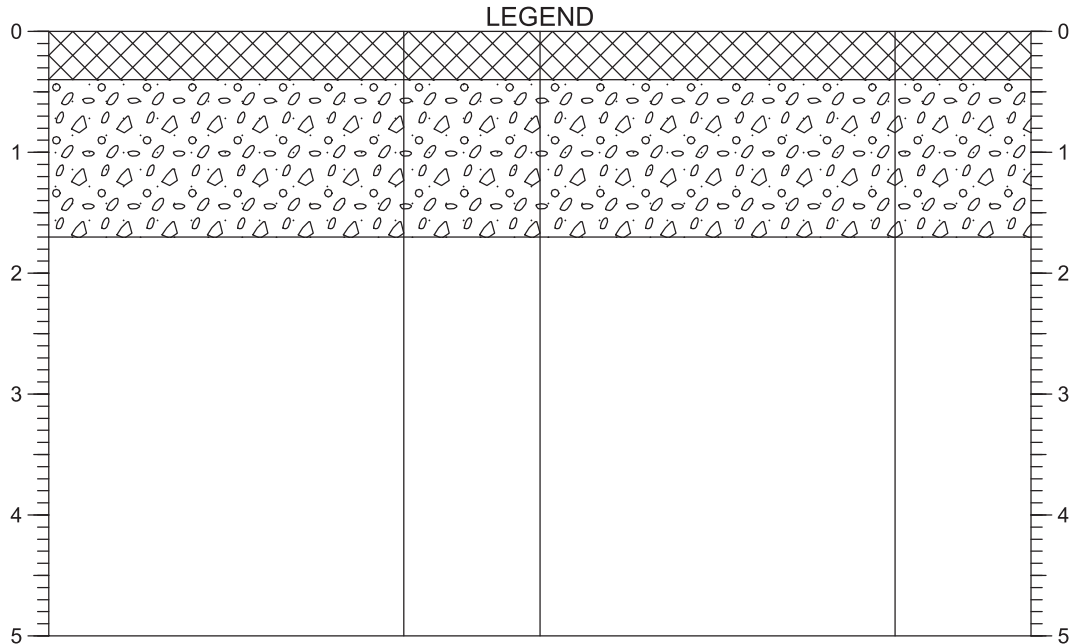
Project No: **2342.18**

Hole ID: **TP408**

TRIAL PIT LOG

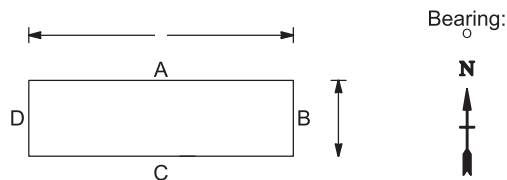
Date: **21/10/2014**

Client: **Spenn Hill Developments Ltd**



STRATA				SAMPLES		TESTS	
Depth	No	DESCRIPTION		Depth	No	Depth	Results
85.14	0.40	MADE GROUND: Dark brown slightly sandy slightly gravelly clay. Gravel is angular to rounded fine to coarse of mixed lithologies including flint, brick and concrete. Sand is fine to coarse. Abundant rootlets in the top 200mm Orange brown sandy angular to subrounded fine to coarse flint GRAVEL. Sand is fine to coarse.					
(1.30)							
83.84	1.70	Trial pit terminated at 1.70m bgl due to difficult excavation through gravels.					

Shoring/Support:
Stability:



REMARKS :

1. Engineer verified logged in general accordance to BS 5930:2010.
2. Area CAT scanned prior to excavation.
3. Trial pit remained dry on completion.
4. Backfilled with arisings.

All measurements in metres
unless otherwise stated

5m/page Scale: 1:62.5

Coordinates to National Grid
Ground Level to Ordnance Datum

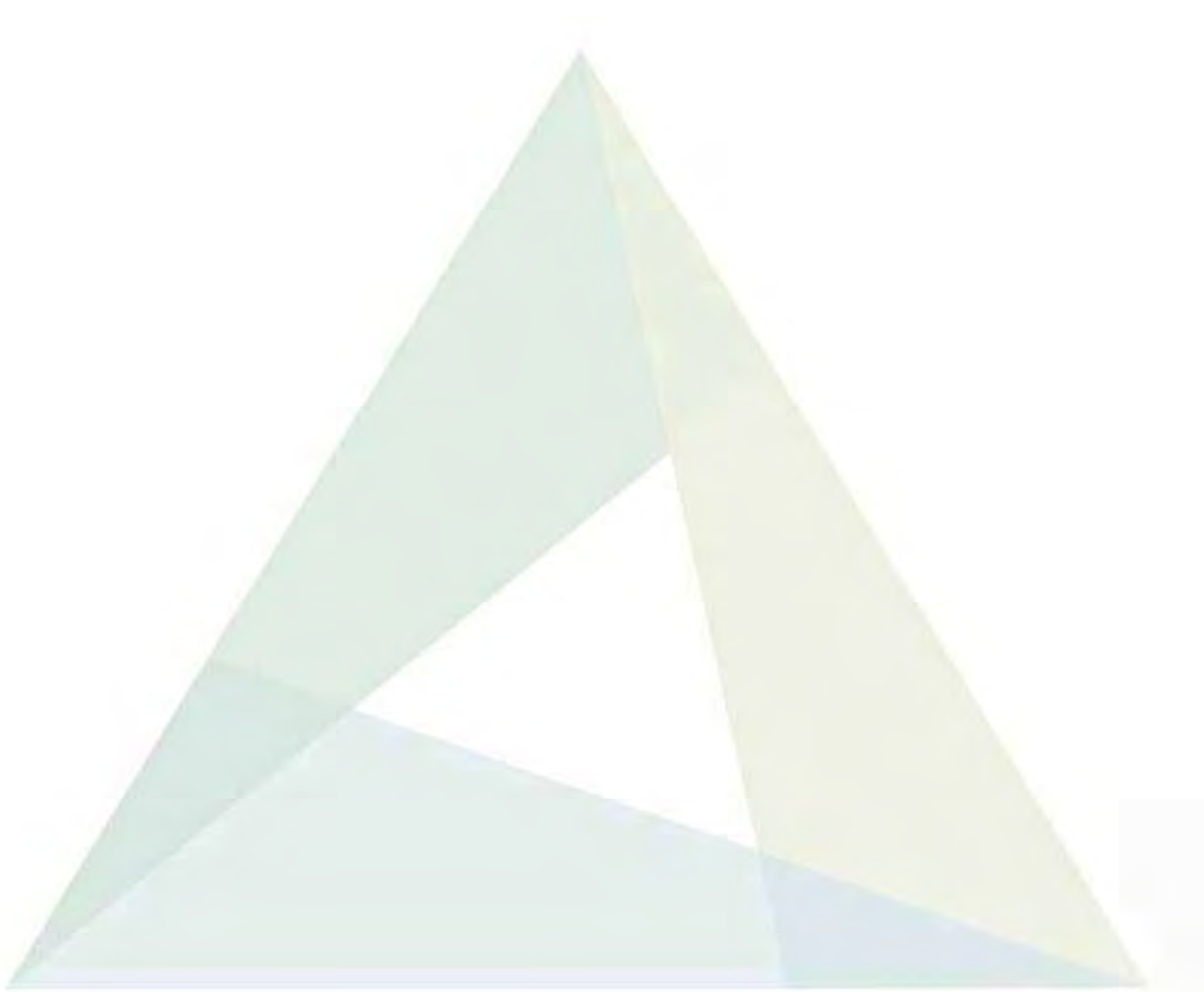
Plant Used: **JCB 3CX**

Coordinates / Level (mAOD):
E: 524085.61 N: 212864.61
Level: 85.54

Logged By: **WC**

Checked By: **WC**

Approved By: **SS**





GROUNDWATER AND GROUND GAS MONITORING RECORD SHEET

Sheet:

1 of 1

Date:

22/10/2014

Project Name:

Broadwater Rd, Welwyn Garden City

Project Number:

3242.18

Personnel:

DP+WC

Weather Conditions:

Sunny, Windy, 15.2 degrees celcius, windspeed 2.6m/s

Gas Kit Model:

GFM 436

Gas Kit Serial No:

LOCATION	Flow Peak (L/hr)	Flow Steady (L/hr)	CH ₄ Peak (%v/v)	CH ₄ Steady (%v/v)	CO ₂ Peak (%v/v)	CO ₂ Steady (%v/v)	O ₂ Min. (%v/v)	O ₂ Steady (%v/v)	Atmospheric Pressure (mb)	PID (ppm)	Well I.D. (mm)	Depth to Product (DTP) (m)	Product Thickness (m)	Depth to Water (DTW) (m)	Depth to Base (DTB) (m)	Height of Water Column (m)	NOTES
BH404																	
BH403																	
BH401																	
BH405																	
BH407																	
BH406																	
BH402																	
BH415																	
BH412																	
BH413																	
BH408																	
BH409																	
BH410																	
BH411																	
BH416																	

GUIDE TO PURGING VOLUMES

To calculate the number of litres to be purged from a well with a different diameter, use the formula $3\pi r^2 h$ (where r = radius of the well and h = height of the water column). Use the formula $\pi r^2 h$ to calculate the volume of a bailer. Please note that the standard bailers Delta-Simons use are typically 0.95 m in length.

Document No. C101

Version: 4.0

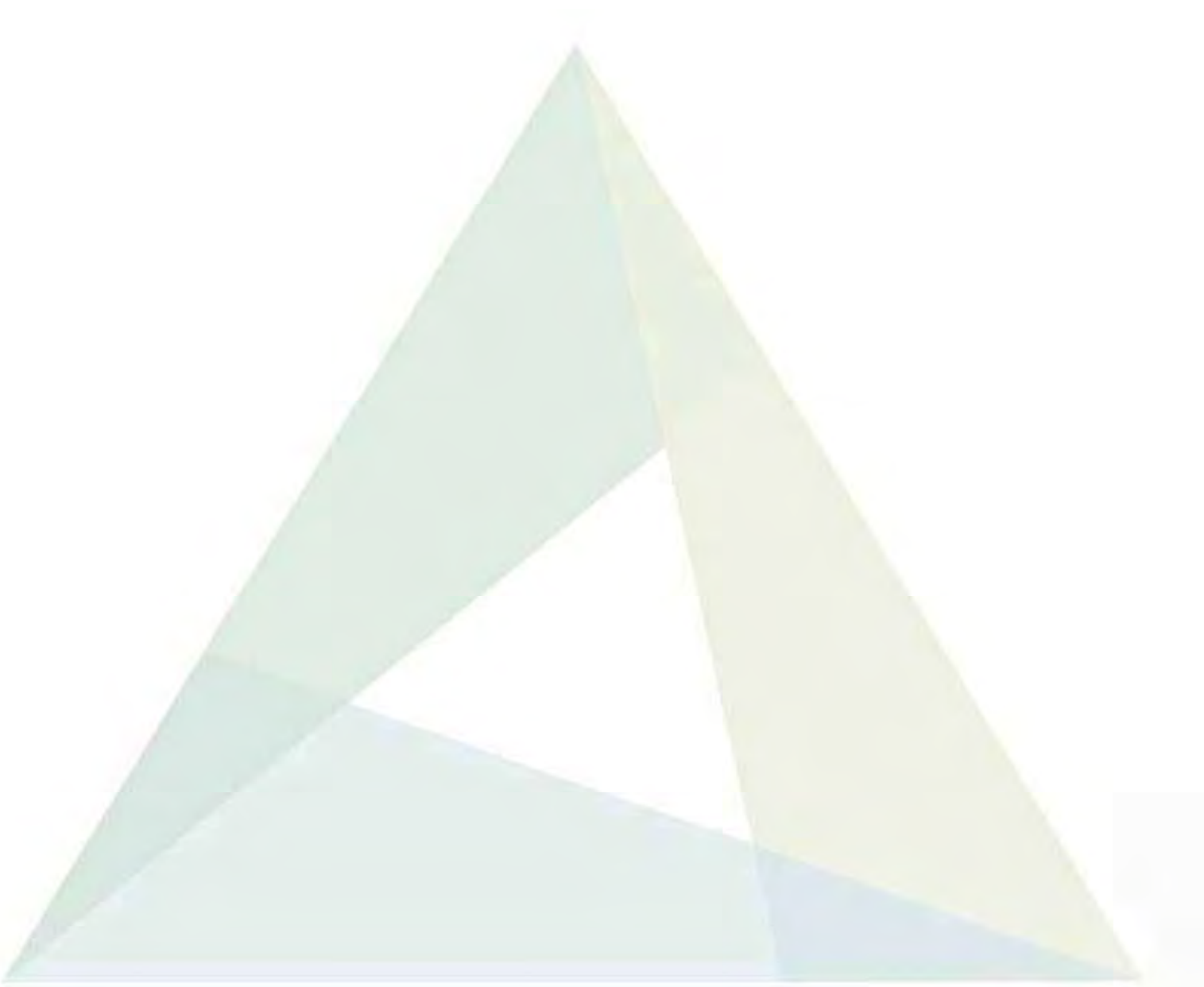
Issue Date: 13/01/12

Author: C Ramsbottom

Authorised By: R Griffiths

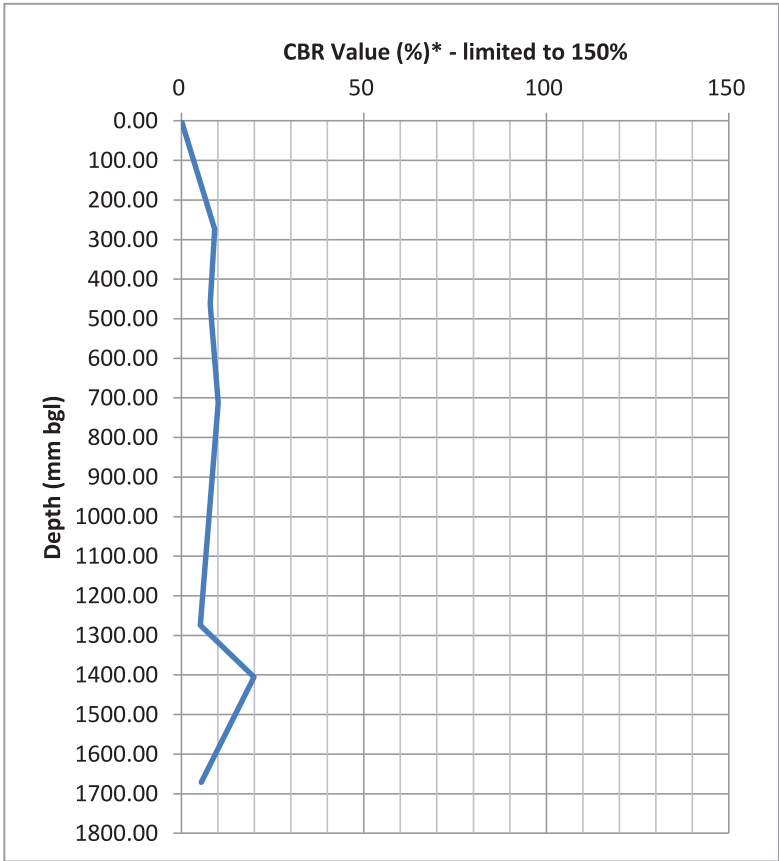
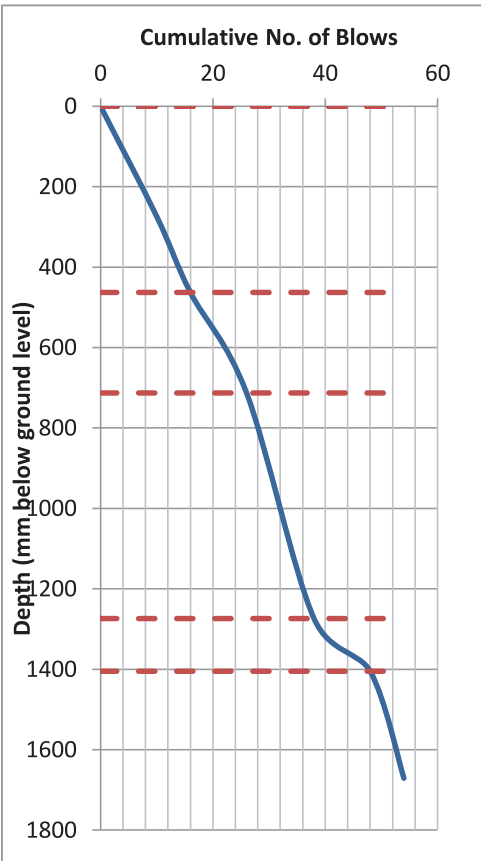
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GROUNDWATER AND GROUND GAS MONITORING RECORD SHEET																Sheet:				
																1	of	1		
Project Name: Broadwater Rd, Welwyn Garden City																Weather Conditions: Dull, Windy, 11.4 degrees celcius, windspeed 3.7m/s				
Project Number: 3242.18																Gas Kit Model: GFM 436				
Personnel: RM																Gas Kit Serial No:				
LOCATION		Flow Peak	Flow Steady	CH ₄ Peak	CH ₄ Steady	CO ₂ Peak	CO ₂ Steady	O ₂ Min.	O ₂ Steady	Atmospheric Pressure	PID	Well I.D.	Depth to Product (DTP)	Product Thickness	Depth to Water (DTW)	Depth to Base (DTB)	Height of Water Column	NOTES		
BH404		(L/hr) 0.1	(L/hr) 0.1	(%v/v) 0.0	(%v/v) 0.0	(%v/v) 0.1	(%v/v) 0.1	(%v/v) 20.3	(%v/v) 20.3	(mb) 1008	(ppm) -	(mm) 50	(m) -	(m) -	(m) DRY	(m) 19.41	(m) -			
BH403		0.0	0.0	0.0	0.0	0.2	0.1	20.2	20.2	1008	-	50	-	-	22.40	24.48	2.08			
BH401		0.0	0.0	0.0	0.0	0.5	0.4	20.3	20.3	1008	-	50	-	-	DRY	20.00				
BH405		0.0	0.0	0.0	0.0	0.0	0.0	20.6	20.6	1008		50			DRY	19.94				
BH407												50			0.40	20.00	19.60	Sucked water from hole		
BH406		0.0	0.0	0.1	0.1	4.3	4.3	6.5	6.5	1008		50			21.58	25.07	3.49			
BH402		0.0	0.0	0.1	0.1	0.0	0.0	20.2	20.2	1008		50			21.43	23.82	2.39			
BH415		0.0	0.0	0.0	0.0	0.0	0.0	20.1	20.1	1008		50			22.32	24.34	2.02			
BH412		0.0	0.0	0.0	0.0	0.2	0.2	20.0	20.0	1008		50			DRY	19.29				
BH413		0.0	0.0	0.0	0.0	0.1	0.1	20.2	20.2	1008		50			DRY	19.38				
BH408		0.0	0.0	0.0	0.0	0.5	0.5	19.3	19.3	1008		50			DRY	19.67				
BH409		0.0	0.0	0.0	0.0	0.2	0.2	20.1	20.1	1008		50			DRY	14.73				
BH410		0.0	0.0	0.0	0.0	0.2	0.2	20.1	20.1	1008		50			22.62	24.08	1.46			
BH411		0.0	0.0	0.1	0.1	0.1	0.1	20.1	20.1	1008		50			DAMP	19.62				
BH416		0.0	0.0	0.0	0.0	0.4	0.4	19.9	19.9	1008		50			DAMP	13.12				
GUIDE TO PURGING VOLUMES																				
To calculate the number of litres to be purged from a well with a different diameter, use the formula $3\pi r^2 h$ (where r = radius of the well and h = height of the water column). Use the formula $\pi r^2 h$ to calculate the volume of a bailer. Please note that the standard bailers Delta-Simons use are typically 0.95 m in length.																				
Document No. C101												Version: 4.0		Issue Date: 13/01/12		Author: C Ramsbottom		Authorised By: R Griffiths		
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TRL Dynamic Cone Penetrometer - Determination of CBR Value (%)*

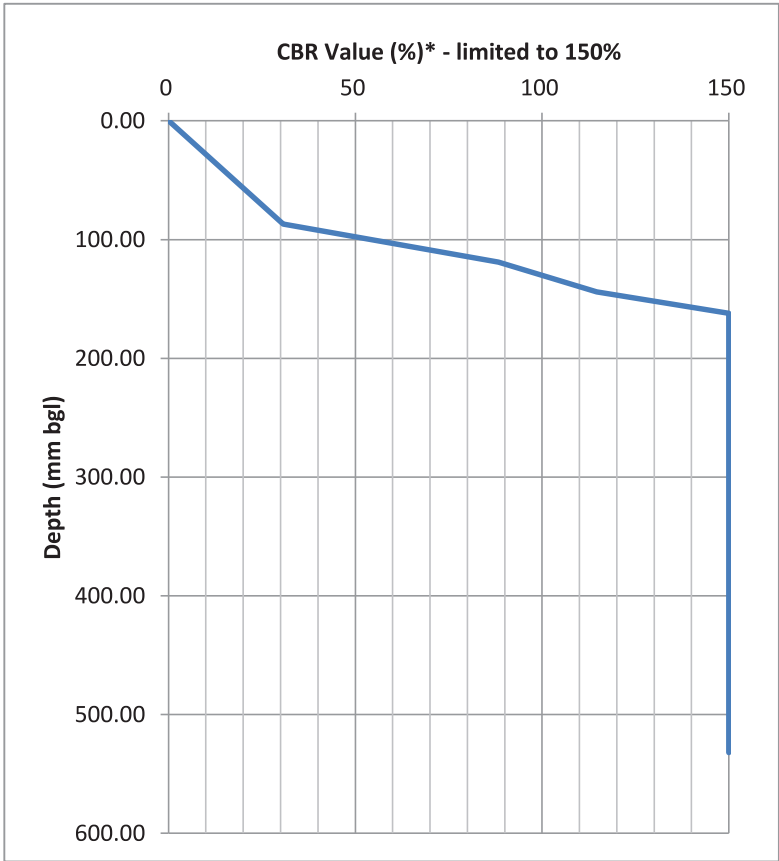
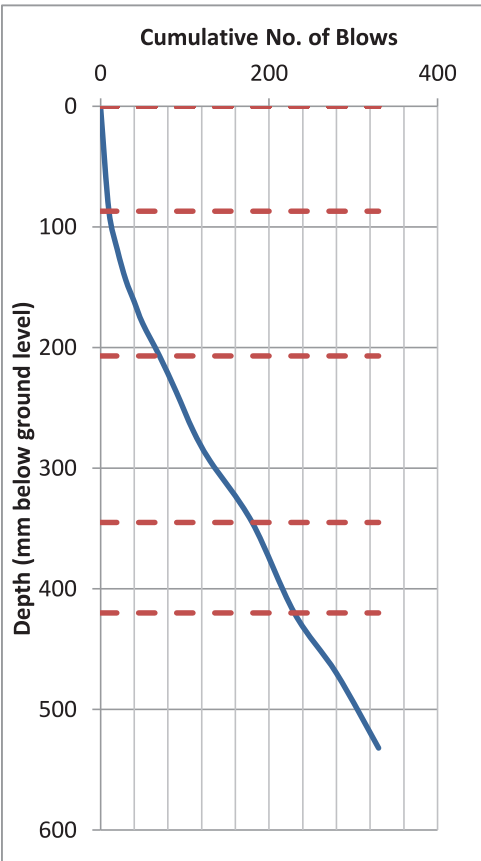
Site Name	Broadwater Rd, WGC	Starting Depth (mm bgl)	0.00
Job Number	2342-18	Surface Level (m AOD)	84.89
Test No.	DCP-TP401A	Easting	524110.814
Date of Test	21-Oct-14	Northing	212639.541

[illegible]

* CBR Interpretation in accordance with DMRB, Vol 7, Sec. 3 Chap.7 Clause 7.31 equation: $CBR = 10((2.48 - 1.057 \times \text{Log } 10(\text{mm/blow})))$

TRL Dynamic Cone Penetrometer - Determination of CBR Value (%)*

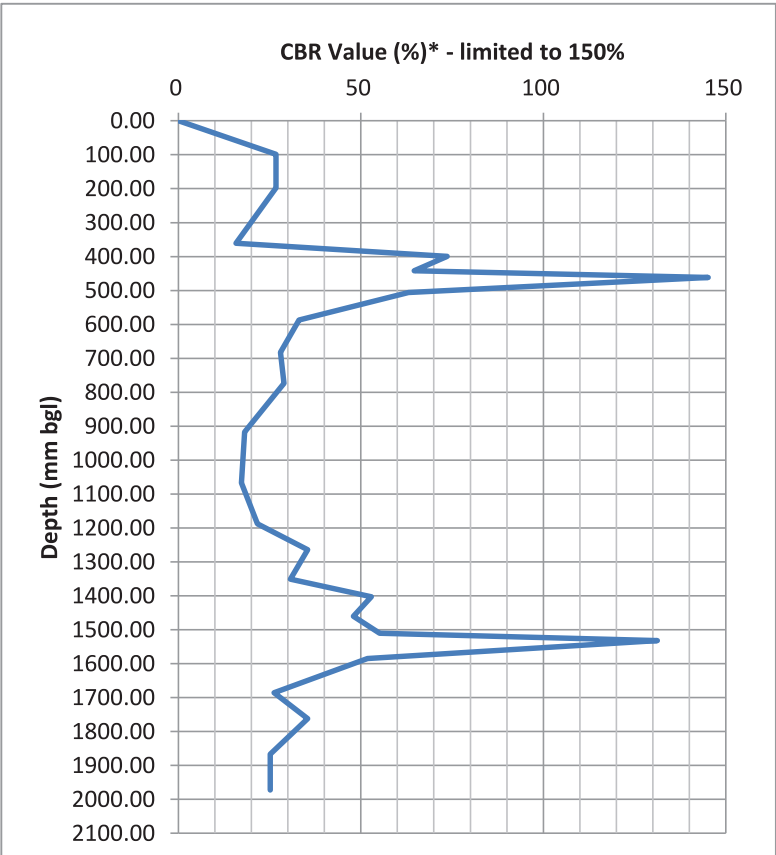
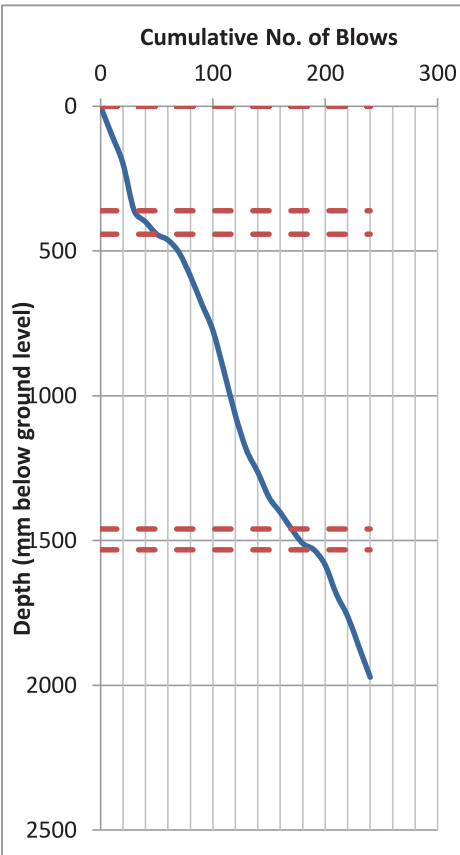
Site Name	Broadwater Rd, WGC	Starting Depth (mm bgl)	0.00
Job Number	2342-18	Surface Level (m AOD)	84.462
Test No.	DCP-TP402	Easting	524197.529
Date of Test	09-Sep-14	Northing	212743.842

[illegible]

* CBR Interpretation in accordance with DMRB, Vol 7, Sec. 3 Chap.7 Clause 7.31 equation: $CBR = 10((2.48 - 1.057 \times \text{Log } 10(\text{mm/blow})))$

TRL Dynamic Cone Penetrometer - Determination of CBR Value (%)*

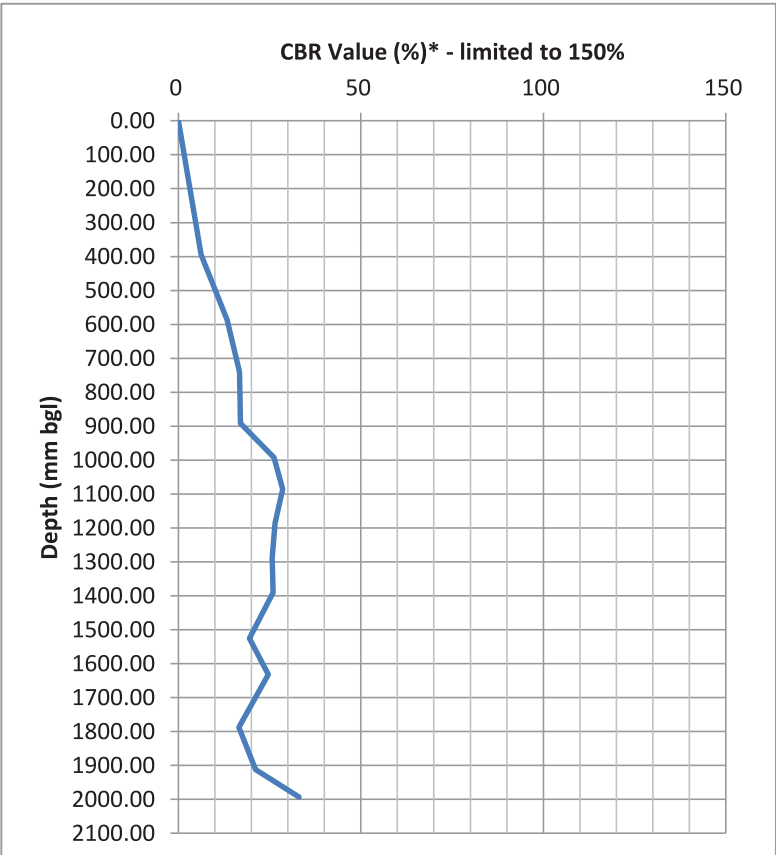
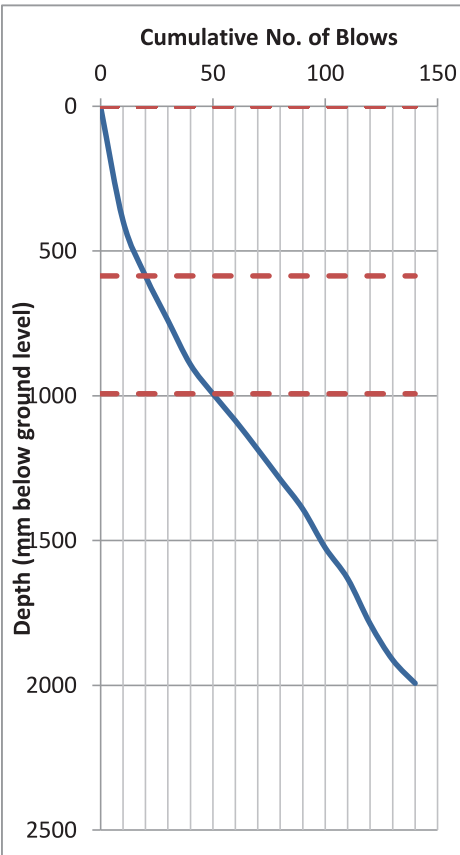
Site Name	Broadwater Rd, WGC	Starting Depth (mm bgl)	0.00
Job Number	2342-18	Surface Level (m AOD)	83.88
Test No.	DCP-TP405	Easting	524110.92
Date of Test	21-Sep-14	Northing	213053.28

[illegible]

* CBR Interpretation in accordance with DMRB, Vol 7, Sec. 3 Chap.7 Clause 7.31 equation: $CBR = 10((2.48 - 1.057 \times \text{Log } 10(\text{mm/blow})))$

TRL Dynamic Cone Penetrometer - Determination of CBR Value (%)*

Site Name	Broadwater Rd, WGC	Starting Depth (mm bgl)	0.00
Job Number	2342-18	Surface Level (m AOD)	83.61
Test No.	DCP-TP406	Easting	524077.54
Date of Test	21-Sep-14	Northing	213067.26

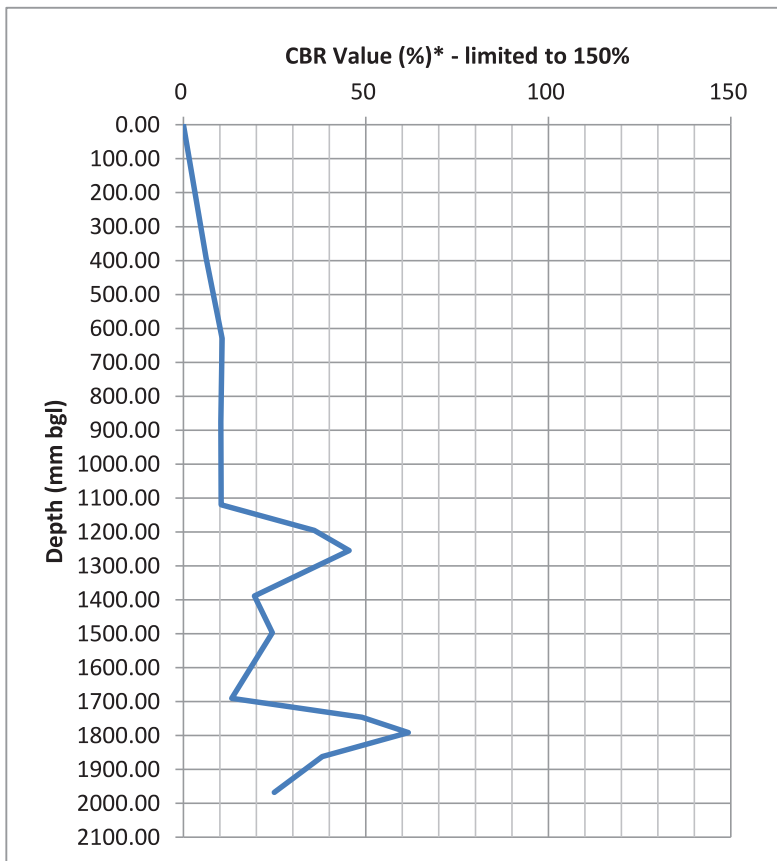
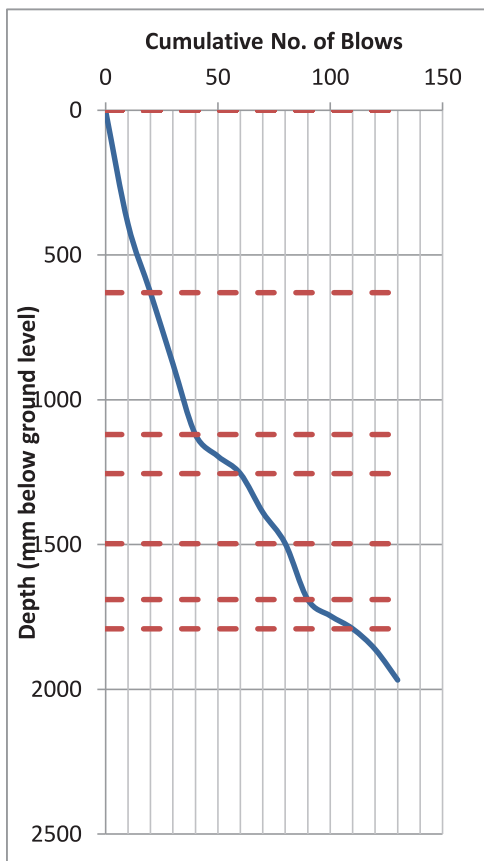
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* CBR Interpretation in accordance with DMRB, Vol 7, Sec. 3 Chap.7 Clause 7.31 equation: $CBR = 10((2.48 - 1.057 \times \text{Log } 10(\text{mm/blow})))$

TRL Dynamic Cone Penetrometer - Determination of CBR Value (%)*

Site Name	Broadwater Rd, WGC	Starting Depth (mm bgl)	0.00
Job Number	2342-18	Surface Level (m AOD)	84.4
Test No.	DCP-TP407	Easting	524052.62
Date of Test	21-Sep-14	Northing	213018.48

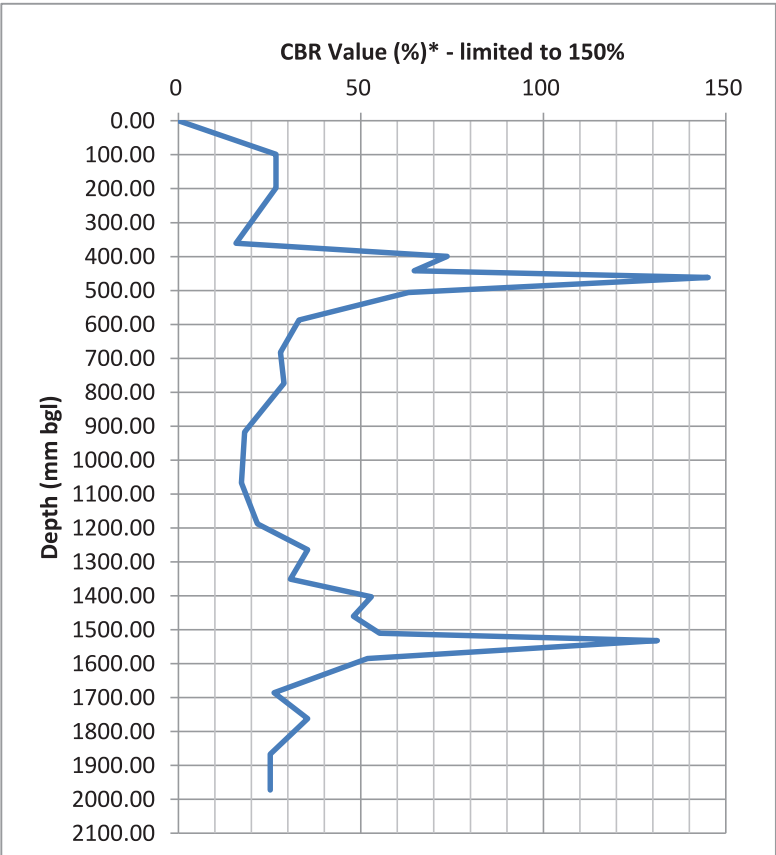
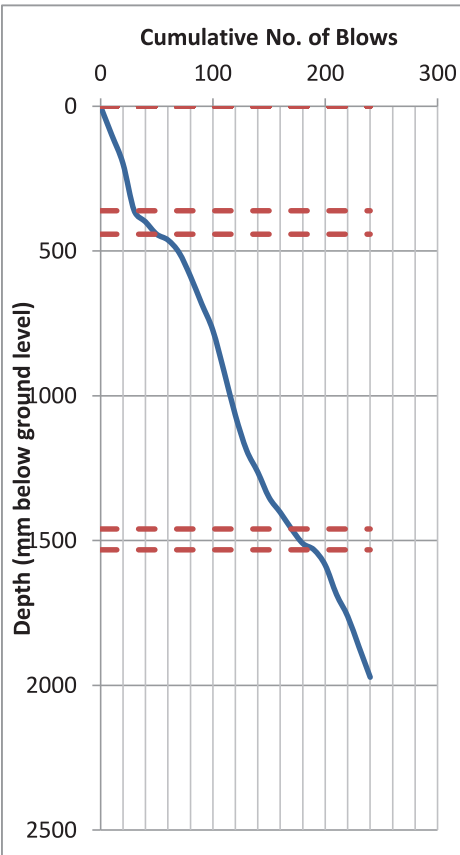
Layer	Blows	Cumulative Blows	Layer Thickness (mm)	Total Depth (mm bgl)	CBR (%)*
1	20	20	630	630	7.9
2	20	40	490	1120	10.3
3	20	60	135	1255	40.1
4	20	80	242	1497	21.7
5	10	90	193	1690	13.2
6	20	110	101	1791	54.5
7	20	130	177	1968	30.1



* CBR Interpretation in accordance with DMRB, Vol 7, Sec. 3 Chap.7 Clause 7.31 equation: $CBR = 10((2.48 - 1.057 \times \log_{10}(\text{mm/blow}))$

TRL Dynamic Cone Penetrometer - Determination of CBR Value (%)*

Site Name	Broadwater Rd, WGC	Starting Depth (mm bgl)	0.00
Job Number	2342-18	Surface Level (m AOD)	84.978
Test No.	DCP-TP405	Easting	524081.032
Date of Test	21-Sep-14	Northing	212804.633

