

# CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

FACTUAL REPORT ON  
GROUND INVESTIGATION

Prepared for CARDIFF PARKWAY  
DEVELOPMENTS LIMITED

Report Ref: 35338

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## FACTUAL REPORT ON GROUND INVESTIGATION

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DEVELOPMENTS LIMITED

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PROJECT: Site redevelopment  
CONSULTANT: Ove Arup & Partners Limited

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ORIGINATOR			APPROVER		
					
E CRIMP Senior Geotechnical Engineer			C THOMAS Geotechnical Consultant		

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## **1. INTRODUCTION**

It is proposed to construct a new business park with associated road and railway infrastructure near St Mellons, Cardiff. Geotechnical Engineering Limited (GEL) was instructed by Ove Arup & Partners Limited (the Consultant) on behalf of Cardiff Parkway Developments Limited (the Client) to carry out an investigation to determine the ground conditions.

The scope of works and terms and conditions of appointment were specified by the Consultant and GEL correspondence reference T28404 dated 21<sup>st</sup> March 2019. The investigation was carried out under the direction and supervision of the Consultant.

This report describes the investigation and presents the findings.

## **2. SITE LOCATION AND GEOLOGY**

The site comprises pastoral fields and agricultural land to the east of St Mellons, Cardiff. The site is centred on approximate National Grid co-ordinates ST 250 808.

British Geological Survey (BGS) England and Wales (Sheet No. 263, Cardiff, 1:50 000, 1986) and the BGS online geology (1:50,000) indicate the site to be underlain by superficial Tidal Flat Deposits (clay and silt) overlying Till (variable composition). Superficial Glaciofluvial Deposits (sand and gravel) are shown to be present to the west of the site. The underlying solid geology is shown to comprise strata of the St Maughans Formation (interbedded mudstones, siltstone and sandstone). In the southernmost section of the site, strata of the Mercia Mudstone Group are shown to be present overlying the St Maughans Formation.





### **3. GROUND INVESTIGATION**

#### **3.1 Fieldwork**

The fieldwork was carried out in general accordance with BS5930:2015 during the period 10<sup>th</sup> June to 1<sup>st</sup> July 2019 and comprised eleven boreholes, five machine excavated trial pits, six cone penetration tests (CPT), five in-situ vane tests and surface water sampling.

The exploratory hole locations were selected by the Consultant and set out by this Company and are shown on Figure 1. The ground level and co-ordinates at each exploratory hole location were established by this Company using GPS techniques.

#### **Boreholes**

The boreholes, referenced BH01 to BH11 (Appendix A), were formed using a track-mounted Geotechnical Pioneer Rig. Initially, an inspection pit was hand excavated to 1.20m at each borehole location to check for buried services. Disturbed samples were taken and retained in a combination of plastic tubs, bags and glass jars. Heavy duty dynamic sampling techniques were then employed to produce a continuous disturbed sample of 112mm nominal diameter. The samples were recovered in semi-rigid plastic liner.

On refusal to dynamic sampling, or on encountering the underlying solid geology, the boreholes were continued by rotary core drilling techniques utilising a water flush. A double-tube swivel core barrel with semi-rigid plastic liner was utilised to recover a continuous sample of 120mm or 90mm diameter. Where appropriate, dynamic sampling techniques were carried out to recover dropped core or where rotary core drilling was not suitable.



The dynamic samples and rotary core were extracted horizontally from the sampler and core barrel respectively, the semi-rigid liner was cut to length and caps placed at each end to retain moisture content. All samples and core were retained in sequence in labelled, wooden coreboxes.

Undisturbed samples of suitable cohesive soils were obtained using a thin-walled stationary piston sampler in accordance with BS EN ISO 22475-1:2006. The samples of 100mm diameter were taken at depths specified by the Consultant and the samples were wax sealed on site to prevent moisture loss. The depths at which the piston samples were taken are shown on the relevant borehole logs (Appendix A).

Undisturbed samples of 100mm nominal diameter were taken in suitable cohesive soils using a thin walled, open drive sampler (UT100). Samples were wax sealed and capped on site to prevent moisture loss.

Standard penetration tests (SPT) were carried out in general accordance with BS EN ISO 22476-3:2005+A1:2011. A split barrel or a solid cone was used depending upon the materials encountered and the split barrel samples retained in airtight jars. The SPT N value was taken as the number of blows to penetrate the 300mm test drive following a 150mm seating drive. Where low penetration was recorded the seating drive was terminated at 25 blows and the test drive completed after a further 100 blows (50 blows in boreholes BH01 and BH02). Detailed SPT results, together with the energy ratio ( $E_r$ ), are presented in Appendix A and summarised as uncorrected N values on the borehole logs.

Boreholes were monitored for groundwater ingress as dynamic sampling proceeded. Upon encountering water, sampling was temporarily stopped to allow the level to stabilise. Water levels were also recorded at the start and finish of each day's work and on completion of the borehole and are presented on the relevant log.



On completion, dual monitoring installations were constructed in boreholes BH01 to BH09. In each case, the borehole was partially backfilled with bentonite to form a lower seal to the instrumentation. The lower groundwater monitoring standpipe comprised a 50mm ID HDPE slotted tube set in a granular filter medium and sealed above with a bentonite plug. The upper combined gas/water monitoring standpipe comprised a 19mm ID PVC slotted tube set in a granular filter medium and sealed above with a bentonite plug.

On completion, a combined gas/water monitoring standpipe was installed in BH10. The installation consisted of a 50mm ID HDPE slotted tube set in a filter response zone of non-calcareous pea gravel. The installation was sealed above and below with a bentonite plug and accessed via a valve assembly.

The installations were protected at the surface by a lockable, raised steel cover set in concrete. Installation details are given on the relevant borehole log.

During the period 16<sup>th</sup> July 2019 to 24<sup>th</sup> September 2019 monitoring of the installations was carried out on a fortnightly basis. The installations were monitored for gas flow and then tested for methane, carbon dioxide, oxygen, hydrogen sulphide and carbon monoxide using a Gas Data GFM 435 gas analyser. Subsequent readings, along with water level records, are tabulated in Appendix A.

The installations were also monitored for Volatile Organic Compounds (VOC's) using a MiniRAE 2000 Portable Photo-Ionisation Detector (PID) with a 10.6eV gas discharge lamp. The detector uses an ultra violet light source to break down the chemicals into positive and negative ions (ionisation). The detector measures the charge of the ionised gas and converts the signal into current. The current is then amplified and displayed as "ppm"; after measurement the ions reform the original gas or vapour allowing it to be sampled. The readings are presented in Appendix A.



Prior to water sampling, the water monitoring standpipes were developed by pumping and then purged until at least three well volumes of water had been removed. Temperature, dissolved oxygen levels, pH, resistivity, conductivity, dissolved solids, salinity and redox potential readings were also taken at various levels during well development and the readings are presented in Appendix A.

On completion, borehole BH11 was backfilled with bentonite pellets and arisings.

### **Cone Penetration Testing and In Situ Shear Vane Testing**

Inspection pits CPT01 to CPT06 and VS01 to VS05 (Appendix A), were hand excavated to a depth of 1.20m to check for buried services, prior to Cone Penetration Testing (prefixed 'CPT') or in situ shear vane testing (prefixed 'VS') being undertaken in these locations. Representative disturbed samples were taken and retained in sealed plastic bags and airtight containers to retain moisture content. On completion, all trial pits were backfilled with arisings.

Cone Penetration Testing was undertaken on behalf of this Company by In Situ SI Limited and comprised a total of six static piezocone penetration tests (CPTU), ten pore water dissipation tests and six seismic Dilatometer Marchetti Tests (SDMT). In addition, in situ shear vane testing was undertaken adjacent to locations CPT01 to CPT05. The results are presented in Appendix B as In Situ SI Limited report reference 1190290.

### **Trial Pits**

The trial pits, referenced TP05 to TP09 (Appendix A), were formed by a wheeled excavator with a 0.60m wide backactor bucket.

Representative disturbed samples were taken and retained in sealed plastic bags and airtight containers to retain moisture content.



Hand vane tests were carried out in suitable cohesive material. The results are presented on the trial pit logs and tabulated in Appendix A.

Photographs of the trial pit profile and spoil heap were taken and are presented in Appendix C.

On completion, all trial pits were backfilled with arisings compacted in suitable layers by the excavator bucket. The ground surface was left slightly proud to accommodate the future inevitable settlement of the backfill.

### **Surface Water Sampling**

Surface water samples were obtained from locations specified by the Consultant during each monitoring visit. The samples were dispatched from site directly to the laboratories of i2 Analytical, Watford, under a Chain of Custody.

### **General**

Samples for chemical analyses were dispatched daily from site directly to the laboratories of i2 Analytical, Watford, under a Chain of Custody. The remaining samples were brought to this Company's laboratory for testing and storage.

## **3.2 Logging**

The logging of soils and rocks was carried out by an Engineering Geologist in general accordance with BS5930:2015. A key to the exploratory hole logs is presented in Appendix A.



Detailed descriptions of the core and samples are given in the borehole logs, Appendix A, along with details of sampling, in situ testing, groundwater ingress, installations and relevant comments on drilling techniques.

Hand vane tests were carried out on suitable samples. The results are summarised on the borehole logs and also tabulated in Appendix A.

Prior to logging, photographs of the core were taken and are presented in Appendix C.

Suitable core subsamples were selected by this Company. The core was carefully logged and prepared prior to preserving the subsample by wrapping in clingfilm and aluminium foil and coating with at least three layers of wax. The sample was further protected by a covering of waxed cheesecloth, labelled and transported horizontally in padded, wooden coreboxes.

The trial pits were logged in situ to a depth of approximately 1.20m and thereafter from the surface. Detailed descriptions are given in the trial pit logs, Appendix A, along with details of sampling and in situ testing, groundwater ingress and relevant comments on stability.

### **3.3 Laboratory Testing**

A schedule of laboratory tests was prepared by the Consultant, the following tests being carried out in accordance with BS1377:1990, unless stated otherwise. The number in brackets refers to the test number given in that standard. The results are presented in Appendix D.

The natural water content was determined on thirty-nine selected samples in accordance with BS EN ISO 17892-1:2014.



Liquid limit, plastic limit and plasticity index tests [Part 2:4.3, 5.3 and 5.4] were carried out on thirty-eight selected samples. Atterberg line plots have also been presented.

Particle size distributions were determined in accordance with BS EN ISO 17892-4:2016 for thirty-three samples by wet sieving [5.2]. The fine fractions of thirty-one of these samples were further analysed by sedimentation using the pipette method [5.4]. The results are presented as grading curves.

The one-dimensional consolidation properties [Part 5:3] were determined in the oedometer on twelve 63.5mm diameter by 19mm thick specimens prepared from UT100 samples. The results are presented in tabular form and also as graphs of void ratio versus log (effective pressure). On nine of these samples the coefficient of secondary compression was determined on a single stage, specified by the Consultant; plots of compression versus log time are presented for these stages.

Unconsolidated undrained triaxial compression tests were carried out under a single cell pressure on twelve specimens prepared from full diameter UT100 samples [Part 7:8]. A cell pressure specified by the Consultant was used. Fully saturated,  $\phi_u = 0$ , conditions were assumed and the undrained cohesion,  $c_u$  was taken as half the deviator stress at failure.

The following tests on rock samples were carried out in accordance with ISRM (2007) unless stated otherwise. Test results are presented in Appendix D.

Four rock cores were tested for unconfined compressive strength.

Point load index tests were carried out on thirty selected lengths of core.

Nineteen samples were despatched to Chemtest Limited (Newmarket) where organic matter was determined to in-house methods.



Four samples were despatched to Chemtest Limited (Newmarket) where loss on ignition was determined to in-house methods.

The BRE SD1 (2005) suite of tests was carried out on twenty-nine samples by Chemtest Limited (Newmarket) using in-house methods.

Selected surface water and groundwater samples were dispatched to i2 Analytical, Watford, where chemical analyses were carried out to in-house methods for a suite of contaminants. The results are presented in Appendix E.

## **GEOTECHNICAL ENGINEERING LIMITED**





#### **4. REFERENCES**

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

British Standards Institution (2012): Geotechnical investigation and testing. Field testing. Standard penetration test. BS EN ISO 22476-3:2005+A1:2011.

British Standards Institution (2016): Methods of test for soils for civil engineering purposes – Part 1: General requirements and sample preparation. BS1377-1:2016.

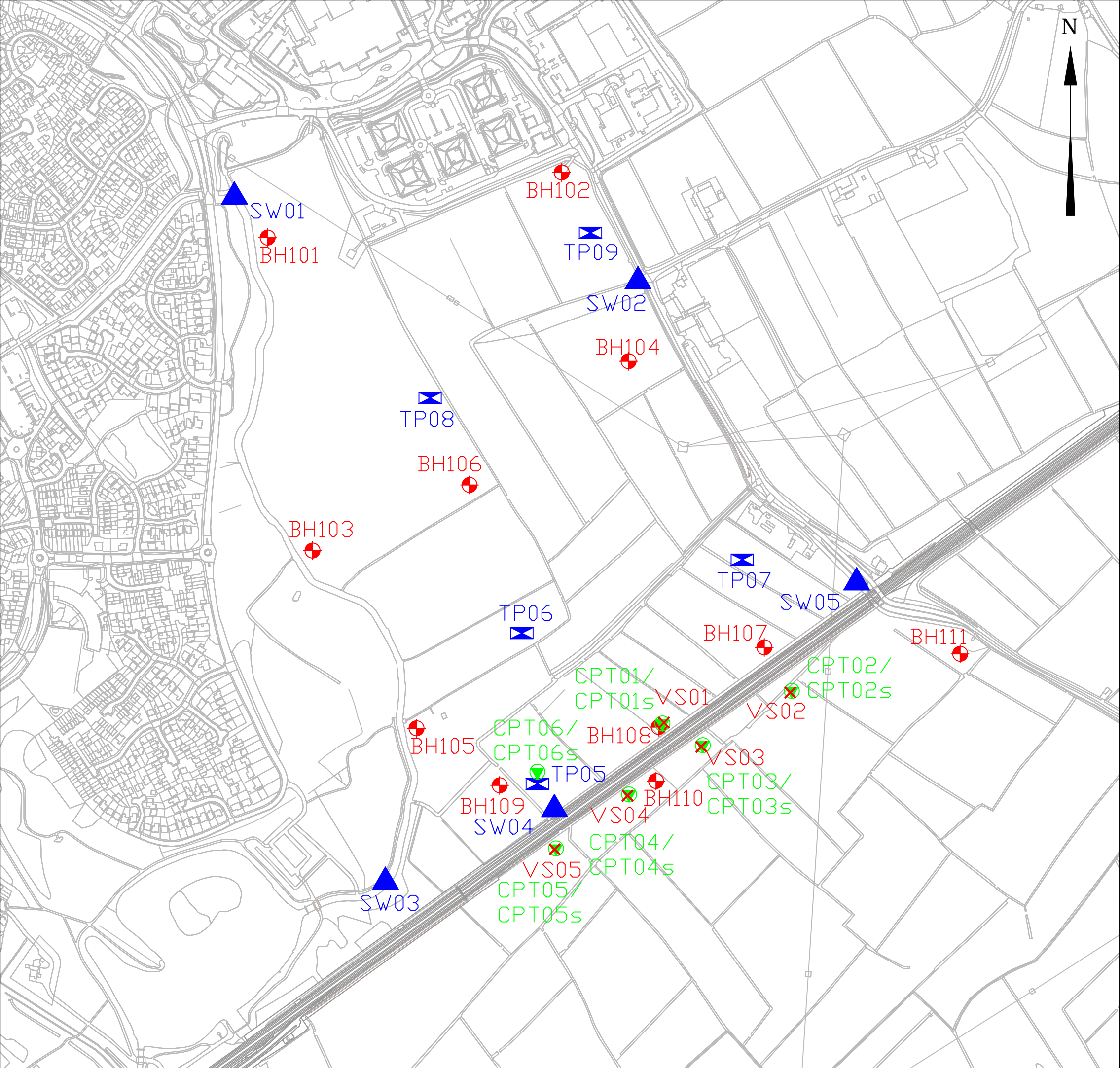
British Standards Institution (1990): Methods of tests for soils for civil engineering purposes. BS 1377 Parts 2-9.

British Standards Institution (2014): Geotechnical investigation and testing – Laboratory testing of soil. Part 1: Determination of water content. BS EN ISO 17892-1:2014.


British Standards Institution (2016): Geotechnical investigation and testing – Laboratory testing of soil. Part 4: Determination of particle size distribution. BS EN ISO 17892-4:2016.

International Society for Rock Mechanics (2007). The complete ISRM suggested methods for rock characterization, testing and monitoring: 1974-2006, edited by R Ulusay & J A Hudson. Ankara, Turkey: Turkish National Group of the International Society for Rock Mechanics.


Building Research Establishment (2005): Concrete in aggressive ground. BRE Special Digest 1. Third Edition.




Key.




Trial Pit Location




Rotary Borehole Location



Cone Penetration Test



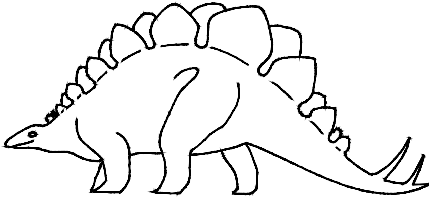
In Situ Vane Test



Surface Water Sample Location

Notes:

Drawing supplied by client.



**geotechnical**

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Client:

Cardiff Parkway Developments Limited

Site:

Cardiff Parkway Initial Ground Investigation

Title:

Exploratory Hole Location Plan

Drawn By:	JM	Checked By:	ZM/RT	Paper Size:	A3
Scale:	1:2000		Date:	Sept 2019	
Contract:	35338			Figure:	01



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# APPENDIX A

## FIELDWORK DATA

# KEY TO EXPLORATORY HOLE LOGS



## Sample type

D Small disturbed	U Undisturbed	L Dynamic	ES Environmental - soil	Cs Core subsample (prepared)
B Bulk disturbed	UT Undisturbed thin wall	C Core	EW Environmental - water	Ls Dynamic subsample (prepared)
LB Large bulk disturbed	P Piston	W Water		

## Test type

S SPT - Split spoon sampler followed by uncorrected SPT 'N' Value

C SPT - Solid cone followed by uncorrected SPT 'N' Value

(\*250 - Where full test drive not completed, linearly extrapolated 'N' value reported, \*\* - Denotes no effective penetration)

H Hand vane - direct reading in kPa - not corrected for BS1377 (1990). Re\* denotes refusal

M Mackintosh probe - number of blows to achieve 100mm penetration

Mx Mexe cone - average reading of equivalent CBR value in %

PP Pocket penetrometer - direct reading in kg/sq.cm

Vo Headspace vapour reading, uncorrected peak values in ppm, using a PID (calibrated with Isobutylene, using a 10.6eV bulb)

## Sample/core range/l<sub>r</sub>

| Dynamic sample

|

■ Undisturbed sample - open drive including thin wall. Symbol length reflects recovery

x x = Total Core Recovery (TCR) as percentage of core run

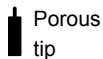
y y = Solid Core Recovery (SCR) as percentage of core run. Assessment of core is based on full diameter.

z z = Rock Quality Designation (RQD). The amount of solid core greater than 100mm expressed as percentage of core run.

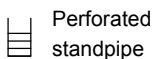
Where SPT has been carried out at beginning of core run, disturbed section of core excluded from SCR and RQD assessment.

l<sub>r</sub> - fracture spacing - the modal fracture spacing (mm) over the indicated length of core. Where spacing varies significantly, the minimum, mode and maximum values are given. NI = non-intact core NA = not applicable

## Instrumentation



Porous tip



Perforated standpipe



Granular response zone



Bentonite seal



Cement/bentonite grout



Soil Backfill



Concrete

## Stratum boundaries

----- Estimated boundary

..... Grading boundary

## Logging

The logging of soils and rocks has been carried out in general accordance with BS 5930:2015.

Chalk is logged in general accordance with Lord et al (2002) CIRIA C574. Where possible, dynamic samples in chalk have been logged in accordance with CIRIA C574; descriptions and gradings (if presented) should be treated with caution given the potential for sample disturbance.

For rocks the term fracture has been used to identify a mechanical break within the core. Where possible incipient and drilling induced fractures have been excluded from the assessment of fracture state. Where doubt exists, a note has been made in the descriptions. All fractures are considered to be continuous unless otherwise reported.

Made Ground is readily identifiable when, within the material make up, man made constituents are evident. Where Made Ground appears to be reworked natural material the differentiation between in situ natural deposits and Made Ground is much more difficult to ascertain. The interpretation of Made Ground within the logs should therefore be treated with caution.

The descriptors "topsoil" and "tarmacadam" are used as generic terms and do not imply conformation to any particular standard or composition.

Rootlets are defined as being less than 2mm in diameter, roots are defined as in excess of 2mm diameter.

## General Comments

The process of drilling and sampling will inevitably lead to disturbance, mixing or loss of material in some soil and rocks.

Indicated water levels are those recorded during the process of drilling or excavating exploratory holes and may not represent standing water levels.

All depths are measured along the axis of the borehole and are related to ground level at the point of entry. All inclinations are measured normal to the axis of the core.

Where provided, the stratigraphic names/geological rock units are for guidance only and may not be wholly accurate.

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH01**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 2

Start Date 10 June 2019

Easting 324710.6

Scale 1 : 50

End Date 11 June 2019

Northing 181410.9

Ground level 5.40mOD

Depth 8.20 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru -ment	description	depth (m)	reduced level (m)	legend
10/06/19 1145hrs	1B	0.20 - 0.40		Vo 0.6				Crop over firm brown slightly sandy CLAY. Abundant rootlets. (MADE GROUND/REWORKED NATURAL DEPOSITS)	0.20	5.20	
	1ES	0.20 - 0.40							0.50	4.90	
	2B	0.60 - 0.80		Vo 1.1				Stiff orangish brown mottled grey CLAY. Frequent rootlets and relic rootlets.	0.90	4.50	
	2ES	0.60 - 0.80									
	3B	1.00 - 1.20		Vo 0.9				Soft grey mottled brownish grey CLAY. Rare rootlets.			
	3ES	1.00 - 1.20									
	4D	1.20 - 1.73	Nil	S 4				Soft brown slightly sandy slightly gravelly CLAY with frequently pockets (up to 20mm) of greenish brown and grey fine sand and silt. Gravel is subangular and subrounded fine to coarse sandstone, quartz and siltstone.			
	5L	1.20 - 2.20						1.90 - 2.05m: Abundant partially decomposed root fragments (up to 20mm diam).	2.05	3.35	
10/06/19 1620hrs 1.60m	7UT	2.20 - 2.65	Nil					Medium dense to dense brownish red locally slightly sandy clayey subangular to rounded fine to coarse sandstone, siltstone and mudstone GRAVEL.			
	9L	2.20 - 3.20						2.05m: Band (20mm) of yellowish brown fine sand.			
11/06/19 0850hrs 1.00m	8D	2.65 - 3.10	Nil	S 30				2.80m: Subrounded sandstone cobble.	3.20	2.20	
	10L	3.20 - 3.65	3.20	S 11				Firm reddish brown slightly sandy slightly gravelly CLAY with frequent pockets (up to 10mm) of greenish grey fine sand and silt. Gravel is subangular and subrounded fine rarely medium sandstone, siltstone and quartz.			
		3.20 - 4.20						3.50 - 3.60m: Brown gravelly fine sand. Gravel is subangular fine sandstone.			
	11D	3.90 - 4.00						4.20 - 4.55m: Very gravelly.			
	12UT	4.20 - 4.65	4.20								
	14L	4.20 - 5.20						4.70 - 5.00m: Recovered as slightly clayey subangular fine to coarse mudstone gravel.	5.20	0.20	
	13D	4.65 - 4.97	4.20	S*88							
	15D	5.10 - 5.20									
	16D	5.20 - 5.53	5.20	S*86				Very stiff reddish brown gravelly CLAY with frequent pockets (up to 60mm) of greenish grey silt. Gravel is subangular fine to coarse lithorelicts of very weak mudstone.	5.80	-0.40	
	17C	5.20 - 6.70									
					80 0 0	NA		Extremely weak reddish brown MUDSTONE. Fractures are 10° and subvertical intersecting very closely spaced undulating rough.	6.50	-1.10	
						NI 20 40		6.10 - 6.20m: Disintegrated to stiff gravelly clay.			
						NI 40 140		6.15m: 10° band (10mm) of light grey silt.			
	18C	6.70 - 6.89	5.20	C*231				Very weak to weak dark reddish brown fine SANDSTONE with frequent dark green reduction spots (up to 50mm). Fractures are subhorizontal very closely and closely spaced undulating smooth.	7.60	-2.20	
		6.70 - 8.20			100 21 0			6.90 - 7.20m: Subvertical undulating rough fracture.			
						NI 60 90		7.15 - 7.45m: 80° undulating smooth fracture.			
								7.45 - 7.60m: Subvertical planar smooth fracture.			
11/06/19 1815hrs								Continued Next Page	{8.00}		

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Dynamic sampled (128mm) 1.20-5.20m. Waterflush rotary core drilled (146mm) 5.20-8.20m.

CASING: 168mm diam to 5.20m.

BACKFILL: On completion, backfilled with bentonite pellets 8.20-8.00m. A slotted standpipe (50mm) was installed to 8.00m, granular response zone 8.00-6.70m, bentonite seal 6.70-2.00m. A second slotted standpipe (19mm) was installed to 2.00m, granular response zone 2.00-0.30m, bentonite seal 0.30-0.10m, concrete and raised cover 0.10- 0.00m.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
1.65	Nil	1.60	20	Seepage


**CONTRACT**  
**35338**
**CHECKED**  
**CT**

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH01**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 2 of 2

Start Date 10 June 2019

Easting 324710.6

Scale 1 : 50

End Date 11 June 2019

Northing 181410.9 Ground level 5.40mOD

Depth 8.20 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru -ment	description	depth (m)	reduced level (m)	legend
1.20m		8.20 - 8.41	5.20	C*200				Extremely weak reddish brown MUDSTONE with rare pocket (up to 30mm) of light grey silt. Fractures are subhorizontal and subvertical intersecting very closely and closely spaced planar smooth and rough.  Borehole completed at 8.20m.	8.20	-2.80	
<div style="display: flex; justify-content: space-between;"> <div> water strike (m) casing (m) rose to (m) time to rise (m) remarks </div> <div> </div> <div> CONTRACT <b>35338</b> </div> <div> CHECKED <b>CT</b> </div> </div>											

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH02**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 2

Start Date 11 June 2019

Easting 325105.0

Scale 1 : 50

End Date 12 June 2019

Northing 181498.2 Ground level 5.10mOD

Depth 12.80 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I <sub>f</sub>	instru- ment	description	depth (m)	reduced level (m)	legend
11/06/19 1000hrs	1B	0.30 - 0.50		Vo 0.4				Crop over firm brown slightly sandy CLAY. Frequent rootlets. (MADE GROUND/REWORKED NATURAL DEPOSITS)	0.20	4.90	
	1ES	0.30 - 0.50									
	2B	0.60 - 0.80		Vo 0.1				Stiff brownish grey mottled orangish brown CLAY. Frequent rootlets.	0.95	4.15	
	2ES	0.60 - 0.80						0.60m: Becoming firm.			
	3B	1.00 - 1.20		Vo 0				Soft to firm light brownish grey CLAY with frequent pockets (up to 100mm) of firm dark brown fibrous peat.	1.20	3.90	
	3ES	1.00 - 1.20		S <1							
	4D	1.20 - 1.65	Nil								
	5L	1.20 - 2.20									
	6D	1.70 - 1.80		H 13				Very soft grey CLAY with abundant partially decomposed root fragments (up to 15mm diam) and pockets of organic material (up to 10mm).			
		1.80		H 9							
		1.90									
	7UT	2.20 - 2.65	Nil								
	10L	2.20 - 3.30									
	8D	2.65 - 2.80						2.55 - 2.85m: Brownish grey. Silty becoming sandy.			
	9D	2.80 - 3.25	Nil	S 2					2.90	2.20	
	11D	3.10 - 3.20		S 2				Very soft reddish brown slightly sandy slightly gravelly CLAY with frequent pockets (up to 40mm) of yellowish green fine sand. Gravel is subangular and subrounded fine and medium sandstone, siltstone and mudstone.			
	12D	3.30 - 3.75	3.15						3.45	1.65	
	13L	3.30 - 4.30						Very loose brown locally clayey fine and medium SAND.			
	14D	3.90 - 4.00									
	UT	4.30 - 4.50	4.15					4.00 - 4.30m: Slightly gravelly. Gravel is subrounded and rounded fine and medium sandstone and siltstone.			
	15D	4.30 - 4.50									
	16D	4.50 - 4.95	4.15	S 15				4.50m: Medium dense.			
	17L	4.50 - 5.30									
	18D	5.20 - 5.30									
	19D	5.30 - 5.75	5.15	S 8					5.50	-0.40	
	20L	5.30 - 6.80	5.30				NA	Firm becoming stiff brownish red locally slightly sandy slightly gravelly CLAY with frequent pockets (up to 10mm) of yellowish green, red and brown fine sand and silt. Gravel is subrounded and rounded fine and medium sandstone and quartz.			
	21D	6.20 - 6.30		H 94							
		6.35		H 84							
		6.50		H 86							
11/06/19 1700hrs 1.00m	22D	6.80 - 7.25	6.80	S 16							
12/06/19 0830hrs 1.00m	23C	6.80 - 8.30			97 0 0		NA		7.15	-2.05	
	24D	7.50 - 7.60						Stiff locally firm brownish red slightly gravelly silty CLAY. Gravel is subangular fine and medium lithorelicts of very weak mudstone.			
Continued Next Page									{8.00}		

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Dynamic sampled (128mm) 1.20-6.80m. Waterflush rotary core drilled (146mm) 6.80-12.80m.

CASING: 168mm diam to 6.80m.

BACKFILL: On completion, borehole backfilled with bentonite pellets 12.80-5.00m. A slotted standpipe (50mm) was installed to 5.00m, granular response zone 5.00-4.00m, bentonite seal 4.00-2.00m. A second slotted standpipe (19mm) was installed to 2.00m, granular response zone 2.00-0.50m, bentonite seal 0.50-0.30m, gravel drainage 0.30-0.20m, concrete and raised cover 0.20-0.00m.

REMARKS: Driller notes flush returns reduced between 9.80 to 10.40m (approx. 60% returned) and flush returns lost from 10.40 to 12.80m.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m) casing (m) rose to (m) time to rise (min) remarks  
1.20 Nil



CONTRACT  
**35338**

CHECKED  
**CT**

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH02**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 2 of 2

Start Date 11 June 2019

Easting 325105.0

Scale 1 : 50

End Date 12 June 2019

Northing 181498.2 Ground level 5.10mOD

Depth 12.80 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru- ment	description	depth (m)	reduced level (m)	legend
12/06/19 1410hrs 1.10m	25D 26C	8.30 - 8.70 8.30 - 9.80	6.80	S*60	99 5 0			7.90 - 8.30m: Tending to extremely weak mudstone. 8.00m: Pocket (60mm) of greenish grey silt. 8.25 - 8.30m: Greenish grey siltstone.			
	27D	8.80 - 8.90						8.90 - 9.00m: Extremely weak reddish brown with green reduction spots (up to 20mm) mudstone.	9.10	-4.00	
	28D 29D 30C	9.70 - 9.80 9.80 - 10.05 9.80 - 10.40	6.80	S*130	100 0 0			Very stiff reddish brown mottled purple and light greenish grey gravelly CLAY tending to extremely weak mudstone. Gravel is subangular and subrounded fine and medium sandstone and lithorelicts of extremely weak mudstone.			
	31C 32D	10.40 - 10.90 10.70 - 10.80			60 0 0			10.40 - 10.90m: 70° very closely spaced thin beds of purplish grey siltstone.			
	33C 34C	10.90 - 11.30 11.30 - 11.48 11.30 - 12.80	6.80	C*167	55 0 0 100 0 0			10.90 - 11.30m: Sandy.			
	35D	11.80 - 11.90						11.75 - 12.20m: Frequent pockets (up to 80mm) of light grey silt.			
	36D	12.70 - 12.80 12.80 - 12.96	6.80	C*250					12.80	-7.70	
								Borehole completed at 12.80m.			
water strike (m) casing (m) rose to (m) time to rise (m) remarks									CONTRACT <b>35338</b>		CHECKED <b>CT</b>



**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH03**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 2

Start Date 12 June 2019

Easting 324770.7

Scale 1 : 50

End Date 13 June 2019

Northing 180991.2 Ground level 5.45mOD

Depth 11.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru -ment	description	depth (m)	reduced level (m)	legend
12/06/19 1015hrs	1B	0.20 - 0.40						Crop over firm brown slightly sandy CLAY. Frequent rootlets. (MADE GROUND/REWORKED NATURAL DEPOSITS)	0.20	5.25	
	2D	0.20 - 0.40							0.55	4.90	
	3B	0.60 - 0.80						Firm brownish grey mottled orangish brown CLAY. Rare rootlets.	1.00	4.45	
	4D	0.60 - 0.80									
	5B	1.00 - 1.20						Soft brownish grey mottled brown CLAY. Rare rootlets.			
	6D	1.00 - 1.20									
	7UT	1.20 - 1.65	Nil					Firm brownish grey mottled grey slightly sandy slightly gravelly CLAY with frequent pockets (up to 15mm) of grey, yellow and brown fine sand. Gravel is subangular fine to coarse sandstone, siltstone and rare quartz.			
	9L	1.20 - 2.20									
	8D	1.75 - 2.20	Nil	S 7							
	10D	1.80 - 1.90									
	11D	2.20 - 2.65	Nil	S 7							
	12L	2.20 - 3.20						2.40 - 2.60m: Sandy.	2.60	2.85	
	13D	2.80 - 2.90						Stiff reddish brown slightly gravelly sandy silty CLAY with frequent pockets (up to 15mm) of light grey and brown fine sand. Gravel is subangular and subrounded fine and medium sandstone, siltstone and quartz.			
		2.90		H 120							
		3.00		H 112							
		3.10		H 114							
	14UT	3.20 - 3.65	3.20								
	17L	3.20 - 4.20									
	15D	3.65 - 3.75									
	16D	3.75 - 4.20	3.20	S 23							
	18D	3.80 - 3.90									
	19D	4.20 - 4.65	4.20	S 24							
	20L	4.20 - 5.00							4.40	1.05	
12/06/19 1710hrs 1.20m	21D	4.80 - 4.90					NA	Very stiff reddish brown gravelly CLAY tending to extremely weak mudstone with frequent pockets (up to 50mm) of light greenish grey silt. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone.			
	22D	5.00 - 5.37	5.00	S*70							
	23C	5.00 - 6.50				93 7 7					
								6.10 - 6.20m: Band of light green silt.			
	24C	6.50 - 6.62	5.20	C*545		100 65 57	NI 130 190	Very weak reddish brown locally purplish grey and greenish grey MUDSTONE. Fractures are subhorizontal and 70-80° very closely and closely spaced undulating smooth locally infilled (up to 10mm) with clayey subangular fine mudstone gravel. 6.75 - 6.95m: Subvertical planar rough fracture. 7.00 - 7.25m: 80° undulating smooth fracture.	6.40	-0.95	
		6.50 - 7.60									
	25C	7.60 - 8.00				100 45 33					
		8.00 - 8.17	5.20	C*429							
								Continued Next Page	{8.00}		

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Dynamic sampled (128mm) 1.20-5.00m. Waterflush rotary core drilled (146mm) 5.00-11.00m.

CASING: 168mm diam to 5.20m.

BACKFILL: On completion, borehole backfilled with bentonite pellets 11.00-6.00m. A slotted standpipe (50mm) was installed to 6.00m, granular response zone 6.00-4.70m, bentonite seal 4.70-2.00m. A second slotted standpipe (19mm) was installed to 2.00m, granular response zone 2.00-0.30m, bentonite seal 0.30-0.10m, concrete and raised cover 0.10-0.00m.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m) casing (m) rose to (m) time to rise (min) remarks

Groundwater not encountered prior to use of water flush.

CONTRACT  
**35338**CHECKED  
**CT**

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH03**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 2 of 2

Start Date 12 June 2019

Easting 324770.7

Scale 1 : 50

End Date 13 June 2019

Northing 180991.2 Ground level 5.45mOD

Depth 11.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru -ment	description	depth (m)	reduced level (m)	legend
13/06/19 0850hrs 1.20m	26C	8.00 - 9.50			93 43 30			7.70 - 7.75m: Recovered non intact as subangular medium and coarse gravel.			
	27C	9.50 - 9.66 9.50 - 11.00	5.20	C*545	100 93 93	140 480 550		Weak reddish brown locally greenish grey MUDSTONE with frequent light green reduction spots (up to 10mm). Fractures are subhorizontal to 10° closely and medium spaced planar rough and undulating smooth.	9.50	-4.05	
13/06/19 1110hrs 2.10m		11.00 - 11.14	5.20	C*462					11.00	-5.55	
								Borehole completed at 11.00m.			
									{18.00}		
water strike (m) casing (m) rose to (m) time to rise (m) remarks									CONTRACT		
Groundwater not encountered prior to use of water flush.									35338		
									CHECKED		
									CT		

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH04**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 2

Start Date 13 June 2019

Easting 325194.7

Scale 1 : 50

End Date 14 June 2019

Northing 181245.1

Ground level 5.10mOD

Depth 16.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru -ment	description	depth (m)	reduced level (m)	legend
13/06/19 1025hrs	1B	0.30 - 0.50						Grass over firm light brown sandy CLAY. Abundant rootlets.	0.10	5.00	
	2D	0.30 - 0.50						Stiff brownish grey mottled orangish brown silty CLAY. Rare rootlets.	0.50	4.60	
	3B	0.60 - 0.80						Firm becoming soft grey locally mottled orangish brown silty CLAY. Rare rootlets.	1.20	3.90	
	4D	0.60 - 0.80						Very soft grey mottled brown organic silty CLAY.			
	5B	1.00 - 1.20									
	6D	1.00 - 1.20									
	7P	1.20 - 2.00	Nil								
					P/S						
	8P	2.00 - 2.55	2.00					Very soft bluish grey CLAY.	2.00	3.10	
					P/S						
	9L	2.55 - 2.80	2.00								
	10D	2.65 - 2.75	2.80								
	11P	2.80 - 3.60									
					P/S						
	12P	3.60 - 4.40	3.60					Firm dark grey slightly clayey pseudo-fibrous PEAT becoming slightly sandy organic silty CLAY. Frequent organic fragments (up to 20mm).	3.60	1.50	
					P/S						
	13P	4.40 - 5.20	3.60					Firm dark grey clayey pseudo-fibrous PEAT with rare pockets (up to 20mm) of soft bluish grey clay. Frequent organic fragments (up to 20mm).	4.40	0.70	
					P/S						
	14P	5.20 - 6.00	5.20					Soft bluish grey CLAY.	5.20	-0.10	
					P/S						
13/06/19 1740hrs 2.00m	15D	6.00 - 6.45	6.00	S 36					6.00	-0.90	
14/06/19 0900hrs 2.00m	16L	6.00 - 7.50						Dense reddish grey slightly clayey slightly gravelly fine to coarse SAND. Gravel is subangular and subrounded fine and medium sandstone, siltstone, mudstone and quartz.	6.45	-1.35	
	17D	6.90 - 7.00						Dense reddish grey slightly clayey slightly gravelly fine to coarse SAND locally sandy GRAVEL. Gravel is subangular and subrounded fine to coarse sandstone, siltstone, mudstone and quartz.	7.10	-2.00	
	18D	7.30 - 7.40						6.55 - 6.65m: Band (90mm) of dark grey fine sand with abundant charcoal fragments (up to 20mm).	7.30	-2.20	
	19D	7.50 - 7.95	7.50	S 15				Stiff dark grey slightly sandy slightly gravelly CLAY. Gravel is subangular and subrounded fine to coarse sandstone, siltstone, mudstone and quartz.			
	20L	7.50 - 9.00									
								Continued Next Page	{8.00}		

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Piston sampled (100mm) 1.20-2.55m and 2.80-6.00m. Dynamic sampled (128mm) 2.55-2.80 and 6.00-9.00m. Waterflush rotary core drilled (146mm) 9.00-11.50m and (116mm) 11.50-16.00m.

CASING: 168mm diam to 9.00m.

BACKFILL: On 17/06/19, borehole backfilled with bentonite pellets 16.00-12.00m. A slotted standpipe (50mm) was installed to 12.00m, granular response zone 12.00-11.00m, bentonite seal 11.00-6.00m. A second slotted standpipe (19mm) was installed to 6.00m, granular response zone 6.00-0.50m, bentonite seal 0.50-0.30m, concrete and raised cover 0.30-0.00m.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
1.20	Nil	1.10	20	Seepage encountered in inspection pit.

CONTRACT  
**35338**CHECKED  
**CT**

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH04**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 2 of 2

Start Date 13 June 2019

Easting 325194.7

Scale 1 : 50

End Date 14 June 2019

Northing 181245.1 Ground level 5.10mOD

Depth 16.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru- ment	description	depth (m)	reduced level (m)	legend
	21D	8.40 - 8.50						Stiff reddish brown slightly sandy slightly gravelly silty CLAY. Gravel is subrounded and rounded fine and medium mudstone, sandstone and siltstone. 7.45 - 7.50m: Subangular sandstone cobble.			
	22C	9.00 - 10.00	9.00		100						
	23D	9.40 - 9.50									
	24D 25C	10.00 - 10.45 10.00 - 11.50	9.00	S 27	100			Stiff to very stiff reddish brown locally mottled purplish grey slightly sandy slightly gravelly CLAY tending to extremely weak mudstone with rare greenish grey reduction spots (up to 40mm). Gravel is subangular and subrounded fine mudstone lithorelicts.	9.80	-4.70	
	26D	10.40 - 10.50									
	27D 28C	11.50 - 11.72 11.50 - 13.00	9.00	S*222	100						
	29D	12.20 - 12.30						12.25 - 12.55m: Mottled greenish grey.			
	30C	13.00 - 13.07 13.00 - 14.30	9.00	C*500	100 91 19	NI 80 170		Very weak and weak reddish brown MUDSTONE with rare greenish grey reduction spots (up to 20mm). Fractures are subhorizontal and 80° very closely and closely spaced undulating rough.	13.10	-8.00	
	C 31C	14.30 - 14.41 14.30 - 14.50 14.50 - 16.00	9.00 9.00	C*429	0 93 77 69	NI 120 330 50 100 100		13.90 - 13.95m: Subhorizontal fracture infilled (up to 20mm) with very stiff reddish brown clay. Weak light reddish brown locally greenish grey MUDSTONE. Fractures are subhorizontal and 80° closely and medium spaced undulating and rough. 14.35 - 14.60m: Medium strong dark reddish brown fine sandstone. Fractures are subhorizontal and 50° very closely spaced planar smooth. 14.60m: 30mm bed of greenish grey silt.	14.20	-9.10	
14/06/19 1640hrs 1.70m		16.00 - 16.11	9.00	C*462				Borehole completed at 16.00m.	16.00	-10.90	
									{18.00}		
water strike (m) casing (m) rose to (m) time to rise (m) remarks								AGS	CONTRACT	CHECKED	
Seepage encountered in inspection pit.									35338	CT	

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH05**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 3

Start Date 21 June 2019

Easting 324910.2

Scale 1 : 50

End Date 25 June 2019

Northing 180752.9 Ground level 5.50mOD

Depth 21.70 m

progress date/time water depth	sample no & type	depth (m)		casing depth (m)	test type & value	samp. /core range	lf	instru -ment	description	depth (m)	reduced level (m)	legend
21/06/19 1020hrs	1B	0.20 - 0.40							Grass over firm brown silty CLAY. Frequent rootlets.	0.20	5.30	
	2D	0.20 - 0.40							Firm grey mottled brown and light grey CLAY with frequent pockets (up to 5mm) of orangish brown fine sand. Frequent rootlets.			
	3B	0.60 - 0.80										
	4D	0.60 - 0.80										
	5B	1.00 - 1.20						0.95		4.55		
	6D	1.00 - 1.20							Firm dark brown silty locally fibrous PEAT with frequent wood fragments (up to 60mm).	1.20	4.30	
	7D	1.20 - 1.65	Nil	S 3								
	8L	1.20 - 2.20							Very soft yellowish brown and greenish brown silty CLAY.	1.60	3.90	
		1.85		H 52					Firm brown and reddish brown slightly gravelly sandy CLAY with rare pockets (up to 30mm) of grey silt. Gravel is subangular to rounded fine and medium sandstone and siltstone.			
	9D	2.00 - 2.10										
	10D	2.20 - 2.65	Nil	S 9								
	11L	2.20 - 3.20								2.50	3.00	
									Soft reddish brown very sandy CLAY with frequent pockets (up to 20mm) of grey silt, locally slightly sandy clayey SILT.			
	12D	3.00 - 3.10		H 24								
	13UT	3.20 - 3.65	3.20									
	16L	3.20 - 4.20								3.65	1.85	
	14D	3.65 - 3.75							Very dense dark reddish brown slightly clayey sandy subangular fine and medium micaceous sandstone GRAVEL.	4.10	1.40	
	15D	3.75 - 4.15	3.20	S*60								
17D	4.00 - 4.10	4.20	C**					4.35		1.15		
18C	4.20 - 5.20											
									5.00	0.50		
	5.20 - 5.40	4.20	C*300						5.65	-0.15		
	5.20 - 6.70											
						</						

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Dynamic sampled (128mm) 1.20-4.20m. Waterflush rotary core drilled (116mm) 4.20-21.70m.

CASING: 168mm diam to 4.20m.

BACKFILL: On completion, borehole backfilled with bentonite pellets 21.70-4.00m. A slotted standpipe (50mm) was installed to 4.00m, granular response zone 4.00-2.70m, bentonite seal 2.70-1.50m. A second slotted standpipe (19mm) was installed to 1.50m, granular response zone 1.50-0.50m, bentonite seal 0.50-0.30m, concrete and raised cover 0.30-0.00m.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
1.65	Nil	1.00	20	Very Slow


**CONTRACT**  
**35338**
**CHECKED**  
**CT**

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH05**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 2 of 3

Start Date 21 June 2019

Easting 324910.2

Scale 1 : 50

End Date 25 June 2019

Northing 180752.9 Ground level 5.50mOD

Depth 21.70 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru- ment	description	depth (m)	reduced level (m)	legend
24/06/19 1640hrs 2.20m  25/06/19 0845hrs 1.30m	21C	8.20 - 8.33 8.20 - 9.70	4.20	C*600	100 67 43			Very weak and weak reddish brown MUDSTONE locally recovered non intact as clayey subangular fine to coarse gravel with frequent pockets (up to 50mm) of greenish grey silt. Fractures are subhorizontal and subvertical extremely closely and very closely spaced planar smooth.  Weak reddish brown MUDSTONE locally disintegrated to very stiff gravelly clay. Fractures are subhorizontal and 40° very closely and closely spaced undulating smooth. 7.75 - 8.00m: Very stiff reddish brown and light green sandy clay. 8.00 - 8.50m: Locally mottled purplish grey.	9.25	-3.75	
	22C	9.70 - 9.87 9.70 - 11.20	4.20	C*462	20 60 130			Weak reddish brown locally micaceous fine SANDSTONE. Fractures are subhorizontal to 10° very closely and closely spaced planar smooth.	10.50	-5.00	
	23C	11.20 - 11.32 11.20 - 12.70	4.20	C*600	90 45 14			Very weak reddish brown MUDSTONE. Fractures are subhorizontal and 45° very closely and closely spaced undulating smooth. 10.90m: Fracture infilled (30mm) with soft reddish brown clay.	11.75	-6.25	
	24C	12.70 - 12.83 12.70 - 14.20	4.20	C*600	NI 60 120			Extremely weak reddish brown locally purplish grey and green MUDSTONE recovered as clayey subangular fine to coarse gravel.	13.00	-7.50	
	25C	14.20 - 14.29 14.20 - 15.70	4.20	C*750	85 27 27			Very weak and weak reddish brown locally purplish grey MUDSTONE frequently disintegrated to clayey subangular fine and medium gravel. Fractures are subhorizontal closely and medium spaced undulating smooth. 13.15 - 13.25m: 45° planar smooth fracture.			
	26C	14.70 - 15.70			NI 70 220			14.00 - 14.10m: Frequent pockets (up to 10mm) of greenish grey silt.  14.45 - 14.50m: 45° planar smooth fracture.			
	27C	15.70 - 15.78 15.70 - 17.20	4.20	C**	100 50 28			16.10 - 16.95m: Non intact. Recovered as clayey subangular fine and medium gravel.	16.95	-11.45	
	28C	17.20 - 17.32 17.20 - 18.70	4.20	C*750	70 28 21			Weak to medium strong reddish brown locally green fine SANDSTONE. Fractures are subhorizontal closely and medium spaced planar smooth. 17.50 - 17.65m: Fractures are 45° very closely spaced planar smooth.			
					89 43 23						
						60 70 250					
	Continued Next Page									{18.00}	
water strike (m) casing (m) rose to (m) time to rise (m) remarks									AGS CONTRACT 35338		CHECKED CT

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH05**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 3 of 3

Start Date 21 June 2019


Easting 324910.2

Scale 1 : 50

End Date 25 June 2019

Northing 180752.9 Ground level 5.50mOD

Depth 21.70 m

progress date/time water depth	sample no & type	depth (m) from to		casing depth (m)	test type & value	samp. /core range	lf	instru- ment	description	depth (m)	reduced level (m)	legend
25/06/19 1250hrs 2.00m	29C	18.70 - 18.84	4.20	C*667	100 75 68	50 50 150			Very weak reddish brown MUDSTONE. Fractures are subhorizontal very closely and closely spaced undulating smooth.	18.10	-12.60	• • • •
		18.70 - 20.20							18.40 - 18.50m: Stiff reddish brown gravelly clay. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone.	18.95	-13.45	
	30Cs	19.70 - 20.00	4.20	C*429	77 60 60	180 270 410		Very weak and weak reddish brown with frequent green reduction spots (up to 30mm) MUDSTONE. Fractures are subhorizontal to 10° closely and medium spaced planar rough.				
	31C	20.20 - 20.31 20.20 - 21.70						20.00 - 20.20m: Disintegrated to clayey subangular fine and medium gravel.				
		21.70 - 21.81	4.20	C*462					21.50 - 21.70m: Disintegrated to green and reddish brown clayey subangular fine and medium gravel.	21.70	-16.20	
									Borehole completed at 21.70m.			
										{28.00}		
water strike (m) casing (m) rose to (m) time to rise (m) remarks												
										CONTRACT 35338	CHECKED CT	

## BOREHOLE LOG



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH06

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 2

Start Date 13 June 2019

Easting 324981.4

Scale 1 : 50

End Date 17 June 2019

Northing 181079.3 Ground level 5.30mOD

Depth 12.60 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru -ment	description	depth (m)	reduced level (m)	legend
13/06/19 1550hrs	1B	0.20 - 0.40						Crop over firm brown silty CLAY. Frequent rootlets. (MADE GROUND/REWORKED NATURAL DEPOSITS)	0.10	5.20	
	2D	0.20 - 0.40									
	3B	0.60 - 0.80						Firm brown locally mottled greyish brown CLAY. Rare rootlets.	0.55	4.75	
	4D	0.60 - 0.80									
13/06/19 1630hrs Dry	5B	1.00 - 1.20						Firm brownish grey mottled grey CLAY.			
	6D	1.00 - 1.20							1.20	4.10	
14/06/19 0820hrs Dry	7UT	1.20 - 1.65	Nil					Very soft bluish grey CLAY.			
	10L	1.20 - 2.20									
	8D	1.65 - 1.75	Nil	S <1					1.85	3.45	
	9D	1.75 - 2.20									
	11D	1.90 - 2.00		H 11				Very soft light brown sandy CLAY with rare pockets (up to 15mm) of light brown coarse sand. Frequent root fragments (up to 15mm diam).			
		2.05							2.40	2.90	
	12P	2.20 - 2.55	Nil								
	14L	2.20 - 3.20		H 20				Firm light brown becoming reddish brown slightly gravelly sandy CLAY with frequent pockets (up to 10mm) of yellow and grey fine sand. Gravel is subangular fine and medium sandstone and mudstone.			
		2.45		S 11					3.30	2.00	
	13D	2.55 - 3.00	Nil								
	15D	2.90 - 3.00						Stiff becoming very stiff reddish brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone.			
	16D	3.20 - 3.65	3.20	S 16				3.40 - 3.50m: Frequent pockets (up to 5mm) of light green silt.			
	17L	3.20 - 4.10						3.90 - 4.00m: Rare pockets (up to 5mm) of light green silt.			
		3.85		H Re*					4.50	0.80	
	18D	3.90 - 4.00		H 110							
	19D	4.10 - 4.38	3.20	S*97							
	20C	4.10 - 5.10									
					98 6 0	NA					
						NI		Weak and medium strong dark reddish brown MUDSTONE. Fractures are subhorizontal and subvertical intersecting very closely spaced undulating smooth.			
								4.50 - 4.90m: 80° fracture stained greenish brown.			
								5.05m: Band (2mm) of green silt.			
								5.10 - 5.60m: Assessed zone of core loss.			
									5.70	-0.40	
								5.70m: Band (5mm) of green silt.			
								Very stiff reddish brown gravelly CLAY tending to extremely weak mudstone. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone.			
								6.35m: Pocket (80mm) of green gravelly silt. Gravel is subangular fine siltstone.	6.40	-1.10	
								Very weak becoming weak reddish brown mottled purplish grey MUDSTONE with frequent light green reduction spots (up to 100mm). Fractures are 10-20° closely and medium spaced undulating smooth and rough.			
								7.20 - 7.40m: Subvertical undulating rough fracture stained greenish brown.			
								7.65 - 7.75m: 50° undulating smooth fracture.			
								Continued Next Page	{8.00}		

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Dynamic sampled (128mm) 1.20-4.10m. Waterflush rotary core drilled (146mm) 4.10-12.60m.

CASING: 168mm diam to 3.20m.

BACKFILL: On completion, borehole backfilled with bentonite pellets 12.60-5.00m. A slotted standpipe (50mm) was installed to 5.00m, granular response zone 5.00-3.70m, bentonite seal 3.70-2.50m. A second slotted standpipe (19mm) was installed to 2.50m, granular response zone 2.50-0.30m, bentonite seal 0.30-0.10m, concrete and raised cover 0.10-0.00m.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
2.20	Nil	1.60	20	Encountered following run 1.20-2.20m.


**CONTRACT**  
**35338**
**CHECKED**  
**CT**



**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH06**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 2 of 2

Start Date 13 June 2019

Easting 324981.4

Scale 1 : 50

End Date 17 June 2019

Northing 181079.3 Ground level 5.30mOD

Depth 12.60 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I <sub>f</sub>	instru -ment	description	depth (m)	reduced level (m)	legend													
14/06/19 1625hrs 1.40m	23C	8.10 - 8.22 8.10 - 9.20	3.20	C*667	95 57 38			8.00m: Pocket (50mm) of light green silt.	8.50	-3.20														
	24C	9.20 - 9.60	3.20	C*231	58 53 0			Very weak and weak reddish brown MUDSTONE with rare green reduction spots (up to 15mm). Fractures are subhorizontal very closely and closely spaced undulating smooth and rough. 8.70 - 8.80m: 45° fracture. 8.90 - 9.10m: Subvertical fracture. 9.40 - 9.60m: Frequent green reduction spots (up to 15mm).	9.90	-4.60														
17/06/19 0920hrs 1.60m	25C	9.60 - 9.88 9.60 - 11.10	3.20	C**	100 49 25	NI 60 200		Very weak dark reddish brown MUDSTONE. Fractures are 20° very closely and closely spaced planar smooth and rough. 10.20 - 10.40m: 50° undulating smooth fracture stained greenish brown. 10.40 - 10.50m: 45° planar rough fracture. 10.60 - 10.65m: Disintegrated to firm gravelly clay. 10.70 - 11.00m: Subvertical undulating rough fracture.	11.20	-5.90														
26C	11.10 - 11.20 11.10 - 12.60																							

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH07**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 3

Start Date 21 June 2019

Easting 325376.8

Scale 1 : 50

End Date 26 June 2019

Northing 180861.4 Ground level 5.05mOD

Depth 26.20 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru -ment	description	depth (m)	reduced level (m)	legend
21/06/19 1000hrs	1B	0.30 - 0.50						Grass over soft dark brown clayey SILT. Abundant rootlets and rare roots (up to 5mm diam).	0.15	4.90	
	2D	0.30 - 0.50									
	3B	0.60 - 0.80						Firm light grey mottled brownish grey and orangish brown slightly sandy CLAY with frequent pockets (up to 10mm) of orangish brown and light grey fine sand. Frequent roots (up to 15mm diam) and rootlets.	0.90	4.15	
	4D	0.60 - 0.80							1.10	3.95	
	5B	1.00 - 1.20									
	6D	1.00 - 1.20						Soft grey mottled brownish grey and light bluish grey slightly sandy CLAY with frequent pockets (up to 7mm) of orangish brown sand and rare pockets (up to 5mm) of purplish grey clay. Frequent rootlets.			
	7P	1.20 - 2.00	Nil		P/S						
	8P	2.00 - 2.80	Nil		P/S			Very soft light grey and bluish grey slightly sandy slightly gravelly peaty CLAY with frequent pockets (up to 80mm) of firm dark brown clayey peat. Gravel is subrounded fine quartz.			
	9P	2.80 - 3.30	2.80		P/S						
	10L	3.20 - 3.60	2.80	H 10							
	11P	3.60 - 4.40	2.80		P/S						
	12P	4.40 - 4.70	4.40		P/S						
	13L	4.70 - 5.20	4.20								
	14P	5.20 - 6.00	5.20		P/S						
	15P	6.00 - 6.80	6.00		P/S						
21/06/19 1640hrs 1.20m									6.80	-1.75	
24/06/19 0900hrs 0.50m	16L	6.80 - 7.45	6.80					Soft bluish grey CLAY.			
	17L	7.45 - 8.30	6.80					7.20 - 7.45m: Subangular quartzite cobble encountered at end of run.	7.45	-2.40	
								Stiff reddish brown slightly sandy gravelly CLAY. Gravel is subangular and subrounded fine to coarse sandstone and	7.80	-2.75	
								Continued Next Page	{8.00}		

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Piston sampled (100mm) 1.20-3.30m, 3.60-4.70m and 5.20-6.80m. Dynamic sampled (128mm) 3.30-3.60m, 4.70-5.20m and 6.80-9.70m. Waterflush rotary core drilled (116mm) 9.70-26.20m.

CASING: 168mm diam to 9.70m.

BACKFILL: On completion borehole backfilled with bentonite 26.20-11.50m. A slotted standpipe (50mm) was installed to 11.50m, granular response zone 11.50-10.50m, bentonite seal 10.50-7.00m. A second slotted standpipe (19mm) was installed to 7.00m, granular response zone 7.00-0.50m, bentonite seal 0.50-0.30m, gravel drain 0.30-0.20m, concrete and raised cover 0.20-0.00m.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
2.00	Nil	1.20	20	Slow


**CONTRACT**  
**35338**
**CHECKED**  
**CT**

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH07**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 2 of 3

Start Date 21 June 2019

Easting 325376.8

Scale 1 : 50

End Date 26 June 2019

Northing 180861.4 Ground level 5.05mOD

Depth 26.20 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru- ment	description	depth (m)	reduced level (m)	legend
	18D 19D 20L	8.10 - 8.20 8.30 - 8.75 8.30 - 9.70	8.30	S 28				quartz. Stiff to very stiff reddish brown slightly sandy CLAY.			
	21D 22D 23C	9.30 - 9.40 9.70 - 10.05 9.70 - 11.20	9.70	S*150	100 51 16			9.10 - 9.20m: Greenish grey silty fine sand.	10.20	-5.15	
	24C	11.20 - 11.30 11.20 - 12.70	9.70	C*600	97 90 52			Extremely weak to very weak reddish brown fine and medium SANDSTONE. Fractures are subhorizontal closely and medium spaced planar rough. 10.40 - 10.50m: Subvertical undulating rough fracture. 10.85 - 10.90m: Subvertical undulating rough fracture. 11.05 - 11.10m: Subvertical undulating rough fracture. 11.05 - 11.25m: Greenish grey. 11.20 - 11.40m: Subvertical planar rough fracture.	12.50	-7.45	
	25C	12.70 - 13.10 12.70 - 14.20	9.70	C*120	100 80 80			Very weak to weak thinly laminated reddish brown locally greenish grey MUDSTONE. Fractures are medium and widely spaced 20° planar smooth.			
24/06/19 1650hrs 0.80m	26C	14.20 - 14.36	9.70	C**	100 97 93						
25/06/19 0940hrs 0.80m	27Cs	14.45 - 14.75									
	28C	15.70 - 15.93 15.70 - 17.20	9.70	C*200	100 85 61			Very weak to weak dark reddish brown locally greenish grey fine SANDSTONE. Fractures are 20° closely and medium spaced planar rough.	15.40	-10.35	
	29C	17.20 - 17.28 17.20 - 18.70	9.70	C**	99 92 92			16.45 - 16.70m: Subvertical planar rough fracture.  17.50 - 17.70m: Greenish grey.	17.70	-12.65	
								Continued Next Page	{18.00}		
water strike (m) casing (m) rose to (m) time to rise (m) remarks									CONTRACT <b>35338</b>		CHECKED <b>CT</b>

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH07**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 3 of 3

Start Date 21 June 2019

Easting 325376.8

Scale 1 : 50

End Date 26 June 2019

Northing 180861.4 Ground level 5.05mOD

Depth 26.20 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru -ment	description	depth (m)	reduced level (m)	legend
25/06/19 1710hrs 0.90m  26/06/19 0915hrs 0.90m       26/06/19 1300hrs 1.10m	30C 31Cs	18.70 - 18.78	9.70	C**	100 85 72	NI 110 310		Very stiff indistinctly structured reddish brown gravelly to very gravelly CLAY locally tending to extremely weak mudstone. Gravel is subangular and subrounded fine to coarse mudstone lithorelitscs.	18.60	-13.55	
		18.70 - 20.20 18.85 - 19.15						Very weak to weak thinly laminated to very thinly bedded reddish brown locally mottled greenish grey MUDSTONE. Fractures are subhorizontal closely and medium spaced planar smooth.			
	32C	20.20 - 20.28	9.70	C**	95 80 61	30 170 320		20.40m: Subhorizontal fracture infilled (up to **mm) with *desc.* clay. 20.60 - 20.80m: Disintegrated to very stiff reddish brown clay-bound mudstone lithorelicts.	20.80	-15.75	
		20.20 - 21.70									
	33C	21.70 - 21.78	9.70	C**	87 81 80			Weak dark reddish brown fine SANDSTONE. Fractures are subhorizontal to 20° closely and medium spaced planar rough. Rare very thin greenish grey beds. 21.00 - 21.25m: Subvertical becoming 80° fracture infilled (up to 5mm) with gypsum.			
		21.70 - 23.20									
	34Cs	22.25 - 22.55									
	35C	23.20 - 23.36	9.70	C**	78 77 43			23.70 - 23.95m: 70° planar rough fracture infilled (up to 5mm) with gypsum.			
		23.20 - 24.70									
	36C	24.70 - 24.76	9.70	C**	98 63 21	NI 70 160		Extremely weak to very weak thinly laminated reddish brown MUDSTONE locally disintegrated to very stiff clay-bound mudstone lithorelicts. Fractures are subhorizontal very closely and closely spaced planar rough.	24.70	-19.65	
		24.70 - 26.20									
		26.20 - 26.27	9.70	C**				Borehole completed at 26.20m.	26.20	-21.15	
									{28.00}		
water strike (m) casing (m) rose to (m) time to rise (m) remarks											
									CONTRACT 35338		CHECKED CT

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH08**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 3

Start Date 17 June 2019

Easting 325235.3

Scale 1 : 50

End Date 20 June 2019

Northing 180754.5

Ground level 5.20mOD

Depth 25.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru -ment	description	depth (m)	reduced level (m)	legend
17/06/19 1320hrs	1B	0.20 - 0.40						Grass over firm brown silty CLAY. Frequent rootlets.	0.20	5.00	x
	2D	0.20 - 0.40						Firm brown mottled grey CLAY with frequent pockets (up to 10mm) of orange fine sand. Rare rootlets.			
	3B	0.60 - 0.80									
	4D	0.60 - 0.80									
	5B	1.00 - 1.20									
	6D	1.00 - 1.20									
17/06/19 1350hrs 1.00m	P	1.20 - 2.00	Nil					Soft greyish brown mottled light grey CLAY with rare wood fragments (up to 20mm).	0.90	4.30	
	7L	1.20 - 2.10							1.20	4.00	
18/06/19 0900hrs 0.80m	8D	1.30 - 1.40						Plastic dark brown clayey amorphous PEAT with frequent wood fragments (up to 30mm).	1.45	3.75	
		1.70		H 10							
		1.85		H 14							
		2.00		H 16				Very soft light bluish grey CLAY with frequent pockets (up to 20mm) of organic material and wood fragments (up to 40mm).			
	9P	2.10 - 2.90	2.10								
					P/S						
	10P	2.90 - 3.70	2.10								
					P/S						
	11P	3.70 - 4.50	3.70								
					P/S						
	P	4.50 - 5.30	4.50								
	12L	5.30 - 6.00	5.30					Soft greyish brown slightly sandy CLAY.	5.30	-0.10	
	P	5.80		H 10				5.70 - 5.80m: Plastic dark brown clayey amorphous peat.			
	13L	6.00 - 6.60	6.00						6.20	-1.00	
		6.00 - 7.00									
	14D	6.50 - 6.60						Firm reddish brown and brown slightly gravelly sandy CLAY with rare pockets (up to 20mm) of grey and brown fine sand. Gravel is angular and subangular fine to coarse sandstone, mudstone and siltstone.			
								6.80m: Subangular sandstone cobble.			
	15L	7.00 - 7.45	7.00	S 22					7.20	-2.00	
		7.00 - 8.50									
								7.20m: Subangular sandstone cobble.			
	16D	7.50 - 7.60						Firm reddish brown CLAY with rare pockets (up to 5mm) of greenish grey silt.	7.50	-2.30	x
											x
											x
								Continued Next Page	{8.00}		

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Dynamic sampled (128mm) 1.20-9.10m. Waterflush rotary core drilled (116mm) 9.10-25.00m.

CASING: 168mm diam to 8.70m.

BACKFILL: On completion, borehole backfilled with bentonite pellets 25.00-9.50m. A slotted standpipe (50mm) was installed to 9.50m, granular response zone 9.50-8.50m, bentonite seal 8.50-6.00m. A second slotted standpipe (19mm) was installed to 6.00m, granular response zone 6.00-0.50m, bentonite seal 0.50-0.30m, gravel drain 0.30-0.20m, concrete and raised cover 0.20-0.00m.

REMARKS: Driller notes flush returns reduced between 13.00m to 25.00m (approx. 75-30% returned).

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
1.20	Nil	1.00	20	


**CONTRACT**  
**35338**
**CHECKED**  
**CT**



CLIENT     CARDIFF PARKWAY DEVELOPMENTS LIMITED

# BH08

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 2 of 3

Start Date 17 June 2019

Easting 325235.3

Scale 1 : 50

End Date 20 June 2019

Northing 180754.5

Ground level      5.20mOD

Depth 25.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	I <sub>f</sub>	instru -ment	description	depth (m)	reduced level (m)	legend
18/06/19 1610hrs 3.00m	17D 18D 19L	8.15 8.25 8.40 - 8.50 8.50 - 8.95 8.50 - 9.10	7.00 8.50	H 28 H 34 S 45		NA		Soft locally firm reddish brown silty CLAY with rare pockets (up to 5mm) of green silt. 7.80 - 7.90m: Abundant pockets (up to 60mm) of green silt.	8.35	-3.15	X X X X
19/06/19 0920hrs 1.90m	20C 21D	9.10 - 10.00 9.40 - 9.50	8.70		100 13 0			Dense reddish brown clayey fine SAND locally sandy clayey silt.  9.10 - 9.30m: Tending to extremely weak fine sandstone.			
	22D 23C	10.00 - 10.27 10.00 - 11.50	8.70	S*261	90 13 11	NI NI 70 40 160 160		Extremely weak light green SILTSTONE locally disintegrated to silt. Fractures are subhorizontal extremely closely and closely spaced planar rough. 9.90 - 10.00m: Subvertical planar smooth fracture.	9.70 10.00	-4.50 -4.80	X X X X X X X X
	24Cs 25C	11.05 - 11.45 11.50 - 11.85 11.50 - 13.00	8.70	C*113		NA		Very weak reddish brown fine SANDSTONE. Fractures are subhorizontal very closely and closely spaced planar smooth. 10.15m: Pocket (60mm) of green silt. 10.30 - 10.45m: Subvertical planar smooth fracture stained dark red.	10.50	-5.30	.
	26D 27C	12.50 - 12.60 13.00 - 13.21 13.00 - 14.50	8.70	C*261	100 0 0			Very stiff reddish brown mottled purplish grey gravelly CLAY tending to extremely weak mudstone with frequent pockets (up to 20mm) of light grey silt. Gravel is subangular and subrounded fine to coarse lithorelicts of extremely weak mudstone. 12.05m: Pocket (40mm) of bluish green silt.			
	28D 29C 30Cs	14.00 - 14.10 14.50 - 14.73 14.50 - 16.00 14.85 - 15.25	8.70	C*261	100 0 0			12.80 - 12.95m: 45° planar smooth fissure.	14.00	-8.80	
	31C 32D 33C	16.00 - 16.20 16.00 - 17.50 16.80 - 16.90 17.50 - 17.67 17.50 - 19.00	8.70	C*353 C*316	100 0 0 100 19 19			Very stiff reddish brown and purplish grey very gravelly CLAY tending to extremely weak mudstone with frequent pockets (up to 80mm) of light green silt. Gravel is subangular fine to coarse lithorelicts of very weak and weak mudstone.  15.30 - 15.50m: Abundant pockets (up to 50mm) of bluish green silt.			
					100 100 180			Very weak reddish brown and purplish brown MUDSTONE. Fractures are subhorizontal closely spaced	17.65 18.00	-12.45 -12.80	
								Continued Next Page	{18.00}		
water strike (m) casing (m) rose to (m) time to rise (m) remarks											
								AGS	CONTRACT	CHECKED	
									35338	CT	

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH08**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 3 of 3

Start Date 17 June 2019

Easting 325235.3


Scale 1 : 50

End Date 20 June 2019

Northing 180754.5

Ground level 5.20mOD

Depth 25.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru- ment	description	depth (m)	reduced level (m)	legend
19/06/19 1640hrs 1.20m	34D	18.20 - 18.30					NA	planar rough.	19.30	-14.10	
	35C	19.00 - 19.14	8.70	C*353	97 41 29	NI 170 280	Very weak and weak reddish brown MUDSTONE with frequent pockets (up to 60mm) of green silt. Fractures are subhorizontal and 40-50° closely and medium spaced undulating smooth. 19.45 - 19.95m: Recovered non intact as clayey subangular fine to coarse mudstone gravel.				
		19.00 - 20.50									
	20/06/19 0940hrs 1.20m	36C	20.50 - 20.70	8.70	C*207	100 25 19		20.50 - 21.10m: Disintegrated to very stiff reddish brown gravelly clay.  21.35 - 21.70m: Locally recovered non intact as subangular fine to coarse mudstone gravel.			
20.50 - 22.00											
37C		22.00 - 22.09	8.70	C*500	93 25 21	NI 110 160	Very weak and weak dark reddish brown micaceous fine SANDSTONE. Fractures are 20-30° very closely and closely spaced planar smooth.  22.80 - 23.05m: Extremely weak. Recovered non intact as subangular fine and medium sandstone gravel. 23.05 - 23.45m: Very stiff reddish brown gravelly clay. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone.				
		22.00 - 23.50									
	38C	23.50 - 23.59	8.70	C*429	86 45 31		23.70 - 24.50m: Purplish brown.  24.10m: 20° fracture infilled (20mm) with soft brown micaceous clay. 24.30 - 24.50m: Extremely closely spaced 50° undulating smooth fractures. 24.55m: Band (30mm) of extremely weak green micaceous siltstone.				
		23.50 - 25.00									
20/06/19 1330hrs 1.20m			25.00 - 25.11	8.70	C*353			24.80 - 25.00m: Weak reddish brown mudstone. Borehole completed at 25.00m.	25.00	-19.80	
									{28.00}		
water strike (m) casing (m) rose to (m) time to rise (m) remarks											
									CONTRACT 35338		CHECKED CT

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH09**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 3

Start Date 18 June 2019

Easting 325021.8

Scale 1 : 50

End Date 20 June 2019

Northing 180676.4 Ground level 5.10mOD

Depth 23.20 m

progress date/time water depth	sample no & type	depth (m)		casing depth (m)	test type & value	samp. /core range	lf	instru- ment	description	depth (m)	reduced level (m)	legend
18/06/19 1230hrs Dry	1B	0.20 - 0.40		Nil					Grass over soft dark brown clayey SILT. Frequent rootlets.	0.10	5.00	
	2D	0.20 - 0.40							Firm light grey mottled brown CLAY with frequent pockets	0.90	4.20	
	3B	0.60 - 0.80							(up to 10mm) of orange fine sand. Frequent roots (up to			
	4D	0.60 - 0.80							20mm diam) and rootlets.			
	5B	1.00 - 1.20										
	6D	1.00 - 1.20							Very soft light grey and bluish grey CLAY with frequent			
	P	1.20 - 2.20								pockets (up to 80mm) of firm dark brown clayey peat and		
	7L	1.20 - 2.20		rare bands (up to 400mm) of pseudofibrous peat.								
					Frequent rootlets and decomposing plant material.							
	8D	1.70 - 1.90		H 14	P/S		3.00 - 4.35m: Slightly gravelly. Gravel is fine and medium	4.35	0.75			
		1.90		H 15								
	2.10		H 12									
9P	2.20 - 3.20	2.20										
10P	3.20 - 4.20 3.20	3.20	H 10	P/S								
11L	4.20 - 5.20	4.20										
12D	5.20 - 5.65	5.20	S 17	98			Frim becoming very stiff indistinctly fissured dark reddish	4.35	0.75			
13C	5.20 - 6.10									brown locally mottled bluish grey slightly sandy gravelly		
										CLAY with rare pockets (up to 10mm) of brown fine sand.		
19/06/19 0820hrs 0.50m								Gravel is subangular and subrounded fine and medium				
								extremely weak mudstone, siltstone and sandstone. Rare				
								decomposing plant material.				
								4.35 - 4.45m: Gravel is fine to coarse sandstone and				
								quartzite.				
								5.70 - 6.15m: Rare reduction spots (up to 5mm) and				
								bands of greenish blue clay (up to 12mm)	6.15	-1.05		
								Very stiff fissured dark reddish brown slightly sandy				
								gravelly CLAY with frequent greenish grey reduction spots				
								(up to 20mm). Gravel is subangular and subrounded fine				
								to coarse lithorelicts of very stiff clay to extremely weak				
								mudstone. Rare fragments of decomposing plant material.				

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Dynamic sampled (128mm) 1.20-5.20m. Waterflush rotary core drilled (116mm) 5.20-23.20m.

CASING: 168mm diam to 5.20m.

BACKFILL: On completion, borehole backfilled with bentonite 23.20-11.00m. A slotted standpipe (50mm) was installed to 11.00m, granular response zone 11.00-9.70m, bentonite seal 9.70-2.00m. A second slotted standpipe (19mm) was installed to 2.00m, granular response zone 2.00-0.40m, bentonite seal 0.40-0.20m, gravel drain 0.20-0.10m, concrete and raised cover 0.10-0.00m.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m) casing (m) rose to (m) time to rise (min) remarks  
 1.10 Nil Seepage observed in inspection pit.



CONTRACT  
**35338**

CHECKED  
**CT**



**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH09**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 2 of 3

Start Date 18 June 2019

Easting 325021.8

Scale 1 : 50

End Date 20 June 2019

Northing 180676.4 Ground level 5.10mOD

Depth 23.20 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	If	instru- ment	description	depth (m)	reduced level (m)	legend
	16C	8.20 - 8.52 8.20 - 9.70	5.20	C* 176	80 240 100 44 30			Extremely weak to weak dark reddish brown MUDSTONE. Fractures are subhorizontal and 50-60° becoming randomly orientated mainly closely spaced planar smooth frequently infilled (up to 3mm) with clay.  8.70 - 9.90m: Fracture surfaces locally weakened (up to 50mm) and recovered as fine to coarse mudstone gravel.			
	17C	9.70 - 9.91 9.70 - 11.20	5.20	C* 500	100 0 0	NI		Very stiff indistinctly structured fissured dark reddish brown gravelly to very gravelly CLAY with locally frequent greenish blue reduction spots. Gravel is subangular and subrounded fine to coarse lithorelicts of extremely weak mudstone. Fissures are subhorizontal to 15° locally infilled (up to 2mm) with clay.	9.90	-4.80	
	18C	11.20 - 11.39 11.20 - 12.70	5.20	C* 667	100 60 33	NI 90 260		Very weak and weak dark reddish brown MUDSTONE with frequent greenish grey reduction spots (up to 30mm) and dark purplish red burrows (up to 5mm diam) locally tending to claybound angular fine and medium gravel sized mudstone lithorelicts. Fractures are subhorizontal to 15° and 70° to subvertical mainly closely spaced planar and undulating rough and smooth frequently infilled (up to 5mm) with clay.	11.10	-6.00	
	19C	12.70 - 12.82 12.70 - 14.20	5.20	C* 667	100 49 51						
	20C	14.20 - 14.42 14.20 - 15.70	5.20	C* 286	97 32 7			13.35 - 13.55m: Bluish green.			
	21C 22Cs	15.70 - 15.82 15.70 - 17.20 15.85 - 16.15	5.20	C* 750	30 150 300 97 80 71			Weak dark reddish brown fine and medium micaceous SANDSTONE with rare bluish green reduction spots. Fractures are subhorizontal to 15° closely and medium spaced planar smooth rarely infilled (up to 15mm) with clay.	15.30	-10.20	
19/06/19 1700hrs 2.00m		17.20 - 17.29	5.20	C**	100 59 29						
20/06/19 0850hrs 1.00m	23C	17.20 - 18.70				NI			17.80	-12.70	
Continued Next Page									{18.00}		
water strike (m) casing (m) rose to (m) time to rise (m) remarks									<div> <div>AGS</div> <div>CONTRACT</div> <div>35338</div> </div> <div>CHECKED</div> <div>CT</div>		

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH09**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 3 of 3

Start Date 18 June 2019

Easting 325021.8

Scale 1 : 50

End Date 20 June 2019

Northing 180676.4 Ground level 5.10mOD

Depth 23.20 m

progress date/time water depth	sample no & type	depth (m)		casing depth (m)	test type & value	samp. /core range	I <sub>f</sub>	instru- ment	description	depth (m)	reduced level (m)	legend	
20/06/19 1610hrs 2.50m	24C	18.70 - 18.78 18.70 - 20.20	5.20	C**		100 73 36	50 140		Very weak locally extremely weak dark reddish brown MUDSTONE with rare spots (up to 30mm) and bands (up to 10mm) of greenish grey reduction. Fractures are subhorizontal to 15° and 70° to subvertical very closely and closely spaced planar and undulating smooth frequently infilled (up to 30mm) with clay.	18.60	-13.50		
	25C	20.20 - 20.34 20.20 - 21.70	5.20	C* 857		97 70 37			Very weak dark reddish brown MUDSTONE thinly and thickly interlaminated with fine sandstone and siltstone. Rare locally frequent spots (up to 50mm) and 2mm bands of greenish grey reduction. Fractures are subhorizontal very closely and closely spaced planar and undulating rough and smooth frequently infilled (up to 5mm) with clay and rarely infilled (up to 15mm) with gravelly clay, rarely with a micaceous veneer. 19.70 - 19.95m: Fine and medium sandstone with thin laminae of mudstone and siltstone.	21.40	-16.30		
	26C	21.70 - 21.80 21.70 - 23.20	5.20	C* 600		98 37 21	NI		Extremely weak and very weak dark reddish brown MUDSTONE locally tending to very stiff gravelly clay. Gravel is subangular fine to coarse gravel sized mudstone lithorelicts. Frequent greenish grey reduction spots (up to 50mm). Fractures are randomly orientated very closely spaced. 22.15 - 22.20m: Disintegrated to fine and medium gravel sized fragments.	22.95	-17.85		
			23.20 - 23.26	5.20	C**		80			Very weak dark reddish brown MUDSTONE. Fractures are subhorizontal and 70° closely spaced planar smooth frequently infilled (up to 1mm) with clay. 23.05 - 23.10m: Extremely weak.	23.20	-18.10	
										Borehole completed at 23.20m.			
											{28.00}		
	water strike (m) casing (m) rose to (m) time to rise (m) remarks												
										AGS CONTRACT 35338		CHECKED CT	

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH10**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 3

Start Date 26 June 2019

Easting 325231.6

Scale 1 : 50

End Date 1 July 2019

Northing 180682.1

Ground level 5.35mOD

Depth 26.70 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru- ment	description	depth (m)	reduced level (m)	legend
26/06/19 1300hrs	1B	0.20 - 0.40						Grass over firm brown clayey SILT. Frequent rootlets.	0.10	5.25	
	2D	0.20 - 0.40						Firm brown and brownish grey slightly sandy CLAY.	0.40	4.95	
	3B	0.60 - 0.80						Frequent rootlets.			
	4D	0.60 - 0.80									
	5B	1.00 - 1.20						Soft brownish grey mottled grey CLAY with rare pockets (up to 10mm) of orangish brown fine sand.			
	6D	1.00 - 1.20						0.90 - 1.20m: Locally bluish grey.			
	7UT	1.20 - 1.65	Nil						1.40	3.95	
	9L	1.20 - 2.20						Firm dark brown clayey PEAT.	1.75	3.60	
	8D	1.70 - 2.15	Nil	S 4							
	10D	1.90 - 2.00						Soft light bluish grey CLAY with abundant wood fragments (up to 50mm) and relict rootlets.			
	11D	2.20 - 2.65	Nil	S 7							
	12L	2.20 - 3.20									
	13D	2.75 2.90 - 3.00 3.10		H 14 H 10				2.95 - 3.05m: Plastic dark brown clayey peat.	3.05	2.30	
	14UT 16L	3.20 - 3.65 3.20 - 4.20	3.20					Very soft light bluish grey silty CLAY.			
26/06/19 1700hrs 1.00m	15D	3.70 - 4.15	3.20	S 2				3.05 - 4.00m: Rare wood fragments (up to 40mm) and relict rootlets.			
	17D	3.90 - 4.00		H 17							
	18L	4.20 - 5.20	4.20								
	19D	4.90 - 5.00							5.10	0.25	
	20UT 23L	5.20 - 5.65 5.20 - 6.70	5.20					Firm dark brown oxidising to black clayey fibrous PEAT. Strong organic odour.			
	21D	5.65 - 5.75									
	22D	5.75 - 6.20	5.20	S 3							
	24D	5.90 - 6.00						6.15 - 6.25m: Very soft grey clay with frequent pockets (up to 10mm) of organic material.			
	25D	6.70 - 7.15	6.70	S 21				6.50 - 6.60m: Slightly sandy.	6.60	-1.25	
	26L	6.70 - 8.20						Stiff brown and greyish brown sandy slightly gravelly CLAY with frequent pockets (up to 10mm) of light grey fine sand. Gravel is angular to subrounded fine and medium sandstone, siltstone and mudstone.			
27/06/19 0945hrs 0.00m	27D	7.50 - 7.60 7.70 7.90		H 52 H 94				7.80 - 7.90m: Firm.			
								Continued Next Page	{8.00}		

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Dynamic sampled (128mm) 1.20-9.20m. Waterflush rotary core drilled (116mm) 9.20-26.70m.

CASING: 168mm diam to 8.20m.

BACKFILL: On completion, borehole backfilled with bentonite pellets 26.70-2.50m. A slotted standpipe (50mm) was installed to 2.50m, granular response zone 2.50-0.50m, bentonite seal 0.50-0.30m, concrete and raised cover 0.30- 0.10m.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m) casing (m) rose to (m) time to rise (min) remarks

Groundwater not encountered prior to use of water flush.

CONTRACT  
**35338**CHECKED  
**CT**



CLIENT     CARDIFF PARKWAY DEVELOPMENTS LIMITED

# BH10

SITE      CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 2 of 3

Start Date 26 June 2019

Easting 325231.6

Scale 1 : 50

End Date 1 July 2019

Northing 180682.1

Ground level      5.35mOD

Depth 26.70 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru -ment	description	depth (m)	reduced level (m)	legend	
27/06/19 1700hrs 1.60m	28D	8.20 - 8.65	8.20	S 22				7.90 - 8.05m: Reddish brown.	8.65	-3.30		
	29L	8.20 - 9.20										
		8.80		H 103		NA	Stiff reddish brown mottled purplish grey slightly sandy gravelly CLAY. Gravel is subangular and subrounded fine and medium lithorelicts of extremely weak mudstone.					
	30D	8.90 - 9.00										
	31C	9.20 - 9.70	8.20		76 0 0							
	32C	9.70 - 10.14 9.70 - 11.20	8.20	C*105		0 0 0	NR	No Recovery.	9.70	-4.35		
28/06/19 0940hrs 1.30m	33C	11.20 - 11.44 11.20 - 12.50	8.20	C*194		82 0 0	NA	Very stiff reddish brown slightly sandy gravelly CLAY tending to extremely weak mudstone. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone.	11.20	-5.85		
							NI	11.90 - 12.00m: Pinkish brown clayey fine sand.	12.00	-6.65		
	34C	12.50 - 12.73 12.50 - 14.00	8.20	C*300		97 4 0		Extremely weak reddish brown mottled greenish grey and purplish grey MUDSTONE recovered non intact as clayey subangular fine to coarse gravel.				
							NI NI 60	Extremely weak to very weak reddish brown MUDSTONE. Fractures are subhorizontal and subvertical intersecting extremely closely and very closely spaced planar smooth and rough. Locally recovered non intact as clayey subangular fine to coarse gravel with frequent pockets (up to 30mm) of light green silt.	12.90	-7.55		
	35C	14.00 - 14.15 14.00 - 15.50	8.20	C*462		97 18 7		13.45 - 13.50m: Dusting of white gypsum crystals (up to 2mm) on fracture surfaces.				
								14.50 - 14.60m: Pocket (100mm) of light green micaceous silt.				
								14.65 - 14.75m: Weak dark reddish brown fine sandstone.				
	36C	15.50 - 15.76 15.50 - 16.70	8.20	C*162		100 0 0		15.35 - 15.50m: Very weak reddish brown fine sandstone.				
							NA	Very stiff reddish brown becoming purplish brown slightly sandy gravelly CLAY. Gravel is subangular fine and medium lithorelicts of extremely weak mudstone.	16.20	-10.85		
	37C	16.70 - 17.00 17.00 - 17.10	8.20	C*667		100 80 80	60 120 120	16.55 - 16.70m: Micaceous.	16.70	-11.35		
	38C	17.00 - 18.50				100 7 7		NI	Weak reddish brown fine SANDSTONE. Fractures are subhorizontal closely spaced planar rough.			
								16.90 - 17.00m: 50° planar smooth fracture.	17.30	-11.95		
								Very weak dark reddish brown and purplish brown MUDSTONE recovered non intact as clayey subangular fine to coarse gravel.				
								Continued Next Page	{18.00}			
water strike (m) casing (m) rose to (m) time to rise (m) remarks												
Groundwater not encountered prior to use of water flush.												
AGS										CONTRACT		CHECKED
										35338		CT

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH10**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 3 of 3

Start Date 26 June 2019

Easting 325231.6

Scale 1 : 50

End Date 1 July 2019

Northing 180682.1 Ground level 5.35mOD

Depth 26.70 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru- ment	description	depth (m)	reduced level (m)	legend
28/06/19 1610hrs 2.80m	39C	18.50 - 18.70 18.50 - 20.00	8.20	C*240	97 2 0			17.85 - 18.00m: Extremely weak greenish grey mottled reddish brown fine sandstone. 18.20 - 18.35m: Greenish grey siltstone recovered non intact as subangular fine and medium siltstone gravel.			
									19.45	-14.10	
29/06/19 0800hrs 1.40m	40C	20.00 - 20.21 20.00 - 21.50	8.20	C*250	93 17 13	NA		Extremely weak reddish brown fine SANDSTONE. Fractures are subhorizontal and subvertical intersecting extremely closely spaced planar smooth.	19.70	-14.35	• • • •
									20.00	-14.65	
	41C	21.50 - 21.60 21.50 - 23.00	8.20	C*600	80 15 12			Extremely weak reddish brown MUDSTONE. Fractures are subhorizontal and 50-60° very closely spaced planar smooth and rough.  Very stiff fissured reddish brown slightly sandy gravelly to very gravelly CLAY. Gravel is subangular and subrounded fine and medium lithorelicts of extremely weak mudstone. Fissures are subhorizontal and subvertical extremely closely and very closely spaced intersecting. 21.00 - 21.20m: Rare pockets (up to 40mm) of bluish green silt.	21.20	-15.85	
									21.90	-16.55	
	42C	23.00 - 23.10 23.00 - 24.50	8.20	C*667	97 52 42			Very weak to weak dark reddish brown MUDSTONE with frequent pockets (up to 70mm) of bluish green silt/siltstone. Fractures are 15-20° very closely and closely spaced planar smooth.	23.35	-18.00	
									24.25	-18.90	
	43C	24.50 - 24.59 24.50 - 26.00	8.20	C*545	77 31 19			Extremely weak dark reddish brown MUDSTONE. Fractures are subhorizontal and subvertical intersecting extremely closely to closely spaced planar smooth and rough. Locally recovered non-intact as clayey subangular fine to coarse gravel with rare pockets (up to 25mm) of bluish green silt.	25.50	-20.15	
									26.70	-21.35	
29/06/19 1400hrs 2.40m	44C	26.00 - 26.07 26.00 - 26.70	8.20	C*750	74 23 0			Very weak dark reddish brown MUDSTONE locally mottled bluish green and rare reduction spots (up to 25mm). Fractures are subhorizontal, 40-50° and 70-80° very closely and closely spaced planar rough and smooth. Locally disintegrated to claybound fine and medium gravel sized lithorelicts.  Weak dark reddish brown MUDSTONE with frequent reduction spots (up to 45mm). Fractures are subhorizontal to 20° very closely and closely spaced planar smooth rarely infilled (up to 40mm) with clay and (up to 2mm) with fine to coarse sand.  Extremely weak dark reddish brown MUDSTONE with rare reduction spots (up to 25mm). Fractures are subhorizontal and subvertical intersecting extremely closely to closely spaced planar and undulating smooth and rough with frequent veneers of mica rarely infilled (up to 20mm) with clay.			
								Borehole completed at 26.70m.			
water strike (m) casing (m) rose to (m) time to rise (m) remarks									{28.00}		
Groundwater not encountered prior to use of water flush.									AGS		
									CONTRACT		
									35338		
									CHECKED		
									CT		

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH11**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 2

Start Date 27 June 2019

Easting 325639.4

Scale 1 : 50

End Date 28 June 2019

Northing 180852.8 Ground level 4.75mOD

Depth 15.40 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru- ment	description	depth (m)	reduced level (m)	legend
27/06/19 0900hrs	1B	0.30 - 0.50						Grass over stiff dark brown clayey SILT. Abundant rootlets. MADE GROUND.	0.10	4.65	
	2D	0.30 - 0.50									
	3B	0.80 - 1.00						Stiff grey mottled orangish brown CLAY. Rare rootlets.			
	4D	0.80 - 1.00									
	5B	1.00 - 1.20							1.00	3.75	
	6D	1.00 - 1.20						Firm grey mottled orangish brown CLAY.	1.20	3.55	
	7D	1.20 - 1.65	Nil	S 1				Firm dark brown clayey fibrous PEAT. Frequent fragments of plant material (up to 30mm).	1.50	3.25	
	8L	1.20 - 2.20						Very soft bluish grey CLAY. Rare fragments of plant material (up to 20mm).			
	9UT	2.20 - 2.65	Nil								
	11L	2.20 - 3.20									
	10D	2.70 - 3.15	Nil	S <1							
	12D	3.20 - 3.65	3.20	S <1							
	13L	3.20 - 4.20									
	14UT	4.20 - 4.65	4.20								
	17L	4.20 - 5.20									
	15D	4.40 - 4.50									
	16D	4.70 - 5.15	4.20	S <1					4.80	-0.05	
	18D	5.10 - 5.20						Firm dark brown clayey fibrous PEAT. Frequent fragments of plant material (up to 30mm).			
	19D	5.20 - 5.65	5.20	S <1							
	20L	5.20 - 6.70							5.80	-1.05	
	21D	6.70 - 7.15	6.70	S 2				Very soft bluish grey silty CLAY with rare fragments of plant material (up to 10mm).			
	22L	6.70 - 8.20									
	23D	7.30 - 7.40							7.60	-2.85	
								Firm dark brown clayey fibrous PEAT. Frequent fragments of plant material (up to 30mm).			
								Continued Next Page	{8.00}		

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Dynamic sampled (128mm) 1.20-12.40m. Waterflush rotary core drilled (116mm) 12.40-15.40m.

CASING: 168mm diam to 11.20m.

BACKFILL: On completion, hole backfilled with bentonite pellets 15.40-0.50m and arisings 0.50-0.00m.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
2.00	Nil	1.20	20	Encountered following run 1.20-2.20m


**CONTRACT**  
**35338**
**CHECKED**  
**CT**

**BOREHOLE LOG**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

**BH11**

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 2 of 2

Start Date 27 June 2019

Easting 325639.4

Scale 1 : 50

End Date 28 June 2019

Northing 180852.8 Ground level 4.75mOD

Depth 15.40 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	lf	instru- ment	description	depth (m)	reduced level (m)	legend
27/06/19 1620hrs 1.20m	24D	8.20 - 8.65	8.20	S 19					8.20	-3.45	
	25L	8.20 - 9.70						Soft bluish grey CLAY.	8.40	-3.65	
	26D	8.60 - 8.70						Medium dense dark reddish brown slightly sandy slightly gravelly SILT. Gravel is subangular and subrounded fine and medium mudstone, sandstone and quartz.	8.80	-4.05	
	27D	9.70 - 10.15	9.70	S 16				Stiff reddish brown slightly sandy gravelly CLAY. Gravel is subangular and subrounded fine to coarse sandstone, mudstone and quartz. Rare greenish grey reduction spots (up to 10mm).	9.70	-4.95	
	28L	9.70 - 11.20						Stiff reddish brown sandy CLAY locally tending to clayey fine sand.			
								10.50 - 10.60m: Greenish grey silt.			
	29D	10.90 - 11.00	11.20	S 23				11.30m: Green subrounded siltstone cobble.			
	30D	11.20 - 11.65						11.85 - 12.00m: Greenish grey subangular fine to coarse siltstone gravel.	12.30	-7.55	
	31L	11.20 - 12.40						Extremely weak and very weak reddish brown MUDSTONE. Fractures are subhorizontal and subvertical closely spaced undulating smooth.	13.45	-8.70	
	32D	11.70 - 11.80						Very stiff reddish brown CLAY tending to extremely weak mudstone with rare green reduction spots (up to 10mm).	14.60	-9.85	
28/06/19 0845hrs 1.55m	33D	12.40 - 12.72	11.20	S*171	100 32 32	NI 110 200		Very weak dark reddish brown fine SANDSTONE. Fractures are subhorizontal to 10° closely spaced planar rough.	15.40	-10.65	
	34C	12.40 - 13.90						15.20 - 15.40m: Very stiff sandy clay tending to extremely weak mudstone.			
	35Cs	13.50 - 13.85				NA		Borehole completed at 15.40m.			
	36C	13.90 - 14.33 13.90 - 15.40	11.20	C*67	100 31 17	NI 70 140					
28/06/19 1200hrs 1.50m		15.40 - 15.68	11.20	C*240							
{18.00}											
water strike (m) casing (m) rose to (m) time to rise (m) remarks											
									CONTRACT 35338		CHECKED CT

# Geotechnical Engineering Limited

## STANDARD PENETRATION TEST



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole no.	borehole depth (m)	s.w.p (m)	bottom depth (m)	casing depth (m)	water level (m)	seating drive		test drive				test type	N	energy ratio (%)
						blows	pen (mm)	blows		pen (mm)				
BH01	1.20	0.08	1.73	Nil	Dry	1 0	75 75	1 1 1 1	75 75 75 75	S	4	75		
BH01	2.65		3.10	Nil	1.60	2 6	75 75	6 6 9 9	75 75 75 75	S	30	75		
BH01	3.20		3.65	3.20	1.10	1 0	75 75	2 3 3 3	75 75 75 75	S	11	75		
BH01	4.65		4.97	4.20	1.30	7 14	75 75	15 26 9	75 75 20	S	88	75		
BH01	5.20		5.53	5.20	1.00	6 14	75 75	15 30 5	75 75 25	S	86	75		
BH01	6.70		6.89	5.20	1.20	13 12	75 50	50	65	C	231	75		
BH01	8.20		8.41	5.20	1.20	5 20	75 55	50	75	C	200	75		
BH02	1.20		1.65	Nil	1.20	1 0	75 75	0 0 0 0	75 75 75 75	S	<1	70		
BH02	2.80		3.25	Nil	1.20	1 0	75 75	0 1 0 1	75 75 75 75	S	2	70		
BH02	3.30		3.75	3.15	1.00	1 0	75 75	0 1 1 0	75 75 75 75	S	2	70		
BH02	4.50		4.95	4.15	1.00	5 4	75 75	3 3 4 5	75 75 75 75	S	15	70		
BH02	5.30		5.75	5.15	1.00	2 1	75 75	1 2 2 3	75 75 75 75	S	8	70		
BH02	6.80		7.25	6.80	1.00	2 2	75 75	3 3 4 6	75 75 75 75	S	16	70		
BH02	8.30		8.70	6.80	1.80	9 10	75 75	8 10 20 12	75 75 75 25	S	60	70		
BH02	9.80		10.05	6.80	1.10	7 18	75 55	30 20	75 40	S	130	70		
BH02	11.30		11.48	6.80	1.10	21 4	75 15	37 13	75 15	C	167	70		
BH02	12.80		12.96	6.80	1.10	12 13	75 20	50	60	C	250	70		
BH03	1.75		2.20	Nil	Dry	2 1	75 75	1 2 2 2	75 75 75 75	S	7	75		
BH03	2.20		2.65	Nil	Dry	1 2	75 75	2 1 2 2	75 75 75 75	S	7	75		
BH03	3.75		4.20	3.20	2.40	2 2	75 75	7 6 5 5	75 75 75 75	S	23	75		
BH03	4.20		4.65	4.20	1.20	1 2	75 75	4 4 6 10	75 75 75 75	S	24	75		
BH03	5.00		5.37	5.00	1.40	4 9	75 75	13 20 17	75 75 65	S	70	75		
BH03	6.50		6.62	5.00	1.20	25	65	100	55	C	545	75		
BH03	8.00		8.17	5.20	1.10	9 16	75 25	100	70	C	429	75		

### notes:

1. Test carried out in general accordance with BS EN ISO 22476-3:2005 + A1:2011
2. s.w.p = self weight penetration.
3. N values have not been subjected to any correction.
4. Test carried out using split spoon S, solid cone C.
5. Where full test drive not completed, linearly extrapolated N value reported.
6. \*\* Denotes no effective penetration.

CONTRACT  
**35338**

CHECKED  
**CT**



**STANDARD PENETRATION TEST**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole no.	borehole depth (m)	s.w.p (m)	bottom depth (m)	casing depth (m)	water level (m)	seating drive		test drive		test type	N	energy ratio (%)
						blows	pen (mm)	blows	pen (mm)			
BH03	9.50		9.66	5.20	2.00	10 15	75 25	100	55	C	545	75
BH03	11.00		11.14	5.20	2.10	25	75	100	65	C	462	75
BH04	6.00		6.45	6.00	1.60	4 5	75 75	6 9 9 12	75 75 75 75	S	36	70
BH04	7.50		7.95	7.50	2.00	6 4	75 75	4 4 4 3	75 75 75 75	S	15	70
BH04	10.00		10.45	9.00	2.20	8 6	75 75	6 6 7 8	75 75 75 75	S	27	70
BH04	11.50		11.72	9.00	2.20	15 10	75 10	30 70	75 60	S	222	70
BH04	13.00		13.07	9.00	2.20	25	10	100	60	C	500	70
BH04	14.30		14.41	9.00	4.00	25	40	100	70	C	429	70
BH04	16.00		16.11	9.00	1.70	25	40	100	65	C	462	70
BH05	1.20		1.65	Nil	Dry	1 0	75 75	0 0 1 2	75 75 75 75	S	3	76
BH05	2.20		2.65	Nil	2.00	1 1	75 75	2 2 2 3	75 75 75 75	S	9	76
BH05	3.75		4.15	3.20	2.00	7 10	75 75	11 11 14 14	75 75 75 25	S	60	76
BH05	4.20		4.29	4.20	1.20	25	75	50	10	C	**	76
BH05	5.20		5.40	4.20	1.10	10 15	75 20	79 21	75 25	C	300	76
BH05	6.70		6.89	4.20	1.10	7 18	75 50	100	65	C	462	76
BH05	8.20		8.33	4.20	1.20	25	75	100	50	C	600	76
BH05	9.70		9.87	4.20	1.20	13 12	75 25	100	65	C	462	76
BH05	11.20		11.32	4.20	1.40	25	65	100	50	C	600	76
BH05	12.70		12.83	4.20	1.50	15 10	75 5	100	50	C	600	76
BH05	14.20		14.29	4.20	1.50	25	50	100	40	C	750	76
BH05	15.70		15.78	4.20	1.60	25	50	100	25	C	**	76
BH05	17.20		17.32	4.20	2.00	10 15	75 5	100	40	C	750	76
BH05	18.70		18.84	4.20	2.40	10 15	75 15	100	45	C	667	76
BH05	20.20		20.31	4.20	2.60	25	40	100	70	C	429	76

## notes:

1. Test carried out in general accordance with BS EN ISO 22476-3:2005 + A1:2011
2. s.w.p = self weight penetration.
3. N values have not been subjected to any correction.
4. Test carried out using split spoon S, solid cone C.
5. Where full test drive not completed, linearly extrapolated N value reported.
6. \*\* Denotes no effective penetration.

**CONTRACT**  
**35338**
**CHECKED**  
**CT**

**STANDARD PENETRATION TEST**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole no.	borehole depth (m)	s.w.p (m)	bottom depth (m)	casing depth (m)	water level (m)	seating drive		test drive				test type	N	energy ratio (%)
						blows	pen (mm)	blows		pen (mm)				
BH05	21.70		21.81	4.20	2.00	25	45	100		65		C	462	76
BH06	1.75		2.20	Nil	Dry	1 0	75 75	0 0 0 0		75 75 75 75		S	<1	75
BH06	2.55		3.00	Nil	1.60	10 5	75 75	2 2 3 4		75 75 75 75		S	11	75
BH06	3.20		3.65	3.20	1.20	2 2	75 75	3 4 3 6		75 75 75 75		S	16	75
BH06	4.10		4.38	3.20	2.00	12 13	75 45	21 21 8		75 75 5		S	97	75
BH06	5.10		5.33	3.20	1.50	2 21	75 75	85 15		75 0		C	400	75
BH06	6.60		6.97	3.20	1.30	6 18	75 75	20 30 50		75 75 65		C	140	75
BH06	8.10		8.22	3.20	1.40	23 2	75 0	100		45		C	667	75
BH06	9.60		9.88	3.20	1.30	10 15	75 75	35 65		75 55		C	231	75
BH06	11.10		11.20	3.20	1.50	25	75	100		20		C	**	74
BH06	12.60		12.73	3.20	2.00	20 5	75 0	100		55		C	545	74
BH07	8.30		8.75	8.30	0.20	2 5	75 75	6 6 8 8		75 75 75 75		S	28	70
BH07	9.70		10.05	9.70	0.60	5 14	75 75	17 43 40		75 75 50		S	150	70
BH07	11.20		11.30	9.70	0.70	25	50	100		50		C	600	70
BH07	12.70		13.10	9.70	0.95	6 19	75 75	25 20 35 20		75 75 75 25		C	120	70
BH07	14.20		14.36	9.70	0.80	2 23	75 75	100		5		C	**	70
BH07	15.70		15.93	9.70	0.80	25	75	50 50		75 75		C	200	70
BH07	17.20		17.28	9.70	0.80	25	75	100		5		C	**	70
BH07	18.70		18.78	9.70	0.80	25	70	100		5		C	**	70
BH07	20.20		20.28	9.70	0.90	25	75	100		5		C	**	70
BH07	21.70		21.78	9.70	0.90	25	75	100		5		C	**	70
BH07	23.20		23.36	9.70	0.90	8 9	75 75	100		5		C	**	70
BH07	24.70		24.76	9.70	0.90	25	45	100		15		C	**	70
BH07	26.20		26.27	9.70	1.10	25	40	100		25		C	**	70

## notes:

1. Test carried out in general accordance with BS EN ISO 22476-3:2005 + A1:2011
2. s.w.p = self weight penetration.
3. N values have not been subjected to any correction.
4. Test carried out using split spoon S, solid cone C.
5. Where full test drive not completed, linearly extrapolated N value reported.
6. \*\* Denotes no effective penetration.

CONTRACT

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**CT**

**STANDARD PENETRATION TEST**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole no.	borehole depth (m)	s.w.p (m)	bottom depth (m)	casing depth (m)	water level (m)	seating drive		test drive		test type	N	energy ratio (%)
						blows	pen (mm)	blows	pen (mm)			
BH08	7.00		7.45	7.00	3.25	9 12	75 75	5 5 4 8	75 75 75 75	S	22	73
BH08	8.50		8.95	7.00	4.00	5 9	75 75	10 13 11 11	75 75 75 75	S	45	73
BH08	10.00		10.27	8.70	1.90	7 14	75 75	40 60	75 40	S	261	73
BH08	11.50		11.85	8.70	1.90	12 12	75 75	15 29 31	75 75 50	C	113	73
BH08	13.00		13.21	8.70	1.90	18 7	75 20	60 40	75 40	C	261	73
BH08	14.50		14.73	8.70	1.90	9 16	75 40	45 55	75 40	C	261	73
BH08	16.00		16.20	8.70	1.20	10 15	75 40	65 35	75 10	C	353	73
BH08	17.50		17.67	8.70	1.20	25	70	70 30	75 20	C	316	73
BH08	19.00		19.14	8.70	1.20	25	50	65 35	75 10	C	353	73
BH08	20.50		20.70	8.70	1.20	25	50	35 65	75 70	C	207	73
BH08	22.00		22.09	8.70	1.20	25	30	100	60	C	500	73
BH08	23.50		23.59	8.70	1.20	25	20	100	70	C	429	73
BH08	25.00		25.11	8.70	1.20	25	20	80 20	75 10	C	353	73
BH09	5.20		5.65	5.20	1.30	3 3	75 75	4 4 4 5	75 75 75 75	S	17	76
BH09	6.70		6.96	5.20	1.00	11 14	75 35	34 56 10	75 75 0	C	200	76
BH09	8.20		8.52	5.20	1.70	4 11	75 75	33 46 21	75 75 20	C	176	76
BH09	9.70		9.91	5.20	1.30	5 19	75 75	100	60	C	500	76
BH09	11.20		11.39	5.20	1.50	13 12	75 65	100	45	C	667	76
BH09	12.70		12.82	5.20	1.30	20 5	75	100	45	C	667	76
BH09	14.20		14.42	5.20	1.20	5 20	75 40	55 45	75 30	C	286	76
BH09	15.70		15.82	5.20	1.40	25	75	100	40	C	750	76
BH09	17.20		17.29	5.20	1.80	25	75	100	15	C	**	76
BH09	18.70		18.78	5.20	1.80	25	50	100	25	C	**	76
BH09	20.20		20.34	5.20	2.20	10 15	75 25	100	35	C	857	76

## notes:

1. Test carried out in general accordance with BS EN ISO 22476-3:2005 + A1:2011
2. s.w.p = self weight penetration.
3. N values have not been subjected to any correction.
4. Test carried out using split spoon S, solid cone C.
5. Where full test drive not completed, linearly extrapolated N value reported.
6. \*\* Denotes no effective penetration.

**CONTRACT**  
**35338**
**CHECKED**  
**CT**

**STANDARD PENETRATION TEST**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole no.	borehole depth (m)	s.w.p (m)	bottom depth (m)	casing depth (m)	water level (m)	seating drive		test drive		test type	N	energy ratio (%)
						blows	pen (mm)	blows	pen (mm)			
BH09	21.70		21.80	5.20	2.00	25	50	100	50	C	600	76
BH09	23.20		23.26	5.20	2.50	25	45	100	15	C	**	76
BH10	1.70		2.15	Nil	1.10	1 1	75 75	1 1 1 1	75 75 75 75	S	4	76
BH10	2.20		2.65	Nil	1.50	1 1	75 75	1 2 2 2	75 75 75 75	S	7	76
BH10	3.70		4.15	3.20	1.20	1	150	1 1	75 225	S	2	76
BH10	5.75		6.20	5.20	2.00	1	75 75	1 1 1	75 75 75 75	S	3	76
BH10	6.70		7.15	6.70	1.30	2 2	75 75	4 5 6 6	75 75 75 75	S	21	76
BH10	8.20		8.65	8.20	1.40	7 12	75 75	7 7 4 4	75 75 75 75	S	22	76
BH10	9.70		10.14	8.20	1.20	7 15	75 75	20 25 30 25	75 75 75 60	C	105	76
BH10	11.20		11.44	8.20	1.30	20 5	75 10	45 50 5	75 75 5	C	194	76
BH10	12.50		12.73	8.20	1.20	13 12	75 50	70 30	75 25	C	300	76
BH10	14.00		14.15	8.20	1.40	14 11	75 5	100	65	C	462	76
BH10	15.50		15.76	8.20	1.30	25	75	33 33 34	75 75 35	C	162	76
BH10	17.00		17.10	8.20	1.40	25	55	100	45	C	667	76
BH10	18.50		18.70	8.20	1.40	23 2	75	55 45	75 50	C	240	76
BH10	20.00		20.21	8.20	2.80	15 10	75 10	50 50	75 45	C	250	76
BH10	21.50		21.60	8.20	1.30	25	50	100	50	C	600	76
BH10	23.00		23.10	8.20	1.80	25	55	100	45	C	667	76
BH10	24.50		24.59	8.20	1.70	25	35	100	55	C	545	76
BH10	26.00		26.07	8.20	2.20	25	30	100	40	C	750	76
BH11	1.20		1.65	Nil	Dry	1 0	75 75	1 0 0 0	75 75 75 75	S	1	73
BH11	2.70		3.15	Nil	2.00	2 0	75 75	0 0 0 0	75 75 75 75	S	<1	73
BH11	3.20		3.65	3.20	1.60	1 0	75 75	0 0 0 0	75 75 75 75	S	<1	73
BH11	4.70		5.15	4.20	1.20	2 0	75 75	0 0 0 0	75 75 75 75	S	<1	73

## notes:

1. Test carried out in general accordance with BS EN ISO 22476-3:2005 + A1:2011
2. s.w.p = self weight penetration.
3. N values have not been subjected to any correction.
4. Test carried out using split spoon S, solid cone C.
5. Where full test drive not completed, linearly extrapolated N value reported.
6. \*\* Denotes no effective penetration.

**CONTRACT**  
**35338**
**CHECKED**  
**CT**

**STANDARD PENETRATION TEST**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole no.	borehole depth (m)	s.w.p (m)	bottom depth (m)	casing depth (m)	water level (m)	seating drive		test drive				test type	N	energy ratio (%)
						blows	pen (mm)	blows		pen (mm)				
BH11	5.20		5.65	5.20	1.20	1 0	75 75	0 0 0 0	75 75 75 75	S	<1	73		
BH11	6.70		7.15	6.70	1.20	2 0	75 75	2 0 0 0	75 75 75 75	S	2	73		
BH11	8.20		8.65	8.20	1.20	2 3	75 75	2 5 4 8	75 75 75 75	S	19	73		
BH11	9.70		10.15	9.70	1.20	2 3	75 75	4 4 4 4	75 75 75 75	S	16	73		
BH11	11.20		11.65	11.20	1.20	6 3	75 75	4 4 6 9	75 75 75 75	S	23	73		
BH11	12.40		12.72	11.20	1.65	8 17	75 65	39 48 13	75 75 25	S	171	73		
BH11	13.90		14.33	11.60	1.20	13 12	75 55	17 13 13 24	75 75 75 75	C	67	73		
BH11	15.40		15.68	11.60	1.50	7 12	75 75	13 87	75 50	C	240	73		

## notes:

1. Test carried out in general accordance with BS EN ISO 22476-3:2005 + A1:2011
2. s.w.p = self weight penetration.
3. N values have not been subjected to any correction.
4. Test carried out using split spoon S, solid cone C.
5. Where full test drive not completed, linearly extrapolated N value reported.
6. \*\* Denotes no effective penetration.

**CONTRACT**  
**35338**
**CHECKED**  
**CT**

## IN-SITU HAND VANE/POCKET PENETROMETER



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	depth (m)	hand vane peak (kPa)	average hand vane peak (kPa)	hand vane remoulded (kPa)	average hand vane remoulded (kPa)	pocket penetrometer (kg/cm <sup>2</sup> )	average pocket penetrometer (kPa)*	remarks
BH02	1.80	13	13	2	2			
BH02	1.90	9	9	2	2			
BH02	6.25	94	94	18	18			
BH02	6.35	84	84	20	20			
BH02	6.50	86	86	18	18			
BH03	2.90	120	120	22	22			
BH03	3.00	112	112	24	24			
BH03	3.10	114	114	26	26			
BH05	1.85	38 52 64	51	12 14 20	15			
BH05	3.00	22 24 24	23	10 8 6	8			
BH06	2.05	10 12	11	2 3	3			
BH06	2.45	18 22	20	10 14	12			
BH06	3.85	>140						
BH06	4.00	110	110					
BH07	3.20	10	10	2	2			
BH08	1.70	10	10	3	3			
BH08	1.85	14	14	4	4			
BH08	2.00	16	16	3	3			
general remarks:								
Hand vane test results reported as undrained shear strength.							CONTRACT	CHECKED
*Average pocket penetrometer results reported as undrained shear strength.							<b>35338</b>	<b>CT</b>

## IN-SITU HAND VANE/POCKET PENETROMETER



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	depth (m)	hand vane peak (kPa)	average hand vane peak (kPa)	hand vane remoulded (kPa)	average hand vane remoulded (kPa)	pocket penetrometer (kg/cm <sup>2</sup> )	average pocket penetrometer (kPa)*	remarks
BH08	5.80	10	10	3	3			
BH08	8.15	28	28	8	8			
BH08	8.25	34	34	12	12			
BH10	2.75	14	14	2	2			
BH10	3.10	10	10	2	2			
BH10	3.90	18 20 14	17	8 6 4	6			
BH10	7.70	52	52	12	12			
BH10	7.90	94	94	20	20			
BH10	8.80	110 96	103	18 14	16			
TP05	0.75	74 69 73	72					
TP05	1.50	30 24	27					
TP05	2.00	25 23	24					
TP06	0.75	103 90 99	97					
TP06	1.00	72 72	72					
TP06	2.30	65 52 46	54					
TP07	0.40	98 101	100					
TP07	0.60	78 84	81					
TP07	1.20	46 37	42					
general remarks:								
Hand vane test results reported as undrained shear strength.							CONTRACT	CHECKED
*Average pocket penetrometer results reported as undrained shear strength.							<b>35338</b>	<b>CT</b>

## IN-SITU HAND VANE/POCKET PENETROMETER



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	depth (m)	hand vane peak (kPa)	average hand vane peak (kPa)	hand vane remoulded (kPa)	average hand vane remoulded (kPa)	pocket penetrometer (kg/cm <sup>2</sup> )	average pocket penetrometer (kPa)*	remarks
TP07	2.60	28 22 28	26					
TP07	3.00	36 39	38					
TP08	0.60	120 128 130	126					
TP08	1.00	65 64	65					
TP08	2.10	36 40 34	37					
TP09	0.25	68	68					
TP09	0.40	74 112	93					
TP09	1.30	24 26 20	23					
TP09	2.80	18 32	25					
TP09	3.40	21 15	18					
general remarks:								
Hand vane test results reported as undrained shear strength.							CONTRACT	CHECKED
*Average pocket penetrometer results reported as undrained shear strength.							<b>35338</b>	<b>CT</b>



**TRIAL PIT LOG****CPT01**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 1

Start Date 17 June 2019 Easting 325240

Scale 1 : 25

End Date 17 June 2019 Northing 180760 Ground level 5.30mOD

Depth 1.20 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
1.20m: Seepage.				Grass over firm dark brown slightly gravelly clayey SILT with rare pockets (up to 10mm) of orangish brown fine and medium sand and brown clay. Gravel is subangular to subrounded fine and medium brick and mudstone. Abundant rootlets. (MADE GROUND)	0.20	5.10	
	1B		0.50- 0.70	Firm light bluish grey mottled light brown CLAY with frequent pockets (up to 20mm) of soft brown clay and rare pockets of reddish brown fine and medium sand (up to 5mm). Frequent roots (up to 3mm diam) and rootlets.			
	2B		1.00- 1.20		1.20	4.10	
				Trial pit completed at 1.20m.			

**Notes**

Trial pit excavated using hand tools in advance of CPT01.  
 A seepage of groundwater was encountered at 1.20m.  
 Trial pit sides remained stable.  
 Trial pit dimensions 0.20x0.20x1.20m.  
 On completion, the trial pit was backfilled and the surface reinstated.

Sketch of Foundation - Not to scale. All dimensions in metres.



CONTRACT

**35338**

CHECKED

**CT**

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

**TRIAL PIT LOG****CPT02**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 1

Start Date 17 June 2019 Easting 325414

Scale 1 : 25

End Date 17 June 2019 Northing 180803 Ground level 4.95mOD

Depth 1.20 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
1.20m: Seepage.				Grass over soft dark brown silty CLAY with frequent pockets (up to 10mm) of bluish grey and organish brown clay and rare pockets (up to 5mm) of black organic material. Abundant rootlets. (MADE GROUND/REWORKED NATURAL DEPOSITS)	0.15	4.80	
	1B		0.50- 0.70	Firm light bluish grey mottled greyish brown and orangish brown CLAY with frequent pockets (up to 5mm) of black organic material and rare pockets (up to 15mm) of dark brown clay and reddish brown fine and medium sand. Frequent rootlets.			
	2B		1.00- 1.20		1.20	3.75	
				Trial pit completed at 1.20m.			

**Notes**

Trial pit excavated using hand tools in advance of CPT02.  
 A seepage of groundwater was encountered at 1.20m.  
 Trial pit sides remained stable.  
 Trial pit dimensions 0.20x0.15x1.20m.  
 On completion, the trial pit was backfilled and the surface reinstated.

Sketch of Foundation - Not to scale. All dimensions in metres.



CONTRACT

**35338**

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**CT**

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

**TRIAL PIT LOG****CPT03**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 1

Start Date 17 June 2019 Easting 325294

Scale 1 : 25

End Date 17 June 2019 Northing 180730 Ground level 5.40mOD

Depth 1.20 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
1.20m: Dry.				Grass over brown mottled organish brown slightly sandy SILT with rare pockets (up to 10mm) of orangish brown fine and medium sand and black organic material (up to 5mm). Abundant rootlets. (MADE GROUND/REWORKED NATURAL DEPOSITS)	0.25	5.15	x x x x x x x x
	1B		0.50- 0.70	Firm light bluish grey mottled brown and orangish brown CLAY with frequent pockets (up to 5mm) of black organic material and rare wood fragments (up to 15mm). Frequent rootlets.			
	2B		1.00- 1.10				
				Trial pit completed at 1.20m.	1.20	4.20	

**Notes**

Trial pit excavated using hand tools in advance of CPT03.  
 Groundwater not encountered.  
 Trial pit sides remained stable.  
 Trial pit dimensions 0.20x0.20x1.20m.  
 On completion, the trial pit was backfilled and the surface reinstated.

Sketch of Foundation - Not to scale. All dimensions in metres.



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**35338**

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**CT**

**TRIAL PIT LOG****CPT04**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 1

Start Date 17 June 2019 Easting 325195

Scale 1 : 25

End Date 17 June 2019 Northing 180664 Ground level 5.25mOD

Depth 1.20 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
1.20m: Seepage.	1B		0.50- 0.70	Grass over brown mottled organish brown slightly sandy SILT with rare pockets (up to 10mm) of orangish brown fine and medium sand and soft brown clay. Abundant rootlets. (MADE GROUND/REWORKED NATURAL DEPOSITS)	0.35	4.90	x x x x x x x x x x x x
				Firm light bluish grey mottled brown and orangish brown silty CLAY with frequent pockets (up to 15mm) of brown clay and black organic material. Frequent rootlets and rare roots (up to 5mm diam).			
	2B		1.00- 1.20	0.90m: Frequent partially decomposed roots (up to 5mm diam).			
				Trial pit completed at 1.20m.	1.20	4.05	

**Notes**

Trial pit excavated using hand tools in advance of CPT04.  
 A seepage of groundwater was encountered at 1.20m.  
 Trial pit sides remained stable.  
 Trial pit dimensions 0.20x0.20x1.20m.  
 On completion, the trial pit was backfilled and the surface reinstated.

Sketch of Foundation - Not to scale. All dimensions in metres.



CONTRACT

**35338**

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**CT**

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

**TRIAL PIT LOG****CPT05**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 1

Start Date 17 June 2019 Easting 325097

Scale 1 : 25

End Date 17 June 2019 Northing 180592 Ground level 5.25mOD

Depth 1.20 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
1.20: Dry.	1B		0.50- 0.70	Grass over firm brown mottled organish brown slightly gravelly clayey SILT with rare pockets (up to 10mm) of orangish brown fine and medium sand, brown clay and black organic material. Gravel is subangular and subrounded fine and medium mudstone and brick. Abundant rootlets. (MADE GROUND)	0.15	5.10	
				Firm light bluish grey mottled brown and orangish brown silty CLAY with frequent pockets (up to 5mm) of soft brown clay and black organic material. Frequent rootlets and rare roots (up to 5mm diam).			
	2B		1.00- 1.20	Soft brownish grey mottled orangish brown CLAY with rare wood fragments (up to 10mm). Frequent rootlets and rare roots (up to 5mm diam).	0.90	4.35	
				Trial pit completed at 1.20m.	1.20	4.05	

**Notes**

Trial pit excavated using hand tools in advance of CPT05.  
 Groundwater was not encountered.  
 Trial pit sides remained stable.  
 Trial pit dimensions 0.20x0.20x1.20m.  
 On completion, the trial pit was backfilled and the surface reinstated.

Sketch of Foundation - Not to scale. All dimensions in metres.



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**35338**

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**CT**

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

**TRIAL PIT LOG****CPT06**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 1

Start Date 17 June 2019 Easting 325072

Scale 1 : 25

End Date 17 June 2019 Northing 180694 Ground level 5.10mOD

Depth 1.20 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
1.20m: Seepage.	1B		0.50- 0.70	Grass over soft dark brown silty CLAY with rare pockets (up to 10mm) of orangish brown fine and medium sand and soft bluish grey clay. Abundant roots (up to 5mm diam.) and rootlets. (MADE GROUND/REWORKED NATURAL DEPOSITS)	0.10	5.00	
				Firm light bluish grey mottled light brown and orangish brown CLAY with rare pockets (up to 15mm) of soft brown clay and reddish brown fine and medium sand. Frequent roots (up to 3mm diam) and rootlets.			
	2B		1.00- 1.20	Soft dark grey slightly sandy CLAY with frequent pockets (up to 40mm) of firm dark brown fibrous peat and rare pockets (up to 20mm) of soft bluish grey clay.	1.00	4.10	
				Trial pit completed at 1.20m.	1.20	3.90	

**Notes**

Trial pit excavated using hand tools in advance of CPT06.  
 A seepage of groundwater was encountered at 1.20m.  
 Trial pit sides remained stable.  
 Trial pit dimensions 0.20x0.20x1.20m.  
 On completion, the trial pit was backfilled and the surface reinstated.

Sketch of Foundation - Not to scale. All dimensions in metres.



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**35338**

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**CT**

## TRIAL PIT LOG



TP05

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 1

Start Date 18 June 2019 Easting 325072

Scale 1 : 25

End Date 18 June 2019 Northing 180678 Ground level 5.05mOD

Depth 2.90 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
1.50m: Flow.	1ES		0.00- 0.10	Reddish brown sandy clayey angular to subrounded fine to coarse sandstone and rare mudstone GRAVEL. (MADE GROUND)	0.25	4.80	
				Firm bluish grey mottled brown silty CLAY with rare fragments of decomposing plant material. Frequent rootlets.			
	1B		0.50- 0.70				
	2D		0.50- 0.70				
		H 72	0.75				
	3B		1.00- 1.20				
	4D		1.00- 1.20				
					1.50	3.55	
	5B	H 27	1.50- 1.70	Soft dark brown organic silty CLAY with a strong organic odour and frequent decomposing plant material.	1.70	3.35	
	6D		1.50- 1.70	Very soft to soft bluish grey rarely mottled brown CLAY with frequent fragments of decomposing plant material.			
2.80m.		H 24	2.00				
	7B		2.50- 2.70				
	8D		2.50- 2.70		2.90	2.15	
				Trial pit completed at 2.90m.			

## Notes

Trial pit excavated by CAT 432 mechanical excavator.  
 Groundwater encountered at 1.50m.  
 Trial pit sidewalls spalling.  
 Trial pit dimensions 2.40x0.80x2.90m.  
 Pit terminated due to water ingress and sidewall instability.  
 On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.



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## TRIAL PIT LOG



TP06

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 2

Start Date 18 June 2019 Easting 325052

Scale 1 : 25

End Date 18 June 2019 Northing 180881 Ground level 5.50mOD

Depth 4.10 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
1.55m: Seepage.				Grass over soft brown slightly sandy silty CLAY. Abundant rootlets and rare roots (up to 3mm diam).	0.15	5.35	
				Very stiff brown mottled bluish grey silty CLAY with frequent pockets (up to 4mm) of black organic silt. Frequent rootlets and relict rootlets.			
	1B		0.50- 0.70				
	2D		0.50- 0.70				
		H 97	0.75				
	3B		1.00- 1.20				
	4D		1.00- 1.20				
				1.55m: 300mm bed of very soft dark brown silty clay with decaying plant material.	1.65	3.85	
				Soft locally stiff dark reddish brown slightly sandy slightly gravelly silty CLAY with a low subrounded sandstone cobble content. Frequent pockets of yellowish brown fine to coarse sand. Gravel is subangular and subrounded fine to coarse sandstone and rare quartzite.			
	5B	H 54	2.20- 2.40				
	6D		2.20- 2.40				
				Soft dark reddish brown slightly gravelly sandy CLAY with frequent pockets (up to 80mm) of bluish grey silty clay and thin beds of very soft dark reddish brown silty clay. Frequent relict rootlets.	2.90	2.60	
	7B		3.00- 3.20				
	8D		3.00- 3.20				
	9B		3.90- 4.10				

## Notes

Trial pit excavated by CAT 432 mechanical excavator.  
Groundwater seepage at 1.55m and 4.10m.  
Trial pit sides remained stable and vertical.  
Trial pit dimensions 2.20x0.70x4.10m.  
On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.



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EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS



**TRIAL PIT LOG****TP06**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 2 of 2

Start Date 18 June 2019 Easting 325052

Scale 1 : 25

End Date 18 June 2019 Northing 180881 Ground level 5.50mOD

Depth 4.10 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
4.10m: Seepage.	10D		3.90- 4.10	Trial pit completed at 4.10m.	4.10	1.40	

**Notes**

Trial pit excavated by CAT 432 mechanical excavator.  
 Groundwater seepage at 1.55m and 4.10m.  
 Trial pit sides remained stable and vertical.  
 Trial pit dimensions 2.20x0.70x4.10m.  
 On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.



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EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

## TRIAL PIT LOG



TP07

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 1

Start Date 18 June 2019 Easting 325347

Scale 1 : 25

End Date 18 June 2019 Northing 180979 Ground level 5.20mOD

Depth 4.00 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
3.00m: Seepage.				Vegetation over soft dark brown slightly sandy silty CLAY. Frequent rootlets.	0.20	5.00	
				Firm dark bluish grey mottled brown silty CLAY with rare pockets (up to 6mm) of yellowish brown sandy silt and frequent fragments of decomposing plant material. Frequent rootlets and rare roots (up to 3mm diam).			
	1B	H 100	0.40				
		H 81	0.50- 0.70				
	2D		0.50- 0.70				
	3B	H 42	1.00- 1.20				
	4D		1.00- 1.20				
Damp.				1.50 - 1.70m: Firm black clayey pseudofibrous peat in south east face.	1.65	3.55	
				Very soft dark bluish grey CLAY with frequent fragments of decomposing plant material.			
	5B		2.00- 2.20				
	6D		2.00- 2.20				
		H 26	2.60				
	7B	H 38	3.00- 3.20				
	8D		3.00- 3.20				
	9B		3.80- 4.00				
	10D		3.80- 4.00				
					4.00	1.20	

## Notes

Trial pit completed at 4.00m.

Trial pit excavated by CAT 432 mechanical excavator.  
 Groundwater seepage at 3.00m.  
 Trial pit sides remained stable and vertical.  
 Trial pit dimensions 2.20x0.70x4.00m.  
 On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.



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EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

## TRIAL PIT LOG



TP08

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 2

Start Date 17 June 2019

Easting 324929

Scale 1 : 25

End Date 17 June 2019

Northing 181196

Ground level 5.80mOD

Depth 4.10 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
3.70m: Flow.				Firm brown slightly sandy silty CLAY. Frequent rootlets.	0.25	5.55	
	1B	H 126	0.50- 0.60	Stiff becoming firm bluish grey mottled brown slightly sandy silty CLAY with rare pockets (up to 30mm) of black organic silt. Frequent rootlets.			
	2D		0.50- 0.60				
		H 65	1.00				
	3B		1.50- 1.60	Soft dark reddish brown slightly gravelly sandy silty CLAY with frequent pockets (up to 40mm) of black organic material and yellowish brown fine to coarse sand. Gravel is subrounded and rounded fine to coarse sandstone. Rare rootlets.	1.40	4.40	
	4D		1.50- 1.60				
	5B	H 37	2.00- 2.20				
	6D		2.00- 2.20				
	7B		3.00- 3.20				
	8D		3.00- 3.20				
				Soft dark reddish brown sandy gravelly CLAY with a low subrounded sandstone cobble content. Rare pockets (up to 60mm) of bluish grey clay. Gravel is angular to rounded fine to coarse sandstone.	3.60	2.20	

## Notes

Trial pit excavated by CAT 432 mechanical excavator.  
Groundwater encountered at 3.70m.  
Trial pit sides remained stable and vertical.  
Trial pit dimensions 2.30x0.70x4.10m.  
On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.



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CT

**TRIAL PIT LOG****TP08**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 2 of 2

Start Date 17 June 2019 Easting 324929

Scale 1 : 25

End Date 17 June 2019 Northing 181196 Ground level 5.80mOD

Depth 4.10 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
3.90m	9B		4.00- 4.10		4.10	1.70	
	10D		4.00- 4.10	Trial pit completed at 4.10m.			

**Notes**

Trial pit excavated by CAT 432 mechanical excavator.  
 Groundwater encountered at 3.70m.  
 Trial pit sides remained stable and vertical.  
 Trial pit dimensions 2.30x0.70x4.10m.  
 On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.



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EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

## TRIAL PIT LOG



TP09

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 2

Start Date 17 June 2019 Easting 325144

Scale 1 : 25

End Date 17 June 2019 Northing 181417 Ground level 4.95mOD

Depth 4.10 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
1.20m: Seepage.	1B 2D	H 68	0.25	Stiff brown and bluish grey mottled slightly sandy silty CLAY. Frequent rootlets.	0.30	4.65	
		H 93	0.40	Stiff bluish grey mottled brown silty CLAY with rare pockets (up to 1.00x0.80m) of dark brown slightly sandy slightly gravelly organic silt. Frequent decomposing plant material and wood fragments (up to 400mm).			
			0.50- 0.70				
			0.50- 0.70				
	3B 4D		0.90- 1.00	Very soft bluish grey mottled brown CLAY with frequent decomposing plant material and wood fragments (up to 500mm).	0.80	4.15	
			0.90- 1.00				
	5B 6D	H 23	1.30	1.20 - 1.50m: 300mm bed of very soft dark brown organic silty clay with abundant plant material.			
	7B 8D	H 25	1.90- 2.20	Very soft bluish grey mottled brown CLAY with rare decomposing plant material and wood fragments (up to 20mm).	2.30	2.65	
			1.90- 2.20				
	9B 10D	H 18	2.80- 3.30	Soft dark brown and bluish grey peaty CLAY with a strong organic odour. Frequent fragments of decomposing wood (up to 40mm) and decomposing plant			
			2.80- 3.30				
			3.40				
			3.80- 4.10		3.80	1.15	
			3.80- 4.10				

## Notes

Trial pit excavated by CAT 432 mechanical excavator.  
Groundwater seepage encountered at 1.20m.  
Trial pit sidewalls spalling below 3.00m.  
Trial pit dimensions 2.20x0.70x4.10m.  
On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.



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EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

**TRIAL PIT LOG****TP09**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 2 of 2

Start Date 17 June 2019 Easting 325144

Scale 1 : 25

End Date 17 June 2019 Northing 181417 Ground level 4.95mOD

Depth 4.10 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
4.10m				material.	4.10	0.85	
				Trial pit completed at 4.10m.			

**Notes**

Trial pit excavated by CAT 432 mechanical excavator.  
 Groundwater seepage encountered at 1.20m.  
 Trial pit sidewalls spalling below 3.00m.  
 Trial pit dimensions 2.20x0.70x4.10m.  
 On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.



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EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

## TRIAL PIT LOG



VS01

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 1

Start Date 17 June 2019 Easting 325242

Scale 1 : 25

End Date 17 June 2019 Northing 180761 Ground level 5.35mOD

Depth 1.20 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
1.20m: Dry.				Grass over firm dark brown slightly gravelly clayey SILT with rare pockets of orangish brown fine and medium sand (up to 10mm) and soft brown clay (up to 5mm). Gravel is subangular to subrounded fine and medium brick and mudstone. Abundant rootlets. (MADE GROUND)	0.20	5.15	
	1B		0.50- 0.70	Firm light bluish grey mottled light brown CLAY with frequent pockets (up to 20mm) of soft brown clay and rare pockets (up to 5mm) of reddish brown fine and medium sand. Frequent roots (up to 3mm diam) and rootlets.			
	2B		1.00- 1.20				
				Trial pit completed at 1.20m.	1.20	4.15	

## Notes

Trial pit excavated using hand tools in advance of VS01.  
 Groundwater was not encountered.  
 Trial pit sides remained stable.  
 Trial pit dimensions 0.20x0.20x1.20m.  
 On completion, the trial pit was backfilled and the surface reinstated.

Sketch of Foundation - Not to scale. All dimensions in metres.



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## TRIAL PIT LOG



VS02

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 1

Start Date 17 June 2019 Easting 325412

Scale 1 : 25

End Date 17 June 2019 Northing 180801 Ground level 4.95mOD

Depth 1.20 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
1.10m: Seepage.				Grass over soft dark brown silty CLAY with frequent pockets (up to 10mm) of soft bluish grey and organish brown clay and rare pockets (up to 5mm) of black organic material. Abundant rootlets. (MADE GROUND?)	0.10	4.85	
	1B		0.50- 0.70	Firm light bluish grey mottled greyish brown and orangish brown CLAY with frequent pockets (up to 5mm) of black organic material and rare pockets (up to 15mm) of soft purplish brown clay and reddish brown fine and medium sand. Frequent rootlets.			
	2B		1.00- 1.15	Firm dark grey orangic CLAY with frequent pockets (up to 40mm) of fibrous peat and rare pockets (up to 20mm) of soft bluish grey clay.	1.15 1.20	3.80 3.75	
				Trial pit completed at 1.20m.			

## Notes

Trial pit excavated using hand tools in advance of VS02.  
 A seepage of groundwater was encountered at 1.10m.  
 Trial pit sides remained stable.  
 Trial pit dimensions 0.20x0.20x1.20m.  
 On completion, the trial pit was backfilled and the surface reinstated.

Sketch of Foundation - Not to scale. All dimensions in metres.



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## TRIAL PIT LOG



VS03

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 1

Start Date 17 June 2019 Easting 325292

Scale 1 : 25

End Date 17 June 2019 Northing 180728 Ground level 5.40mOD

Depth 1.20 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
1.20m: Dry.				Grass over brown mottled organish brown slightly sandy SILT with rare pockets (up to 10mm) of orangish brown fine and medium sand and black organic material. Abundant rootlets. (MADE GROUND/REWORKED NATURAL DEPOSITS)	0.30	5.10	x x x x x x x x x
	1B		0.50- 0.70	Firm light bluish grey mottled brown and orangish brown CLAY with frequent pockets of black carbonaceous material (up to 5mm) and rare wood fragments (up to 15mm). Frequent rootlets.			
	2B		1.00- 1.20		1.20	4.20	
				Trial pit completed at 1.20m.			

## Notes

Trial pit excavated using hand tools in advance of VS03.  
 A seepage of groundwater was encountered at 1.20m.  
 Trial pit sides remained stable.  
 Trial pit dimensions 0.20x0.20x1.20m.  
 On completion, the trial pit was backfilled and the surface reinstated.

Sketch of Foundation - Not to scale. All dimensions in metres.



CONTRACT

35338

CHECKED

CT

**TRIAL PIT LOG****VS04**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 1

Start Date 17 June 2019 Easting 325193

Scale 1 : 25

End Date 17 June 2019 Northing 180663 Ground level 5.10mOD

Depth 1.20 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
1.20m: Dry.				Grass over brown mottled organish brown slightly sandy SILT with rare pockets (up to 10mm) of orangish brown fine and medium sand, brown clay and black organic material. Abundant rootlets. (MADE GROUND/REWORKED NATURAL DEPOSITS)	0.20	4.90	x x x x x x x x
	1B		0.50- 0.70	Soft light bluish grey mottled brown and orangish brown silty CLAY with frequent pockets (up to 5mm) of soft brown clay and black organic material. Frequent rootlets and rare roots (up to 5mm diam).			
	2B		1.00- 1.20				
				Trial pit completed at 1.20m.	1.20	3.90	

**Notes**

Trial pit excavated using hand tools in advance of VS04.  
 A seepage of groundwater was encountered at 1.20m.  
 Trial pit sides remained stable.  
 Trial pit dimensions 0.20x0.20x1.20m.  
 On completion, the trial pit was backfilled and the surface reinstated.

Sketch of Foundation - Not to scale. All dimensions in metres.



CONTRACT

**35338**

CHECKED

**CT**

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

## TRIAL PIT LOG



VS05

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Sheet 1 of 1

Start Date 17 June 2019 Easting 325096

Scale 1 : 25

End Date 17 June 2019 Northing 180591 Ground level 5.30mOD

Depth 1.20 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
1.20m: Dry.	1B		0.50- 0.70	Grass over firm brown mottled organish brown slightly gravelly clayey SILT with rare pockets (up to 10mm) of orangish brown fine and medium sand, brown clay and black organic material (up to 5mm). Gravel is subangular and subrounded fine to coarse brick and mudstone. (MADE GROUND)	0.15	5.15	
				Firm light bluish grey mottled brown and orangish brown silty CLAY with frequent pockets (up to 5mm) of soft brown clay and black organic material. Frequent rootlets and rare roots (up to 5mm diam).			
	2B		1.00- 1.20	Soft brownish grey mottled orangish brown CLAY with rare wood fragments (up to 10mm). Frequent rootlets and rare roots (up to 5mm diam).	0.90	4.40	
				Trial pit completed at 1.20m.	1.20	4.10	

## Notes

Trial pit excavated using hand tools in advance of VS05.  
 A seepage of groundwater was encountered at 1.20m.  
 Trial pit sides remained stable.  
 Trial pit dimensions 0.20x0.20x1.20m.  
 On completion, the trial pit was backfilled and the surface reinstated.

Sketch of Foundation - Not to scale. All dimensions in metres.