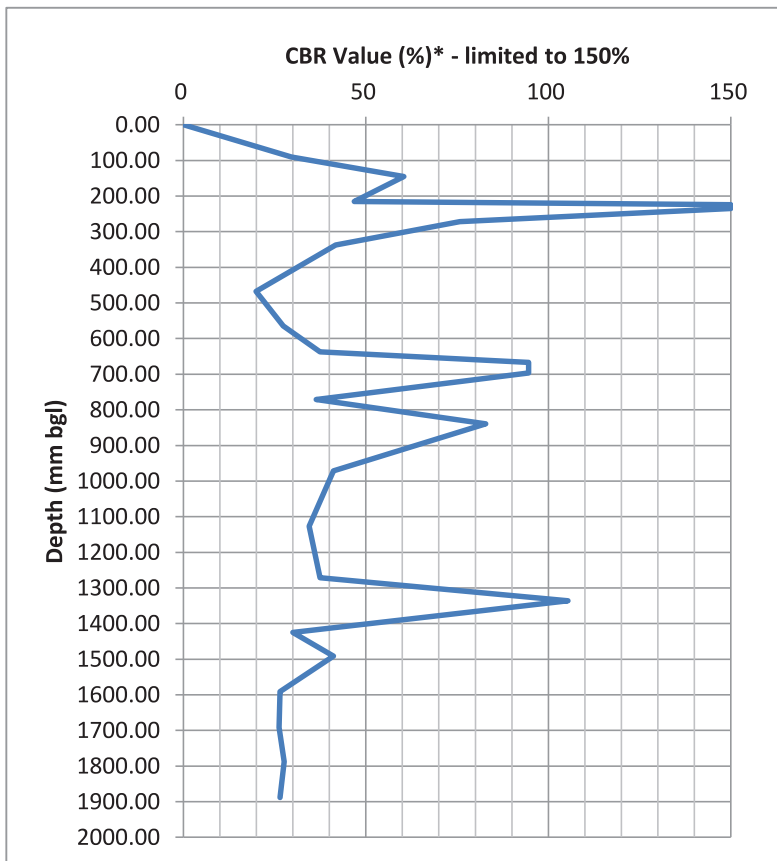
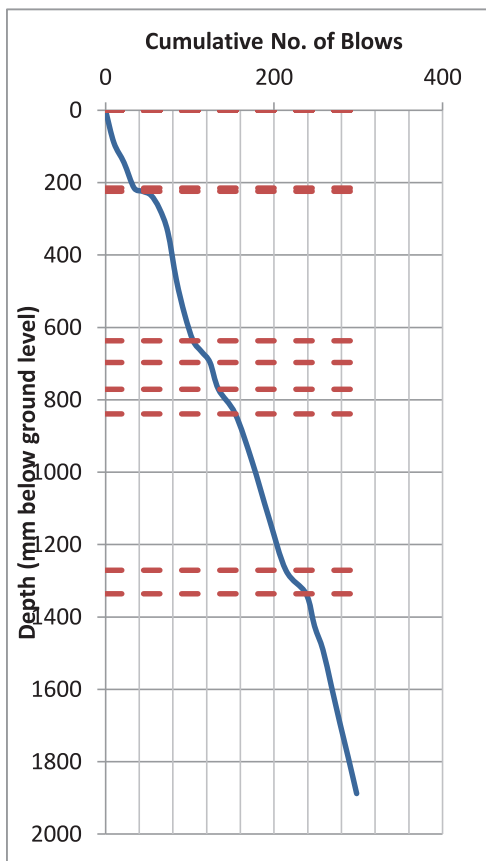
[illegible]

* CBR Interpretation in accordance with DMRB, Vol 7, Sec. 3 Chap.7 Clause 7.31 equation: $CBR = 10((2.48 - 1.057 \times \text{Log } 10(\text{mm/blow})))$

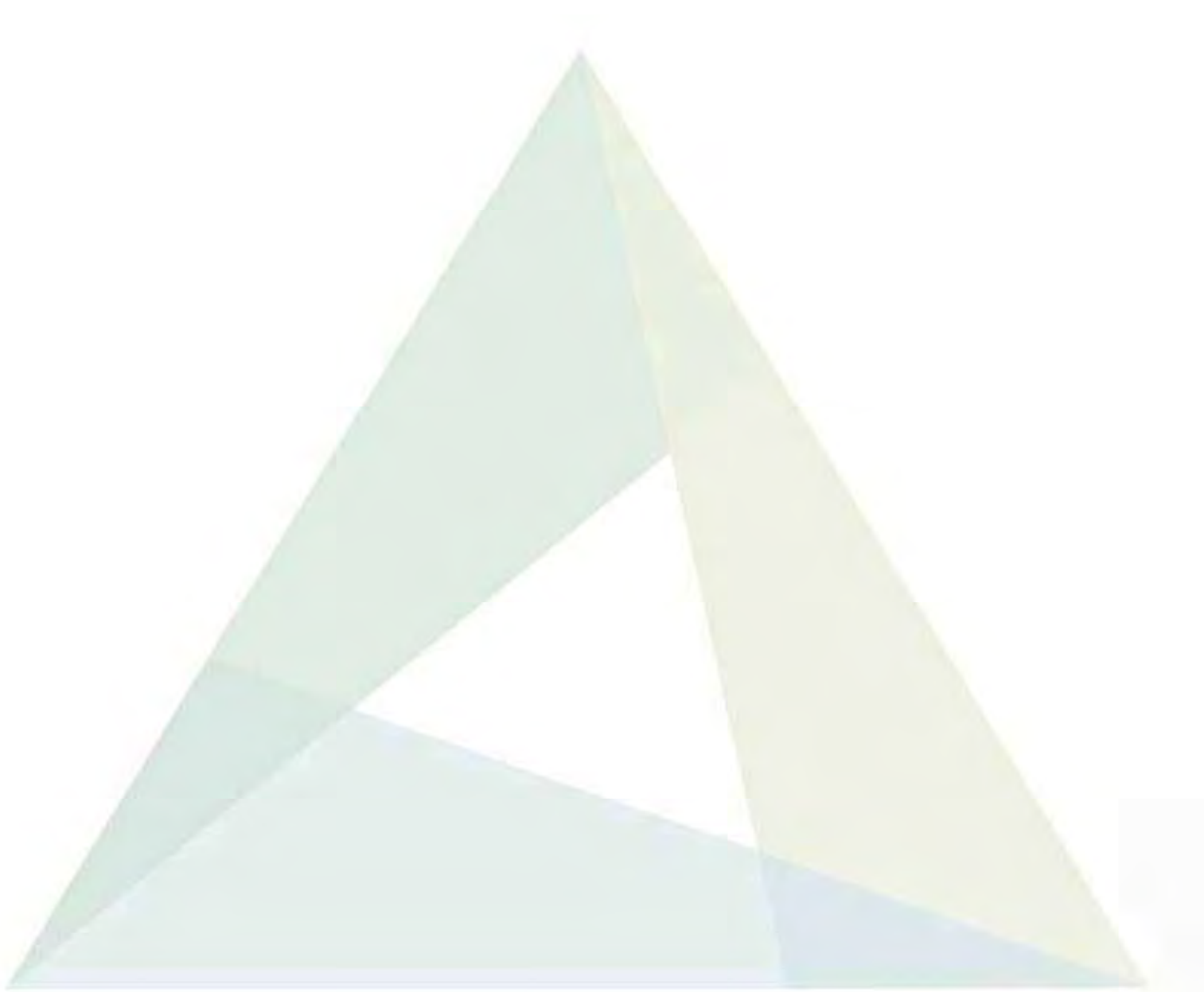
TRL Dynamic Cone Penetrometer - Determination of CBR Value (%)*

Site Name	Broadwater Rd, WGC	Starting Depth (mm bgl)	0.00
Job Number	2342-18	Surface Level (m AOD)	84.978
Test No.	DCP-BH402	Easting	524081.032
Date of Test	09-Oct-14	Northing	212804.633

Layer	Blows	Cumulative Blows	Layer Thickness (mm)	Total Depth (mm bgl)	CBR (%)*
1	34	34	215	215	43.0
2	10	44	9	224	>100
3	60	104	413	637	39.3
4	20	124	60	697	94.6
5	10	134	74	771	36.4
6	20	154	68	839	82.8
7	60	214	432	1271	37.5
8	24	238	65	1336	>100
9	60	298	660	1996	23.9



* CBR Interpretation in accordance with DMRB, Vol 7, Sec. 3 Chap.7 Clause 7.31 equation: $CBR = 10 / ((2.48 - 1.057 \times \log_{10}(\text{mm/blow}))$



WELWYN GARDEN CITY

SOIL INVESTIGATION

REPORT

Piezococone Test

Standard Data Interpretation

Project Ref.: 106006-1	Lankelma Limited Cold Harbour Lane Iden TN31 7UT East Sussex, UK Telephone: +44(0)1797280050 Email: info@lankelma.com Website: www.lankelma.com
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PROJECT:	Welwyn Garden City
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CLIENT:	Delta Simons
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FIELDWORK

CPT Rig	20.5 tonne track-truck mounted CPT unit (UK15)
Date Fieldwork Started	23/10/2014
Date Fieldwork Completed	23/10/2014
Lankelma's Representative	Emma Stickland
Client's Representative	Simon Steele

REPORT

Status	Revision	Action	Date	Name
Final	0	Completed	27/10/14	Callum Davidson
		Checked	28/10/14	Emma Stickland
		Approved	28/10/14	Chris Dimelow

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2.2	FIELD LOGISTICS.....	1
3	RAW DATA REDUCTION AND PRESENTATION	2
4	INTERPRETATIVE DATA.....	2
4.1	IN-SITU STRESS CONDITIONS	2
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APPENDICES

APPENDIX A	General Information
APPENDIX B	Cone Penetration Test Results - Raw Data Plots
APPENDIX C	Standard Interpretation Results

1 INTRODUCTION

At the request of Delta Simons, a CPT led soils investigation was carried out on project *Welwyn Garden City*.

Site location:

Hyde Way
Welwyn Garden City
Hertfordshire
AL7 3AX

1.1 COMPLETED WORKS

- 10 nr. Piezocone Tests (CPTu); and
- Factual report plus standard geotechnical data interpretation.

The *Summary Tables* section details the field records.

2 FIELDWORK

2.1 CONE PENETRATION TESTING

Cone Penetration Tests were performed with a 20.5 tonne track-truck mounted CPT unit (UK15) equipped with an 18 tonne capacity hydraulic ram set.

An electric penetrometer of a type conforming to the requirements of clause 3.1 of BS1377: 1990: Part 9 was used on this project. Cone measurements included cone tip resistance, friction sleeve resistance and dynamic pore water pressure (Piezometer) sampled at a 10mm resolution. Cone maintenance, checks and calibrations were carried out in accordance with recommendations of the International Reference Procedure for CPTU (ISSMGE, 1999). Copies of all calibration certificates for the cones used are presented in Appendix A. Refer to the cone calibration certificates for the cone type and dimensional data.

The filter element was located in the u_2 position between the cone and friction sleeve and was replaced after every test. The pore pressure system was saturated with 1000cSt silicone fluid.

2.2 FIELD LOGISTICS

The client was responsible for the positioning and re-survey of all investigative locations.

Target depth for the investigation was 20m. Table 1 details the final test depths and reasons for test termination (*Refusal Factor*). Termination depths were advised to, and agreed with, the client's on-site representative.

3 RAW DATA REDUCTION AND PRESENTATION

The CPT results are presented in Appendix B. The corrected cone resistance (q_t), local side friction, pore water pressure, friction ratio and inclination are all presented against depth and elevation in accordance with recommendations of the International Reference Procedure for CPTU (ISSMGE, 1999). CPT data and the associated derived geotechnical parameters are included in the AGS 3.1 data file provided.

Penetration length readings are corrected for inclination and sleeve readings are depth corrected for the dimensional offset between cone tip and sleeve during post processing. An additional shift of -80mm is applied to the sleeve to account for tip failure zone offset (see 'CPT Interpretation Notes'). 'Rod spikes' (artefacts of the 1m interval pause for rod string addition) are filtered from the cone tip and sleeve data.

4 INTERPRETATIVE DATA

4.1 IN-SITU STRESS CONDITIONS

The in-situ total and effective stress states are calculated based on an assumed total unit weight of soil (17 kN/m^3 above the inferred piezometric surface and 18 kN/m^3 below) and a hydrostatic pore pressure state. The depth of the piezometric surface has been assumed at a generic 2mBGL across the site based on interpretation of piezocone measurements or other observations by Lankelma. The data are applied in calculation of stress normalised geotechnical parameters.

4.2 SOIL BEHAVIOUR TYPE

The Soil Behaviour Type (SBT) is presented as the Soil Behaviour Type Index, I_c , for both stress-normalised and non-normalised evaluations according to the charts of Robertson (1998 & 2010) applicable to predominantly silicate soils.

The I_c provides a continuous profile of SBT variation with depth such that the end user may choose appropriate stratigraphic subdivisions. The basis of I_c and its approximation of the original chart classification zones may be seen from Appendix A figure 'CPT Soil Behaviour Type Chart'. The loss of fidelity is dominantly in zones 1 (*sensitive fine grained*) and zones 8 & 9 (*overconsolidated or cemented*). To account for this approximation a profile of sensitivity and OCR is provided in the Standard Interpretation Results (see section 'Geotechnical Parameters').

Non-stress normalised SBT index I_c :

$$I_c = \left[\left(3.47 - \log \left(\frac{q_c}{\sigma_{atm}} \right)^2 \right)^2 + (\log R_f + 1.22)^2 \right]^{0.5}$$

Stress-normalised SBT index I_c :

$$I_c = ((3.47 - \log Q_t)^2 + (\log F_r + 1.22)^2)^{0.5}$$

(See glossary of terms and symbols Appendix A)

The results are presented on the plots of Appendix C - *Standard Interpretation Results*.

4.3 GEOTECHNICAL PARAMETERS

4.3.1 RELATIVE DENSITY

The relative density of sands is calculated based on an empirical relationship proposed by Jamiolkowski *et al.* (2001) based on a large database of undisturbed frozen samples and calibration chamber tests. The expected accuracy may be evaluated from the distribution of calibration data in the figures presented below. The relationship has the following form:

$$D_r = 100 \left[0.268 \cdot \ln \left(\frac{q_t / \sigma_{atm}}{\sqrt{\sigma_{vo}' / \sigma_{atm}}} \right) - k \right]$$

(See glossary of terms and symbols Appendix A - *General Information*)

K = Compressibility dependant constant. For medium compressibility = -0.675 (applied generic value), for high compressibility and sands with significant carbonate or calcareous composition ≤ -1 , for low compressibility ≥ -2.0

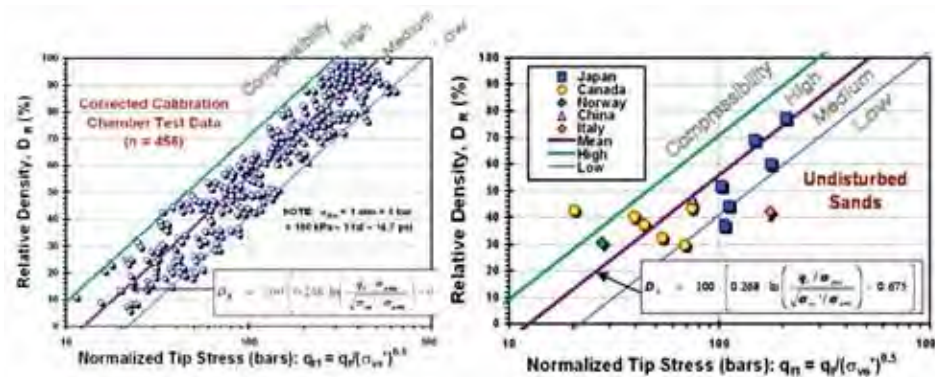


Figure 4-1 Relative density with normalised tip stress and sand compressibility from calibration chamber tests (left) and undisturbed frozen samples (right). Jamiolkowski *et al.* (2001) (Reproduced from NCHRP Synthesis 368 (2007)).

The results are presented on the plots of Appendix C - *Standard Interpretation Results*.

4.3.2 UNDRAINED SHEAR STRENGTH

S_u is estimated from the net cone tip resistance using the following equation:

$$s_u = \frac{(q_c - \sigma_{vo})}{N_k} \quad (\text{Lunne } et al. (1981))$$

where N_k is an empirical cone factor.

Research has shown that the cone factor N_k varies between 11 and 21 for normally to moderately overconsolidated soils with an average value of 15. For moderately to heavily overconsolidated soils the N_k factor may range from 20 to 30+. S_u values are presented for N_k factors of 15 and 20.

The results are presented on the plots of Appendix C - *Standard Interpretation Results*.

4.3.3 OVERCONSOLIDATION RATIO

The preconsolidation stress of clays is calculated based on the method proposed by Mayne (1995) and Demers and Leroueil (2002) and has the following form:

$$\sigma'_p = k \cdot (q_t - \sigma_{v0}) = 0.33(q_t - \sigma_{v0})$$

$$OCR = \sigma'_p / \sigma_{v0}'$$

(See glossary of terms and symbols Appendix A)

The factor k may be expected to lie in the range 0.2 to 0.5 with 0.33 representing the average.

Higher values of k are recommended for aged heavily overconsolidated clays (Robertson, 2009) and may be calibrated accordingly. The figure below demonstrates the expected accuracy of the above methods in prediction of preconsolidation stress, of particular note is the under prediction for fissured clays.

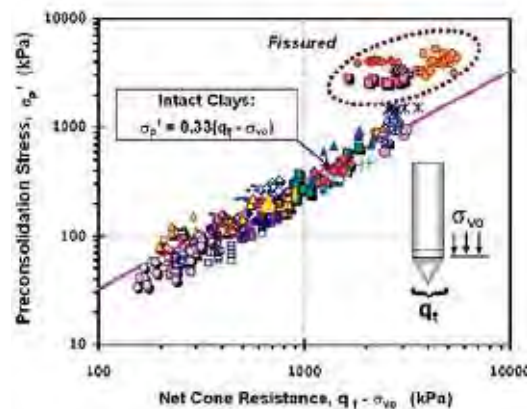


Figure 4-2 Preconsolidation stress from net cone resistance in clays (Reproduced from Mayne (2007)).

4.3.4 SENSITIVITY

The sensitivity of the soil, as defined by the ratio of undrained shear strength to remoulded shear strength, is calculated using the factored normalised cone resistance (S_u) and remoulded shear strength taken as equal to the direct friction sleeve measurement. The relationship has the following form (Mayne, 2007):

$$s_t = 0.073 \cdot (q_t - \sigma_{v0}) / f_s$$

(See glossary of terms and symbols Appendix A - *General Information*)

The results are presented on the plots of Appendix C - *Standard Interpretation Results*.

5 CPT DATA INTERPRETATION NOTES

Provided below is an inexhaustive set of cautionary notes on interpretation of the acquired CPT data with reference to examples within the dataset where appropriate.

SOIL BEHAVIOUR TYPE

The soil behaviour type (SBT) as defined by Robertson *et al.* (1986) is not intended to replace soil classification based on particle size fractions. Rather, the SBT will generally show bias in the classification towards the soil fraction that dominates soil behaviour in response to cone penetration (Cone tip: analogous to bearing capacity failure, friction sleeve: analogous to remoulded S_u or simple shear). In general the stress-normalised SBT will be more accurate, but may be less reliable at very shallow depths (1-2m) due to the particular stress normalisation procedure applied.

DRAINED AND UNDRAINED SOIL BEHAVIOUR

Geotechnical parameters appropriate for drained and undrained cone penetration conditions are derived for drained and undrained soil behaviour types (SBTs) respectively, however to account for uncertainty in the SBT correlation with drainage behaviour, all parameters are derived over the range of mixed soil types 'Silt Mixtures' and 'Sand Mixtures' or I_c 2.05-2.95 (Robertson, 2010). For partially drained conditions, or for partially saturated low permeability soils, error will be introduced within derived parameters.

Piezcone dynamic pore water pressures behaviour, dissipations or other site specific observations may be used to identify the appropriate limits of application. Dissipations to t_{50} exceeding 30 seconds indicate undrained penetration behaviour (Kim *et al.*, 2010).

DYNAMIC PORE PRESSURE DATA

During penetration, strong dilation in shear at the cone shoulder may result in cavitation and desaturation of the piezo system and may take time to recover (up to 1m penetration). Penetration through soils of partial saturation will provide unrepresentative readings and may desaturate the piezo system introducing variable error.

CONE TIP AND SLEEVE OFFSET

The accuracy of the SBT is sensitive to offset error in the friction ratio. Penetration through zones of anisotropic soil stiffness may lead to offset of the cone tip and sleeve readings due to variation in the tip failure zone shape/depth. For low to moderate risk projects this is generally insignificant. The friction ratio is often inaccurate in heavily disturbed soils with a 'blocky' macro fabric.

For this investigation a friction sleeve depth offset correction of -80mm was applied together with a 5 data point moving average on the friction ratio to minimise the influence of this effect on derived parameters.

CONE TYPE

The reference cone type has a 10cm² projected cone tip area and 150cm² friction sleeve area (S10 cone). In practice it is common to use an alternative cone having a 15cm² tip area with a 200 - 225cm² sleeve area (S15 cone) for improved sensitivity and penetration depth potential. Use of the S15 cone will have the following known influences on data with respect to the reference S10:

- More pronounced transitions zones and thin layer effects (larger zone of influence and failure zone).
- Possible marginal increase in u_2 position dynamic pore pressures in undrained/partially drained penetration.

TRANSITION ZONES AND THIN LAYER EFFECTS

During penetration at the boundary between soils of contrasting stiffness, a transition zone is often evident prior to mobilization of the true soil stiffness. These should be cautiously ignored in assessment of soil behaviour type and parameter evaluation. Where the stiff layer is thin (<~0.5m) the true stiffness will not be fully mobilised. The effect for thin low stiffness layers is less significant. Procedures for thin-layer effect correction are provided by Robertson and Wride (1998). In choosing characteristic values of the tip, sleeve and derived parameter results, large scale peak and trough values may be more representative of the local value.

GRAVELS

The presence of gravel or larger clasts in a soil is often characterised by short peaks in the CPT tip and sleeve readings, possibly with associated inclinometer 'shake' and/or sharp reductions in pore water readings due to dilation effects. Frequent gravels in soft or loose soils may generate highly erroneous friction ratio values. Where gravels are matrix supported the tip and sleeve peaks may be ignored or filtered in choosing characteristic values for bulk behaviour.

6 REFERENCES

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SUMMARY TABLES

Table 1 CPT Test Summary

TEST ID	FINAL DEPTH (mBGL)	Cone ID {C=Cone tip; F=Friction Sleeve; I= Inclination; P = Piezo; S=Subtraction cone; 15/10 = cone projected area (cm2) }	CPT RIG	PRE DRILLED / INSPECTION PIT (m)	CASING DEPTH (m)	REFUSAL FACTOR	DISSIPATIONS		SEISMIC CONE SAMPLES	EASTING	NORTHING	ELEVATION (m)	DATE OF TEST	REMARKS
CPT401	19.70	S15-CFIP.843	UK15	8.00		Target depth				524113.58	212667.21	84.56	23/10/2014	
CPT402	10.71	S15-CFIP.843	UK15	8.00		Lateral support				524164.75	212638.96	84.46	23/10/2014	
CPT403	20.20	S15-CFIP.843	UK15	8.00		Target depth				524176.08	212732.72	84.47	23/10/2014	
CPT404	20.21	S15-CFIP.843	UK15			Target depth				524256.84	213021.70	84.15	23/10/2014	
CPT405	19.82	S15-CFIP.843	UK15	6.00		Total reaction load				524141.44	213021.46	84.66	23/10/2014	
CPT406	8.09	S15-CFIP.843	UK15	8.00		Lateral support				524054.08	212913.08	85.08	23/10/2014	
CPT407	6.47	S15-CFIP.843	UK15			Total cone load				524192.11	212866.79	85.14	23/10/2014	
CPT408	8.33	S15-CFIP.843	UK15	8.00		Lateral support				524056.30	212880.65	85.69	23/10/2014	
CPT408A	8.33	S15-CFIP.843	UK15	8.00		Lateral support				524056.30	212880.65	85.69	23/10/2014	
CPT408B	20.21	S15-CFIP.843	UK15	8.00		Target depth				524056.30	212880.65	85.69	23/10/2014	

CPT Test Plots are presented in Appendices B and C

APPENDIX A GENERAL INFORMATION

LIST OF FIGURES

Description	Pages Included
Cone Calibration Certificate: S15-CFIP.843	1
Data Sheet: 20.5 Tonne Track-Truck Mounted CPT Unit (UK15)	1
CPT Soil Behaviour Type Chart	1
Glossary of Terms	1



	Serial number	Last Calibration Date	Max error	Error unit
Load cell	1171080	22/04/2014	0.1	% of rec value
DMM (load cell)	096526	03/12/2013	0.017@ 200mV	% of rec value
DMM (cone)	097936	03/12/2013	0.020@ 20V	% of rec value
DMM (sleeve)	224837	02/07/2014	0.020@ 20V	% of rec value
Power supply	326B026G2	06/12/2013	≤0.01 Regulation	% of rec value
Pressure meter	4009509	03/12/2013	+/- 0.01 bar	@ Full range

Three graphs showing the relationship between input load and output mV for different sensors:

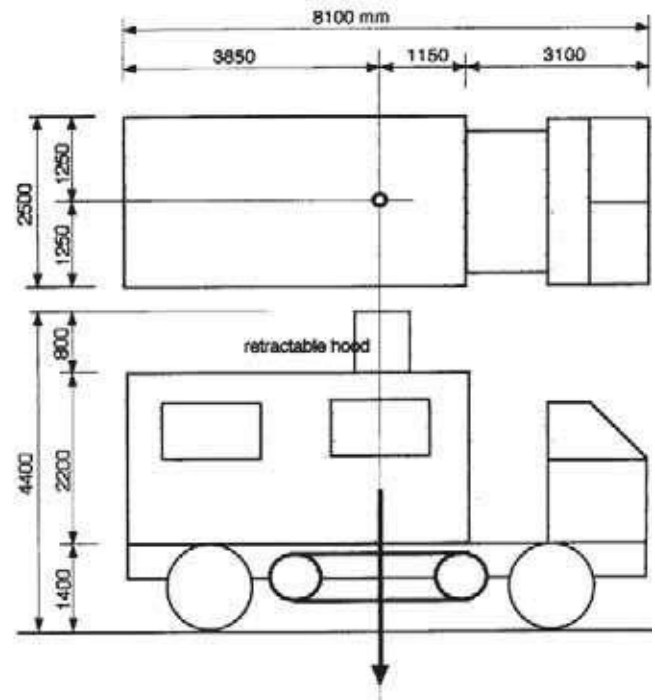
- Graph 1 (Left):** Input Load and Unload (kN) vs. Output (mV) to show linearity. The x-axis ranges from 0 to 40 kN, and the y-axis ranges from 0 to 4000 mV. The data points show a strong linear correlation.
- Graph 2 (Middle):** Input Load and Unload (kN) vs. Output (mV) to show linearity. The x-axis ranges from 0 to 40 kN, and the y-axis ranges from 0 to 4000 mV. The data points show a strong linear correlation.
- Graph 3 (Right):** Input Load and Unload (Bar) vs. Output (mV) to show linearity. The x-axis ranges from 0 to 10 Bar, and the y-axis ranges from 0 to 4500 mV. The data points show a strong linear correlation.

	Dimensional Values in mm					
	Straightness	Sleeve Ø	Sleeve T/B Ødiff	Tip Ø	Tip Definition	Crosstalk MΩ
Tolerance	0.5mm	43.6 Min.	0.3 Max	43.4 Min.	Qualitative Ass.	Must be None
Actual	0.34	43.8	0.08	43.5	pass	pass
Replaced						
Note : Check all dimensions before testing as the tip and sleeve are consumable items.						

UK15-Track-Truck CPT Unit



<u>Technical Detail</u>	
<u>Specification</u>	<u>Dimensions</u>
Weight	20.5 tonnes
Maximum Ram Capacity	18 Tonnes
Maximum Operating Capacity	17 Tonnes
Maximum Travelling Speed	86.4 km/h
Track Material	Steel
Length of Tracks	3.30m
Width of Tracks	0.65m
Jack Plate Dimensions	Tracks act as jacks
Jack Length	-
Jack Arrangements	1 on each side
Maximum Ground Clearance when Jacks Deployed	0.21m
Maximum Ground Bearing Pressure (Tracking/Pushing)	51kPa
Maximum Bearing Pressure when Pulling	95kPa
Maximum Testing Gradient	10°
Maximum Traversing Gradient	30° Assessed by Operator
Noise Output at 2m	Testing – 81dBA Driving 89dBA
Fuel	Diesel
Hydraulics	Non Biodegradable
Clamp Arrangement	Hydraulic Dial Clamp
Data Acquisition System	Fixed Geo-Explorer
Ram Stroke	1.24m
Casing Size	Up to 60mm

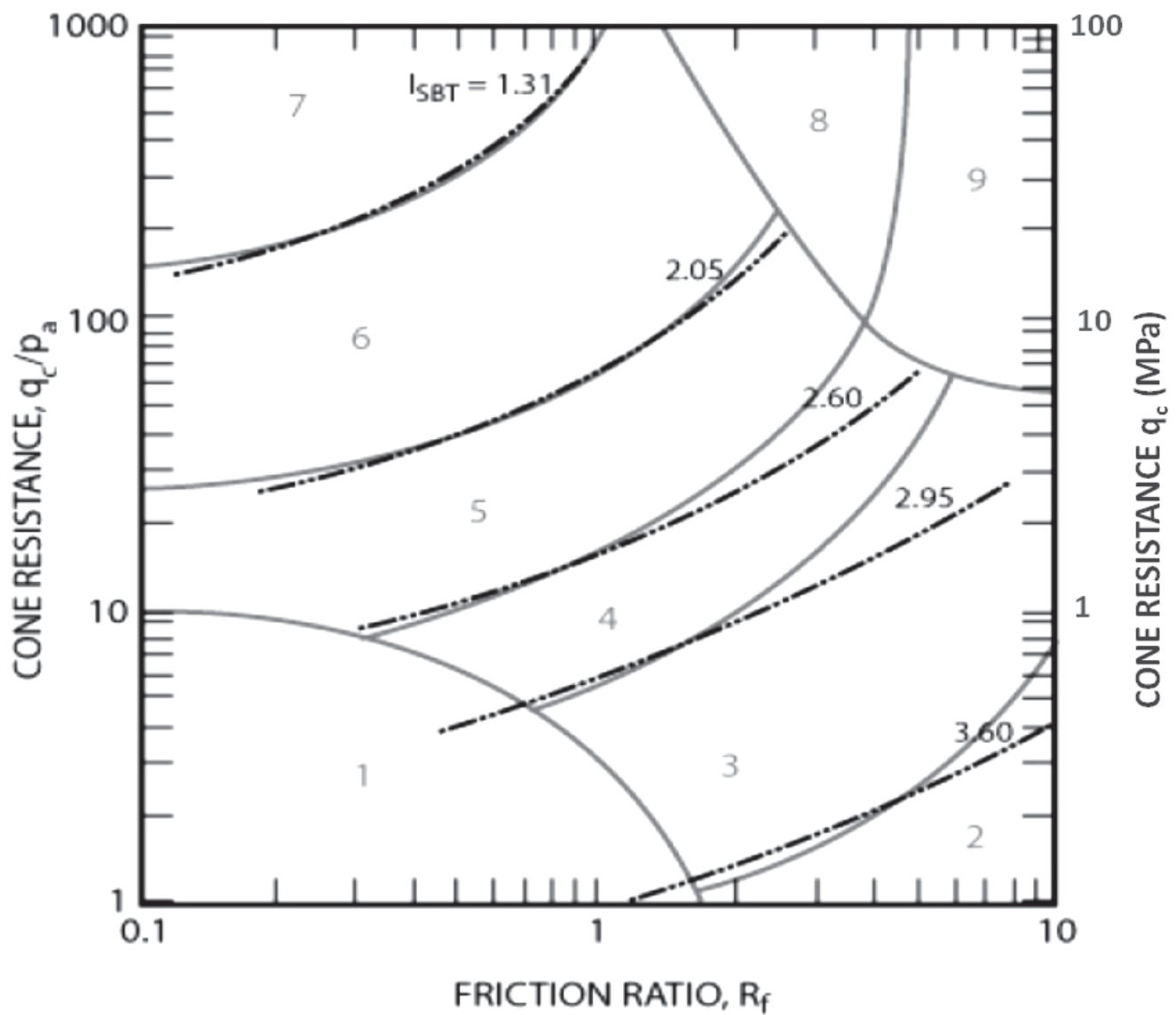


Special Features

- Ability to work on marginal sites
- Highly versatile
- Ability to drive from the back and front
- Traverse over public highway and soft ground



CPT SOIL BEHAVIOUR TYPE CHART



Non-normalised SBT chart by Robertson *et al.* (2010) based on dimensionless cone resistance (q_c/p_a) and friction ratio, R_f , showing contours of $I_{c\text{ index}}$. The chart is also applicable to stress-normalised tip/sleeve values Q_t and F_r .

Zone	Soil Behaviour Type (SBT)	
1	Sensitive fine-grained	6 Sands: clean sand to sandy silt
2	Clay – organic soil	7 Dense sand to gravelly sand
3	Clays: Clay to silty clay	8 Stiff sand to clayey sand*
4	Silt mixtures: clayey silt to silty clay	9 Stiff fine grained*
5	Sand mixtures: Silty sand to sandy silt	*Overconsolidated or cemented

GLOSSARY OF CPT TERMS AND SYMBOLS

SYMBOLS

- q_c :- Cone resistance.** The total force acting on the cone Q_c , divided by the projected area of the cone, A_c ; ($q_c = Q_c / A_c$).
- f_s :- Friction sleeve resistance.** The total frictional force acting on the friction sleeve, F_s , divided by its surface area, A_s . $f_s = F_s / A_s$.
- q_t :- Corrected cone resistance.** The cone resistance q_c corrected for unequal pore water pressure effects on the cone face and shoulder.
- R_f :- Friction ratio** The ratio, expressed as a percentage, of the sleeve friction, f_s , to the cone resistance, q_c , both measured at the same depth; [$R_f = (f_s / q_c) \cdot 100$].
- Q_t :- Stress normalised cone resistance (Method 1)** $= (q_c - \sigma_v) / \sigma'_v$
- q_{t1} :- Stress normalised cone resistance (Method 2)** $= (q_t) / (\sigma'_v)^{0.5}$
- F_r :- Normalised friction sleeve resistance** $= f_s / (q_c - \sigma_v)$
- σ_v :- Total overburden stress**
- σ'_v :- Effective overburden stress**
- σ_{atm} , or, P_a :- Reference atmospheric stress = 100kPa**
- I_c :- Soil Behaviour Type Index**
- B_q :- Pore pressure ratio.** The net pore pressure normalized with respect to the net cone resistance. $= (u_2 - u_0) / (q_t - \sigma_v)$

TERMS

Cone Tip:- The conical tip section of the cone penetrometer.

Friction sleeve:- The section of the cone penetrometer upon which the sleeve friction is measured, located behind the cone tip.

Piezocone:- A cone penetrometer with a pore pressure measurement system.

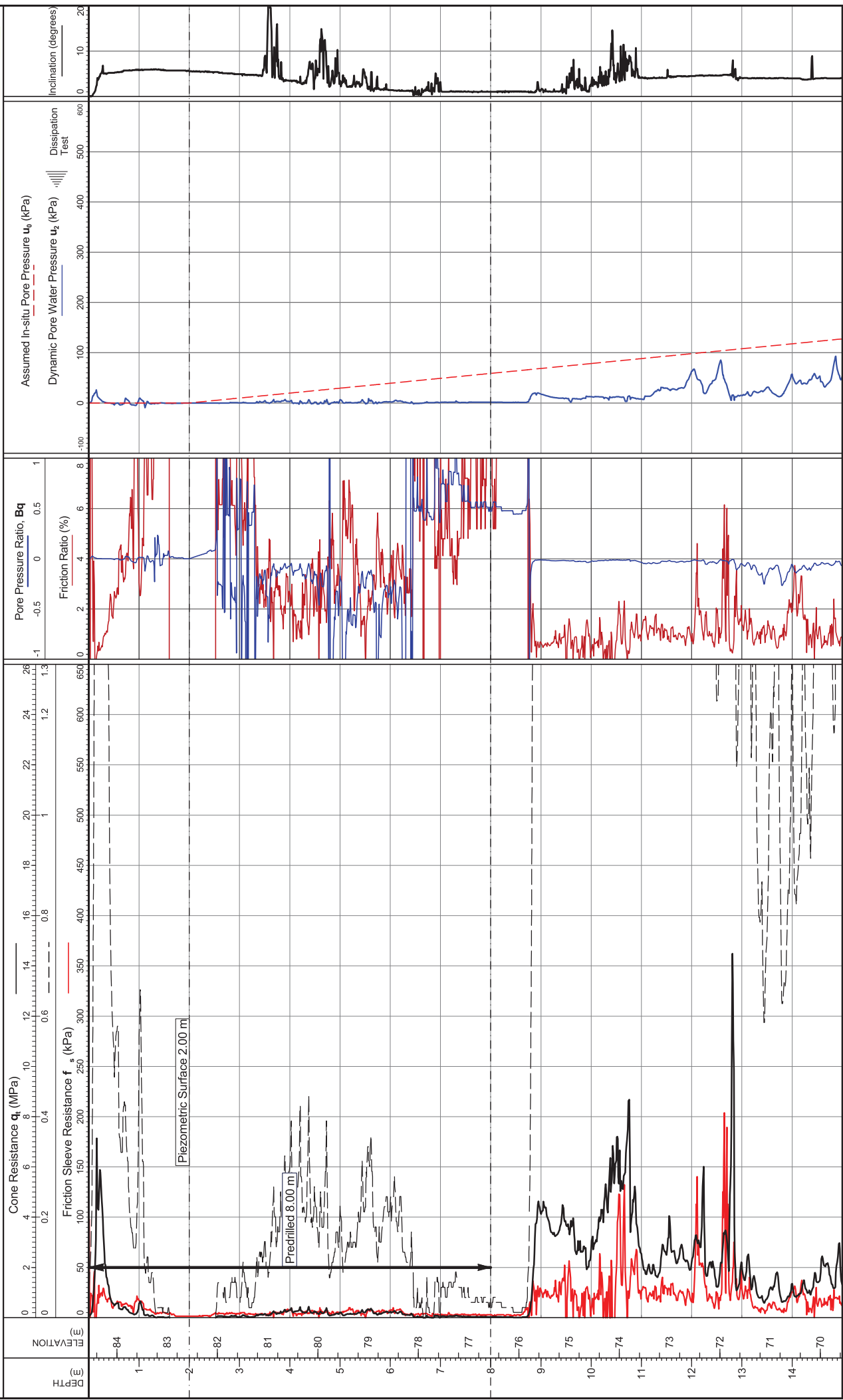
Dynamic pore pressure:- The pore pressure generated during penetration and measured by a pore pressure sensor. u_1 when measured on the conical tip face, u_2 when measured just behind the conical tip.