CONTRACT

35338

CHECKED

CT

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH01	16/07/19 14:20:15	1015	0	0.2	0.0	7.9	0.0	0	0	0.0	0.0	23	1.39	
BH01	16/07/19 14:20:30			0.2	0.0	7.8	0.0	0	0	0.0				
BH01	16/07/19 14:20:45			0.2	0.0	7.8	0.0	0	0	0.0				
BH01	16/07/19 14:21:00			0.2	0.0	7.8	0.0	0	0	0.0				
BH01	16/07/19 14:21:15			0.2	0.0	7.7	0.0	0	0	0.0				
BH01	16/07/19 14:21:30			0.2	0.0	7.7	0.0	0	0	0.0				
BH01	16/07/19 14:21:45			0.2	0.0	7.7	0.0	0	0	0.0				
BH01	16/07/19 14:22:00			0.2	0.0	7.7	0.0	0	0	0.0				
BH01	16/07/19 14:23:00										0.0			
BH01	16/07/19 14:24:00										0.0			
BH01	16/07/19 14:25:00										0.0			
BH01	16/07/19 14:26:00													
BH01	01/08/19 12:00:15			0.1	0.0	20.9	0.0	0	0	0.0				
BH01	01/08/19 12:00:30			0.1	0.0	20.9	0.0	0	0	0.0				
BH01	01/08/19 12:00:45			0.1	0.0	20.9	0.0	0	0	0.0				
BH01	01/08/19 12:01:00			0.1	0.0	20.9	0.0	0	0	0.0				
BH01	01/08/19 12:01:15			0.1	0.0	20.9	0.0	0	0	0.0				
BH01	01/08/19 12:01:30			0.1	0.0	21.0	0.0	0	0	0.0				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT <b>35338</b>	CHECKED <b>CT</b>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH01	01/08/19 12:01:45	1021	0	0.1	0.0	21.1	0.0	0	0	0.0	0.0	22	1.12	
BH01	01/08/19 12:02:00			0.1	0.0	21.1	0.0	0	0	0.0				
BH01	01/08/19 12:03:00													
BH01	01/08/19 12:04:00													
BH01	01/08/19 12:05:00													
BH01	01/08/19 12:06:00	1007	0								0.0	18	0.83	
BH01	14/08/19 15:10:15			0.7	0.0	17.7	0.0	0	0	0.6				
BH01	14/08/19 15:10:30			0.1	0.0	19.4	0.0	0	0	0.6				
BH01	14/08/19 15:10:45			0.1	0.0	19.6	0.0	0	0	0.5				
BH01	14/08/19 15:11:00			0.0	0.0	19.8	0.0	0	0	0.5				
BH01	14/08/19 15:11:15			0.0	0.0	20.0	0.0	0	0	0.5				
BH01	14/08/19 15:11:30			0.0	0.0	20.0	0.0	0	0	0.5				
BH01	14/08/19 15:11:45			0.0	0.0	20.0	0.0	0	0	0.5				
BH01	14/08/19 15:12:00			0.0	0.0	20.0	0.0	0	0	0.5				
BH01	14/08/19 15:13:00													
BH01	14/08/19 15:14:00													
BH01	14/08/19 15:15:00													
BH01	14/08/19 15:16:00													
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH01	23/08/19 14:05:15	1024	0	0.0	0.0	21.1	0.0	0	0	0.0	0.0	23	0.99	
BH01	23/08/19 14:05:30			0.0	0.0	21.1	0.0	0	0	0.0				
BH01	23/08/19 14:05:45			0.0	0.0	21.2	0.0	0	0	0.0				
BH01	23/08/19 14:06:00			0.0	0.0	21.2	0.0	0	0	0.0				
BH01	23/08/19 14:06:15			0.0	0.0	21.2	0.0	0	0	0.0				
BH01	23/08/19 14:06:30			0.0	0.0	21.3	0.0	0	0	0.0				
BH01	23/08/19 14:06:45			0.0	0.0	21.3	0.0	0	0	0.0				
BH01	23/08/19 14:07:00			0.0	0.0	21.4	0.0	0	0	0.0				
BH01	23/08/19 14:08:00													
BH01	23/08/19 14:09:00													
BH01	23/08/19 14:10:00													
BH01	23/08/19 14:11:00													
BH01	11/09/19 13:05:15			0.0	0.0	20.6	0.0	0	0	1.2				
BH01	11/09/19 13:05:30			0.0	0.0	20.6	0.0	0	0	1.1				
BH01	11/09/19 13:05:45			0.0	0.0	20.6	0.0	0	0	1.0				
BH01	11/09/19 13:06:00			0.0	0.0	20.6	0.0	0	0	1.0				
BH01	11/09/19 13:06:15			0.0	0.0	20.6	0.0	0	0	0.9				
BH01	11/09/19 13:06:30			0.0	0.0	20.6	0.0	0	0	0.8				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks						
BH01	11/09/19 13:06:45	1019	0	0.0	0.0	20.6	0.0	0	0	0.8	0.0	19	0.95							
BH01	11/09/19 13:07:00			0.0	0.0	20.6	0.0	0	0	0.8										
BH01	11/09/19 13:08:00																			
BH01	11/09/19 13:09:00																			
BH01	11/09/19 13:10:00																			
BH01	11/09/19 13:11:00																			
BH01	24/09/19 13:10:15			0.1	0.0	21.0	0.0	0	0	0.0										
BH01	24/09/19 13:10:30			0.1	0.0	21.0	0.0	0	0	0.0										
BH01	24/09/19 13:10:45			0.1	0.0	21.0	0.0	0	0	0.0										
BH01	24/09/19 13:11:00			0.0	0.0	21.1	0.0	0	0	0.0										
BH01	24/09/19 13:11:15	1002	0	0.0	0.0	21.1	0.0	0	0	0.0	0.0	18	0.92							
BH01	24/09/19 13:11:30			0.0	0.0	21.1	0.0	0	0	0.0										
BH01	24/09/19 13:11:45			0.0	0.0	21.1	0.0	0	0	0.0										
BH01	24/09/19 13:12:00			0.0	0.0	21.1	0.0	0	0	0.0										
BH01	24/09/19 13:13:00																			
BH01	24/09/19 13:14:00																			
BH01	24/09/19 13:15:00																			
BH01	24/09/19 13:16:00																			
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe															CONTRACT 35338	CHECKED CT				

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH01	16/07/19 14:15:15	1015	0	0.0	0.0	20.2	0.0	0	0	0.0	0.0	23	1.43	
BH01	16/07/19 14:15:30			0.0	0.0	20.4	0.0	0	0	0.0				
BH01	16/07/19 14:15:45			0.0	0.0	20.4	0.0	0	0	0.0				
BH01	16/07/19 14:16:00			0.0	0.0	20.4	0.0	0	0	0.0				
BH01	16/07/19 14:16:15			0.0	0.0	20.4	0.0	0	0	0.0				
BH01	16/07/19 14:16:30			0.0	0.0	20.4	0.0	0	0	0.0				
BH01	16/07/19 14:16:45			0.0	0.0	20.4	0.0	0	0	0.0				
BH01	16/07/19 14:17:00			0.0	0.0	20.4	0.0	0	0	0.0				
BH01	16/07/19 14:18:00													
BH01	16/07/19 14:19:00													
BH01	16/07/19 14:20:00													
BH01	16/07/19 14:21:00													
BH01	01/08/19 11:26:15			0.0	0.1	20.8	0.0	0	0	0.0				
BH01	01/08/19 11:26:30			0.0	0.1	20.9	0.0	0	0	0.0				
BH01	01/08/19 11:26:45			0.0	0.1	20.9	0.0	0	0	0.0				
BH01	01/08/19 11:27:00			0.0	0.1	20.9	0.0	0	0	0.0				
BH01	01/08/19 11:27:15			0.0	0.1	20.9	0.0	0	0	0.0				
BH01	01/08/19 11:27:30			0.0	0.1	20.9	0.0	0	0	0.0				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe														



**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks	
BH01	01/08/19 11:27:45	1021	0	0.0	0.1	20.9	0.0	0	0	0.0					
BH01	01/08/19 11:28:00			0.0	0.1	20.9	0.0	0	0	0.0					
BH01	01/08/19 11:29:00										-0.6				
BH01	01/08/19 11:30:00										0.0				
BH01	01/08/19 11:31:00										0.0				
BH01	01/08/19 11:32:00											22	1.14		
BH01	14/08/19 15:00:15					0.0	0.0	20.3	0.0	0	0	0.4			
BH01	14/08/19 15:00:30					0.0	0.0	20.3	0.0	0	0	0.5			
BH01	14/08/19 15:00:45					0.0	0.0	20.3	0.0	0	0	0.4			
BH01	14/08/19 15:01:00					0.0	0.0	20.3	0.0	0	0	0.4			
BH01	14/08/19 15:01:15			0.0	0.0	20.3	0.0	0	0	0.4					
BH01	14/08/19 15:01:30			0.0	0.0	20.3	0.0	0	0	0.4					
BH01	14/08/19 15:01:45			0.0	0.0	20.3	0.0	0	0	0.4					
BH01	14/08/19 15:02:00			0.0	0.0	20.3	0.0	0	0	0.4					
BH01	14/08/19 15:03:00										0.0				
BH01	14/08/19 15:04:00										0.0				
BH01	14/08/19 15:05:00										0.0				
BH01	14/08/19 15:06:00	1008	0									18	0.93		
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338	CHECKED CT	

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole / trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH01	23/08/19 13:56:15	1024	0	0.0	0.0	21.3	0.0	0	0	0.0	0.0	23	0.95	
BH01	23/08/19 13:56:30			0.0	0.0	21.3	0.0	0	0	0.0				
BH01	23/08/19 13:56:45			0.0	0.0	21.3	0.0	0	0	0.0				
BH01	23/08/19 13:57:00			0.0	0.0	21.3	0.0	0	0	0.0				
BH01	23/08/19 13:57:15			0.0	0.0	21.4	0.0	0	0	0.0				
BH01	23/08/19 13:57:30			0.0	0.0	21.4	0.0	0	0	0.0				
BH01	23/08/19 13:57:45			0.0	0.0	21.4	0.0	0	0	0.0				
BH01	23/08/19 13:58:00			0.0	0.0	21.4	0.0	0	0	0.0				
BH01	23/08/19 13:59:00													
BH01	23/08/19 14:00:00													
BH01	23/08/19 14:01:00													
BH01	23/08/19 14:02:00													
BH01	27/08/19 00:00:00													
BH01	11/09/19 12:56:15			0.3	0.0	20.4	0.0	0	0	1.8				
BH01	11/09/19 12:56:30			0.3	0.0	20.4	0.0	0	0	1.7				
BH01	11/09/19 12:56:45			0.3	0.0	20.4	0.0	0	0	1.5				
BH01	11/09/19 12:57:00			0.3	0.0	20.3	0.0	0	0	1.3				
BH01	11/09/19 12:57:15			0.3	0.0	20.3	0.0	0	0	1.1				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT <b>35338</b>	CHECKED <b>CT</b>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH01	11/09/19 12:57:30	1019	0	0.3	0.0	20.2	0.0	0	0	1.0			0.97	
BH01	11/09/19 12:57:45			0.3	0.0	20.2	0.0	0	0	0.9				
BH01	11/09/19 12:58:00			0.3	0.0	20.2	0.0	0	0	0.8				
BH01	11/09/19 12:59:00											0.0		
BH01	11/09/19 13:00:00											0.0		
BH01	11/09/19 13:01:00											0.0		
BH01	11/09/19 13:02:00													
BH01	12/09/19 00:00:00													
BH01	24/09/19 13:00:15					0.1	0.0	21.0	0.0	0	0	0.1		
BH01	24/09/19 13:00:30					0.1	0.0	20.9	0.0	0	0	0.0		
BH01	24/09/19 13:00:45					0.1	0.0	20.9	0.0	0	0	0.0		
BH01	24/09/19 13:01:00					0.1	0.0	20.9	0.0	0	0	0.0		
BH01	24/09/19 13:01:15					0.1	0.0	20.9	0.0	0	0	0.0		
BH01	24/09/19 13:01:30					0.1	0.0	20.9	0.0	0	0	0.0		
BH01	24/09/19 13:01:45					0.1	0.0	20.9	0.0	0	0	0.0		
BH01	24/09/19 13:02:00					0.1	0.0	20.9	0.0	0	0	0.0		
BH01	24/09/19 13:03:00											0.0		
BH01	24/09/19 13:04:00											0.0		
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338	

Geotechnical Engineering Limited

# GAS AND GROUNDWATER LEVELS



CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH01	24/09/19 13:05:00										0.0			
BH01	24/09/19 13:06:00	1002	0									18	0.96	
<div>remarks</div> <div># denotes result exceeding capacity of gas monitoring equipment</div> <div>VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.</div> <div>50mm standpipe</div>													<div>CONTRACT</div> <div>35338</div>	<div>CHECKED</div> <div>CT</div>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH02	16/07/19 12:34:00	1021	0									23	1.24	Gas cap replaced with gas valve.
BH02	31/07/19 12:00:15			0.1	0.0	21.0	0.0	0	0	0.1				
BH02	31/07/19 12:00:30			0.1	0.0	21.0	0.0	0	0	0.1				
BH02	31/07/19 12:00:45			0.1	0.0	21.1	0.0	0	0	0.1				
BH02	31/07/19 12:01:00			0.0	0.0	21.1	0.0	0	0	0.1				
BH02	31/07/19 12:01:15			0.0	0.0	21.1	0.0	0	0	0.1				
BH02	31/07/19 12:01:30			0.0	0.0	21.1	0.0	0	0	0.1				
BH02	31/07/19 12:01:45			0.0	0.0	21.1	0.0	0	0	0.0				
BH02	31/07/19 12:02:00			0.0	0.0	21.1	0.0	0	0	0.0				
BH02	31/07/19 12:03:00										0.0			
BH02	31/07/19 12:04:00										0.0			
BH02	31/07/19 12:05:00										0.0			
BH02	31/07/19 12:06:00	1014	0									21	0.88	
BH02	14/08/19 14:45:15			0.0	0.0	20.6	0.0	0	0	0.0				
BH02	14/08/19 14:45:30			0.0	0.0	20.5	0.0	0	0	0.0				
BH02	14/08/19 14:45:45			0.0	0.0	20.5	0.0	0	0	0.0				
BH02	14/08/19 14:46:00			0.0	0.0	20.4	0.0	0	0	0.0				
BH02	14/08/19 14:46:15			0.0	0.0	20.3	0.0	0	0	0.0				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT <b>35338</b>	CHECKED <b>CT</b>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks	
BH02	14/08/19 14:46:30	1008	0	0.0	0.0	20.3	0.0	0	0	0.0					
BH02	14/08/19 14:46:45			0.0	0.0	20.3	0.0	0	0	0.0					
BH02	14/08/19 14:47:00			0.0	0.0	20.3	0.0	0	0	0.0					
BH02	14/08/19 14:48:00										0.0				
BH02	14/08/19 14:49:00										0.0				
BH02	14/08/19 14:50:00										0.0				
BH02	14/08/19 14:51:00												18		0.65
BH02	23/08/19 13:40:15			0.0	0.0	21.8	0.0	0	0	0.0					
BH02	23/08/19 13:40:30			0.0	0.0	21.6	0.0	0	0	0.0					
BH02	23/08/19 13:40:45			0.0	0.0	21.5	0.0	0	0	0.0					
BH02	23/08/19 13:41:00	0.0	0.0	21.5	0.0	0	0	0.0							
BH02	23/08/19 13:41:15	0.0	0.0	21.5	0.0	0	0	0.0							
BH02	23/08/19 13:41:30	0.0	0.0	21.5	0.0	0	0	0.0							
BH02	23/08/19 13:41:45	0.0	0.0	21.5	0.0	0	0	0.0							
BH02	23/08/19 13:42:00	1024	0								0.0				
BH02	23/08/19 13:43:00										0.0				
BH02	23/08/19 13:44:00										0.0				
BH02	23/08/19 13:45:00											20	0.53		
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT 35338	CHECKED CT	

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks	
BH02	10/09/19 13:55:15	1019	0	0.0	0.0	20.7	0.0	0	0	0.0					
BH02	10/09/19 13:55:30			0.0	0.0	20.7	0.0	0	0	0.0					
BH02	10/09/19 13:55:45			0.0	0.0	20.7	0.0	0	0	0.0					
BH02	10/09/19 13:56:00			0.0	0.0	20.7	0.0	0	0	0.0					
BH02	10/09/19 13:56:15			0.0	0.0	20.7	0.0	0	0	0.0					
BH02	10/09/19 13:56:30			0.0	0.0	20.7	0.0	0	0	0.0					
BH02	10/09/19 13:56:45			0.0	0.0	20.7	0.0	0	0	0.0					
BH02	10/09/19 13:57:00														0.0
BH02	10/09/19 13:58:00														0.0
BH02	10/09/19 13:59:00										0.0				
BH02	10/09/19 14:00:00														
BH02	24/09/19 12:45:15					0.3	0.0	20.6	0.0	0	0	0.0			
BH02	24/09/19 12:45:30					0.2	0.0	20.8	0.0	0	0	0.0			
BH02	24/09/19 12:45:45					0.1	0.0	20.8	0.0	0	0	0.0			
BH02	24/09/19 12:46:00					0.1	0.0	20.9	0.0	0	0	0.0			
BH02	24/09/19 12:46:15					0.1	0.0	20.9	0.0	0	0	0.0			
BH02	24/09/19 12:46:30					0.1	0.0	20.9	0.0	0	0	0.0			
BH02	24/09/19 12:46:45					0.1	0.0	20.9	0.0	0	0	0.0			
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT 35338		CHECKED CT

Geotechnical Engineering Limited

# GAS AND GROUNDWATER LEVELS



CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks	
BH02	24/09/19 12:47:00	1001	0	0.1	0.0	20.9	0.0	0	0	0.0					
BH02	24/09/19 12:48:00										0.0				
BH02	24/09/19 12:49:00										0.0				
BH02	24/09/19 12:50:00										0.0				
BH02	24/09/19 12:51:00											18	0.65		
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT 35338	CHECKED CT	



**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH02	16/07/19 12:31:15	1021	0	0.1	0.0	20.3	0.0	0	0	6.0	0.0	23	1.09	
BH02	16/07/19 12:31:30			0.0	0.0	20.4	0.0	0	0	5.2				
BH02	16/07/19 12:31:45			0.0	0.0	20.3	0.0	0	0	4.0				
BH02	16/07/19 12:32:00			0.0	0.0	20.3	0.0	0	0	3.4				
BH02	16/07/19 12:32:15			0.0	0.0	20.3	0.0	0	0	3.0				
BH02	16/07/19 12:32:30			0.0	0.0	20.3	0.0	0	0	2.6				
BH02	16/07/19 12:32:45			0.0	0.0	20.3	0.0	0	0	2.4				
BH02	16/07/19 12:33:00			0.0	0.0	20.3	0.0	0	0	2.2				
BH02	16/07/19 12:34:00													
BH02	16/07/19 12:35:00													
BH02	16/07/19 12:36:00													
BH02	16/07/19 12:37:00													
BH02	16/07/19 12:38:00													
BH02	31/07/19 14:10:15			0.0	0.0	21.4	0.0	0	0	47.6				
BH02	31/07/19 14:10:30			0.0	0.0	21.4	0.0	0	0	40.1				
BH02	31/07/19 14:10:45			0.0	0.0	21.2	0.0	0	0	29.1				
BH02	31/07/19 14:11:00			0.0	0.0	21.2	0.0	0	0	18.6				
BH02	31/07/19 14:11:15			0.0	0.0	21.2	0.0	0	0	15.6				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks	
BH02	31/07/19 14:11:30	1014	0	0.0	0.0	21.2	0.0	0	0	13.8		21	0.80		
BH02	31/07/19 14:11:45			0.0	0.0	21.2	0.0	0	0	11.8					
BH02	31/07/19 14:12:00			0.0	0.0	21.2	0.0	0	0	11.2					
BH02	31/07/19 14:13:00										0.0				
BH02	31/07/19 14:14:00										0.0				
BH02	31/07/19 14:15:00										0.0				
BH02	31/07/19 14:16:00														
BH02	14/08/19 14:37:15			0.1	0.0	19.7	0.0	0	0	1.6					
BH02	14/08/19 14:37:30			0.0	0.0	20.3	0.0	0	0	1.3					
BH02	14/08/19 14:37:45			0.0	0.0	20.4	0.0	0	0	1.3					
BH02	14/08/19 14:38:00			0.0	0.0	20.4	0.0	0	0	1.2					
BH02	14/08/19 14:38:15			0.0	0.0	20.4	0.0	0	0	1.1					
BH02	14/08/19 14:38:30			0.0	0.0	20.4	0.0	0	0	1.0					
BH02	14/08/19 14:38:45			0.0	0.0	20.4	0.0	0	0	0.9					
BH02	14/08/19 14:39:00			0.0	0.0	20.4	0.0	0	0	0.8					
BH02	14/08/19 14:40:00										0.0				
BH02	14/08/19 14:41:00										0.0				
BH02	14/08/19 14:42:00										0.0				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe															CONTRACT 35338

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH02	14/08/19 14:43:00	1008	0									18	0.55	
BH02	23/08/19 13:32:15			0.0	0.0	21.6	0.0	0	0	0.0				
BH02	23/08/19 13:32:30			0.0	0.0	21.5	0.0	0	0	0.0				
BH02	23/08/19 13:32:45			0.0	0.0	21.5	0.0	0	0	0.0				
BH02	23/08/19 13:33:00			0.0	0.0	21.5	0.0	0	0	0.0				
BH02	23/08/19 13:33:15			0.0	0.0	21.5	0.0	0	0	0.0				
BH02	23/08/19 13:33:30			0.0	0.0	21.5	0.0	0	0	0.0				
BH02	23/08/19 13:33:45			0.0	0.0	21.5	0.0	0	0	0.0				
BH02	23/08/19 13:34:00			0.0	0.0	21.5	0.0	0	0	0.0				
BH02	23/08/19 13:35:00										0.0			
BH02	23/08/19 13:36:00										0.0			
BH02	23/08/19 13:37:00										0.0			
BH02	23/08/19 13:38:00	1024	0									20	0.53	
BH02	27/08/19 00:00:00													
BH02	10/09/19 13:48:15			0.1	0.0	20.7	0.0	0	0	0.1				
BH02	10/09/19 13:48:30			0.1	0.0	20.7	0.0	0	0	0.1				
BH02	10/09/19 13:48:45			0.1	0.0	20.7	0.0	0	0	0.0				
BH02	10/09/19 13:49:00			0.1	0.0	20.7	0.0	0	0	0.0				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT <b>35338</b>	CHECKED <b>CT</b>



SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks			
BH02	10/09/19 13:49:15	1019	-4	0.1	0.0	20.7	0.0	0	0	0.0			0.64				
BH02	10/09/19 13:49:30			0.1	0.0	20.7	0.0	0	0	0.0							
BH02	10/09/19 13:49:45			0.0	0.0	20.7	0.0	0	0	0.0							
BH02	10/09/19 13:50:00			0.0	0.0	20.7	0.0	0	0	0.0							
BH02	10/09/19 13:51:00														-0.7		
BH02	10/09/19 13:52:00														-0.8		
BH02	10/09/19 13:53:00														-0.6		
BH02	10/09/19 13:54:00																
BH02	12/09/19 00:00:00																
BH02	24/09/19 12:36:15			0.2	0.0	20.9	0.0	0	0	0.6							
BH02	24/09/19 12:36:30			0.2	0.0	20.9	0.0	0	0	0.4							
BH02	24/09/19 12:36:45			0.2	0.0	20.9	0.0	0	0	0.3							
BH02	24/09/19 12:37:00			0.1	0.0	20.9	0.0	0	0	0.2							
BH02	24/09/19 12:37:15			0.1	0.0	20.9	0.0	0	0	0.2							
BH02	24/09/19 12:37:30			0.1	0.0	20.9	0.0	0	0	0.1							
BH02	24/09/19 12:37:45			0.1	0.0	21.0	0.0	0	0	0.0							
BH02	24/09/19 12:38:00			0.1	0.0	21.0	0.0	0	0	0.0							
BH02	24/09/19 12:39:00										0.0						
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338		CHECKED CT		

Geotechnical Engineering Limited

# GAS AND GROUNDWATER LEVELS



CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH02	24/09/19 12:40:00	1001	0								0.0	18	0.61	
BH02	24/09/19 12:41:00										0.0			
BH02	24/09/19 12:42:00													
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338	CHECKED CT

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH03	16/07/19 14:50:15	1016	0	3.9	0.0	4.5	0.0	0	0	52.8	0.0	24	1.39	
BH03	16/07/19 14:50:30			4.0	0.0	1.6	0.0	0	0	60.4				
BH03	16/07/19 14:50:45			4.0	0.0	1.4	0.0	0	0	62.2				
BH03	16/07/19 14:51:00			4.0	0.0	1.1	0.0	0	0	62.4				
BH03	16/07/19 14:51:15			4.0	0.0	1.0	0.0	0	0	62.1				
BH03	16/07/19 14:51:30			4.0	0.0	0.9	0.0	0	0	62.5				
BH03	16/07/19 14:51:45			4.0	0.0	0.9	0.0	0	0	62.7				
BH03	16/07/19 14:52:00			4.0	0.0	0.9	0.0	0	0	63.1				
BH03	16/07/19 14:53:00													
BH03	16/07/19 14:54:00													
BH03	16/07/19 14:55:00													
BH03	16/07/19 14:56:00													
BH03	01/08/19 12:00:15			4.5	0.0	1.2	0.0	0	0	62.7				
BH03	01/08/19 12:00:30			4.6	0.0	1.3	0.0	0	0	62.5				
BH03	01/08/19 12:00:45			4.7	0.0	1.5	0.0	0	0	62.3				
BH03	01/08/19 12:01:00			4.7	0.0	1.6	0.0	0	0	61.8				
BH03	01/08/19 12:01:15			4.7	0.0	1.4	0.0	0	0	61.1				
BH03	01/08/19 12:01:30			4.7	0.0	1.3	0.0	0	0	60.5				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH03	01/08/19 12:01:45	1021	0	4.7	0.0	1.2	0.0	0	0	53.7	0.0	22	1.45	
BH03	01/08/19 12:02:00			4.7	0.0	1.2	0.0	0	0	51.4				
BH03	01/08/19 12:03:00													
BH03	01/08/19 12:04:00													
BH03	01/08/19 12:05:00													
BH03	01/08/19 12:06:00													
BH03	14/08/19 15:45:15			5.5	0.0	0.8	0.0	0	0	0.8				
BH03	14/08/19 15:45:30			5.6	0.0	0.5	0.0	0	0	0.8				
BH03	14/08/19 15:45:45			5.6	0.0	0.2	0.0	0	0	0.9				
BH03	14/08/19 15:46:00			5.6	0.0	0.1	0.0	0	0	0.9				
BH03	14/08/19 15:46:15	5.6	0.0	0.1	0.0	0	0	0.9						
BH03	14/08/19 15:46:30	5.6	0.0	0.0	0.0	0	0	0.9						
BH03	14/08/19 15:46:45	5.6	0.0	0.0	0.0	0	0	0.9						
BH03	14/08/19 15:47:00	5.6	0.0	0.0	0.0	0	0	0.9						
BH03	14/08/19 15:48:00	1008	135								16.2	18	1.14	
BH03	14/08/19 15:49:00										15.7			
BH03	14/08/19 15:50:00										15.4			
BH03	14/08/19 15:51:00													
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT 35338	CHECKED CT

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH03	23/08/19 14:58:15	1024	0	4.1	0.0	3.8	0.0	0	0	0.0	0.0	23	0.11	
BH03	23/08/19 14:58:30			3.9	0.0	5.6	0.0	0	0	0.0				
BH03	23/08/19 14:58:45			3.8	0.0	6.2	0.0	0	0	0.0				
BH03	23/08/19 14:59:00			3.6	0.0	7.0	0.0	0	0	0.0				
BH03	23/08/19 14:59:15			3.4	0.0	7.5	0.0	0	0	0.0				
BH03	23/08/19 14:59:30			3.3	0.0	7.9	0.0	0	0	0.0				
BH03	23/08/19 14:59:45			3.2	0.0	8.4	0.0	0	0	0.0				
BH03	23/08/19 15:00:00			3.1	0.0	8.6	0.0	0	0	0.0				
BH03	23/08/19 15:01:00													
BH03	23/08/19 15:02:00													
BH03	23/08/19 15:03:00													
BH03	23/08/19 15:04:00													
BH03	11/09/19 14:10:15			4.5	0.0	6.0	0.0	0	0	0.0				
BH03	11/09/19 14:10:30			2.4	0.0	5.9	0.0	0	0	0.0				
BH03	11/09/19 14:10:45			1.7	0.0	5.6	0.0	0	0	0.0				
BH03	11/09/19 14:11:00			0.3	0.0	5.5	0.0	0	0	0.0				
BH03	11/09/19 14:11:15			0.1	0.0	5.5	0.0	0	0	0.0				
BH03	11/09/19 14:11:30			0.0	0.0	5.5	0.0	0	0	0.0				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe														



**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks	
BH03	11/09/19 14:11:45	1018	0	0.0	0.0	5.5	0.0	0	0	0.0					
BH03	11/09/19 14:12:00			0.0	0.0	5.5	0.0	0	0	0.0					
BH03	11/09/19 14:13:00										0.0				
BH03	11/09/19 14:14:00										0.0				
BH03	11/09/19 14:15:00										0.0				
BH03	11/09/19 14:16:00											19	1.01		
BH03	24/09/19 13:30:15			0.5	0.0	21.2	0.0	0	0	0.0					
BH03	24/09/19 13:30:30			2.9	0.0	12.4	0.0	0	0	0.0					
BH03	24/09/19 13:30:45			4.5	0.0	5.5	0.0	0	0	0.0					
BH03	24/09/19 13:31:00			4.5	0.0	5.5	0.0	0	0	0.0					
BH03	24/09/19 13:31:15	4.4	0.0	5.8	0.0	0	0	0.0							
BH03	24/09/19 13:31:30	4.4	0.0	6.1	0.0	0	0	0.0							
BH03	24/09/19 13:31:45	4.4	0.0	6.3	0.0	0	0	0.0							
BH03	24/09/19 13:32:00	4.3	0.0	6.4	0.0	0	0	0.0							
BH03	24/09/19 13:33:00									-1.7					
BH03	24/09/19 13:34:00									-1.3					
BH03	24/09/19 13:35:00									0.0					
BH03	24/09/19 13:36:00	1001	0								18	1.11			
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT 35338		CHECKED CT

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH03	16/07/19 14:45:15	1018	0	0.0	2.4	19.3	22.1	0	0	12.4	0.0	24	1.72	No PID recorded  No PID recorded
BH03	16/07/19 14:45:30			0.0	0.0	19.9	0.0	0	0	12.1				
BH03	16/07/19 14:45:45			0.0	0.0	19.9	0.0	0	0	11.8				
BH03	16/07/19 14:46:00			0.1	0.0	20.0	0.0	0	0	11.3				
BH03	16/07/19 14:46:15			0.1	0.0	20.0	0.0	0	0	10.9				
BH03	16/07/19 14:46:30			0.1	0.0	20.0	0.0	0	0					
BH03	16/07/19 14:46:45			0.1	0.0	20.0	0.0	0	0					
BH03	16/07/19 14:47:00			0.1	0.0	20.0	0.0	0	0	10.2				
BH03	16/07/19 14:48:00													
BH03	16/07/19 14:49:00													
BH03	16/07/19 14:50:00													
BH03	16/07/19 14:51:00													
BH03	01/08/19 12:10:15			0.2	0.0	21.1	0.0	0	0	11.4				
BH03	01/08/19 12:10:30			0.2	0.0	21.1	0.0	0	0	11.1				
BH03	01/08/19 12:10:45			0.2	0.0	21.1	0.0	0	0	11.0				
BH03	01/08/19 12:11:00			0.2	0.0	21.1	0.0	0	0	10.8				
BH03	01/08/19 12:11:15			0.2	0.0	21.1	0.0	0	0	10.7				
BH03	01/08/19 12:11:30			0.2	0.0	21.1	0.0	0	0	10.3				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH03	01/08/19 12:11:45	1021	0	0.2	0.0	21.1	0.0	0	0	10.2	0.0	22	1.60	
BH03	01/08/19 12:12:00			0.2	0.0	21.1	0.0	0	0	10.0				
BH03	01/08/19 12:13:00													
BH03	01/08/19 12:14:00													
BH03	01/08/19 12:15:00													
BH03	01/08/19 12:16:00													
BH03	14/08/19 15:36:15			0.0	0.0	19.2	0.0	0	0	1.6				
BH03	14/08/19 15:36:30			0.0	0.0	19.6	0.0	0	0	1.4				
BH03	14/08/19 15:36:45			0.0	0.0	19.8	0.0	0	0	1.2				
BH03	14/08/19 15:37:00			0.0	0.0	20.0	0.0	0	0	1.1				
BH03	14/08/19 15:37:15	1008	0	0.0	0.0	20.0	0.0	0	0	1.0	0.0	18	1.37	
BH03	14/08/19 15:37:30			0.0	0.0	20.0	0.0	0	0	0.9				
BH03	14/08/19 15:37:45			0.0	0.0	20.0	0.0	0	0	0.9				
BH03	14/08/19 15:38:00			0.0	0.0	20.0	0.0	0	0	0.9				
BH03	14/08/19 15:39:00													
BH03	14/08/19 15:40:00													
BH03	14/08/19 15:41:00													
BH03	14/08/19 15:42:00													
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338	CHECKED CT

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH03	23/08/19 14:49:15	1023	0	0.2	0.0	21.0	0.0	0	0	1.1	0.0	23	1.27	
BH03	23/08/19 14:49:30			0.1	0.0	21.1	0.0	0	0	0.9				
BH03	23/08/19 14:49:45			0.1	0.0	21.2	0.0	0	0	0.7				
BH03	23/08/19 14:50:00			0.1	0.0	21.3	0.0	0	0	0.5				
BH03	23/08/19 14:50:15			0.1	0.0	21.4	0.0	0	0	0.5				
BH03	23/08/19 14:50:30			0.1	0.0	21.4	0.0	0	0	0.4				
BH03	23/08/19 14:50:45			0.1	0.0	21.5	0.0	0	0	0.1				
BH03	23/08/19 14:51:00			0.1	0.0	21.5	0.0	0	0	0.0				
BH03	23/08/19 14:52:00													
BH03	23/08/19 14:53:00													
BH03	23/08/19 14:54:00													
BH03	23/08/19 14:55:00													
BH03	27/08/19 00:00:00													
BH03	11/09/19 14:01:15			0.6	0.0	19.1	0.0	0	0	1.2				
BH03	11/09/19 14:01:30			0.6	0.0	19.4	0.0	0	0	0.1				
BH03	11/09/19 14:01:45			0.6	0.0	19.4	0.0	0	0	0.0				
BH03	11/09/19 14:02:00			0.6	0.0	19.5	0.0	0	0	0.0				
BH03	11/09/19 14:02:15			0.6	0.0	19.5	0.0	0	0	0.0				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks		
BH03	11/09/19 14:02:30	1018	0	0.6	0.0	19.6	0.0	0	0	0.0						
BH03	11/09/19 14:02:45			0.6	0.0	19.6	0.0	0	0	0.0						
BH03	11/09/19 14:03:00			0.6	0.0	19.6	0.0	0	0	0.0						
BH03	11/09/19 14:04:00											0.0				
BH03	11/09/19 14:05:00											0.0				
BH03	11/09/19 14:06:00											0.0				
BH03	11/09/19 14:07:00													19	1.50	
BH03	12/09/19 00:00:00															
BH03	24/09/19 13:40:15					0.0	0.0	21.2	0.0	0	0	0.0				
BH03	24/09/19 13:40:30					0.0	0.0	21.0	0.0	0	0	0.0				
BH03	24/09/19 13:40:45					0.0	0.0	21.0	0.0	0	0	0.0				
BH03	24/09/19 13:41:00					0.0	0.0	21.0	0.0	0	0	0.0				
BH03	24/09/19 13:41:15					0.0	0.0	21.0	0.0	0	0	0.0				
BH03	24/09/19 13:41:30					0.0	0.0	21.0	0.0	0	0	0.0				
BH03	24/09/19 13:41:45					0.0	0.0	21.0	0.0	0	0	0.0				
BH03	24/09/19 13:42:00					0.0	0.0	21.0	0.0	0	0	0.0				
BH03	24/09/19 13:43:00												0.0			
BH03	24/09/19 13:44:00												0.0			
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338	CHECKED CT		

Geotechnical Engineering Limited

# GAS AND GROUNDWATER LEVELS



CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH03	24/09/19 13:45:00										0.0			
BH03	24/09/19 13:46:00	1002	0									18	1.50	
<div>remarks</div> <div># denotes result exceeding capacity of gas monitoring equipment</div> <div>VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.</div> <div>50mm standpipe</div>													<div>CONTRACT</div> <div>35338</div>	<div>CHECKED</div> <div>CT</div>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH04	17/07/19 17:00:15	1011	0	2.9	0.0	18.5	0.0	0	0	0.4	0.0 0.0 0.0	22	1.25	
BH04	17/07/19 17:00:30			3.0	0.0	17.0	0.0	0	0	0.6				
BH04	17/07/19 17:00:45			3.0	0.0	16.8	0.0	0	0	2.7				
BH04	17/07/19 17:01:00			3.0	0.0	16.4	0.0	0	0	4.3				
BH04	17/07/19 17:01:15			3.0	0.0	16.3	0.0	0	0	4.4				
BH04	17/07/19 17:01:30			3.0	0.0	16.2	0.0	0	0	4.4				
BH04	17/07/19 17:01:45			3.0	0.0	16.2	0.0	0	0	4.3				
BH04	17/07/19 17:02:00			3.0	0.0	16.2	0.0	0	0	4.3				
BH04	17/07/19 17:03:00													
BH04	17/07/19 17:04:00													
BH04	17/07/19 17:05:00													
BH04	17/07/19 17:06:00													
BH04	31/07/19 12:00:15			4.3	0.0	13.4	0.0	0	0	0.5				
BH04	31/07/19 12:00:30			4.9	0.0	12.1	0.0	0	0	0.5				
BH04	31/07/19 12:00:45			4.9	0.0	12.9	0.0	0	0	0.6				
BH04	31/07/19 12:01:00			4.9	0.0	12.5	0.0	0	0	0.7				
BH04	31/07/19 12:01:15			4.9	0.0	12.1	0.0	0	0	0.9				
BH04	31/07/19 12:01:30			5.1	0.0	12.0	0.0	0	0	0.9				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks	
BH04	31/07/19 12:01:45	1013	0	5.1	0.0	12.1	0.0	0	0	1.0					
BH04	31/07/19 12:02:00			5.1	0.0	12.1	0.0	0	0	1.1					
BH04	31/07/19 12:03:00										0.0				
BH04	31/07/19 12:04:00										0.0				
BH04	31/07/19 12:05:00										0.0	21	1.22		
BH04	14/08/19 13:15:15					0.0	0.0	20.6	0.0	0	0	0.3			
BH04	14/08/19 13:15:30					0.0	0.0	20.6	0.0	0	0	0.3			
BH04	14/08/19 13:15:45					0.0	0.0	20.5	0.0	0	0	0.3			
BH04	14/08/19 13:16:00					0.0	0.0	20.4	0.0	0	0	0.3			
BH04	14/08/19 13:16:15					0.0	0.0	20.4	0.0	0	0	0.3			
BH04	14/08/19 13:16:30			0.0	0.0	20.4	0.0	0	0	0.3					
BH04	14/08/19 13:16:45			0.0	0.0	20.4	0.0	0	0	0.3					
BH04	14/08/19 13:17:00			0.0	0.0	20.4	0.0	0	0	0.3					
BH04	14/08/19 13:18:00										0.0				
BH04	14/08/19 13:19:00										0.0				
BH04	14/08/19 13:20:00										0.0				
BH04	14/08/19 13:21:00	1008	0									18	0.78		
BH04	23/08/19 13:13:15			1.5	0.0	19.4	0.0	0	0	0.0					
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT 35338	CHECKED CT	



**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH04	23/08/19 13:13:30	1025	0	1.7	0.0	17.1	0.0	0	0	0.0	0.0	20	0.70	
BH04	23/08/19 13:13:45			1.9	0.0	14.3	0.0	0	0	0.0				
BH04	23/08/19 13:14:00			1.4	0.0	16.0	0.0	0	0	0.0				
BH04	23/08/19 13:14:15			0.9	0.0	17.3	0.0	0	0	0.0				
BH04	23/08/19 13:14:30			0.8	0.0	17.9	0.0	0	0	0.0				
BH04	23/08/19 13:14:45			0.7	0.0	18.7	0.0	0	0	0.0				
BH04	23/08/19 13:15:00			0.6	0.0	19.2	0.0	0	0	0.0				
BH04	23/08/19 13:16:00													
BH04	23/08/19 13:17:00													
BH04	23/08/19 13:18:00													
BH04	23/08/19 13:19:00													
BH04	10/09/19 14:15:15			4.0	0.0	14.4	0.0	0	0	0.0				
BH04	10/09/19 14:15:30			4.7	0.0	11.9	0.0	0	0	0.0				
BH04	10/09/19 14:15:45			4.7	0.0	11.5	0.0	0	0	0.0				
BH04	10/09/19 14:16:00			4.8	0.0	11.1	0.0	0	0	0.0				
BH04	10/09/19 14:16:15			4.8	0.0	10.8	0.0	0	0	0.0				
BH04	10/09/19 14:16:30			4.8	0.0	10.4	0.0	0	0	0.0				
BH04	10/09/19 14:16:45			4.8	0.0	10.3	0.0	0	0	0.0				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks	
BH04	10/09/19 14:17:00	1018	0	4.8	0.0	10.3	0.0	0	0	0.0					
BH04	10/09/19 14:18:00										0.0				
BH04	10/09/19 14:19:00										0.0				
BH04	10/09/19 14:20:00										0.0				
BH04	10/09/19 14:21:00											18	0.86		
BH04	23/09/19 12:50:15	1009	0	4.4	0.0	11.9	0.0	0	0	0.0					
BH04	23/09/19 12:50:30			4.5		10.5									
BH04	23/09/19 12:50:45			4.6		10.4									
BH04	23/09/19 12:51:00			4.6		10.3									
BH04	23/09/19 12:51:15			4.6		10.3									
BH04	23/09/19 12:51:30					10.3									
BH04	23/09/19 12:51:45					10.4									
BH04	23/09/19 12:52:00					10.4									
BH04	23/09/19 12:53:00											0.0			
BH04	23/09/19 12:54:00											0.0			
BH04	23/09/19 12:55:00											0.0			
BH04	23/09/19 12:56:00												16		0.64
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT 35338		CHECKED CT

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH04	17/07/19 16:45:15	1012	0	0.0	0.0	19.5	0.0	0	0	14.6	0.0	22	1.30	
BH04	17/07/19 16:45:30			0.0	0.0	19.7	0.0	0	0	18.7				
BH04	17/07/19 16:45:45			0.0	0.0	19.9	0.0	0	0	21.2				
BH04	17/07/19 16:46:00			0.0	0.0	19.9	0.0	0	0	25.7				
BH04	17/07/19 16:46:15			0.0	0.0	20.0	0.0	0	0	29.0				
BH04	17/07/19 16:46:30			0.0	0.0	20.0	0.0	0	0	32.5				
BH04	17/07/19 16:46:45			0.0	0.0	20.0	0.0	0	0	37.5				
BH04	17/07/19 16:47:00			0.0	0.0	20.0	0.0	0	0	42.3				
BH04	17/07/19 16:48:00													
BH04	17/07/19 16:49:00													
BH04	17/07/19 16:50:00													
BH04	17/07/19 16:51:00													
BH04	31/07/19 10:34:15			0.1	0.0	21.1	0.0	0	0	136.7				
BH04	31/07/19 10:34:30			0.1	0.0	21.0	0.0	0	0	138.8				
BH04	31/07/19 10:34:45			0.1	0.0	20.9	0.0	0	0	139.9				
BH04	31/07/19 10:35:00			0.1	0.0	20.9	0.0	0	0	140.4				
BH04	31/07/19 10:35:15			0.1	0.0	20.0	0.0	0	0	133.3				
BH04	31/07/19 10:35:30			0.1	0.0	20.9	0.0	0	0	122.9				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks	
BH04	31/07/19 10:35:45	1016	0	0.1	0.0	20.9	0.0	0	0	119.5					
BH04	31/07/19 10:36:00			0.1	0.0	20.9	0.0	0	0	117.9					
BH04	31/07/19 10:37:00										0.0				
BH04	31/07/19 10:38:00										0.0				
BH04	31/07/19 10:39:00										0.0				
BH04	31/07/19 10:40:00											19	0.91		
BH04	01/08/19 13:15:00														
BH04	14/08/19 13:07:15					0.0	0.0	20.8	0.0	0	0	0.5			
BH04	14/08/19 13:07:30					0.0	0.0	20.3	0.0	0	0	0.5			
BH04	14/08/19 13:07:45					0.0	0.0	20.3	0.0	0	0	0.5			
BH04	14/08/19 13:08:00					0.0	0.0	20.3	0.0	0	0	0.4			
BH04	14/08/19 13:08:15					0.0	0.0	20.3	0.0	0	0	0.4			
BH04	14/08/19 13:08:30					0.0	0.0	20.3	0.0	0	0	0.4			
BH04	14/08/19 13:08:45					0.0	0.0	20.3	0.0	0	0	0.3			
BH04	14/08/19 13:09:00					0.0	0.0	20.3	0.0	0	0	0.3			
BH04	14/08/19 13:10:00												0.0		
BH04	14/08/19 13:11:00												0.0		
BH04	14/08/19 13:12:00												0.0		
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338		CHECKED CT

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH04	14/08/19 13:13:00	1008	0									18	0.80	
BH04	23/08/19 13:01:15			0.0	0.0	21.2	0.0	0	0	0.0				
BH04	23/08/19 13:01:30			0.0	0.0	21.2	0.0	0	0	0.0				
BH04	23/08/19 13:01:45			0.0	0.0	21.2	0.0	0	0	0.0				
BH04	23/08/19 13:02:00			0.0	0.0	21.2	0.0	0	0	0.0				
BH04	23/08/19 13:02:15			0.0	0.0	21.2	0.0	0	0	0.0				
BH04	23/08/19 13:02:30			0.0	0.0	21.2	0.0	0	0	0.0				
BH04	23/08/19 13:02:45			0.0	0.0	21.2	0.0	0	0	0.0				
BH04	23/08/19 13:03:00			0.0	0.0	21.2	0.0	0	0	0.0				
BH04	23/08/19 13:04:00										0.0			
BH04	23/08/19 13:05:00										0.0			
BH04	23/08/19 13:06:00										0.0			
BH04	23/08/19 13:07:00	1025	0									20	0.70	
BH04	27/08/19 00:00:00													
BH04	10/09/19 14:06:15			0.0	0.0	20.7	0.0	0	0	0.2				
BH04	10/09/19 14:06:30			0.0	0.0	20.7	0.0	0	0	0.1				
BH04	10/09/19 14:06:45			0.0	0.0	20.7	0.0	0	0	0.1				
BH04	10/09/19 14:07:00			0.0	0.0	20.7	0.0	0	0	0.1				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT <b>35338</b>	CHECKED <b>CT</b>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH04	10/09/19 14:07:15	1018	0	0.0	0.0	20.6	0.0	0	0	0.1	0.0	18	0.88	
BH04	10/09/19 14:07:30			0.0	0.0	20.6	0.0	0	0	0.1				
BH04	10/09/19 14:07:45			0.0	0.0	20.6	0.0	0	0	0.1				
BH04	10/09/19 14:08:00			0.0	0.0	20.6	0.0	0	0	0.1				
BH04	10/09/19 14:09:00													
BH04	10/09/19 14:10:00													
BH04	10/09/19 14:11:00													
BH04	10/09/19 14:12:00													
BH04	12/09/19 00:00:00													
BH04	23/09/19 12:40:15			0.1	0.0	20.8	0.0	0	0	0.0				
BH04	23/09/19 12:40:30			0.1	0.0	20.8	0.0	0	0	0.0				
BH04	23/09/19 12:40:45			0.1	0.0	20.8	0.0	0	0	0.0				
BH04	23/09/19 12:41:00			0.0	0.0	20.9	0.0	0	0	0.0				
BH04	23/09/19 12:41:15			0.0	0.0	20.9	0.0	0	0	0.0				
BH04	23/09/19 12:41:30			0.0	0.0	20.9	0.0	0	0	0.0				
BH04	23/09/19 12:41:45			0.0	0.0	20.9	0.0	0	0	0.0				
BH04	23/09/19 12:42:00			0.0	0.0	20.9	0.0	0	0	0.0				
BH04	23/09/19 12:43:00										0.0			
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe														

Geotechnical Engineering Limited

# GAS AND GROUNDWATER LEVELS



CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH04	23/09/19 12:44:00	1009	0								0.0	16	0.87	
BH04	23/09/19 12:45:00										0.0			
BH04	23/09/19 12:46:00													
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338	CHECKED CT

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH05	18/07/19 11:05:15			0.0	0.0	19.7	0.0	0	0	1.4				
BH05	18/07/19 11:05:30			3.2	0.0	10.4	0.0	0	0	2.5				
BH05	18/07/19 11:05:45			3.3	0.0	8.0	0.0	0	0	3.6				
BH05	18/07/19 11:06:00			5.5	0.0	7.3	0.0	0	0	5.0				
BH05	18/07/19 11:06:15			5.9	0.0	5.9	0.0	0	0	7.1				
BH05	18/07/19 11:06:30			6.1	0.0	5.0	0.0	0	0	8.0				
BH05	18/07/19 11:06:45			6.4	0.0	5.5	0.0	0	0	8.6				
BH05	18/07/19 11:07:00			6.5	0.0	3.3	0.0	0	0	9.0				
BH05	18/07/19 11:08:00									8.5				Only PID recorded
BH05	18/07/19 11:09:00									8.1				Only PID recorded
BH05	18/07/19 11:10:00									7.7				Only PID recorded
BH05	18/07/19 11:11:00										0.0			
BH05	18/07/19 11:12:00										0.0			
BH05	18/07/19 11:13:00										0.0			
BH05	18/07/19 11:14:00	1011	0									18	1.29	
BH05	31/07/19 12:00:15			0.0	0.0	21.3	0.0	0	0	1.1				
BH05	31/07/19 12:00:30			0.0	0.0	21.3	0.0	0	0	0.9				
BH05	31/07/19 12:00:45			0.0	0.0	21.3	0.0	0	0	0.7				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT <b>35338</b>	CHECKED <b>CT</b>



**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH05	31/07/19 12:01:00	1014	0	0.0	0.0	21.3	0.0	0	0	0.6	0.0	21	1.10	
BH05	31/07/19 12:01:15			0.0	0.0	21.3	0.0	0	0	0.5				
BH05	31/07/19 12:01:30			0.0	0.0	21.3	0.0	0	0	0.5				
BH05	31/07/19 12:01:45			0.0	0.0	21.3	0.0	0	0	0.4				
BH05	31/07/19 12:02:00			0.0	0.0	21.3	0.0	0	0	0.3				
BH05	31/07/19 12:03:00													
BH05	31/07/19 12:04:00													
BH05	31/07/19 12:05:00													
BH05	31/07/19 12:06:00													
BH05	14/08/19 12:45:15			0.0	0.0	20.7	0.0	0	0	0.9				
BH05	14/08/19 12:45:30			0.0	0.0	20.3	0.0	0	0	0.6				
BH05	14/08/19 12:45:45			0.0	0.0	20.3	0.0	0	0	0.6				
BH05	14/08/19 12:46:00			0.0	0.0	20.3	0.0	0	0	0.6				
BH05	14/08/19 12:46:15			0.0	0.0	20.3	0.0	0	0	0.5				
BH05	14/08/19 12:46:30			0.0	0.0	20.3	0.0	0	0	0.5				
BH05	14/08/19 12:46:45			0.0	0.0	20.3	0.0	0	0	0.4				
BH05	14/08/19 12:47:00			0.0	0.0	20.3	0.0	0	0	0.3				
BH05	14/08/19 12:48:00										0.0			
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT 35338	CHECKED CT

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH05	14/08/19 12:49:00	1008	0								0.0	18	0.40	
BH05	14/08/19 12:50:00										0.0			
BH05	14/08/19 12:51:00													
BH05	23/08/19 12:40:15			0.2	0.0	21.2	0.0	0	0	0.0				
BH05	23/08/19 12:40:30			0.2	0.0	21.2	0.0	0	0	0.0				
BH05	23/08/19 12:40:45			0.1	0.0	21.3	0.0	0	0	0.0				
BH05	23/08/19 12:41:00			0.1	0.0	21.3	0.0	0	0	0.0				
BH05	23/08/19 12:41:15			0.1	0.0	21.3	0.0	0	0	0.0				
BH05	23/08/19 12:41:30			0.1	0.0	21.3	0.0	0	0	0.0				
BH05	23/08/19 12:41:45			0.1	0.0	21.3	0.0	0	0	0.0				
BH05	23/08/19 12:42:00	1023	5	0.1	0.0	21.3	0.0	0	0	0.0		20	0.43	
BH05	23/08/19 12:43:00										0.7			
BH05	23/08/19 12:44:00										0.9			
BH05	23/08/19 12:45:00										1.5			
BH05	23/08/19 12:46:00													
BH05	10/09/19 13:30:15			0.3	0.0	19.6	0.0	0	0	0.0				
BH05	10/09/19 13:30:30			0.1	0.0	20.4	0.0	0	0	0.0				
BH05	10/09/19 13:30:45			0.1	0.0	20.5	0.0	0	0	0.0				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH05	10/09/19 13:31:00	1017	0	0.1	0.0	20.6	0.0	0	0	0.0	0.0	18	1.06	
BH05	10/09/19 13:31:15			0.0	0.0	20.7	0.0	0	0	0.0				
BH05	10/09/19 13:31:30			0.0	0.0	20.7	0.0	0	0	0.0				
BH05	10/09/19 13:31:45			0.0	0.0	20.7	0.0	0	0	0.0				
BH05	10/09/19 13:32:00			0.0	0.0	20.7	0.0	0	0	0.0				
BH05	10/09/19 13:33:00													
BH05	10/09/19 13:34:00													
BH05	10/09/19 13:35:00													
BH05	10/09/19 13:36:00													
BH05	23/09/19 12:10:15			0.0	0.0	20.9	0.0	0	0	0.0				
BH05	23/09/19 12:10:30			0.0	0.0	20.9	0.0	0	0	0.0				
BH05	23/09/19 12:10:45			0.0	0.0	20.9	0.0	0	0	0.0				
BH05	23/09/19 12:11:00			0.0	0.0	20.9	0.0	0	0	0.0				
BH05	23/09/19 12:11:15			0.0	0.0	20.9	0.0	0	0	0.0				
BH05	23/09/19 12:11:30			0.0	0.0	20.9	0.0	0	0	0.0				
BH05	23/09/19 12:11:45			0.0	0.0	20.9	0.0	0	0	0.0				
BH05	23/09/19 12:12:00			0.0	0.0	20.9	0.0	0	0	0.0				
BH05	23/09/19 12:13:00										0.0			
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT 35338	CHECKED CT

Geotechnical Engineering Limited

# GAS AND GROUNDWATER LEVELS



CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH05	23/09/19 12:14:00	1012	0								0.0	17	1.13	
BH05	23/09/19 12:15:00										0.0			
BH05	23/09/19 12:16:00													
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT 35338	CHECKED CT

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH05	18/07/19 11:15:15	1011	0	0.0	0.0	18.6	0.0	0	0	25.1	0.0	18	1.40	
BH05	18/07/19 11:15:30			0.0	0.0	19.1	0.0	0	0	34.0				
BH05	18/07/19 11:15:45			0.0	0.0	19.5	0.0	0	0	56.5				
BH05	18/07/19 11:16:00			0.0	0.0	19.6	0.0	0	0	52.7				
BH05	18/07/19 11:16:15			0.0	0.0	19.7	0.0	0	0	51.4				
BH05	18/07/19 11:16:30			0.0	0.0	19.8	0.0	0	0	54.3				
BH05	18/07/19 11:16:45			0.0	0.0	19.9	0.0	0	0	52.4				
BH05	18/07/19 11:17:00			0.0	0.0	19.9	0.0	0	0	51.1				
BH05	18/07/19 11:18:00													
BH05	18/07/19 11:19:00													
BH05	18/07/19 11:20:00													
BH05	18/07/19 11:21:00													
BH05	31/07/19 13:42:15			0.0	0.0	20.5	0.0	0	0	3.0				
BH05	31/07/19 13:42:30			0.0	0.0	20.8	0.0	0	0	3.0				
BH05	31/07/19 13:42:45			0.0	0.0	21.0	0.0	0	0	2.8				
BH05	31/07/19 13:43:00			0.0	0.0	21.1	0.0	0	0	3.1				
BH05	31/07/19 13:43:15			0.0	0.0	21.1	0.0	0	0	4.2				
BH05	31/07/19 13:43:30			0.0	0.0	21.1	0.0	0	0	4.2				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH05	31/07/19 13:43:45	1014	0	0.0	0.0	21.1	0.0	0	0	4.5	0.0	21	1.21	
BH05	31/07/19 13:44:00			0.0	0.0	21.1	0.0	0	0	6.2				
BH05	31/07/19 13:45:00													
BH05	31/07/19 13:46:00													
BH05	31/07/19 13:47:00													
BH05	01/08/19 10:30:00													
BH05	14/08/19 12:33:15			0.0	0.0	20.5	0.0	0	0	1.9				
BH05	14/08/19 12:33:30			0.0	0.0	20.5	0.0	0	0	2.0				
BH05	14/08/19 12:33:45			0.0	0.0	20.4	0.0	0	0	1.9				
BH05	14/08/19 12:34:00			0.0	0.0	20.4	0.0	0	0	1.2				
BH05	14/08/19 12:34:15	1009	0	0.0	0.0	20.4	0.0	0	0	1.6	0.0	18	1.06	
BH05	14/08/19 12:34:30			0.0	0.0	20.4	0.0	0	0	1.6				
BH05	14/08/19 12:34:45			0.0	0.0	20.4	0.0	0	0	1.3				
BH05	14/08/19 12:35:00			0.0	0.0	20.4	0.0	0	0	1.4				
BH05	14/08/19 12:36:00													
BH05	14/08/19 12:37:00													
BH05	14/08/19 12:38:00													
BH05	14/08/19 12:39:00													
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH05	23/08/19 12:32:15	1022	8	0.0	0.0	21.5	0.0	0	0	1.9	1.5 1.9 1.7	20	0.93	Peak Flow 3.1l/hr
BH05	23/08/19 12:32:30			0.0	0.0	21.5	0.0	0	0	2.1				
BH05	23/08/19 12:32:45			0.0	0.0	21.5	0.0	0	0	2.2				
BH05	23/08/19 12:33:00			0.0	0.0	21.4	0.0	0	0	0.8				
BH05	23/08/19 12:33:15			0.0	0.0	21.4	0.0	0	0	0.8				
BH05	23/08/19 12:33:30			0.0	0.0	21.4	0.0	0	0	0.8				
BH05	23/08/19 12:33:45			0.0	0.0	21.4	0.0	0	0	0.7				
BH05	23/08/19 12:34:00			0.0	0.0	21.4	0.0	0	0	0.4				
BH05	23/08/19 12:35:00													
BH05	23/08/19 12:36:00													
BH05	23/08/19 12:37:00													
BH05	23/08/19 12:38:00													
BH05	27/08/19 00:00:00													
BH05	10/09/19 13:19:15			0.0	0.0	20.8	0.0	0	0	0.4				
BH05	10/09/19 13:19:30			0.0	0.0	20.7	0.0	0	0	0.4				
BH05	10/09/19 13:19:45			0.0	0.0	20.7	0.0	0	0	0.3				
BH05	10/09/19 13:20:00			0.0	0.0	20.7	0.0	0	0	0.2				
BH05	10/09/19 13:20:15			0.0	0.0	20.7	0.0	0	0	0.2				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH05	10/09/19 13:20:30	1017	0	0.0	0.0	20.7	0.0	0	0	0.2			1.20	
BH05	10/09/19 13:20:45			0.0	0.0	20.7	0.0	0	0	0.2				
BH05	10/09/19 13:21:00			0.0	0.0	20.7	0.0	0	0	0.2				
BH05	10/09/19 13:22:00										0.0			
BH05	10/09/19 13:23:00										0.0			
BH05	10/09/19 13:24:00										0.0			
BH05	10/09/19 13:25:00													
BH05	12/09/19 00:00:00													
BH05	23/09/19 12:00:15			0.2	0.0	20.5	0.0	0	0	0.2				
BH05	23/09/19 12:00:30			0.0	0.0	20.8	0.0	0	0	0.1				
BH05	23/09/19 12:00:45			0.0	0.0	20.8	0.0	0	0	0.1				
BH05	23/09/19 12:01:00			0.0	0.0	20.8	0.0	0	0	0.0				
BH05	23/09/19 12:01:15			0.0	0.0	20.8	0.0	0	0	0.0				
BH05	23/09/19 12:01:30			0.0	0.0	20.8	0.0	0	0	0.0				
BH05	23/09/19 12:01:45			0.0	0.0	20.8	0.0	0	0	0.0				
BH05	23/09/19 12:02:00			0.0	0.0	20.8	0.0	0	0	0.0				
BH05	23/09/19 12:03:00										0.0			
BH05	23/09/19 12:04:00										0.0			
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338	



Geotechnical Engineering Limited

# GAS AND GROUNDWATER LEVELS



CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH05	23/09/19 12:05:00										0.0			
BH05	23/09/19 12:06:00	1012	0									17	1.25	
<div>remarks</div> <div># denotes result exceeding capacity of gas monitoring equipment</div> <div>VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.</div> <div>50mm standpipe</div>													<div>CONTRACT</div> <div>35338</div>	<div>CHECKED</div> <div>CT</div>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH06	18/07/19 14:15:15	1010	0	1.1	0.0	19.0	0.0	0	0	0.6	0.0	21		Water depth not recorded.
BH06	18/07/19 14:15:30			1.1	0.0	19.0	0.0	0	0	0.6				
BH06	18/07/19 14:15:45			1.1	0.0	18.9	0.0	0	0	0.6				
BH06	18/07/19 14:16:00			1.1	0.0	18.9	0.0	0	0	0.6				
BH06	18/07/19 14:16:15			1.1	0.0	18.9	0.0	0	0	0.7				
BH06	18/07/19 14:16:30			1.1	0.0	18.9	0.0	0	0	0.7				
BH06	18/07/19 14:16:45			1.1	0.0	18.8	0.0	0	0	0.7				
BH06	18/07/19 14:17:00			1.1	0.0	18.8	0.0	0	0	0.8				
BH06	18/07/19 14:18:00													
BH06	18/07/19 14:19:00													
BH06	18/07/19 14:20:00													
BH06	18/07/19 14:21:00													
BH06	01/08/19 12:00:15			1.7	0.0	14.2	0.0	0	0	0.8				
BH06	01/08/19 12:00:30			1.8	0.0	13.4	0.0	0	0	0.8				
BH06	01/08/19 12:00:45			1.8	0.0	12.9	0.0	0	0	0.7				
BH06	01/08/19 12:01:00			1.9	0.0	12.3	0.0	0	0	0.7				
BH06	01/08/19 12:01:15			1.9	0.0	11.8	0.0	0	0	0.6				
BH06	01/08/19 12:01:30			2.2	0.0	11.4	0.0	0	0	0.5				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH06	01/08/19 12:01:45	1021	0	2.2	0.0	11.4	0.0	0	0	0.5				
BH06	01/08/19 12:02:00			2.2	0.0	11.4	0.0	0	0	0.5				
BH06	01/08/19 12:03:00										0.0			
BH06	01/08/19 12:04:00										0.0			
BH06	01/08/19 12:05:00										0.0			
BH06	01/08/19 12:06:00											22	1.39	
BH06	14/08/19 16:05:15			2.0	0.0	20.6	0.0	0	0	0.0				
BH06	14/08/19 16:05:30			2.0	0.0	20.5	0.0	0	0	0.0				
BH06	14/08/19 16:05:45			2.0	0.0	18.9	0.0	0	0	0.0				
BH06	14/08/19 16:06:00			2.1	0.0	13.1	0.0	0	0	0.0				
BH06	14/08/19 16:06:15			2.2	0.0	12.4	0.0	0	0	0.0				
BH06	14/08/19 16:06:30			2.2	0.0	12.2	0.0	0	0	0.0				
BH06	14/08/19 16:06:45			2.2	0.0	12.2	0.0	0	0	0.0				
BH06	14/08/19 16:07:00			2.2	0.0	12.2	0.0	0	0	0.0				
BH06	14/08/19 16:08:00										3.0			
BH06	14/08/19 16:09:00										3.0			
BH06	14/08/19 16:10:00										3.0			
BH06	14/08/19 16:11:00	1008	11									18	0.90	
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT <b>35338</b>	CHECKED <b>CT</b>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH06	23/08/19 15:35:15	1023	0	0.0	0.0	21.7	0.0	0	0	0.1	0.0	24	0.63	
BH06	23/08/19 15:35:30			0.0	0.0	21.7	0.0	0	0	0.1				
BH06	23/08/19 15:35:45			0.0	0.0	21.7	0.0	0	0	0.1				
BH06	23/08/19 15:36:00			0.0	0.0	21.7	0.0	0	0	0.0				
BH06	23/08/19 15:36:15			0.0	0.0	21.7	0.0	0	0	0.0				
BH06	23/08/19 15:36:30			0.0	0.0	21.7	0.0	0	0	0.0				
BH06	23/08/19 15:36:45			0.0	0.0	21.7	0.0	0	0	0.0				
BH06	23/08/19 15:37:00			0.0	0.0	21.7	0.0	0	0	0.0				
BH06	23/08/19 15:38:00													
BH06	23/08/19 15:39:00													
BH06	23/08/19 15:40:00													
BH06	23/08/19 15:41:00													
BH06	11/09/19 14:55:15			0.8	0.0	19.6	0.0	0	0	0.1				
BH06	11/09/19 14:55:30			2.3	0.0	17.0	0.0	0	0	0.1				
BH06	11/09/19 14:55:45			3.4	0.0	15.3	0.0	0	0	0.1				
BH06	11/09/19 14:56:00			3.6	0.0	14.8	0.0	0	0	0.1				
BH06	11/09/19 14:56:15			3.6	0.0	14.7	0.0	0	0	0.1				
BH06	11/09/19 14:56:30			3.7	0.0	14.6	0.0	0	0	0.0				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH06	11/09/19 14:56:45	1018	0	3.7	0.0	14.5	0.0	0	0	0.0	0.0	19	0.84	
BH06	11/09/19 14:57:00			3.7	0.0	14.5	0.0	0	0	0.0				
BH06	11/09/19 14:58:00													
BH06	11/09/19 14:59:00													
BH06	11/09/19 15:00:00													
BH06	11/09/19 15:01:00													
BH06	24/09/19 14:10:15			0.3	0.0	20.5	0.0	0	0	0.0				
BH06	24/09/19 14:10:30			0.2	0.0	20.6	0.0	0	0	0.0				
BH06	24/09/19 14:10:45			0.1	0.0	20.7	0.0	0	0	0.0				
BH06	24/09/19 14:11:00			0.1	0.0	20.8	0.0	0	0	0.0				
BH06	24/09/19 14:11:15	1001	0	0.1	0.0	20.9	0.0	0	0	0.0	0.0	18	0.58	
BH06	24/09/19 14:11:30			0.0	0.0	20.9	0.0	0	0	0.0				
BH06	24/09/19 14:11:45			0.0	0.0	20.9	0.0	0	0	0.0				
BH06	24/09/19 14:12:00			0.0	0.0	20.9	0.0	0	0	0.0				
BH06	24/09/19 14:13:00													
BH06	24/09/19 14:14:00													
BH06	24/09/19 14:15:00													
BH06	24/09/19 14:16:00													
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH06	18/07/19 13:42:15	1010	0	0.3	0.1	17.9	0.0	0	0	15.4	0.0	21	1.63	
BH06	18/07/19 13:42:30			0.3	0.0	19.4	0.0	0	0	17.1				
BH06	18/07/19 13:42:45			0.3	0.0	19.3	0.0	0	0	17.4				
BH06	18/07/19 13:43:00			0.3	0.0	19.6	0.0	0	0	16.7				
BH06	18/07/19 13:43:15			0.3	0.0	19.7	0.0	0	0	16.6				
BH06	18/07/19 13:43:30			0.3	0.0	19.8	0.0	0	0	16.5				
BH06	18/07/19 13:43:45			0.3	0.0	19.8	0.0	0	0	16.2				
BH06	18/07/19 13:44:00			0.3	0.0	19.9	0.0	0	0	15.7				
BH06	18/07/19 13:45:00													
BH06	18/07/19 13:46:00													
BH06	18/07/19 13:47:00													
BH06	18/07/19 13:48:00													
BH06	01/08/19 12:10:15			0.9	0.0	19.2	0.0	0	0	18.7				
BH06	01/08/19 12:10:30			0.7	0.0	20.0	0.0	0	0	19.4				
BH06	01/08/19 12:10:45			0.7	0.0	20.1	0.0	0	0	20.1				
BH06	01/08/19 12:11:00			0.7	0.0	20.2	0.0	0	0	20.4				
BH06	01/08/19 12:11:15			0.7	0.0	20.2	0.0	0	0	19.8				
BH06	01/08/19 12:11:30			0.7	0.0	20.4	0.0	0	0	19.6				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338	CHECKED CT

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH06	01/08/19 12:11:45	1021	-1	0.7	0.0	20.4	0.0	0	0	18.9				
BH06	01/08/19 12:12:00			0.6	0.0	20.4	0.0	0	0	18.8				
BH06	01/08/19 12:13:00										0.0			
BH06	01/08/19 12:14:00										-0.1			
BH06	01/08/19 12:15:00										0.0			
BH06	01/08/19 12:16:00											22	1.42	
BH06	14/08/19 15:57:15			0.0	0.0	20.4	0.0	0	0	1.1				
BH06	14/08/19 15:57:30			0.0	0.0	20.4	0.0	0	0	1.0				
BH06	14/08/19 15:57:45			0.0	0.0	20.4	0.0	0	0	0.9				
BH06	14/08/19 15:58:00			0.0	0.0	20.4	0.0	0	0	0.7				
BH06	14/08/19 15:58:15			0.0	0.0	20.4	0.0	0	0	0.6				
BH06	14/08/19 15:58:30			0.0	0.0	20.4	0.0	0	0	0.6				
BH06	14/08/19 15:58:45			0.0	0.0	20.4	0.0	0	0	0.7				
BH06	14/08/19 15:59:00			0.0	0.0	20.4	0.0	0	0	0.6				
BH06	14/08/19 16:00:00										3.0			
BH06	14/08/19 16:01:00										3.0			
BH06	14/08/19 16:02:00										3.0			
BH06	14/08/19 16:03:00	1008	11									18	1.21	
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT <b>35338</b>	CHECKED <b>CT</b>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks		
BH06	23/08/19 15:26:15	1022	0	0.1	0.0	20.7	0.0	0	0	0.9	0.0	24	0.91			
BH06	23/08/19 15:26:30			0.1	0.0	20.9	0.0	0	0	0.8						
BH06	23/08/19 15:26:45			0.1	0.0	20.9	0.0	0	0	0.7						
BH06	23/08/19 15:27:00			0.0	0.0	21.2	0.0	0	0	0.6						
BH06	23/08/19 15:27:15			0.0	0.0	21.2	0.0	0	0	0.5						
BH06	23/08/19 15:27:30			0.0	0.0	21.2	0.0	0	0	0.4						
BH06	23/08/19 15:27:45			0.0	0.0	21.3	0.0	0	0	0.4						
BH06	23/08/19 15:28:00			0.0	0.0	21.3	0.0	0	0	0.4						
BH06	23/08/19 15:29:00															
BH06	23/08/19 15:30:00															
BH06	23/08/19 15:31:00															
BH06	23/08/19 15:32:00															
BH06	27/08/19 00:00:00															
BH06	11/09/19 14:47:15					0.2	0.0	19.8	0.0	0					0	0.3
BH06	11/09/19 14:47:30					0.0	0.0	20.5	0.0	0					0	0.2
BH06	11/09/19 14:47:45					0.0	0.0	20.6	0.0	0					0	0.2
BH06	11/09/19 14:48:00					0.0	0.0	20.6	0.0	0					0	0.2
BH06	11/09/19 14:48:15					0.0	0.0	20.7	0.0	0					0	0.2
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe															CONTRACT 35338	CHECKED CT



**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks		
BH06	11/09/19 14:48:30	1018	0	0.0	0.0	20.7	0.0	0	0	0.2			1.06			
BH06	11/09/19 14:48:45			0.0	0.0	20.7	0.0	0	0	0.1						
BH06	11/09/19 14:49:00			0.0	0.0	20.7	0.0	0	0	0.1						
BH06	11/09/19 14:50:00														0.0	
BH06	11/09/19 14:51:00														0.0	
BH06	11/09/19 14:52:00														0.0	
BH06	11/09/19 14:53:00															
BH06	12/09/19 00:00:00															
BH06	24/09/19 14:00:15					0.2	0.0	20.9	0.0	0	0	0.8				
BH06	24/09/19 14:00:30					0.2	0.0	20.9	0.0	0	0	0.7				
BH06	24/09/19 14:00:45					0.2	0.0	20.9	0.0	0	0	0.7				
BH06	24/09/19 14:01:00					0.2	0.0	20.9	0.0	0	0	0.6				
BH06	24/09/19 14:01:15					0.2	0.0	20.9	0.0	0	0	0.6				
BH06	24/09/19 14:01:30					0.2	0.0	20.9	0.0	0	0	0.5				
BH06	24/09/19 14:01:45					0.2	0.0	20.9	0.0	0	0	0.5				
BH06	24/09/19 14:02:00					0.2	0.0	20.9	0.0	0	0	0.5				
BH06	24/09/19 14:03:00												0.0			
BH06	24/09/19 14:04:00												0.0			
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338		CHECKED CT	

Geotechnical Engineering Limited

# GAS AND GROUNDWATER LEVELS



CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH06	24/09/19 14:05:00										0.0			
BH06	24/09/19 14:06:00	1001	0									18	0.93	
<div>remarks</div> <div># denotes result exceeding capacity of gas monitoring equipment</div> <div>VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.</div> <div>50mm standpipe</div>													<div>CONTRACT</div> <div>35338</div>	<div>CHECKED</div> <div>CT</div>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH07	17/07/19 15:30:15	1009	0	1.2	0.0	19.2	0.0	0	0	1.0	0.0	22	1.35	
BH07	17/07/19 15:30:30			1.8	0.0	18.7	0.0	0	0	1.0				
BH07	17/07/19 15:30:45			1.8	0.0	18.7	0.0	0	0	0.6				
BH07	17/07/19 15:31:00			1.8	0.0	18.7	0.0	0	0	0.5				
BH07	17/07/19 15:31:15			1.8	0.0	18.7	0.0	0	0	0.8				
BH07	17/07/19 15:31:30			1.8	0.0	18.7	0.0	0	0	0.9				
BH07	17/07/19 15:31:45			1.8	0.0	18.7	0.0	0	0	0.7				
BH07	17/07/19 15:32:00			1.8	0.0	18.7	0.0	0	0	0.5				
BH07	17/07/19 15:33:00													
BH07	17/07/19 15:34:00													
BH07	17/07/19 15:35:00													
BH07	17/07/19 15:36:00													
BH07	31/07/19 12:00:15			2.0	0.0	19.4	0.0	0	0	0.2				
BH07	31/07/19 12:00:30			2.0	0.0	19.3	0.0	0	0	0.2				
BH07	31/07/19 12:00:45			2.0	0.0	19.3	0.0	0	0	0.2				
BH07	31/07/19 12:01:00			2.0	0.0	19.3	0.0	0	0	0.2				
BH07	31/07/19 12:01:15			2.0	0.0	19.1	0.0	0	0	0.2				
BH07	31/07/19 12:01:30			2.0	0.0	19.1	0.0	0	0	0.2				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT 35338	CHECKED CT

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH07	31/07/19 12:01:45	1014	0	2.0	0.0	19.1	0.0	0	0	0.2				
BH07	31/07/19 12:02:00			2.0	0.0	19.1	0.0	0	0	0.2				
BH07	31/07/19 12:03:00										0.0			
BH07	31/07/19 12:04:00										0.0			
BH07	31/07/19 12:05:00										0.0			
BH07	31/07/19 12:06:00											21	1.13	
BH07	14/08/19 10:45:15			2.8	0.0	20.7	0.0	0	0	0.2				
BH07	14/08/19 10:45:30			2.8	0.0	19.4	0.0	0	0	0.1				
BH07	14/08/19 10:45:45			2.7	0.0	18.7	0.0	0	0	0.1				
BH07	14/08/19 10:46:00			2.7	0.0	17.2	0.0	0	0	0.1				
BH07	14/08/19 10:46:15			2.7	0.0	17.2	0.0	0	0	0.1				
BH07	14/08/19 10:46:30			2.7	0.0	17.2	0.0	0	0	0.1				
BH07	14/08/19 10:46:45			2.7	0.0	17.2	0.0	0	0	0.1				
BH07	14/08/19 10:47:00			2.7	0.0	17.2	0.0	0	0	0.1				
BH07	14/08/19 10:48:00										0.0			
BH07	14/08/19 10:49:00										0.0			
BH07	14/08/19 10:50:00										0.0			
BH07	14/08/19 10:51:00	1009	-28									15	0.75	
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT <b>35338</b>	CHECKED <b>CT</b>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH07	23/08/19 11:20:15	1026	0	0.0	0.0	21.3	0.0	0	0	0.0	0.0	20	0.88	
BH07	23/08/19 11:20:30			0.0	0.0	21.3	0.0	0	0	0.0				
BH07	23/08/19 11:20:45			0.0	0.0	21.3	0.0	0	0	0.0				
BH07	23/08/19 11:21:00			0.0	0.0	21.3	0.0	0	0	0.0				
BH07	23/08/19 11:21:15			0.0	0.0	21.3	0.0	0	0	0.0				
BH07	23/08/19 11:21:30			0.0	0.0	21.3	0.0	0	0	0.0				
BH07	23/08/19 11:21:45			0.0	0.0	21.3	0.0	0	0	0.0				
BH07	23/08/19 11:22:00			0.0	0.0	21.3	0.0	0	0	0.0				
BH07	23/08/19 11:23:00													
BH07	23/08/19 11:24:00													
BH07	23/08/19 11:25:00													
BH07	23/08/19 11:26:00													
BH07	10/09/19 11:45:15			4.1	0.0	17.1	0.0	0	0	0.0				
BH07	10/09/19 11:45:30			4.1	0.0	17.1	0.0	0	0	0.0				
BH07	10/09/19 11:45:45			4.0	0.0	17.1	0.0	0	0	0.0				
BH07	10/09/19 11:46:00			4.0	0.0	17.1	0.0	0	0	0.0				
BH07	10/09/19 11:46:15			4.0	0.0	17.1	0.0	0	0	0.0				
BH07	10/09/19 11:46:30			3.9	0.0	17.2	0.0	0	0	0.0				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH07	10/09/19 11:46:45	1018	0	3.9	0.0	17.2	0.0	0	0	0.0				
BH07	10/09/19 11:47:00			3.8	0.0	17.2	0.0	0	0	0.0				
BH07	10/09/19 11:48:00										0.0			
BH07	10/09/19 11:49:00										0.0			
BH07	10/09/19 11:50:00										0.0			
BH07	10/09/19 11:51:00											17	1.03	
BH07	23/09/19 10:45:15	1011	0	3.7	0.0	18.6	0.0	0	0	0.0				
BH07	23/09/19 10:45:30			4.1	0.0	18.3	0.0	0	0	0.0				
BH07	23/09/19 10:45:45			4.1	0.0	18.3	0.0	0	0	0.0				
BH07	23/09/19 10:46:00			4.1	0.0	18.3	0.0	0	0	0.0				
BH07	23/09/19 10:46:15			4.1	0.0	18.3	0.0	0	0	0.0				
BH07	23/09/19 10:46:30			4.0	0.0	18.3	0.0	0	0	0.0				
BH07	23/09/19 10:46:45			3.8	0.0	18.4	0.0	0	0	0.0				
BH07	23/09/19 10:47:00			3.8	0.0	18.4	0.0	0	0	0.0				
BH07	23/09/19 10:48:00										0.0			
BH07	23/09/19 10:49:00										0.0			
BH07	23/09/19 10:50:00										0.0			
BH07	23/09/19 10:51:00											17	1.04	
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT 35338	

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH07	17/07/19 15:05:15			0.4	0.0	19.9	0.0	0	0	10.0				
BH07	17/07/19 15:05:30			0.5	0.0	19.5	0.0	0	0	10.5				
BH07	17/07/19 15:05:45			0.5	0.0	19.5	0.0	0	0	11.2				
BH07	17/07/19 15:06:00			0.5	0.0	19.5	0.0	0	0	11.4				
BH07	17/07/19 15:06:15			0.5	0.0	19.4	0.0	0	0	11.4				
BH07	17/07/19 15:06:30			0.5	0.0	19.4	0.0	0	0	11.6				
BH07	17/07/19 15:06:45			0.5	0.0	19.3	0.0	0	0	11.6				
BH07	17/07/19 15:07:00			0.5	0.0	19.3	0.0	0	0	11.9				
BH07	17/07/19 15:08:00										-15.5			
BH07	17/07/19 15:09:00										-10.2			
BH07	17/07/19 15:10:00										-9.4			
BH07	17/07/19 15:11:00												1.29	
BH07	31/07/19 11:47:15			0.3	0.0	20.9	0.0	0	0	102.8				
BH07	31/07/19 11:47:30			0.3	0.0	20.9	0.0	0	0	119.8				
BH07	31/07/19 11:47:45			0.2	0.0	20.9	0.0	0	0	144.8				
BH07	31/07/19 11:48:00			0.2	0.0	20.9	0.0	0	0	140.3				
BH07	31/07/19 11:48:15			0.2	0.0	20.9	0.0	0	0	135.9				
BH07	31/07/19 11:48:30			0.2	0.0	20.9	0.0	0	0	123.4				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT <b>35338</b>	CHECKED <b>CT</b>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH07	31/07/19 11:48:45	1015	0	0.2	0.0	20.9	0.0	0	0	110.6	0.0	21	1.03	
BH07	31/07/19 11:49:00			0.2	0.0	20.9	0.0	0	0	112.3				
BH07	31/07/19 11:50:00													
BH07	31/07/19 11:51:00													
BH07	31/07/19 11:52:00													
BH07	14/08/19 10:34:15			0.0	0.0	20.4	0.0	0	0	0.8				
BH07	14/08/19 10:34:30			0.1	0.0	20.3	0.0	0	0	1.0				
BH07	14/08/19 10:34:45			0.1	0.0	20.3	0.0	0	0	1.1				
BH07	14/08/19 10:35:00			0.2	0.0	20.2	0.0	0	0	1.0				
BH07	14/08/19 10:35:15			0.3	0.0	20.2	0.0	0	0	1.0				
BH07	14/08/19 10:35:30	1009	-28	0.4	0.0	20.1	0.0	0	0	1.0	-5.4	15	1.05	
BH07	14/08/19 10:35:45			0.4	0.0	20.1	0.0	0	0	0.9				
BH07	14/08/19 10:36:00			0.4	0.0	20.0	0.0	0	0	0.8				
BH07	14/08/19 10:37:00													
BH07	14/08/19 10:38:00													
BH07	14/08/19 10:39:00													
BH07	14/08/19 10:40:00													
BH07	23/08/19 11:11:15			0.1	0.0	21.3	0.0	0	0	0.2				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe														



**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH07	23/08/19 11:11:30	1027	0	0.1	0.0	21.3	0.0	0	0	0.1	0.0	20	1.00	
BH07	23/08/19 11:11:45			0.1	0.0	21.3	0.0	0	0	0.0				
BH07	23/08/19 11:12:00			0.1	0.0	21.2	0.0	0	0	0.0				
BH07	23/08/19 11:12:15			0.1	0.0	21.2	0.0	0	0	0.0				
BH07	23/08/19 11:12:30			0.1	0.0	21.2	0.0	0	0	0.0				
BH07	23/08/19 11:12:45			0.1	0.0	21.2	0.0	0	0	0.0				
BH07	23/08/19 11:13:00			0.1	0.0	21.2	0.0	0	0	0.0				
BH07	23/08/19 11:14:00													
BH07	23/08/19 11:15:00													
BH07	23/08/19 11:16:00													
BH07	23/08/19 11:17:00													
BH07	23/08/19 11:18:00													
BH07	27/08/19 00:00:00													
BH07	10/09/19 11:36:15			0.3	0.0	20.1	0.0	0	0	0.8				
BH07	10/09/19 11:36:30			0.3	0.0	20.6	0.0	0	0	0.5				
BH07	10/09/19 11:36:45			0.3	0.0	20.6	0.0	0	0	0.5				
BH07	10/09/19 11:37:00			0.3	0.0	20.5	0.0	0	0	0.5				
BH07	10/09/19 11:37:15			0.3	0.0	20.5	0.0	0	0	0.4				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338	CHECKED CT

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks	
BH07	10/09/19 11:37:30	1018	-277	0.5	0.0	20.5	0.0	0	0	0.4					
BH07	10/09/19 11:37:45			0.5	0.0	20.6	0.0	0	0	0.2					
BH07	10/09/19 11:38:00			0.5	0.0	20.6	0.0	0	0	0.2					
BH07	10/09/19 11:39:00										-17.1				
BH07	10/09/19 11:40:00										-12.0				
BH07	10/09/19 11:41:00										-9.1				
BH07	10/09/19 11:42:00														
BH07	10/09/19 11:43:00														
BH07	12/09/19 00:00:00														
BH07	23/09/19 10:33:15					0.0	0.0	21.2	0.0	0	0	0.0			
BH07	23/09/19 10:33:30					0.0	0.0	21.2	0.0	0	0	0.0			
BH07	23/09/19 10:33:45					0.0	0.0	21.0	0.0	0	0	0.0			
BH07	23/09/19 10:34:00					0.0	0.0	21.1	0.0	0	0	0.0			
BH07	23/09/19 10:34:15					0.0	0.0	21.1	0.0	0	0	0.0			
BH07	23/09/19 10:34:30					0.0	0.0	21.1	0.0	0	0	0.0			
BH07	23/09/19 10:34:45					0.0	0.0	21.1	0.0	0	0	0.0			
BH07	23/09/19 10:35:00					0.0	0.0	21.1	0.0	0	0	0.0			
BH07	23/09/19 10:36:00												0.0		
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338		CHECKED CT

Geotechnical Engineering Limited

# GAS AND GROUNDWATER LEVELS



CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH07	23/09/19 10:37:00	1011	0								0.0	17	1.06	
BH07	23/09/19 10:38:00										0.0			
BH07	23/09/19 10:39:00													
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338	CHECKED CT

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH08	17/07/19 13:45:15	1013	0	0.0	0.0	20.3	0.0	0	0	37.0	0.0	23	1.39	
BH08	17/07/19 13:45:30			0.0	0.0	20.2	0.0	0	0	14.3				
BH08	17/07/19 13:45:45			0.0	0.0	20.2	0.0	0	0	18.4				
BH08	17/07/19 13:46:00			0.0	0.0	20.2	0.0	0	0	21.1				
BH08	17/07/19 13:46:15			0.0	0.0	20.2	0.0	0	0	22.4				
BH08	17/07/19 13:46:30			0.0	0.0	20.2	0.0	0	0	24.0				
BH08	17/07/19 13:46:45			0.0	0.0	20.2	0.0	0	0	23.4				
BH08	17/07/19 13:47:00			0.0	0.0	20.2	0.0	0	0	23.4				
BH08	17/07/19 13:48:00													
BH08	17/07/19 13:49:00													
BH08	17/07/19 13:50:00													
BH08	17/07/19 13:51:00													
BH08	31/07/19 12:00:15			2.6	0.0	18.3	0.0	0	0	8.9				
BH08	31/07/19 12:00:30			2.6	0.0	18.2	0.0	0	0	6.7				
BH08	31/07/19 12:00:45			2.7	0.0	18.1	0.0	0	0	6.3				
BH08	31/07/19 12:01:00			2.8	0.0	18.0	0.0	0	0	5.6				
BH08	31/07/19 12:01:15			2.8	0.0	18.2	0.0	0	0	5.1				
BH08	31/07/19 12:01:30			2.7	0.0	18.2	0.0	0	0	4.1				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH08	31/07/19 12:01:45	1014	0	2.7	0.0	18.3	0.0	0	0	3.1				
BH08	31/07/19 12:02:00			2.6	0.0	18.3	0.0	0	0	2.2				
BH08	31/07/19 12:03:00										0.0			
BH08	31/07/19 12:04:00										0.0			
BH08	31/07/19 12:05:00										0.0			
BH08	31/07/19 12:06:00											19	0.85	
BH08	14/08/19 12:00:15			0.0	0.0	20.4	0.0	0	0	0.3				
BH08	14/08/19 12:00:30			0.0	0.0	20.4	0.0	0	0	0.3				
BH08	14/08/19 12:00:45			0.0	0.0	20.4	0.0	0	0	0.3				
BH08	14/08/19 12:01:00			0.0	0.0	20.4	0.0	0	0	0.3				
BH08	14/08/19 12:01:15			0.0	0.0	20.4	0.0	0	0	0.3				
BH08	14/08/19 12:01:30			0.0	0.0	20.4	0.0	0	0	0.3				
BH08	14/08/19 12:01:45			0.0	0.0	20.4	0.0	0	0	0.3				
BH08	14/08/19 12:02:00			0.0	0.0	20.4	0.0	0	0	0.3				
BH08	14/08/19 12:03:00										0.0			
BH08	14/08/19 12:04:00										0.3			
BH08	14/08/19 12:05:00										0.0			
BH08	14/08/19 12:06:00	1009	0									15	1.17	
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT <b>35338</b>	CHECKED <b>CT</b>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH08	23/08/19 11:45:15	1025	5	0.2	0.0	20.8	0.0	0	0	0.0	0.9 0.9 0.7	20	1.11	Peak Flow 1.7l/hr
BH08	23/08/19 11:45:30			0.1	0.0	21.0	0.0	0	0	0.0				
BH08	23/08/19 11:45:45			0.1	0.0	21.1	0.0	0	0	0.0				
BH08	23/08/19 11:46:00			0.0	0.0	21.1	0.0	0	0	0.0				
BH08	23/08/19 11:46:15			0.0	0.0	21.2	0.0	0	0	0.0				
BH08	23/08/19 11:46:30			0.0	0.0	21.2	0.0	0	0	0.0				
BH08	23/08/19 11:46:45			0.0	0.0	21.2	0.0	0	0	0.0				
BH08	23/08/19 11:47:00			0.0	0.0	21.2	0.0	0	0	0.0				
BH08	23/08/19 11:48:00													
BH08	23/08/19 11:49:00													
BH08	23/08/19 11:50:00													
BH08	23/08/19 11:51:00													
BH08	10/09/19 12:15:15			0.0	0.0	20.8	0.0	0	0	0.0				
BH08	10/09/19 12:15:30			0.0	0.0	20.8	0.0	0	0	0.0				
BH08	10/09/19 12:15:45			0.0	0.0	20.8	0.0	0	0	0.0				
BH08	10/09/19 12:16:00			0.0	0.0	20.8	0.0	0	0	0.0				
BH08	10/09/19 12:16:15			0.0	0.0	20.8	0.0	0	0	0.0				
BH08	10/09/19 12:16:30			0.0	0.0	20.8	0.0	0	0	0.0				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks		
BH08	10/09/19 12:16:45	1018	0	0.0	0.0	20.8	0.0	0	0	0.0						
BH08	10/09/19 12:17:00			0.0	0.0	20.8	0.0	0	0	0.0						
BH08	10/09/19 12:18:00										0.0					
BH08	10/09/19 12:19:00										0.0					
BH08	10/09/19 12:20:00										0.0					
BH08	10/09/19 12:21:00															
BH08	23/09/19 11:25:15					0.3	0.0	20.7	0.0	0	0	0.0				
BH08	23/09/19 11:25:30					0.2	0.0	20.9	0.0	0	0	0.0				
BH08	23/09/19 11:25:45					0.2	0.0	20.8	0.0	0	0	0.0				
BH08	23/09/19 11:26:00					0.3	0.0	20.8	0.0	0	0	0.0				
BH08	23/09/19 11:26:15			0.3	0.0	20.8	0.0	0	0	0.0						
BH08	23/09/19 11:26:30			0.3	0.0	20.8	0.0	0	0	0.0						
BH08	23/09/19 11:26:45			0.4	0.0	20.8	0.0	0	0	0.0						
BH08	23/09/19 11:27:00			0.4	0.0	20.8	0.0	0	0	0.0						
BH08	23/09/19 11:28:00										0.0					
BH08	23/09/19 11:29:00										0.0					
BH08	23/09/19 11:30:00										0.0					
BH08	23/09/19 11:31:00	1010	0									17	1.21			
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT 35338	CHECKED CT		

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH08	17/07/19 13:30:15	1014	-37	0.6	0.0	18.2	0.0	0	0	10.0	-6.6 -6.1 -6.0	23	1.42	
BH08	17/07/19 13:30:30			0.5	0.0	18.6	0.0	0	0	9.7				
BH08	17/07/19 13:30:45			0.3	0.0	18.8	0.0	0	0	9.2				
BH08	17/07/19 13:31:00			0.2	0.0	19.3	0.0	0	0	9.1				
BH08	17/07/19 13:31:15			0.2	0.0	19.8	0.0	0	0	9.0				
BH08	17/07/19 13:31:30			0.1	0.0	19.8	0.0	0	0	8.6				
BH08	17/07/19 13:31:45			0.1	0.0	19.8	0.0	0	0	8.4				
BH08	17/07/19 13:32:00			0.1	0.0	19.8	0.0	0	0	8.1				
BH08	17/07/19 13:33:00													
BH08	17/07/19 13:34:00													
BH08	17/07/19 13:35:00													
BH08	17/07/19 13:36:00													
BH08	31/07/19 12:24:15			0.0	0.0	21.2	0.0	0	0	3.0				
BH08	31/07/19 12:24:30			0.0	0.0	21.2	0.0	0	0	3.0				
BH08	31/07/19 12:24:45			0.0	0.0	21.2	0.0	0	0	3.0				
BH08	31/07/19 12:25:00			0.0	0.0	21.2	0.0	0	0	2.7				
BH08	31/07/19 12:25:15			0.0	0.0	21.2	0.0	0	0	2.5				
BH08	31/07/19 12:25:30			0.0	0.0	21.2	0.0	0	0	2.3				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338	CHECKED CT



**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH08	31/07/19 12:25:45	1014	0	0.0	0.0	21.2	0.0	0	0	1.9				
BH08	31/07/19 12:26:00			0.0	0.0	21.2	0.0	0	0	1.7				
BH08	31/07/19 12:27:00										0.0			
BH08	31/07/19 12:28:00										0.0			
BH08	31/07/19 12:29:00											21	1.29	
BH08	01/08/19 09:00:00													
BH08	14/08/19 11:48:15			0.0	0.0	20.6	0.0	0	0	1.4				
BH08	14/08/19 11:48:30			0.0	0.0	20.4	0.0	0	0	1.3				
BH08	14/08/19 11:48:45			0.0	0.0	20.4	0.0	0	0	1.2				
BH08	14/08/19 11:49:00			0.0	0.0	20.5	0.0	0	0	1.1				
BH08	14/08/19 11:49:15			0.0	0.0	20.4	0.0	0	0	0.9				
BH08	14/08/19 11:49:30			0.0	0.0	20.4	0.0	0	0	0.9				
BH08	14/08/19 11:49:45			0.0	0.0	20.4	0.0	0	0	0.9				
BH08	14/08/19 11:50:00			0.0	0.0	20.4	0.0	0	0	0.9				
BH08	14/08/19 11:51:00										-4.5			
BH08	14/08/19 11:52:00										-3.7			
BH08	14/08/19 11:53:00										-3.5			
BH08	14/08/19 11:54:00	1009	-26									15	1.20	
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT <b>35338</b>	CHECKED <b>CT</b>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH08	23/08/19 11:35:15	1026	0	0.0	0.0	21.5	0.0	0	0	0.9	0.0	20	1.09	
BH08	23/08/19 11:35:30			0.0	0.0	21.4	0.0	0	0	1.9				
BH08	23/08/19 11:35:45			0.0	0.0	21.3	0.0	0	0	1.9				
BH08	23/08/19 11:36:00			0.0	0.0	21.3	0.0	0	0	2.0				
BH08	23/08/19 11:36:15			0.0	0.0	21.3	0.0	0	0	2.2				
BH08	23/08/19 11:36:30			0.0	0.0	21.3	0.0	0	0	2.4				
BH08	23/08/19 11:36:45			0.0	0.0	21.3	0.0	0	0	2.4				
BH08	23/08/19 11:37:00			0.0	0.0	21.3	0.0	0	0	2.4				
BH08	23/08/19 11:38:00													
BH08	23/08/19 11:39:00													
BH08	23/08/19 11:40:00													
BH08	23/08/19 11:41:00													
BH08	27/08/19 00:00:00													
BH08	10/09/19 12:07:15			0.5	0.0	20.5	0.0	0	0	0.0				
BH08	10/09/19 12:07:30			0.4	0.0	20.6	0.0	0	0	0.0				
BH08	10/09/19 12:07:45			0.2	0.0	20.8	0.0	0	0	0.0				
BH08	10/09/19 12:08:00			0.1	0.0	20.9	0.0	0	0	0.0				
BH08	10/09/19 12:08:15			0.0	0.0	20.9	0.0	0	0	0.0				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks						
BH08	10/09/19 12:08:30	1018	0	0.0	0.0	20.9	0.0	0	0	0.0	0.0	18	1.18							
BH08	10/09/19 12:08:45			0.0	0.0	20.9	0.0	0	0	0.0										
BH08	10/09/19 12:09:00			0.0	0.0	20.9	0.0	0	0	0.0										
BH08	10/09/19 12:10:00																			
BH08	10/09/19 12:11:00																			
BH08	10/09/19 12:12:00																			
BH08	10/09/19 12:13:00																			
BH08	12/09/19 00:00:00																			
BH08	23/09/19 11:16:15			0.0	0.0	21.2	0.0	0	0	0.0										
BH08	23/09/19 11:16:30			0.0	0.0	21.1	0.0	0	0	0.0										
BH08	23/09/19 11:16:45			0.0	0.0	21.1	0.0	0	0	0.0										
BH08	23/09/19 11:17:00			0.0	0.0	21.1	0.0	0	0	0.0										
BH08	23/09/19 11:17:15			0.0	0.0	21.1	0.0	0	0	0.0										
BH08	23/09/19 11:17:30			0.0	0.0	21.1	0.0	0	0	0.0										
BH08	23/09/19 11:17:45			0.0	0.0	21.1	0.0	0	0	0.0										
BH08	23/09/19 11:18:00			0.0	0.0	21.1	0.0	0	0	0.0										
BH08	23/09/19 11:19:00																			
BH08	23/09/19 11:20:00																			
remarks															CONTRACT 35338	CHECKED CT				
# denotes result exceeding capacity of gas monitoring equipment																				
VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe																				

Geotechnical Engineering Limited

# GAS AND GROUNDWATER LEVELS



CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH08	23/09/19 11:21:00										-0.6			
BH08	23/09/19 11:22:00	1010	-4									17	1.21	
<div>remarks</div> <div># denotes result exceeding capacity of gas monitoring equipment</div> <div>VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.</div> <div>50mm standpipe</div>													<div>CONTRACT</div> <div>35338</div>	<div>CHECKED</div> <div>CT</div>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH09	17/07/19 12:15:15	1014	0	9.7	0.0	1.0	0.0	0	0	12.8	0.0	23	1.22	
BH09	17/07/19 12:15:30			9.7	0.0	1.0	0.0	0	0	15.6				
BH09	17/07/19 12:15:45			9.7	0.0	0.8	0.0	0	0	17.9				
BH09	17/07/19 12:16:00			9.7	0.0	0.3	0.0	0	0	18.4				
BH09	17/07/19 12:16:15			9.7	0.0	0.3	0.0	0	0	18.5				
BH09	17/07/19 12:16:30			9.8	0.0	0.3	0.0	0	0	18.5				
BH09	17/07/19 12:16:45			9.8	0.0	0.3	0.0	0	0	18.6				
BH09	17/07/19 12:17:00			9.8	0.0	0.3	0.0	0	0	18.4				
BH09	17/07/19 12:17:00													
BH09	17/07/19 12:17:00													
BH09	17/07/19 12:17:00													
BH09	17/07/19 12:17:00													
BH09	31/07/19 12:00:15			0.2	0.0	21.3	0.0	0	0	6.5				
BH09	31/07/19 12:00:30			2.4	0.0	18.1	0.0	0	0	5.3				
BH09	31/07/19 12:00:45			3.8	0.0	11.4	0.0	0	0	4.9				
BH09	31/07/19 12:01:00			5.8	0.0	6.8	0.0	0	0	4.2				
BH09	31/07/19 12:01:15			5.5	0.0	6.8	0.0	0	0	3.9				
BH09	31/07/19 12:01:30			5.2	0.0	6.8	0.0	0	0	3.8				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT 35338	CHECKED CT

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH09	31/07/19 12:01:45	1013	0	5.0	0.0	6.7	0.0	0	0	3.9	0.0	21	0.72	
BH09	31/07/19 12:02:00			4.8	0.0	6.7	0.0	0	0	4.0				
BH09	31/07/19 12:03:00													
BH09	31/07/19 12:04:00													
BH09	31/07/19 12:05:00													
BH09	14/08/19 12:14:15			0.0	0.0	20.5	0.0	0	0	0.5				
BH09	14/08/19 12:14:30			0.0	0.0	20.5	0.0	0	0	0.4				
BH09	14/08/19 12:14:45			0.0	0.0	20.5	0.0	0	0	0.4				
BH09	14/08/19 12:15:00			0.0	0.0	20.4	0.0	0	0	0.5				
BH09	14/08/19 12:15:15			0.0	0.0	20.4	0.0	0	0	0.4				
BH09	14/08/19 12:15:30	1009	0	0.0	0.0	20.4	0.0	0	0	0.4	0.0	17	0.45	
BH09	14/08/19 12:15:45			0.0	0.0	20.4	0.0	0	0	0.3				
BH09	14/08/19 12:16:00			0.0	0.0	20.4	0.0	0	0	0.2				
BH09	14/08/19 12:17:00													
BH09	14/08/19 12:18:00													
BH09	14/08/19 12:19:00													
BH09	14/08/19 12:20:00													
BH09	23/08/19 12:15:15			0.0	0.0	21.6	0.0	0	0	0.0				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT <b>35338</b>	CHECKED <b>CT</b>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH09	23/08/19 12:15:30	1024	3	0.0	0.0	21.6	0.0	0	0	0.0	1.2	20	0.58	Peak Flow 1.7
BH09	23/08/19 12:15:45			0.0	0.0	21.5	0.0	0	0	0.0				
BH09	23/08/19 12:16:00			0.0	0.0	21.5	0.0	0	0	0.0				
BH09	23/08/19 12:16:15			0.0	0.0	21.5	0.0	0	0	0.0				
BH09	23/08/19 12:16:30			0.0	0.0	21.4	0.0	0	0	0.0				
BH09	23/08/19 12:16:45			0.0	0.0	21.4	0.0	0	0	0.0				
BH09	23/08/19 12:17:00			0.0	0.0	21.4	0.0	0	0	0.0				
BH09	23/08/19 12:18:00													
BH09	23/08/19 12:19:00													
BH09	23/08/19 12:20:00													
BH09	23/08/19 12:21:00													
BH09	10/09/19 12:35:15			10.5	0.0	5.3	0.0	0	0	0.0				
BH09	10/09/19 12:35:30			10.5	0.0	5.2	0.0	0	0	0.0				
BH09	10/09/19 12:35:45			10.6	0.0	5.1	0.0	0	0	0.0				
BH09	10/09/19 12:36:00			10.6	0.0	5.1	0.0	0	0	0.0				
BH09	10/09/19 12:36:15			10.9	0.0	4.7	0.0	0	0	0.0				
BH09	10/09/19 12:36:30			10.9	0.0	4.6	0.0	0	0	0.0				
BH09	10/09/19 12:36:45			11.0	0.0	4.5	0.0	0	0	0.0				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT 35338	

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks	
BH09	10/09/19 12:37:00	1017	0	11.1	0.0	4.4	0.0	0	0	0.0					
BH09	10/09/19 12:38:00											0.0			
BH09	10/09/19 12:39:00											0.0			
BH09	10/09/19 12:40:00											0.0			
BH09	10/09/19 12:41:00														
BH09	23/09/19 11:50:15					7.8	0.0	9.9	0.0	0	0	0.0			
BH09	23/09/19 11:50:30					4.3	0.0	12.8	0.0	0	0	0.0			
BH09	23/09/19 11:50:45					4.1	0.0	12.9	0.0	0	0	0.0			
BH09	23/09/19 11:51:00					3.8	0.0	13.0	0.0	0	0	0.0			
BH09	23/09/19 11:51:15					3.6	0.0	13.1	0.0	0	0	0.0			
BH09	23/09/19 11:51:30			3.4	0.0	13.2	0.0	0	0	0.0					
BH09	23/09/19 11:51:45			3.4	0.0	13.2	0.0	0	0	0.0					
BH09	23/09/19 11:52:00			3.4	0.0	13.3	0.0	0	0	0.0					
BH09	23/09/19 11:53:00										0.0				
BH09	23/09/19 11:54:00										0.0				
BH09	23/09/19 11:55:00										0.0				
BH09	23/09/19 11:56:00	1010	0									17	0.91		
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 19mm standpipe													CONTRACT 35338	CHECKED CT	



**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks			
BH09	17/07/19 12:02:15	1015	0	0.2	0.0	19.6	0.0	0	0	45.1							
BH09	17/07/19 12:02:30			0.2	0.0	19.8	0.0	0	0	91.0							
BH09	17/07/19 12:02:45			0.1	0.0	19.8	0.0	0	0	102.6							
BH09	17/07/19 12:03:00			0.1	0.0	19.8	0.0	0	0	104.1							
BH09	17/07/19 12:03:15			0.1	0.0	19.8	0.0	0	0	99.0							
BH09	17/07/19 12:03:30			0.1	0.0	19.8	0.0	0	0	118.1							
BH09	17/07/19 12:03:45			0.1	0.0	19.8	0.0	0	0	120.3							
BH09	17/07/19 12:04:00			0.1	0.0	19.8	0.0	0	0	113.5							
BH09	17/07/19 12:05:00										0.0						
BH09	17/07/19 12:06:00										0.0						
BH09	17/07/19 12:07:00										0.0						
BH09	17/07/19 12:08:00																
BH09	31/07/19 13:03:15					0.1	0.0	21.0	0.0	0	0	2.6					
BH09	31/07/19 13:03:30					0.1	0.0	21.1	0.0	0	0	2.4					
BH09	31/07/19 13:03:45					0.1	0.0	21.1	0.0	0	0	2.3					
BH09	31/07/19 13:04:00					0.1	0.0	21.1	0.0	0	0	2.1					
BH09	31/07/19 13:04:15					0.1	0.0	21.1	0.0	0	0	2.0					
BH09	31/07/19 13:04:30					0.1	0.0	21.1	0.0	0	0	2.0					
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338	CHECKED CT			

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks						
BH09	31/07/19 13:04:45	1014	0	0.1	0.0	21.1	0.0	0	0	1.9	0.0	21	1.22							
BH09	31/07/19 13:05:00			0.1	0.0	21.1	0.0	0	0	1.9										
BH09	31/07/19 13:06:00																			
BH09	31/07/19 13:07:00																			
BH09	31/07/19 13:08:00																			
BH09	14/08/19 12:25:15			0.0	0.0	20.6	0.0	0	0	0.6										
BH09	14/08/19 12:25:30			0.0	0.0	20.4	0.0	0	0	0.5										
BH09	14/08/19 12:25:45			0.0	0.0	20.4	0.0	0	0	0.5										
BH09	14/08/19 12:26:00			0.0	0.0	20.4	0.0	0	0	0.5										
BH09	14/08/19 12:26:15			0.0	0.0	20.4	0.0	0	0	0.5										
BH09	14/08/19 12:26:30	1009	0	0.0	0.0	20.4	0.0	0	0	0.5	0.0	17	0.50							
BH09	14/08/19 12:26:45			0.0	0.0	20.4	0.0	0	0	0.5										
BH09	14/08/19 12:27:00			0.0	0.0	20.4	0.0	0	0	0.5										
BH09	14/08/19 12:28:00																			
BH09	14/08/19 12:29:00																			
BH09	14/08/19 12:30:00																			
BH09	14/08/19 12:31:00																			
BH09	23/08/19 12:05:15			0.1	0.0	21.7	0.0	0	0	0.0										
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe															CONTRACT 35338	CHECKED CT				

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH09	23/08/19 12:05:30	1024	7	0.1	0.0	21.6	0.0	0	0	0.0	1.5 1.2 0.9	20	0.57	Peak Flow 3.0 l/hr
BH09	23/08/19 12:05:45			0.1	0.0	21.5	0.0	0	0	0.0				
BH09	23/08/19 12:06:00			0.1	0.0	21.5	0.0	0	0	0.0				
BH09	23/08/19 12:06:15			0.1	0.0	21.4	0.0	0	0	0.0				
BH09	23/08/19 12:06:30			0.1	0.0	21.4	0.0	0	0	0.0				
BH09	23/08/19 12:06:45			0.1	0.0	21.4	0.0	0	0	0.0				
BH09	23/08/19 12:07:00			0.1	0.0	21.4	0.0	0	0	0.0				
BH09	23/08/19 12:08:00													
BH09	23/08/19 12:09:00													
BH09	23/08/19 12:10:00													
BH09	23/08/19 12:11:00													
BH09	27/08/19 00:00:00													
BH09	10/09/19 12:25:15			0.1	0.0	20.8	0.0	0	0	0.0				
BH09	10/09/19 12:25:30			0.1	0.0	20.8	0.0	0	0	0.0				
BH09	10/09/19 12:25:45			0.1	0.0	20.8	0.0	0	0	0.0				
BH09	10/09/19 12:26:00			0.1	0.0	20.8	0.0	0	0	0.0				
BH09	10/09/19 12:26:15			0.1	0.0	20.8	0.0	0	0	0.0				
BH09	10/09/19 12:26:30			0.1	0.0	20.8	0.0	0	0	0.0				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe														

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks	
BH09	10/09/19 12:26:45	1017	0	0.1	0.0	20.8	0.0	0	0	0.0					
BH09	10/09/19 12:27:00			0.1	0.0	20.8	0.0	0	0	0.0					
BH09	10/09/19 12:28:00										0.0				
BH09	10/09/19 12:29:00										0.0				
BH09	10/09/19 12:30:00										0.0				
BH09	10/09/19 12:31:00											18	0.89		
BH09	12/09/19 00:00:00														
BH09	23/09/19 11:41:15			0.1	0.0	21.0	0.0	0	0	0.0					
BH09	23/09/19 11:41:30			0.1	0.0	21.0	0.0	0	0	0.0					
BH09	23/09/19 11:41:45			0.1	0.0	21.0	0.0	0	0	0.0					
BH09	23/09/19 11:42:00			0.1	0.0	21.0	0.0	0	0	0.0					
BH09	23/09/19 11:42:15			0.1	0.0	21.0	0.0	0	0	0.0					
BH09	23/09/19 11:42:30			0.1	0.0	21.0	0.0	0	0	0.0					
BH09	23/09/19 11:42:45			0.1	0.0	21.0	0.0	0	0	0.0					
BH09	23/09/19 11:43:00			0.1	0.0	21.0	0.0	0	0	0.0					
BH09	23/09/19 11:44:00											0.0			
BH09	23/09/19 11:45:00											0.0			
BH09	23/09/19 11:46:00											0.0			
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338		CHECKED CT

Geotechnical Engineering Limited

# GAS AND GROUNDWATER LEVELS



CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH09	23/09/19 11:47:00	1010	0									17	0.91	
<div>remarks</div> <div># denotes result exceeding capacity of gas monitoring equipment</div> <div>VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.</div> <div>50mm standpipe</div>													<div>CONTRACT</div> <div>35338</div>	<div>CHECKED</div> <div>CT</div>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH10	18/07/19 09:30:15			1.0	0.0	18.3	0.0	0	0	43.8				
BH10	18/07/19 09:30:30			1.3	0.0	15.3	0.0	0	0	53.0				
BH10	18/07/19 09:30:45			1.3	0.0	12.1	0.0	0	0	61.0				
BH10	18/07/19 09:31:00			1.9	0.0	12.0	0.0	0	0	67.2				
BH10	18/07/19 09:31:15			2.1	0.0	11.9	0.0	0	0	72.8				
BH10	18/07/19 09:31:30			2.4	0.0	11.5	0.0	0	0	76.2				
BH10	18/07/19 09:31:45			2.8	0.0	9.4	0.0	0	0	79.6				
BH10	18/07/19 09:32:00			3.2	0.0	8.8	0.0	0	0	80.1				
BH10	18/07/19 09:33:00									90.8				
BH10	18/07/19 09:34:00									94.5				
BH10	18/07/19 09:35:00									100.4				
BH10	18/07/19 09:36:00									101.2				
BH10	18/07/19 09:37:00									99.3				
BH10	18/07/19 09:38:00									105.1				
BH10	18/07/19 09:39:00									99.2				
BH10	18/07/19 09:40:00									98.1				
BH10	18/07/19 09:41:00										0.0			
BH10	18/07/19 09:42:00										0.0			
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT <b>35338</b>	CHECKED <b>CT</b>

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH10	18/07/19 09:43:00	1012	0								0.0	18	1.29	
BH10	18/07/19 09:44:00													
BH10	30/07/19 12:00:15			2.9	0.0	7.4	0.0	0	0	4.6				
BH10	30/07/19 12:00:30			3.0	0.0	6.8	0.0	0	0	4.8				
BH10	30/07/19 12:00:45			3.1	0.0	6.6	0.0	0	0	5.1				
BH10	30/07/19 12:01:00			3.1	0.0	6.4	0.0	0	0	5.3				
BH10	30/07/19 12:01:15			3.2	0.0	5.8	0.0	0	0	5.5				
BH10	30/07/19 12:01:30			3.2	0.0	5.0	0.0	0	0	5.8				
BH10	30/07/19 12:01:45			3.3	0.0	5.4	0.0	0	0	6.0				
BH10	30/07/19 12:02:00			3.4	0.0	5.3	0.0	0	0	5.9				
BH10	30/07/19 12:03:00	1002	0								0.0	18	0.90	
BH10	30/07/19 12:04:00										0.0			
BH10	30/07/19 12:05:00										0.0			
BH10	30/07/19 12:06:00													
BH10	01/08/19 15:00:00													
BH10	14/08/19 14:13:15			1.6	0.0	17.8	0.0	0	0	4.0				
BH10	14/08/19 14:13:30			1.6	0.0	16.6	0.0	0	0	4.2				
BH10	14/08/19 14:13:45			1.8	0.0	16.1	0.0	0	0	4.4				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338	CHECKED CT

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks	
BH10	14/08/19 14:14:00	1009	0	2.1	0.0	15.6	0.0	0	0	4.4					
BH10	14/08/19 14:14:00			2.6	0.0	15.4	0.0	0	0	4.4					
BH10	14/08/19 14:14:15			2.4	0.0	15.6	0.0	0	0	4.4					
BH10	14/08/19 14:14:30			2.4	0.0	15.5	0.0	0	0	4.4					
BH10	14/08/19 14:14:45			2.6	0.0	15.4	0.0	0	0	4.4					
BH10	14/08/19 14:15:00											0.0	18		0.68
BH10	14/08/19 14:16:00											0.0			
BH10	14/08/19 14:17:00											0.0			
BH10	14/08/19 14:18:00														
BH10	23/08/19 10:35:15			1.1	0.0	18.2	0.0	0	0	18.4					
BH10	23/08/19 10:35:30			1.0	0.0	18.3	0.0	0	0	18.9					
BH10	23/08/19 10:35:45			1.0	0.0	18.4	0.0	0	0	90.2					
BH10	23/08/19 10:36:00			0.9	0.0	18.5	0.0	0	0	88.6					
BH10	23/08/19 10:36:15			0.9	0.0	18.6	0.0	0	0	80.3					
BH10	23/08/19 10:36:30			0.9	0.0	18.7	0.0	0	0	73.2					
BH10	23/08/19 10:36:45			0.8	0.0	18.8	0.0	0	0	69.0					
BH10	23/08/19 10:37:00			0.8	0.0	18.9	0.0	0	0	52.1					
BH10	23/08/19 10:38:00											0.0			
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT 35338		CHECKED CT



**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks					
BH10	23/08/19 10:39:00	1028	0								0.0	19	0.50						
BH10	23/08/19 10:40:00										0.0								
BH10	23/08/19 10:41:00																		
BH10	27/08/19 00:00:00																		
BH10	10/09/19 10:55:15			4.6	0.0	12.4	0.0	0	0	0.4									
BH10	10/09/19 10:55:30			5.1	0.0	9.6	0.0	0	0	0.5									
BH10	10/09/19 10:55:45			5.2	0.0	9.3	0.0	0	0	0.5									
BH10	10/09/19 10:56:00			5.3	0.0	9.1	0.0	0	0	0.5									
BH10	10/09/19 10:56:15			5.3	0.0	8.9	0.0	0	0	0.6									
BH10	10/09/19 10:56:30			5.4	0.0	8.6	0.0	0	0	0.7									
BH10	10/09/19 10:56:45	5.4	0.0	8.5	0.0	0	0	0.7				17	1.10						
BH10	10/09/19 10:57:00	5.5	0.0	8.5	0.0	0	0	0.0											
BH10	10/09/19 10:58:00								0.0										
BH10	10/09/19 10:59:00								0.0										
BH10	10/09/19 11:00:00								0.0										
BH10	10/09/19 11:01:00	1020	0																
BH10	12/09/19 00:00:00																		
BH10	24/09/19 11:44:15			3.9	0.0	14.6	0.0	0	0	0.0									
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe															CONTRACT 35338	CHECKED CT			

**GAS AND GROUNDWATER LEVELS**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H <sub>2</sub> O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH10	24/09/19 11:44:30			4.5	0.0	13.2	0.0	0	0	0.0				
BH10	24/09/19 11:44:45			4.7	0.0	13.0	0.0	0	0	0.0				
BH10	24/09/19 11:45:00			4.8	0.0	12.6	0.0	0	0	0.0				
BH10	24/09/19 11:45:15			4.8	0.0	12.5	0.0	0	0	0.0				
BH10	24/09/19 11:45:30			4.9	0.0	12.3	0.0	0	0	0.0				
BH10	24/09/19 11:45:45			5.0	0.0	12.1	0.0	0	0	0.0				
BH10	24/09/19 11:46:00			5.1	0.0	12.1	0.0	0	0	0.0				
BH10	24/09/19 11:47:00										0.0			
BH10	24/09/19 11:48:00										0.0			
BH10	24/09/19 11:49:00										0.0			
BH10	24/09/19 11:50:00	1002	0									18	1.16	
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene. 50mm standpipe													CONTRACT <b>35338</b>	CHECKED <b>CT</b>

**GROUNDWATER TESTING DATA**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	install	date and time	sample depth (m)	groundwater temperature (°C)	dissolved oxygen concentration (mg/l)	pH	pHmv (mV)	resistivity (ohmcm)	conductivity (uS/cm)	actual conductivity (uS/cm)	total dissolved solids (ppm)	salinity (PSU)	redox (mV)	dissolved oxygen saturation (%)	remarks
BH01	50mm standpipe	01/08/19 11:32:00		16.03	8.88	8.00		3277.0	368.2		239.3	0.20	-58.8		
BH01	50mm standpipe	27/08/19 00:00:00		12.79	3.06	7.40		1722.0	750.7		457.3	0.40	-46.1		
BH01	50mm standpipe	12/09/19 00:00:00		12.95	0.00	7.30		2079.6	620.0		0.4	0.30	76.7		
BH02	50mm standpipe	16/07/19 12:38:00		15.16	5.00	7.40		17.5	2.8		0.0	0.00	120.6		
BH02	50mm standpipe	31/07/19 14:16:00		22.91	8.30	6.60		29588.3	35.19		22.87	0.02	-14.7		
BH02	50mm standpipe	27/08/19 00:00:00		15.66	1.44	7.50		1701.8	806.8		582.4	0.50	-53.3		
BH02	50mm standpipe	12/09/19 00:00:00		14.13	0.74	7.30		3074.0	405.2		0.3	0.20	58.3		
BH03	50mm standpipe	16/07/19 14:51:00		14.95	6.77	7.90		1.0	1006.8		650.0	1.30	-42.8		
BH03	50mm standpipe	01/08/19 12:16:00		13.09	0.00	7.40		1695.0	763.4		496.0	0.40	-0.9		
BH03	50mm standpipe	27/08/19 00:00:00		13.67	1.58	6.80		1295.5	980.4		637.3	0.50	-45.7		
BH03	50mm standpipe	12/09/19 00:00:00		14.20	0.60	7.50		2689.0	628.3		0.3	0.20	63.8		
BH04	50mm standpipe	17/07/19 16:51:00		12.41	1.16	7.60		907.3	1456.5		950.0	0.70	-31.0		
BH04	50mm standpipe	01/08/19 13:15:00		13.03	5.51	7.00		950.0	1364.0		886.0	0.70	-0.8		
BH04	50mm standpipe	27/08/19 00:00:00		12.88	2.81	6.80		918.6	1434.4		927.7	0.70	-8.7		
BH04	50mm standpipe	12/09/19 00:00:00		12.76	0.20	7.30		2364.0	665.1		0.4	0.30	83.1		
BH05	50mm standpipe	18/07/19 11:21:00		31.97	1.18	7.96		9419.7	1261.6		40	0.08	-102.6		
BH05	50mm standpipe	01/08/19 10:30:00		20.43	8.98	7.76		26041.0	42.07		27.34	0.02	3.4		
BH05	50mm standpipe	27/08/19 00:00:00		18.27	9.43	7.76		9345.0	41.12		27.38	0.02	-28.5		
remarks # denotes result exceeding capacity of testing equipment														CONTRACT <b>35338</b>	CHECKED <b>CT</b>

**GROUNDWATER TESTING DATA**

CLIENT: CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	install	date and time	sample depth (m)	groundwater temperature (°C)	dissolved oxygen concentration (mg/l)	pH	pHmv (mV)	resistivity (ohmcm)	conductivity (uS/cm)	actual conductivity (uS/cm)	total dissolved solids (ppm)	salinity (PSU)	redox (mV)	dissolved oxygen saturation (%)	remarks
BH05	50mm standpipe	12/09/19 00:00:00		15.87	0.84	7.30		10230.0	171.9		0.1	0.00	8.6		
BH06	50mm standpipe	18/07/19 13:48:00		12.61	0.23	7.54		875.9	1462.50		940.00	0.75	-29.4		
BH06	50mm standpipe	01/08/19 12:16:00		15.11	0.36	7.60		1277.0	964.0		627.0	0.50	-32.8		
BH06	50mm standpipe	27/08/19 00:00:00		12.61	0.34	6.60		899.7	1439.6		933.4	0.70	-45.4		
BH06	50mm standpipe	12/09/19 00:00:00		13.31	0.75	6.90		1226.4	999.8		0.7	0.50	48.9		
BH07	50mm standpipe	31/07/19 11:52:00		24.64	8.14	6.70		23497.5	42.9		27.9	0.00	41.4		
BH07	50mm standpipe	14/08/19 10:40:00		14.50	0.20	7.90		944.6	1321.7		85.1	0.70	96.5		
BH07	50mm standpipe	27/08/19 00:00:00		12.62	4.15	6.20		762.1	1736.5		1128.1	0.90	-92.3		
BH07	50mm standpipe	12/09/19 00:00:00		12.60	0.70	7.10		1953.6	631.4		0.4	0.30	-38.6		
BH08	50mm standpipe	17/07/19 13:36:00		12.89	1.33	7.20		592.0	2184.6		1360.0	1.10	-144.9		
BH08	50mm standpipe	01/08/19 09:00:00		13.49	0.83	7.23		2593.0	494.295		321	0.24	-13.0		
BH08	50mm standpipe	27/08/19 00:00:00		13.31	8.49	6.10		685.0	2075.3		1216.2	1.10	-93.3		
BH08	50mm standpipe	12/09/19 00:00:00		12.58	0.83	7.20		1031.5	1291.7		0.8	0.60	-68.0		
BH09	50mm standpipe	31/07/19 13:08:00		17.34	9.65	8.10		43.3	27.4		20.0	0.01	-20.2		
BH09	50mm standpipe	27/08/19 00:00:00		14.19	2.44	6.40		208.1	6072.9		3764.4	3.10	-91.3		
BH09	50mm standpipe	12/09/19 00:00:00		15.20	9.92	7.50		19478.0	63.2		0.0	0.00	2.6		
BH10	50mm standpipe	18/07/19 09:44:00		21.37	7.10	7.81		2323.1	462.04		300	0.22	88.6		
BH10	50mm standpipe	01/08/19 15:00:00		21.00	0.00	7.91		581.3	1860.00		1209.00	0.95	-141.1		
remarks # denotes result exceeding capacity of testing equipment														CONTRACT <b>35338</b>	CHECKED <b>CT</b>

## GROUNDWATER TESTING DATA



SITE: CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

[illegible]



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# **APPENDIX B**

## **SUBCONTRACTOR REPORTS**

# **IN SITU**

SITE INVESTIGATION

## **STATIC CONE PENETRATION TEST FACTUAL REPORT**

**CLIENT: Geotechnical Engineering Ltd**

**PROJECT: Cardiff Parkway**



<b>Project</b>	<b>Cardiff Parkway</b>
<b>Project No.</b>	<b>1190290</b>
<b>Client</b>	<b>Geotechnical Engineering Ltd</b>
<b>Address</b>	<b>Centurion House, Olympus Park, Quedgeley, Gloucestershire, GL2 4NF</b>

**Attention:** Mr Chris Morgan,

Dear Mr. Morgan,

We have pleasure in providing a digital copy of our report and data in AGS format for the above project.

We hope that you are satisfied with the performance of our staff, equipment and reporting on this project. If you should have any queries about any aspect of the works carried out, please do not hesitate to contact us. We look forward to being of service to you in the future.

Yours faithfully,

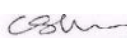


**In Situ Site Investigation Limited**



Darren Ward

Director

### Report Issue

Issue	Date	Prepared	Sign	Checked	Sign	Approved	Sign
01	12/07/2019	Chloe Wickens		Luisa Dhimetri		Darren Ward	



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## 1.0 INTRODUCTION

In Situ Site Investigation Limited (In Situ) was engaged in a geotechnical site investigation at Cardiff Parkway at the request of Geotechnical Engineering. The site investigation consisted of completing 6 Static Piezocone Penetration Tests (CPTU), 10 Dissipation Tests and 6 Seismic Dilatometer Marchetti Tests (SDMT) to provide information on the soil conditions and derived geotechnical parameters at:

GEL Compound,  
Hendre Lake Car Park,  
Cypress Drive,  
St Mellons,  
Cardiff,  
CF3 0RF

All test locations were provided by the client. A site map is included in the end of Appendix A of this report (if provided by the client). The tests were stopped when they reached the target depth as per the client's technical specifications or for other technical reasons, as detailed in the *Project Summary Table* in *Appendix A.1* and on each CPTU log included in Appendix B of this report.

The fieldwork was carried out from 17<sup>th</sup> June 2019 to 25<sup>th</sup> June 2019 as per the client's request.

The work on site and the final factual reporting have been undertaken in accordance with the international technical standard *BS EN ISO 22475-1:2012*.

## 2.0 FIELDWORK

### 2.1 CONE PENETRATION TESTS

The fieldwork activity is summarised in Table 2.1.

Table 2.1 Fieldwork Summary	
<b>CPT Operator/s</b>	Callum Murray & Alistair Gray
<b>Date Started</b>	17 <sup>th</sup> June 2019
<b>Date Finished</b>	25 <sup>th</sup> June 2019
<b>In Situ S.I. Project Manager</b>	Darren Ward
<b>Main Contractor's Site Manager</b>	Ari Mouldsley

#### 2.1.1 Rig Information

Details of CPTU rig used in this project are shown in Table 2.2. Full data sheet for the rig is presented in *Appendix A.2*.

Table 2.2 Rig Summary	
<b>Rig Name</b>	<b>Rig Description</b>
CPT017	19 Tonne Track Mounted CPT Rig

#### 2.1.2 CPTU Cone

Details of electric CPTU cone (Type TE2) used in this project conforming to the requirements of Application Class 2 of *ISO 22476-1:2012*, are shown in Table 2.3.

Table 2.3 Cone Summary		
<b>Number</b>	<b>Cross-section area</b>	<b>Filter position</b>
S15-CFIIP.1735	15cm <sup>2</sup>	U <sub>2</sub>
Mag.1760	15cm <sup>2</sup>	U <sub>2</sub>

A full datasheet of the cone used is shown in *Appendix A.3*.

The cone's measured parameters are shown in Table 2.4.

**Table 2.4 Completed Fieldwork Summary**

6 CPTU to a maximum depth of 9.16m. Each test measured Cone Resistance,  $q_c$ , Sleeve Friction,  $f_s$ , Porewater Pressure in the shoulder position,  $u_2$ , Inclination in X and Y axes.

19 MAG tests to a maximum depth of 7.00m. Each MAG test measured Magnetic Field X (nT), Magnetic Field Y (nT) and Magnetic Field Z (nT).

*Provision of factual report with estimated soil type, derived geotechnical parameters & AGS data file.*

### 2.1.3 CPTU Cone Calibration

The cone resistance and sleeve friction are recorded by calibrated load cells in the cone. The CPTU load cells and pressure transducers are regularly calibrated in line with ISO 22476-1:2012 standard by the cone manufacturer. The cone calibration certificate for the cone used at this site are presented in *Appendix A.4*.

### 2.1.4 CPTU Cone Saturation

The pore water pressure is recorded using a calibrated pressure transducer located in the piezocone. To ensure pore water pressure measurements are not affected by the presence of air in the measuring transducer, a de-airing procedure is carried out prior to each test. The cone and filter are saturated using a glycerine fluid with a viscosity of 10,000 CST.

### 2.1.5 Test Procedure

The tests are carried out in accordance with the *International Standard for Electrical Cone and Piezocone Penetration Test (ISO 22476-1:2012)*.

The final depths of the tests were determined by either completion to the specified test depth or when the maximal safe capacity of the equipment was reached. A schedule of the tests performed is shown in *Appendix A.1*, which has been compiled from the operators' daily progress reports.

The data is transmitted from the digital CPTU through an umbilical cable that runs through the push rods to the data acquisition system. Results are displayed instantaneously on the computer logging screen. The results are recorded on the computer hard disc.

The rate of penetration is kept constant at 2cm/s  $\pm 10\%$  except when penetrating very dense or hard strata. Before each test is carried out zero values are taken of the cone to check if it is within calibration. At the end of each test, zero values are taken again to see if there has been any drift during the test. These values are inspected during the post processing stage.

This is a quality check on the data and the testing procedure. Individual test zero values are shown on their corresponding test results in *Appendix B*.

#### 2.1.6 In Situ Pore Pressure ( $u_0$ )

The in situ or hydrostatic pore pressure is required for the calculation of several derived parameters included in this report. For this report, the groundwater level is assumed at 2.00 m below ground surface, for calculation purposes. The in situ pore pressure ( $u_0$ ) values are presented on the pore pressure plot, on *CPT Log 01*, which is included in *Appendix B*.

## 2.2 POSITIONING

Positioning and surveying of all investigated locations was the responsibility of the client. The site map and position of the tests are presented in *Appendix A.9*. All tests coordinates are included in the summary sheet in *Appendix A.1*, if supplied from the client.

## 2.3 DISSIPATION TESTS

As per the client's request 10 dissipation tests were performed at the required depth.

A summary table of the dissipation tests is presented in *Appendix A1*.

The dissipation test is carried out by pausing the penetration at a point when there is excess porewater pressure. This excess pore pressure generated around the cone will then start to dissipate, and the decay of pore pressure with time is recorded. The rate of dissipation depends upon the coefficient of consolidation, which in turn depends on the compressibility and permeability of the soil and on the diameter of the probe. It is common to record the time to reach 50% dissipation,  $t_{50}$ . If the equilibrium pore pressure is required, the dissipation test is continued until no further dissipation is observed. This can occur rapidly in sands, but may take many hours in plastic clays. If  $t_{50}$  is not reached, due to soils' conditions,  $t_{40}$ ,  $t_{30}$  or  $t_{20}$  are calculated. The calculation procedures for dissipation tests are explained in Section 4.16 of this report.

The data recorded from the dissipation tests on site is used to calculate the consolidation characteristics, as shown in Dissipation Test Graphs, *Appendix B*.

## 2.4 SEISMIC TESTS

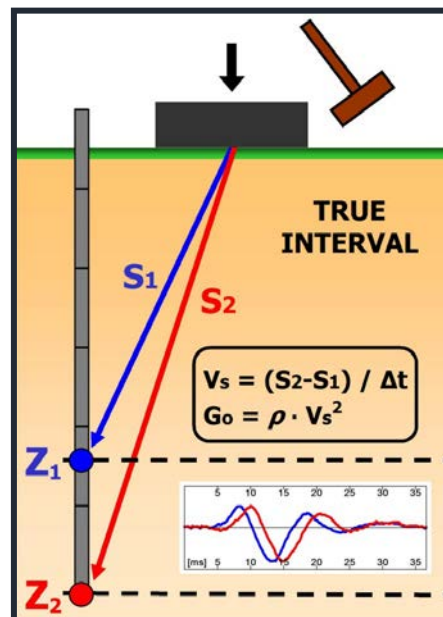
The shear wave velocity,  $V_s$  data was measured every 50 cm, by using Seismic Dilatometer Marchetti, *SDMT* probe. Results of the tests are shown in Appendix D, where a SDMT report generated from SDMT software is included.

### 2.3.1 S Wave Test Procedure

SDMT tests are carried out in accordance with *ASTM D7400-14* standard and ISSMGE TC10 guideline (*Butcher et al., 2015*). The seismic module is a tubular element equipped with two S wave receivers, at a distance of 0.5 m and two P wave receivers at a distance of 0.604 m apart. The test interval varies from 0.5m to 1m depending on the client's requirements.

The S wave is generated at the ground surface by hitting a steel beam that sits under the tracks of the CPT rig with a hammer. The S wave reaches the upper and then the lower receivers and  $V_s$  is obtained by the following formula and Figure 2.1:

$$V_s = \frac{S_2 - S_1}{\Delta t}$$

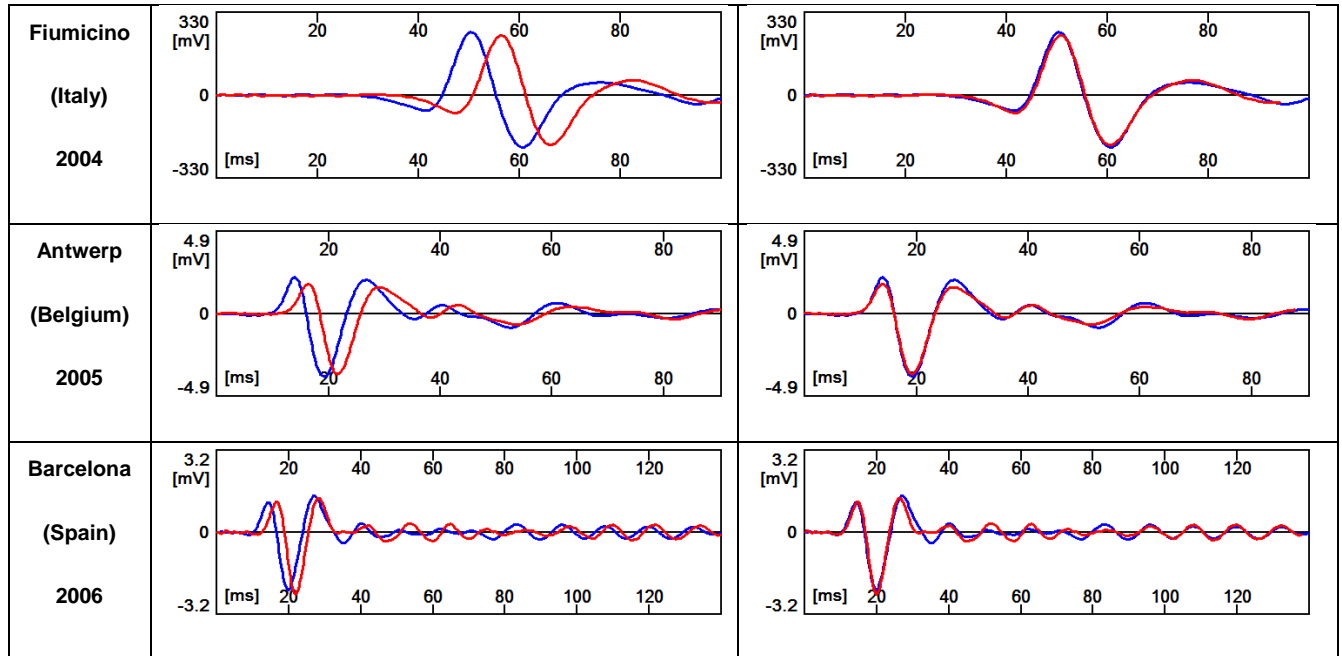


**Figure 2.1:** Test procedure to obtain  $V_s$ .

This process is carried out 3 times and if the coefficient of variation is less than 10% then the test is accepted. If it is more than 10% further hits are taken until the variation is less than 10%.



Once collected the Vs is calculated by re-phasing the S2 wave over the S1 wave as shown in Figure 2.2. All Vs results are presented alongside the CPT results in *Appendix D*. All seismogram data and tabular data are presented in *Appendix D*.



**Figure 2.2:** Vs wave re-phasing.

## 3.0 CONE PENETRATION MEASURED PARAMETERS

All measured parameters of tests carried with the CPTU cone are shown in *Appendix B* and all the information about data processing and results are given in sections 3.1, 3.2 and 3.3.

### 3.1 DATA PROCESSING

The measured parameters, cone end resistance,  $q_c$ , sleeve friction,  $f_s$ , porewater pressure measurements with filter in shoulder position,  $u_2$  and inclination for  $x$  and  $y$  axis,  $I_x$ ,  $I_y$ , were recorded for every 10 mm of penetration keeping a constant speed of 20 mm/s  $\pm$  5 mm/s, which may slightly change when the cone is penetrating hard strata.

The measured data from the site works is processed and presented using specialised CPT software. The interpretations on the CPTU results were carried out following the recommendations of *Lunne et al. (1997)*, *Robertson (2015)* and *BS EN ISO 22475-1:2012*. Measured parameters, mentioned in *Sections 3.2* and *3.3*, were used to derive all the geotechnical parameters, which are presented in *Chapter 4.0*. The soil behaviour type method used on this report is *Robertson et al. (1986)*, shown in *Figure 3.2*.

#### 3.1.1 Zero Measurements

Before and after each CPTU test, zero measurements are recorded for each channel of the cone. The zero measurements are presented on the logs in *Appendix B*. This is a routine quality check carried out on site.

### 3.2 MEASURED PARAMETERS

#### 3.2.1 Cone Resistance ( $q_c$ )

Cone resistance,  $q_c$ , is measured as the total force acting on the cone, divided by the projected area of the cone. The results are presented in MPa, on *CPT Log 01*, in *Appendix B*, scale 0-20 MPa with a minor scale printing on the same graph at 0-4 MPa.

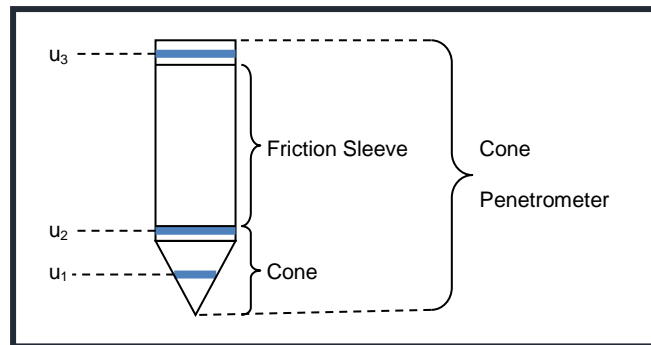
#### 3.2.2 Sleeve Friction ( $f_s$ )

Sleeve friction,  $f_s$ , is measured as the total frictional force acting on the friction sleeve divided by its surface area. The results are presented in kPa, on *CPT Log 01*, in *Appendix B*, using a scale of 0-500 kPa.

### 3.2.3 Porewater pressure ( $u_2$ )

The pore pressure,  $u_2$ , is measured during the test. If the material is free draining and saturation is maintained it will normally measure hydrostatic pore pressure. In materials that are not free draining, it will record the total pore pressure (hydrostatic plus any excess pore pressures generated) created by the cone penetration through this material.

The filter element can be mounted in one of three positions. For all tests carried out in this project the filter was mounted in the  $u_2$  position (see *Figure 3.1*).



**Figure 3.1:** Diagram showing pore pressure filter locations (after Lunne et al., 1997)

### 3.2.4 Inclination ( $I_x$ , $I_y$ )

The CPT rig was set up to obtain a thrust direction as near as possible to vertical. The CPTU cones have inclinometers incorporated to measure the non-verticality of the test. For test depths less than 15 m, significant non-verticality is unusual, provided the initial thrust direction is vertical.

## 3.3 ESTIMATED SOIL BEHAVIOUR TYPE

### 3.3.1 Friction Ratio ( $R_f$ )

The friction ratio,  $R_f$  is the ratio between the sleeve friction and the cone resistance (Lunne et al., 1997).

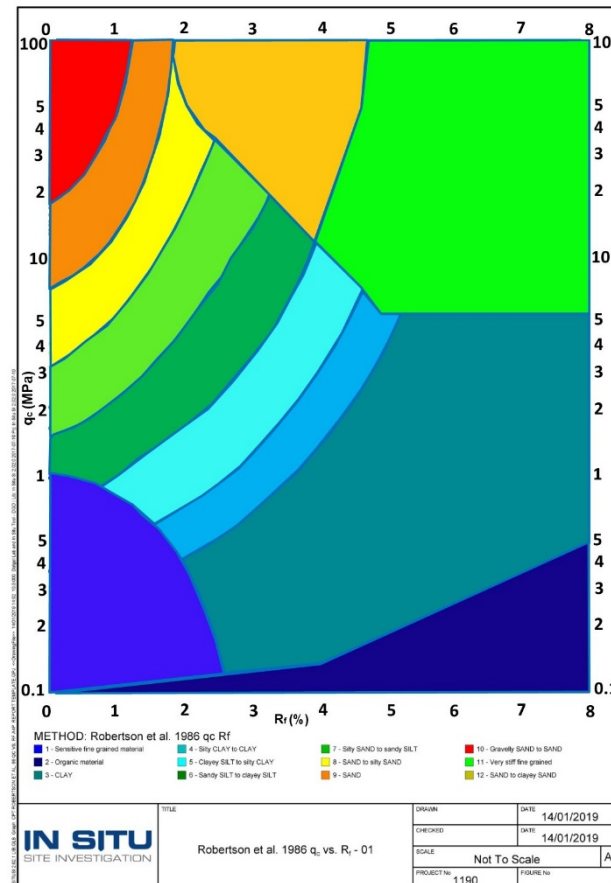
$$\text{Friction Ratio } (R_f) = \left( \frac{\text{Sleeve Friction } (f_s)}{\text{Cone Resistance } (q_c)} \right) \times 100$$

### 3.3.2 Estimated Soil Behaviour Type (SBT)

The estimation of soil behaviour type, *SBT*, using measurements of cone resistance and sleeve friction is based upon the variations of the friction ratio and cone resistance. The friction

ratio varies depending upon whether the soil is cohesive or granular. The cone resistance varies depending on the strength and densities of the soil.

The interpretation used in this report is *Robertson et al. (1986)*, which is shown in Figure 3.2. The results are presented on *CPT Log 01*, in *Appendix B*.



**Figure 3.2:** *Robertson et al., 1986 soil behaviour type chart.*

### 3.3.3 Pore Pressure Ratio ( $B_q$ )

Pore pressure ratio,  $B_q$  is the ratio between the measured pore pressure generated during penetration and the corrected cone resistance minus the total overburden stress.

Pore pressure ratio as defined by *Senneset and Janbu (1985)* is defined as:

$$B_q = \frac{u_2 - u_0}{q_t - \sigma_{vo}}$$

where

- $u_2$  is pore pressure measured between the cone and the friction sleeve
- $u_0$  is equilibrium pore pressure
- $\sigma_{vo}$  is total overburden stress
- $q_t$  is cone resistance corrected for unequal end area effects

## 3.4 APPLIED CORRECTIONS

### 3.4.1 Corrected Cone Resistance ( $q_t$ )

For each penetration test, the measured cone resistance,  $q_c$ , can be corrected for the “unequal area effect” due to the influence of the ambient pore water pressure acting on the cone.

The correction has been applied using the following equation by Lunne et al., 1997:

$$q_t = q_c + [u_2 \cdot (1 - \alpha)]$$

where

$\alpha$  is the cone area ratio

The cone used on this project has a cone area ratio of 0.79. This value is geometrically measured.

### 3.4.2 Depth Correction

All tests in the report have been corrected for depth difference caused by inclination. This has been calculated using the method described in ISO 22476-1:2012.

To calculate the corrected depth the following formula is used:

$$z = \int_0^l C_{inc} \cdot dl$$

where

$z$  is penetration depth, in  $m$

$l$  is penetration length, in  $m$

$C_{inc}$  is correction factor for the effect of the inclination of the CPTU relative to the vertical axis.

The equation for calculating the correction factor for the influence of the inclination for a bi-axial inclinometer is:

$$C_{inc} = \frac{1}{\sqrt{(1 + \tan^2 \beta_1 + \tan^2 \beta_2)}}$$

where

$\beta_1$  is the angle between the vertical axis and the projection of the axis of the CPTU on a vertical plane, in degrees

$\beta_2$  is the angle between the vertical axis and the projection of the axis of the CPTU on a vertical plane that is perpendicular to the plane of angle  $\beta_1$ , in degrees

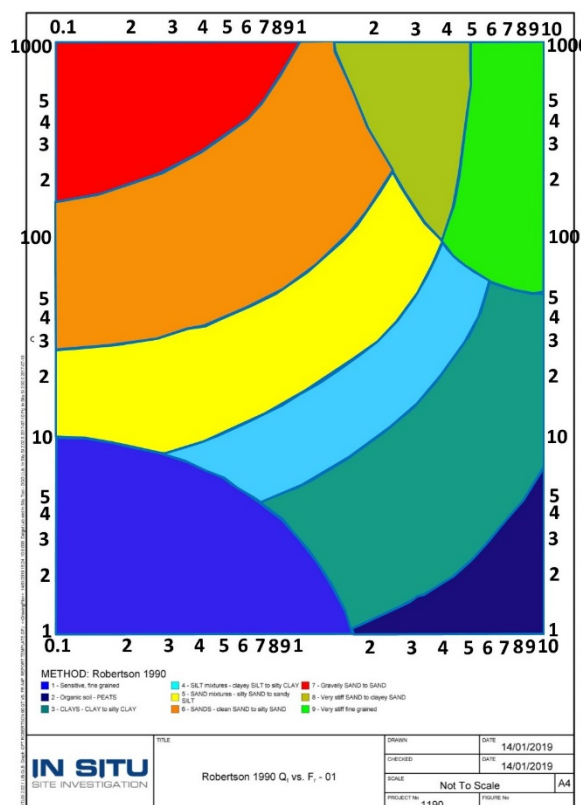
## 4.0 GEOTECHNICAL DERIVED PARAMETERS

A number of empirical correlations can be used to derive geotechnical parameters from CPTU data. This report includes only the parameters which are described in this chapter. The results of all correlations used to obtain the geotechnical derived parameters are presented on *CPT Log 02* and *CPT Log 03* in *Appendix B*.

**Please, note that each empirical correlation is derived for a certain type of soil, and may not be appropriate for all the soil types encountered on this project.**

### 4.1 SOIL BEHAVIOUR TYPE INDEX ( $I_c$ )

The soil behaviour type index,  $I_c$ , was derived by *Jefferies and Davies (1991)*, and was created to simplify the application of CPTU SBT chart shown in *Chapter 3, Figure 3.2*. This approach has been modified for use with the *Robertson (1990)* normalised CPT soil classification chart, *Figure 4.1*. The normalised cone parameters  $Q_t$  and  $F_r$  (for definitions see *Appendix A5 Symbol List*) can be combined into one Soil Behaviour Type Index,  $I_c$ , (*Lunne et al., 1997*).



**Figure 4.1:** Robertson 1990 soil behaviour type chart.

The soil behaviour type index,  $I_c$ , can then be defined using *Robertson (2010)* formula, given below:

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

where

$Q_t$  is the normalized cone resistance which represents the simple normalization with a stress exponent ( $n$ ) of 1.0, which applies well to clay-like soils

$F_R$  is the normalized friction ratio, in %

The boundaries of soil behaviour type are then given in terms of the index,  $I_c$ , presented in *Table 4.1* below.

The soils behaviour type index does not apply to zones 1, 8 and 9. The profiles of  $I_c$  provide a simple guide to the continuous variation of soil behaviour type in a given soil profile based on CPTU results, with a reliability greater than 80% compared with soil samples (*Robertson, 2015*).

Zone	Soil Behaviour Type	$I_c$
1	Sensitive fine grained	N/A
2	Organic Soils – clay	>3.6
3	Clays – silty clay to clay	2.95 – 3.6
4	Silt mixtures – clayey silt to silty clay	2.60 – 2.95
5	Sand mixtures – silty sand to sandy silt	2.05 – 2.6
6	Sands – clean sand to silty sand	1.31 – 2.05
7	Gravelly sand to dense sand	<1.31
8	Very stiff sand to clayey sand*	N/A
9	Very stiff fine grained *	N/A

\* Heavily over consolidated or cemented

**Table 4.1:** Normalized CPTU Soil Behaviour Type ( $SBT_n$ ) Index values,  $I_c$ . (*Robertson, 2010*)

## 4.2 N VALUE OF STANDARD PENETRATION TEST (SPT) ( $N_{60}$ )

The derived  $N$  value of  $SPT$ ,  $N_{60}$ , is strongly and directly related to the cone resistance,  $q_c$ .

In this report the  $N_{60}$  value is derived using the following correlations, developed by *Robertson and Wride (1998)* and *Jefferies and Davies (1998)*

1) *Robertson & Wride (1998)*

$$N_{60} = \frac{q_c}{8.5 \cdot p_a \left(1 - \frac{I_c}{4.6}\right)}$$

2) *Jefferies and Davies (1993)*

$$N_{60} = \frac{q_c}{0.85 \cdot \left(1 - \frac{I_c}{4.75}\right)}$$

where

- $q_c$  is the cone resistance
- $p_a$  is the atmospheric pressure equal to  $100 \text{ kPa}$
- $I_c$  is the soil behaviour type index calculated as given in *section 4.1*

It is suggested that this method provides a better estimation of the  $N$  value than the actual  $SPT$  test, due to its poor repeatability. But in fine grained soil with high sensitivity these methods of estimating  $N_{60}$  may overestimate it (*Jefferies and Davies, 1991*).

## 4.3 RELATIVE DENSITY ( $D_r$ )

Relative density,  $D_r$ , is an intermediate parameter for coarse grained soils, widely used to describe sand deposits. All the research on deriving the relative density from CPTU tests results are carried out for **clean predominantly quartz sands**. The studies have shown that CPTU resistance in granular soils is controlled by sand relative density, in situ effective stresses and compressibility. The more compressible sands tend to give lower penetration resistance for a given relative density than less compressible sands.

In this report relative density is calculated using the methods suggested by *Baldi et al., (1986)*, *Jamiolkowski et al., (2001)* and *Kulhawy and Mayne (1990)* as shown in the equations below:

1) *Baldi et al., (1986)*

$$D_r = \frac{1}{C_2} \cdot \ln \left( \frac{q_c \cdot Wehr}{C_1 \cdot (\sigma'_{v0})^{0.55}} \right) \cdot 100$$



where

$C_1$  is a consolidation coefficient which is 157 for normally consolidated soils and 181 for over consolidated soils

$C_2$  is a consolidation coefficient which is 2.41 for normally consolidated soils and 2.46 for over consolidated soils

Wehr is a correction coefficient for calcareous soils

2) Jamiolkowski et al., (2001)

$$D_r = 100 \cdot \left[ 0.268 \cdot \ln \left( \frac{q_t / \sigma_{atm}}{\sqrt{\sigma'_{v0} / \sigma_{atm}}} \right) + C_1 \right]$$

where

$C_1$  is a compressibility coefficient which is -0.675 for average compressible soils,  $\leq 1.0$  for high compressible soils and carbonate or calcareous sands and  $\geq -2.0$  for low compressible soils

$q_t$  is corrected cone resistance

$\sigma_{atm}$  is the atmospheric pressure

3) Kulhawy and Mayne, (1990)

$$D_r = \left[ \frac{q_{c1}}{305 \cdot C_1 \cdot OCR^{0.18} \cdot (1.2 + 0.05 \cdot \log(t/100))} \right]^{0.5} \cdot 100$$

where

$q_{c1}$  is the cone resistance corrected for initial vertical effective stress and atmospheric pressure, calculated by the following formula

$$q_{c1} = \frac{q_c}{\sqrt{\sigma'_{v0} \cdot \sigma_{atm}}}$$

where

$q_c$  is the cone resistance in kPa

$\sigma'_{v0}$  is the initial vertical effective stress in kPa

$C_1$  is a compressibility coefficient which is -0.91 for low compressible sands, 1.0 for medium compressible sands and 1.09 for high compressible sands

$t$  is time in years

#### 4.4 FRICTION ANGLE ( $\phi'$ )

Friction angle,  $\phi'$ , is used to express the shear strength of uncemented, coarse grained soils. In this report friction angle is derived by the correlations of *Mayne and Campanella (2005)*, *Robertson and Campanella (1983)* and *Kulhawy and Mayne (1990)*.

1) Mayne and Campanella, (2005)

$$\varphi' = 29.5^0 \cdot B_q^{0.121} \cdot [0.256 + 0.336 \cdot B_q + \log Q_t]$$

where

$B_q$  is the pore pressure ratio, calculated as in Session 3.3

$Q_t$  is the normalized cone resistance

2) Robertson and Campanella, (1983)

$$\varphi' = \tan^{-1} \left( 0.1 + 0.38 \cdot \log \left( \frac{q_t}{\sigma'_{v0}} \right) \right)$$

where

$q_c$  is the cone resistance in *kPa*

$\sigma'_{v0}$  is the initial vertical effective stress in *kPa*

3) Kulhawy and Mayne, (1990)

$$\varphi' = 17.6^0 + 11.0^0 \cdot \log(q_{t1})$$

where

$q_{t1}$  is the corrected cone resistance corrected for initial vertical effective stress and atmospheric pressure, calculated by the following formula

$$q_{t1} = \frac{q_t}{\sqrt{\sigma'_{v0} \cdot \sigma_{atm}}}$$

The method suggested by *Mayne and Campanella (2005)* will not provide reliable results for heavily over consolidated soils, fissured geomaterials and highly cemented or structures clays. This approach gives reliable results when pore pressure is positive and varies  $0.1 < B_q < 1.0$ . The correlation suggested by *Robertson and Campanella (1983)* estimates the peak friction angle for uncemented, unaged, moderately compressible, predominately quartz sands. For sands of higher compressibility, the method will tend to predict low friction angles. The method suggested by *Kulhawy and Mayne (1990)* is an alternate relationship for clean, rounded, uncemented, quartz sands.

## 4.5 FINES CONTENT (FC)

The fines content, *FC*, in this report is estimated using two different methods, one from *Robertson and Wride (1998)* and the other, *Suzuki et al. (1998)* as presented below:

1) Robertson and Wride (1998)

$$I_c < 1.26: FC = 0$$

$$1.26 \leq I_c \leq 3.5: FC(\%) = 1.75I_c^{3.25} - 3.7$$

$$3.5 < I_c: FC = 100\%$$

2) Suzuki et al. (1998)

$$FC(\%) = 2.8I_c^{2.6}$$

where

$I_c$  is the soil behaviour type index, calculated as in section 4.1

#### 4.6 UNDRAINED SHEAR STRENGTH ( $s_u$ )

Estimation of undrained shear strength,  $s_u$ , from CPTU tests using corrected cone resistance is carried out using the following correlation from *Lunne et al. (1981)*:

$$s_u = \frac{(q_t - \sigma_{v0})}{N_{kt}}$$

where

$N_{kt}$  is the empirical cone factor, which varies from 10 (6 for very soft sensitive fine grained soils) to 20. In this report 3 values are considered: 15, 17.5 and 20.  $N_{kt}$  tends to increase with increasing plasticity and decrease with increasing soil sensitivity. It decreases as  $B_q$  increases. (*Lunne et al., 1997*)

$\sigma_{v0}$  = total overburden stress.

This report only presents the undrained shear strength data on soils with soil behaviour type index,  $I_c$  values greater than 2.60.

The value of undrained shear strength,  $s_u$  to be used in analysis depends on the design problem. In general, the simple shear in the direction of loading often represents the average undrained strength. For larger, moderate to high risk projects, where high quality field and laboratory data may be available, site specific correlations should be developed based on appropriate and reliable values of  $s_u$ .

#### 4.7 SENSITIVITY ( $S_t$ )

The sensitivity,  $S_t$  of clays is defined as the ratio of undisturbed peak undrained shear strength to totally remoulded undrained shear strength.

In this report  $S_t$  is calculated using two correlations developed by *Schmertmann (1978)* and *Mayne (2007)*.

## 1) Schmertmann (1978)

$$S_t = \frac{s_u}{s_{u(rem)}} = \frac{q_t - \sigma_v}{N_{kt}} \left( \frac{1}{f_s} \right)$$

where

$s_{u(rem)}$  is the remoulded undrained shear strength. It can be assumed equal to the sleeve resistance,  $f_s$ .

## 2) Mayne (2007)

$$S_t = \frac{0.073 \cdot (q_t - \sigma_{v0})}{f_s}$$

For relatively sensitive clays,  $S_t > 10$ , the value of  $f_s$  can be very low and not very accurate, hence the estimate of sensitivity should be used as a guide only.

## 4.8 SOIL UNIT WEIGHT ( $\gamma$ )

Soil unit weight,  $\gamma$  in this report is calculated by using one method for sands, considered under dry conditions and two methods for clays, considered under saturated conditions. These relationships are developed by *Mayne (2007)* and the equations are presented below:

## 1) Mayne (2007)

Dry unit weight for sands:

$$\gamma_{dry} = 1.89 \cdot \log(q_{t1}) + 11.82$$

Saturated unit weight for clays method 1

$$\gamma_{sat} = 8.32 \cdot \log(V_s) - 1.61 \cdot \log(z)$$

Saturated unit for clays method 2

$$\gamma_{sat} = 2.60 \cdot \log(f_s) + 15 \cdot G_s - 26.5$$

where

$q_{t1}$  is the corrected cone resistance corrected for initial vertical effective stress and atmospheric pressure, calculated by the following formula:

$$q_{t1} = \frac{q_t}{\sqrt{\sigma'_{v0} \cdot \sigma_{atm}}}$$

$z$  is the depth

$V_s$  is the shear wave velocity, calculated as  $V_s = 118.8 \cdot \log(f_s) + 18.5$

$G_s$  is the specific gravity of solids, typically between 2.40 and 2.90

## 4.9 STATE PARAMETER ( $\psi$ )

The state parameter,  $\psi$  is defined as the difference between the current void ratio,  $e$  and the void ratio at critical state  $e_{cs}$ , at the same mean effective stress for granular soils.

The problem of evaluating the state parameter from CPTU response is complex and depends on several soil parameters, including shear stiffness, shear strength, compressibility and plastic hardening. (*Jefferies and Been, 2006*)

In this report, the state parameter is calculated based on five methods as follows:

- 1) Been et al. (1987)

$$\psi = -\frac{\ln\left(\frac{Q_p}{k}\right)}{m}$$

and

$$Q_p = \left(\frac{3Q_t}{1 + 2K_0}\right)$$

where

$Q_t$  is the normalized cone resistance  
 $K_0$  is the coefficient of lateral earth pressure

- 2) Shuttle and Jefferies (1998)

$$\psi = -\frac{\ln\left(\frac{Q_p}{k}\right)}{m}$$

where

$$k = \left((3.79 + 1.12\ln(I_r))(1 + 1.06(M - 1.25))(1 - 0.30(N - 0.2))(H/1000)^{0.326}(-1.55(\lambda - 0.01))\right)^{1.45}$$

$$m = 1.45(1.04 + 0.46\ln(I_r))(1 - 0.4(M - 1.25))(1 - 0.30(N - 0.2))(H/100)^{0.15}(1 - 2.21(\lambda - 0.01))$$

where

$Q_t$  is the normalised cone resistance  
 $I_r$  is rigidity index  
 $K_0$  is the coefficient of lateral earth pressure  
 $M$  is critical state ratio  
 $N$  is dilation parameter  
 $H$  is plastic hardening modulus;  
 $\lambda$  is slope CSL line

- 3) Shuttle and Jefferies (1998)

The state parameter calculated according this third method is similar to state parameter calculated as presented in the second method, except for the rigidity index that is calculated as follows:

$$I_r = I_{r100} \left( \frac{P_a}{\sigma'_{v0}} \right)^{0.5}$$

where

$I_{r100}$  is rigidity index in reference pressure  
 $P_a$  is the reference pressure equal to 100 kPa  
 $\sigma'_{v0}$  is effective vertical overburden stress

#### 4) Plewes (1992)

$$\psi = - \frac{\ln \left( \frac{Q_p / (1 - B_q)}{k'} \right)}{m'}$$

where

$$\begin{aligned}
 k' &= M \left( 3 + \frac{0.85}{\lambda} \right) \\
 m' &= 11.9 - 13.3\lambda \\
 \lambda &= \frac{F_r}{10}
 \end{aligned}$$

where

$Q_t$  is the normalised cone resistance  
 $B_q$  is pore pressure ratio  
 $K_0$  is the coefficient of lateral earth pressure  
 $F_R$  is normalised friction ratio  
 $M$  is critical state ration

#### 5) Been and Jefferies (1992)

$$\psi = - \frac{\ln \left( \frac{Q_p / (1 - B_q)}{k'} \right)}{m'}$$

where

$$\begin{aligned}
 k' &= M \left( 3 + \frac{0.85}{\lambda} \right) \\
 m' &= 11.9 - 13.3\lambda \\
 \lambda &= \frac{1}{34 - 10I_c}
 \end{aligned}$$

For high-risk projects a detailed interpretation of CPTU results using laboratory results and numerical modelling can be appropriate (e.g. *Shuttle and Cunning, 2007*), although soil variability can complicate the interpretation procedure. For low risk projects and in the initial screening for high-risk projects there is a need for a simple estimate of soil state.

*Plewes et al (1991)* provided a mean to estimate soil state using the normalised soil behaviour type, *SBTn* chart suggested by *Jefferies and Davies (1991)*. *Jefferies and Been (2006)* suggested that soils with a state parameter less than  $-0.05$  are dilative at large strains.

#### 4.10 IN SITU STRESS RATIO ( $K_0$ )

There are various estimations to determine in situ stress ratio,  $K_0$ , from CPTU in fine grained soils. In this report the methods suggested by *Mayne (2007)* and *Kulhawy and Mayne (1990)* are used, as given below:

- 1) Mayne (2007)

$$K_0 = (1 - \sin\phi')OCR^{\sin\phi'}$$

$$Max K_0 = K_p = \frac{(1 + \sin\phi')}{(1 - \sin\phi')}$$

$$K_0 = 0.192\left(\frac{q_t}{\sigma_{atm}}\right)^{0.22}\left(\frac{\sigma_{atm}}{\sigma_{v0}}\right)^{0.22}OCR^{0.27}$$

where

OCR is the overconsolidation ratio, calculated as presented in session 4.12

- 2) Kulhawy and Mayne (1990)

$$K_0 = 0.1\left(\frac{q_t - \sigma_{v0}}{\sigma_{v0}'}\right)$$

These approaches are generally limited to mechanically overconsolidated, fine grained soils. As considerable scatter exists in the database used for these correlations, in moderate to high risk projects further tests should be performed and these correlations must be considered only as a guide.

#### 4.11 OVERCONSOLIDATION RATIO (OCR)

Overconsolidation ratio, *OCR* is defined as the ratio of the maximum past effective consolidation stress and the present effective overburden stress:

$$OCR = \frac{\sigma'_p}{\sigma'_{v0}}$$

This definition is appropriate for mechanically overconsolidated soils, where the only change has been the removal of overburden stress. For cemented and aged soils, the *OCR* may represent the ratio of the yield stress and the present effective overburden stress.

In this report  $\sigma'_p$  is calculated based on six methods as presented below:

- 1) Mayne (1995)

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

- 2) Chen and Mayne (1996)

$$\sigma'_p = 0.53\Delta u$$

- 3) Mayne (2005)

$$\sigma'_p = 0.6(q_t - u_2)$$

- 4) Robertson (2009)

$$\sigma'_p = 0.25(Q_t^{1.25} - \sigma'_{v0})$$

- 5) Mayne (2005)

$$\sigma'_p = \left[ \frac{0.192 \left( \frac{q_t}{\sigma_{atm}} \right)^{0.125}}{(1 - \sin\phi') \left( \frac{\sigma'_{v0}}{\sigma_{atm}} \right)^{0.31}} \right]^{\left( \frac{1}{\sin\phi' - 0.27} \right)} \sigma'_{v0}$$

- 6) Mayne (2007)

$$\sigma'_p = 0.101 \sigma_{atm}^{0.102} (G_0)^{0.478} \sigma'_{v0}{}^{0.420}$$

For larger, moderate to high risk projects, where additional high-quality field and laboratory data may be available, site specific correlations should be developed based in consistent and relevant values of *OCR*.

#### 4.12 SMALL STRAIN YOUNG'S MODULUS ( $E_0$ )

Deriving small strain undrained Young's modulus,  $E_0$ , from CPTU is difficult. There is insufficient data available to make a direct correlation and it is recommended that  $c_u$  should be derived, then  $E_u$  estimated as a rough order of value from one of the available correlations between  $E_u$  and  $c_u$  (Meigh, 1987).

In this report the small strain Young's modulus is derived as follows:

- 1) Defined from elastic theory:

$$E_0 = 2(1 + \nu)G_0$$

where

- $\nu$  is the Poisson ratio, equal to 0.2
- $G_0$  is the small strain shear modulus calculated by the formula given below:



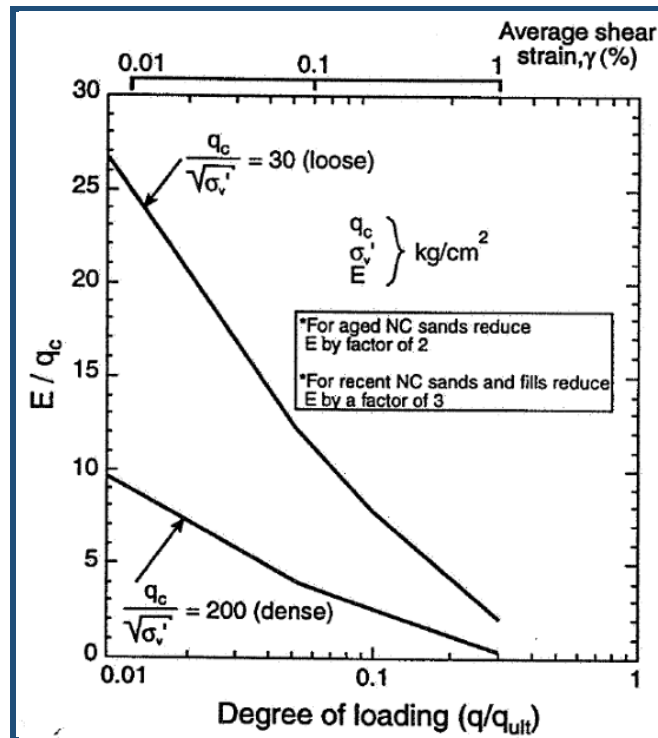
$$G_0 = 1634 \left( \frac{q_c}{\sqrt{\sigma'_{v0}}} \right)^{-0.75} q_c$$

2) Calculated based on the degree of loading,  $q_c$ , effective stress and reduction factor

$$E_0 = \alpha q_c$$

where

$\alpha$  is calculated from degree of loading,  $q_c$ , effective stress and reduction factor, given in Figure 4.2



**Figure 4.2:** Estimation of equivalent Young's modulus for sand based on degree of loading  
(Robertson, 1990)

### 4.13 CONSTRAINED MODULUS ( $M$ )

Constrained Modulus,  $M$ , can be estimated by CPTU using the following empirical relationship:

$$M = \alpha_M (q_t - \sigma_{v0})$$

where

$\alpha_M$  varies with soil plasticity and natural water content for a wide range of fine-grained soils and organic soils. *Meigh (1987)* suggested that  $\alpha_M$  lies in the range of 2 to 8, whereas *Mayne (2001)* suggested the value of 5.

*Robertson (2001)* suggested that  $\alpha_M$  varies with  $Q_t$ , such that:

When  $I_c > 2.2$  (fine grained soils) use:  $\alpha_M = Q_t$  when  $Q_t < 14$   
 $\alpha_M = 14$  when  $Q_t > 14$

When  $I_c < 2.2$  (coarse grained soils) use:  $\alpha_M = 0.0188[10^{(0.55I_c+1.68)}]$

In this report the Constrained Modulus,  $M$ , is calculated after *Kulhawy and Mayne (1990)* using the equation below:

$$M = 8.25(q_t - \sigma_{v0})$$

Also, an alternative method is included in the results, developed by *Burns and Mayne (2002)* using the following relationship:

$$M = 0.02G_0$$

#### 4.13.1 Equivalent Oedometer Coefficient of Compressibility ( $m_v$ )

Equivalent oedometer coefficient of compressibility,  $m_v$  can be calculated directly by the Constrained Modulus,  $M$ , as follows:

$$m_v = \frac{1}{M}$$

#### 4.14 SMALL STRAIN SHEAR MODULUS ( $G_0$ )

Elastic theory states that the small strain shear modulus,  $G_0$ , can be determined from the following equation:

$$G_0 = \rho v_s^2$$

where

$\rho$  is the mass density of the soil  
 $v_s$  is the shear wave velocity

In this report the small strain shear modulus,  $G_0$ , will be presented calculated by the two methods shown below, developed by *Rix and Stoke (1992)* and *BE, UB Rix and Stoke (1992)*, respectively.

$$G_0 = 1634 \left( \frac{q_c}{\sqrt{\sigma'_{v0}}} \right)^{-0.75} q_c$$

$$G_0 = \frac{\gamma_{bulk}}{g} v_s^2$$

where

$q_c$  is the net cone tip resistance in kPa  
 $\sigma'_{v0}$  is the effective initial vertical stress in kPa  
 $\gamma_{bulk}$  is the bulk density of the soil  
 $v_s$  is the shear wave velocity

This correlation of  $G_0$  is applicable to all soil types.

#### 4.14.1 Mass Density of Soil ( $\rho$ )

Mass density of soil,  $\rho$ , is defined as:

$$\rho = \frac{\gamma}{g}$$

where

$\gamma$  is the elastic stiffness of the soils at shear strain less than  $10^{-4}\%$ ,  $\gamma < 10^{-4}\%$ .

### 4.15 HYDRAULIC CONDUCTIVITY ( $k$ )

An approximate estimate of soil hydraulic conductivity or coefficient of permeability,  $k$ , can be made from an estimate of soil behaviour type using the CPTU *SBT chart* as presented in the table below:

SBT Zone	SBT	Range of $k$ (m/s)	SBT <sub>n</sub> $I_c$
1	Sensitive fine grained	$3 \times 10^{-10}$ to $3 \times 10^{-8}$	NA
2	Organic soils-clay	$1 \times 10^{-10}$ to $1 \times 10^{-8}$	$I_c > 3.60$
3	Clay	$1 \times 10^{-10}$ to $1 \times 10^{-9}$	$2.95 < I_c < 3.60$
4	Silt Mixture	$3 \times 10^{-9}$ to $1 \times 10^{-7}$	$2.60 < I_c < 2.95$
5	Sand Mixture	$1 \times 10^{-7}$ to $1 \times 10^{-5}$	$2.05 < I_c < 2.60$
6	Sand	$1 \times 10^{-5}$ to $1 \times 10^{-3}$	$1.31 < I_c < 2.05$
7	Dense sand to gravelly sand	$1 \times 10^{-3}$ to 1	$I_c < 1.31$
8	*Very dense/ stiff soil	$1 \times 10^{-8}$ to $1 \times 10^{-3}$	NA
9	*Very stiff fine grained soil	$1 \times 10^{-9}$ to $1 \times 10^{-7}$	NA

\*Overconsolidated and/ or cemented

**Table 4.2:** Estimated soils' permeability ( $k$ ) based on the CPTU SBT chart by Robertson (2009)

The average relationship between soils' permeability,  $k$  and SBT<sub>n</sub>  $I_c$ , shown in Table 4.2, can be represented by the following relationships:

$$\begin{aligned} \text{When } 1.0 < I_c \leq 3.27 & \quad k = 10^{(0.952 - 3.04I_c)} \\ \text{When } 3.27 < I_c \leq 4.0 & \quad k = 10^{(-4.52 - 1.37I_c)} \end{aligned}$$

In this report, the hydraulic conductivity is estimated as a function of soil types from 2 CPTU classification charts, *Robertson et al. (1986)* and *Robertson et al. (1990)*, considering both minimum and maximum values.

The hydraulic conductivity (coefficient of permeability),  $k$ , values (minimum and maximum), defined after soils' behaviour type by *Robertson et al. (1986)* are presented in *Table 4.3*, below:

SBT Zone	Soil Behaviour Type (SBT)	Range of hydraulic conductivity, $k$ (m/s)
1	Sensitive fine grained	$3 \times 10^{-9}$ to $3 \times 10^{-8}$
2	Organic soils	$1 \times 10^{-8}$ to $1 \times 10^{-6}$
3	Clay	$1 \times 10^{-10}$ to $1 \times 10^{-9}$
4	Silty CLAY to CLAY	$3 \times 10^{-9}$ to $1 \times 10^{-8}$
5	Clayey SILT to silty CLAY	$1 \times 10^{-8}$ to $1 \times 10^{-7}$
6	Sandy SILT to clayey SILT	$1 \times 10^{-7}$ to $1 \times 10^{-6}$
7	Silty SAND to sandy SILT	$1 \times 10^{-5}$ to $1 \times 10^{-6}$
8	SAND to silty SAND	$1 \times 10^{-5}$ to $1 \times 10^{-4}$
9	SAND	$1 \times 10^{-4}$ to $1 \times 10^{-3}$
10	Gravelly SAND to SAND	$1 \times 10^{-3}$ to 1
11	Very stiff fine grained	$1 \times 10^{-8}$ to $1 \times 10^{-6}$
12	SAND to clayey SAND	$3 \times 10^{-7}$ to $3 \times 10^{-4}$

**Table 4.3:** Estimated soil permeability ( $k$ ) based on SBT chart by *Robertson et al. (1986)*

The hydraulic conductivity (coefficient of permeability),  $k$  values (min and max), defined after soils' behaviour type by *Robertson et al. (1990)* are presented in *Table 4.4*, below:

SBT Zone	Soil Behaviour Type (SBT)	Range of hydraulic conductivity, $k$ (m/s)
1	Sensitive fine grained	$3 \times 10^{-9}$ to $3 \times 10^{-8}$
2	Organic soils	$1 \times 10^{-8}$ to $1 \times 10^{-6}$
3	Clay	$1 \times 10^{-10}$ to $1 \times 10^{-9}$
4	Silt Mixture	$3 \times 10^{-9}$ to $1 \times 10^{-7}$
5	Sand Mixture	$1 \times 10^{-7}$ to $1 \times 10^{-5}$
6	Sand	$1 \times 10^{-5}$ to $1 \times 10^{-3}$
7	Gravelly sands to dense sands	$1 \times 10^{-3}$ to 1
8	Very stiff sand to clayey sand	$1 \times 10^{-8}$ to $1 \times 10^{-6}$
9	Very stiff fine grained	$1 \times 10^{-8}$ to $1 \times 10^{-6}$

**Table 4.4:** Estimated soils' permeability ( $k$ ) based on SBT chart by *Robertson et al. (1990)*.

#### 4.15.1 Coefficients of permeability (hydraulic conductivity, $k_h$ , $k_v$ )

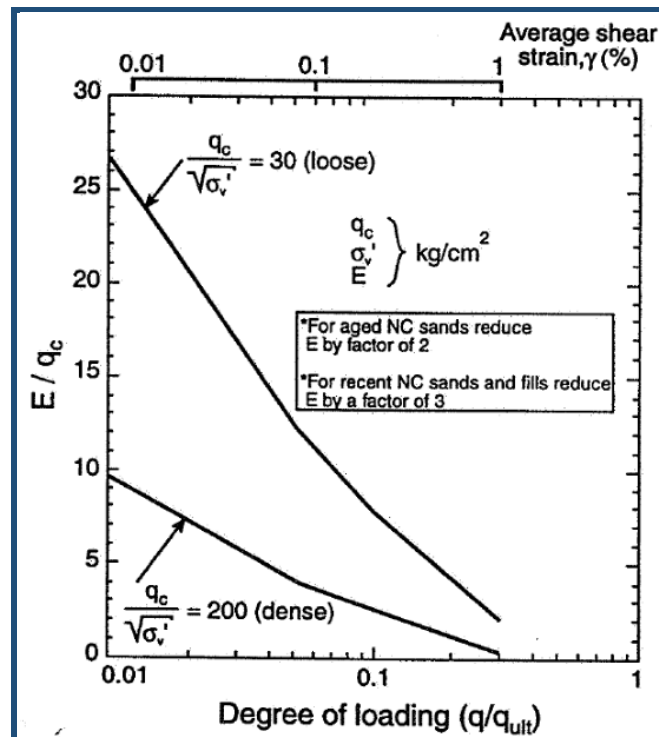
The horizontal coefficient of permeability can be estimated from the following expression:

$$k_h = \frac{\gamma_w}{2.3\sigma'_{v0}} RR c_h$$

where

RR is the compression ratio in the overconsolidated range. It represents the strain per log cycle of effective stress during recompression and can be determined from laboratory consolidation tests ( $0.5 \times 10^{-2} < RR < 2 \times 10^{-2}$  was recommended by *Baligh and Levadoux*).

*Robertson et al. (1992a)* presented a summary of available data from dissipations and laboratory tests to determined  $k_h$  values (Figure 4.3), which can be used as a rough guide to estimate  $k_h$  from  $t_{50}$ .



**Figure 4.3:** Proposed chart for evaluating  $k_h$  from  $t_{50}$  for  $10\text{cm}^2$  piezocones (*Robertson et al., 1992a*)

*Jamiolkowski et al. (1985)* presented Table 4.4 which can be used to estimate  $k_v$  from  $k_h$ .

Based on the table below, the nature of clay is considered no macrofabric, or only slightly developed macrofabric, essentially homogenous deposits, so the ratio use is  $k_h/k_v$  equal to 1.5, unless it is specified otherwise from the clients.

Nature of clay	$k_h/k_v$
No macrofabric, or only slightly developed macrofabric, essentially homogeneous deposits	1 to 1.5
From fairly well to well developed macrofabric, e.g. sedimentary clays with discontinuous lenses and layers of more permeable material	2 to 4
Varved clays and other deposits containing embedded and more or less continuous permeable layers	3 to 15

**Table 4.4:** Range of field values of  $k_h/k_v$  for soft clays (from Jamiolkowski et al., 1985).

Estimation of soil permeability from CPTU and dissipation data is subject to much uncertainty and should be used as a guide only.

## 4.16 CONSOLIDATION CHARACTERISTICS

All the results of consolidation characteristics calculated using the formulas below are presented in *Dissipation Graphs, Appendix B*.

### 4.16.1 Rigidity Index ( $I_R$ )

The rigidity index,  $I_R$ , for fine grained soils is defined using the following formula, developed by Mayne (2001):

$$I_R = \exp\left[\left(\frac{1.5}{M} + 2.925\right)\left(\frac{q_t - \sigma_{v0}}{q_t - u_2}\right)\right] - 2.925$$

where

$M$  is the Cam-Clay constant, slope of the critical state line defined as:

$$M = \frac{6 \sin \phi'}{3 - \sin \phi'}$$

where

$\phi'$  is the internal friction angle.

The second method used to define the rigidity index,  $I_R$ , for fine grained soils is based on plasticity index and overconsolidation ratio,  $OCR$  and calculated after the relationship developed by Keaveny and Mitchell (1986) as follows:

$$I_R = \frac{\exp(0.0435(137 - PI))}{[1 + \ln\{1 + 0.385(OCR - 1)^{3.2}\}]^{0.8}}$$

where

$PI$  is the plasticity index of the soil, equal to 20.

$OCR$  is the overconsolidation ratio of the soil

#### 4.16.2 Coefficients of consolidation ( $c_h$ , $c_v$ )

The coefficient of consolidation is interlinked with the hydraulic conductivity through the formula below:

$$c = \frac{kM}{\gamma_w}$$

where

M	is the 1-D constrained modulus relevant to the problem (i.e. unloading, reloading, virgin loading, etc)
$\gamma_w$	is the unit weight of water
k	is the hydraulic conductivity

In geotechnical practice it is very difficult to measure  $c$  and  $k$ , because due to soil anisotropy  $c$  and  $k$  have different values in the horizontal,  $c_h$  and  $k_h$  and vertical  $c_v$  and  $k_v$  directions. The relevant design values depend on drainage and loading direction.

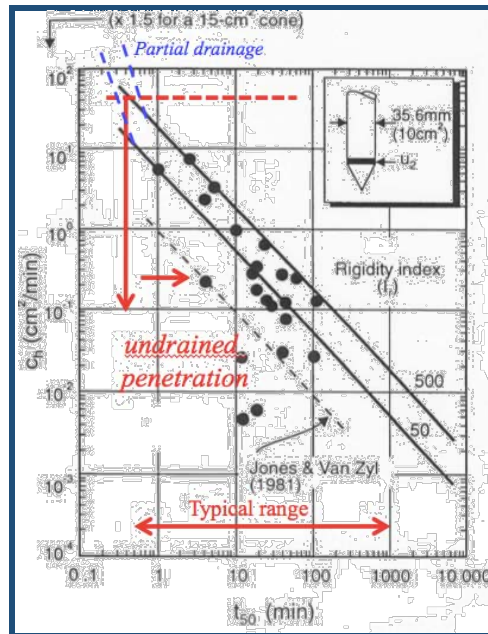
The coefficient of consolidation can be estimated by measuring the dissipation or rate of decay of pore pressure with time after a stop in CPTU penetration. The coefficient of consolidation should be interpreted at 50% dissipation, using the following formula:

$$c = \left(\frac{T_{50}}{t_{50}}\right)r_0^2$$

where

$T_{50}$	is theoretical time factor
$t_{50}$	is measured time for 50% dissipation
$r_0$	is penetrometer radius

In soils of very low permeability the time for dissipation can be decreased by using smaller diameter probes. A theoretical solution for these cases is given by *Teh and Houlsby (1991)* and it is compared with data from around the world by *Robertson et al. (1992)*, as shown in *Figure 4.3*.



**Figure 4.3:** Average laboratory  $c_h$  values and CPTU results

(after Robertson et al. 1992, Teh and Houlsby theory shown as solid lines for  $I_R = 50$  and  $I_R = 500$ ).

$c_h$  estimation is controlled by soil stress history, sensitivity, anisotropy, rigidity index (relative stiffness), fabric and history. In overconsolidated soils, the pore pressure behind the cone tip can be low or negative, results in dissipation data that can initially rise before decreasing to the equilibrium values. Care is required to ensure the dissipation test to end at the right moment of time, not stopped prematurely after the initial rise.

An approximate estimate of the coefficient of consolidation in the vertical direction can be obtained using the ratios of permeability in the horizontal and vertical directions given in the Section 4.15 on Hydraulic Conductivity, since:

$$c_v = c_h \left( \frac{k_v}{k_h} \right)$$

Considering that  $k_h/k_v = 1.25$  (from Table 4.4), the ratio  $c_h/c_v$  used for calculation purposes in this report is equal to 1.25.

For relative short dissipations, the dissipation results can be plotted on a square-root time scale. The gradient of the initial straight line in  $m$ , where:

$$c_h = (\frac{m}{M_T})^2 r^2 I_r^{0.5}$$

where

$M_T$  is 1.15 for  $u_2$  position and  $10\text{ cm}^2$  cone ( $r=1.78\text{ cm}$ ).



#### 4.16 CORRELATED SHEAR WAVE VELOCITY ( $V_s$ )

Correlated Shear wave velocity,  $V_s$  in this report is estimated after Mayne (2006), Hegazy and Mayne (1995), Mayne and Rix (1995) and Baldi et al. (1989) as follows:

- 1) Mayne (2006)

$$V_s = 118.8 \log f_s + 18.5$$

where

$f_s$  is in *kPa*

- 2) Hegazy and Mayne (1995)

$$V_s = (10.1 \log q_t - 11.4)^{1.67} \left( \frac{f_s}{q_t} \cdot 100 \right)^{0.3}$$

where

$q_t, f_s$  are in *kPa*

- 3) Mayne and Rix (1995)

$$V_s = 1.75 (q_t)^{0.627}$$

where

$q_t$  is in *kPa*

- 4) Baldi et al. (1989)

$$V_s = 277 (q_t)^{0.13} (\sigma'_{v0})^{0.13}$$

where

$q_t, \sigma'_{v0}$  are in *kPa*

## 5.0 MAGNETOMETER TESTS MEASUREMENTS

All measured parameters of MAG tests carried with the MAG cone are shown in *Appendix C*.

### 5.1 DATA PROCESSING

The measured parameters, Magnetic Field X (nT), Magnetic Field Y (nT) and Magnetic Field Z (nT) were recorded for every 10 mm of penetration.

The measured magnetometer data from the site works is processed and presented using specialised CPT software. During processing the three measured components are combined to give the total magnetic field strength.

#### 5.1.1 Zero Measurements and Data quality

Before and after each MAG test, zero measurements are recorded for each magnetic channel of the cone. The zero measurements are presented on the logs in *Appendix B*. This is a routine quality check carried out on site.

The summary of MAG tests is presented in *Appendix A.1*

### 5.2 MEASURED AND DERIVED PARAMETERS

#### 5.2.1 Magnetic Field X, Magnetic Field Y and Magnetic Field Z

The measured parameters, Magnetic Field X, Magnetic Field Y and Magnetic Field Z are measured on site. The results are presented in nT, on MAG Log, in *Appendix B*, scale -100000 to 100000 nT.

#### 5.2.2 Total Magnetic Field

Total Magnetic Field is calculated based on each measured Magnetic Field, using the formula below:

$$\text{Magnetic Field Total} = \sqrt{\text{MAGX}^2 + \text{MAGY}^2 + \text{MAGZ}^2}$$

where

MAGX	is the Magnetic Field measured in X direction
MAGY	is the Magnetic Field measured in Y direction

**MAGZ** is the Magnetic Field measured in Z direction

The results are presented in *nT*, on *MAG Log*, in *Appendix B*, using a scale of *0-100000 nT*.

### *5.2.3 Magnetic Field Gradient*

Magnetic Field Gradient is calculated as the difference between two consecutive values of Total Magnetic Field.

The results are presented in *nT/cm*, on *MAG Log*, in *Appendix B*, using a scale of *-500 to 500 nT/cm*.

## 6.0 GEONOR H10 VANE

The Geonor vane is used to measure the in situ undrained shear strength and also the remoulded shear strength in clays. The system is used predominantly in soft clay material.

The system is designed to be pushed into the soil using a CPT rig reducing the potential soil disturbance that can be created by drilling.



**Figure 6.1:** Geonor H10 Vane equipment.

The vane consists of a number of different parts. There is the vane itself that sits on a number of 1m long inner rods. The inner rods run up inside the 1m long outer rods. At the base of the outer rods is the vane housing shoe in which the vane sits when it is being pushed through the ground. Finally at the top is the calibrated torsion head.

A full set of results are displayed in Appendix E

## 7.0 CPTU RESULTS APPLICATIONS

### 7.1 SOIL PROFILING AND APPLICATIONS IN GEOTECHNICAL DESIGN

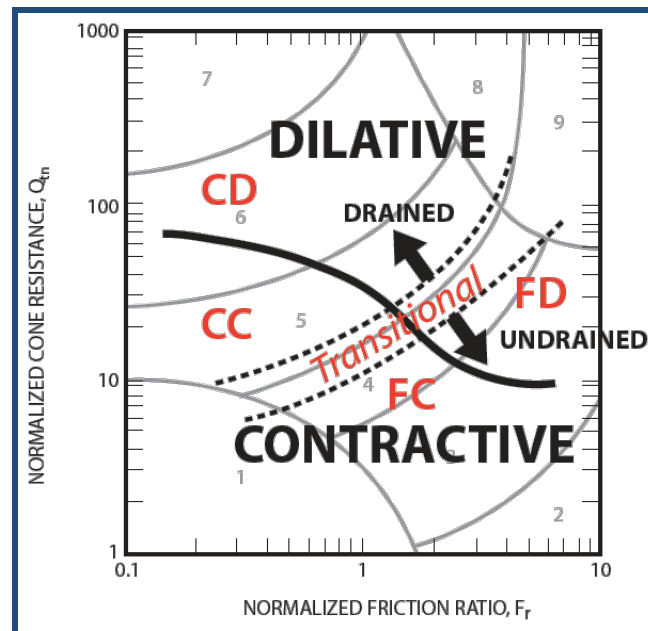
#### 7.1.1 Soil Behaviour Type

The major applications of CPTU are on *soil behaviour type and soil profiling*. Typically, the cone resistance,  $q_c$  is high in sands and low in clays, and the friction ratio,  $R_f = f_s/q_t$  is low in sands and high in clays. The CPTU cannot be expected to provide accurate predictions of soil type based on *physical characteristics*, e.g. *grain size distribution*, but provides a guide to the *mechanical characteristics*, including: *strength*, *stiffness*, and *compressibility* of the soils, or the *soil behaviour type*, *SBT*.

The most commonly used CPTU soil behaviour type chart, suggested by *Robertson et al. (1986)* uses the basic CPTU measured parameters of cone resistance,  $q_c$  and friction ratio,  $R_f$ . The chart is global in nature and can provide reasonable predictions of soil behaviour type for CPTU testing. The expected overlap in some zones is modified in the interpretations of this report somewhat based on previous experience or local knowledge of the site.

Since both the penetration resistance and sleeve resistance increase with depth due to the increase in effective overburden stress, the CPTU data requires normalization for overburden stress for very shallow and/or very deep tests. A popular CPTU soil behaviour chart based on normalized CPTU data is firstly proposed by *Robertson (1990)*. The chart identifies general trends in ground response, such as: *increasing soil density*, *OCR*, *age* and *cementation* for granular soils, and *increasing stress history*, *OCR* and *soil sensitivity* for cohesive soils.

A more general normalized CPTU *SBT* chart, using large strain *soil behaviour* descriptions, proposed by *Robertson (2012)* is shown in *Figure 7.1*.



**Figure 7.1:** Normalized CPTU Soil Behaviour Type ( $SBT_n$ ) chart,  $Q_{tn}$ - $F_R$  using general large strain soil behaviour description (Robertson, 2012).

\*

- CD is coarse grained dilative soil-predominately drained CPTU
- CC is coarse grained contractive soil-predominately drained CPTU
- FD is fine grained dilative soil-predominately undrained CPTU
- FC is fine grained contractive soil-predominately undrained CPTU

### 7.1.2 Soil Profiling

CPTU is an excellent test for soil profiling. The continuous monitoring of pore pressure during the cone penetration improves the soil stratigraphy descriptions. The pore pressure develops in response to the soil type being penetrated in the area where the pore pressure element is located. Soft, firm or stiff clays and contractive silts can show very high pore pressure. Very stiff overconsolidated clays and dilative silts can give very low or negative pore pressures same as very dense silty sands.

The thin layers of sand, or silt in a thick layer of clay, or thin layers of clay or silt in a thick layer of sand are easily distinguished during a CPTU test, which will give a response time sufficiently fast to observe pore pressure changes even in the very thin layers of soils ( $< 5mm$ ), depending on the response of soil to the advancing of cone.

The sandy soils tend to produce high cone resistance and low friction ratio, whereas soft clayey soils tend to produce low cone resistance and high friction ratio. Organic soils such as peat tend to have very low cone resistance and very high friction ratio. Soils with high horizontal stresses (*high OCR*) tend to have higher cone resistance and friction ratio.

CPTU is an excellent tool to classify the soils based on their behaviour type, and not based on grain size distribution.

The measurement of sleeve friction,  $f_s$  is often less reliable than the measurement of cone resistance,  $q_c$  (Lunne *et al.*, 1986), but to overpass these problems pore pressure parameter ratio,  $B_q$ , and the classification charts based on it.

For more reliability in soil profiling, the soil interpretations in this report are carried out based on three parameters measured on site, cone resistance, sleeve friction and pore pressure and three derived geotechnical parameters soil behaviour type index for all soils, undrained shear strength for cohesive soils and relative density for granular soils.

Generally, soils that fall in zones 8, 9 and 10 of Robertson *et al.* (1986) chart (6 and 7 of Robertson (1990) chart) represent approximately drained penetration, whereas, soils in zones 1, 2, 3, 4, 5 and 6 of Robertson *et al.* (1986) chart (1, 2, 3 and 4 of Robertson (1990) chart) represent approximately undrained penetration. Soils in zones 7, 11 and 12 of Robertson *et al.* (1986) (5, 8 and 9 of Robertson (1990) chart) may represent partially drained penetration. The classification is often influenced by changes in *stress history*, *in situ stresses*, *sensitivity*, *stiffness*, *mineralogy*, etc. An advantage of pore pressure measurements during cone penetration is the ability to evaluate drainage conditions more directly. (Lunne *et al.*, 1997)

The information about the rate and manner of excess pore pressures during the dissipations significantly helps the accurate classification in the corresponding depths of dissipation tests. In very stiff, overconsolidated clayey soils, the pore pressure behind the cone is very low and sometimes negative of the equilibrium pore pressure,  $u_0$ , whereas the pore pressure on the face of the cone is very large due to the large increase in normal stresses created by the cone penetration. When penetration is stopped in overconsolidated clays, pore pressure recorded behind the cone may initially increase before decreasing to the equilibrium pore pressure. The rise is caused by local equalization of the high pore pressure gradient around the cone.

Cone penetration in fine grained soils, such as clays and silts, is generally undrained. Cone penetration tests under undrained conditions generate high pore pressure and this reading is extremely useful, because it affects both cone resistance and sleeve friction measurements. These parameters should be corrected using the measured pore pressure.

CPTU in coarse grained soils, such as sandy or gravelly soils is generally drained. In these conditions there is no excess pore pressure generated as a result of cone penetration. Relative density has been used as the main parameter for description of sandy deposits.

### 7.1.3 Applications in geotechnical design

CPTU measured parameters are used to derive geotechnical parameters, which are the input in several geotechnical analyses. An alternate approach is to directly apply CPTU results to the geotechnical calculations.

As a guide, *Table 7.1* shows a summary of the applicability of CPTU results for direct design applications. The ratings shown in the table have been assigned based on current experience and represent a qualitative evaluation of the confidence level assessed to each design problem and general soil type. Details of ground conditions and project requirements can influence these ratings.

Type of soil	Pile Design	Bearing Capacity	Settlement	Compaction Control	Liquefaction
Sand	A-B	A-B	B-C	A-B	A-B
Clay	A-B	A-B	B-C	C-D	A-B
Intermediate Soils	A-B	B-C	B-C	B-C	A-B

**Table 7.1:** Perceived applicability of CPTU for various direct design problems.

- A is high
- B is high to moderate
- C is moderate
- D is moderate to low



## 8.0 REFERENCES

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## APPENDIX A

## APPENDIX A1 – Project Summary Sheet

### *Piezocene Tests Summary Sheet*

HOLE ID	Final Depth (m)	Date of Test	Cone Used	Test Remarks
CPT 01	9.16	17/06/2019	S15-CFIP.1735	Test refused on total pressure.
CPT 02	7.91	24/06/2019	S15-CFIP.1735	Test refused on inclination.
CPT 03	7.98	21/06/2019	S15-CFIP.1735	Test refused on total pressure.
CPT 04	8.44	21/06/2019	S15-CFIP.1735	Test refused on total pressure.
CPT 05	7.64	21/06/2019	S15-CFIP.1735	Test refused on total pressure.
CPT 06	7.60	17/06/2019	S15-CFIP.1735	Test refused on total pressure.

### *Coordinates*

HOLE ID	Easting	Northing	Elevation
CPT 01	325239.80	180759.50	5.30
CPT 02	325413.60	180803.00	4.95
CPT 03	325294.20	180730.20	5.40
CPT 04	325195.40	180664.20	5.25
CPT 05	325097.40	180591.80	5.25
CPT 06	325071.90	180693.60	5.10

### *Dissipation Tests Summary Sheet*

HOLE ID	Final Depth (m)	Date of Test	Cone Used	Test Remarks
CPT 01	3.00	17/06/2019	S15-CFIP.1735	Test OK.
CPT 02	2.00	24/06/2019	S15-CFIP.1735	Test OK.
CPT 02	6.00	24/06/2019	S15-CFIP.1735	Test OK.
CPT 03	4.02	21/06/2019	S15-CFIP.1735	Test OK.
CPT 03	7.00	21/06/2019	S15-CFIP.1735	Test OK.
CPT 04	2.00	21/06/2019	S15-CFIP.1735	Test OK.
CPT 04	4.99	21/06/2019	S15-CFIP.1735	Test OK.
CPT 05	3.00	21/06/2019	S15-CFIP.1735	Test OK.
CPT 05	6.21	21/06/2019	S15-CFIP.1735	Test OK.
CPT 06	2.00	17/06/2019	S15-CFIP.1735	Test OK.

### MAG Tests Summary Sheet

HOLE ID	Final Depth (m)	Cone Used	Mag Staus	Test Remarks
H2A010 T2	6.66	Mag 1760	Clear 3.8m onwards	Test Refused on Total Pressure
H2B034 T2	7.00	Mag 1760	Clear 3.2m onwards	Test Reached Target Depth
H2B035 T2	7.02	Mag 1760	Clear 3.8m onwards	Test Reached Target Depth
H2B036 T2	7.00	Mag 1760	Clear 4.0m onwards	Test Reached Target Depth
H2B037 T2	0.51	Mag 1760		Test Refused on Total Pressure
H2B037 T3	7.00	Mag 1760	Clear 4.4m onwards	Test Reached Target Depth
H302 T2	7.00	Mag 1760	Clear 0.4m onwards	Test Reached Target Depth
H309 T2	7.00	Mag 1760	Clear 1.8m onwards	Test Reached Target Depth
H310 T2	7.00	Mag 1760	Clear 1.8m onwards	Test Reached Target Depth
H341	7.01	Mag 1760	Clear 2.4m onwards	Test Reached Target Depth
H1026	7.00	Mag 1760	Clear 3.0m onwards	Test Reached Target Depth
H3012	7.00	Mag 1760	Clear 2.2m onwards	Test Reached Target Depth
H3014/26	7.00	Mag 1760	Clear 2.0m onwards	Test Reached Target Depth
H3015/27	7.00	Mag 1760	Clear 3.2m onwards	Test Reached Target Depth
H3024	7.00	Mag 1760	Clear 2.0m onwards	Test Reached Target Depth
H3033	7.00	Mag 1760	Clear 2.0m onwards	Test Reached Target Depth
H3040	7.00	Mag 1760	Clear 2.8m onwards	Test Reached Target Depth
H3042	7.00	Mag 1760	Clear 2.6m onwards	Test Reached Target Depth
H3043	7.00	Mag 1760	Clear 2.2m onwards	Test Reached Target Depth
H3044	7.00	Mag 1760	Clear 2.2m onwards	Test Reached Target Depth
H3045	7.00	Mag 1760	Clear 2.0m onwards	Test Reached Target Depth
H3046	7.00	Mag 1760	Clear 2.4m onwards	Test Reached Target Depth
H3013025	7.00	Mag 1760	Clear 2.2m onwards	Test Reached Target Depth
H3016028	7.00	Mag 1760	Clear 3.0m onwards	Test Reached Target Depth
H3018030	7.00	Mag 1760	Clear 4.0m onwards	Test Reached Target Depth
H3019029	7.00	Mag 1760	Clear 3.0m onwards	Test Reached Target Depth
H3019031	7.00	Mag 1760	Clear 2.0m onwards	Test Reached Target Depth
H3020032	7.00	Mag 1760	Clear 1.6m onwards	Test Reached Target Depth
H3022034	7.00	Mag 1760	Clear 2.0m onwards	Test Reached Target Depth

HS3038	7.00	Mag 1760	Clear 2.6m onwards	Test Reached Target Depth
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KEY for MAG Status	
Clear	Clear of UXO.
Clear 1.0m onwards	Disturbance of magnetic field to depth shown due to artificial ground but otherwise clear.
Obstruction	Buried obstruction or refused test due to geology. Change location, then re-test.
Low risk 2.3m	Low risk anomaly at depth shown. Unlikely to be UXB, and clear below.
Suspected existing pile	Disturbance of magnetic field at depth of 0-7.0m, clear below.
Anomaly x metres	Significant magnetic anomaly at depth shown.



## APPENDIX A2 – CPT Rig Datasheet

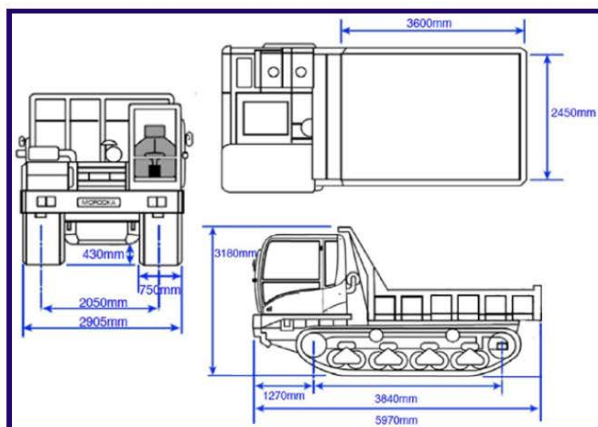
### RIGS

#### 19 TONNE CPT TRACK MOUNTED RIG (CPT017)

We have a variety of rigs giving us the capacity to meet our clients' needs and specifications for each individual project.

This rubber tracked rig weighs 19 tonnes and is able to push up to a depth of 40 metres, depending on the ground conditions. It has low ground bearing pressure and is ideal for soft, boggy sites which are inaccessible for our wheeled rigs.

CPT RIG DETAILS	
DRIVE SYSTEM:	RUBBER TRACKED
TOTAL WEIGHT:	19 TONNES
GROUND BEARING PRESSURE:	35kPa
CPT RAM THRUST CAPACITY:	20 TONNES
MAXIMUM PENETRATION:	30-40M DEPENDING ON THE GROUND CONDITIONS.
PERFORMANCE RATES:	100-150M OF TESTING A DAY, DEPENDING ON ACCESS TO POSITIONS.
TYPICAL SITES FOR THIS RIG:	SOFT, BOGGY SITES. THE RIG HAS LOW GROUND BEARING PRESSURE.

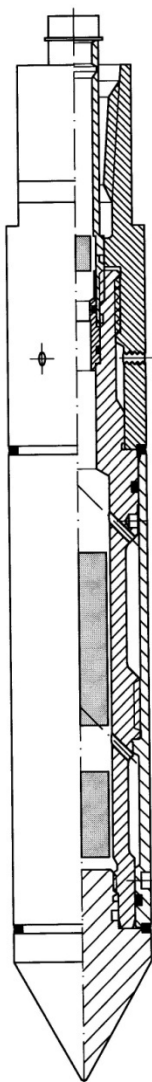




## APPENDIX A3 – Cone Datasheet



Rijksstraatweg 22F  
 2171 AL Sassenheim  
 Tel. : +31 71 301 92 51  
 Fax : +31 71 301 92 52  
 E-mail : info@geopoint.nl  
 ING bank : 68.23.01.396  
 Postbank : 5226758  
 BTW nr. : NL806331677801



# SPECIFICATIONS

## S15 SERIES

## ELECTRICAL CONES

The electronic subtraction cones have been developed to address the durability problems inherent in other cone designs. The unit consists of a single element temperature compensated strain gauge transducer for measuring both cone resistance and local sleeve friction. This design is therefore more robust than a compression type cone. The cone support electronics package is located directly behind the transducer. The precision strain gauge amplifiers and power supply eliminate the effects of cable resistance on the measurements. A standard subtraction cone is capable of measuring simultaneously the following channels: Tip, Local friction, Pore pressure, Temperature and Inclination.

### GENERAL SPECIFICATIONS

Cone Tip Section Area	1,500 mm <sup>2</sup>
Friction Sleeve Surface	22,500 mm <sup>2</sup>
Total Length	325 mm
Weight	4200 g
Power Supply	± 15 VDC, 100 mA.
Output	0 – 10 VDC*
Working Temperature	0 - 60°C
Storage Temperature	- 40 to + 85°C
Connector	Lemo 10 pins (others on request)

### TIP RESISTANCE

Range	100/150* kN
Accuracy	0.25 % FS
Maximum Load	150 % of range
Cone Area Ratio	0.75

### LOCAL SLEEVE FRICTION

Range	100/150* kN
Accuracy	0.50 % FS
Maximum Load	150 %
Sleeve Area Ratio	1.0 (EA)

### PORE PRESSURE

Range	1/2/5/10* MPa
Accuracy	0.5 % FS
Maximum Load	150 % of range

### INCLINATION

Range	25 ° (biaxial)
Accuracy	< 2 °

All our equipment complies with the ISSMGE, ASTM, DIN and NEN Standards.

*\*Other output and voltage ranges available on request. Loadcells may be calibrated for lower ranges.*

## APPENDIX A4 – Cone Calibration Certificate

**Eijkelkamp GeoPoint**  
 SoilSolutions

Rijksweg 22F  
 2171 AL Sassenheim  
 The Netherlands

T +31 71 301 9251  
 E info@eijkelkamp-geopoint.com  
 I eijkelkamp-geopoint.com

### Cone Calibration Certificate

Certificate: **GS-1735-001**  
 Instrument Type: Electric Subtraction Cone  
 Model: S15-CFIIP  
 Serial number: 1735  
 Calibration date: 20-11-2018  
 Client: Insitu  
 Calibrated by: W.Volgering  
 Calibration instruments  
 Manufacturer: Hottinger Baldwin Messtechnik GmbH  
 HBM certificate no.: 49046  
**Calibration conditions**  
 Ambient temperature: 20.4 °C  
 Atmospheric pressure: 1012 mBar  
**Cone specifications**  
 Cone base area: 1500 mm<sup>2</sup>  
 Load tip resistance (nom.): 100 kN  
 Friction sleeve area: 22500 mm<sup>2</sup>  
 Load tip + local friction (nom.): 100 kN  
 Load friction sleeve (nom.): 22.5 kN  
 Load pore pressure (nom.): 2 MPa  
 Inclination (nom.): +/- 20 °  
 Temperature compensation (all channels): 0...+40 °C  
 Maximum overload capacity (all channels): 100 %  
 Cone area ratio (a): 0.79  
 Max. Inaccuracy, relative to measurement value: 1.0 %

Tip:		Sleeve:		Pore Pressure:		Inclinometer:		
qc in kN	mV	fs in kN	mV	MPa	mV	Degrees	X (mV)	Y (mV)
<b>Zero points:</b>								
0	0	0	0	0	0	0	2484	2440
5	0306	5	0313	0.4	1659	-20	0423	0355
10	0613	10	0627	0.8	3313	20	4516	4502
15	0920	15	0941	1.2	4964			
20	1228	20	1257	1.6	6606			
25	1537	25	1572	2.0	8243			
30	1845	30	1889					
35	2154	35	2204					
40	2462	40	2521					
45	2770	45	2835					
50	3075	50	3148					
75	4602	75	4711					
100	6123	100	6269					

Max. error, abs. qc: 35 kPa  
 Max. error, abs. fs: 2 kPa  
 Max. error, abs. u2: 10 kPa  
 Max. error, abs. I: 1 °

This calibration is compliant with GeoPoint Systems internal quality system, internal calibration procedures and meets the requirements of NEN2649, NEN-EN-ISO 22476-1, NORSOK G-001, ISSMFE and ASTM using calibration equipment traceable to (Inter-) National Standards.

Approved by: B. van Eijk  
 Date: 20-11-2018

Eijkelkamp GeoPoint SoilSolutions  
 V.A.T. NO. NL 8584.21.422.B01  
 Trade Reg. Arnhem no. 70686149

IBAN NL43 RABO 0326 7904 38  
 BIC: RABONL2U

## APPENDIX A5 – Symbol List

### English

a	is area ratio of the cone ( $= A_n/A_c$ )
A	is area
$A_c$	is projected area of the cone
$A_n$	is cross sectional area of load cell or shaft
$A_s$	is area of friction sleeve
$A_{sb}$	is bottom end area of friction sleeve
$A_{st}$	is top end area of friction sleeve
$B_q$	is pore pressure parameter ( $= (u_2 - u_0)/(q_t - \sigma_{v0})$ )
$C_h$	is horizontal coefficient of consolidation
$C_v$	is vertical coefficient of consolidation
D	is diameter
$D_r$	is relative density ( $= \frac{e_{max}-e}{e_{max}-e_{min}} \times 100\%$ )
e	is void ratio
$e_{max}$	is maximum void ratio
$e_{min}$	is minimum void ratio
E	is Young's modulus
$f_s$	is unit sleeve friction resistance
$f_t$	is sleeve friction corrected for pore pressure effects
$F_s$	is total force acting on friction sleeve
$F_R$	is normalized friction ratio ( $= f_s/(q_t - \sigma_{v0})$ )
FoS	is factor of safety
FC	is fines content
g	is acceleration due to gravity
$G_0$	is initial or maximum shear modulus, shear stiffness
$I_c$	is soil behavior type index
$I_r$	is rigidity index ( $= G/s_u$ )
$I_p$	is plasticity index
k	is coefficient of permeability
$k_h$	is coefficient of permeability in horizontal direction
$k_v$	is coefficient of permeability in vertical direction
$K_0$	is coefficient of earth pressure at rest ( $= \sigma'_{h0}/\sigma'_{v0}$ )
L	is length
$m_v$	is coefficient of volume change
M	is constrained deformation modulus
M7.5	is earthquake magnitude of 7.5 Richter scale
N	is number of blows of SPT
$N_{60}$	is SPT energy ratio
$N_k$	is cone factor
$N_{ke}$	is cone factor
$N_{kt}$	is cone factor
$N_{\Delta u}$	is cone factor
$p_a$	is reference stress ( $= 100 \text{ kPa}$ )
$q_c$	is measured cone resistance
$q_e$	is effective cone resistance ( $= q_t - u_2$ )
$q_n$	is net cone resistance ( $= q_t - \sigma_{v0}$ )
$q_t$	is corrected cone resistance ( $= q_c - (1 - a)u_2$ )
$Q_c$	is total force acting on the cone
$Q_t$	is normalized cone resistance ( $= q_t - \sigma_{v0}/\sigma'_{v0}$ )

$R_f$	is friction ratio $(= (f_t/q_t) \times 100\%)$ or alternatively $(= (f_t/q_t) \times 100\%)$
$s_u$	is undrained shear strength
$s_{ur}$	is remoulded undrained shear strength
$S_t$	is sensitivity
$t$	is time
$t_{50}$	is time for 50% dissipation of excess pore water pressure
$T_{50}$	is time factor at $U = 50\%$
$u$	is pore water pressure
$u_0$	is in situ pore pressure
$u_1$	is pore pressure measured on the cone
$u_2$	is pore pressure measured behind the cone
$u_3$	is pore pressure measured behind sleeve friction
$\Delta u$	is excess pore water pressure
$U$	is normalized excess pore pressure
$V_s$	is shear wave velocity
$z$	is depth

### Greek

$\alpha$	is constant
$\alpha$	is cone roughness
$\beta$	is constant
$\beta_1$	is the angle between the vertical axis and the projection of the axis of the CPTU on a vertical plane, in degrees
$\beta_2$	is the angle between the vertical axis and the projection of the axis of the CPTU on a vertical plane that is perpendicular to the plane of angle $\beta_1$ , in degrees
$\gamma$	is unit weight of soil
$\gamma_w$	unit weight of water
$\Delta$	is change
$\Delta u$	is excess pore pressure $(= u - u_0)$
$\mu$	is Poisson's ratio
$\rho$	is density
$\psi$	is state parameter
$\sigma, \sigma'$	is normal stress (total, effective)
$\sigma_h, \sigma'_h$	is horizontal stress (total, effective)
$\sigma_v, \sigma'_v$	is horizontal stress (total, effective)
$\sigma_{v0}, \sigma'_{v0}$	is overburden stress (total, effective)
$T_{av}$	is average cyclic shear stress
$T_{cy}$	is cyclic shear stress
$\phi'$	is effective friction angle

## APPENDIX A6 – Abbreviations

ASTM	American Society for Testing and Materials
CPTU	Cone Penetration Test with Pore Pressure Measurement (Piezocone Test)
CRR	Cyclic Resistance Ratio
CSR	Cyclic Stress Ratio
GWT	Ground Water Table
NC	Normally Consolidated
OC	Over consolidated
OCR	Over consolidation Ratio
PL	Limit Pressure
SDMT	Seismic Dilatometer Marchetti
SPT	Standard Penetration Test
TC	Technical Committee

## APPENDIX A7 – Glossary

### CPT

Cone Penetration Test.

### Cone

The part of the cone penetrometer on which the end bearing is developed.

### Cone Penetrometer

The assembly containing the *cone*, *friction sleeve*, any other sensors and measuring systems, as well as the connections to the *push-rods*.

### Cone resistance, $q_c$

The total force acting on the cone,  $Q_c$ , divided by the projected area of the cone,  $A_c$ .  $q_c = Q_c / A_c$

### Corrected cone resistance, $q_t$

The *cone resistance*,  $q_c$  corrected for pore water pressure effects.

### Corrected sleeve friction, $f_t$

The *sleeve friction* corrected for pore water pressure effects on the ends of the *friction sleeve*.

### Data acquisition system

The system used to measure and record the measurements made by the *cone penetrometer*.

### Dissipation Test

A test when the decay of the pore water pressure is monitored during a pause in penetration.

### Filter element

The porous element inserted into the cone penetrometer to allow transmission of the pore water pressure to the pore pressure sensor, while maintaining the correct profile of the *cone penetrometer*.

### Friction ratio, $R_f$

The ratio, expressed as a percentage of the *sleeve friction*,  $f_s$ , to the *cone resistance*,  $q_c$ , both measured at the same depth.

### Friction reducer

A local enlargement on the push-rod surface, placed at a distance above the cone penetrometer, and provided to reduce the friction on the *push-rods*.

### Friction sleeve

The section of the *cone penetrometer* upon which the *sleeve friction* is measured.

### Normalized cone resistance, $Q_c$ or $Q_t$

The *cone resistance* expressed in a non-dimensional form and taking account of stress changes *in situ*,  $Q_c = (q_c - \sigma_{v0}) / \sigma'_{v0}$ , or when the *corrected cone resistance* is used  $Q_t = (q_t - \sigma_{v0}) / \sigma'_{v0}$ . Where  $\sigma_{v0}$  and  $\sigma'_{v0}$  are the total and effective vertical stress respectively.

### Net cone resistance, $q_n$

The *corrected cone resistance* minus the vertical total stress.  $q_n = q_t - \sigma_{v0}$

### Normalized friction ratio, $F_r$

The *sleeve friction* normalized by the *net cone resistance*.

### Piezocone

A *cone penetrometer* containing a pore pressure sensor.

### **Pore pressure, $u$**

The pore pressure generated during penetration and measured by a pore pressure sensor,  $u_1$  when measured on the cone,  $u_2$  when measured just behind the cone and  $u_3$  when measured just behind the friction sleeve.

### **Pore pressure ratio, $B_q$**

The *net pore pressure* normalized with respect to the *net cone resistance*.

### **Push-rods**

The thick-walled tubes or rods used for advancing the cone penetrometer.

### **Rig machine**

The equipment which pushes the cone penetrometer and rods into the ground.

### **Sleeve friction, $f_s$**

The total frictional force acting on the *friction sleeve*,  $F_s$ , divided by its *surface area*,  $A_s$ .  $f_s = F_s / A_s$

## APPENDIX A8 – Soils Description Tables

### GRANULAR SOILS (Sands and Gravels)

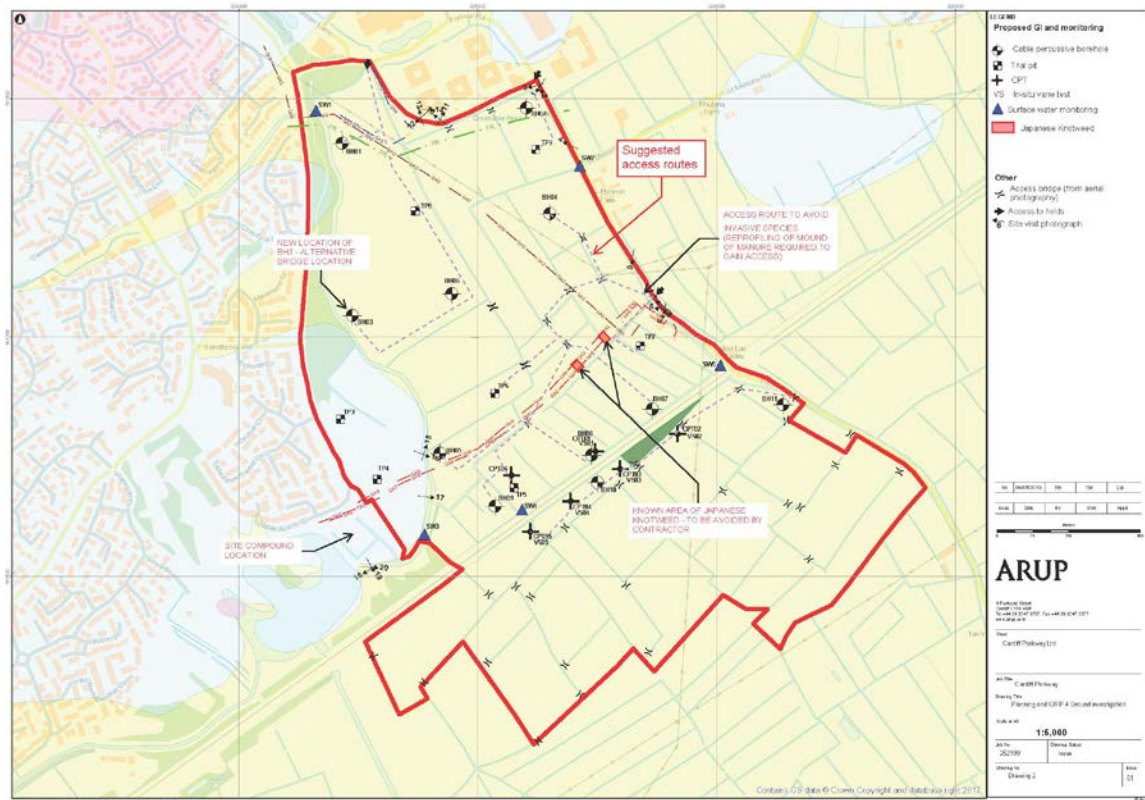
Description	Relative Density $D_r$ (%)	SPT N value, $N_{SPT}$
Very Loose	0 – 15	0 - 4
Loose	15 – 35	4 - 10
Medium Dense	35 – 65	10 - 30
Dense	65 – 85	30 - 50
Very Dense	>85	>50

### COHESIVE SOILS (Clays and Silts)

Term based on measurement	Undrained Shear Strength Classification, $s_u$ (kPa)
Extremely low	<10
Very low	10 - 20
Low	20 - 40
Medium	40 - 75
High	75 - 150
Very high	150 - 300
Extremely high	>300



## APPENDIX A9 – Site Map and Pictures from Site Works



## **APPENDIX B**

### **Cone Penetration Measured Parameters and Geotechnical Derived Parameters**



PointID

CPT 01

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325239.800 m

NORTHING : 180759.500 m

ELEVATION : 5.300 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

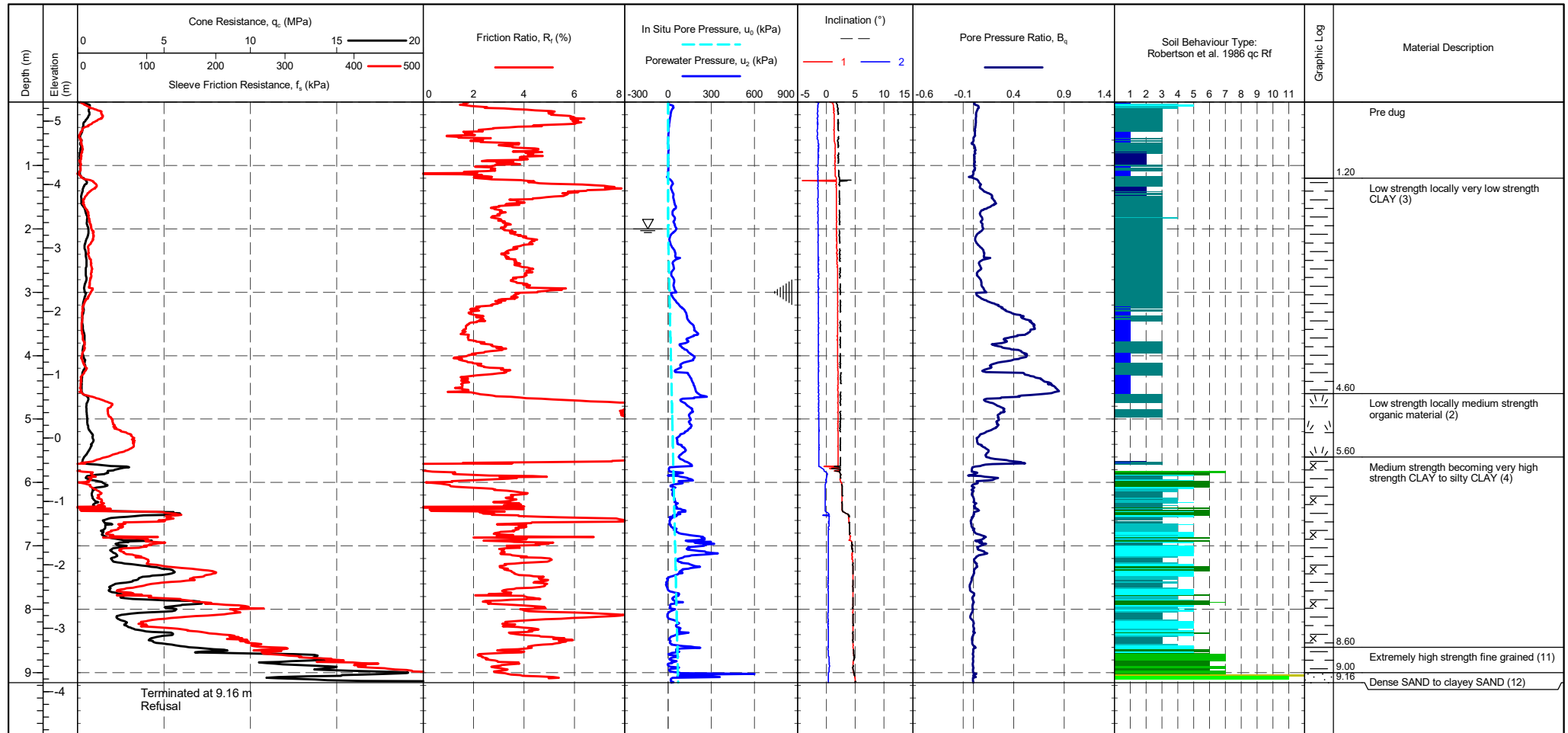
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 17/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 01  
WEATHER : Overcast & Mild

Transducer :  
Tip :  
Sleeve :  
Pore Pressure 2 :  
X-Y Inclinator :

CPTU ZERO VALUES

	Pre	Post	Difference

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material	5 - Clayey SILT to silty CLAY	9 - SAND
2 - Organic material	6 - Sandy SILT to clayey SILT	10 - Gravelly SAND to SAND
3 - CLAY	7 - Silty SAND to sandy SILT	11 - Very stiff fine grained
4 - Silty CLAY to CLAY	8 - SAND to silty SAND	12 - SAND to clayey SAND

Groundwater Level

Disipation Test



PointID

CPT 01

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325239.800 m

NORTHING : 180759.500 m

ELEVATION : 5.300 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:  
Test refused on total pressure.

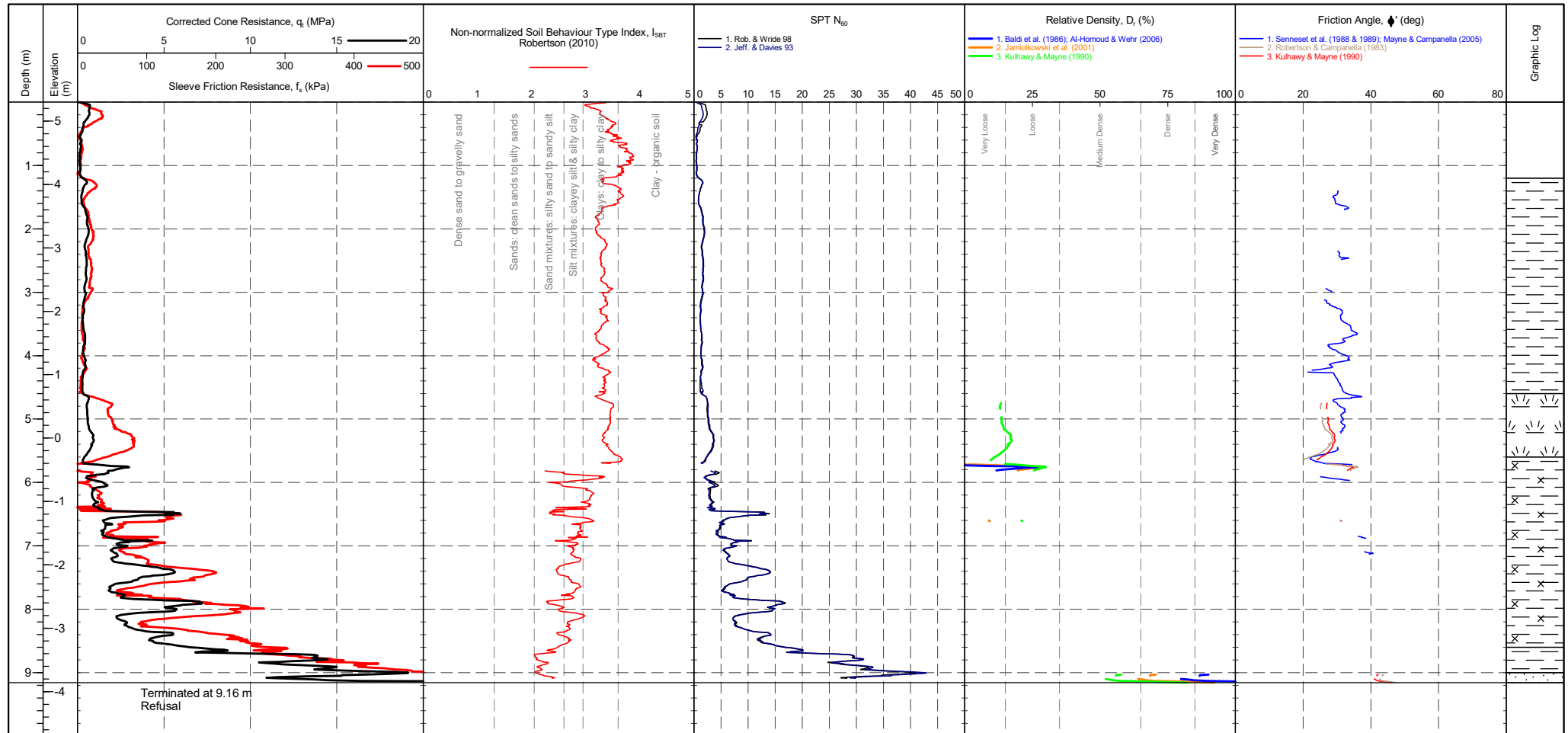
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 17/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 01  
WEATHER : Overcast & Mild

CPTU ZERO VALUES  
Transducer Pre Post Difference  
Tip  
Sleeve  
Pore Pressure 2  
X-Y Inclinator

Groundwater Level  
Dissipation Test





PointID

CPT 01

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325239.800 m

NORTHING : 180759.500 m

ELEVATION : 5.300 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:  
Test refused on total pressure.

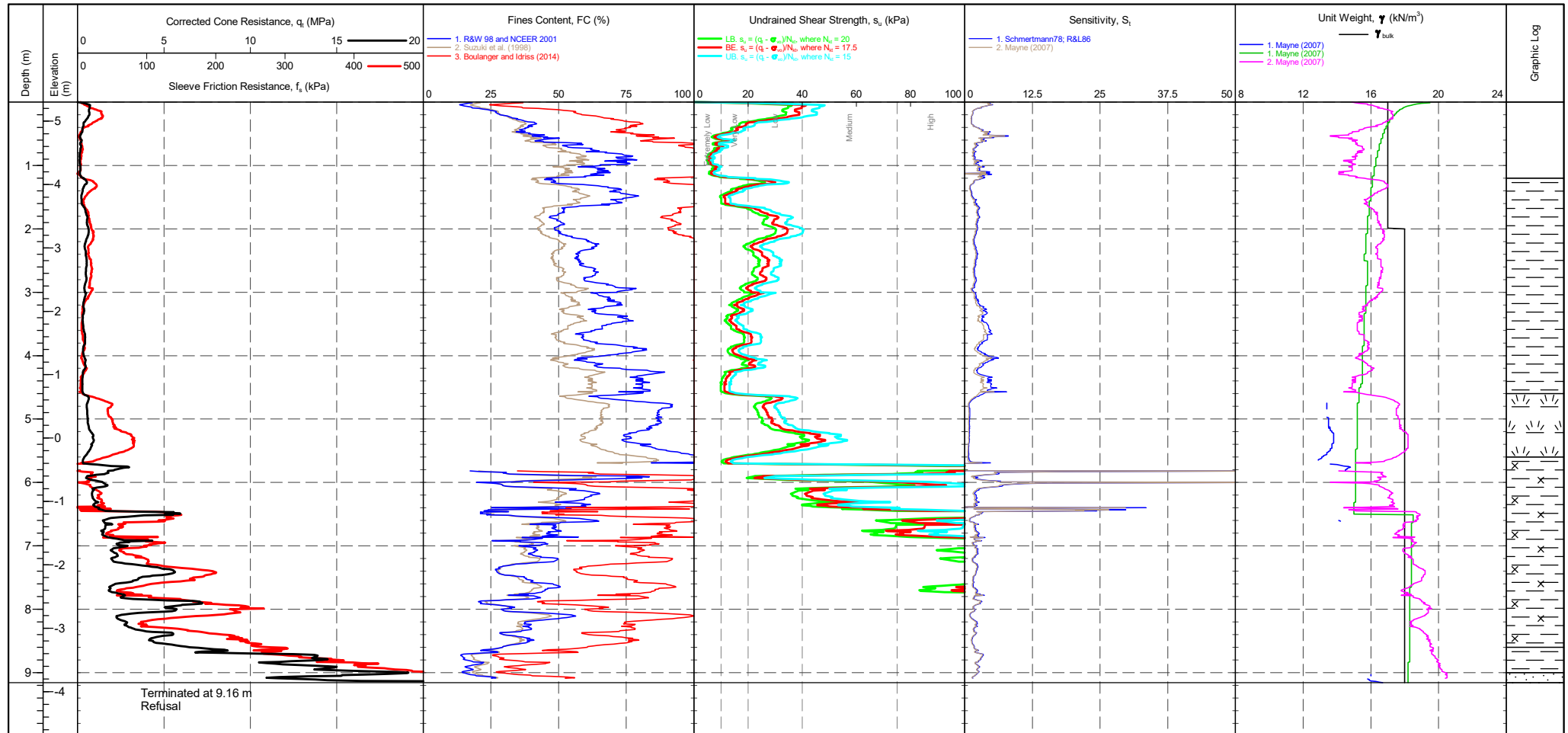
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 17/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 01  
WEATHER : Overcast & Mild

CPTU ZERO VALUES  
Transducer Pre Post Difference  
Tip  
Sleeve  
Pore Pressure 2  
X-Y Inclinator

Groundwater Level  
Dissipation Test



PointID

CPT 01

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325239.800 m

NORTHING : 180759.500 m

ELEVATION : 5.300 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

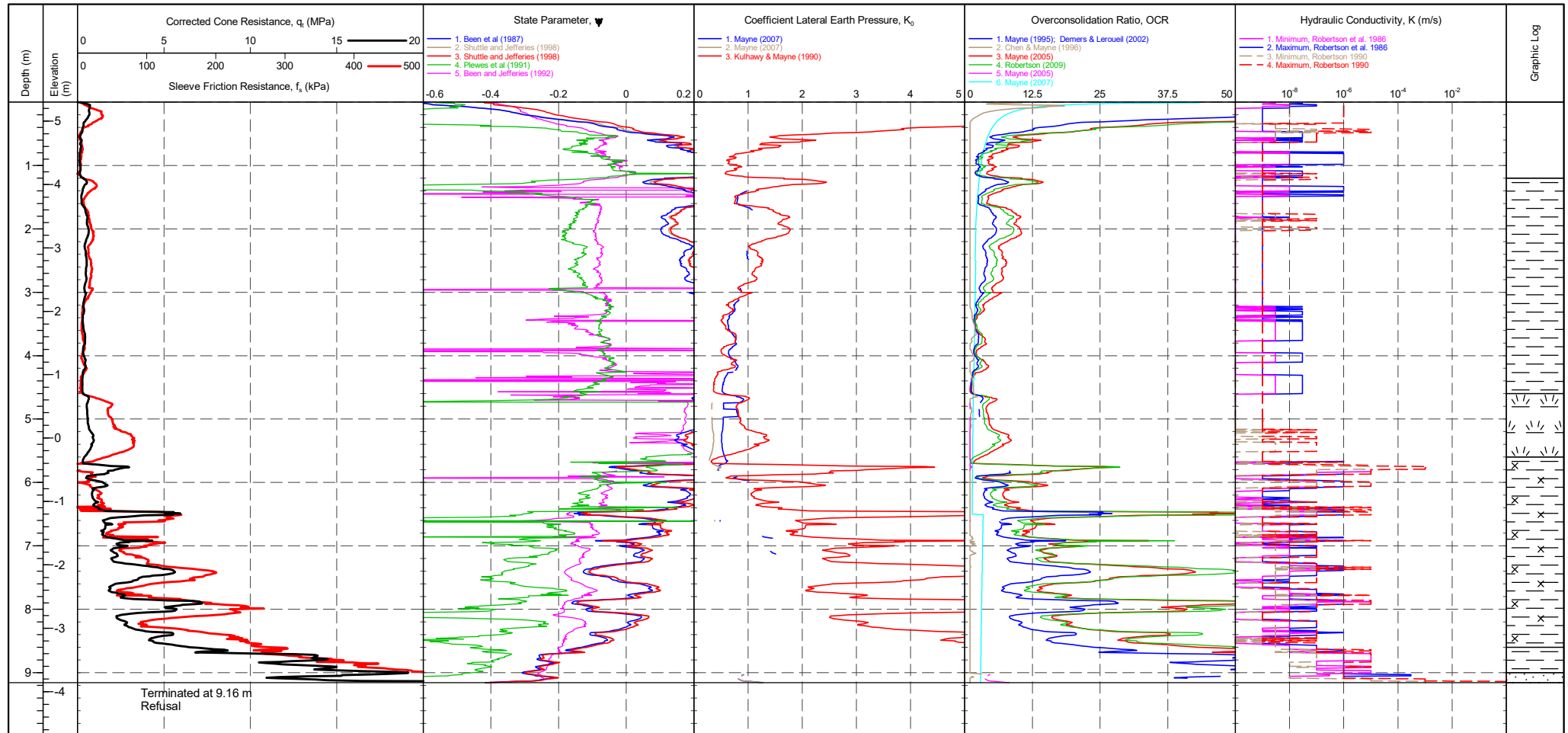
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 17/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 01  
WEATHER : Overcast & Mild

Transducer :  
Tip :  
Sleeve :  
Pore Pressure 2 :  
X-Y Inclinator :  
CPTU ZERO VALUES :  
Pre :  
Post :  
Difference :

Groundwater Level  
Dissipation Test



PointID

CPT 01

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325239.800 m

NORTHING : 180759.500 m

ELEVATION : 5.300 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

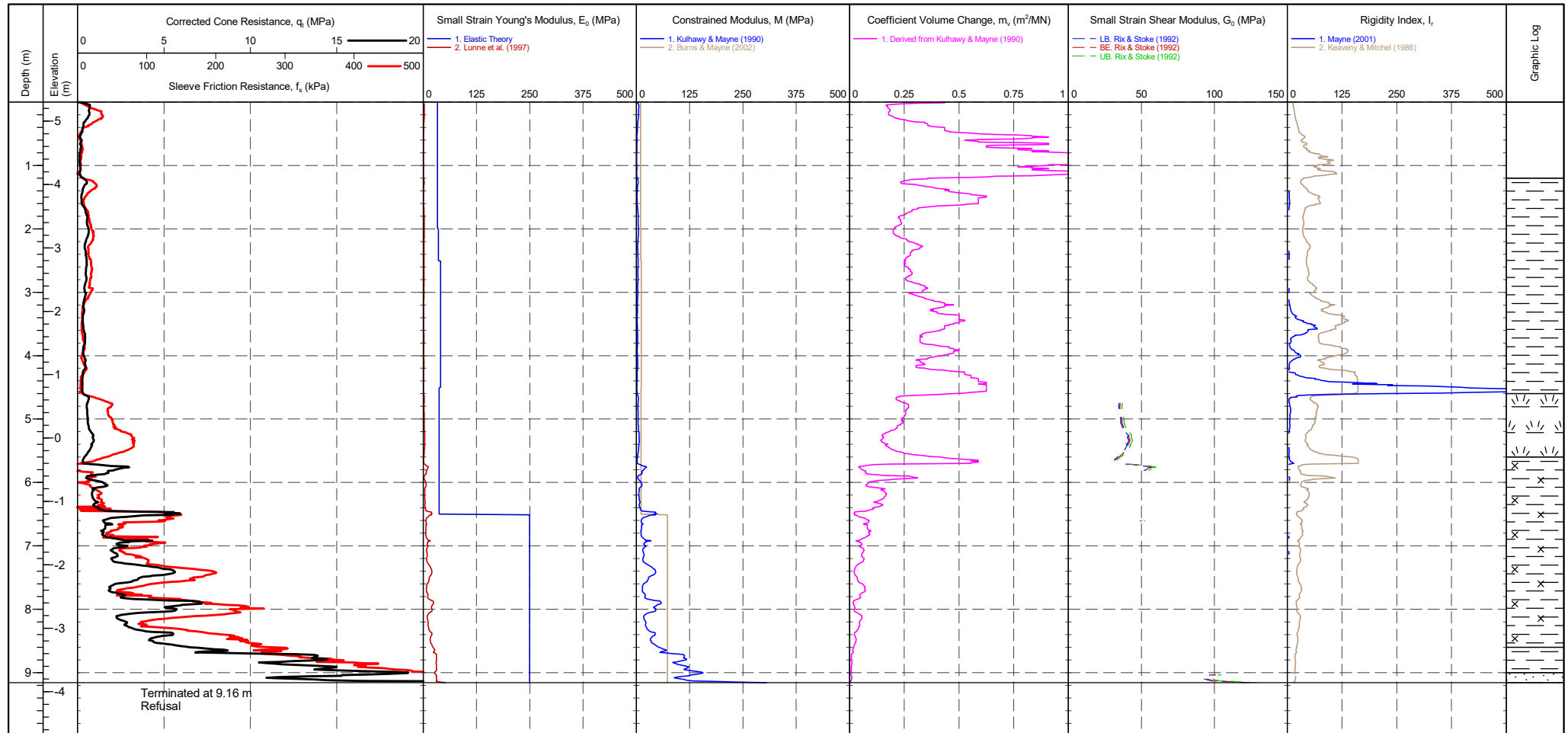
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 17/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

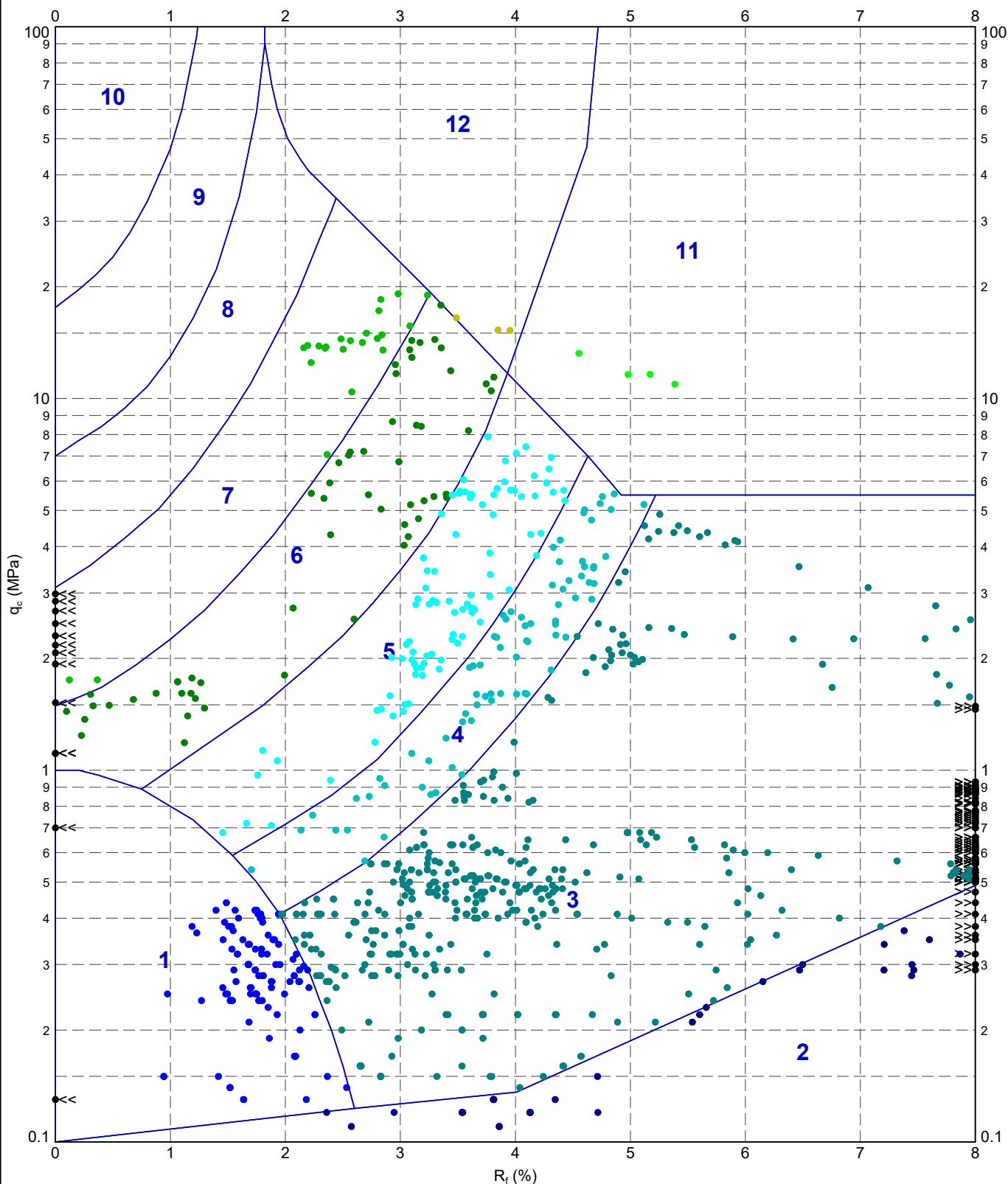
TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 01  
WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level  
Dissipation Test

INSITU 2.02.1 UB.GLB Graph: CPT ROBERTSON ET AL. 86 QC VS. RF MAP 1190290-CARDIFF PARKWAY GPJ <<DrawingFile>> 10/07/2019 10:07 10.0.000 Dageel Lab and In Situ Tool - DGD [Lib: In Situ SI 2.02.0 2017-07-10 Pjt: In Situ SI 2.02.0 2017-07-10



METHOD: Robertson et al. 1986 qc Rf

- |                                     |                               |                              |                              |
|-------------------------------------|-------------------------------|------------------------------|------------------------------|
| 1 - Sensitive fine grained material | 4 - Silty CLAY to CLAY        | 7 - Silty SAND to sandy SILT | 10 - Gravelly SAND to SAND   |
| 2 - Organic material                | 5 - Clayey SILT to silty CLAY | 8 - SAND to silty SAND       | 11 - Very stiff fine grained |
| 3 - CLAY                            | 6 - Sandy SILT to clayey SILT | 9 - SAND                     | 12 - SAND to clayey SAND     |

**IN SITU**  
SITE INVESTIGATION

TITLE

Geotechnical Engineering  
Cardiff  
Cardiff Parkway  
Robertson et al. 1986  $q_c$  vs.  $R_f$  - CPT 01

DRAWN

DATE

10/07/2019

CHECKED

DATE

10/07/2019

SCALE

Not To Scale

A4

PROJECT No

1190290

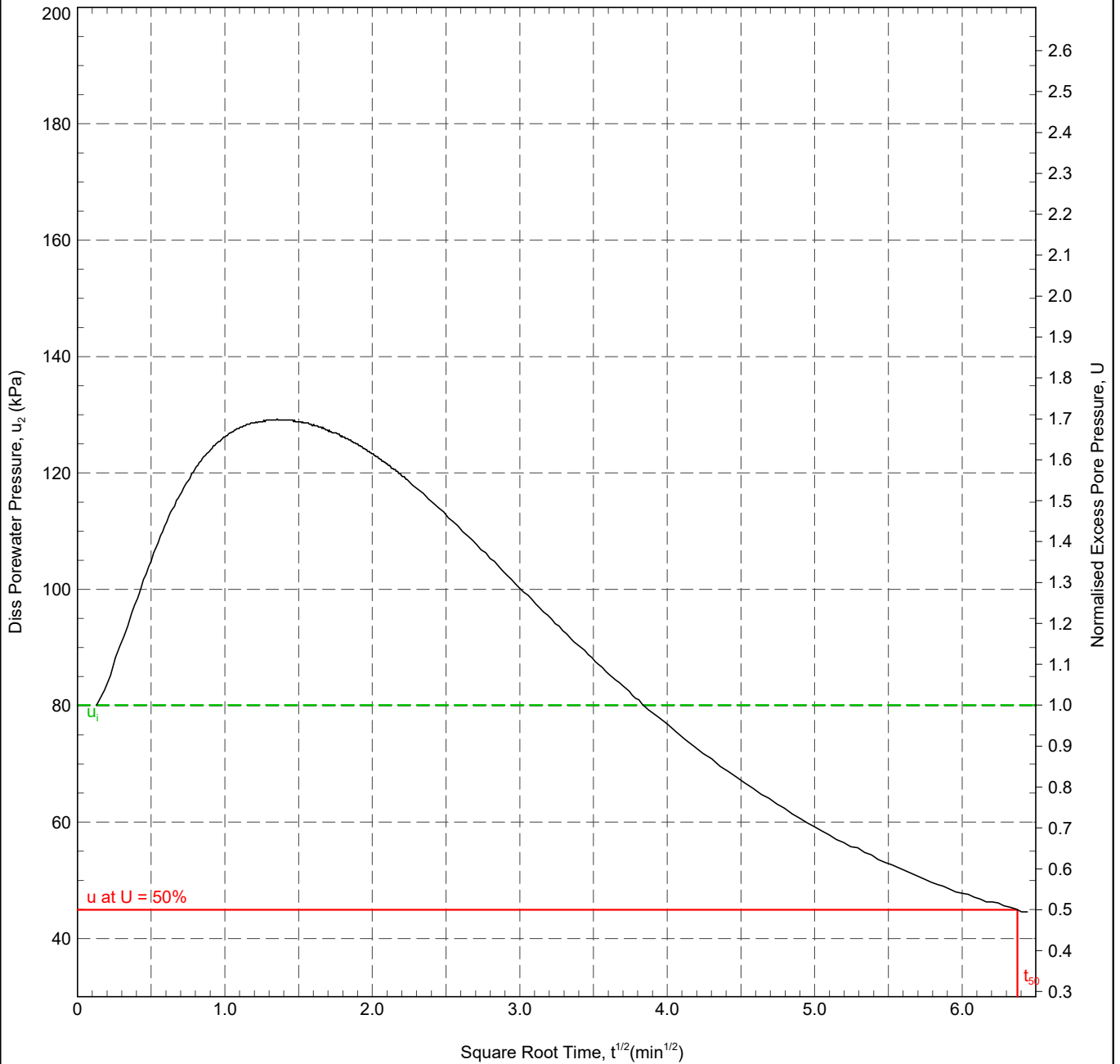
FIGURE No



CLIENT : Geotechnical Engineering  
ENGINEER :  
PROJECT : Cardiff Parkway  
LOCATION : Cardiff  
PROJECT No. : 1190290

AREA : Cardiff  
EASTING : 325239.8 m  
NORTHING : 180759.5 m  
COORD. SYS.:  
ELEVATION : 5.30 m

SHEET : 1 OF 1  
STATUS : Final  
DATE : 17/06/19



In Situ Pore Pressure,  $u_0$ : 9.8 kPa  
Initial Pore Pressure,  $u_1$ : 80.1 kPa  
Final Pore Pressure: 44.6 kPa  
Degree of Dissipation: 50%  
Dissipation Pressure: 45.0 kPa  
Time for 50% Dissipation,  $t_{50}$ : 40.64 min

Rigidity Index,  $I_r$ : 50  
Horizontal Coefficient of Consolidation,  $c_h$ :  $1.19 \times 10^1$  m<sup>2</sup>/yr  
Ratio  $c_h/c_v$ : 1.25  
Vertical Coefficient of Consolidation,  $c_v$ :  $9.48 \times 10^0$  m<sup>2</sup>/yr

RIG :  
CONE TYPE : S15-CFIP  
CONE ID : S15-CFIP.1735  
OPERATOR : AG & CM

ANALYSED BY : LD  
CHECKED BY : LD  
APPROVED BY : DW

DATE: 03/07/2019  
DATE: 03/07/2019  
DATE: 03/07/2019

REMARK  
Test OK.



PointID

## CPT 02

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325413.600 m

NORTHING : 180803.000 m

ELEVATION : 4.950 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on inclination.

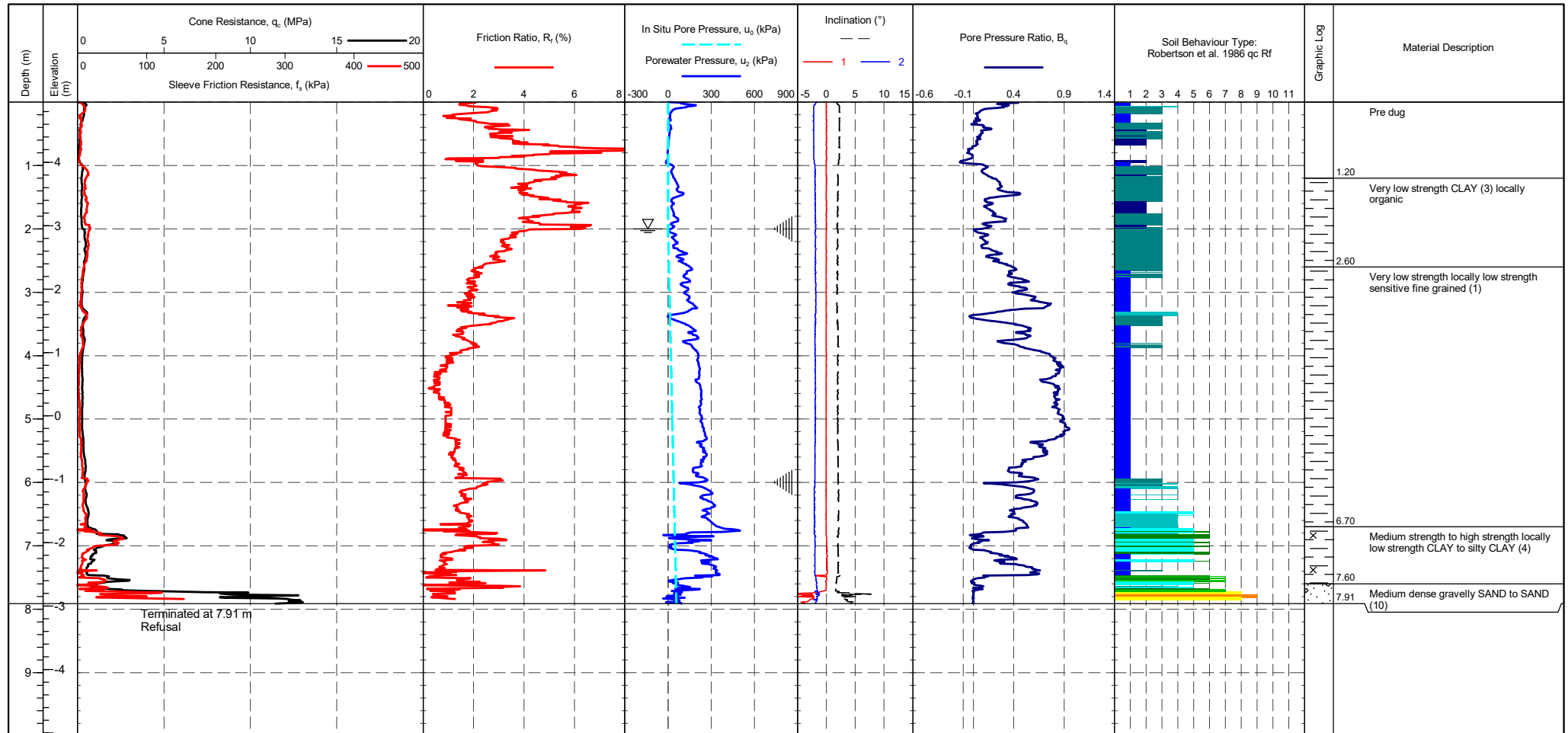
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 24/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 02  
WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material	5 - Clayey SILT to silty CLAY	9 - SAND
2 - Organic material	6 - Sandy SILT to clayey SILT	10 - Gravelly SAND to SAND
3 - CLAY	7 - Silty SAND to sandy SILT	11 - Very stiff fine grained
4 - Silty CLAY to CLAY	8 - SAND to silty SAND	12 - SAND to clayey SAND

Groundwater Level

Disipation Test



PointID

CPT 02

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325413.600 m

NORTHING : 180803.000 m

ELEVATION : 4.950 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:  
Test refused on inclination.

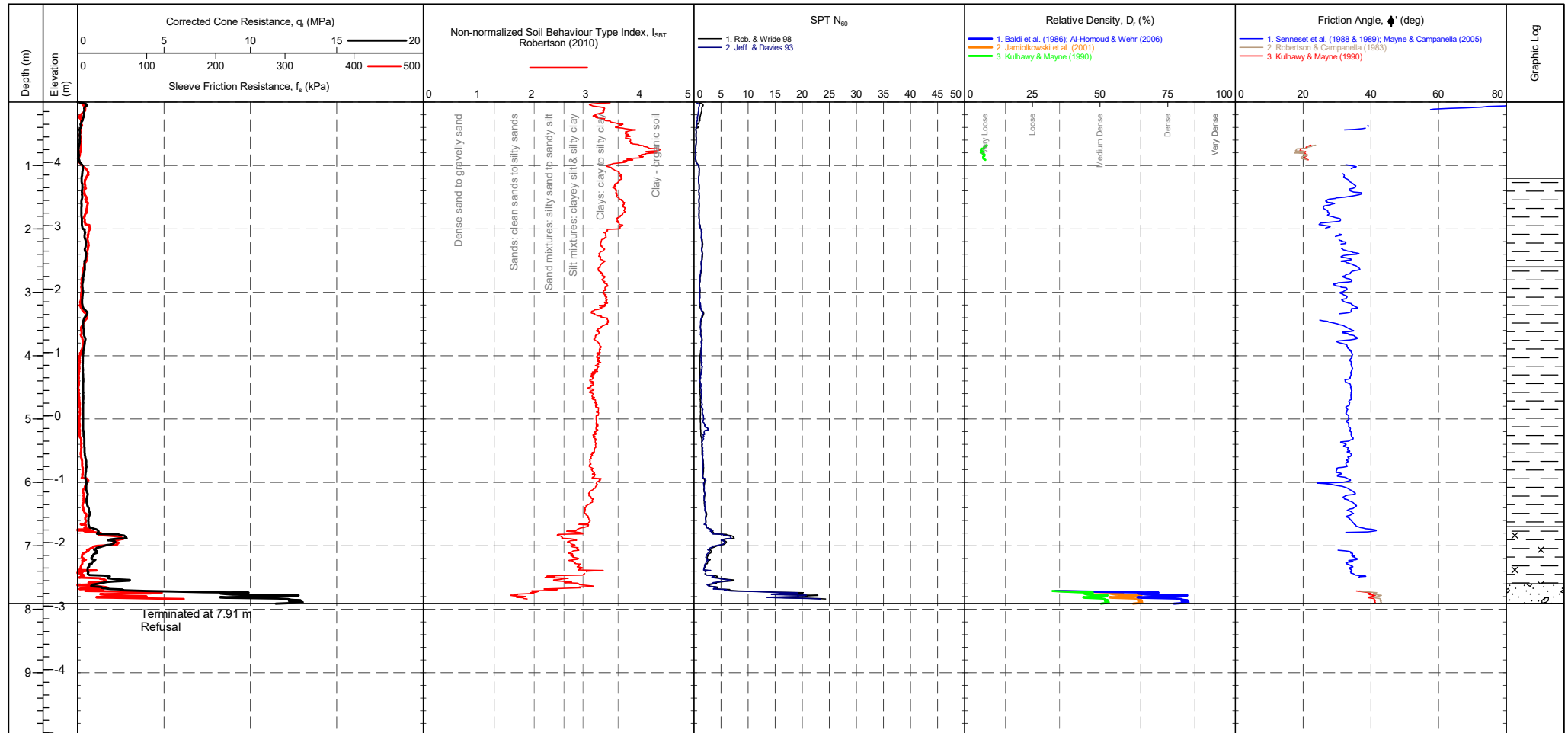
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 24/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 02  
WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level

Dissipation Test



PointID

CPT 02

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325413.600 m

NORTHING : 180803.000 m

ELEVATION : 4.950 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:  
Test refused on inclination.

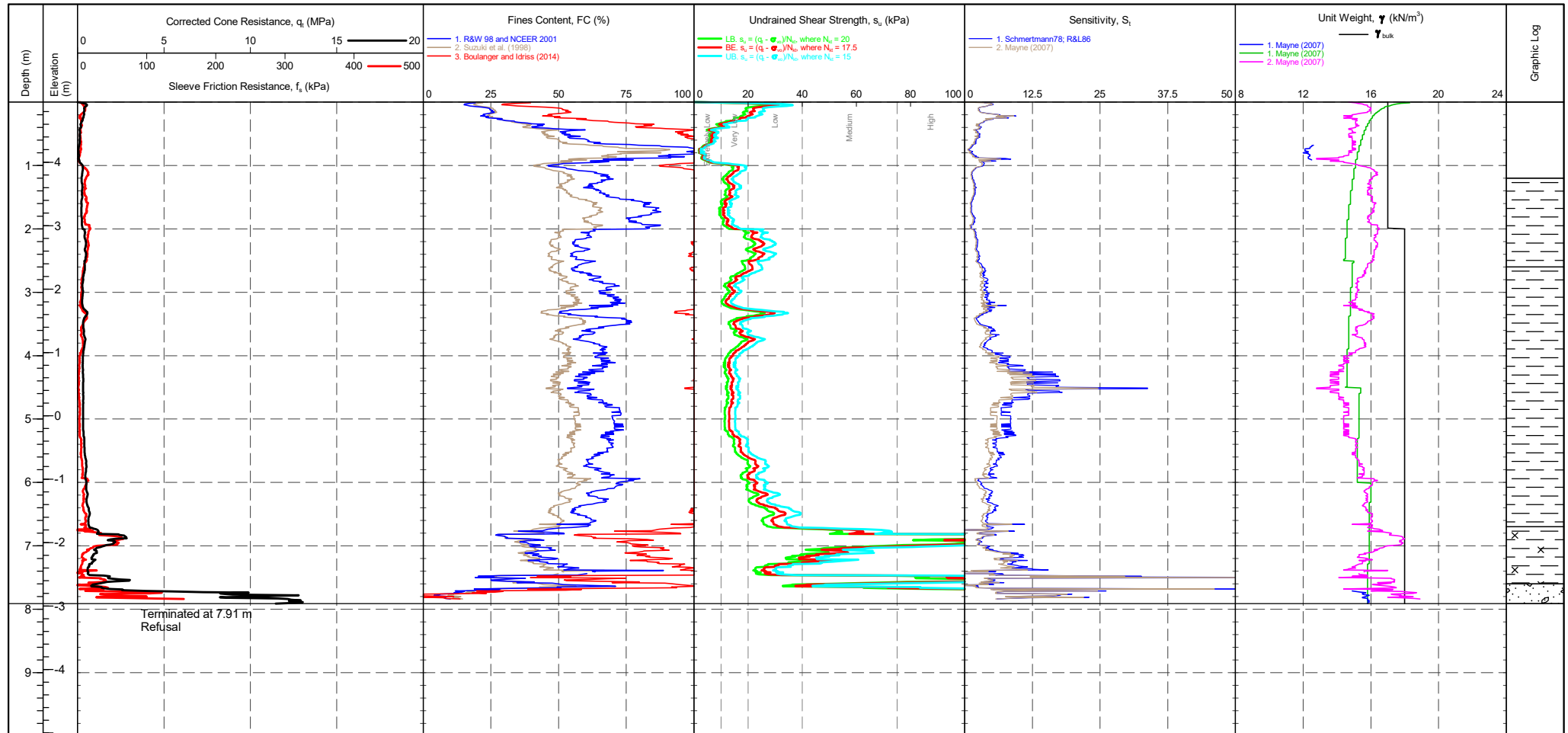
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 24/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 02  
WEATHER : Overcast & Mild

CPTU ZERO VALUES  
Transducer Pre Post Difference  
Tip  
Sleeve  
Pore Pressure 2  
X-Y Inclinator

Groundwater Level  
Dissipation Test



PointID

CPT 02

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325413.600 m

NORTHING : 180803.000 m

ELEVATION : 4.950 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on inclination.

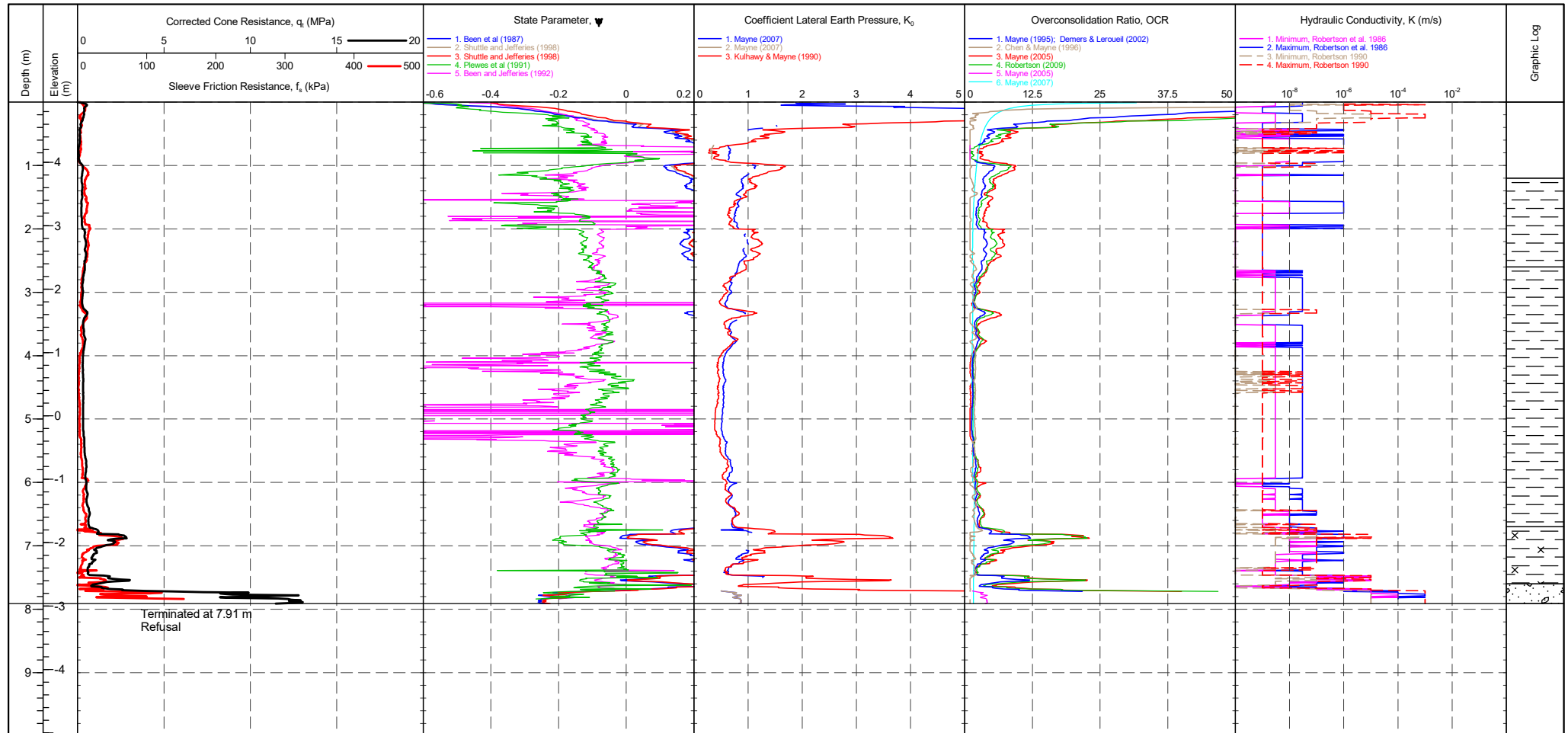
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 24/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 02  
WEATHER : Overcast & Mild

CPTU ZERO VALUES  
Transducer Pre Post Difference  
Tip  
Sleeve  
Pore Pressure 2  
X-Y Inclinator

Groundwater Level  
Dissipation Test



PointID

CPT 02

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325413.600 m

NORTHING : 180803.000 m

ELEVATION : 4.950 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:  
Test refused on inclination.

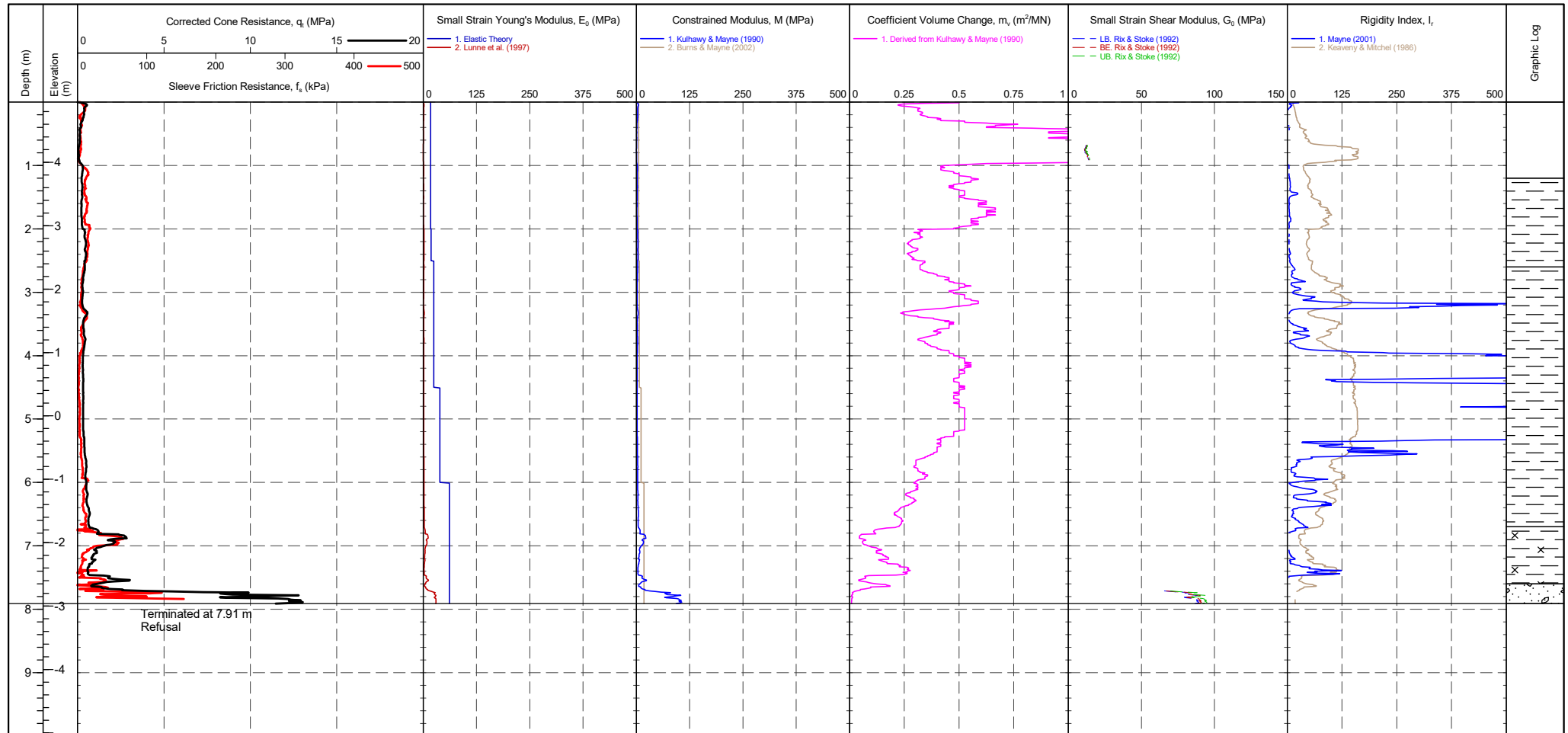
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 24/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

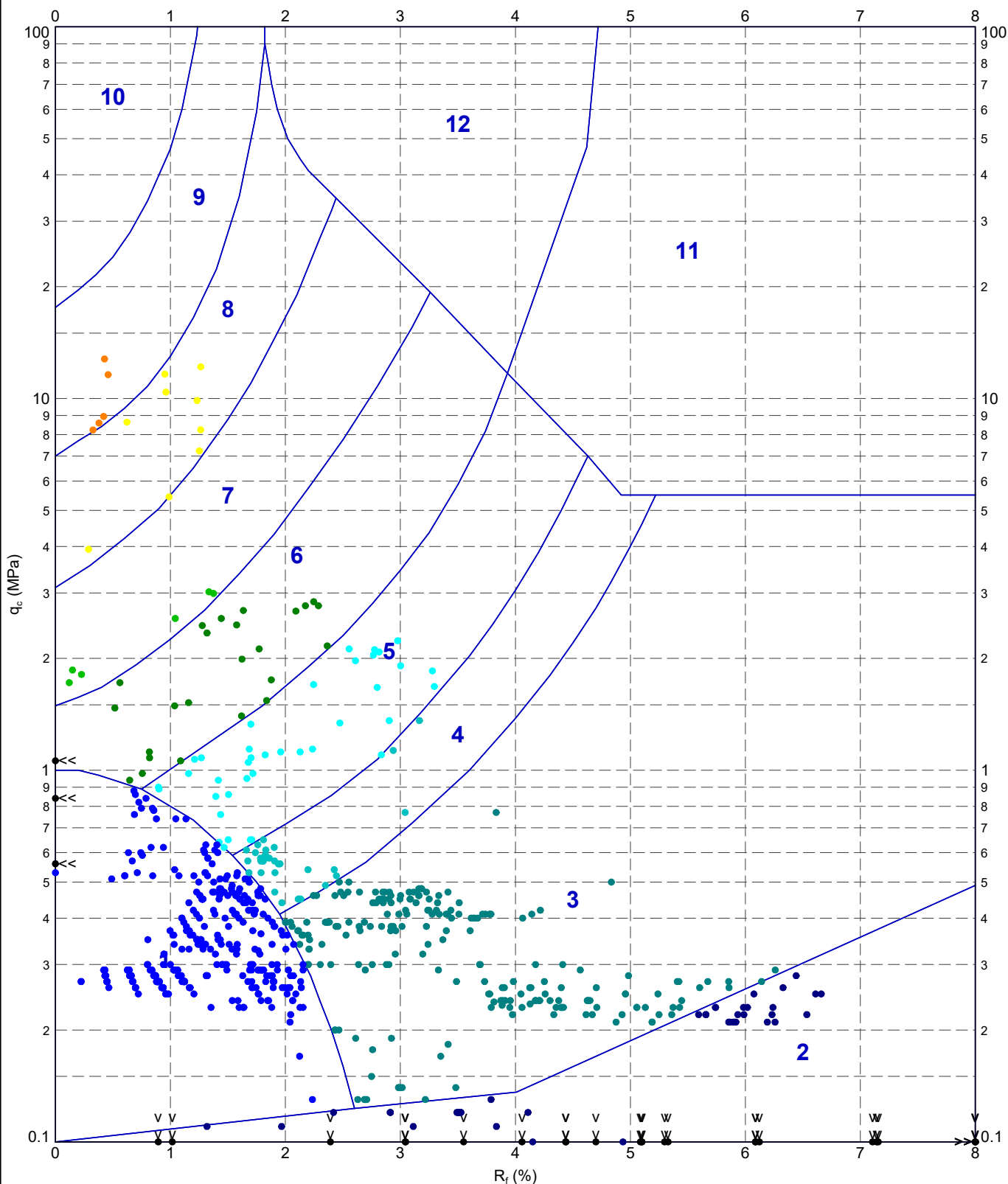
TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 02  
WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level  
Dissipation Test

INSITU 2.02.1 UB.GLB Graph: CPT ROBERTSON ET AL. 86 QC VS. RF MAP: 1190290-CARDIFF PARKWAY.GPJ <<DrawingFile>> 10/07/2019 10:07 10.0.0.000 Datagel Lab and In Situ Tool - DGD [Lib: In Situ SI 2.02.0 2017-07-10 Proj: In Situ SI 2.02.0 2017-07-10]



METHOD: Robertson et al. 1986 qc Rf

- |                                     |                               |                              |                              |
|-------------------------------------|-------------------------------|------------------------------|------------------------------|
| 1 - Sensitive fine grained material | 4 - Silty CLAY to CLAY        | 7 - Silty SAND to sandy SILT | 10 - Gravelly SAND to SAND   |
| 2 - Organic material                | 5 - Clayey SILT to silty CLAY | 8 - SAND to silty SAND       | 11 - Very stiff fine grained |
| 3 - CLAY                            | 6 - Sandy SILT to clayey SILT | 9 - SAND                     | 12 - SAND to clayey SAND     |

**IN SITU**  
SITE INVESTIGATION

TITLE

Geotechnical Engineering  
Cardiff  
Cardiff Parkway  
Robertson et al. 1986  $q_c$  vs.  $R_f$  - CPT 02

DRAWN

DATE

10/07/2019

CHECKED

DATE

10/07/2019

SCALE

Not To Scale

A4

PROJECT No

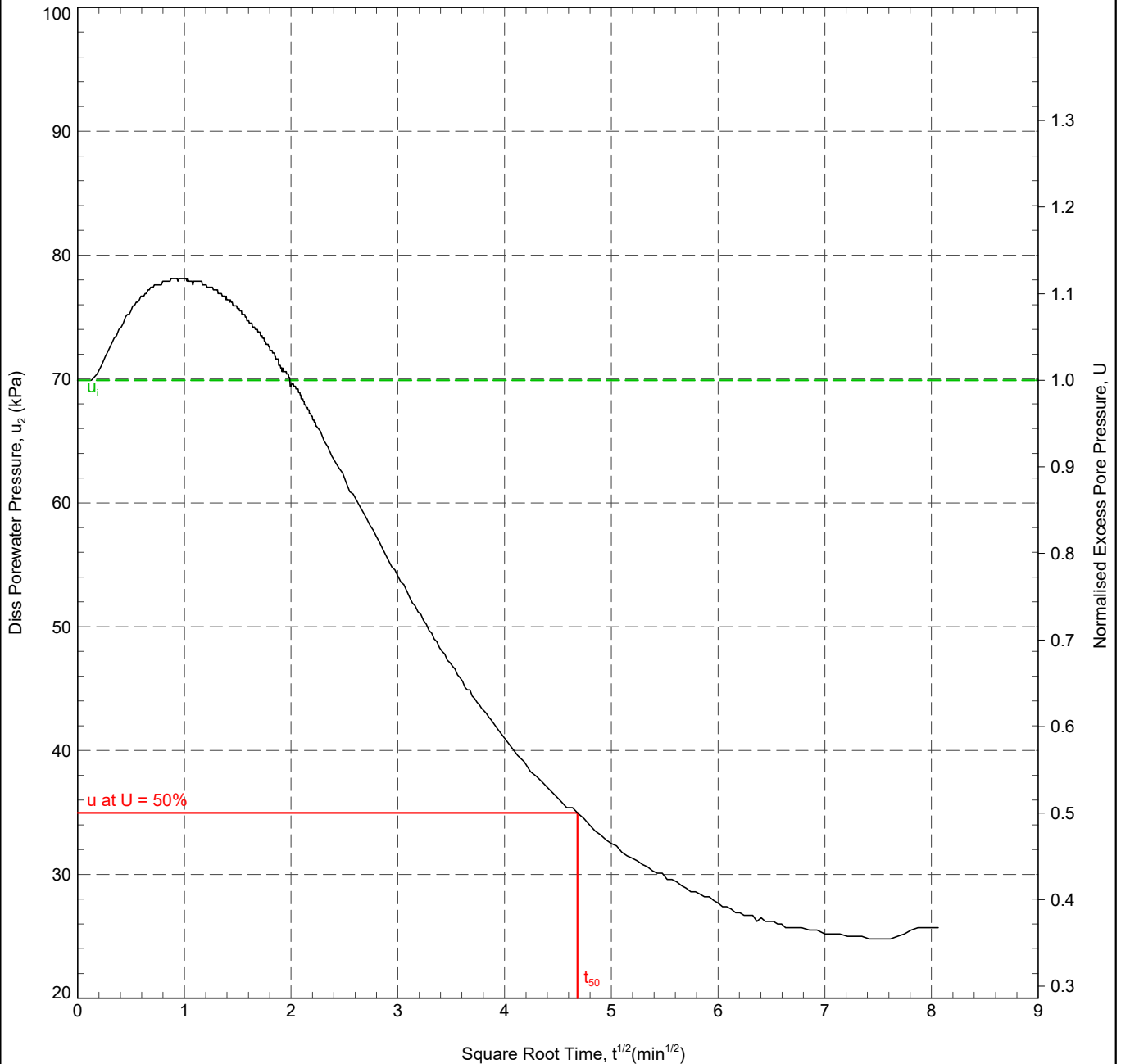
1190290

FIGURE No

CLIENT : Geotechnical Engineering  
ENGINEER :  
PROJECT : Cardiff Parkway  
LOCATION : Cardiff  
PROJECT No. : 1190290

AREA : Cardiff  
EASTING : 325413.6 m  
NORTHING : 180803.0 m  
COORD. SYS.:  
ELEVATION : 4.95 m

SHEET : 1 OF 1  
STATUS : Final  
DATE : 24/06/19



In Situ Pore Pressure,  $u_0$ : 0.0 kPa  
Initial Pore Pressure,  $u_i$ : 69.9 kPa  
Final Pore Pressure: 25.7 kPa  
Degree of Dissipation: 50%  
Dissipation Pressure: 35.0 kPa  
Time for 50% Dissipation,  $t_{50}$ : 21.93 min

Rigidity Index,  $I_r$ : 100  
Horizontal Coefficient of Consolidation,  $c_h$ :  $3.11 \times 10^{-1} \text{ m}^2/\text{yr}$   
Ratio  $c_h/c_v$ : 1.25  
Vertical Coefficient of Consolidation,  $c_v$ :  $2.49 \times 10^{-1} \text{ m}^2/\text{yr}$

RIG :  
CONE TYPE : S15-CFIP  
CONE ID : S15-CFIP.1735  
OPERATOR : AG & CM

ANALYSED BY : LD  
CHECKED BY : LD  
APPROVED BY : DW

DATE: 03/07/2019  
DATE: 03/07/2019  
DATE: 03/07/2019

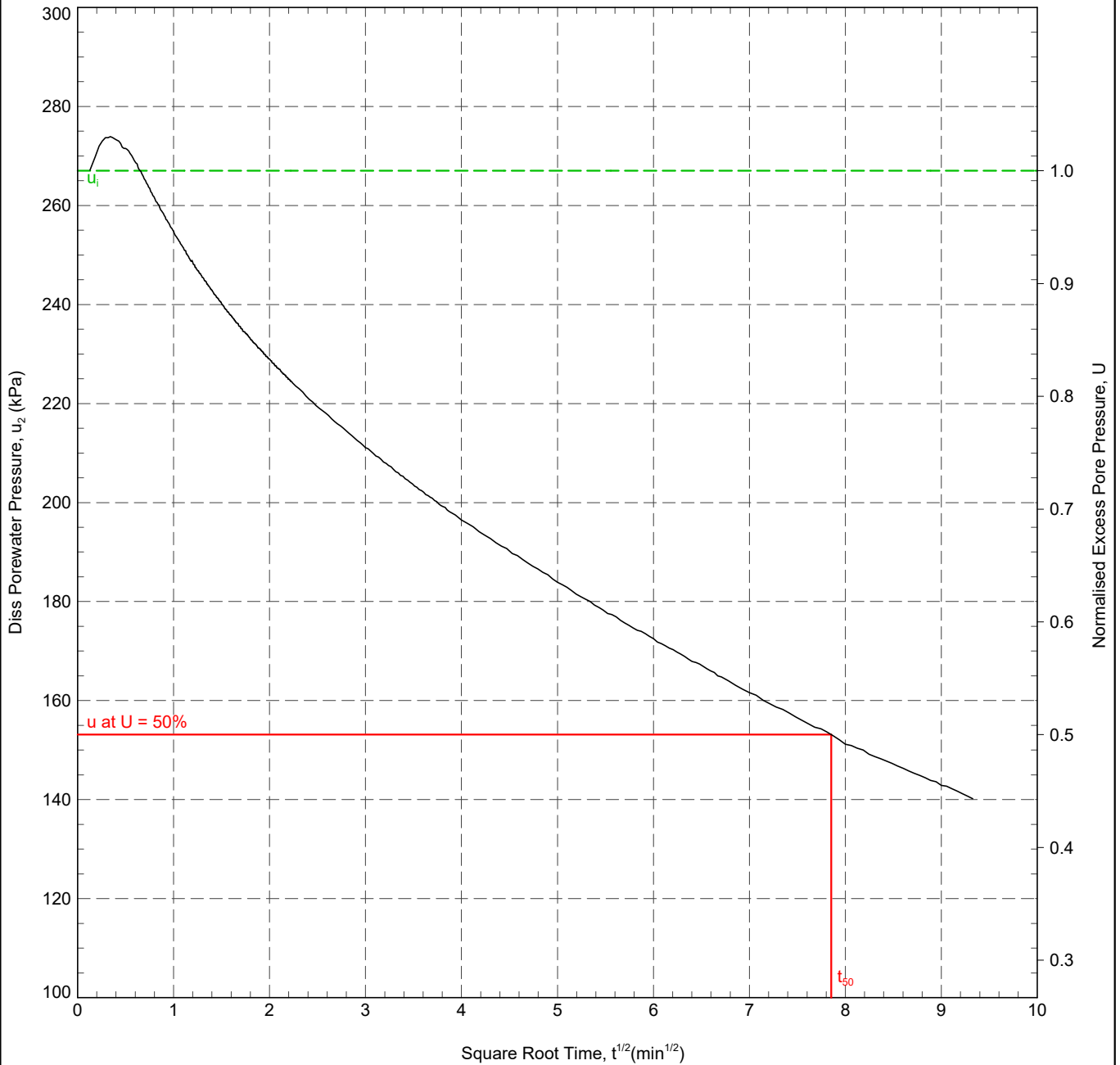
REMARK  
Test OK.



CLIENT : Geotechnical Engineering  
ENGINEER :  
PROJECT : Cardiff Parkway  
LOCATION : Cardiff  
PROJECT No. : 1190290

AREA : Cardiff  
EASTING : 325413.6 m  
NORTHING : 180803.0 m  
COORD. SYS.:  
ELEVATION : 4.95 m

SHEET : 1 OF 1  
STATUS : Final  
DATE : 24/06/19



In Situ Pore Pressure,  $u_0$ : 39.2 kPa  
Initial Pore Pressure,  $u_i$ : 267.0 kPa  
Final Pore Pressure,  $u_f$ : 140.2 kPa  
Degree of Dissipation: 50%  
Dissipation Pressure: 153.1 kPa  
Time for 50% Dissipation,  $t_{50}$ : 61.67 min

Rigidity Index,  $I_r$ : 100  
Horizontal Coefficient of Consolidation,  $c_h$ :  $1.10 \times 10^1$  m<sup>2</sup>/yr  
Ratio  $c_h/c_v$ : 1.25  
Vertical Coefficient of Consolidation,  $c_v$ :  $8.84 \times 10^0$  m<sup>2</sup>/yr

RIG :  
CONE TYPE : S15-CFIP  
CONE ID : S15-CFIP.1735  
OPERATOR : AG & CM

ANALYSED BY : LD  
CHECKED BY : LD  
APPROVED BY : DW

DATE: 03/07/2019  
DATE: 03/07/2019  
DATE: 03/07/2019

REMARK  
Test OK.



PointID

CPT 03

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325294.200 m

NORTHING : 180730.200 m

ELEVATION : 5.400 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

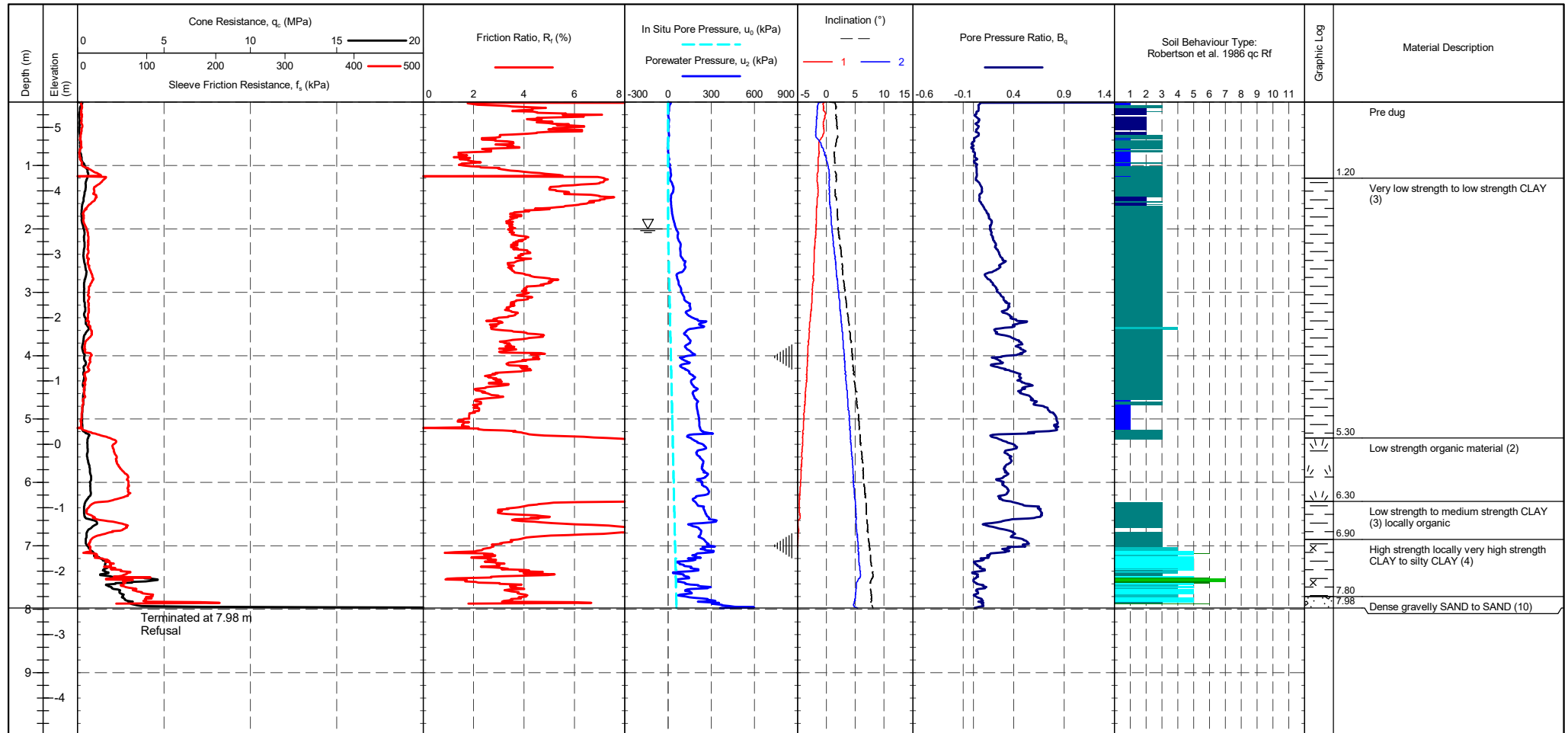
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 03  
WEATHER : Overcast & Mild

Transducer :  
Tip :  
Sleeve :  
Pore Pressure 2 :  
X-Y Inclinator :  
CPTU ZERO VALUES  
Pre Post Difference

METHOD: Robertson et al. 1986  $q_c$   $R_f$

1 - Sensitive fine grained material	5 - Clayey SILT to silty CLAY	9 - SAND
2 - Organic material	6 - Sandy SILT to clayey SILT	10 - Gravelly SAND to SAND
3 - CLAY	7 - Silty SAND to sandy SILT	11 - Very stiff fine grained
4 - Silty CLAY to CLAY	8 - SAND to silty SAND	12 - SAND to clayey SAND

Groundwater Level  
Dissipation Test



PointID

CPT 03

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325294.200 m

NORTHING : 180730.200 m

ELEVATION : 5.400 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

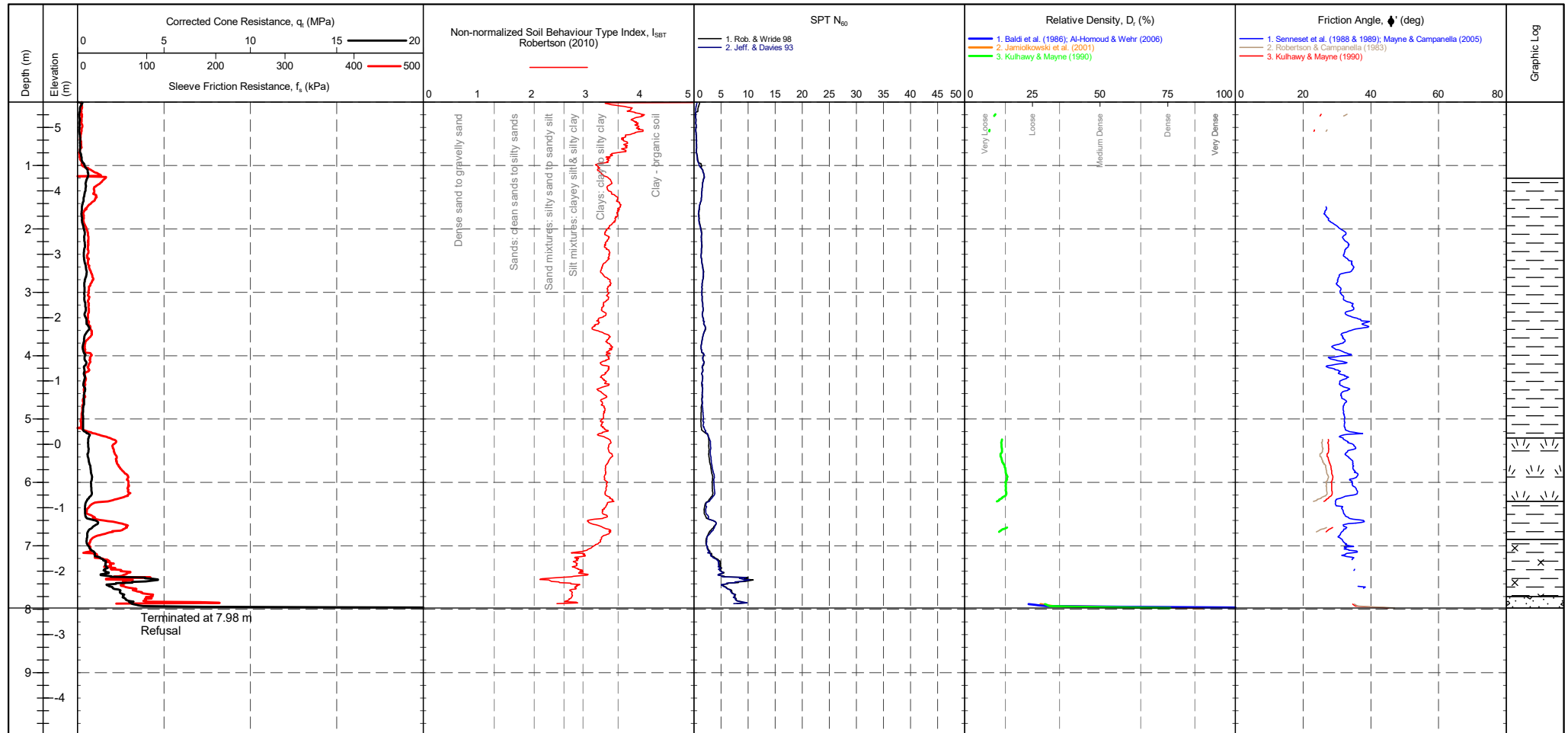
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 03  
WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinometer			

Groundwater Level

Dissipation Test



PointID

CPT 03

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325294.200 m

NORTHING : 180730.200 m

ELEVATION : 5.400 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

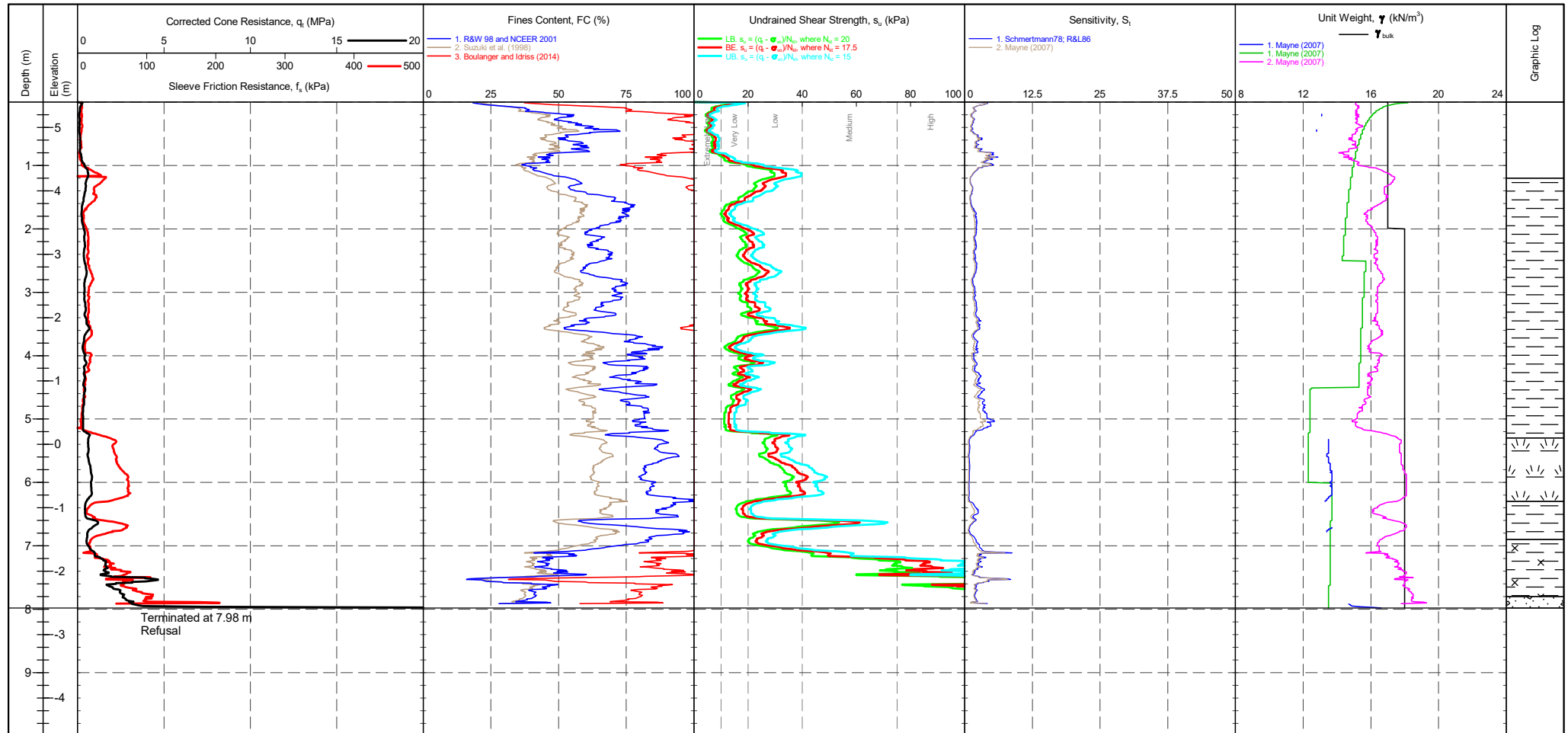
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 03  
WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y inclinometer			

Groundwater Level

Dissipation Test



PointID

## CPT 03

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325294.200 m

NORTHING : 180730.200 m

ELEVATION : 5.400 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

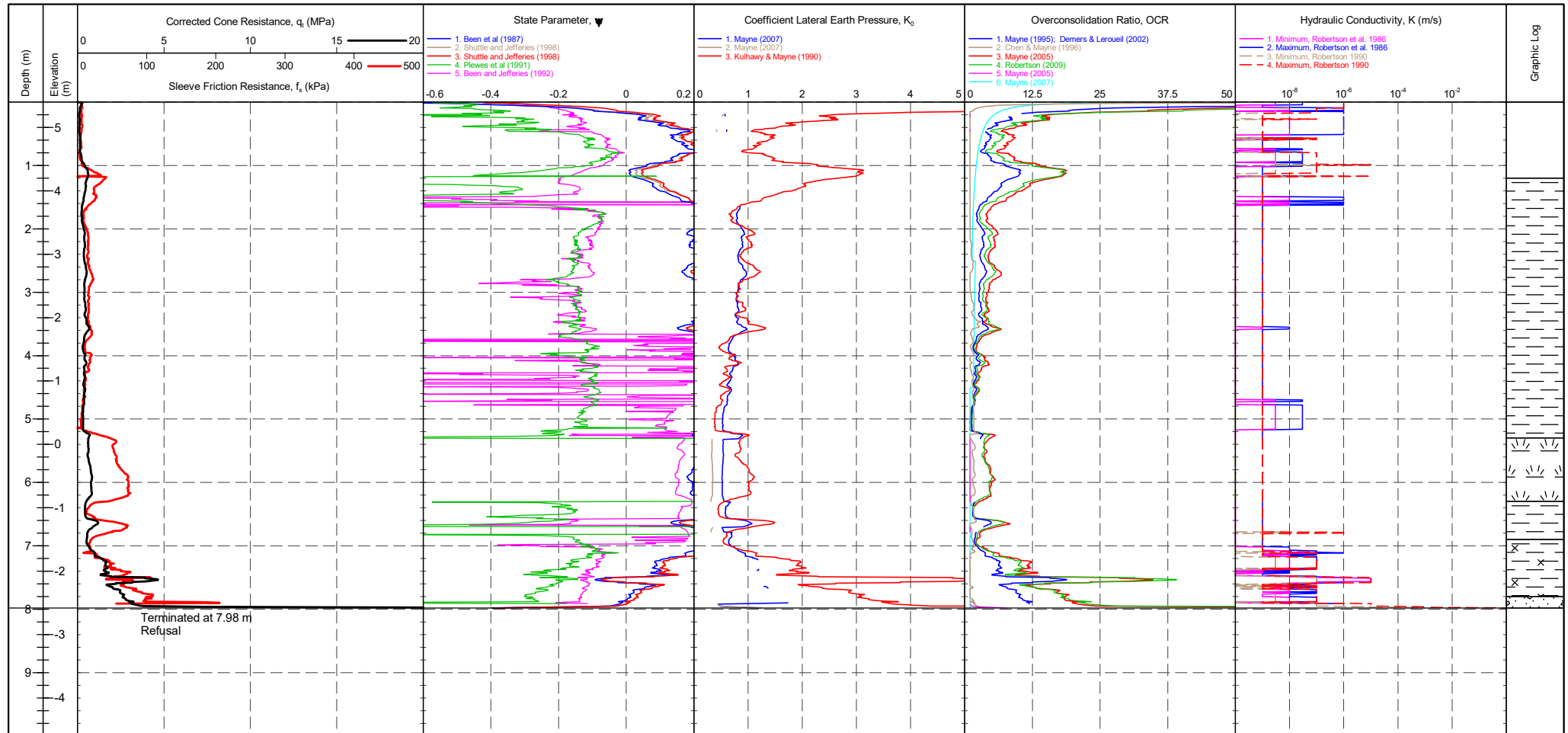
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 03  
WEATHER : Overcast & Mild

CPTU ZERO VALUES  
Transducer Pre Post Difference  
Tip  
Sleeve  
Pore Pressure 2  
X-Y Inclinator

Groundwater Level  
Dissipation Test



PointID

CPT 03

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325294.200 m

NORTHING : 180730.200 m

ELEVATION : 5.400 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

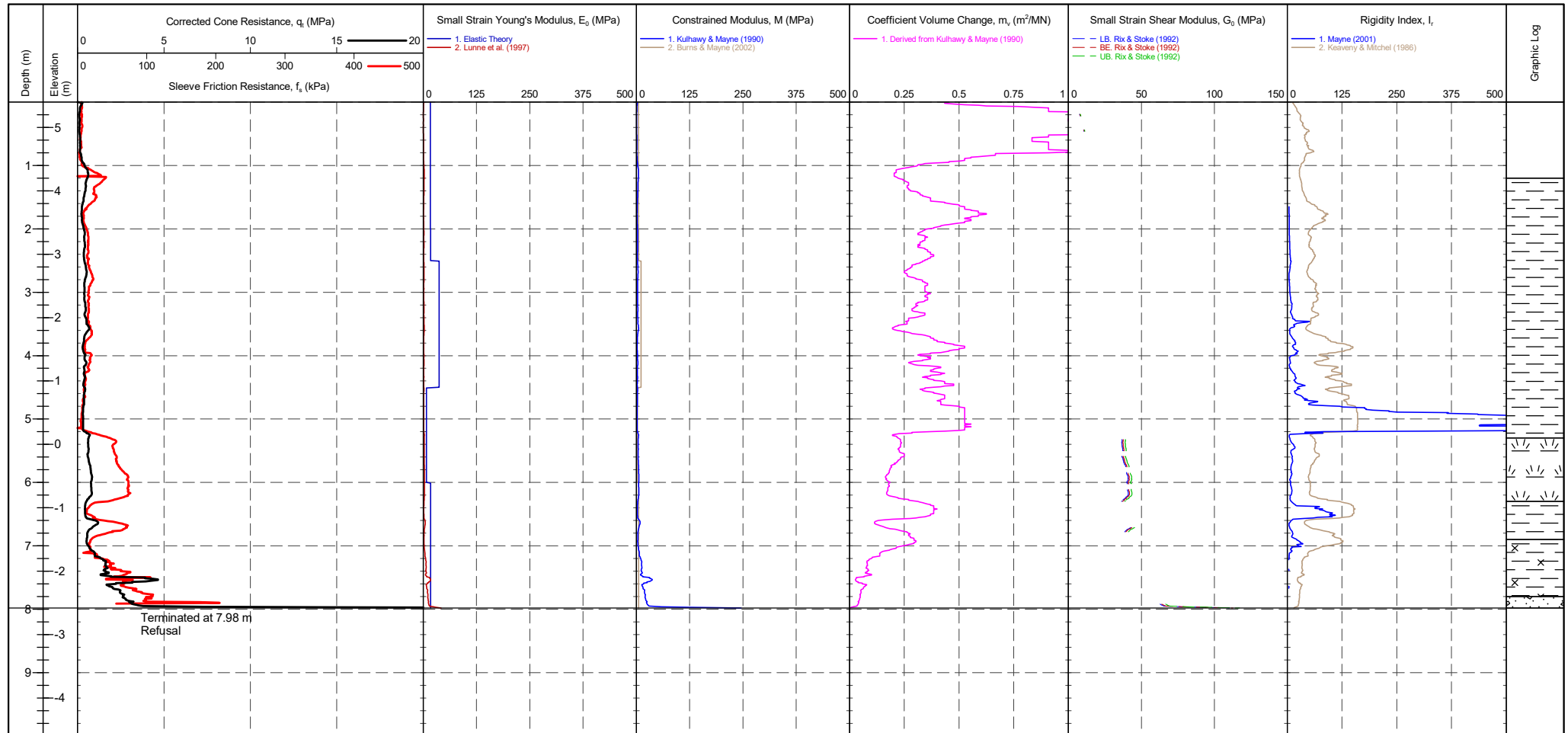
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
 CONE AREA : 15cm<sup>2</sup>  
 CONE AREA RATIO : 0.8  
 FILTER POSITION : u2  
 FILTER TYPE : HDPE  
 FRICTION REDUCER : None

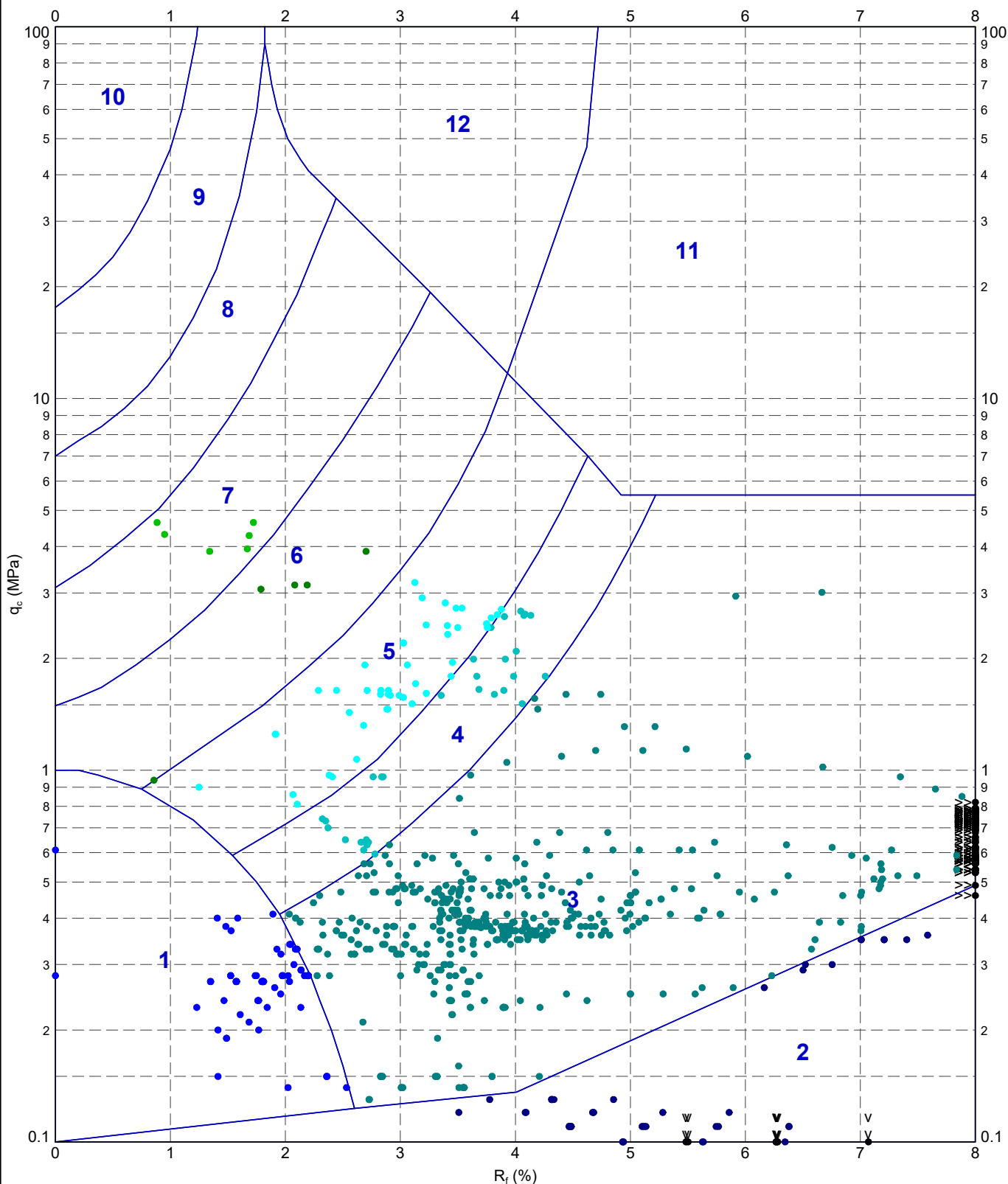
TEST TYPE : TE2  
 APPLICATION CLASS : 2  
 RIG :  
 OPERATOR :  
 FILE NAME : 1190290-CPT 03  
 WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level  
 Dissipation Test

INSITU 2.02.1 UB.GLB Graph: CPT ROBERTSON ET AL. 86 QC VS. RF MAP: 1190290-CARDIFF PARKWAY.GPJ <<DrawingFile>> 10/07/2019 10:07 10.0.000 D:\git\In Situ\SI 2.02.0\2017-07-10\Proj\In Situ\SI 2.02.0\2017-07-10



METHOD: Robertson et al. 1986 qc Rf

- |                                     |                               |                              |                              |
|-------------------------------------|-------------------------------|------------------------------|------------------------------|
| 1 - Sensitive fine grained material | 4 - Silty CLAY to CLAY        | 7 - Silty SAND to sandy SILT | 10 - Gravelly SAND to SAND   |
| 2 - Organic material                | 5 - Clayey SILT to silty CLAY | 8 - SAND to silty SAND       | 11 - Very stiff fine grained |
| 3 - CLAY                            | 6 - Sandy SILT to clayey SILT | 9 - SAND                     | 12 - SAND to clayey SAND     |

**IN SITU**  
SITE INVESTIGATION

TITLE

Geotechnical Engineering  
Cardiff  
Cardiff Parkway  
Robertson et al. 1986  $q_c$  vs.  $R_f$  - CPT 03

DRAWN

DATE

10/07/2019

CHECKED

DATE

10/07/2019

SCALE

Not To Scale

A4

PROJECT No

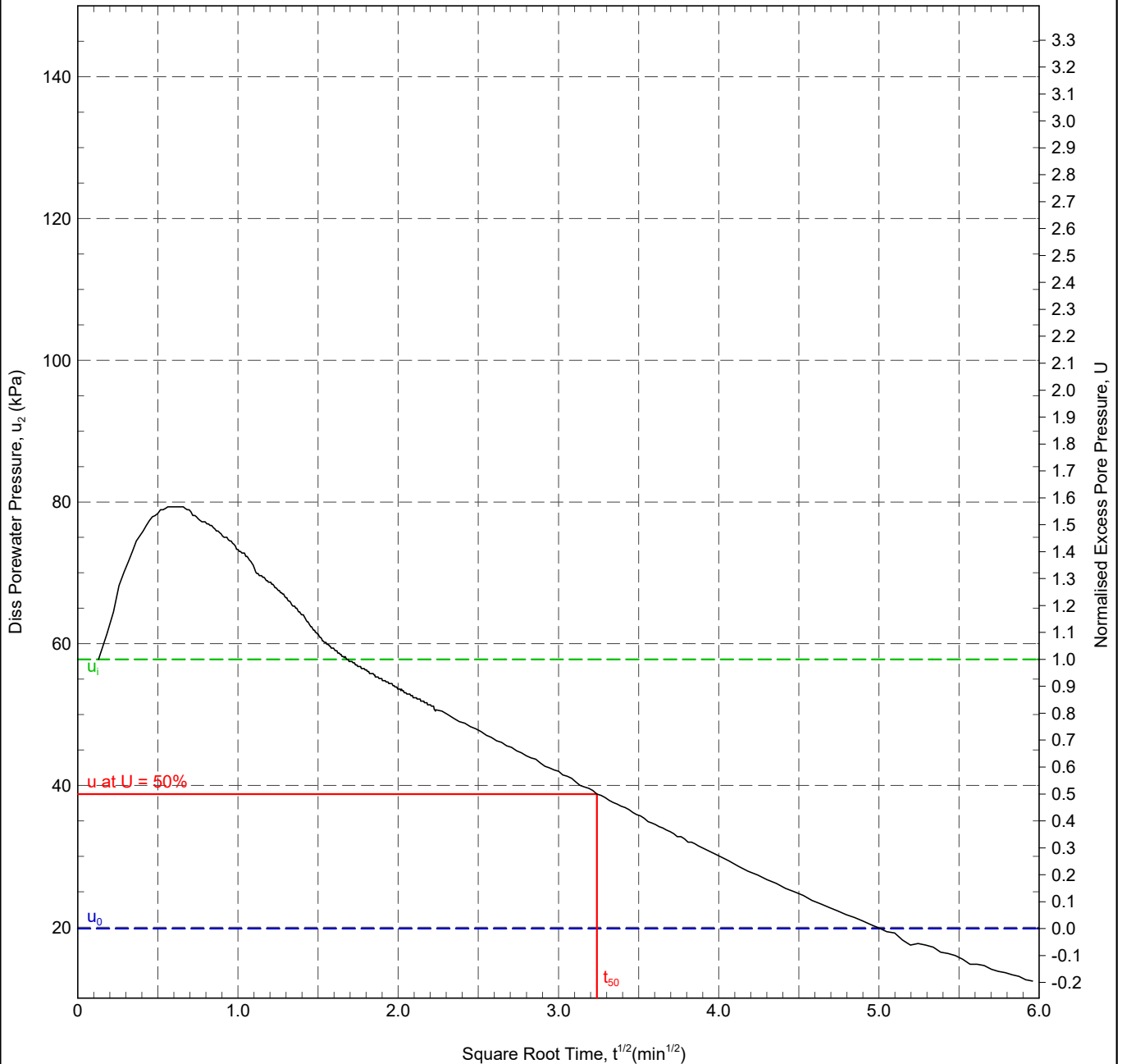
1190290

FIGURE No

CLIENT : Geotechnical Engineering  
ENGINEER :  
PROJECT : Cardiff Parkway  
LOCATION : Cardiff  
PROJECT No. : 1190290

AREA : Cardiff  
EASTING : 325294.2 m  
NORTHING : 180730.2 m  
COORD. SYS.:  
ELEVATION : 5.40 m

SHEET : 1 OF 1  
STATUS : Final  
DATE : 21/06/19



In Situ Pore Pressure,  $u_0$ : 19.8 kPa  
Initial Pore Pressure,  $u_1$ : 57.8 kPa  
Final Pore Pressure: 12.4 kPa  
Degree of Dissipation: 50%  
Dissipation Pressure: 38.8 kPa  
Time for 50% Dissipation,  $t_{50}$ : 10.50 min

Rigidity Index,  $I_r$ : 50  
Horizontal Coefficient of Consolidation,  $c_h$ :  $4.59 \times 10^1$  m<sup>2</sup>/yr  
Ratio  $c_h/c_v$ : 1.25  
Vertical Coefficient of Consolidation,  $c_v$ :  $3.67 \times 10^1$  m<sup>2</sup>/yr

RIG :  
CONE TYPE : S15-CFIP  
CONE ID : S15-CFIP.1735  
OPERATOR : AG & CM

ANALYSED BY : LD  
CHECKED BY : LD  
APPROVED BY : DW

DATE: 03/07/2019  
DATE: 03/07/2019  
DATE: 03/07/2019

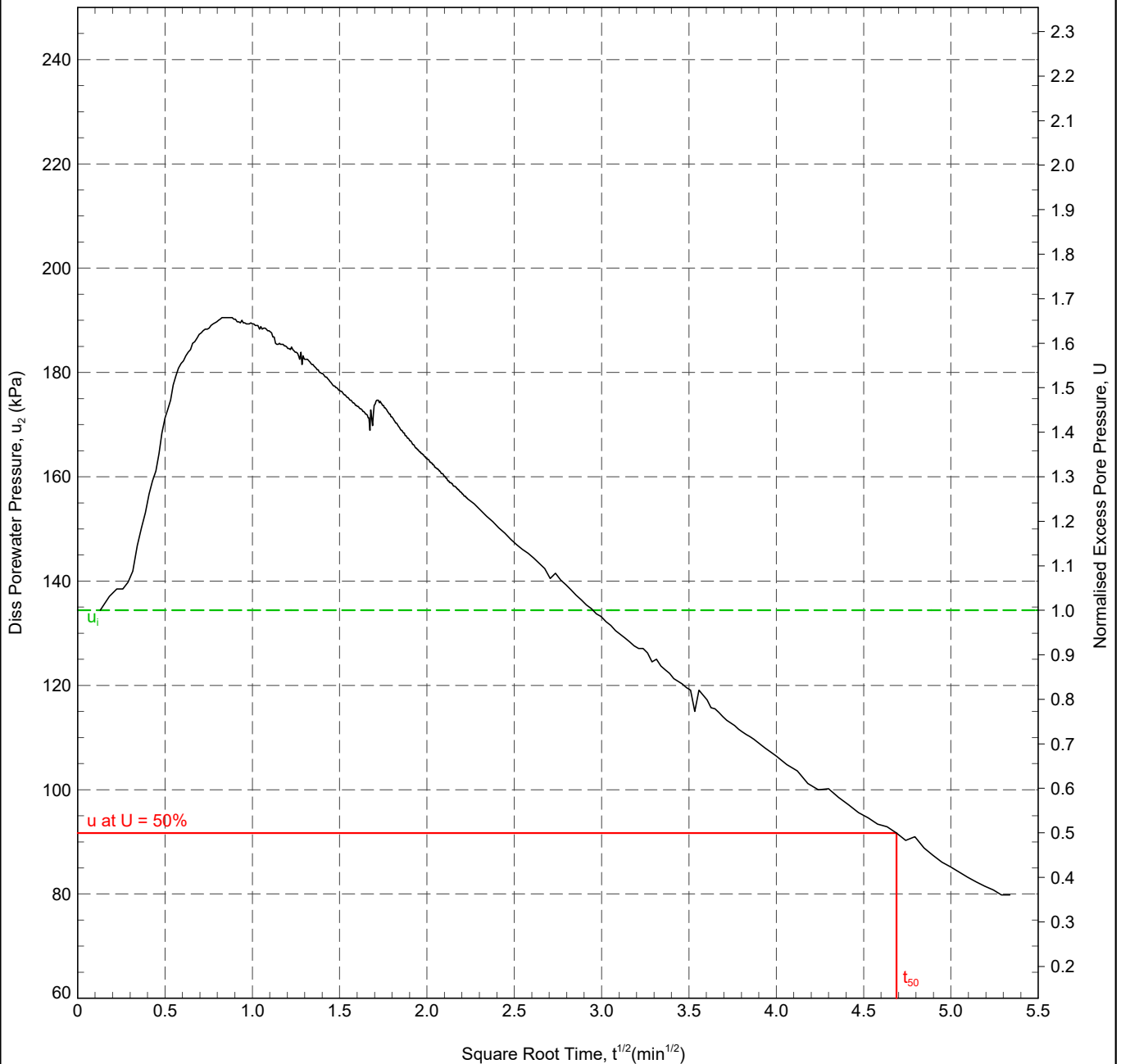
REMARK  
Test OK.



CLIENT : Geotechnical Engineering  
ENGINEER :  
PROJECT : Cardiff Parkway  
LOCATION : Cardiff  
PROJECT No. : 1190290

AREA : Cardiff  
EASTING : 325294.2 m  
NORTHING : 180730.2 m  
COORD. SYS.:  
ELEVATION : 5.40 m

SHEET : 1 OF 1  
STATUS : Final  
DATE : 21/06/19



In Situ Pore Pressure,  $u_0$ : 49.1 kPa  
Initial Pore Pressure,  $u_i$ : 134.4 kPa  
Final Pore Pressure: 79.8 kPa  
Degree of Dissipation: 50%  
Dissipation Pressure: 91.7 kPa  
Time for 50% Dissipation,  $t_{50}$ : 21.98 min

Rigidity Index,  $I_r$ : 50  
Horizontal Coefficient of Consolidation,  $c_h$ :  $2.19 \times 10^{-1}$  m<sup>2</sup>/yr  
Ratio  $c_h/c_v$ : 1.25  
Vertical Coefficient of Consolidation,  $c_v$ :  $1.75 \times 10^{-1}$  m<sup>2</sup>/yr

RIG :  
CONE TYPE : S15-CFIP  
CONE ID : S15-CFIP.1735  
OPERATOR : AG & CM

ANALYSED BY : LD  
CHECKED BY : LD  
APPROVED BY : DW

DATE: 03/07/2019  
DATE: 03/07/2019  
DATE: 03/07/2019

REMARK  
Test OK.



PointID

CPT 04

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325195.400 m

NORTHING : 180664.200 m

ELEVATION : 5.250 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

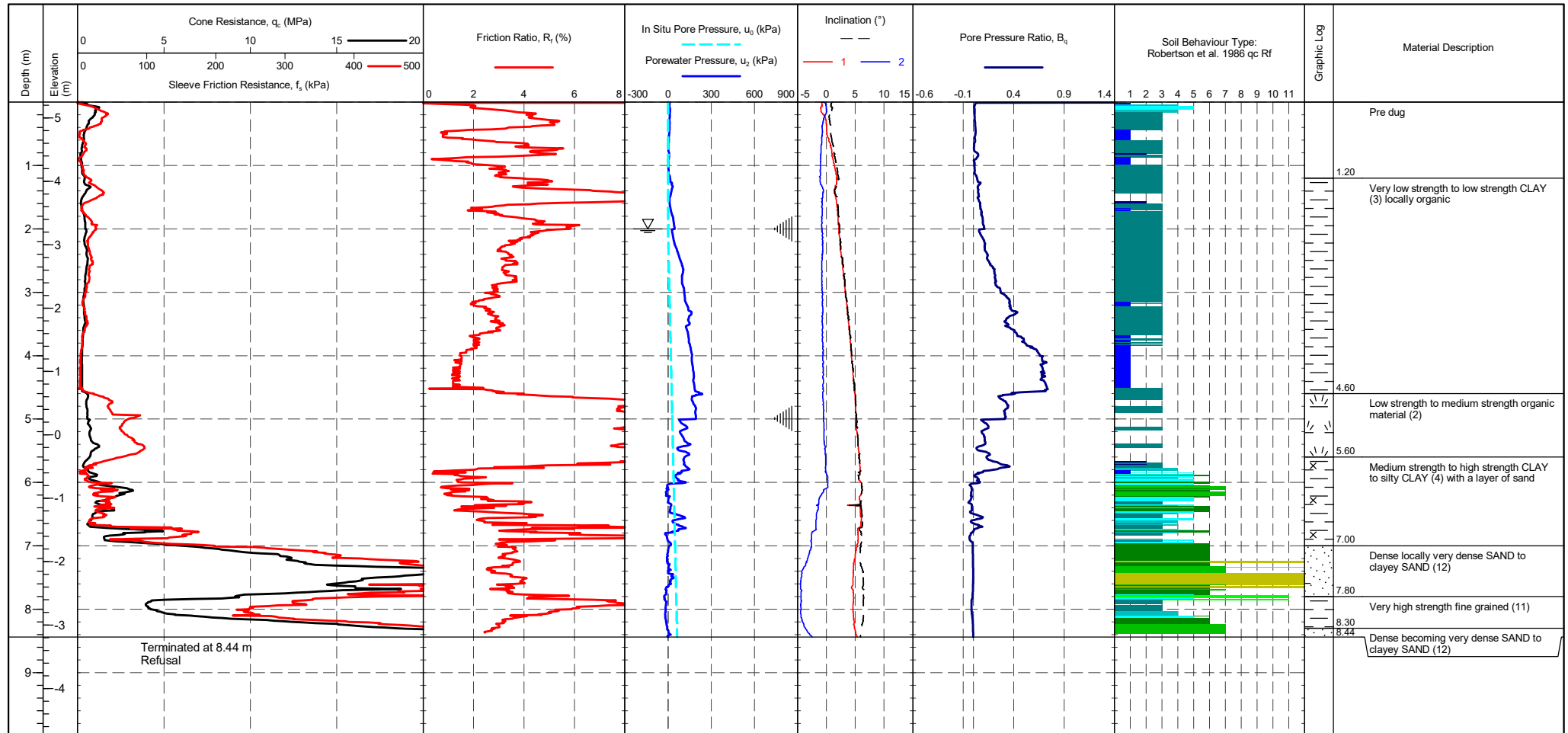
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 04  
WEATHER : Overcast & Mild

Transducer :  
Tip :  
Sleeve :  
Pore Pressure 2 :  
X-Y Inclinator :

CPTU ZERO VALUES

Pre	Post	Difference

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material	5 - Clayey SILT to silty CLAY	9 - SAND
2 - Organic material	6 - Sandy SILT to clayey SILT	10 - Gravelly SAND to SAND
3 - CLAY	7 - Silty SAND to sandy SILT	11 - Very stiff fine grained
4 - Silty CLAY to CLAY	8 - SAND to silty SAND	12 - SAND to clayey SAND

Groundwater Level

Dissipation Test



PointID

CPT 04

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325195.400 m

NORTHING : 180664.200 m

ELEVATION : 5.250 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:  
Test refused on total pressure.

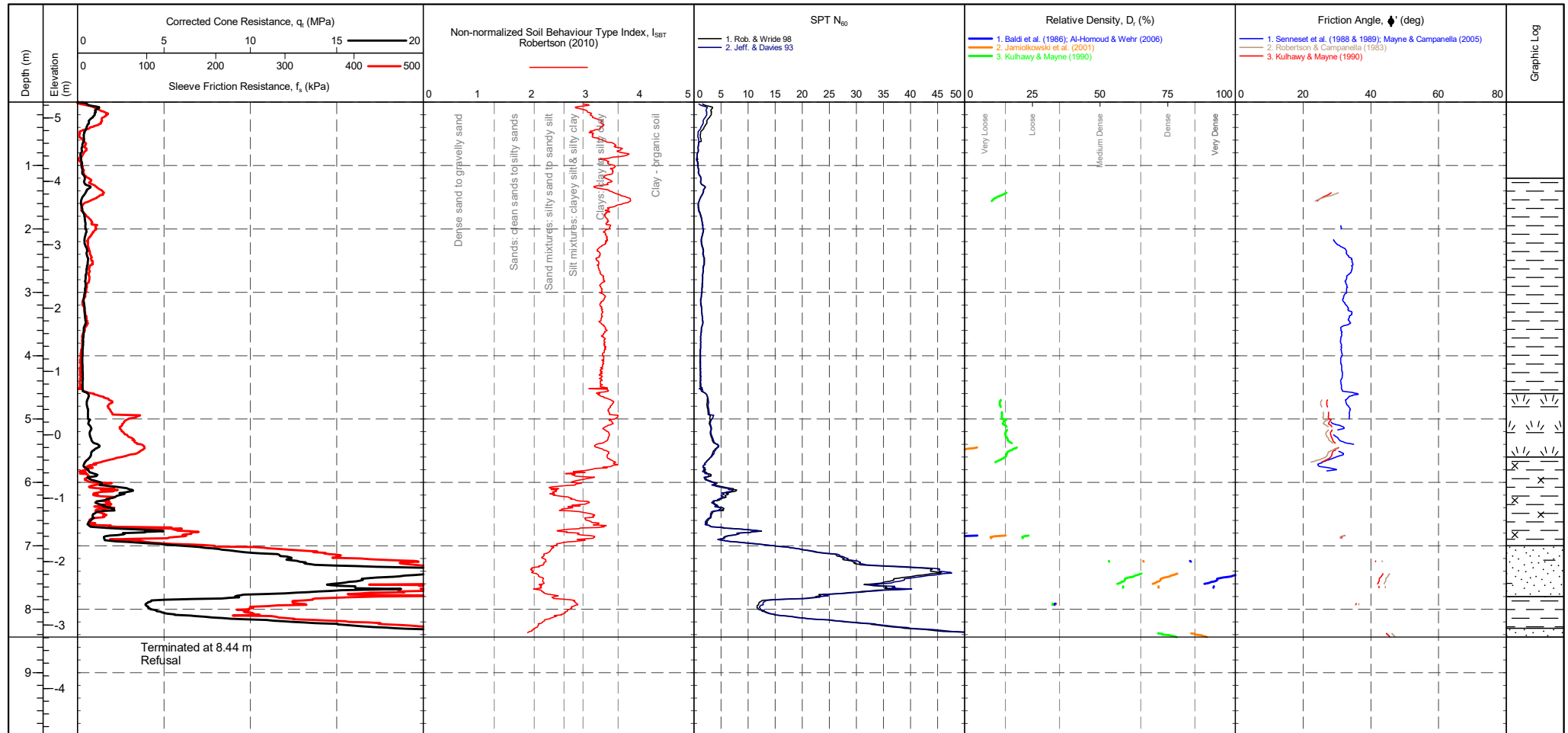
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 04  
WEATHER : Overcast & Mild

CPTU ZERO VALUES  
Transducer Pre Post Difference  
Tip  
Sleeve  
Pore Pressure 2  
X-Y Inclinator

Groundwater Level  
Dissipation Test



PointID

CPT 04

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325195.400 m

NORTHING : 180664.200 m

ELEVATION : 5.250 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:  
Test refused on total pressure.

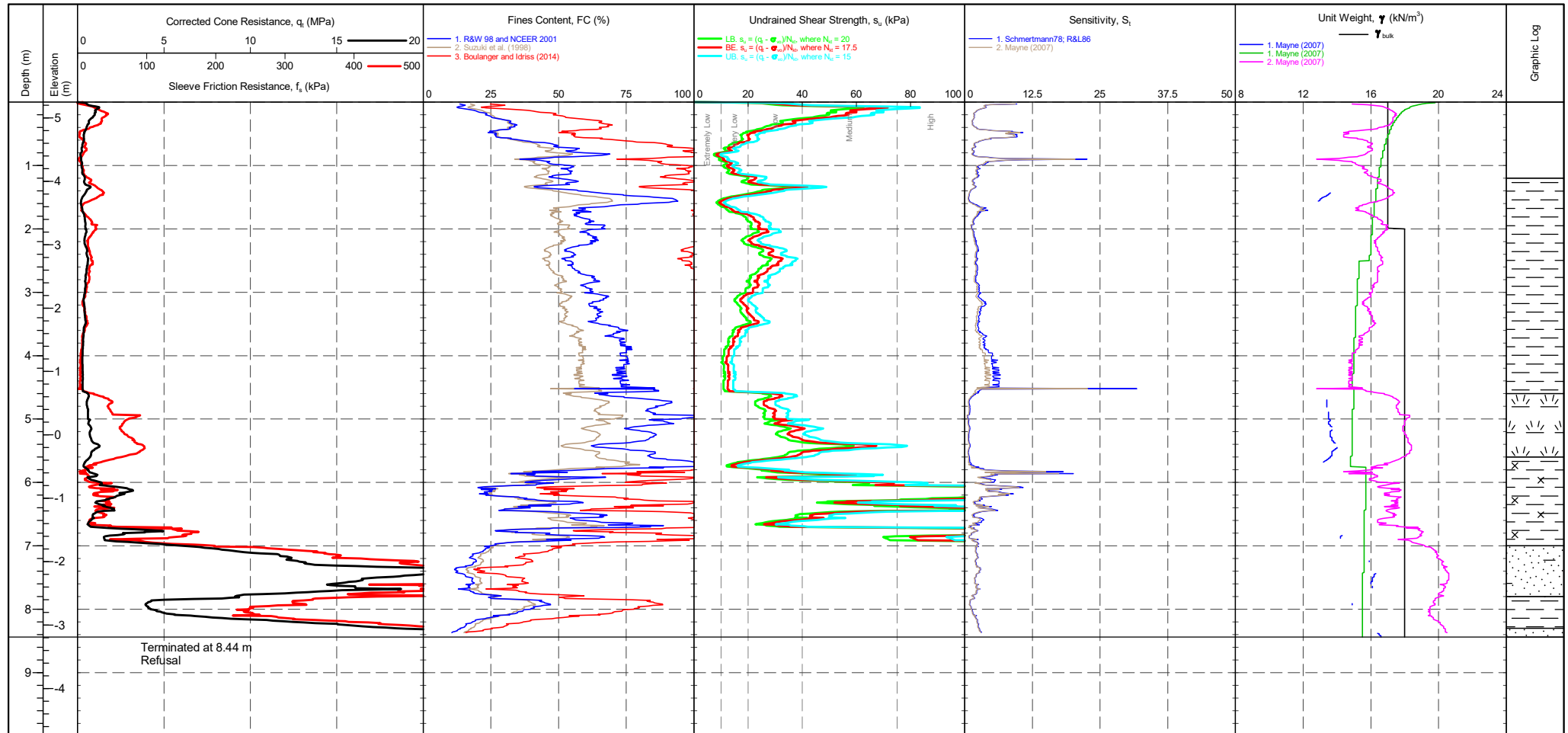
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 04  
WEATHER : Overcast & Mild

CPTU ZERO VALUES  
Transducer Pre Post Difference  
Tip  
Sleeve  
Pore Pressure 2  
X-Y Inclinator

Groundwater Level  
Dissipation Test



PointID

CPT 04

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325195.400 m

NORTHING : 180664.200 m

ELEVATION : 5.250 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

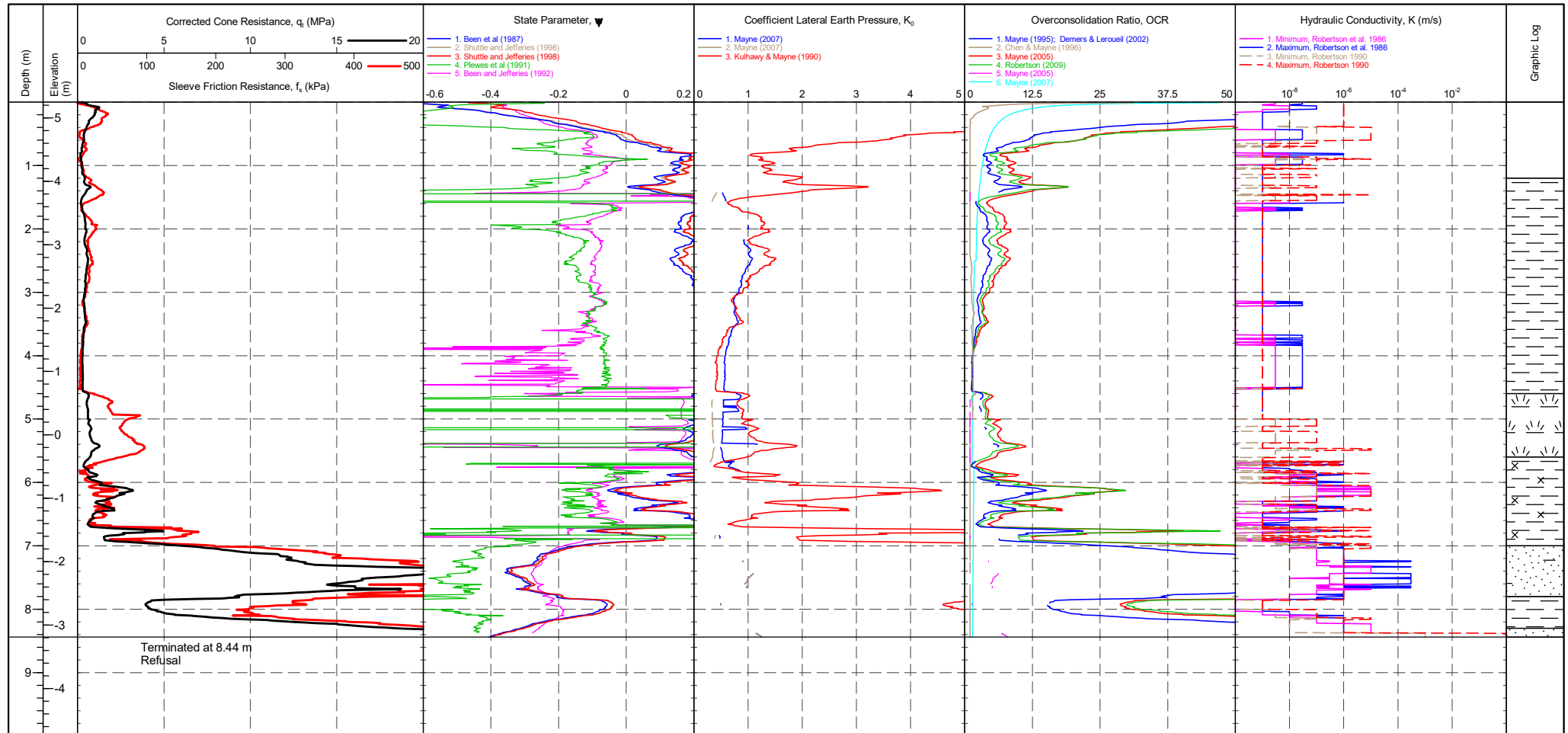
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 04  
WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level

Dissipation Test



PointID

CPT 04

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325195.400 m

NORTHING : 180664.200 m

ELEVATION : 5.250 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

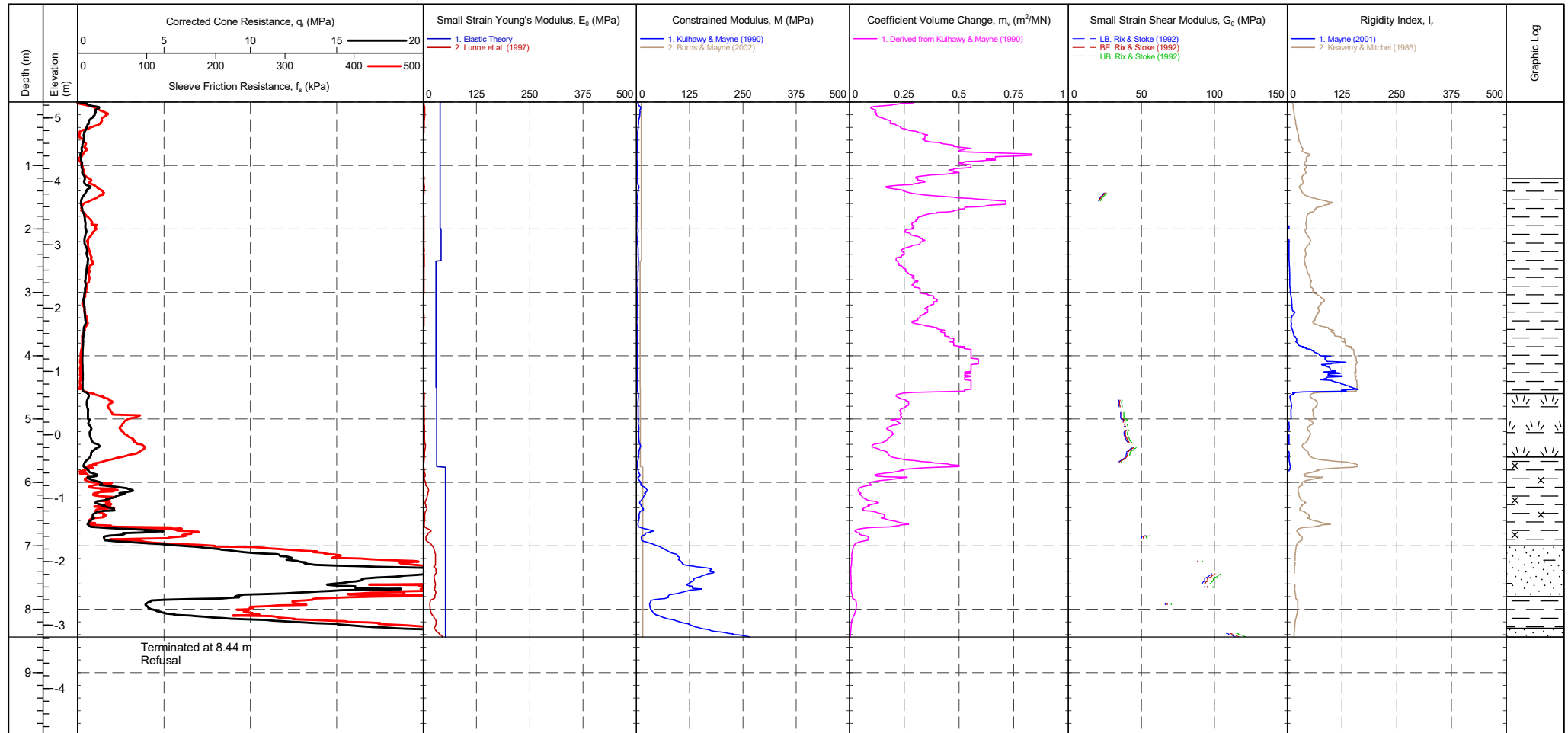
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

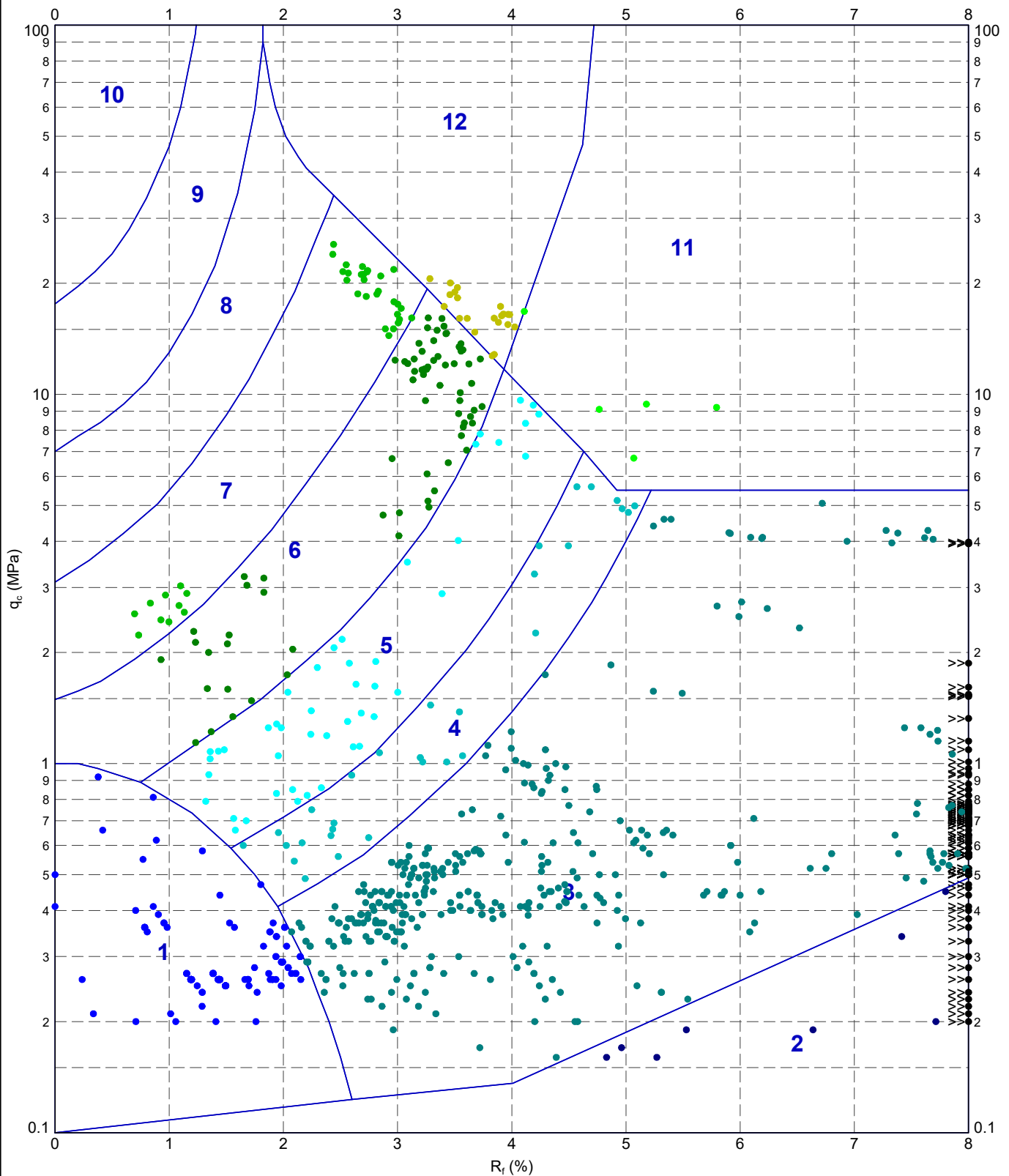
TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 04  
WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level  
Dissipation Test

INSITU 2.02.1 UB.GLB Graph CPT ROBERTSON ET AL. 86 QC VS. RF MAP 1190290-CARDIFF PARKWAY.GPJ <<DrawingFile>> 10/07/2019 10:08 10.0.0.000 Datagel Lab and In Situ Tool - DGD [Lib: In Situ SI 2.02.0 2017-07-10 Phj: In Situ SI 2.02.0 2017-07-10



METHOD: Robertson et al. 1986 qc Rf

- |                                     |                               |                              |                              |
|-------------------------------------|-------------------------------|------------------------------|------------------------------|
| 1 - Sensitive fine grained material | 4 - Silty CLAY to CLAY        | 7 - Silty SAND to sandy SILT | 10 - Gravelly SAND to SAND   |
| 2 - Organic material                | 5 - Clayey SILT to silty CLAY | 8 - SAND to silty SAND       | 11 - Very stiff fine grained |
| 3 - CLAY                            | 6 - Sandy SILT to clayey SILT | 9 - SAND                     | 12 - SAND to clayey SAND     |

**IN SITU**  
SITE INVESTIGATION

TITLE

Geotechnical Engineering  
Cardiff  
Cardiff Parkway  
Robertson et al. 1986  $q_c$  vs.  $R_f$  - CPT 04

DRAWN

DATE

10/07/2019

CHECKED

DATE

10/07/2019

SCALE

Not To Scale

A4

PROJECT No

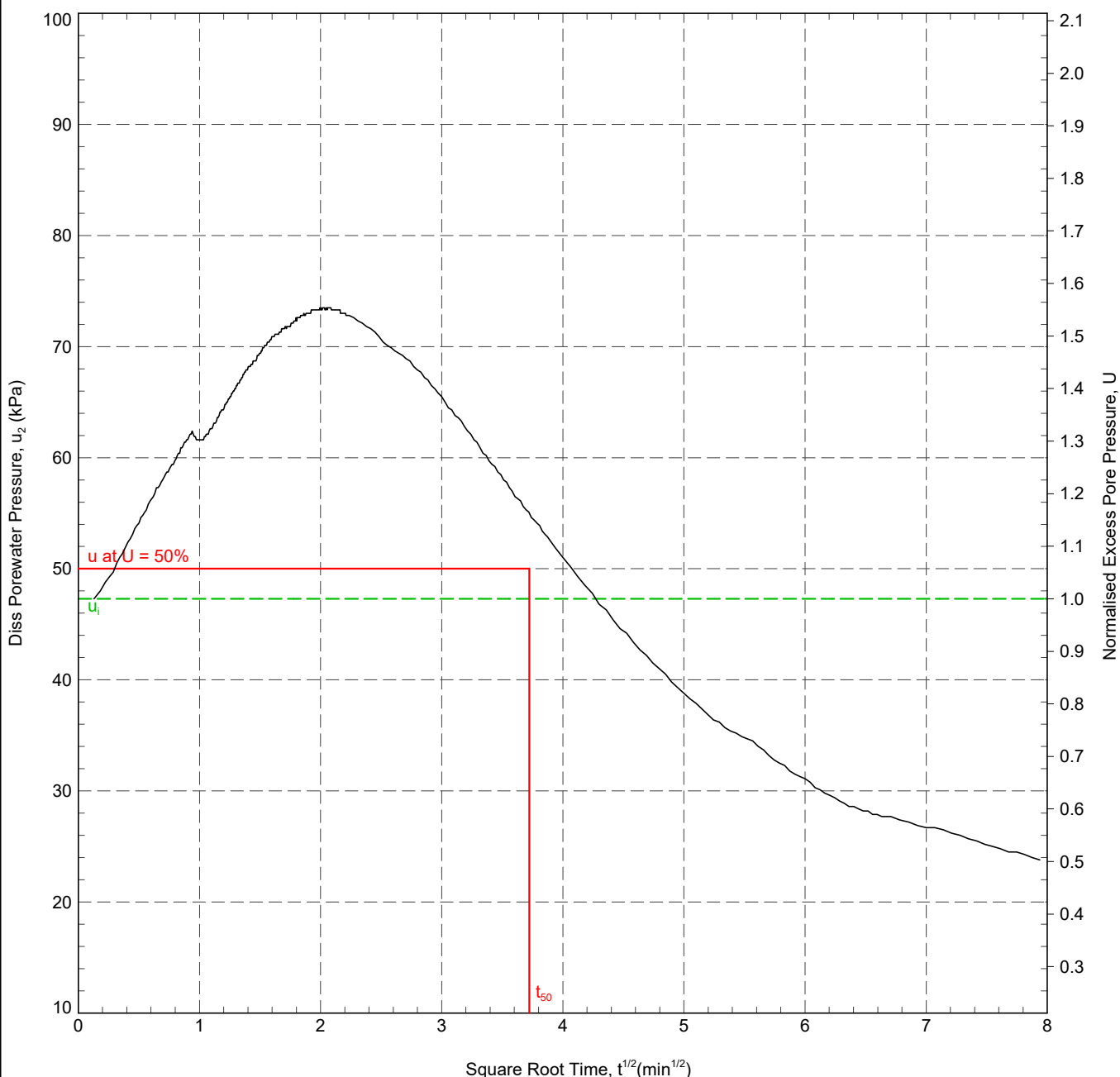
1190290

FIGURE No

CLIENT : Geotechnical Engineering  
ENGINEER :  
PROJECT : Cardiff Parkway  
LOCATION : Cardiff  
PROJECT No. : 1190290

AREA : Cardiff  
EASTING : 325195.4 m  
NORTHING : 180664.2 m  
COORD. SYS.:  
ELEVATION : 5.25 m

SHEET : 1 OF 1  
STATUS : Final  
DATE : 21/06/19



In Situ Pore Pressure,  $u_0$ : 0.0 kPa  
Initial Pore Pressure,  $u_i$ : 47.3 kPa  
Final Pore Pressure: 23.8 kPa  
Degree of Dissipation: 50%  
Dissipation Pressure: 50.0 kPa  
Time for 50% Dissipation,  $t_{50}$ : 13.87 min

Rigidity Index,  $I_r$ : 50  
Ratio  $c_h/c_v$ : 1.25  
Vertical Coefficient of Consolidation,  $c_v$ :  $7.70 \times 10^{-10}$  m<sup>2</sup>/yr

RIG :  
CONE TYPE : S15-CFIP  
CONE ID : S15-CFIP.1735  
OPERATOR : AG & CM

ANALYSED BY : LD  
CHECKED BY : LD  
APPROVED BY : DW

DATE: 03/07/2019  
DATE: 03/07/2019  
DATE: 03/07/2019

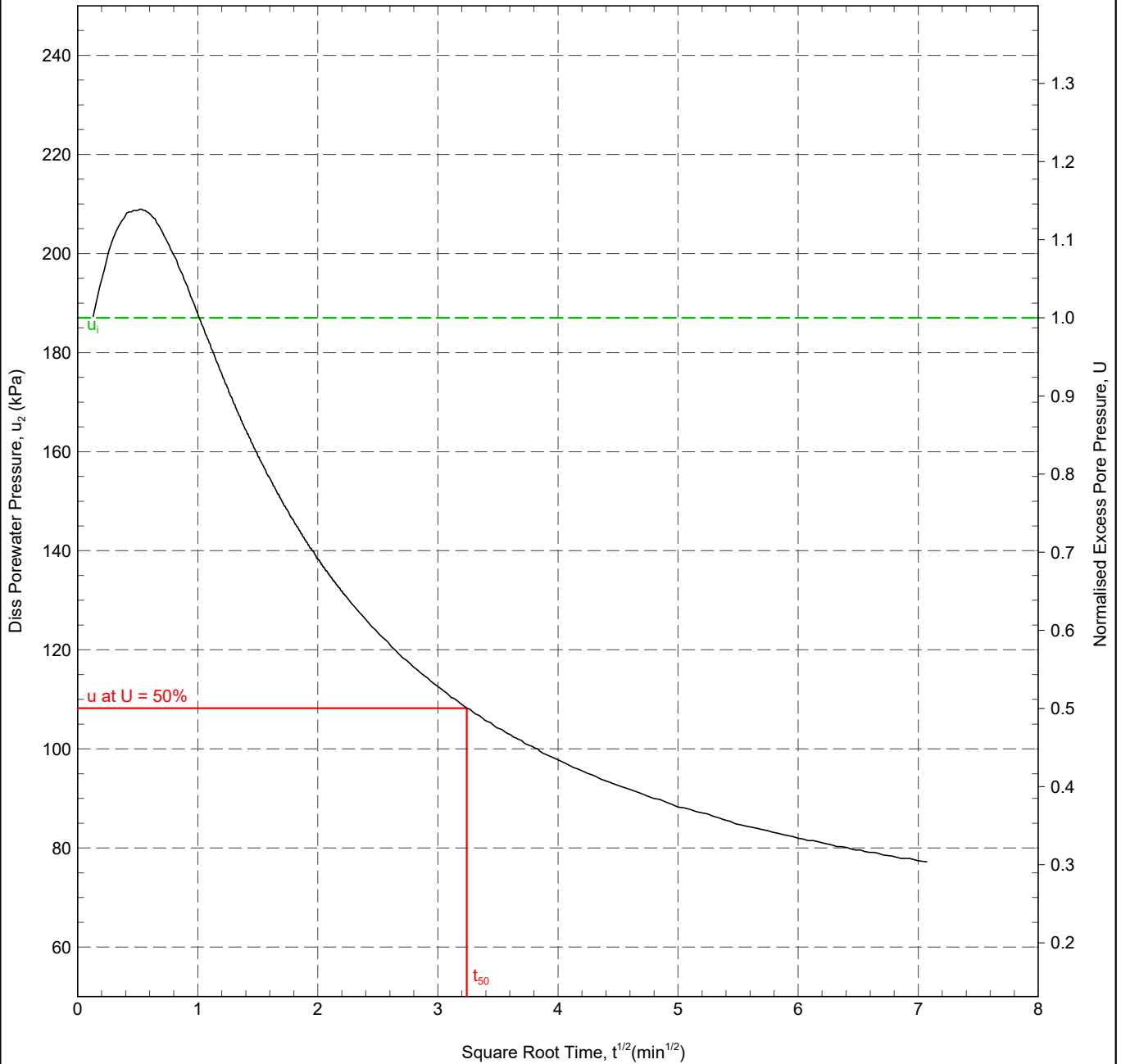
REMARK  
Test OK.