APPENDIX B CONE PENETRATION TEST RESULTS**RAW DATA PLOTS****LIST OF FIGURES:**

Test ID		Pages included
Cone Penetration Test	CPT401	2
Cone Penetration Test	CPT402	1
Cone Penetration Test	CPT403	2
Cone Penetration Test	CPT404	2
Cone Penetration Test	CPT405	2
Cone Penetration Test	CPT406	1
Cone Penetration Test	CPT407	1
Cone Penetration Test	CPT408	1
Cone Penetration Test	CPT408A	1
Cone Penetration Test	CPT408B	2

Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²):1500
Cone ID: S15-CFIP 843
Operator: Ben Ranson
Rtg Used: UK15
Date of test: 23/10/2014 10:48:27

Location: Hertfordshire
Coordinates: 524113.58, 212667.21
Elevation: 84.56
Coordinate system:

Remarks:
*Piezometric surface origin: Est. from u2 piezo data
Termination Remark: Target depth

Date of plot:
27-10-14
Checked by:
Emma Stickland

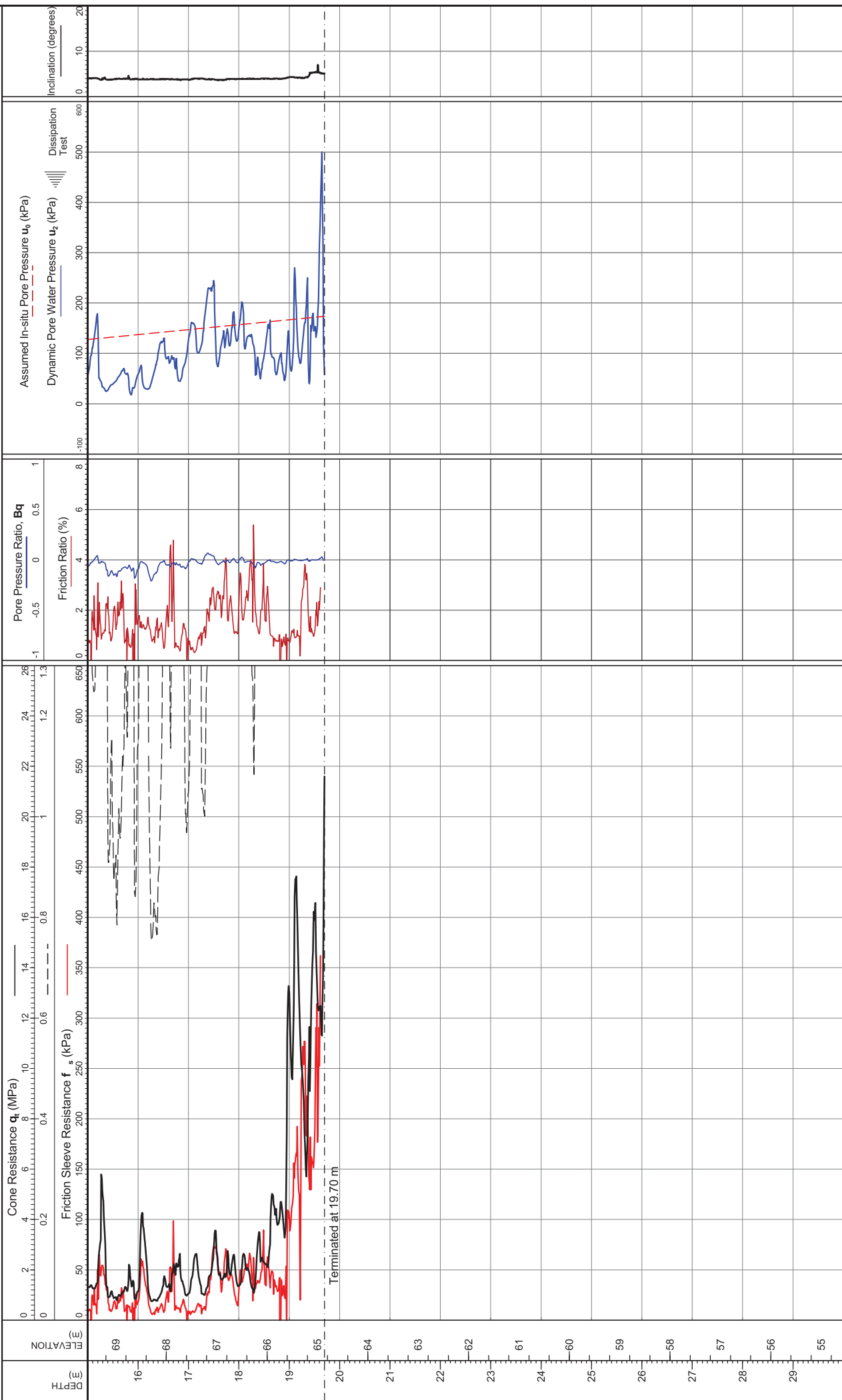
Lankelma Project Ref:
P-106006-1

TEST ID: CPT401

Page 1 of 2

Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²): 1500
Cone ID: S15-CFIP 843
Operator: Ben Ranson
Rig Used: UK15
Date of test: 23/10/2014 10:48:27

Location: Hertfordshire
Coordinates: 524113.58, 212667.21
Elevation: 84.56
Coordinate system:

Remarks:
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Termination Remark: Target depth

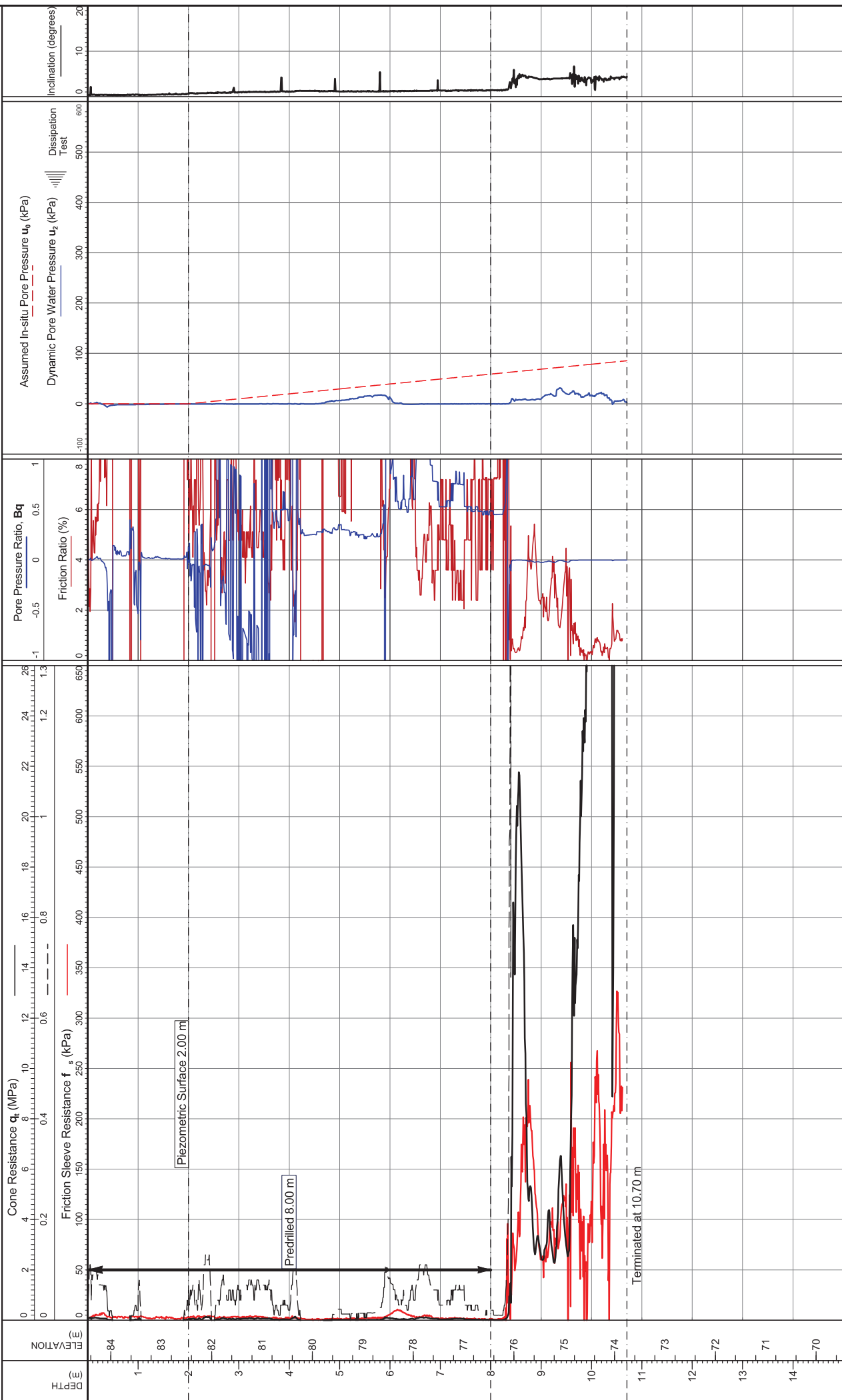
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Checked by:
Emma Stickland

Lankelma Project Ref:
P-106006-1

TEST ID: CPT401
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Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²): 1500
Cone ID: S15-CFIP 843
Operator: Ben Ranson
Rtg Used: UK15
Date of test: 23/10/2014 09:59:20

Location: Hertfordshire
Coordinates: 524164.75, 212638.96
Elevation: 84.46
Coordinate system:

Remarks:
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Termination Remark: Lateral support

Date of plot:
27-10-14

Checked by:
Emma Stuckland

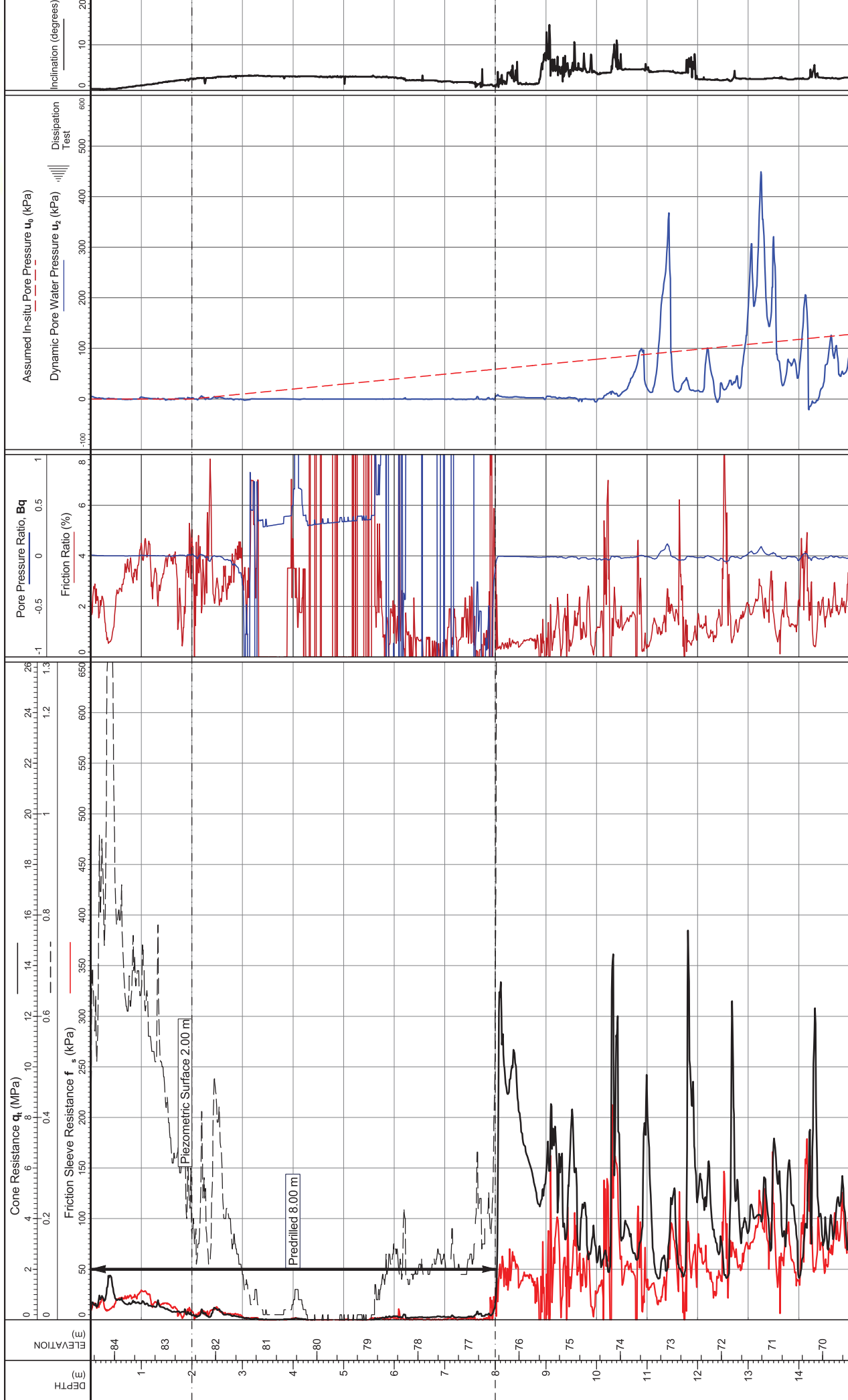
Lankelma Project Ref:
P-106006-1

TEST ID: CPT402

Page 1 of 1

Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²): 1500
Cone ID: S15-CFIP 843
Operator: Ben Ranson
Rtg Used: UK15
Date of test: 23/10/2014 09:05:10

Location: Hertfordshire
Coordinates: 524176.08, 212732.72
Elevation: 84.47
Coordinate system:

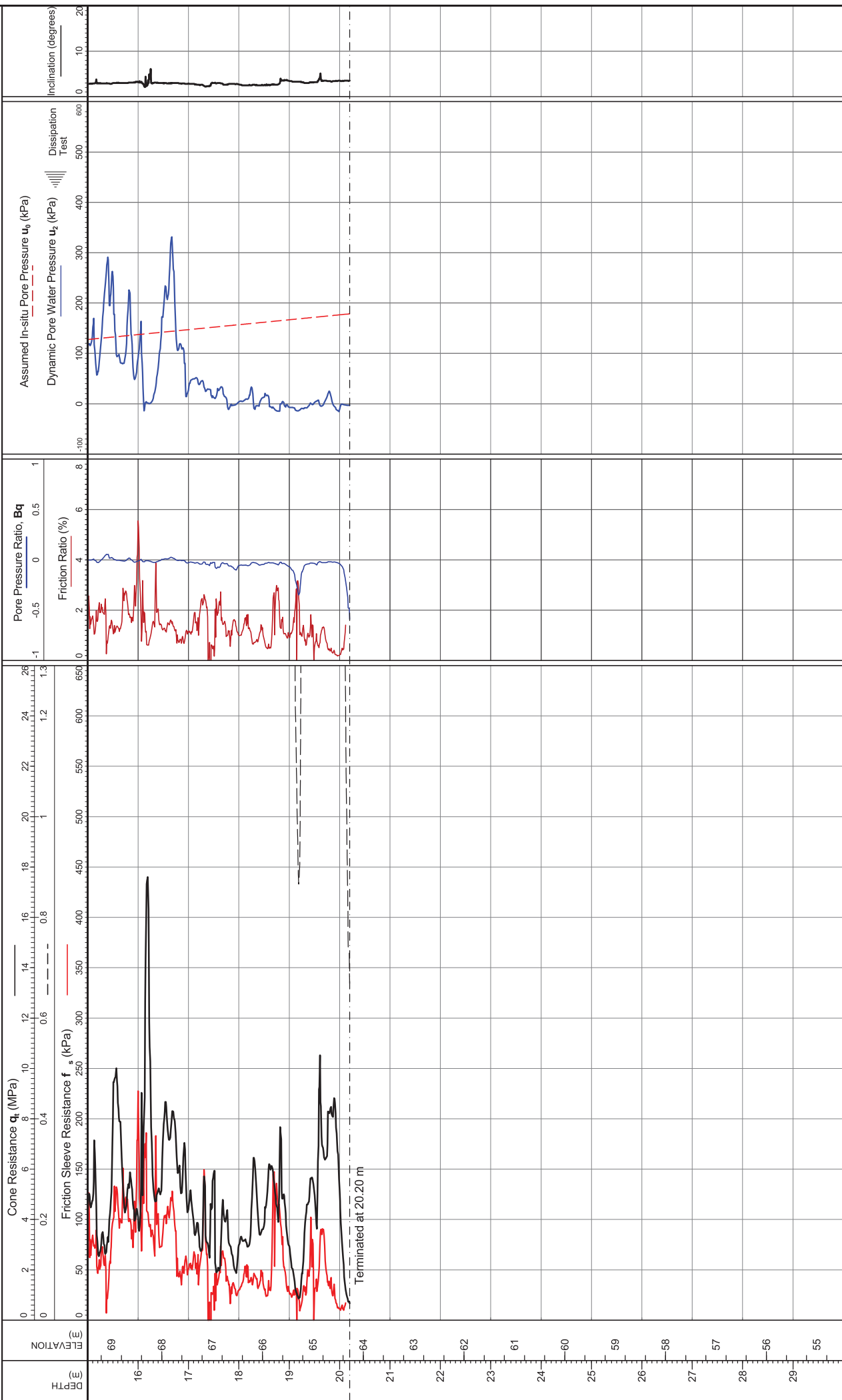
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*Piezometric surface origin: Est. from u2 piezo data
Termination Remark: Target depth

Date of plot:
27-10-14
Checked by:
Emma Stickland

TEST ID: CPT403
Page 1 of 2

Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²): 1500
Cone ID: S15-CFIP.843
Operator: Ben Ranson
Rig Used: UK15
Date of test: 23/10/2014 09:05:10

Location: Hertfordshire
Coordinates: 524176.08, 212732.72
Elevation: 84.47
Coordinate system:

Remarks:
*Piezometric surface origin: Est. from u2 piezo data

Termination Remark: Target depth

Date of plot:
27-10-14

Checked by:
Emma Stickland

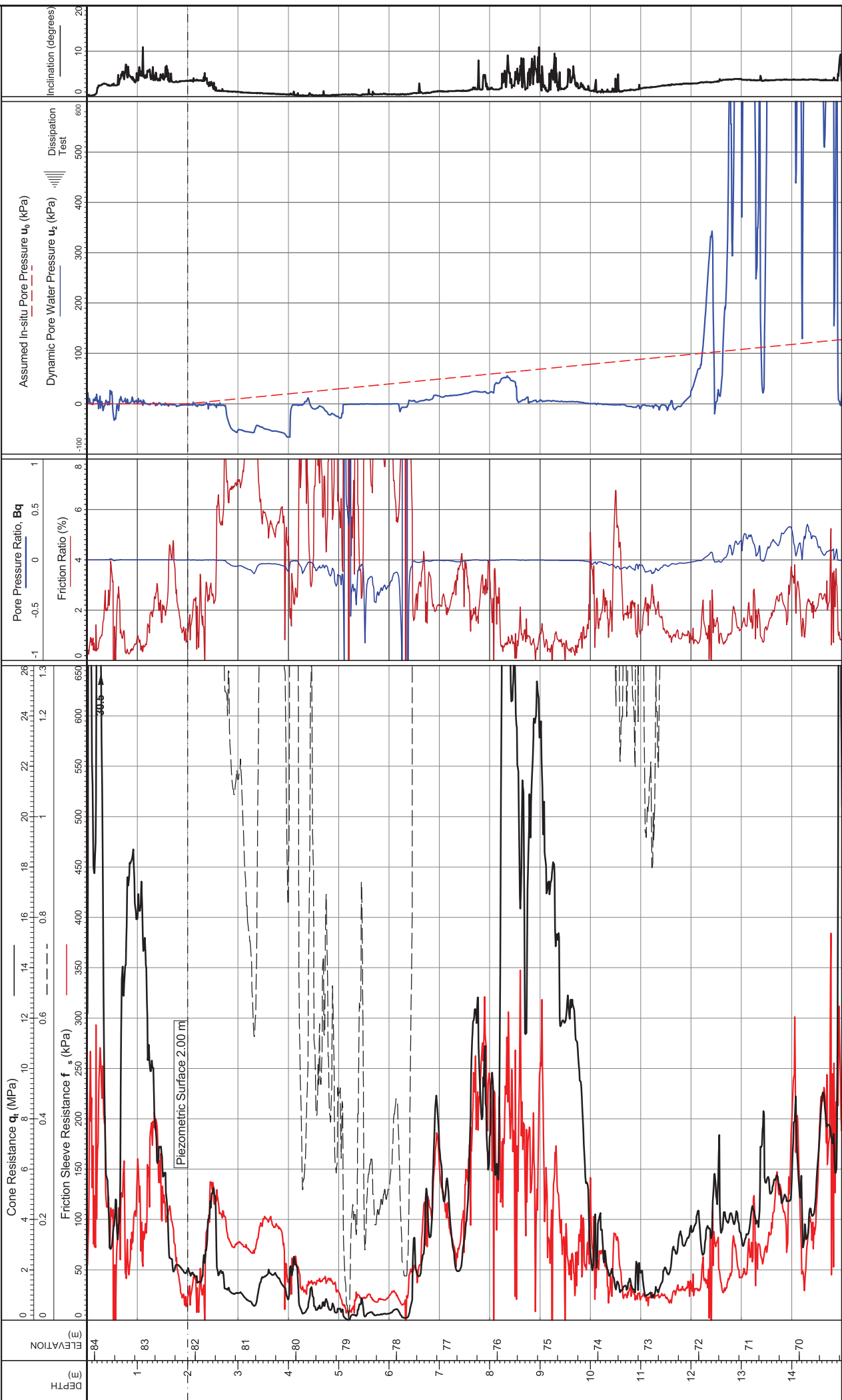
Lankelma Project Ref:
P-106006-1

TEST ID: CPT403

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Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²): 1500
Cone ID: S15-CFIP 843
Operator: Ben Ranson
Rtg Used: UK15
Date of test: 23/10/2014 14:31:58

Location: Hertfordshire
Coordinates: 524256.84, 213021.7
Elevation: 84.15
Coordinate system:

Remarks:
*Piezometric surface origin: Est. from u₂ piezo data
Termination Remark: Target depth

Date of plot:
27-10-14
Checked by:
Emma Stickland

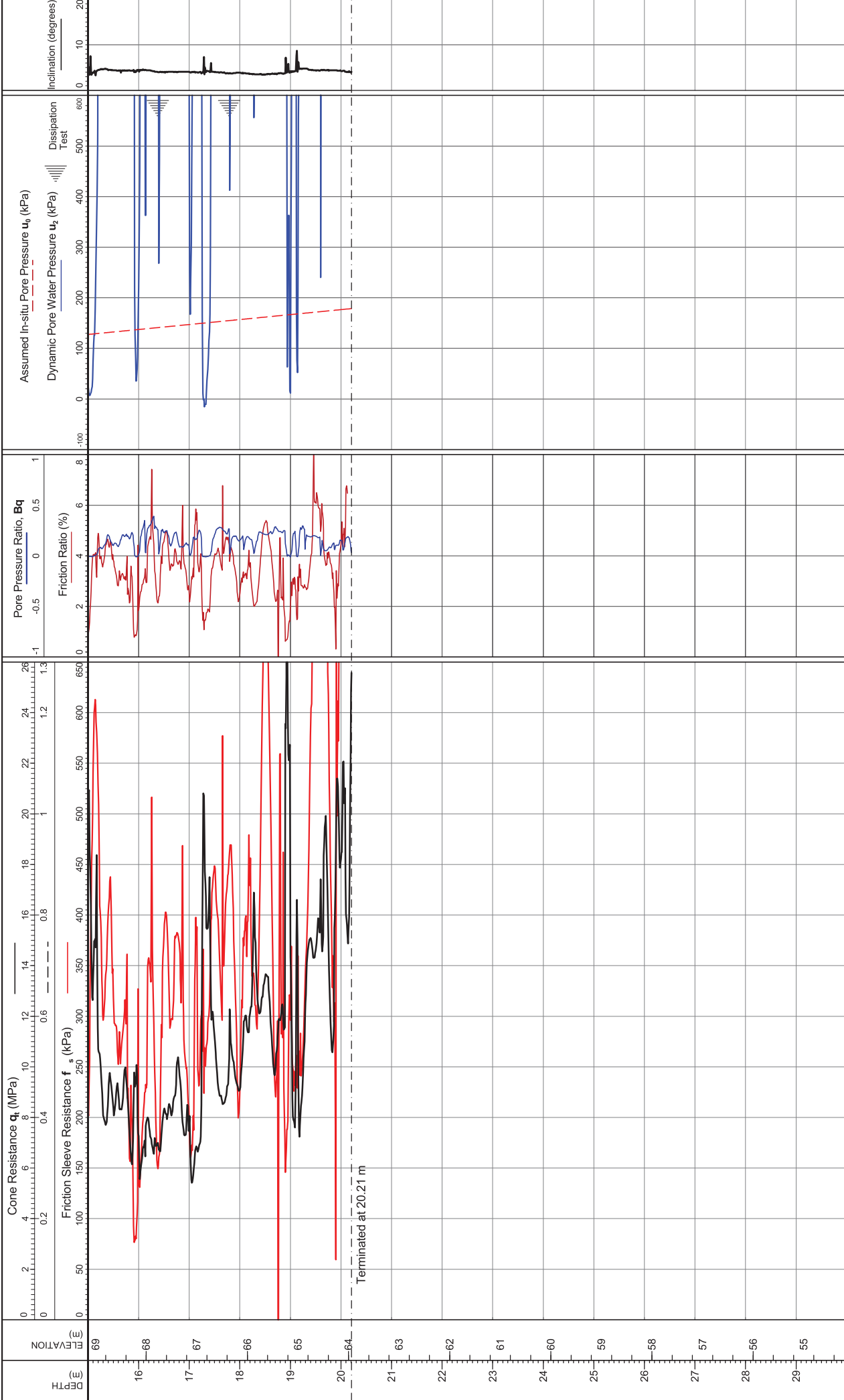
Lankelma Project Ref:
P-106006-1

TEST ID: CPT404

Page 1 of 2

Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²): 1500
Cone ID: S15-CFIP.843
Operator: Ben Ranson
Rtg Used: UK15
Date of test: 23/10/2014 14:31:58

Location: Hertfordshire
Coordinates: 524256.84, 213021.7
Elevation: 84.15
Coordinate system:

Remarks:
*Piezometric surface origin: Est. from u_2 piezo data

Date of plot:
27-10-14

Checked by:
Emma Stuckland

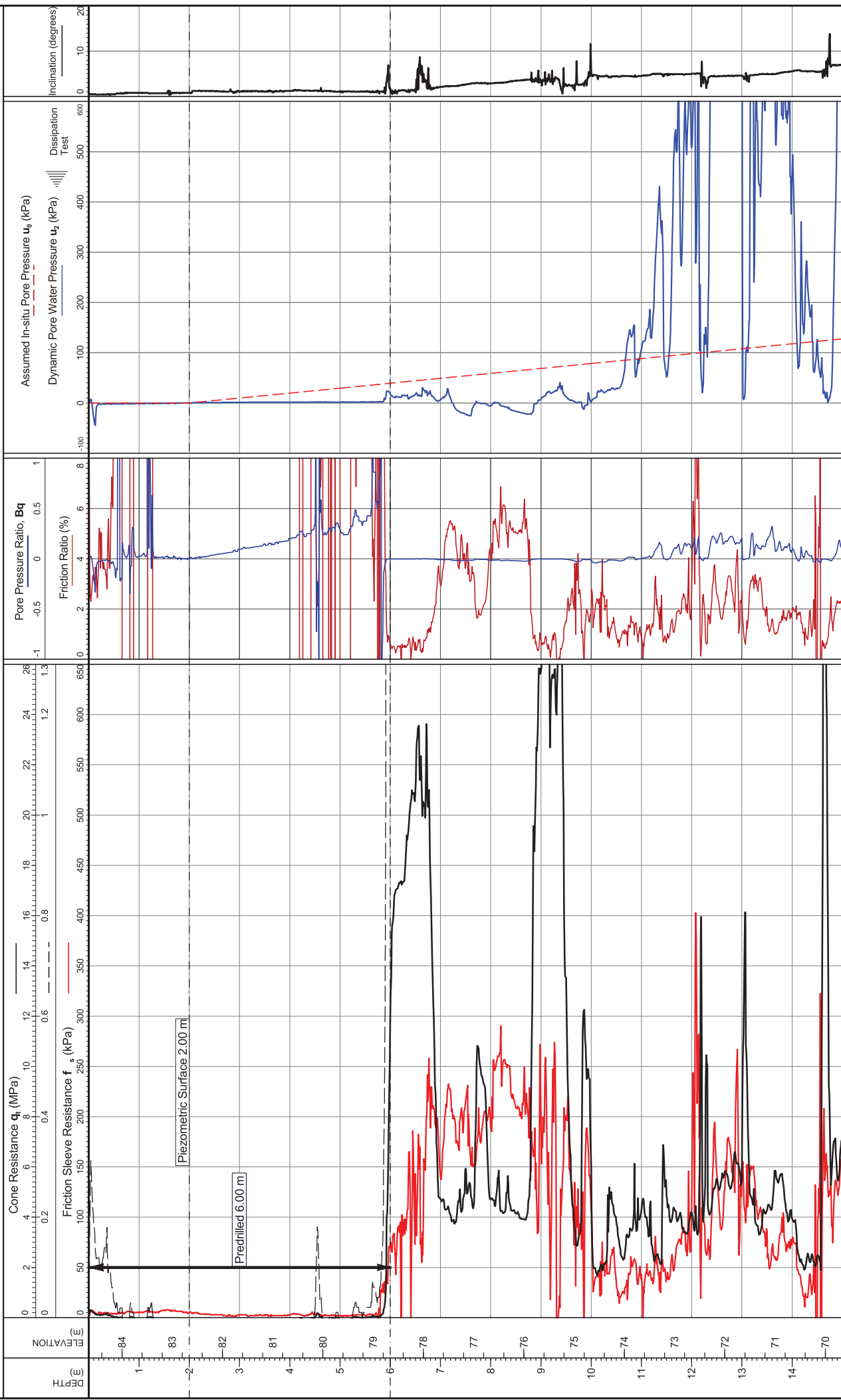
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TEST ID: CPT404

Page 2 of 2

Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²): 1500
Cone ID: S15-CFIP 843
Operator: Ben Ranson
Rtg Used: UK15
Date of test: 23/10/2014 15:33:32

Location: Hertfordshire
Coordinates: 524141.44, 213021.46
Elevation: 84.66
Coordinate system:

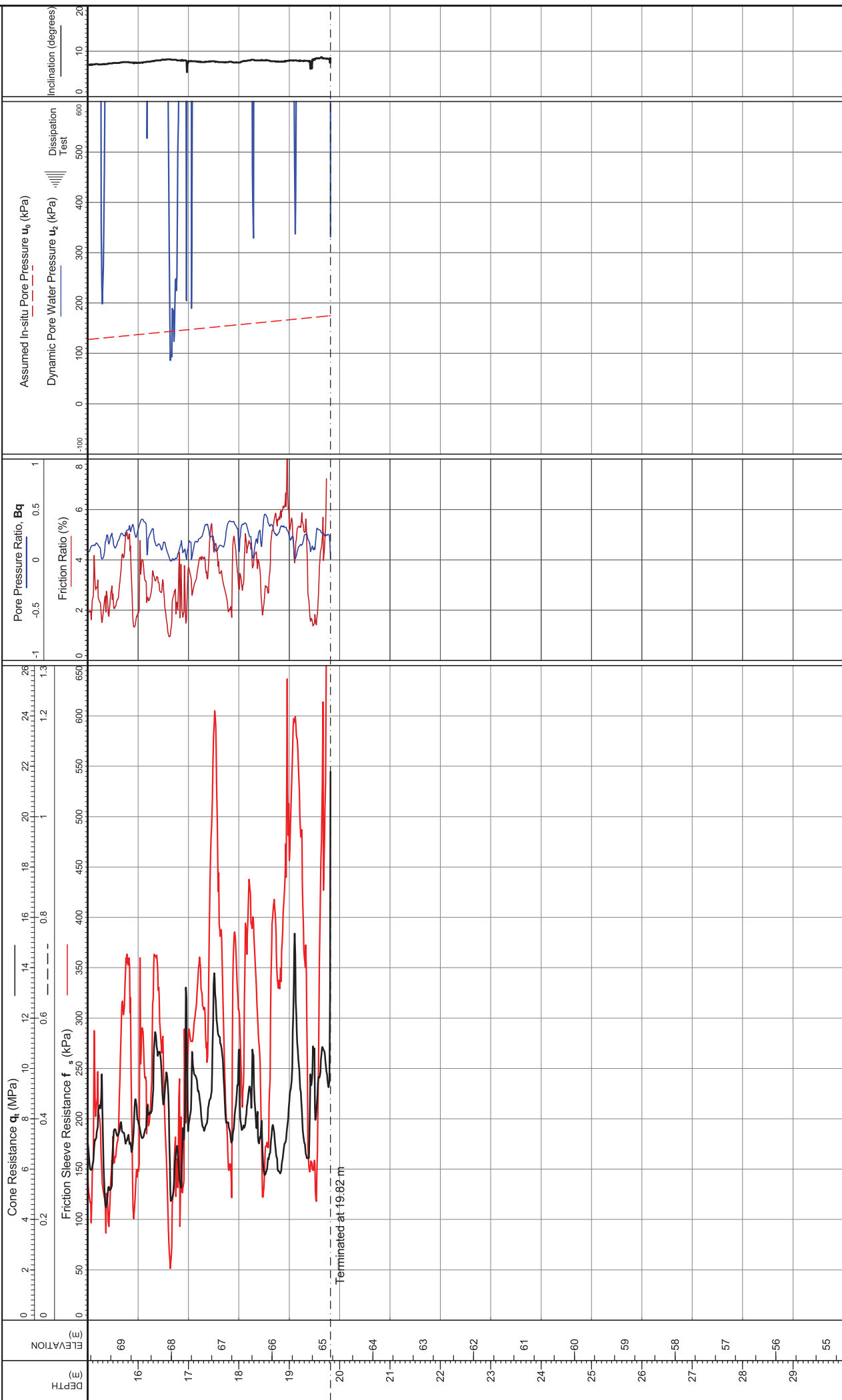
Remarks:
*Piezometric surface origin: Est. from u_2 piezo data
Termination Remark: Total reaction load

Date of plot:
27-10-14
Checked by:
Emma Stickland

TEST ID: CPT405
Page 1 of 2

Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²): 1500
Cone ID: S15-CFIP.843
Operator: Ben Ranson
Rig Used: UK15
Date of test: 23/10/2014 15:33:32

Location: Hertfordshire
Coordinates: 524141.44, 213021.46
Elevation: 84.66
Coordinate system:

Remarks:
*Piezometric surface origin: Est. from u2 piezo data
Termination Remark: Total reaction load

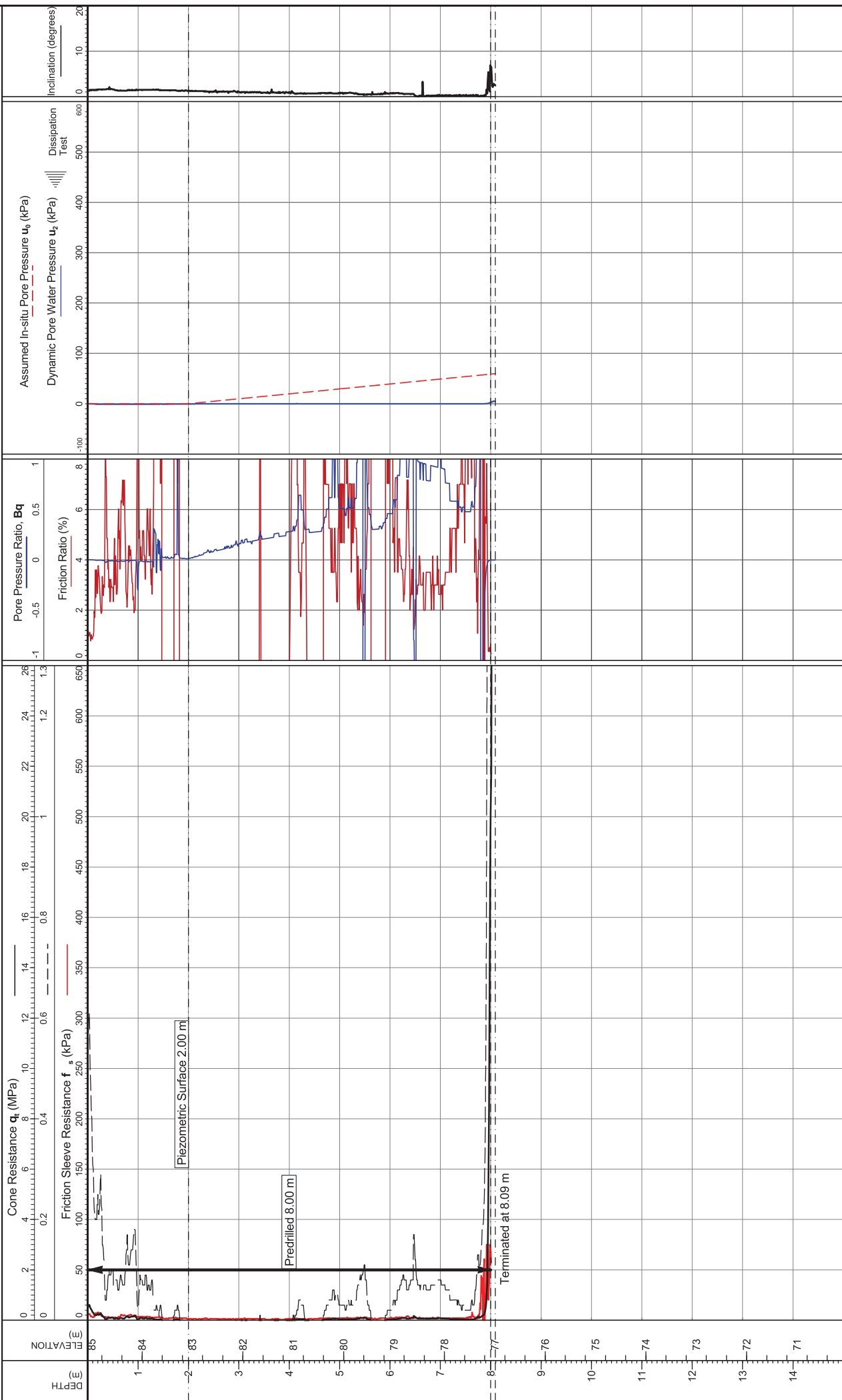
Date of plot:
27-10-14
Checked by:
Emma Stickland

Lankelma Project Ref:
P-106006-1

TEST ID: CPT405
Page 2 of 2

Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²): 1500
Cone ID: S15-CFIP.843
Operator: Ben Ranson
Rtg Used: UK15
Date of test: 23/10/2014 12:25:58

Location: Hertfordshire
Coordinates: 524054.08, 212913.08
Elevation: 85.08
Coordinate system:

Remarks:
*Piezometric surface origin: Est. from u2 piezo data
Termination Remark: Lateral support

Date of plot:
27-10-14
Checked by:
Emma Stickland

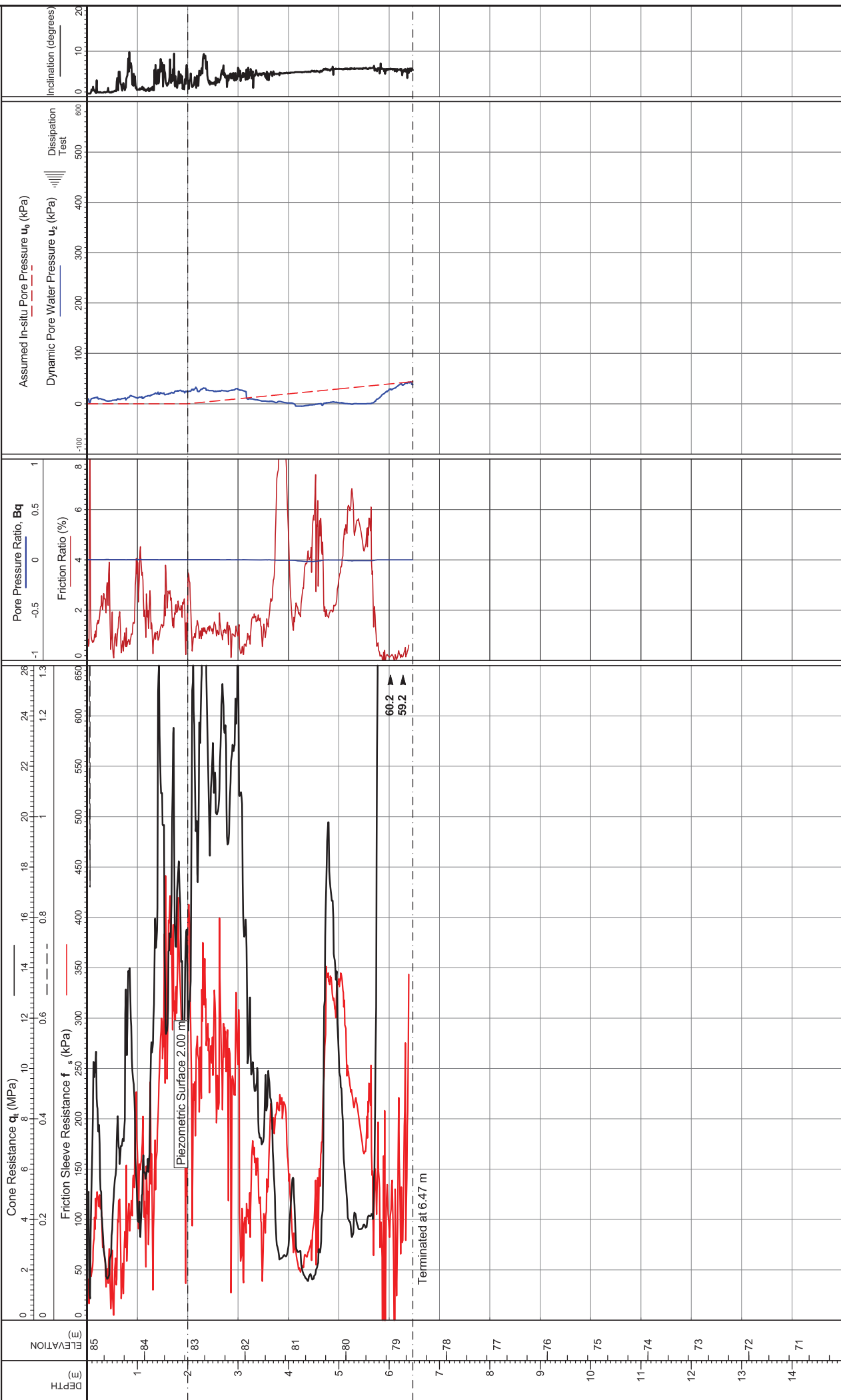
Lankelma Project Ref:
P-106006-1

TEST ID: CPT406

Page 1 of 1

Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²): 1500
Cone ID: S15-CFIP.843
Operator: Ben Ranson
Rtg Used: UK15
Date of test: 23/10/2014 13:42:58

Location: Hertfordshire
Coordinates: 524192.11, 212866.79
Elevation: 85.14
Coordinate system:

Remarks:
*Piezometric surface origin: Est. from u2 piezo data

Termination Remark: Total cone load

Date of plot:
27-10-14

Checked by:
Emma Stickland

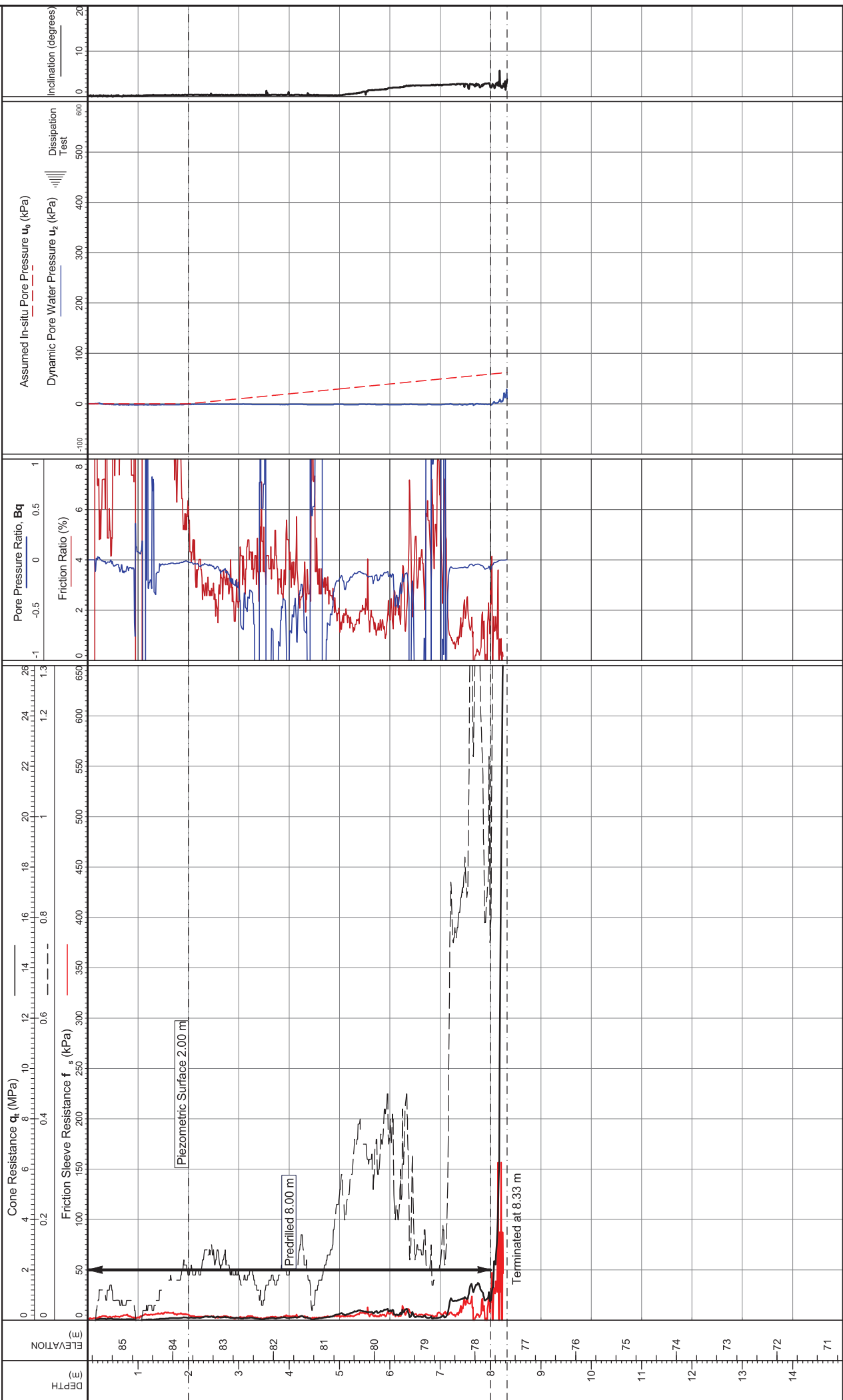
Lankelma Project Ref:
P-106006-1

TEST ID: CPT407

Page 1 of 1

Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²): 1500
Cone ID: S15-CFIP 843
Operator: Ben Ranson
Rtg Used: UK15
Date of test: 23/10/2014 11:40:39

Location: Hertfordshire
Coordinates: 524056.3, 212880.65
Elevation: 85.69
Coordinate system:

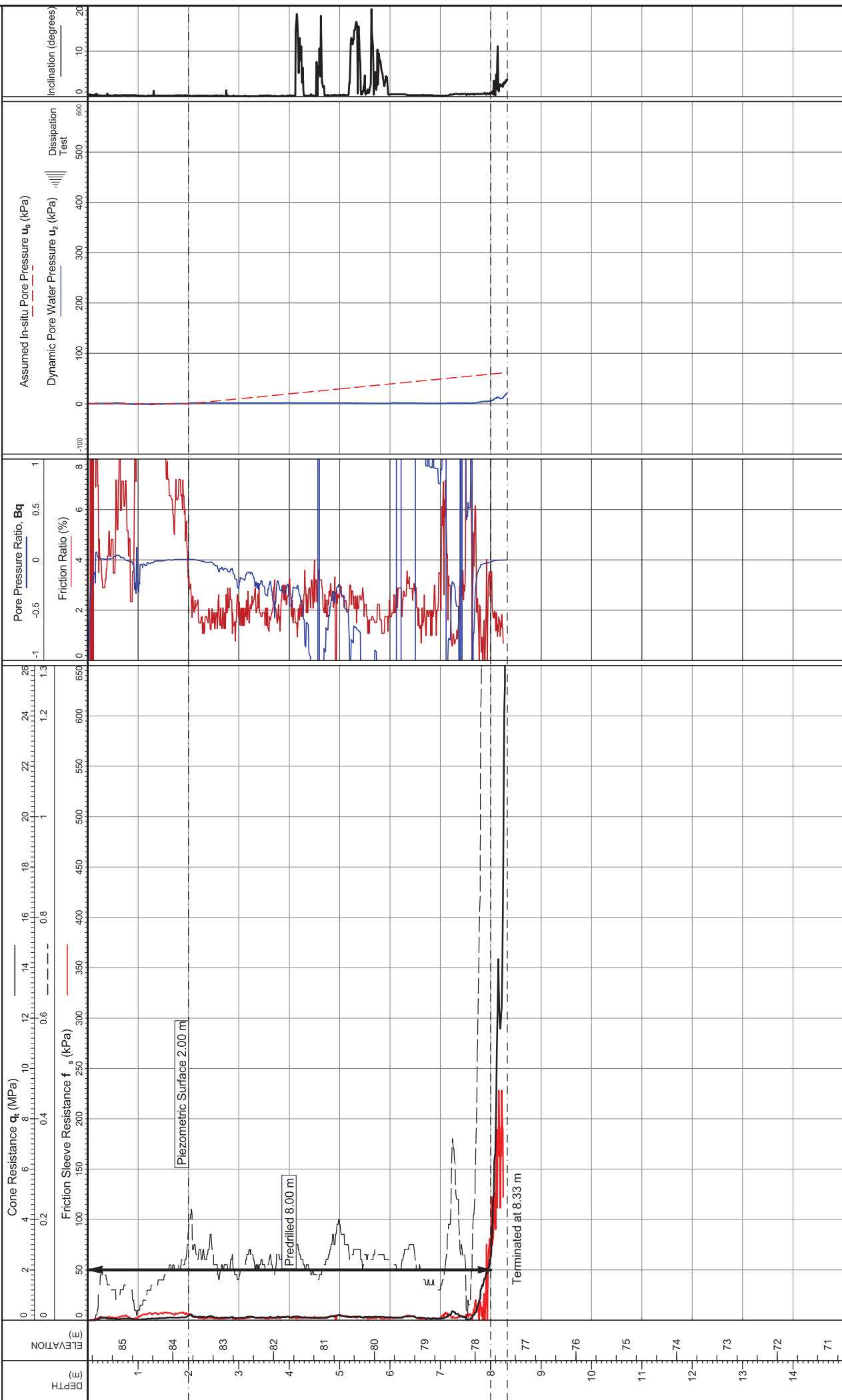
Remarks:
*Piezometric surface origin: Est. from u_2 piezo data
Termination Remark: Lateral support

Date of plot:
27-10-14
Checked by:
Emma Stickland

TEST ID: CPT408
Page 1 of 1

Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²): 1500
Cone ID: S15-CFIP 843
Operator: Ben Ranson
Rtg Used: UK15
Date of test: 23/10/2014 12:03:01

Location: Hertfordshire
Coordinates: 524056.3, 212880.65
Elevation: 85.69
Coordinate system:

Remarks:
*Piezometric surface origin: Est. from u_2 piezo data
Termination Remark: Lateral support

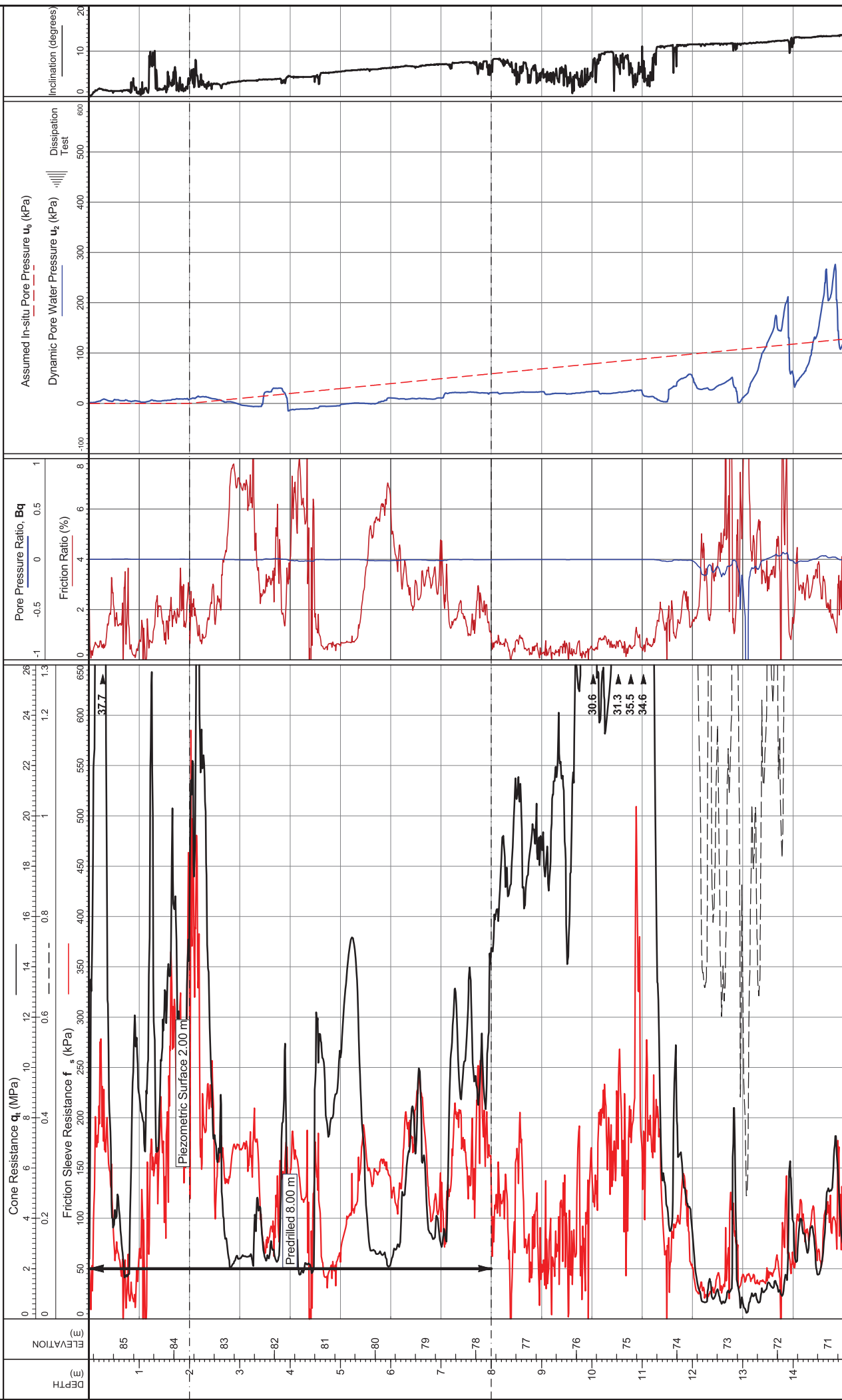
Date of plot:
27-10-14
Checked by:
Emma Stickland

Lankelma Project Ref:
P-106006-1

TEST ID: CPT408A

Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm2): 1500
Cone ID: S15-CFP.843
Operator: Ben Ranson
Rtg Used: UK15
Date of test: 23/10/2014 12:46:36

Location: Hertfordshire
Coordinates: 524056.3, 212880.65
Elevation: 85.69
Coordinate system:

Remarks:
*Piezometric surface origin: Est. from u2 piezo data
Termination Remark: Target depth

Date of plot:
27-10-14
Checked by:
Emma Stickland

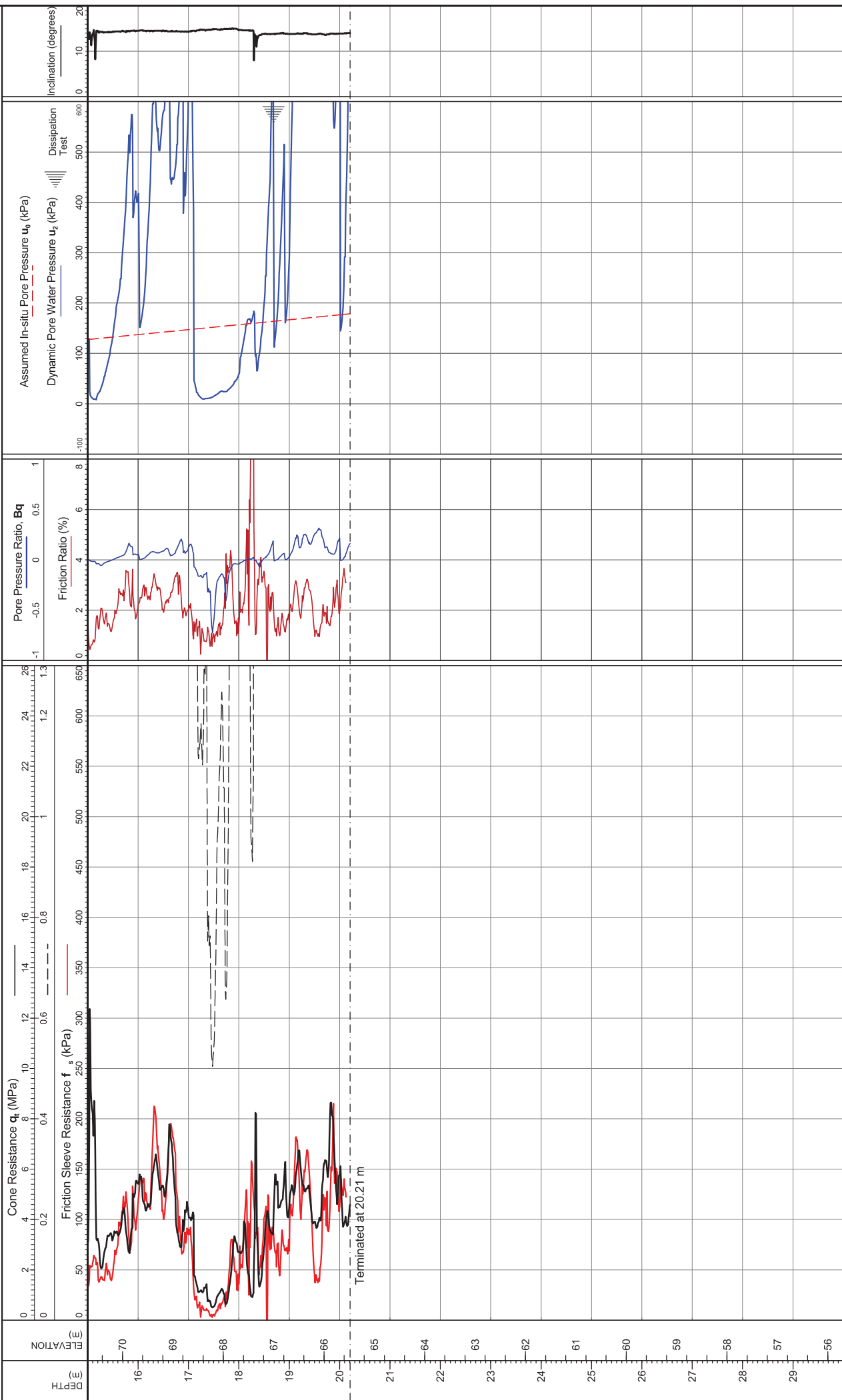
Lankelma Project Ref:
P-106006-1

TEST ID: CPT408B

Page 1 of 2

Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²): 1500
Cone ID: S15-CFIP.843
Operator: Ben Ranson
Rtg Used: UK15
Date of test: 23/10/2014 12:46:36

Location: Hertfordshire
Coordinates: 524056.3, 212880.65
Elevation: 85.69
Coordinate system:

Remarks:
*Piezometric surface origin: Est. from u_2 piezo data
Termination Remark: Target depth

Date of plot:
27-10-14
Checked by:
Emma Stickland

TEST ID: CPT408B
Page 2 of 2

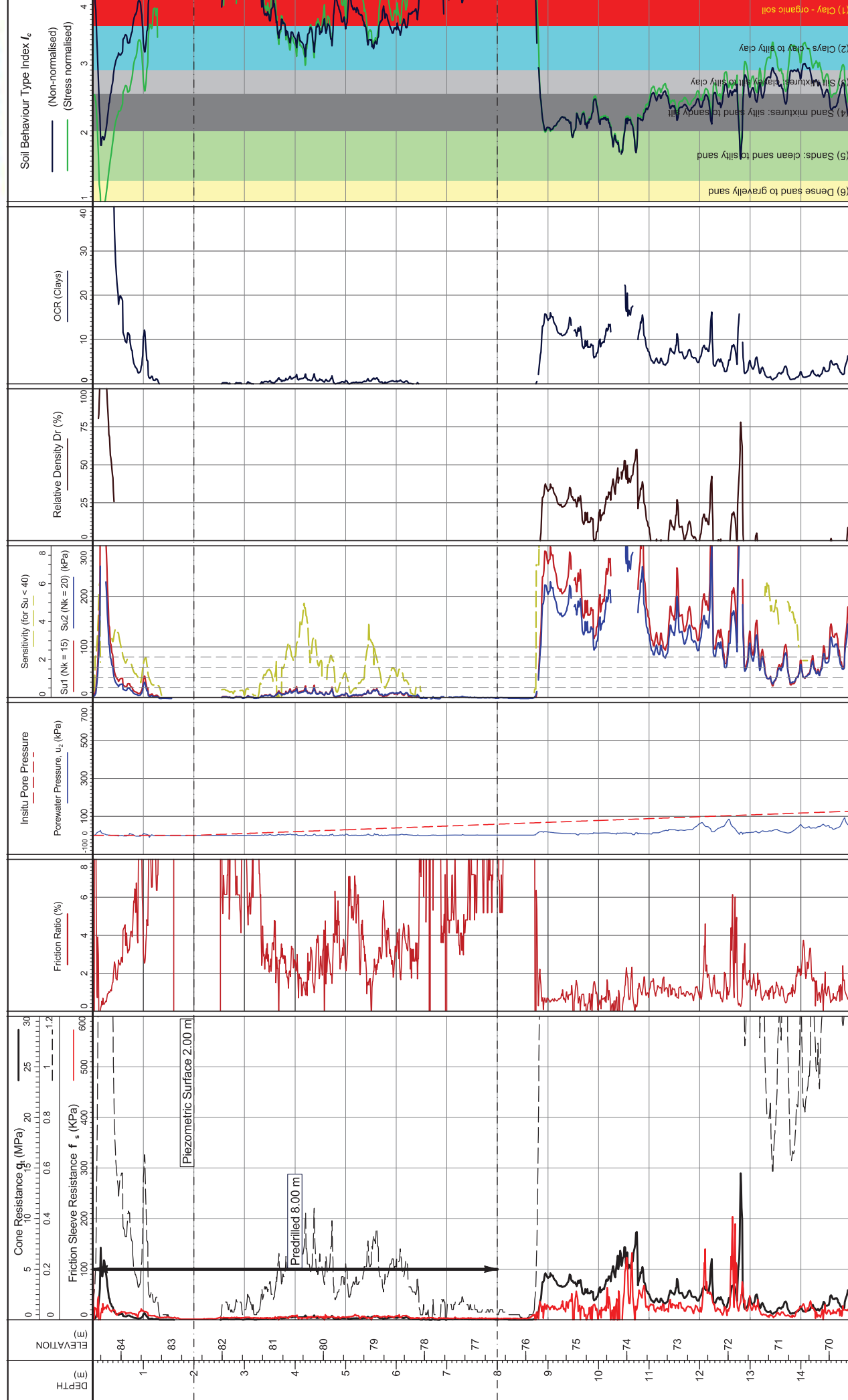
APPENDIX C STANDARD INTERPRETATION RESULTS**LIST OF FIGURES:**

Test ID		Pages included
Cone Penetration Test	CPT401	2
Cone Penetration Test	CPT402	1
Cone Penetration Test	CPT403	2
Cone Penetration Test	CPT404	2
Cone Penetration Test	CPT405	2
Cone Penetration Test	CPT406	1
Cone Penetration Test	CPT407	1
Cone Penetration Test	CPT408	1
Cone Penetration Test	CPT408A	1
Cone Penetration Test	CPT408B	2



Client: DELTA SIMONS

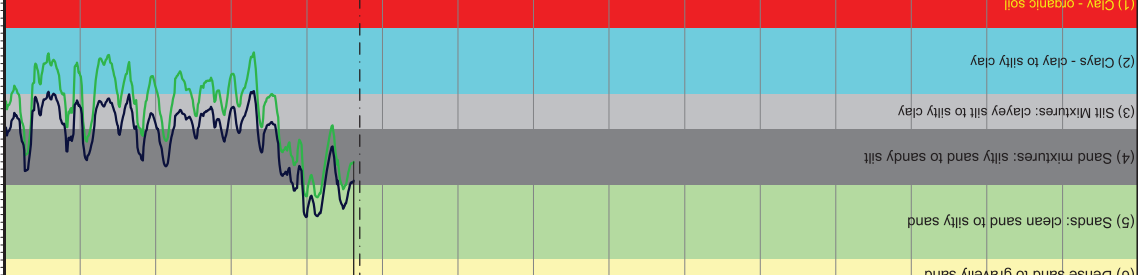
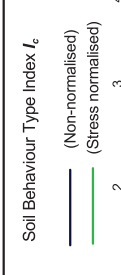
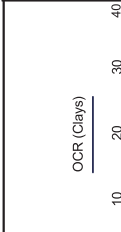
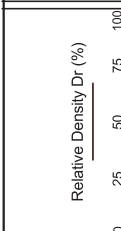
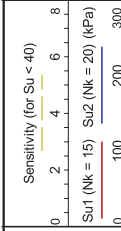
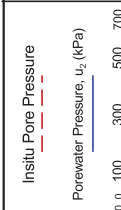
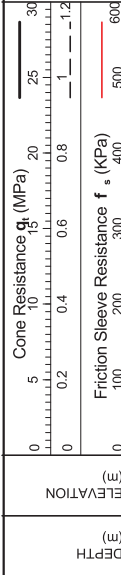
Project: WELWYN GARDEN CITY



Cone area (mm ²): 1500 ConeID: S15-CFIP 843 Operator: Ben Ranson Rig Used: UK15 Date of test: 23/10/2014 10:48:27		Location: Hertfordshire Coordinates: 524113.58, 212667.21 Elevation: 84.56 Coordinate system:	Remarks: *Piezometric surface origin: Est. from u2 piezo data Termination Remark: Target depth	Both drained and undrained parameters are calculated for mixed SBTs = I_c 2.05-2.95. See report section 'Drained and Undrained Behaviour' for discussion. See report section 'Interpretative Data' for methods and discussion of parameter evaluation.	Date of plot: 28-10-14 Lankelma Project Ref: P-106006-1 Checked by: Emma Stickland	TEST ID: CPT401 Page 1 of 2
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Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm2): 1500
ConeID: S15-CFIP 843
Operator: Ben Ranson
Rig Used: UK15
Date of test: 23/10/2014 10:48:27

Location: Hertfordshire
Coordinates: 524113.58, 212667.21
Elevation: 84.56
Coordinate system:

Remarks: *Piezometric surface origin: Est. from u2 piezo data
Termination Remark:
Target depth

Both drained and undrained parameters are calculated for mixed SBTs = $I_c 2.05-2.95$. See report section 'Drained and Undrained Behaviour' for discussion.
Dissipation for methods and discussion of parameter evaluation.
See report section 'Interpretative Data' for methods and discussion of parameter evaluation.

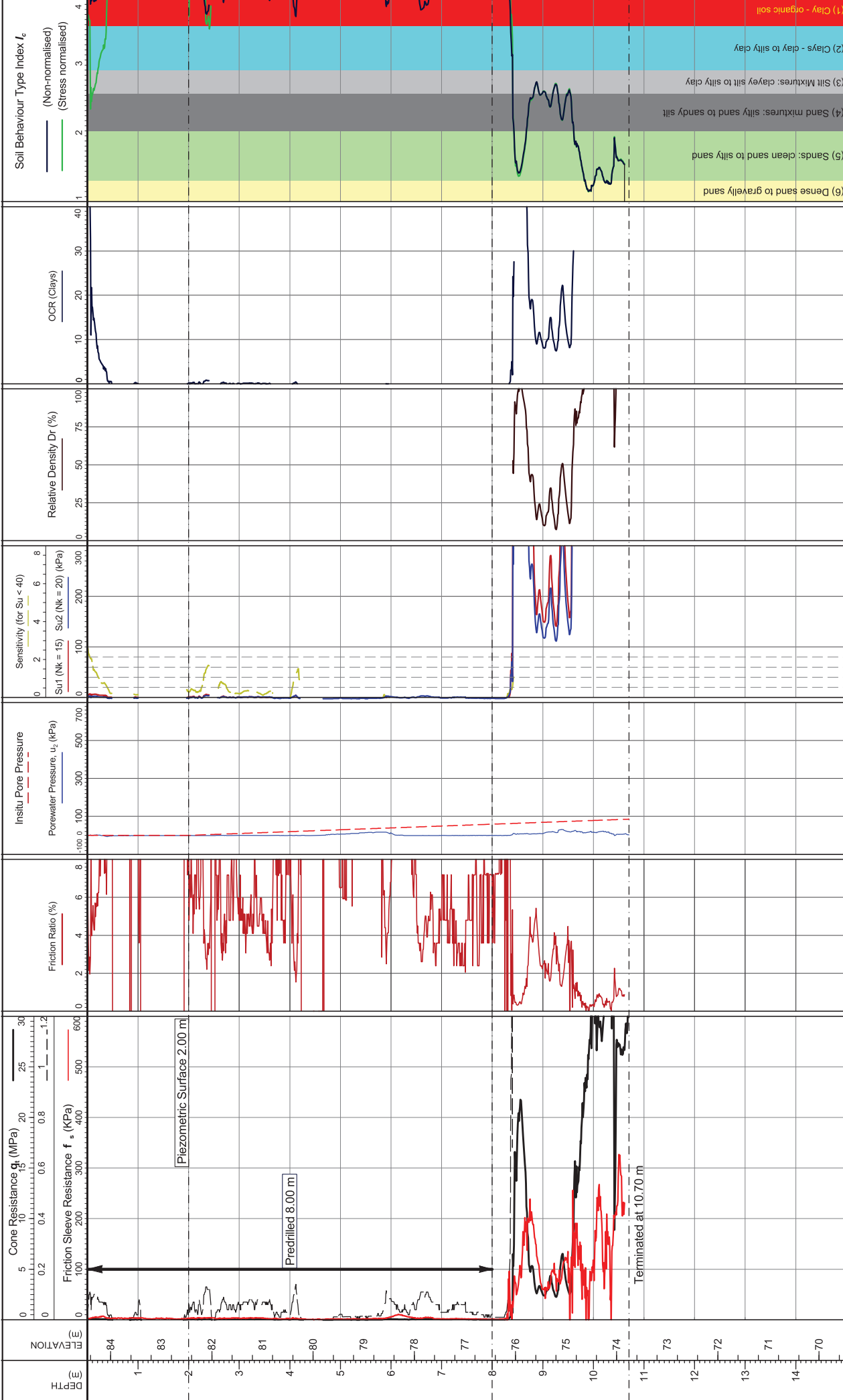
Date of plot: 28-10-14
Lankelma Project Ref: P-106006-1
Checked by: Emma Stickland

TEST ID: CPT401



Client: DELTA SIMONS

Project: WELWYN GARDEN CITY

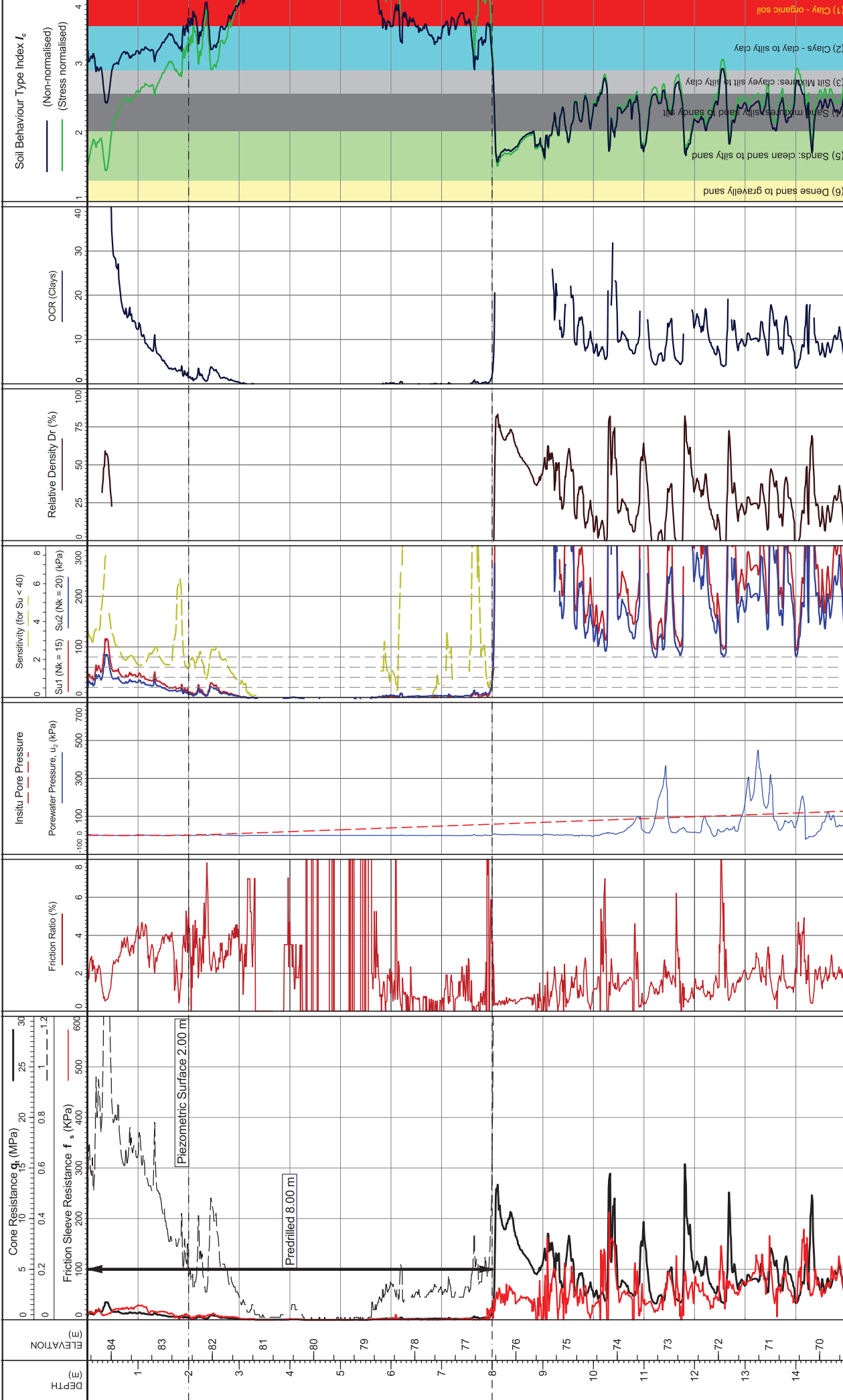


Cone area (mm2): 1500 ConeID: S15-CFIP.843 Operator: Ben Ranson Rig Used: UK15 Date of test: 23/10/2014 09:59:20	Location: Hertfordshire Coordinates: 524164.75, 212638.96 Elevation: 84.46 Coordinate system:	Remarks: *Piezometric surface origin: Est. from u2 piezo data Termination Remark: Lateral support	Both drained and undrained parameters are calculated for mixed SBTs = $I_c 2.05-2.95$. See report section 'Drained and Undrained Behaviour' for discussion. See report section 'Interpretative Data' for methods and discussion of parameter evaluation.	Date of plot: 28-10-14 Checked by: Emma Stickland	TEST ID: CPT402 Page 1 of 1
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Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



TEST ID: CPT403

Page 1 of 2

Date of plot: 28-10-14

Checked by: Emma Stickland

Both drained and undrained parameters are calculated for mixed SBTs = I_c 2.05-2.95. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretative Data' for methods and discussion of parameter evaluation.

Remarks: *Piezometric surface origin: Est. from u2 piezo data

Termination Remark: Target depth

Cone area (mm²): 1500

ConeID: S15-CFIP 843

Operator: Ben Ranson

Rig Used: UK15

Date of test: 23/10/2014 09:05:10

Location: Hertfordshire

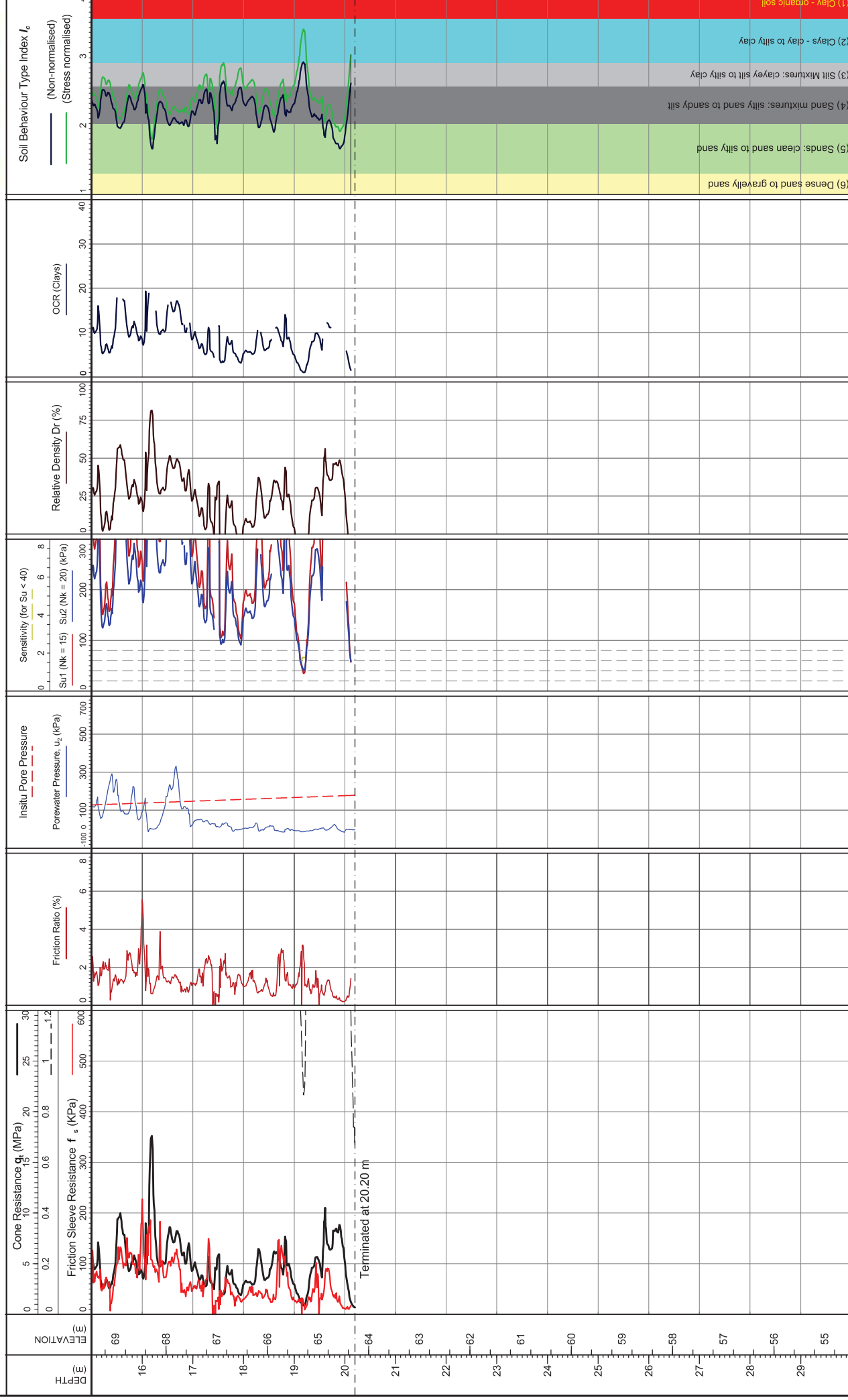
Coordinates: 524176.08, 212732.72

Elevation: 84.47

Coordinate system:

Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Date of plot: 28-10-14
Lankelma Project Ref: P-106006-1

Page 2 of 2

Both drained and undrained parameters are calculated for mixed SBTs = lc 2.05-2.95. See report section "Drained and

Dissipation
Test

Remarks: *Piezometric surface origin: Est. from u2 piezo data

Termination Remark:
Target dentin

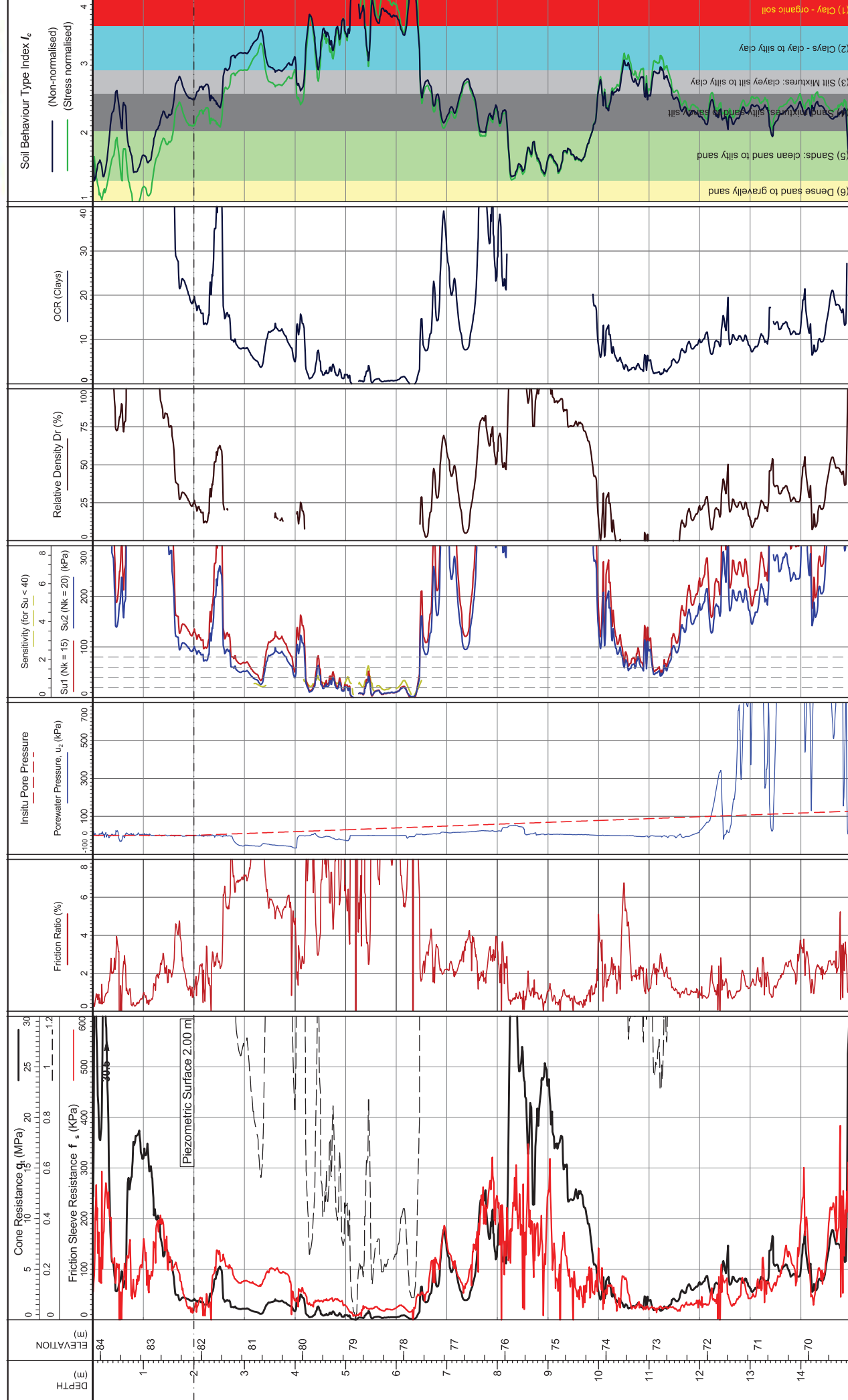
Location: Hertfordshire
Coordinates: 524176.08, 212732.72
Elevation: 84.47
Coordinate system:

Cone area (mm2):1500
ConeID: S15-CFIP.843
Operator: Ben Ranson
Rig Used: UK15
Date of test: 23/10/2014 09:05:10



Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²): 1500
ConeID: S15-CFIP 843
Operator: Ben Ranson
Rig Used: UK15
Date of test: 23/10/2014 14:31:58

Location: Hertfordshire
Coordinates: 524256.84, 213021.7
Elevation: 84.15
Coordinate system:

Remarks: *Piezometric surface origin: Est. from u2 piezo data
Termination Remark:
Target depth

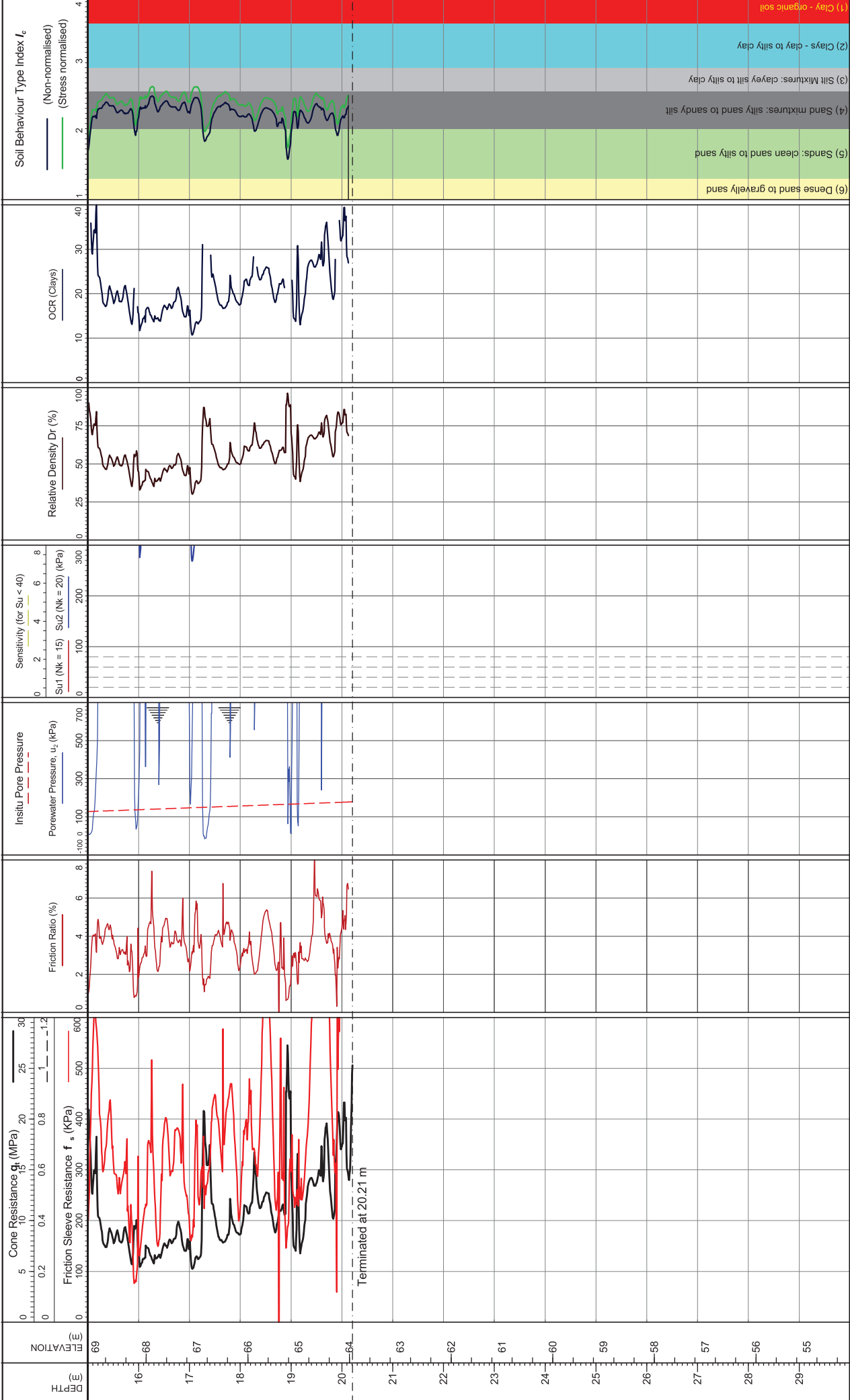
Both drained and undrained parameters are calculated for mixed SBTs = I_c 2.05-2.95. See report section 'Drained and Undrained Behaviour' for discussion.
See report section 'Interpretative Data' for methods and discussion of parameter evaluation.