CLIENT : Geotechnical Engineering  
ENGINEER :  
PROJECT : Cardiff Parkway  
LOCATION : Cardiff  
PROJECT No. : 1190290

AREA : Cardiff  
EASTING : 325195.4 m  
NORTHING : 180664.2 m  
COORD. SYS.:  
ELEVATION : 5.25 m

SHEET : 1 OF 1  
STATUS : Final  
DATE : 21/06/19



In Situ Pore Pressure,  $u_0$ : 29.3 kPa  
Initial Pore Pressure,  $u_i$ : 187.0 kPa  
Final Pore Pressure: 77.2 kPa  
Degree of Dissipation: 50%  
Dissipation Pressure: 108.2 kPa  
Time for 50% Dissipation,  $t_{50}$ : 10.50 min

Rigidity Index,  $I_r$ : 50  
Horizontal Coefficient of Consolidation,  $c_h$ :  $4.59 \times 10^1$  m<sup>2</sup>/yr  
Vertical Coefficient of Consolidation,  $c_v$ :  $1.50 \times 10^1$  m<sup>2</sup>/yr

RIG :  
CONE TYPE : S15-CFIP  
CONE ID : S15-CFIP.1735  
OPERATOR : AG & CM

ANALYSED BY : LD  
CHECKED BY : LD  
APPROVED BY : DW

DATE: 03/07/2019  
DATE: 03/07/2019  
DATE: 03/07/2019

REMARK  
Test OK.



PointID

CPT 05

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325097.400 m

NORTHING : 180591.800 m

ELEVATION : 5.250 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

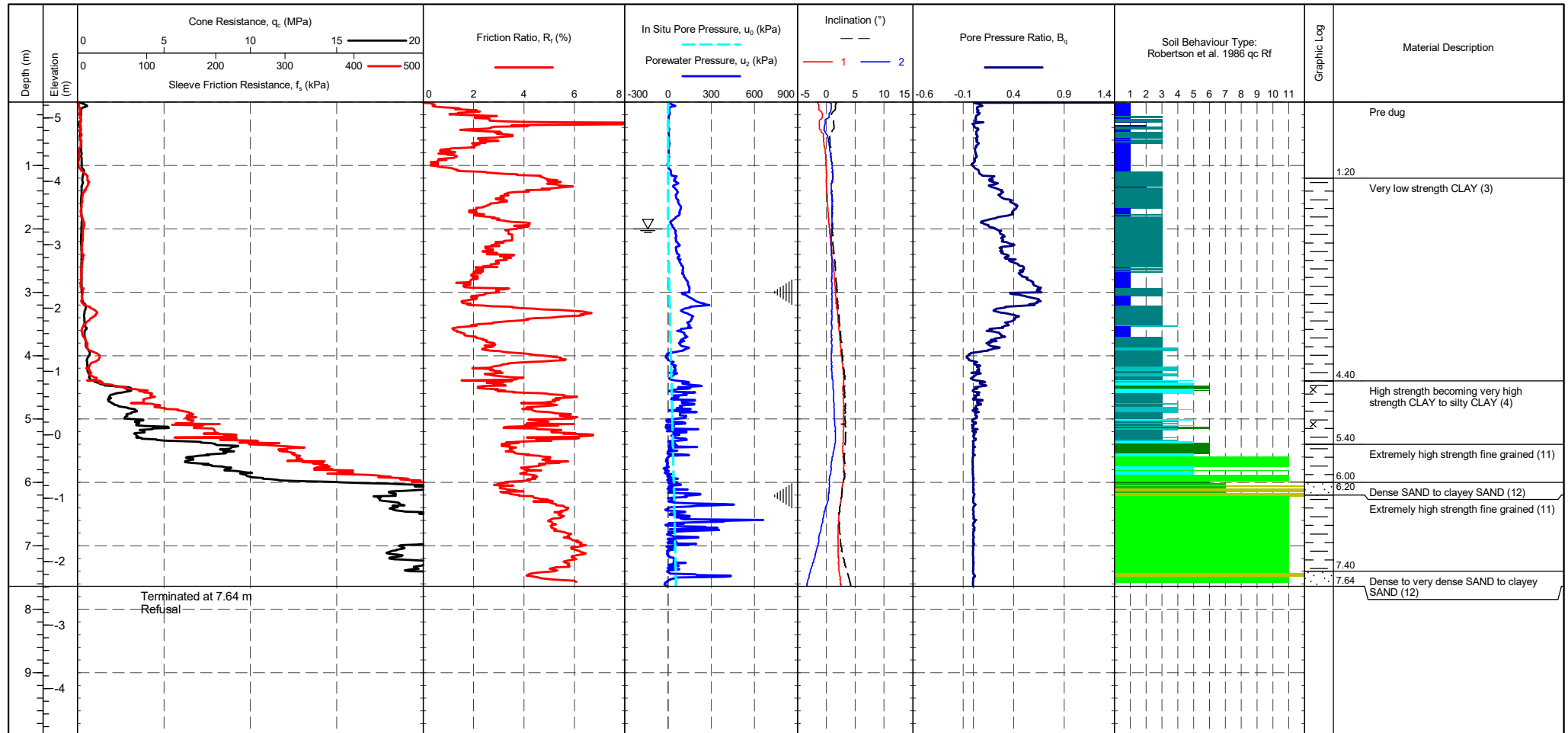
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 05  
WEATHER : Overcast & Mild

Transducer :  
Tip :  
Sleeve :  
Pore Pressure 2 :  
X-Y Inclinator :

CPTU ZERO VALUES

Pre	Post	Difference

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material	5 - Clayey SILT to silty CLAY	9 - SAND
2 - Organic material	6 - Sandy SILT to clayey SILT	10 - Gravelly SAND to SAND
3 - CLAY	7 - Silty SAND to sandy SILT	11 - Very stiff fine grained
4 - Silty CLAY to CLAY	8 - SAND to silty SAND	12 - SAND to clayey SAND

Groundwater Level

Dissipation Test



PointID

## CPT 05

CLIENT : Geotechnical Engineering

PROJECT: Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325097.400 m

NORTHING : 180591.800 m

ELEVATION : 5.250 m OD

CHECKED BY \_\_\_\_\_ :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

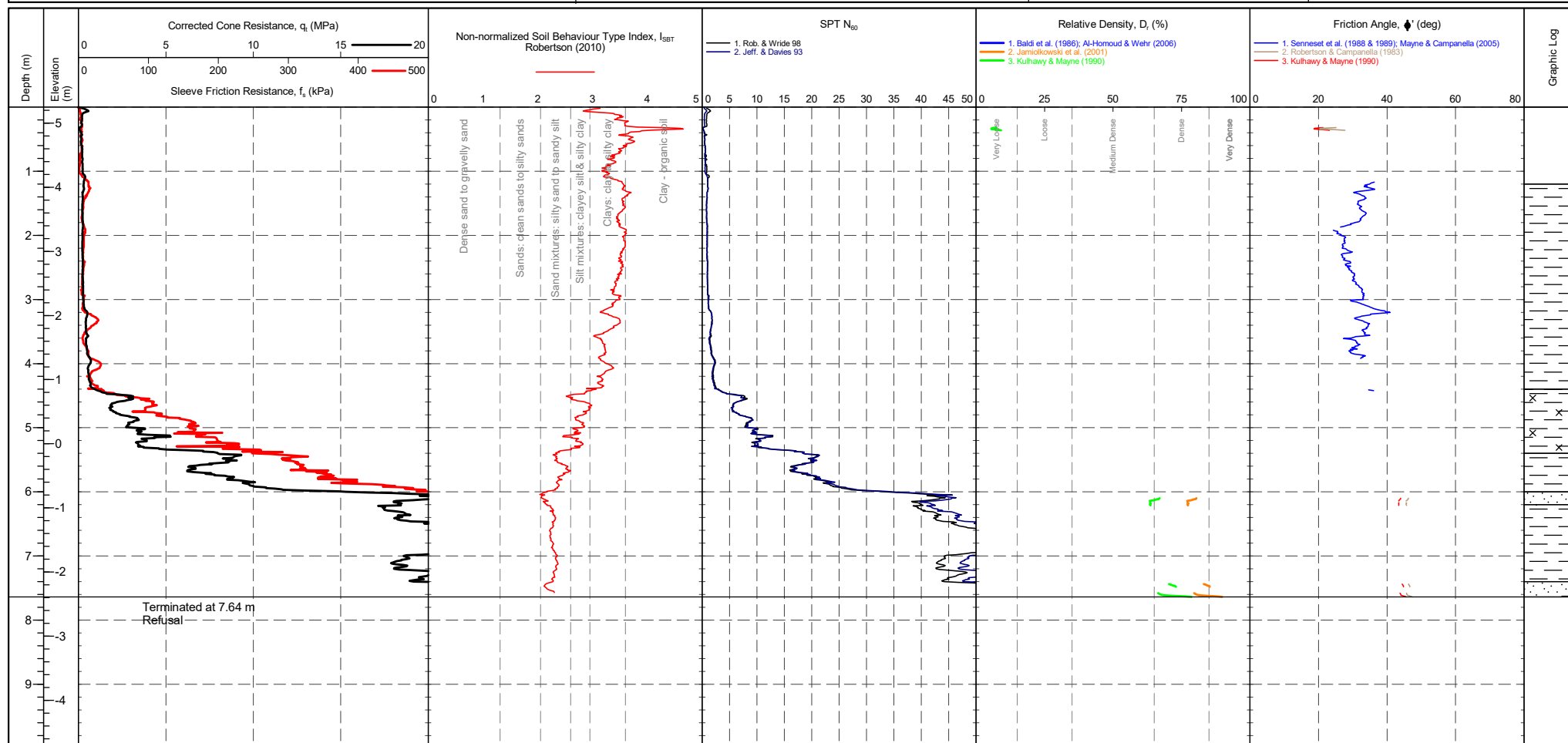
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID	: S15-CFIP.1735
CONE AREA	: 15cm <sup>2</sup>
CONE AREA RATIO	: 0.8
FILTER POSITION	: u2
FILTER TYPE	: HDPE
FRICTION REDUCER	: None

TEST TYPE	: TE2
APPLICATION CLASS	: 2
RIG	:
OPERATOR	:
FILE NAME	: 1190290-CPT 05
WEATHER	: Overcast & Mild

	CPTU ZERO VALUES		
Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level

Dissipation Test



PointID

CPT 05

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325097.400 m

NORTHING : 180591.800 m

ELEVATION : 5.250 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

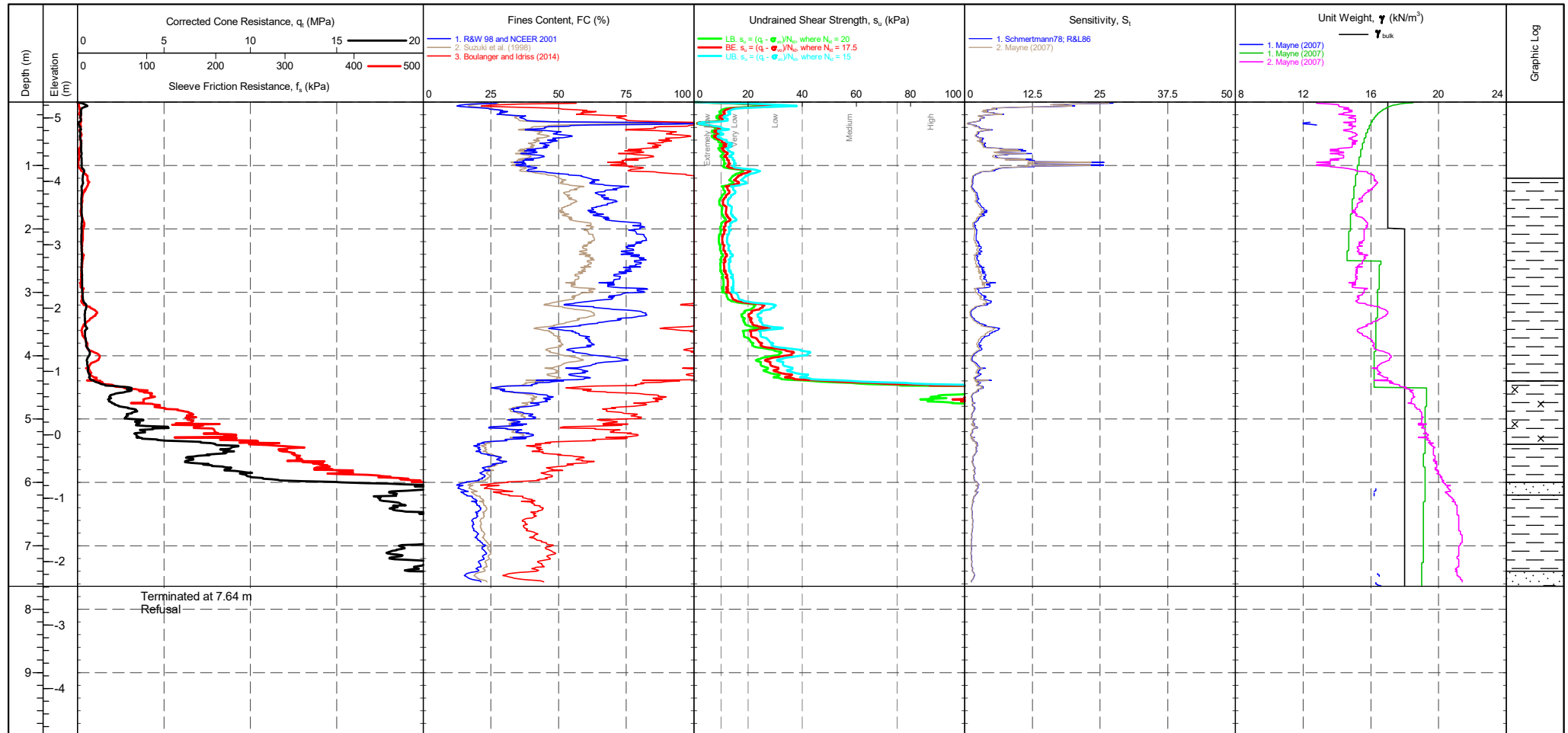
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 05  
WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level

Dissipation Test



PointID

CPT 05

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325097.400 m

NORTHING : 180591.800 m

ELEVATION : 5.250 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

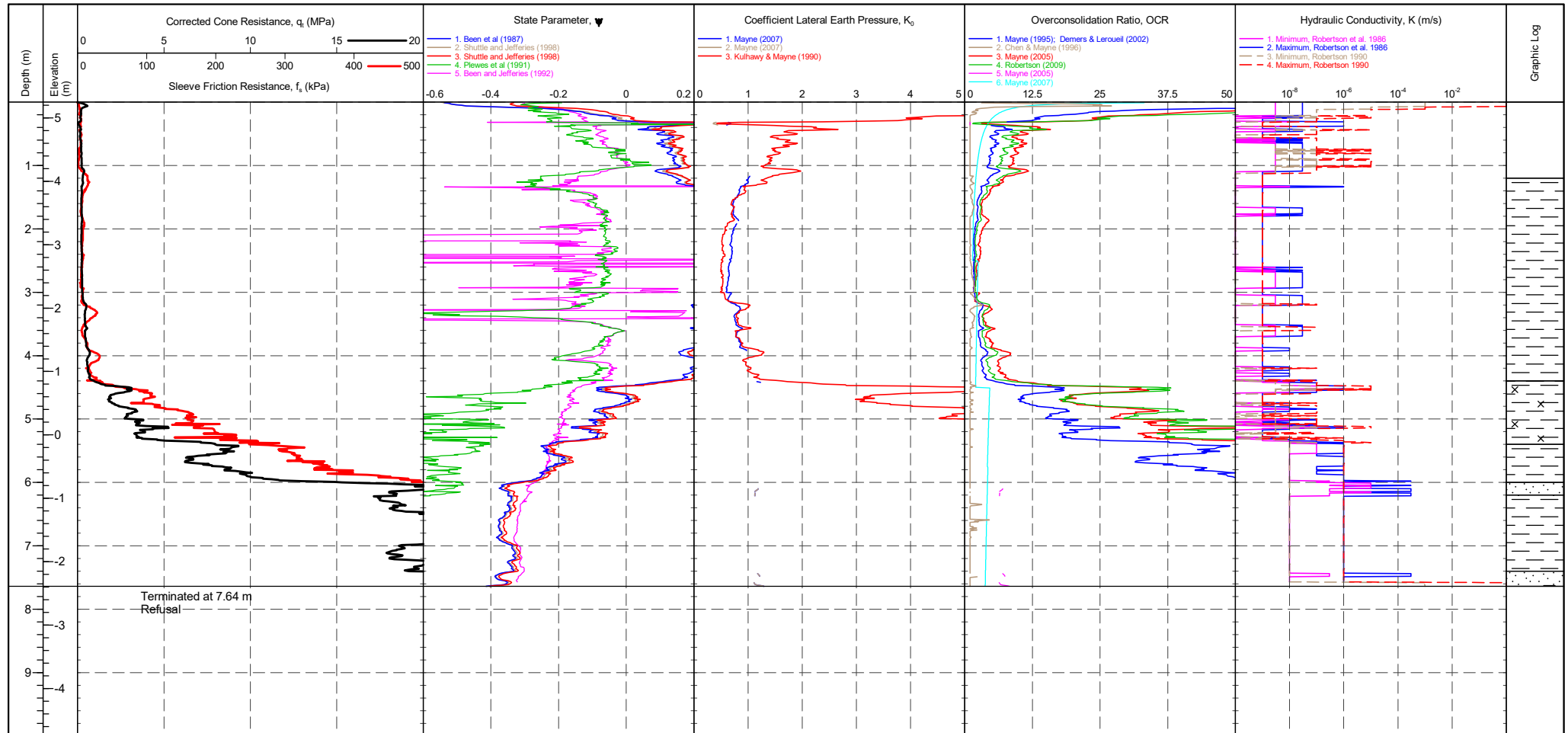
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 05  
WEATHER : Overcast & Mild

CPTU ZERO VALUES  
Transducer Pre Post Difference  
Tip  
Sleeve  
Pore Pressure 2  
X-Y Inclinator

Groundwater Level  
Dissipation Test



PointID

CPT 05

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325097.400 m

NORTHING : 180591.800 m

ELEVATION : 5.250 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

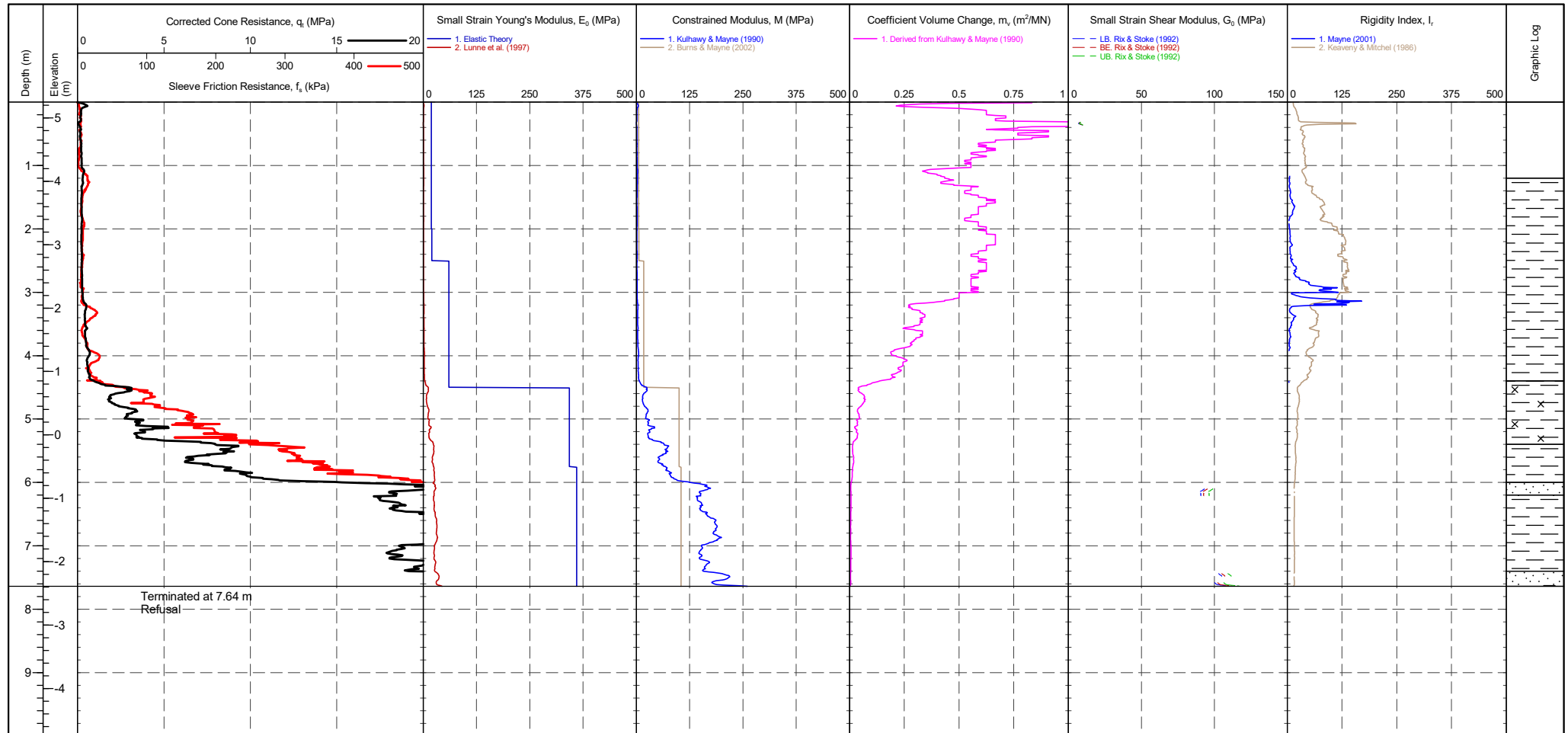
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
 CONE AREA : 15cm<sup>2</sup>  
 CONE AREA RATIO : 0.8  
 FILTER POSITION : u2  
 FILTER TYPE : HDPE  
 FRICTION REDUCER : None

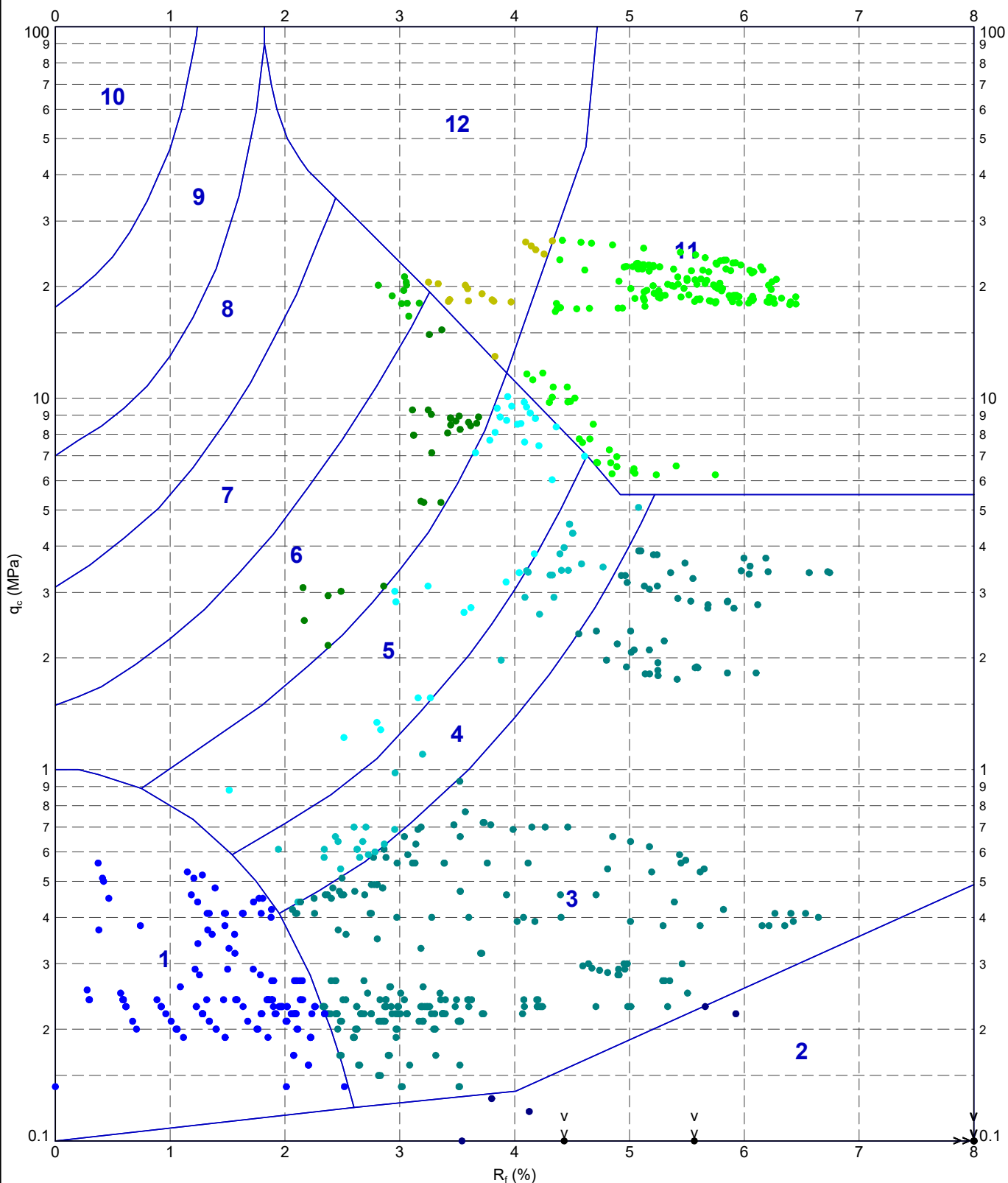
TEST TYPE : TE2  
 APPLICATION CLASS : 2  
 RIG :  
 OPERATOR :  
 FILE NAME : 1190290-CPT 05  
 WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level  
 Dissipation Test

INSITU 2.02.1 LB.GLB Graph: CPT ROBERTSON ET AL. 86 QC VS. RF MAP 1190290-CARDIFF PARKWAY.GPJ <<DrawingFile>> 10/07/2019 10:08 10.0.0.000 D:\git\Lab and In Situ Tool - DGD [Lib: In Situ SI 2.02.0 2017-07-10 Pjt: In Situ SI 2.02.0 2017-07-10



METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material

2 - Organic material

3 - CLAY

4 - Silty CLAY to CLAY

5 - Clayey SILT to silty CLAY

6 - Sandy SILT to clayey SILT

7 - Silty SAND to sandy SILT

8 - SAND to silty SAND

9 - SAND

10 - Gravelly SAND to SAND

11 - Very stiff fine grained

12 - SAND to clayey SAND

**IN SITU**  
SITE INVESTIGATION

TITLE

Geotechnical Engineering  
Cardiff  
Cardiff Parkway  
Robertson et al. 1986  $q_c$  vs.  $R_f$  - CPT 05

DRAWN

DATE

10/07/2019

CHECKED

DATE

10/07/2019

SCALE

Not To Scale

A4

PROJECT No

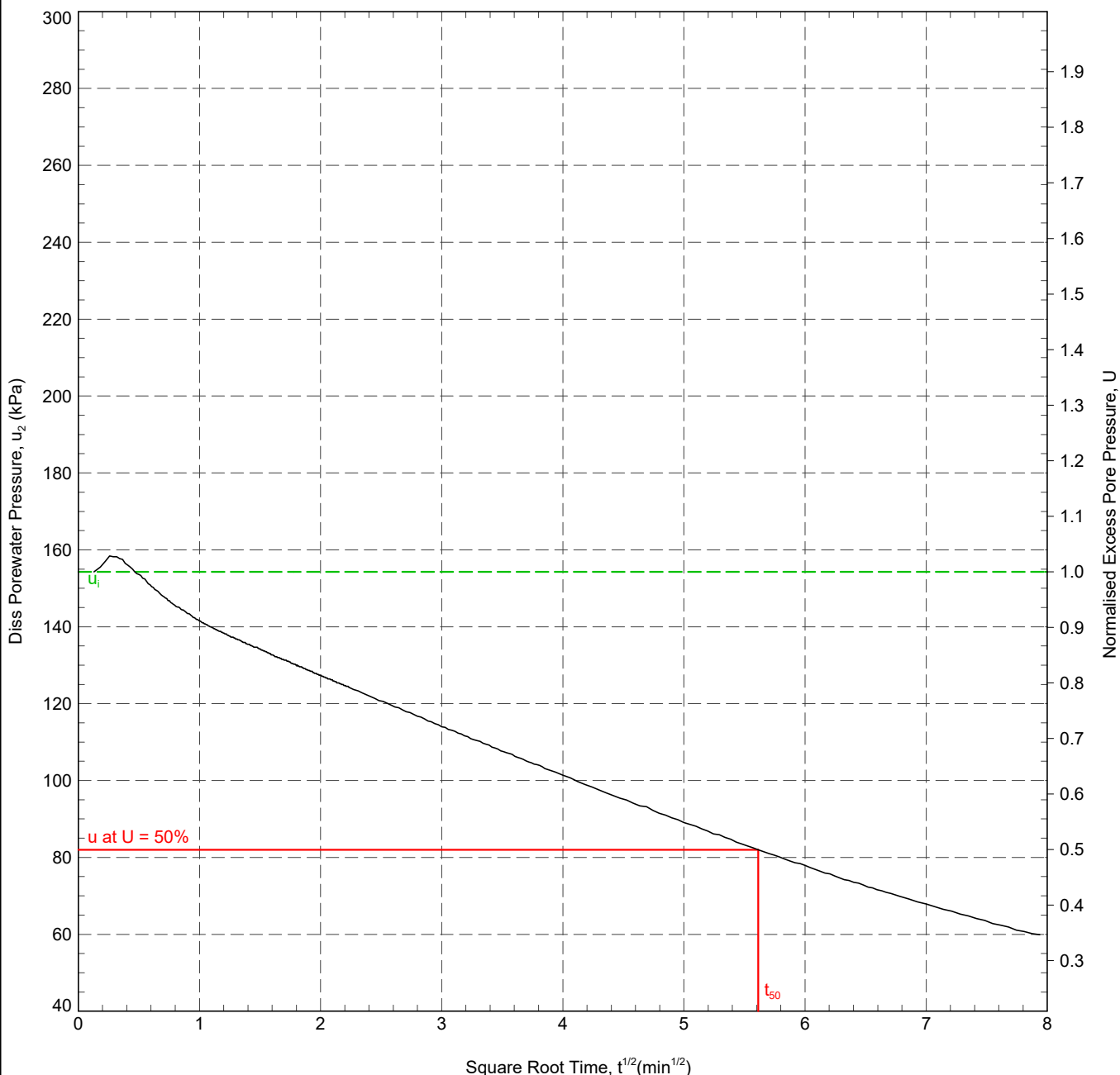
1190290

FIGURE No

CLIENT : Geotechnical Engineering  
ENGINEER :  
PROJECT : Cardiff Parkway  
LOCATION : Cardiff  
PROJECT No. : 1190290

AREA : Cardiff  
EASTING : 325097.4 m  
NORTHING : 180591.8 m  
COORD. SYS.:  
ELEVATION : 5.25 m

SHEET : 1 OF 1  
STATUS : Final  
DATE : 21/06/19



In Situ Pore Pressure,  $u_0$ : 9.8 kPa  
Initial Pore Pressure,  $u_i$ : 154.3 kPa  
Final Pore Pressure: 59.9 kPa  
Degree of Dissipation: 50%  
Dissipation Pressure: 82.0 kPa  
Time for 50% Dissipation,  $t_{50}$ : 31.50 min

Rigidity Index,  $I_r$ : 116.2  
Horizontal Coefficient of Consolidation,  $c_h$ :  $2.33 \times 10^1$  m<sup>2</sup>/yr  
Ratio  $c_h/c_v$ : 1.25  
Vertical Coefficient of Consolidation,  $c_v$ :  $1.86 \times 10^1$  m<sup>2</sup>/yr

RIG :  
CONE TYPE : S15-CFIP  
CONE ID : S15-CFIP.1735  
OPERATOR : AG & CM

ANALYSED BY : LD  
CHECKED BY : LD  
APPROVED BY : DW

DATE: 03/07/2019  
DATE: 03/07/2019  
DATE: 03/07/2019

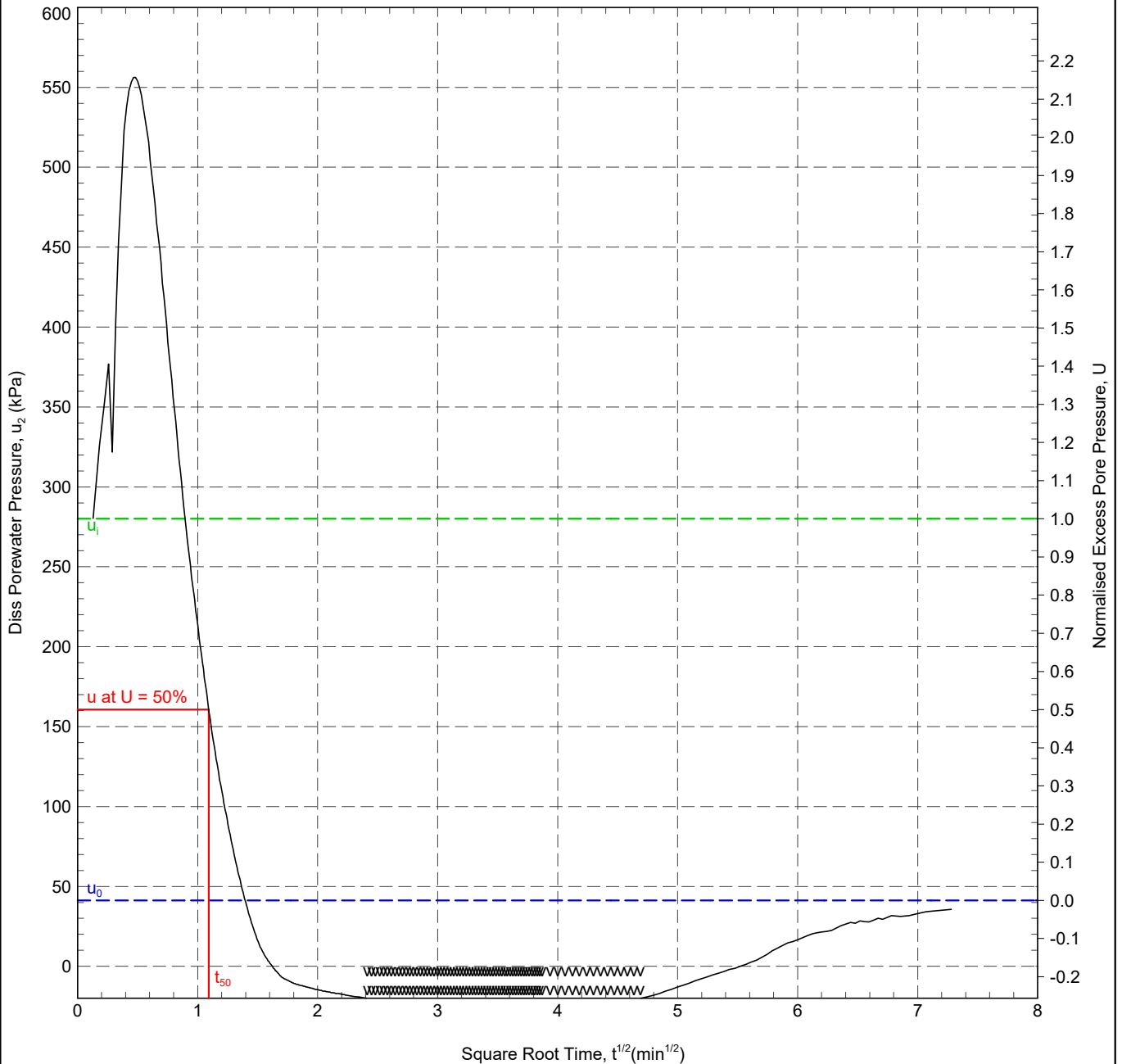
REMARK  
Test OK.



CLIENT : Geotechnical Engineering  
ENGINEER :  
PROJECT : Cardiff Parkway  
LOCATION : Cardiff  
PROJECT No. : 1190290

AREA : Cardiff  
EASTING : 325097.4 m  
NORTHING : 180591.8 m  
COORD. SYS.:  
ELEVATION : 5.25 m

SHEET : 1 OF 1  
STATUS : Final  
DATE : 21/06/19



In Situ Pore Pressure,  $u_0$ : 41.3 kPa  
Initial Pore Pressure,  $u_i$ : 280.0 kPa  
Final Pore Pressure: 35.7 kPa  
Degree of Dissipation: 50%  
Dissipation Pressure: 160.6 kPa  
Time for 50% Dissipation,  $t_{50}$ : 1.19 min

Rigidity Index,  $I_r$ : 100  
Horizontal Coefficient of Consolidation,  $c_h$ :  $5.71 \times 10^2$  m<sup>2</sup>/yr  
Ratio  $c_h/c_v$ : 1.25  
Vertical Coefficient of Consolidation,  $c_v$ :  $4.57 \times 10^2$  m<sup>2</sup>/yr

RIG :  
CONE TYPE : S15-CFIP  
CONE ID : S15-CFIP.1735  
OPERATOR : AG & CM

ANALYSED BY : LD  
CHECKED BY : LD  
APPROVED BY : DW

DATE: 03/07/2019  
DATE: 03/07/2019  
DATE: 03/07/2019

REMARK  
Test OK.



PointID

CPT 06

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325071.900 m

NORTHING : 180693.600 m

ELEVATION : 5.100 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

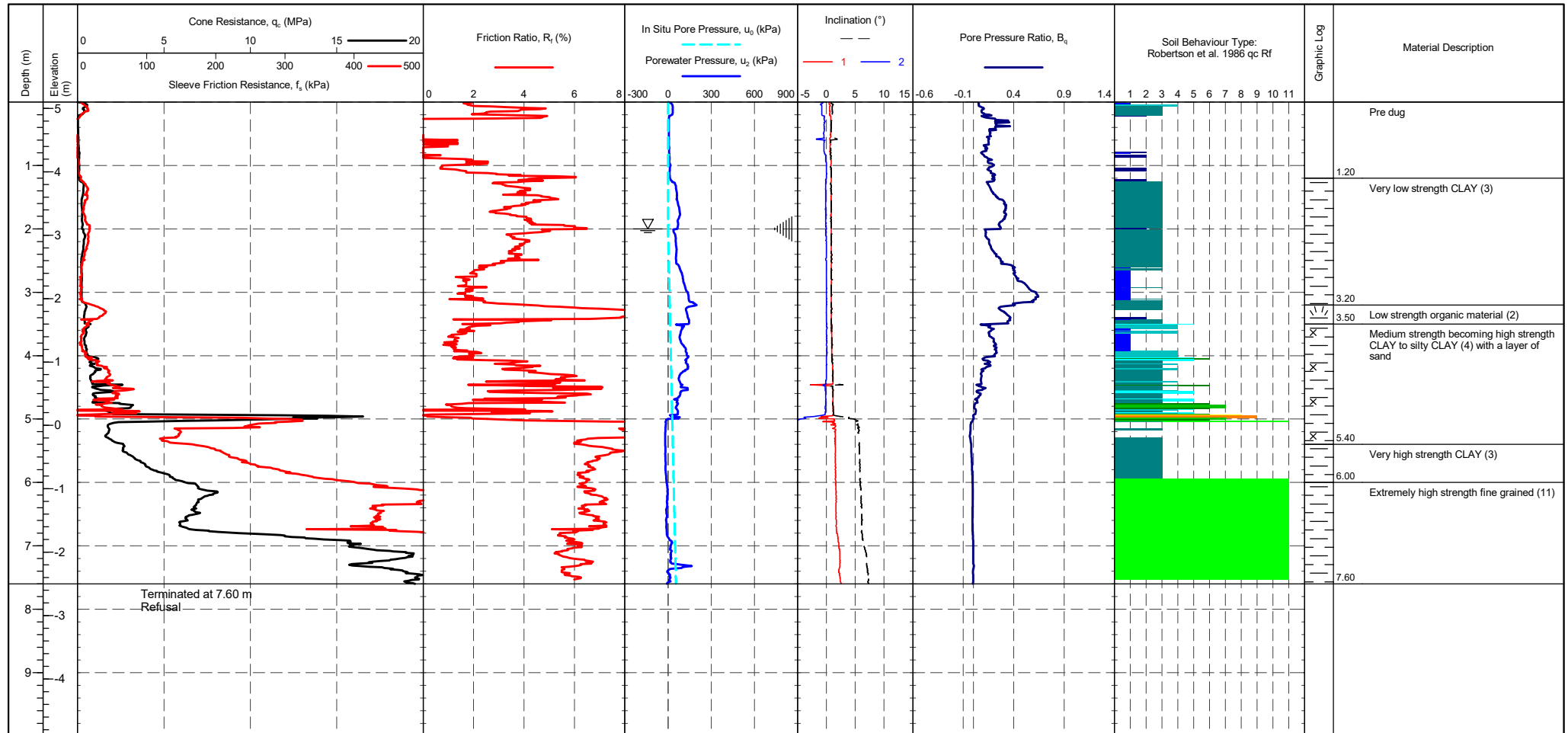
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 17/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 06  
WEATHER : Overcast & Mild

Transducer :  
Tip :  
Sleeve :  
Pore Pressure 2 :  
X-Y Inclinator :

CPTU ZERO VALUES

Pre	Post	Difference

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material	5 - Clayey SILT to silty CLAY	9 - SAND
2 - Organic material	6 - Sandy SILT to clayey SILT	10 - Gravelly SAND to SAND
3 - CLAY	7 - Silty SAND to sandy SILT	11 - Very stiff fine grained
4 - Silty CLAY to CLAY	8 - SAND to silty SAND	12 - SAND to clayey SAND

Groundwater Level

Disipation Test



PointID

CPT 06

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325071.900 m

NORTHING : 180693.600 m

ELEVATION : 5.100 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:  
Test refused on total pressure.

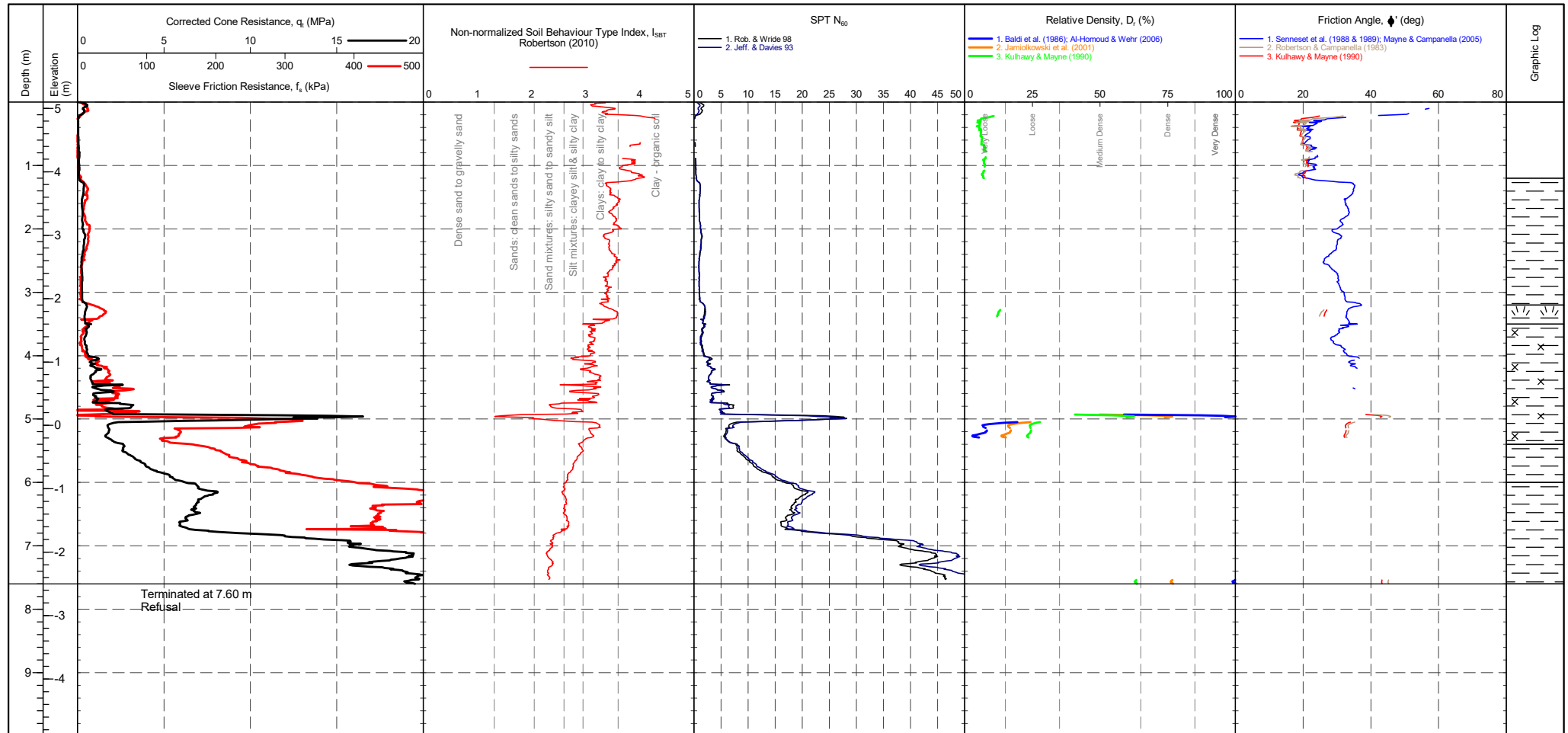
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 17/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 06  
WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level  
Dissipation Test



PointID

CPT 06

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325071.900 m

NORTHING : 180693.600 m

ELEVATION : 5.100 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:  
Test refused on total pressure.

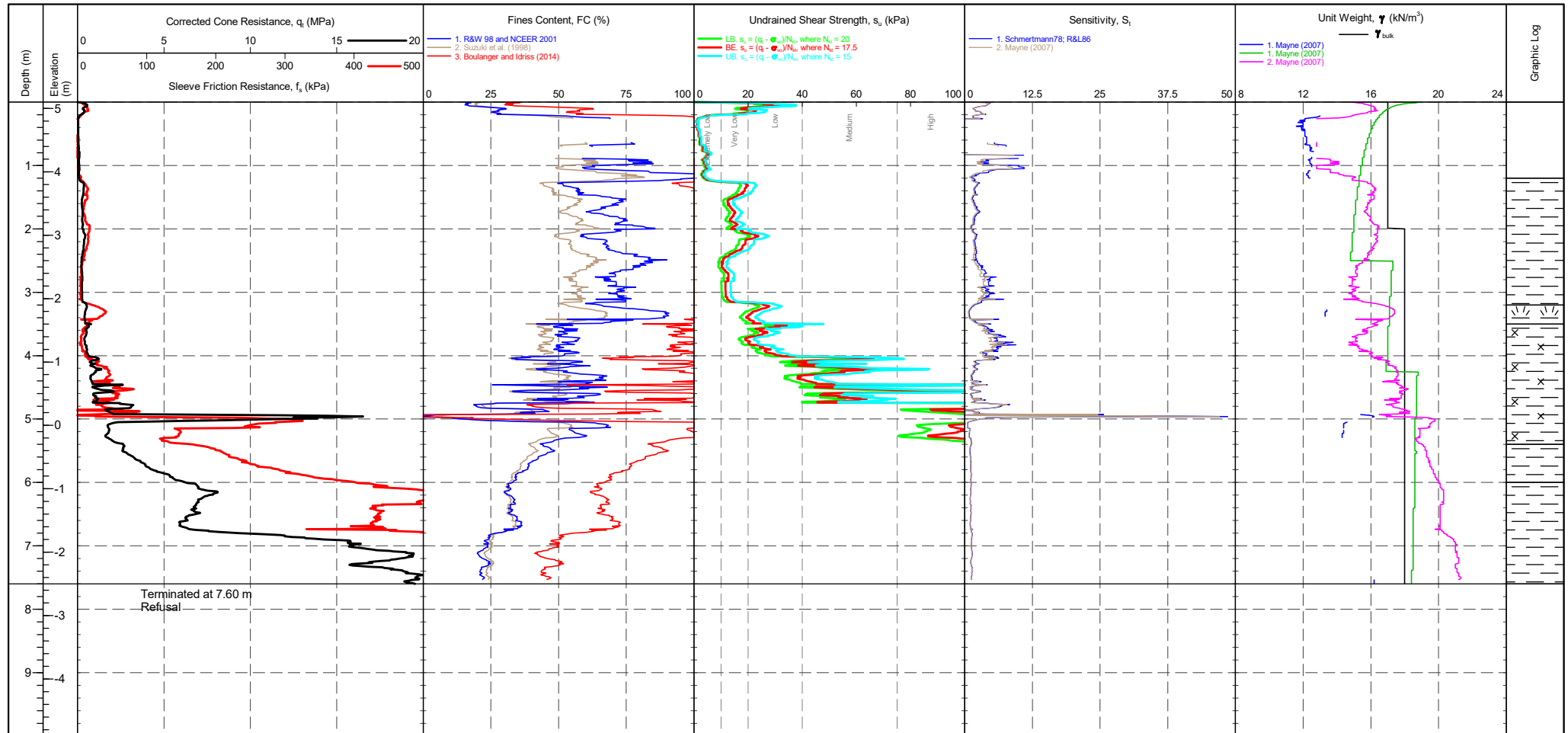
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 17/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 06  
WEATHER : Overcast & Mild

CPTU ZERO VALUES  
Transducer Pre Post Difference  
Tip  
Sleeve  
Pore Pressure 2  
X-Y Inclinator

Groundwater Level  
Dissipation Test



PointID

CPT 06

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325071.900 m

NORTHING : 180693.600 m

ELEVATION : 5.100 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

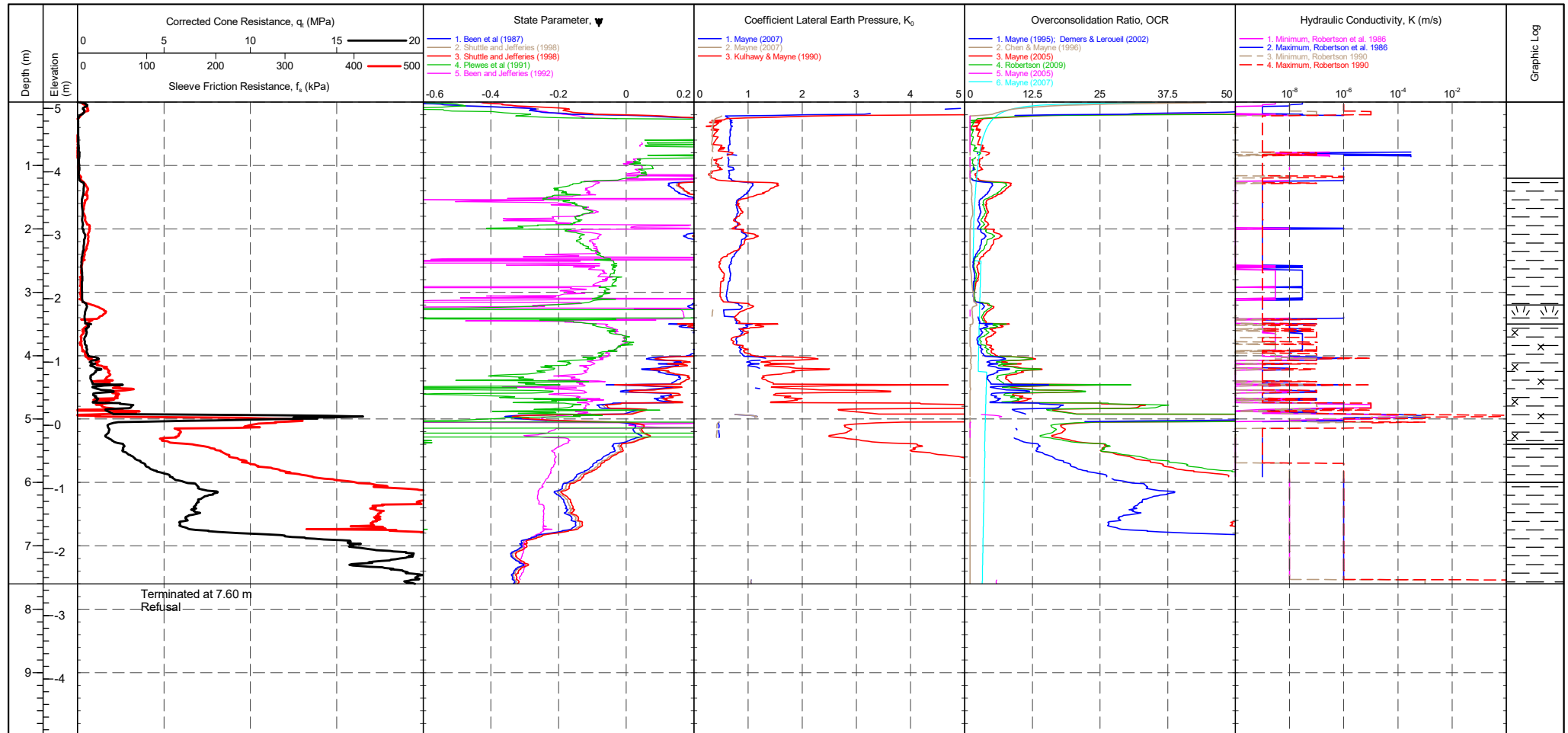
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 17/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 06  
WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level

Dissipation Test



PointID

CPT 06

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325071.900 m

NORTHING : 180693.600 m

ELEVATION : 5.100 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

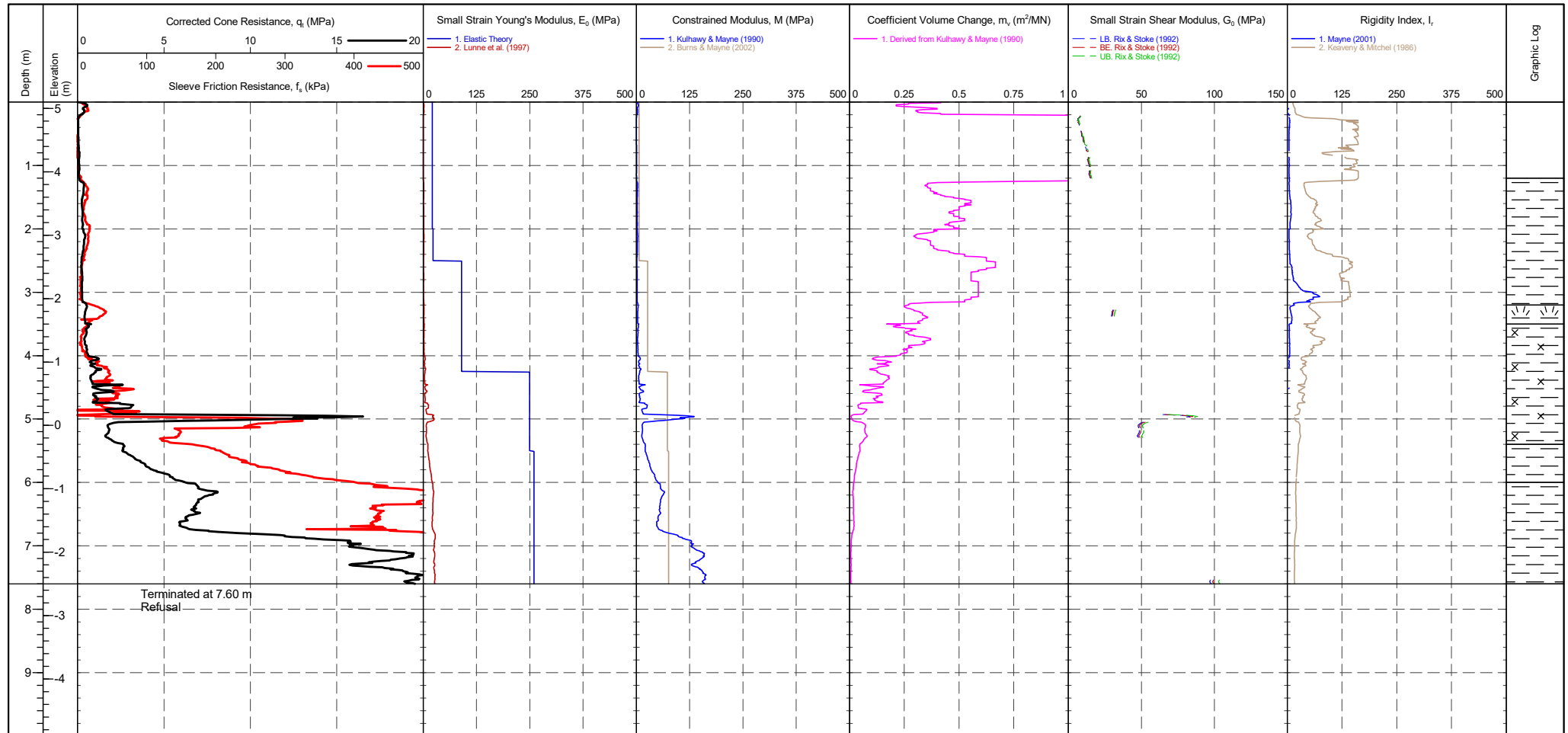
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 17/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
 CONE AREA : 15cm<sup>2</sup>  
 CONE AREA RATIO : 0.8  
 FILTER POSITION : u2  
 FILTER TYPE : HDPE  
 FRICTION REDUCER : None

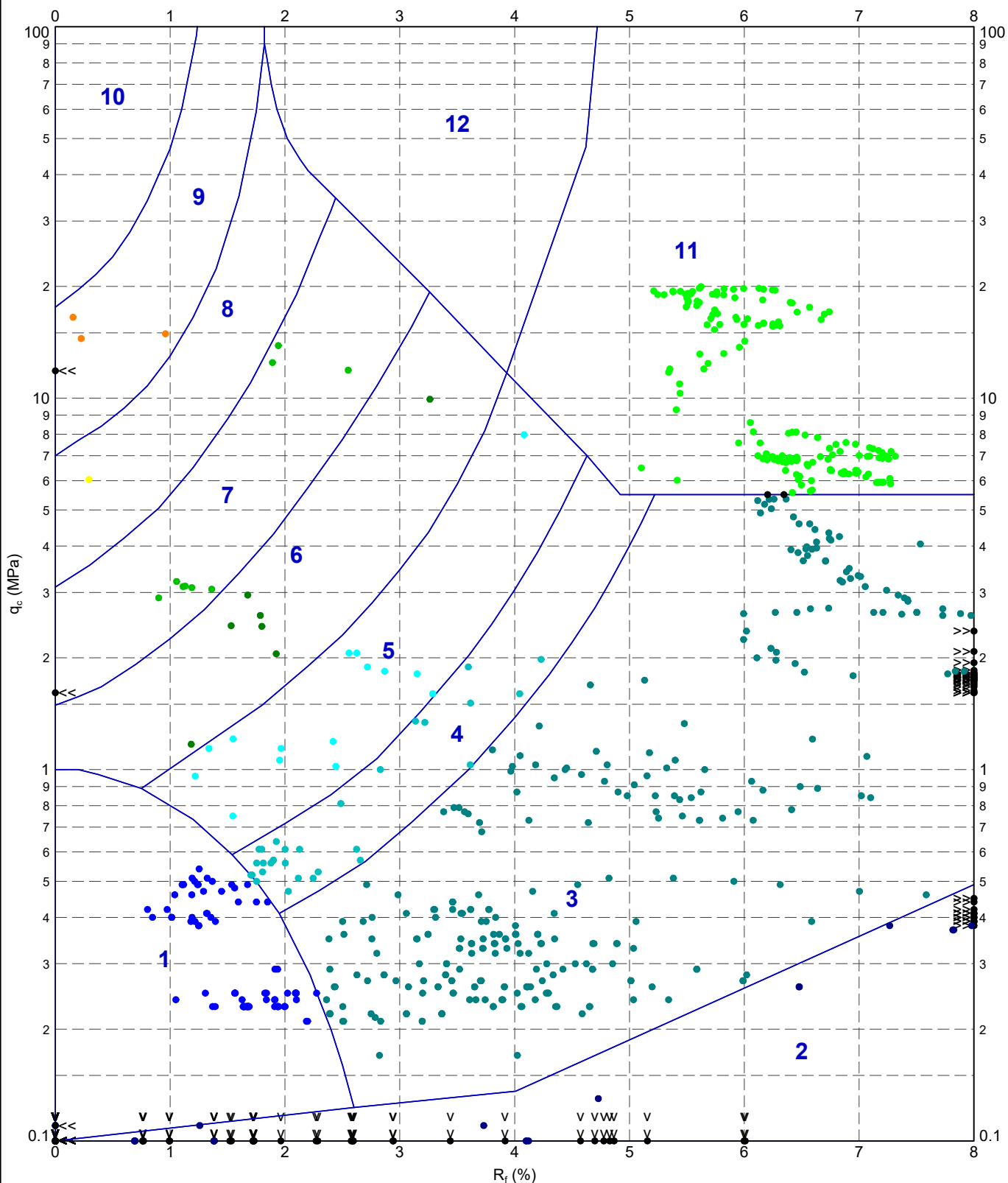
TEST TYPE : TE2  
 APPLICATION CLASS : 2  
 RIG :  
 OPERATOR :  
 FILE NAME : 1190290-CPT 06  
 WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level  
 Dissipation Test

INSITU 2.02.1 UB.GLB Graph: CPT ROBERTSON ET AL. 86 QC VS. RF MAP: 1190290-CARDIFF PARKWAY.GPJ <<DrawingFile>> 10/07/2019 10:08 10.0.0.000 Datagel Lab and In Situ Tool - DGD [Lib: In Situ SI 2.02.0 2017-07-10 Proj: In Situ SI 2.02.0 2017-07-10]



METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material

2 - Organic material

3 - CLAY

4 - Silty CLAY to CLAY

5 - Clayey SILT to silty CLAY

6 - Sandy SILT to clayey SILT

7 - Silty SAND to sandy SILT

8 - SAND to silty SAND

9 - SAND

10 - Gravelly SAND to SAND

11 - Very stiff fine grained

12 - SAND to clayey SAND

**IN SITU**  
SITE INVESTIGATION

TITLE

Geotechnical Engineering  
Cardiff  
Cardiff Parkway  
Robertson et al. 1986 qc vs. Rf - CPT 06

DRAWN

CHECKED

SCALE

PROJECT No

1190290

DATE

10/07/2019

DATE

10/07/2019

Not To Scale

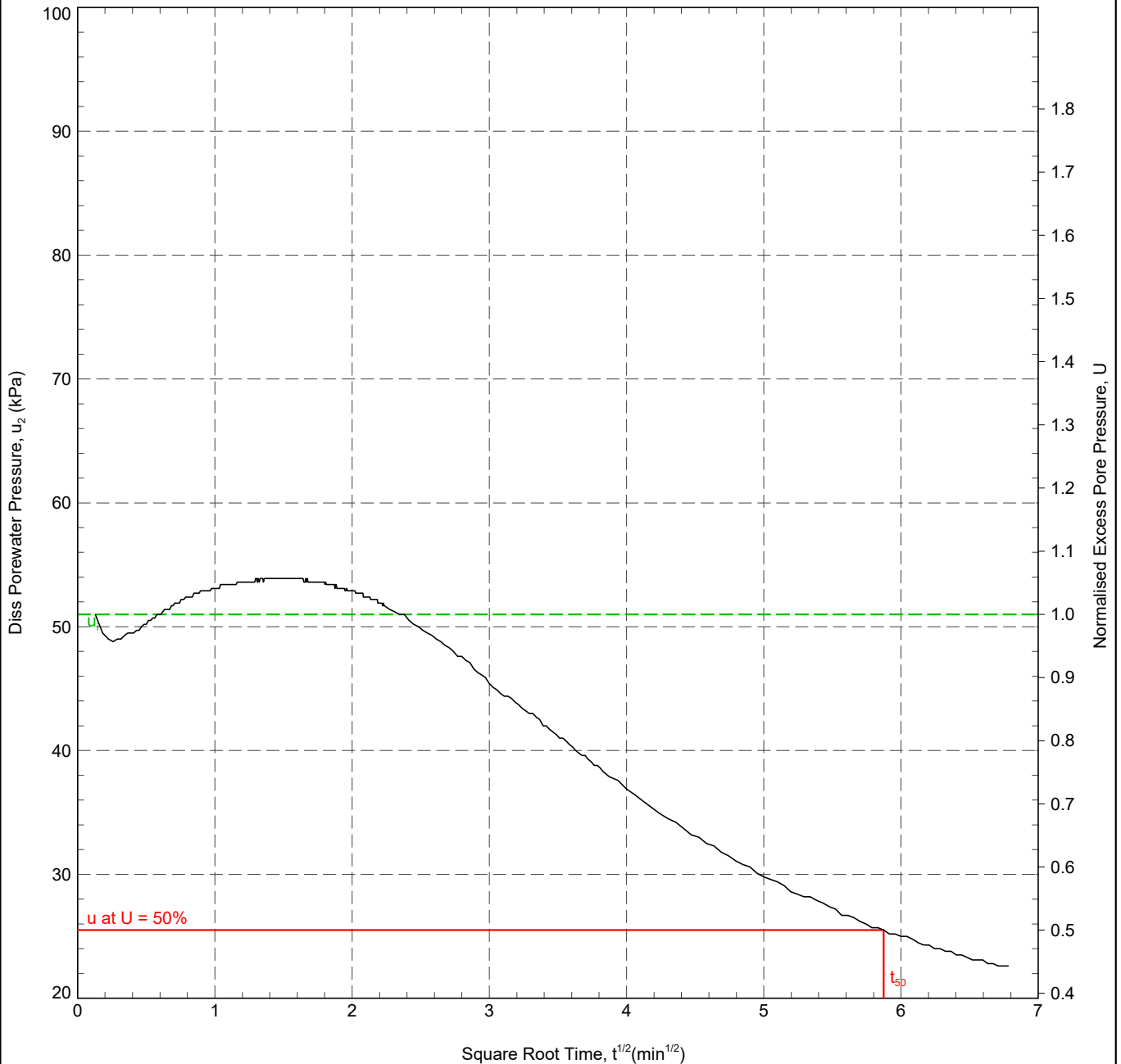
A4

FIGURE No

CLIENT : Geotechnical Engineering  
ENGINEER :  
PROJECT : Cardiff Parkway  
LOCATION : Cardiff  
PROJECT No. : 1190290

AREA : Cardiff  
EASTING : 325071.9 m  
NORTHING : 180693.6 m  
COORD. SYS.:  
ELEVATION : 5.10 m

SHEET : 1 OF 1  
STATUS : Final  
DATE : 17/06/19



In Situ Pore Pressure,  $u_0$ : 0.0 kPa  
Initial Pore Pressure,  $u_i$ : 51.0 kPa  
Final Pore Pressure: 22.6 kPa  
Degree of Dissipation: 50%  
Dissipation Pressure: 25.5 kPa  
Time for 50% Dissipation,  $t_{50}$ : 34.50 min

Rigidity Index,  $I_r$ : 50  
Horizontal Coefficient of Consolidation,  $c_h$ :  $1.40 \times 10^{-1}$  m<sup>2</sup>/yr  
Ratio  $c_h/c_v$ : 1.25  
Vertical Coefficient of Consolidation,  $c_v$ :  $1.12 \times 10^{-1}$  m<sup>2</sup>/yr

RIG :  
CONE TYPE : S15-CFIP  
CONE ID : S15-CFIP.1735  
OPERATOR : AG & CM

ANALYSED BY : LD  
CHECKED BY : LD  
APPROVED BY : DW

DATE: 03/07/2019  
DATE: 03/07/2019  
DATE: 03/07/2019

REMARK  
Test OK.



## **APPENDIX C**

### **Magnetometer Data**



PointID

**H2A010 T2**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

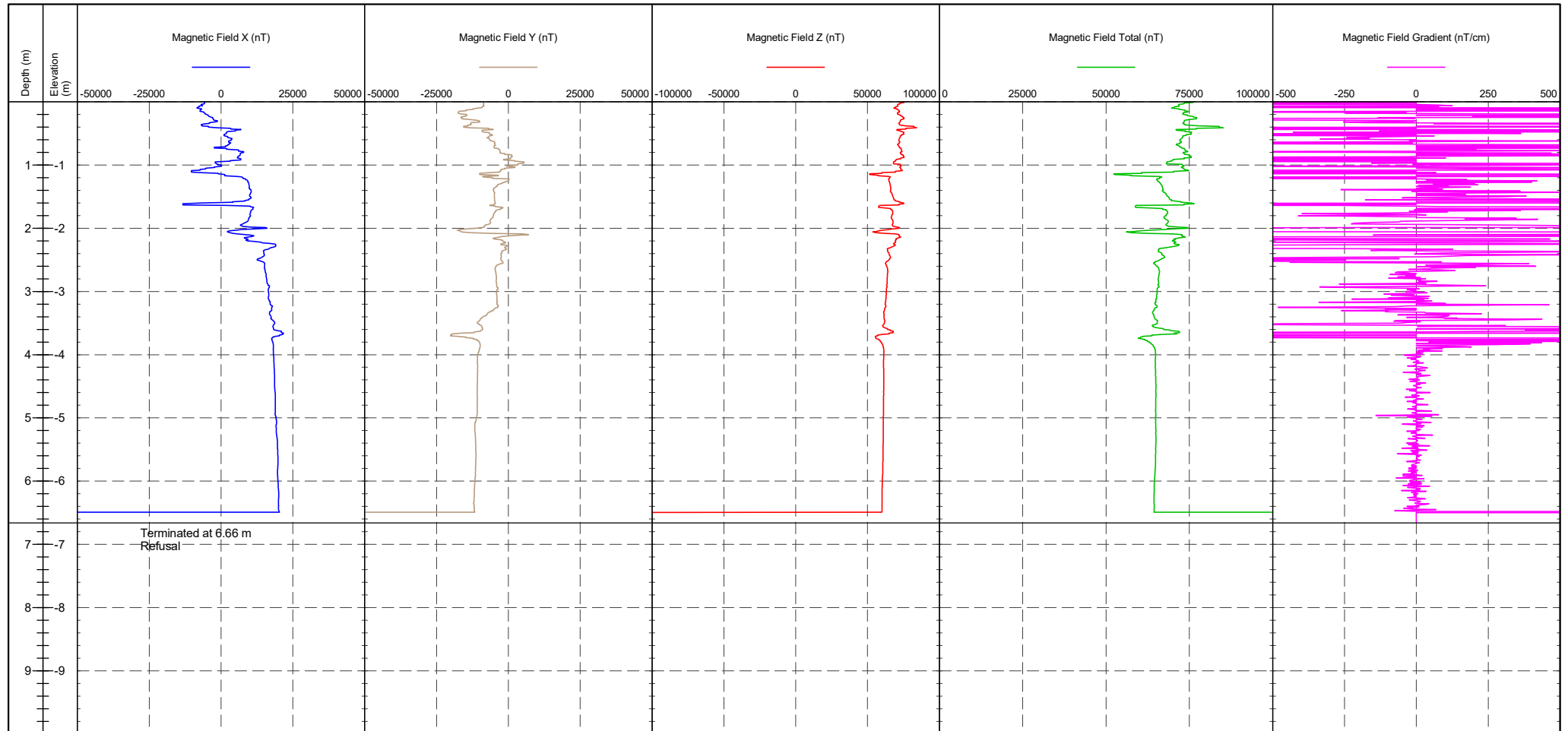
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Refusal

Remark:  
Test refused on total pressure.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 25/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H2A010 T2  
WEATHER :

Transducer Pre Post Difference  
Tip 0 mV  
Sleeve 0 mV  
Pore Pressure 2 0 mV  
X-Y Inclinator 2526 mV 2486 mV

CPTU ZERO VALUES



PointID

**H2B034 T2**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

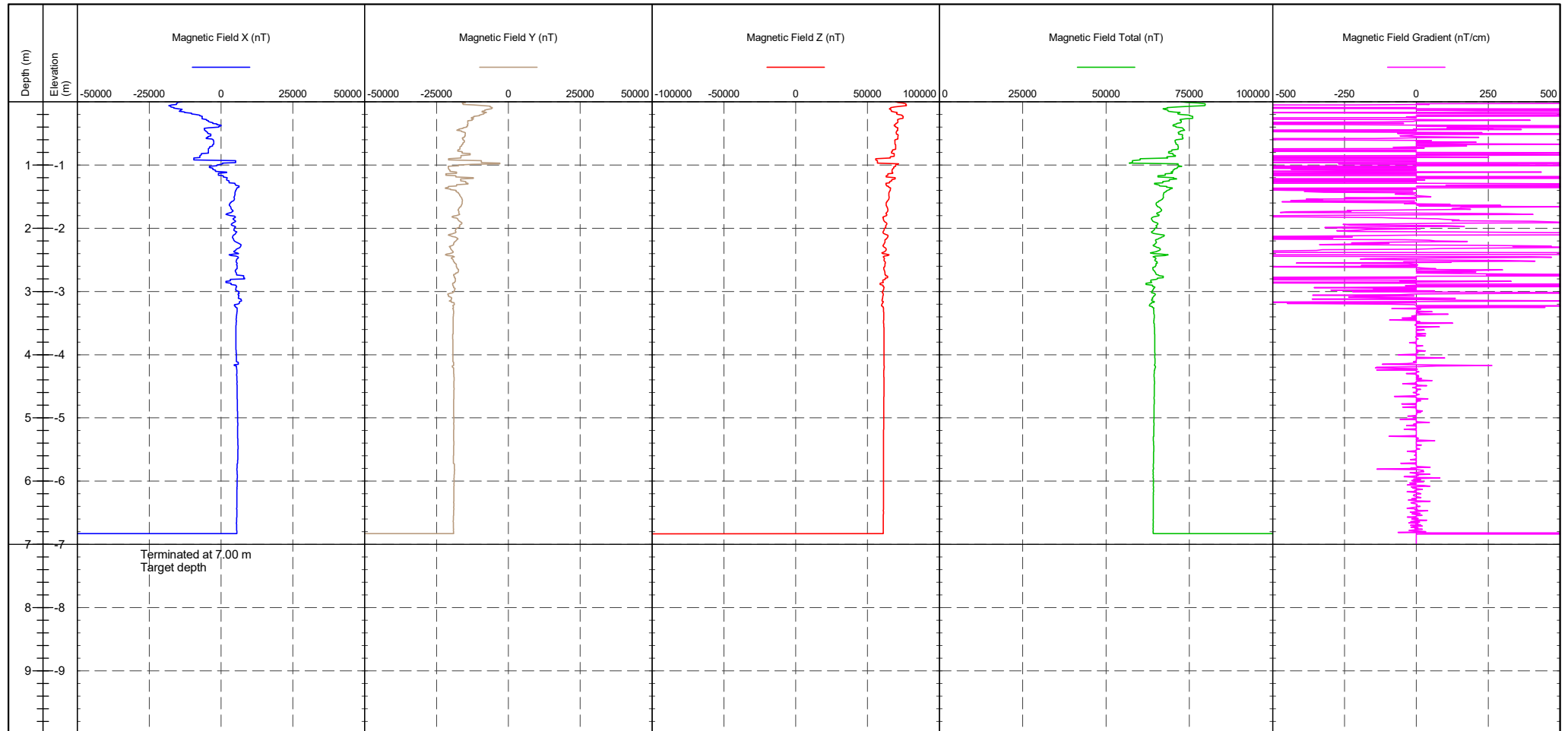
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 25/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H2B034 T2  
WEATHER :

CPTU ZERO VALUES  
Transducer Pre Post Difference  
Tip 0 mV  
Sleeve 0 mV  
Pore Pressure 2 0 mV  
X-Y Inclinator 2417 mV 2527 mV



PointID

**H2B035 T2**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

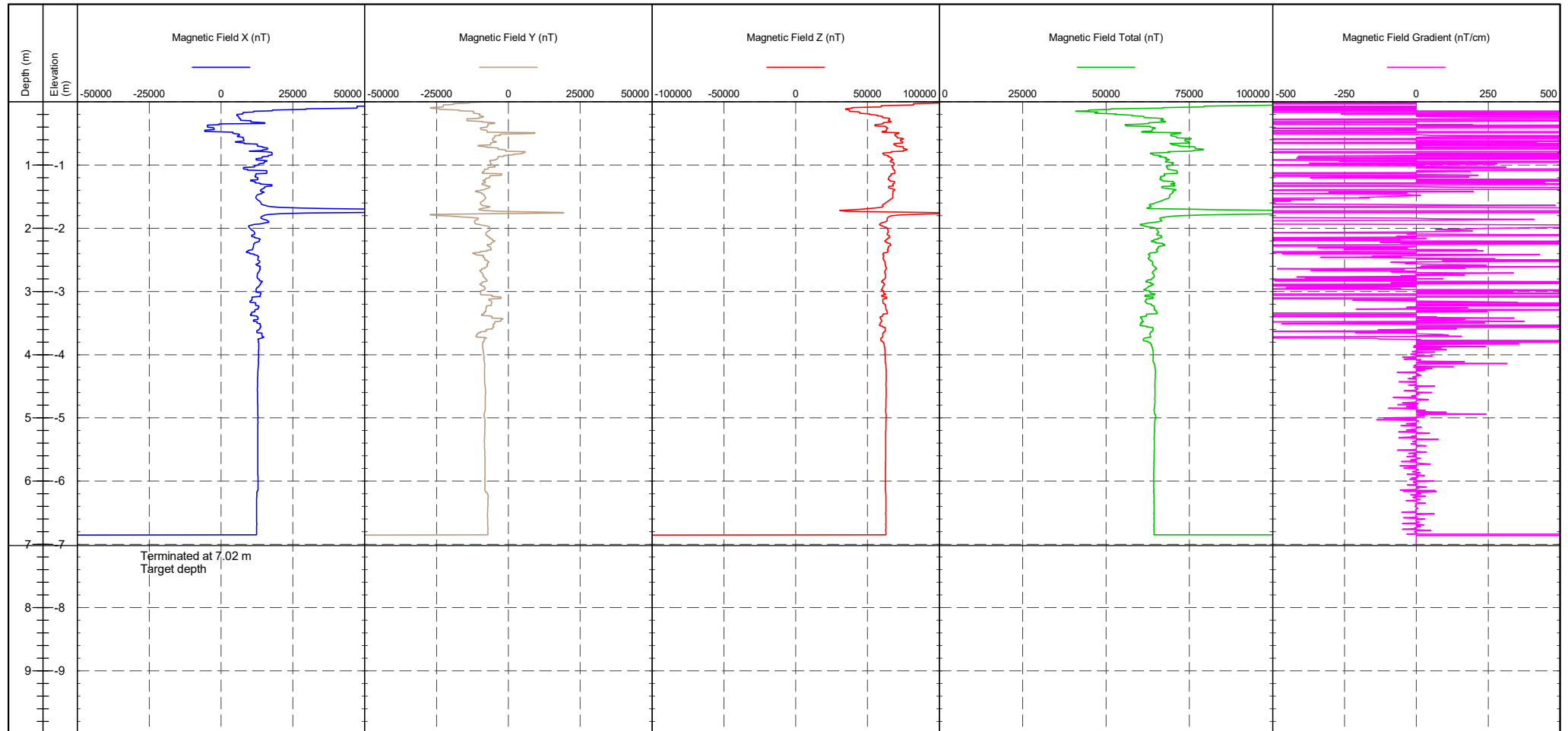
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 25/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H2B035 T2  
WEATHER :

Transducer Pre Post Difference  
Tip 0 mV  
Sleeve 0 mV  
Pore Pressure 2 0 mV  
X-Y Inclinator 2320 mV 2577 mV

CPTU ZERO VALUES



PointID

**H2B036 T2**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

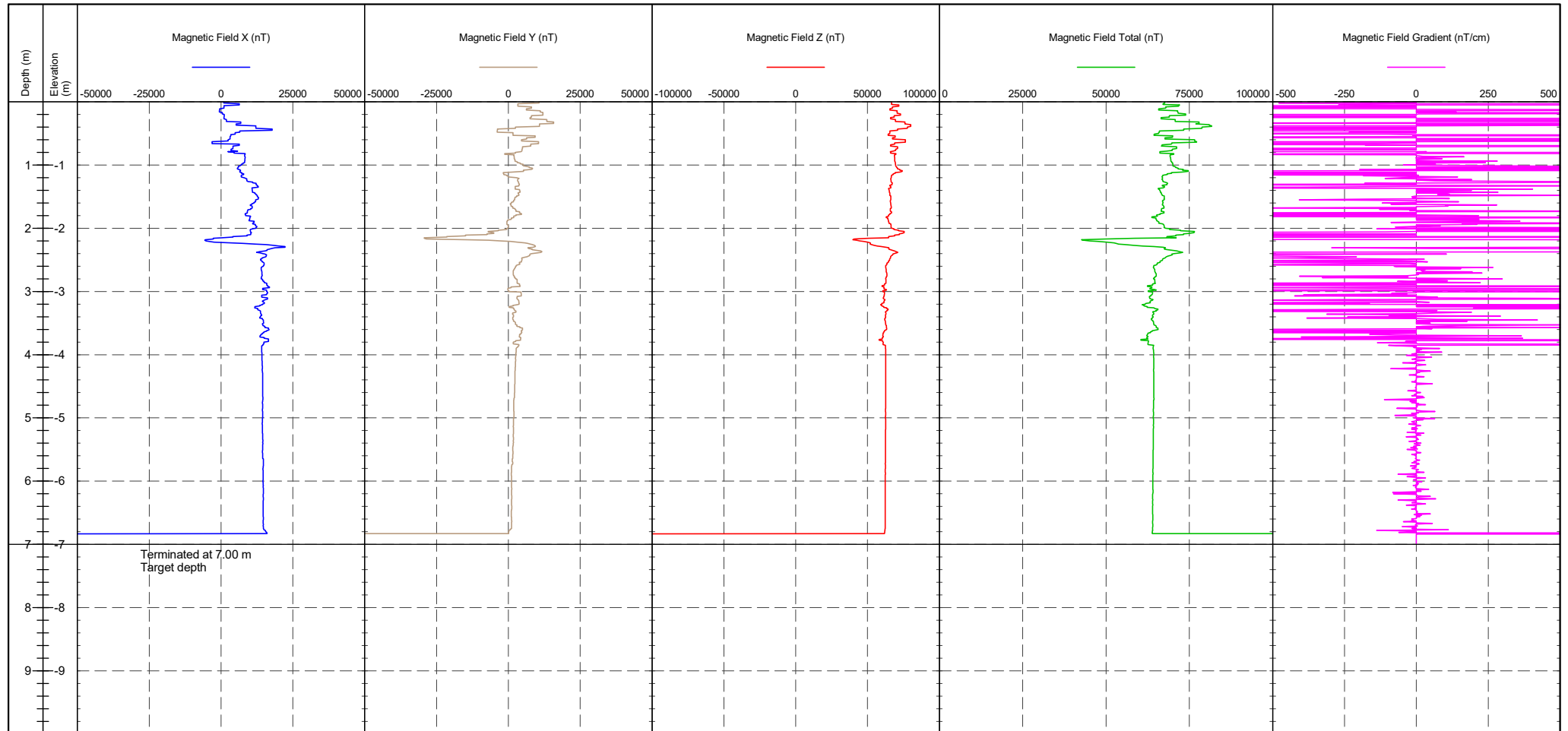
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 25/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H2B036 T2  
WEATHER :

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	0 mV		
Sleeve	0 mV		
Pore Pressure 2	0 mV		
X-Y Inclinator	2514 mV	2526 mV	



PointID

**H2B037 T2**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

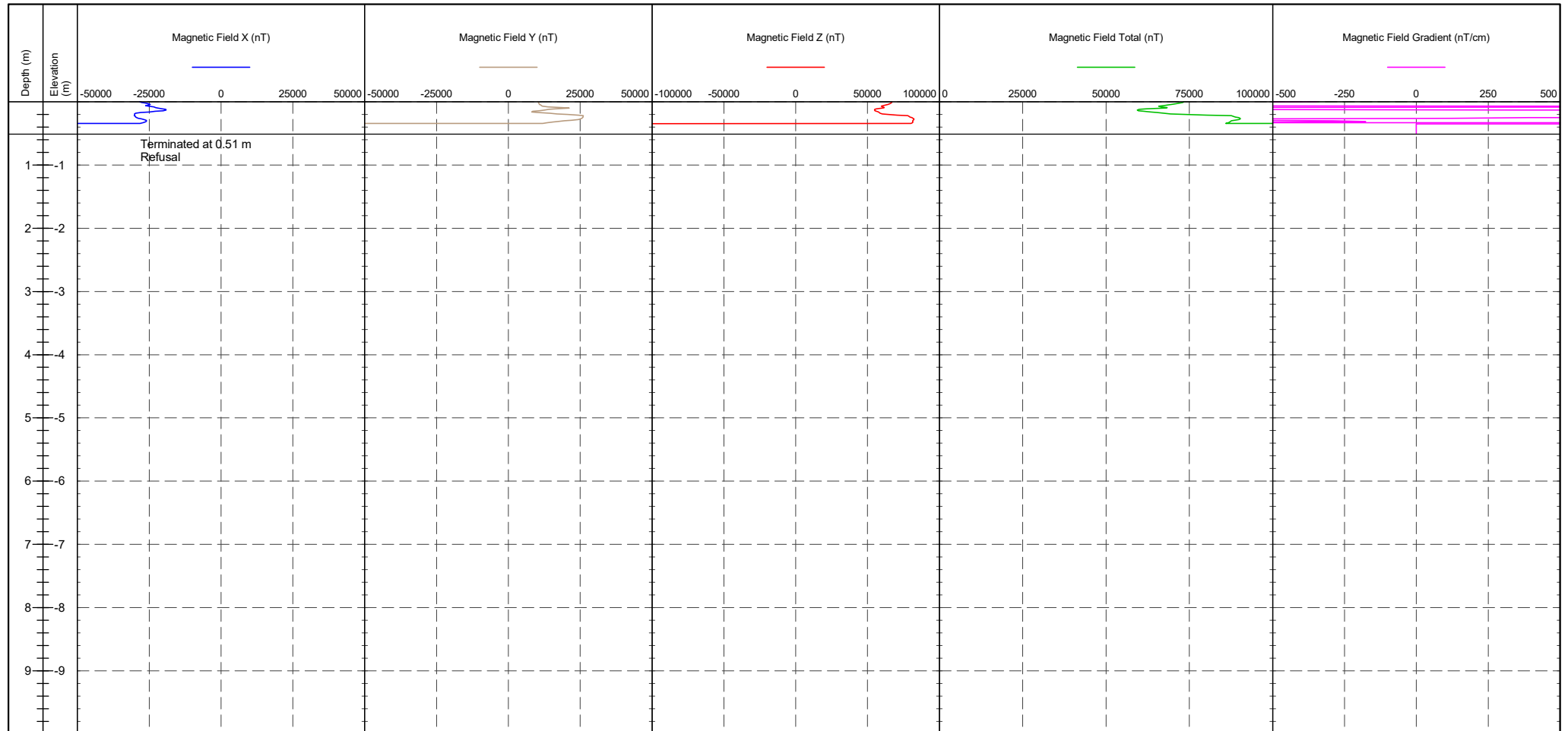
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Refusal

Remark:  
Test refused on total pressure.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 25/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H2B037 T2  
WEATHER :

CPTU ZERO VALUES  
Transducer Pre Post Difference  
Tip 0 mV  
Sleeve 0 mV  
Pore Pressure 2 0 mV  
X-Y Inclinator 2516 mV 2516 mV



PointID

**H2B037 T3**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

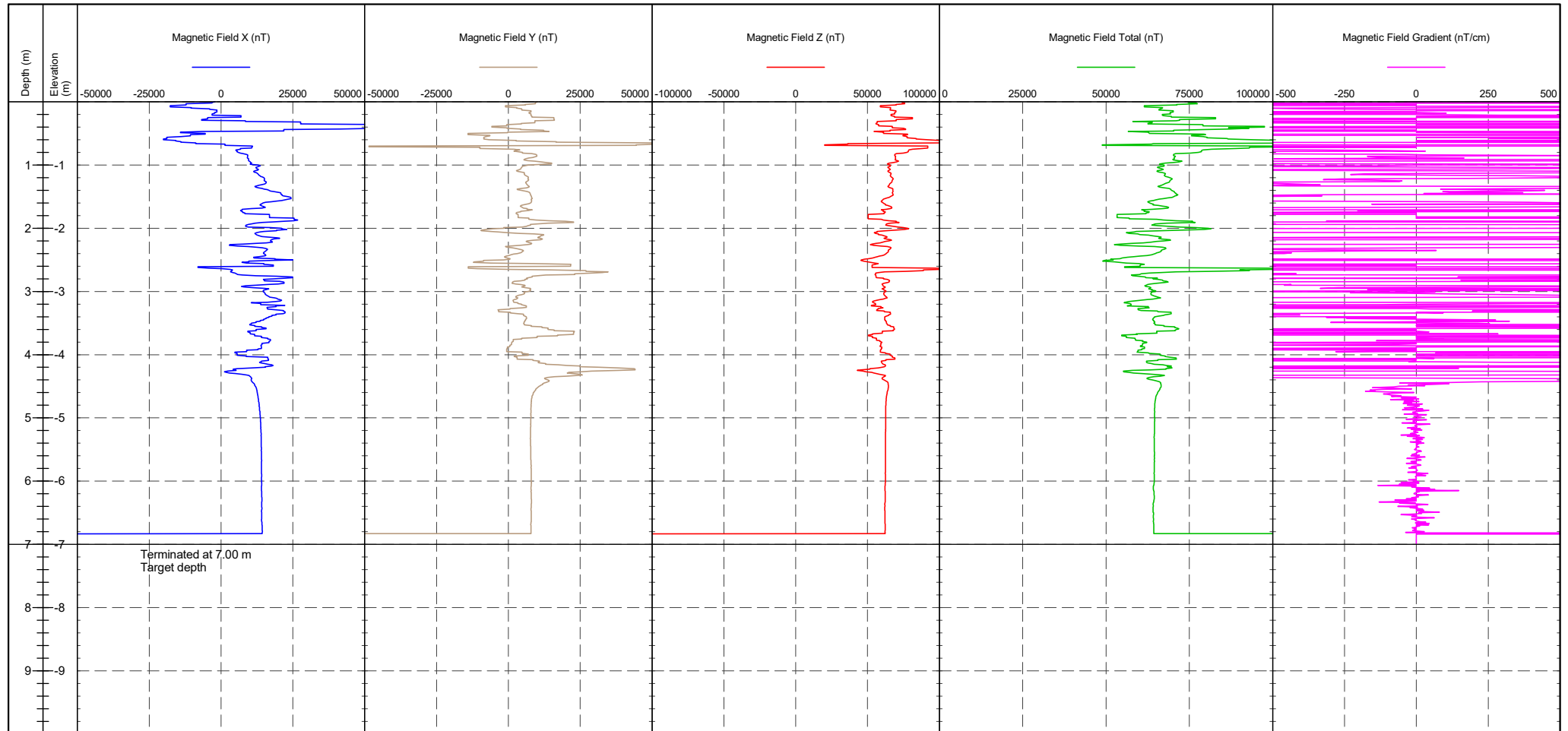
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 25/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H2B037 T3  
WEATHER :

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	0 mV		
Sleeve	0 mV		
Pore Pressure 2	0 mV		
X-Y Inclinator	2401 mV	2544 mV	



PointID

**H302 T2**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

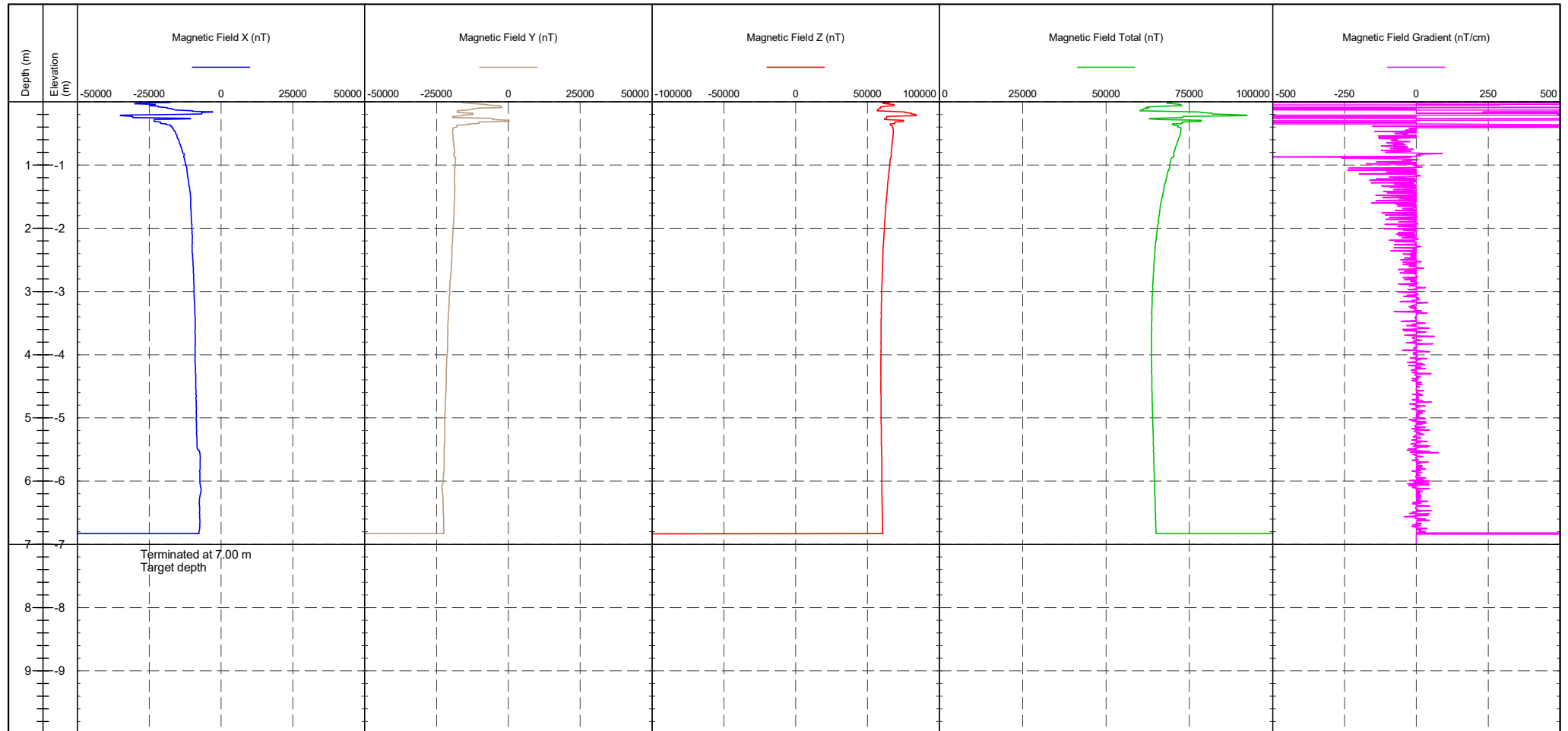
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 25/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H302 T2  
WEATHER :

Transducer Pre Post Difference  
Tip 0 mV  
Sleeve 0 mV  
Pore Pressure 2 0 mV  
X-Y Inclinator 2715 mV 2579 mV

CPTU ZERO VALUES





PointID

**H309 T2**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

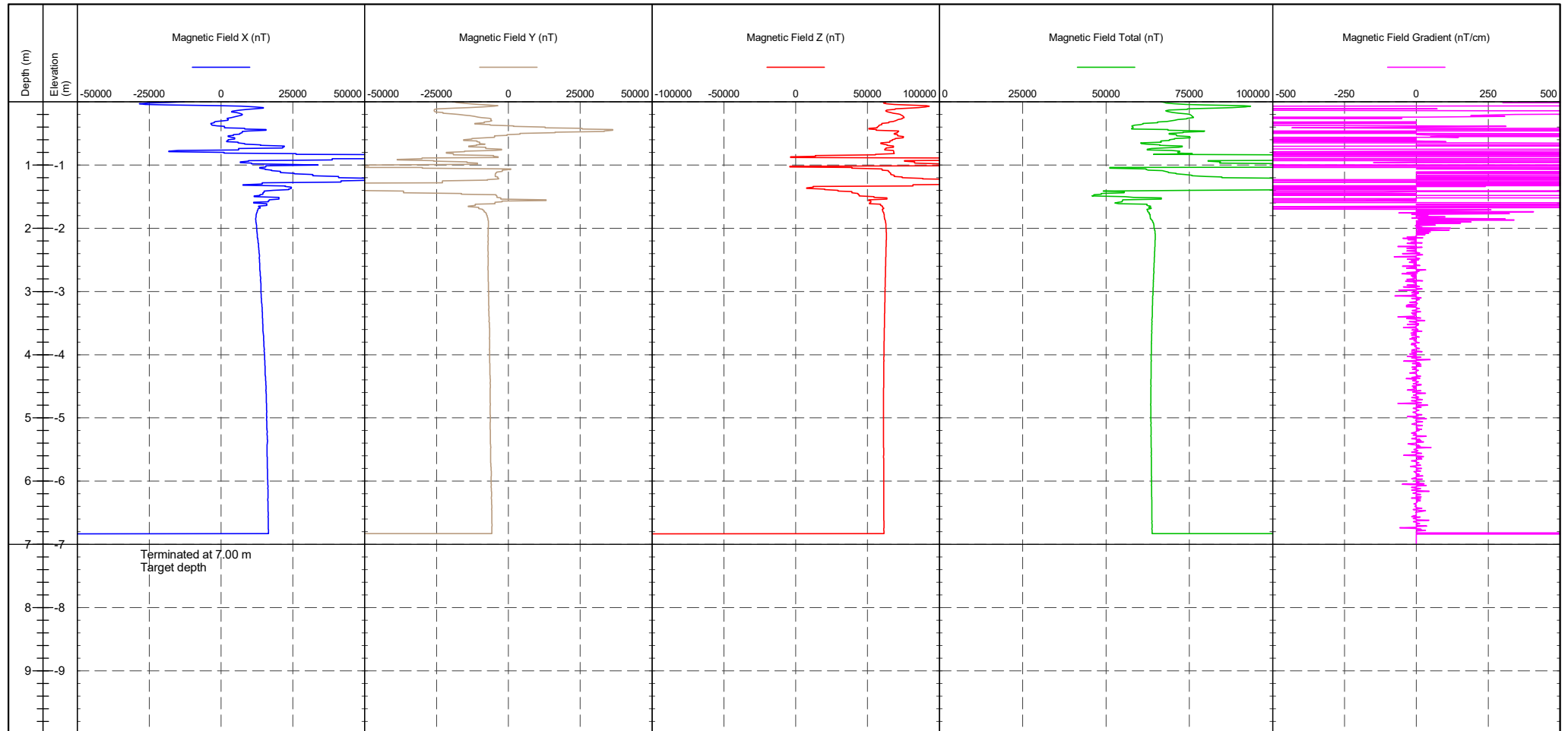
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H309 T2  
WEATHER :

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	0 mV		
Sleeve	0 mV		
Pore Pressure 2	0 mV		
X-Y Inclinator	2632 mV	2569 mV	



PointID

**H310 T2**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

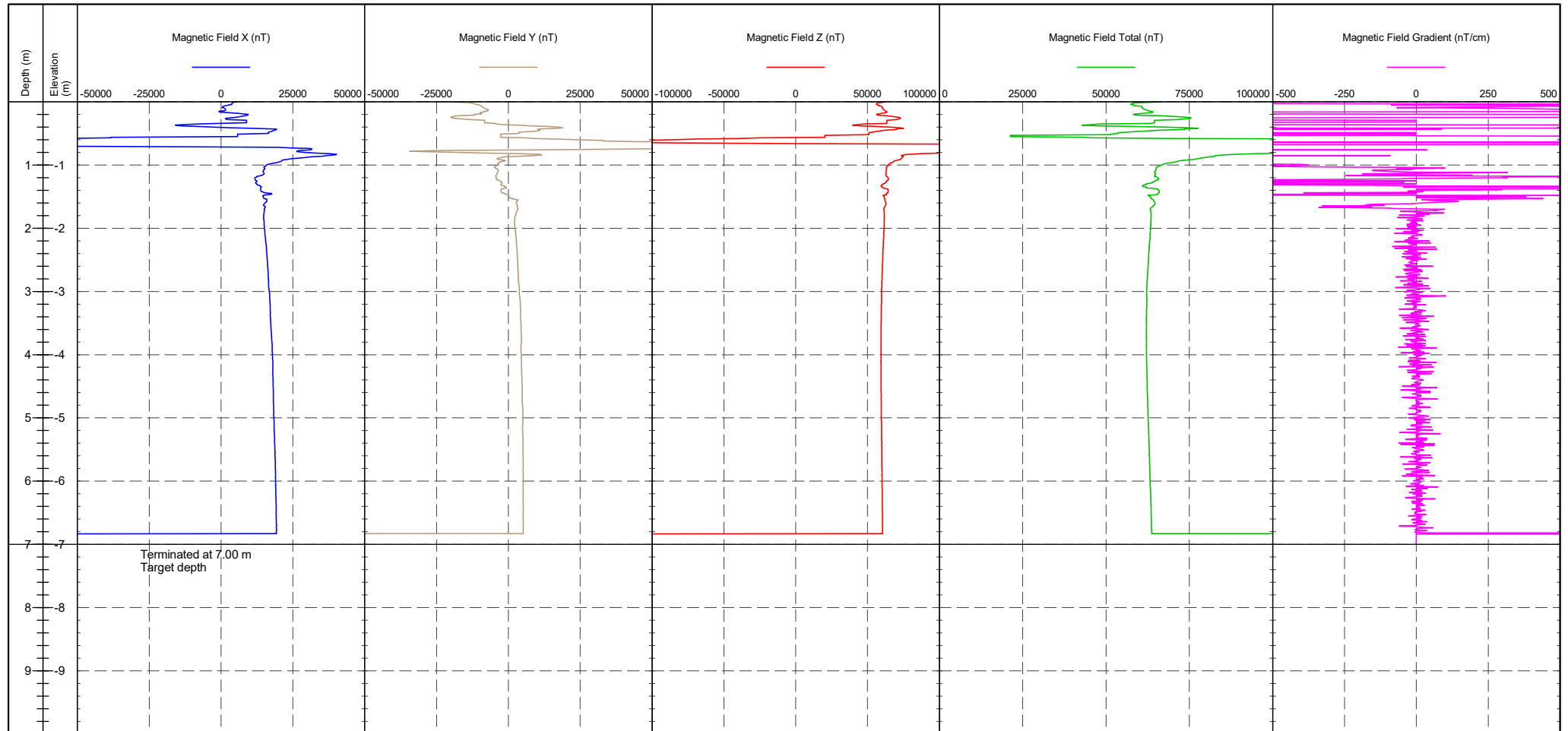
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H310 T2  
WEATHER :

Transducer Pre Post Difference  
Tip 0 mV  
Sleeve 0 mV  
Pore Pressure 2 0 mV  
X-Y Inclinator 2475 mV 2510 mV

CPTU ZERO VALUES



PointID

**H341**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

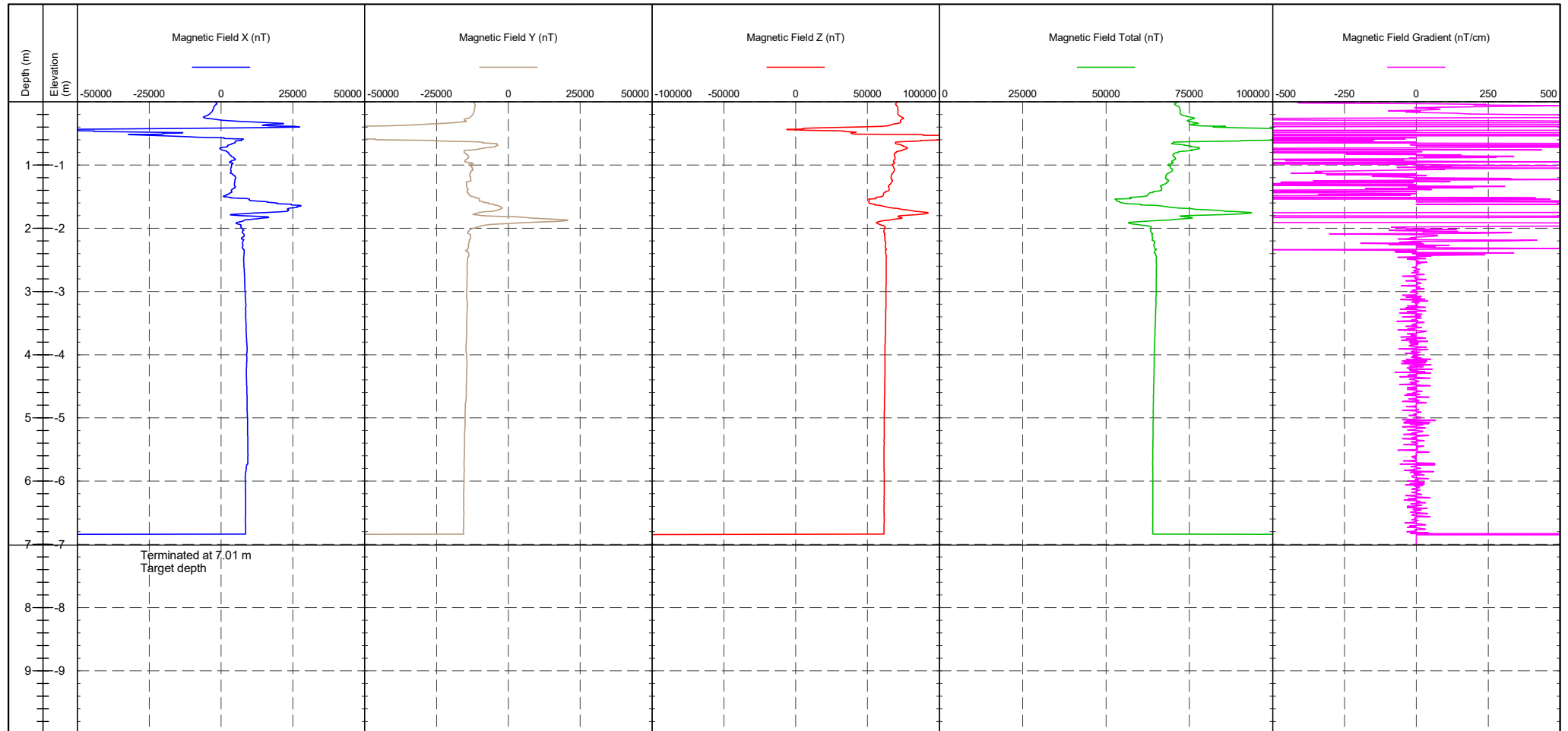
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H341  
WEATHER :

Transducer Pre Post Difference  
Tip 0 mV  
Sleeve 0 mV  
Pore Pressure 2 0 mV  
X-Y Inclinator 2485 mV 2506 mV

CPTU ZERO VALUES



PointID

**H1026**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

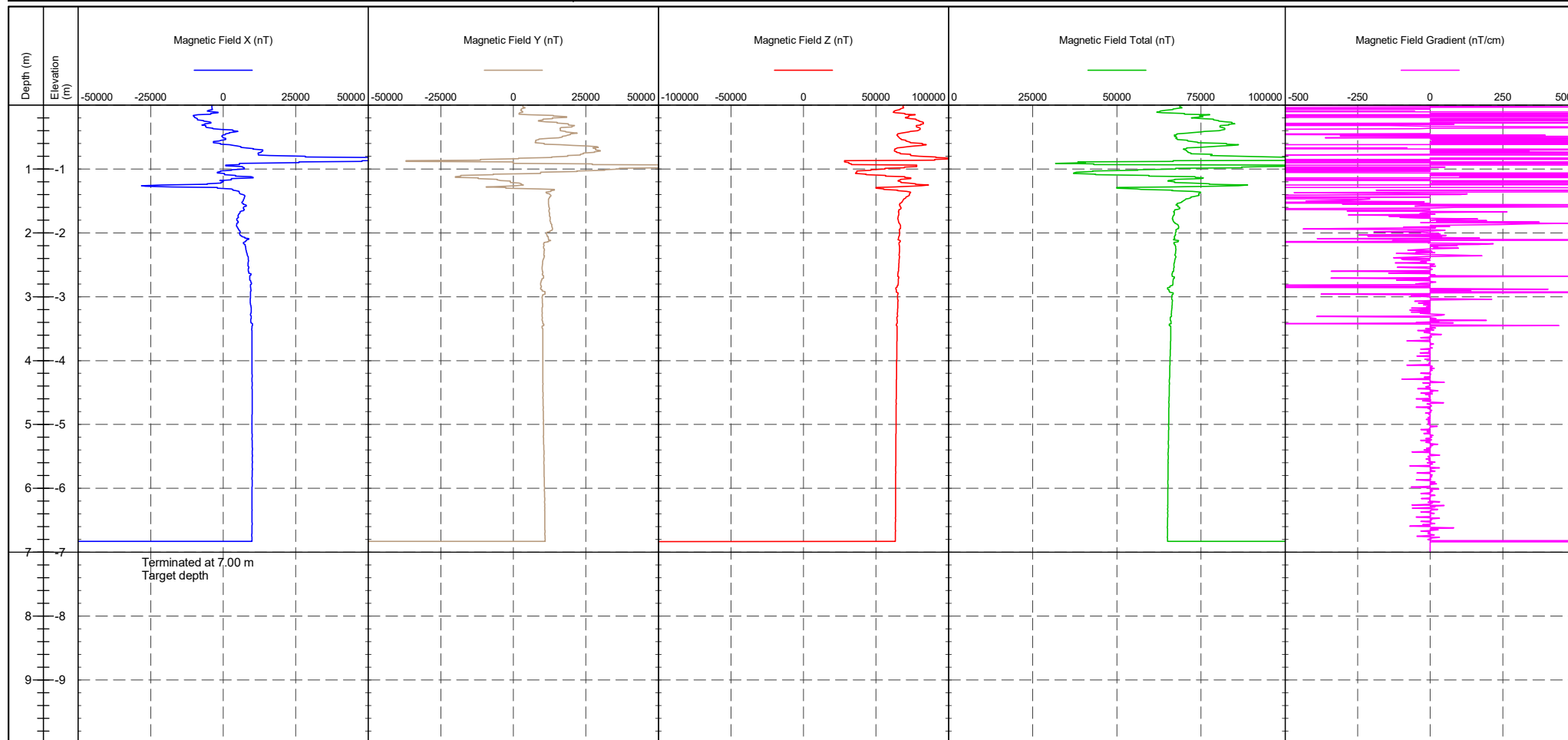
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 25/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



Terminated at 7.00 m  
Target depth

CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H1026  
WEATHER :

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	0 mV		
Sleeve	0 mV		
Pore Pressure 2	0 mV		
X-Y Inclinator	2571 mV	2575 mV	



PointID

**H3012**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

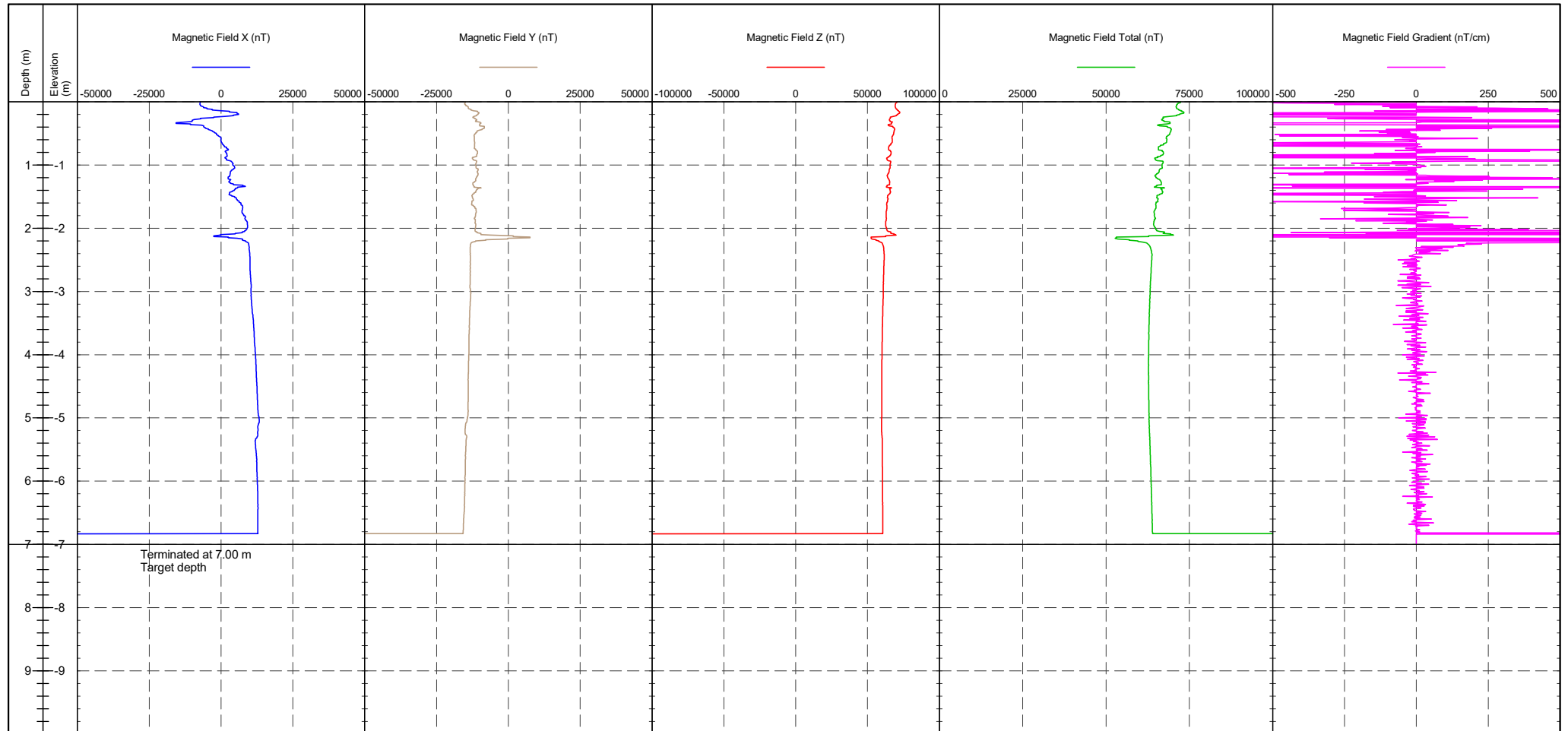
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 25/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3012  
WEATHER :

CPTU ZERO VALUES  
Transducer Pre Post Difference  
Tip 0 mV  
Sleeve 0 mV  
Pore Pressure 2 0 mV  
X-Y Inclinator 2627 mV 2502 mV



PointID

**H3014/26**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

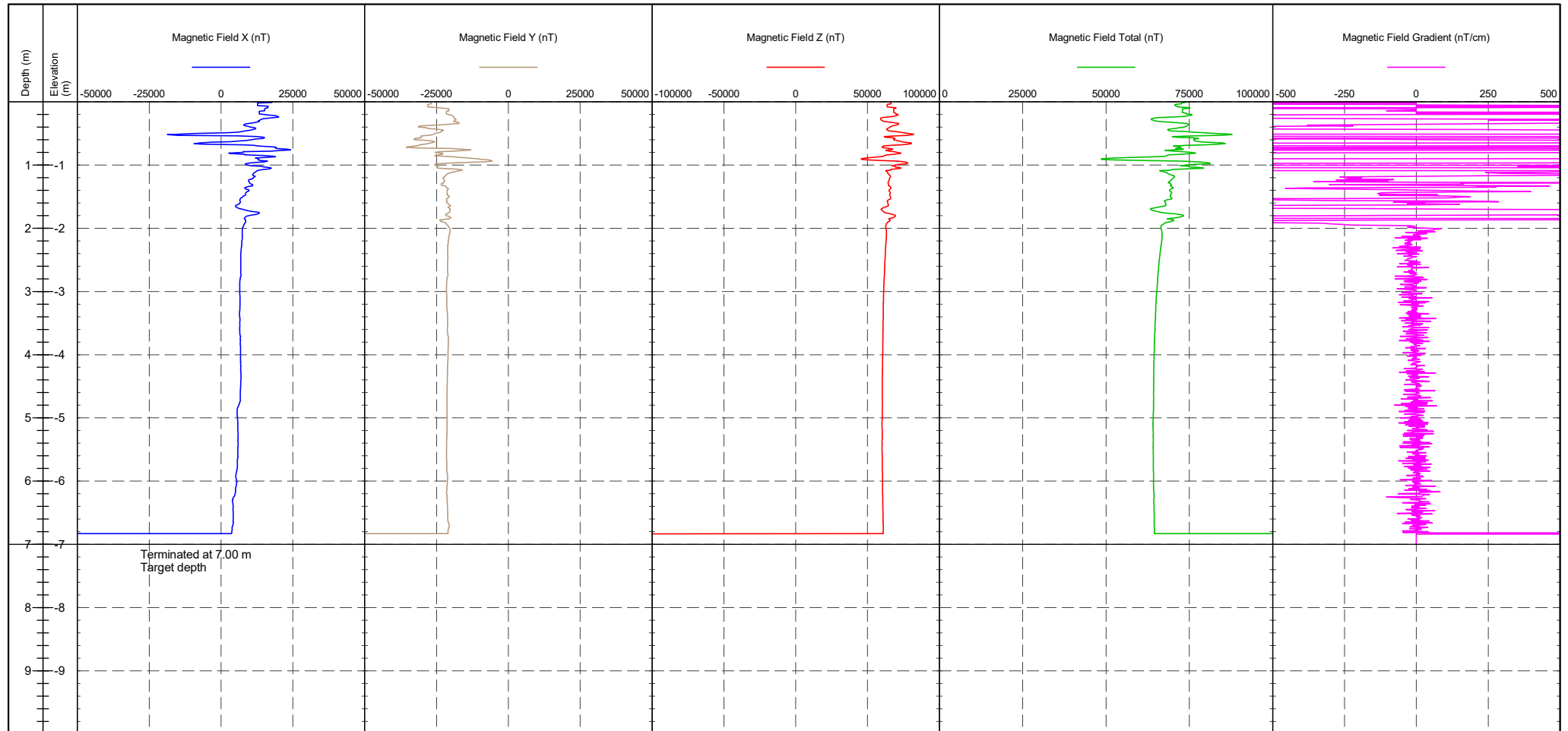
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3014/26  
WEATHER :

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	0 mV		
Sleeve	0 mV		
Pore Pressure 2	0 mV		
X-Y Inclinator	2829 mV	2503 mV	



PointID

**H3015/27**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

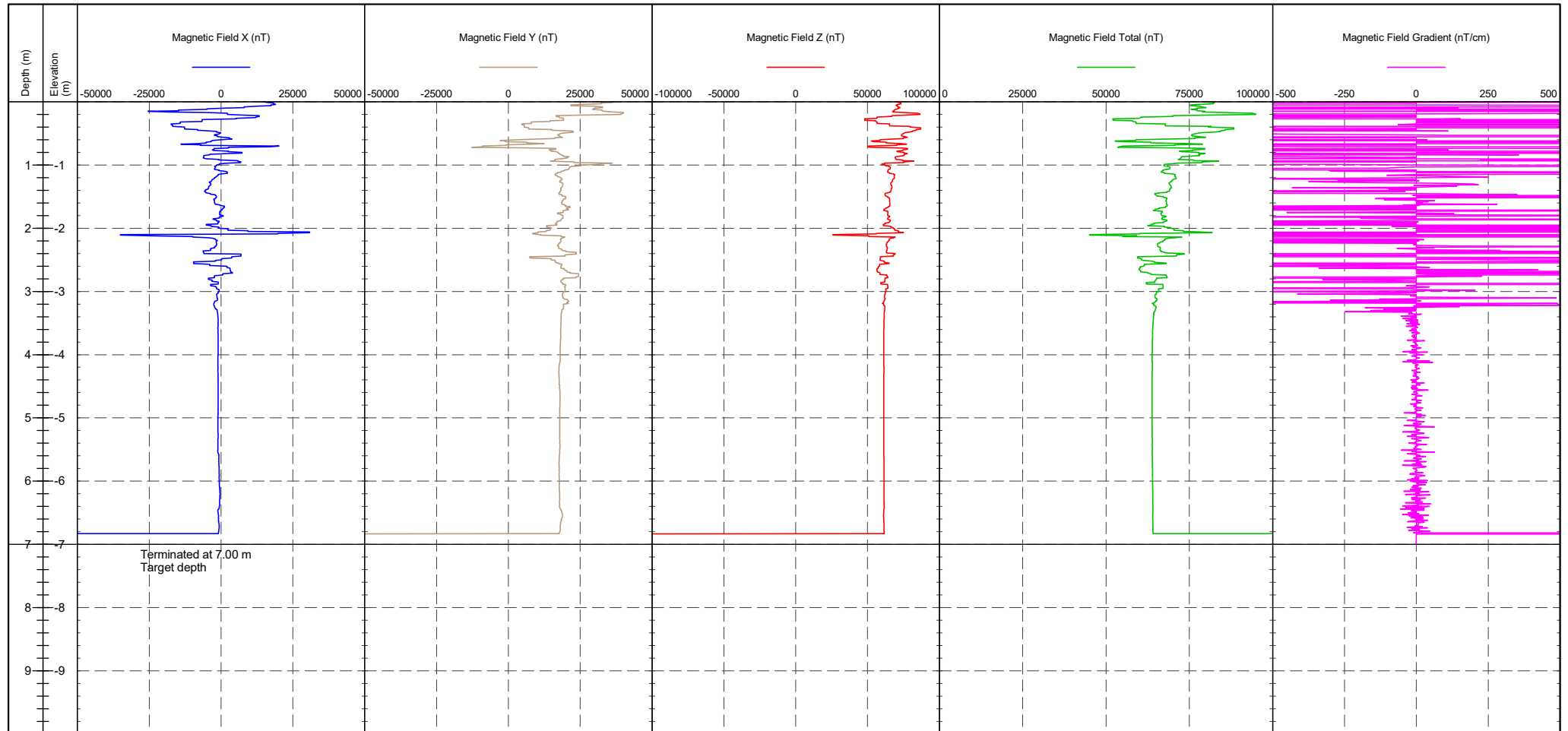
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3015/27  
WEATHER :

Transducer Pre Post Difference  
Tip 0 mV  
Sleeve 0 mV  
Pore Pressure 2 0 mV  
X-Y Inclinator 2469 mV 2360 mV

CPTU ZERO VALUES



PointID

**H3024**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

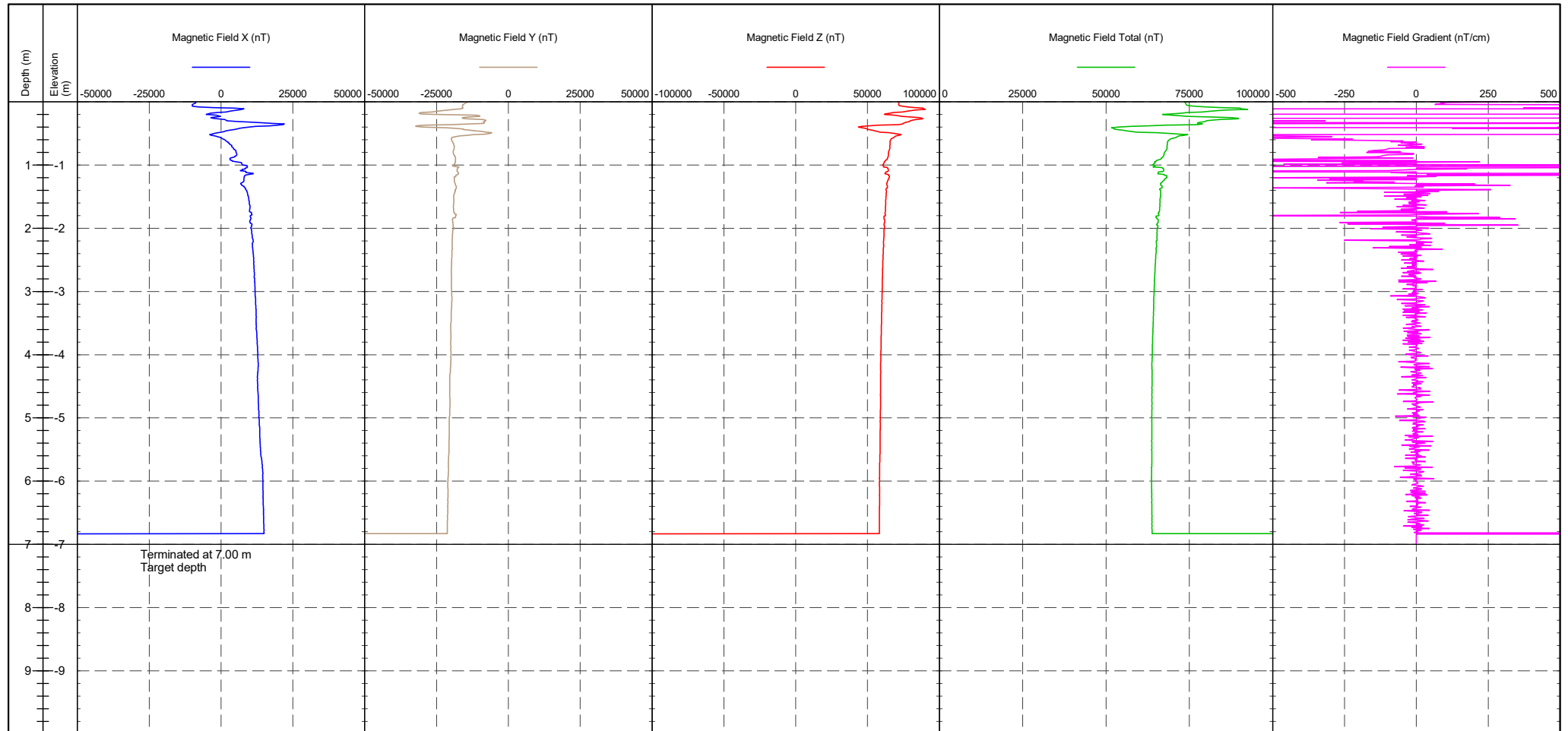
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 25/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3024  
WEATHER :

Transducer Pre Post Difference  
Tip 0 mV  
Sleeve 0 mV  
Pore Pressure 2 0 mV  
X-Y Inclinator 2530 mV 2529 mV

CPTU ZERO VALUES





PointID

**H3033**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

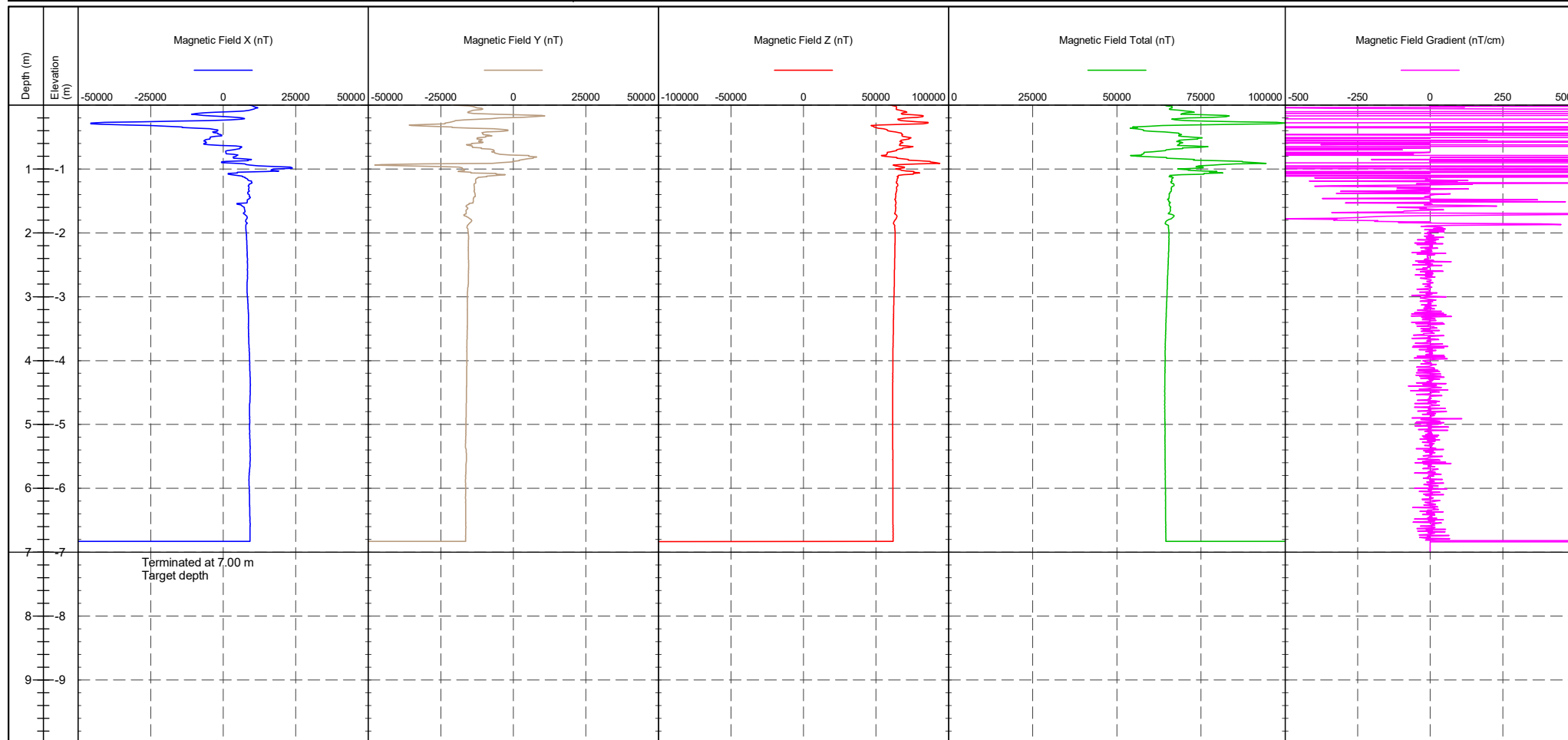
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3033  
WEATHER :

CPTU ZERO VALUES  
Transducer Pre Post Difference  
Tip 0 mV  
Sleeve 0 mV  
Pore Pressure 2 0 mV  
X-Y Inclinator 2542 mV 2904 mV



PointID

**H3040**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

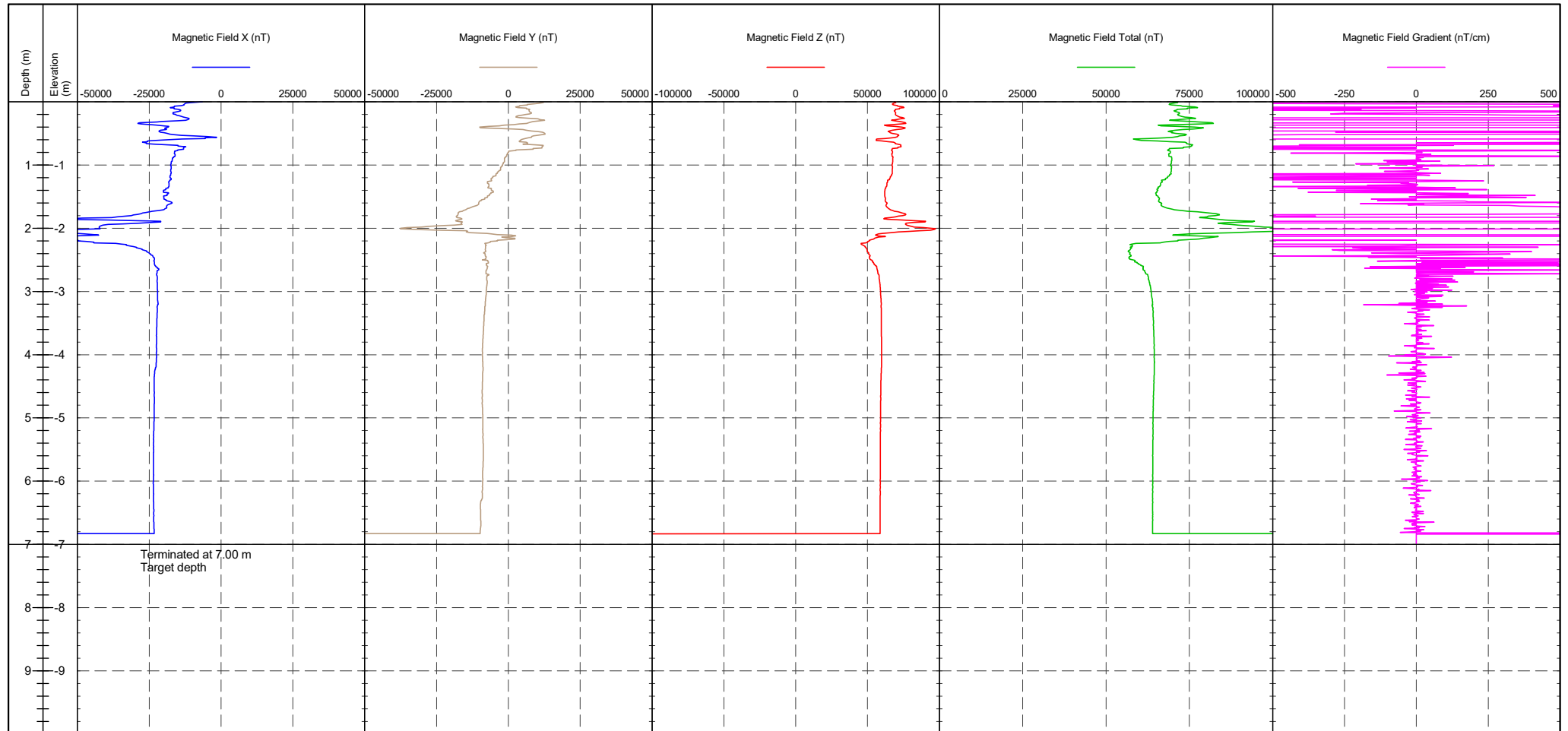
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3040  
WEATHER :

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	0 mV		
Sleeve	0 mV		
Pore Pressure 2	0 mV		
X-Y Inclinator	2418 mV	2396 mV	



PointID

**H3042**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

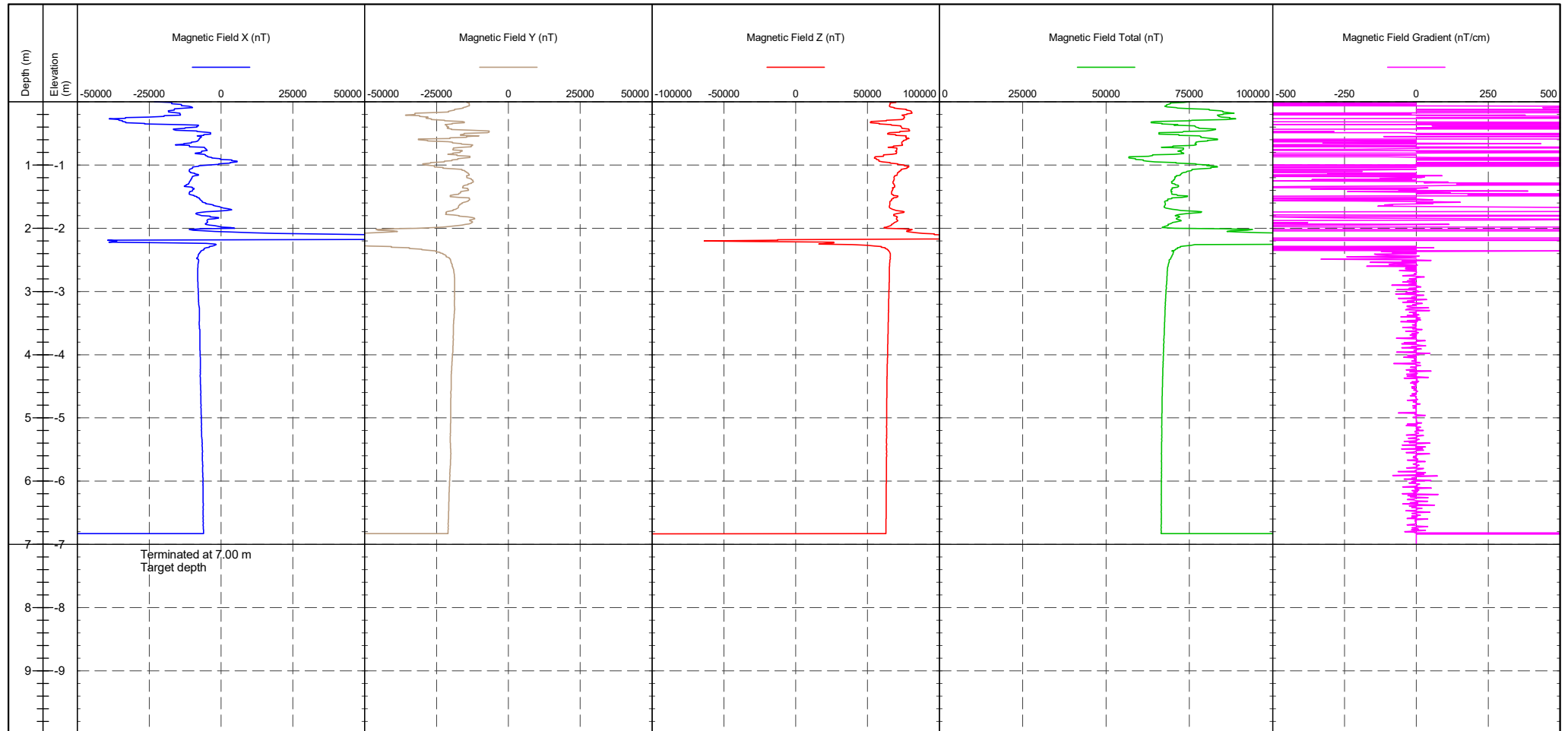
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 25/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3042  
WEATHER :

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	0 mV		
Sleeve	0 mV		
Pore Pressure 2	0 mV		
X-Y Inclinator	2484 mV	2487 mV	



PointID

**H3043**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

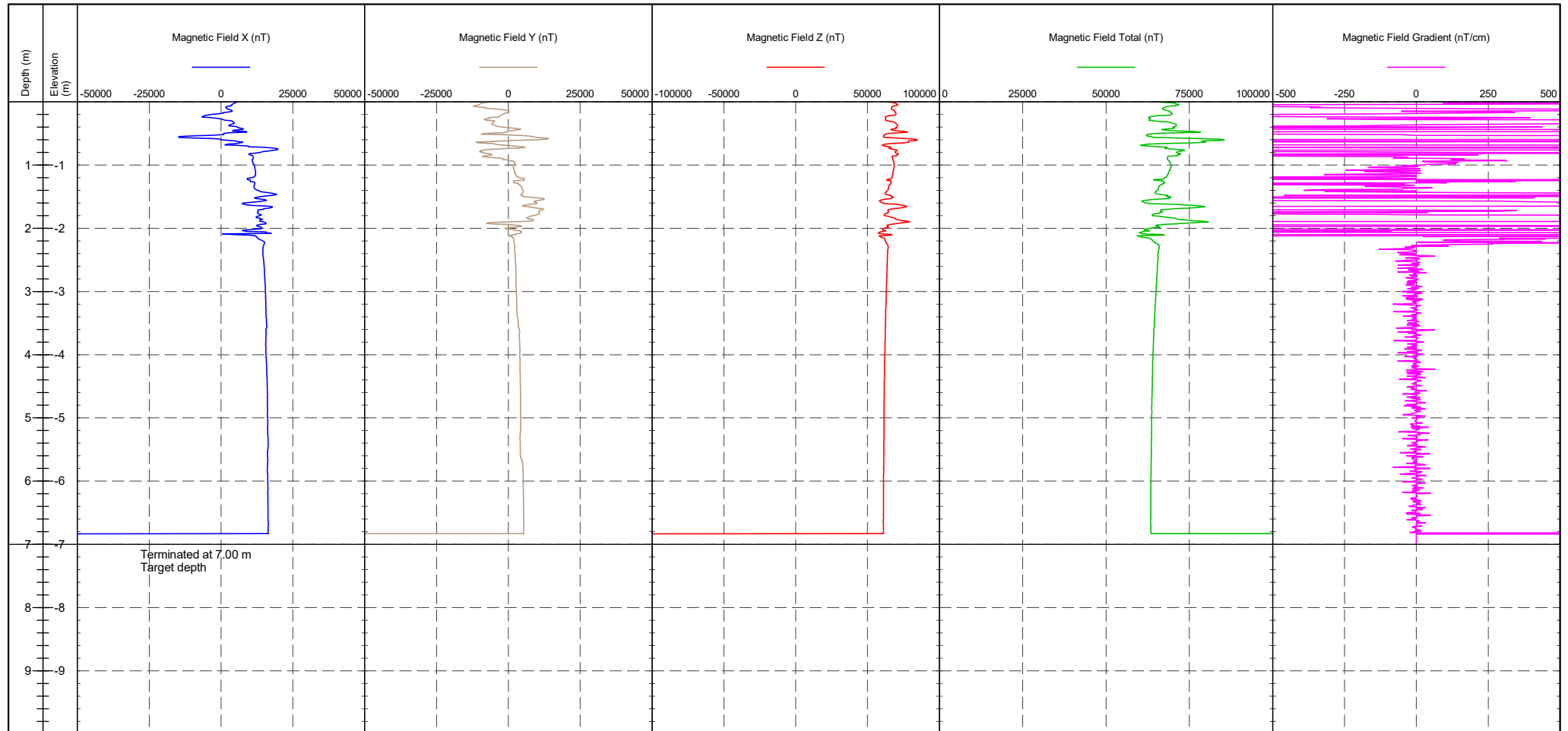
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3043  
WEATHER :

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	0 mV		
Sleeve	0 mV		
Pore Pressure 2	0 mV		
X-Y Inclinator	2556 mV	2563 mV	



PointID

**H3044**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

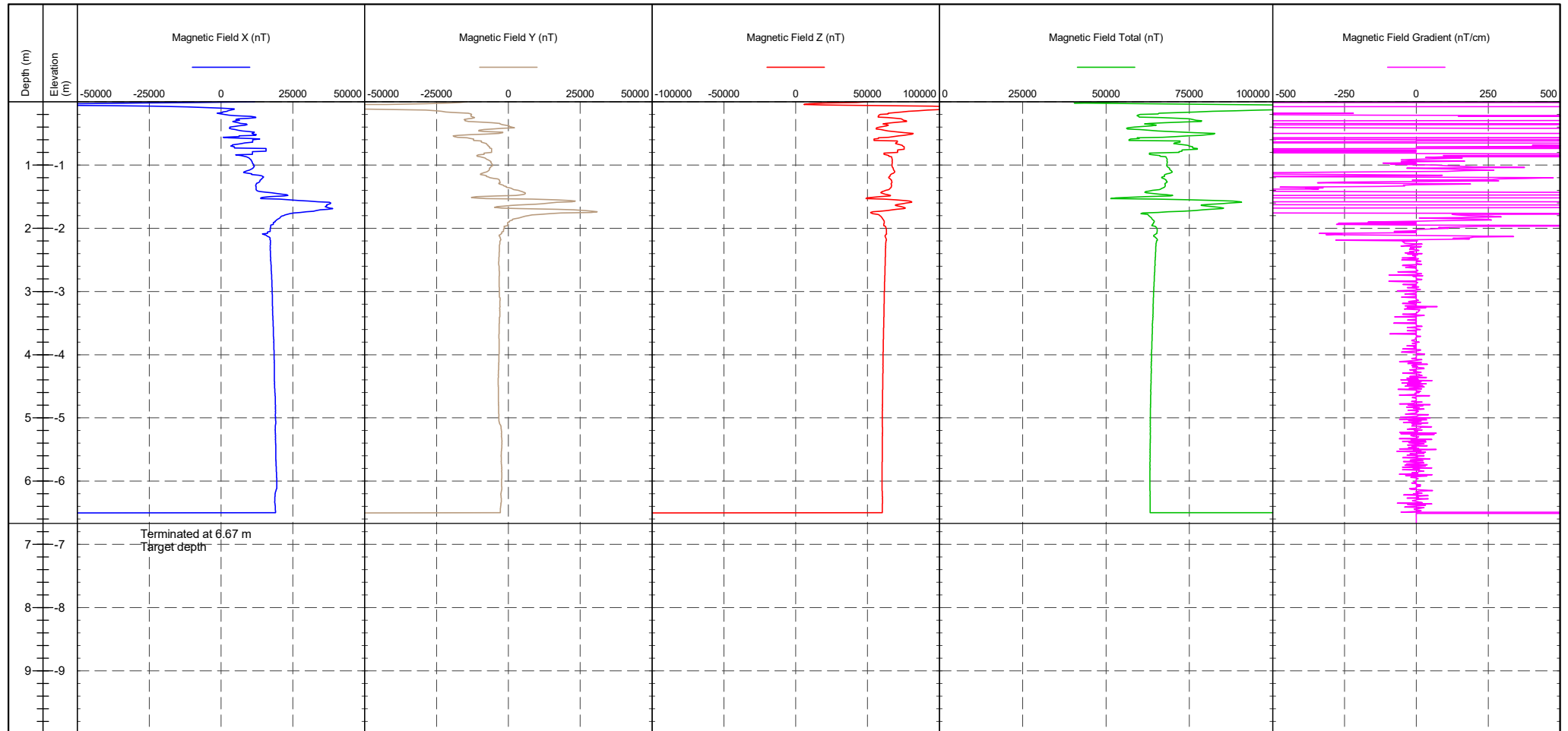
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3044  
WEATHER :

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	0 mV		
Sleeve	0 mV		
Pore Pressure 2	0 mV		
X-Y Inclinator	2567 mV	2547 mV	



PointID

**H3045**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

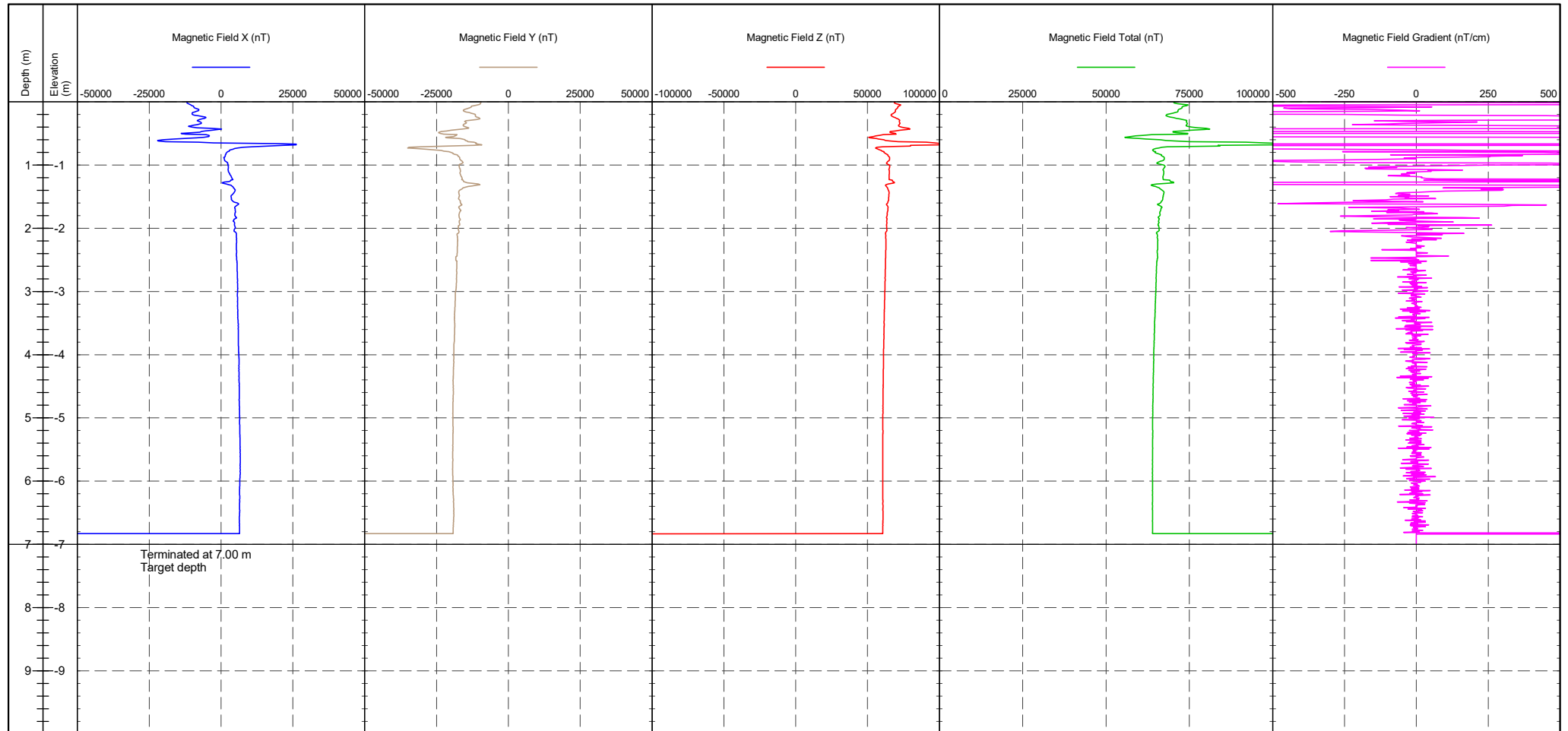
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3045  
WEATHER :

CPTU ZERO VALUES  
Transducer Pre Post Difference  
Tip 0 mV  
Sleeve 0 mV  
Pore Pressure 2 0 mV  
X-Y Inclinator 2563 mV 2589 mV



PointID

**H3046**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

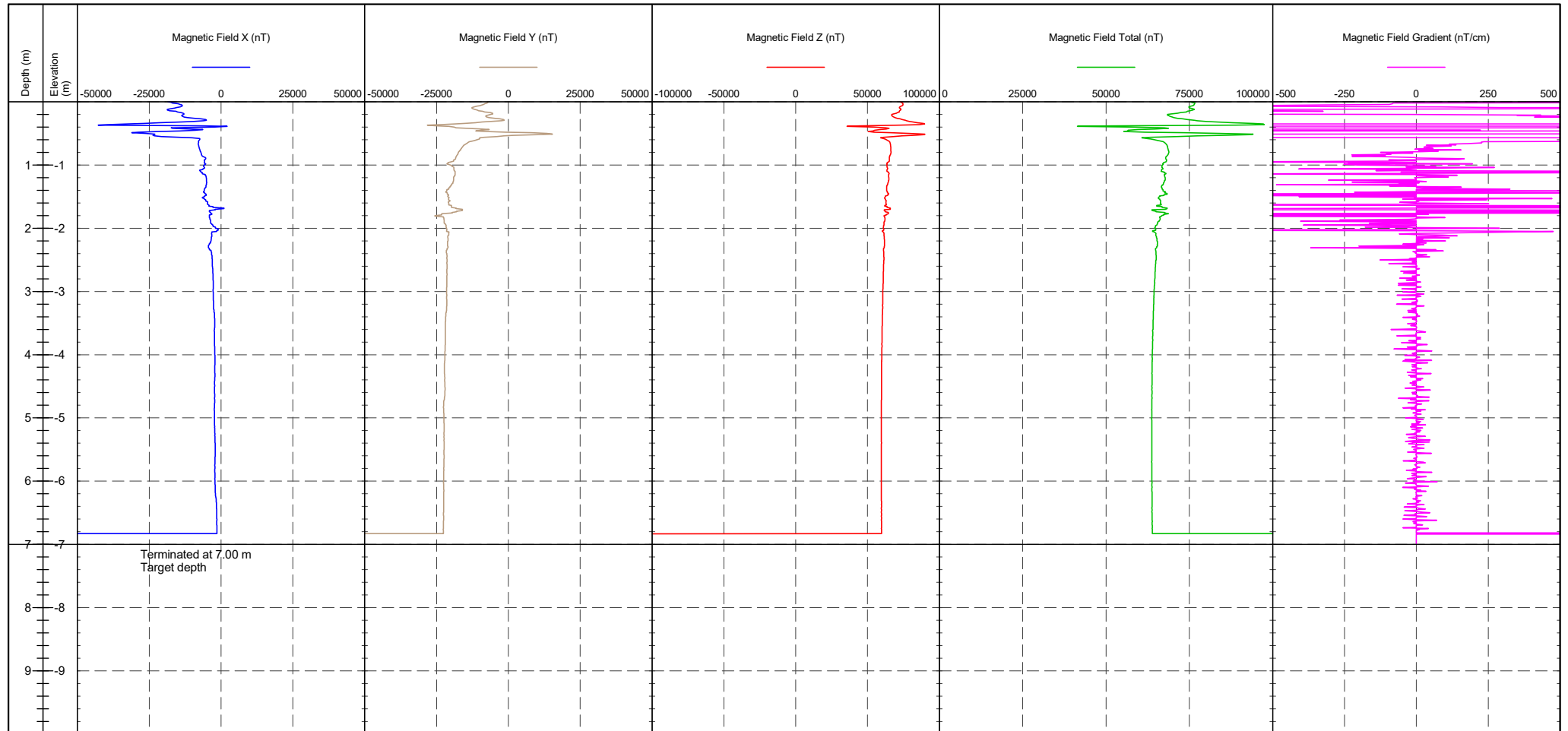
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3046  
WEATHER :

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	0 mV		
Sleeve	0 mV		
Pore Pressure 2	0 mV		
X-Y Inclinator	2581 mV	2559 mV	



PointID

**H3013025**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

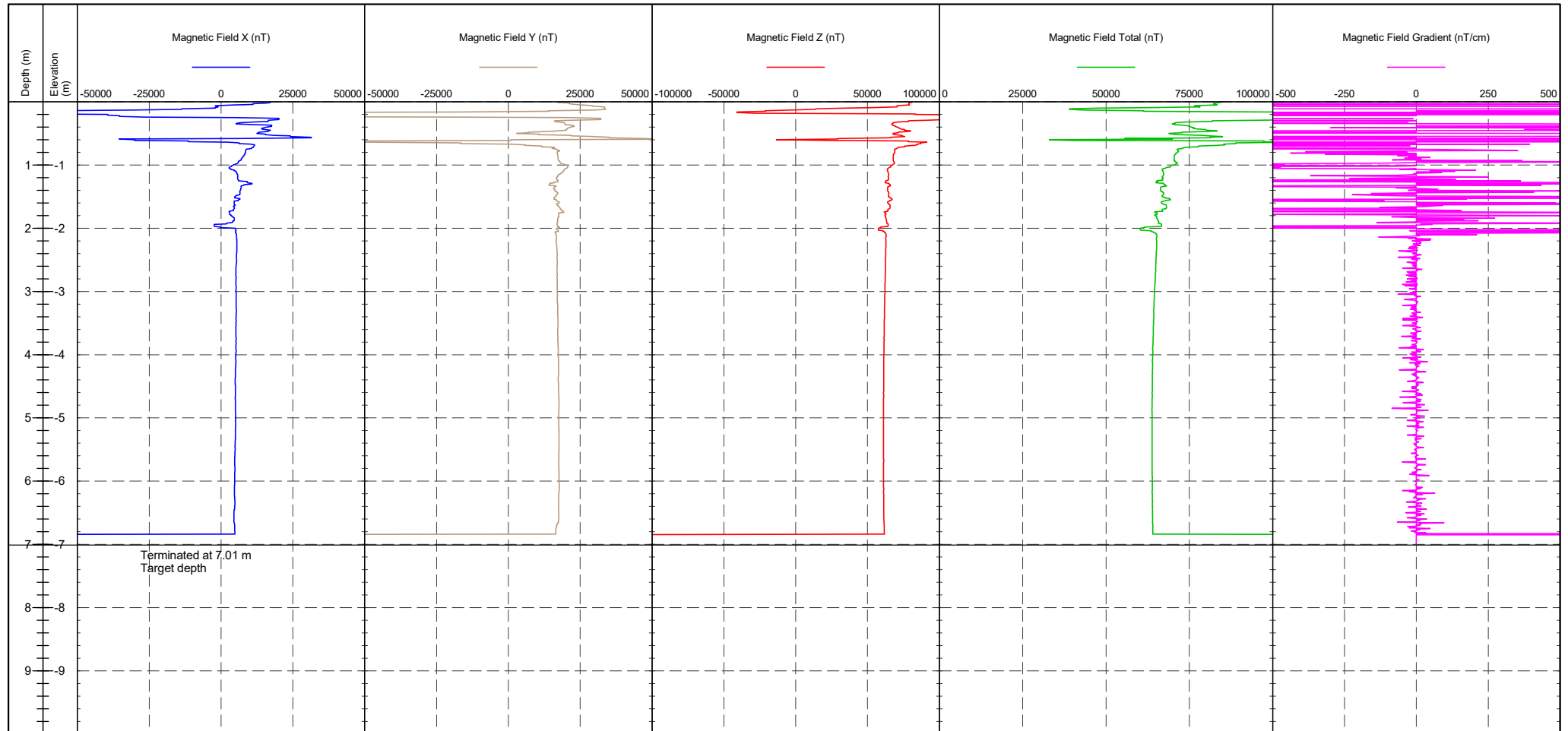
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3013025  
WEATHER :