Date of plot: 28-10-14
Checked by: Emma Stickland

TEST ID: CPT404
Page 1 of 2

Client: DELTA SIMONS

Project: WELWYN GARDEN CITY

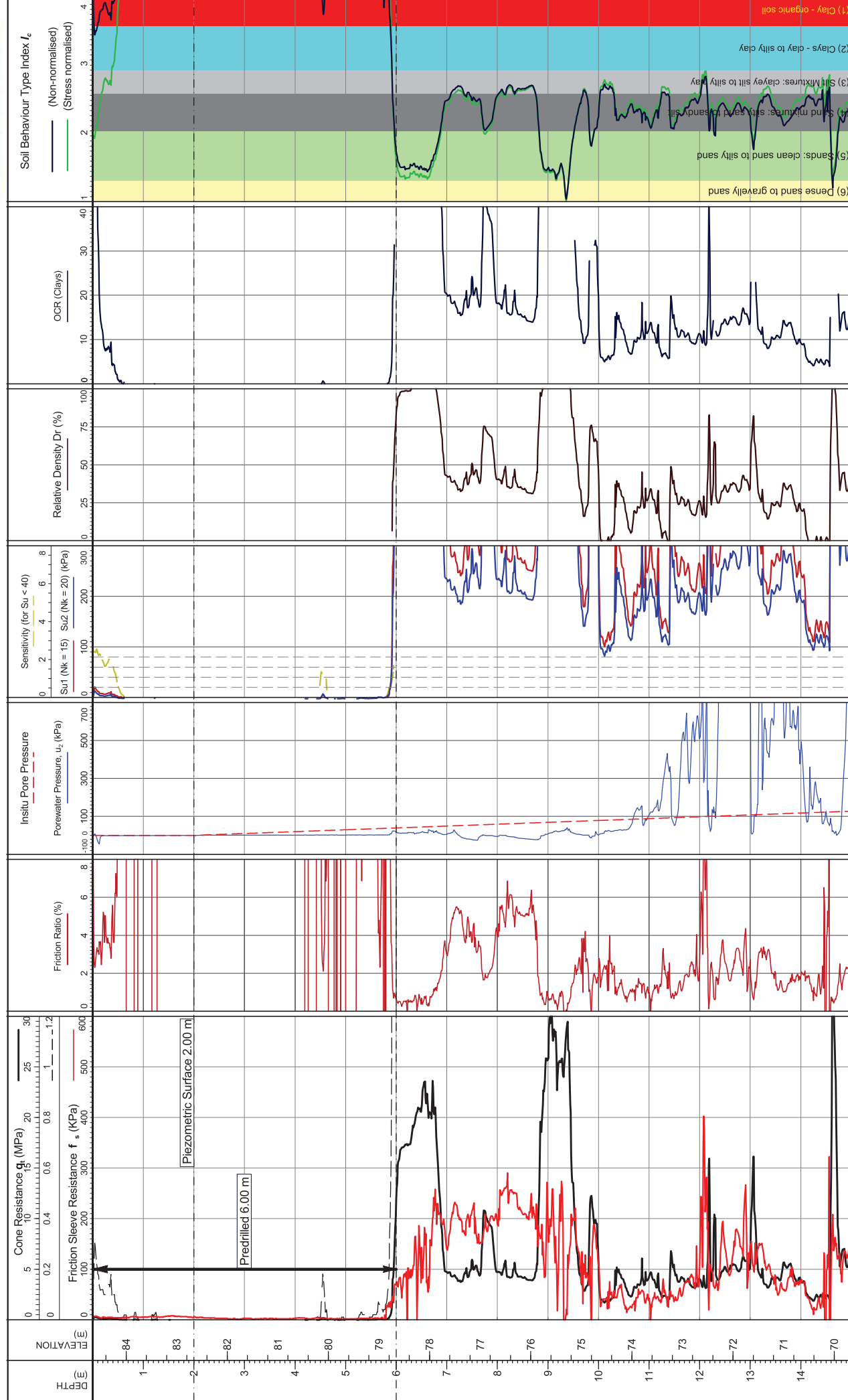


Cone area (mm ²): 1500 ConeID: S15-CFIP.843 Operator: Ben Ranson Rig Used: UK15 Date of test: 23/10/2014 14:31:58	Location: Hertfordshire Coordinates: 524256.84, 213021.7 Elevation: 84.15 Coordinate system:	Remarks: *Piezometric surface origin: Est. from u2 piezo data Termination Remark: Target depth	Both drained and undrained parameters are calculated for mixed SBTs = I_c 2.05-2.95. See report section 'Drained and Undrained Behaviour' for discussion. See report section 'Interpretative Data' for methods and discussion of parameter evaluation.	Date of plot: 28-10-14 Lankelma Project Ref: P-106006-1 Checked by: Emma Stickland	TEST ID: CPT404 Page 2 of 2
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Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²): 1500
ConeID: S15-CFIP 843
Operator: Ben Ranson
Rig Used: UK15
Date of test: 23/10/2014 15:33:32

Location: Hertfordshire
Coordinates: 524141.44, 213021.46
Elevation: 84.66
Coordinate system:

Remarks: *Piezometric surface origin: Est. from u2 piezo data

Termination Remark:
Total reaction load

Both drained and undrained parameters are calculated for mixed SBTs = $I_c 2.05-2.95$. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretative Data' for methods and discussion of parameter evaluation.

Date of plot: 28-10-14
Lankelma Project Ref: P-106006-1

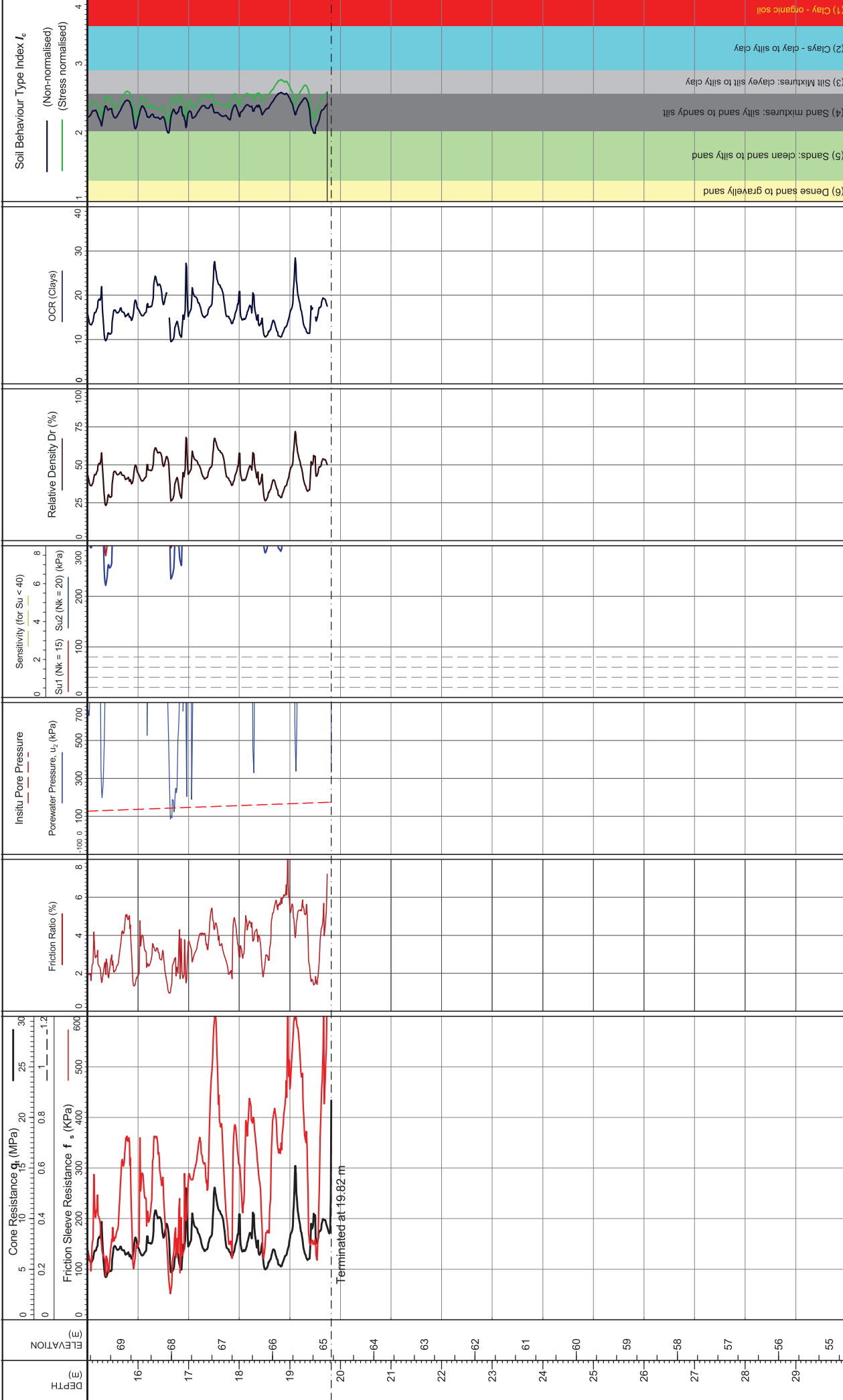
Checked by: Emma Stickland

TEST ID: CPT405

Page 1 of 2

Client: DELTA SIMONS

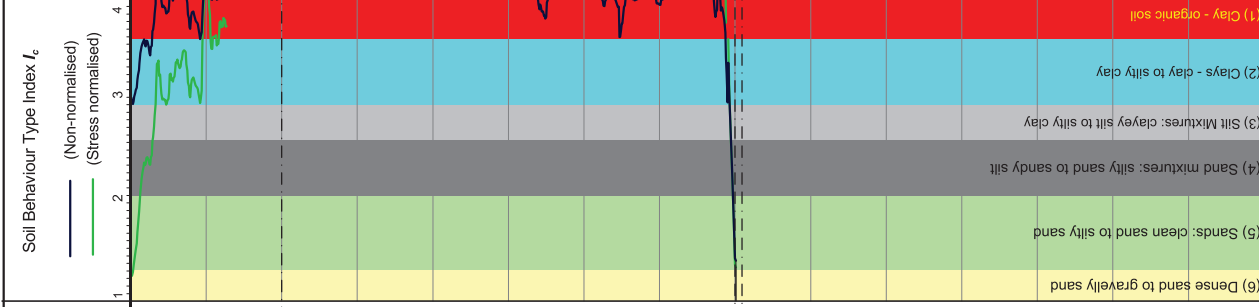
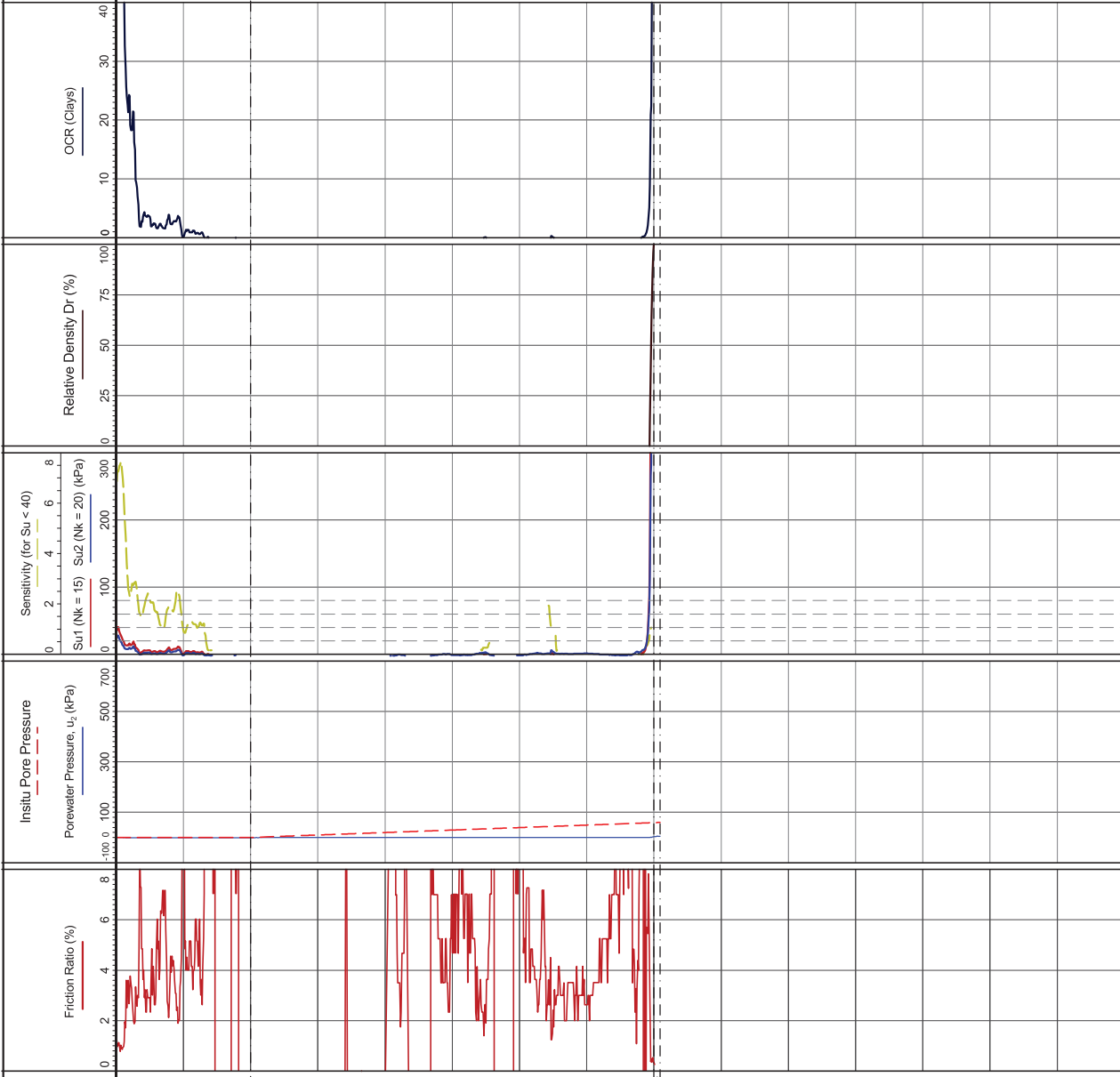
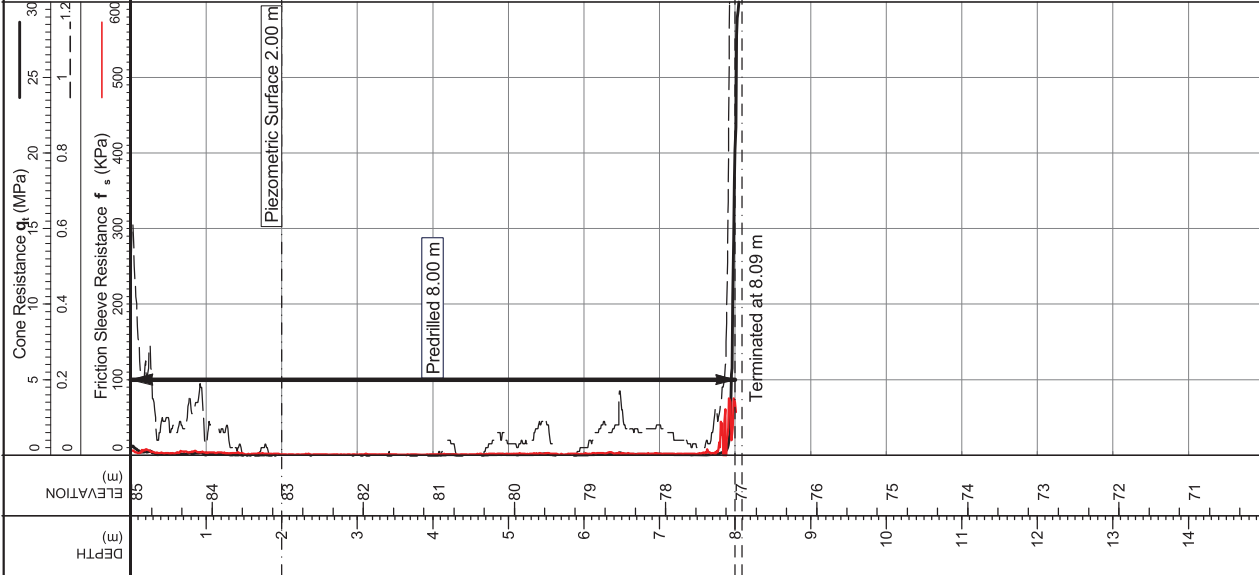
Project: WELWYN GARDEN CITY



Cone area (mm ²): 1500 ConeID: S15-CFIP.843 Operator: Ben Ranson Rig Used: UK15 Date of test: 23/10/2014 15:33:32	Location: Hertfordshire Coordinates: 524141.44, 213021.46 Elevation: 84.66 Coordinate system:	Remarks: *Piezometric surface origin: Est. from u2 piezo data Termination Remark: Total reaction load	Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.05-2.95. See report section 'Drained and Undrained Behaviour' for discussion. See report section 'Interpretative Data' for methods and discussion of parameter evaluation.	Date of plot: 28-10-14 Checked by: Emma Stickland	Date of plot: 28-10-14 Checked by: Emma Stickland	Lankelma Project Ref: P-106006-1	TEST ID: CPT405 Page 2 of 2
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Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²): 1500
ConeID: S15-CFIP 843
Operator: Ben Ranson
Rig Used: UK15
Date of test: 23/10/2014 12:25:58

Location: Hertfordshire
Coordinates: 524054.08, 212913.08
Elevation: 85.08
Coordinate system:

Remarks: *Piezometric surface origin: Est. from u2 piezo data
Termination Remark:
Lateral support

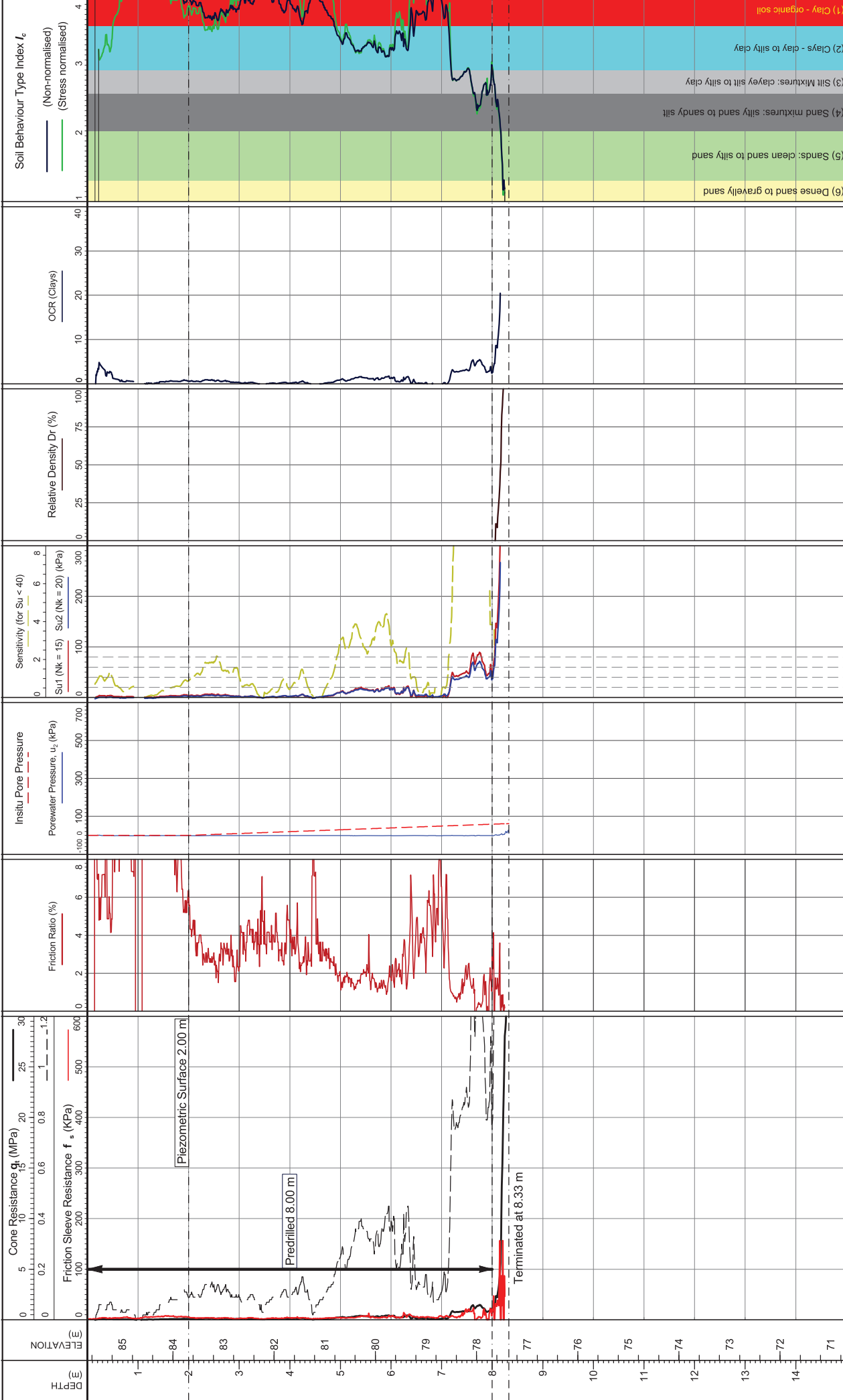
Both drained and undrained parameters are calculated for mixed SBTs = $I_c 2.05-2.95$. See report section 'Drained and Undrained Behaviour' for discussion.
See report section 'Interpretative Data' for methods and discussion of parameter evaluation.

Date of plot: 28-10-14
Checked by: Emma Stickland
TEST ID: CPT406
Page 1 of 1



Client: DELTA SIMONS

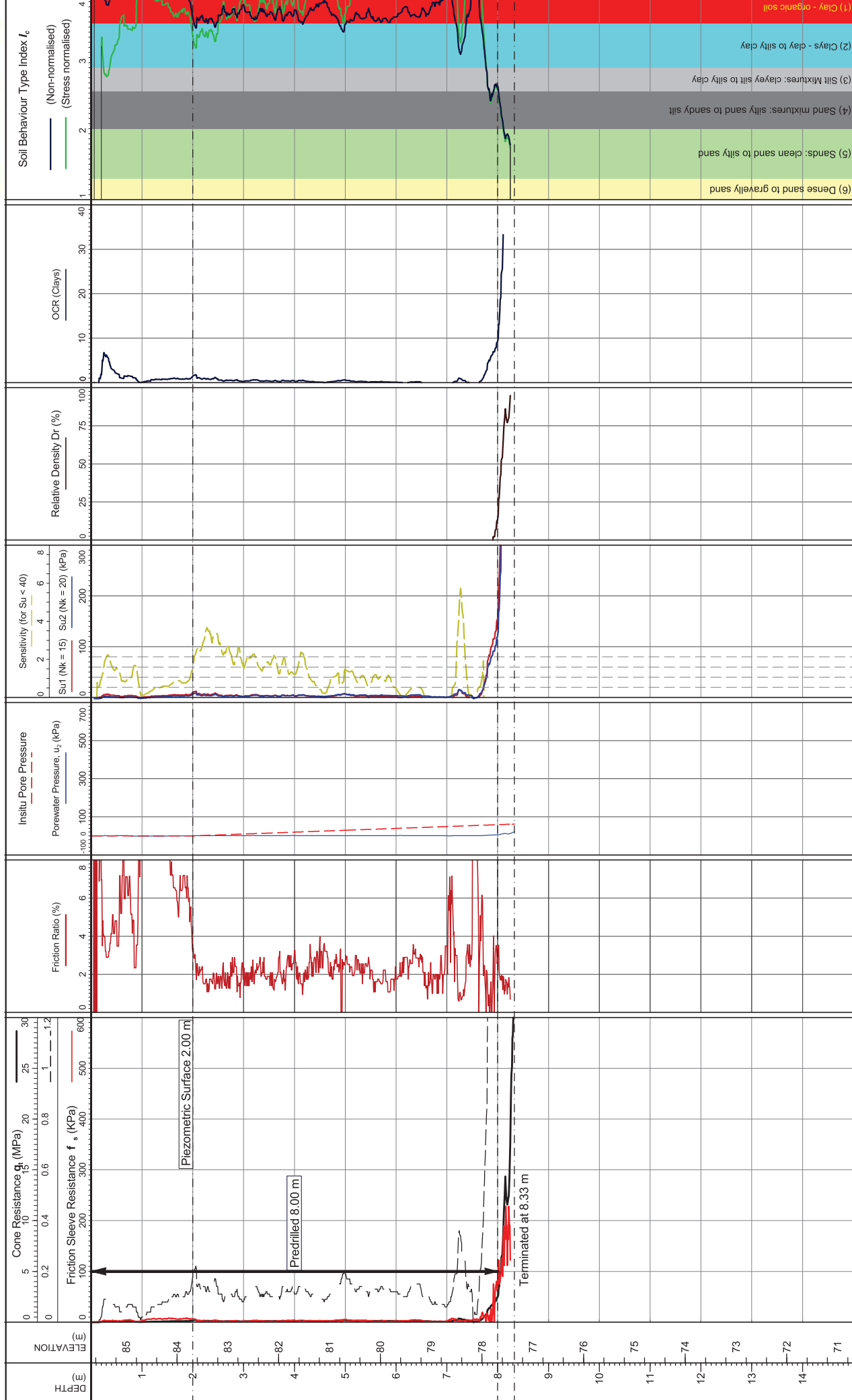
Project: WELWYN GARDEN CITY



Cone area (mm ²): 1500 ConeID: S15-CFIP.843 Operator: Ben Ranson Rig Used: UK15 Date of test: 23/10/2014 11:40:39	Location: Hertfordshire Coordinates: 524056.3, 212880.65 Elevation: 85.69 Coordinate system:	Remarks: *Piezometric surface origin: Est. from u2 piezo data Termination Remark: Lateral support	Both drained and undrained parameters are calculated for mixed SBTs = I_c 2.05-2.95. See report section 'Drained and Undrained Behaviour' for discussion. Dissipation Test See report section 'Interpretative Data' for methods and discussion of parameter evaluation.	Date of plot: 28-10-14 Lankelma Project Ref: P-106006-1 Checked by: Emma Stickland	TEST ID: CPT408 Page 1 of 1
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Client: DELTA SIMONS

Project: WELWYN GARDEN CITY

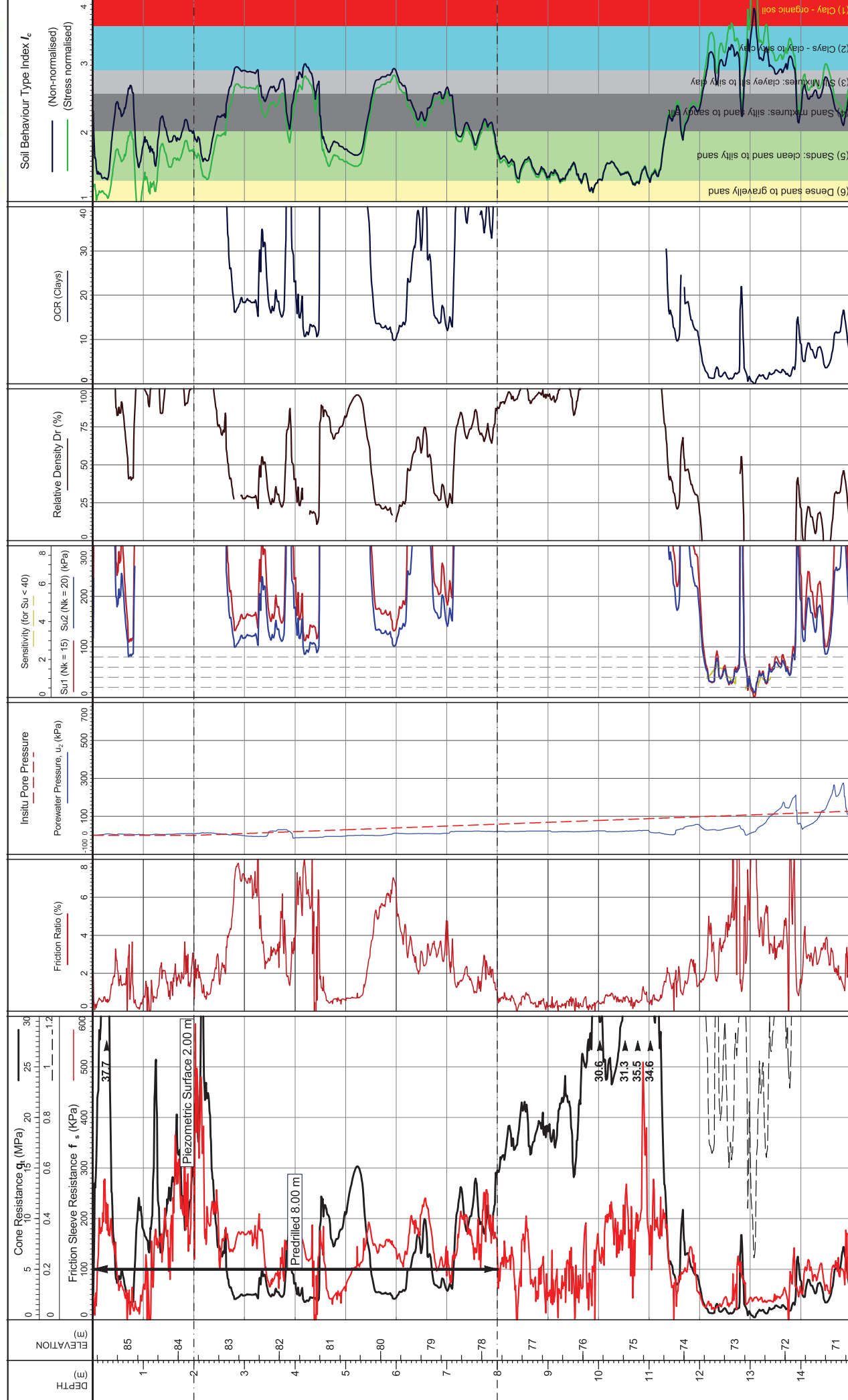


Cone area (mm ²): 1500 ConeID: S15-CFIP 843 Operator: Ben Ranson Rig Used: UK15 Date of test: 23/10/2014 12:03:01	Location: Hertfordshire Coordinates: 524056.3, 212880.65 Elevation: 85.69 Coordinate system:	Remarks: *Piezometric surface origin: Est. from u2 piezo data Termination Remark: Lateral support	Both drained and undrained parameters are calculated for mixed SBTs = $I_c 2.05-2.95$. See report section 'Drained and Undrained Behaviour' for discussion. See report section 'Interpretative Data' for methods and discussion of parameter evaluation.	Date of plot: 28-10-14 Lankelma Project Ref: P-106006-1 Checked by: Emma Stickland	TEST ID: CPT408A Page 1 of 1
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Client: DELTA SIMONS

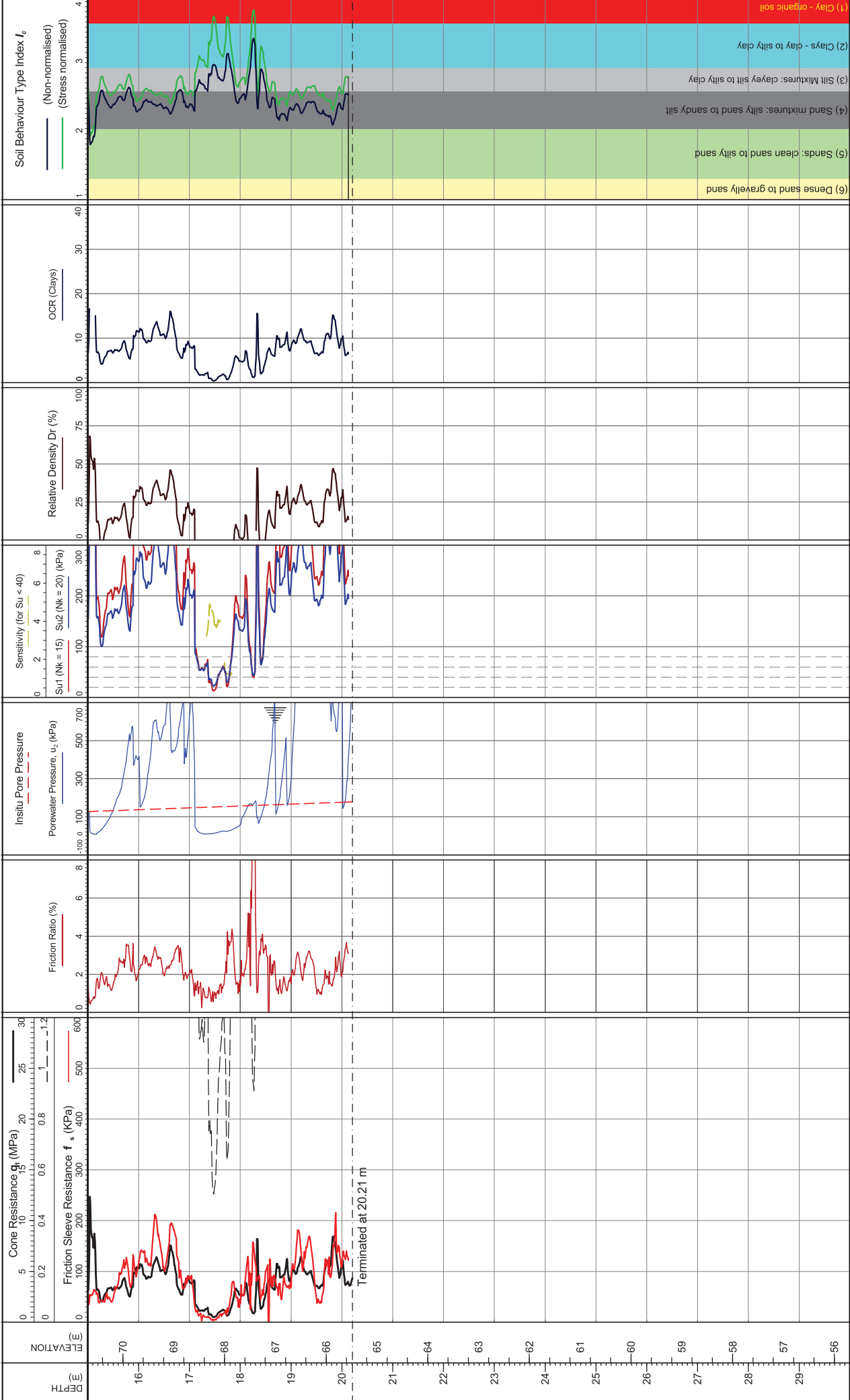
Project: WELWYN GARDEN CITY



TEST ID: CPT408B
Date of plot: 28-10-14
Date of plot: 28-10-14
Checked by: Emma Stickland
Lankelma Project Ref: P-106006-1
Both drained and undrained parameters are calculated for mixed SBTs = I_c 2.05-2.95. See report section 'Drained and Undrained Behaviour' for discussion.
See report section 'Interpretative Data' for methods and discussion of parameter evaluation.
Remarks: *Piezometric surface origin: Est. from u2 piezo data
Termination Remark: Target depth
Location: Hertfordshire
Coordinates: 524056.3, 212880.65
Elevation: 85.69
Coordinate system:
Cone area (mm2): 1500
ConeID: S15-CFIP 843
Operator: Ben Ranson
Rig Used: UK15
Date of test: 23/10/2014 12:46:36

Client: DELTA SIMONS

Project: WELWYN GARDEN CITY



Cone area (mm²): 1500
ConeID: S15-CFIP.843
Operator: Ben Ranson
Rig Used: UK15
Date of test: 23/10/2014 12:46:36

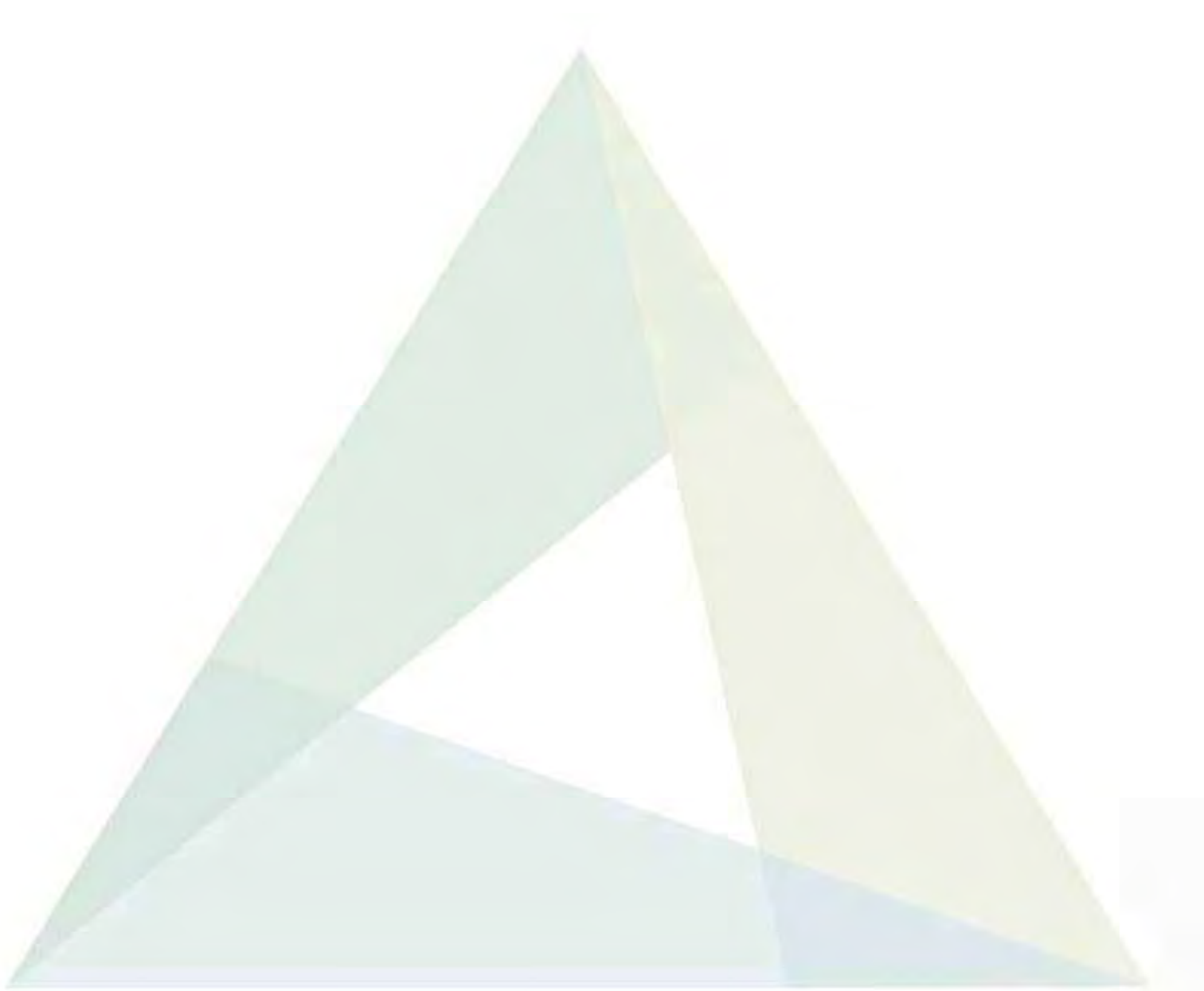
Location: Hertfordshire
Coordinates: 524056.3, 212880.65
Elevation: 85.69
Coordinate system:

Remarks: *Piezometric surface origin: Est. from u2 piezo data
Termination Remark:
Target depth

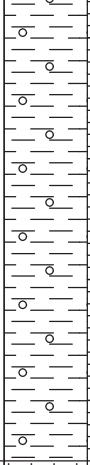
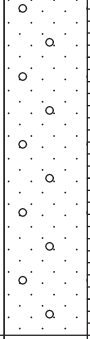
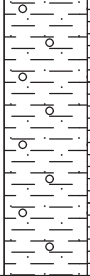
Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.05-2.95. See report section 'Drained and Undrained Behaviour' for discussion.
Dissipation Test for methods and discussion of parameter evaluation.

Date of plot: 28-10-14
Lankelma Project Ref: P-106006-1
Checked by: Emma Stickland

TEST ID: CPT408B



Project:	Broadwater Road, Welwyn Garden City	Project No:	2342.18	Hole ID:	CPT401
ROTARY OPEN HOLE BOREHOLE LOG		Date:		Client:	Spenn Hill Developments Ltd

Description Of Strata	Legend	Water	Casing Depth / (Diam. mm) Date	Reduced Level / Depth (Thickness)	Flush Return %	Core Recovery			Depth / Core Length	Sample Details		Test Results SPT N Value/Drive mm	Backfill Details
						TCR %	SCR %	RQD %		Type	Ref.		
MADE GROUND: Concrete.				84.36 0.20 84.26 0.30									
MADE GROUND: Fine to coarse gravel.													
Orange gravelly CLAY. (LOWESTOFT FORMATION).				(4.20)									
Orange brown gravelly SAND with bands of clay. (LOWESTOFT FORMATION).				80.06 4.50 (2.80)									
Soft to firm brown gravelly sandy CLAY. (KESGRAVE CATHMENT SUBGROUP).				77.26 7.30 (2.30)									
Borehole complete at 9.60m bgl.				74.96 9.60									

REMARKS :

- Engineer verified logged in general accordance to BS 5930:2010.
- Area CAT scanned prior to excavation.
- Borehole remained dry on completion.
- Backfilled with arisings.

WATER LEVEL OBSERVATIONS

Date	Time	Water Strike	Standing Level	Casing Depth

NO WATER ENCOUNTERED:

All measurements in metres unless otherwise stated	10m/page Scale: 1:62.50	Coordinates to National Grid Ground Level to Ordnance Datum	Page 1 of 1
Plant Used: Dando 2000	Coordinates / Level (mAOD): E: 524113.58 N: 212667.21 Level: 84.56	Logged By: WC	Checked By: WC Approved By: SS

Project:	Broadwater Road, Welwyn Garden City	Project No:	2342.18	Hole ID:	CPT402
ROTARY OPEN HOLE BOREHOLE LOG		Date:		Client:	Spenn Hill Developments Ltd

Description Of Strata	Legend	Water	Casing Depth / (Diam. mm) Date	Reduced Level / Depth (Thickness)	Flush Return %	Core Recovery			Depth / Core Length	Sample Details		Test Results SPT N Value/Drive mm	Backfill Details
						TCR %	SCR %	RQD %		Type	Ref.		
MADE GROUND: Concrete.				84.26 0.20 84.16 0.30									
MADE GROUND: Gravel. Orange slightly gravelly CLAY. (LOWESTOFT FORMATION).				(3.20)									
Orange SAND. (LOWESTOFT FORMATION).				80.96 3.50 (1.50)									
Soft brown sandy CLAY. (LOWESTOFT FORMATION).				79.46 5.00 (2.40)									
Clayey gravelly SAND. (POSSIBLE KESGRAVE CATHMENT SUBGROUP).				77.06 7.40 (0.70)									
CLAY. (POSSIBLE KESGRAVE CATHMENT SUBGROUP).				76.36 8.10 (0.90)									
Borehole complete at 9.00m bgl.				75.46 9.00									

REMARKS :

- Engineer verified logged in general accordance to BS 5930:2010.
- Area CAT scanned prior to excavation.
- Borehole remained dry on completion.
- Backfilled with arisings.

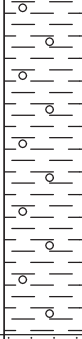
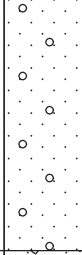
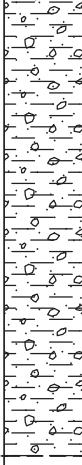
WATER LEVEL OBSERVATIONS

Date	Time	Water Strike	Standing Level	Casing Depth

NO WATER ENCOUNTERED:

All measurements in metres unless otherwise stated	10m/page Scale: 1:62.50	Coordinates to National Grid Ground Level to Ordnance Datum	Page 1 of 1
Plant Used: Dando 2000	Coordinates / Level (mAOD): E: 524164.75 N: 212638.96 Level: 84.46	Logged By: WC	Checked By: WC Approved By: SS

Project:	Broadwater Road, Welwyn Garden City	Project No:	2342.18	Hole ID:	CPT403
ROTARY OPEN HOLE BOREHOLE LOG		Date:		Client:	Spenn Hill Developments Ltd

Description Of Strata	Legend	Water	Casing Depth / (Diam. mm) Date	Reduced Level / Depth (Thickness)	Flush Return %	Core Recovery			Depth / Core Length	Sample Details		Test Results SPT N Value/Drive mm	Backfill Details
						TCR %	SCR %	RQD %		Type	Ref.		
MADE GROUND: Concrete.				84.17 0.30									
Orange brown gravelly CLAY. (LOWESTOFT FORMATION).				(2.80)									
Brown gravelly SAND. (LOWESTOFT FORMATION).				81.37 3.10									
Brown sandy gravelly CLAY. (POSSIBLE KESGRAVE CATHMENT SUBGROUP).				79.27 5.20									
Borehole complete at 9.00m bgl.				75.47 9.00									

REMARKS :

1. Engineer verified logged in general accordance to BS 5930:2010.
2. Area CAT scanned prior to excavation.
3. Borehole remained dry on completion.
4. Backfilled with arisings.

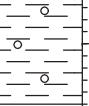
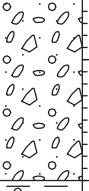
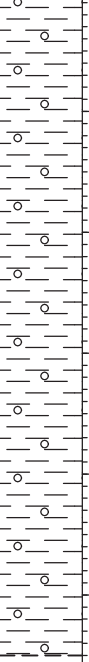
WATER LEVEL OBSERVATIONS

Date	Time	Water Strike	Standing Level	Casing Depth

NO WATER ENCOUNTERED:

All measurements in metres unless otherwise stated	10m/page Scale: 1:62.50	Coordinates to National Grid Ground Level to Ordnance Datum	Page 1 of 1
Plant Used: Dando 2000	Coordinates / Level (mAOD): E: 524176.08 N: 212732.72 Level: 84.47	Logged By: WC	Checked By: WC Approved By: SS

Project:	Broadwater Road, Welwyn Garden City	Project No:	2342.18	Hole ID:	CPT404
ROTARY OPEN HOLE BOREHOLE LOG		Date:		Client:	Spenn Hill Developments Ltd

Description Of Strata	Legend	Water	Casing Depth / (Diam. mm) Date	Reduced Level / Depth (Thickness)	Flush Return %	Core Recovery			Depth / Core Length	Sample Details		Test Results	Backfill Details
						TCR %	SCR %	RQD %		Type	Ref.	SPT N Value/Drive mm	
MADE GROUND: Asphalt.				84.00 0.15 83.80 0.35									
MADE GROUND: Gravelly clay. (FILL)													
Soft to firm gravelly CLAY. (LOWESTOFT FORMATION).				(1.15)									
				82.65 1.50									
Sandy fine to coarse GRAVEL. (LOWESTOFT FORMATION).				(1.50)									
				81.15 3.00									
Soft to firm gravelly CLAY. (LOWESTOFT FORMATION).				(5.50)									
Borehole complete at 8.50m bgl.				75.65 8.50									

REMARKS :

1. Engineer verified logged in general accordance to BS 5930:2010.
2. Area CAT scanned prior to excavation.
3. Borehole remained dry on completion.
4. Backfilled with arisings.

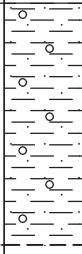
WATER LEVEL OBSERVATIONS

Date	Time	Water Strike	Standing Level	Casing Depth

NO WATER ENCOUNTERED:

All measurements in metres unless otherwise stated	10m/page Scale: 1:62.50	Coordinates to National Grid Ground Level to Ordnance Datum	Page 1 of 1
Plant Used: Dando 2000	Coordinates / Level (mAOD): E: 524256.84 N: 213021.7 Level: 84.15	Logged By: WC	Checked By: WC Approved By: SS

Project:	Broadwater Road, Welwyn Garden City	Project No:	2342.18	Hole ID:	CPT405
ROTARY OPEN HOLE BOREHOLE LOG		Date:		Client:	Spenn Hill Developments Ltd

Description Of Strata	Legend	Water	Casing Depth / (Diam. mm) Date	Reduced Level / Depth (Thickness)	Flush Return %	Core Recovery			Depth / Core Length	Sample Details		Test Results SPT N Value/Drive mm	Backfill Details
						TCR %	SCR %	RQD %		Type	Ref.		
MADE GROUND: Concrete.				84.36 0.30									
Soft slightly gravelly sandy CLAY. (LOWESTOFT FORMATION).				(6.70)									
Soft to firm gravelly sandy CLAY. (POSSIBLE KESGRAVE CATHMENT SUBGROUP).				77.66 7.00 (2.00)									
Borehole complete at 9.00m bgl.				75.66 9.00									

REMARKS :

1. Engineer verified logged in general accordance to BS 5930:2010.
2. Area CAT scanned prior to excavation.
3. Borehole remained dry on completion.
4. Backfilled with arisings.

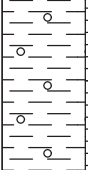
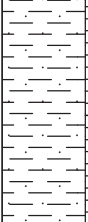
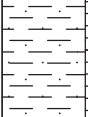
WATER LEVEL OBSERVATIONS

Date	Time	Water Strike	Standing Level	Casing Depth

NO WATER ENCOUNTERED:

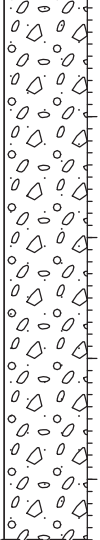
All measurements in metres unless otherwise stated	10m/page Scale: 1:62.50	Coordinates to National Grid Ground Level to Ordnance Datum	Page 1 of 1
Plant Used: Dando 2000	Coordinates / Level (mAOD): E: 524141.44 N: 213021.46 Level: 84.66	Logged By: WC	Checked By: WC Approved By: SS

Project: Broadwater Road, Welwyn Garden City	Project No: 2342.18	Hole ID: CPT406
ROTARY OPEN HOLE BOREHOLE LOG		Date: Client: Spenn Hill Developments Ltd

Description Of Strata	Legend	Water	Casing Depth / (Diam. mm) Date	Reduced Level / Depth (Thickness)	Flush Return %	Core Recovery			Depth / Core Length	Sample Details		Test Results	Backfill Details
						TCR %	SCR %	RQD %		Type	Ref.	SPT N Value/Drive mm	
MADE GROUND: Concrete and brick.				84.98 0.10									
Soft to firm gravelly CLAY. (LOWESTOFT FORMATION).				(1.70)									
Sandy medium to coarse GRAVEL. (LOWESTOFT FORMATION).				83.28 1.80									
				(1.20)									
Brown slightly gravelly sandy CLAY. (LOWESTOFT FORMATION).				82.08 3.00									
				(2.10)									
Sandy medium to coarse GRAVEL. (KESGRAVE CATHMENT SUBGROUP).				79.98 5.10									
				(1.90)									
Coarse GRAVEL. Occasional cobbles. (KESGRAVE CATHMENT SUBGROUP).				78.08 7.00									
				(0.50)									
Soft to firm sandy CLAY. (POSSIBLE KESGRAVE CATHMENT SUBGROUP).				77.58 7.50									
				(1.10)									
Borehole complete at 8.60m bgl.				76.48 8.60									

REMARKS : 1. Engineer verified logged in general accordance to BS 5930:2010. 2. Area CAT scanned prior to excavation. 3. Borehole remained dry on completion. 4. Backfilled with arisings.						WATER LEVEL OBSERVATIONS					
							Date	Time	Water Strike	Standing Level	Casing Depth
						NO WATER ENCOUNTERED:					
All measurements in metres unless otherwise stated			10m/page Scale: 1:62.50		Coordinates to National Grid Ground Level to Ordnance Datum				Page 1 of 1		
Plant Used: Dando 2000			Coordinates / Level (mAOD): E: 524054.08 N: 212913.08 Level: 85.08			Logged By: WC		Checked By: WC		Approved By: SS	

Project:	Broadwater Road, Welwyn Garden City	Project No:	2342.18	Hole ID:	CPT407
ROTARY OPEN HOLE BOREHOLE LOG		Date:		Client:	Spn Hill Developments Ltd

Description Of Strata	Legend	Water	Casing Depth / (Diam. mm) Date	Reduced Level / Depth (Thickness)	Flush Return %	Core Recovery			Depth / Core Length	Sample Details		Test Results SPT N Value/Drive mm	Backfill Details
						TCR %	SCR %	RQD %		Type	Ref.		
TOPSOIL.				85.04 0.10									
MADE GROUND: Sandy gravelly clay.				84.64 0.50									
Orange brown sandy GRAVEL. Occasional bands of clays. Infrequent cobbles. (POSSIBLE LOWEST OF FORMATION).				(5.00)									
Borehole complete at 5.50m bgl.				79.64 5.50									

REMARKS :

1. Engineer verified logged in general accordance to BS 5930:2010.
2. Area CAT scanned prior to excavation.
3. Borehole remained dry on completion.
4. Backfilled with arisings.

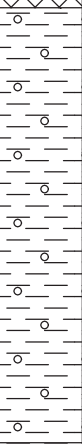
WATER LEVEL OBSERVATIONS

Date	Time	Water Strike	Standing Level	Casing Depth

NO WATER ENCOUNTERED:

All measurements in metres unless otherwise stated	10m/page Scale: 1:62.50	Coordinates to National Grid Ground Level to Ordnance Datum	Page 1 of 1
Plant Used: Dando 2000	Coordinates / Level (mAOD): E: 524192.11 N: 212866.79 Level: 85.14	Logged By: WC	Checked By: WC Approved By: SS

Project:	Broadwater Road, Welwyn Garden City	Project No:	2342.18	Hole ID:	CPT408
ROTARY OPEN HOLE BOREHOLE LOG		Date:		Client:	Spen Hill Developments Ltd

Description Of Strata	Legend	Water	Casing Depth / (Diam. mm) Date	Reduced Level / Depth (Thickness)	Flush Return %	Core Recovery			Depth / Core Length	Sample Details		Test Results SPT N Value/Drive mm	Backfill Details
						TCR %	SCR %	RQD %		Type	Ref.		
MADE GROUND: Concrete.				83.58 0.30									
MADE GROUND: Concrete and brick.				(0.50) 83.08 0.80									
Orange gravelly CLAY. (LOWESTOFT FORMATION).				(3.60)									
SAND with bands of flint gravel. (KESGRAVE CATHMENT SUBGROUP).				79.48 4.40									
Soft CLAY. (POSSIBLE KESGRAVE CATHMENT SUBGROUP).				76.68 7.20									
Borehole complete at 9.00m bgl.				(1.80) 74.88 9.00									

REMARKS :

1. Engineer verified logged in general accordance to BS 5930:2010.
2. Area CAT scanned prior to excavation.
3. Borehole remained dry on completion.
4. Backfilled with arisings.

WATER LEVEL OBSERVATIONS

Date	Time	Water Strike	Standing Level	Casing Depth

NO WATER ENCOUNTERED:

All measurements in metres unless otherwise stated	10m/page Scale: 1:62.50	Coordinates to National Grid Ground Level to Ordnance Datum	Page 1 of 1
Plant Used: Dando 2000	Coordinates / Level (mAOD): E: 524110.92 N: 213053.28 Level: 83.88	Logged By: WC	Checked By: WC Approved By: SS

Delta-Simons
3 Henley Office Park, Doddington Road,
Lincoln, LN6 3QR
Tel: +44 (0) 870 0400 012
Fax: +44 (0) 1522 698393
Email: info@deltasimons.com



Project:	Broadwater Road, Welwyn Garden City	Project No:	2342.18	Hole ID:	CPT408B
		Date:		Client:	Spenn Hill Developments Ltd

Description Of Strata	Legend	Water	Casing Depth / (Diam. mm) Date	Depth (Thickness)	Flush Return %	Core Recovery			Depth / Core Length	Sample Details		Test Results	
						TCR %	SCR %	RQD %		Type	Ref.		
				1.00									
				(7.00)									
				8.00									
				(3.50)									
				11.50									
				12.10									
				(1.80)									
				13.90									
				(3.30)									
				17.20									
				(1.30)									
				18.50									
				(1.70)									
				20.20									

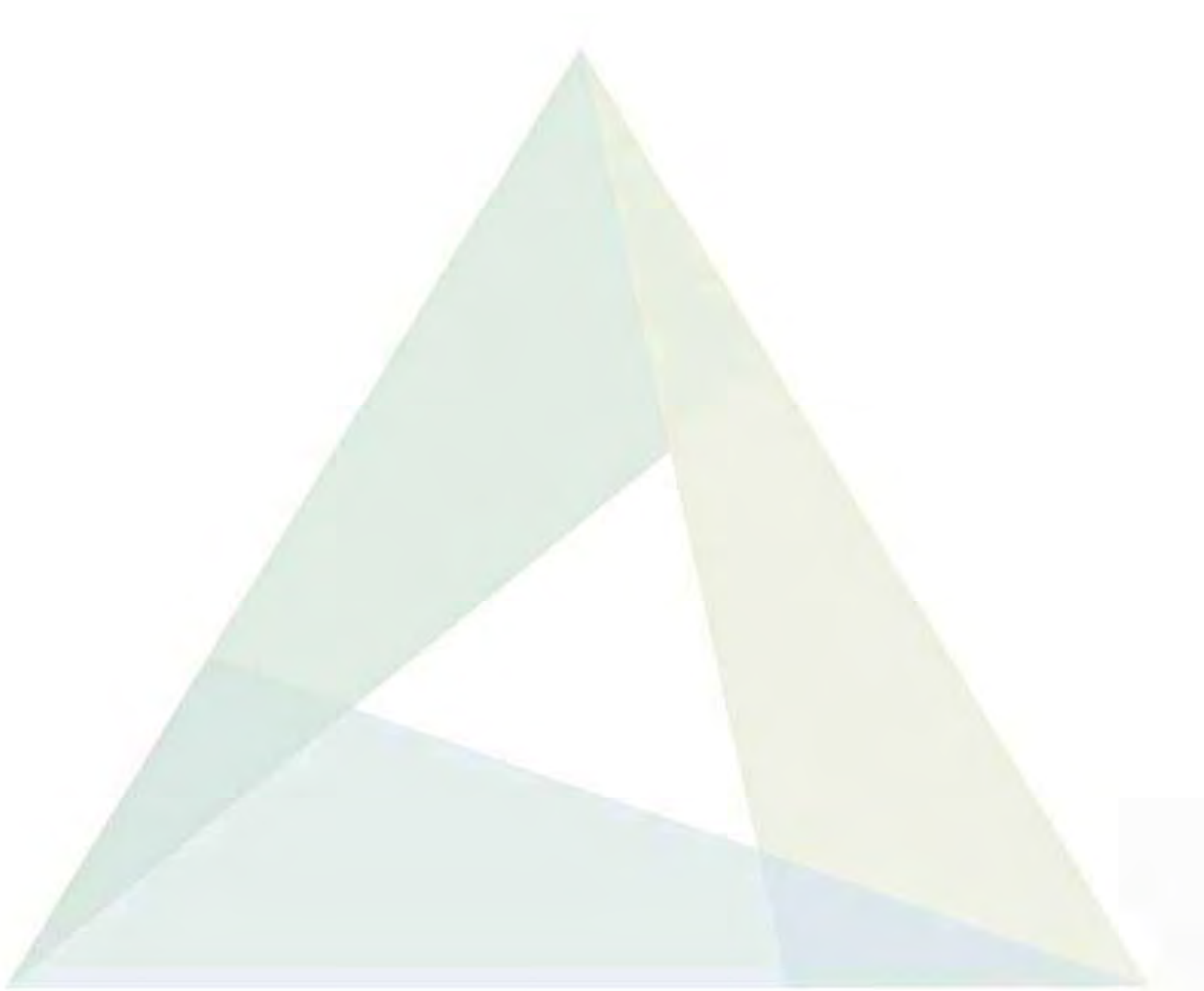
REMARKS :

WATER LEVEL OBSERVATIONS

Date	Time	Water Strike	Standing Level	Casing Depth

NO WATER ENCOUNTERED:

All measurements in metres unless otherwise stated	10m/page Scale: 1:152.63	Coordinates to Local Grid Ground Level to Local Datum	Page 1 of 1
Plant Used:	Coordinates / Level (mAOD): E: 524051.85 N: 212879.17 Level: 85.19	Logged By: WC	Checked By: WC Approved By: SS



Contract Number: PSL14/5609

Client's Reference:

Report Date: 21 November 2014

Client Name: Delta Simons Environmental Consultant
3 Henley Office Park
Doddington Road
Lincoln

LN6 3QR

For the attention of: Will Capps

Contract Title: Welwyn Garden City

Date Received: 30/10/2014

Date Commenced: 30/10/2014

Date Completed: 14/11/2014

Notes: Observations and Interpretations are outside the UKAS Accreditation

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

Checked and Approved Signatories:



R Gunson
(Director)

A Watkins
(Director)

M Beastall
(Laboratory Manager)

D Lambe
(Senior Technician)

S Royle
(Senior Technician)

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Depth m	Description of Sample
BH401	3	D	2.50-3.00	Brown very gravelly very sandy CLAY.
BH401	2	B	6.00-6.50	Brown very sandy GRAVEL.
BH402	2	B	5.00-5.50	Brown gravelly sandy CLAY.
BH402	10	D	13.50-13.95	Pale brown CLAY with chalk
BH403	4	D	3.50-3.95	Brown very gravelly very sandy CLAY.
BH403	4	B	16.50-16.95	White CHALK.
BH404	1	U	2.50-2.95	Firm brown very sandy CLAY.
BH404	5	D	5.00	Brown slightly gravelly sandy CLAY.
BH404	3	B	8.40	Brown sandy slightly silty GRAVEL.
BH405	5	D	4.50-4.95	Brown very gravelly very sandy CLAY.
BH406	1	B	2.50-2.95	Brown very gravelly very sandy CLAY.
BH406	1	U	7.50-7.95	Soft brown very sandy CLAY.
BH406	2	B	9.00-9.45	Brown very sandy slightly silty GRAVEL.
BH406	18	D	24.00-24.45	White CHALK.
BH407	1	U	6.00-6.45	Firm brown gravelly very sandy CLAY.
BH407	9	D	7.50-7.95	Brown very gravelly very sandy CLAY.
BH408	2	B	2.50-3.00	Brown very gravelly very sandy CLAY.
BH408	3	B	14.90	Brown gravelly very sandy silty CLAY with chalk.
BH409	3	D	1.50-2.00	Brown very gravelly slightly sandy CLAY.

PST
Professional Soils Laboratory

WELWYN GARDEN CITY:

Contract No:

SL14/5609

Client Ref:

GC2342-18



Hole Number	Sample Number	Sample Type	Depth m	Description of Sample
BH410	5	D	3.50-4.00	Brown very gravelly very sandy CLAY.
BH411	8	D	9.00-9.50	Brown slightly gravelly sandy CLAY.
BH411	3	B	11.50	White CHALK with flint.
BH412	1	B	2.50-2.95	Brown very gravelly very sandy CLAY.
BH413	2	D	1.00	Brown slightly gravelly slightly sandy CLAY.
BH413	1	U	1.50-1.95	Firm brown very sandy CLAY.
BH413	4	B	10.50-10.95	Dark brown sandy very clayey GRAVEL.
BH413	5	B	16.50-16.95	White CHALK.
BH414	1	U	2.50-2.95	Brown slightly gravelly sandy CLAY.
BH415	2	B	4.50-4.95	Brown slightly gravelly sandy CLAY.
BH415	3	B	6.00-6.45	Brown very gravelly slightly silty SAND.
BH416	1	U	1.50-1.95	Brown very gravelly sandy CLAY.
BH416	2	U	3.50-3.95	Firm brown very sandy CLAY.
BH416	6	D	4.50-4.95	Brown slightly gravelly SAND.

PSL
Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
WELWYN GARDEN CITY.					
PSL14/5609					
WGC2342-18					

SUMMARY OF SOIL CLASSIFICATION TESTS

(B.S. 1377 : PART 2 : 1990)

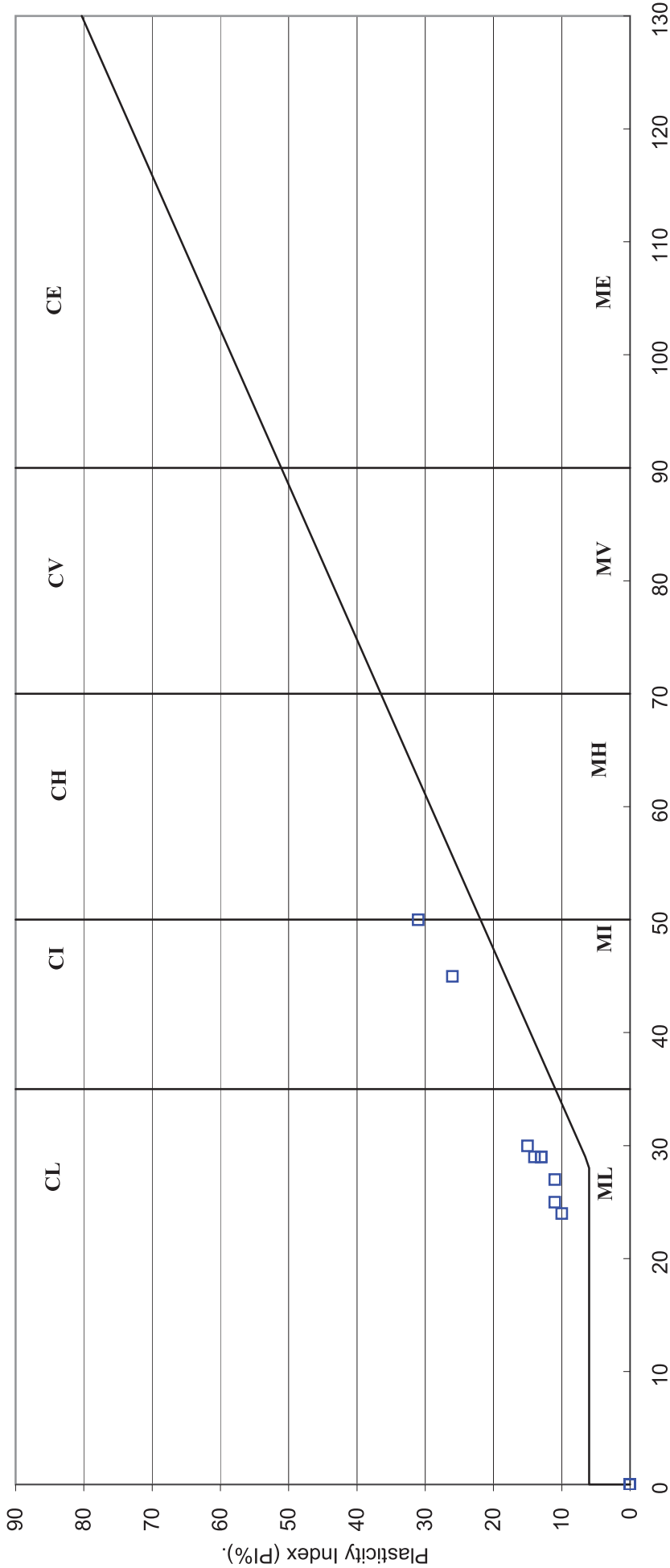
Hole Number	Sample Number	Sample Type	Depth m	Moisture Content % Clause 3.2	Bulk Density Mg/m ³ Clause 7.2	Dry Density Mg/m ³ Clause 7.2	Particle Density Mg/m ³ Clause 8.2	Liquid Limit % Clause 4.3/4.4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	% Passing .425mm	Remarks
BH401	3	D	2.50-3.00	19				30	15	15	70	Low plasticity CL.
BH402	2	B	5.00-5.50	25				45	19	26	89	Intermediate plasticity CL.
BH402	10	D	13.50-13.95	34								
BH403	4	D	3.50-3.95	11				24	14	10	64	Low plasticity CL.
BH404	5	D	5.00	22								
BH405	5	D	4.50-4.95	11				25	14	11	66	Low plasticity CL.
BH406	1	B	2.50-2.95	13								
BH406	18	D	24.00-24.45	27								
BH407	9	D	7.50-7.95	16				27	16	11	64	Low plasticity CL.
BH408	2	B	2.50-3.00	18				29	15	14	62	Low plasticity CL.
BH409	3	D	1.50-2.00	20								
BH410	5	D	3.50-4.00	15				29	16	13	62	Low plasticity CL.
BH411	8	D	9.00-9.50	15								
BH412	1	B	2.50-2.95	17				29	16	13	71	Low plasticity CL.
BH413	2	D	1.00	19								
BH413	5	B	16.50-16.95	32								
BH414	1	U	2.50-2.95	17								
BH415	2	B	4.50-4.95	19				50	19	31	85	Intermediate plasticity CL.
BH416	1	U	1.50-1.95	12								

SYMBOLS : NP : Non Plastic

	Compiled by	Date	Checked by	Date	Approved by	Date
WELWYN GARDEN CITY.						
Contract No:			PSL14/5609			
Client Ref:			WGC2342-18			

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(B.S.5930 : 1999)



(B.S. 1377 : PART 2 : 1990)

SYMBOLS: NP : Non Plastic

Compiled by	Date	Checked by	Date	Approved by	Date
WELWYN GARDEN CITY.					
				Contract No:	PSL14/5609
				Client Ref:	WGC2342-18

(B.S. 1377 : PART 2 : 1990)

SYMBOLS: NP : Non Plastic

How

Professional Soils Laboratory

PSLR002

Particle Size Distribution Test

BS1377 : Part 2 : 1990

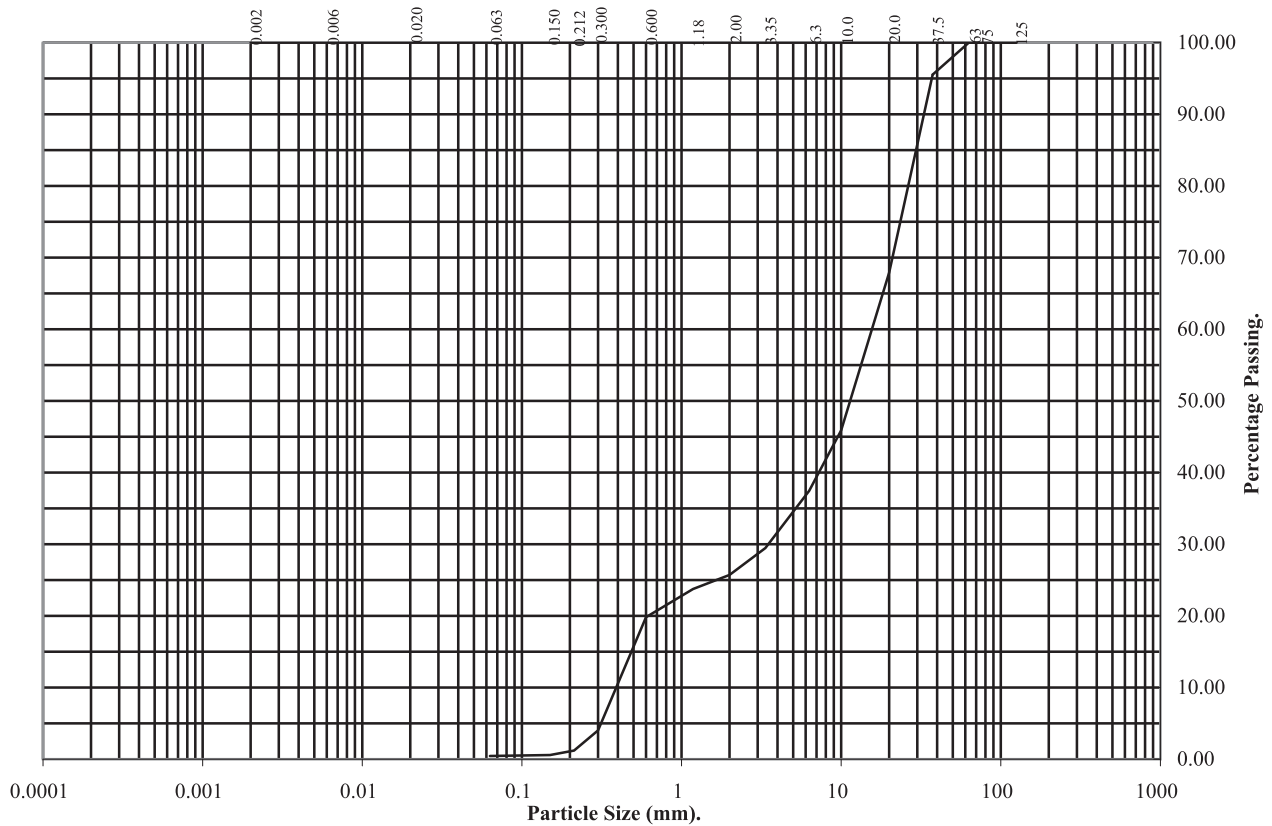
Wet Sieve, Clause 9.2

Hole Number: BH401

Depth (m): 6.00-6.50

Sample Number: 2

Sample Type: B



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	96
20	68
10	46
6.3	37
3.35	29
2	26
1.18	24
0.6	20
0.3	4
0.212	1
0.15	1
0.063	0

Soil Fraction	Total Percentage
Cobbles	0
Gravel	74
Sand	26
Silt / Clay	0

Remarks:

See summary of soil descriptions.

Checked By	Date	Approved By	Date

PSL

Professional Soils Laboratory

WELWYN GARDEN CITY.

Contract No.:
PSL14/5609

Particle Size Distribution Test

BS1377 : Part 2 : 1990

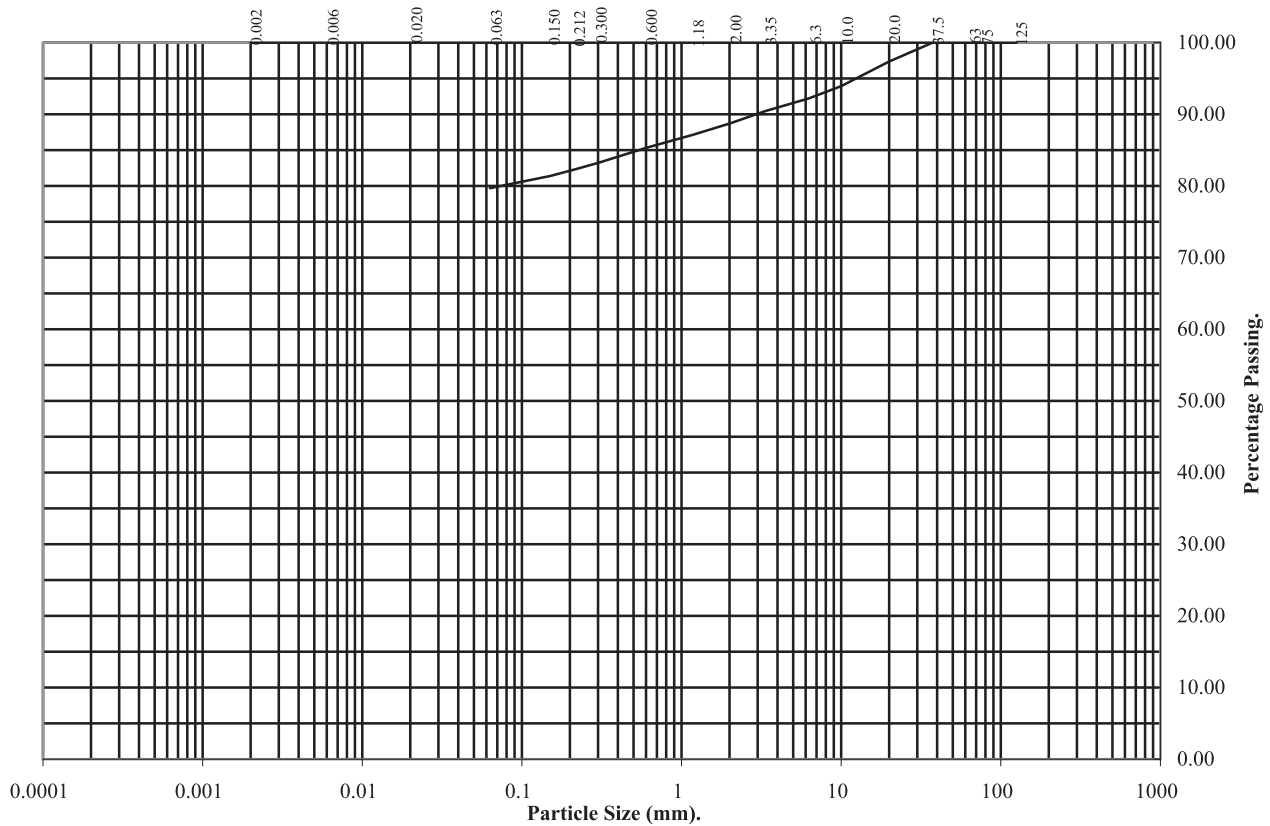
Wet Sieve, Clause 9.2

Hole Number: BH403

Depth (m): 16.50-16.95

Sample Number: 4

Sample Type: B



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	97
10	94
6.3	92
3.35	90
2	89
1.18	87
0.6	85
0.3	83
0.212	82
0.15	81
0.063	80

Soil Fraction	Total Percentage
Cobbles	0
Gravel	11
Sand	9
Silt / Clay	80

Remarks:

See summary of soil descriptions.