Transducer Pre Post Difference  
Tip 0 mV  
Sleeve 0 mV  
Pore Pressure 2 0 mV  
X-Y Inclinator 2476 mV 2191 mV

CPTU ZERO VALUES





PointID

**H3016028**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

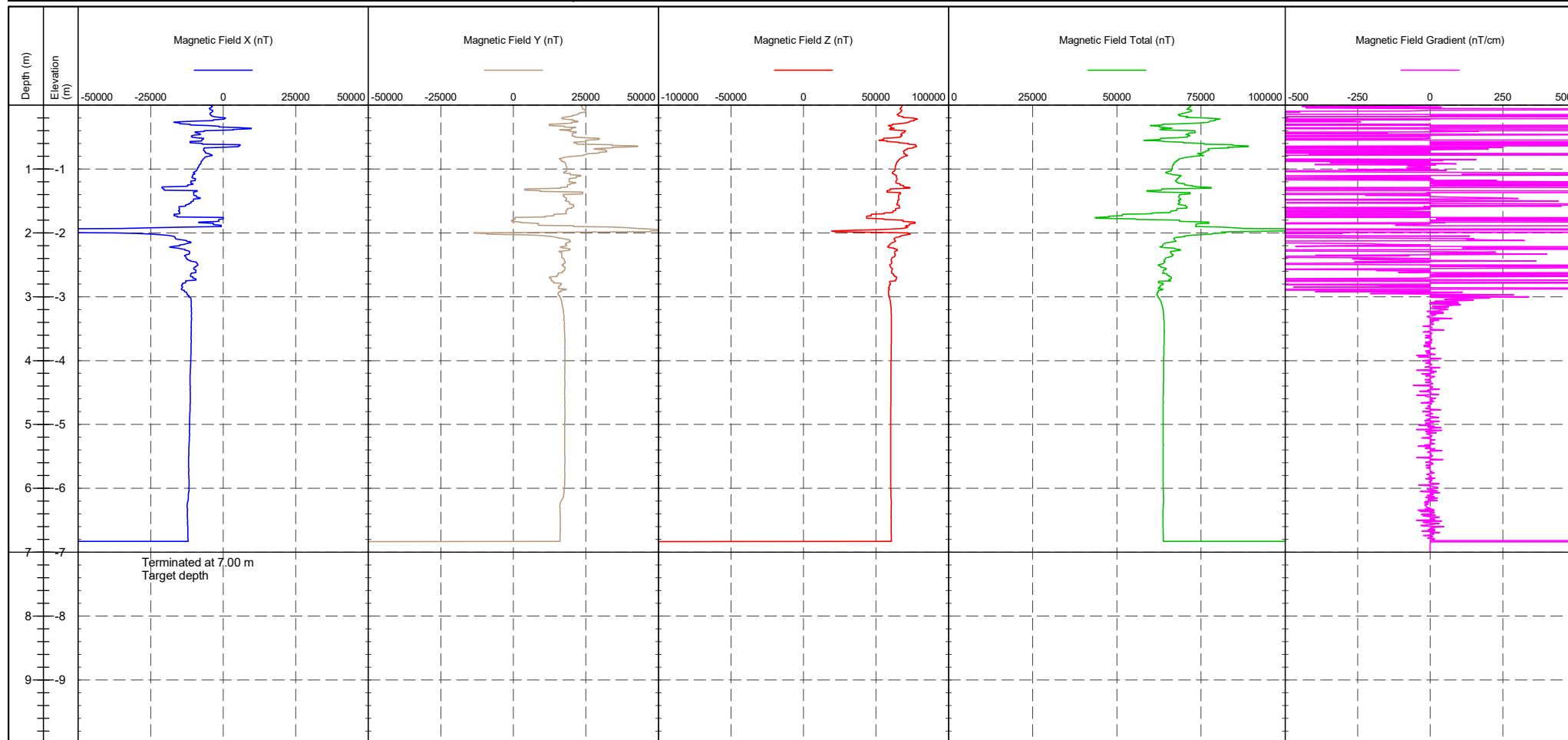
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3016028  
WEATHER :

Transducer Pre Post Difference  
Tip 0 mV  
Sleeve 0 mV  
Pore Pressure 2 0 mV  
X-Y Inclinator 2473 mV 2456 mV

CPTU ZERO VALUES



PointID

**H3018030**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

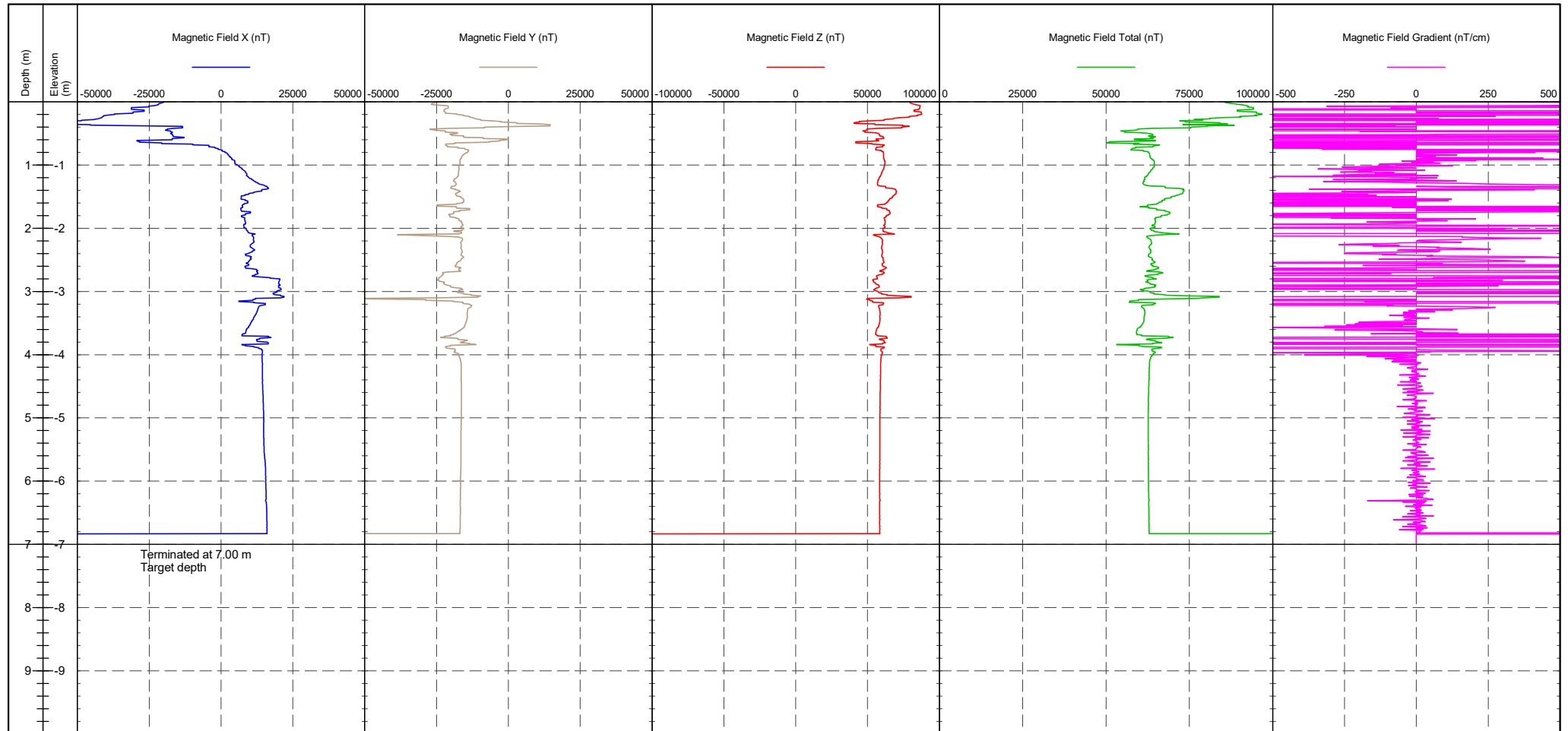
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3018030  
WEATHER :

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	0 mV		
Sleeve	0 mV		
Pore Pressure 2	0 mV		
X-Y Inclinator	2490 mV	2459 mV	



PointID

**H3019029**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

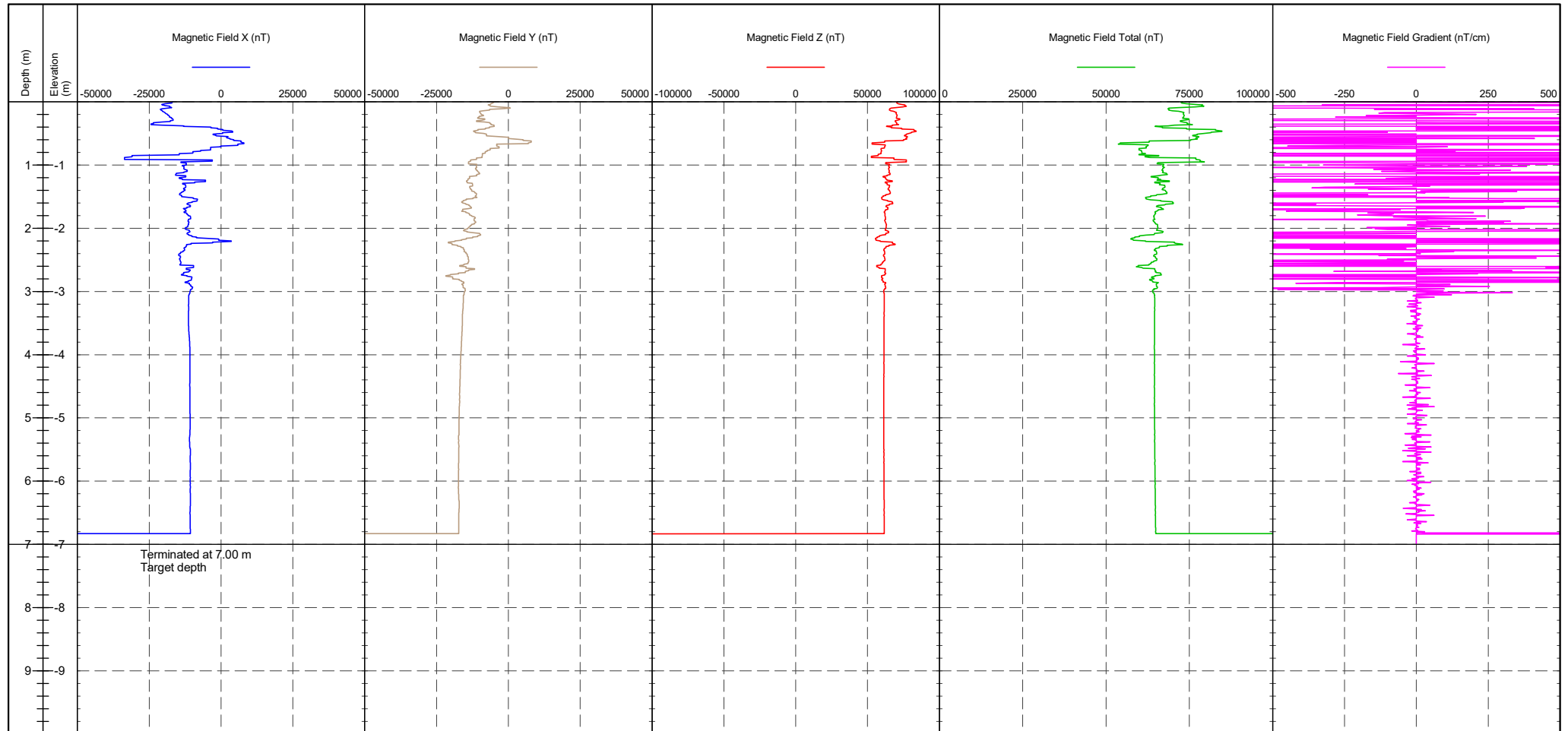
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3019029  
WEATHER :

Transducer Pre Post Difference  
Tip 0 mV  
Sleeve 0 mV  
Pore Pressure 2 0 mV  
X-Y Inclinator 2480 mV 2579 mV

CPTU ZERO VALUES



PointID

**H3019031**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

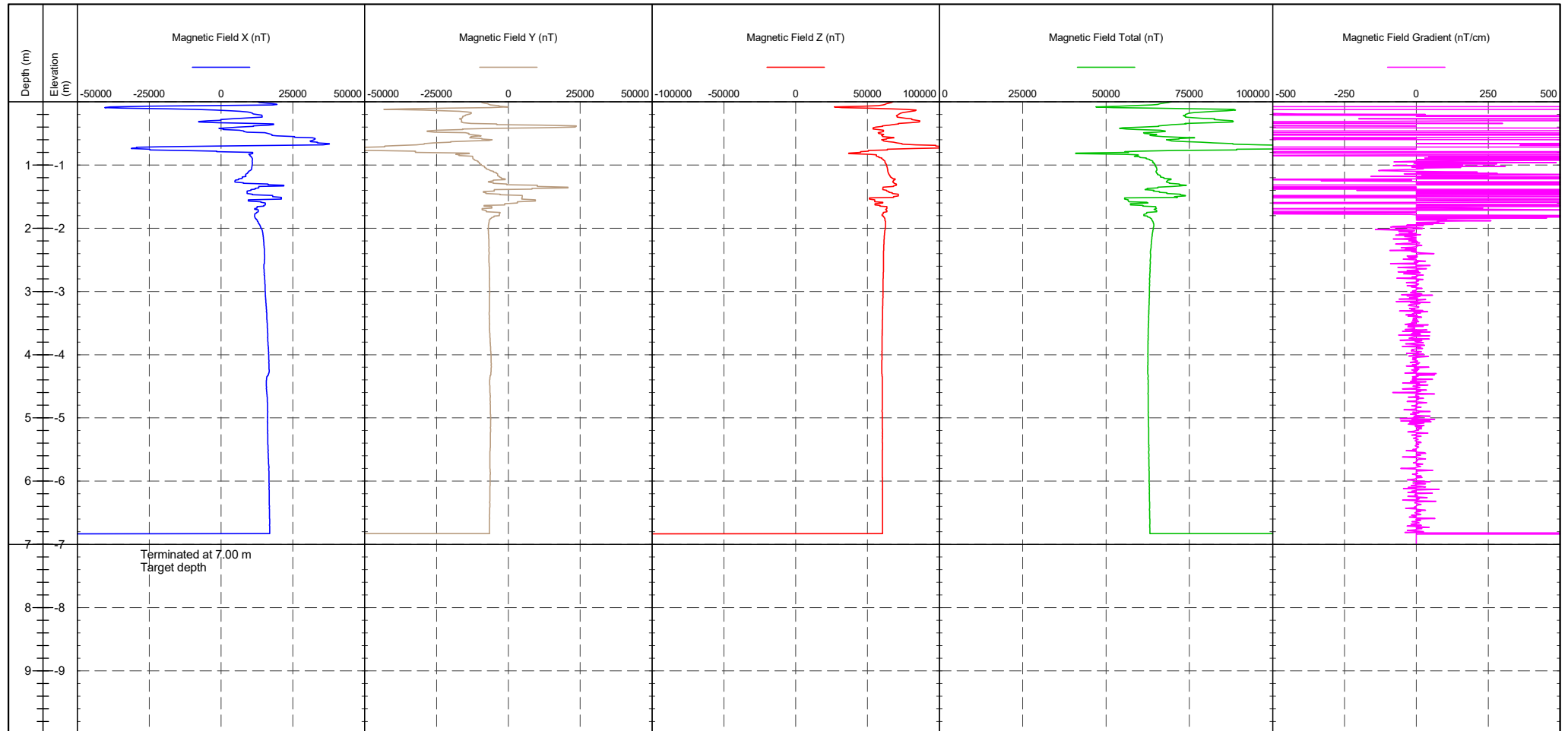
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3019031  
WEATHER :

Transducer Pre Post Difference  
Tip 0 mV  
Sleeve 0 mV  
Pore Pressure 2 0 mV  
X-Y Inclinator 2544 mV 2675 mV

CPTU ZERO VALUES



PointID

**H3020032**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

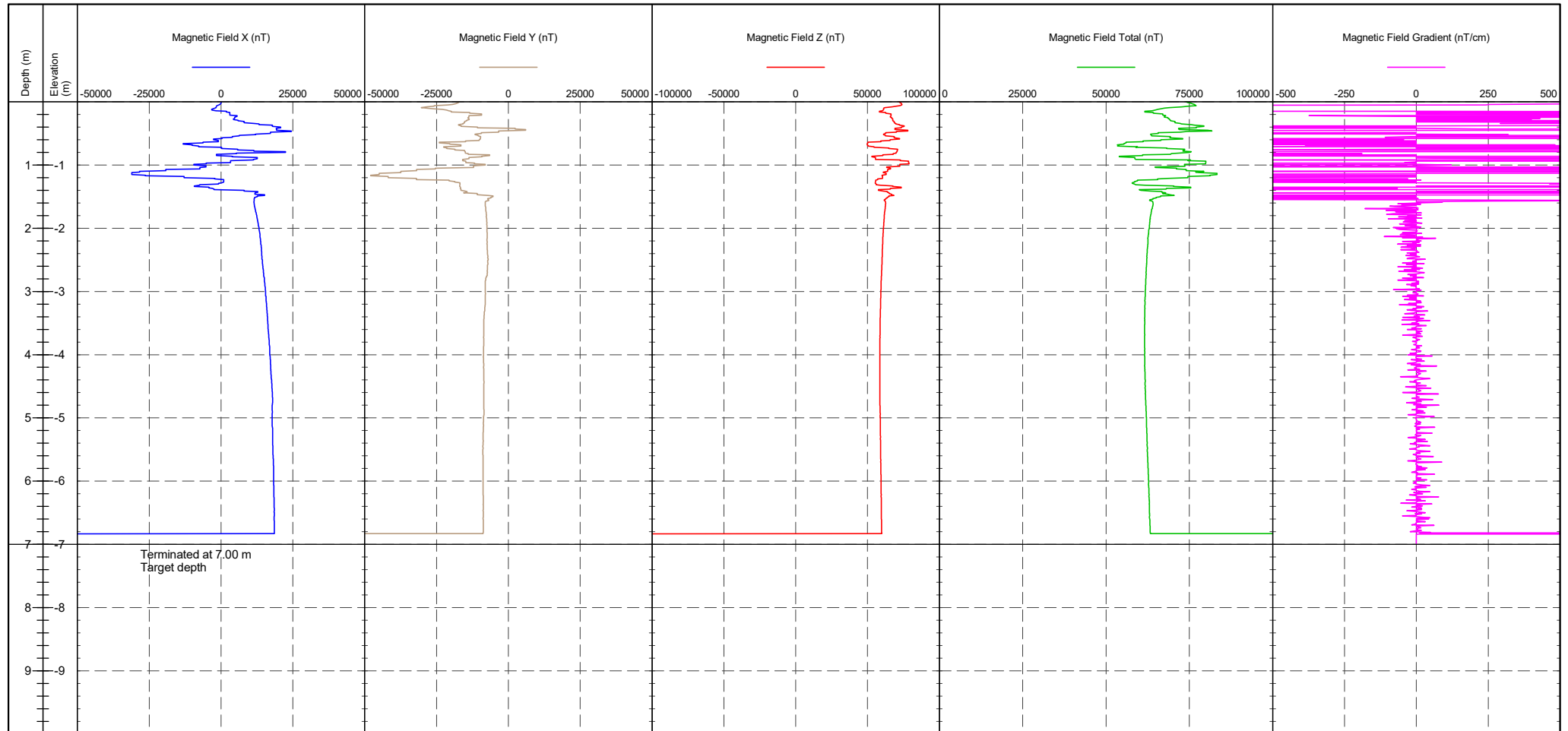
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3020032  
WEATHER :

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	0 mV		
Sleeve	0 mV		
Pore Pressure 2	0 mV		
X-Y Inclinator	2500 mV	2493 mV	



PointID

**H3022034**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

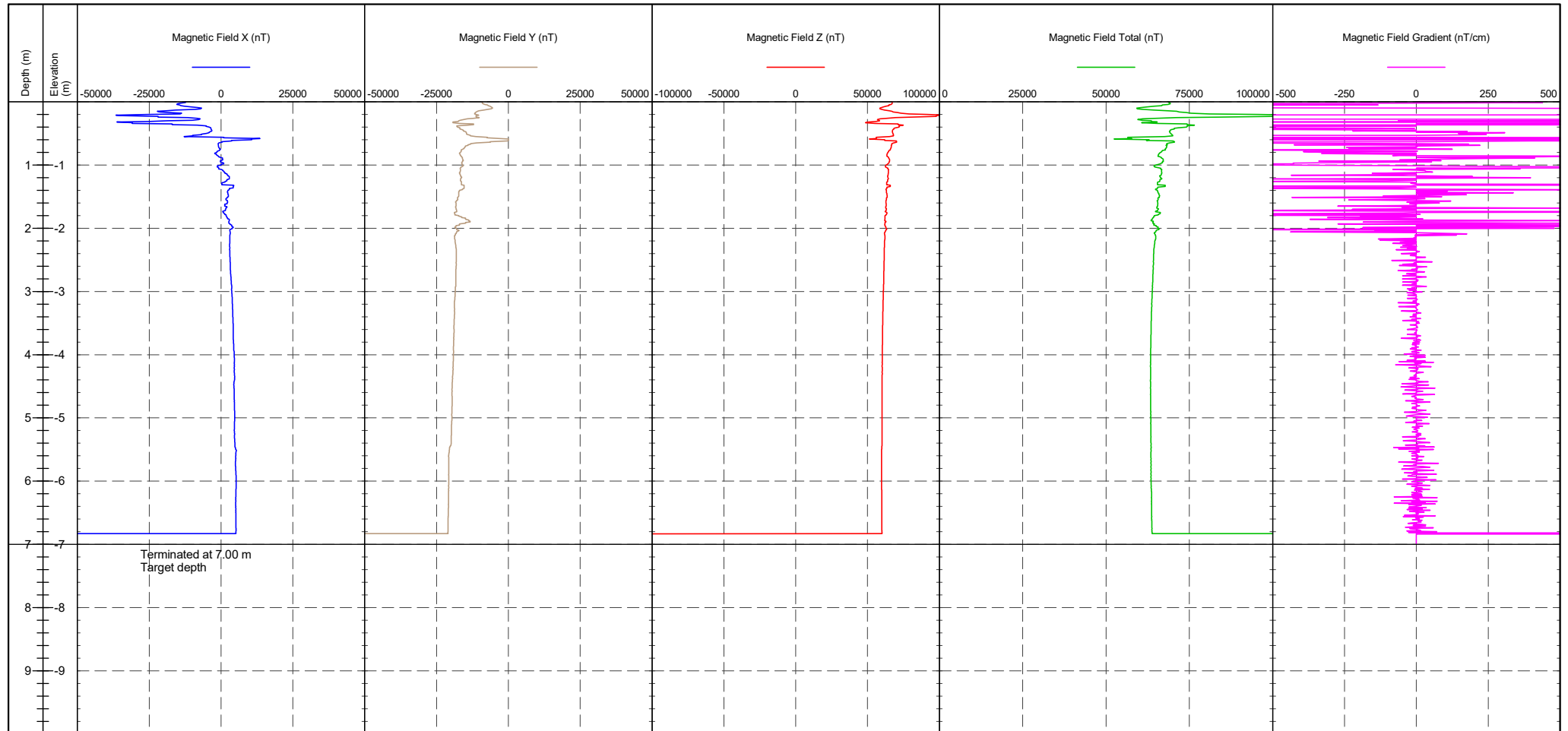
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-H3022034  
WEATHER :

CPTU ZERO VALUES  
Transducer Pre Post Difference  
Tip 0 mV  
Sleeve 0 mV  
Pore Pressure 2 0 mV  
X-Y Inclinator 2554 mV 2541 mV



PointID

**HS3038**

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

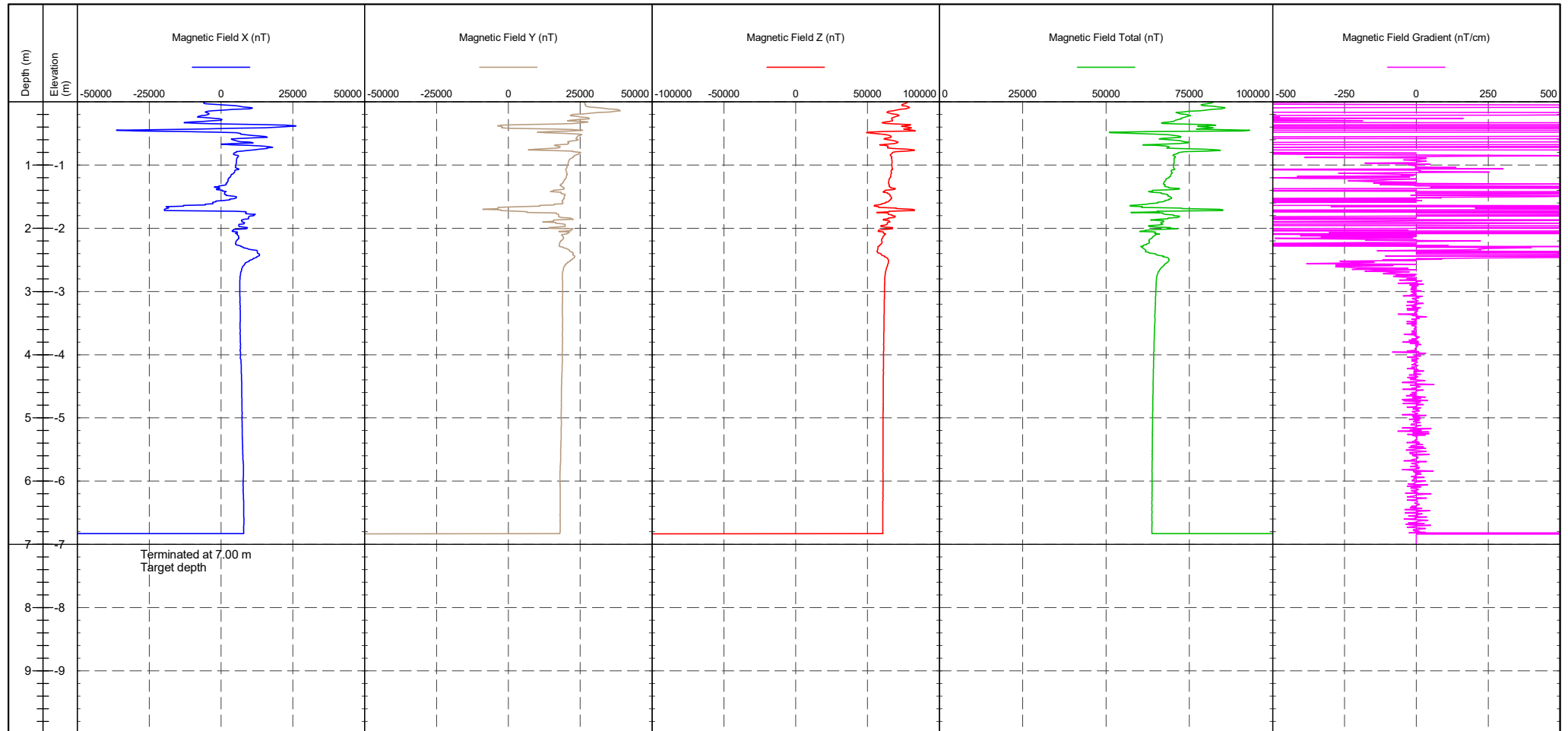
LOCATION : Cardiff

PROJECT No. : 1190290

EASTING :  
NORTHING :  
ELEVATION : 0.000 m OD  
CHECKED BY : LD  
TERMINATION REASON : Target depth

Remark:  
Test reached the target depth.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 24/06/2019  
PLOT DATE : 26/06/2019  
METHOD :



CONE ID : Magnetometer.1760  
CONE AREA :  
CONE AREA RATIO :  
FILTER POSITION :  
FILTER TYPE :  
FRICTION REDUCER :

TEST TYPE :  
APPLICATION CLASS :  
RIG : CPT 017  
OPERATOR : AG & CM  
FILE NAME : 1190290-HS3038  
WEATHER :

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	0 mV		
Sleeve	0 mV		
Pore Pressure 2	0 mV		
X-Y Inclinator	2411 mV	2450 mV	

## APPENDIX D

### Seismic Dilatometer Marchetti (SDMT) Measurements





PointID

CPT 01

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325239.800 m

NORTHING : 180759.500 m

ELEVATION : 5.300 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

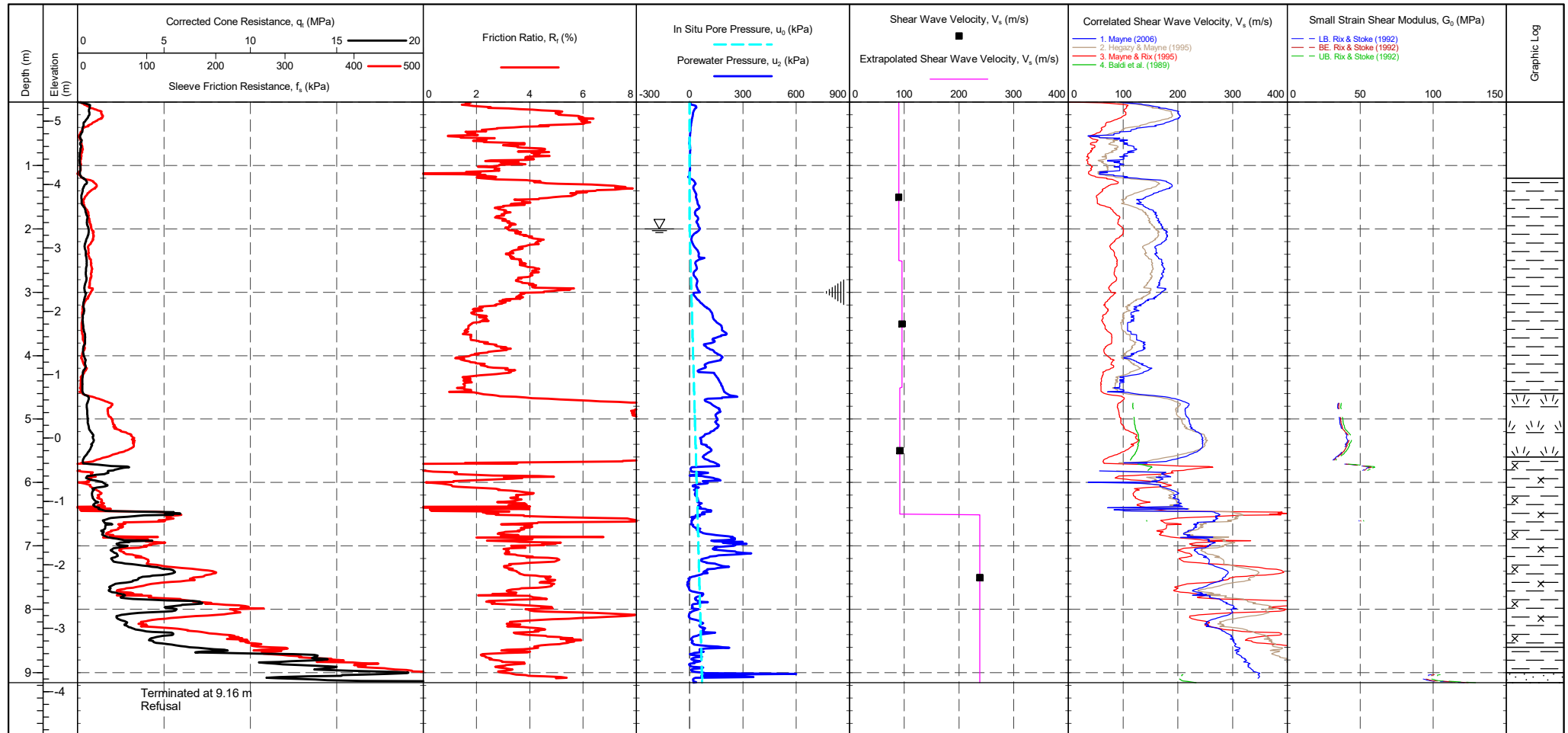
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 17/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
 CONE AREA : 15cm<sup>2</sup>  
 CONE AREA RATIO : 0.8  
 FILTER POSITION : u2  
 FILTER TYPE : HDPE  
 FRICTION REDUCER : None

TEST TYPE : TE2  
 APPLICATION CLASS : 2  
 RIG :  
 OPERATOR :  
 FILE NAME : 1190290-CPT 01  
 WEATHER : Overcast & Mild

CPTU ZERO VALUES  
 Transducer Pre Post Difference  
 Tip  
 Sleeve  
 Pore Pressure 2  
 X-Y Inclinator

Groundwater Level  
 Dissipation Test



PointID

## CPT 02

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325413.600 m

NORTHING : 180803.000 m

ELEVATION : 4.950 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on inclination.

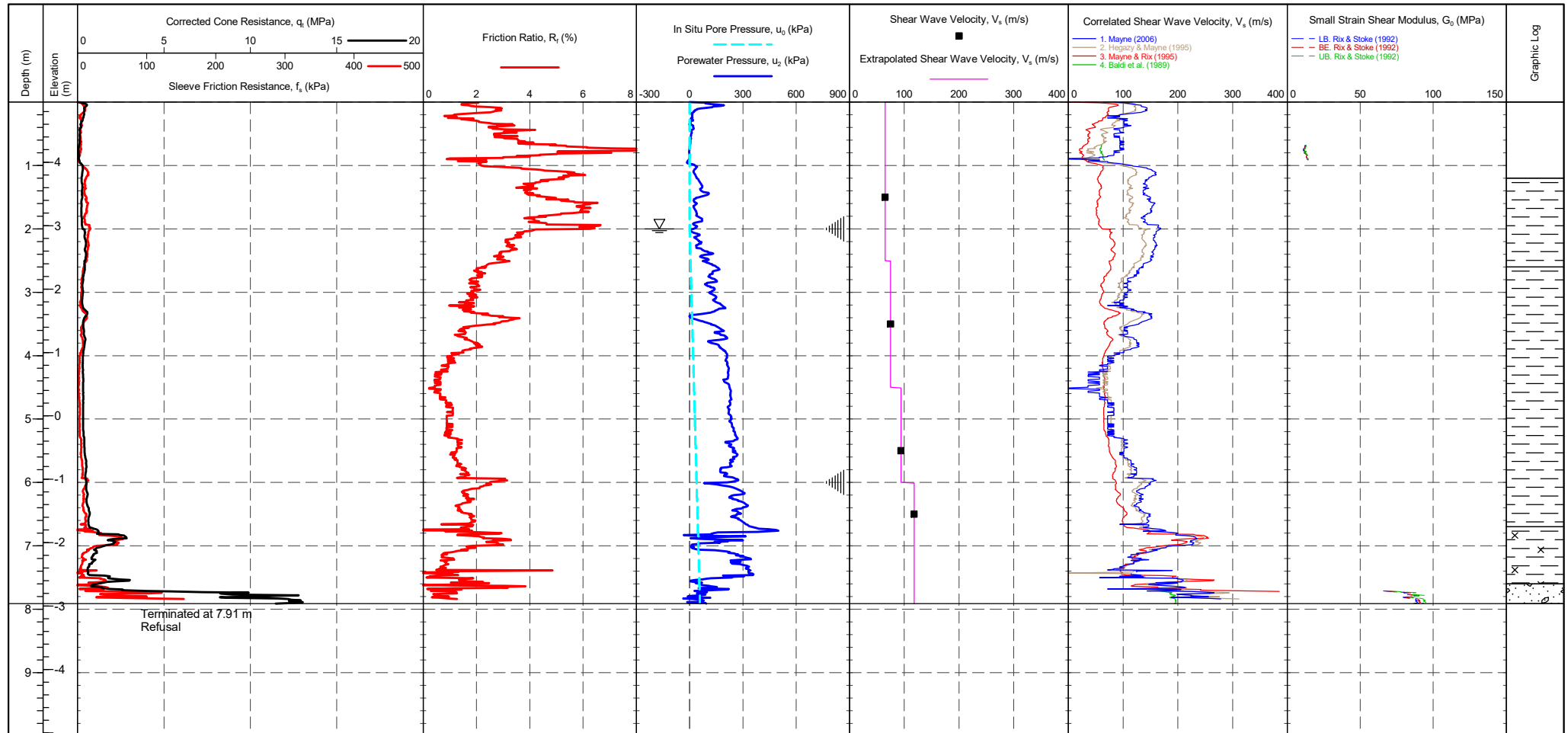
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 24/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
 CONE AREA : 15cm<sup>2</sup>  
 CONE AREA RATIO : 0.8  
 FILTER POSITION : u2  
 FILTER TYPE : HDPE  
 FRICTION REDUCER : None

TEST TYPE : TE2  
 APPLICATION CLASS : 2  
 RIG :  
 OPERATOR :  
 FILE NAME : 1190290-CPT 02  
 WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level  
 Dissipation Test



PointID

CPT 03

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325294.200 m

NORTHING : 180730.200 m

ELEVATION : 5.400 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

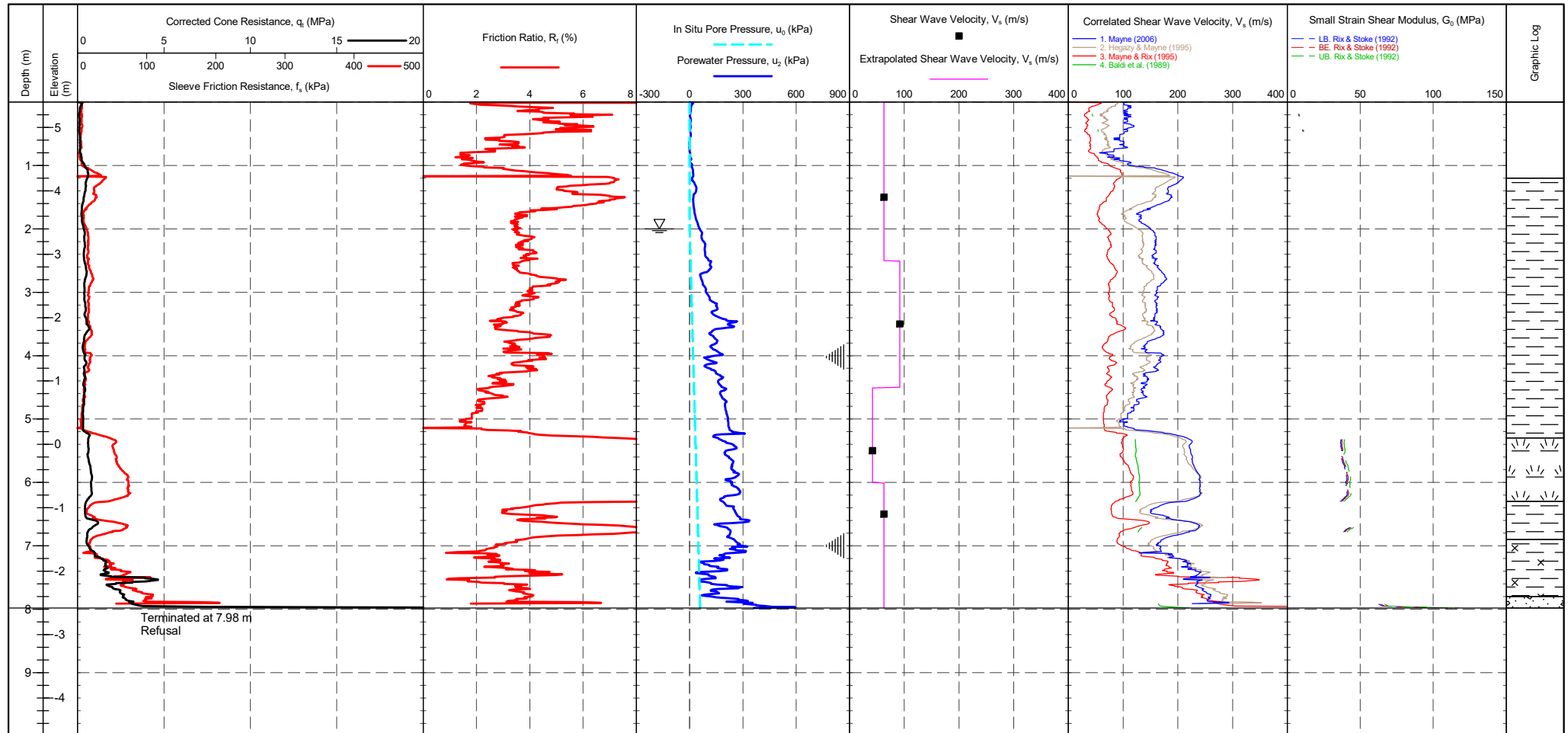
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
 CONE AREA : 15cm<sup>2</sup>  
 CONE AREA RATIO : 0.8  
 FILTER POSITION : u2  
 FILTER TYPE : HDPE  
 FRICTION REDUCER : None

TEST TYPE : TE2  
 APPLICATION CLASS : 2  
 RIG :  
 OPERATOR :  
 FILE NAME : 1190290-CPT 03  
 WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level  
 Dissipation Test



PointID

CPT 04

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325195.400 m

NORTHING : 180664.200 m

ELEVATION : 5.250 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

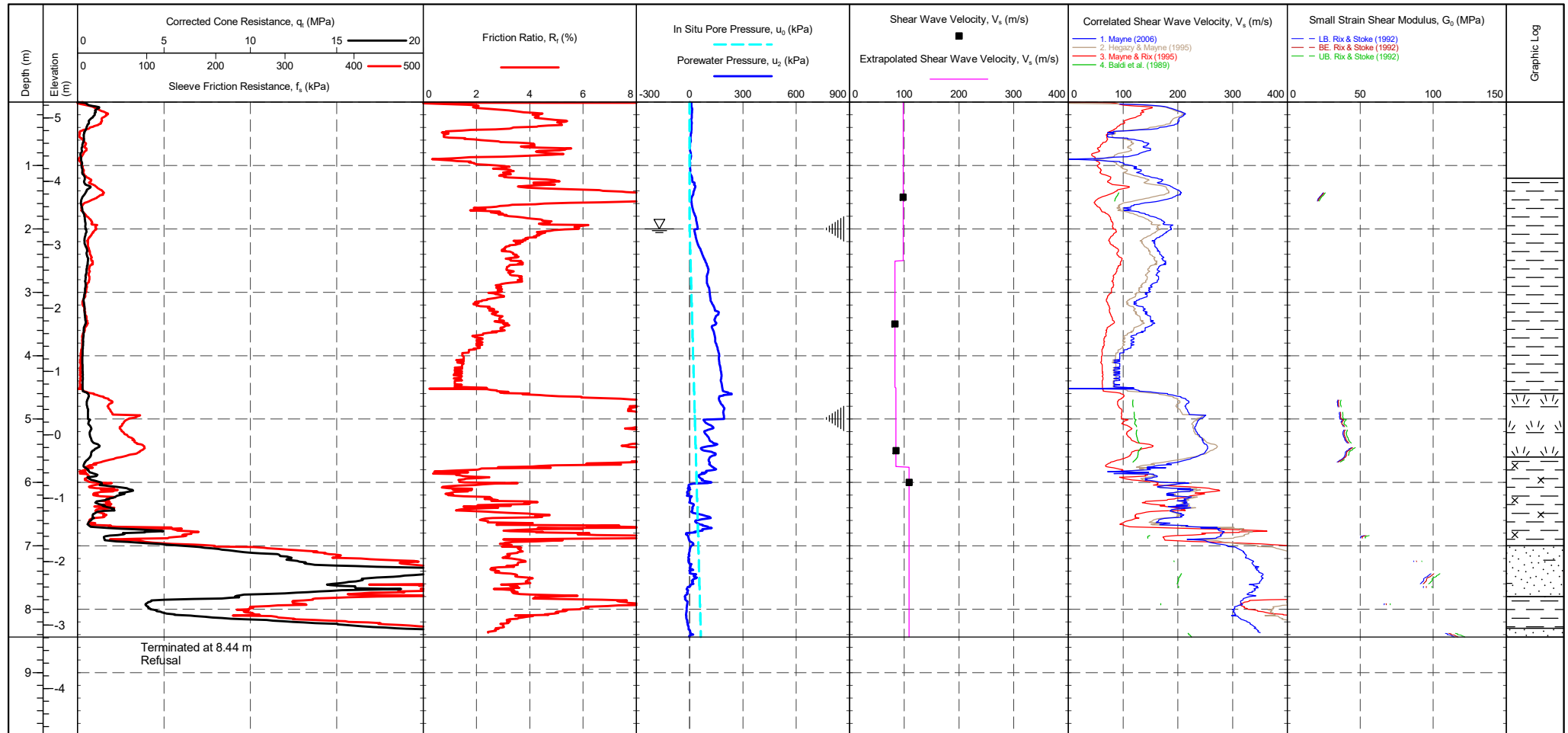
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 04  
WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level

Dissipation Test



PointID

CPT 05

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325097.400 m

NORTHING : 180591.800 m

ELEVATION : 5.250 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

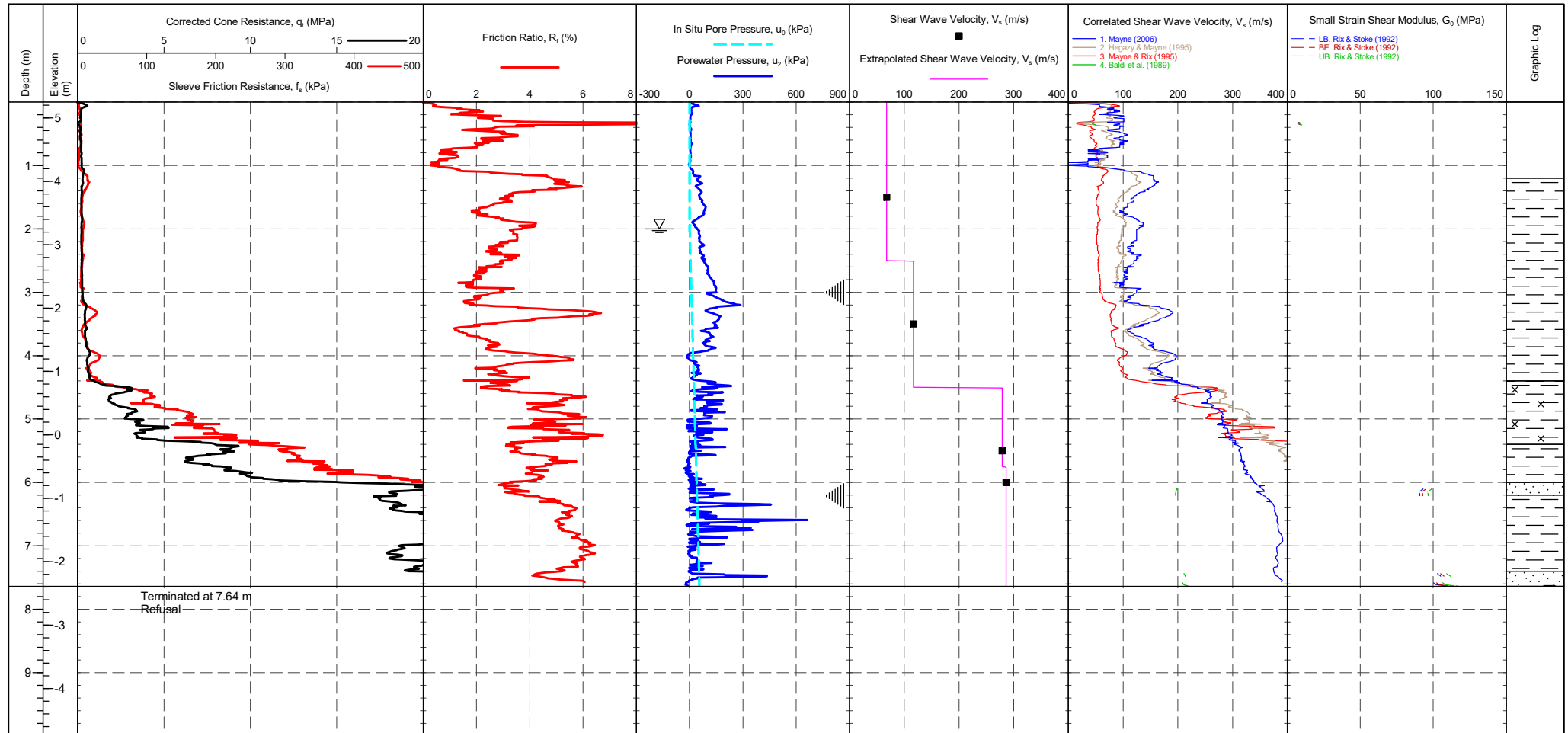
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
 CONE AREA : 15cm<sup>2</sup>  
 CONE AREA RATIO : 0.8  
 FILTER POSITION : u2  
 FILTER TYPE : HDPE  
 FRICTION REDUCER : None

TEST TYPE : TE2  
 APPLICATION CLASS : 2  
 RIG :  
 OPERATOR :  
 FILE NAME : 1190290-CPT 05  
 WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level  
 Dissipation Test



PointID

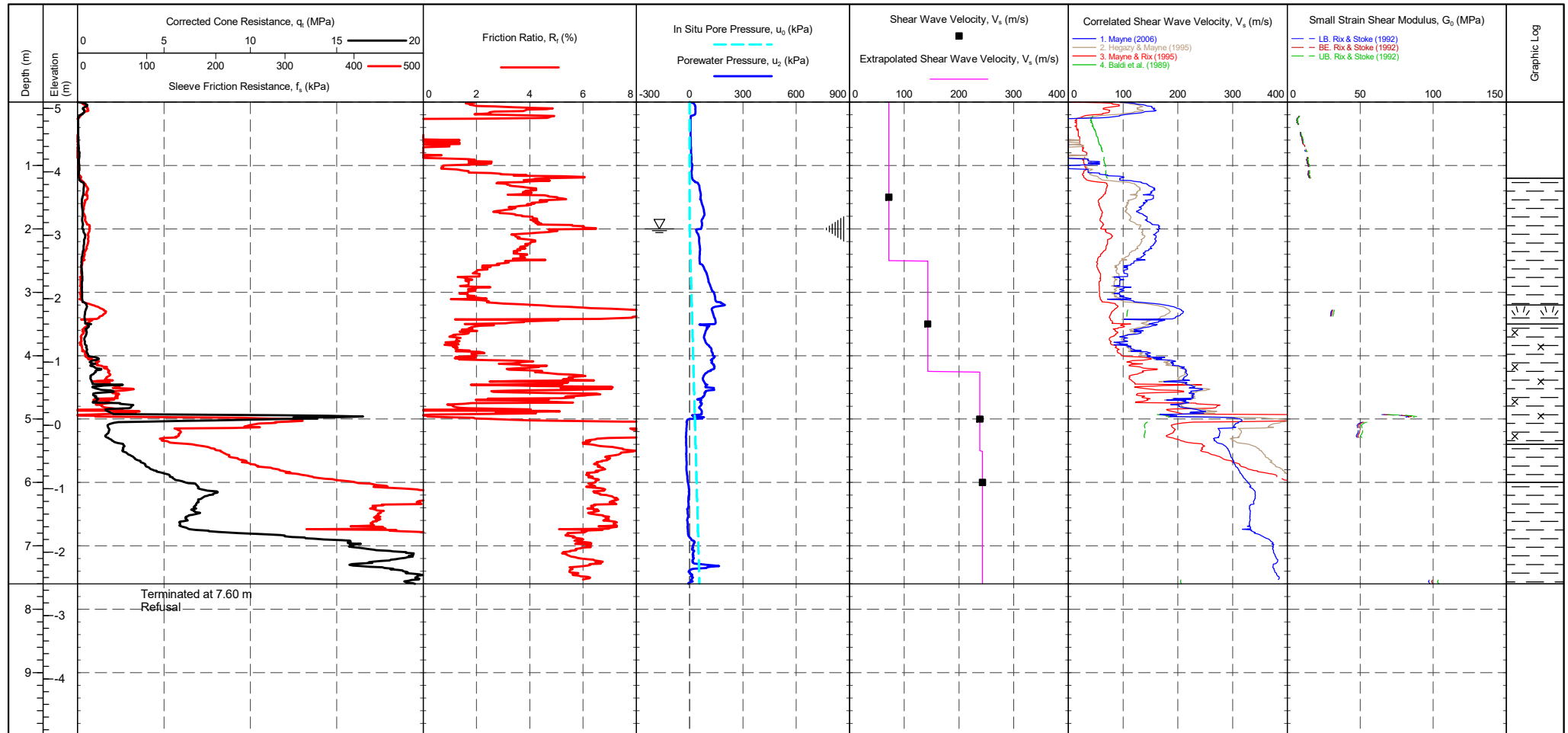
**CPT 06**

CLIENT : Geotechnical Engineering  
PROJECT : Cardiff Parkway  
LOCATION : Cardiff  
PROJECT No. : 1190290

EASTING : 325071.900 m  
NORTHING : 180693.600 m  
ELEVATION : 5.100 m OD  
CHECKED BY :  
TERMINATION REASON : Refusal

Remark:  
Test refused on total pressure.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 17/06/2019  
PLOT DATE : 04/07/2019  
METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 06  
WEATHER : Overcast & Mild

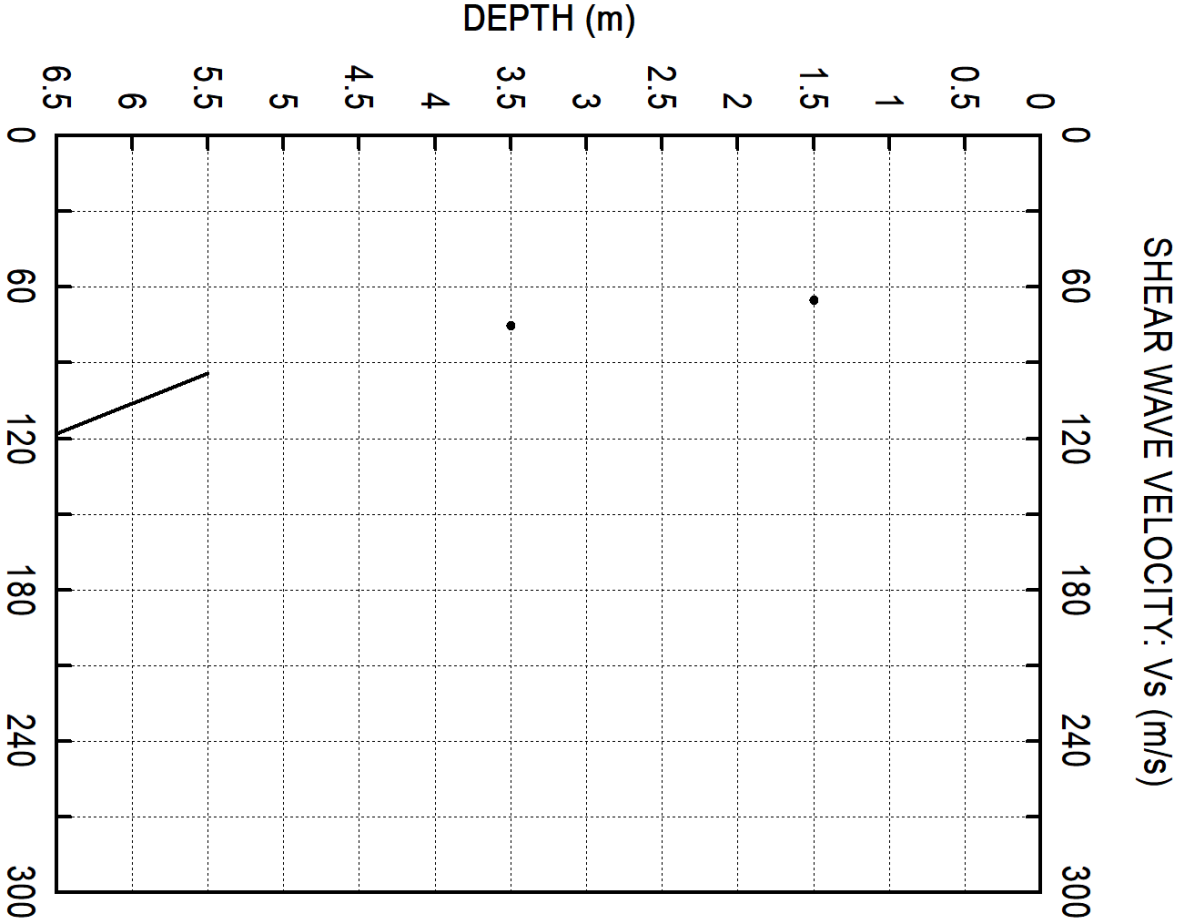
CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

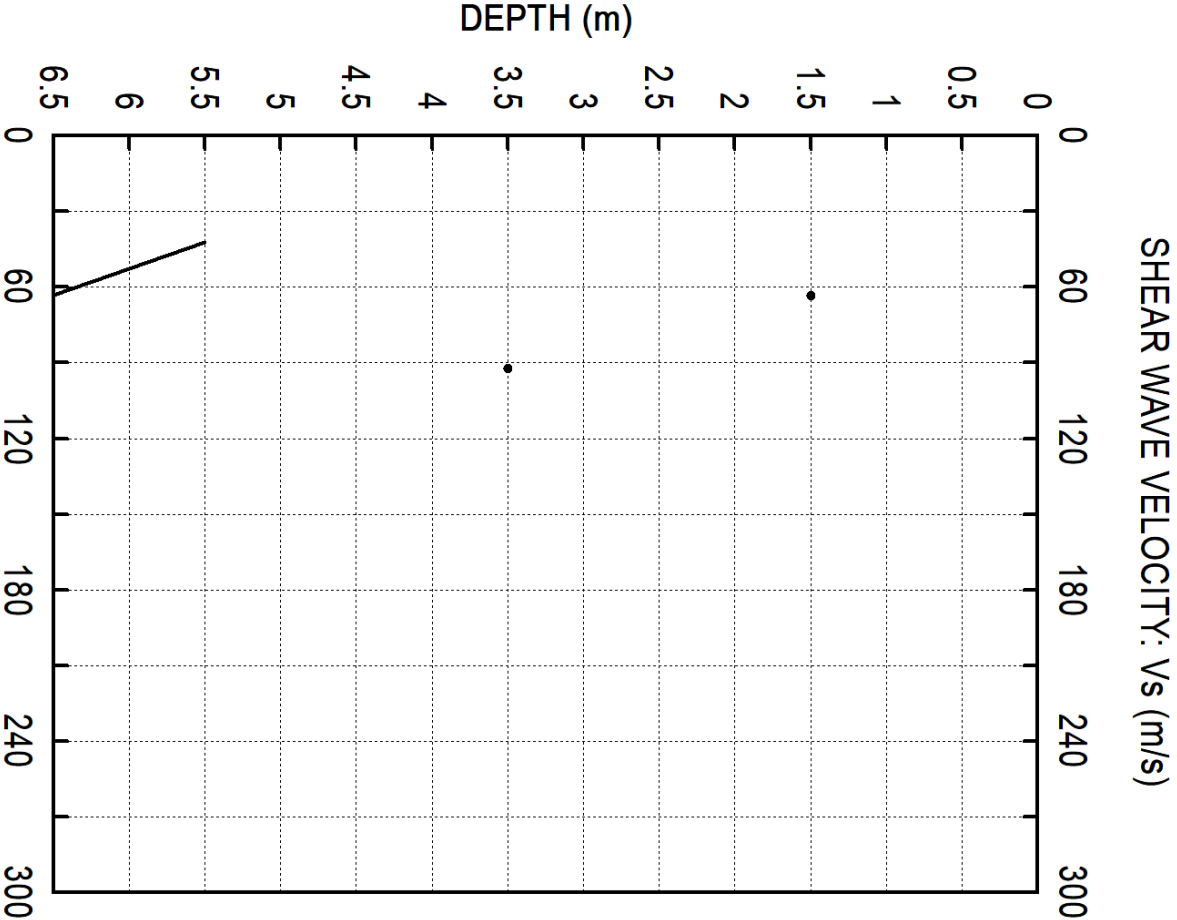
Groundwater Level  
Dissipation Test

In Situ SI	CUSTOMER	TEST
JOB	LOCATION	SCPT02
		24 JUN 2019

SEISMIC DILATOMETER TEST ( S D M T )

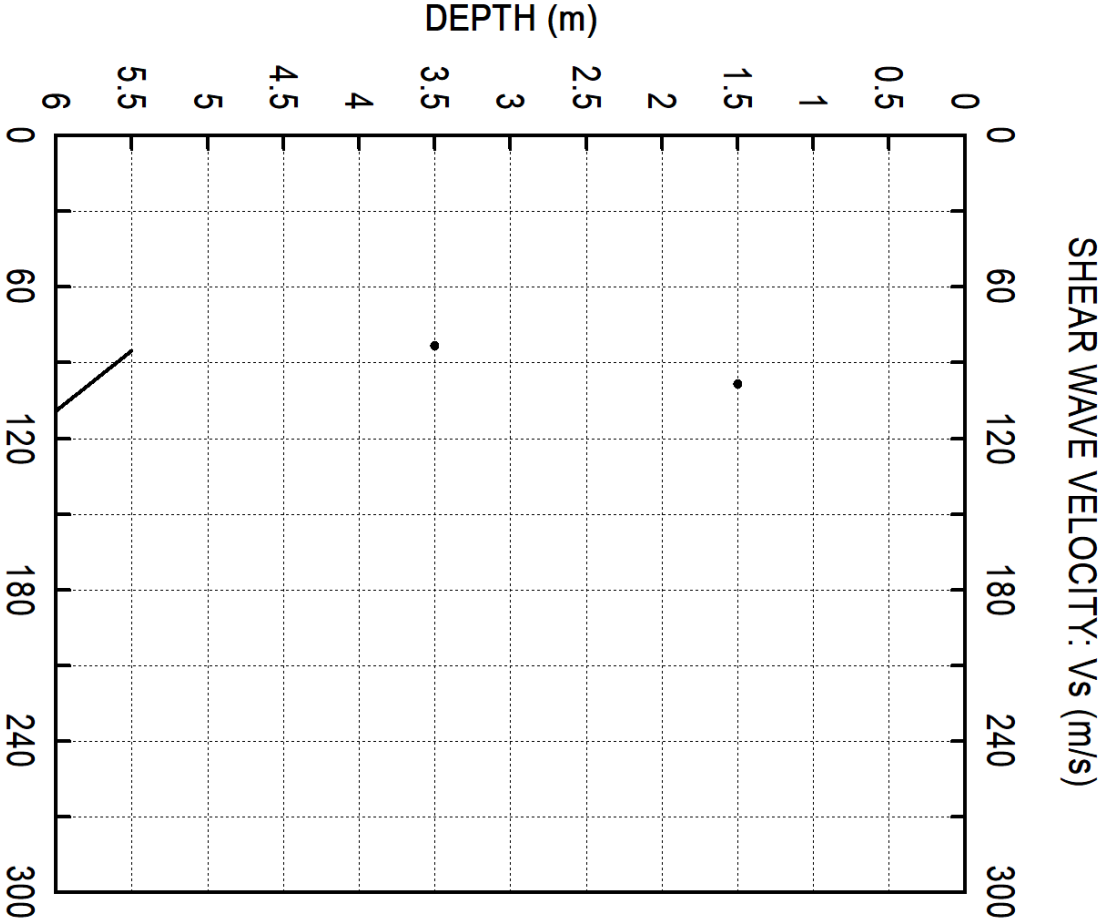


In Situ SI	CUSTOMER	TEST
JOB	LOCATION	SCPT03
		24 JUN 2019

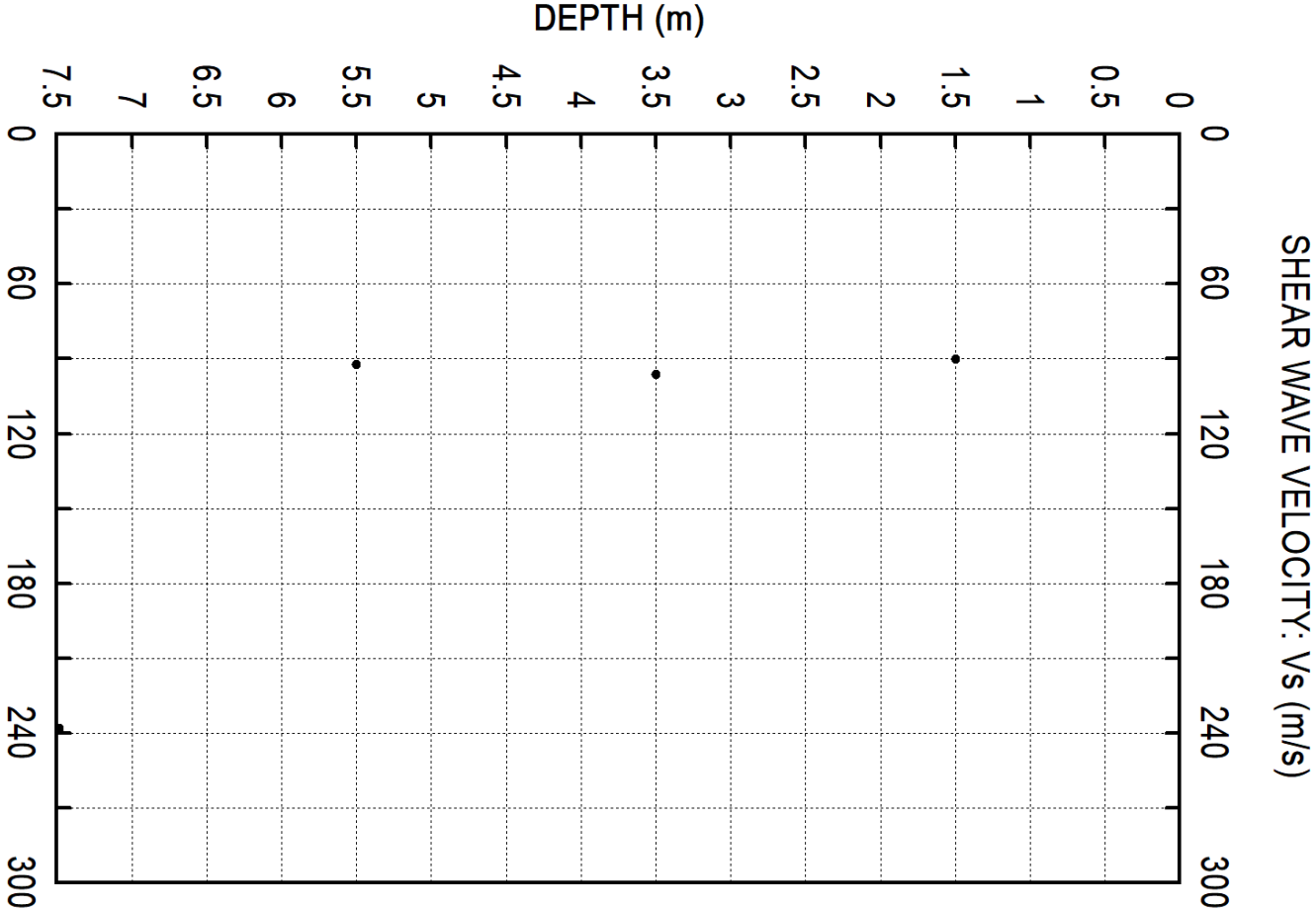




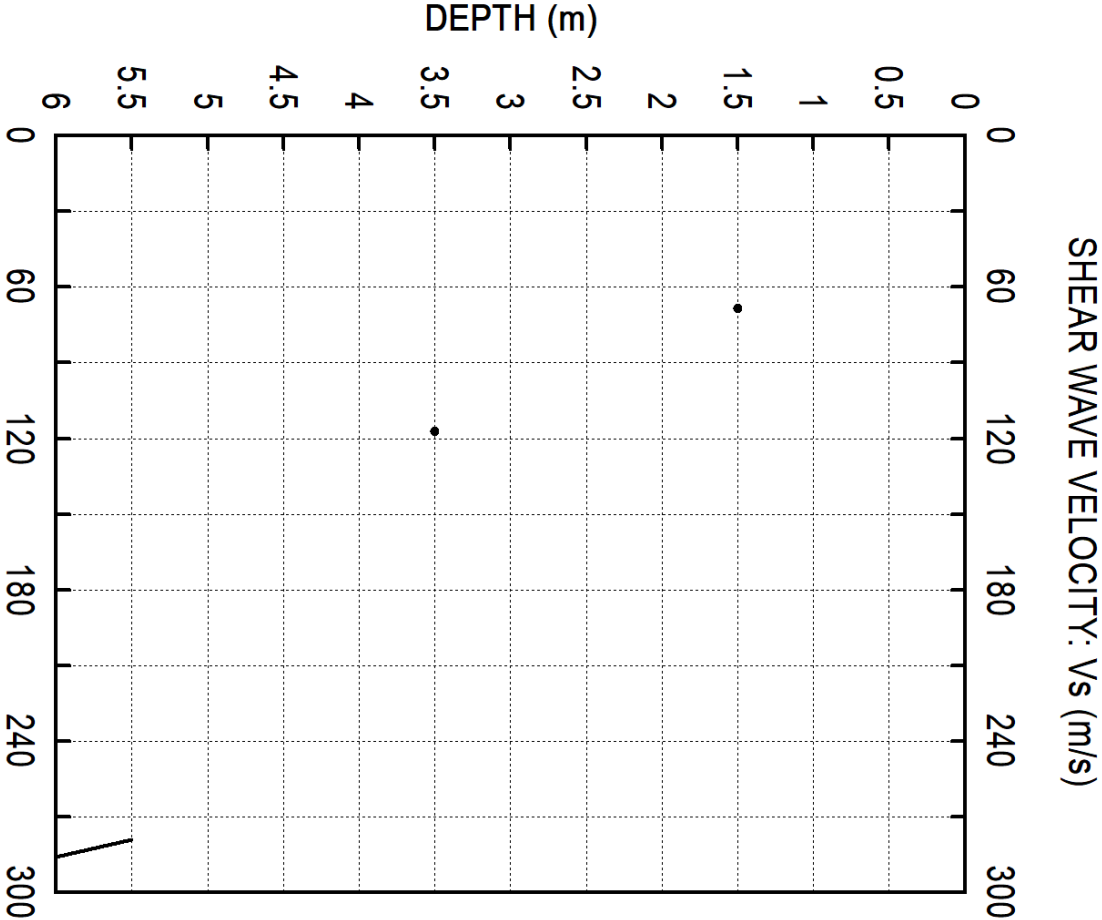
In Situ SI	CUSTOMER	TEST
JOB	LOCATION	SCPT04
		24 JUN 2019



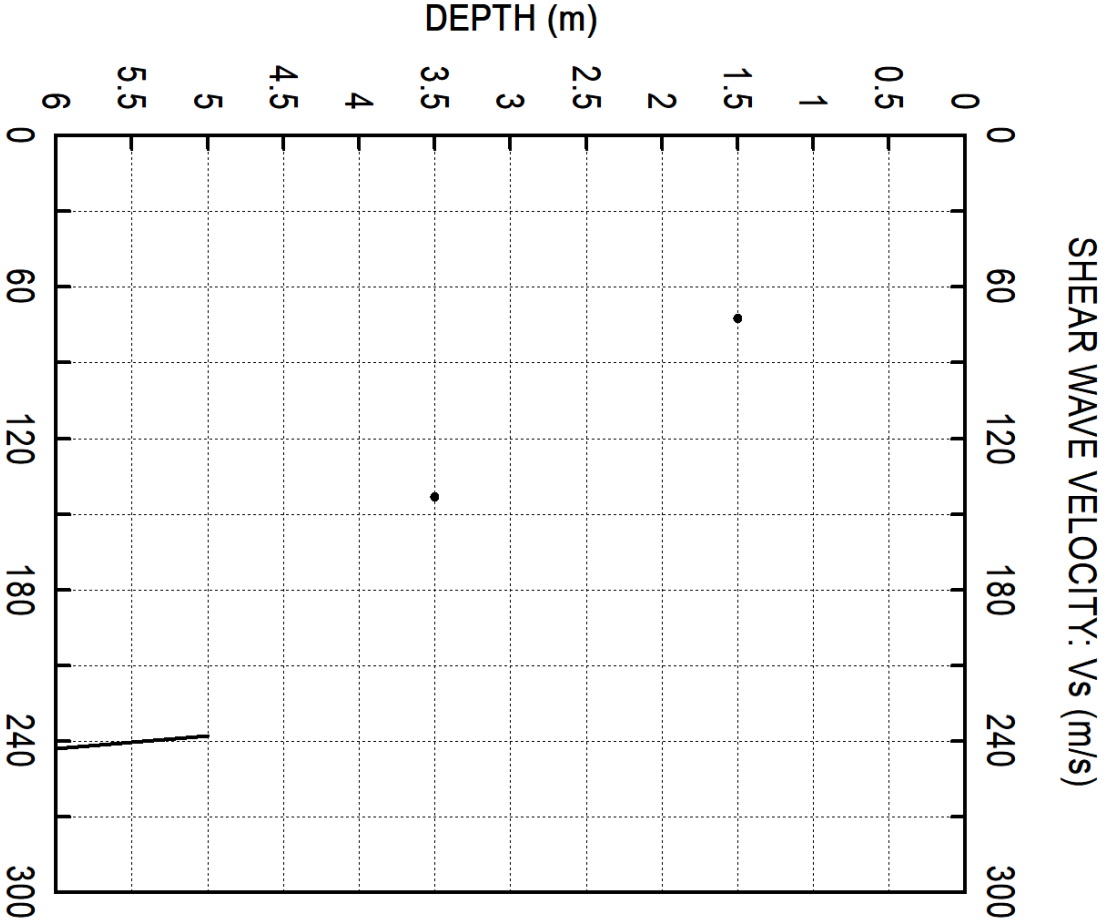
In Situ SI	CUSTOMER	TEST
JOB	LOCATION	SCPT01
		25 JUN 2019



In Situ SI	CUSTOMER	TEST
JOB	LOCATION	SCPT05
		24 JUN 2019



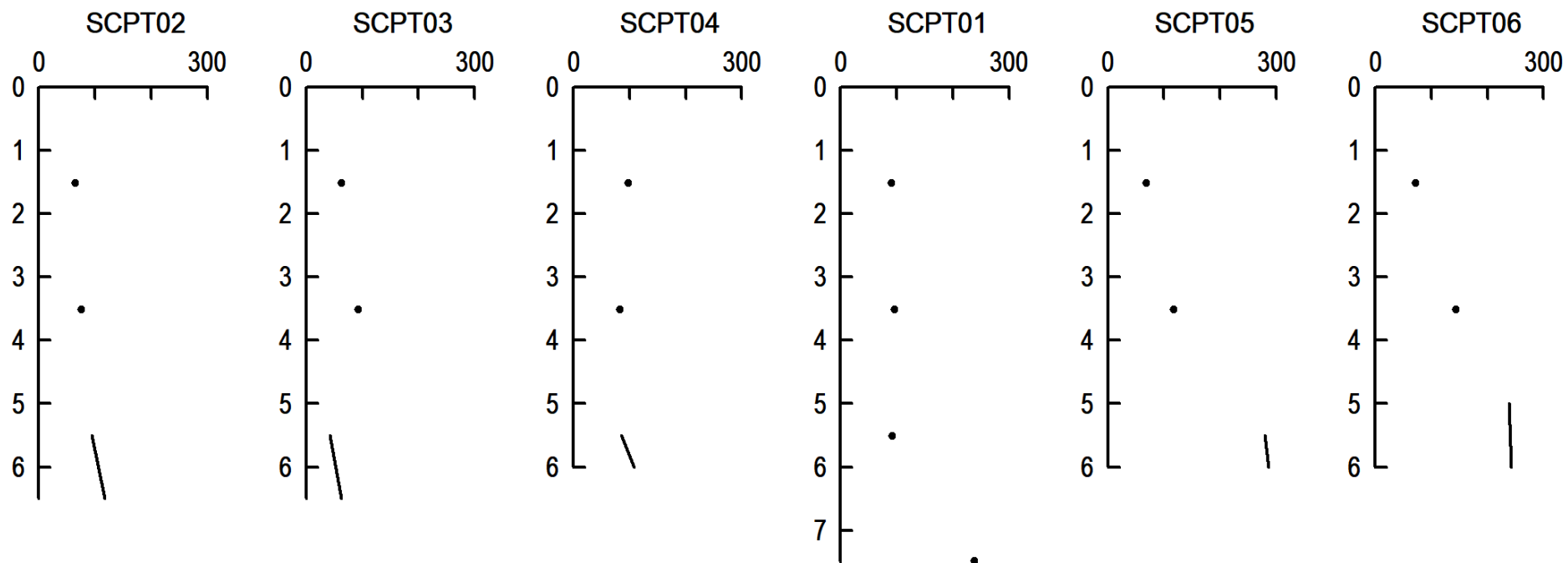
In Situ SI	CUSTOMER	TEST
JOB	LOCATION	SCPT06
		25 JUN 2019



In Situ SI  
JOB

CUSTOMER  
LOCATION

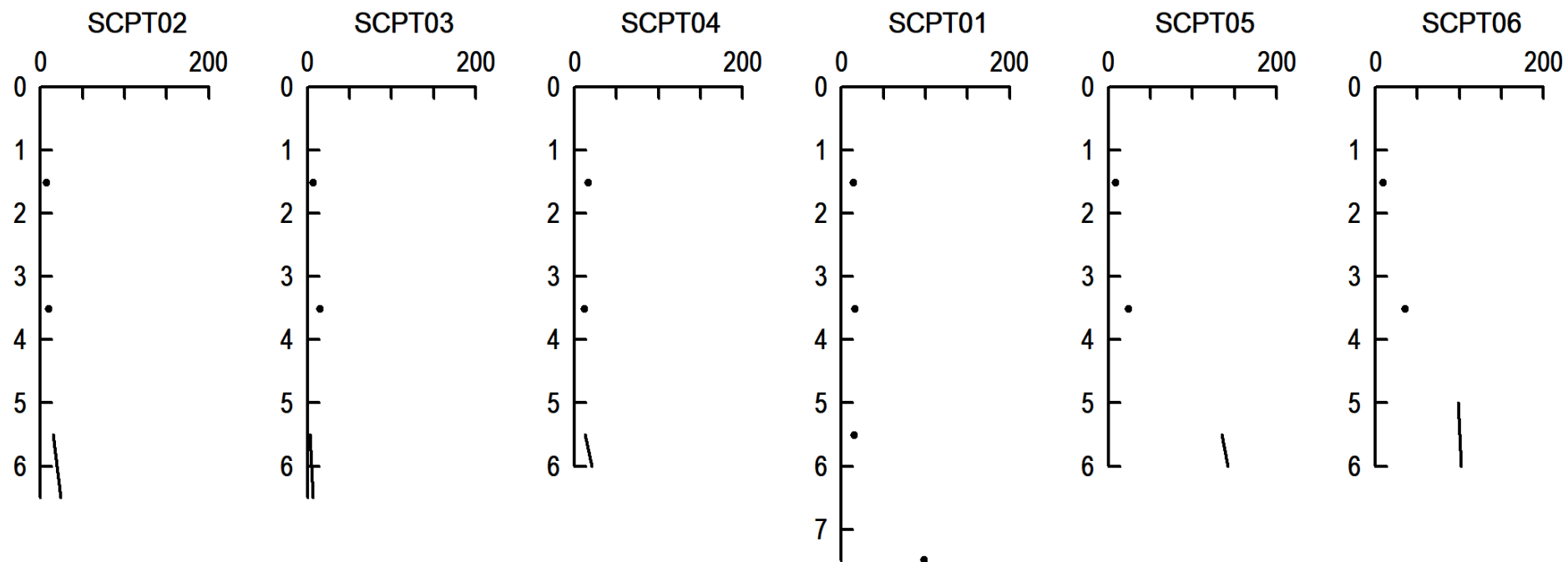
CROSS SECTION OF SHEAR WAVE VELOCITY  $V_s$  (m/s)



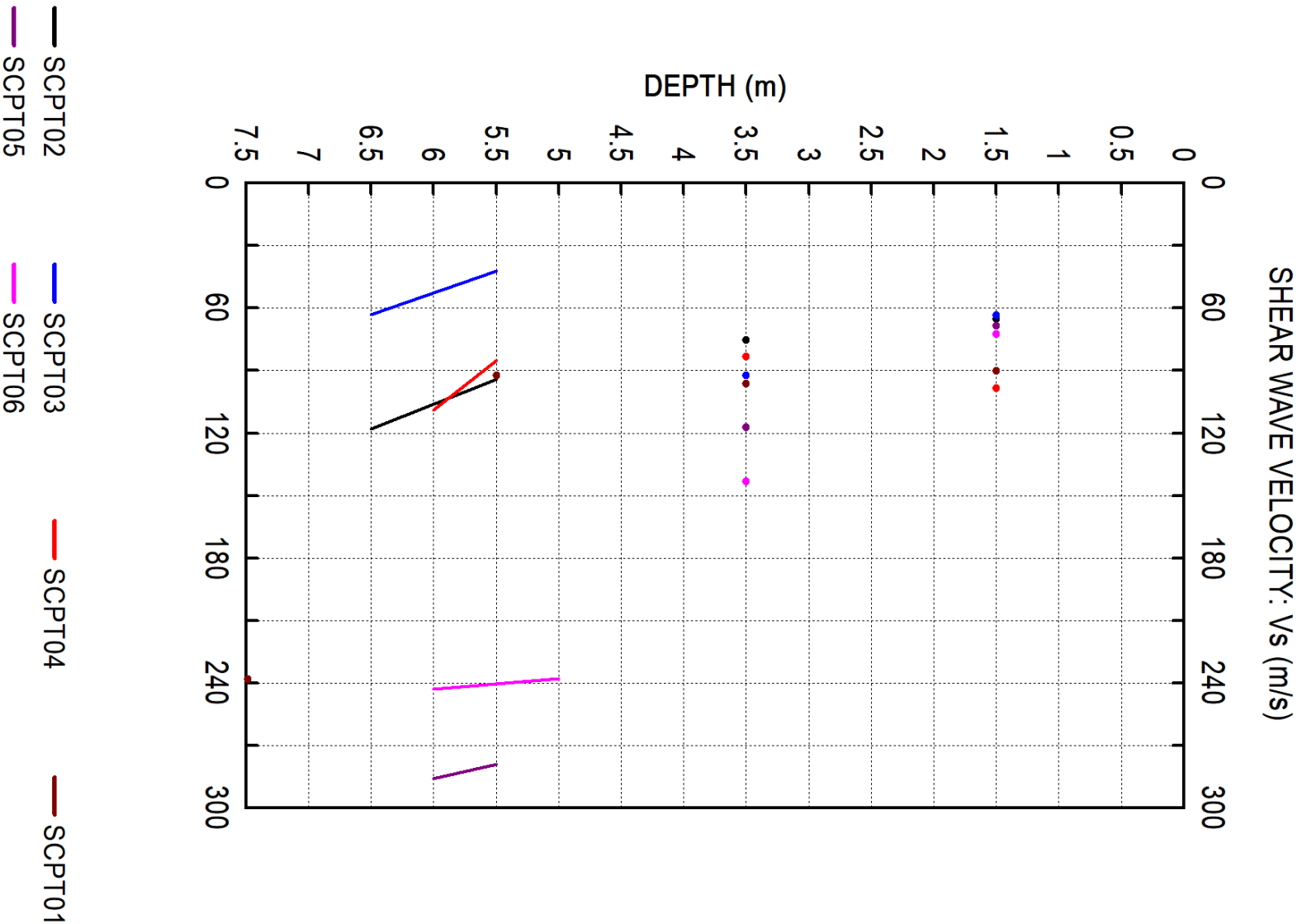
In Situ SI  
JOB

CUSTOMER  
LOCATION

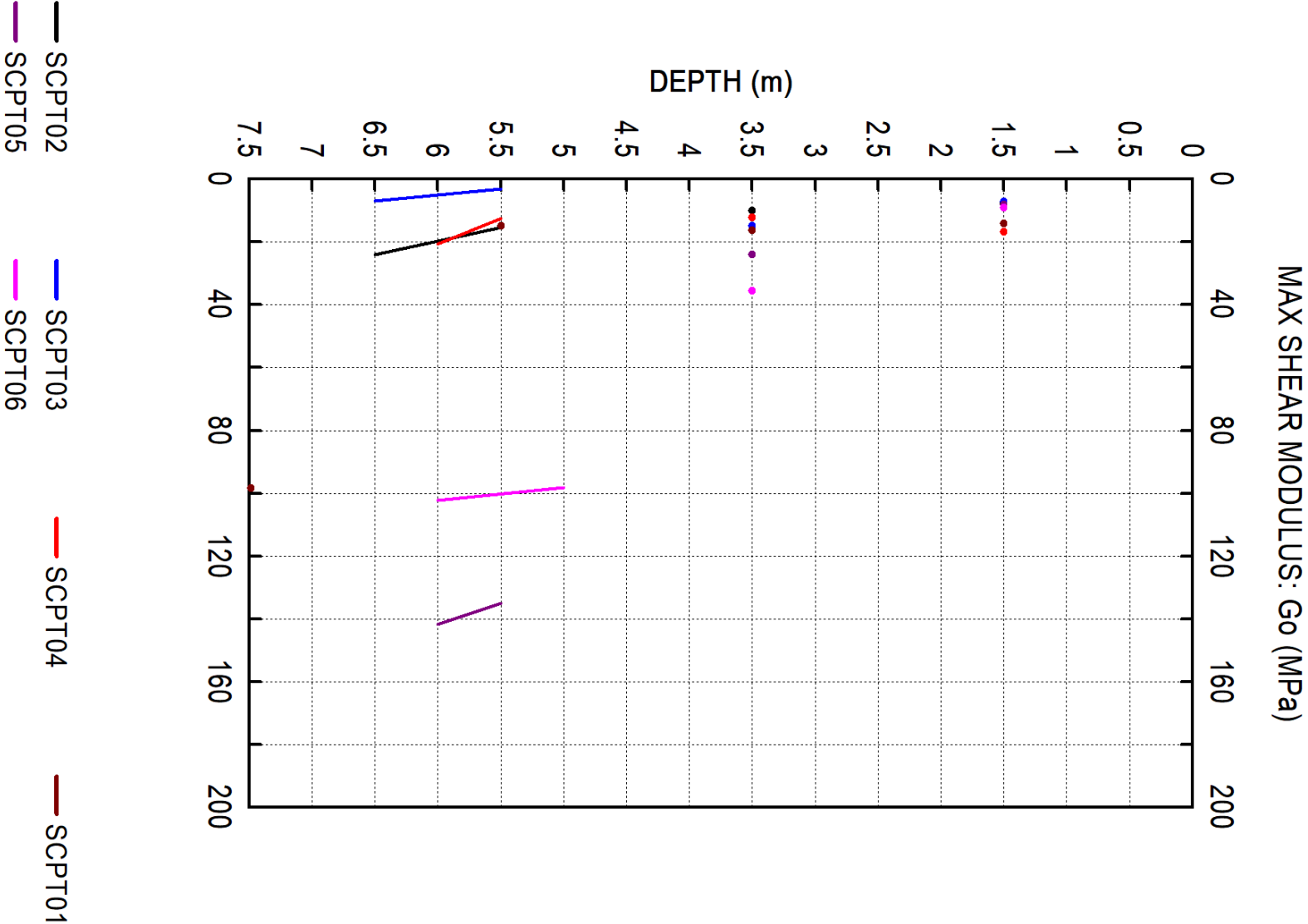
CROSS SECTION OF MAX SHEAR MODULUS  $G_o$  (MPa)



In Situ SI	CUSTOMER	
JOB	LOCATION	
SUPERIMPOSED TEST RESULTS		



In Situ SI	CUSTOMER	
JOB	LOCATION	
SUPERIMPOSED TEST RESULTS		





## SCPT02 - Tabular data: Vs, Go, Vs Repeatability

*Each Vs value in the 'Vs Repeatability' column corresponds to a distinct energization.*

Z	Vs	Go	Rho	Vs Repeatability	Var Coeff.
[m]	[m/s]	[MPa]	[kg/m <sup>3</sup> ]	[m/s]	[%]
1.50	65	7.3	1733	0,65,64,67	1.99
3.50	75	9.7	1733	74,74,76	1.33
5.50	94	15.3	1733	94,94,93	0.61
6.50	118	24.1	1733	118,119,116	1.09

## SCPT03 - Tabular data: Vs, Go, Vs Repeatability

*Each Vs value in the 'Vs Repeatability' column corresponds to a distinct energization.*

Z	Vs	Go	Rho	Vs Repeatability	Var Coeff.
[m]	[m/s]	[MPa]	[kg/m <sup>3</sup> ]	[m/s]	[%]
1.50	63	6.9	1733	73,60,61,59	9.01
3.50	92	14.7	1733	91,92,92	0.63
5.50	42	3.1	1733	42,42,42	0.00
6.50	63	6.9	1733	63,63,64	0.92

## SCPT04 - Tabular data: Vs, Go, Vs Repeatability

*Each Vs value in the 'Vs Repeatability' column corresponds to a distinct energization.*

Z	Vs	Go	Rho	Vs Repeatability	Var Coeff.
[m]	[m/s]	[MPa]	[kg/m <sup>3</sup> ]	[m/s]	[%]
1.50	98	16.6	1733	97,97,100	1.44
3.50	83	11.9	1733	84,83,83	0.70
5.50	85	12.5	1733	85,83,86	1.52
6.00	109	20.6	1733	109,110,107	1.18

## SCPT01 - Tabular data: Vs, Go, Vs Repeatability

*Each Vs value in the 'Vs Repeatability' column corresponds to a distinct energization.*

Z	Vs	Go	Rho	Vs Repeatability	Var Coeff.
[m]	[m/s]	[MPa]	[kg/m <sup>3</sup> ]	[m/s]	[%]
1.50	90	14.0	1733	91,89,89	1.11
3.50	96	16.0	1733	97,95,96	0.85
5.50	92	14.7	1733	94,90,93	1.88
7.50	238	98.2	1733	251,224,246,232	4.53

## SCPT05 - Tabular data: Vs, Go, Vs Repeatability

*Each Vs value in the 'Vs Repeatability' column corresponds to a distinct energization.*

Z	Vs	Go	Rho	Vs Repeatability	Var Coeff.
[m]	[m/s]	[MPa]	[kg/m <sup>3</sup> ]	[m/s]	[%]
1.50	68	8.0	1733	76,67,66,65	6.49
3.50	117	23.7	1733	122,115,114,116	2.67
5.50	279	135	1733	317,321,250,223,273,288	12.50
6.00	286	142	1733	261,260,325,297	9.48

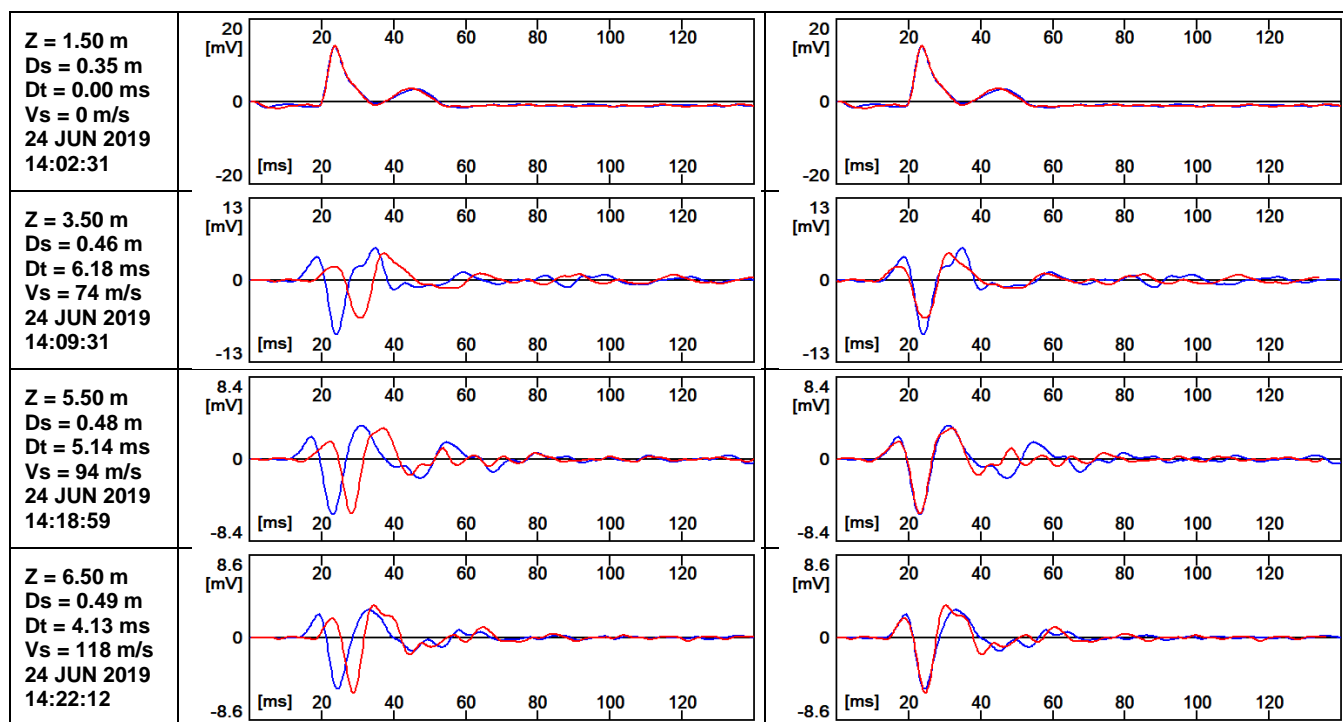
## SCPT06 - Tabular data: Vs, Go, Vs Repeatability

*Each Vs value in the 'Vs Repeatability' column corresponds to a distinct energization.*

Z	Vs	Go	Rho	Vs Repeatability	Var Coeff.
[m]	[m/s]	[MPa]	[kg/m <sup>3</sup> ]	[m/s]	[%]
1.50	72	9.0	1733	70,73,72	1.79
3.50	143	35.4	1733	141,144,144	0.99
5.00	238	98.2	1733	227,254,232	4.93
6.00	243	102	1733	242,243,243	0.24

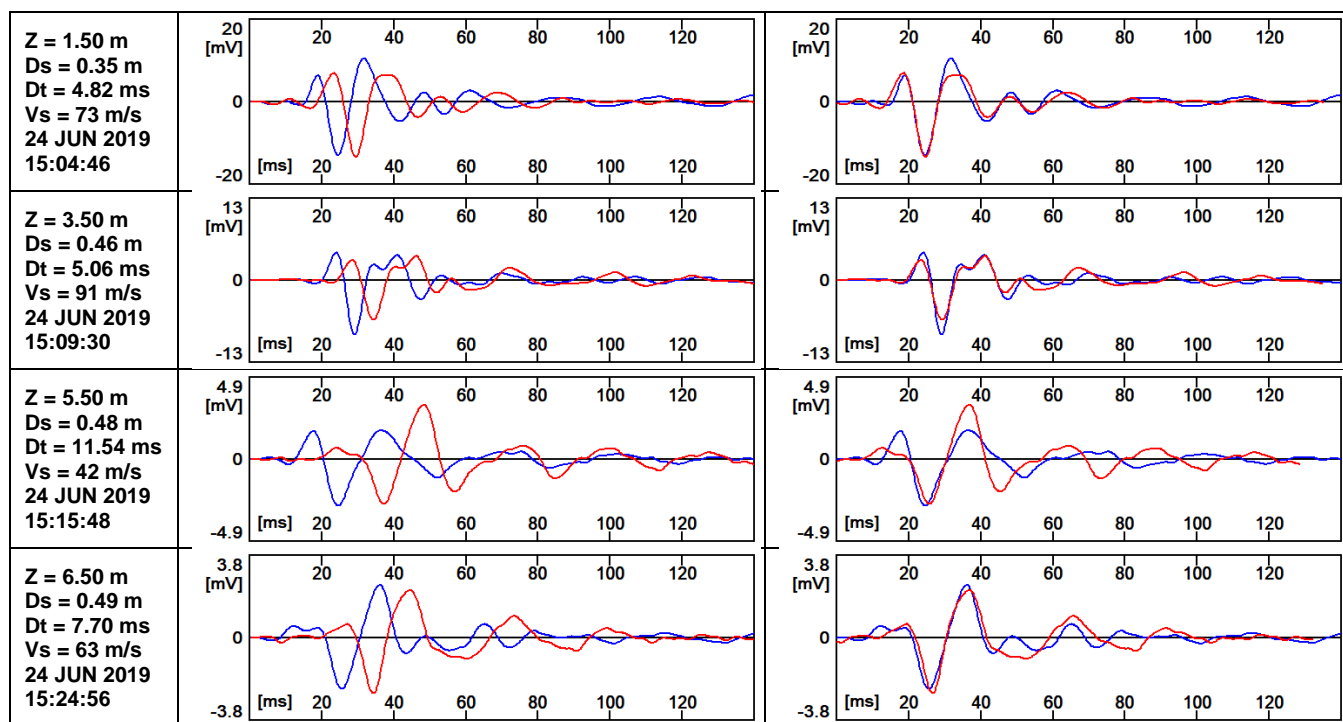
## RECORDED

## RE-PHASED



## RECORDED

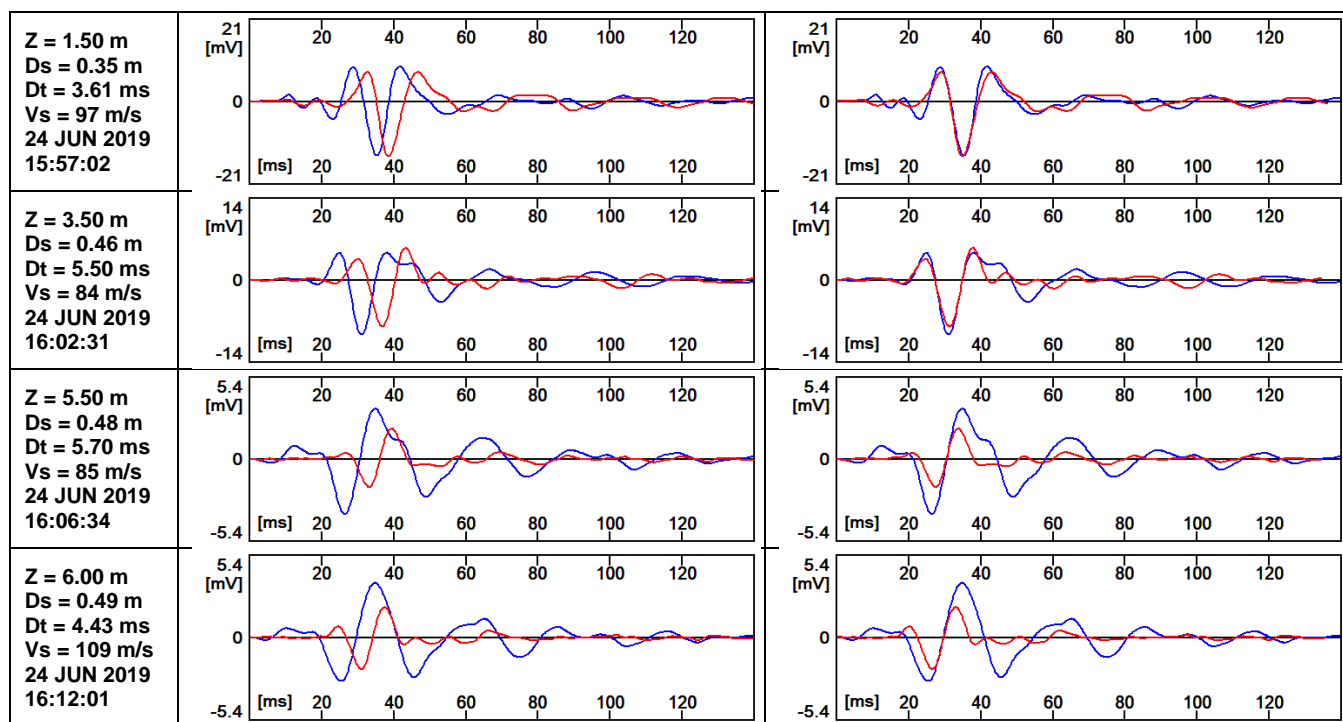
## RE-PHASED





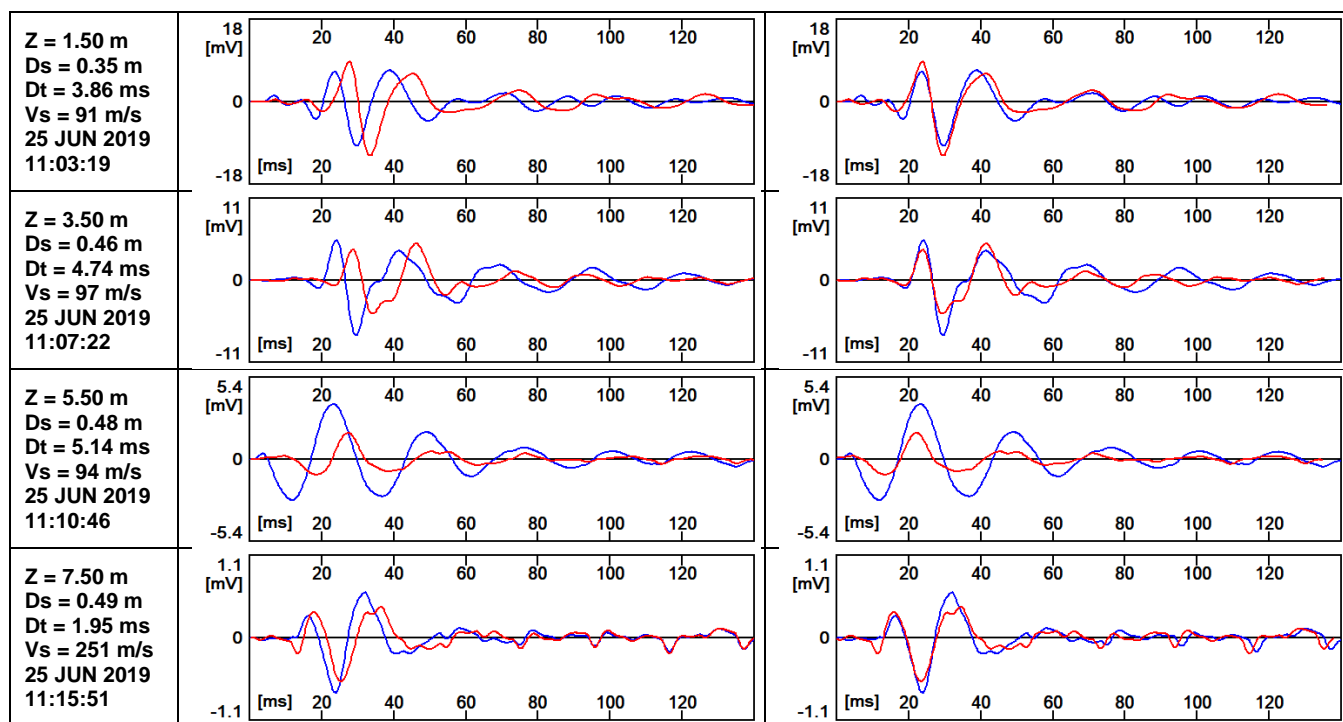
## RECORDED

## RE-PHASED



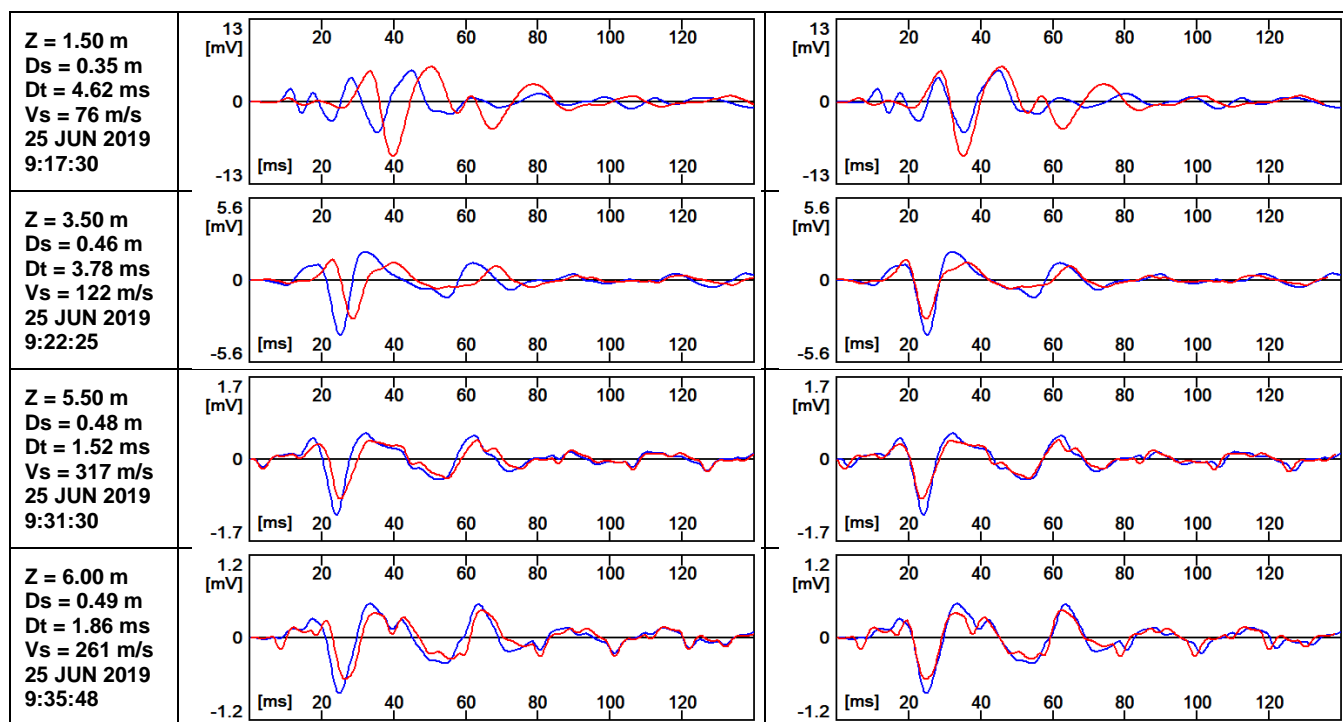
## RECORDED

## RE-PHASED



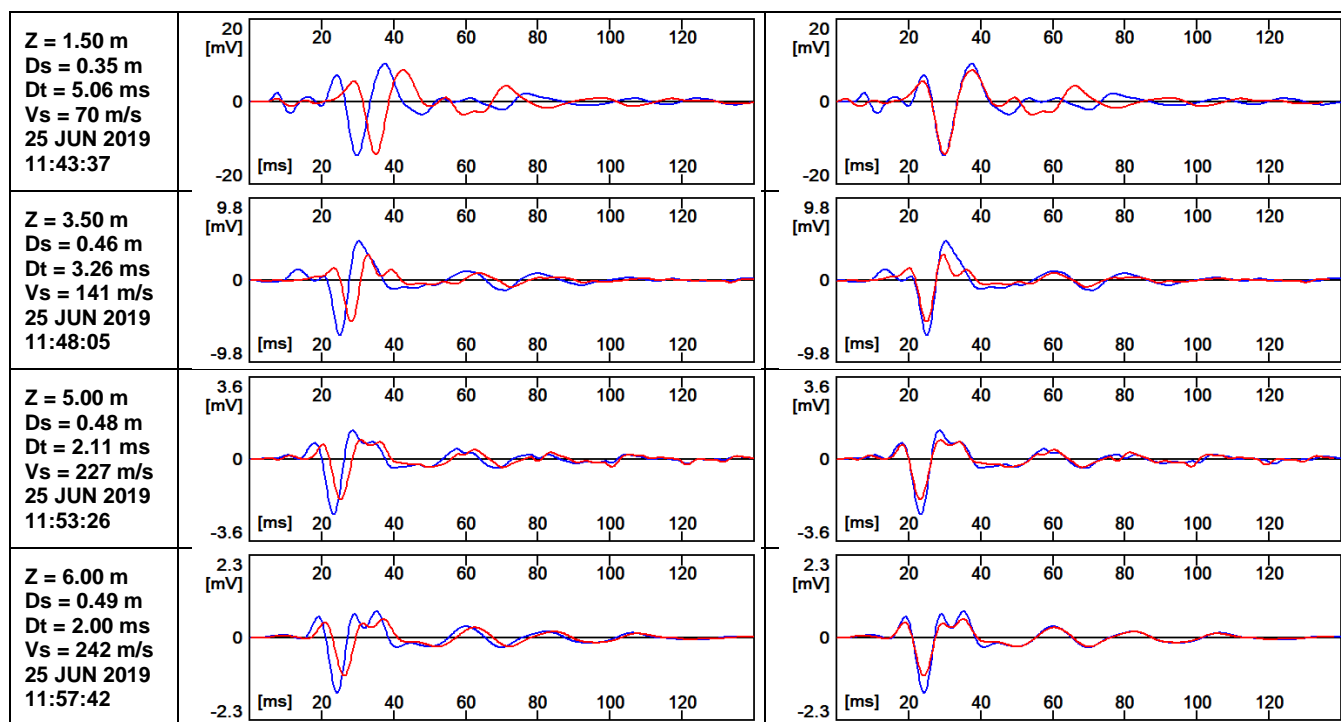
## RECORDED

## RE-PHASED



## RECORDED

## RE-PHASED



## APPENDIX E

### Vane Tests



PointID

CPT 01

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325239.800 m

NORTHING : 180759.500 m

ELEVATION : 5.300 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

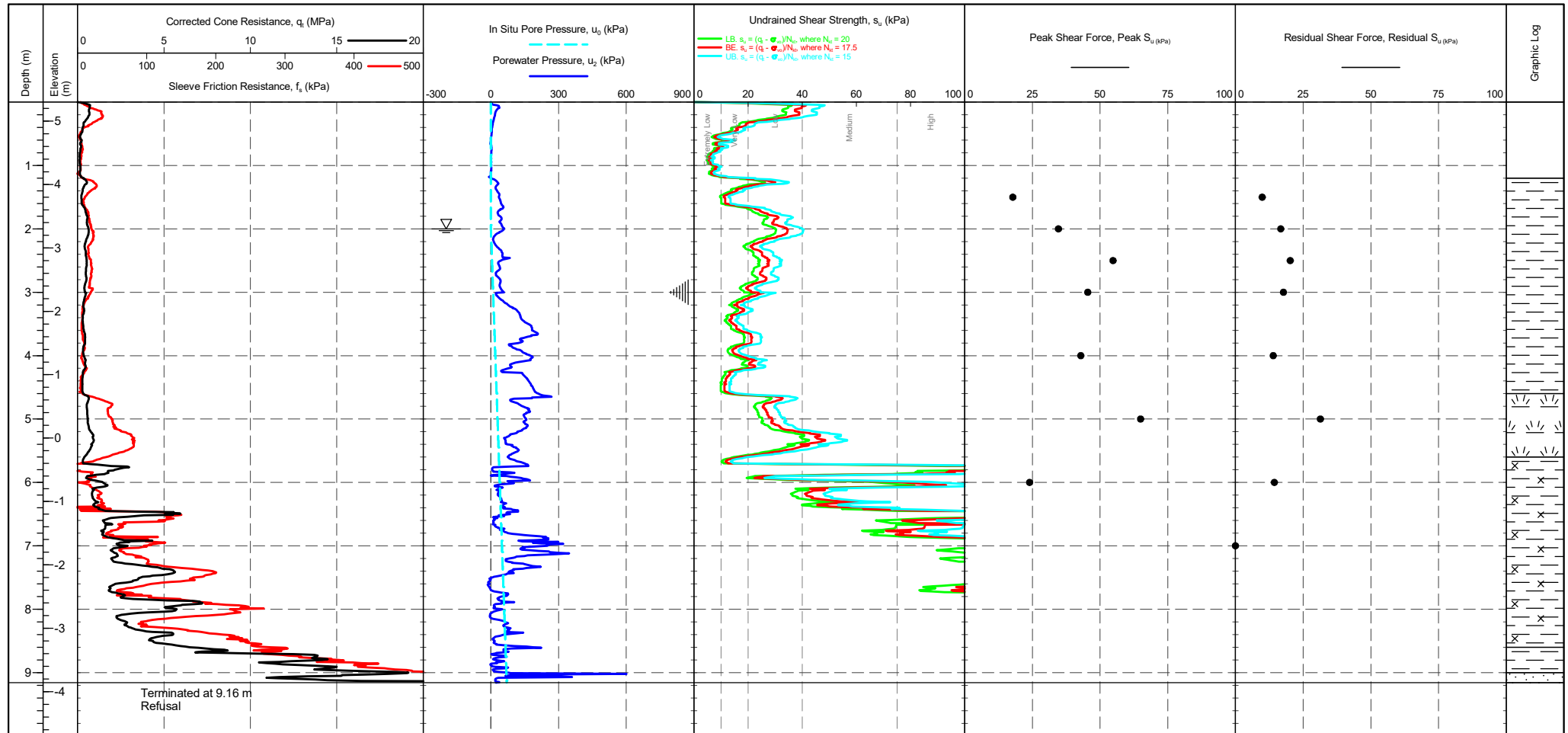
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 17/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 01  
WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level  
Dissipation Test



PointID

CPT 02

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325413.600 m

NORTHING : 180803.000 m

ELEVATION : 4.950 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on inclination.

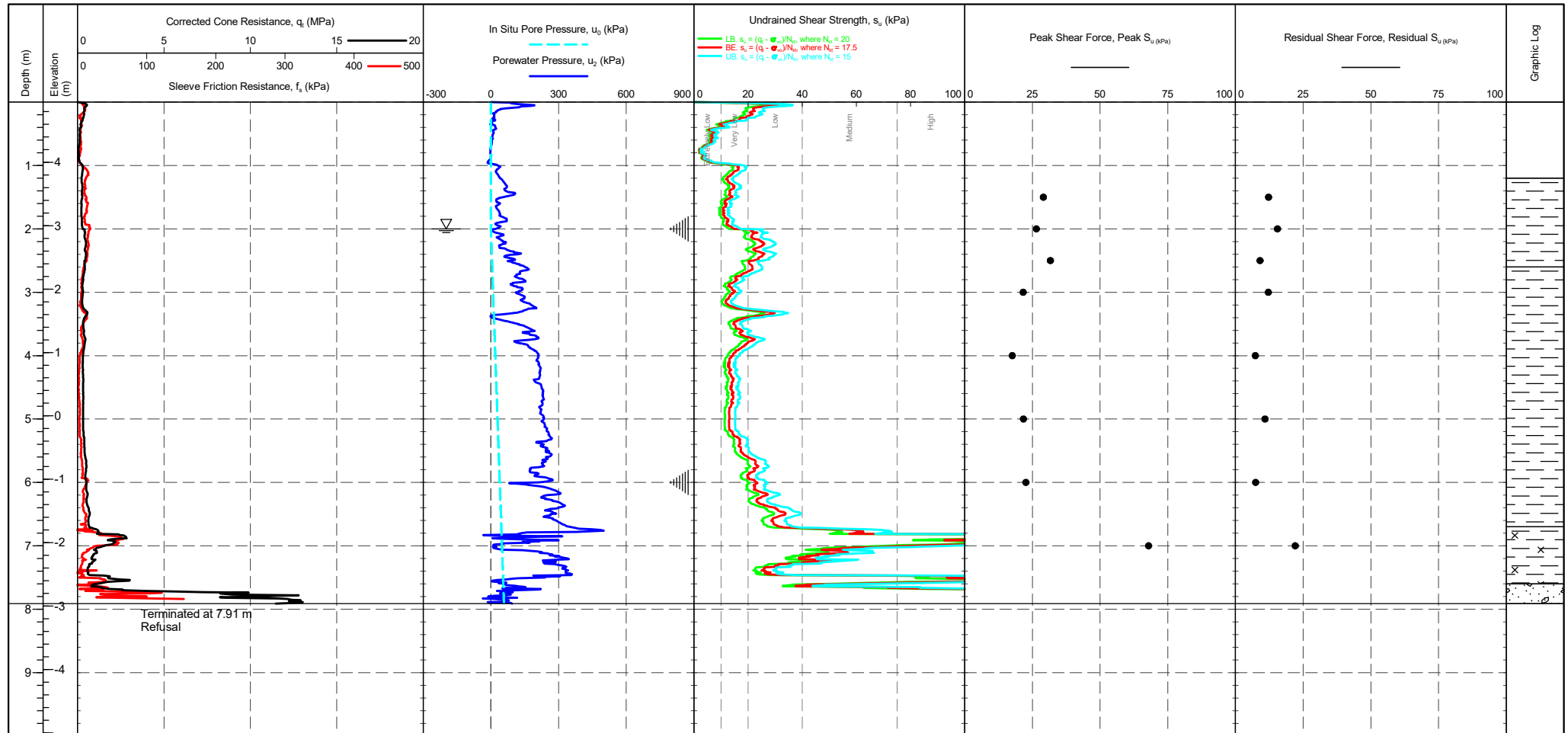
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 24/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 02  
WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level  
Dissipation Test



PointID

CPT 03

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325294.200 m

NORTHING : 180730.200 m

ELEVATION : 5.400 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

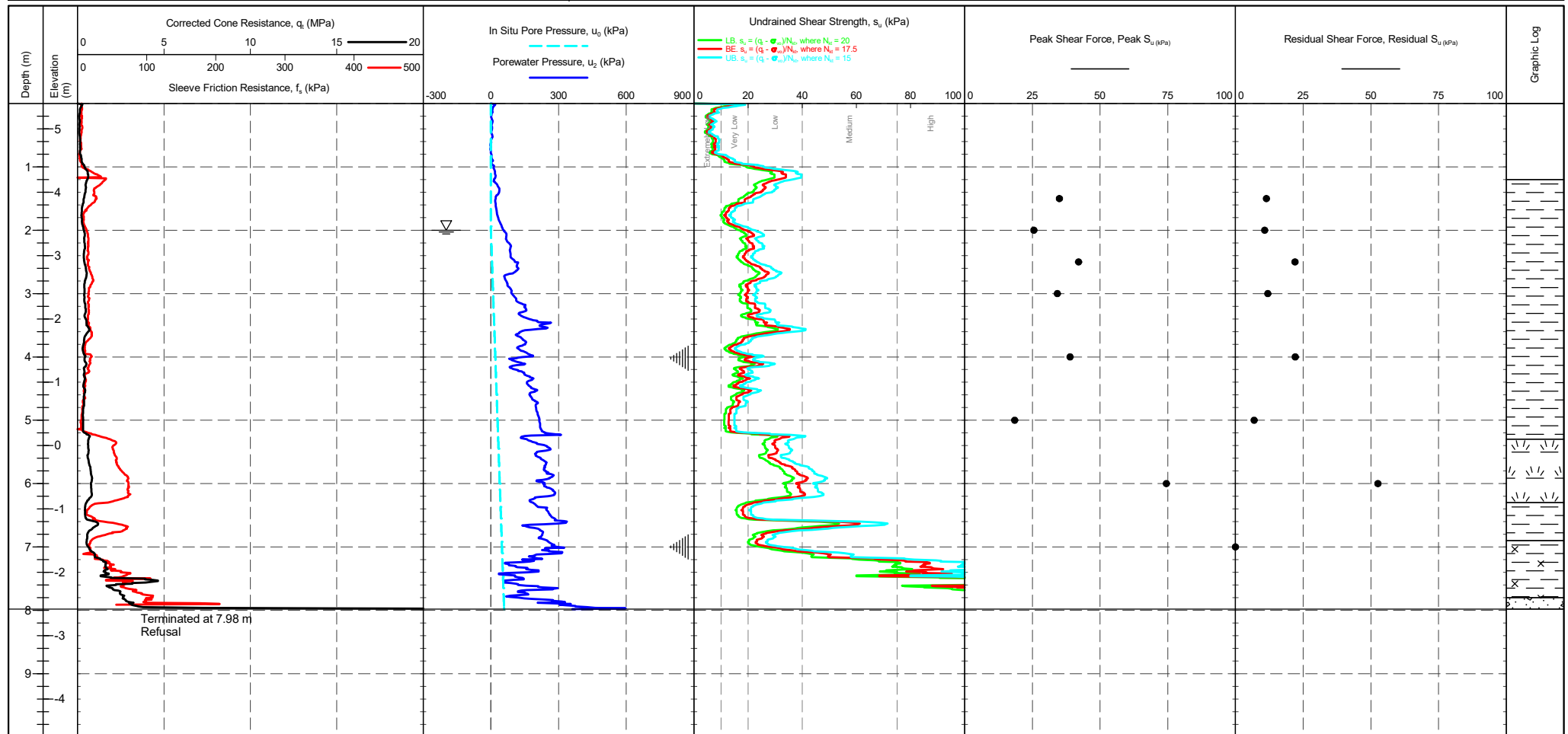
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 03  
WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level

Dissipation Test





PointID

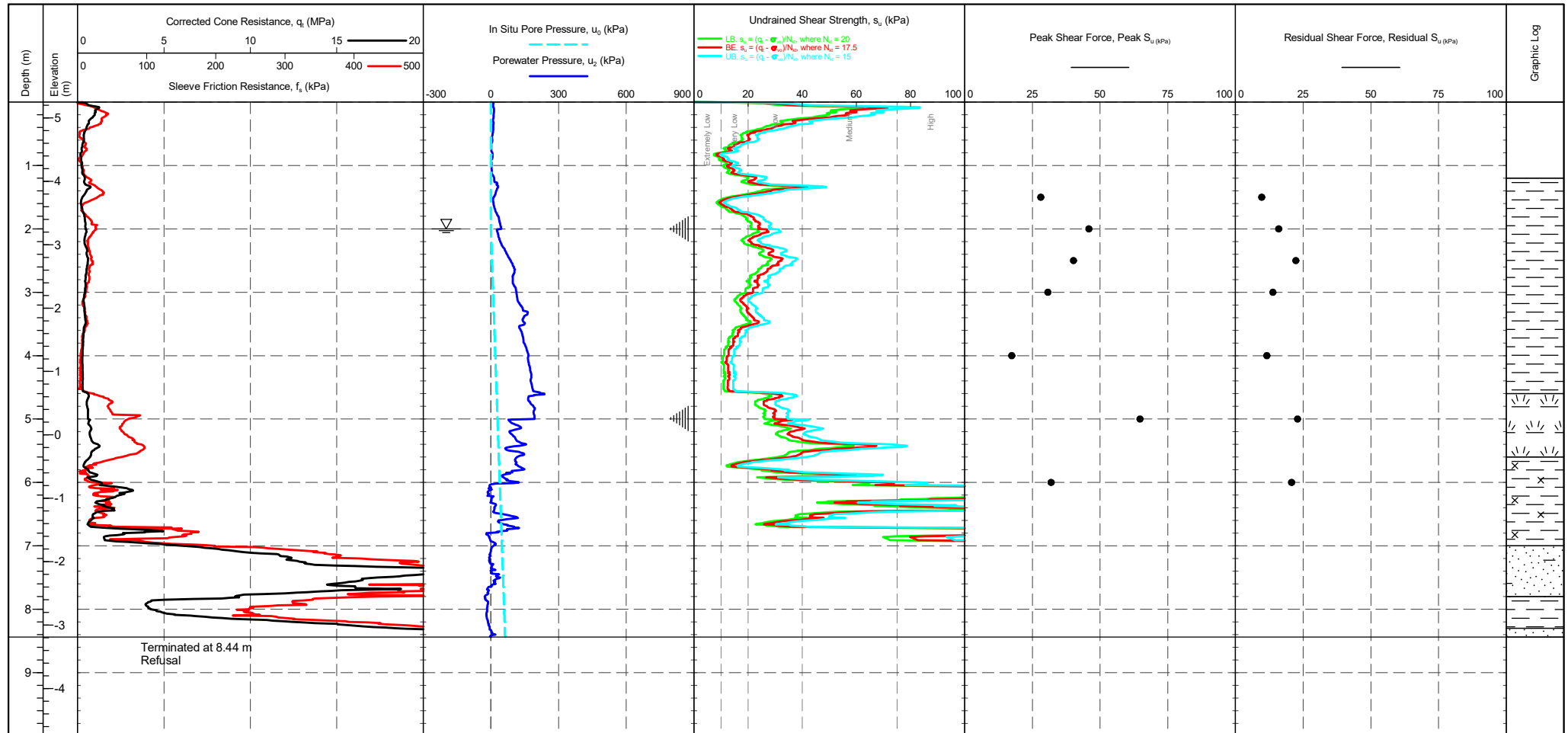
**CPT 04**

CLIENT : Geotechnical Engineering  
PROJECT : Cardiff Parkway  
LOCATION : Cardiff  
PROJECT No. : 1190290

EASTING : 325195.400 m  
NORTHING : 180664.200 m  
ELEVATION : 5.250 m OD  
CHECKED BY :  
TERMINATION REASON : Refusal

Remark:  
Test refused on total pressure.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 21/06/2019  
PLOT DATE : 04/07/2019  
METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 04  
WEATHER : Overcast & Mild

CPTU ZERO VALUES  
Transducer Pre Post Difference  
Tip  
Sleeve  
Pore Pressure 2  
X-Y Inclinator

Groundwater Level  
Dissipation Test



PointID

CPT 05

CLIENT : Geotechnical Engineering

PROJECT : Cardiff Parkway

LOCATION : Cardiff

PROJECT No. : 1190290

EASTING : 325097.400 m

NORTHING : 180591.800 m

ELEVATION : 5.250 m OD

CHECKED BY :

TERMINATION REASON : Refusal

Remark:

Test refused on total pressure.

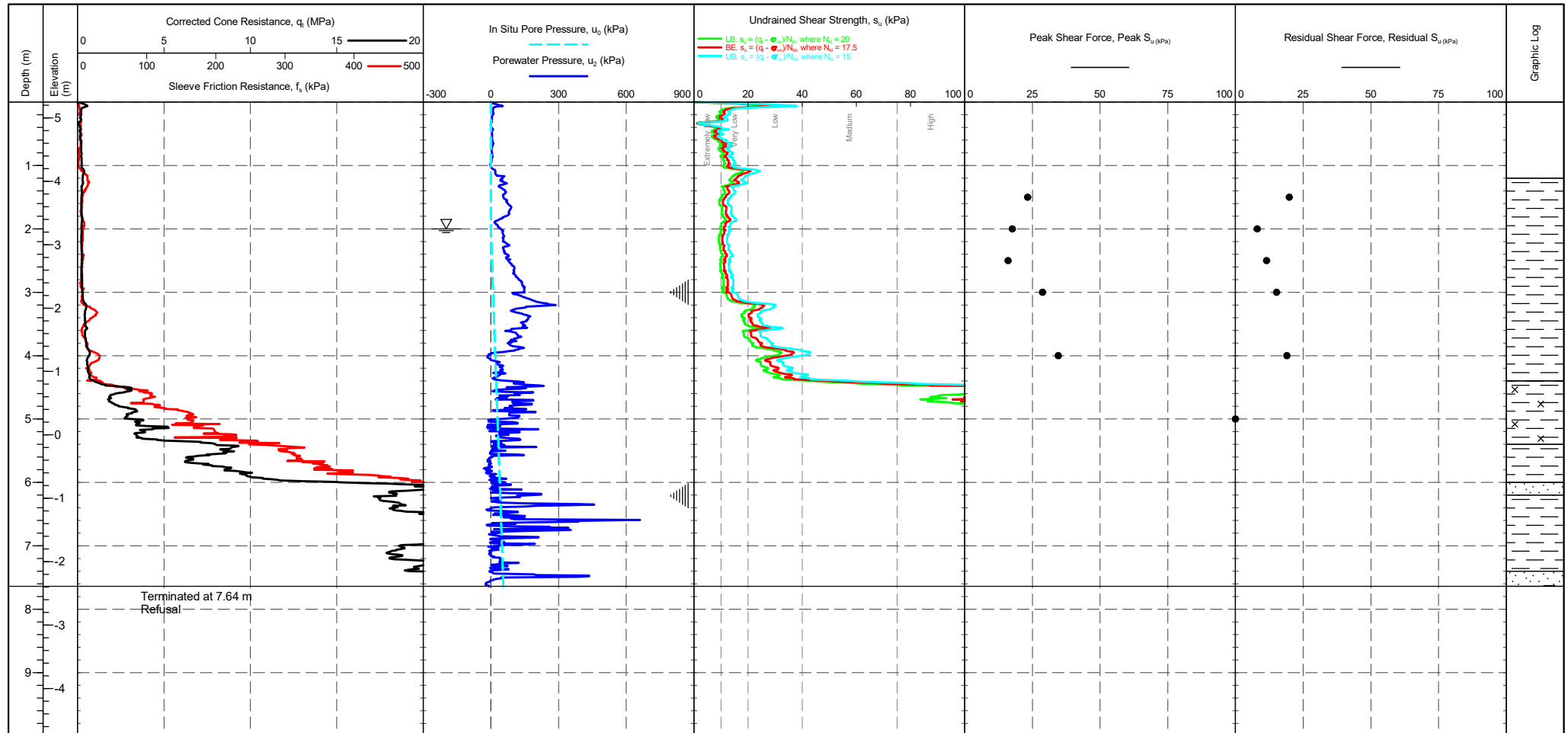
SHEET : 1 OF 1

STATUS : Final

TEST DATE : 21/06/2019

PLOT DATE : 04/07/2019

METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1735  
CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 05  
WEATHER : Overcast & Mild

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip			
Sleeve			
Pore Pressure 2			
X-Y Inclinator			

Groundwater Level

Dissipation Test



PointID

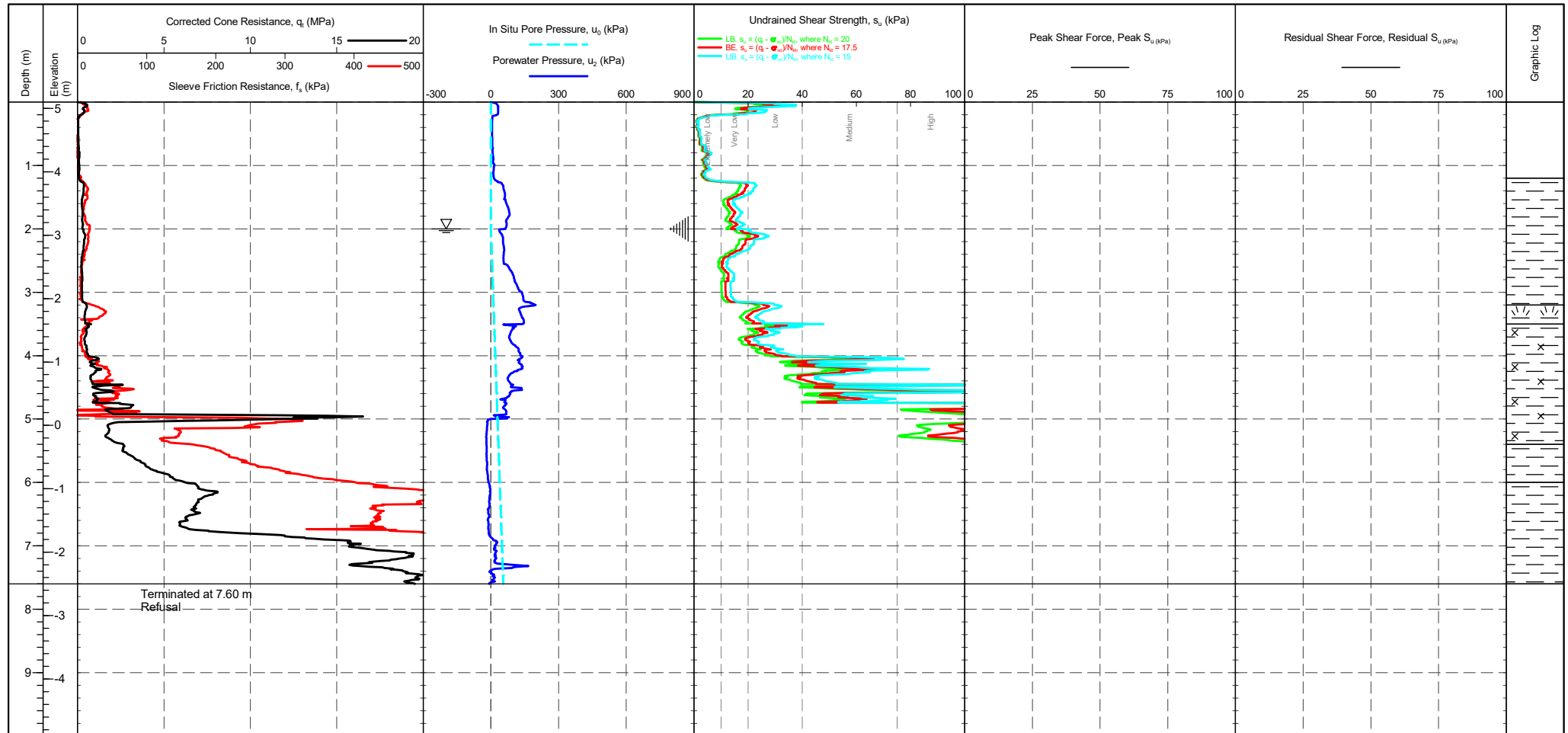
**CPT 06**

CLIENT : Geotechnical Engineering  
PROJECT : Cardiff Parkway  
LOCATION : Cardiff  
PROJECT No. : 1190290

EASTING : 325071.900 m  
NORTHING : 180693.600 m  
ELEVATION : 5.100 m OD  
CHECKED BY :  
TERMINATION REASON : Refusal

Remark:  
Test refused on total pressure.

SHEET : 1 OF 1  
STATUS : Final  
TEST DATE : 17/06/2019  
PLOT DATE : 04/07/2019  
METHOD : ISO 22476-1:2012



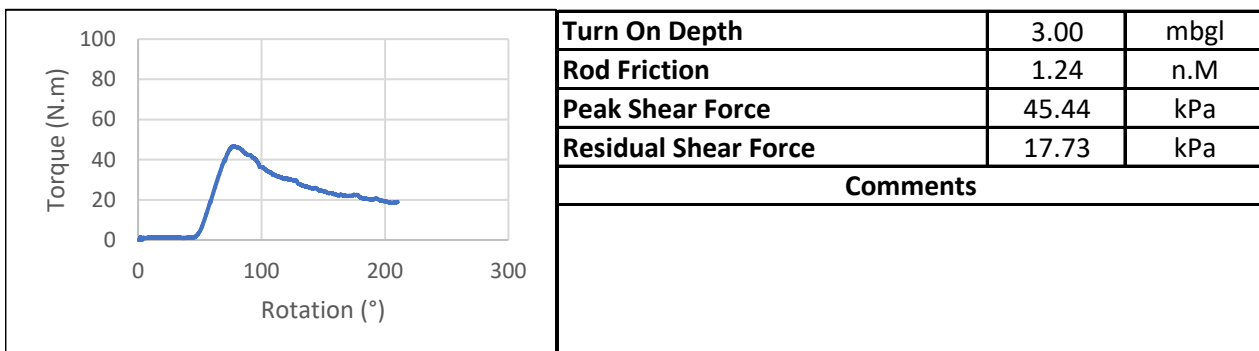
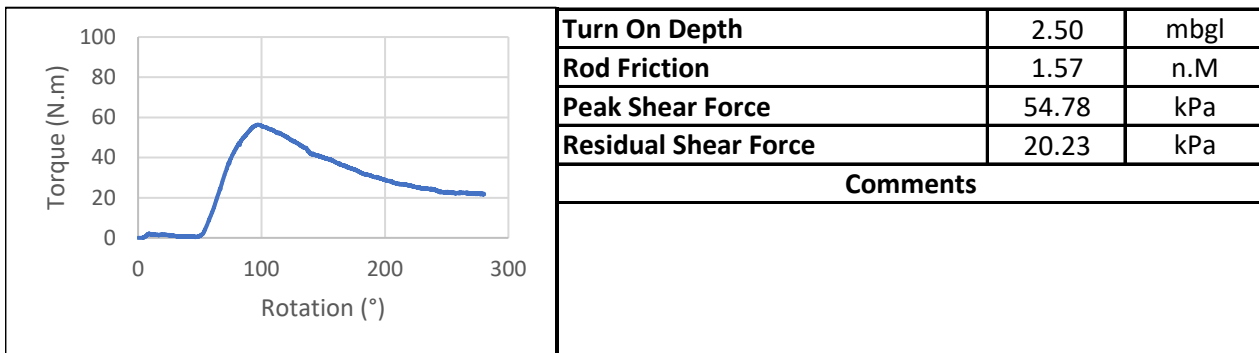
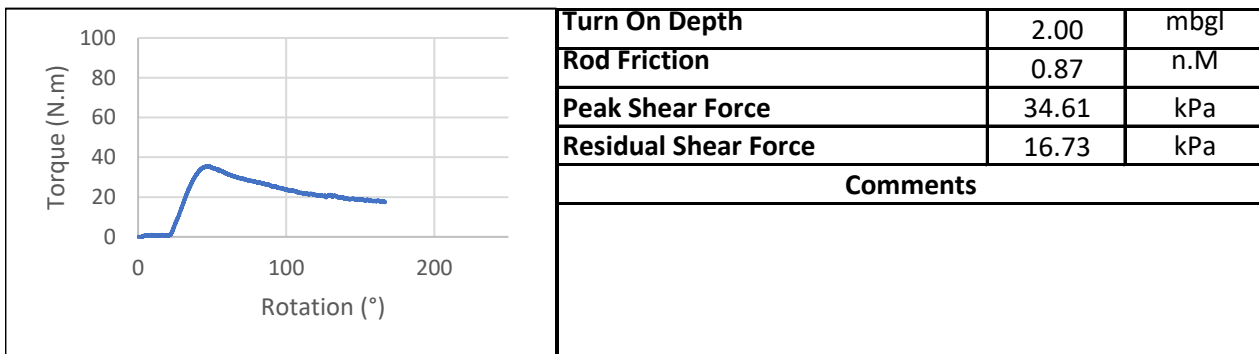
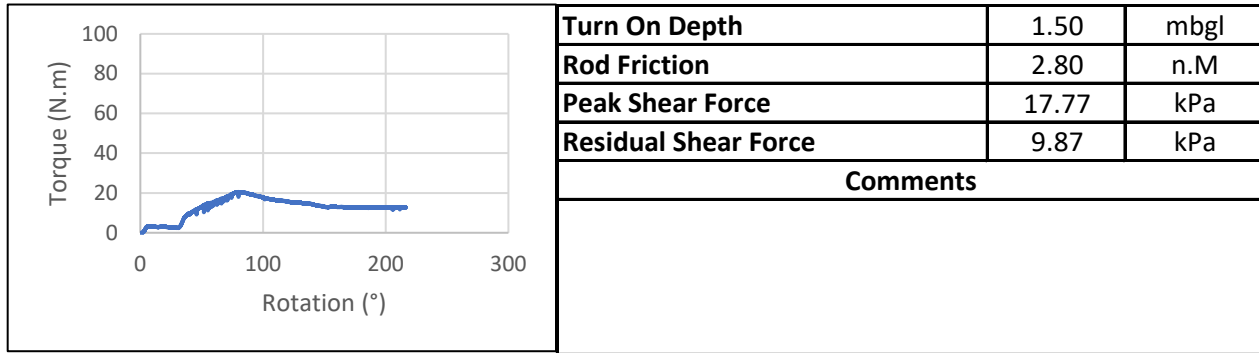
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CONE AREA : 15cm<sup>2</sup>  
CONE AREA RATIO : 0.8  
FILTER POSITION : u2  
FILTER TYPE : HDPE  
FRICTION REDUCER : None

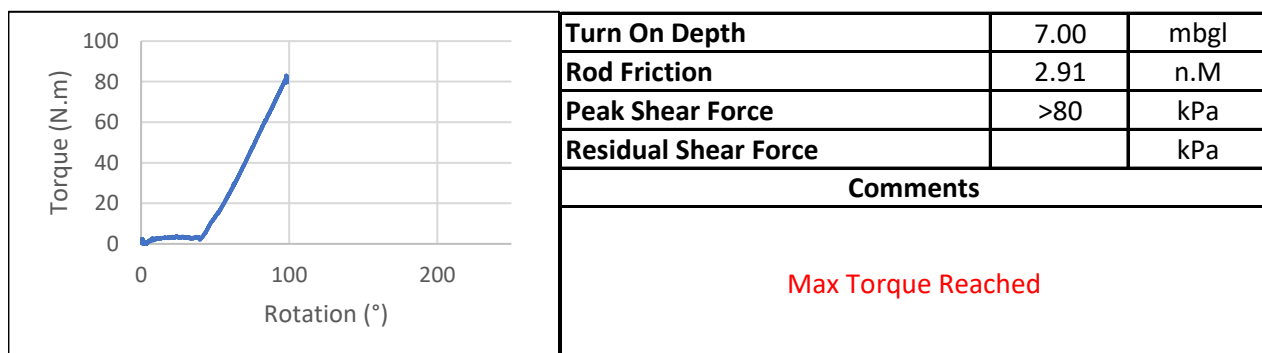
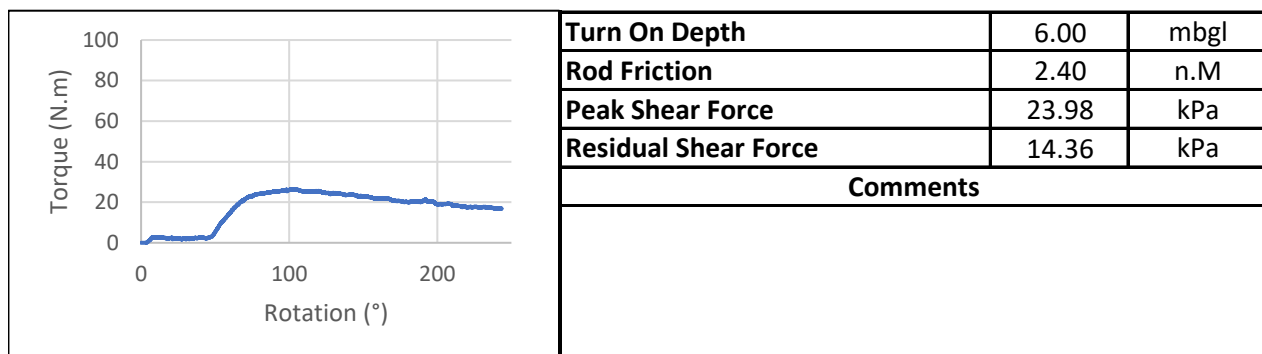
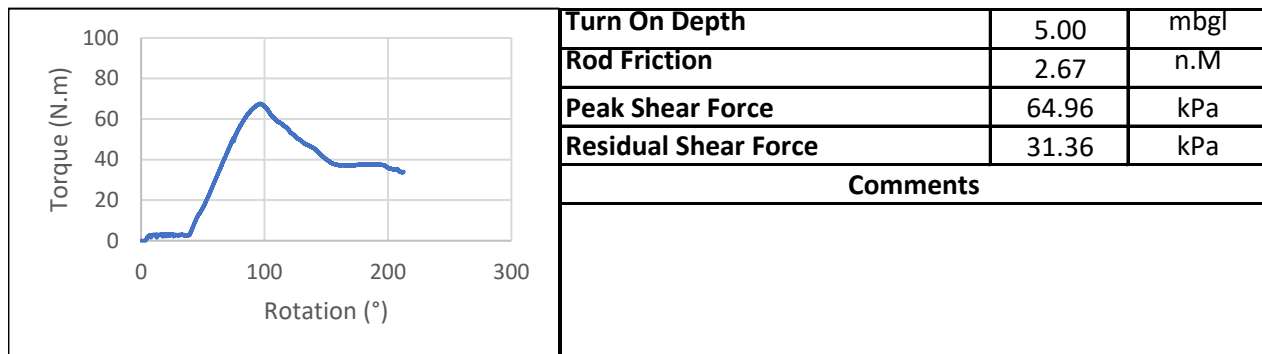
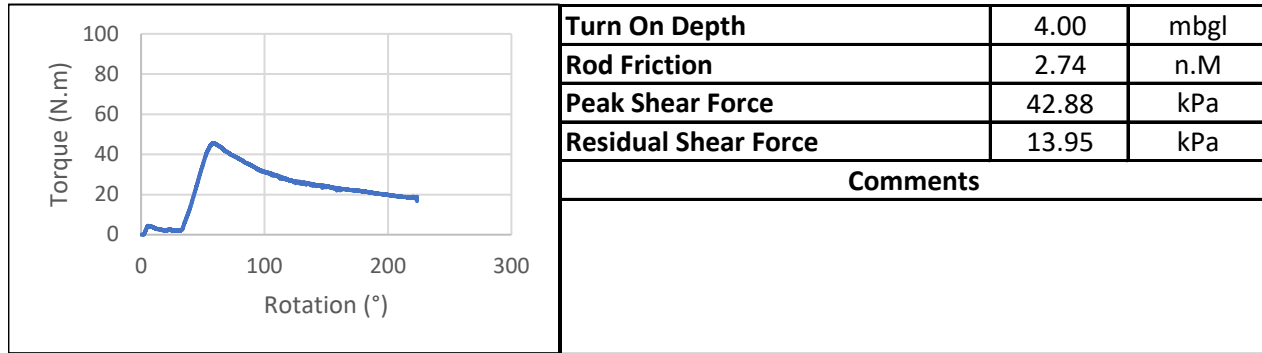
TEST TYPE : TE2  
APPLICATION CLASS : 2  
RIG :  
OPERATOR :  
FILE NAME : 1190290-CPT 06  
WEATHER : Overcast & Mild

CPTU ZERO VALUES  
Transducer Pre Post Difference  
Tip  
Sleeve  
Pore Pressure 2  
X-Y Inclinator

Groundwater Level  
Dissipation Test

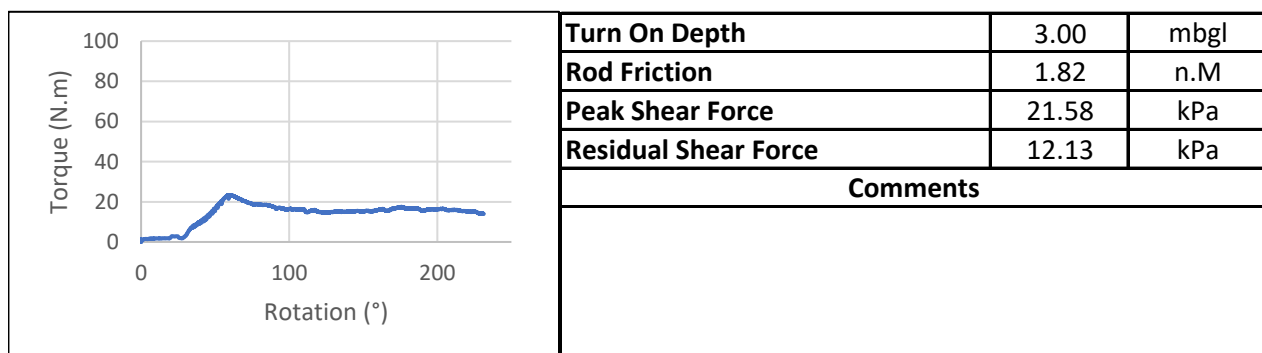
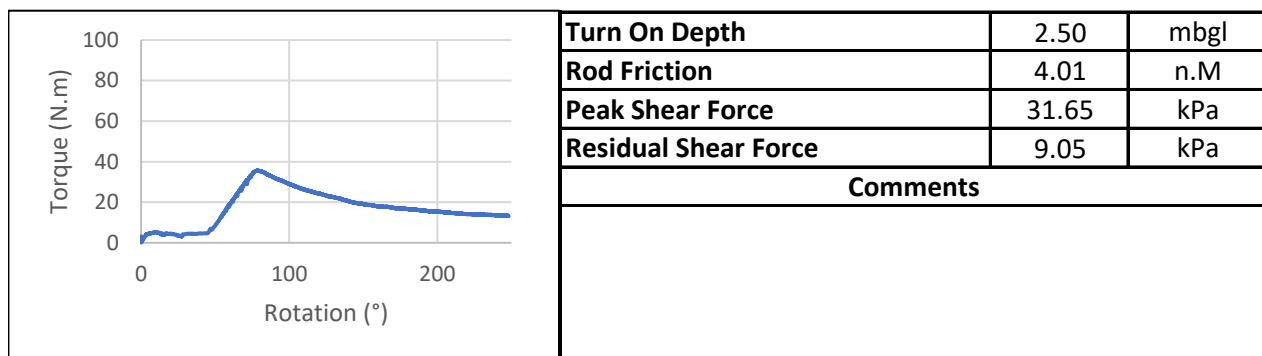
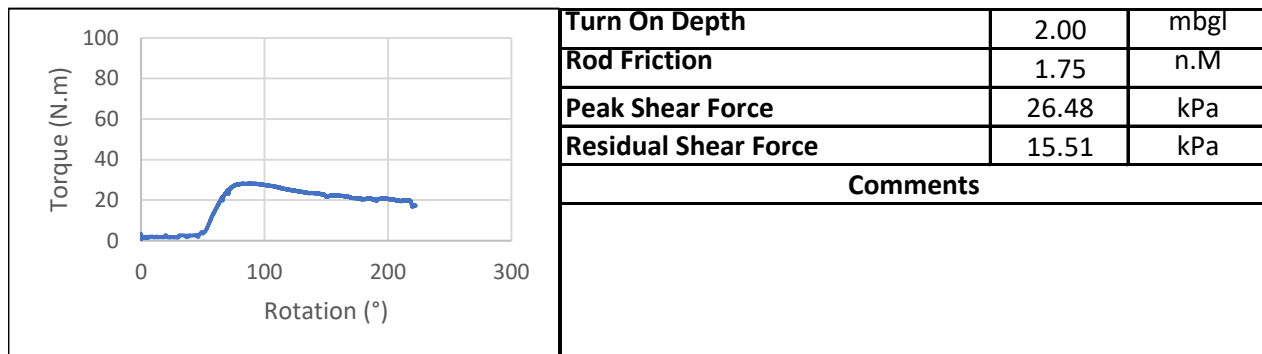
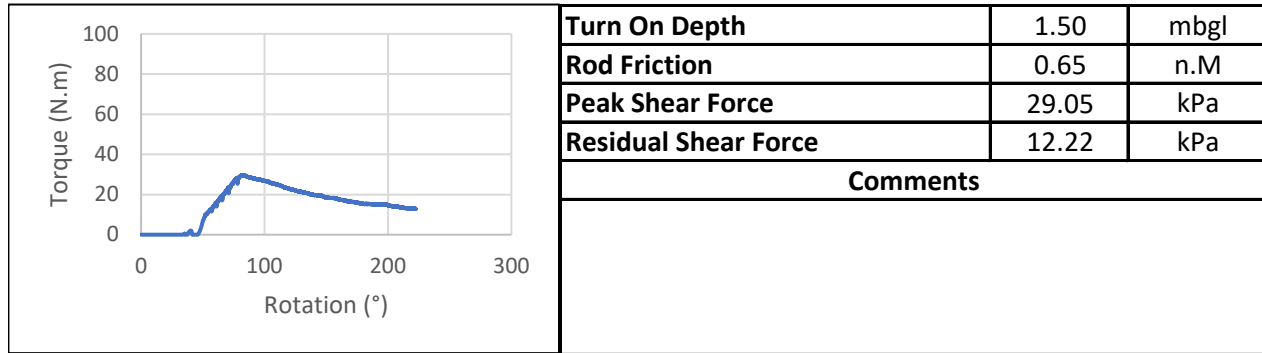
Location: VS01

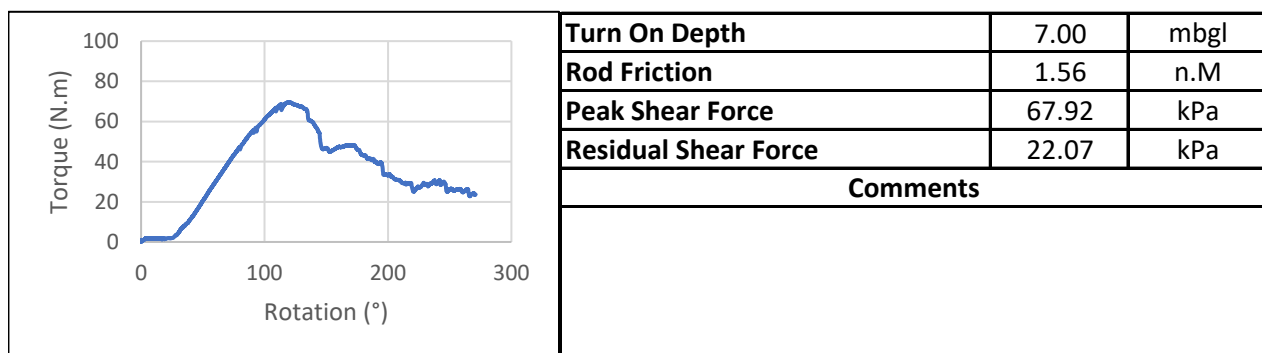
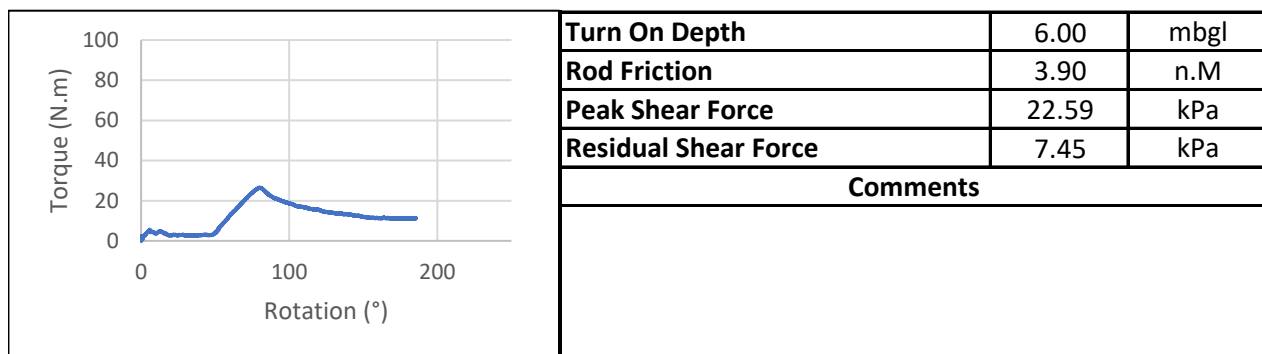
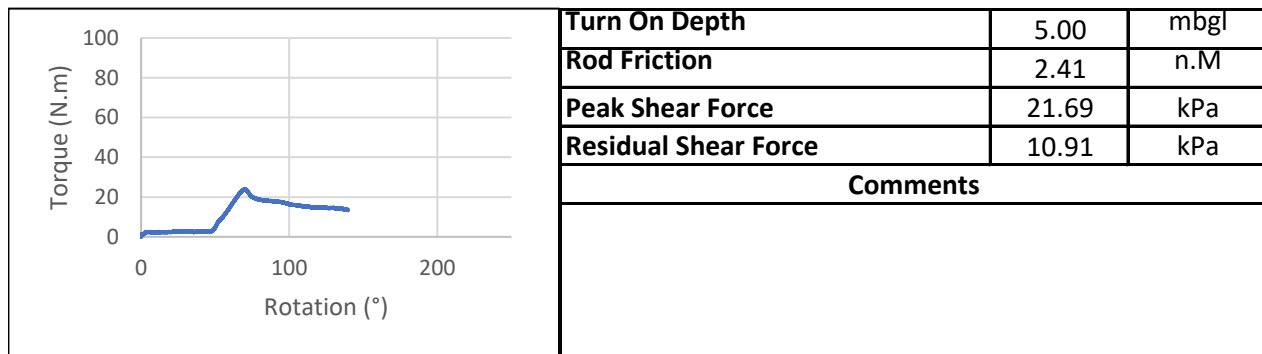
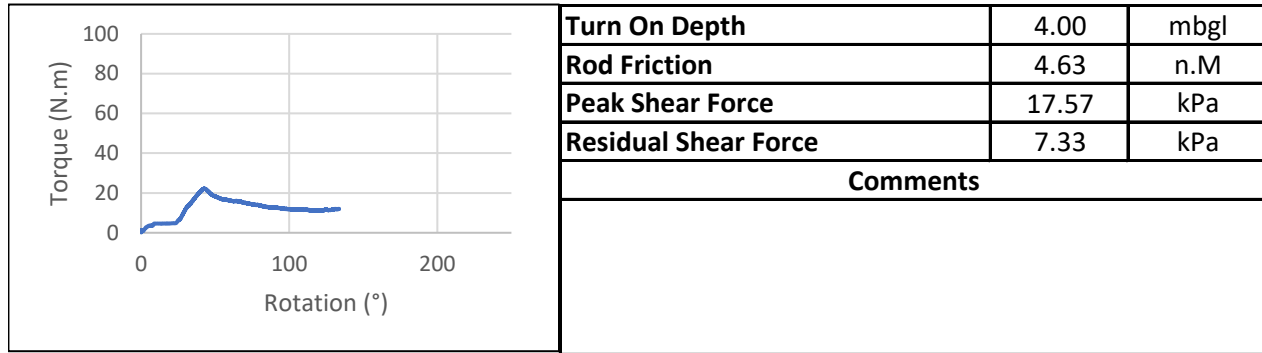




End of test	
Final Turn Depth	7.00m
Reason For Refusal	Refusal on turn

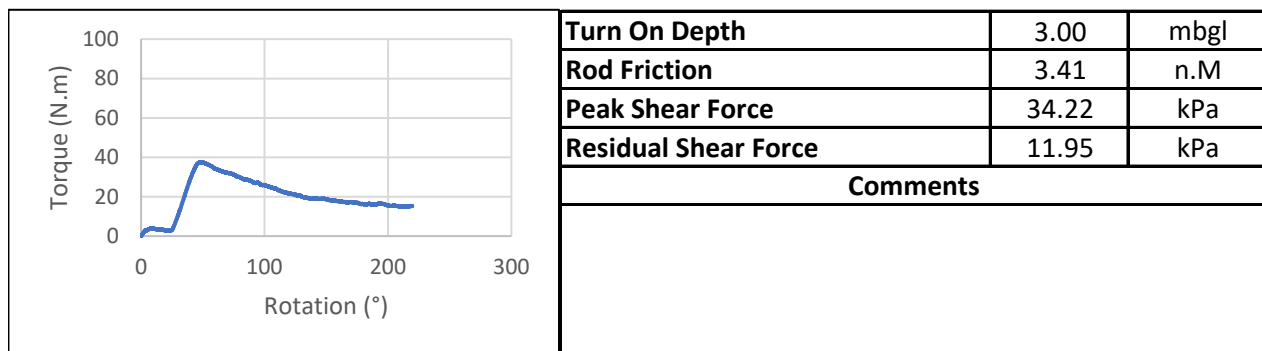
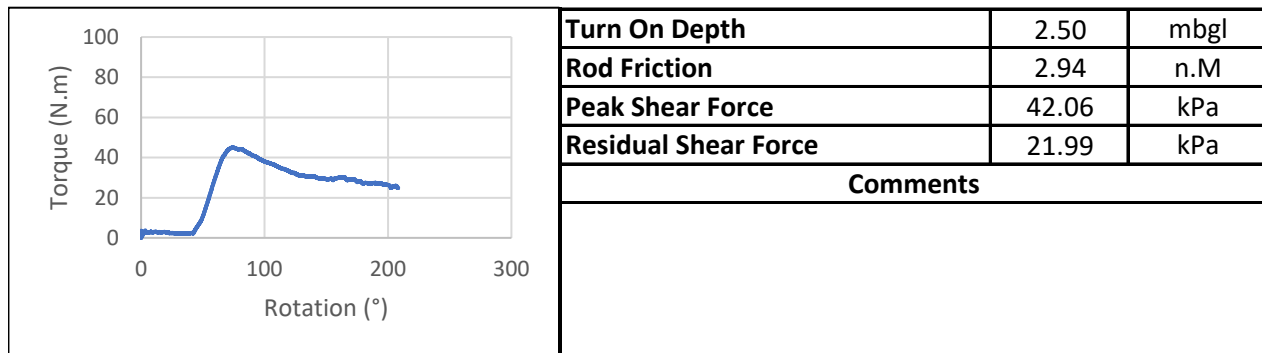
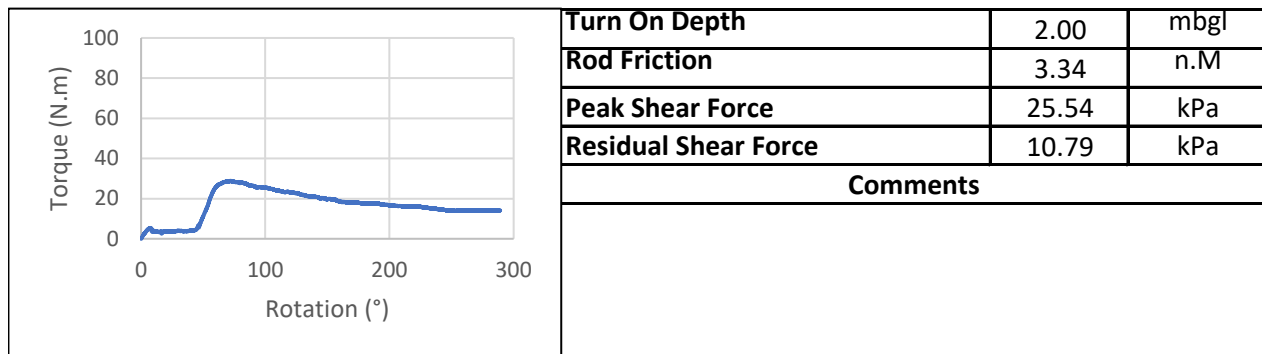
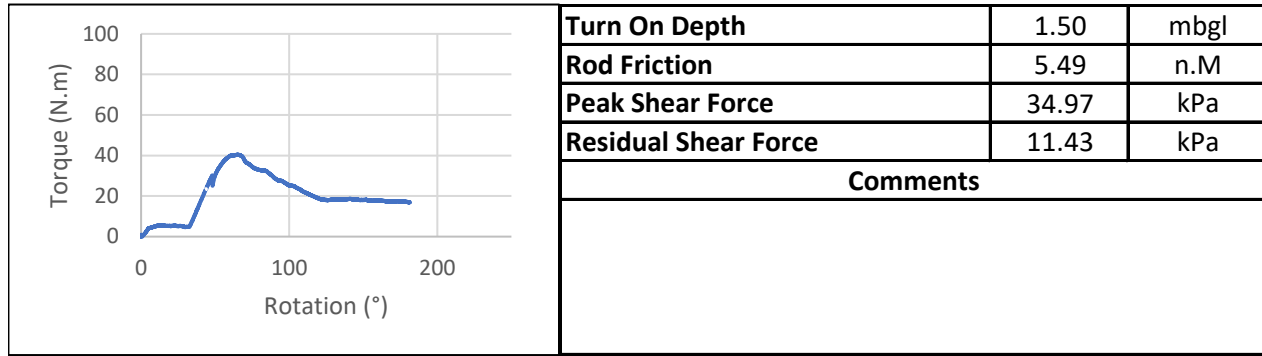
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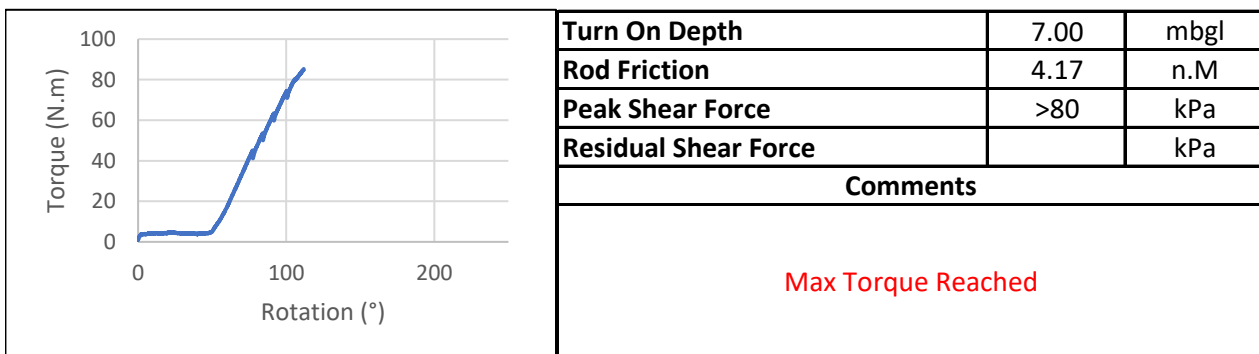
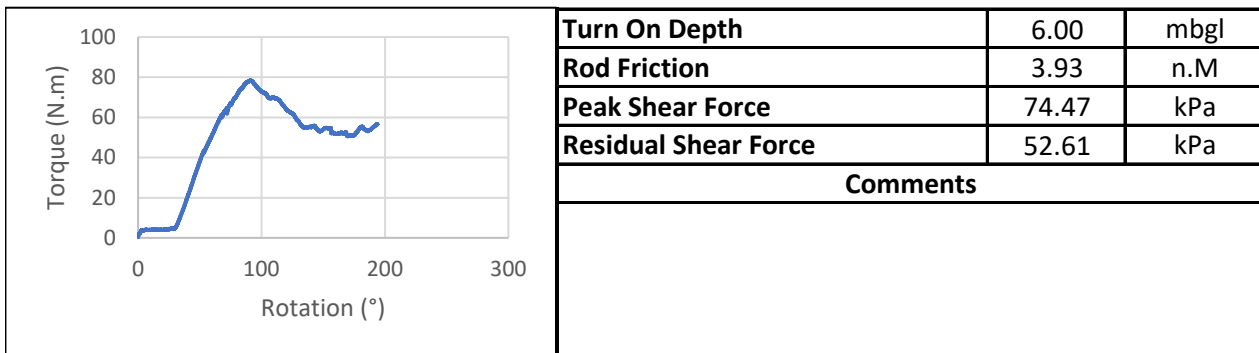
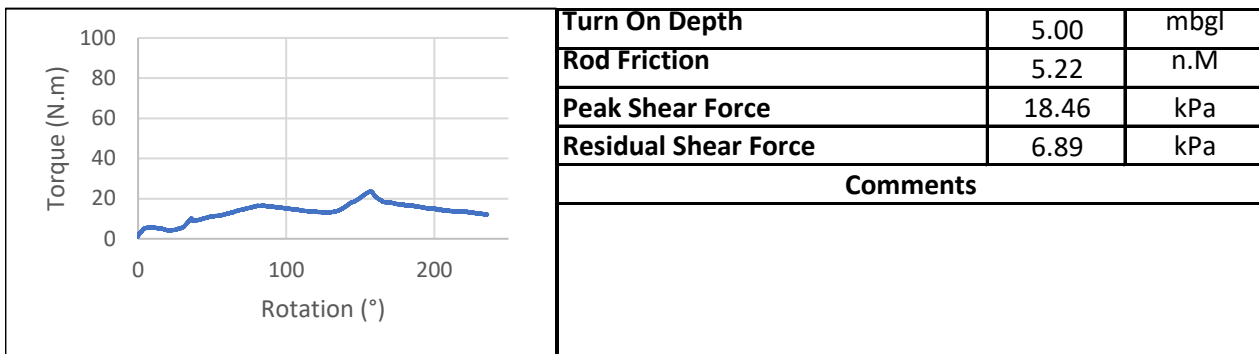
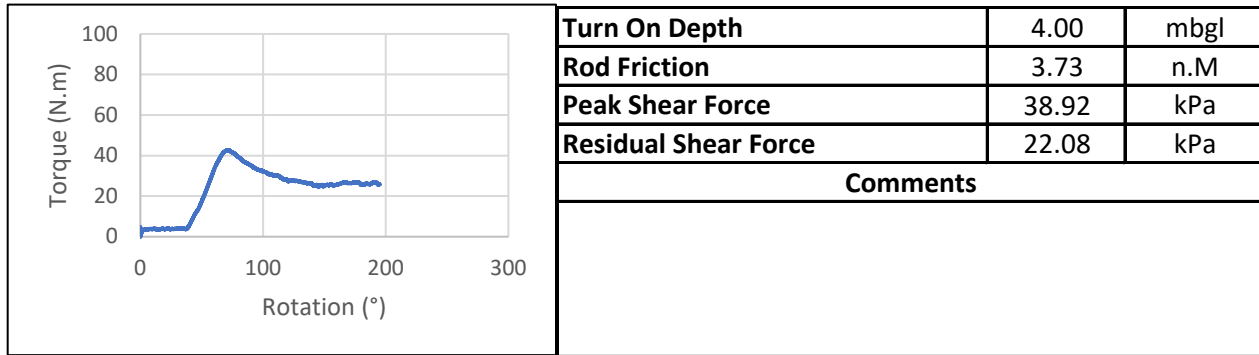


End of test	
Final Turn Depth	7.00m
Reason For Refusal	Refusal on tonnage

Location: VS03

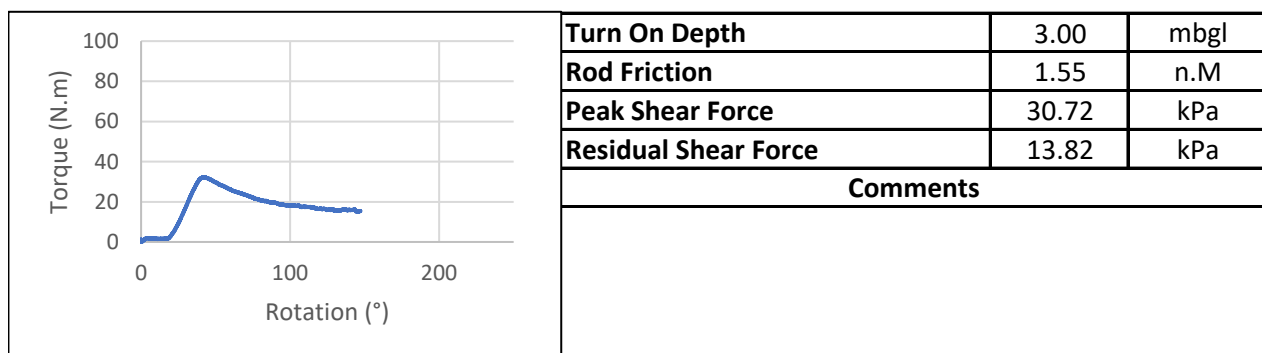
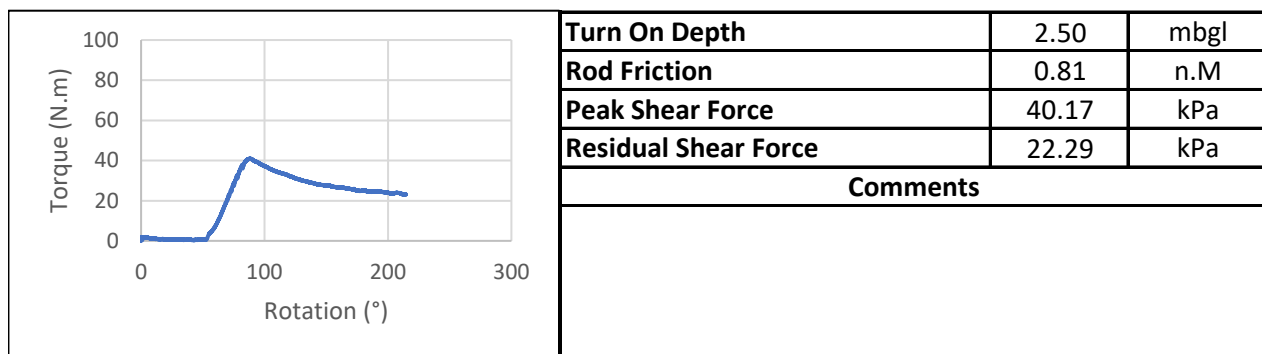
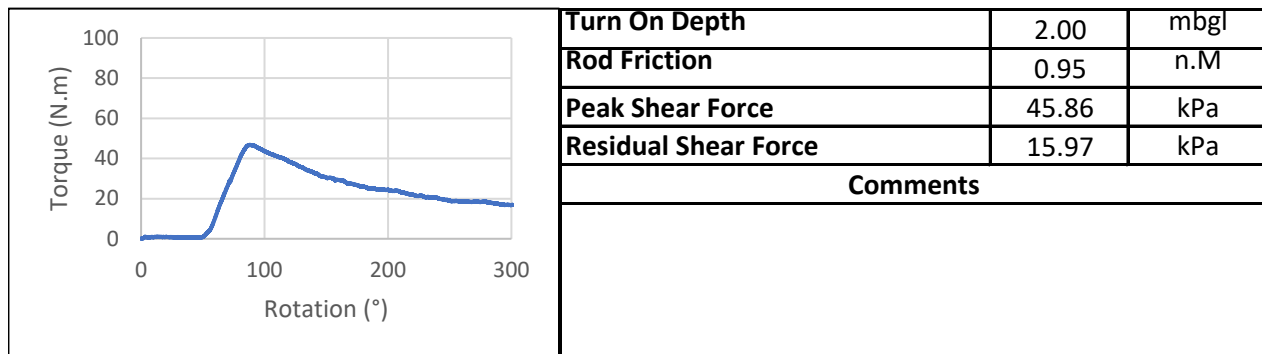
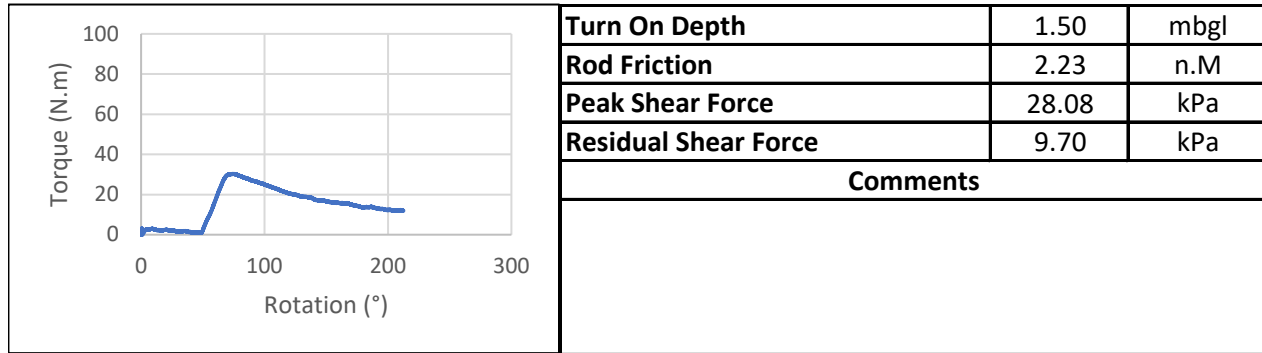


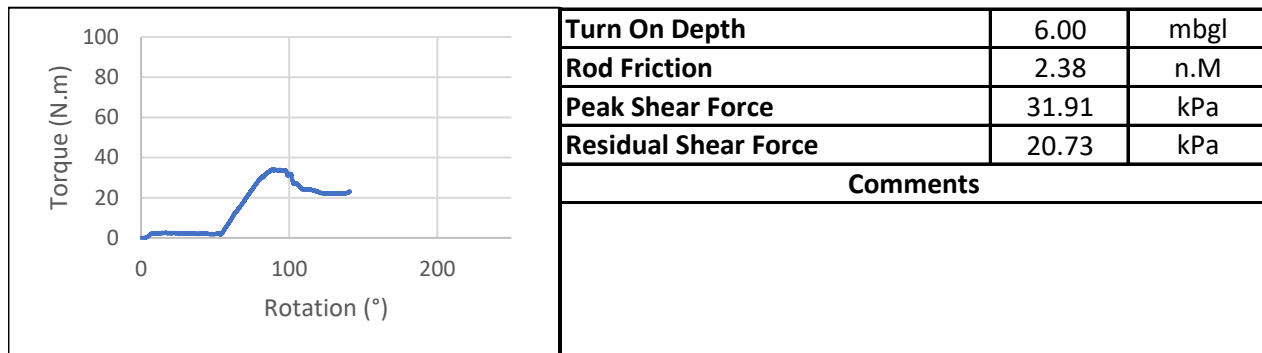
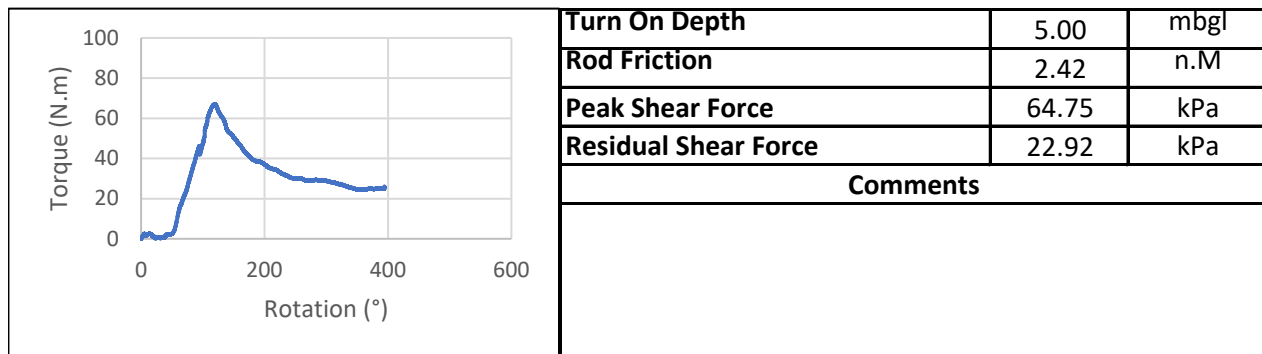
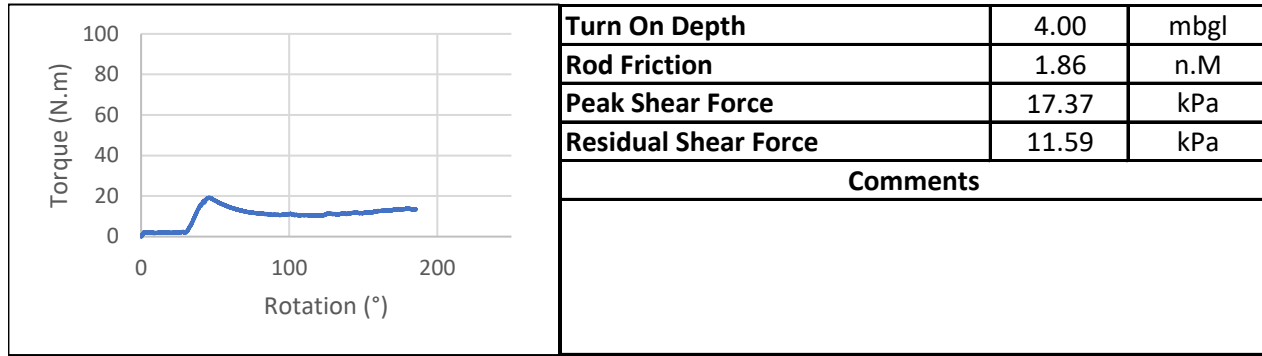




End of test	
Final Turn Depth	7.00m
Reason For Refusal	Refusal on turn

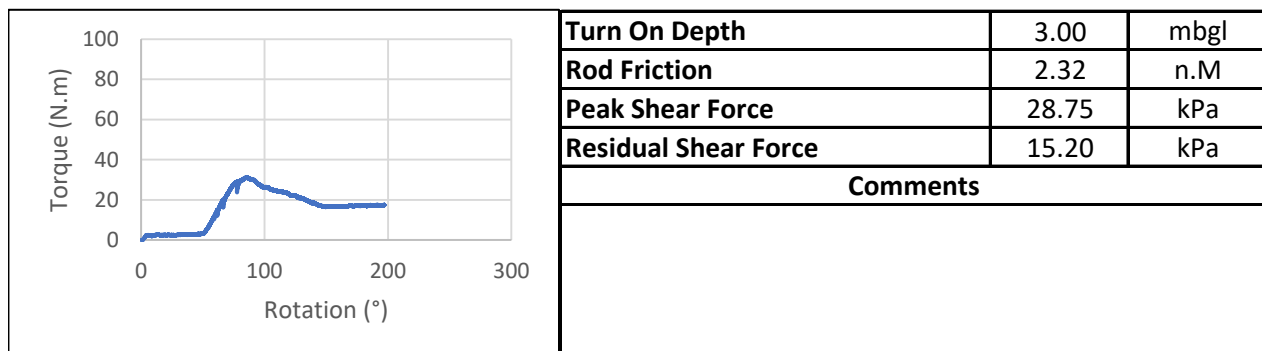
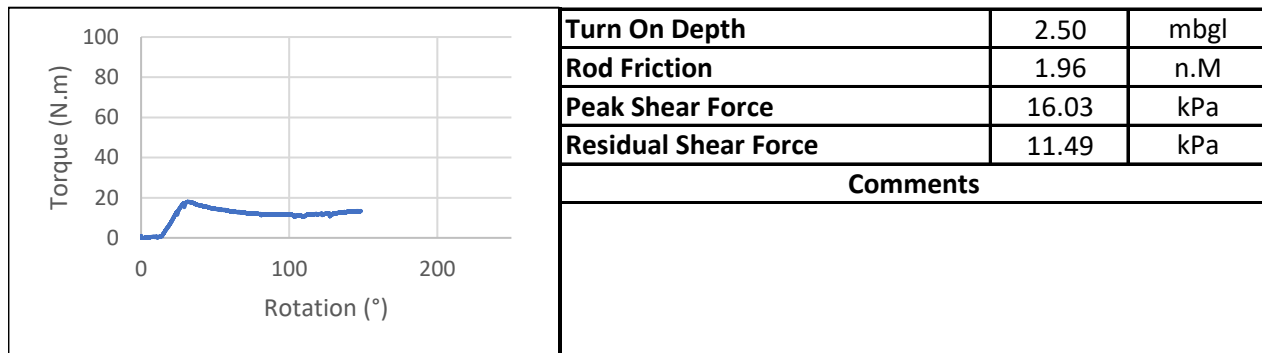
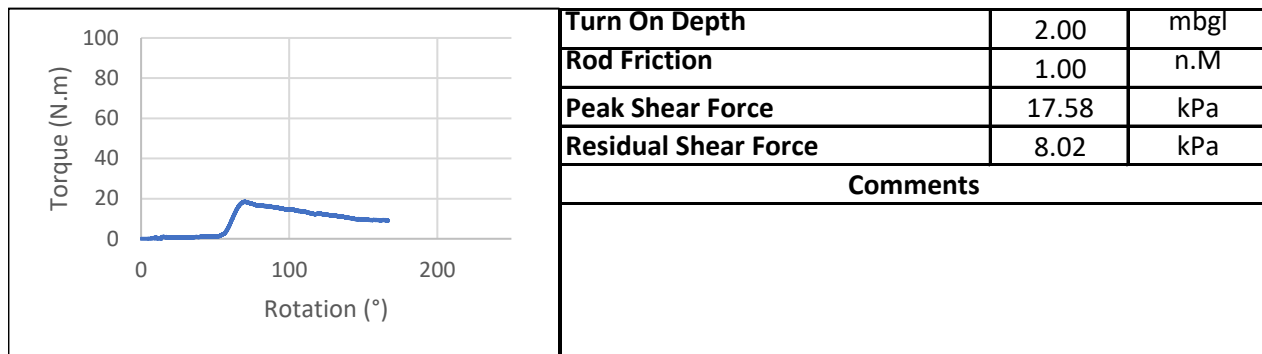
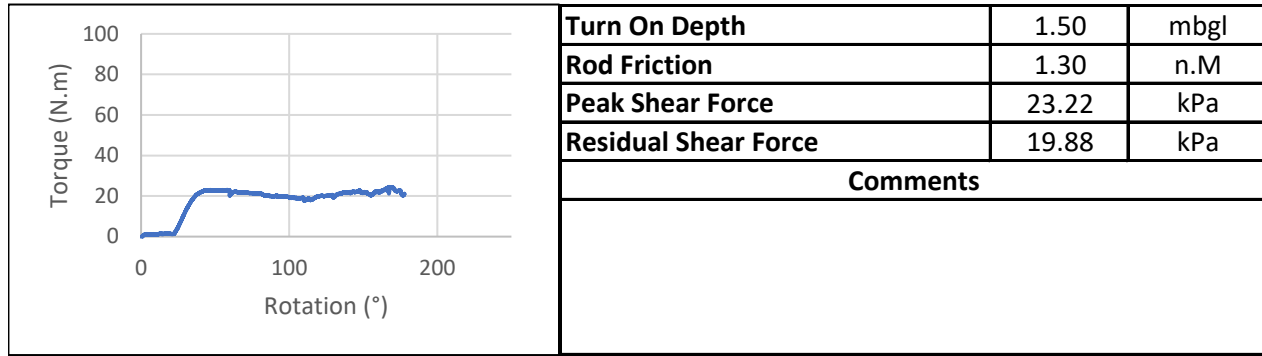
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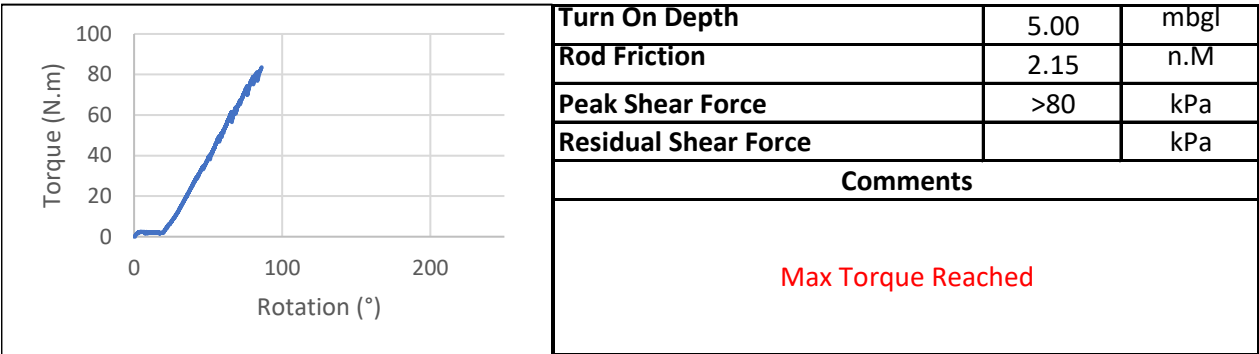
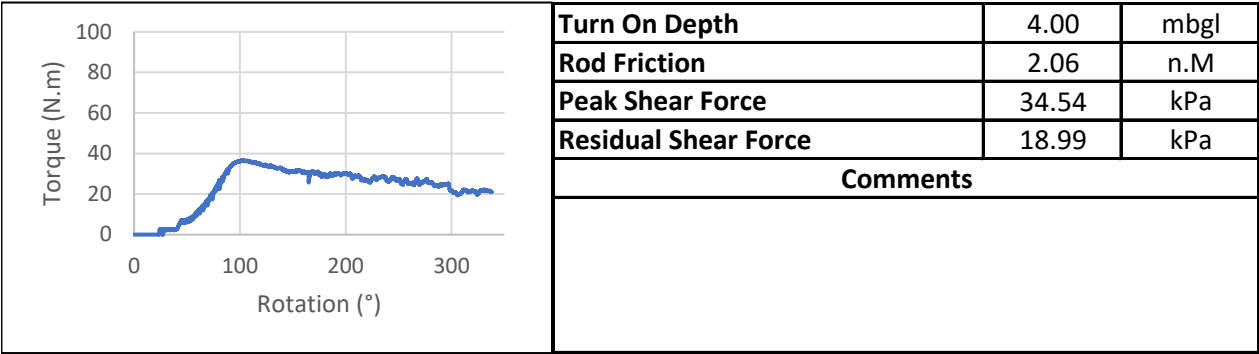




End of test	
Final Turn Depth	6.00m
Reason For Refusal	Refusal on tonnage

Location: VS05



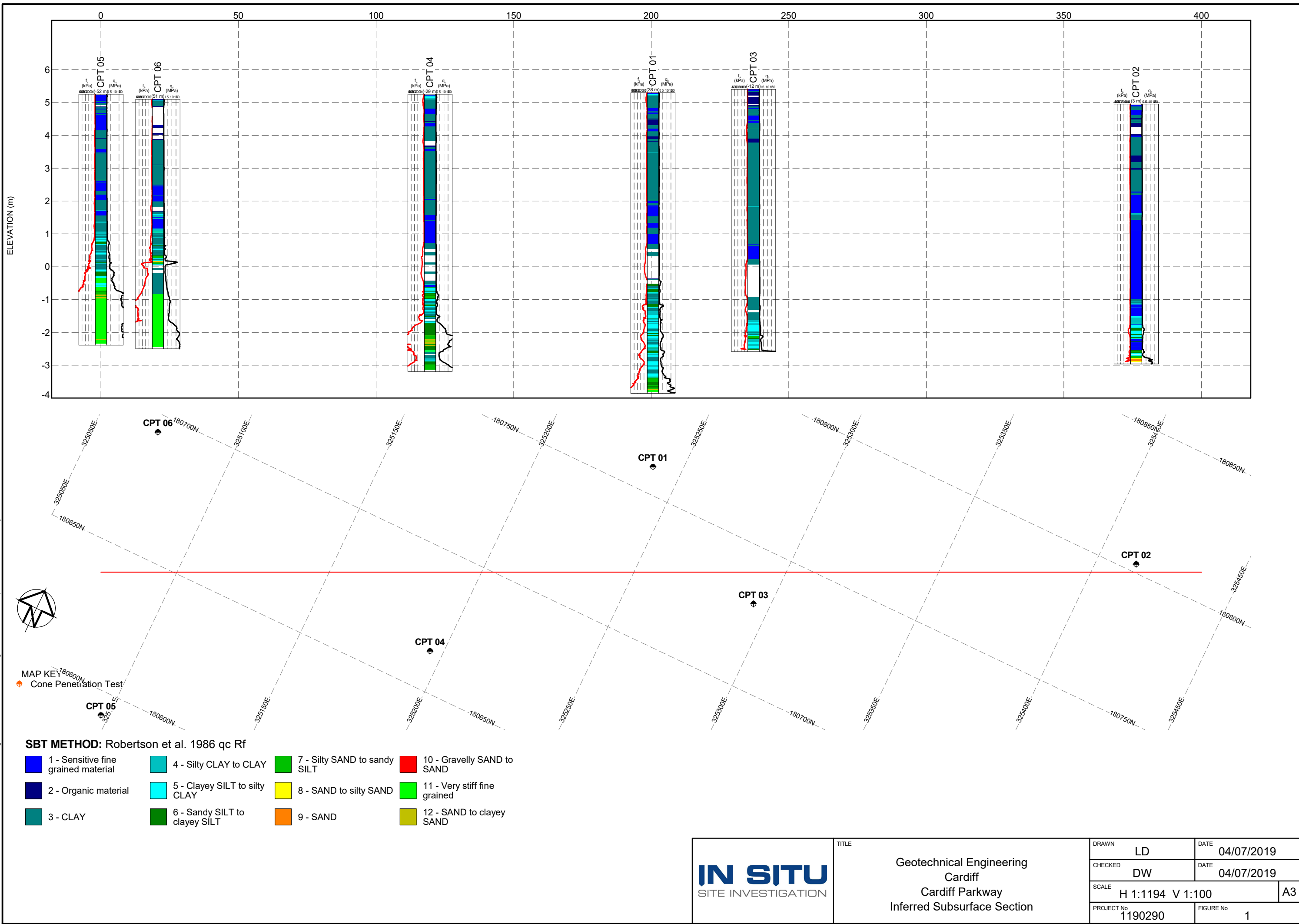


End of test	
Final Turn Depth	5.00m
Reason For Refusal	Refusal on turn

## APPENDIX F

### Section

IN SITU 2.02.1 LUB.GLB Fence CPT FENCE A3L 1190290-CARDIFF GPJ <DrawingFile> 04/07/2019 15:11 10.00.01.07 Dated Lab and in Situ Test - DGD | Lie in Situ SJ 2.02.0 2017.05-10.Pdf in Situ SJ 2.02.0 2017.07-10





*IN SITU SITE INVESTIGATION*

Unit 23 Hastings Innovation  
Centre,  
Highfield Drive  
St. Leonards on Sea, East Sussex,  
TN38 9UH, U.K.

Company No.: 6339499  
VAT No.: 922 3561 41





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## **APPENDIX C**

### **PHOTOGRAPHS**



Borehole: BH01 Box 1: 1.20-5.20m



Borehole: BH01 Box 2: 5.20-8.20m



Borehole: BH02 Box 1: 1.20-4.30m





Borehole: BH02 Box 2: 4.30-6.80m



Borehole: BH02 Box 3: 6.80-9.80m



Borehole: BH02 Box 4: 9.80-12.80m





Borehole: BH03 Box 1: 1.20-5.00m



Borehole: BH03 Box 2: 5.00-8.00m



Borehole: BH03 Box 3: 8.00-11.00m





Borehole: BH04 Box 1: 1.20-7.50m



Borehole: BH04 Box 2: 7.50-10.00m



Borehole: BH04 Box 3: 10.00-13.00m





Borehole: BH04 Box 4: 13.00-16.00m



Borehole: BH05 Box 1: 1.20-4.20m



Borehole: BH05 Box 2: 4.20-6.70m





Borehole: BH05 Box 3: 6.70-9.70m



Borehole: BH05 Box 4: 9.70-12.70m



Borehole: BH05 Box 5: 12.70-15.70m





Borehole: BH05 Box 6: 15.70-18.70m



Borehole: BH05 Box 7: 18.70-21.70m



Borehole: BH06 Box 1: 1.20-4.10m





Borehole: BH06 Box 2: 4.10-6.60m



Borehole: BH06 Box 3: 6.60-9.60m



Borehole: BH06 Box 4: 9.60-12.60m





Borehole: BH07 Box 1: 1.20-8.30m



Borehole: BH07 Box 2: 8.30-11.20m



Borehole: BH07 Box 3: 11.20-14.20m





Borehole: BH07 Box 4: 14.20-17.20m



Borehole: BH07 Box 5: 17.20-20.20m



Borehole: BH07 Box 6: 20.20-23.20m





Borehole: BH07 Box 7 23.20-26.20m



Borehole: BH08 Box 1 1.20-7.00m



Borehole: BH08 Box 2 7.00-10.00m





Borehole: BH08 Box 3 10.00-13.00m



Borehole: BH08 Box 4 13.00-16.00m



Borehole: BH08 Box 5 16.00-19.00m



Borehole: BH08 Box 6 19.00-22.00m



Borehole: BH08 Box 7 22.00-25.00m





Borehole: BH09 Box 1: 1.20-5.20m



Borehole: BH09 Box 2: 5.20-8.20m



Borehole: BH09 Box 3: 8.20-11.20m



Borehole: BH09 Box 4: 11.20-14.20m



Borehole: BH09 Box 5: 14.20-17.20m



Borehole: BH09 Box 6: 17.20-20.20m





Borehole: BH09 Box 7: 20.20-23.20m



Borehole: BH10 Box 1: 1.20-4.20m



Borehole: BH10 Box 2: 4.20-6.70m





Borehole: BH10 Box 3: 6.70-9.70m



Borehole: BH10 Box 4: 9.70-14.00m



Borehole: BH10 Box 5: 14.00-17.00m





Borehole: BH10 Box 6: 17.00-20.00m



Borehole: BH10 Box 7: 20.00-23.00m



Borehole: BH10 Box 8: 23.00-26.00m



Borehole: BH10 Box 9: 26.00-26.70m





Borehole: BH11 Box 1: 1.20-4.20m



Borehole: BH11 Box 2: 4.20-6.70m



Borehole: BH11 Box 3: 6.70-9.70m



Borehole: BH11 Box 4: 9.70-12.40m

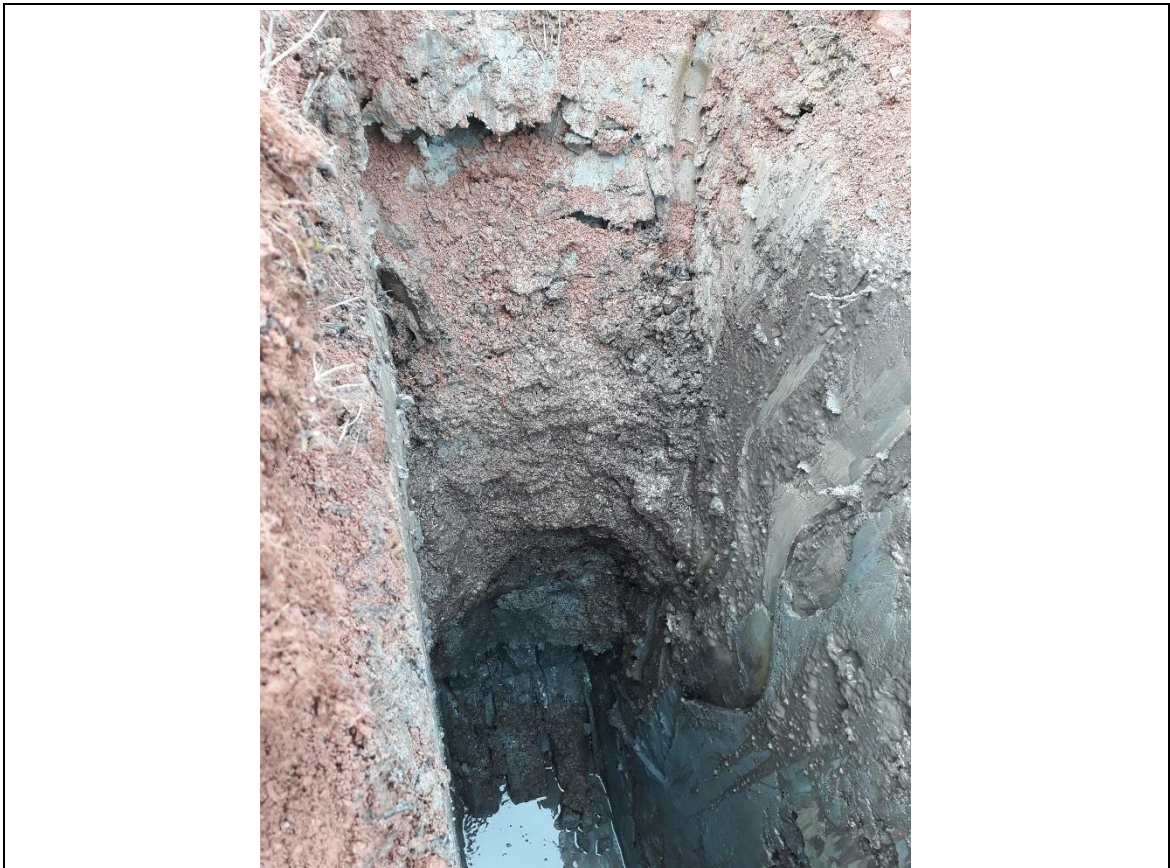


Borehole: BH11 Box 5: 12.40-15.40m



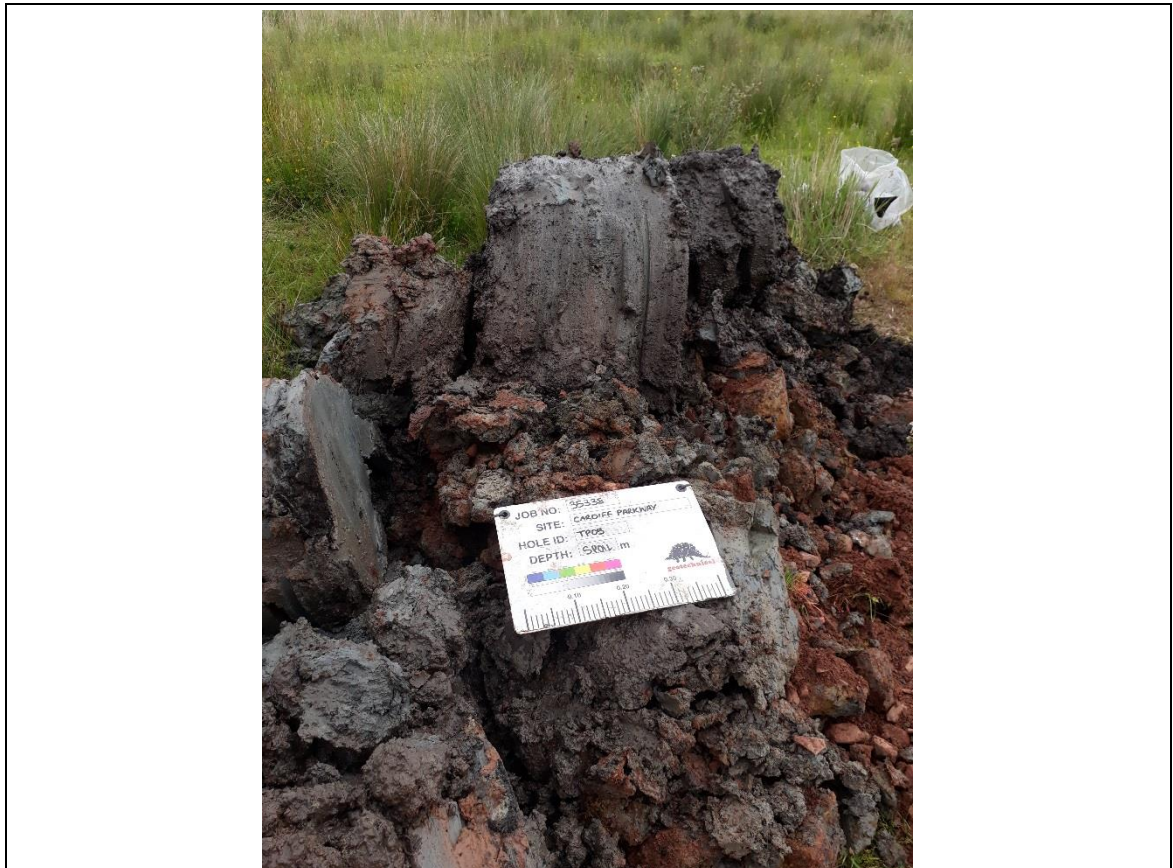


Trial Pit: TP05



Trial Pit: TP05





Trial Pit: TP05



Trial Pit: TP06





Trial Pit: TP06



Trial Pit: TP06





Trial Pit: TP07



Trial Pit: TP07





Trial Pit: TP07



Trial Pit: TP08





Trial Pit: TP08



Trial Pit: TP08





Trial Pit: TP09



Trial Pit: TP09





Trial Pit: TP09



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# **APPENDIX D**

## **LABORATORY TESTING**



2718



GEOTECHNICAL ENGINEERING LIMITED

For the attention of Edward Crimp/James Taylor

Version No. 3

Page No. 1 of 36


Date of Issue 13/08/2019

**TEST REPORT**

PROJECT/SITE	CARDIFF PARKWAY INITIAL GROUND INVESTIGATION	Samples received	24/06/2019
GEL REPORT NUMBER	35338	Schedule received	24/06/2019
Your ref/PO:		Testing commenced	26/06/2019
Test report refers to	Schedule A	Status	Final

**SUMMARY OF RESULTS ATTACHED**

TEST METHOD & DESCRIPTION	QUANTITY	ACCREDITED TEST
BS EN ISO 17892-1: 2014:5. Water Content	10	YES
BS1377: Part 2: 1990:4.2-4.4&5.2-5.4, Liquid & Plastic Limits	9	YES
BS EN ISO 17892-4: 2016: 5.2, Particle Size Distribution - Wet Sieve	7	YES
BS EN ISO 17892-4: 2016: 5.4, Particle Size Distribution - Pipette	6	YES
BS1377: Part 5: 1990:3, Consolidation	2	YES
BS1377: Part 7: 1990:8&9, Undrained Triaxial Compression	3	YES
ISRM: 2007: Point Load Strength Test	3	YES
Organic Matter Content (Subcontracted)	3	YES
BRE SD1 Suite (Subcontracted)	6	YES/NO

Remarks This report may not be partially reproduced without written permission from this laboratory.	Approved Signatories: <b>W Jones (Laboratory Manager)</b> E Crimp (Senior Engineer) J Hanson (Director) N Parry (Director) 
---	--

Doc TR01 Rev No. 20 Revision date 09/10/17 DC:JH

**Geotechnical Engineering Ltd**

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Gloucester GL2 4NF

**www.geoeng.co.uk**

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TEL: 01452 527743  
Fax: 01452 729314

Registered number: 00700739

VAT Number: 682 5857 89

Payments: Geotechnical Engineering Limited

Sort code: 16-22-11 Bank account: 11125135



**LIQUID AND PLASTIC LIMITS**

BS.1377 : PART 2 : 1990 : 4 and 5



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	sample		specimen depth (m)	natural water content (%)	specimen preparation and test method	fraction >0.425 mm (%)	liquid limit (%)	plastic limit (%)	plasticity index (%)	description and remarks		
	no./type	depth (m)										
BH01	3B	1.00	1.00	22.5	BXE	13	31	20	11	Orangish brown slightly gravelly slightly sandy silty CLAY		
BH01	7UT	2.20	2.20	13.2	BXE	31	23	NP		Brown silty very gravelly SAND		
BH01	12UT	4.20	4.55	14.9	BXE	48	26	16	10	Brown slightly sandy gravelly silty CLAY		
BH02	2B	0.60	0.60	31.9	BXE	0	65	25	40	Greyish brown slightly sandy silty CLAY		
BH02	7UT	2.20	2.45	65.9	BXE	1	59	27	32	Greyish brown slightly sandy silty organic CLAY with rare wood fragments		
BH02	21D	6.20	6.20	12.6	BXE	26	26	15	11	Reddish brown slightly sandy slightly gravelly silty CLAY		
BH03	4D	0.60	0.60	32.9	E					Grey and brown mottled orange slightly gravelly slightly sandy silty CLAY		
BH03	7UT	1.20	1.50	18.4	BXE	11	38	18	20	Brown mottled grey slightly gravelly slightly sandy silty CLAY		
BH03	14UT	3.20	3.45	14.0	BXE	19	23	15	8	Brown mottled grey slightly gravelly sandy silty CLAY		
BH03	21D	4.80	4.80	8.8	BXE	28	33	19	14	Purplish brown mottled grey slightly sandy slightly gravelly silty CLAY		
general remarks natural water content determined in accordance with BS EN ISO 17892 - 1 : 2014 (unless specified) NP denotes non plastic # denotes sample tested is smaller than that which is recommended in accordance with BS1377 or BS EN ISO 17892												
specimen preparation A - as received B - washed on 0.425mm sieve C - air dried D - oven dried (60°C) E - oven dried (105°C) F - not known										test method X - cone penetrometer (test 4.3) Y - cone penetrometer (test 4.4) Z - casagrande apparatus (test 4.5)	CONTRACT  35338	CHECKED  TB

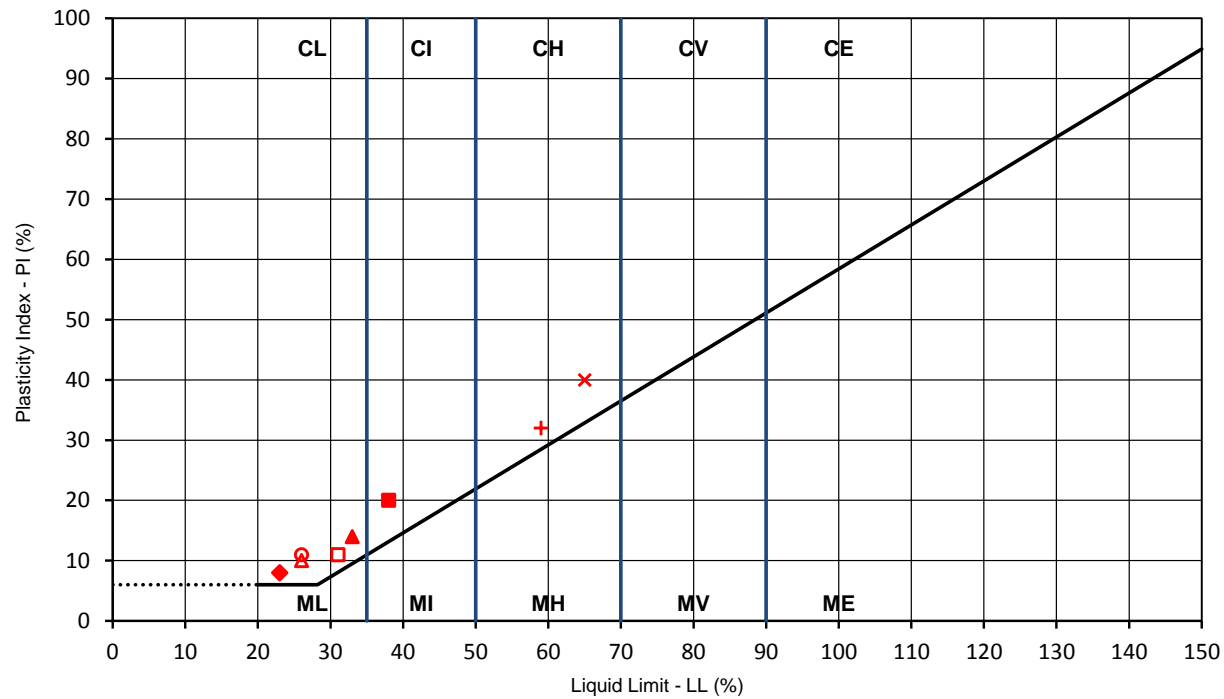
Geotechnical Engineering Limited

# ATTERBERG LINE PLOT



CLIENT    CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE        CARDIFF PARKWAY INITIAL GROUND INVESTIGATION



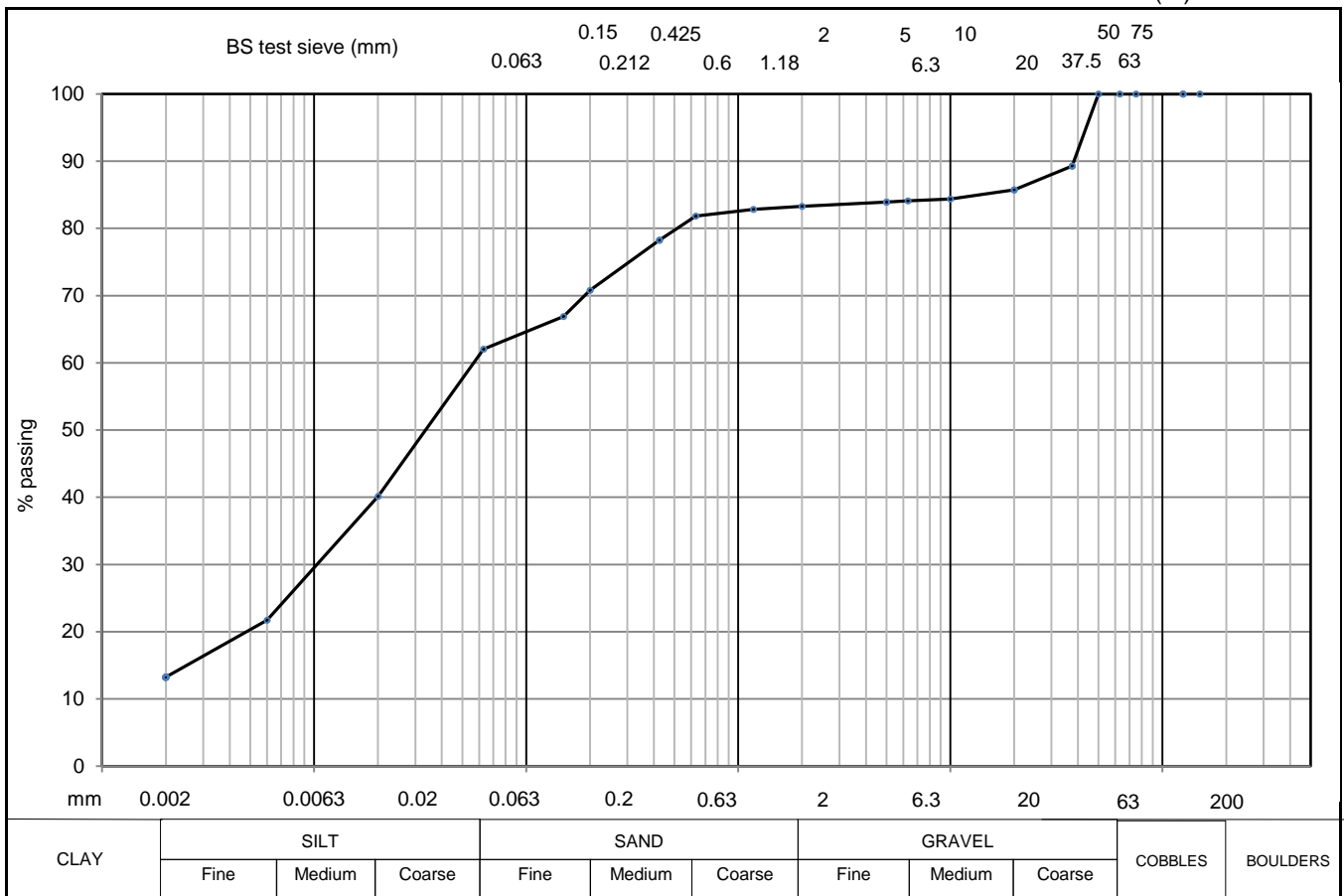
	BH/TP No.	depth (m)	LL	PL	PI	remarks
□	BH01	1.00	31	20	11	
	BH01	2.20	23	NP		
△	BH01	4.55	26	16	10	
×	BH02	0.60	65	25	40	
+	BH02	2.45	59	27	32	
○	BH02	6.20	26	15	11	
■	BH03	1.50	38	18	20	
◆	BH03	3.45	23	15	8	
▲	BH03	4.80	33	19	14	

CONTRACT	CHECKED
35338	TB



CLIENT	CARDIFF PARKWAY DEVELOPMENTS LIMITED
SITE	CARDIFF PARKWAY INITIAL GROUND INVESTIGATION
DESCRIPTION	Orangish brown slightly gravelly slightly sandy silty CLAY

BH/TP No.	BH01
SAMPLE No./TYPE	3B
SAMPLE DEPTH (m)	1.00
SPECIMEN TOP (m)	1.00
SPECIMEN BASE (m)	1.20



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY	13						
SILT	49	150		5	84	20	40
SILT & CLAY	62						
SAND	21	75		2	83	6	22
GRAVEL	17						
COBBLE & BOULDER	0	63		1.18	83	2	13
test method(s)	5.2 & 5.4	50	100	0.63	82		
test method		37.5	89	0.425	78		
5.2 - sieving		20	86	0.2	71		
5.3 - sedimentation by hydrometer		10	84	0.15	67		
5.4 - sedimentation by pipette		6.3	84	0.063	62		
remarks # denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m <sup>3</sup>						CONTRACT	CHECKED
						<b>35338</b>	<b>TB</b>



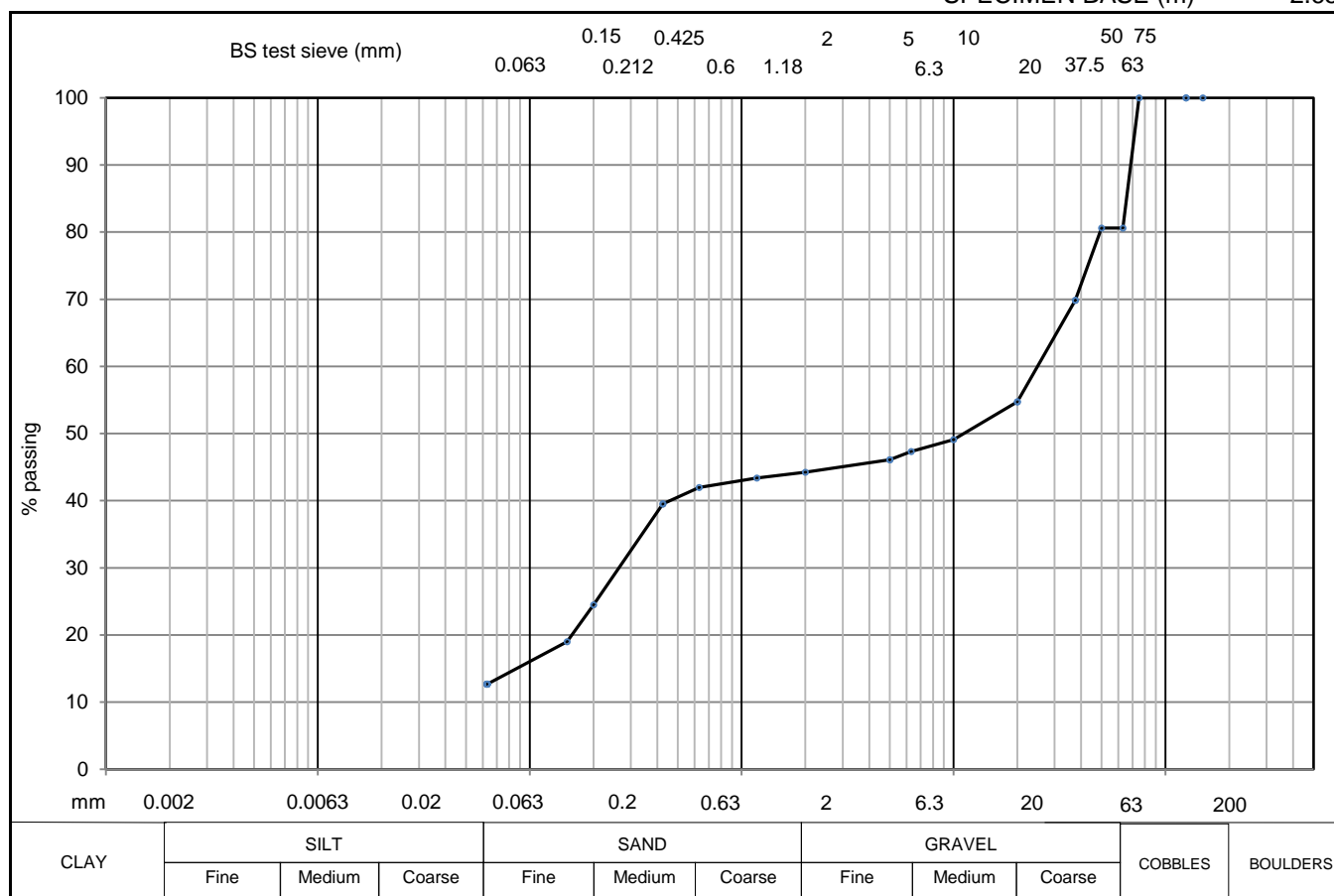
BH/TP No. BH01

SAMPLE No./TYPE 7UT

SAMPLE DEPTH (m) 2.20

SPECIMEN TOP (m) 2.20

SPECIMEN BASE (m) 2.65



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
CLAY	13	150	100	5	46	20	
SILT							
SILT & CLAY							
SAND							
GRAVEL							
COBBLE & BOULDER	32	75	81	2	44	6	
	36						
	19	63	81	1.18	43	2	
test method(s)	5.2	50	81	0.63	42		
test method		37.5	70	0.425	39		
5.2 - sieving		20	55	0.2	24		
5.3 - sedimentation by hydrometer		10	49	0.15	19		
5.4 - sedimentation by pipette		6.3	47	0.063	13		
remarks						CONTRACT	CHECKED
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892						35338	TB
Particle density assigned an assumed value of 2.70 Mg/m3							



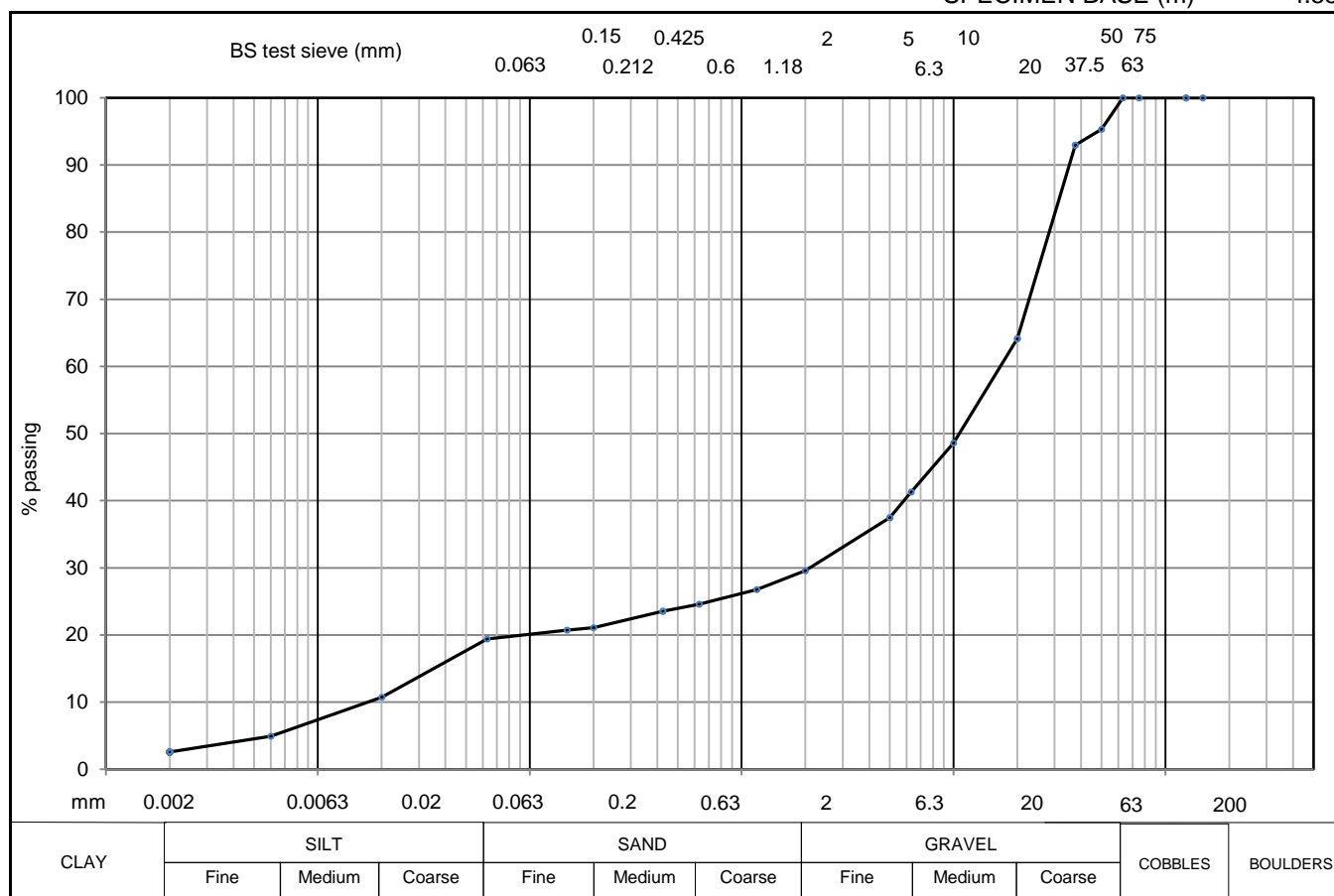
BH/TP No. BH01

SAMPLE No./TYPE 12UT

SAMPLE DEPTH (m) 4.20

SPECIMEN TOP (m) 4.20

SPECIMEN BASE (m) 4.55



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer		
CLAY	3	150	100	5	37	20	11		
SILT	17								
SILT & CLAY	19								
SAND	10								
GRAVEL	70								
COBBLE & BOULDER	0	63	27	1.18	2	3			
test method(s)	5.2 & 5.4	50					95	0.63	25
test method		37.5					93	0.425	24
5.2 - sieving		20					64	0.2	21
5.3 - sedimentation by hydrometer		10					49	0.15	21
5.4 - sedimentation by pipette		6.3					41	0.063	19
remarks							CONTRACT	CHECKED	
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3						35338	TB		

**PARTICLE SIZE DISTRIBUTION**

BS EN ISO 17892 - 4 : 2016 : 5



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH02

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

7UT

DESCRIPTION Greyish brown slightly sandy silty organic CLAY

SAMPLE DEPTH (m)

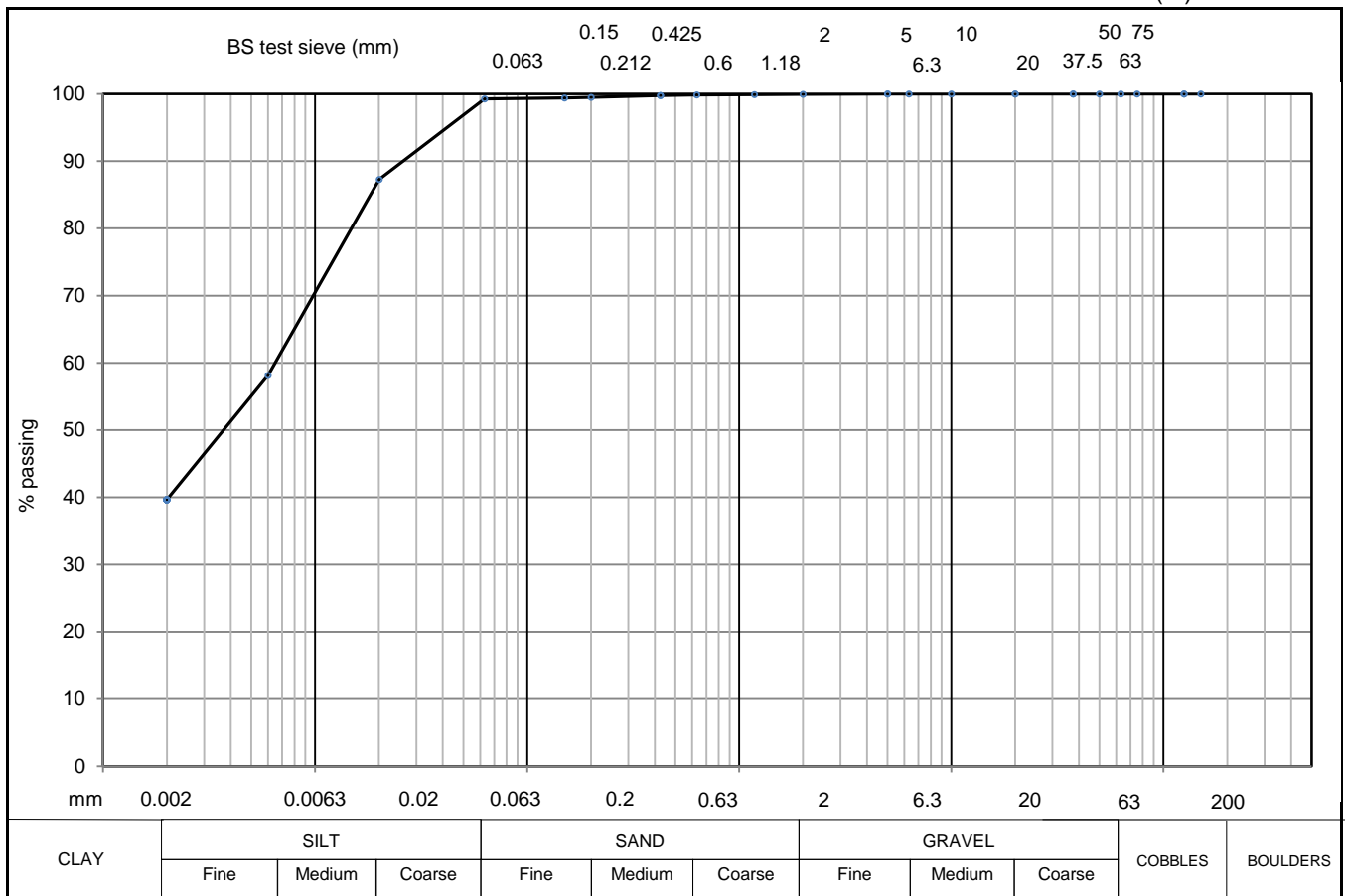
2.20

SPECIMEN TOP (m)

2.47

SPECIMEN BASE (m)

2.50



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY	40						
SILT	60	150		5	100	20	87
SILT & CLAY	99						
SAND	1	75		2	100	6	58
GRAVEL	0						
COBBLE & BOULDER	0	63		1.18	100	2	40
test method(s)	5.2 & 5.4	50		0.63	100		
test method		37.5		0.425	100		
5.2 - sieving		20		0.2	99		
5.3 - sedimentation by hydrometer		10		0.15	99		
5.4 - sedimentation by pipette		6.3		0.063	99		
remarks	# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3					CONTRACT	CHECKED
						35338	TB

**PARTICLE SIZE DISTRIBUTION**

BS EN ISO 17892 - 4 : 2016 : 5



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH02

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

17L

DESCRIPTION Brown very clayey very sandy GRAVEL with medium cobble content

SAMPLE DEPTH (m)

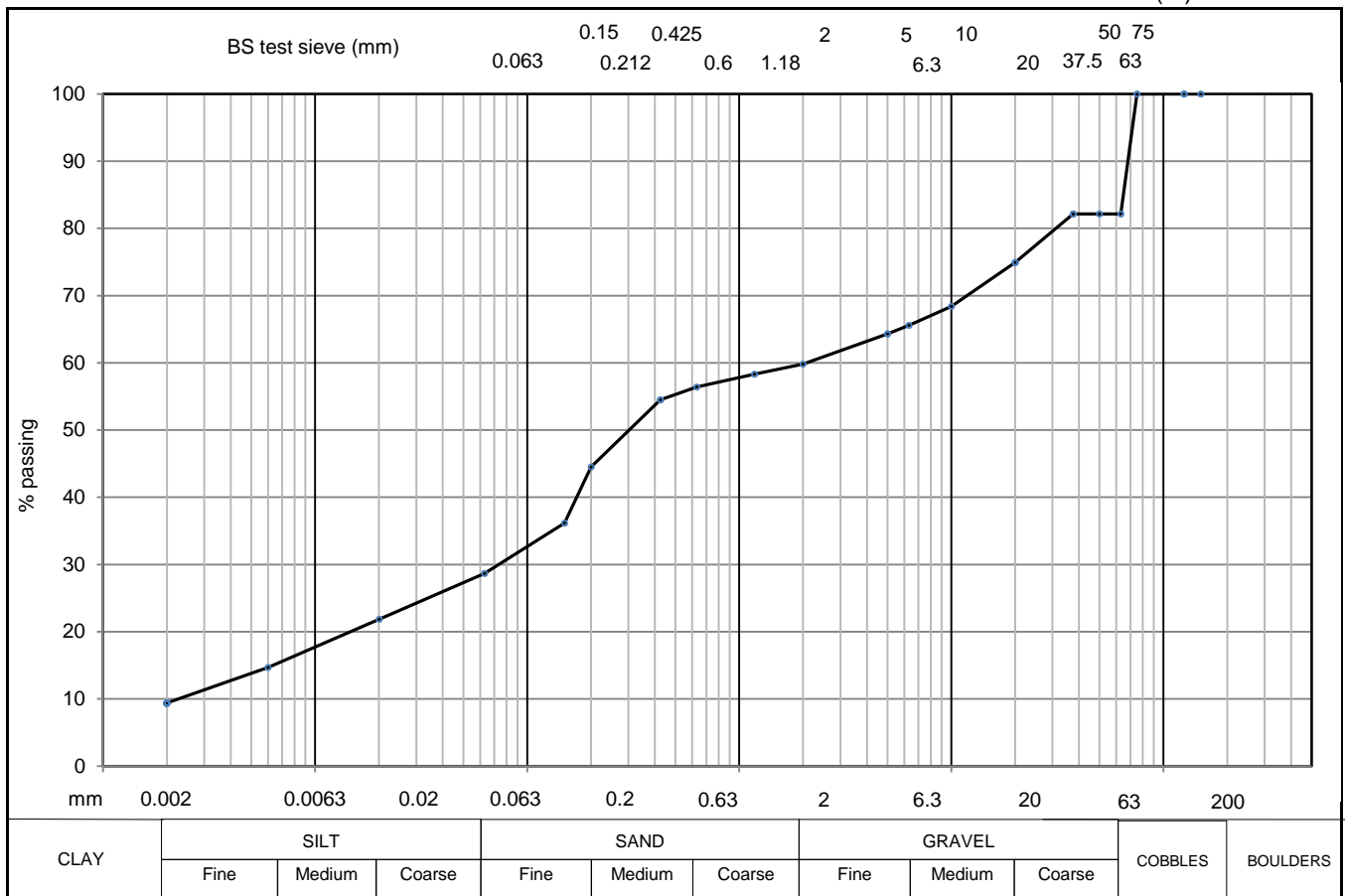
4.50

SPECIMEN TOP (m)

4.50

SPECIMEN BASE (m)

5.30



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY	9						
SILT	19	150		5	64	20	22
SILT & CLAY	29						
SAND	31	75	100	2	60	6	15
GRAVEL	22						
COBBLE & BOULDER	18	63	82	1.18	58	2	9
test method(s)	5.2 & 5.4	50	82	0.63	56		
test method		37.5	82	0.425	55		
5.2 - sieving		20	75	0.2	45		
5.3 - sedimentation by hydrometer		10	68	0.15	36		
5.4 - sedimentation by pipette		6.3	66	0.063	29		
remarks	# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3					CONTRACT	CHECKED
						35338	TB



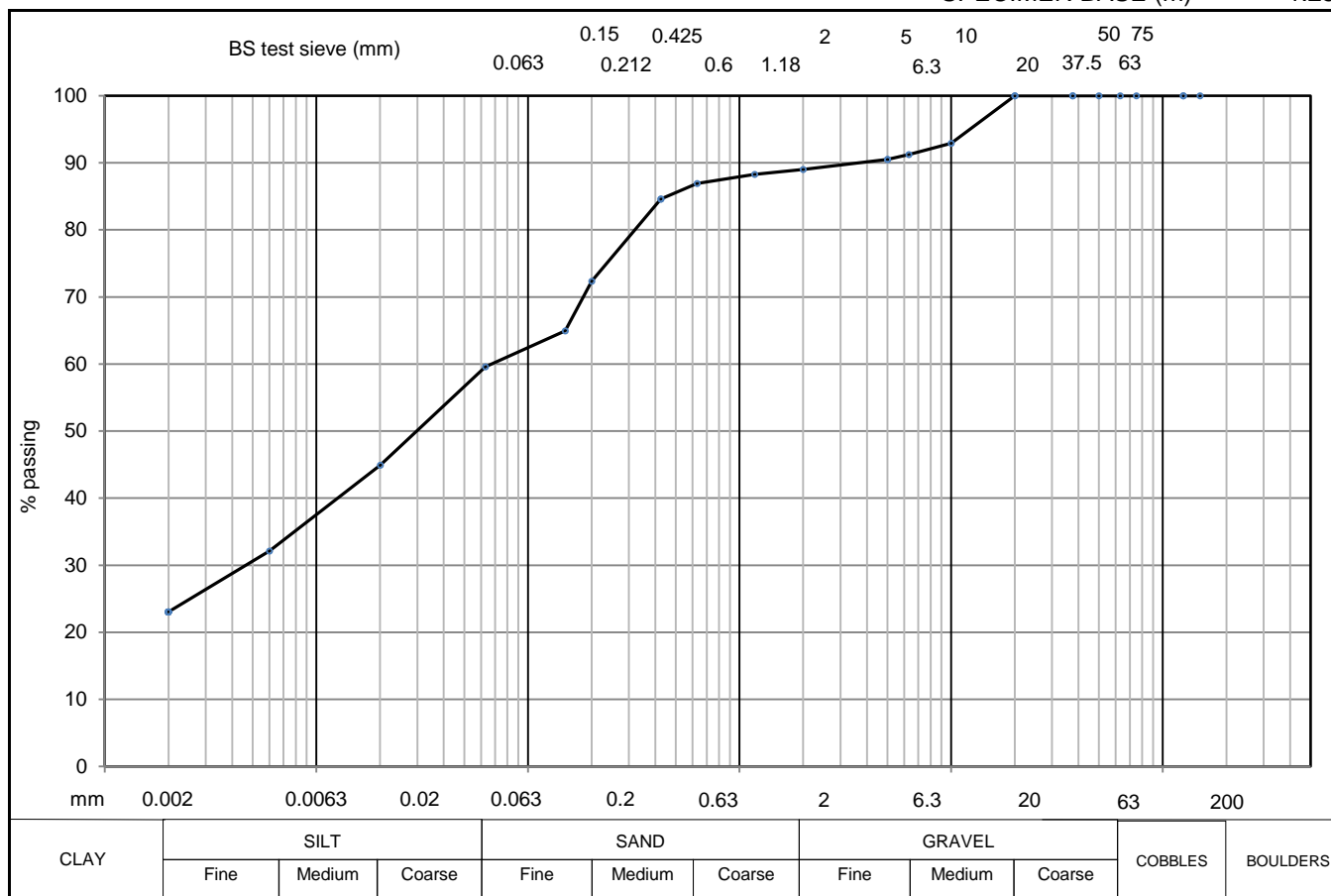
BH/TP No. BH03

SAMPLE No./TYPE 7UT

SAMPLE DEPTH (m) 1.20

SPECIMEN TOP (m) 1.20

SPECIMEN BASE (m) 1.25

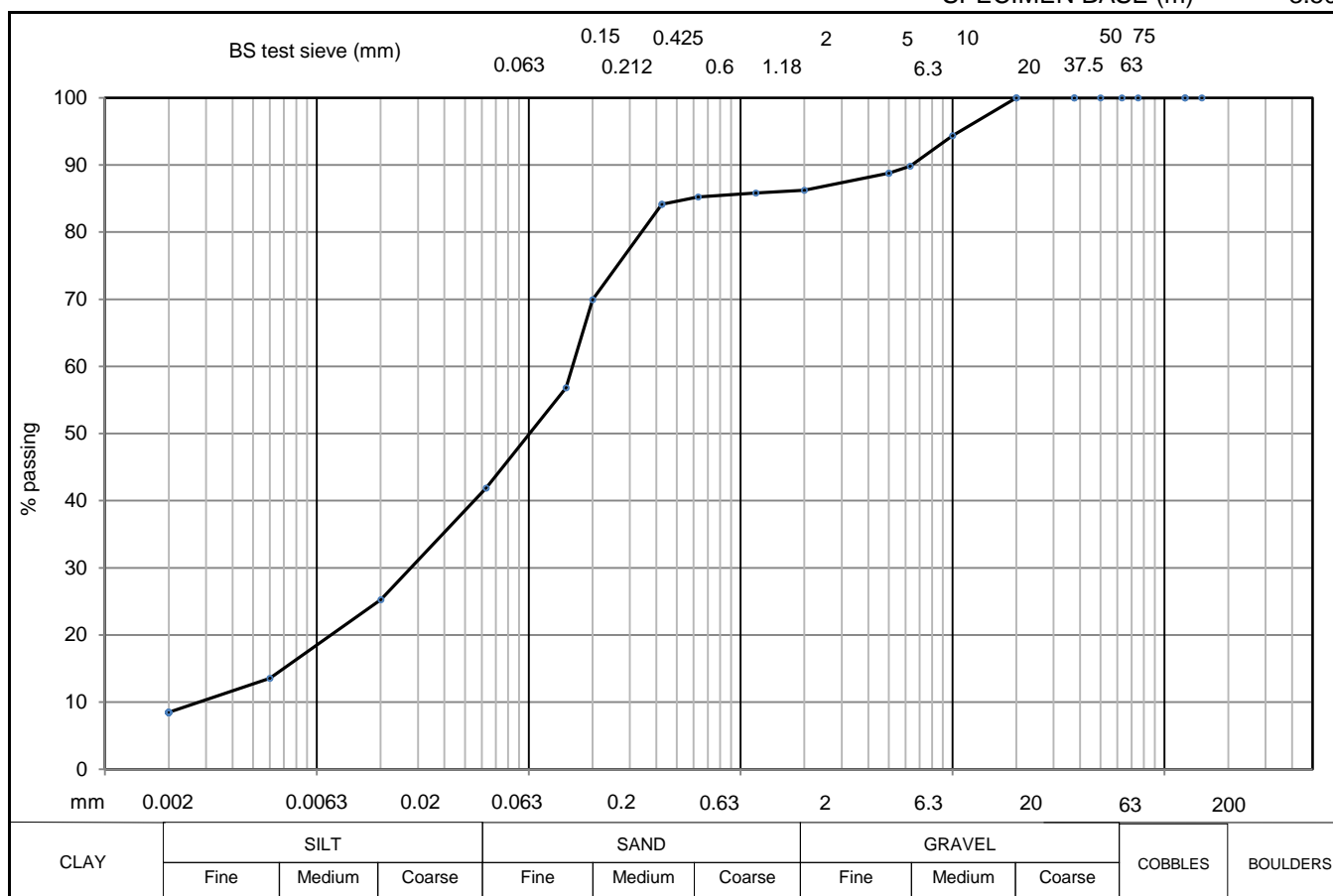


soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY	23	150		5	90	20	45
SILT	37						
SILT & CLAY	60						
SAND	29						
GRAVEL	11						
COBBLE & BOULDER	0	75		2	89	6	32
test method(s)	5.2 & 5.4	63		1.18	88	2	23
test method		50		0.63	87		
5.2 - sieving		37.5	100	0.425	85		
5.3 - sedimentation by hydrometer		20		0.2	72		
5.4 - sedimentation by pipette		10	93	0.15	65		
		6.3	91	0.063	60		
remarks # denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3						CONTRACT  <b>35338</b>	CHECKED  <b>TB</b>





BH/TP No.	BH03
SAMPLE No./TYPE	14UT
SAMPLE DEPTH (m)	3.20
SPECIMEN TOP (m)	3.47
SPECIMEN BASE (m)	3.50



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
CLAY	9	150		5	89	20	25
SILT	33						
SILT & CLAY	42						
SAND	44						
GRAVEL	14						
COBBLE & BOULDER	0	75		2	86	6	14
test method(s)	5.2 & 5.4	63		1.18	86	2	8
test method		50		0.63	85		
5.2 - sieving		37.5		0.425	84		
5.3 - sedimentation by hydrometer		20	100	0.2	70		
5.4 - sedimentation by pipette		10	94	0.15	57		
		6.3	90	0.063	42		
remarks # denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3						CONTRACT  <b>35338</b>	CHECKED  <b>TB</b>

**DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES****BS.1377 : Part 5 : 1990 : 3**

CLIENT    CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH02

SITE        CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

7UT

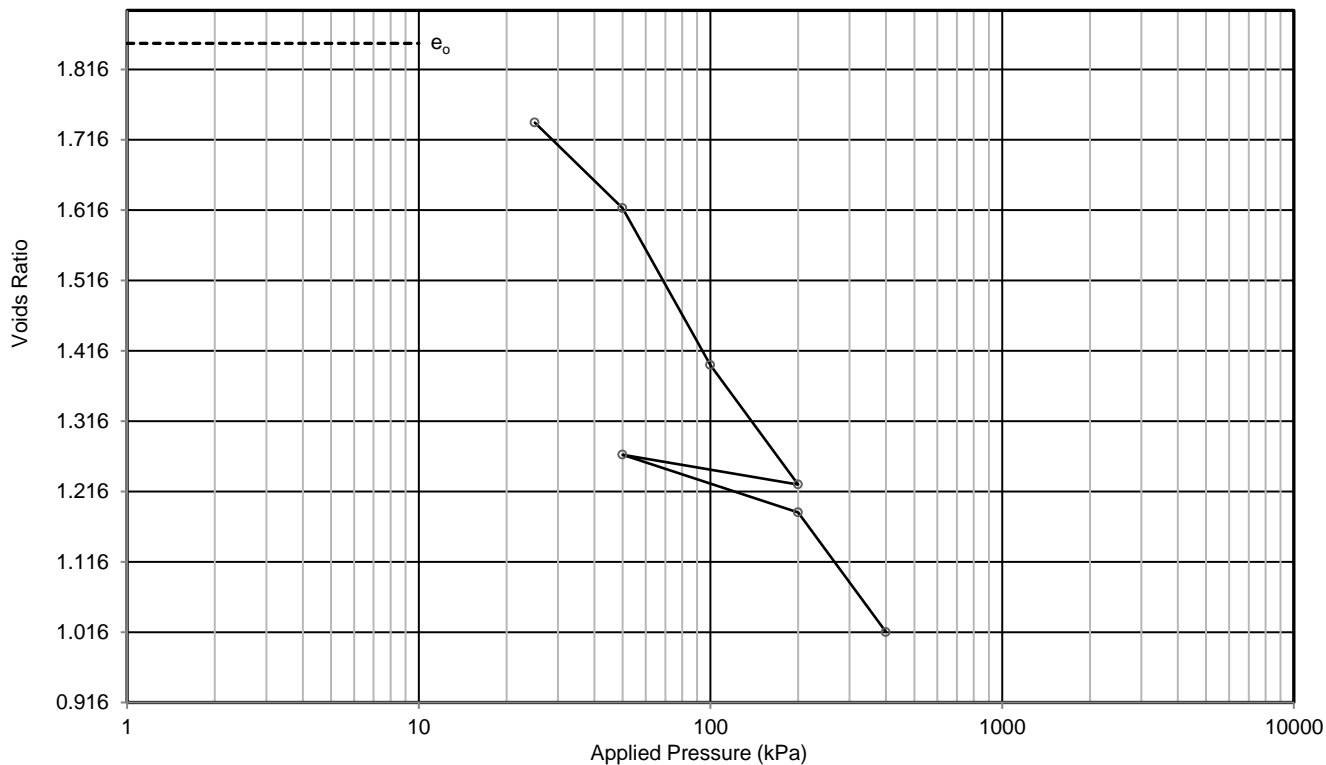
DESCRIPTION    Greyish brown slightly organic CLAY with rare wood fragments

SAMPLE DEPTH (m)

2.20

SPECIMEN DEPTH (m)

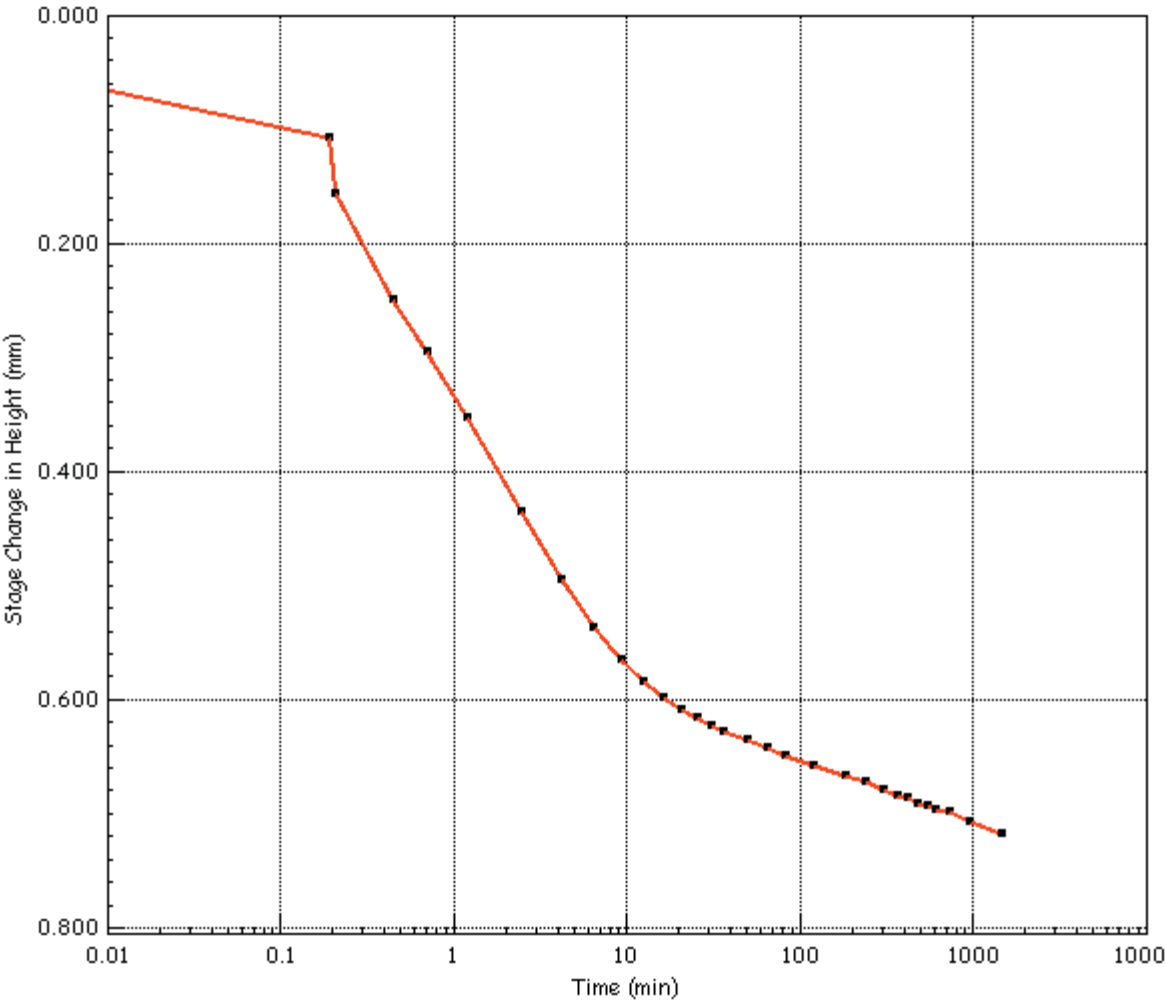
2.45




test and sample details			test results				
			pressure stage	voids ratio	laboratory coefficients of		
			(kPa)		compressibility mv (m <sup>2</sup> /MN)	consolidation Cv (m <sup>2</sup> /yr)	Csec (m <sup>2</sup> /yr)
specimen diameter	mm	63.55					
specimen height	mm	17.79					
initial moisture content	%	68.7					
final moisture content	%	40.7					
initial bulk density	Mg/m <sup>3</sup>	1.60	25	1.740	1.6	2.7	0.01
initial dry density	Mg/m <sup>3</sup>	0.95	50	1.619	1.8	0.56	
initial voids ratio		1.853	100	1.396	1.7	0.42	
initial degree of saturation	%	100	200	1.226	0.71	0.36	
particle density	Mg/m <sup>3</sup>	#2.70	50	1.268	0.13		
swelling pressure	kPa	N/A	200	1.186	0.24	1.2	
			400	1.016	0.39	0.34	
P'o to P'o +100 kPa		-					
laboratory temperature	oC	20 ± 2					
method of time fitting		root time					
remarks	# denotes particle density has been assigned an assumed value load frame corrections applied				CONTRACT	CHECKED	
					35338	TB	

# Oedometer Consolidation Settlement Report

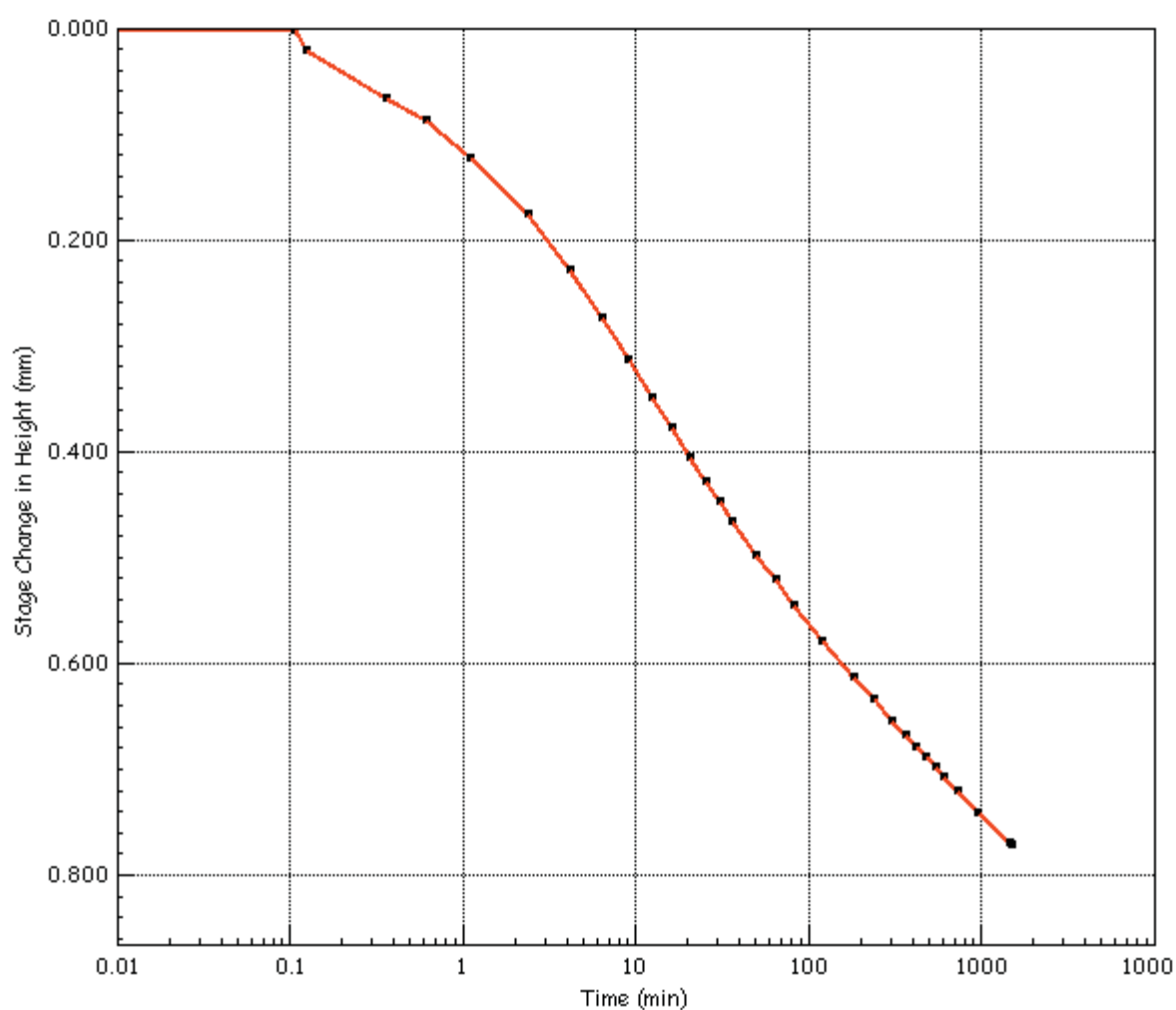
Vertical Stress	$\sigma'_i$	(kPa)	25
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.014
Height Settlement	$\Delta L_s$	(mm)	0.703
Voids Ratio	$e_f$	.	-0.163




	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 7	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	01/07/2019	
	Client	CARDFF PARKWAY		Sample	7UT	
	Operator	TA/JT/JG	Checked	*	Approved	*
Borehole BH02						

# Oedometer Consolidation Settlement Report

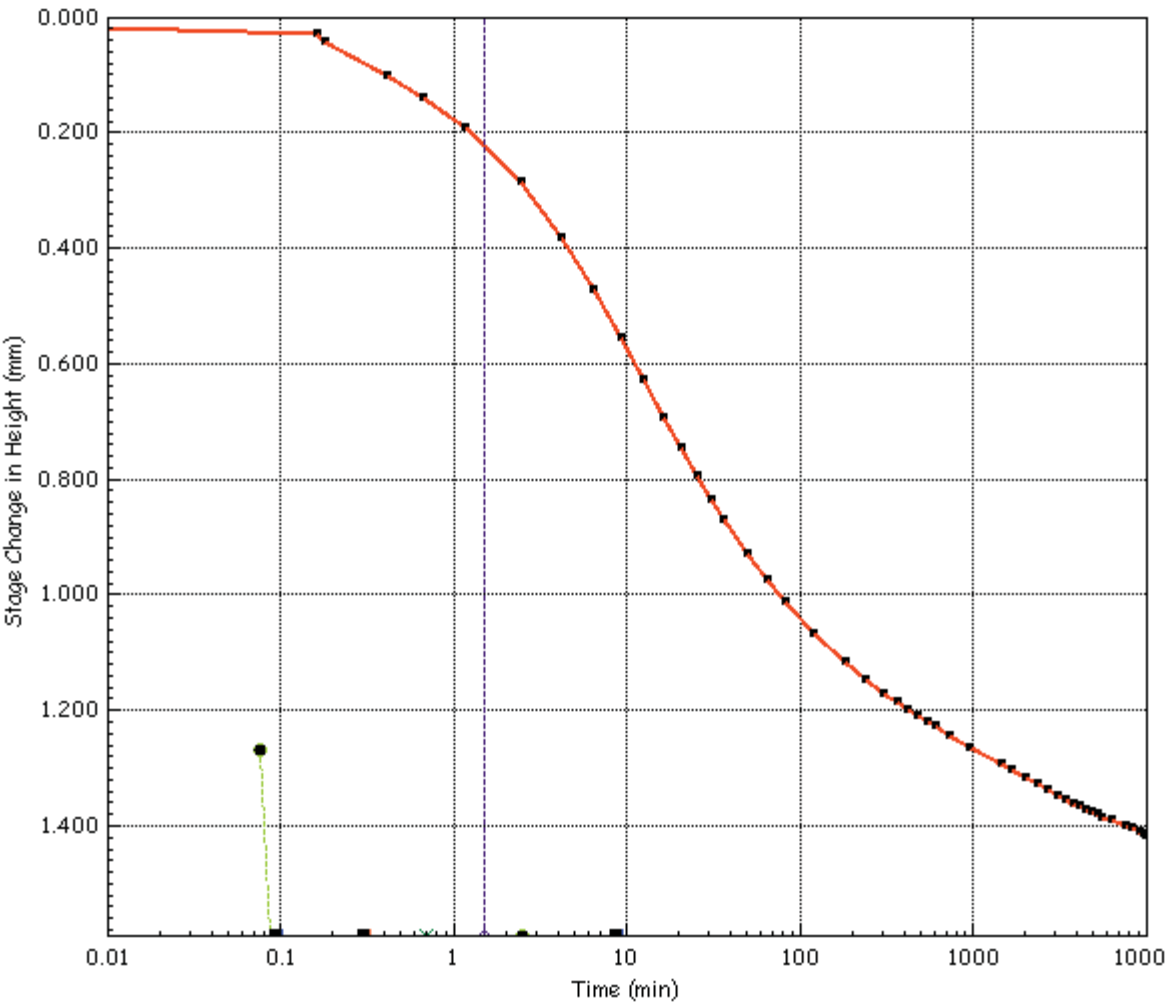
Vertical Stress	$\sigma'_i$	(kPa)	50
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.026
Height Settlement	$\Delta L_s$	(mm)	1.462
Voids Ratio	$e_f$	.	-0.196




	Test Method	BS1377 - 5 : 1990 : Clause 3	Test Name	FRAME 7
	Site Reference		Database:	.\SQLEXPRESS \ GEL
	Jobfile	35338	Test Date	01/07/2019
	Client	CARDDFF PARKWAY	Sample	7UT
	Operator	TA/JT/JG	Borehole	BH02
Checked			*	Approved
				*

# Oedometer Consolidation Settlement Report

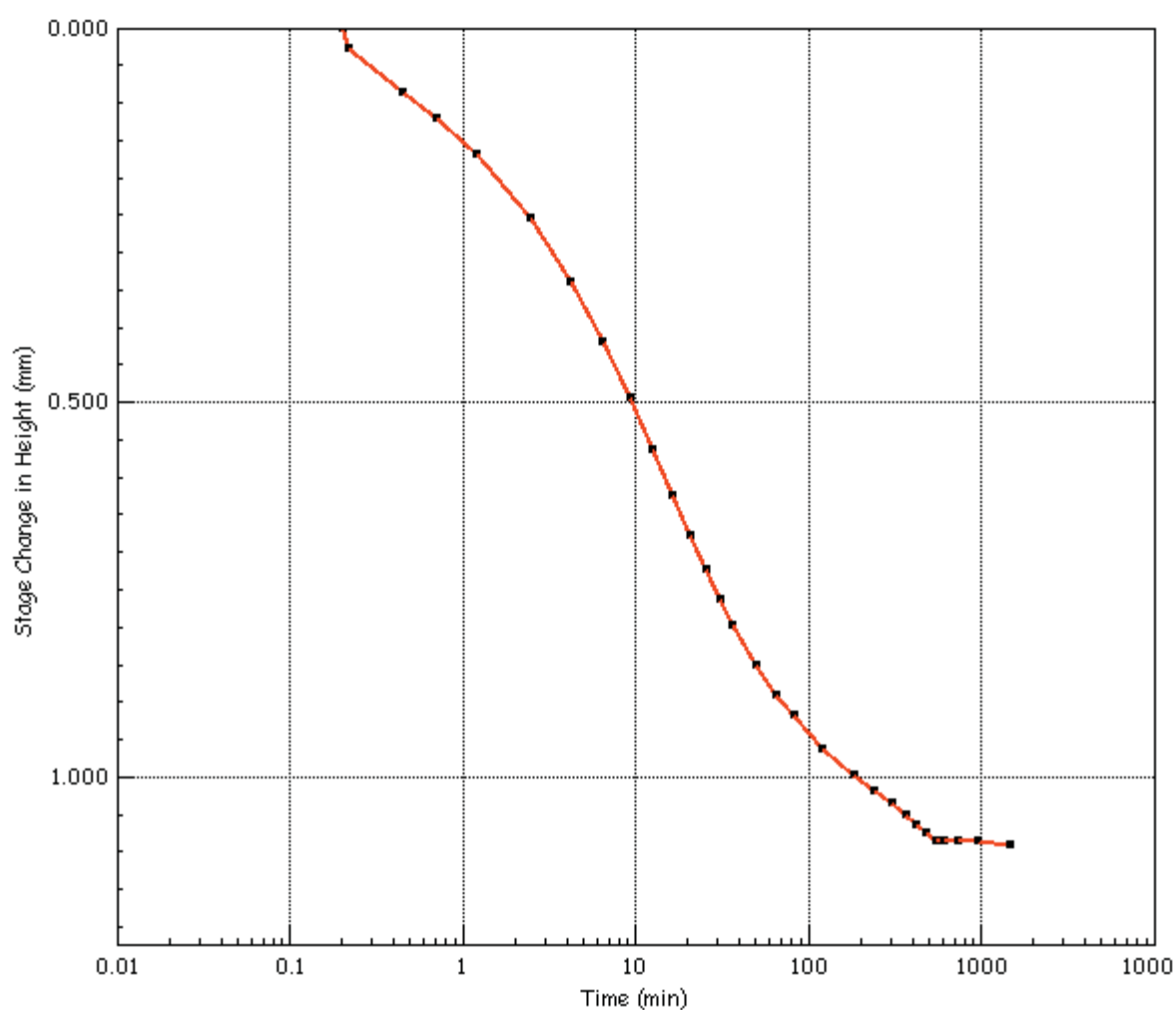
Vertical Stress	$\sigma'_{i1}$	(kPa)	100
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.047
Height Settlement	$\Delta L_s$	(mm)	2.853
Voids Ratio	$e_f$	.	-0.256




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 7		
					Database:		.\SQLEXPRESS \ GEL		
	Site Reference				Test Date		01/07/2019		
	Jobfile		35338		Sample		7UT		
	Client		CARDFF PARKWAY		Borehole		BH02		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	

# Oedometer Consolidation Settlement Report

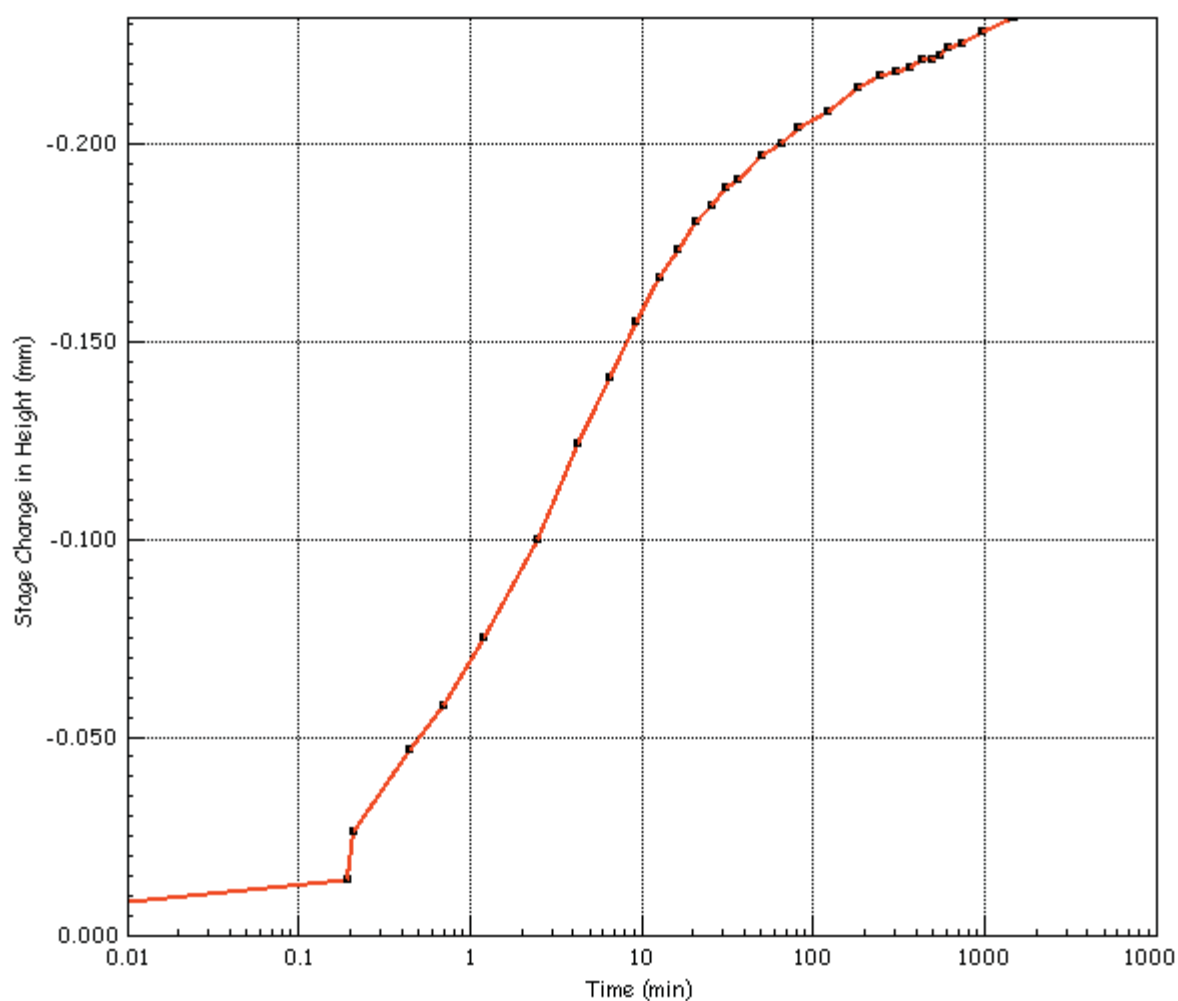
Vertical Stress	$\sigma'_{i1}$	(kPa)	200
Initial Temperature	$T_{i1}$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.078
Height Settlement	$\Delta L_s$	(mm)	3.912
Voids Ratio	$e_f$	.	-0.302




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 7		
					Database: .\SQLEXPRESS \ GEL				
	Site Reference				Test Date		01/07/2019		
	Jobfile		35338		Sample		7UT		
	Client		CARDFF PARKWAY		Borehole		BH02		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	

# Oedometer Consolidation Settlement Report

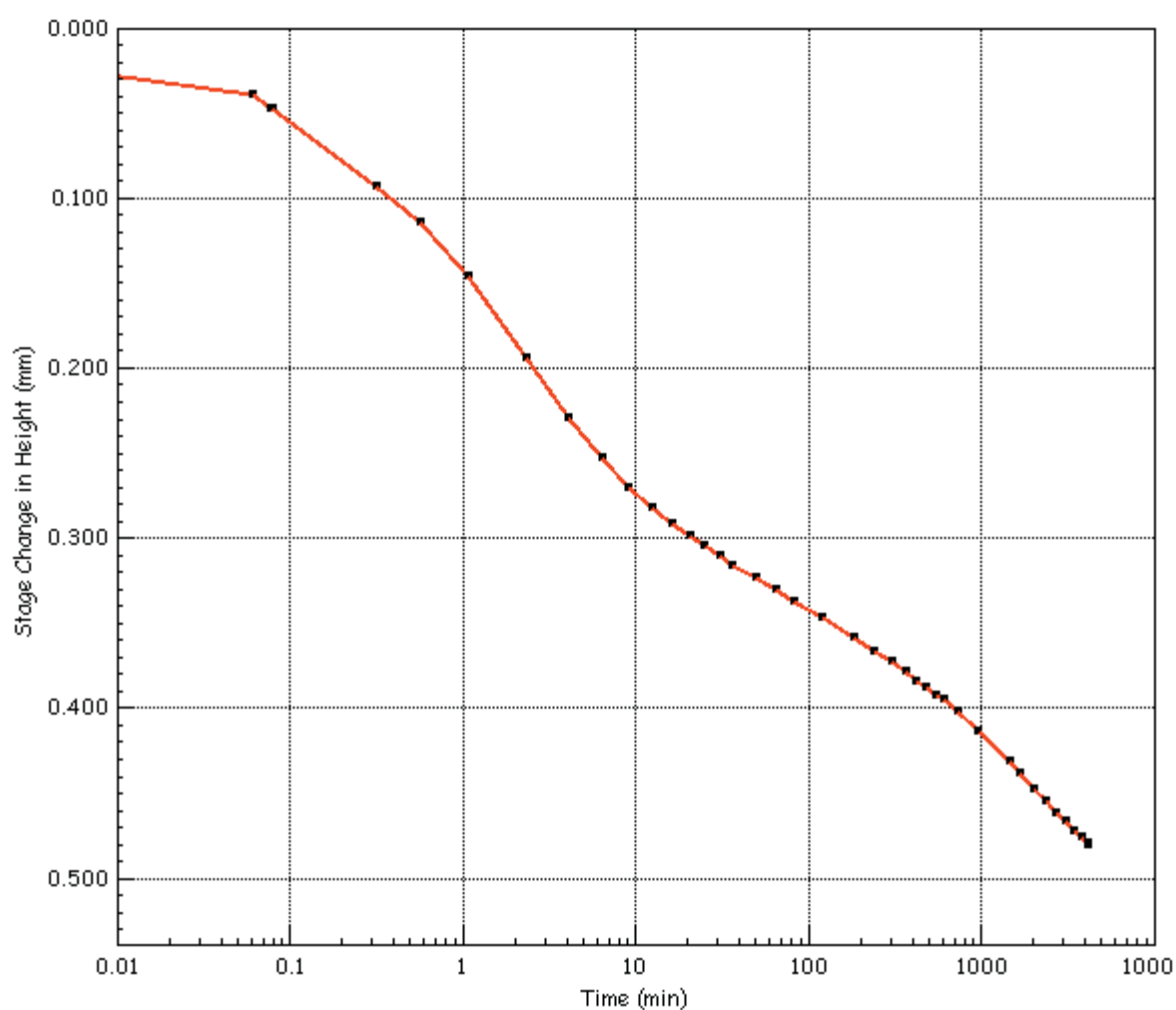
Vertical Stress	$\sigma'_i$	(kPa)	50
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.113
Height Settlement	$\Delta L_s$	(mm)	3.647
Voids Ratio	$e_f$	.	-0.291




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 7				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date				01/07/2019		
	Jobfile				Sample				7UT		
	Client				Borehole				BH02		
	CARDFF PARKWAY										
Operator		TA/JT/JG		Checked		*		Approved		*	

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	200
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.078
Height Settlement	$\Delta L_s$	(mm)	4.159
Voids Ratio	$e_f$	.	-0.313

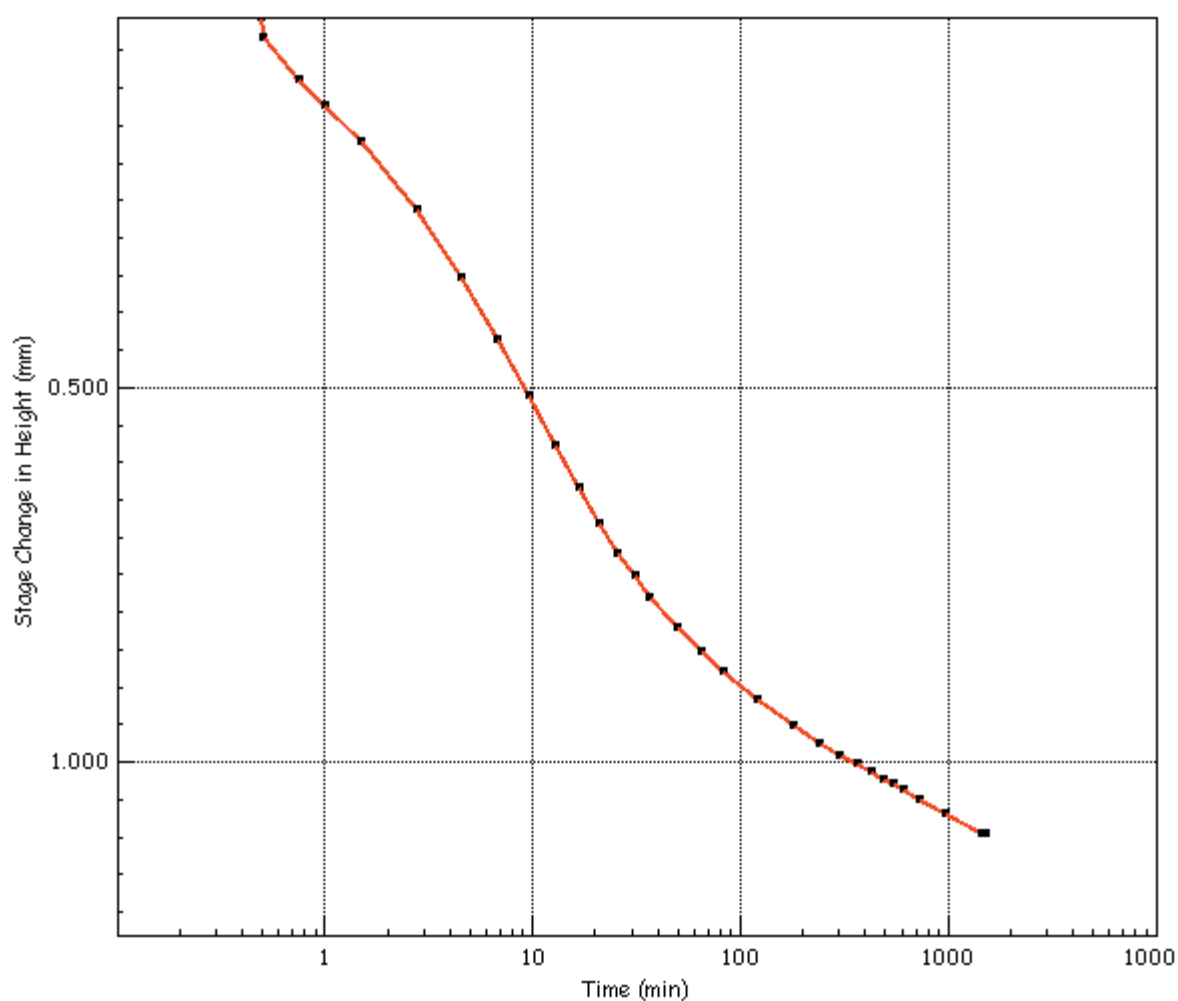



	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 7		
					Database: .\SQLEXPRESS \ GEL				
	Site Reference				Test Date		01/07/2019		
	Jobfile		35338		Sample		7UT		
	Client		CARDFF PARKWAY		Borehole		BH02		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	



# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	400
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.115
Height Settlement	$\Delta L_s$	(mm)	5.219
Voids Ratio	$e_f$	.	-0.359



	Test Method	BS1377 - 5 : 1990 : Clause 3	Test Name	FRAME 7
	Site Reference		Database:	.\SQLEXPRESS \ GEL
	Jobfile	35338	Test Date	01/07/2019
	Client	CARDDFF PARKWAY	Sample	7UT
	Operator	TA/JT/JG	Borehole	BH02
Operator		TA/JT/JG	Checked	*
			Approved	*

**DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES****BS.1377 : Part 5 : 1990 : 3**

CLIENT    CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH03

SITE        CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

7UT

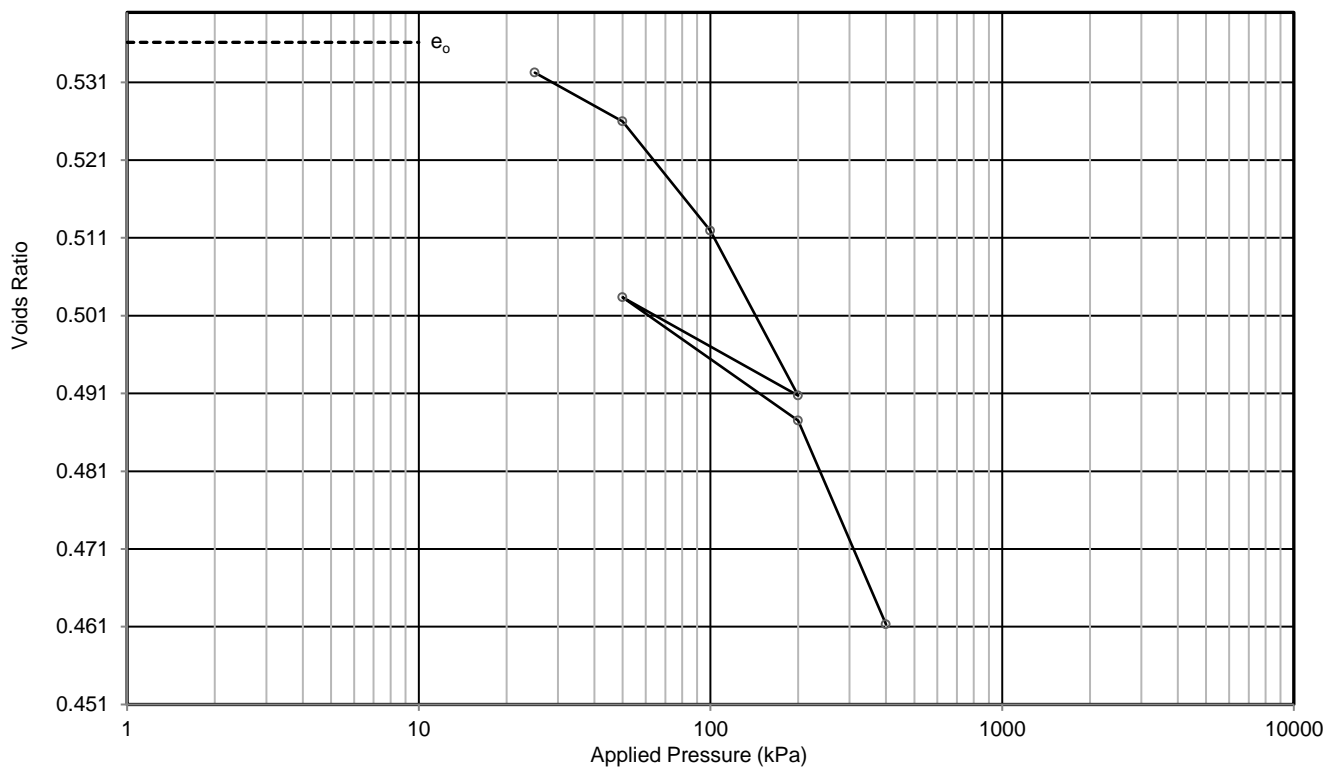
DESCRIPTION    Brown mottled grey slightly gravelly slightly sandy CLAY

SAMPLE DEPTH (m)

1.20

SPECIMEN DEPTH (m)

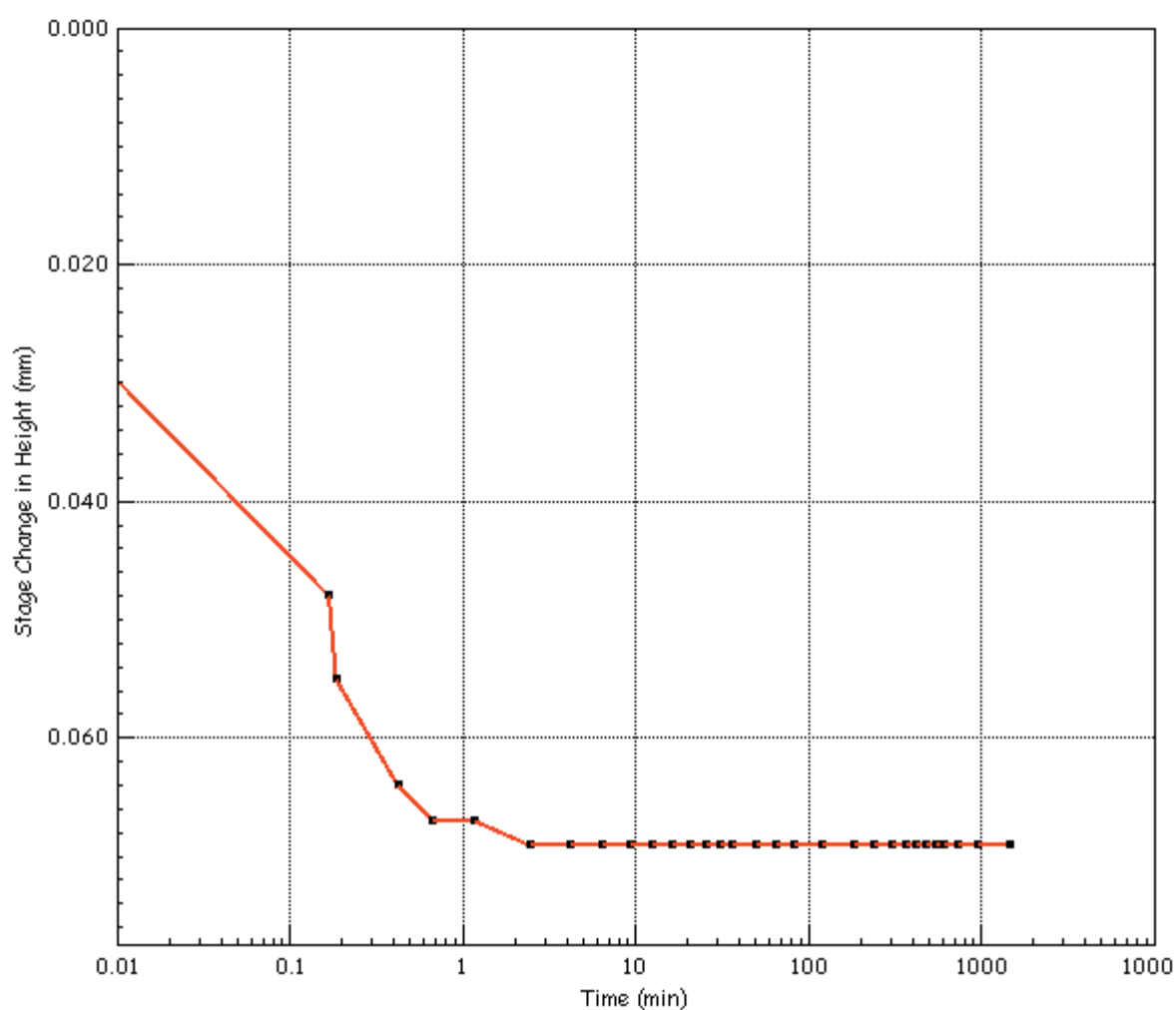
1.53




test and sample details			test results			
			pressure stage (kPa)	voids ratio	laboratory coefficients of compressibility $m_v$ ( $m^2/MN$ )	consolidation $C_v$ ( $m^2/yr$ )
specimen diameter	mm	63.49				
specimen height	mm	18.12				
initial moisture content	%	18.9				
final moisture content	%	18.6				
initial bulk density	$Mg/m^3$	2.09	25	0.532	0.10	8.7
initial dry density	$Mg/m^3$	1.76	50	0.526	0.16	3.9
initial voids ratio		0.536	100	0.512	0.18	2.7
initial degree of saturation	%	95	200	0.491	0.14	2.4
particle density	$Mg/m^3$	#2.70	50	0.503	0.056	
swelling pressure	kPa	N/A	200	0.487	0.070	2.5
			400	0.461	0.088	2.6
P'o to P'o +100 kPa		-				
laboratory temperature	$^{\circ}C$	$20 \pm 2$				
method of time fitting		root time				
remarks	# denotes particle density has been assigned an assumed value load frame corrections applied				CONTRACT <b>35338</b>	CHECKED <b>TB</b>

# Oedometer Consolidation Settlement Report

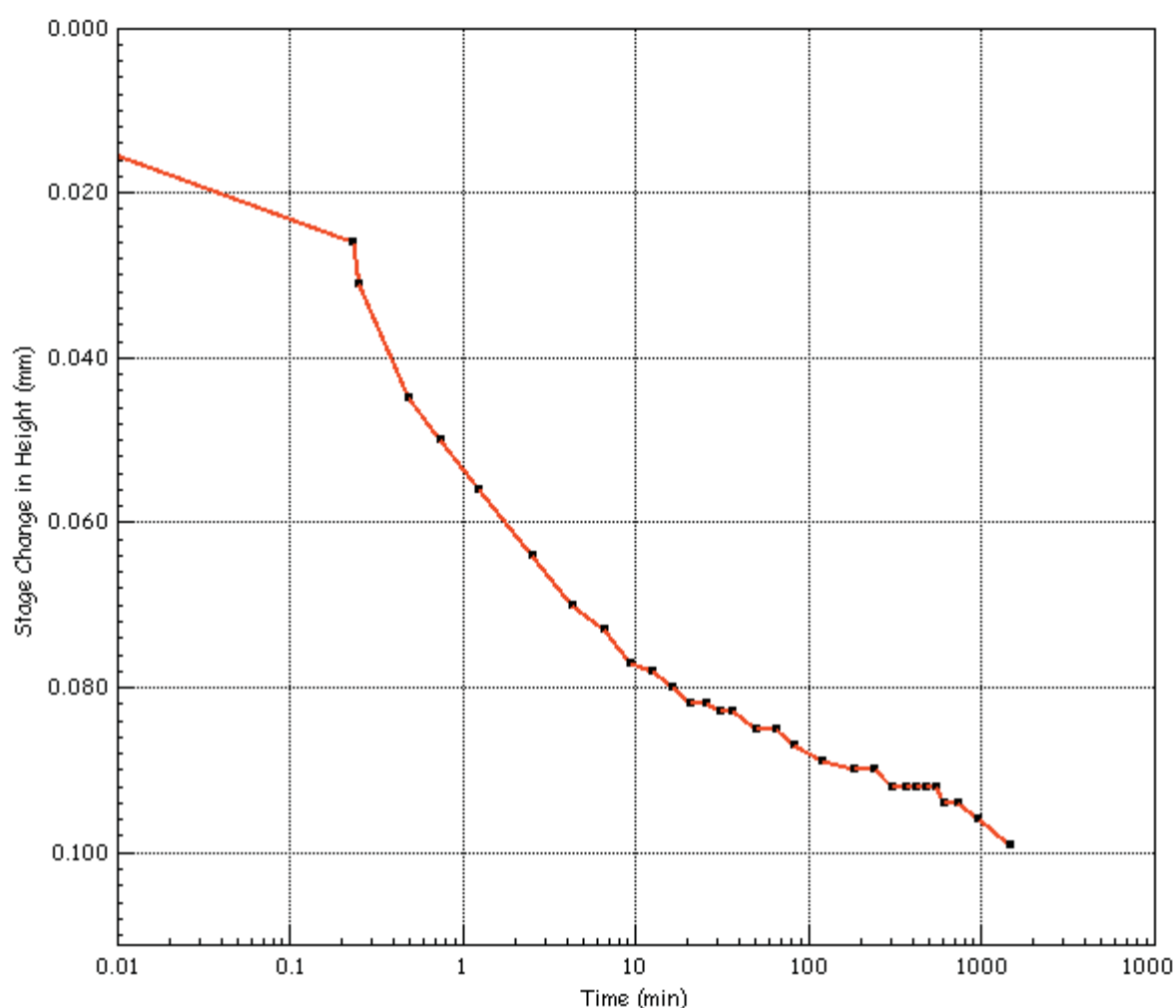
Vertical Stress	$\sigma'_i$	(kPa)	25
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.023
Height Settlement	$\Delta L_s$	(mm)	0.046
Voids Ratio	$e_f$	.	-0.135




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 9		
					Database: .\SQLEXPRESS \ GEL				
	Site Reference				Test Date		01/07/2019		
	Jobfile		35338		Sample		7UT		
	Client		CARDFF PARKWAY		Borehole		BH03		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	

# Oedometer Consolidation Settlement Report

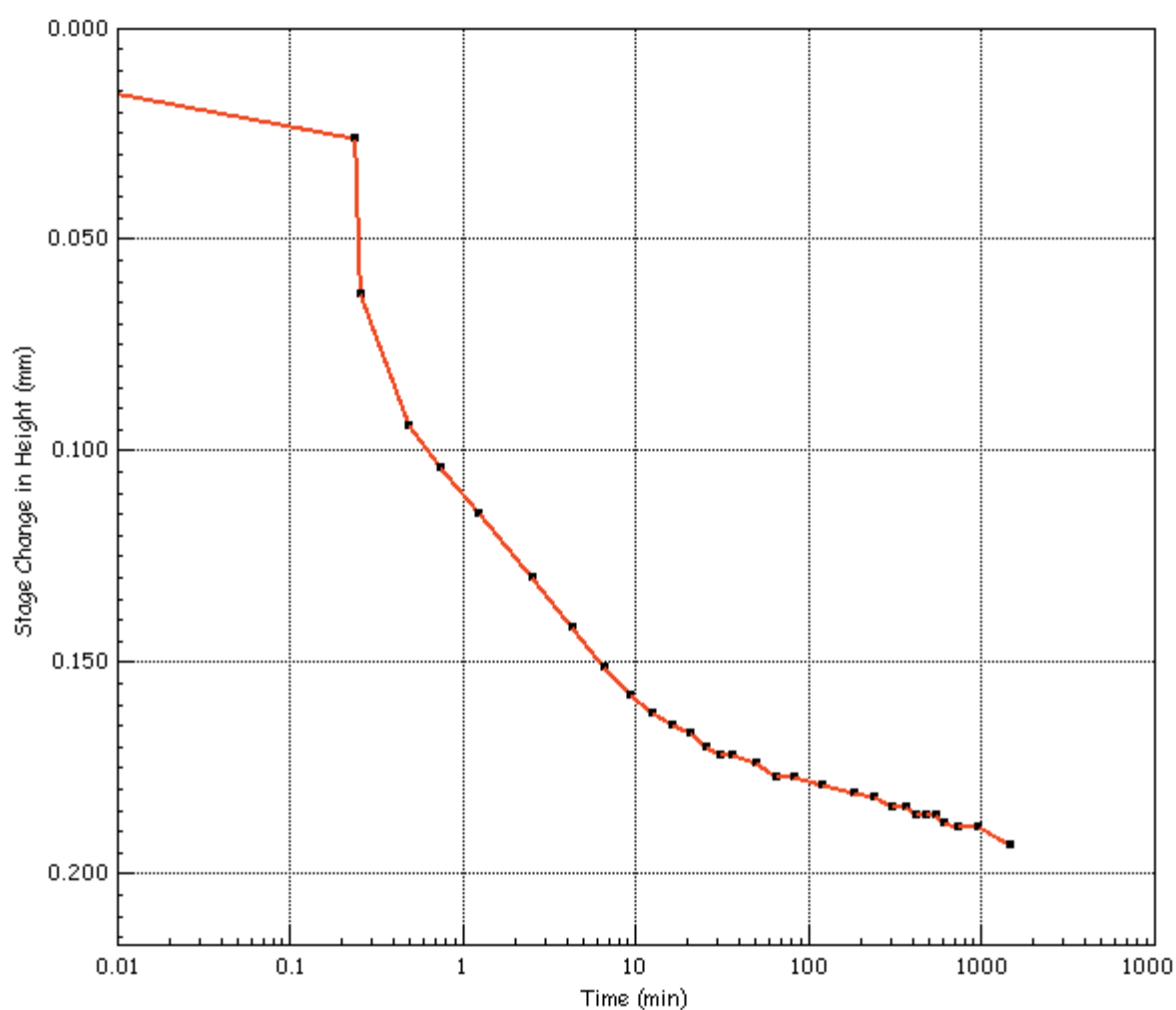
Vertical Stress	$\sigma'_i$	(kPa)	50
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.048
Height Settlement	$\Delta L_s$	(mm)	0.120
Voids Ratio	$e_f$	.	-0.138




	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 9	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	01/07/2019	
	Client	CARDFF PARKWAY		Sample	7UT	
	Operator	TA/JT/JG	Checked	*	Approved	*

# Oedometer Consolidation Settlement Report

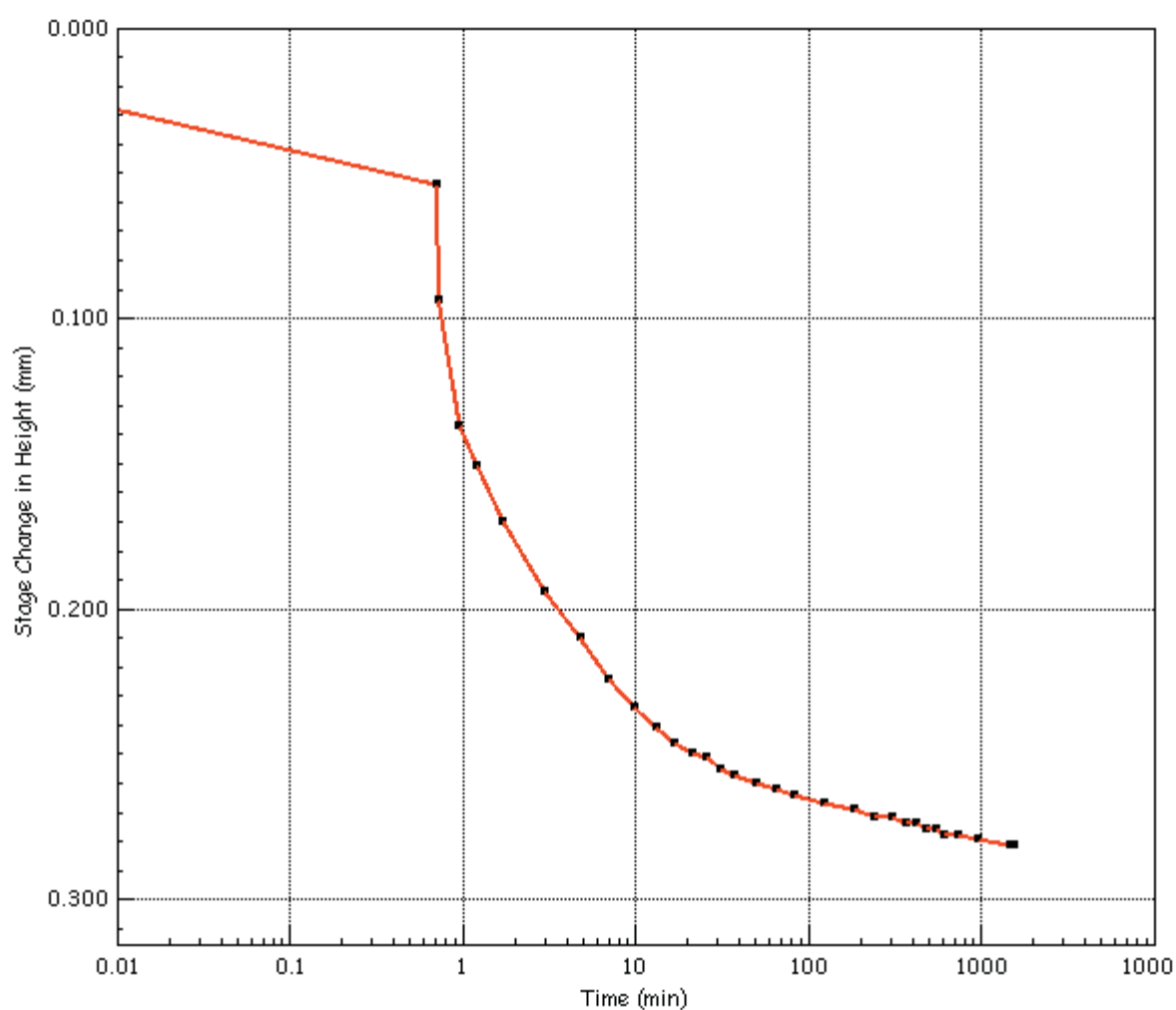
Vertical Stress	$\sigma'_{i_1}$	(kPa)	100
Initial Temperature	$T_{i_1}$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.075
Height Settlement	$\Delta L_s$	(mm)	0.286
Voids Ratio	$e_f$	.	-0.145




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 9		
					Database:		.\SQLEXPRESS \ GEL		
	Site Reference				Test Date		01/07/2019		
	Jobfile		35338		Sample		7UT		
	Client		CARDFF PARKWAY		Borehole		BH03		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	

# Oedometer Consolidation Settlement Report

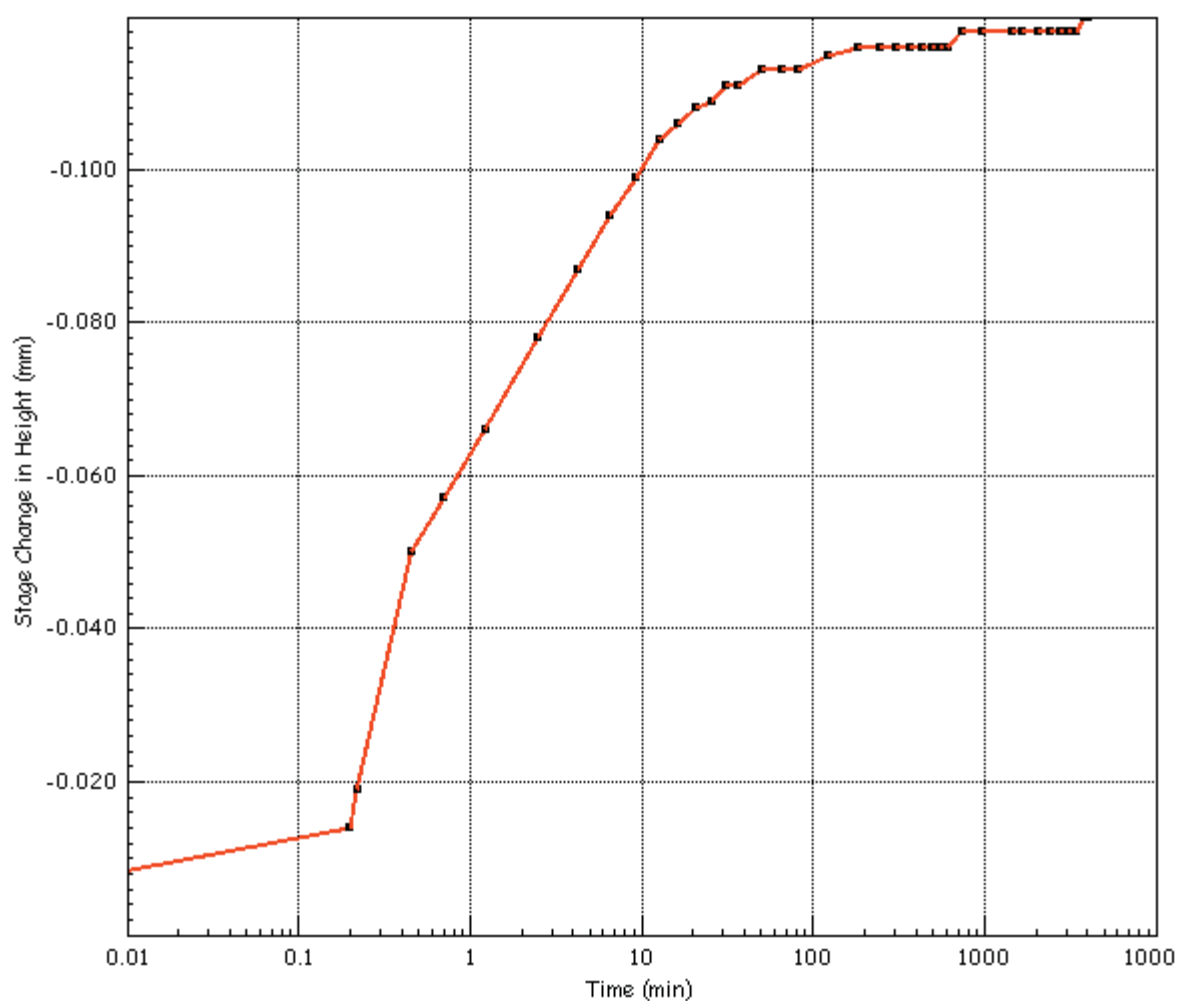
Vertical Stress	$\sigma'_{i1}$	(kPa)	200
Initial Temperature	$T_{i1}$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.106
Height Settlement	$\Delta L_s$	(mm)	0.536
Voids Ratio	$e_f$	.	-0.156




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 9						
					Database: .\SQLEXPRESS \ GEL								
	Site Reference				Test Date				01/07/2019				
	Jobfile				Sample				7UT				
	Client				Borehole				BH03				
	Operator				TA/JT/JG		Checked		*		Approved		*

# Oedometer Consolidation Settlement Report

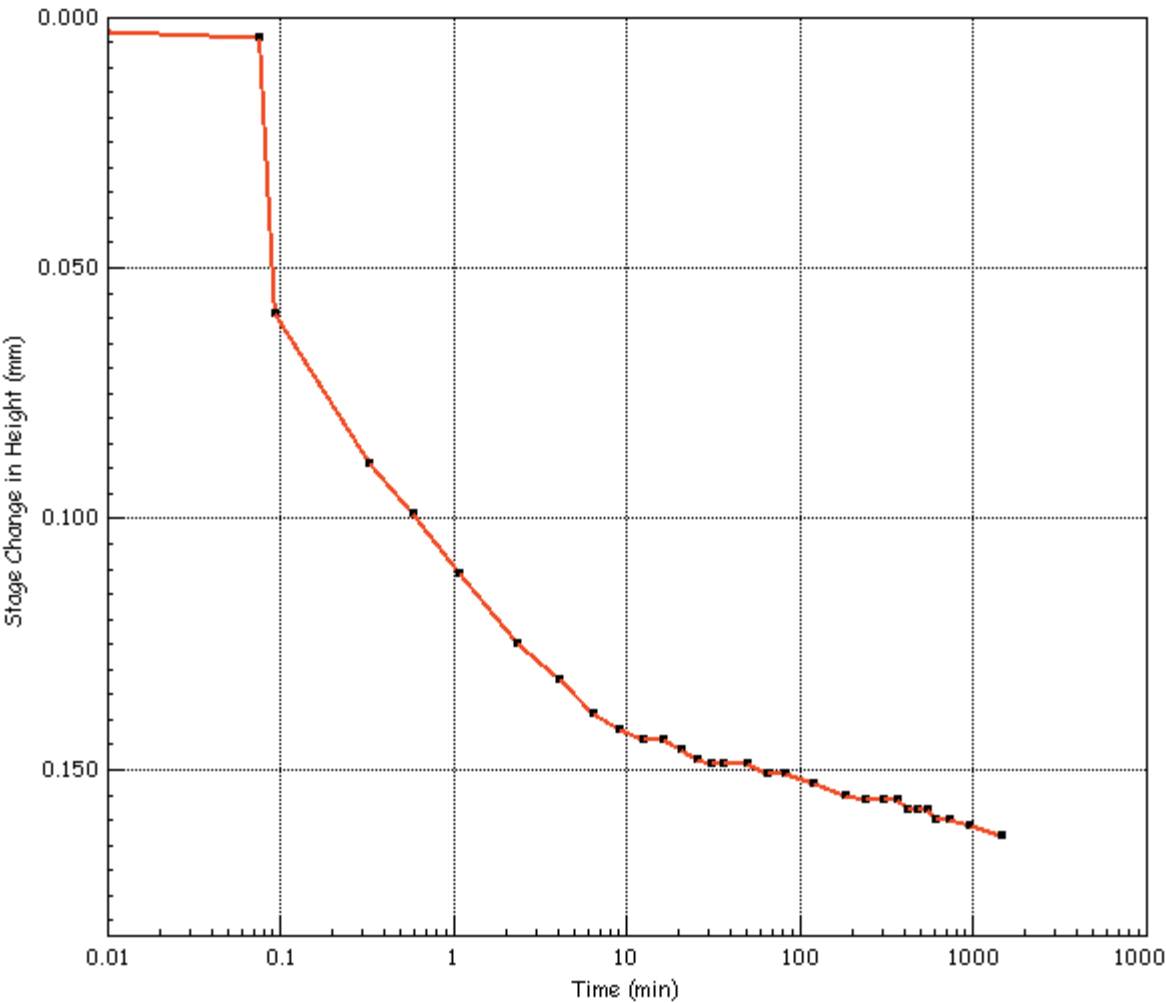
Vertical Stress	$\sigma'_{i_1}$	(kPa)	50
Initial Temperature	$T_{i_1}$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.135
Height Settlement	$\Delta L_s$	(mm)	0.387
Voids Ratio	$e_f$	.	-0.150




	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 9	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	01/07/2019	
	Client	CARDFF PARKWAY		Sample	7UT	
	Operator	TA/JT/JG		Borehole	BH03	
Checked			*		Approved	
					*	

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_{i1}$	(kPa)	200
Initial Temperature	$T_{i1}$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.106
Height Settlement	$\Delta L_s$	(mm)	0.574
Voids Ratio	$e_f$	.	-0.158

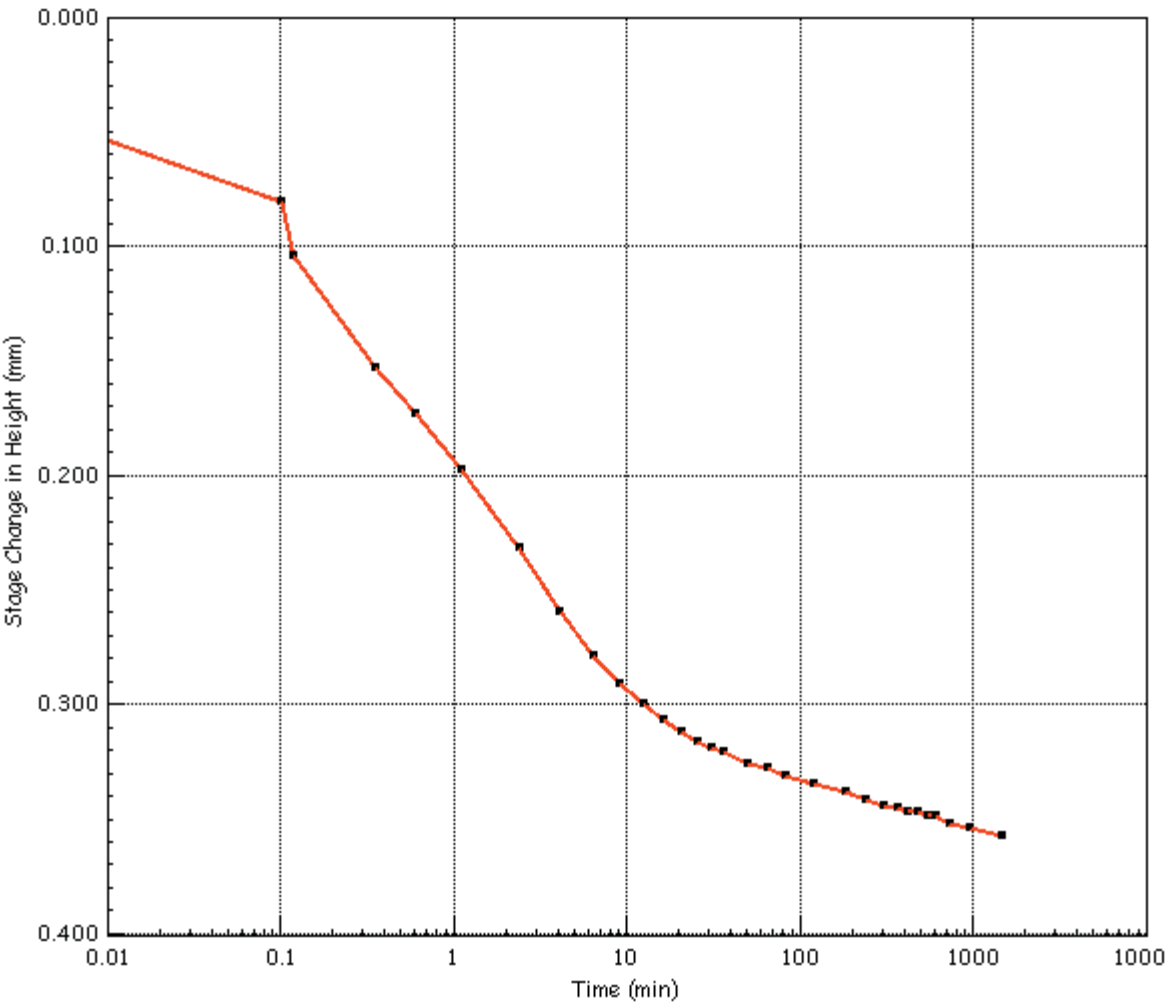



	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 9		
					Database:		.\SQLEXPRESS \ GEL		
	Site Reference				Test Date		01/07/2019		
	Jobfile		35338		Sample		7UT		
	Client		CARDFF PARKWAY		Borehole		BH03		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	



# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	400
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.151
Height Settlement	$\Delta L_s$	(mm)	0.883
Voids Ratio	$e_f$	.	-0.171



	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 9		
					Database:		.\SQLEXPRESS \ GEL		
	Site Reference				Test Date		01/07/2019		
	Jobfile		35338		Sample		7UT		
	Client		CARDFF PARKWAY		Borehole		BH03		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	sample		specimen depth (m)	code	moisture content		dimensions		density		cell pressure (kPa)	rate of strain (%/min)	deviator stress (kPa)	failure strain (%)	failure mode	shear strength* (kPa)	description and remarks		
	no./type	depth (m)			initial (%)	final (%)	length (mm)	diameter (mm)	bulk (Mg/m3)	dry (Mg/m3)									
BH02	7UT	2.20	2.22	UU100	65.9	71.7	206	104	1.56	0.94	40	2.0	17	13.6	B	9	Greyish brown slightly sandy silty organic CLAY with rare wood fragments Brown mottled grey slightly gravelly slightly sandy silty CLAY  Brown mottled grey slightly gravelly slightly sandy silty CLAY		
BH03	7UT	1.20	1.25	UU100	18.4	17.8	206	104	2.07	1.75	20	2.0	138	19.9	I	69			
BH03	14UT	3.20	3.22	UU100	14	14.1	206	104	2.24	1.97	60	2.0	158	18.9	I	79			
general remarks:				code:		failure mode:		membrane type/thickness:										CONTRACT	CHECKED
* shear strength taken as half deviator stress at failure for each stage membrane correction applied sample taken vertically (unless otherwise specified) strain rate 2%/min (unless otherwise specified)				UU - unconsolidated undrained M - multi stage S - set of three R - remoulded		B - barrel (plastic failure) S - shear (brittle failure) I - intermediate O - other (see remarks)		latex membrane used (unless otherwise specified) 38 - 0.2mm 70 - 0.4mm 100 - 0.4mm										35338	TB

**POINT LOAD STRENGTH TEST**

I.S.R.M. Suggested Methods : 2007 Edition



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	sample depth (m)	test type	test orien- tation	moisture condition	width  W (mm)	length  L (mm)	platen sep.  D (mm)	failure load  P (kN)	equiv. diam.  De (mm)	Is  (MPa)	size factor	Is(50)  (MPa)	description and remarks
BH01	7.50	D	Y	P		60	90	2.46	90.00	0.30	1.30	0.40	Reddish brown SANDSTONE
BH01	7.50	A	X	P	90		60	6.44	82.92	0.94	1.26	1.18	Reddish brown SANDSTONE
BH03	7.30	D	Y	P		50	90	0.69	90.00	0.09	1.30	0.11	Reddish brown MUDSTONE
BH03	7.30	A	X	P	90		60	0.71	82.92	0.10	1.26	0.13	Reddish brown MUDSTONE
BH03	9.60	D	Y	P		25	120	0.41	120.00	0.03	1.48	0.04	Reddish brown MUDSTONE
BH03	9.60	A	X	P	120		30	0.56	67.70	0.12	1.15	0.14	Reddish brown MUDSTONE
general remarks tests carried out in accordance with I.S.R.M.(2007): Suggested Methods for Determining Point Load Strength test machine PLM02													
test type		test orientation relative to discontinuities			moisture condition			CONTRACT					CHECKED
A - axial		X - perpendicular			U - unknown			35338					TB
D - diametral		Y - parallel			P - partially air dried								
I - irregular lump		Z - oblique			S - soaked								



2183

# Final Report

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<b>Report No.:</b>	19-22925-1		
<b>Initial Date of Issue:</b>	12-Jul-2019		
<b>Client</b>	Geotechnical Engineering Ltd		
<b>Client Address:</b>	Centurion House Olympus Park Quedgeley Gloucester Gloucestershire GL2 4NF		
<b>Contact(s):</b>	GEL Wendy Jones		
<b>Project</b>	35338 Cardiff Parkway		
<b>Quotation No.:</b>		<b>Date Received:</b>	08-Jul-2019
<b>Order No.:</b>	35338/B	<b>Date Instructed:</b>	08-Jul-2019
<b>No. of Samples:</b>	4		
<b>Turnaround (Wkdays):</b>	5	<b>Results Due:</b>	12-Jul-2019
<b>Date Approved:</b>	12-Jul-2019		
<b>Approved By:</b>			
			
<b>Details:</b>	Robert Monk, Technical Manager		

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## Results - Soil

**Project: 35338 Cardiff Parkway**

<b>Client: Geotechnical Engineering Ltd</b>	<b>Chemtest Job No.:</b>				19-22925	19-22925	19-22925	19-22925
Quotation No.:	<b>Chemtest Sample ID.:</b>				854656	854657	854658	854659
	Client Sample ID.:				7UT	12UT	7UT	7UT
	Sample Location:				BH01	BH01	BH02	BH03
	Sample Type:				SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				2.20	4.20	2.20	1.20
	Bottom Depth (m):				2.65	4.65	2.65	1.65
	Date Sampled:				04-Jul-2019	04-Jul-2019	04-Jul-2019	04-Jul-2019
<b>Determinand</b>	<b>Accred.</b>	<b>SOP</b>	<b>Units</b>	<b>LOD</b>				
Moisture	N	2030	%	0.020	17	11	39	15
pH (2.5:1)	N	2010		N/A	8.3	8.5		8.2
Magnesium (Water Soluble)	N	2120	g/l	0.010	< 0.010	< 0.010		< 0.010
Sulphate (2:1 Water Soluble) as SO <sub>4</sub>	U	2120	g/l	0.010	0.035	< 0.010		0.012
Total Sulphur	U	2175	%	0.010	0.067	0.029		0.018
Chloride (Water Soluble)	U	2220	g/l	0.010	< 0.010	< 0.010		< 0.010
Nitrate (Water Soluble)	N	2220	g/l	0.010	< 0.010	< 0.010		< 0.010
Sulphate (Acid Soluble)	U	2430	%	0.010	< 0.010	< 0.010		< 0.010
Organic Matter	U	2625	%	0.40			2.6	

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measurement by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.