Checked By	Date	Approved By	Date

PSL

Professional Soils Laboratory

WELWYN GARDEN CITY.

Contract No.:
PSL14/5609

Particle Size Distribution Test

BS1377 : Part 2 : 1990

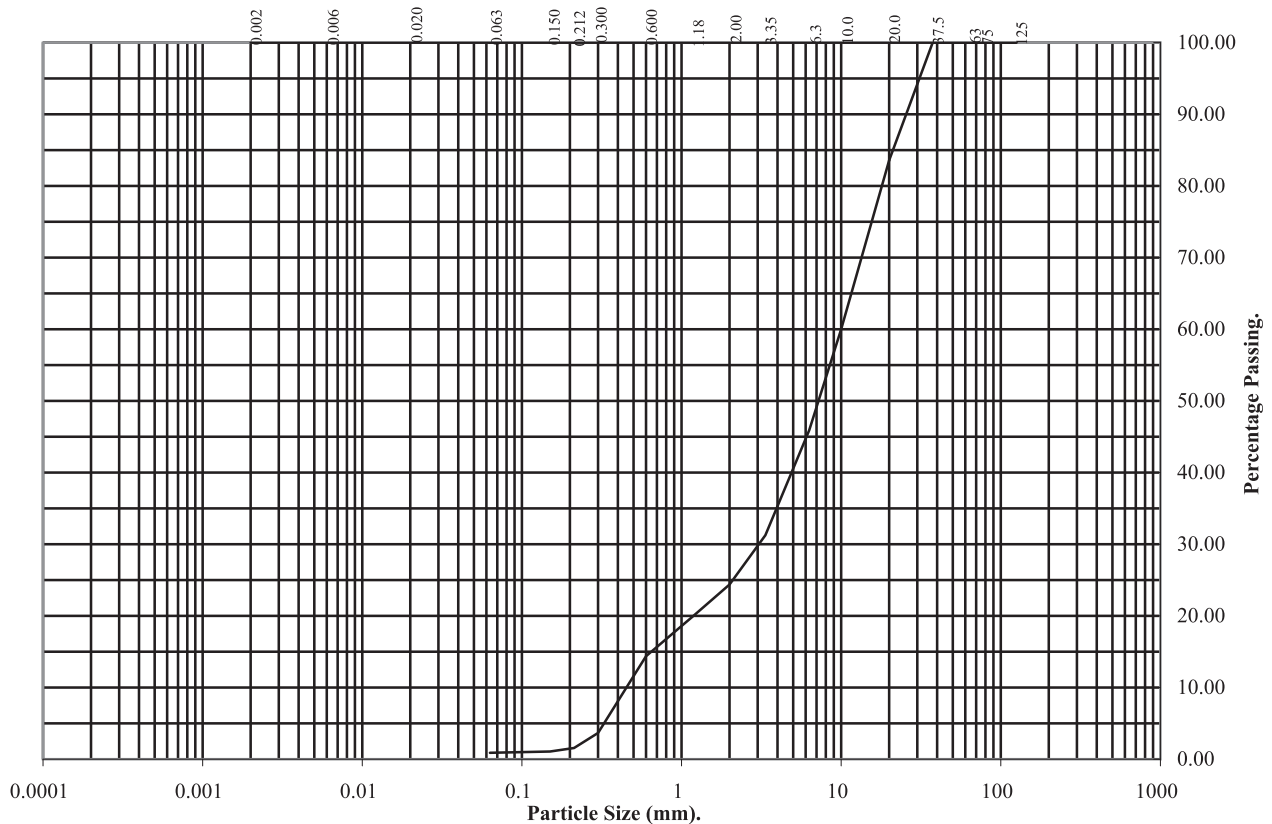
Wet Sieve, Clause 9.2

Hole Number: BH406

Depth (m): 9.00-9.45

Sample Number: 2

Sample Type: B



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	84
10	60
6.3	46
3.35	31
2	24
1.18	20
0.6	14
0.3	4
0.212	2
0.15	1
0.063	1

Soil Fraction	Total Percentage
Cobbles	0
Gravel	76
Sand	23
Silt / Clay	1

Remarks:

See summary of soil descriptions.

Checked By	Date	Approved By	Date

PSL

Professional Soils Laboratory

WELWYN GARDEN CITY.

Contract No.:
PSL14/5609

Particle Size Distribution Test

BS1377 : Part 2 : 1990

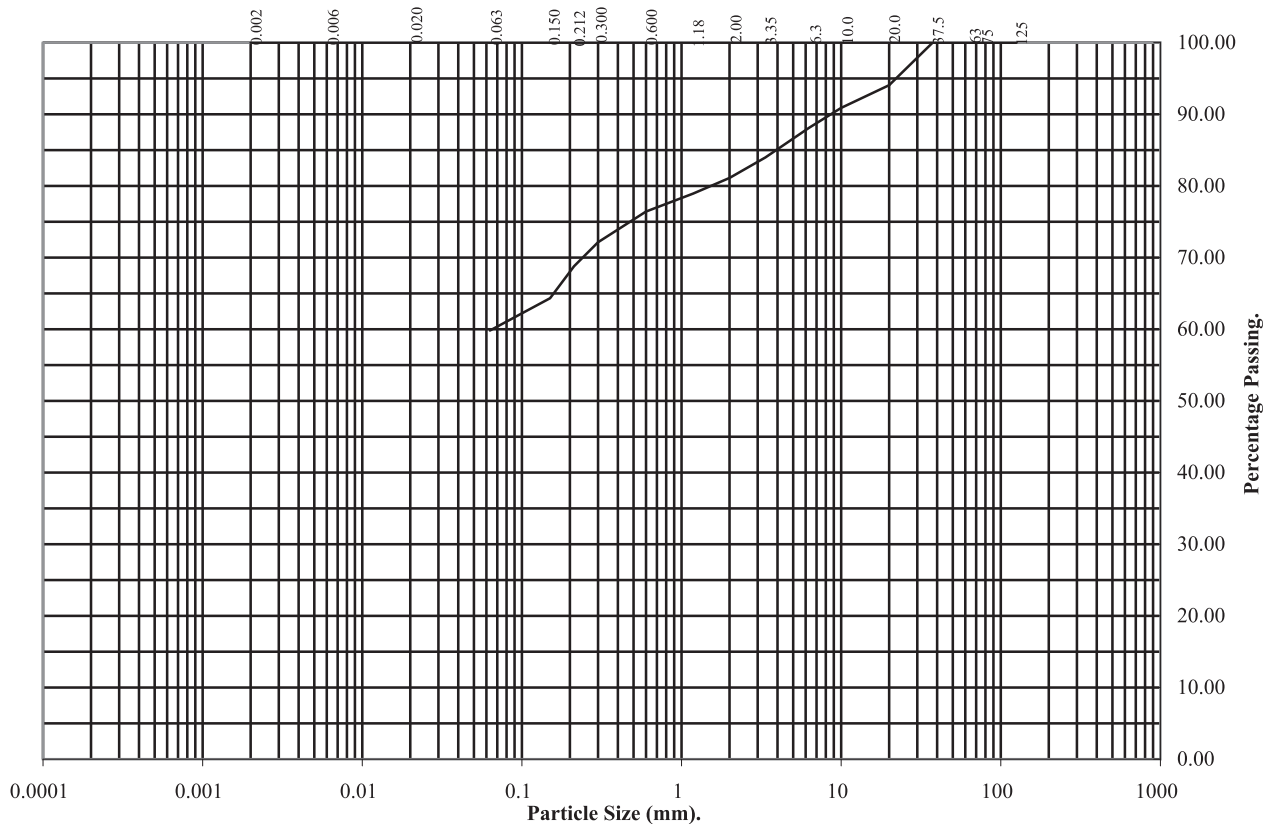
Wet Sieve, Clause 9.2

Hole Number: BH408

Depth (m): 14.90

Sample Number: 3

Sample Type: B



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	94
10	91
6.3	88
3.35	84
2	81
1.18	79
0.6	76
0.3	72
0.212	69
0.15	64
0.063	60

Soil Fraction	Total Percentage
Cobbles	0
Gravel	19
Sand	21
Silt / Clay	60

Remarks:

See summary of soil descriptions.

Checked By	Date	Approved By	Date

PSL

Professional Soils Laboratory

WELWYN GARDEN CITY.

Contract No.:
PSL14/5609

Particle Size Distribution Test

BS1377 : Part 2 : 1990

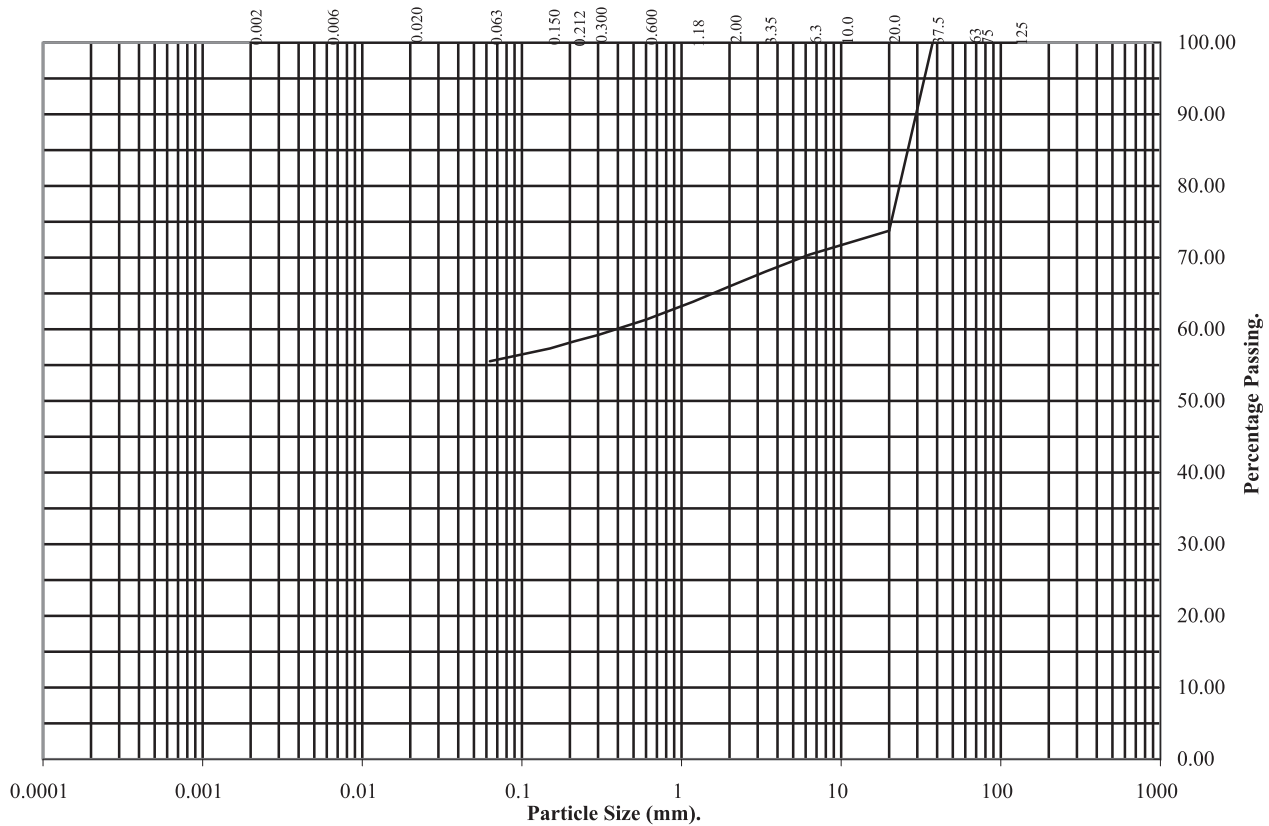
Wet Sieve, Clause 9.2

Hole Number: BH411

Depth (m): 11.50

Sample Number: 3

Sample Type: B



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	74
10	72
6.3	70
3.35	68
2	66
1.18	64
0.6	61
0.3	59
0.212	58
0.15	57
0.063	56

Soil Fraction	Total Percentage
Cobbles	0
Gravel	34
Sand	10
Silt / Clay	56

Remarks:

See summary of soil descriptions.

Checked By	Date	Approved By	Date
			14/11/14

PSL

Professional Soils Laboratory

WELWYN GARDEN CITY.

Contract No.:
PSL14/5609

Particle Size Distribution Test

BS1377 : Part 2 : 1990

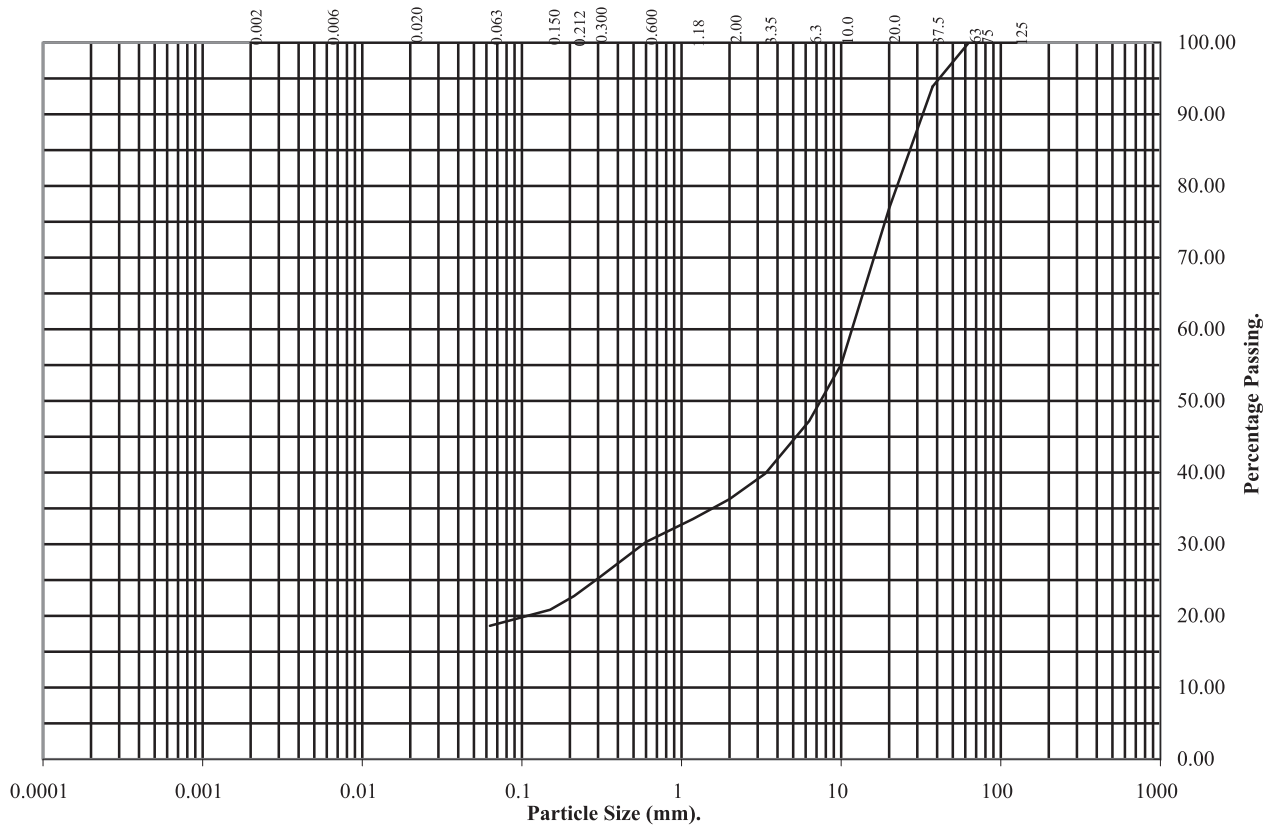
Wet Sieve, Clause 9.2

Hole Number: BH413

Depth (m): 10.50-10.95

Sample Number: 4

Sample Type: B



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	94
20	77
10	55
6.3	47
3.35	40
2	36
1.18	34
0.6	30
0.3	25
0.212	23
0.15	21
0.063	19

Soil Fraction	Total Percentage
Cobbles	0
Gravel	64
Sand	17
Silt / Clay	19

Remarks:

See summary of soil descriptions.

Checked By	Date	Approved By	Date
			14/11/14

PSL

Professional Soils Laboratory

WELWYN GARDEN CITY.

Contract No.:
PSL14/5609

Particle Size Distribution Test

BS1377 : Part 2 : 1990

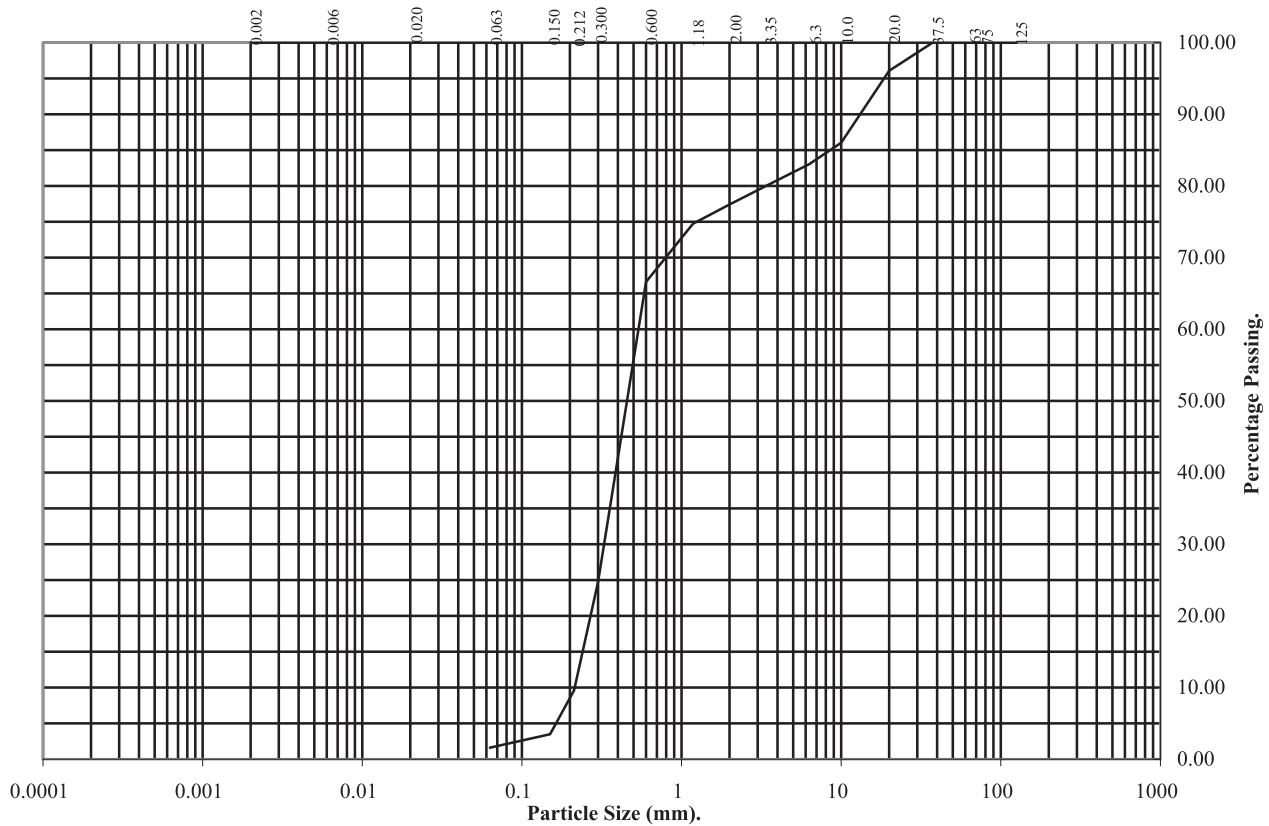
Wet Sieve, Clause 9.2

Hole Number: BH415

Depth (m): 6.00-6.45

Sample Number: 3

Sample Type: B



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	96
10	86
6.3	83
3.35	80
2	77
1.18	75
0.6	67
0.3	25
0.212	10
0.15	3
0.063	2

Soil Fraction	Total Percentage
Cobbles	0
Gravel	23
Sand	75
Silt / Clay	2

Remarks:

See summary of soil descriptions.

Checked By	Date	Approved By	Date
			14/11/14

PSL

Professional Soils Laboratory

WELWYN GARDEN CITY.

Contract No.:
PSL14/5609

Undrained Shear Strength in Triaxial Compression

without measurement of Pore Pressure

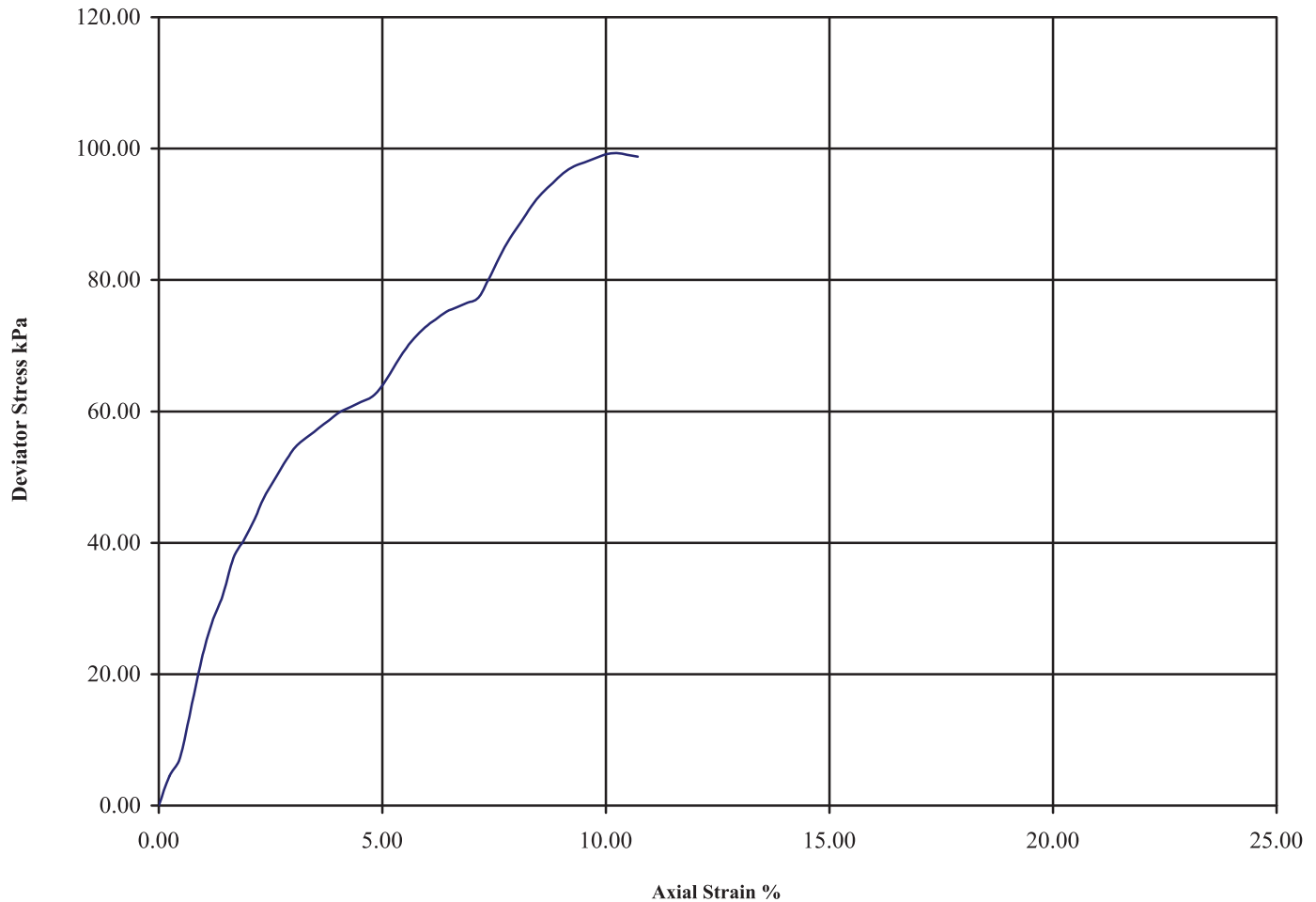
B.S. 1377 : Part 7 : Clause 9 : 1990

Hole Number: BH404

Depth (m): 2.50-2.95

Sample Number: 1

Sample Type: U



Diameter (mm):		102	Height (mm):		210	Test:	100mm Multistage		
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure θ_3 (kPa)	Corr. Max. Deviator Stress $(\theta_1 - \theta_3)_f$ (kPa)	Shear Strength Cu $\frac{1}{2}(\theta_1 - \theta_3)_f$ (kPa)	Failure Strain (%)	Mode of Failure	Remarks
A	20	2.03	1.69	50	62	31	4.8	Compound	Sample taken from top of tube Rate of strain = 1.9 %/min Latex Membrane used 0.2 mm thickness Membrane Correction applied (kPa) 0.36 0.36 0.35
				100	77	39	7.1		See summary of soil descriptions.
				150	99	50	10.2		Checked Date Approved Date

14/11/14

PSL

Professional Soils Laboratory

WELWYN GARDEN CITY.

Contract No:
PSL14/5609

Undrained Shear Strength in Triaxial Compression

without measurement of Pore Pressure

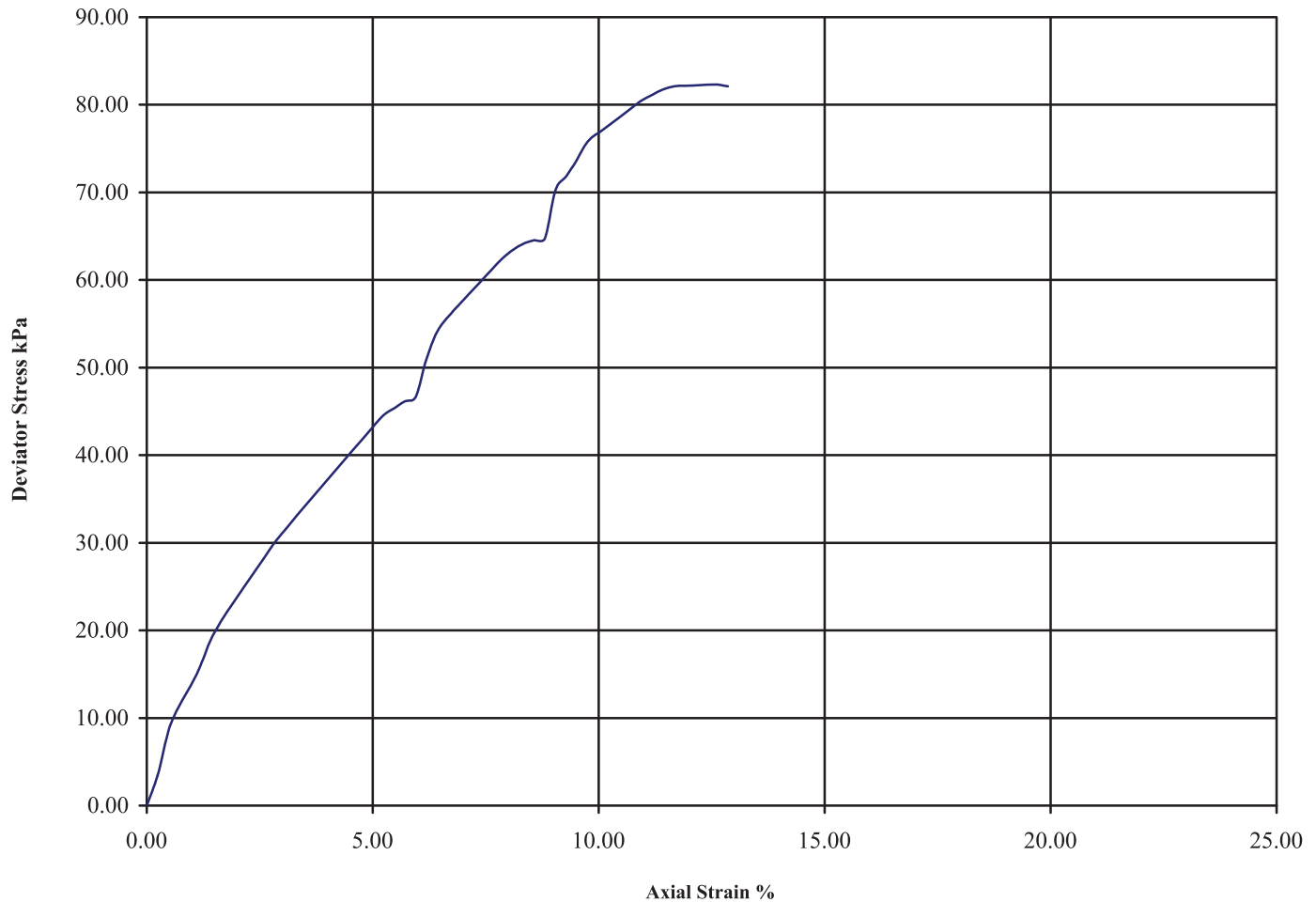
B.S. 1377 : Part 7 : Clause 9 : 1990

Hole Number: BH406

Depth (m): 7.50-7.95

Sample Number: 1

Sample Type: U



Diameter (mm):		102	Height (mm):		210	Test:	100mm Multistage						
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Remarks				
									Sample taken from top of tube				
									Rate of strain = 1.9 %/min				
									Latex Membrane used 0.2 mm thickness				
									Membrane Correction applied (kPa)				
A	21	2.20	1.82	150	47	23	6.0	Compound	0.36	0.36	0.35		
				300	65	32	8.6		See summary of soil descriptions.				
				450	82	41	12.6		Checked	Date	Approved	Date	

PSL Professional Soils Laboratory		WELWYN GARDEN CITY.	Contract No: PSL14/5609
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Undrained Shear Strength in Triaxial Compression

without measurement of Pore Pressure

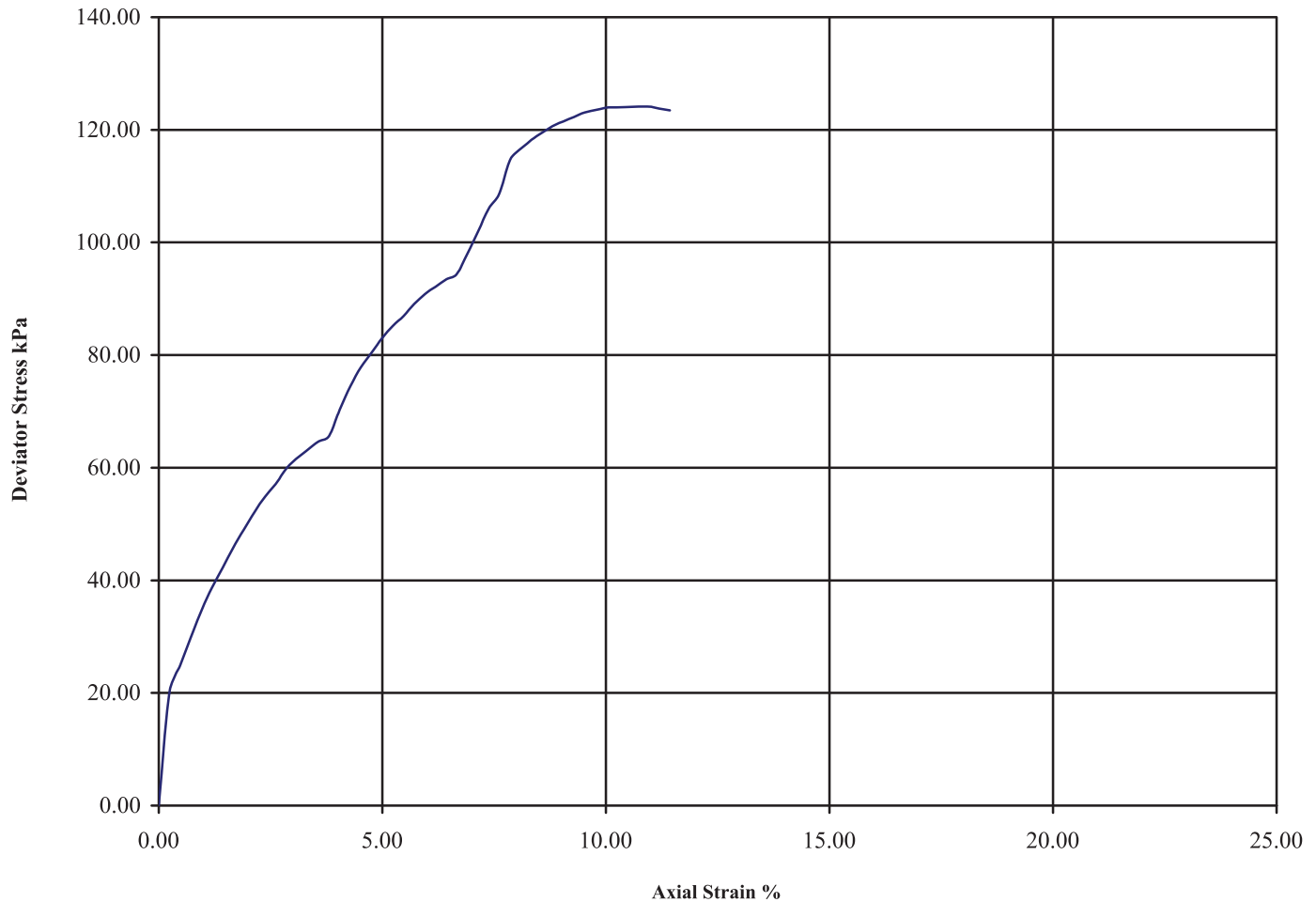
B.S. 1377 : Part 7 : Clause 9 : 1990

Hole Number: BH407

Depth (m): 6.00-6.45

Sample Number: 1

Sample Type: U



Diameter (mm):		102	Height (mm):		210	Test:	100mm Multistage						
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Remarks				
									Sample taken from top of tube				
									Rate of strain = 1.9 %/min				
									Latex Membrane used 0.2 mm thickness				
									Membrane Correction applied (kPa)				
A	18	2.12	1.80	130	66	33	3.8	Compound	0.37	0.36	0.35		
				260	94	47	6.7		See summary of soil descriptions.				
				390	124	62	11.0		Checked	Date	Approved	Date	



WELWYN GARDEN CITY.

Contract No:
PSL14/5609

Undrained Shear Strength in Triaxial Compression

without measurement of Pore Pressure

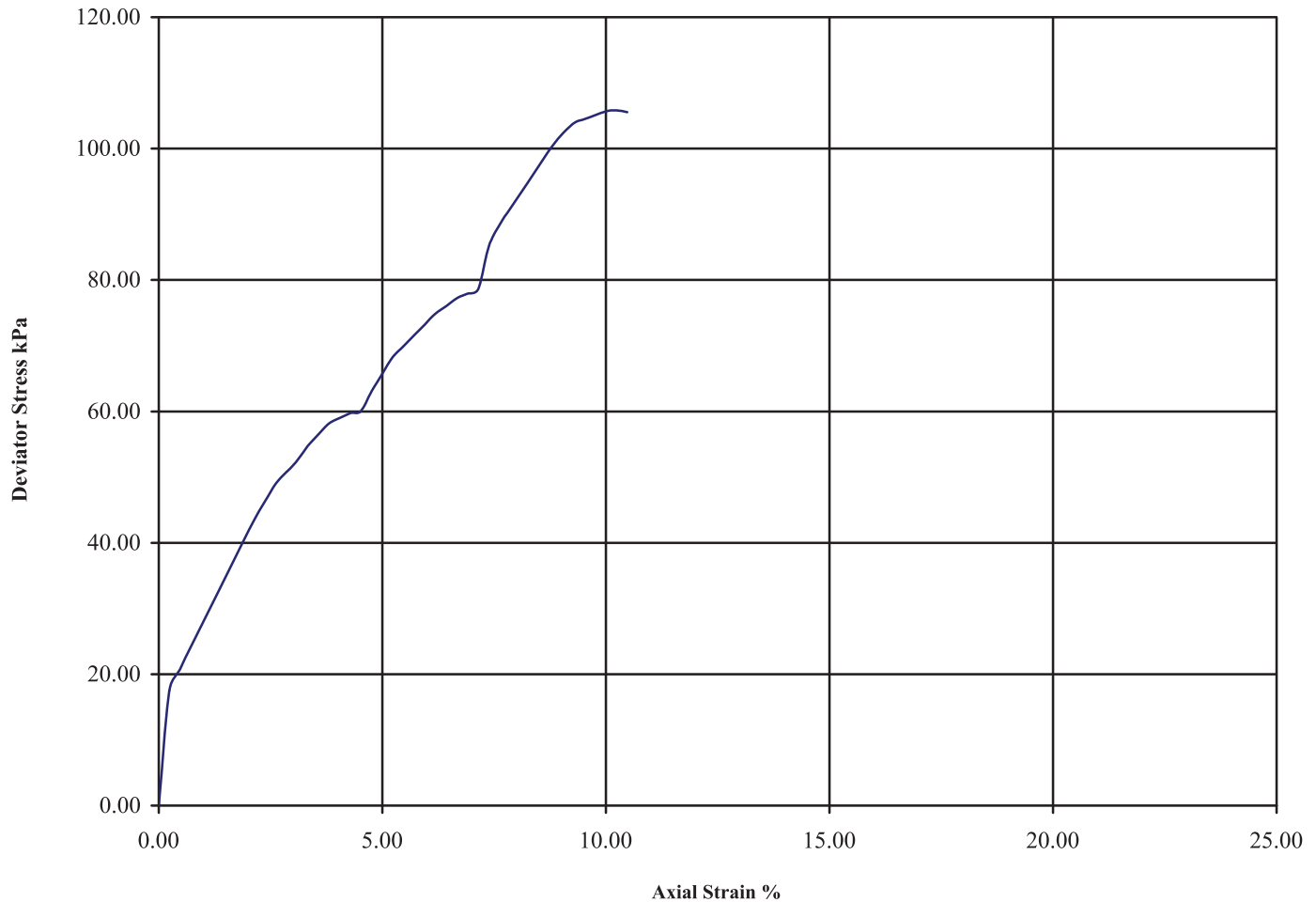
B.S. 1377 : Part 7 : Clause 9 : 1990

Hole Number: BH413

Depth (m): 1.50-1.95

Sample Number: 1

Sample Type: U



Diameter (mm):		102	Height (mm):		210	Test:	100mm Multistage						
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Remarks				
									Sample taken from top of tube				
									Rate of strain = 1.9 %/min				
									Latex Membrane used 0.2 mm thickness				
									Membrane Correction applied (kPa)				
A	21	2.10	1.73	30	60	30	4.5	Compound	0.36	0.36	0.35		
				60	79	39	7.1		See summary of soil descriptions.				
				90	106	53	10.2		Checked	Date	Approved	Date	
												14/11/14	

PSL Professional Soils Laboratory		WELWYN GARDEN CITY.	Contract No: PSL14/5609
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Undrained Shear Strength in Triaxial Compression

without measurement of Pore Pressure

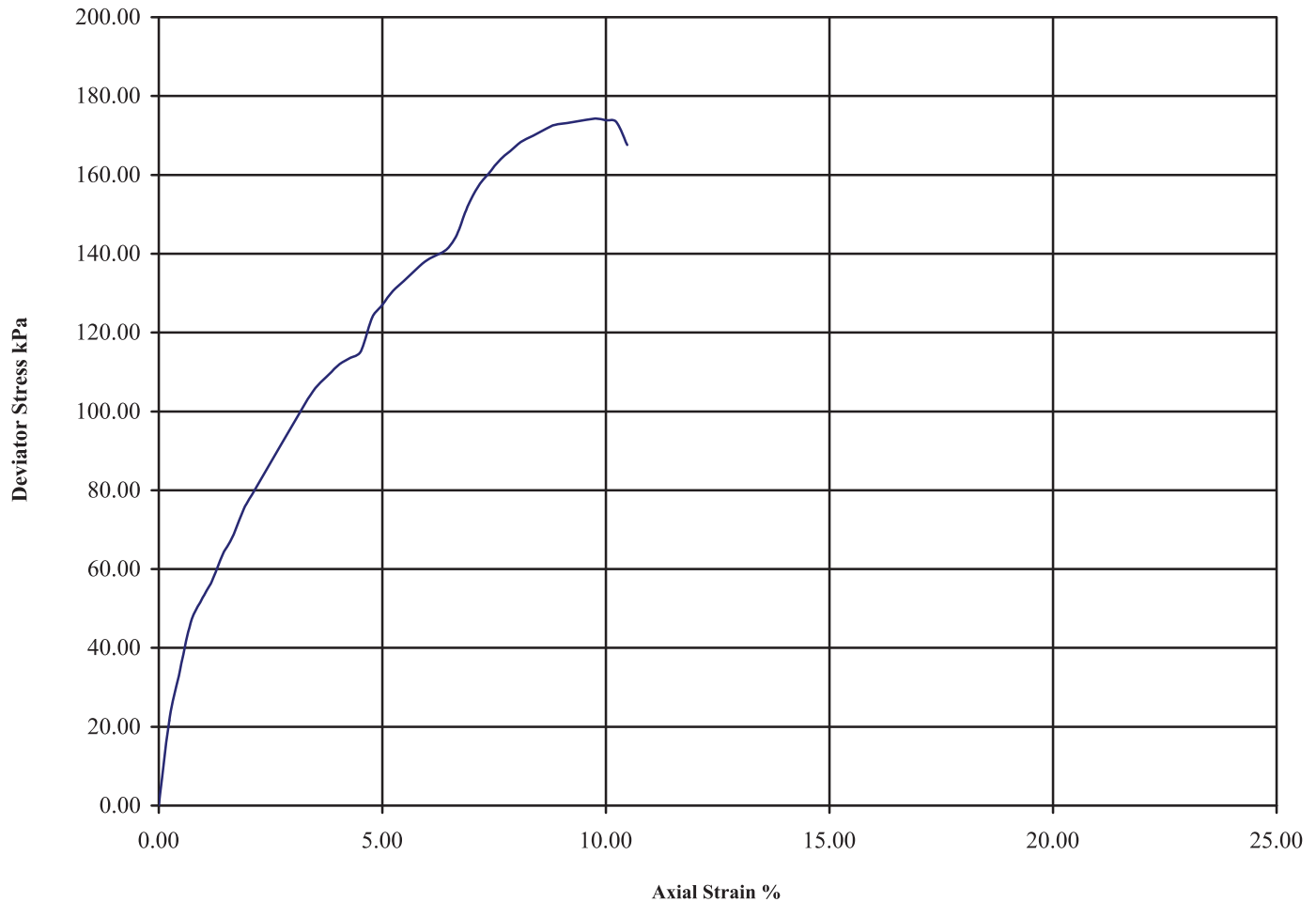
B.S. 1377 : Part 7 : Clause 9 : 1990

Hole Number: BH416

Depth (m): 3.50-3.95

Sample Number: 2

Sample Type: U



Diameter (mm):		102		Height (mm):		210	Test:	100mm Multistage		
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Remarks	
A	23	2.00	1.62	70	115	58	4.5	Compound	Sample taken from top of tube	
				140	141	71	6.4		Rate of strain = 1.9 %/min	
				210	174	87	9.8		Latex Membrane used 0.2 mm thickness	
									Membrane Correction applied (kPa)	
									0.36	0.36 0.35
									See summary of soil descriptions.	
									Checked	Date
									Approved	Date
										14/11/14

PSL Professional Soils Laboratory		WELWYN GARDEN CITY.	Contract No: PSL14/5609
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Certificate of Analysis

Certificate Number 14-20389

14-Nov-14

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

Our Reference 14-20389

Client Reference PSL14/5609

Contract Title Welwyn Garden City

Description 10 Soil samples.