## **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, SVOCs, PCBs, Phenols

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

All Asbestos testing is performed at the indicated laboratory

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

### **Sample Deviation Codes**

---

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

### **Sample Retention and Disposal**

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All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

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

[customerservices@chemtest.com](mailto:customerservices@chemtest.com)



2183

# Final Report

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<b>Report No.:</b>	19-21617-1		
<b>Initial Date of Issue:</b>	02-Jul-2019		
<b>Client</b>	Geotechnical Engineering Ltd		
<b>Client Address:</b>	Centurion House Olympus Park Quedgeley Gloucester Gloucestershire GL2 4NF		
<b>Contact(s):</b>	GEL Wendy Jones		
<b>Project</b>	35338 Cardiff Parkway		
<b>Quotation No.:</b>		<b>Date Received:</b>	27-Jun-2019
<b>Order No.:</b>	35338/B	<b>Date Instructed:</b>	27-Jun-2019
<b>No. of Samples:</b>	4		
<b>Turnaround (Wkdays):</b>	3	<b>Results Due:</b>	01-Jul-2019
<b>Date Approved:</b>	02-Jul-2019		
<b>Approved By:</b>			
			
<b>Details:</b>	Robert Monk, Technical Manager		

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## Results - Soil

**Project: 35338 Cardiff Parkway**

<b>Client: Geotechnical Engineering Ltd</b>	<b>Chemtest Job No.:</b>				19-21617	19-21617	19-21617	19-21617
Quotation No.:	<b>Chemtest Sample ID.:</b>				849499	849500	849501	849502
	Client Sample ID.:				3B	2B	8D	4D
	Sample Location:				BH01	BH02	BH02	BH03
	Sample Type:				SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				1.00	0.60	2.65	0.60
	Bottom Depth (m):				1.20	0.80	2.80	0.80
	Date Sampled:				26-Jun-2019	26-Jun-2019	26-Jun-2019	26-Jun-2019
<b>Determinand</b>	<b>Accred.</b>	<b>SOP</b>	<b>Units</b>	<b>LOD</b>				
Moisture	N	2030	%	0.020	15	22	38	22
pH (2.5:1)	N	2010		N/A	8.1	8.6	8.2	
Magnesium (Water Soluble)	N	2120	g/l	0.010	< 0.010	< 0.010	0.015	
Sulphate (2:1 Water Soluble) as SO <sub>4</sub>	U	2120	g/l	0.010	0.010	0.014	0.36	
Total Sulphur	U	2175	%	0.010	0.016	0.015	0.81	
Chloride (Water Soluble)	U	2220	g/l	0.010	< 0.010	< 0.010	0.022	
Nitrate (Water Soluble)	N	2220	g/l	0.010	< 0.010	< 0.010	< 0.010	
Sulphate (Acid Soluble)	U	2430	%	0.010	0.016	0.025	0.12	
Organic Matter	U	2625	%	0.40	0.78			0.86

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
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[customerservices@chemtest.com](mailto:customerservices@chemtest.com)



2718



GEOTECHNICAL ENGINEERING LIMITED

For the attention of James Taylor/Edward Crimp

Version No. 4

Page No. 1 of 41


Date of Issue 13/08/2019

**TEST REPORT**

PROJECT/SITE	CARDIFF PARKWAY INITIAL GROUND INVESTIGATION	Samples received	04/07/2019
GEL REPORT NUMBER	35338	Schedule received	04/07/2019
Your ref/PO:		Testing commenced	05/07/2019
Test report refers to	Schedule B	Status	Final

**SUMMARY OF RESULTS ATTACHED**

TEST METHOD & DESCRIPTION	QUANTITY	ACCREDITED TEST
BS EN ISO 17892-1: 2014:5. Water Content	8	YES
BS1377: Part 2: 1990:4.2-4.4&5.2-5.4, Liquid & Plastic Limits	8	YES
BS EN ISO 17892-4: 2016: 5.2, Particle Size Distribution - Wet Sieve	5	YES
BS EN ISO 17892-4: 2016: 5.4, Particle Size Distribution - Pipette	5	YES
BS1377: Part 5: 1990:3, Consolidation	3	YES
BS1377: Part 7: 1990:8&9, Undrained Triaxial Compression	3	YES
ISRM: 2007: Point Load Strength Test	12	YES
Organic Matter Content (Subcontracted)	4	YES
BRE SD1 Suite (Subcontracted)	9	YES/NO

Remarks This report may not be partially reproduced without written permission from this laboratory.	Approved Signatories: <b>W Jones (Laboratory Manager)</b> E Crimp (Senior Engineer) J Hanson (Director) N Parry (Director) 
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Doc TR01

Rev No. 20

Revision date 09/10/17

DC:JH

**Geotechnical Engineering Ltd**

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Gloucester GL2 4NF

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Registered number: 00700739

VAT Number: 682 5857 89

Payments: Geotechnical Engineering Limited

Sort code: 16-22-11 Bank account: 11125135

**LIQUID AND PLASTIC LIMITS**

BS.1377 : PART 2 : 1990 : 4 and 5



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	sample		specimen depth (m)	natural water content (%)	specimen preparation and test method	fraction >0.425 mm (%)	liquid limit (%)	plastic limit (%)	plasticity index (%)	description and remarks
	no./type	depth (m)								
BH06	7UT	1.20	1.25	46.1	BXE	0	76	33	43	Brown mottled grey and orange organic silty CLAY
BH06	17L	3.20	3.60	14	BXE	24	35	21	14	Reddish brown slightly sandy slightly gravelly silty CLAY
BH08	9P	2.10	2.10	39.3	BXE	0	50	25	25	Grey slightly sandy silty CLAY
BH08	11P	3.70	3.75	64.4	BXE	0	53	30	23	Greyish brown organic silty CLAY
BH08	14D	6.50	6.50	20	BXE	27	31	14	17	Reddish brown slightly sandy slightly gravelly silty CLAY
BH08	32D	16.80	16.80	7.3	BXE	24	30	19	11	Grey mottled reddish brown slightly sandy slightly gravelly silty CLAY
BH09	3B	0.60	0.60	32.5	BXE	1	64	26	38	Brownish grey slightly sandy silty CLAY
BH09	9P	2.20	2.30	63.2	BXE	0	56	28	28	Bluish grey organic silty CLAY
general remarks natural water content determined in accordance with BS EN ISO 17892 - 1 : 2014 (unless specified) NP denotes non plastic # denotes sample tested is smaller than that which is recommended in accordance with BS1377 or BS EN ISO 17892										
specimen preparation A - as received B - washed on 0.425mm sieve C - air dried							test method X - cone penetrometer (test 4.3) Y - cone penetrometer (test 4.4) Z - casagrande apparatus (test 4.5)			
							CONTRACT		CHECKED	
							35338		TB	

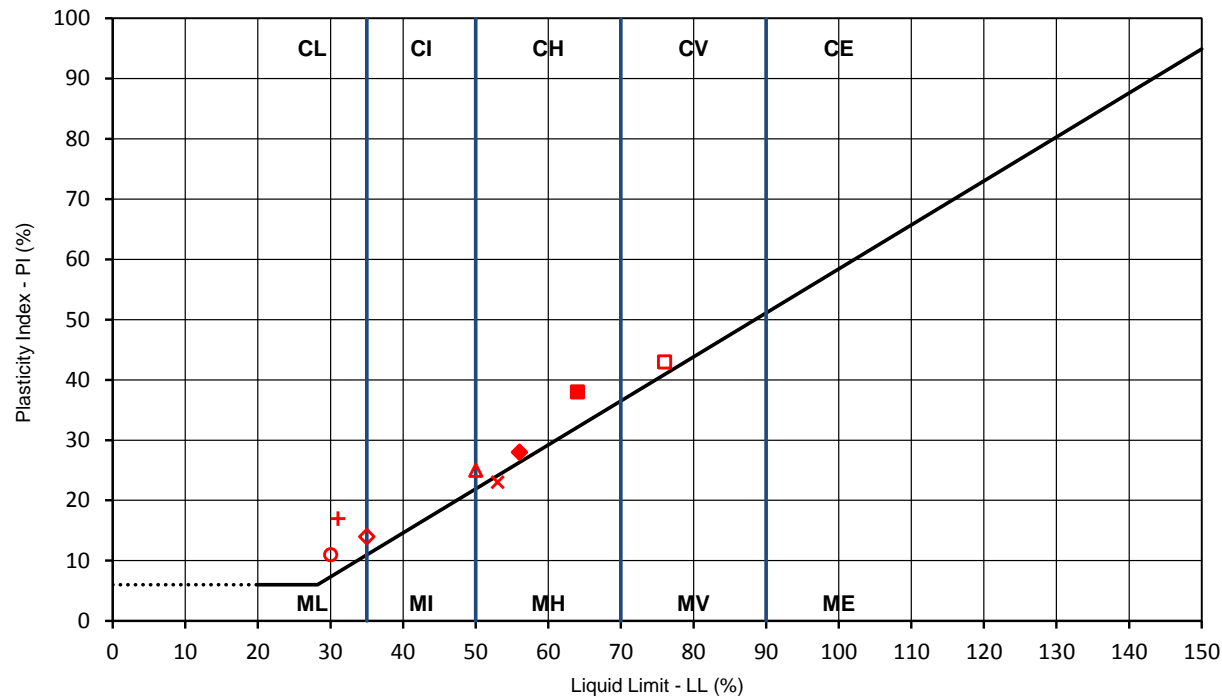
Geotechnical Engineering Limited

# ATTERBERG LINE PLOT



CLIENT    CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE        CARDIFF PARKWAY INITIAL GROUND INVESTIGATION



BH/TP No.		depth (m)	LL	PL	PI	remarks
□	BH06	1.25	76	33	43	
◇	BH06	3.60	35	21	14	
△	BH08	2.10	50	25	25	
×	BH08	3.75	53	30	23	
+	BH08	6.50	31	14	17	
○	BH08	16.80	30	19	11	
■	BH09	0.60	64	26	38	
◆	BH09	2.30	56	28	28	

CONTRACT	CHECKED
35338	TB

**PARTICLE SIZE DISTRIBUTION**

BS EN ISO 17892 - 4 : 2016 : 5



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH06

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

7UT

DESCRIPTION Brown mottled grey slightly sandy organic silty CLAY

SAMPLE DEPTH (m)

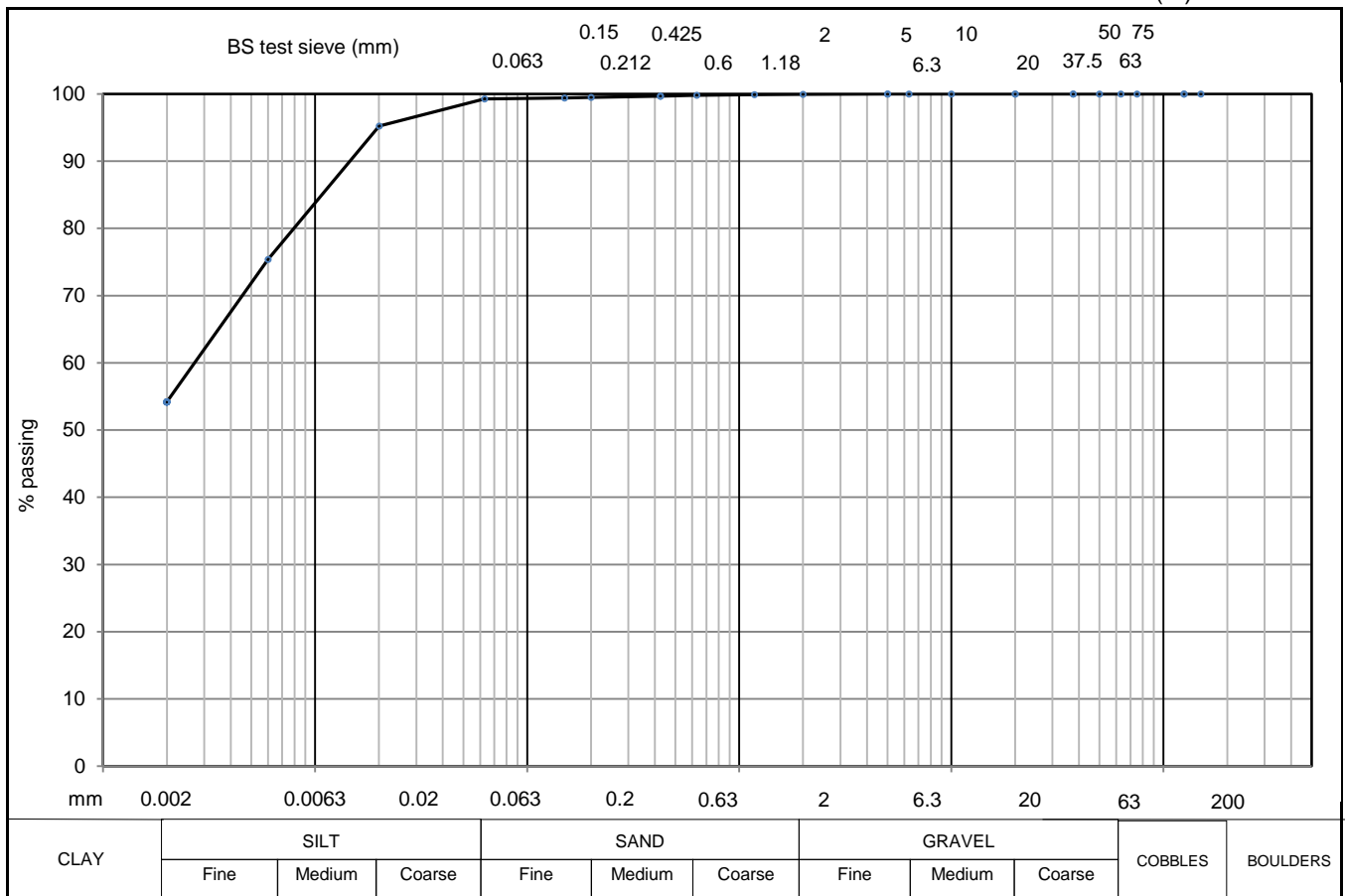
1.20

SPECIMEN TOP (m)

1.30

SPECIMEN BASE (m)

1.35



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY	54						
SILT	45	150		5	100	20	95
SILT & CLAY	99						
SAND	1	75		2	100	6	75
GRAVEL	0						
COBBLE & BOULDER	0	63		1.18	100	2	54
test method(s)	5.2 & 5.4	50		0.63	100		
test method		37.5		0.425	100		
5.2 - sieving		20		0.2	99		
5.3 - sedimentation by hydrometer		10		0.15	99		
5.4 - sedimentation by pipette		6.3		0.063	99		
remarks	# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3					CONTRACT	CHECKED
						35338	TB



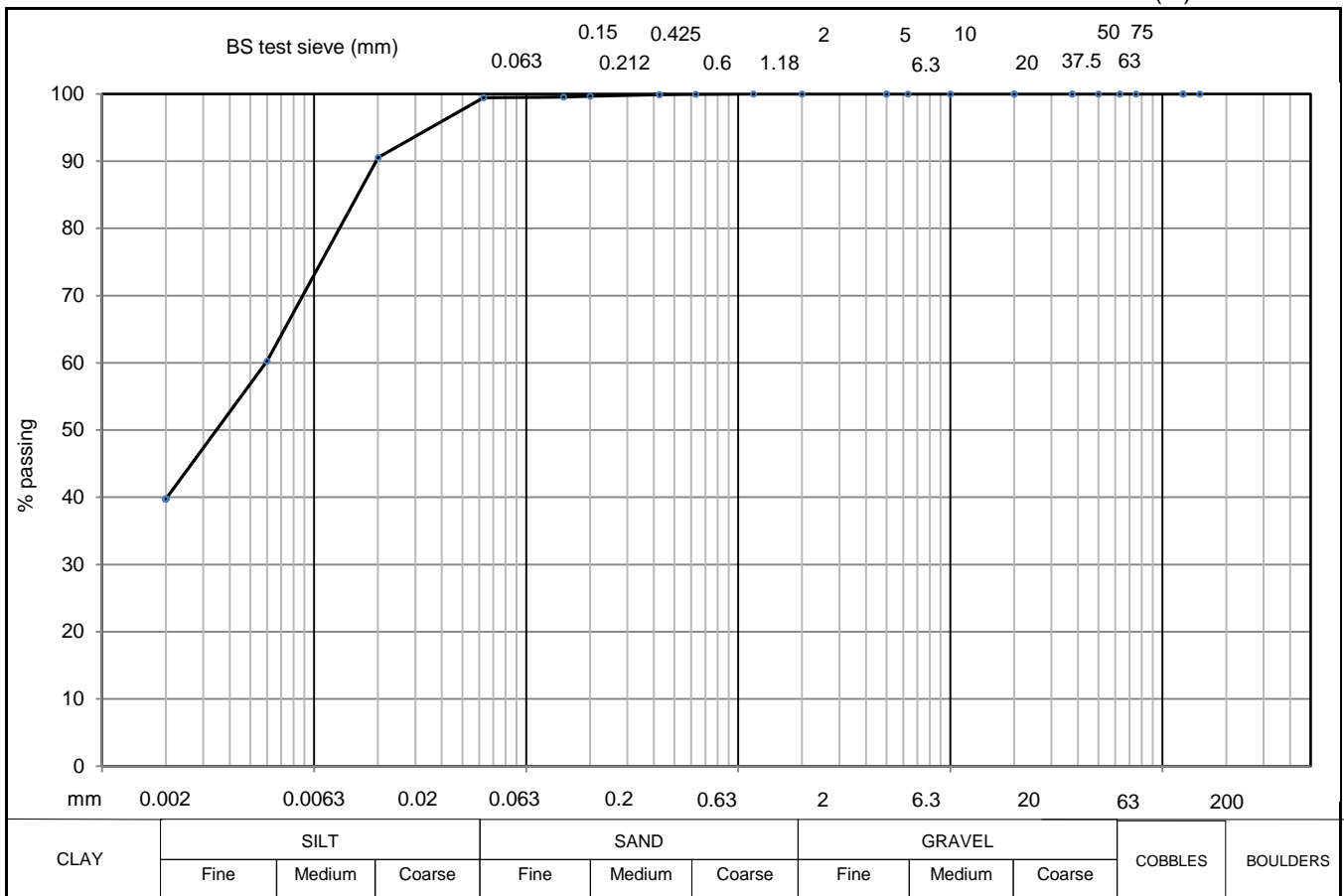
BH/TP No. BH08

SAMPLE No./TYPE 11P

SAMPLE DEPTH (m) 3.70

SPECIMEN TOP (m) 4.00

SPECIMEN BASE (m) 4.10



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer	
CLAY	40	150		5	100	20	91	
SILT	60							
SILT & CLAY	99							
SAND	1			75		2	6	60
GRAVEL	0							
COBBLE & BOULDER	0	63		1.18		2	40	
test method(s)	5.2 & 5.4	50		0.63	100			
test method		37.5		0.425	100			
5.2 - sieving		20		0.2	100			
5.3 - sedimentation by hydrometer		10		0.15	100			
5.4 - sedimentation by pipette		6.3		0.063	99			
remarks						CONTRACT	CHECKED	
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892						35338	TB	
Particle density assigned an assumed value of 2.70 Mg/m3								





CLIENT                      CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No. BH08

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

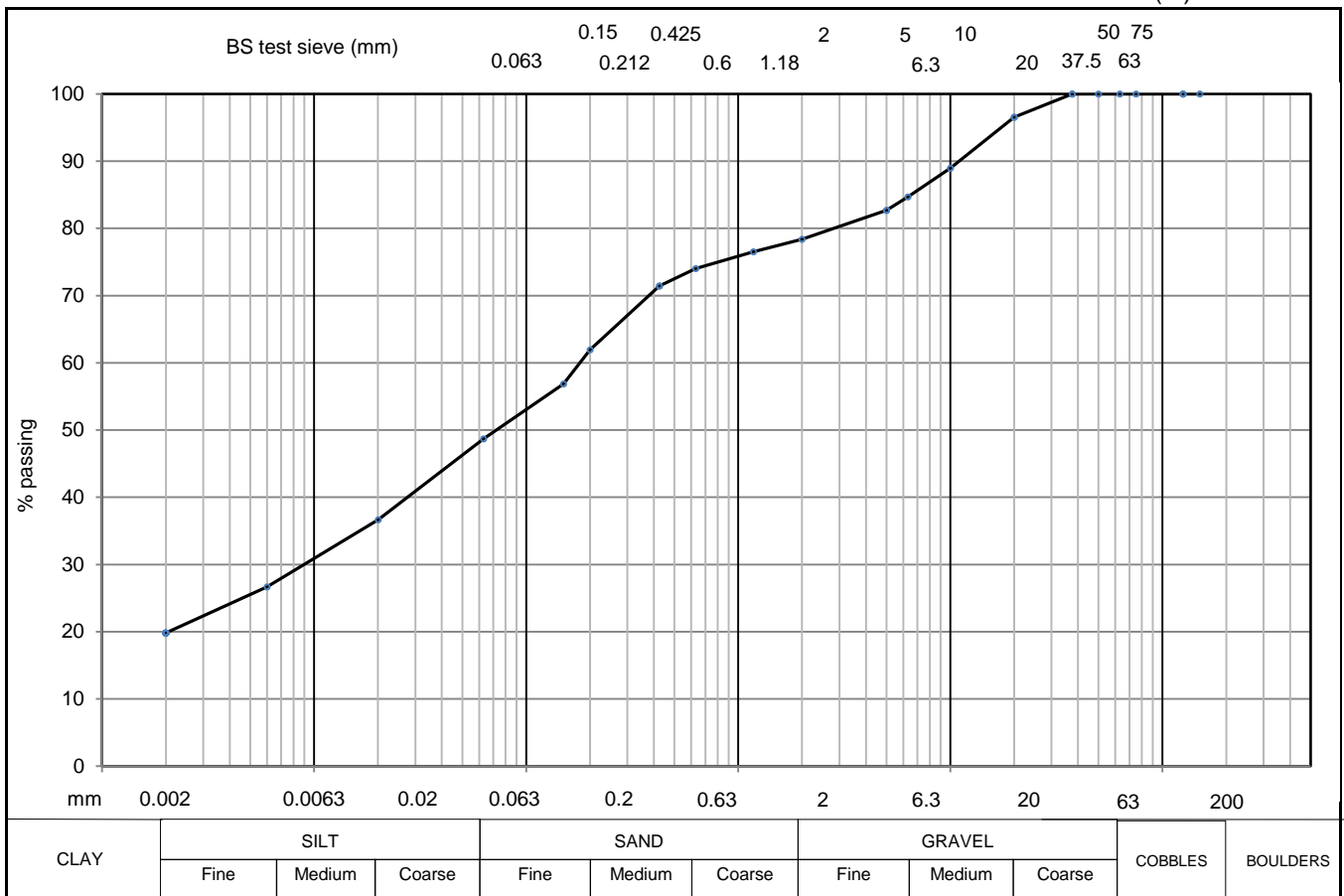
SAMPLE No./TYPE 14D

DESCRIPTION Reddish brown slightly gravelly slightly sandy silty CLAY

SAMPLE DEPTH (m) 6.50

SPECIMEN TOP (m) 6.50

SPECIMEN BASE (m)	6.60
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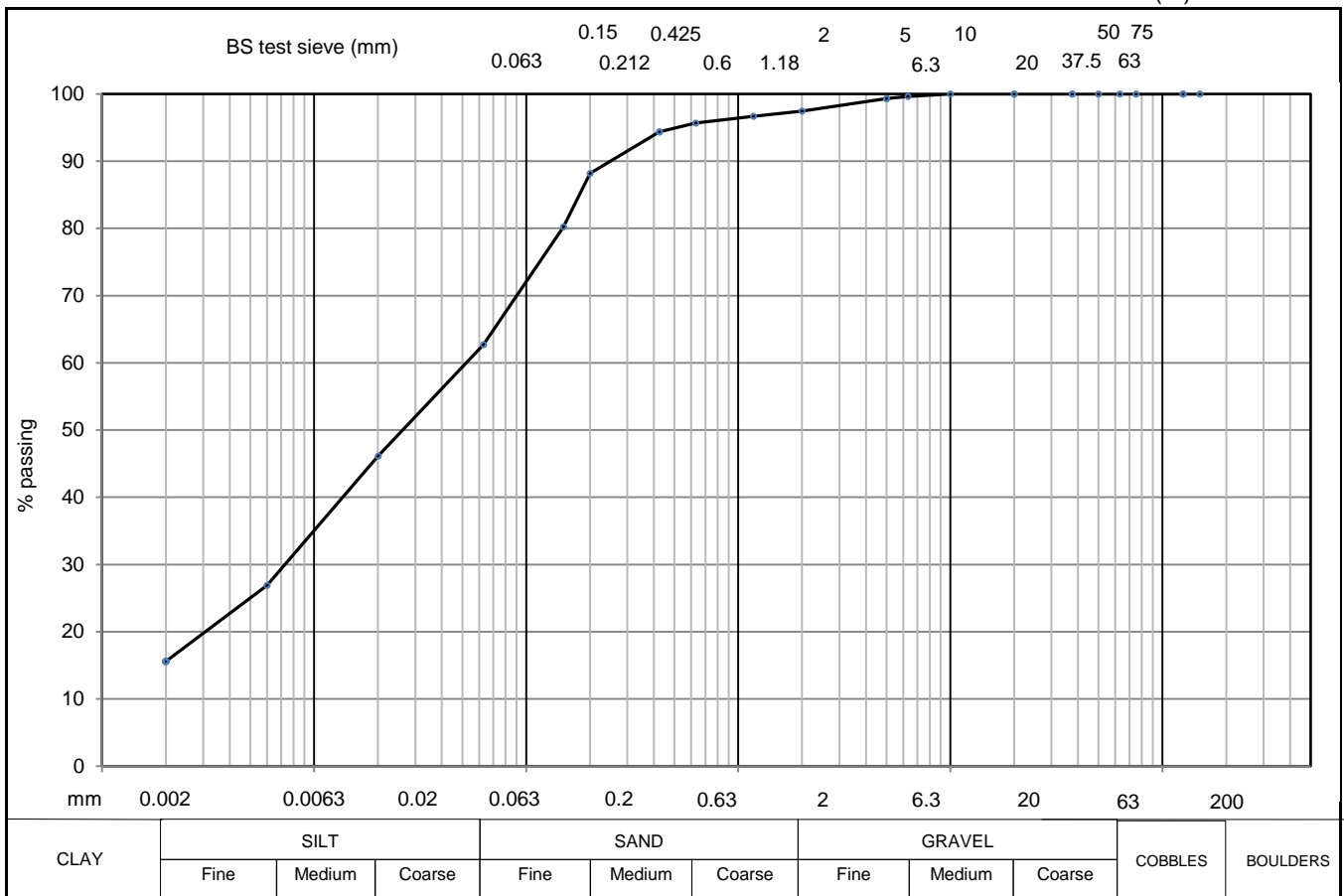


soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY	20	150		5	83	20	37
SILT	29						
SILT & CLAY	49						
SAND	30						
GRAVEL	22						
COBBLE & BOULDER	0	63	100	1.18	77	2	20
test method(s)	5.2 & 5.4	50		0.63	74		
test method		37.5		0.425	71		
5.2 - sieving		20		0.2	62		
5.3 - sedimentation by hydrometer		10		0.15	57		
5.4 - sedimentation by pipette		6.3	85	0.063	49		
remarks						CONTRACT	CHECKED
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892						35338	TB
Particle density assigned an assumed value of 2.70 Mg/m3							



CLIENT	CARDIFF PARKWAY DEVELOPMENTS LIMITED
SITE	CARDIFF PARKWAY INITIAL GROUND INVESTIGATION
DESCRIPTION	Reddish brown slightly gravelly slightly sandy clayey SILT

BH/TP No.	BH08
SAMPLE No./TYPE	18D
SAMPLE DEPTH (m)	8.50
SPECIMEN TOP (m)	8.50
SPECIMEN BASE (m)	8.95



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer	
CLAY	16	150		5	99	20	46	
SILT	47							
SILT & CLAY	63							
SAND	35			75	2	97	6	27
GRAVEL	3							
COBBLE & BOULDER	0	63		1.18	97	2	16	
test method(s)	5.2 & 5.4	50		0.63	96			
test method		37.5		0.425	94			
5.2 - sieving		20		0.2	88			
5.3 - sedimentation by hydrometer		10	100	0.15	80			
5.4 - sedimentation by pipette		6.3	100	0.063	63			
remarks						CONTRACT	CHECKED	
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892						35338	TB	
Particle density assigned an assumed value of 2.70 Mg/m3								



CLIENT                      CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No. BH09

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

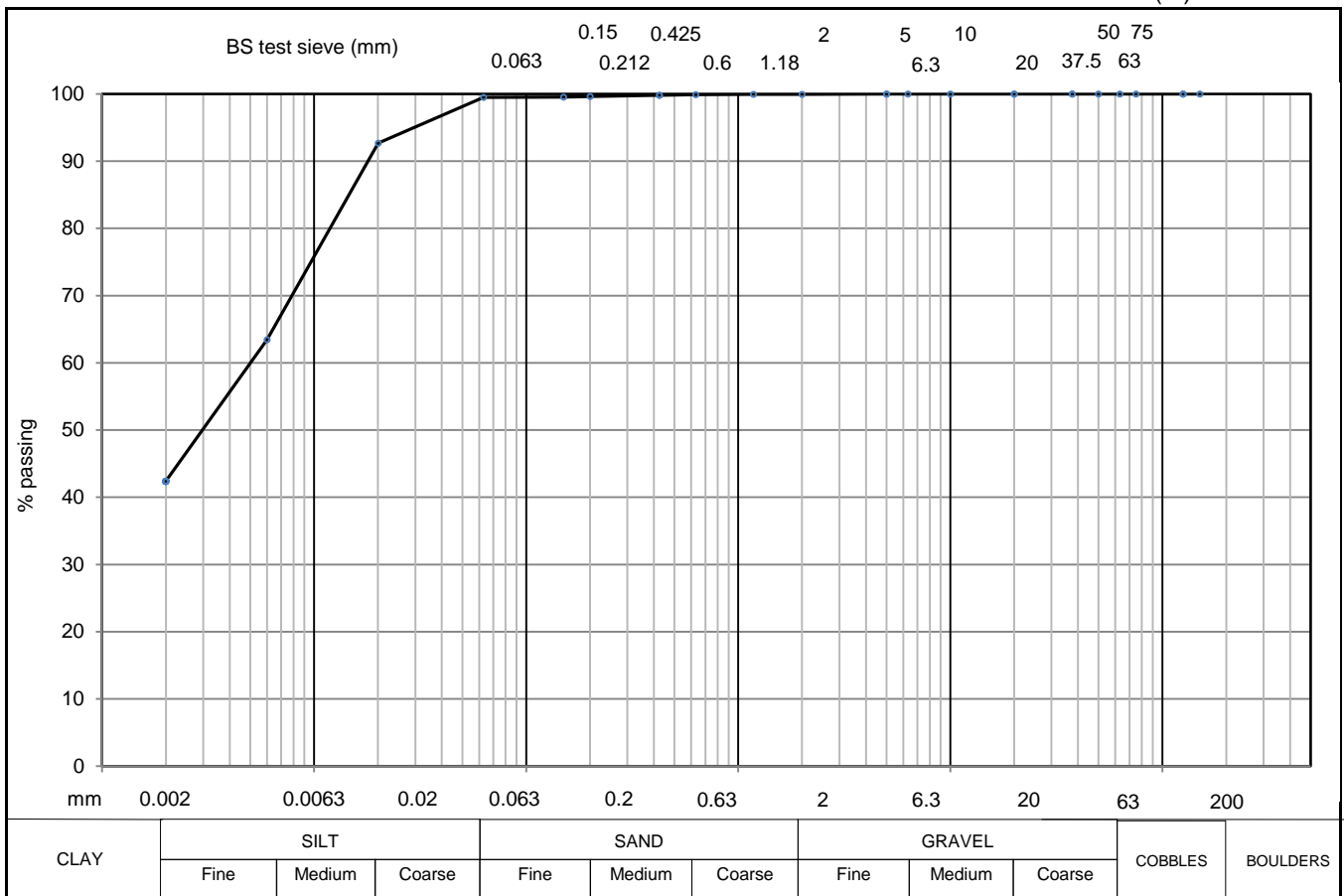
SAMPLE No./TYPE 9P

DESCRIPTION Greyish brown silty CLAY

SAMPLE DEPTH (m) 2.20

SPECIMEN TOP (m)	2.60
------------------	------

SPECIMEN BASE (m) 2.65



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer	
CLAY	42	150		5	100	20	93	
SILT	57							
SILT & CLAY	100							
SAND	0			75	2	100	6	63
GRAVEL	0							
COBBLE & BOULDER	0	63		1.18	100	2	42	
test method(s)	5.2 & 5.4	50		0.63	100			
test method		37.5		0.425	100			
5.2 - sieving		20		0.2	100			
5.3 - sedimentation by hydrometer		10		0.15	100			
5.4 - sedimentation by pipette		6.3		0.063	100			
remarks						CONTRACT	CHECKED	
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892						35338	TB	
Particle density assigned an assumed value of 2.70 Mg/m3								

**DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES****BS.1377 : Part 5 : 1990 : 3**

CLIENT    CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH06

SITE        CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

7UT

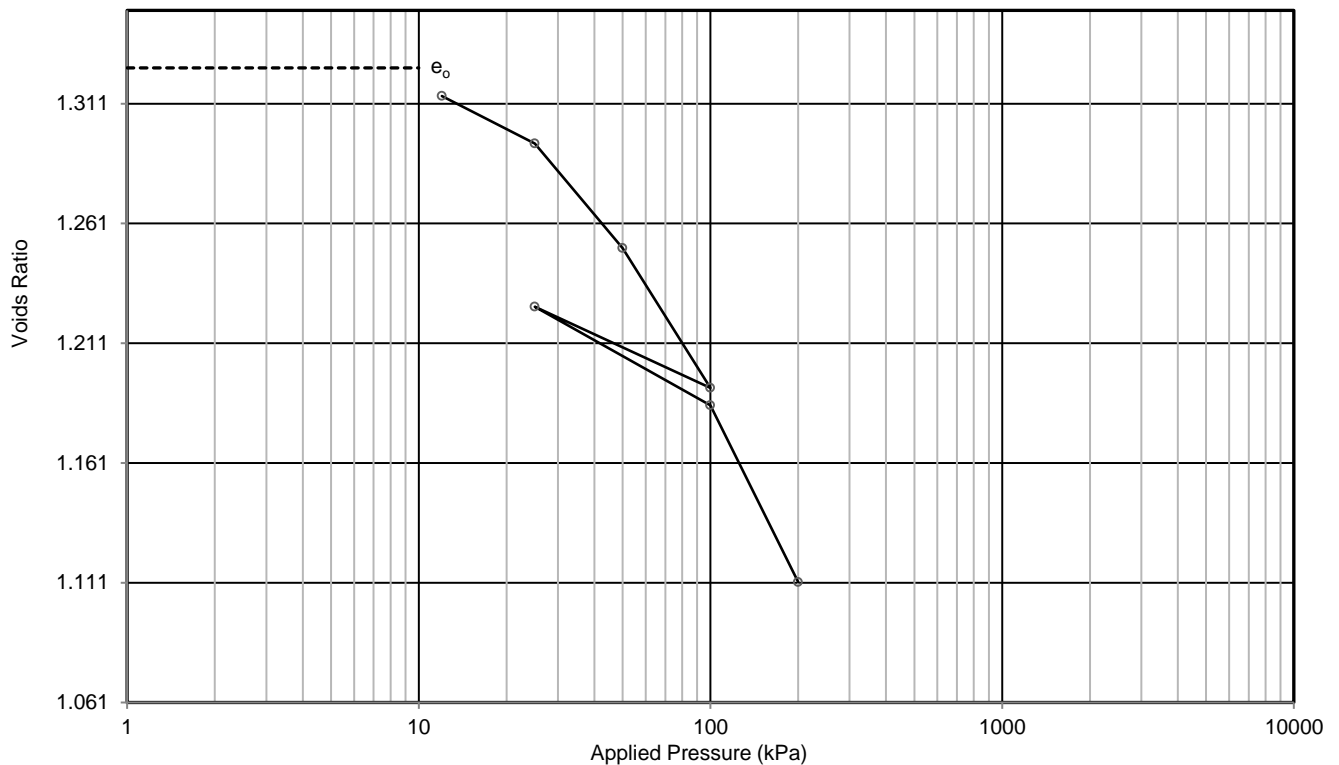
DESCRIPTION    Brown mottled grey and orange slightly organic silty CLAY

SAMPLE DEPTH (m)

1.20

SPECIMEN DEPTH (m)

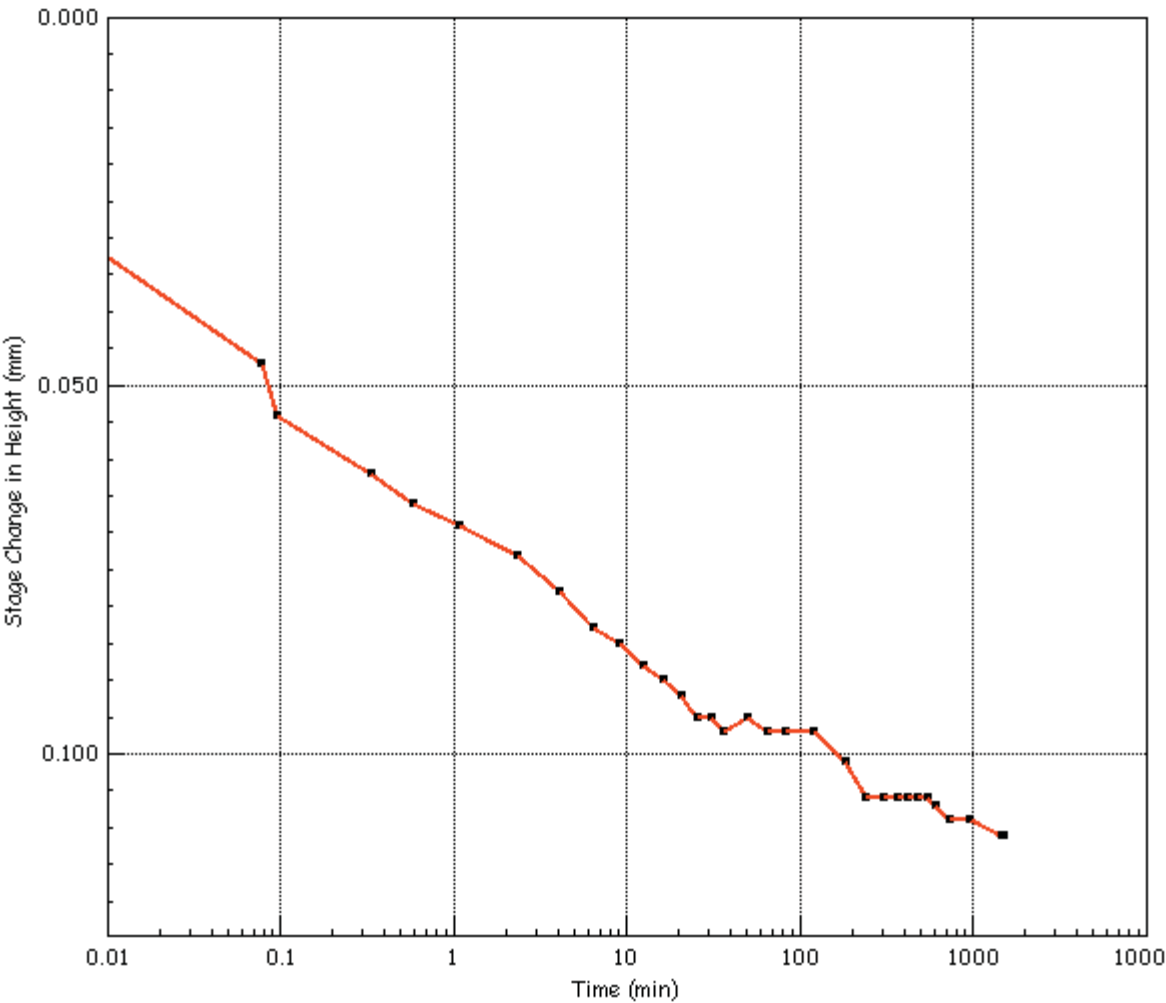
1.25




test and sample details			test results			
			pressure stage	voids ratio	laboratory coefficients of compressibility	consolidation
			(kPa)		$m_v$ ( $m^2/MN$ )	$C_v$ ( $m^2/yr$ )
specimen diameter	mm	63.48				
specimen height	mm	19.01				
initial moisture content	%	48.0				
final moisture content	%	41.9				
initial bulk density	$Mg/m^3$	1.72	12	1.314	0.42	1.5
initial dry density	$Mg/m^3$	1.16	25	1.294	0.66	0.46
initial voids ratio		1.326	50	1.251	0.76	0.50
initial degree of saturation	%	98	100	1.192	0.52	0.35
particle density	$Mg/m^3$	#2.70	25	1.226	0.21	
swelling pressure	kPa	N/A	100	1.185	0.25	0.98
			200	1.111	0.34	0.32
P'o to P'o +100 kPa		-				
laboratory temperature	$^{\circ}C$	$20 \pm 2$				
method of time fitting		root time				
remarks	# denotes particle density has been assigned an assumed value load frame corrections applied				CONTRACT <b>35338</b>	CHECKED <b>TB</b>

# Oedometer Consolidation Settlement Report

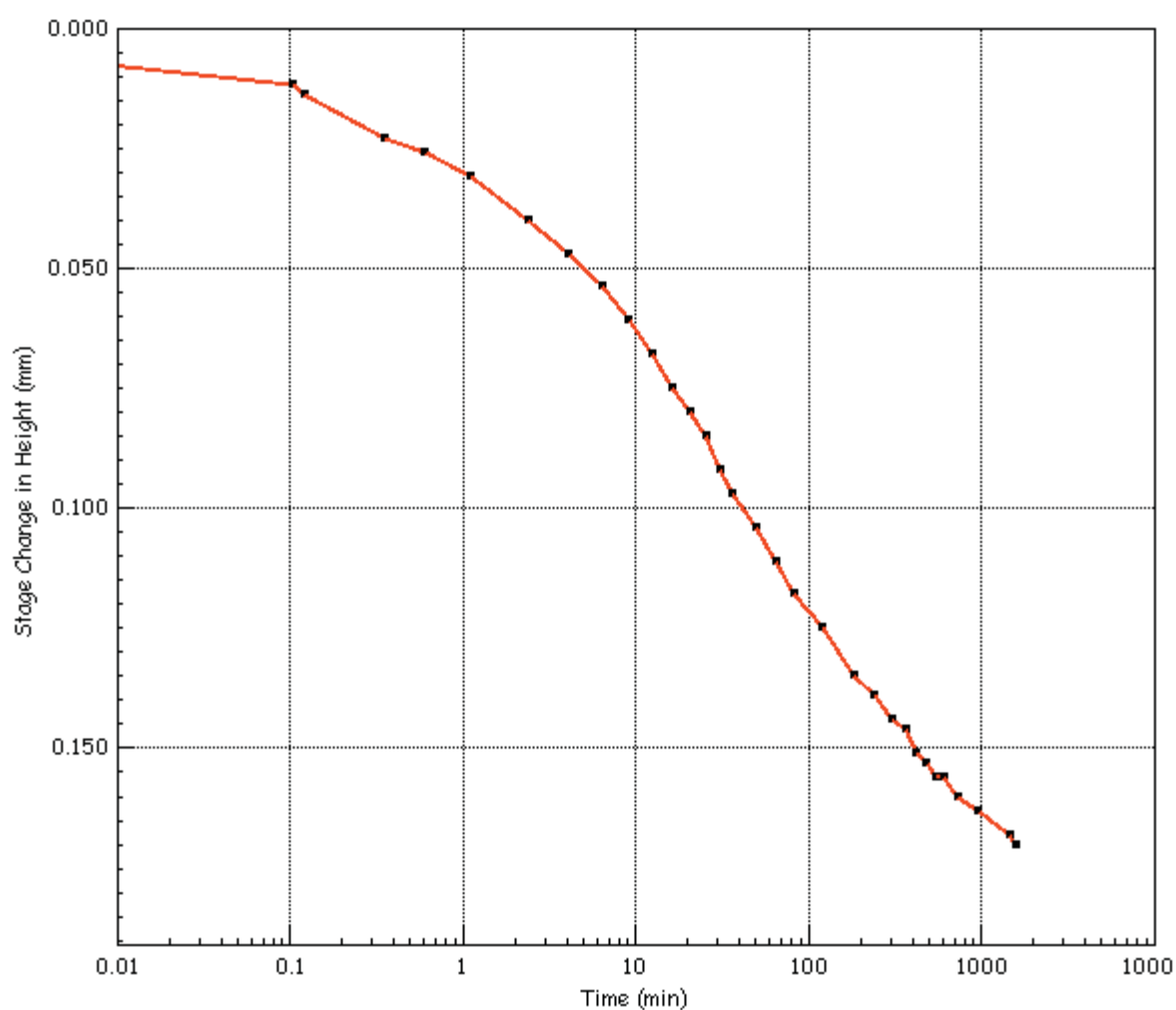
Vertical Stress	$\sigma'_i$	(kPa)	12.0
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.015
Height Settlement	$\Delta L_s$	(mm)	0.096
Voids Ratio	$e_f$	.	-0.137




	Test Method	BS1377 - 5 : 1990 : Clause 3	Test Name	FRAME 9
	Site Reference		Database:	.\SQLEXPRESS \ GEL
	Jobfile	35338	Test Date	10/07/2019
	Client	CARDFF PARKWAY	Sample	7UT
	Operator	TA/JT/JG	Borehole	BH06
Checked			*	Approved
				*

# Oedometer Consolidation Settlement Report

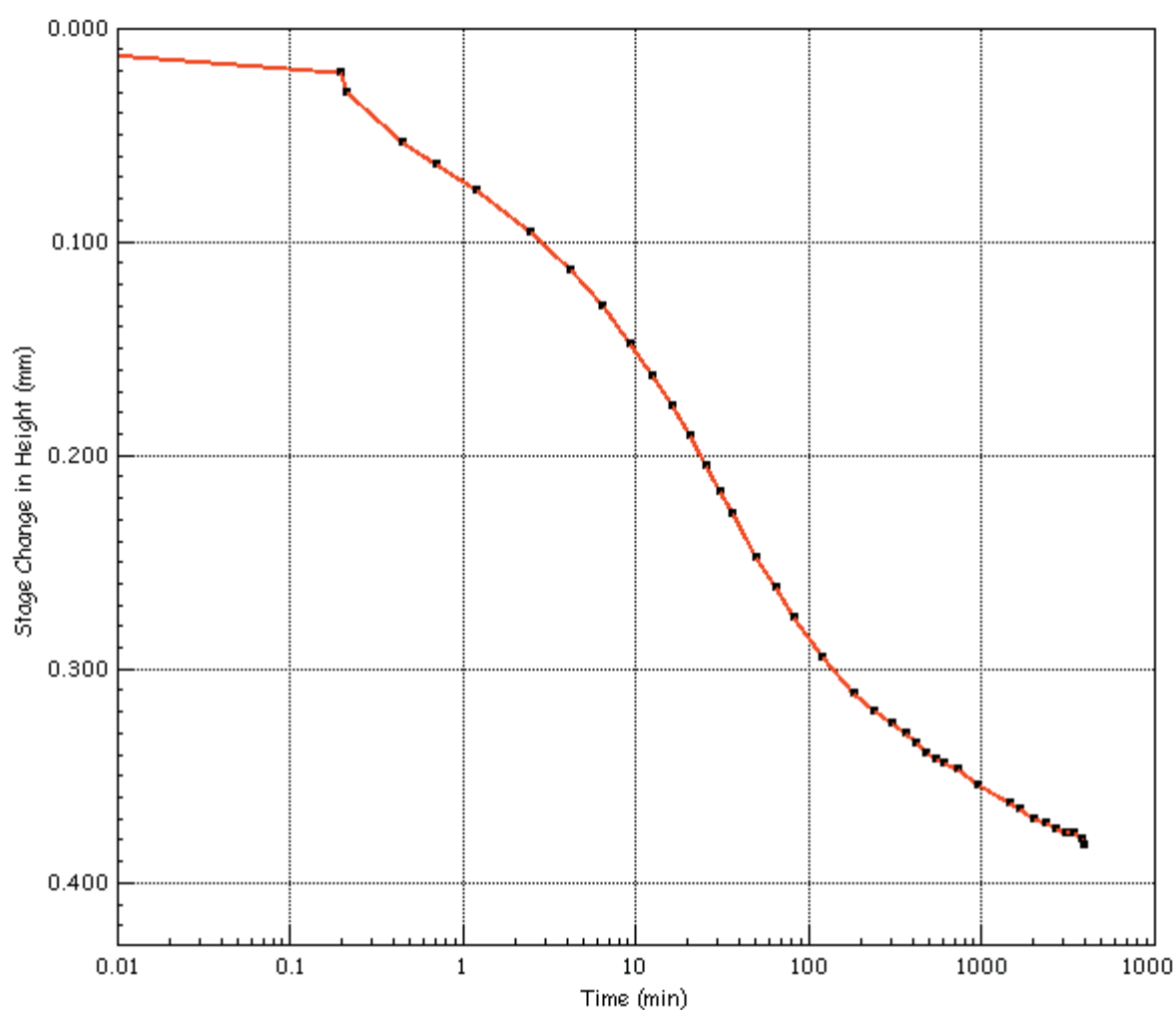
Vertical Stress	$\sigma'_i$	(kPa)	25
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.023
Height Settlement	$\Delta L_s$	(mm)	0.258
Voids Ratio	$e_f$	.	-0.144




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 9						
					Database: .\SQLEXPRESS \ GEL								
	Site Reference				Test Date				10/07/2019				
	Jobfile				Sample				7UT				
	Client				Borehole				BH06				
	Operator				TA/JT/JG		Checked		*		Approved		*

# Oedometer Consolidation Settlement Report

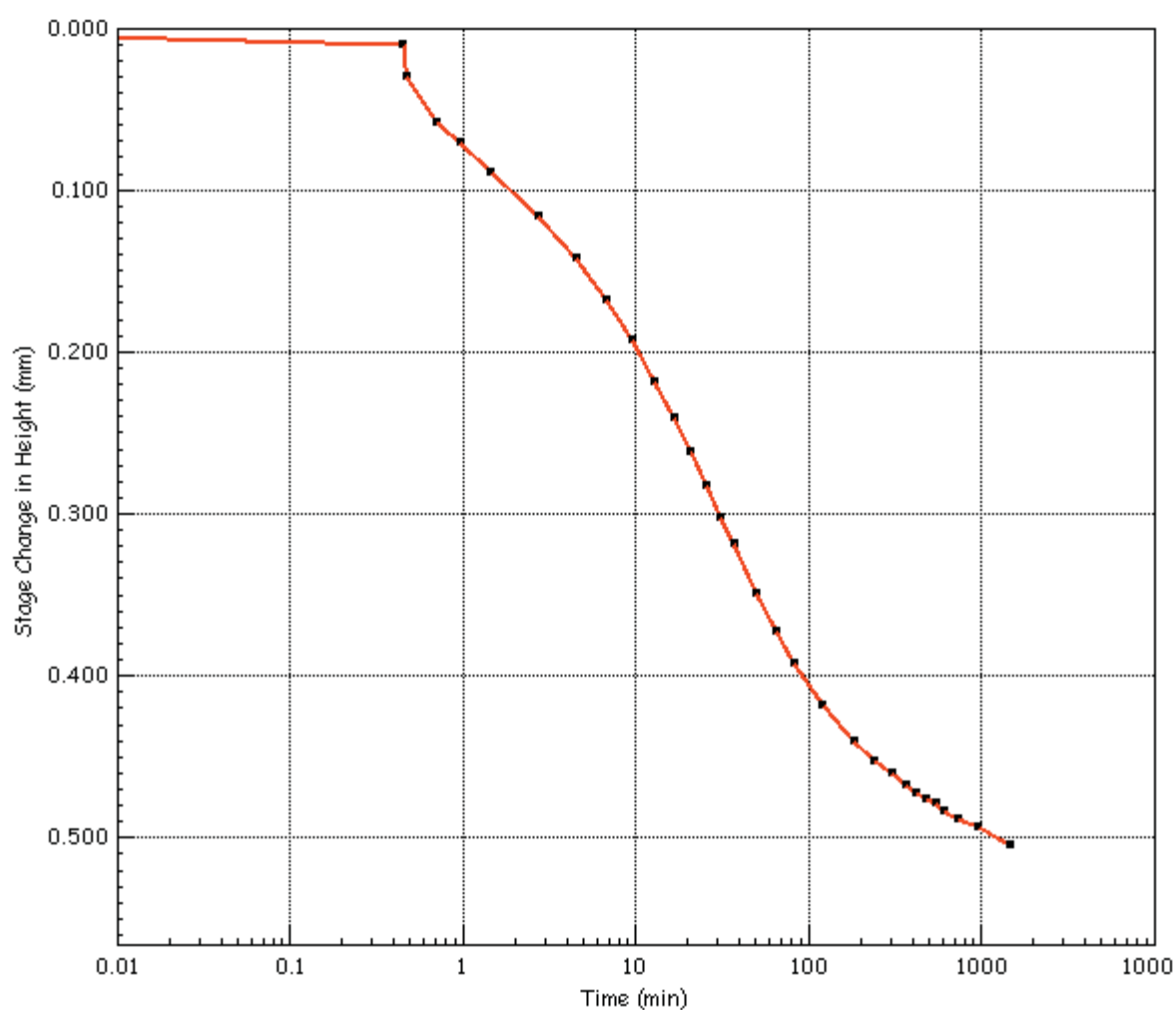
Vertical Stress	$\sigma'_{i_1}$	(kPa)	50
Initial Temperature	$T_i$	(°C)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.048
Height Settlement	$\Delta L_s$	(mm)	0.615
Voids Ratio	$e_f$	.	-0.159




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 9						
					Database: .\SQLEXPRESS \ GEL								
	Site Reference				Test Date				10/07/2019				
	Jobfile				Sample				7UT				
	Client				Borehole				BH06				
	Operator				TA/JT/JG		Checked		*		Approved		*

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	100
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.075
Height Settlement	$\Delta L_s$	(mm)	1.092
Voids Ratio	$e_f$	.	-0.180

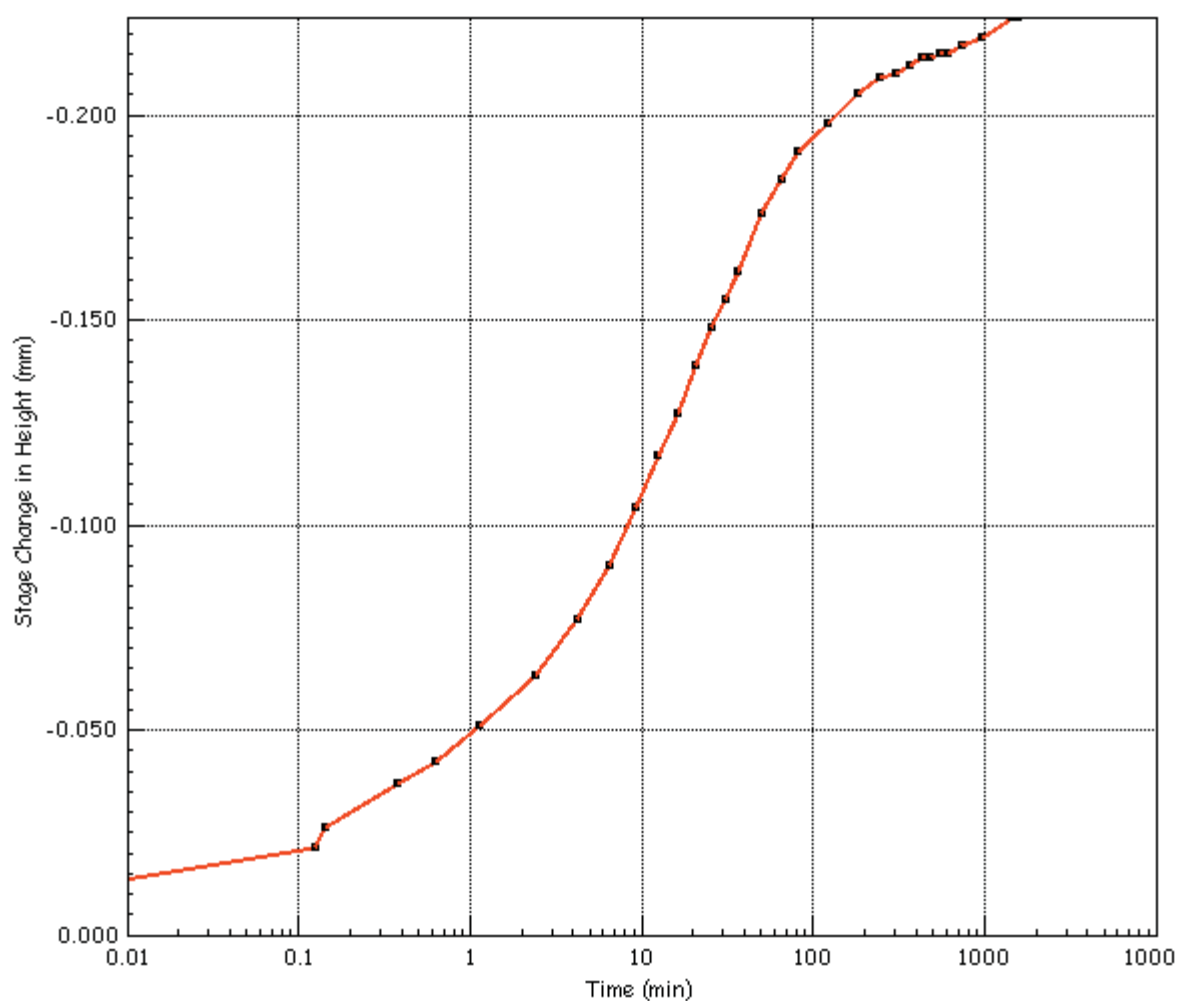



	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 9	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	10/07/2019	
	Client	CARDFF PARKWAY		Sample	7UT	
	Operator	TA/JT/JG	Checked	*	Approved	*



# Oedometer Consolidation Settlement Report

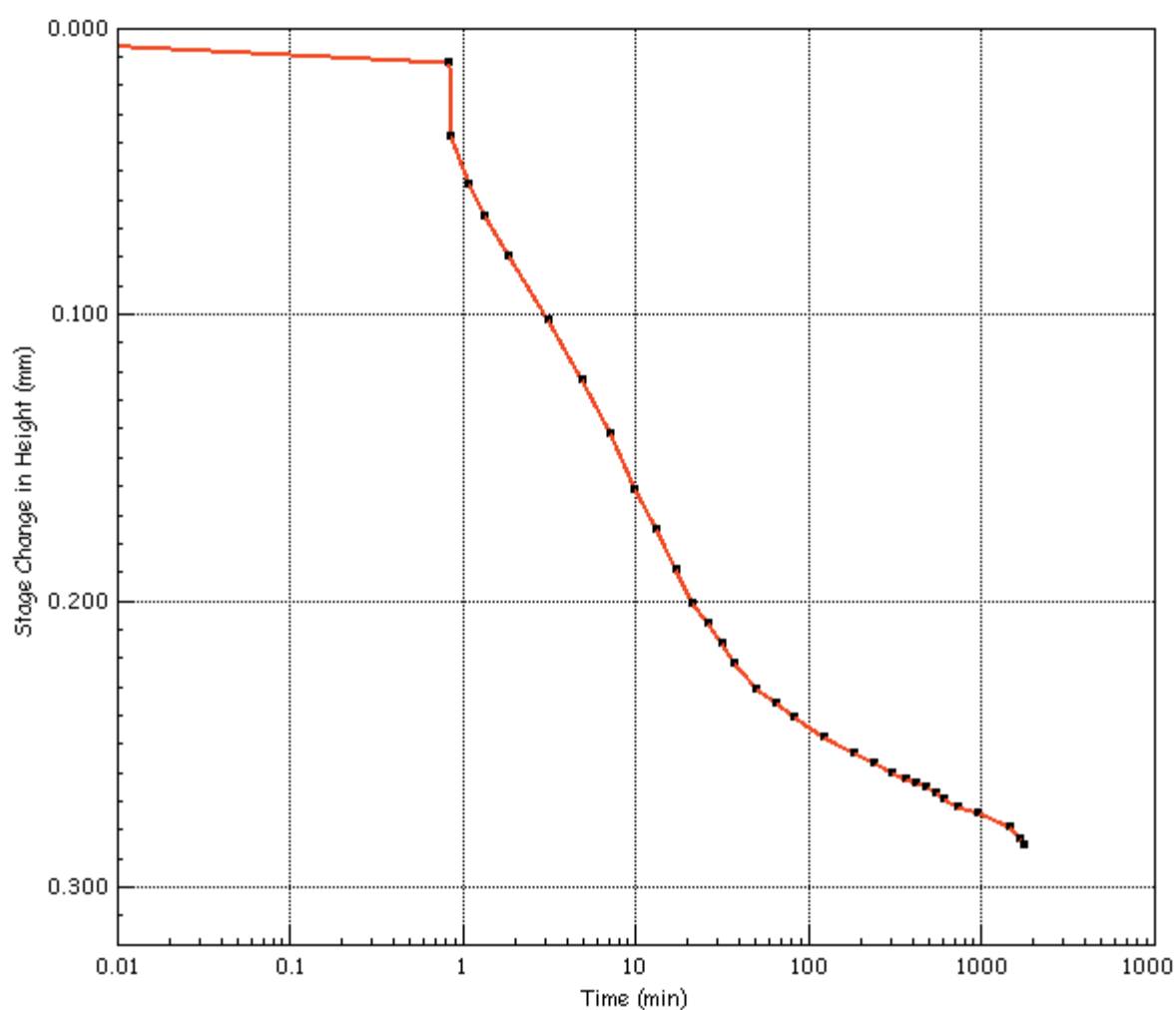
Vertical Stress	$\sigma'_i$	(kPa)	25
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.126
Height Settlement	$\Delta L_s$	(mm)	0.815
Voids Ratio	$e_f$	.	-0.168




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 9				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date				10/07/2019		
	Jobfile				Sample				7UT		
	Client				Borehole				BH06		
	CARDFF PARKWAY										
Operator		TA/JT/JG		Checked		*		Approved		*	

# Oedometer Consolidation Settlement Report

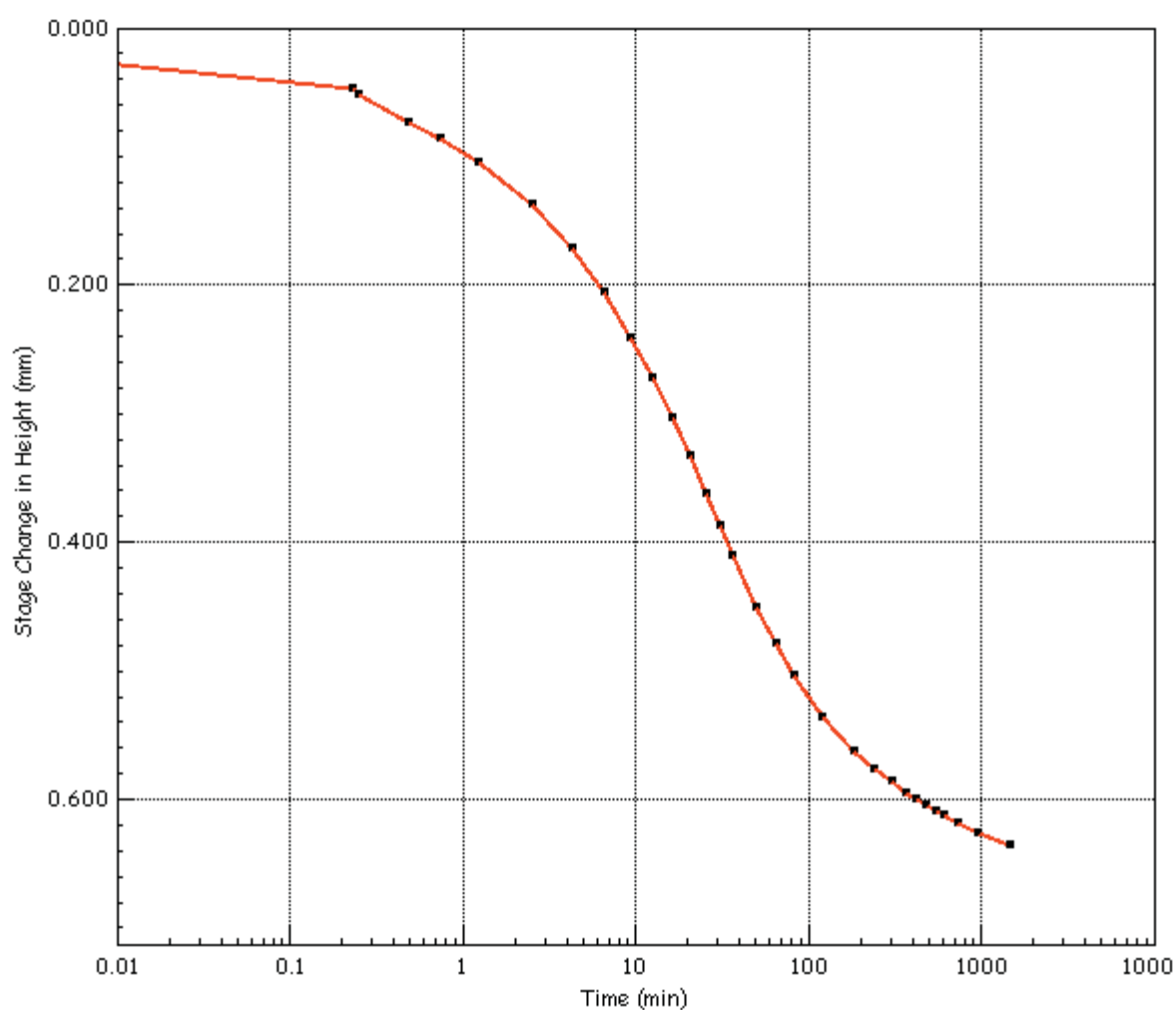
Vertical Stress	$\sigma'_i$	(kPa)	100
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.075
Height Settlement	$\Delta L_s$	(mm)	1.151
Voids Ratio	$e_f$	.	-0.183




	Test Method	BS1377 - 5 : 1990 : Clause 3	Test Name	FRAME 9
	Site Reference		Database:	.\SQLEXPRESS \ GEL
	Jobfile	35338	Test Date	10/07/2019
	Client	CARDDFF PARKWAY	Sample	7UT
	Operator	TA/JT/JG	Borehole	BH06
Checked			*	Approved
				*

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	200
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.106
Height Settlement	$\Delta L_s$	(mm)	1.755
Voids Ratio	$e_f$	.	-0.209



	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 9	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	10/07/2019	
	Client	CARDFF PARKWAY		Sample	7UT	
	Operator	TA/JT/JG	Checked	*	Approved	*

**DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES****BS.1377 : Part 5 : 1990 : 3**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH08

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

11P

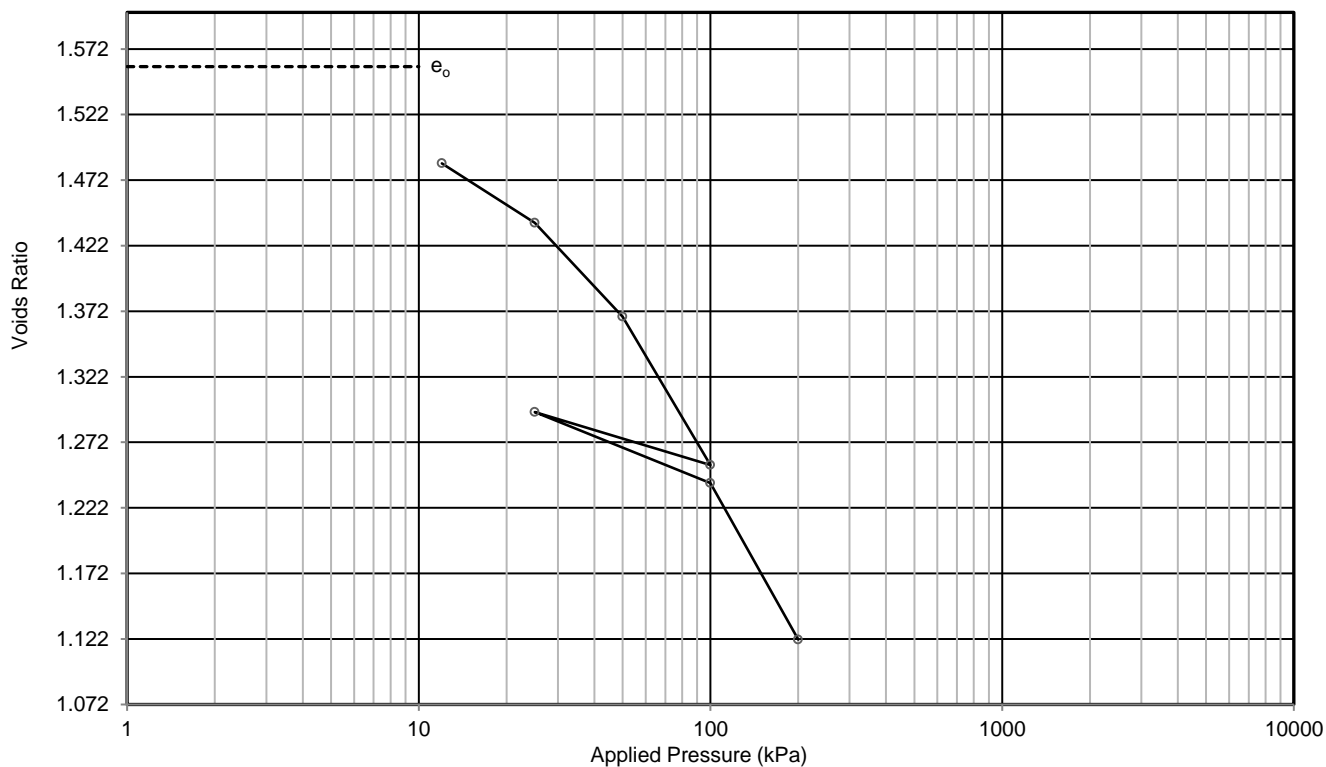
DESCRIPTION Greyish brown slightly organic silty CLAY

SAMPLE DEPTH (m)

3.70

SPECIMEN DEPTH (m)

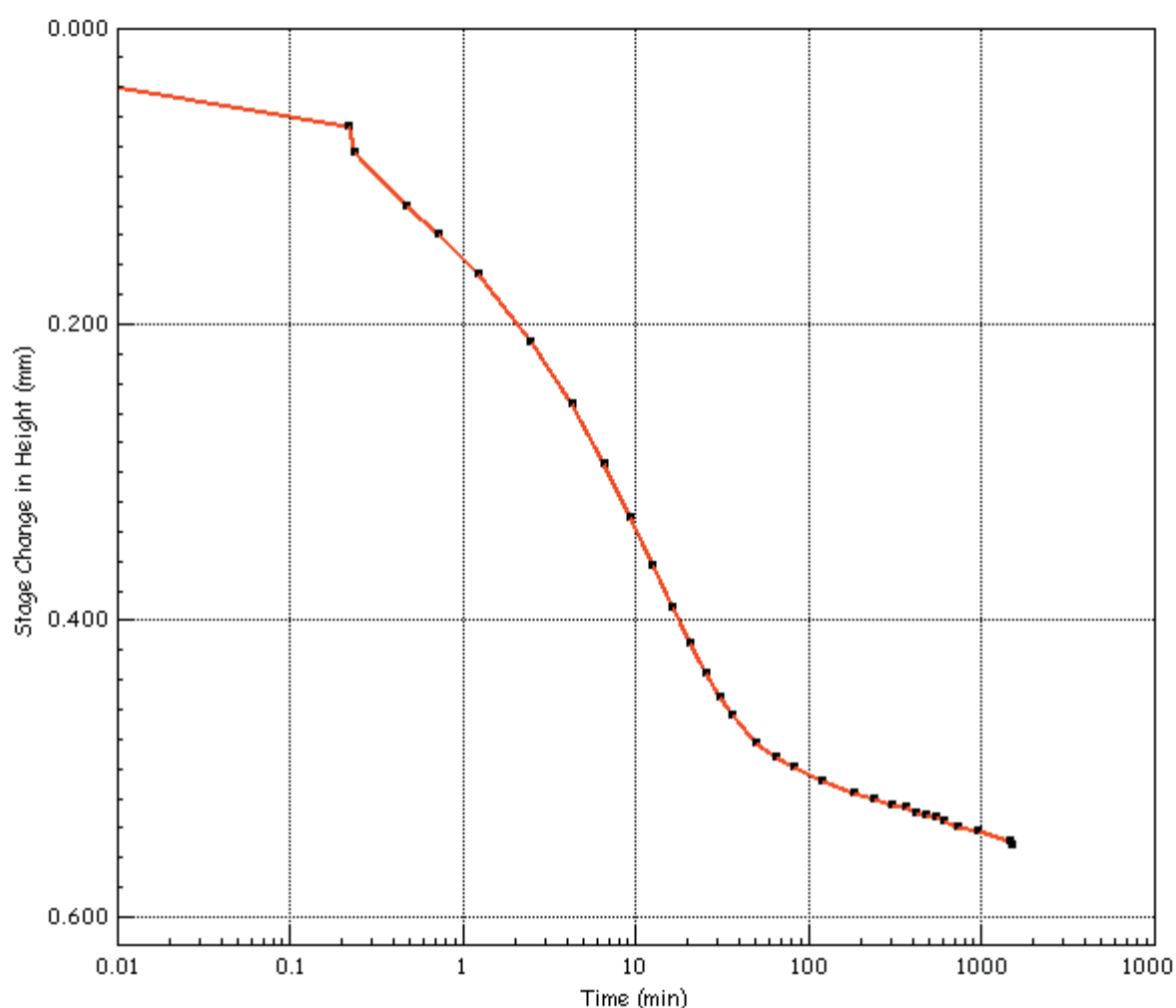
3.75




test and sample details			test results				
			pressure stage	voids ratio	laboratory coefficients of		
			(kPa)		compressibility mv (m <sup>2</sup> /MN)	consolidation Cv (m <sup>2</sup> /yr)	Csec (m <sup>2</sup> /yr)
specimen diameter	mm	63.40					
specimen height	mm	18.92					
initial moisture content	%	57.2					
final moisture content	%	42.8					
initial bulk density	Mg/m <sup>3</sup>	1.66	12	1.485	2.4	1.3	
initial dry density	Mg/m <sup>3</sup>	1.06	25	1.439	1.4	0.75	
initial voids ratio		1.559	50	1.368	1.2	0.74	
initial degree of saturation	%	99	100	1.255	0.96	0.54	0.0074
particle density	Mg/m <sup>3</sup>	#2.70	25	1.295	0.24		
swelling pressure	kPa	N/A	100	1.241	0.32	2.2	
			200	1.122	0.53	0.42	
P' <sub>o</sub> to P' <sub>o</sub> +100 kPa		-					
laboratory temperature	oC	20 ± 2					
method of time fitting		root time					
remarks	# denotes particle density has been assigned an assumed value load frame corrections applied				CONTRACT	CHECKED	
					35338	TB	

# Oedometer Consolidation Settlement Report

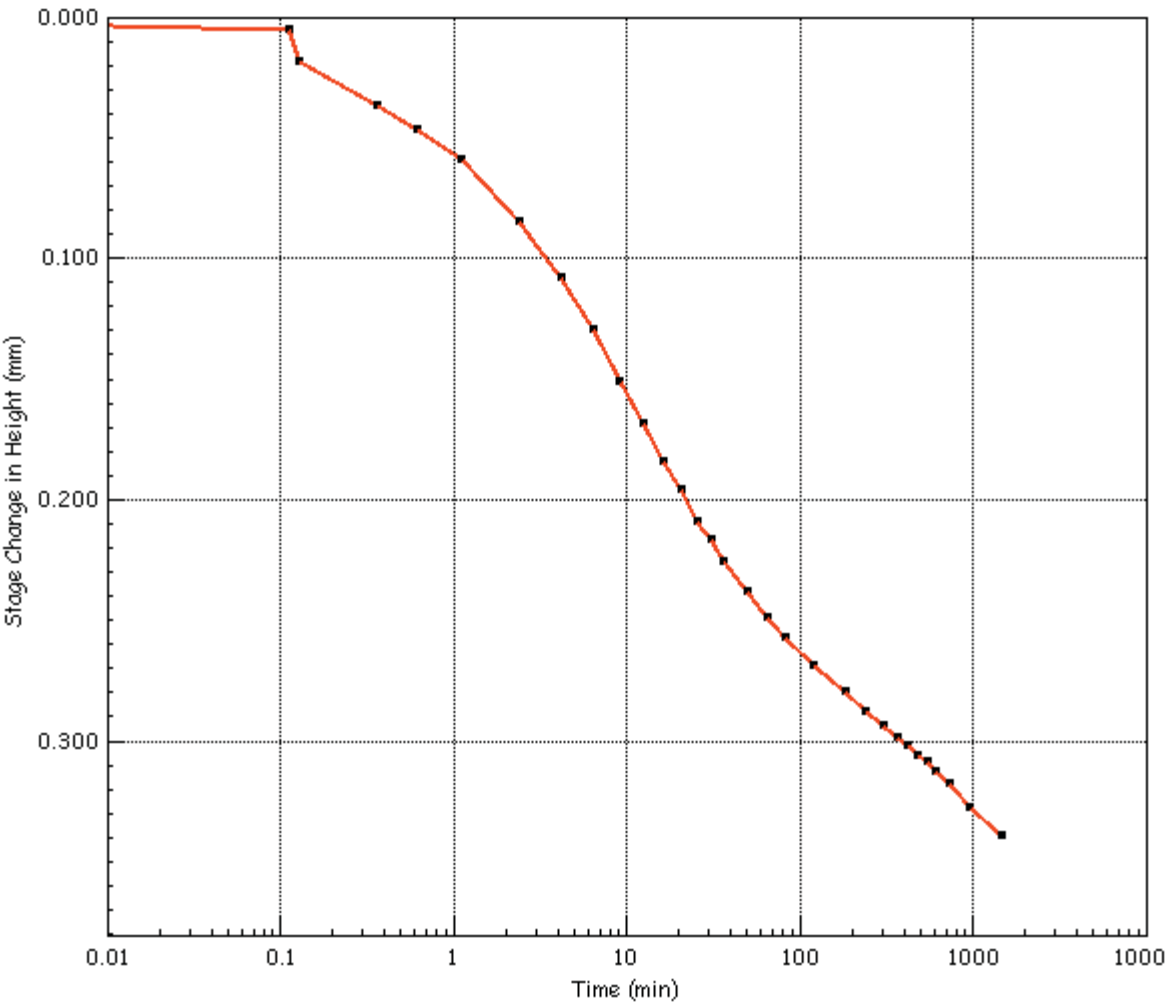
Vertical Stress	$\sigma'_{i1}$	(kPa)	12.0
Initial Temperature	$T_{i1}$	(°C)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.005
Height Settlement	$\Delta L_s$	(mm)	0.546
Voids Ratio	$e_f$	.	-0.156




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 3		
					Database: .\SQLEXPRESS \ GEL				
	Site Reference				Test Date		09/07/2019		
	Jobfile		35338		Sample		11P		
	Client		CARDFF PARKWAY		Borehole		BH08		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	

# Oedometer Consolidation Settlement Report

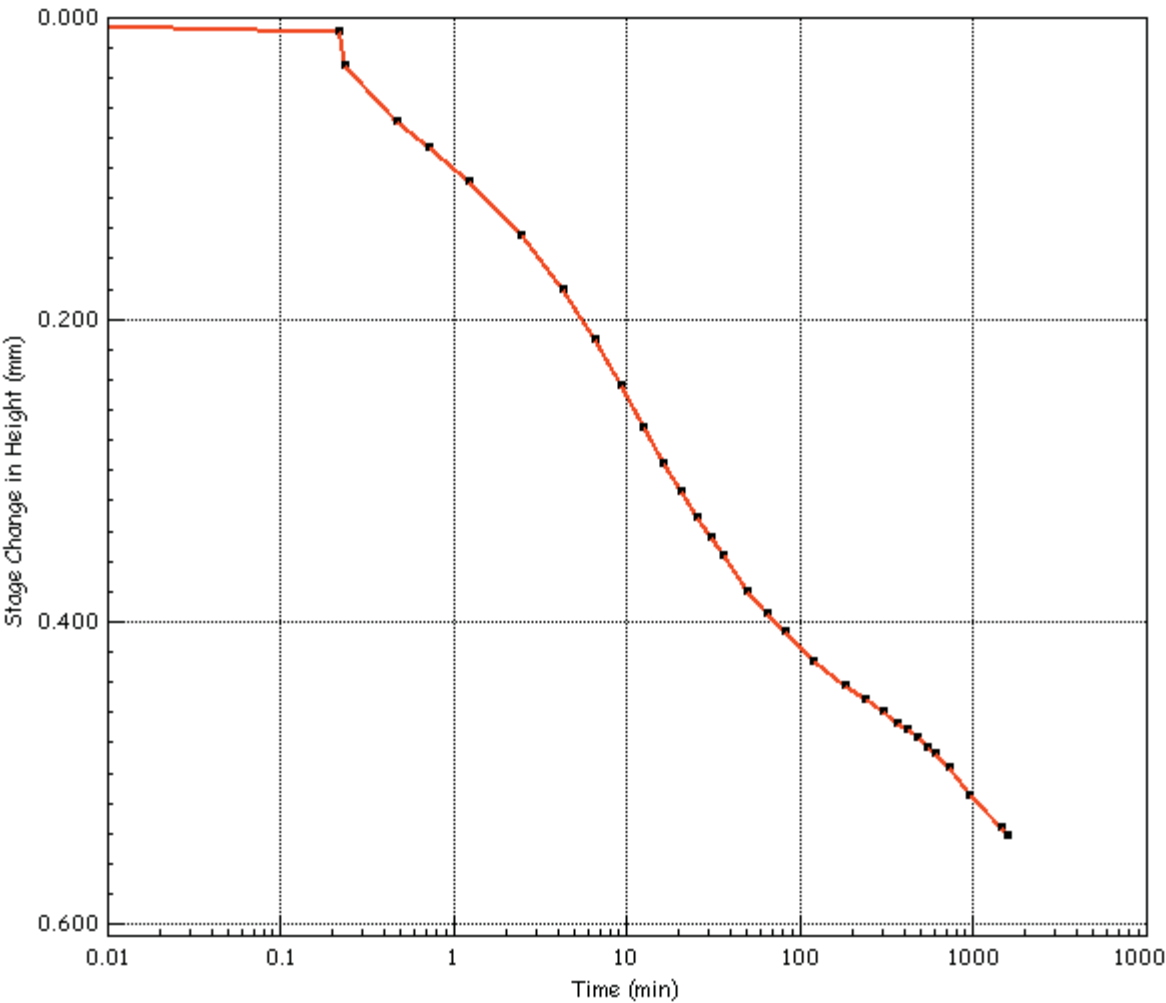
Vertical Stress	$\sigma'_i$	(kPa)	25
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.012
Height Settlement	$\Delta L_s$	(mm)	0.881
Voids Ratio	$e_f$	.	-0.171




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 3				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date				09/07/2019		
	Jobfile		35338		Sample		11P				
	Client		CARDFF PARKWAY		Borehole		BH08				
	Operator		TA/JT/JG		Checked		*		Approved		*

# Oedometer Consolidation Settlement Report

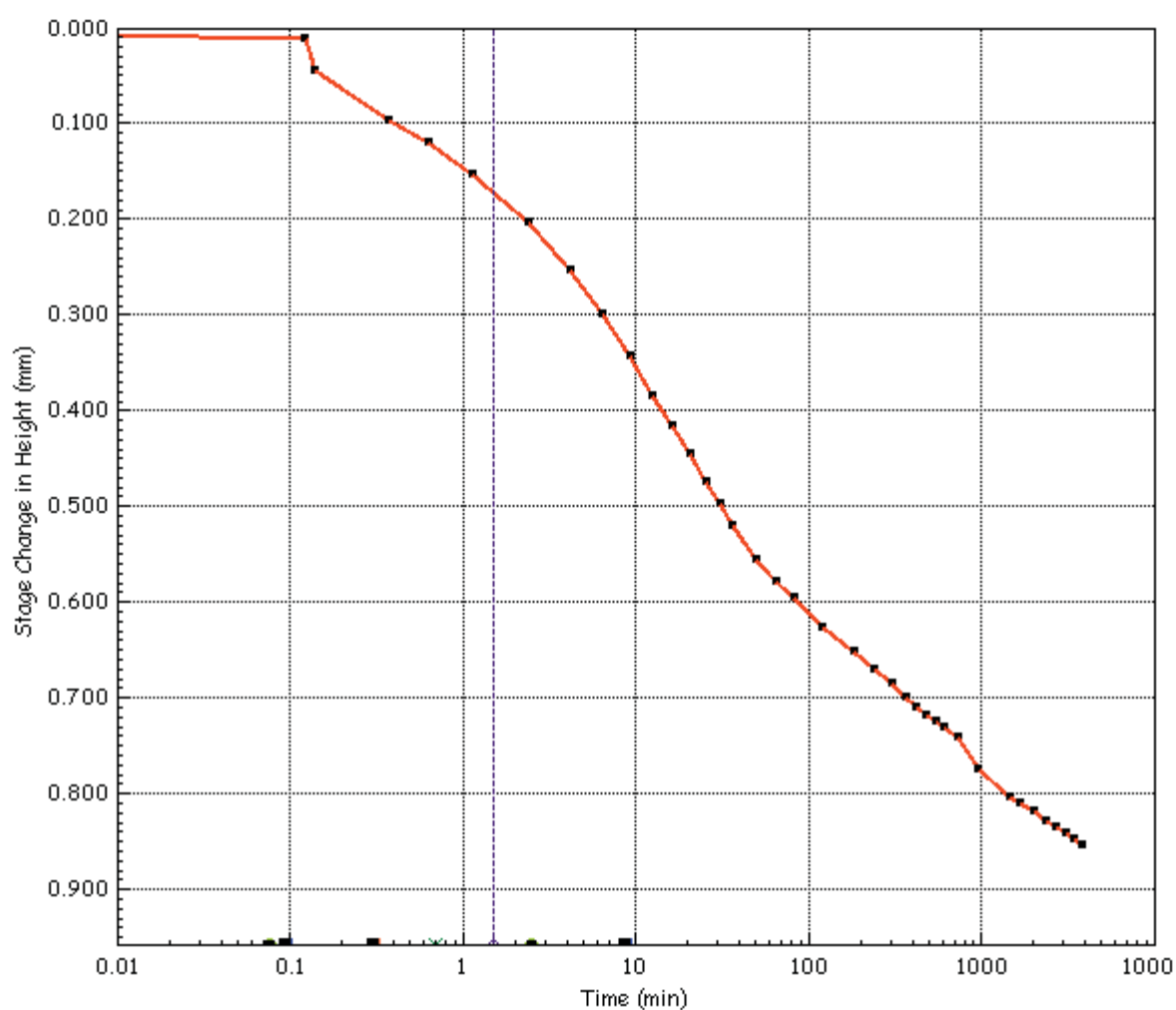
Vertical Stress	$\sigma'_i$	(kPa)	50
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.026
Height Settlement	$\Delta L_s$	(mm)	1.410
Voids Ratio	$e_f$	.	-0.194




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 3				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date				09/07/2019		
	Jobfile		35338		Sample		11P				
	Client		CARDFF PARKWAY		Borehole		BH08				
	Operator		TA/JT/JG		Checked		*		Approved		*

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	100
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.061
Height Settlement	$\Delta L_s$	(mm)	2.232
Voids Ratio	$e_f$	.	-0.230

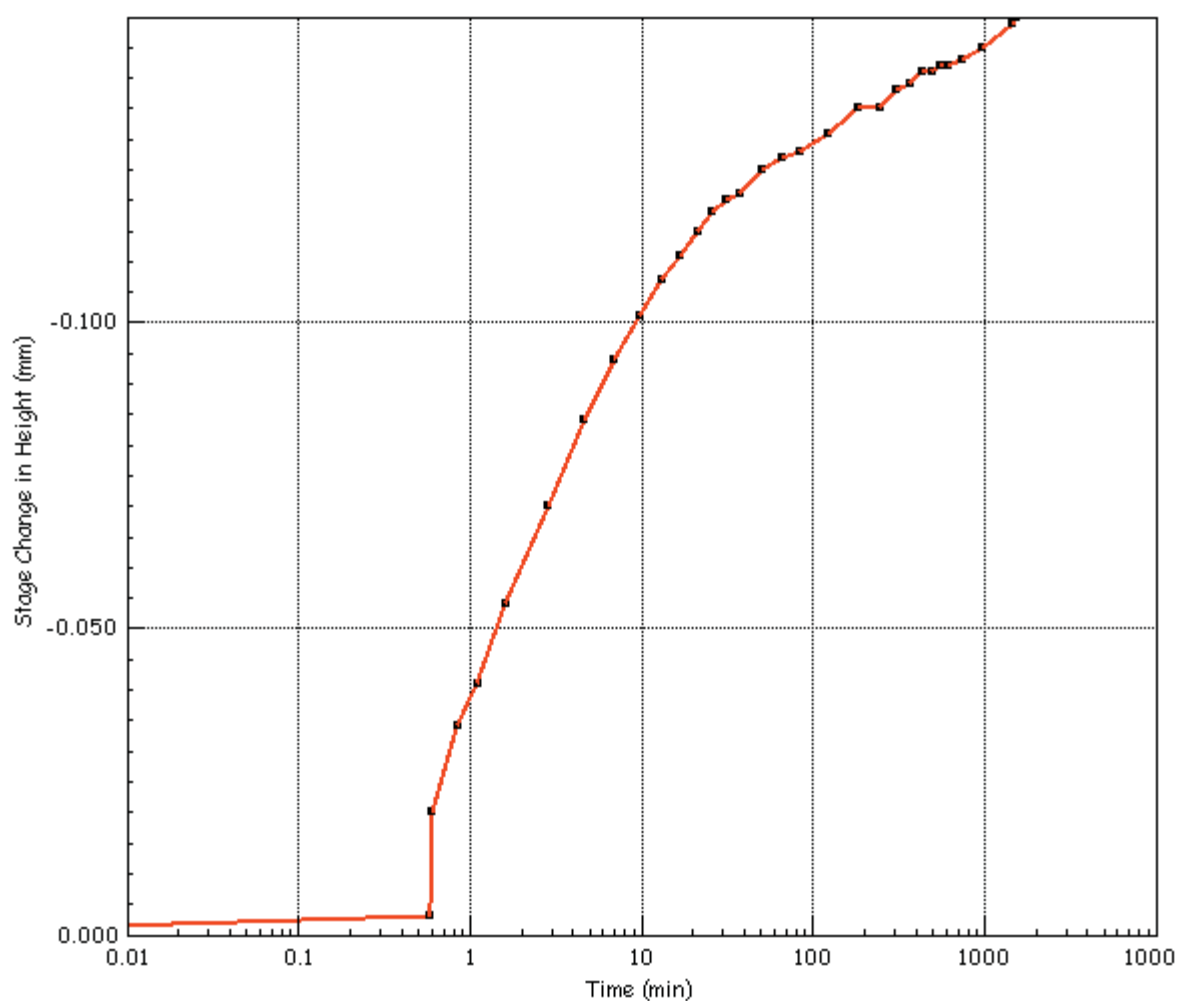



	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 3	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	09/07/2019	
	Client	CARDFF PARKWAY		Sample	11P	
	Operator	TA/JT/JG	Checked	*	Approved	*



# Oedometer Consolidation Settlement Report

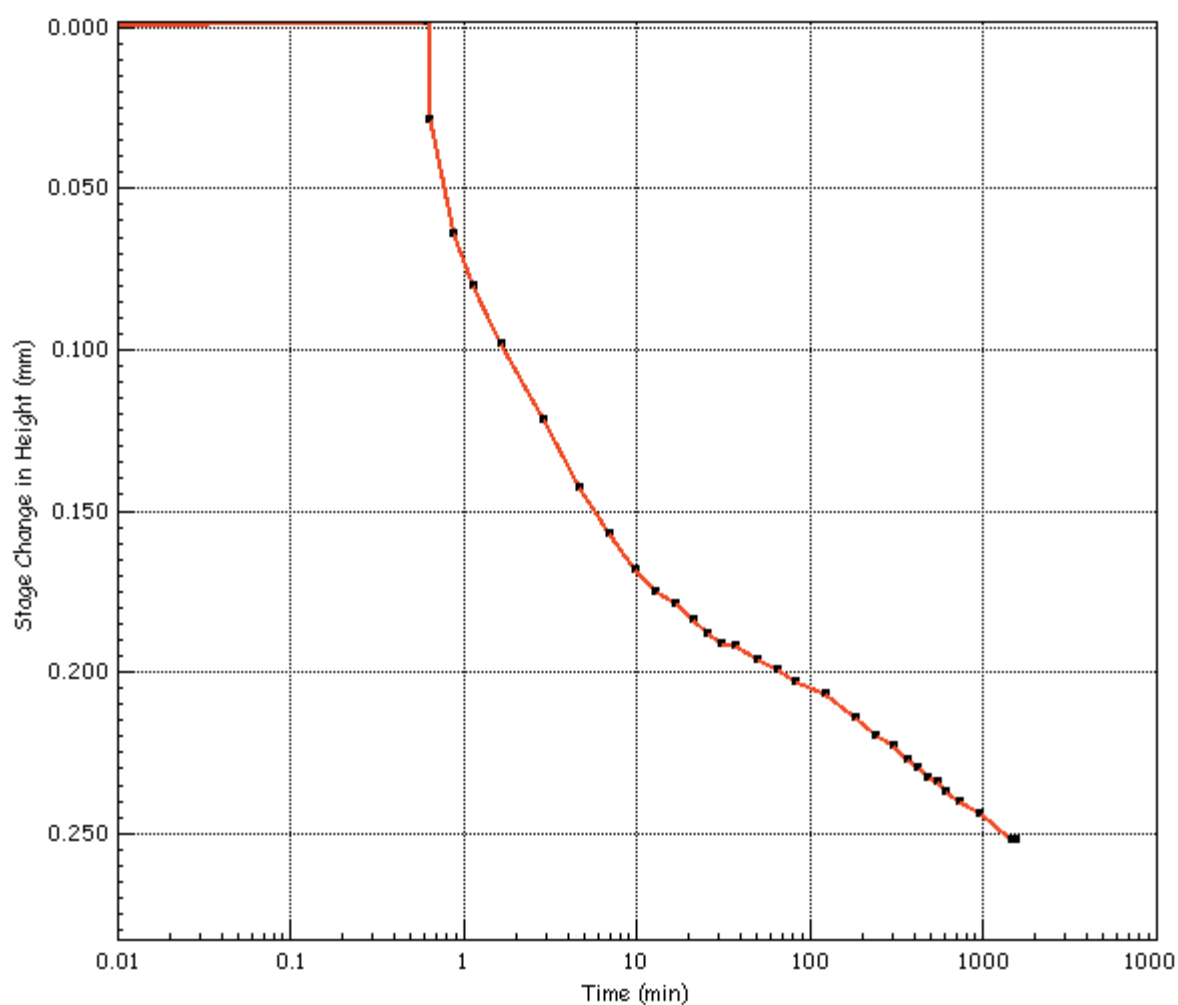
Vertical Stress	$\sigma'_i$	(kPa)	25
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.210
Height Settlement	$\Delta L_s$	(mm)	1.949
Voids Ratio	$e_f$	.	-0.217




	Test Method	BS1377 - 5 : 1990 : Clause 3	Test Name	FRAME 3
	Site Reference		Database:	.\SQLEXPRESS \ GEL
	Jobfile	35338	Test Date	09/07/2019
	Client	CARDFF PARKWAY	Sample	11P
	Operator	TA/JT/JG	Borehole	BH08
Checked			*	Approved
				*

# Oedometer Consolidation Settlement Report

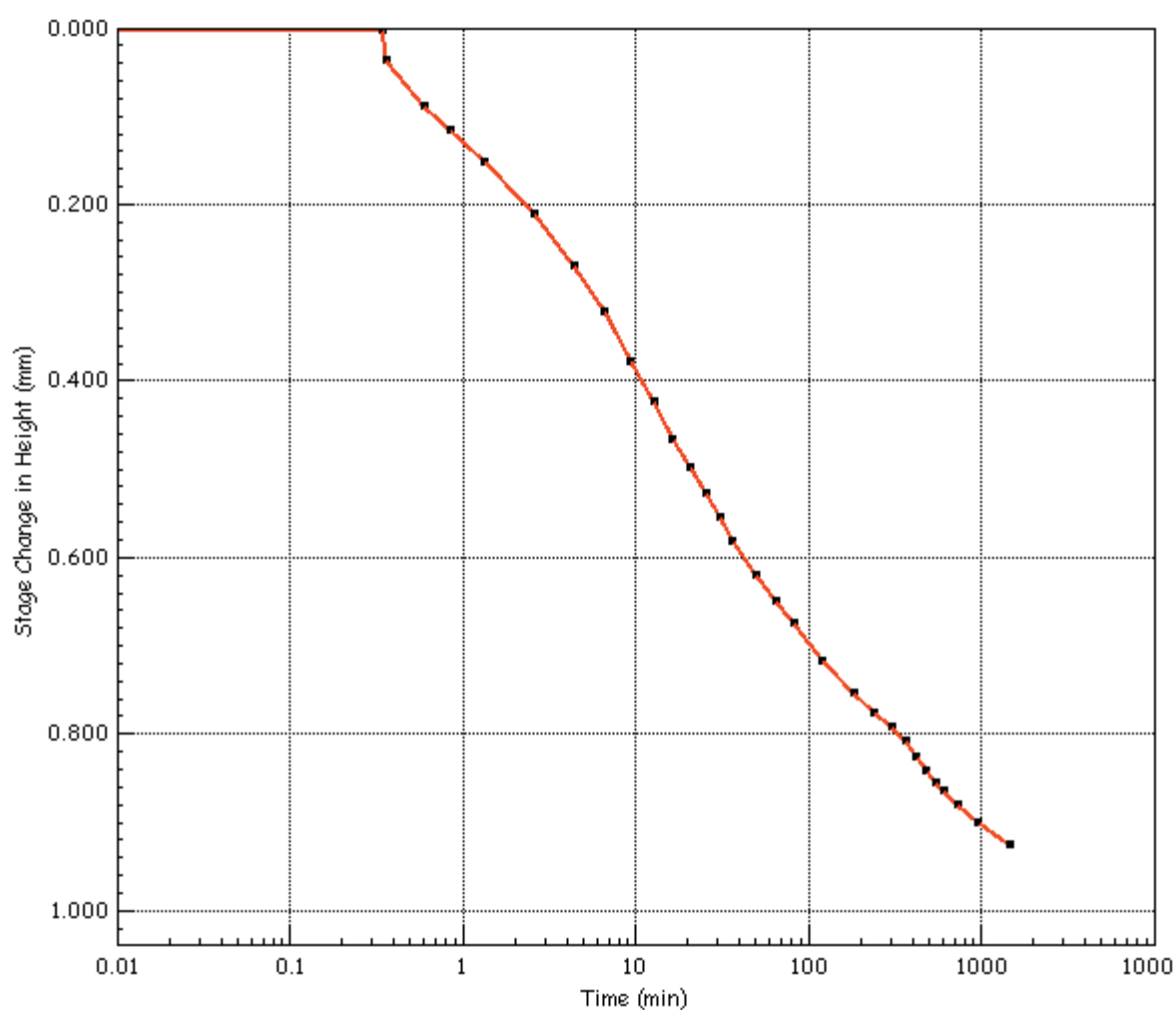
Vertical Stress	$\sigma'_i$	(kPa)	100
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.061
Height Settlement	$\Delta L_s$	(mm)	2.350
Voids Ratio	$e_f$	.	-0.235




	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 3	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	09/07/2019	
	Client	CARDFF PARKWAY		Sample	11P	
	Operator	TA/JT/JG	Checked	*	Approved	*

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	200
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.104
Height Settlement	$\Delta L_s$	(mm)	4.578
Voids Ratio	$e_f$	.	-0.331



	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 3	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	09/07/2019	
	Client	CARDFF PARKWAY		Sample	11P	
	Operator	TA/JT/JG	Checked	*	Approved	*

**DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES****BS.1377 : Part 5 : 1990 : 3**

CLIENT    CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH09

SITE        CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

9P

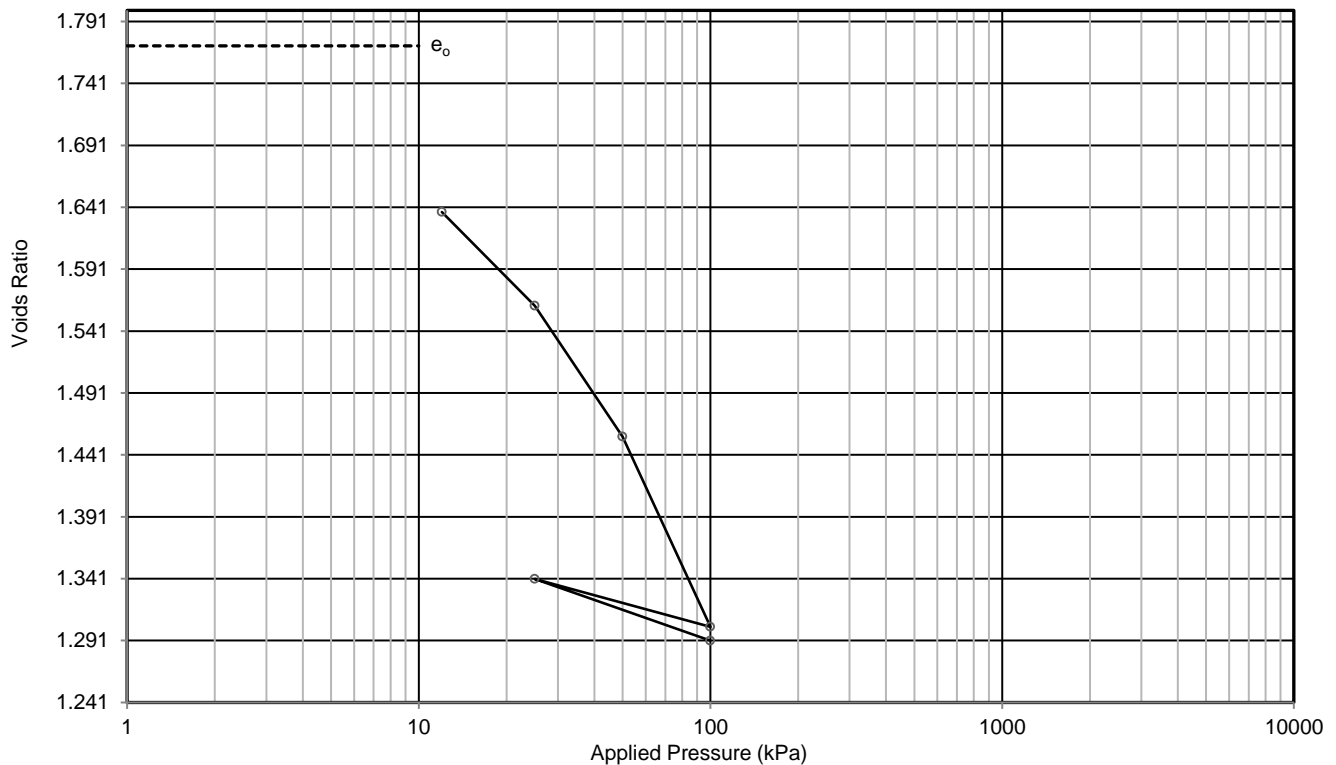
DESCRIPTION    Bluish grey slightly organic silty CLAY

SAMPLE DEPTH (m)

2.20

SPECIMEN DEPTH (m)

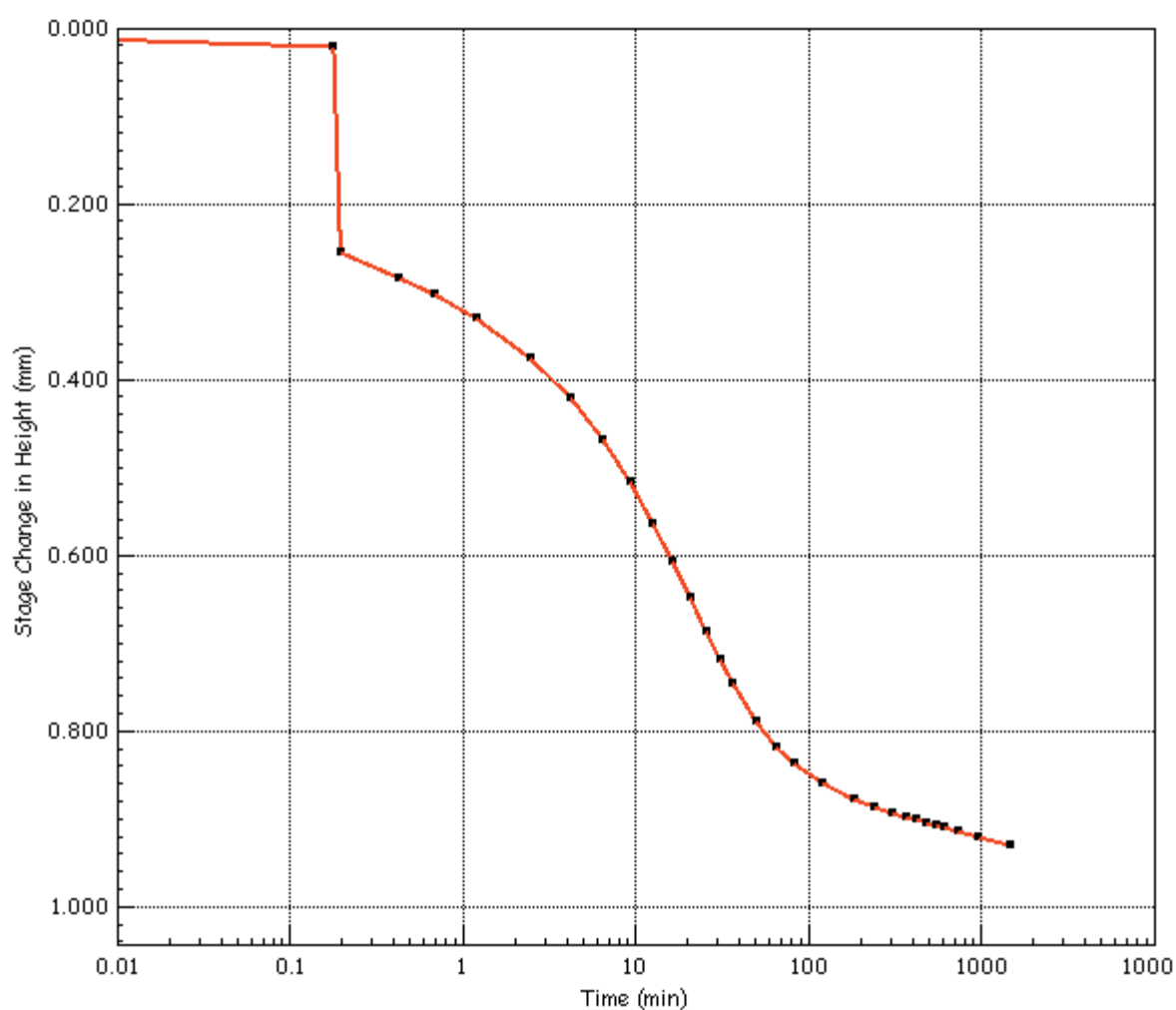
2.30




test and sample details			test results				
			pressure stage	voids ratio	laboratory coefficients of		
			(kPa)		compressibility mv (m <sup>2</sup> /MN)	consolidation Cv (m <sup>2</sup> /yr)	Csec (m <sup>2</sup> /yr)
specimen diameter	mm	63.33					
specimen height	mm	18.87					
initial moisture content	%	65.9					
final moisture content	%	51.2					
initial bulk density	Mg/m <sup>3</sup>	1.62	12	1.637	4	0.56	
initial dry density	Mg/m <sup>3</sup>	0.97	25	1.561	2.2	0.48	
initial voids ratio		1.771	50	1.456	1.7	0.42	
initial degree of saturation	%	100	100	1.302	1.3	0.37	0.0087
particle density	Mg/m <sup>3</sup>	#2.70	25	1.341	0.22		
swelling pressure	kPa	N/A	100	1.291	0.28	1.9	
P'o to P'o +100 kPa		-					
laboratory temperature	oC	20 ± 2					
method of time fitting		root time					
remarks	# denotes particle density has been assigned an assumed value load frame corrections applied				CONTRACT	CHECKED	
					35338	TB	

# Oedometer Consolidation Settlement Report

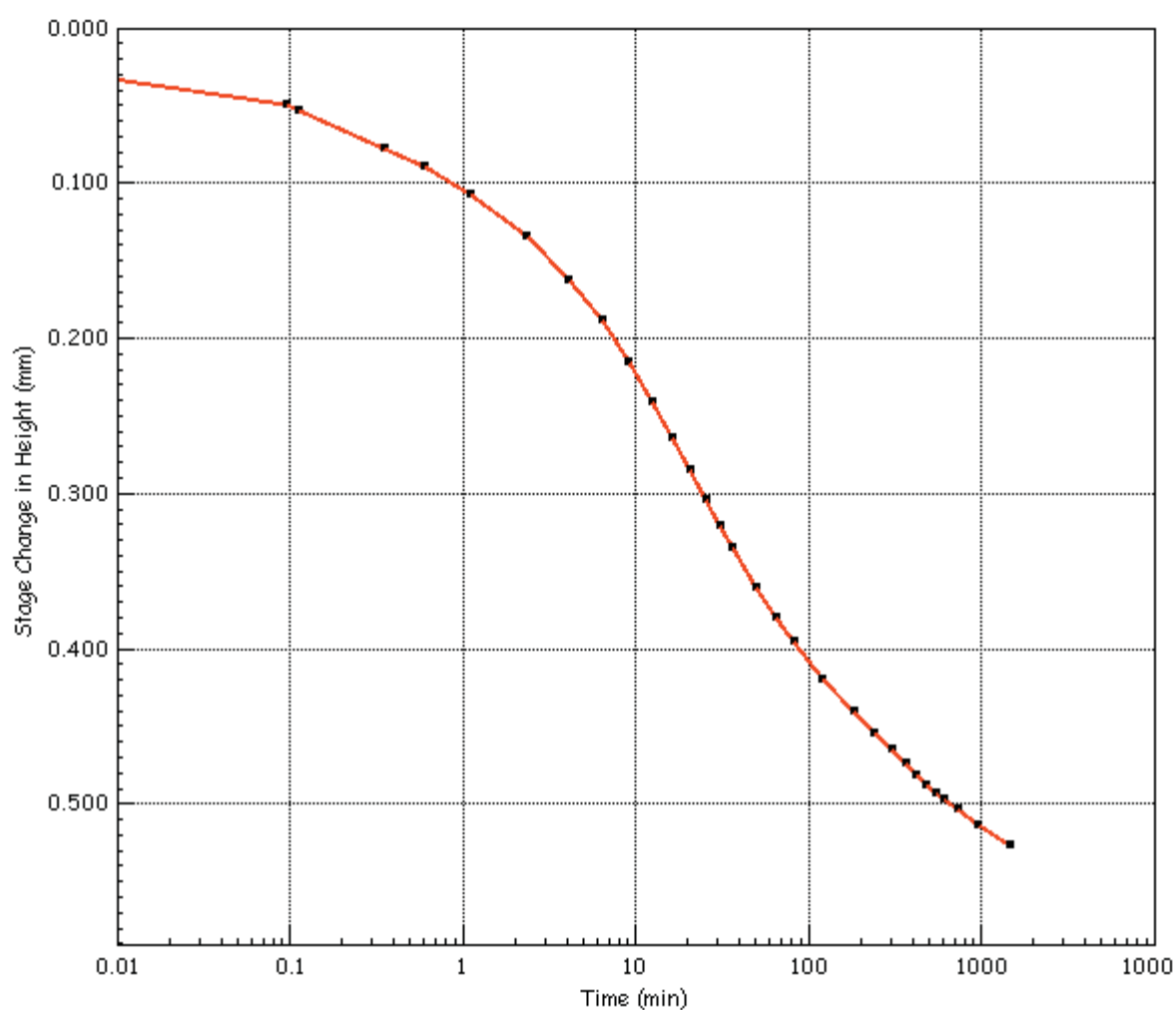
Vertical Stress	$\sigma'_i$	(kPa)	12.0
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.015
Height Settlement	$\Delta L_s$	(mm)	0.914
Voids Ratio	$e_f$	.	-0.172




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 4				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date				09/07/2019		
	Jobfile				Sample				9P		
	Client				Borehole				BH09		
	CARDFF PARKWAY										
Operator		TA/JT/JG		Checked		*		Approved		*	

# Oedometer Consolidation Settlement Report

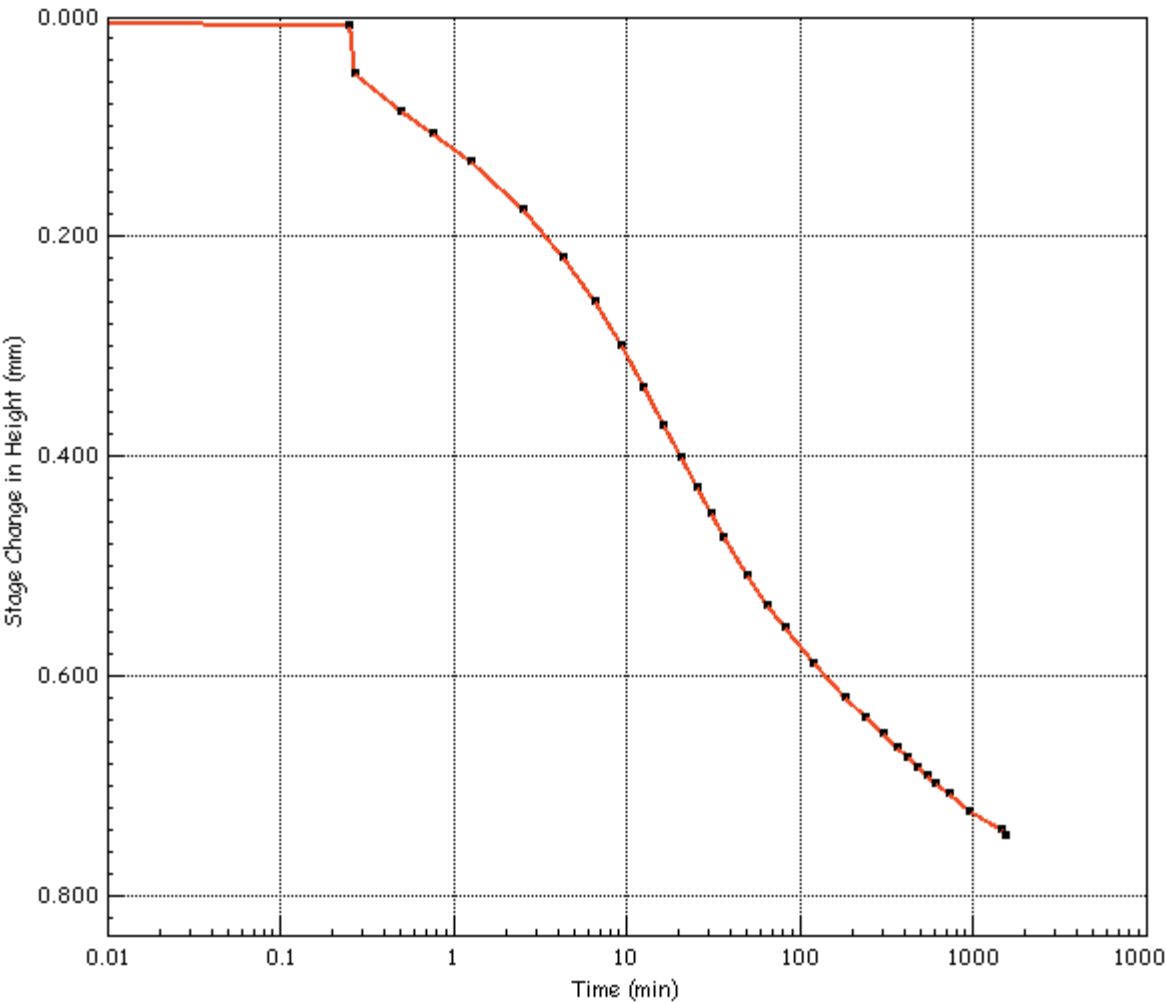
Vertical Stress	$\sigma'_i$	(kPa)	25
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.031
Height Settlement	$\Delta L_s$	(mm)	1.429
Voids Ratio	$e_f$	.	-0.195




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 4				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date				09/07/2019		
	Jobfile				Sample				9P		
	Client				Borehole				BH09		
	CARDFF PARKWAY										
Operator		TA/JT/JG		Checked		*		Approved		*	

# Oedometer Consolidation Settlement Report

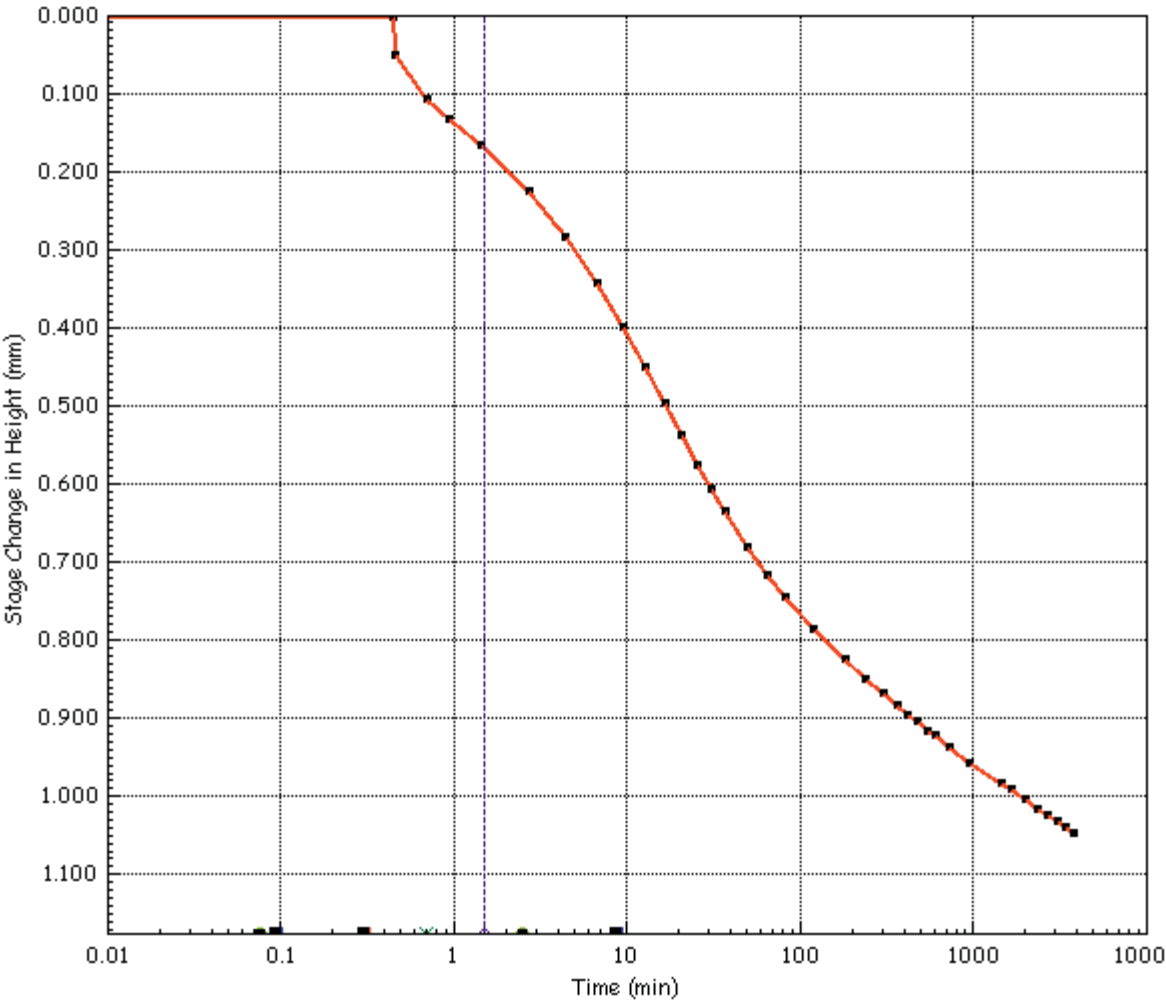
Vertical Stress	$\sigma'_i$	(kPa)	50
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.056
Height Settlement	$\Delta L_s$	(mm)	2.149
Voids Ratio	$e_f$	.	-0.226




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 4				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date				09/07/2019		
	Jobfile		35338		Sample		9P				
	Client		CARDFF PARKWAY		Borehole		BH09				
	Operator		TA/JT/JG		Checked		*		Approved		*

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	100
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.083
Height Settlement	$\Delta L_s$	(mm)	3.172
Voids Ratio	$e_f$	.	-0.270

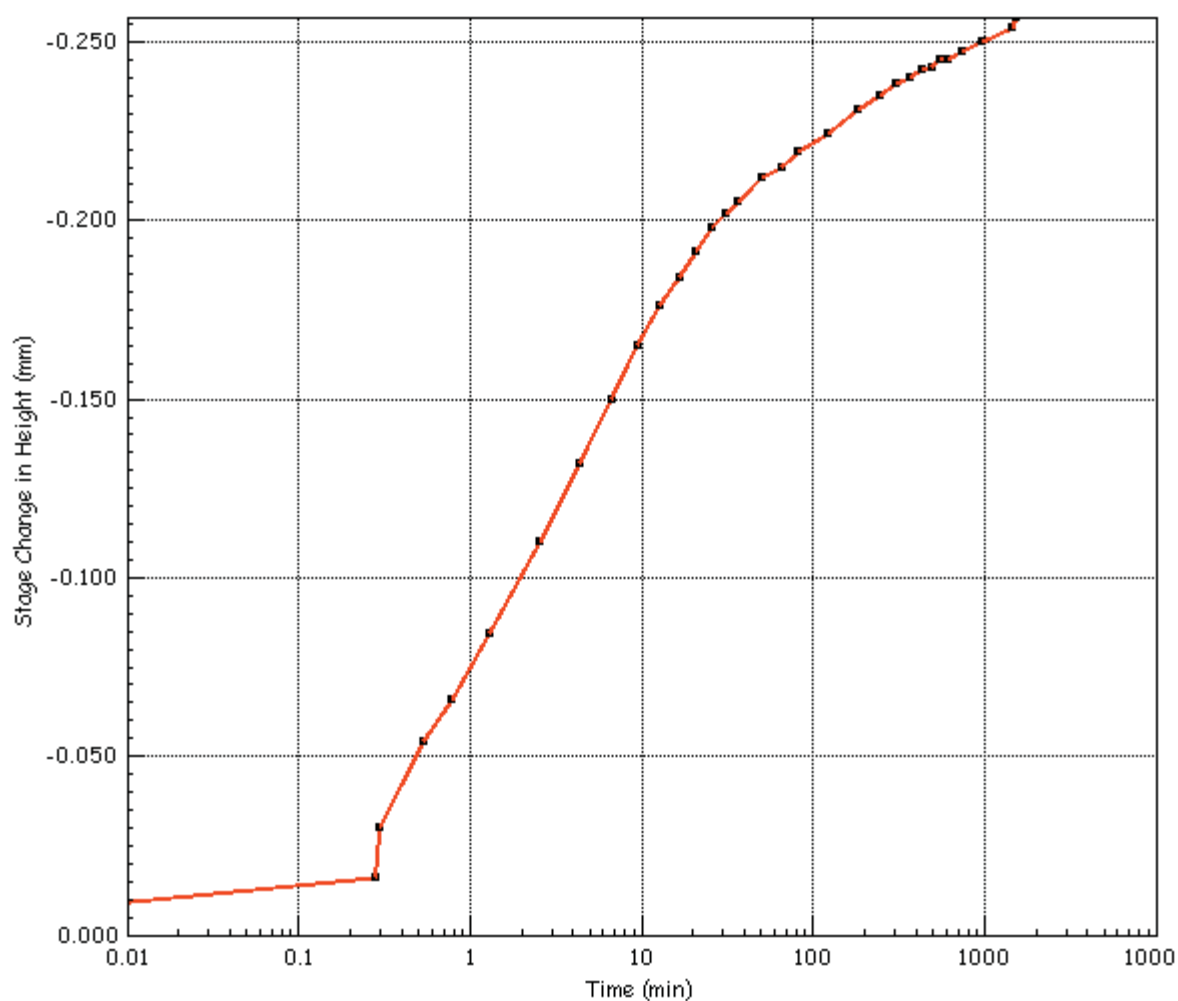



	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 4		
					Database:		.\SQLEXPRESS \ GEL		
	Site Reference				Test Date		09/07/2019		
	Jobfile		35338		Sample		9P		
	Client		CARDFF PARKWAY		Borehole		BH09		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	



# Oedometer Consolidation Settlement Report

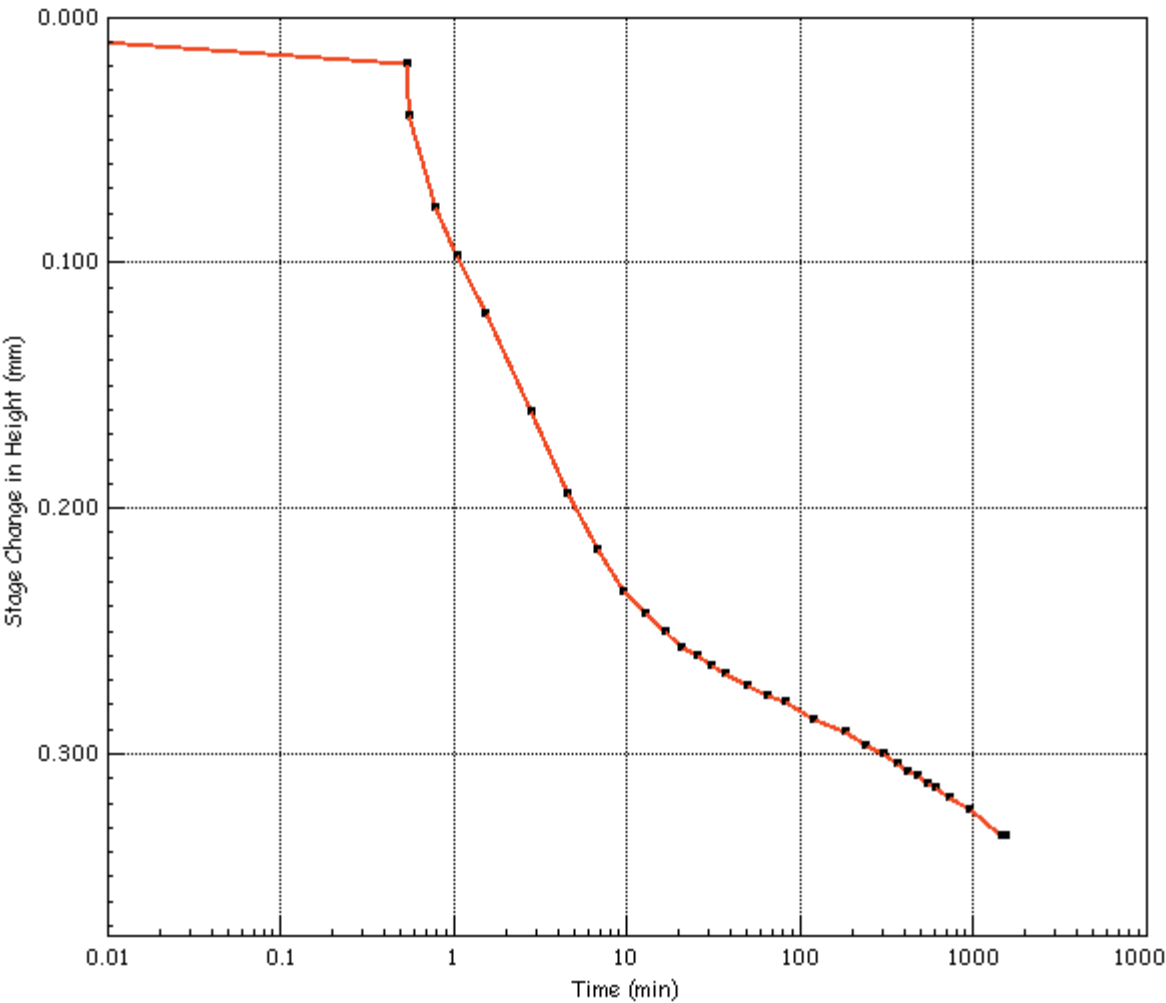
Vertical Stress	$\sigma'_i$	(kPa)	25
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.089
Height Settlement	$\Delta L_s$	(mm)	2.932
Voids Ratio	$e_f$	.	-0.260




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 4				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date				09/07/2019		
	Jobfile				Sample				9P		
	Client				Borehole				BH09		
	CARDFF PARKWAY										
Operator		TA/JT/JG		Checked		*		Approved		*	

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	100
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.083
Height Settlement	$\Delta L_s$	(mm)	3.271
Voids Ratio	$e_f$	.	-0.275



	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 4	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	09/07/2019	
	Client	CARDFF PARKWAY		Sample	9P	
	Operator	TA/JT/JG	Checked	*	Approved	*



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	sample		specimen depth (m)	code	moisture content		dimensions		density		cell pressure (kPa)	rate of strain (%/min)	deviator stress (kPa)	failure strain (%)	failure mode	shear strength* (kPa)	description and remarks		
	no./type	depth (m)			initial (%)	final (%)	length (mm)	diameter (mm)	bulk (Mg/m3)	dry (Mg/m3)									
BH06	7UT	1.20	1.41	UU100	46.1	40.1	206	104	1.45	0.99	20	2.0	29	6.3	I	14	Brown mottled grey and orange organic silty CLAY		
BH08	11P	3.70	3.80	UU100	64.4	64.7	200	100	1.65	1.00	60	2.0	33	3.5	S	16	Greyish brown organic silty CLAY		
BH09	9P	2.20	2.40	UU100	63.2	63.7	200	100	1.51	0.92	40	2.0	25	6.5	S	13	Bluish grey slightly organic silty CLAY		
general remarks:				code:		failure mode:		membrane type/thickness:										CONTRACT	CHECKED
* shear strength taken as half deviator stress at failure for each stage				UU - unconsolidated undrained		B - barrel (plastic failure)		latex membrane used (unless otherwise specified)										35338	TB
membrane correction applied				M - multi stage		S - shear (brittle failure)		38 - 0.2mm											
sample taken vertically (unless otherwise specified)				S - set of three		I - intermediate		70 - 0.4mm											
strain rate 2%/min (unless otherwise specified)				R - remoulded		O - other (see remarks)		100 - 0.4mm											

**POINT LOAD STRENGTH TEST**

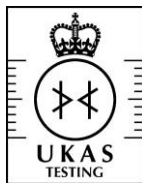
I.S.R.M. Suggested Methods : 2007 Edition



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	sample depth (m)	test type	test orien- tation	moisture condition	width  W (mm)	length  L (mm)	platen sep.  D (mm)	failure load  P (kN)	equiv. diam.  De (mm)	Is  (MPa)	size factor	Is(50)  (MPa)	description and remarks
BH06	5.62	I	U	P	50	90	55	5.06	59.17	1.45	1.08	1.56	Reddish brown MUDSTONE
BH06	7.80	D	Y	P		40	100	0.16	100.00	0.02	1.37	0.02	Reddish brown MUDSTONE
BH06	7.80	A	X	P	100		40	0.39	71.36	0.08	1.17	0.09	Reddish brown MUDSTONE
BH06	9.40	A	X	P	100		40	2.48	71.36	0.49	1.17	0.57	Reddish brown MUDSTONE
BH06	11.36	D	Y	P		40	80	3.94	80.00	0.62	1.24	0.76	Reddish brown MUDSTONE
BH06	11.36	A	X	P	80		30	4.16	55.28	1.36	1.05	1.42	Reddish brown MUDSTONE
BH08	18.20	I	U	P	70	40	30	1.20	51.71	0.45	1.02	0.46	Reddish brown MUDSTONE
BH08	21.75	D	Y	P		70	90	1.63	90.00	0.20	1.30	0.26	Reddish brown MUDSTONE
BH08	21.75	A	X	P	90		70	1.54	89.56	0.19	1.30	0.25	Reddish brown MUDSTONE
BH08	23.80	D	Y	P		50	70	0.96	70.00	0.20	1.16	0.23	Reddish brown SANDSTONE
BH08	23.80	A	X	P	70		50	0.59	66.76	0.13	1.14	0.15	Reddish brown SANDSTONE
BH09	8.90	I	U	P	70	40	40	1.26	59.71	0.35	1.08	0.38	Reddish brown MUDSTONE
BH09	13.05	I	U	P	90	110	70	1.96	89.56	0.24	1.30	0.32	Reddish brown MUDSTONE
BH09	16.80	D	Y	P		50	90	5.49	90.00	0.68	1.30	0.88	Reddish brown SANDSTONE
BH09	16.80	A	X	P	90		45	6.74	71.81	1.31	1.18	1.54	Reddish brown SANDSTONE
BH09	17.55	D	Y	P		60	90	3.47	90.00	0.43	1.30	0.56	Reddish brown SANDSTONE
BH09	17.55	A	X	P	90		60	12.80	82.92	1.86	1.26	2.34	Reddish brown SANDSTONE
BH09	21.85	D	Y	P		30	90	0.21	90.00	0.03	1.30	0.03	Reddish Brown MUDSTONE
BH09	21.85	A	X	P	90		35	0.39	63.33	0.10	1.11	0.11	Reddish Brown MUDSTONE
general remarks tests carried out in accordance with I.S.R.M.(2007): Suggested Methods for Determining Point Load Strength test machine PLM02													
test type		test orientation relative to discontinuities				moisture condition				CONTRACT		CHECKED	
A - axial		X - perpendicular				N - natural moisture content				35338		TB	
D - diametral		Y - parallel				P - partially air dried							
I - irregular lump		Z - oblique				S - soaked							



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# Final Report

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**Report No.:** 19-22897-1

**Initial Date of Issue:** 15-Jul-2019

**Client** Geotechnical Engineering Ltd

**Client Address:** Centurion House  
Olympus Park  
Quedgeley  
Gloucester  
Gloucestershire  
GL2 4NF

**Contact(s):** GEL  
Wendy Jones

**Project** 35338B Cardiff Parkway Initial Ground Investigation

<b>Quotation No.:</b>		<b>Date Received:</b>	08-Jul-2019
<b>Order No.:</b>	35338B/WJ	<b>Date Instructed:</b>	08-Jul-2019
<b>No. of Samples:</b>	8		
<b>Turnaround (Wkdays):</b>	5	<b>Results Due:</b>	12-Jul-2019
<b>Date Approved:</b>	15-Jul-2019		

**Approved By:**



**Details:** Robert Monk, Technical Manager

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## Results - Soil

**Project: 35338B Cardiff Parkway Initial Ground Investigation**

<b>Client: Geotechnical Engineering Ltd</b>	<b>Chemtest Job No.:</b>				19-22897	19-22897	19-22897	19-22897	19-22897	19-22897	19-22897	19-22897
<b>Quotation No.:</b>	<b>Chemtest Sample ID.:</b>				854548	854549	854550	854551	854552	854553	854554	854555
	Client Sample ID.:				2D	25C	7L	21D	29C	1B	16C	25C
	Sample Location:				BH06	BH06	BH08	BH08	BH08	BH09	BH09	BH09
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.20	9.60	1.20	9.40	14.50	0.20	8.20	20.20
	Bottom Depth (m):				0.40	11.10	2.10	9.50	16.00	0.40	9.70	21.70
	Date Sampled:				05-Jul-2019	05-Jul-2019	05-Jul-2019	05-Jul-2019	05-Jul-2019	05-Jul-2019	05-Jul-2019	05-Jul-2019
<b>Determinand</b>	<b>Accred.</b>	<b>SOP</b>	<b>Units</b>	<b>LOD</b>								
Moisture	N	2030	%	0.020	15	9.8	43	9.9	5.4	20	9.6	9.2
pH (2.5:1)	N	2010		N/A	8.3	8.6		9.6	8.4	9.5	9.7	9.5
Magnesium (Water Soluble)	N	2120	g/l	0.010	0.010	< 0.010		< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Sulphate (2:1 Water Soluble) as SO <sub>4</sub>	U	2120	g/l	0.010	0.49	0.051		< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Total Sulphur	U	2175	%	0.010	0.087	0.030		0.028	0.019	0.011	0.019	< 0.010
Chloride (Water Soluble)	U	2220	g/l	0.010	0.041	< 0.010		0.028	< 0.010	0.010	0.081	0.071
Nitrate (Water Soluble)	N	2220	g/l	0.010	< 0.010	< 0.010		< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Sulphate (Acid Soluble)	U	2430	%	0.010	0.16	0.020		0.036	0.020	< 0.010	< 0.010	< 0.010
Organic Matter	U	2625	%	0.40			7.8					

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measurement by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.

## **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, SVOCs, PCBs, Phenols

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

All Asbestos testing is performed at the indicated laboratory

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

### **Sample Deviation Codes**

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- 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
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

### **Sample Retention and Disposal**

---

All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

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

[customerservices@chemtest.com](mailto:customerservices@chemtest.com)





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# Final Report

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**Report No.:** 19-23528-1

**Initial Date of Issue:** 18-Jul-2019

**Client** Geotechnical Engineering Ltd

**Client Address:** Centurion House  
Olympus Park  
Quedgeley  
Gloucester  
Gloucestershire  
GL2 4NF

**Contact(s):** GEL  
Wendy Jones

**Project** 35338B Cardiff Parkway Initial Ground  
Investigation

<b>Quotation No.:</b>		<b>Date Received:</b>	12-Jul-2019
<b>Order No.:</b>	35338B/WJ	<b>Date Instructed:</b>	12-Jul-2019
<b>No. of Samples:</b>	3		
<b>Turnaround (Wkdays):</b>	5	<b>Results Due:</b>	18-Jul-2019
<b>Date Approved:</b>	18-Jul-2019		

**Approved By:**



**Details:** Martin Dyer, Laboratory Manager

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**Project: 35338B Cardiff Parkway Initial Ground Investigation**

<b>Client: Geotechnical Engineering Ltd</b>	<b>Chemtest Job No.:</b>				19-23528	19-23528	19-23528
Quotation No.:	<b>Chemtest Sample ID.:</b>				856967	856968	856969
	Client Sample ID.:				7UT	11P	9P
	Sample Location:				BH06	BH08	BH09
	Sample Type:				SOIL	SOIL	SOIL
	Top Depth (m):				1.20	3.70	2.20
	Bottom Depth (m):				1.65	4.50	3.20
	Date Sampled:				10-Jul-2019	10-Jul-2019	10-Jul-2019
<b>Determinand</b>	<b>Accred.</b>	<b>SOP</b>	<b>Units</b>	<b>LOD</b>			
Moisture	N	2030	%	0.020	46	36	37
pH (2.5:1)	N	2010		N/A	7.5	8.5	
Magnesium (Water Soluble)	N	2120	g/l	0.010	0.021	0.014	
Sulphate (2:1 Water Soluble) as SO <sub>4</sub>	U	2120	g/l	0.010	0.25	0.12	
Total Sulphur	U	2175	%	0.010	0.55	0.20	
Chloride (Water Soluble)	U	2220	g/l	0.010	< 0.010	0.15	
Nitrate (Water Soluble)	N	2220	g/l	0.010	< 0.010	< 0.010	
Sulphate (Acid Soluble)	U	2430	%	0.010	0.18	0.094	
Organic Matter	U	2625	%	0.40	14	1.5	1.9

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measurement by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.

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---

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[customerservices@chemtest.com](mailto:customerservices@chemtest.com)



2718



GEOTECHNICAL ENGINEERING LIMITED

For the attention of James Taylor/Edward Crimp

Version No. 4

Page No. 1 of 47

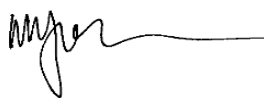
Date of Issue 13/08/2019

**TEST REPORT**

PROJECT/SITE	CARDIFF PARKWAY INITIAL GROUND INVESTIGATION	Samples received	16/07/2019
GEL REPORT NUMBER	35338	Schedule received	16/07/2019
Your ref/PO:		Testing commenced	18/07/2019
Test report refers to	Schedule C	Status	Final

**SUMMARY OF RESULTS ATTACHED**

TEST METHOD & DESCRIPTION	QUANTITY	ACCREDITED TEST
BS EN ISO 17892-1: 2014:5. Water Content	15	YES
BS1377: Part 2: 1990:4.2-4.4&5.2-5.4, Liquid & Plastic Limits	15	YES
BS EN ISO 17892-4: 2016: 5.2, Particle Size Distribution - Wet Sieve	12	YES
BS EN ISO 17892-4: 2016: 5.4, Particle Size Distribution - Pipette	12	YES
BS1377: Part 5: 1990:3, Consolidation	3	YES
BS1377: Part 7: 1990:8&9, Undrained Triaxial Compression	2	YES
ISRM: Suggested Methods: 2007: Uniaxial Compressive Strength of Rock	1	YES
ISRM: 2007: Point Load Strength Test	5	YES
Organic Matter Content (Subcontracted)	9	YES
Loss On Ignition (Subcontracted)	2	YES
BRE SD1 Suite (Subcontracted)	8	YES/NO

Remarks This report may not be partially reproduced without written permission from this laboratory.	Approved Signatories: <b>W Jones (Laboratory Manager)</b> E Crimp (Senior Engineer) J Hanson (Director) N Parry (Director) 
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Doc TR01

Rev No. 20

Revision date 09/10/17

DC:JH

**Geotechnical Engineering Ltd**

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Gloucester GL2 4NF

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VAT Number: 682 5857 89

Payments: Geotechnical Engineering Limited

Sort code: 16-22-11 Bank account: 11125135

**LIQUID AND PLASTIC LIMITS**

BS.1377 : PART 2 : 1990 : 4 and 5



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	sample		specimen depth (m)	natural water content (%)	specimen preparation and test method	fraction >0.425 mm (%)	liquid limit (%)	plastic limit (%)	plasticity index (%)	description and remarks	
	no./type	depth (m)									
BH10	2D	0.20	0.20	31.3	BXE	2	65	25	40	Brown mottled orange slightly gravelly slightly sandy silty CLAY with rare rootlets	
BH10	14UT	3.20	3.30	59.7	BXE	2	61	29	32	Grey slightly gravelly slightly sandy silty organic CLAY	
BH10	20UT	5.20	5.30	367	BXD	5	466	278	188	Black slightly gravelly slightly sandy clayey PEAT	
BH11	4D	0.80	0.80	34.2	BXE	1	58	25	33	Brown mottled orange slightly sandy silty CLAY	
BH11	9UT	2.20	2.30	56.3	BXE	0	58	27	31	Grey mottled brown slightly sandy silty organic CLAY	
BH11	19D	5.20	5.20	220	BXD	8	107	63	44	Dark brown mottled grey slightly gravelly slightly sandy clayey PEAT	
BH11	23D	7.30	7.30	60	BXE	1	54	26	28	Grey slightly sandy silty organic CLAY	
BH11	26D	8.60	8.60	14.5	BXE	33	21	NP		Reddish brown slightly gravelly sandy SILT	
BH11	29D	10.90	10.90	13.6	BXE	2	23	15	8	Reddish brown mottled grey slightly gravelly slightly sandy silty CLAY	
TP05	4D	1.00	1.00	33	BXE	2	66	28	38	Greyish brown slightly gravelly slightly sandy silty CLAY	
TP06	8D	3.00	3.00	19.6	BXE	2	25	14	11	Reddish brown sandy silty CLAY	
TP07	1B	0.50	0.50	28.4	BXE	0	55	24	31	Greyish brown silty CLAY with rare rootlets	
TP07	8D	3.00	3.00	50.2	BXE	3	52	23	29	Grey slightly sandy organic silty CLAY with rare rootlets	
TP08	6D	2.00	2.00	17.1	BXE	27	30	16	14	Reddish brown slightly sandy slightly gravelly silty CLAY	
TP09	7B	2.80	2.80	50.9	BXE	0	54	26	28	Greyish brown slightly sandy silty organic CLAY	
general remarks natural water content determined in accordance with BS EN ISO 17892 - 1 : 2014 (unless specified) NP denotes non plastic # denotes sample tested is smaller than that which is recommended in accordance with BS1377 or BS EN ISO 17892											
specimen preparation A - as received B - washed on 0.425mm sieve C - air dried							test method X - cone penetrometer (test 4.3) Y - cone penetrometer (test 4.4) Z - casagrande apparatus (test 4.5)			CONTRACT  35338	CHECKED  TB

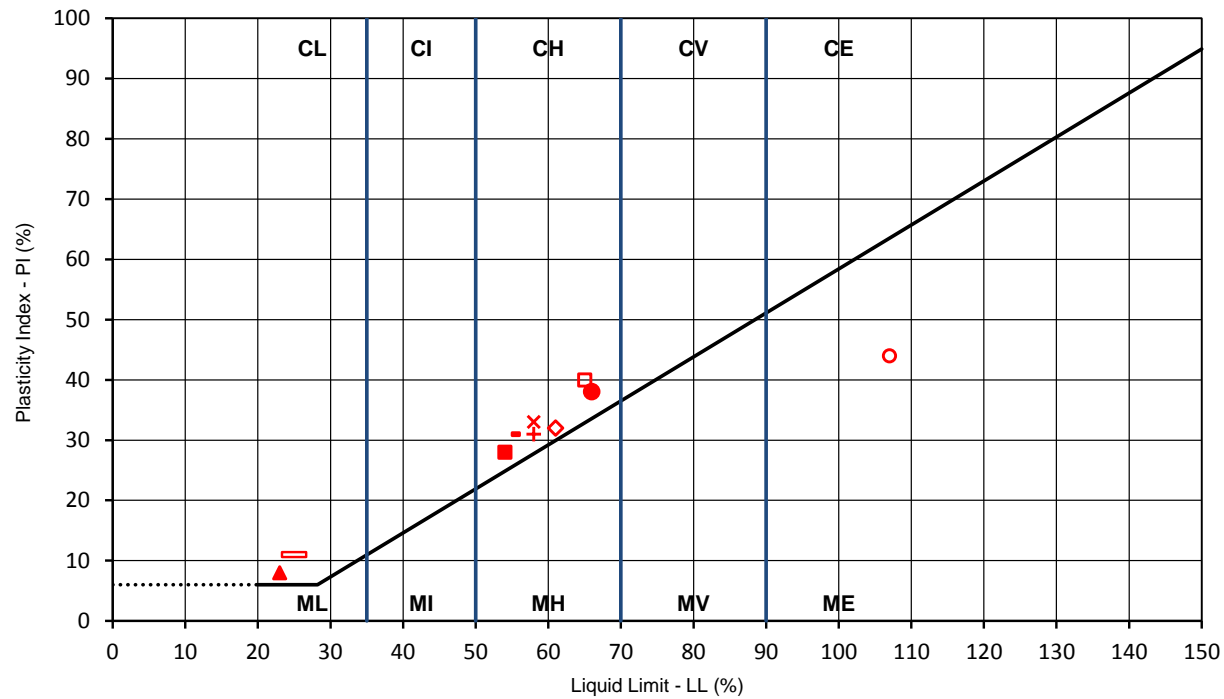
Geotechnical Engineering Limited

# ATTERBERG LINE PLOT



CLIENT    CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE        CARDIFF PARKWAY INITIAL GROUND INVESTIGATION



BH/TP No.		depth (m)	LL	PL	PI	remarks
□	BH10	0.20	65	25	40	
◇	BH10	3.30	61	29	32	
	BH10	5.30	466	278	188	result exceeds plot
×	BH11	0.80	58	25	33	
+	BH11	2.30	58	27	31	
○	BH11	5.20	107	63	44	
■	BH11	7.30	54	26	28	
	BH11	8.60	21	NP		
▲	BH11	10.90	23	15	8	
●	TP05	1.00	66	28	38	
▢	TP06	3.00	25	14	11	
▪	TP07	0.50	55	24	31	

CONTRACT	CHECKED
35338	TB

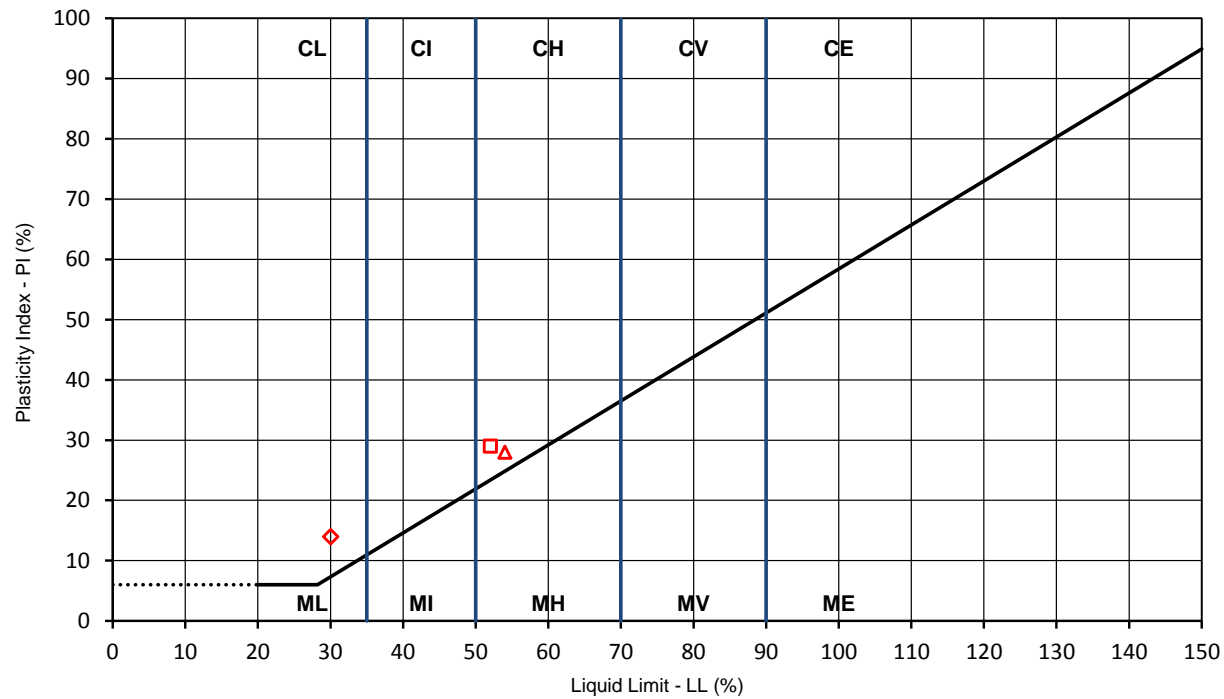
Geotechnical Engineering Limited

# ATTERBERG LINE PLOT



CLIENT    CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE        CARDIFF PARKWAY INITIAL GROUND INVESTIGATION



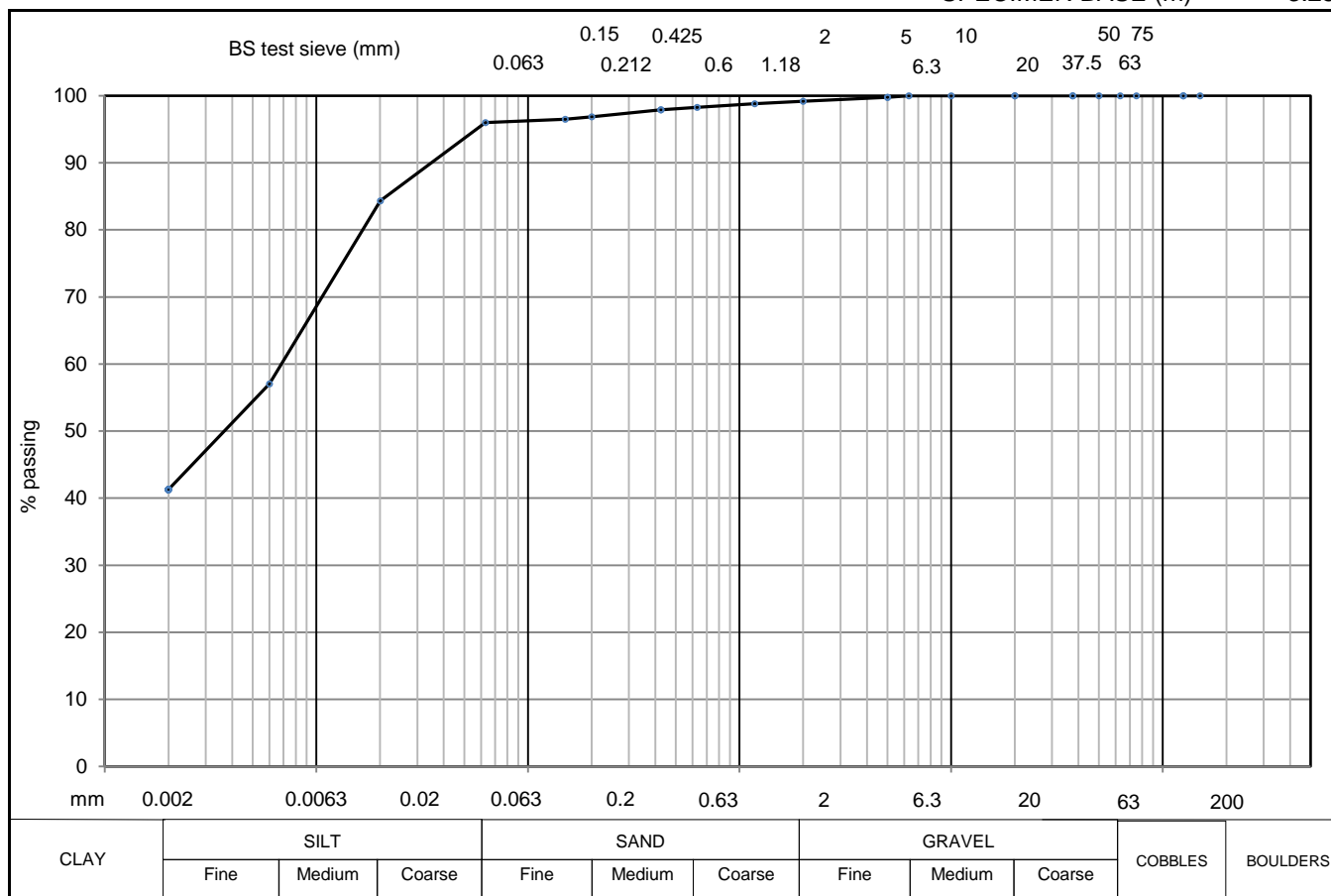
BH/TP No.		depth (m)	LL	PL	PI	remarks
□	TP07	3.00	52	23	29	
◇	TP08	2.00	30	16	14	
△	TP09	2.80	54	26	28	

CONTRACT	CHECKED
35338	TB





SPECIMEN BASE (m) 3.25



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
CLAY	41	150		5	100	20	84
SILT	55						
SILT & CLAY	96						
SAND	3						
GRAVEL	1						
COBBLE & BOULDER	0						
test method(s)	5.2 & 5.4	50		0.63	98		
test method		37.5		0.425	98		
5.2 - sieving		20		0.2	97		
5.3 - sedimentation by hydrometer		10		0.15	97		
5.4 - sedimentation by pipette		6.3	100	0.063	96		
remarks							
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892						35338	TB
Particle density assigned an assumed value of 2.70 Mg/m3							



CLIENT            CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No. BH10

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

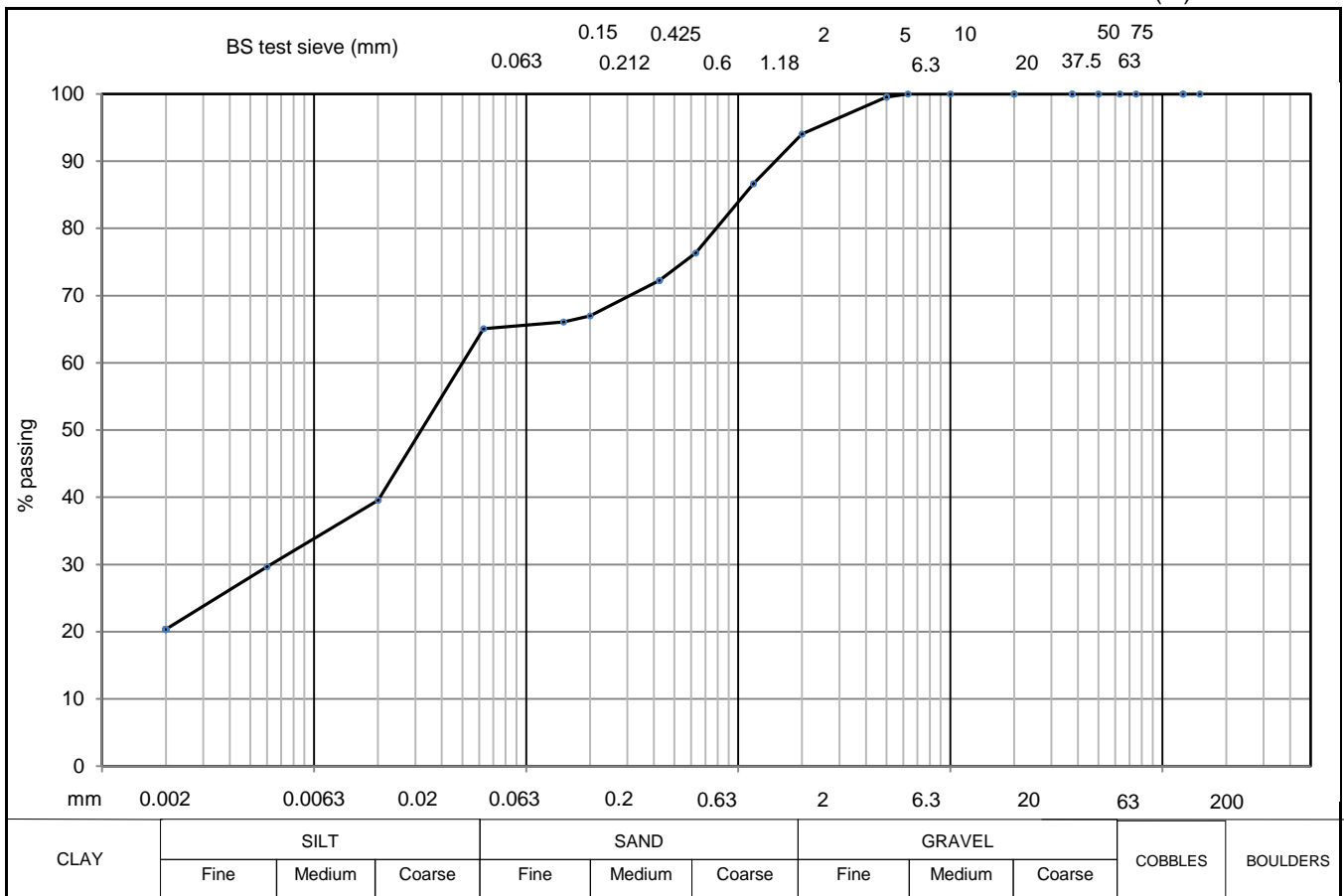
SAMPLE No./TYPE 20UT

DESCRIPTION Black slightly gravelly slightly sandy clayey PEAT

SAMPLE DEPTH (m) 5.20

SPECIMEN TOP (m) 5.25

SPECIMEN BASE (m) 5.30



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer	
CLAY	20	150		5	100	20	40	
SILT	45							
SILT & CLAY	65							
SAND	29			75	2	94	6	30
GRAVEL	6							
COBBLE & BOULDER	0	63		1.18	87	2	20	
test method(s)	5.2 & 5.4	50		0.63	76			
test method		37.5		0.425	72			
5.2 - sieving		20		0.2	67			
5.3 - sedimentation by hydrometer		10		0.15	66			
5.4 - sedimentation by pipette		6.3	100	0.063	65			
remarks						CONTRACT	CHECKED	
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892						35338	TB	
Particle density assigned an assumed value of 2.70 Mg/m3								

**PARTICLE SIZE DISTRIBUTION**

BS EN ISO 17892 - 4 : 2016 : 5



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH10

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

25D

DESCRIPTION Brown mottled dark brown slightly gravelly sandy silty CLAY

SAMPLE DEPTH (m)

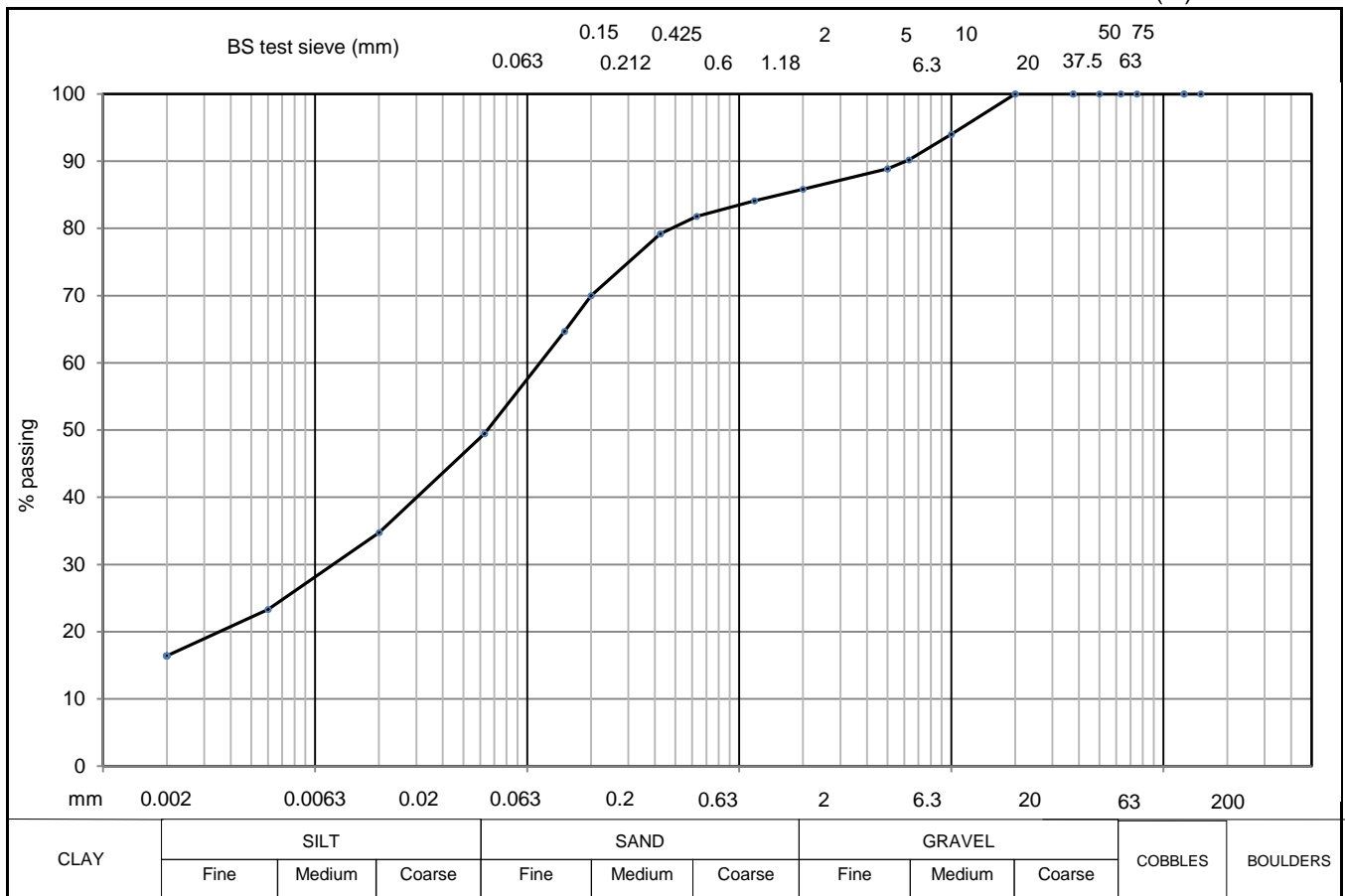
6.70

SPECIMEN TOP (m)

6.70

SPECIMEN BASE (m)

7.15



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY	16						
SILT	33	150		5	89	20	35
SILT & CLAY	49						
SAND	36	75		2	86	6	23
GRAVEL	14						
COBBLE & BOULDER	0	63		1.18	84	2	16
test method(s)	5.2 & 5.4	50		0.63	82		
test method		37.5		0.425	79		
5.2 - sieving		20	100	0.2	70		
5.3 - sedimentation by hydrometer		10	94	0.15	65		
5.4 - sedimentation by pipette		6.3	90	0.063	49		
remarks	# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3					CONTRACT	CHECKED
						35338	TB



CLIENT                      CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No. BH11

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

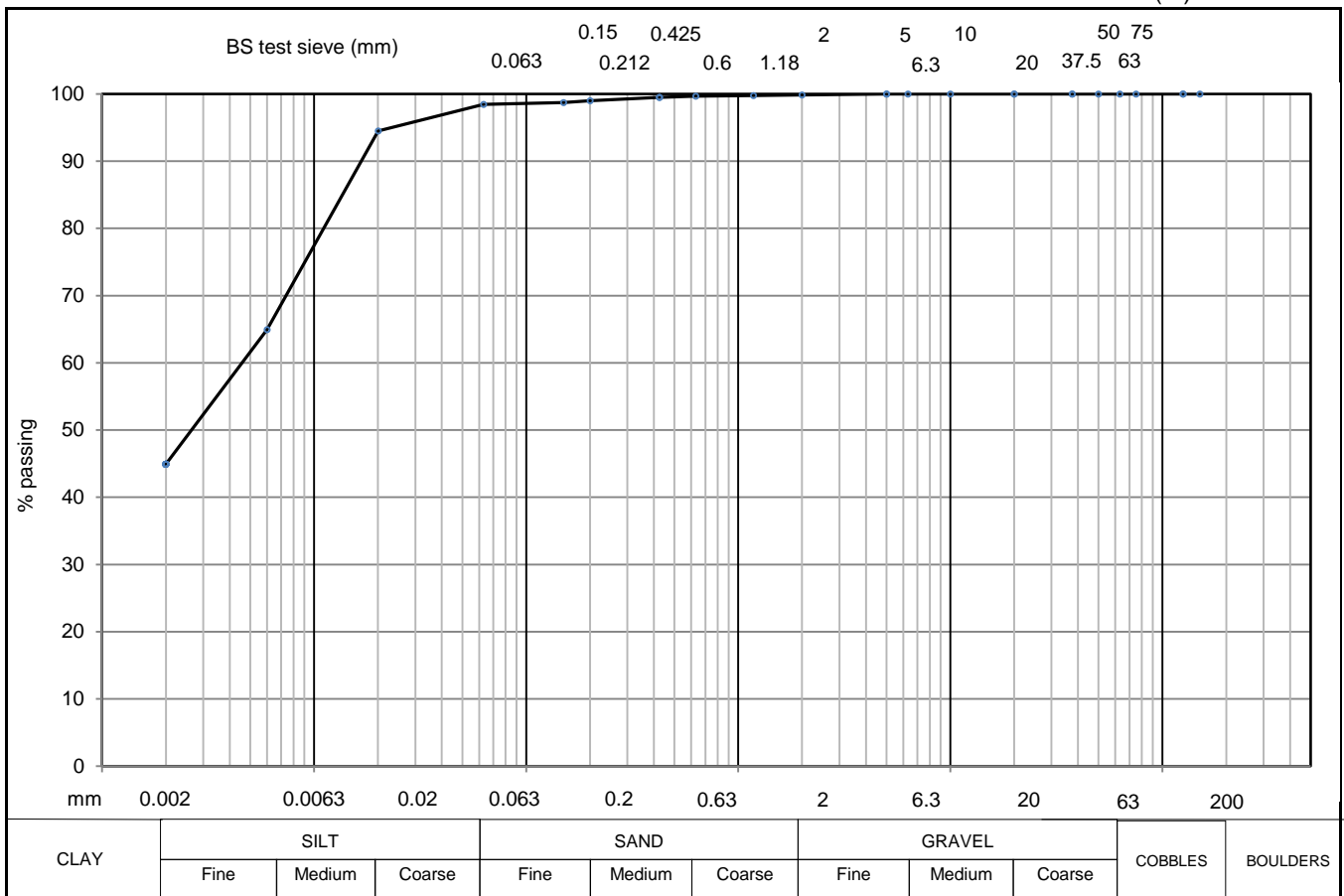
SAMPLE No./TYPE 9UT

DESCRIPTION Grey mottled brown slightly sandy silty organic CLAY

SAMPLE DEPTH (m) 2.20

SPECIMEN TOP (m) 2.25

SPECIMEN BASE (m) 2.30



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer	
CLAY	45	150		5	100	20	95	
SILT	54							
SILT & CLAY	98							
SAND	1			75	2	100	6	65
GRAVEL	0							
COBBLE & BOULDER	0	63		1.18	100	2	45	
test method(s)	5.2 & 5.4	50		0.63	100			
test method		37.5		0.425	99			
5.2 - sieving		20		0.2	99			
5.3 - sedimentation by hydrometer		10		0.15	99			
5.4 - sedimentation by pipette		6.3		0.063	98			
remarks						CONTRACT	CHECKED	
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892						35338	TB	
Particle density assigned an assumed value of 2.70 Mg/m3								



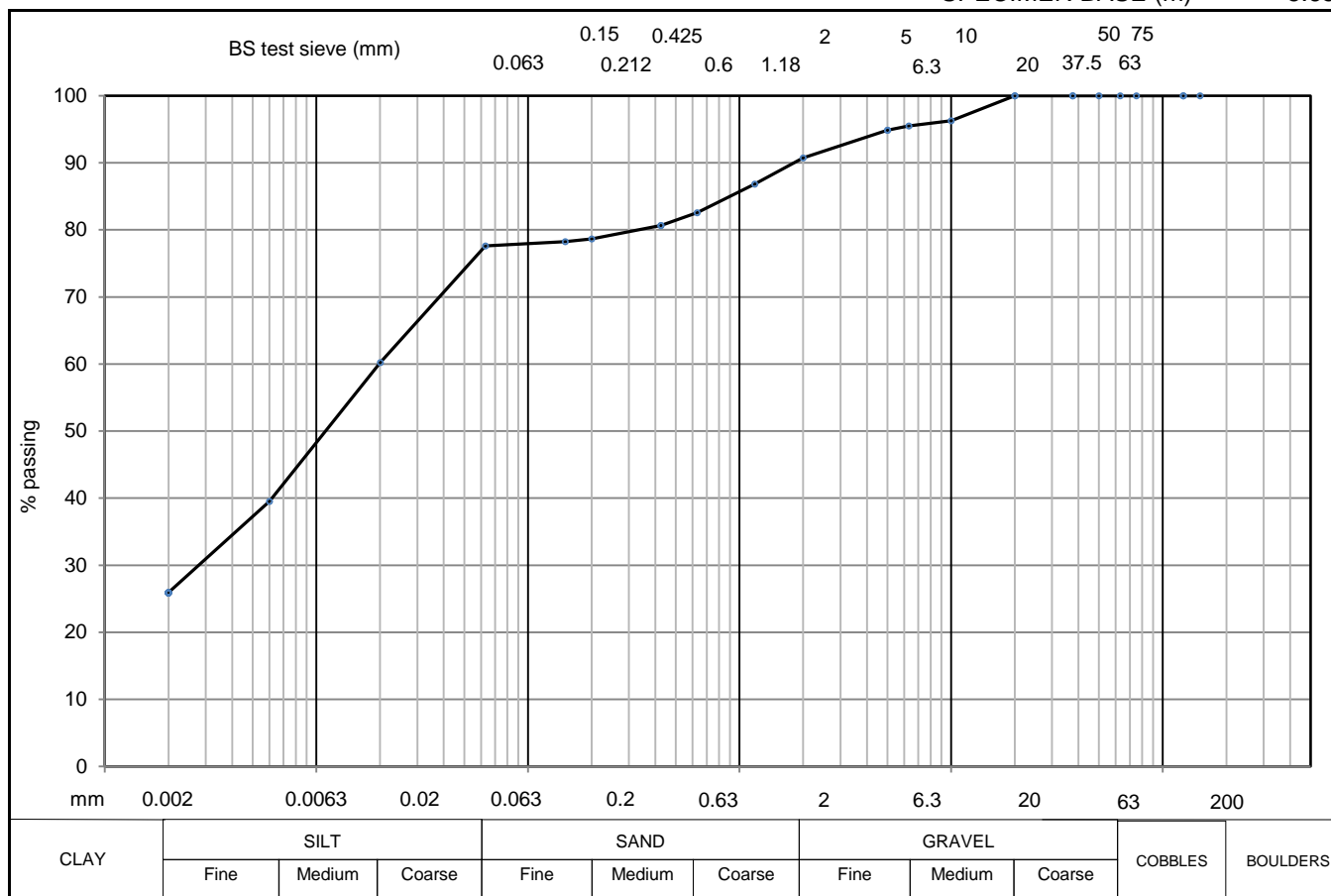
BH/TP No. BH11

SAMPLE No./TYPE 19D

SAMPLE DEPTH (m) 5.20

SPECIMEN TOP (m) 5.20

SPECIMEN BASE (m) 5.65



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY	26	150		5	95	20	60
SILT	52						
SILT & CLAY	78						
SAND	13						
GRAVEL	9						
COBBLE & BOULDER	0						
test method(s)	5.2# & 5.4	50		0.63	83		
test method		37.5		0.425	81		
5.2 - sieving		20	100	0.2	79		
5.3 - sedimentation by hydrometer		10	96	0.15	78		
5.4 - sedimentation by pipette		6.3	95	0.063	78		
remarks # denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3						CONTRACT  <b>35338</b>	CHECKED  <b>TB</b>