Date Received 10-Nov-14

Date Started 11-Nov-14

Date Completed 14-Nov-14

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

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

Approved By



Rob Brown
Business Manager



Summary of Chemical Analysis Soil Samples

Our Ref 14-20389

Client Ref PSL14/5609

Contract Title Welwyn Garden City

Lab No	728255	728256	728257	728258	728259	728260	728261	728262	728263	728264
Sample ID	BH 401	BH 402	BH 403	BH 405	BH 406	BH 409	BH 410	BH 411	BH 415	BH 416
Depth	1.00-1.00	4.50-4.95	5.40-5.80	5.10-5.50	10.50-10.95	8.40	18.00-18.50	3.50-4.00	28.50-28.95	10.50-10.95
Other ID										
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units
Metals			
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l
Inorganics			
pH	DETSC 2008#		
Chloride Aqueous Extract	DETSC 2055	1	mg/l
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l
Total Sulphur as S	DETSC 2320	0.01	%
Total Sulphate as SO4	DETSC 2321#	0.01	%

Information in Support of the Analytical Results

Our Ref 14-20389
 Client Ref PSL14/5609
 Contract Welwyn Garden City

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
728255	BH 401 1.00-1.00 SOIL		PG	Sample date not supplied	
728256	BH 402 4.50-4.95 SOIL		GJ 500ml	Sample date not supplied	
728257	BH 403 5.40-5.80 SOIL		GJ 500ml	Sample date not supplied	
728258	BH 405 5.10-5.50 SOIL		GJ 500ml	Sample date not supplied	
728259	BH 406 10.50-10.95 SOIL		PG	Sample date not supplied	
728260	BH 409 8.40 SOIL		GJ 500ml	Sample date not supplied	
728261	BH 410 18.00-18.50 SOIL		PG	Sample date not supplied	
728262	BH 411 3.50-4.00 SOIL		PB 1L	Sample date not supplied	
728263	BH 415 28.50-28.95 SOIL		PG	Sample date not supplied	
728264	BH 416 10.50-10.95 SOIL		GJ 500ml	Sample date not supplied	

Key: P-Plastic G-Bag G-Glass J-Jar B-Bottle

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

Soil Analysis Notes

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

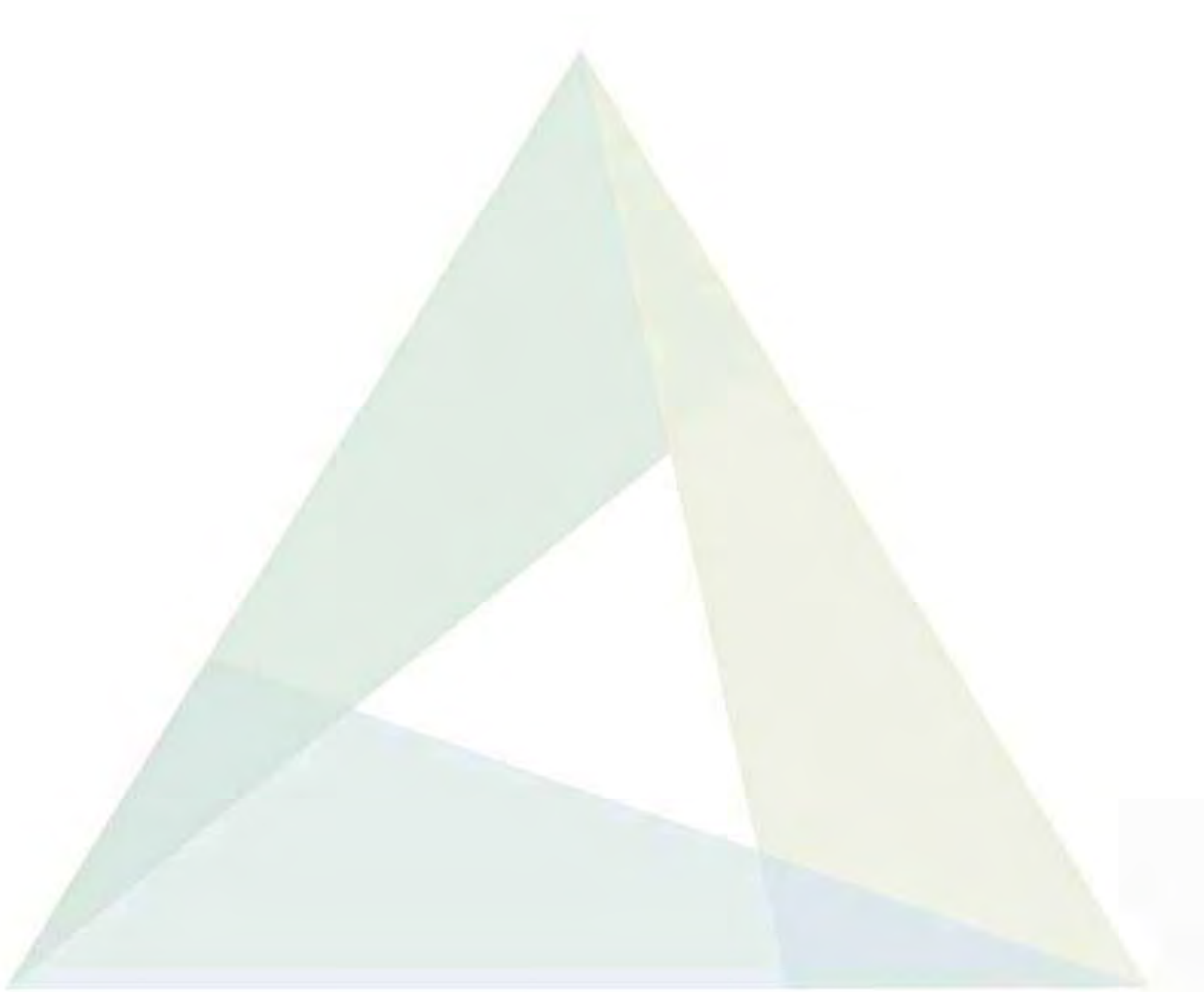
Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

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

Disposal

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

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





Final Report

Report Number: 14-12878 Issue-1

Initial Date of Issue: 31-Oct-14

Client: Delta Simons

Client Address: 3 Henley Office Park
Doddington Road
Lincoln
Lincolnshire
LN6 3QR

Contact(s): Paul Huteson

Project: 2342.18 - Welwyn Garden City

Quotation No.: **Date Received:** 27-Oct-14

Order No.: **Date Instructed:** 27-Oct-14

No. of Samples: 10 **Results Due:** 31-Oct-14

Turnaround:
(Weekdays) 5

Date Approved: 31-Oct-14

Appro

Detail

Darrell Hall, Laboratory Director

Results Summary - Water

Project: 2342.18 - Welwyn Garden City

Client: Delta Simons	14-12878	14-12878	14-12878	14-12878	14-12878	14-12878	14-12878	14-12878	14-12878	14-12878	14-12878	14-12878	14-12878
Quotation No.:	Chemtest Job No.:	Chemtest Sample ID.:	62736	62737	62738	62739	62740	62741	62742	62743	62744	62745	14-12878
Order No.:	Client Sample Ref.:	Client Sample ID.:	BH208	BH302D	BH8	BH415	BHB	BHC	BH402	BH406	BH403	BH410	
	Sample Type:	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	
	Top Depth (m):												
	Bottom Depth(m):												
	Date Sampled:	22-Oct-14	22-Oct-14	22-Oct-14	22-Oct-14	22-Oct-14	22-Oct-14	22-Oct-14	22-Oct-14	22-Oct-14	22-Oct-14	22-Oct-14	22-Oct-14
Determinand	Accred.	SOP	Units	LOD									
pH	U	1010			7.6	7.7	7.8	7.9	7.6	7.0	7.5	7.7	
Sulphate	U	1220	mg/l	1	25	100	120	62	110	14	27	100	

Report Information

Key

- U UKAS accredited
- M MCERTS and UKAS accredited
- N Unaccredited
- S This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
- SN This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
- T This analysis has been subcontracted to an unaccredited laboratory
- I/S Insufficient Sample
- U/S Unsuitable sample
- N/E not evaluated
- < "less than"
- > "greater than"

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVCOs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at our Coventry laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 1 month following the date of the test report

All water samples will be retained for 7 days following the date of the test report

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.co.uk



Final Report

Report Number: 14-13235 Issue-1

Initial Date of Issue: 04-Nov-14

Client: Delta Simons

Client Address: 3 Henley Office Park
Doddington Road
Lincoln
Lincolnshire
LN6 3QR

Contact(s): Simon Steele

Project: WGC

Quotation No.: **Date Received:** 31-Oct-14

Order No.: DS22893 **Date Instructed:** 31-Oct-14

No. of Samples: 8 **Results Due:** 06-Nov-14

Turnaround:
(Weekdays) 5

Date Approved: 04-Nov-14

Appr

Darrell Hall, Laboratory Director

Results Summary - Water

Project: WGC

Client: Delta Simons	14-13235	Chemtest Job No.:	14-13235	14-13235	14-13235	14-13235	14-13235	14-13235	14-13235	14-13235	14-13235	14-13235
Quotation No.:		Chemtest Sample ID.:	64403	64404	64405	64406	64407	64408	64409	64410		
Order No.: DS22893		Client Sample Ref.:										
		Client Sample ID.:	BH302D	BH8	BHB	BHC	BH402	BH403	BH10	BH415		
		Sample Type:	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER		
		Top Depth (m):										
		Bottom Depth(m):										
		Date Sampled:										
Determinand		Accred.	SOP	Units	LOD							
pH		U	1010				7.3	7.8	7.9	7.8		
Sulphate		U	1220	mg/l	1	13	9.0	74	74	76	31	110
												76

Report Information

Key

- U UKAS accredited
- M MCERTS and UKAS accredited
- N Unaccredited
- S This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
- SN This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
- T This analysis has been subcontracted to an unaccredited laboratory
- I/S Insufficient Sample
- U/S Unsuitable sample
- N/E not evaluated
- < "less than"
- > "greater than"

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVCOs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at our Coventry laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 1 month following the date of the test report

All water samples will be retained for 7 days following the date of the test report

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.co.uk

Appendix D: Lead Local Flood Authority Consultation

From: James Lester [<mailto:James.Lester@hertfordshire.gov.uk>] **On Behalf Of** Flood and Water Management
Sent: 02 November 2017 12:40
To: Nick Yeo <nick.yeo@rma-environmental.co.uk>
Cc: Flood and Water Management <FloodandWaterManagement@hertfordshire.gov.uk>
Subject: RE: Pre-application enquiry at land off Hyde Way, Welwyn Garden City, AL7 3UQ

Nick

The LLFA incident record does not hold any records of surface water flooding in this area. However, absence of records does not mean that there has never been any surface water flooding.

There have been reports to the Highway Authority about Hydeway flooding:

- Flooding of the footway on Hydeway near the post box being flooded on 28/10/2015.
- The road where the footbridge from the railway station joins Hydeway flooding also on 28/10/2015.
- There was another report on 22/11/2016 of a long flood on Hydeway impeding pedestrians ability to cross safely, however I do not know where on the road this flooding occurred.

Yours sincerely,
James Lester

James Lester

Investigations Officer, Lead Local Flood Authority [HCC]

Postal Point CHN215

Hertfordshire County Council, County Hall, Pegs Lane, Hertford, SG13 8DN

t: 01992 555532 **Comnet / Internal:** 25532

From: Nick Yeo [<mailto:nick.yeo@rma-environmental.co.uk>]

Sent: 26 October 2017 15:43

To: Flood and Water Management

Subject: Pre-application enquiry at land off Hyde Way, Welwyn Garden City, AL7 3UQ

Good Afternoon

We have been instructed to undertake a Flood Risk Assessment for a mixed use development at land off Hyde Way, Welwyn Garden City, AL7 3UQ. The approximate grid reference is TL 24142 12774 and I have attached a site location plan.

The EA's surface water flood mapping shows the site has an area of surface water flood risk in the north of the site. We would welcome any initial comments you have on the development of the site and whether you have any records of surface water flooding at the site or in the vicinity of the site.

Kind regards
Nick

Nick Yeo
Environmental Consultant, RMA Environmental

Office: 01884 842740

Email: nick.yeo@rma-environmental.co.uk

Web: www.rma-environmental.co.uk

Office Address: Suite 4, Swallow Court, Devonshire Gate, Tiverton, Devon, EX16 7EJ

Registered Office: 2 Chartfield House, Castle Street, Taunton, TA1 4AS

Registered in England No: 6915388

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Appendix E: Pitman Associates Detailed Drainage Strategy

SCOPE

This design addresses runoff from all areas within the red line boundary for the planning application.

DESIGN CONSTRAINTS

Infiltration

A ground investigation undertaken by Delta Simons Environmental ('Factual and Interpretive Geotechnical Report 2342.18 Nov 2014') identified significant dissolution features within the chalk bedrock underlying the site. These features preclude the use of concentrated infiltration within the development.

Thames Water

In correspondence regarding a previous application to develop the site (N6/2015/0293/PP) Thames Water agreed to take a peak flow of 310l/s from the site for all events up to the 100year plus climate change (ICIS Design 'Addendum to FRA July 2016').

DESIGN STANDARDS

The proposed surface water drainage system is to be designed to ensure that all runoff from the 100year rainfall event plus an allowance for climate change is managed in accordance with the above constraints and the requirements of the DEFRA document Non-Statutory Technical Standards for Sustainable Drainage Systems.

DESIGN STRATEGY

The site has been divided into four subcatchments, each with a point of discharge to the public surface water sewer. The drainage design for each sub-catchment is based on the following approach:

- Roofs will be constructed as green or brown roofs as far as practicable.
- All external parking spaces will be constructed of permeable paving with an impermeable membrane to prevent infiltration unless a location-specific ground investigation confirms that infiltration is acceptable.
- As far as practicable runoff from ground level surfaces will be directed to tree-pits or other soft-landscaped areas which are hydraulically connected to the main drainage system.
- Landscaped basins will be used to attenuate runoff from the north west of the site.
- The capacity of the basins will be supplemented with geocellular tanks where required.
- The location of attenuation features follows the following principles:
 - Features are located to facilitate ease of maintenance.
 - Features are located to facilitate ease of replacement i.e. avoid tanks in basements.
 - Rationalise tanks where practicable to limit the number of flow controls requiring inspection and maintenance.

- Mitigate the risk of blockage by avoiding flow controls with orifices less than 100mm in diameter.

There has been a tightening of standards since Thames Water agreed to accept a discharge from the site of 310l/s, in particular that sites should aspire to achieve greenfield runoff rates as far as practicable. In recognition of this the proposed peak rate of discharge has been limited to less than 50% of the rate agreed with Thames Water in 2016.

Compliance with Technical Standards for Sustainable Drainage Systems

The following sections describe how the proposed surface water drainage system meets the requirements of the DEFRA document Non-Statutory Technical Standards for Sustainable Drainage Systems.

S1 Where the drainage system discharges to a surface water body that can accommodate uncontrolled surface water discharges without any impact on flood risk from that surface water body (e.g. the sea or a large estuary) the peak flow control standards (S2 and S3 below) and volume control technical standards (S4 and S6 below) need not apply

There are no water bodies in the vicinity of the proposed development that are capable of accommodating uncontrolled runoff without increasing flood risk.

S2 For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

Not applicable – brownfield site.

S3 For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

The greenfield runoff rates from the four sub-catchments have been estimated using the HR Wallingford Greenfield Runoff Tool (see Appendix A) and are shown in the following table.

Return Period (years)	Sub-catchment A (1.057ha)	Sub-catchment B (1.072ha)	Sub-catchment C (1.350ha)	Sub-catchment D (1.418ha)	Total Runoff (l/s)
Qbar	1.79	1.81	2.28	2.40	8.28
1	1.51	1.53	1.93	2.03	7.00
30	4.10	4.16	5.24	5.50	19.00
100	5.69	5.77	7.26	7.63	26.35

Table 1 – Greenfield Runoff Rates

The brownfield runoff rates from the four sub-catchments have been estimated using simplified MicroDrainage models (see Appendix A) and are shown in the following table.

Return Period (years)	Sub-catchment A (1.057ha)	Sub-catchment B (1.072ha)	Sub-catchment C (1.350ha)	Sub-catchment D (1.418ha)	Total Runoff* (l/s)
Qbar	-	-	-	-	-
1	80.3	0	145.1	171.9	397.3
30	122.6	0	284.4	224.2	631.2
100	123.1	0	324.5	230.0	677.6

*Excludes overland flow

Table 2 – Brownfield Runoff Rates

It is proposed to limit the peak rate of discharge from the site to less than 50% of the rate agreed with Thames Water in 2016 (i.e. <50% of 310l/s). The following table shows the proposed rates of discharge and the proportional improvement compared to existing rates.

Return Period (years)	Existing Runoff Rate (l/s)	Total Runoff (l/s)	Reduction in Peak Rate of Runoff
Qbar	-	-	-
1	397.3	125.2	68%
30	631.2	137.9	78%
100	677.6	139.4	79%

Table 3 – Proposed Runoff Rates

S4 *Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.*

Not applicable – greenfield site.

S5 *Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.*

The existing site is covered entirely in impermeable surfaces. The introduction of green roofs and considerable areas of landscaping will ensure the volume of runoff from the site is less than the existing volume for the equivalent rainfall event.

S6 *Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.*

Not applicable – compliant with S5.

S7 *The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.*

The drainage system has been designed such that runoff from all events up to the 100year+40% event will be stored below ground level. Refer to the MicroDrainage outputs in Appendix A.

S8 *The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.*

The drainage system has been designed such that runoff from all events up to the 100year+40% event will be stored below ground level. Refer to the MicroDrainage outputs in Appendix A.

S9 *The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.*

Refer to Section 4.9 and Figure 4.1 in the main body of the report.

S10 *Components must be designed to ensure structural integrity of the drainage system and any adjacent structures or infrastructure under anticipated loading conditions over the design life of the development taking into account the requirement for reasonable levels of maintenance.*

The drainage system will be located beyond the zone of influence of adjacent foundations. Where this is not practicable, foundations will be designed to allow for the replacement of the drainage system without the need for special support.

S11 *The materials, including products, components, fittings or naturally occurring materials, which are specified by the designer must be of a suitable nature and quality for their intended use.*

The surface water system will be designed in accordance with the SuDS Manual. The design will allow for replacement of component parts without long-term detriment to the performance of the system.

S12 *Pumping should only be used to facilitate drainage for those parts of the site where it is not reasonably practicable to drain water by gravity.*

Pumping is not proposed.

S13 *The mode of construction of any communication with an existing sewer or drainage system must be such that the making of the communication would not be prejudicial to the structural integrity and functionality of the sewerage or drainage system.*

Connections to the public sewer will be made only by appropriately qualified contractors.

S14 *Damage to the drainage system resulting from associated construction activities must be minimised and must be rectified before the drainage system is considered to be completed.*

See S13 above.

APPENDIX A CALCULATIONS

- 1. Greenfield runoff rates**
- 2. MicroDrainage printouts for existing drainage systems**
- 3. MicroDrainage printouts for proposed drainage systems**

1. Greenfield Runoff Rates



Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:

Site name:

Site location:

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance 'Rainfall runoff management for developments', SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:

Longitude:

Reference:

Date:

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):

1

Notes

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

Methodology

Q_{BAR} estimation method:

Calculate from SPR and SAAR

SPR estimation method:

Calculate from SOIL type

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

Soil characteristics

SOIL type:

Default	Edited
2	2

HOST class:

N/A	N/A
-----	-----

SPR/SPRHOST:

0.3	0.3
-----	-----

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

Hydrological characteristics

SAAR (mm):

Default	Edited
655	655

Hydrological region:

6	6
---	---

Growth curve factor 1 year:

0.85	0.85
------	------

Growth curve factor 30 years:

2.3	2.3
-----	-----

Growth curve factor 100 years:

3.19	3.19
------	------

Growth curve factor 200 years:

3.74	3.74
------	------

(3) Is $SPR/SPRHOST \leq 0.3$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

Q_{BAR} (l/s):

Default	Edited
1.69	1.69

1 in 1 year (l/s):

1.43	1.43
------	------

1 in 30 years (l/s):

3.88	3.88
------	------

1 in 100 year (l/s):

5.38	5.38
------	------

1 in 200 years (l/s):

6.31	6.31
------	------

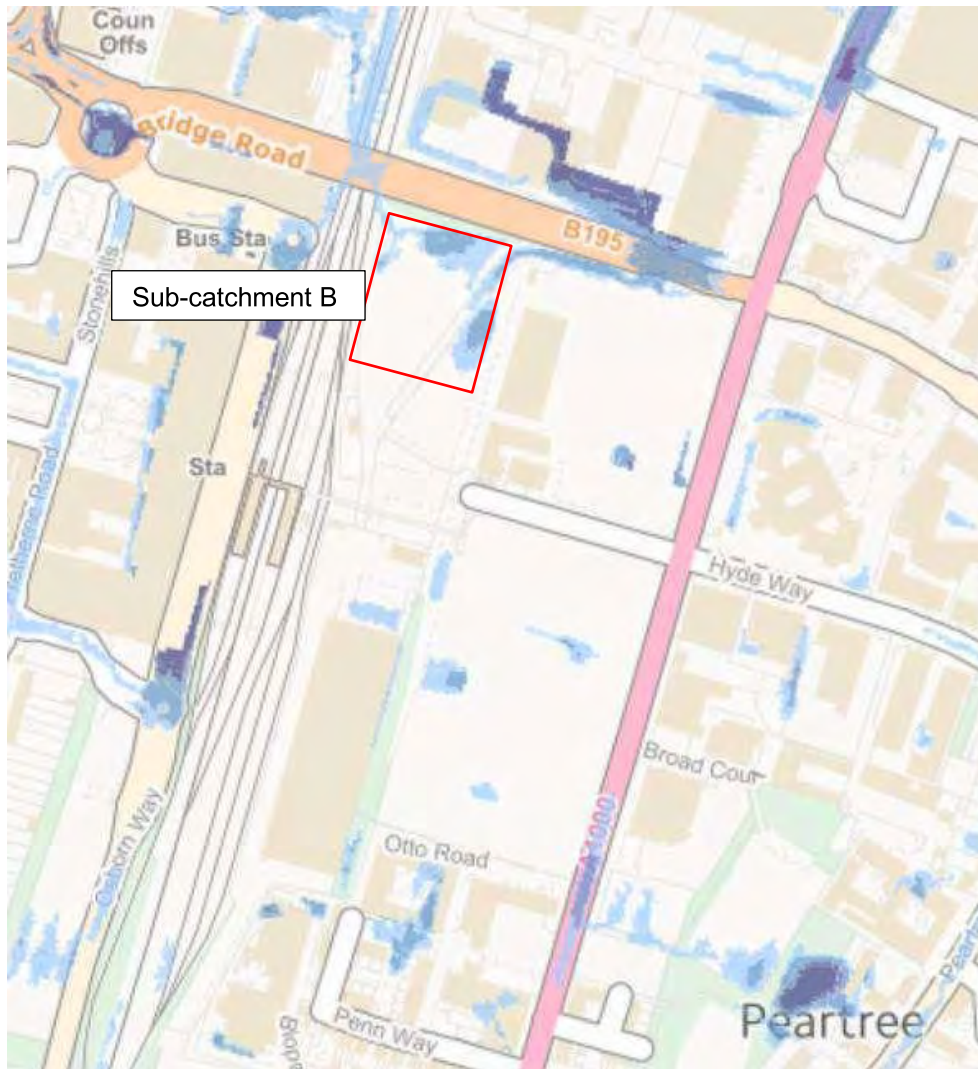
Pro-rata for sub-catchments

Return Period (years)	Sub-catchment A (1.057ha)	Sub-catchment B (1.072ha)	Sub-catchment C (1.350ha)	Sub-catchment D (1.418ha)	Total Runoff (l/s)
Qbar	1.79	1.81	2.28	2.40	8.28
1	1.51	1.53	1.93	2.03	7.00
30	4.10	4.16	5.24	5.50	19.00
100	5.69	5.77	7.26	7.63	26.35

2. MicroDrainage printouts for existing drainage systems

The runoff rates from the existing sub-catchments have been estimated using a simplified model. The last pipe in each model is based on the existing points of connection to the public sewer as shown on the drainage survey drawings. The rates do not include overland flow and so are likely to be underestimated.

There is no model for sub-catchment B as runoff from this area generally appears to pond on site as shown from the following extract of the surface water flood map.



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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	53.000	0.236	224.6	0.197	6.00	0.0	0.600	o	450	Pipe/Conduit	
S1.001	21.000	0.093	225.8	0.036	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.000	51.400	0.228	225.4	0.226	6.00	0.0	0.600	o	450	Pipe/Conduit	
S2.001	20.300	0.101	201.0	0.044	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.002	52.700	0.176	299.4	0.297	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.003	47.900	0.160	299.4	0.142	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.004	50.800	0.187	271.7	0.114	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.005	10.000	0.040	250.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.006	100.000	0.520	192.3	0.000	0.00	0.0	0.600	o	270	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	75.00	6.65	83.525	0.197	0.0	0.0	0.0	1.35	215.1	40.0
S1.001	75.00	6.91	83.289	0.233	0.0	0.0	0.0	1.35	214.5	47.3
S2.000	75.00	6.63	83.525	0.226	0.0	0.0	0.0	1.35	214.7	45.9
S2.001	75.00	6.87	83.297	0.270	0.0	0.0	0.0	1.43	227.5	54.8
S1.002	75.00	7.66	83.196	0.800	0.0	0.0	0.0	1.17	186.0	162.5
S1.003	75.00	8.35	83.020	0.942	0.0	0.0	0.0	1.17	186.0«	191.3
S1.004	75.00	9.04	82.860	1.056	0.0	0.0	0.0	1.23	195.4«	214.5
S1.005	75.00	9.24	82.673	1.056	0.0	0.0	0.0	0.82	32.7«	214.5
S1.006	75.00	10.82	82.260	1.056	0.0	0.0	0.0	1.06	60.5«	214.5

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	85.600	2.075	Open Manhole	1350	S1.000	83.525	450				
S2	85.400	2.111	Open Manhole	1350	S1.001	83.289	450	S1.000	83.289	450	
S3	85.500	1.975	Open Manhole	1350	S2.000	83.525	450				
S4	85.500	2.203	Open Manhole	1350	S2.001	83.297	450	S2.000	83.297	450	
S5	85.500	2.304	Open Manhole	1350	S1.002	83.196	450	S1.001	83.196	450	
								S2.001	83.196	450	
S6	85.500	2.480	Open Manhole	1350	S1.003	83.020	450	S1.002	83.020	450	
S7	85.300	2.440	Open Manhole	1350	S1.004	82.860	450	S1.003	82.860	450	
S8	85.050	2.377	Open Manhole	1350	S1.005	82.673	225	S1.004	82.673	450	
S9	85.390	3.130	Open Manhole	1200	S1.006	82.260	270	S1.005	82.633	225	328
S	85.400	3.660	Open Manhole	0		OUTFALL		S1.006	81.740	270	

No coordinates have been specified, layout information cannot be produced.

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	450	S1	85.600	83.525	1.625	Open Manhole	1350
S1.001	o	450	S2	85.400	83.289	1.661	Open Manhole	1350
S2.000	o	450	S3	85.500	83.525	1.525	Open Manhole	1350
S2.001	o	450	S4	85.500	83.297	1.753	Open Manhole	1350
S1.002	o	450	S5	85.500	83.196	1.854	Open Manhole	1350
S1.003	o	450	S6	85.500	83.020	2.030	Open Manhole	1350
S1.004	o	450	S7	85.300	82.860	1.990	Open Manhole	1350
S1.005	o	225	S8	85.050	82.673	2.152	Open Manhole	1350
S1.006	o	270	S9	85.390	82.260	2.860	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	53.000	224.6	S2	85.400	83.289	1.661	Open Manhole	1350
S1.001	21.000	225.8	S5	85.500	83.196	1.854	Open Manhole	1350
S2.000	51.400	225.4	S4	85.500	83.297	1.753	Open Manhole	1350
S2.001	20.300	201.0	S5	85.500	83.196	1.854	Open Manhole	1350
S1.002	52.700	299.4	S6	85.500	83.020	2.030	Open Manhole	1350
S1.003	47.900	299.4	S7	85.300	82.860	1.990	Open Manhole	1350
S1.004	50.800	271.7	S8	85.050	82.673	1.927	Open Manhole	1350
S1.005	10.000	250.0	S9	85.390	82.633	2.532	Open Manhole	1200
S1.006	100.000	192.3	S	85.400	81.740	3.390	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.006	S	85.400	81.740	82.260	0	0

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Volumetric Runoff Coeff 0.950

Foul Sewage per hectare (l/s) 0.000

Areal Reduction Factor 1.000

Additional Flow - % of Total Flow 0.000

Hot Start (mins) 0

MADD Factor * 10m³/ha Storage 2.000

Hot Start Level (mm) 0

Inlet Coeffiecient 0.800

Manhole Headloss Coeff (Global) 0.500

Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0

Number of Offline Controls 0

Number of Time/Area Diagrams 0

Number of Online Controls 0

Number of Storage Structures 0

Number of Real Time Controls 0

Margin for Flood Risk Warning (mm) 300.0

DVD Status OFF

Analysis Timestep

Fine Inertia Status OFF

DTS Status ON

Profile(s)

Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960

Return Period(s) (years) 1, 30, 100

Climate Change (%) 0, 0, 0

									Water	Surcharged
PN	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth
	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)
S1.000	S1	15 Summer		1	+0%	30/15 Summer			83.642	-0.333
S1.001	S2	30 Summer		1	+0%	30/15 Summer	30/15 Summer		83.480	-0.259
S2.000	S3	15 Summer		1	+0%	30/15 Summer	30/30 Summer		83.652	-0.323
S2.001	S4	15 Summer		1	+0%	30/15 Summer	100/15 Summer		83.483	-0.264
S1.002	S5	30 Summer		1	+0%	30/15 Summer	100/15 Summer		83.474	-0.172
S1.003	S6	30 Summer		1	+0%	30/15 Summer	100/15 Summer		83.445	-0.025
S1.004	S7	30 Summer		1	+0%	1/15 Summer	100/15 Summer		83.408	0.098
S1.005	S8	30 Summer		1	+0%	1/15 Summer	30/15 Summer		83.364	0.466
S1.006	S9	30 Summer		1	+0%	1/15 Summer			83.004	0.474

		Flooded		Half Drain	Pipe			
	US/MH	Volume	Flow /	Overflow	Time	Flow		Level
PN	Name	(m³)	Cap.	(l/s)	(mins)	(l/s)	Status	Exceeded
S1.000	S1	0.000	0.15			29.7	OK	
S1.001	S2	0.000	0.18			31.6	OK	12
S2.000	S3	0.000	0.17			34.1	OK	5
S2.001	S4	0.000	0.22			39.2	OK	5
S1.002	S5	0.000	0.60			101.6	OK	3
S1.003	S6	0.000	0.64			107.6	OK	1
S1.004	S7	0.000	0.52			92.5	SURCHARGED	4
S1.005	S8	0.000	3.01			82.1	SURCHARGED	12
S1.006	S9	0.000	1.36			80.3	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Volumetric Runoff Coeff 0.950

Foul Sewage per hectare (l/s) 0.000

Areal Reduction Factor 1.000

Additional Flow - % of Total Flow 0.000

Hot Start (mins) 0

MADD Factor * 10m³/ha Storage 2.000

Hot Start Level (mm) 0

Inlet Coeffiecient 0.800

Manhole Headloss Coeff (Global) 0.500

Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0

Number of Offline Controls 0

Number of Time/Area Diagrams 0

Number of Online Controls 0

Number of Storage Structures 0

Number of Real Time Controls 0

Margin for Flood Risk Warning (mm) 300.0

DVD Status OFF

Analysis Timestep

Fine Inertia Status OFF

DTS Status ON

Profile(s)

Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960

Return Period(s) (years) 1, 30, 100

Climate Change (%) 0, 0, 0

US/MH		Return Climate		First (X)		First (Y)		First (Z)		Water	Surcharged
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level		Depth
S1.000	S1	15 Summer	30	+0%	30/15 Summer				85.440		1.465
S1.001	S2	30 Summer	30	+0%	30/15 Summer	30/15 Summer			85.409		1.670
S2.000	S3	15 Winter	30	+0%	30/15 Summer	30/30 Summer			85.494		1.519
S2.001	S4	15 Winter	30	+0%	30/15 Summer	100/15 Summer			85.457		1.710
S1.002	S5	30 Summer	30	+0%	30/15 Summer	100/15 Summer			85.434		1.788
S1.003	S6	30 Summer	30	+0%	30/15 Summer	100/15 Summer			85.351		1.881
S1.004	S7	30 Summer	30	+0%	1/15 Summer	100/15 Summer			85.231		1.921
S1.005	S8	30 Summer	30	+0%	1/15 Summer	30/15 Summer			85.064		2.166
S1.006	S9	30 Winter	30	+0%	1/15 Summer				84.262		1.732

Flooded		Half Drain		Pipe				
US/MH	Volume	Flow /	Overflow	Time	Flow		Level	
PN	Name	(m³)	Cap. (l/s)	(mins)	(l/s)	Status	Exceeded	
S1.000	S1	0.000	0.30		58.0	FLOOD RISK		
S1.001	S2	9.494	0.45		77.8	FLOOD	12	
S2.000	S3	0.000	0.33		63.6	FLOOD RISK	5	
S2.001	S4	0.000	0.35		63.1	FLOOD RISK	5	
S1.002	S5	0.000	0.77		131.4	FLOOD RISK	3	
S1.003	S6	0.000	0.87		146.0	FLOOD RISK	1	
S1.004	S7	0.000	0.93		165.4	FLOOD RISK	4	
S1.005	S8	13.805	4.53		123.6	FLOOD	12	
S1.006	S9	0.000	2.08		122.6	SURCHARGED		

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Volumetric Runoff Coeff 0.950

Foul Sewage per hectare (l/s) 0.000

Areal Reduction Factor 1.000

Additional Flow - % of Total Flow 0.000

Hot Start (mins) 0

MADD Factor * 10m³/ha Storage 2.000

Hot Start Level (mm) 0

Inlet Coeffiecient 0.800

Manhole Headloss Coeff (Global) 0.500

Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0

Number of Offline Controls 0

Number of Time/Area Diagrams 0

Number of Online Controls 0

Number of Storage Structures 0

Number of Real Time Controls 0

Margin for Flood Risk Warning (mm) 300.0

DVD Status OFF

Analysis Timestep

Fine Inertia Status OFF

DTS Status ON

Profile(s)

Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960

Return Period(s) (years) 1, 30, 100

Climate Change (%) 0, 0, 0

US/MH		Return Climate		First (X)		First (Y)		First (Z)		Water	Surcharged
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level		Depth
S1.000	S1	30 Summer	100	+0%	30/15 Summer				85.474		1.499
S1.001	S2	30 Summer	100	+0%	30/15 Summer	30/15 Summer			85.443		1.704
S2.000	S3	30 Summer	100	+0%	30/15 Summer	30/30 Summer			85.513		1.538
S2.001	S4	30 Summer	100	+0%	30/15 Summer	100/15 Summer			85.503		1.756
S1.002	S5	15 Summer	100	+0%	30/15 Summer	100/15 Summer			85.501		1.855
S1.003	S6	15 Summer	100	+0%	30/15 Summer	100/15 Summer			85.500		2.030
S1.004	S7	15 Summer	100	+0%	1/15 Summer	100/15 Summer			85.301		1.991
S1.005	S8	60 Summer	100	+0%	1/15 Summer	30/15 Summer			85.087		2.189
S1.006	S9	60 Summer	100	+0%	1/15 Summer				84.271		1.741

Flooded		Half Drain		Pipe			Level
PN	US/MH Name	Volume (m³)	Flow / Cap. (l/s)	Time (mins)	Flow (l/s)	Status	Exceeded
S1.000	S1	0.000	0.43		83.8	FLOOD RISK	
S1.001	S2	42.627	0.62		106.1	FLOOD	12
S2.000	S3	13.394	0.40		77.5	FLOOD	5
S2.001	S4	2.885	0.46		82.3	FLOOD	5
S1.002	S5	2.203	0.91		153.8	FLOOD	3
S1.003	S6	0.074	0.97		163.0	FLOOD	1
S1.004	S7	1.135	1.13		200.2	FLOOD	4
S1.005	S8	37.238	4.52		123.1	FLOOD	12
S1.006	S9	0.000	2.09		123.1	SURCHARGED	

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XP Solutions	Network 2020.1	

Discharge Wizard Results for Storm

Summary

Discharge Rates Check - Fail

Discharge Volumes Check - Fail

Minimal Discharge Check - Not Run

Discharge Rates Check

PN	RP(yrs)/ CC(%)	Pre-development Discharge Rate (l/s)	Post-development Discharge Rate (l/s)	Pass/Fail
1.006	1yr +0%	1.0	80.3	Fail
1.006	30yr +0%	1.0	122.6	Fail
1.006	100yr +0%	1.0	123.1	Fail

Discharge Volumes Check

PN	Volume Calculation Method	Pre-development Volume (m³)	Post-development Volume (m³)	Pass/Fail
1.006	Greenfield	51.409	614.862	Fail

(Pre-development runoff volume (except those marked with '*') for the 100 year, 360 minutes, Winter storm)

(Post-development runoff volume for the 100 year, 360 minutes, Winter storm with 0% climate change)