**PARTICLE SIZE DISTRIBUTION**

BS EN ISO 17892 - 4 : 2016 : 5



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH11

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

23D

DESCRIPTION Grey slightly sandy silty organic CLAY

SAMPLE DEPTH (m)

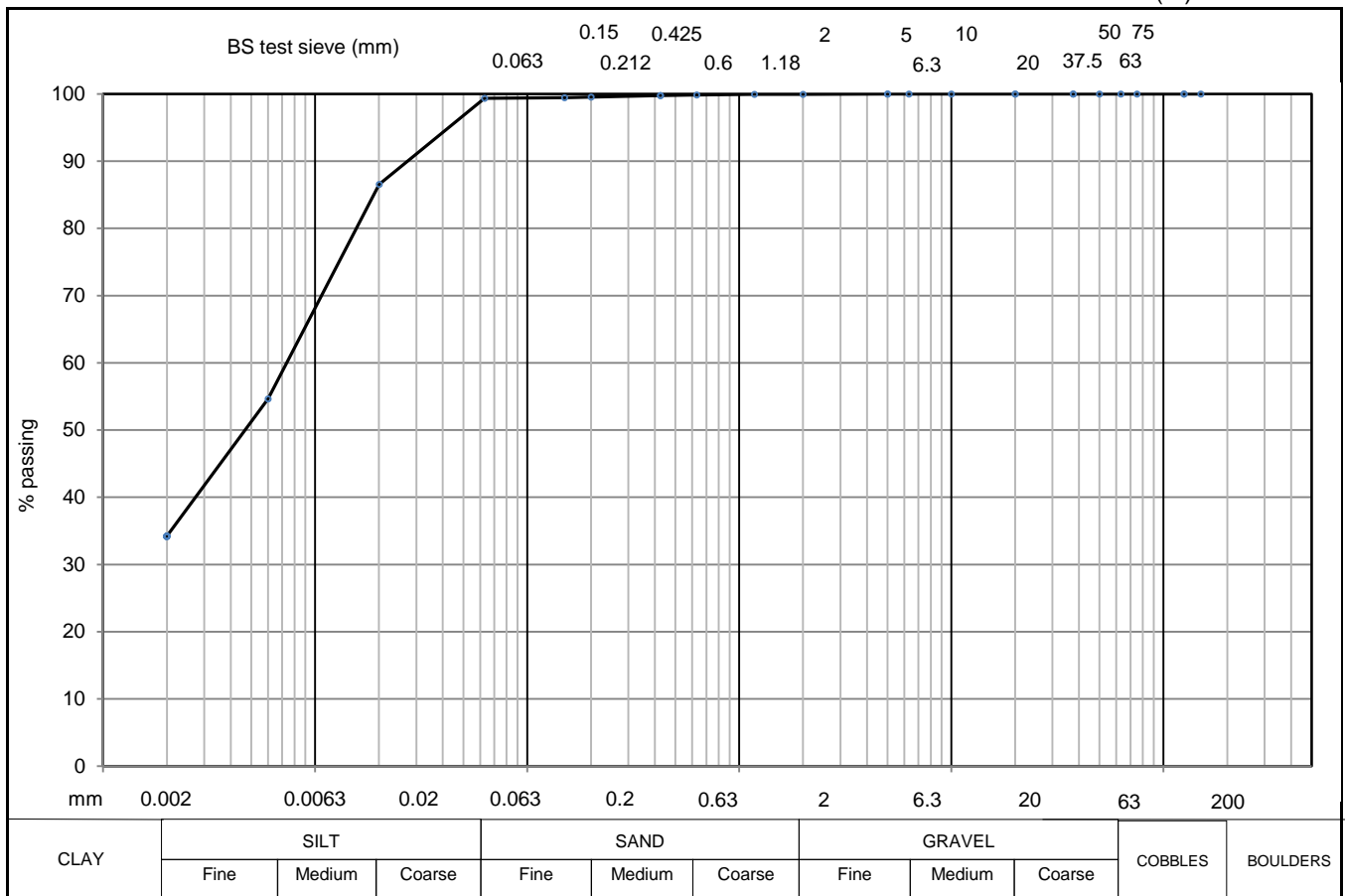
7.30

SPECIMEN TOP (m)

7.30

SPECIMEN BASE (m)

7.40



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY	34						
SILT	65	150		5	100	20	87
SILT & CLAY	99						
SAND	1	75		2	100	6	55
GRAVEL	0						
COBBLE & BOULDER	0	63		1.18	100	2	34
test method(s)	5.2 & 5.4	50		0.63	100		
test method		37.5		0.425	100		
5.2 - sieving		20		0.2	100		
5.3 - sedimentation by hydrometer		10		0.15	99		
5.4 - sedimentation by pipette		6.3		0.063	99		
remarks	# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3					CONTRACT	CHECKED
						35338	TB

**PARTICLE SIZE DISTRIBUTION**

BS EN ISO 17892 - 4 : 2016 : 5



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH11

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

26D

DESCRIPTION Reddish brown slightly gravelly sandy SILT

SAMPLE DEPTH (m)

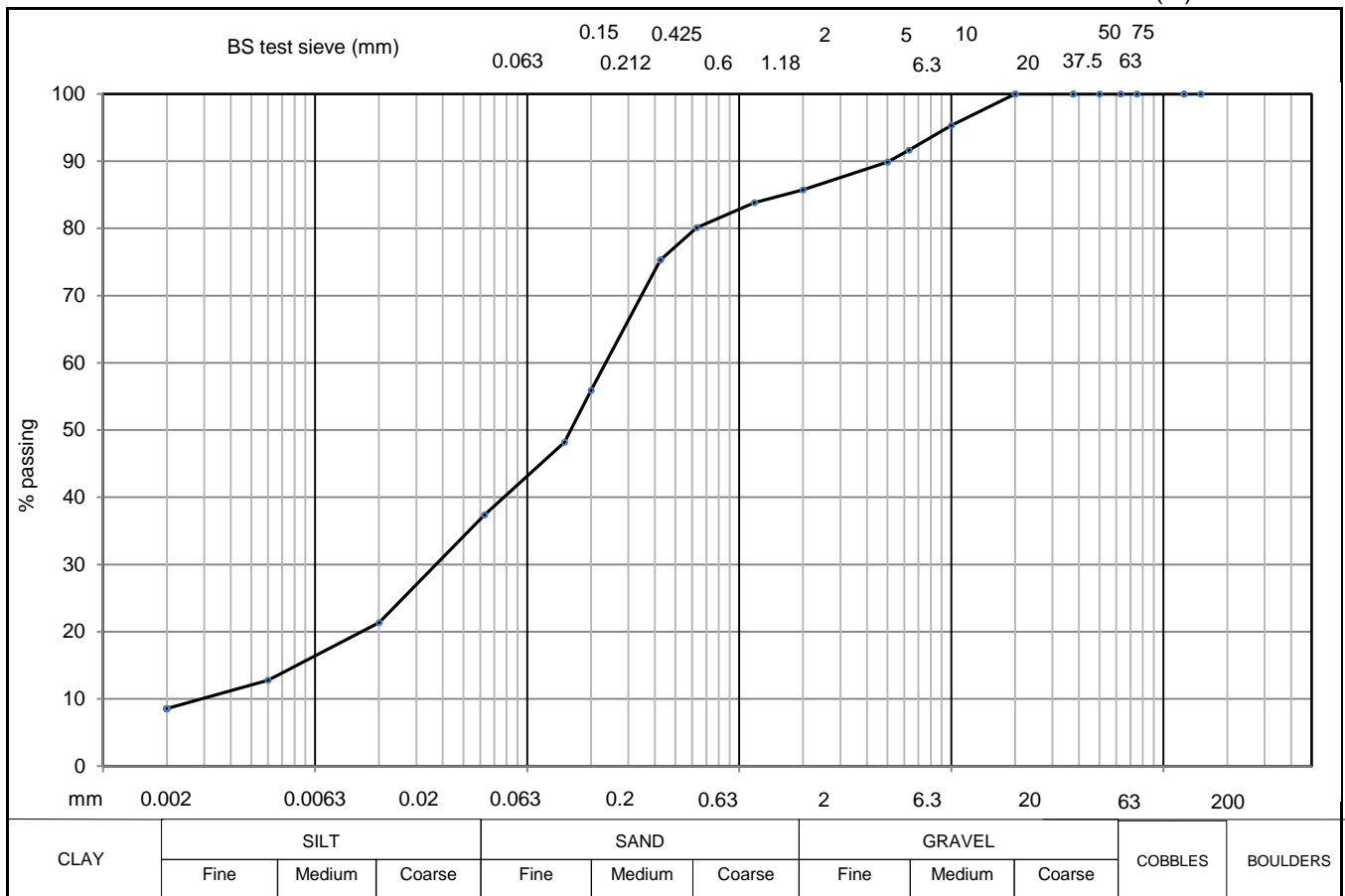
8.60

SPECIMEN TOP (m)

8.60

SPECIMEN BASE (m)

8.70



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY	9						
SILT	29	150		5	90	20	21
SILT & CLAY	37						
SAND	48	75		2	86	6	13
GRAVEL	14						
COBBLE & BOULDER	0	63		1.18	84	2	9
test method(s)	5.2 & 5.4	50		0.63	80		
test method		37.5		0.425	75		
5.2 - sieving		20	100	0.2	56		
5.3 - sedimentation by hydrometer		10	95	0.15	48		
5.4 - sedimentation by pipette		6.3	92	0.063	37		
remarks	# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3					CONTRACT	CHECKED
						35338	TB

**PARTICLE SIZE DISTRIBUTION**

BS EN ISO 17892 - 4 : 2016 : 5



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

TP05

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

4D

DESCRIPTION Greyish brown slightly gravelly slightly sandy silty CLAY

SAMPLE DEPTH (m)

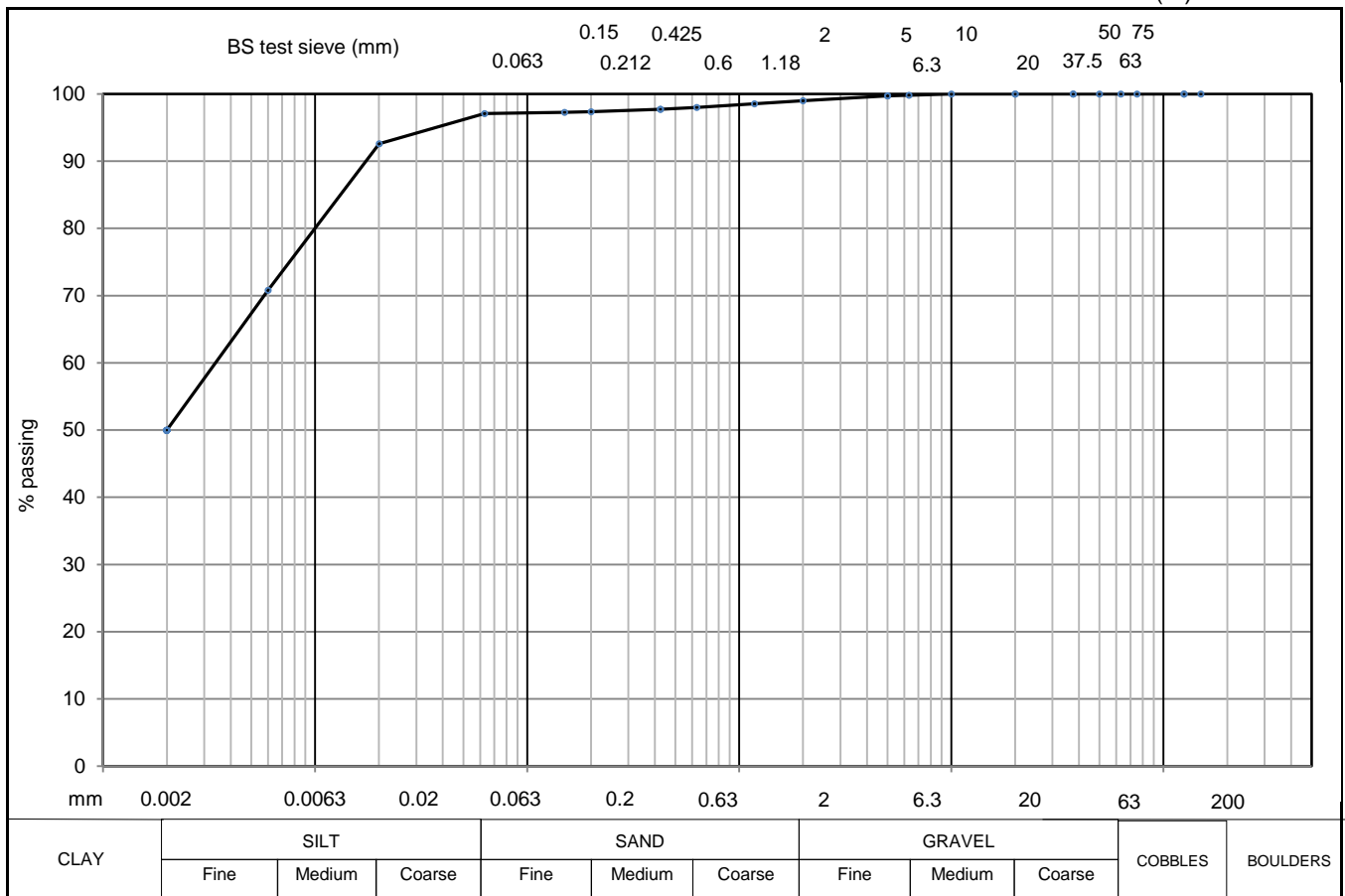
1.00

SPECIMEN TOP (m)

1.00

SPECIMEN BASE (m)

1.20

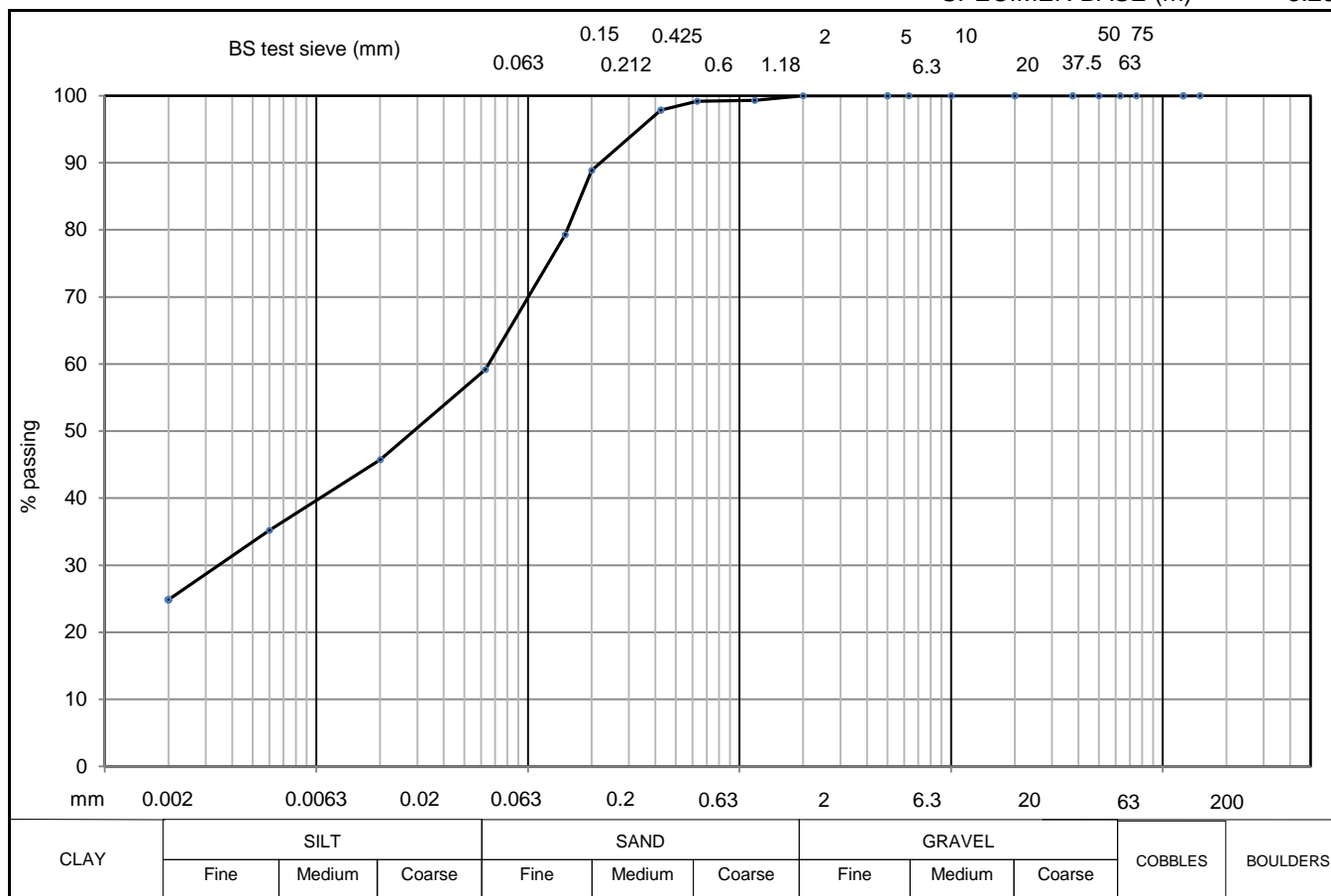


soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY	50						
SILT	47	150		5	100	20	93
SILT & CLAY	97						
SAND	2	75		2	99	6	71
GRAVEL	1						
COBBLE & BOULDER	0	63		1.18	99	2	50
test method(s)	5.2 & 5.4	50		0.63	98		
test method		37.5		0.425	98		
5.2 - sieving		20		0.2	97		
5.3 - sedimentation by hydrometer		10	100	0.15	97		
5.4 - sedimentation by pipette		6.3	100	0.063	97		
remarks						CONTRACT	CHECKED
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892						35338	TB
Particle density assigned an assumed value of 2.70 Mg/m3							





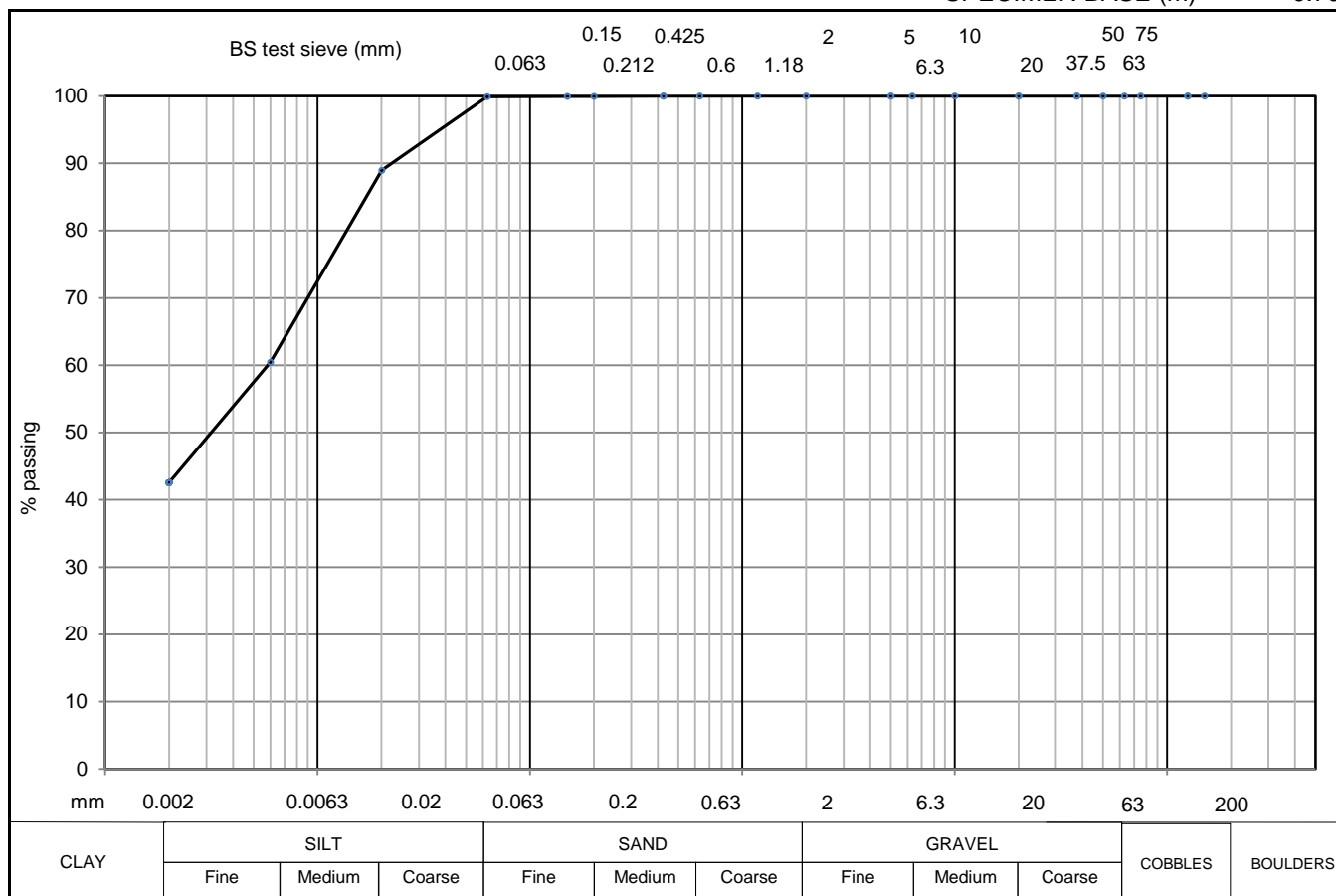
SPECIMEN BASE (m) 3.20



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
CLAY	25	150		5	100	20	46
SILT	34						
SILT & CLAY	59						
SAND	41						
GRAVEL	0						
COBBLE & BOULDER	0						
test method(s)	5.2 & 5.4	50		0.63	99		
test method		37.5		0.425	98		
5.2 - sieving		20		0.2	89		
5.3 - sedimentation by hydrometer		10		0.15	79		
5.4 - sedimentation by pipette		6.3		0.063	59		
remarks # denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3						CONTRACT  <b>35338</b>	CHECKED  <b>TB</b>



SPECIMEN BASE (m) 0.70



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
CLAY	43	150		5		20	89
SILT	57						
SILT & CLAY	100						
SAND	0						
GRAVEL	0						
COBBLE & BOULDER	0						
test method(s)	5.2 & 5.4	50		0.63	100		
test method		37.5		0.425	100		
5.2 - sieving		20		0.2	100		
5.3 - sedimentation by hydrometer		10		0.15	100		
5.4 - sedimentation by pipette		6.3		0.063	100		
remarks # denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3						<b>CONTRACT</b>  <b>35338</b>	<b>CHECKED</b>  <b>TB</b>



CLIENT                      CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No. TP07

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

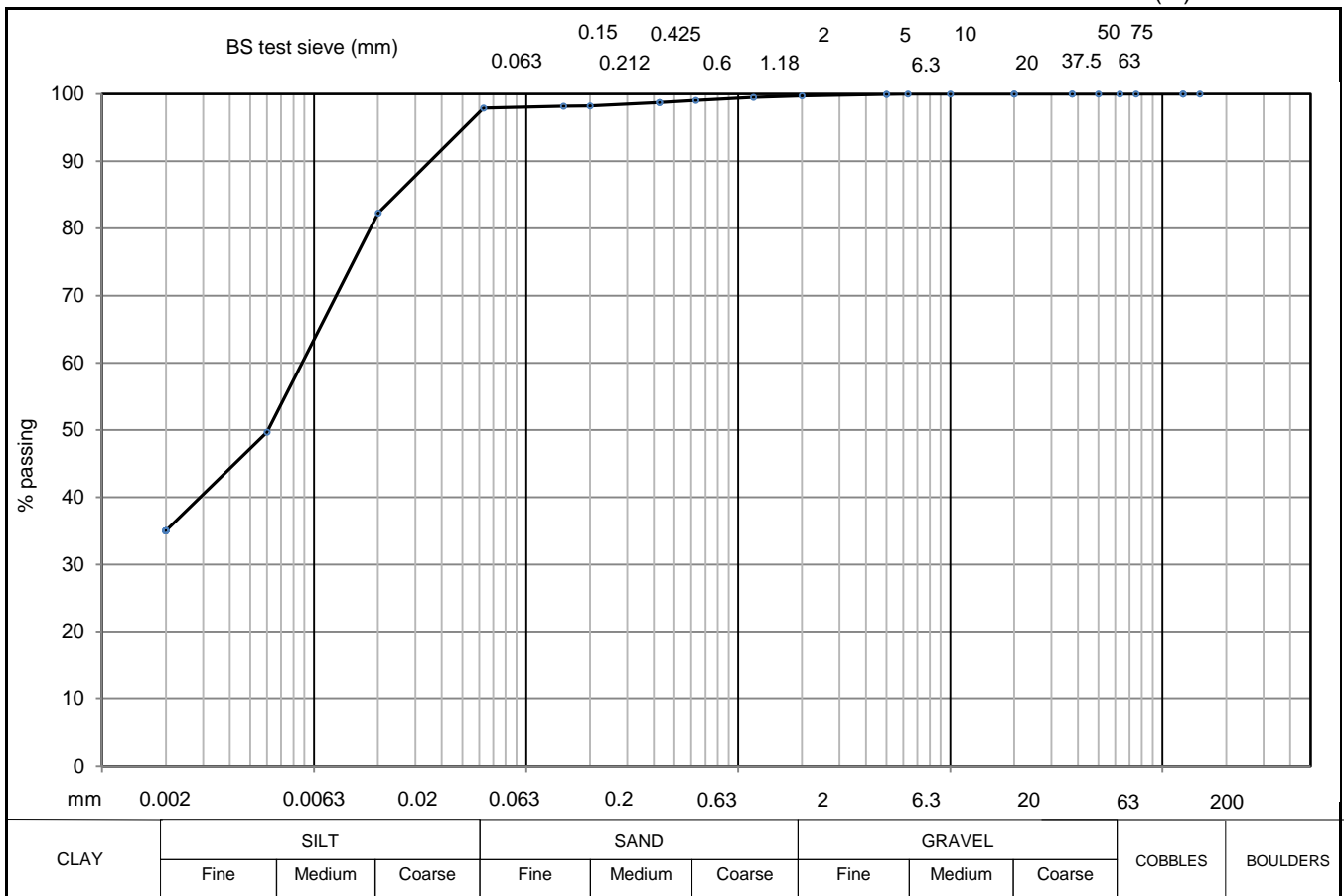
SAMPLE No./TYPE 8D

DESCRIPTION Grey slightly sandy organic silty CLAY with rare rootlets

SAMPLE DEPTH (m) 3.00

SPECIMEN TOP (m) 3.00

SPECIMEN BASE (m) 3.20



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer	
CLAY	35	150		5	100	20	82	
SILT	63							
SILT & CLAY	98							
SAND	2			75	2	100	6	50
GRAVEL	0							
COBBLE & BOULDER	0	63		1.18	100	2	35	
test method(s)	5.2 & 5.4	50		0.63	99			
test method		37.5		0.425	99			
5.2 - sieving		20		0.2	98			
5.3 - sedimentation by hydrometer		10		0.15	98			
5.4 - sedimentation by pipette		6.3	100	0.063	98			
remarks						CONTRACT	CHECKED	
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892						35338	TB	
Particle density assigned an assumed value of 2.70 Mg/m3								



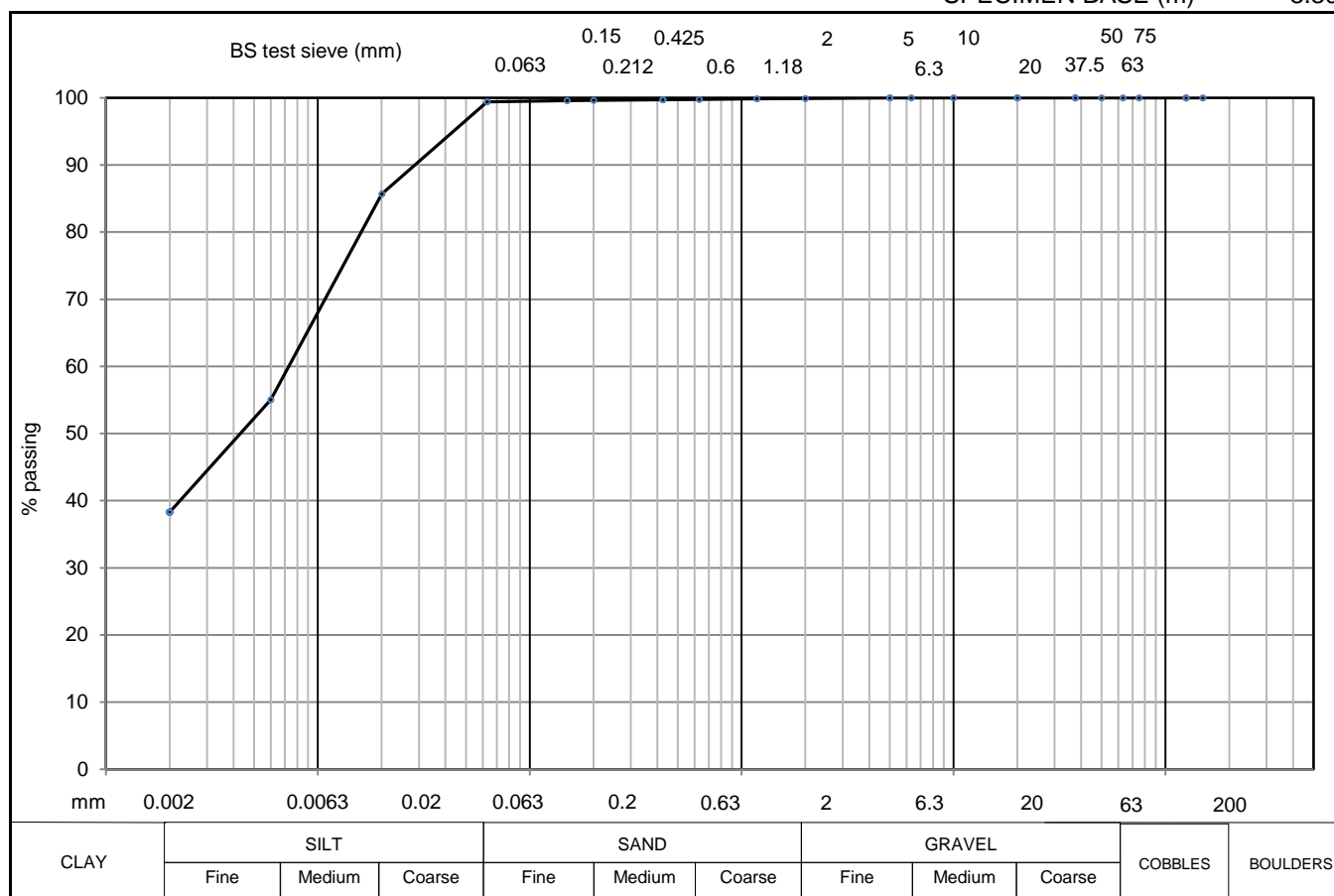
BH/TP No. TP09

SAMPLE No./TYPE 7B

SAMPLE DEPTH (m) 2.80

SPECIMEN TOP (m) 2.80

SPECIMEN BASE (m) 3.30



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
CLAY	38	150		5	100	20	86
SILT	61						
SILT & CLAY	99						
SAND	0						
GRAVEL	0						
COBBLE & BOULDER	0						
test method(s)	5.2 & 5.4	50		0.63	100		
test method		37.5		0.425	100		
5.2 - sieving		20		0.2	100		
5.3 - sedimentation by hydrometer		10		0.15	100		
5.4 - sedimentation by pipette		6.3	100	0.063	99		
remarks # denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3						<b>CONTRACT</b>  <b>35338</b>	<b>CHECKED</b>  <b>TB</b>

**DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES****BS.1377 : Part 5 : 1990 : 3**

CLIENT    CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH10

SITE        CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

14UT

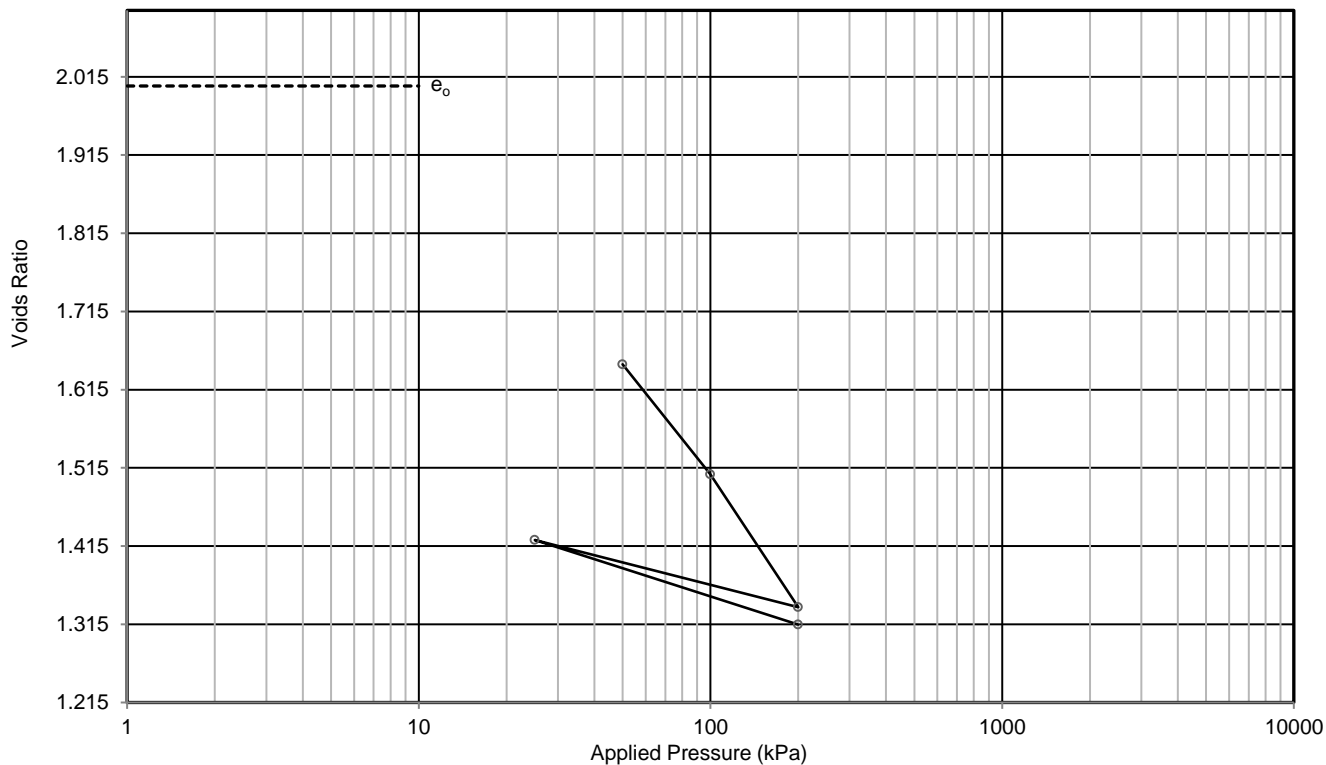
DESCRIPTION    Grey slightly gravelly slightly sandy silty organic CLAY

SAMPLE DEPTH (m)

3.20

SPECIMEN DEPTH (m)

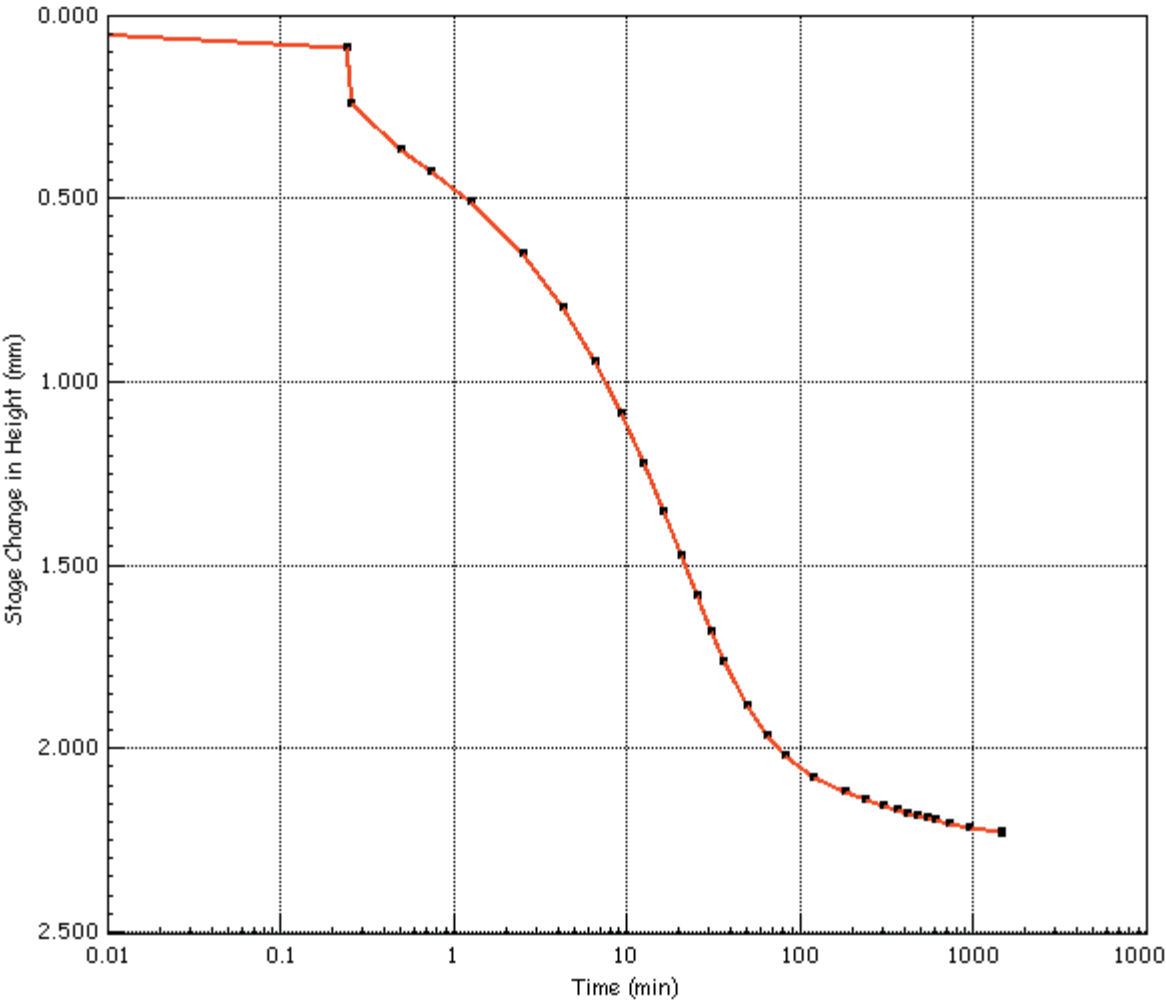
3.35




test and sample details			test results				
			pressure stage	voids ratio	laboratory coefficients of		
			(kPa)		compressibility mv (m <sup>2</sup> /MN)	consolidation Cv    Csec (m <sup>2</sup> /yr)	
specimen diameter	mm	63.48					
specimen height	mm	18.42					
initial moisture content	%	74.8					
final moisture content	%	51.0					
initial bulk density	Mg/m <sup>3</sup>	1.57	50	1.647	2.4	0.51	
initial dry density	Mg/m <sup>3</sup>	0.90	100	1.507	1.1	0.39	0.0065
initial voids ratio		2.003	200	1.337	0.68	0.39	
initial degree of saturation	%	101	25	1.423	0.21		
particle density	Mg/m <sup>3</sup>	#2.70	200	1.315	0.26	1.4	
swelling pressure	kPa	N/A					
P'o to P'o +100 kPa		-					
laboratory temperature	oC	20 ± 2					
method of time fitting		root time					
remarks	# denotes particle density has been assigned an assumed value load frame corrections applied				CONTRACT	CHECKED	
					<b>35338</b>	<b>TB</b>	

# Oedometer Consolidation Settlement Report

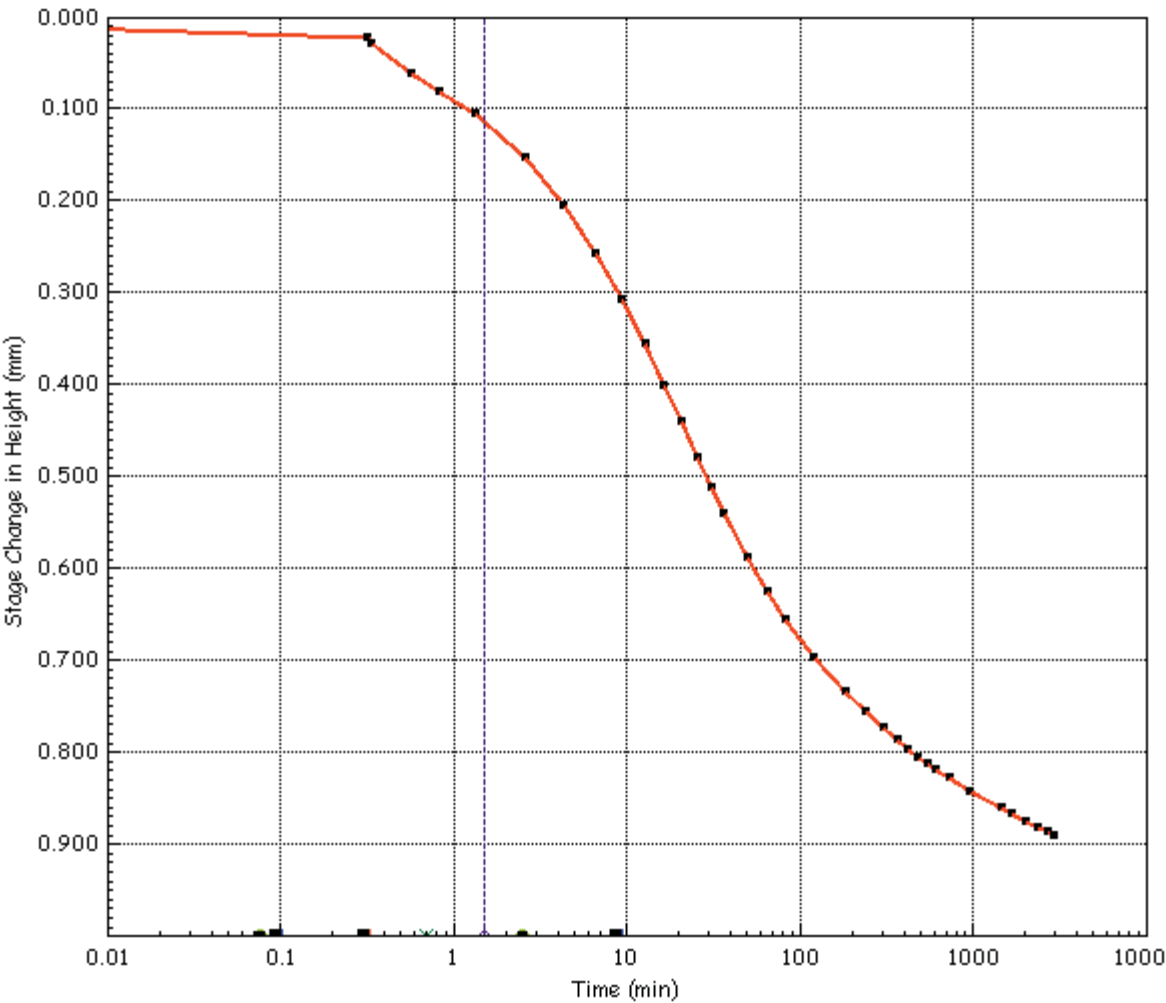
Vertical Stress	$\sigma'_i$	(kPa)	50
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.048
Height Settlement	$\Delta L_s$	(mm)	2.183
Voids Ratio	$e_f$	.	-0.227




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 9		
					Database:		.\SQLEXPRESS \ GEL		
	Site Reference				Test Date		22/07/2019		
	Jobfile		35338		Sample		14UT		
	Client		CARDFF PARKWAY		Borehole		BH10		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	

# Oedometer Consolidation Settlement Report

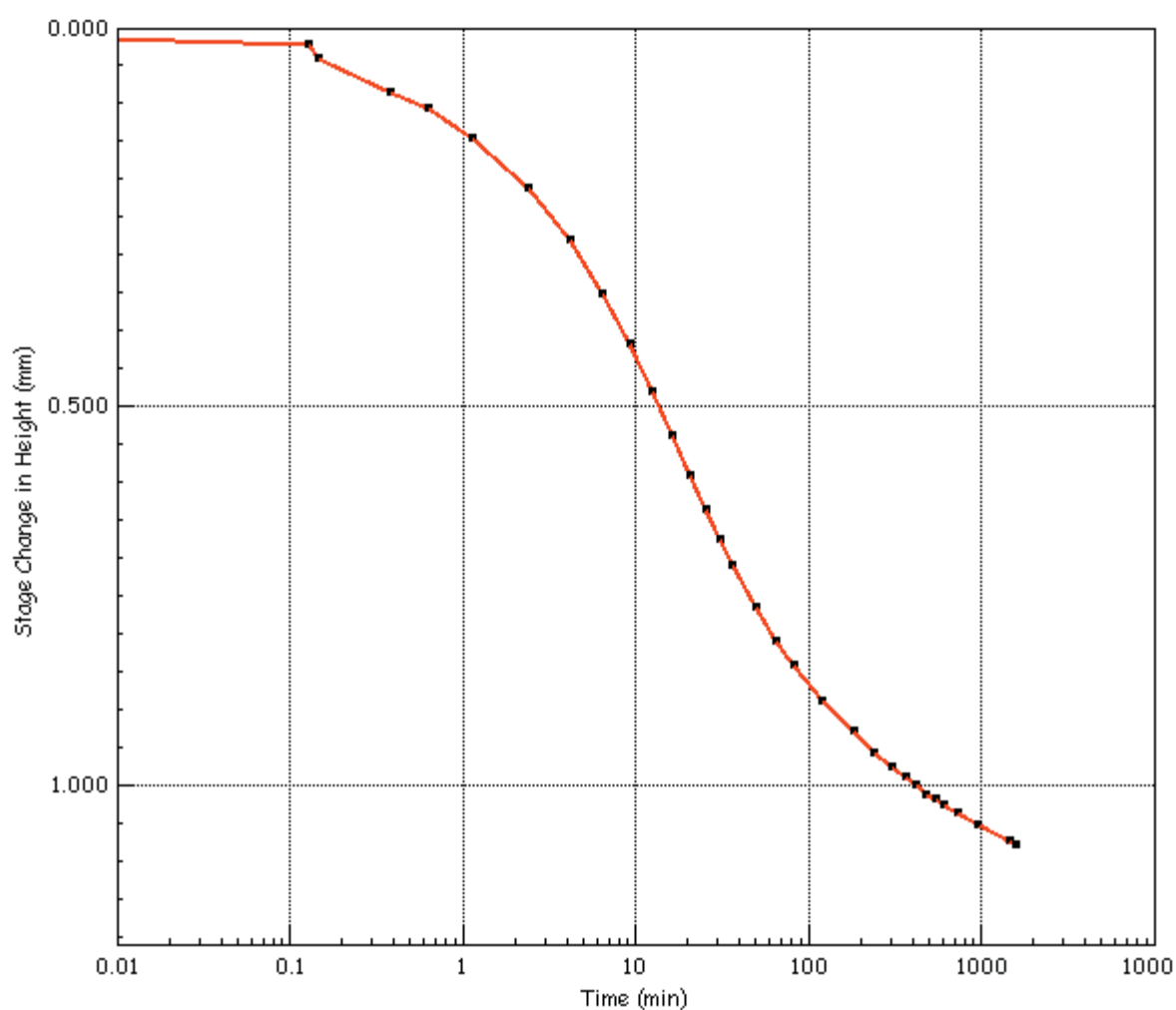
Vertical Stress	$\sigma'_i$	(kPa)	100
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.075
Height Settlement	$\Delta L_s$	(mm)	3.046
Voids Ratio	$e_f$	.	-0.265




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 9		
					Database:		.\SQLEXPRESS \ GEL		
	Site Reference				Test Date		22/07/2019		
	Jobfile		35338		Sample		14UT		
	Client		CARDFF PARKWAY		Borehole		BH10		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	200
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.106
Height Settlement	$\Delta L_s$	(mm)	4.088
Voids Ratio	$e_f$	.	-0.310

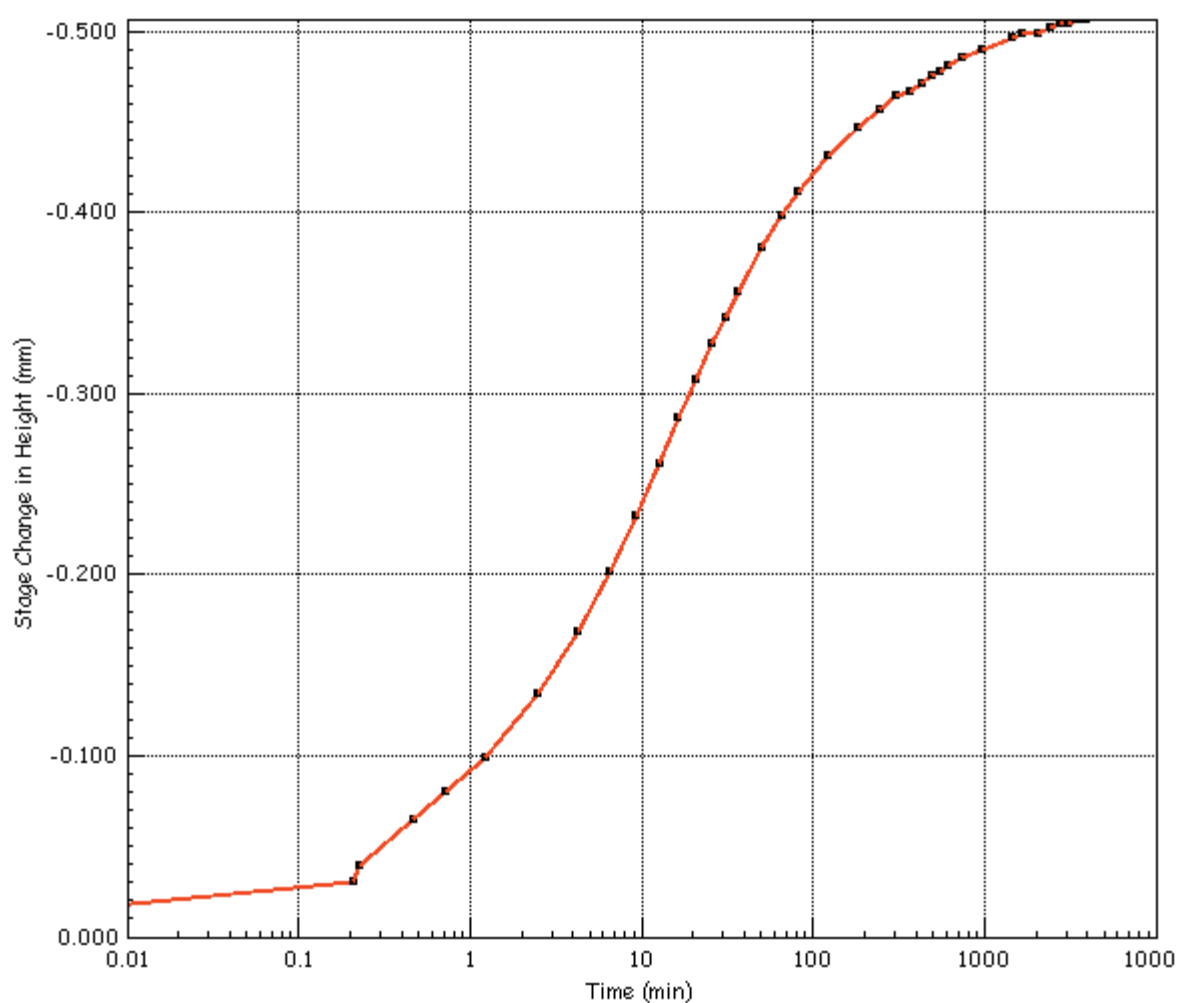



	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 9						
					Database: .\SQLEXPRESS \ GEL								
	Site Reference				Test Date				22/07/2019				
	Jobfile				Sample				14UT				
	Client				Borehole				BH10				
	Operator				TA/JT/JG		Checked		*		Approved		*



# Oedometer Consolidation Settlement Report

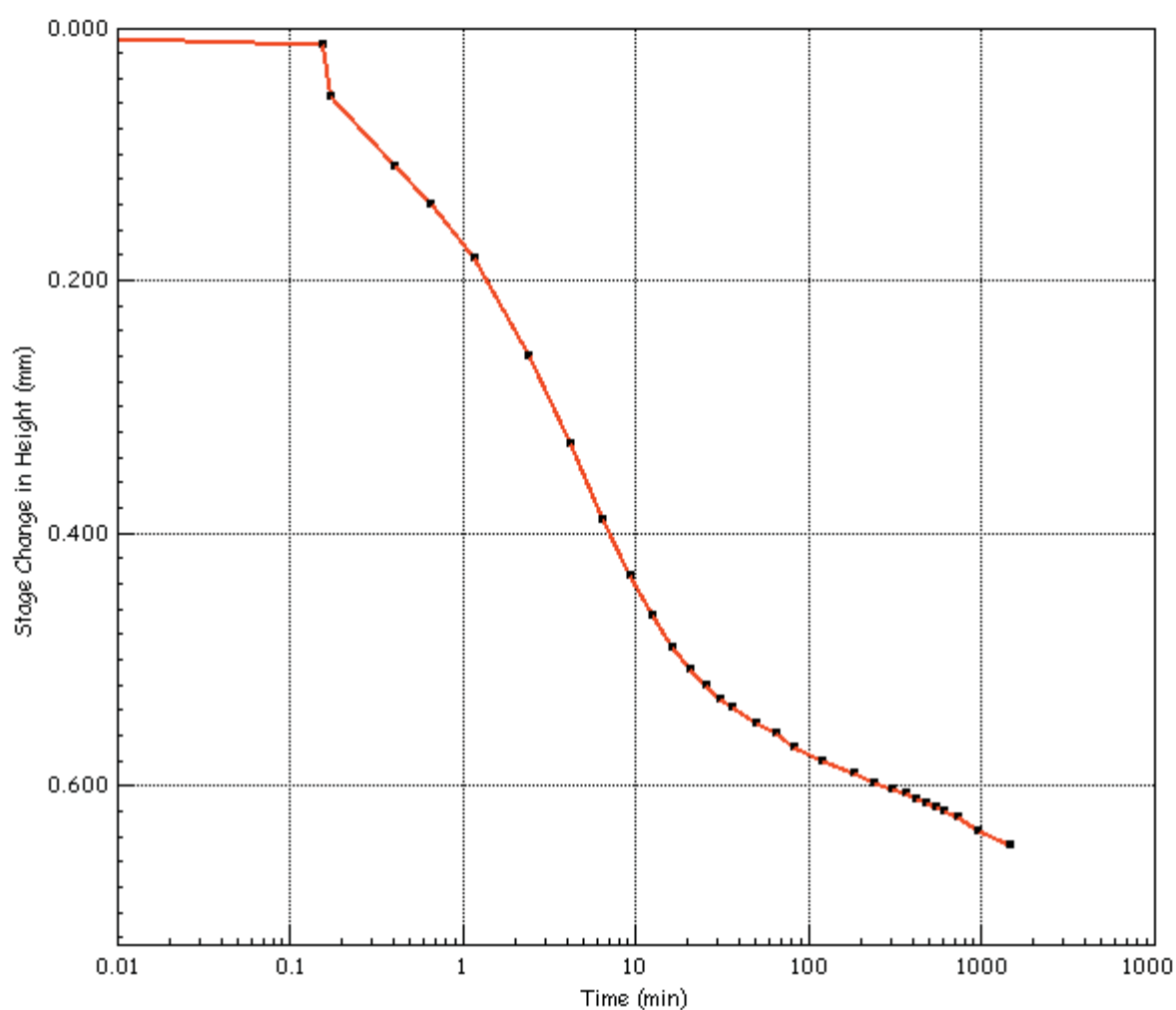
Vertical Stress	$\sigma'_i$	(kPa)	25
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.126
Height Settlement	$\Delta L_s$	(mm)	3.560
Voids Ratio	$e_f$	.	-0.287




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 9						
					Database: .\SQLEXPRESS \ GEL								
	Site Reference				Test Date				22/07/2019				
	Jobfile				Sample				14UT				
	Client				Borehole				BH10				
	Operator				TA/JT/JG		Checked		*		Approved		*

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	200
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.106
Height Settlement	$\Delta L_s$	(mm)	4.224
Voids Ratio	$e_f$	.	-0.316



	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 9		
					Database: .\SQLEXPRESS \ GEL				
	Site Reference				Test Date		22/07/2019		
	Jobfile		35338		Sample		14UT		
	Client		CARDFF PARKWAY		Borehole		BH10		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	

**DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES****BS.1377 : Part 5 : 1990 : 3**

CLIENT    CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH10

SITE        CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

20UT

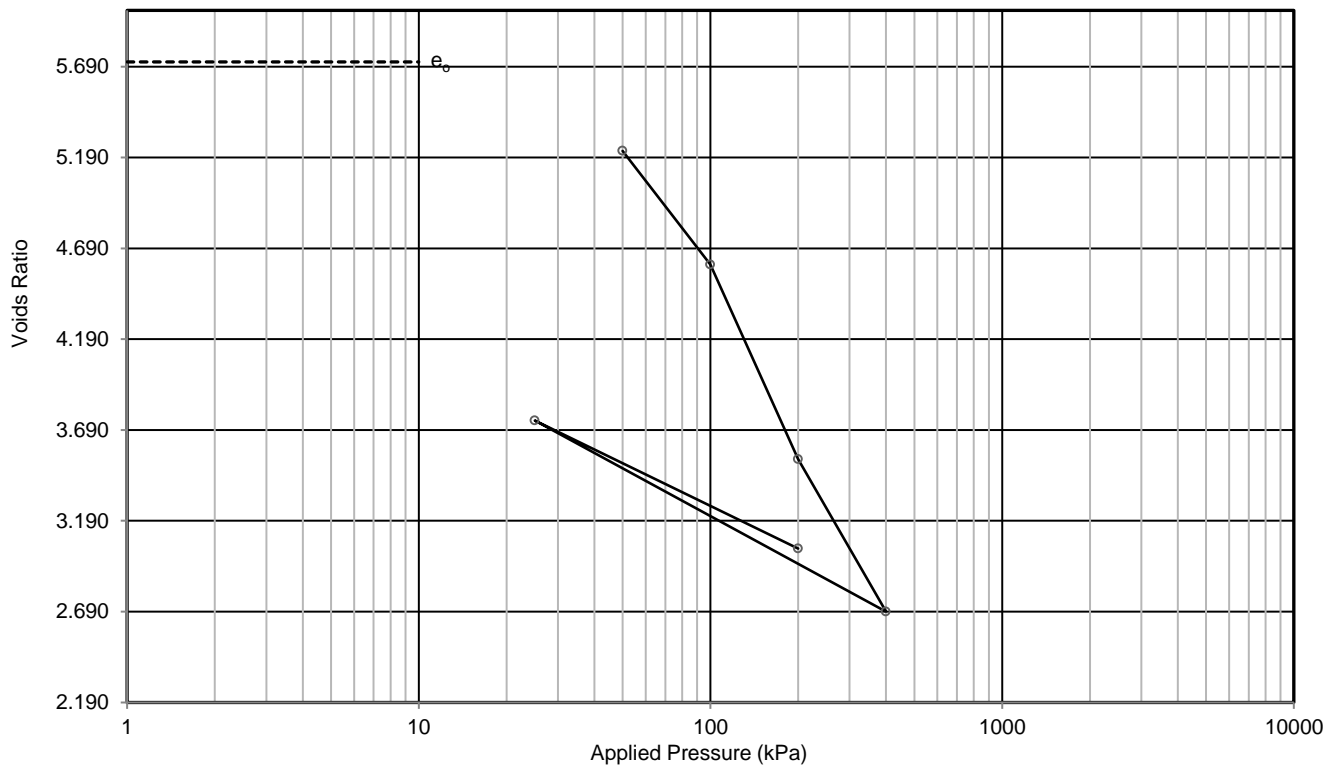
DESCRIPTION    Black slightly gravelly slightly sandy clayey PEAT

SAMPLE DEPTH (m)

5.20

SPECIMEN DEPTH (m)

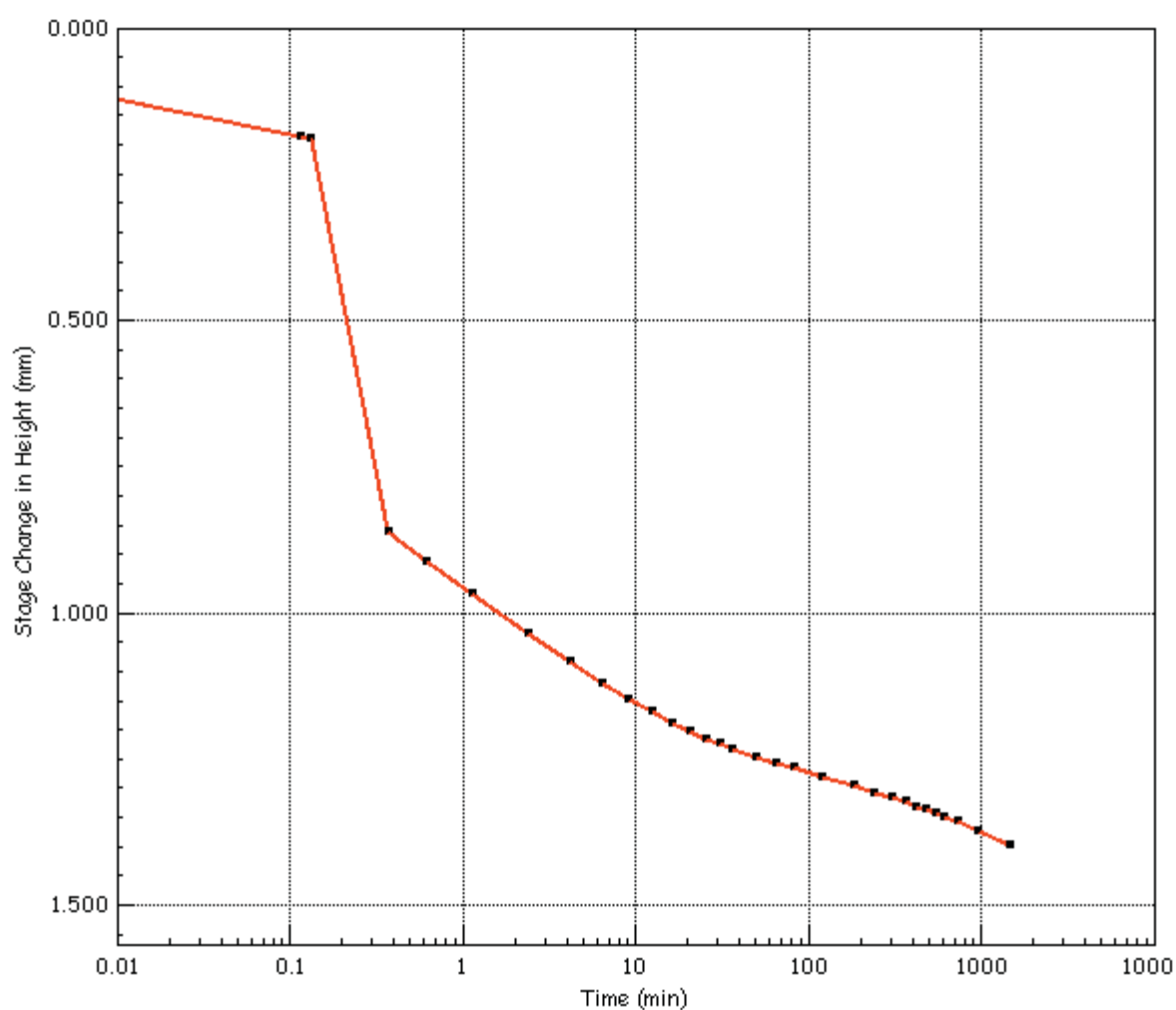
5.35




test and sample details			test results				
			pressure stage	voids ratio	laboratory coefficients of		
			(kPa)		compressibility $m_v$ ( $m^2/MN$ )	consolidation $C_v$ $C_{sec}$ ( $m^2/yr$ )	
specimen diameter	mm	63.55					
specimen height	mm	18.94					
initial moisture content	%	355.9					
final moisture content	%	235.2					
initial bulk density	$Mg/m^3$	0.98	50	5.226	1.5	3.6	0.028
initial dry density	$Mg/m^3$	0.22	100	4.601	2.0	1.1	
initial voids ratio		5.716	200	3.529	1.9	0.38	
initial degree of saturation	%	90	400	2.690	0.93	0.12	
particle density	$Mg/m^3$	#1.45	25	3.742	0.76		
swelling pressure	kPa	N/A	200	3.038	0.85	0.25	
P'o to P'o +100 kPa		-					
laboratory temperature	$^{\circ}C$	20 $\pm$ 2					
method of time fitting		root time					
remarks	# denotes particle density has been assigned an assumed value load frame corrections applied				CONTRACT	CHECKED	
					<b>35338</b>	<b>TB</b>	

# Oedometer Consolidation Settlement Report

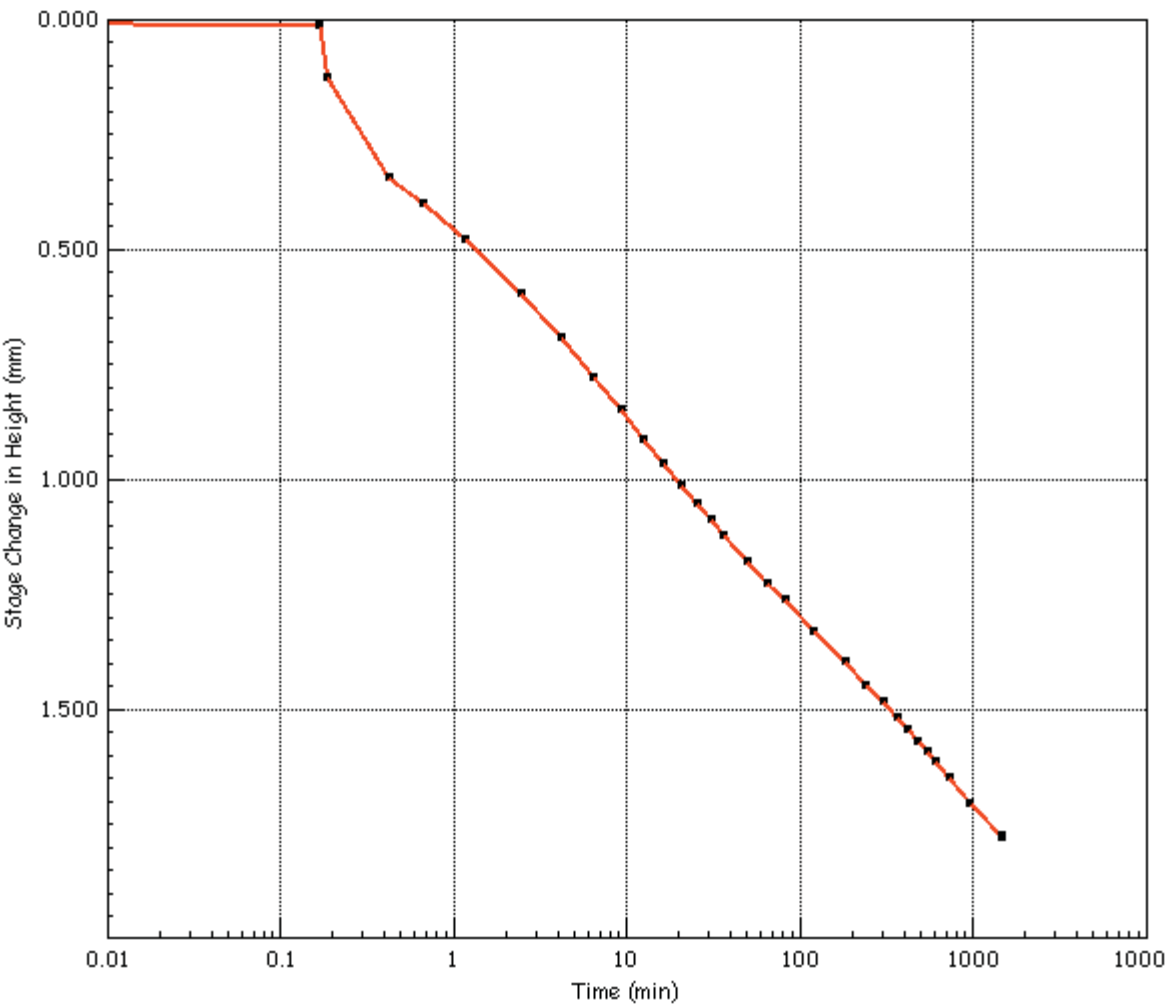
Vertical Stress	$\sigma'_i$	(kPa)	50
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.014
Height Settlement	$\Delta L_s$	(mm)	1.382
Voids Ratio	$e_f$	.	-0.193




	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 8	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	22/07/2019	
	Client	CARDFF PARKWAY		Sample	20UT	
	Operator	TA/JT/JG	Checked	*	Approved	*

# Oedometer Consolidation Settlement Report

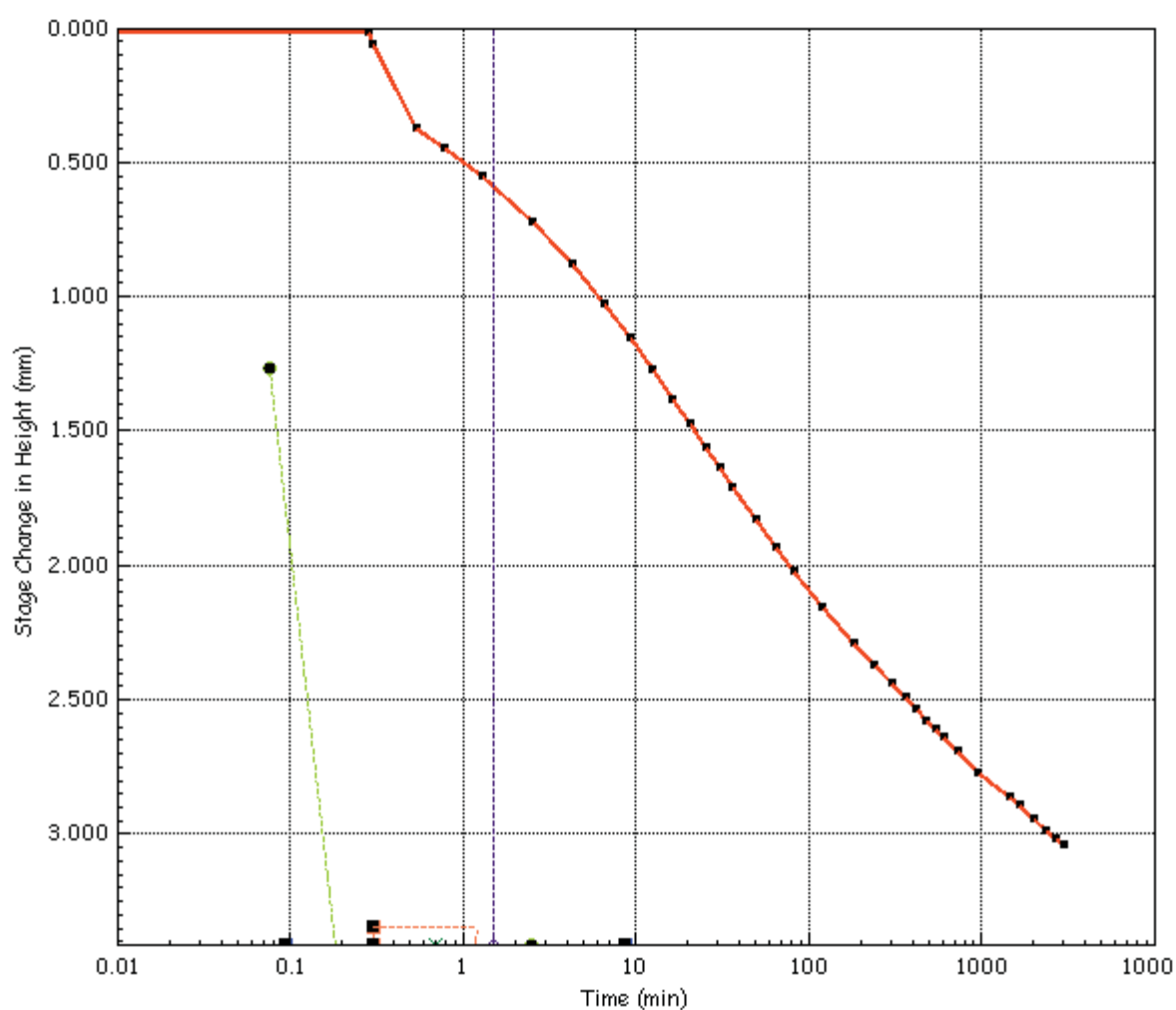
Vertical Stress	$\sigma'_i$	(kPa)	100
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.028
Height Settlement	$\Delta L_s$	(mm)	3.145
Voids Ratio	$e_f$	.	-0.269




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 8		
					Database:		.\SQLEXPRESS \ GEL		
	Site Reference				Test Date		22/07/2019		
	Jobfile		35338		Sample		20UT		
	Client		CARDFF PARKWAY		Borehole		BH10		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	

# Oedometer Consolidation Settlement Report

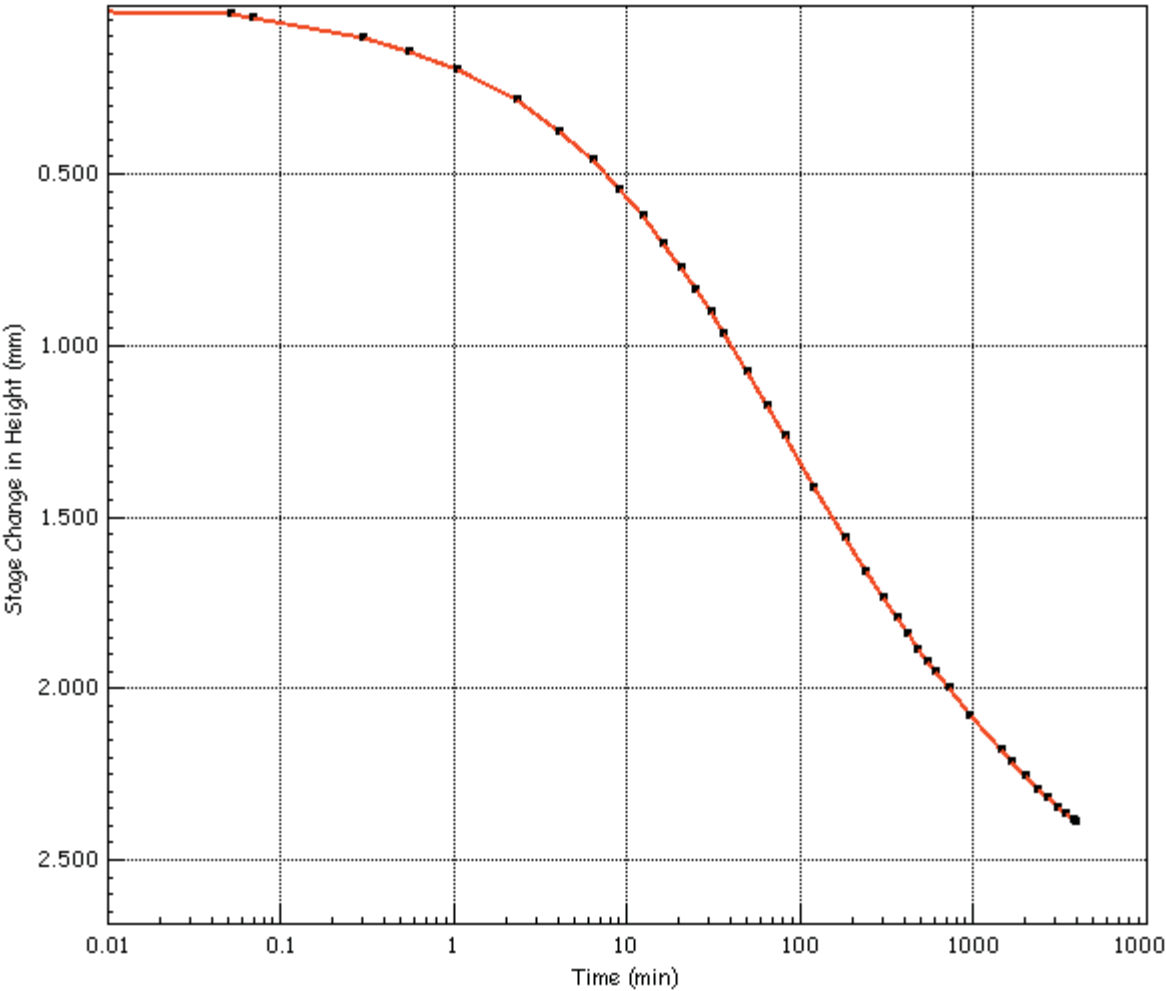
Vertical Stress	$\sigma'_i$	(kPa)	200
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.043
Height Settlement	$\Delta L_s$	(mm)	6.168
Voids Ratio	$e_f$	.	-0.400




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 8		
					Database:		.\SQLEXPRESS \ GEL		
	Site Reference				Test Date		22/07/2019		
	Jobfile		35338		Sample		20UT		
	Client		CARDFF PARKWAY		Borehole		BH10		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	

# Oedometer Consolidation Settlement Report

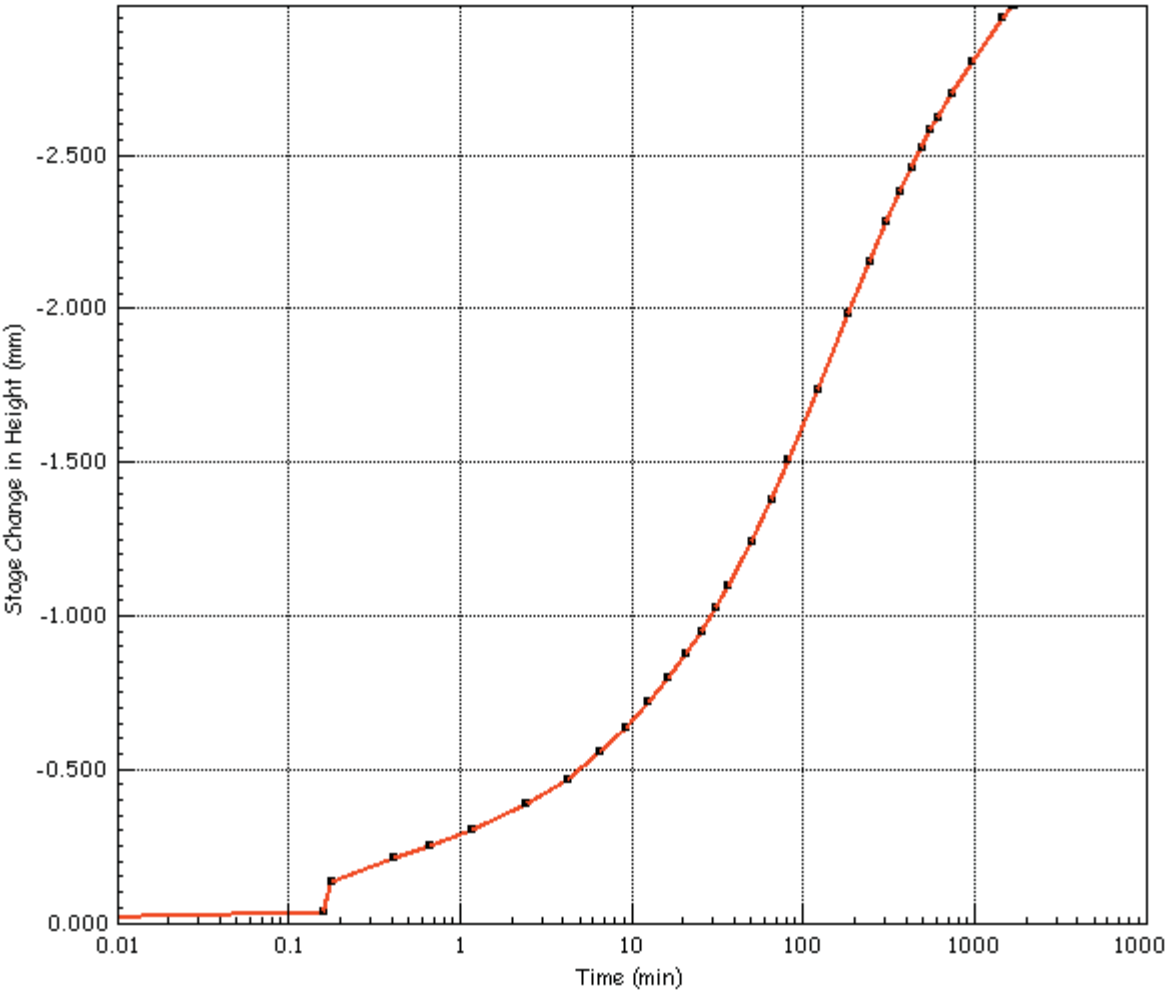
Vertical Stress	$\sigma'_i$	(kPa)	400
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.066
Height Settlement	$\Delta L_s$	(mm)	8.534
Voids Ratio	$e_f$	.	-0.503




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 8		
					Database:		.\SQLEXPRESS \ GEL		
	Site Reference				Test Date		22/07/2019		
	Jobfile		35338		Sample		20UT		
	Client		CARDFF PARKWAY		Borehole		BH10		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	25
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.040
Height Settlement	$\Delta L_s$	(mm)	5.567
Voids Ratio	$e_f$	.	-0.374

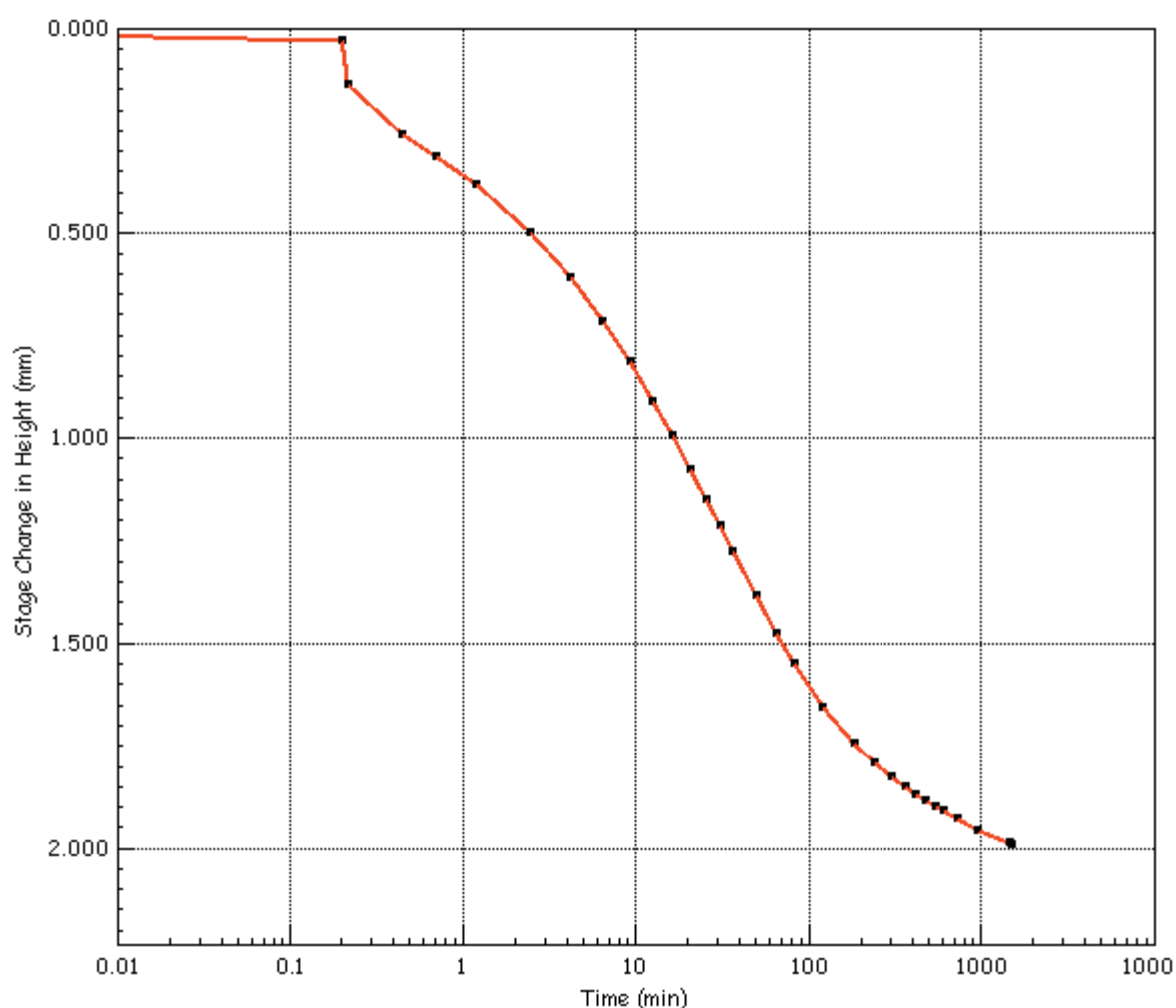



	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 8		
					Database: .\SQLEXPRESS \ GEL				
	Site Reference				Test Date		22/07/2019		
	Jobfile		35338		Sample		20UT		
	Client		CARDDFF PARKWAY		Borehole		BH10		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	



# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	200
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.043
Height Settlement	$\Delta L_s$	(mm)	7.554
Voids Ratio	$e_f$	.	-0.460



	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 8						
					Database: .\SQLEXPRESS \ GEL								
	Site Reference				Test Date				22/07/2019				
	Jobfile				Sample				20UT				
	Client				Borehole				BH10				
	Operator				TA/JT/JG		Checked		*		Approved		*

**DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES****BS.1377 : Part 5 : 1990 : 3**

CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH11

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

9UT

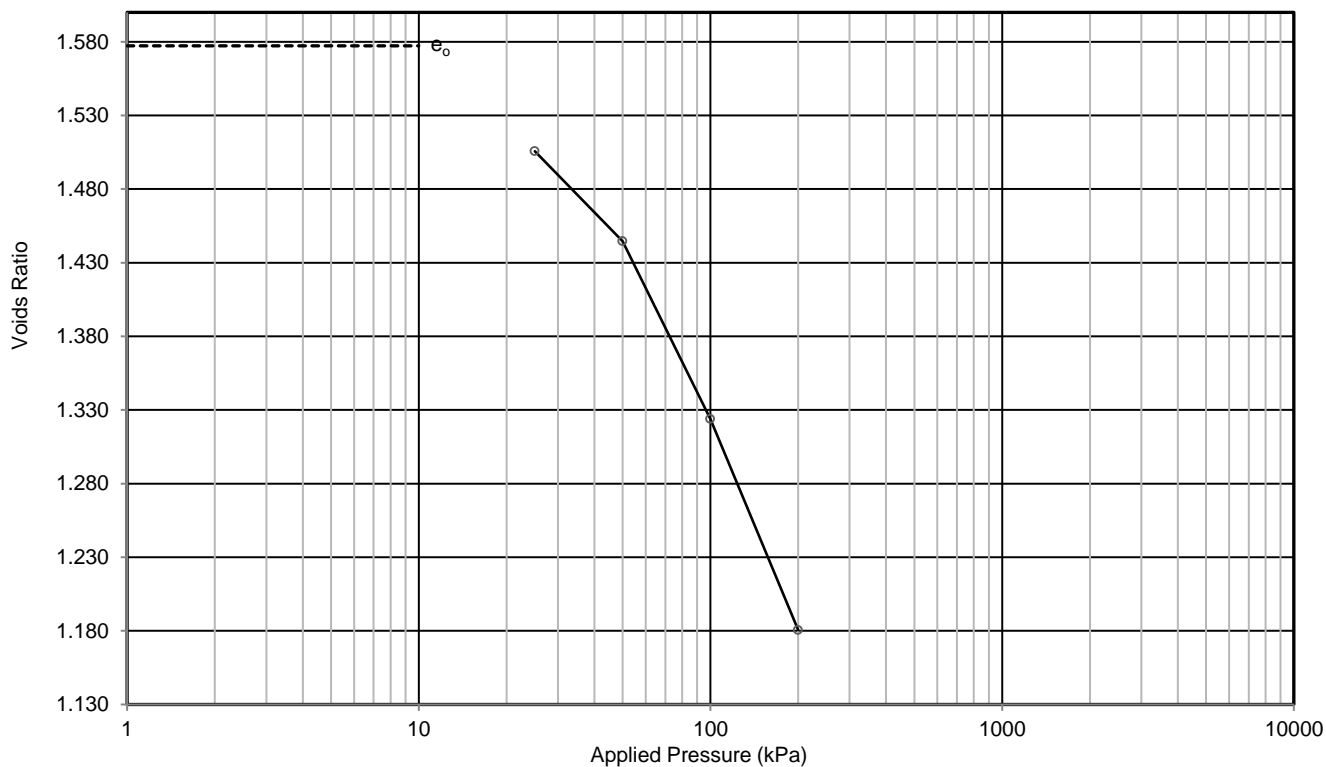
DESCRIPTION Grey mottled brown slightly sandy silty organic CLAY

SAMPLE DEPTH (m)

2.20

SPECIMEN DEPTH (m)

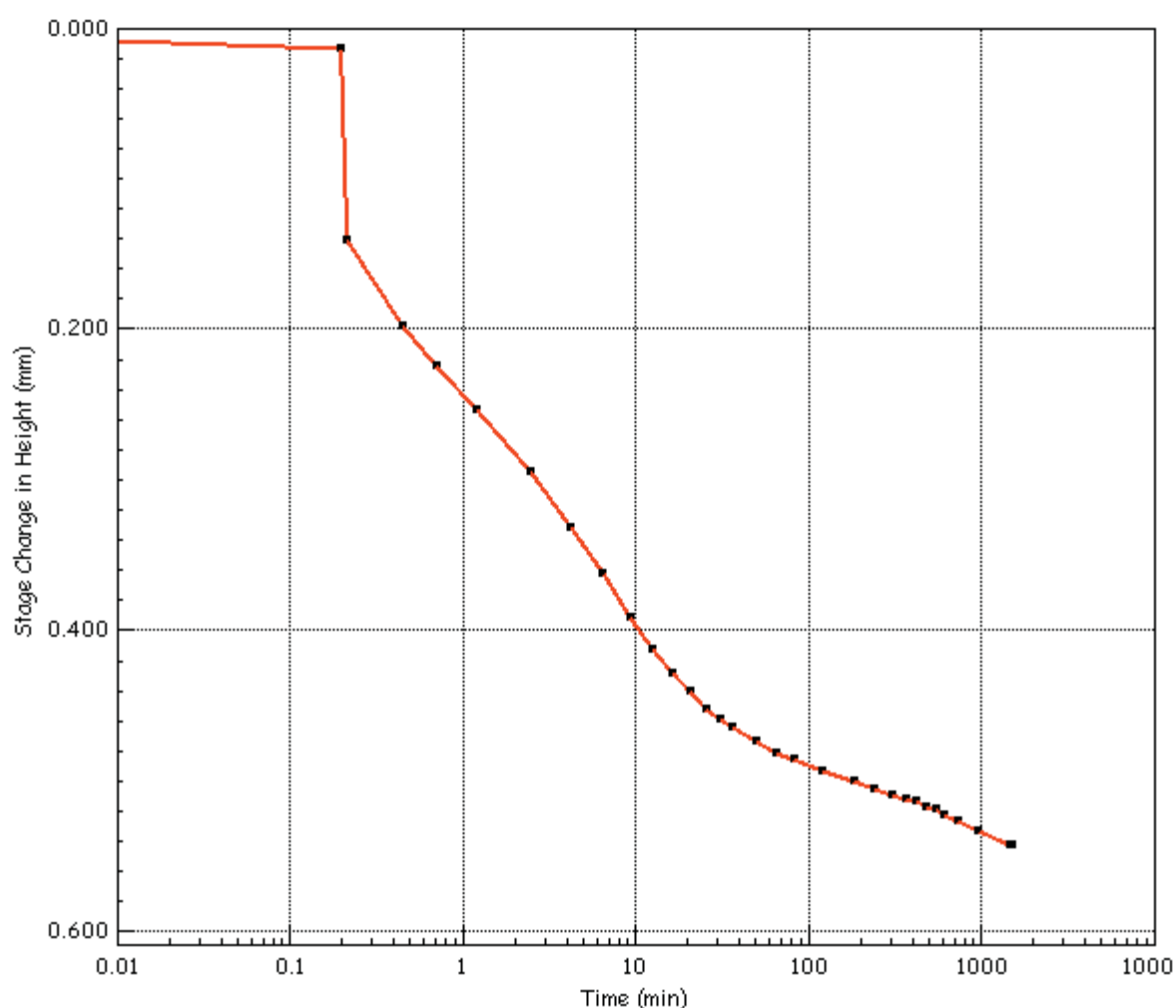
2.30




test and sample details			test results				
			pressure stage (kPa)	voids ratio	laboratory coefficients of compressibility mv (m <sup>2</sup> /MN)	consolidation Cv Csec (m <sup>2</sup> /yr)	
specimen diameter	mm	63.48					
specimen height	mm	19.01					
initial moisture content	%	55.5					
final moisture content	%	46.7					
initial bulk density	Mg/m <sup>3</sup>	1.63	25	1.506	1.1	1.7	0.0082
initial dry density	Mg/m <sup>3</sup>	1.05	50	1.445	0.98	0.75	
initial voids ratio		1.577	100	1.324	0.99	0.67	
initial degree of saturation	%	95	200	1.180	0.62	0.61	
particle density	Mg/m <sup>3</sup>	#2.70					
swelling pressure	kPa	N/A					
P'o to P'o +100 kPa		-					
laboratory temperature	oC	20 ± 2					
method of time fitting		root time					
remarks	# denotes particle density has been assigned an assumed value load frame corrections applied				CONTRACT <b>35338</b>	CHECKED <b>TB</b>	

# Oedometer Consolidation Settlement Report

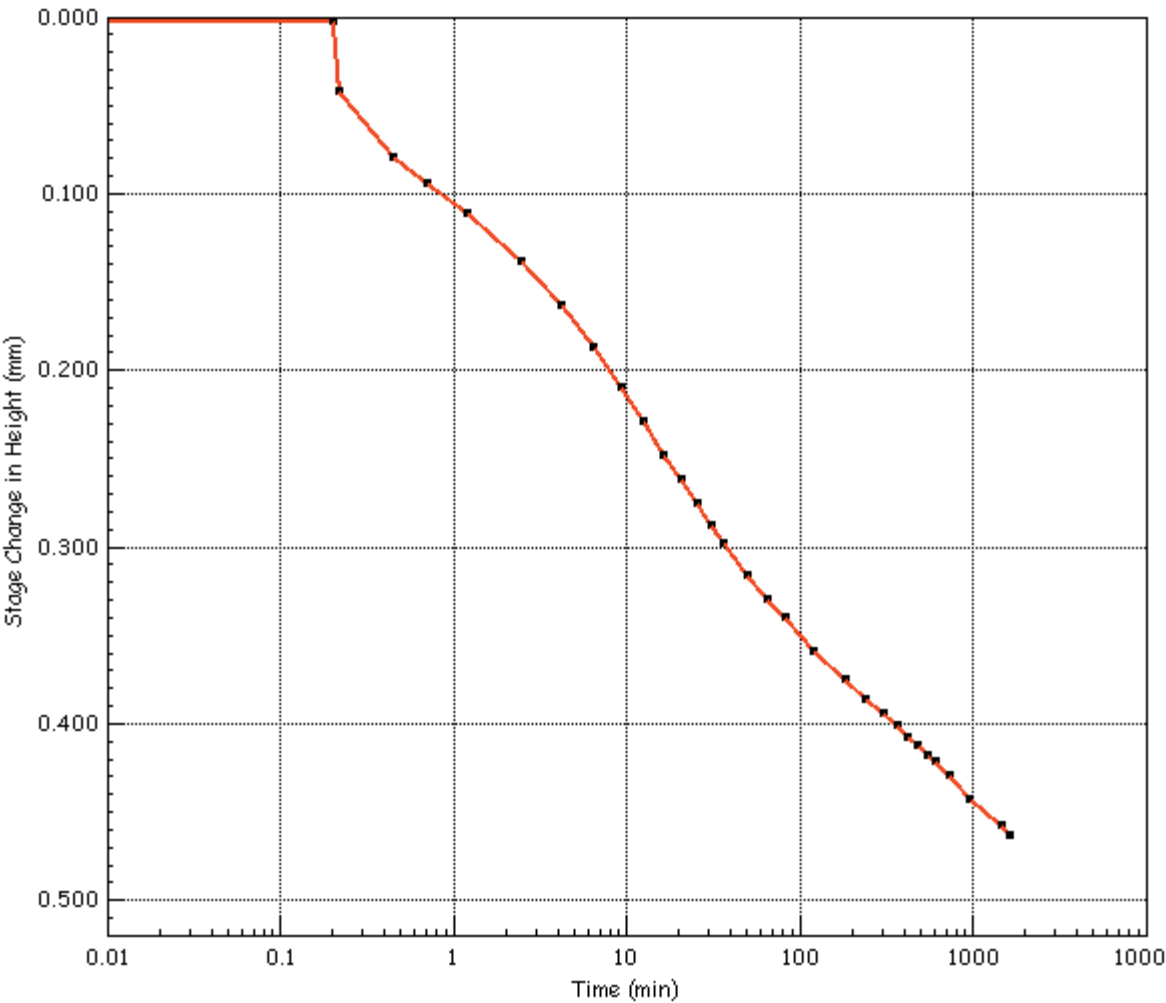
Vertical Stress	$\sigma'_{i_1}$	(kPa)	25
Initial Temperature	$T_{i_1}$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.014
Height Settlement	$\Delta L_s$	(mm)	0.528
Voids Ratio	$e_f$	.	-0.156
	$T_f$		
	$t_{50}$		
	$t_{90}$		
	$C_v$		
	$m_v$		
	$C_{SEC}$		




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 7				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date				23/07/2019		
	Jobfile				Sample				FRAME 7		
	Client				Borehole				BH11		
	CARDFF PARKWAY										
Operator		TA/JT/JG		Checked		*		Approved		*	

# Oedometer Consolidation Settlement Report

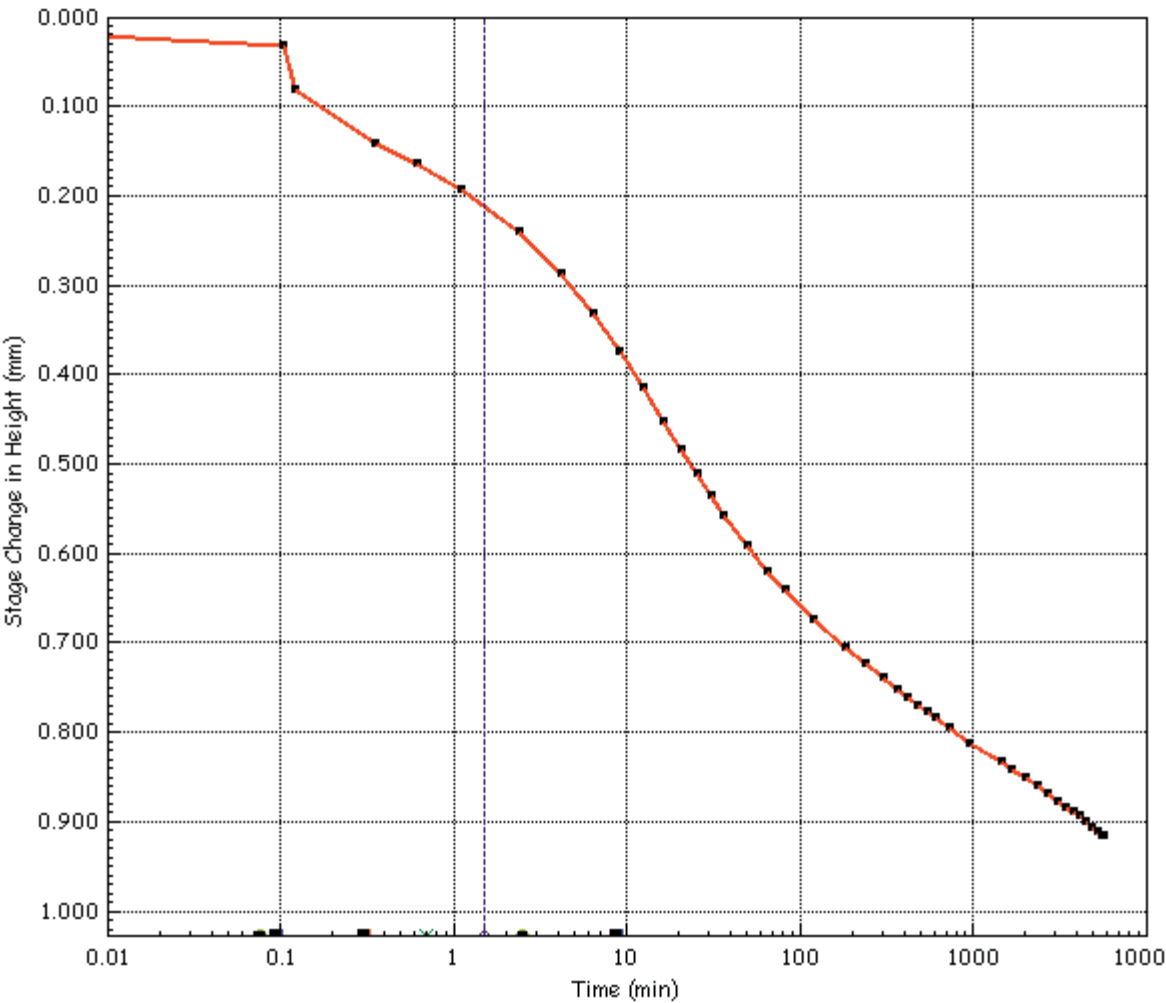
Vertical Stress	$\sigma'_i$	(kPa)	50
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.026
Height Settlement	$\Delta L_s$	(mm)	0.979
Voids Ratio	$e_f$	.	-0.175




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 7		
					Database:		.\SQLEXPRESS \ GEL		
	Site Reference				Test Date		23/07/2019		
	Jobfile		35338		Sample		FRAME 7		
	Client		CARDFF PARKWAY		Borehole		BH11		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	

# Oedometer Consolidation Settlement Report

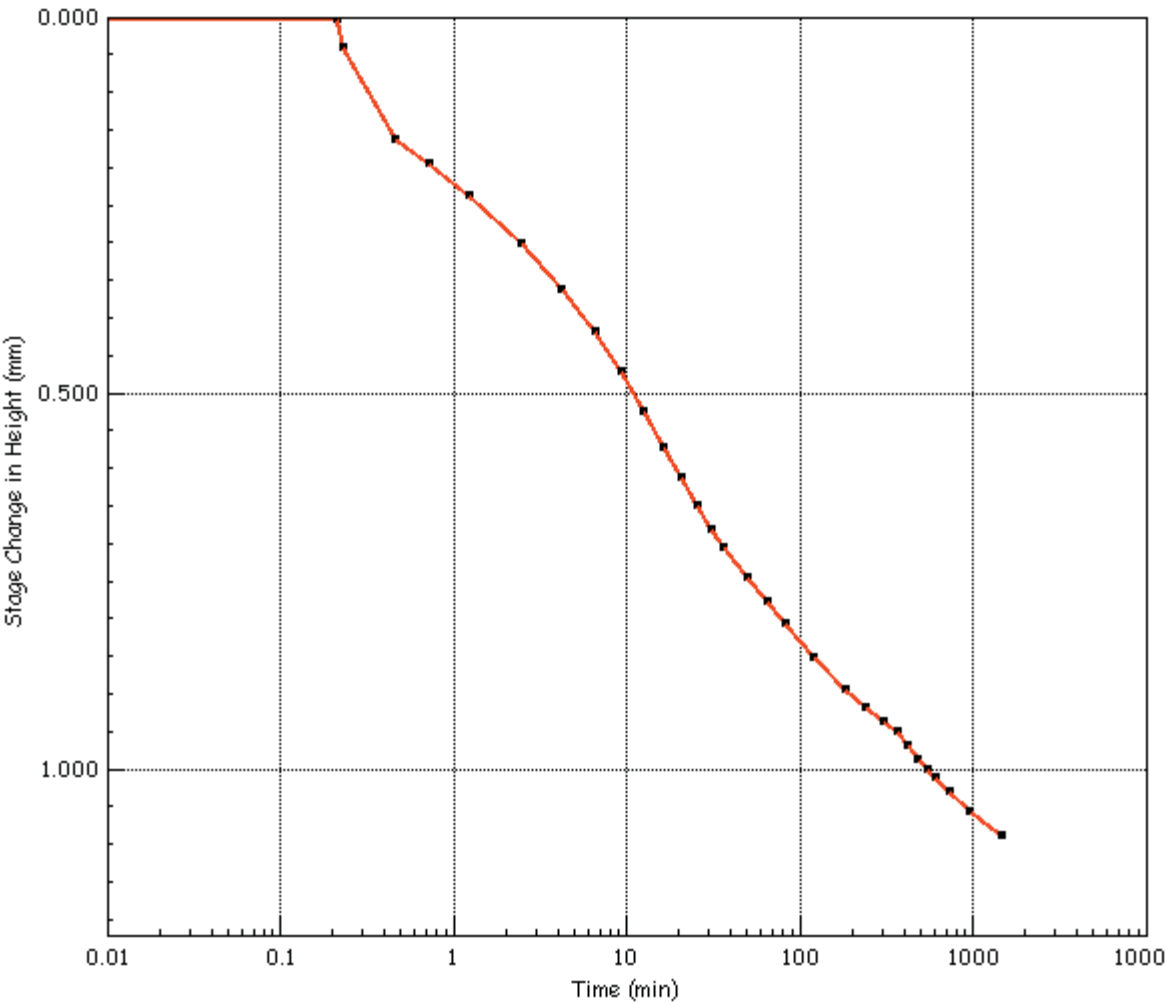
Vertical Stress	$\sigma'_i$	(kPa)	100
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.047
Height Settlement	$\Delta L_s$	(mm)	1.870
Voids Ratio	$e_f$	.	-0.214




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 7		
					Database:		.\SQLEXPRESS \ GEL		
	Site Reference				Test Date		23/07/2019		
	Jobfile		35338		Sample		FRAME 7		
	Client		CARDFF PARKWAY		Borehole		BH11		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	200
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.078
Height Settlement	$\Delta L_s$	(mm)	2.927
Voids Ratio	$e_f$	.	-0.260



	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 7	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	23/07/2019	
	Client	CARDFF PARKWAY		Sample	FRAME 7	
	Operator	TA/JT/JG	Checked	*	Approved	*



SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	sample		specimen depth (m)	code	moisture content		dimensions		density		cell pressure (kPa)	rate of strain (%/min)	deviator stress (kPa)	failure strain (%)	failure mode	shear strength* (kPa)	description and remarks
	no./type	depth (m)			initial (%)	final (%)	length (mm)	diameter (mm)	bulk (Mg/m3)	dry (Mg/m3)							
BH10	14UT	3.20	3.40	UU100	59.7	66.3	206	104	1.62	1.01	60	2.0	12	8.3	I	6	Grey slightly gravelly slightly sandy silty organic CLAY
BH10	20UT	5.20	5.40	UU100	367.2	379.3	206	104	1.04	0.22	95	2.0	89	5.8	S	45	Black slightly gravelly slightly sandy clayey PEAT



SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	sample		specimen depth (m)	diameter D (mm)	height H (mm)	H/D	moisture content (%)	bulk density (Mg/m3)	loading rate (kN/min)	time to failure (min:sec)	UCS (MPa)	description, codes and remarks
	no./type	depth (m)										
BH11	35Cs	13.50	13.50	89.1	266.6	2.99	10.2	2.35	1	03:56	0.63	Reddish brown MUDSTONE, N, AxCa
<div>general remarks</div> <div>sample obtained from vertically drilled core (unless specified), test machine - VJT6000</div> <div><div>coding:</div><div><div>moisture condition</div><div>N - natural moisture content</div><div>F - fully saturated</div><div>S - soaked</div><div>P - air/partially dried</div></div><div><div>sample storage</div><div>U - not wrapped</div><div>F - wrapped in cling film/foil</div><div>W - waxed</div><div>G - contained in sealed Geoline</div></div><div><div>failure mode</div><div>Ax - axial cleavage</div><div>Ca - cataclasis</div><div>Sh - shear</div><div>Ex - explosive</div><div>Ot - other</div></div></div>												
											CONTRACT	CHECKED
											35338	TB



**POINT LOAD STRENGTH TEST**

I.S.R.M. Suggested Methods : 2007 Edition



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	sample depth (m)	test type	test orien- tation	moisture condition	width  W (mm)	length  L (mm)	platen sep.  D (mm)	failure load  P (kN)	equiv. diam.  De (mm)	Is  (MPa)	size factor	Is(50)  (MPa)	description and remarks
BH10	13.55	D	Y	P		30	90	0.05	90.00	0.01	1.30	0.01	Reddish brown MUDSTONE
BH10	13.55	A	X	P	90		35	0.56	63.33	0.14	1.11	0.16	Reddish brown MUDSTONE
BH10	16.70	I	U	P	90	110	65	6.23	86.30	0.84	1.28	1.07	Pinkish brown SANDSTONE
BH10	23.53	I	U	P	80	140	90	0.86	95.75	0.09	1.34	0.13	Purplish brown MUDSTONE
BH10	24.93	D	Y	P		60	90	1.77	90.00	0.22	1.30	0.28	Purplish brown MUDSTONE
BH10	24.93	A	X	P	90		40	2.19	67.70	0.48	1.15	0.55	Purplish brown MUDSTONE
BH11	13.38	I	U	P	80	85	40	0.23	63.83	0.06	1.12	0.06	Orangish brown MUDSTONE
general remarks tests carried out in accordance with I.S.R.M.(2007): Suggested Methods for Determining Point Load Strength test machine PLM02													
test type		test orientation relative to discontinuities						moisture condition				CONTRACT	CHECKED
A - axial		X - perpendicular		U - unknown		N - natural moisture content				35338		TB	
D - diametral		Y - parallel		P - partially air dried									
I - irregular lump		Z - oblique		S - soaked									



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# Final Report

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**Report No.:** 19-24373-1

**Initial Date of Issue:** 25-Jul-2019

**Client** Geotechnical Engineering Ltd

**Client Address:** Centurion House  
Olympus Park  
Quedgeley  
Gloucester  
Gloucestershire  
GL2 4NF

**Contact(s):** GEL  
Wendy Jones

**Project** 35338 C Cardiff Parkway Initial Ground Investigation

**Quotation No.:** **Date Received:** 19-Jul-2019

**Order No.:** 35338/WJ **Date Instructed:** 19-Jul-2019

**No. of Samples:** 12

**Turnaround (Wkdays):** 5 **Results Due:** 25-Jul-2019

**Date Approved:** 25-Jul-2019

**Approved By:**



**Details:** Robert Monk, Technical Manager

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## Results - Soil

**Project: 35338 C Cardiff Parkway Initial Ground Investigation**

<b>Client: Geotechnical Engineering Ltd</b>	<b>Chemtest Job No.:</b>					19-24373	19-24373	19-24373	19-24373	19-24373	19-24373	19-24373	19-24373
Quotation No.:	<b>Chemtest Sample ID.:</b>					860638	860639	860640	860641	860642	860643	860644	860645
	Client Sample ID.:					2D	10D	1B	19D	23D	29D	4D	8D
	Sample Location:					BH10	BH10	BH11	BH11	BH11	BH11	TP05	TP06
	Sample Type:					SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):					0.2	1.9	0.3	5.2	7.3	10.9	1	3
	Bottom Depth (m):					0.4	2	0.5	5.65	7.4	11	1.2	3.2
	Date Sampled:					18-Jul-2019	18-Jul-2019	18-Jul-2019	18-Jul-2019	18-Jul-2019	18-Jul-2019	18-Jul-2019	18-Jul-2019
<b>Determinand</b>	<b>Accred.</b>	<b>SOP</b>	<b>Units</b>	<b>LOD</b>									
Moisture	N	2030	%	0.020	20	29	20	51	36	11	24	16	21
pH (2.5:1)	N	2010		N/A	7.3	8.0	8.4	7.9	8.3	8.9			
Magnesium (Water Soluble)	N	2120	g/l	0.010	< 0.010	0.020	< 0.010	0.038	0.044	0.015			
Sulphate (2:1 Water Soluble) as SO <sub>4</sub>	U	2120	g/l	0.010	< 0.010	0.31	< 0.010	0.47	0.57	< 0.010			
Total Sulphur	U	2175	%	0.010	0.044	0.34	0.055	2.0	1.1	0.039			
Chloride (Water Soluble)	U	2220	g/l	0.010	< 0.010	0.042	0.015	0.84	0.68	0.062			
Nitrate (Water Soluble)	N	2220	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010			
Sulphate (Acid Soluble)	U	2430	%	0.010	0.016	0.11	0.036	0.37	0.14	0.020			
LOI	U	2610	%	0.10				30					
Organic Matter	U	2625	%	0.40				19			0.64	< 0.40	0.45

**Project: 35338 C Cardiff Parkway Initial Ground Investigation**

<b>Client: Geotechnical Engineering Ltd</b>	<b>Chemtest Job No.:</b>				19-24373	19-24373	19-24373
Quotation No.:	<b>Chemtest Sample ID.:</b>				860647	860648	860649
	Client Sample ID.:				8D	6D	7B
	Sample Location:				TP07	TP08	TP09
	Sample Type:				SOIL	SOIL	SOIL
	Top Depth (m):				3	2	2.8
	Bottom Depth (m):				3.2	2.2	3.3
	Date Sampled:				18-Jul-2019	18-Jul-2019	18-Jul-2019
<b>Determinand</b>	<b>Accred.</b>	<b>SOP</b>	<b>Units</b>	<b>LOD</b>			
Moisture	N	2030	%	0.020	32	15	33
pH (2.5:1)	N	2010		N/A			
Magnesium (Water Soluble)	N	2120	g/l	0.010			
Sulphate (2:1 Water Soluble) as SO <sub>4</sub>	U	2120	g/l	0.010			
Total Sulphur	U	2175	%	0.010			
Chloride (Water Soluble)	U	2220	g/l	0.010			
Nitrate (Water Soluble)	N	2220	g/l	0.010			
Sulphate (Acid Soluble)	U	2430	%	0.010			
LOI	U	2610	%	0.10			
Organic Matter	U	2625	%	0.40	1.7	0.50	1.9

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measurement by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.

## **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, SVOCs, PCBs, Phenols

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

All Asbestos testing is performed at the indicated laboratory

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

### **Sample Deviation Codes**

---

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

### **Sample Retention and Disposal**

---

All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

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

[customerservices@chemtest.com](mailto:customerservices@chemtest.com)



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# Final Report

---

**Report No.:** 19-24373-1

**Initial Date of Issue:** 25-Jul-2019

**Client** Geotechnical Engineering Ltd

**Client Address:** Centurion House  
Olympus Park  
Quedgeley  
Gloucester  
Gloucestershire  
GL2 4NF

**Contact(s):** GEL  
Wendy Jones

**Project** 35338 C Cardiff Parkway Initial Ground Investigation

**Quotation No.:** **Date Received:** 19-Jul-2019

**Order No.:** 35338/WJ **Date Instructed:** 19-Jul-2019

**No. of Samples:** 12

**Turnaround (Wkdays):** 5 **Results Due:** 25-Jul-2019

**Date Approved:** 25-Jul-2019

**Approved By:**



**Details:** Robert Monk, Technical Manager

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# Final Report

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**Report No.:** 19-24728-1

**Initial Date of Issue:** 31-Jul-2019

**Client** Geotechnical Engineering Ltd

**Client Address:** Centurion House  
Olympus Park  
Quedgeley  
Gloucester  
Gloucestershire  
GL2 4NF

**Contact(s):** Wendy Jones  
GEL

**Project** 35338 C Cardiff Parkway Initial Ground  
Investigation

**Quotation No.:** **Date Received:** 24-Jul-2019

**Order No.:** 35338 /WJ **Date Instructed:** 24-Jul-2019

**No. of Samples:** 3

**Turnaround (Wkdays):** 5 **Results Due:** 30-Jul-2019

**Date Approved:** 31-Jul-2019

**Approved By:**



**Details:** Amy Parekh-Pross, Technical Projects  
Manager

---



**Project: 35338 C Cardiff Parkway Initial Ground Investigation**

<b>Client: Geotechnical Engineering Ltd</b>	<b>Chemtest Job No.:</b>				19-24728	19-24728	19-24728
Quotation No.:	<b>Chemtest Sample ID.:</b>				862386	862387	862388
	Client Sample ID.:				14UT	20UT	9UT
	Sample Location:				BH10	BH10	BH11
	Sample Type:				SOIL	SOIL	SOIL
	Top Depth (m):				3.20	5.20	2.20
	Bottom Depth (m):				3.65	5.65	2.65
	Date Sampled:				23-Jul-2019	23-Jul-2019	23-Jul-2019
<b>Determinand</b>	<b>Accred.</b>	<b>SOP</b>	<b>Units</b>	<b>LOD</b>			
Moisture	N	2030	%	0.020	36	77	35
pH (2.5:1)	N	2010		N/A		7.7	8.3
Magnesium (Water Soluble)	N	2120	g/l	0.010		0.042	0.020
Sulphate (2:1 Water Soluble) as SO <sub>4</sub>	U	2120	g/l	0.010		0.47	0.16
Total Sulphur	U	2175	%	0.010		7.1	0.53
Chloride (Water Soluble)	U	2220	g/l	0.010		0.58	0.12
Nitrate (Water Soluble)	N	2220	g/l	0.010		< 0.010	< 0.010
Sulphate (Acid Soluble)	U	2430	%	0.010		0.94	0.11
LOI	U	2610	%	0.10		65	
Organic Matter	U	2625	%	0.40	2.4		1.6

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
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2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.

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[customerservices@chemtest.com](mailto:customerservices@chemtest.com)



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GEOTECHNICAL ENGINEERING LIMITED

For the attention of James Taylor/Edward Crimp

Version No. 3

Page No. 1 of 47

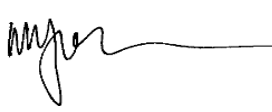
Date of Issue 13/08/2019

**TEST REPORT**

PROJECT/SITE	CARDIFF PARKWAY INITIAL GROUND INVESTIGATION	Samples received	18/07/2019
GEL REPORT NUMBER	35338	Schedule received	18/07/2019
Your ref/PO:		Testing commenced	23/07/2019
Test report refers to	Schedule D	Status	Final

**SUMMARY OF RESULTS ATTACHED**

TEST METHOD & DESCRIPTION	QUANTITY	ACCREDITED TEST
BS EN ISO 17892-1: 2014:5. Water Content	6	YES
BS1377: Part 2: 1990:4.2-4.4&5.2-5.4, Liquid & Plastic Limits	6	YES
BS EN ISO 17892-4: 2016: 5.2, Particle Size Distribution - Wet Sieve	9	YES
BS EN ISO 17892-4: 2016: 5.4, Particle Size Distribution - Pipette	8	YES
BS1377: Part 5: 1990:3, Consolidation	4	YES
BS1377: Part 7: 1990:8&9, Undrained Triaxial Compression	4	YES
ISRM: Suggested Methods: 2007: Uniaxial Compressive Strength of Rock	3	YES
ISRM: 2007: Point Load Strength Test	10	YES
BRE SD1 Suite (Subcontracted)	6	YES/NO
Loss On Ignition (Subcontracted)	2	YES
Organic Matter Content (Subcontracted)	3	YES

Remarks This report may not be partially reproduced without written permission from this laboratory.	Approved Signatories: <b>W Jones (Laboratory Manager)</b> E Crimp (Senior Engineer) J Hanson (Director) N Parry (Director) 
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Doc TR01

Rev No. 20

Revision date 09/10/17

DC:JH

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Sort code: 16-22-11 Bank account: 11125135

**LIQUID AND PLASTIC LIMITS**

BS.1377 : PART 2 : 1990 : 4 and 5



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	sample		specimen depth (m)	natural water content (%)	specimen preparation and test method	fraction >0.425 mm (%)	liquid limit (%)	plastic limit (%)	plasticity index (%)	description and remarks	
	no./type	depth (m)									
BH04	7P	1.20	1.65	37.2	BXE	0	49	25	24	Grey mottled brown silty organic CLAY	
BH04	12P	3.60	4.25	65.7	BXE	0	51	25	26	Grey slightly sandy silty organic CLAY	
BH05	2D	0.20	0.20	27.6	BXE	2	60	24	36	Brown slightly sandy silty CLAY with rare rootlets	
BH05	13UT	3.20	3.35	12.8	BXE	4	35	25	10	Reddish brown slightly gravelly slightly sandy clayey SILT	
BH07	2D	0.30	0.30	34.7	BXE	0	69	28	41	Greyish brown silty CLAY with rare rootlets	
BH07	15P	6.00	6.10	83.8	BXE	0	65	33	32	Greyish brown slightly sandy silty organic CLAY	
general remarks natural water content determined in accordance with BS EN ISO 17892 - 1 : 2014 (unless specified) NP denotes non plastic # denotes sample tested is smaller than that which is recommended in accordance with BS1377 or BS EN ISO 17892											
specimen preparation A - as received B - washed on 0.425mm sieve C - air dried							test method X - cone penetrometer (test 4.3) Y - cone penetrometer (test 4.4) Z - casagrande apparatus (test 4.5)			CONTRACT  35338	CHECKED  TB

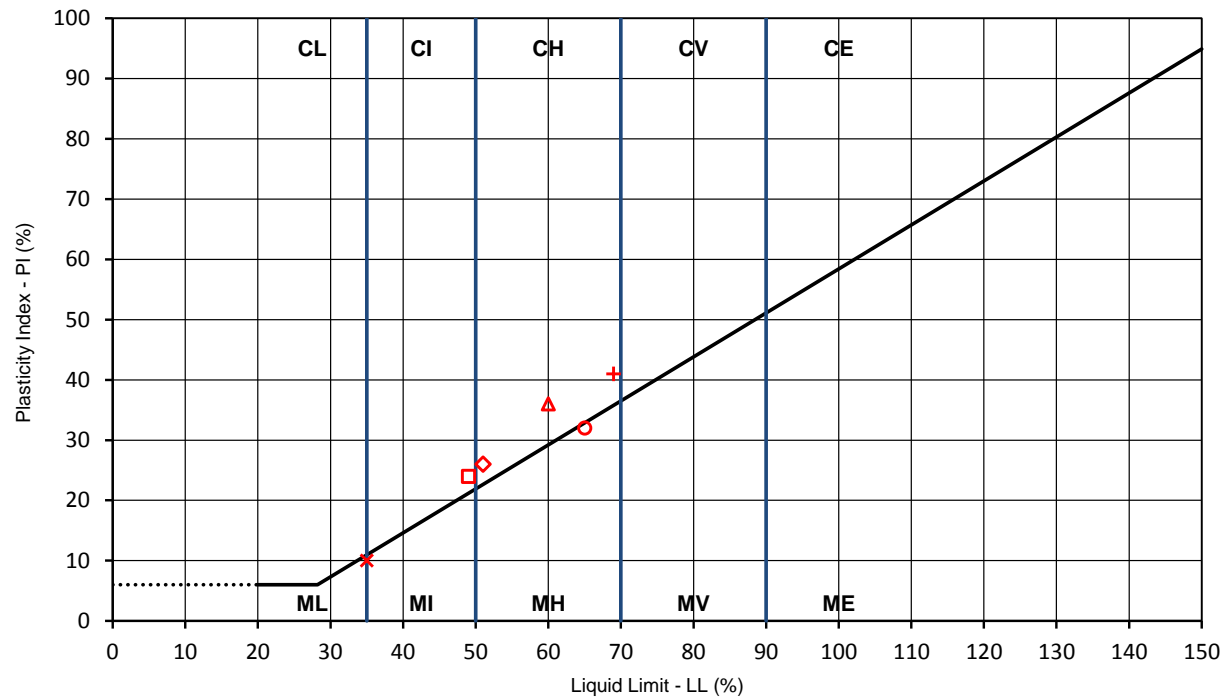
Geotechnical Engineering Limited

# ATTERBERG LINE PLOT



CLIENT    CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE        CARDIFF PARKWAY INITIAL GROUND INVESTIGATION



BH/TP No.		depth (m)	LL	PL	PI	remarks
□	BH04	1.65	49	25	24	
◇	BH04	4.25	51	25	26	
△	BH05	0.20	60	24	36	
×	BH05	3.35	35	25	10	
+	BH07	0.30	69	28	41	
○	BH07	6.10	65	33	32	

CONTRACT	CHECKED
35338	TB

**PARTICLE SIZE DISTRIBUTION**

BS EN ISO 17892 - 4 : 2016 : 5



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH04

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

7P

DESCRIPTION Grey mottled brown silty organic CLAY

SAMPLE DEPTH (m)

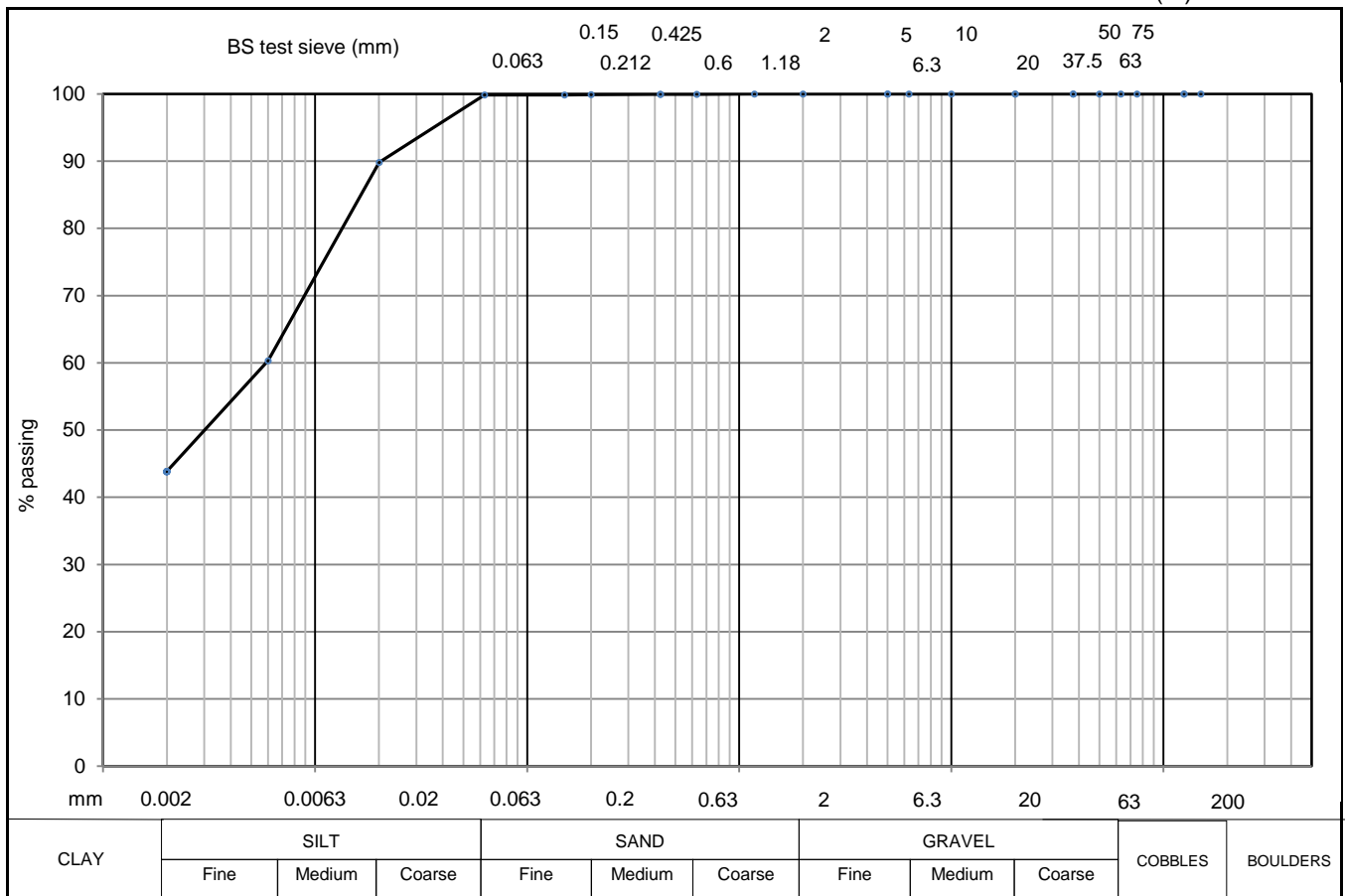
1.20

SPECIMEN TOP (m)

1.60

SPECIMEN BASE (m)

1.70



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY	44						
SILT	56	150		5		20	90
SILT & CLAY	100						
SAND	0	75		2		6	60
GRAVEL	0						
COBBLE & BOULDER	0	63		1.18	100	2	44
test method(s)	5.2 & 5.4	50		0.63	100		
test method		37.5		0.425	100		
5.2 - sieving		20		0.2	100		
5.3 - sedimentation by hydrometer		10		0.15	100		
5.4 - sedimentation by pipette		6.3		0.063	100		
remarks	# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3					CONTRACT	CHECKED
						35338	TB



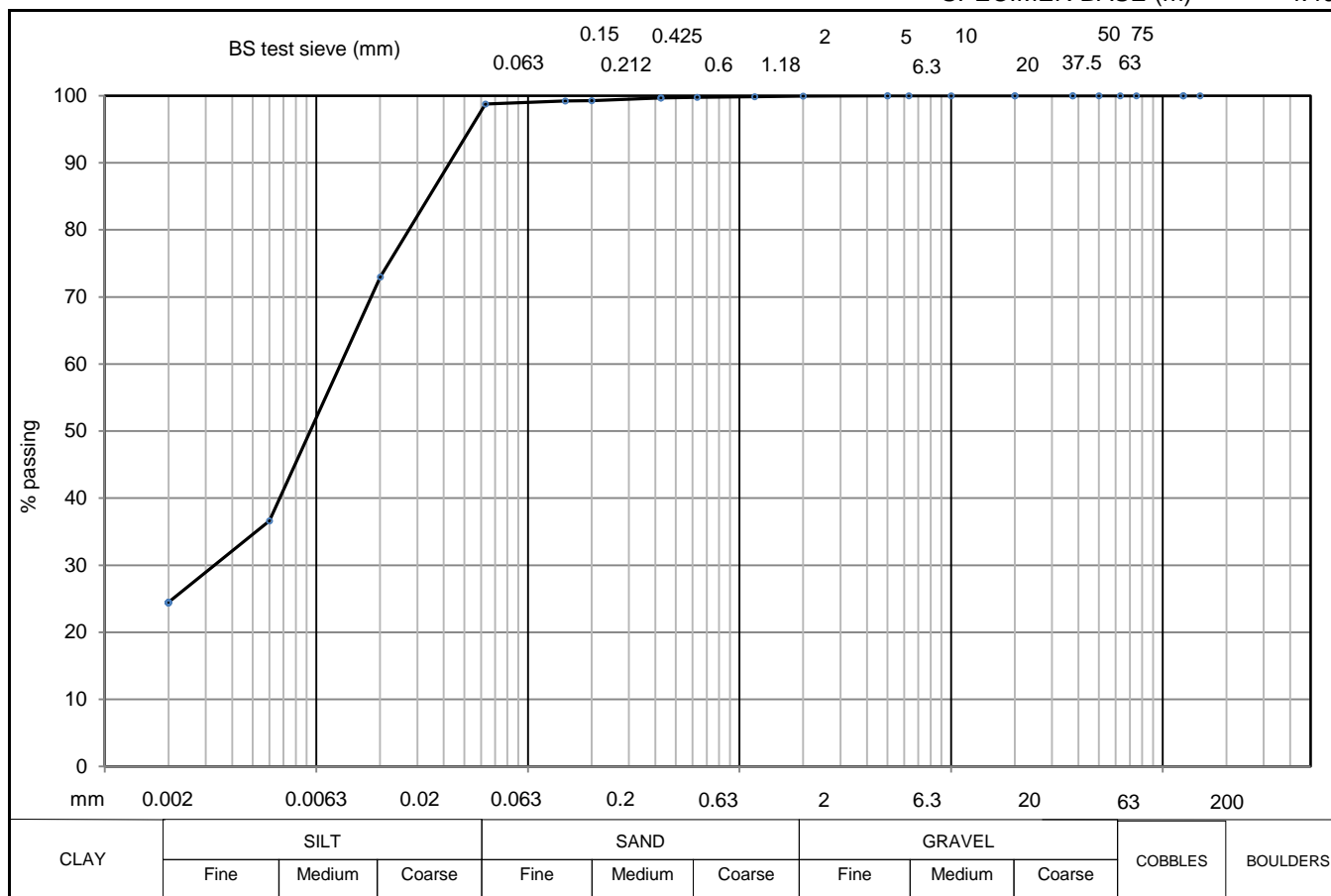
BH/TP No. BH04

SAMPLE No./TYPE 12P

SAMPLE DEPTH (m) 3.60

SPECIMEN TOP (m) 4.30

SPECIMEN BASE (m) 4.40



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY	25	150		5	100	20	73
SILT	74						
SILT & CLAY	99						
SAND	1						
GRAVEL	0						
COBBLE & BOULDER	0						
test method(s)	5.2 & 5.4	50		0.63	100		
test method		37.5		0.425	100		
5.2 - sieving		20		0.2	99		
5.3 - sedimentation by hydrometer		10		0.15	99		
5.4 - sedimentation by pipette		6.3		0.063	99		
remarks # denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3						CONTRACT  <b>35338</b>	CHECKED  <b>TB</b>



**PARTICLE SIZE DISTRIBUTION**

BS EN ISO 17892 - 4 : 2016 : 5



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH04

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

17D

DESCRIPTION Brown clayey very sandy GRAVEL

SAMPLE DEPTH (m)

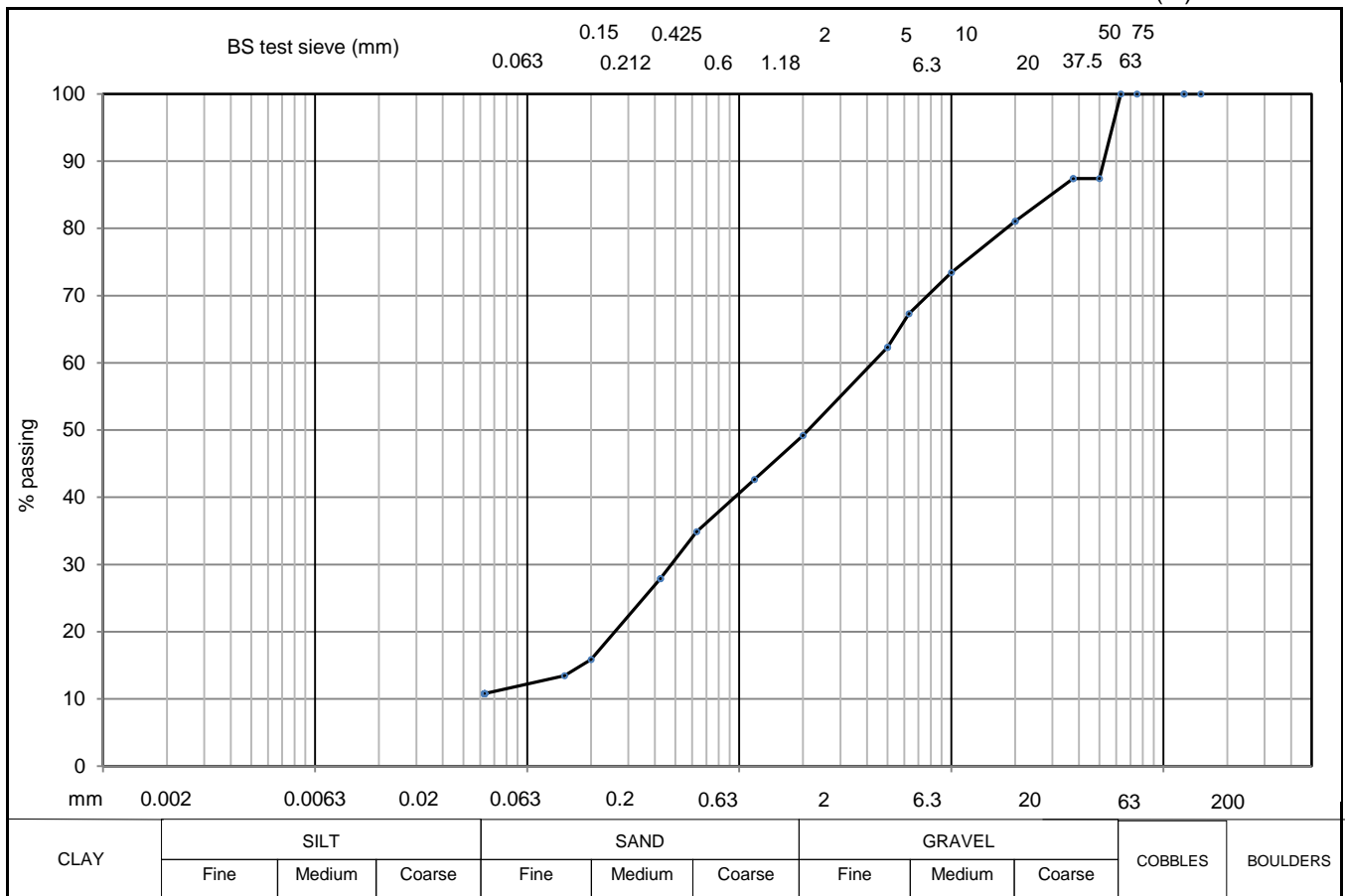
6.90

SPECIMEN TOP (m)

6.90

SPECIMEN BASE (m)

7.00



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY							
SILT		150		5	62	20	
SILT & CLAY	11						
SAND	38	75		2	49	6	
GRAVEL	51						
COBBLE & BOULDER	0	63	100	1.18	43	2	
test method(s)	5.2#	50	87	0.63	35		
test method		37.5	87	0.425	28		
5.2 - sieving		20	81	0.2	16		
5.3 - sedimentation by hydrometer		10	73	0.15	13		
5.4 - sedimentation by pipette		6.3	67	0.063	11		
remarks	# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3					CONTRACT	CHECKED
						35338	TB

**PARTICLE SIZE DISTRIBUTION**

BS EN ISO 17892 - 4 : 2016 : 5



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH04

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

19D

DESCRIPTION Reddish brown mottled brown slightly gravelly slightly sandy clayey SILT

SAMPLE DEPTH (m)

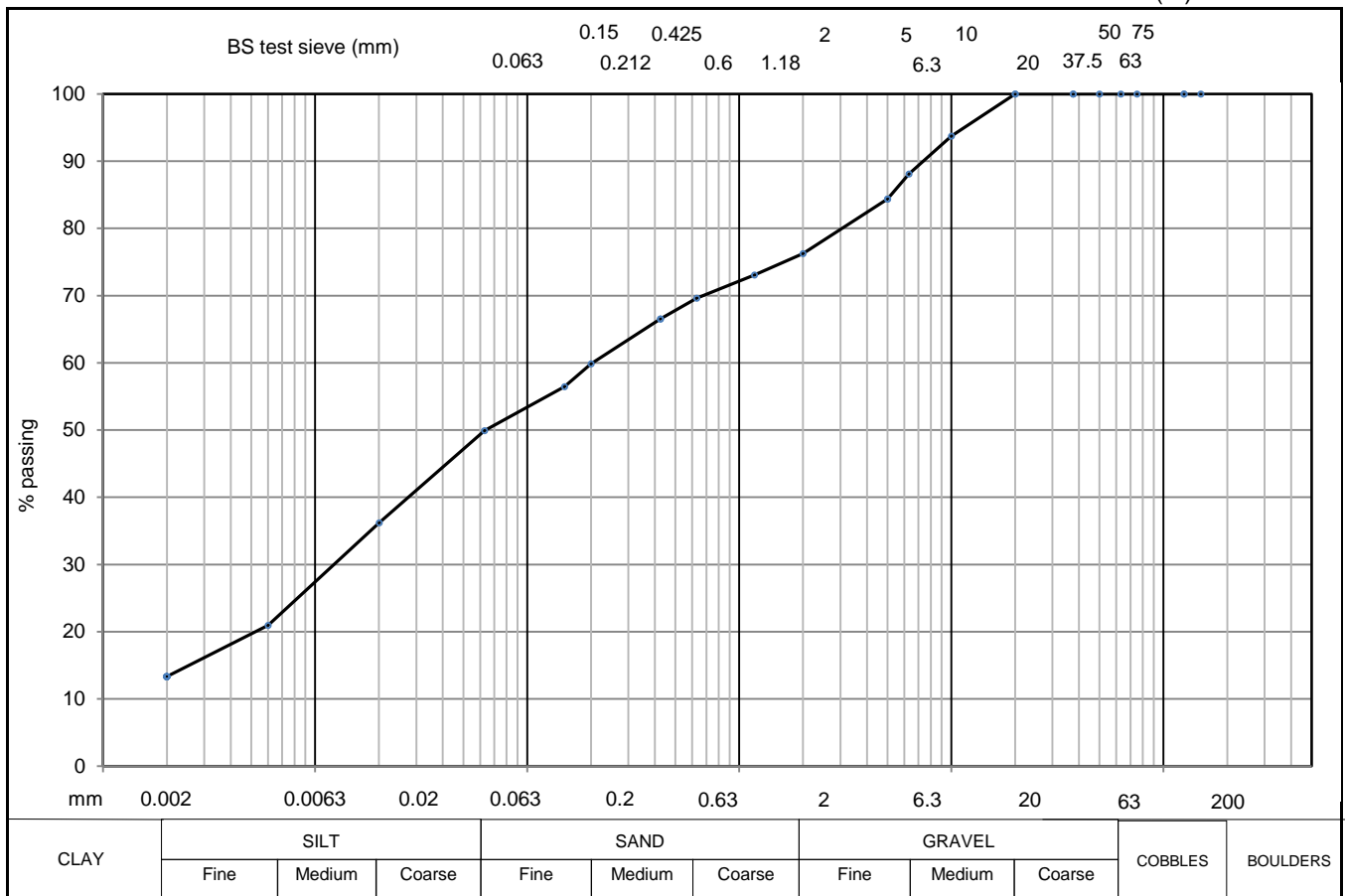
7.50

SPECIMEN TOP (m)

7.50

SPECIMEN BASE (m)

7.95



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY	13						
SILT	37	150		5	84	20	36
SILT & CLAY	50						
SAND	26	75		2	76	6	21
GRAVEL	24						
COBBLE & BOULDER	0	63		1.18	73	2	13
test method(s)	5.2 & 5.4	50		0.63	70		
test method		37.5		0.425	67		
5.2 - sieving		20	100	0.2	60		
5.3 - sedimentation by hydrometer		10	94	0.15	56		
5.4 - sedimentation by pipette		6.3	88	0.063	50		
remarks	# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3					CONTRACT	CHECKED
						35338	TB



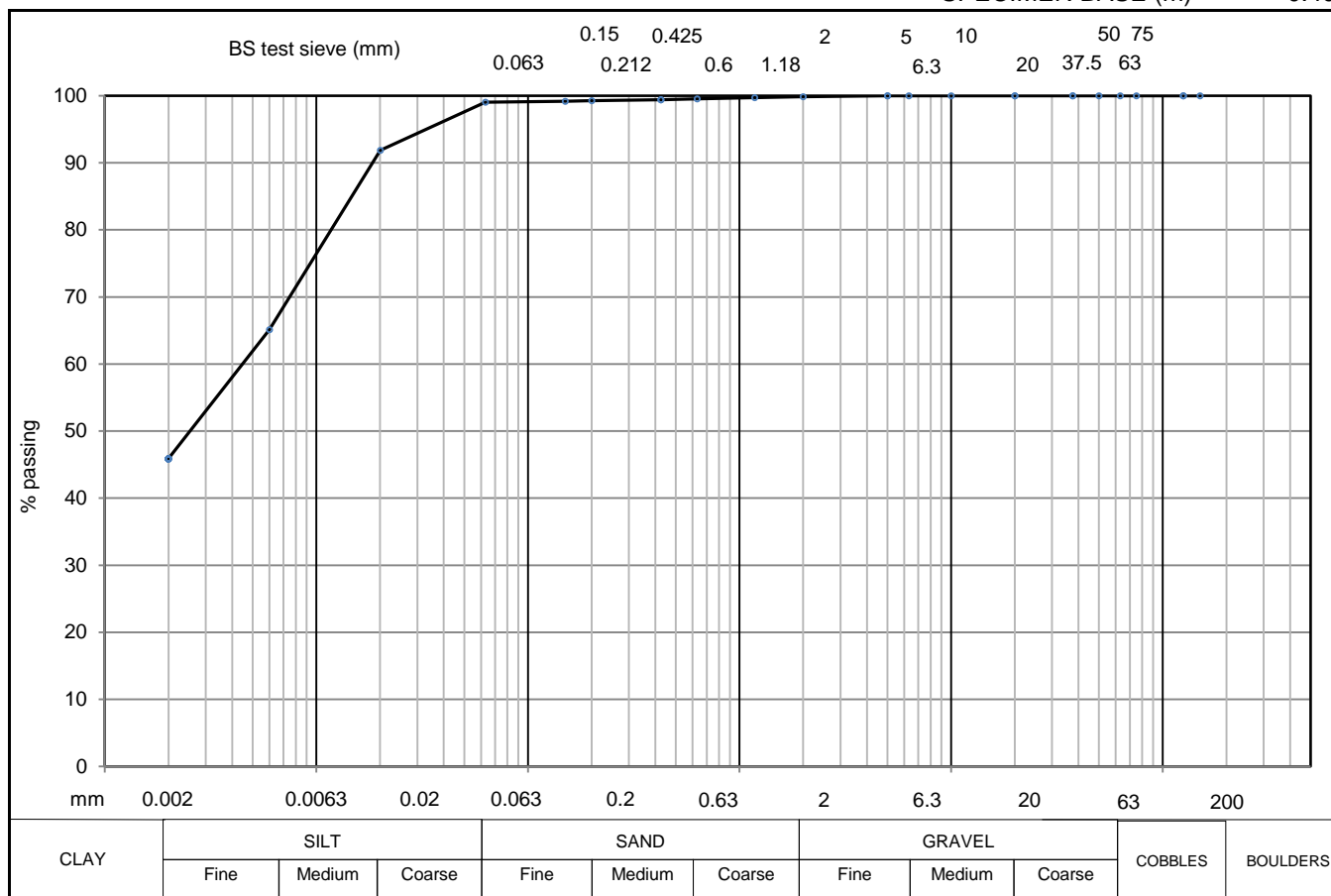
BH/TP No. BH05

SAMPLE No./TYPE 2D

SAMPLE DEPTH (m) 0.20

SPECIMEN TOP (m) 0.20

SPECIMEN BASE (m) 0.40

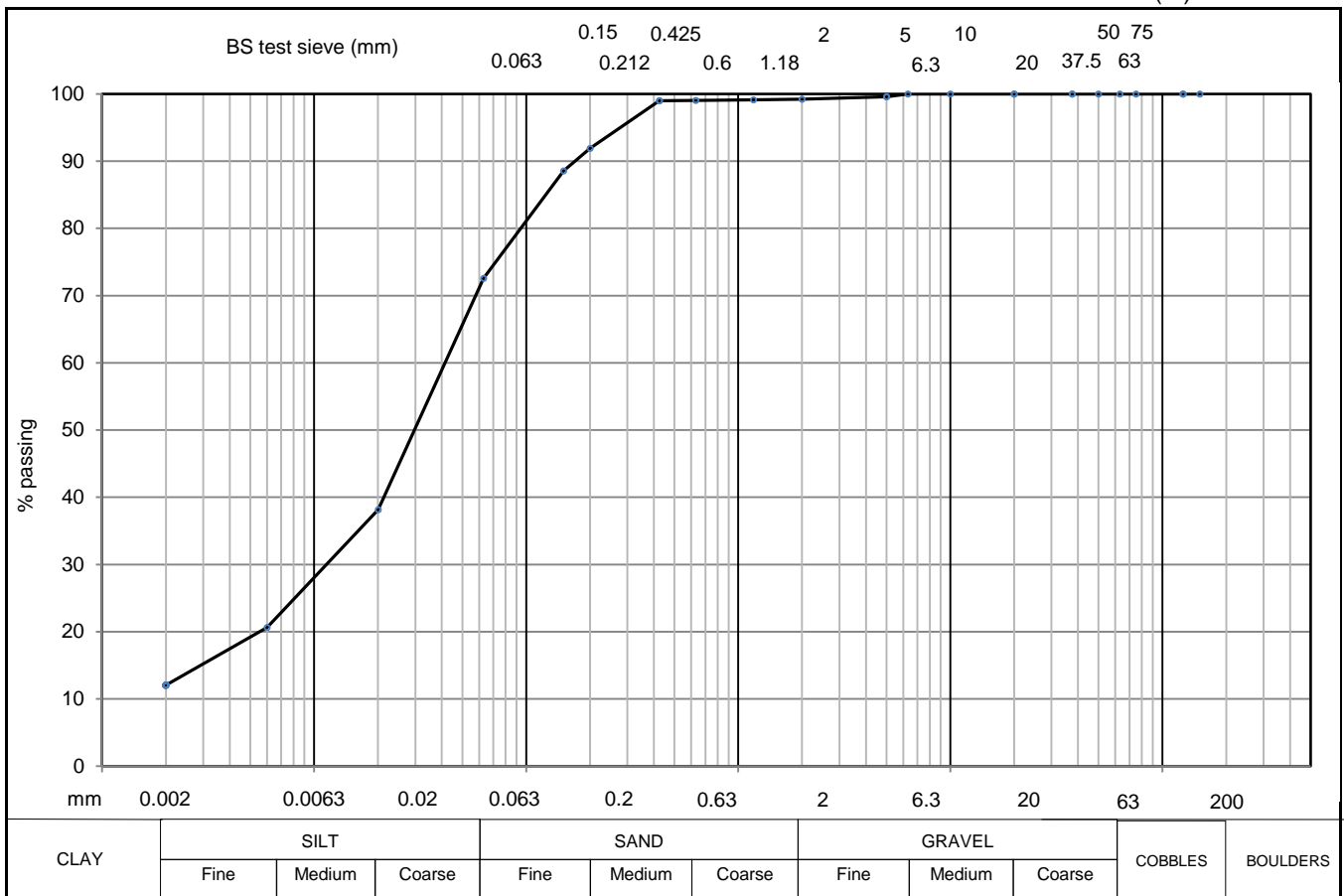


soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY	46	150		5	100	20	92
SILT	53						
SILT & CLAY	99						
SAND	1						
GRAVEL	0						
COBBLE & BOULDER	0						
test method(s)	5.2 & 5.4	50		0.63	100		
test method		37.5		0.425	99		
5.2 - sieving		20		0.2	99		
5.3 - sedimentation by hydrometer		10		0.15	99		
5.4 - sedimentation by pipette		6.3		0.063	99		
remarks # denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3						<b>CONTRACT</b>  <b>35338</b>	<b>CHECKED</b>  <b>TB</b>



CLIENT	CARDIFF PARKWAY DEVELOPMENTS LIMITED
SITE	CARDIFF PARKWAY INITIAL GROUND INVESTIGATION
DESCRIPTION	Reddish brown slightly gravelly slightly sandy clayey SILT

BH/TP No.	BH05
SAMPLE No./TYPE	13UT
SAMPLE DEPTH (m)	3.20
SPECIMEN TOP (m)	3.35
SPECIMEN BASE (m)	3.45



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer	
CLAY	12	150		5	100	20	38	
SILT	61							
SILT & CLAY	73							
SAND	27			75	2	99	6	21
GRAVEL	1							
COBBLE & BOULDER	0	63		1.18	99	2	12	
test method(s)	5.2 & 5.4	50		0.63	99			
test method		37.5		0.425	99			
5.2 - sieving		20		0.2	92			
5.3 - sedimentation by hydrometer		10		0.15	89			
5.4 - sedimentation by pipette		6.3	100	0.063	73			
remarks						CONTRACT	CHECKED	
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892						35338	TB	
Particle density assigned an assumed value of 2.70 Mg/m3								

**PARTICLE SIZE DISTRIBUTION**

BS EN ISO 17892 - 4 : 2016 : 5



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

DESCRIPTION Reddish brown slightly gravelly slightly sandy clayey SILT

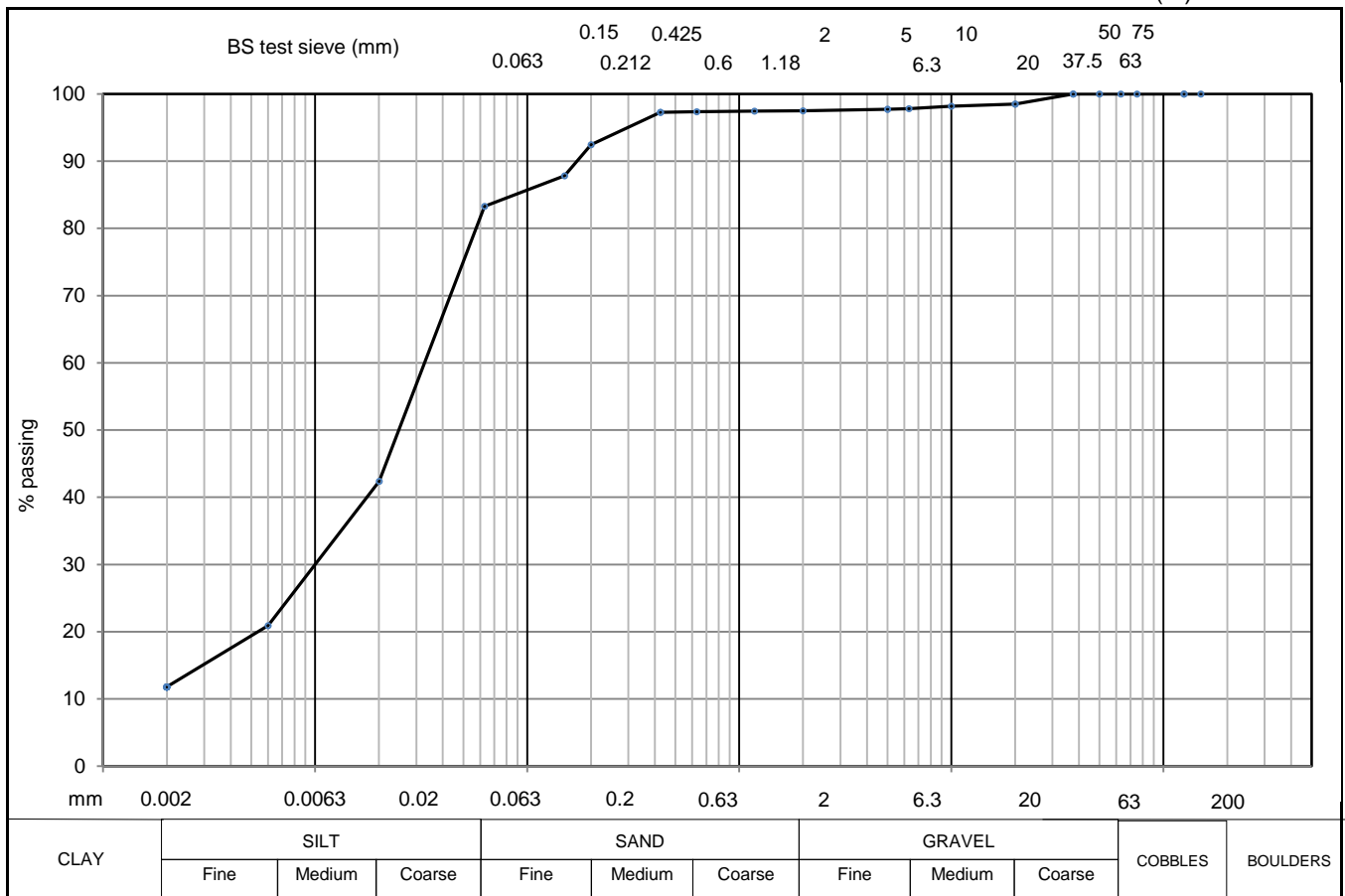
BH/TP No. BH05

SAMPLE No./TYPE 14D

SAMPLE DEPTH (m) 3.65

SPECIMEN TOP (m) 3.65

SPECIMEN BASE (m) 3.75



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY	12						
SILT	72	150		5	98	20	42
SILT & CLAY	83						
SAND	14	75		2	98	6	21
GRAVEL	2						
COBBLE & BOULDER	0	63		1.18	97	2	12
test method(s)	5.2 & 5.4	50		0.63	97		
test method		37.5	100	0.425	97		
5.2 - sieving		20	99	0.2	92		
5.3 - sedimentation by hydrometer		10	98	0.15	88		
5.4 - sedimentation by pipette		6.3	98	0.063	83		
remarks	# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3					CONTRACT	CHECKED
						35338	TB



CLIENT                      CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No. BH07

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

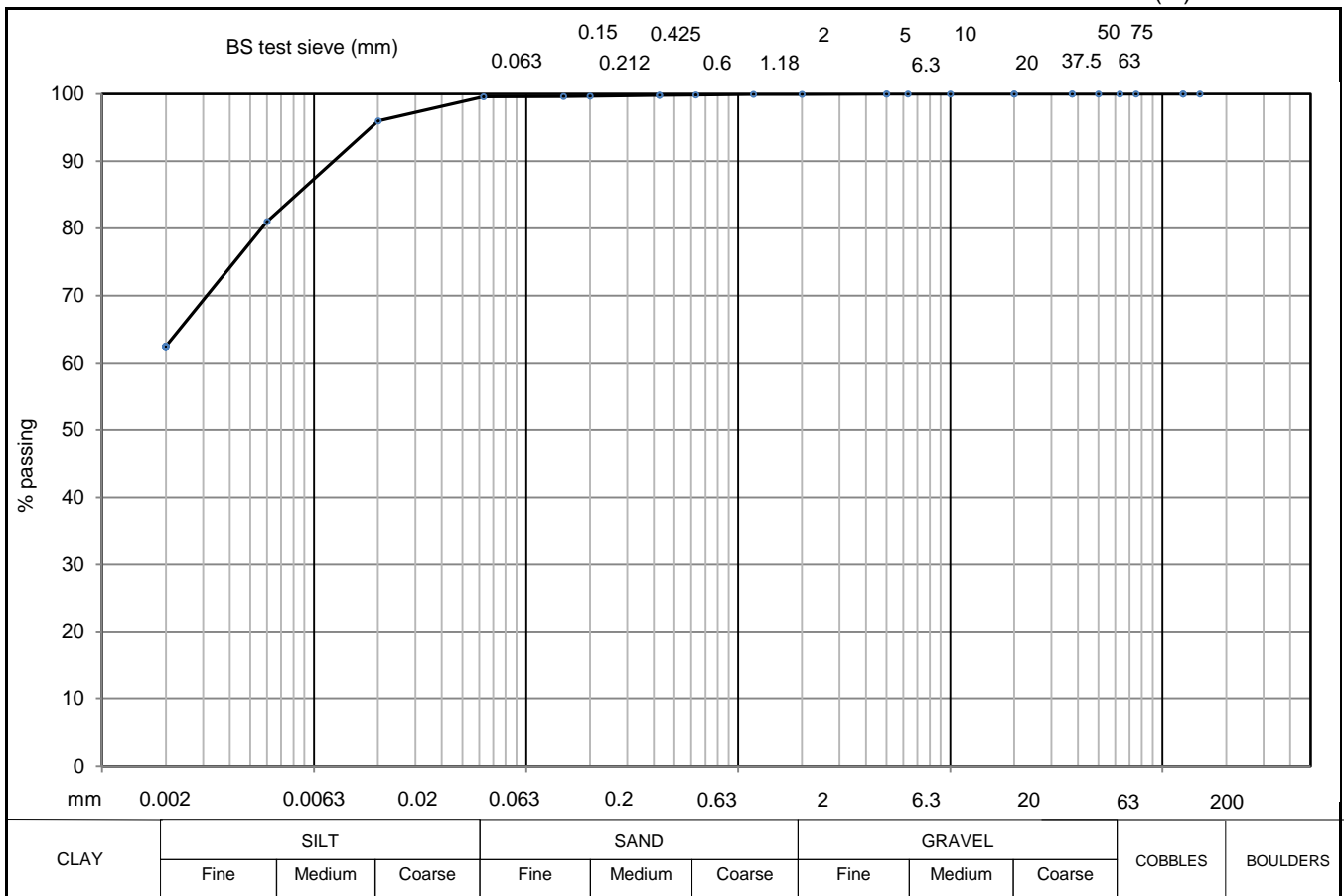
SAMPLE No./TYPE 2D

DESCRIPTION Greyish brown silty CLAY with rare rootlets

SAMPLE DEPTH (m) 0.30

SPECIMEN TOP (m)	0.30
------------------	------

SPECIMEN BASE (m)	0.50
-------------------	------



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY	62	150		5	100	20	96
SILT	37						
SILT & CLAY	100						
SAND	0						
GRAVEL	0						
COBBLE & BOULDER	0	75		2	100	6	81
		63		1.18	100	2	62
test method(s)	5.2 & 5.4	50		0.63	100		
test method		37.5		0.425	100		
5.2 - sieving		20		0.2	100		
5.3 - sedimentation by hydrometer		10		0.15	100		
5.4 - sedimentation by pipette		6.3		0.063	100		
remarks # denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3						CONTRACT	CHECKED
						35338	TB



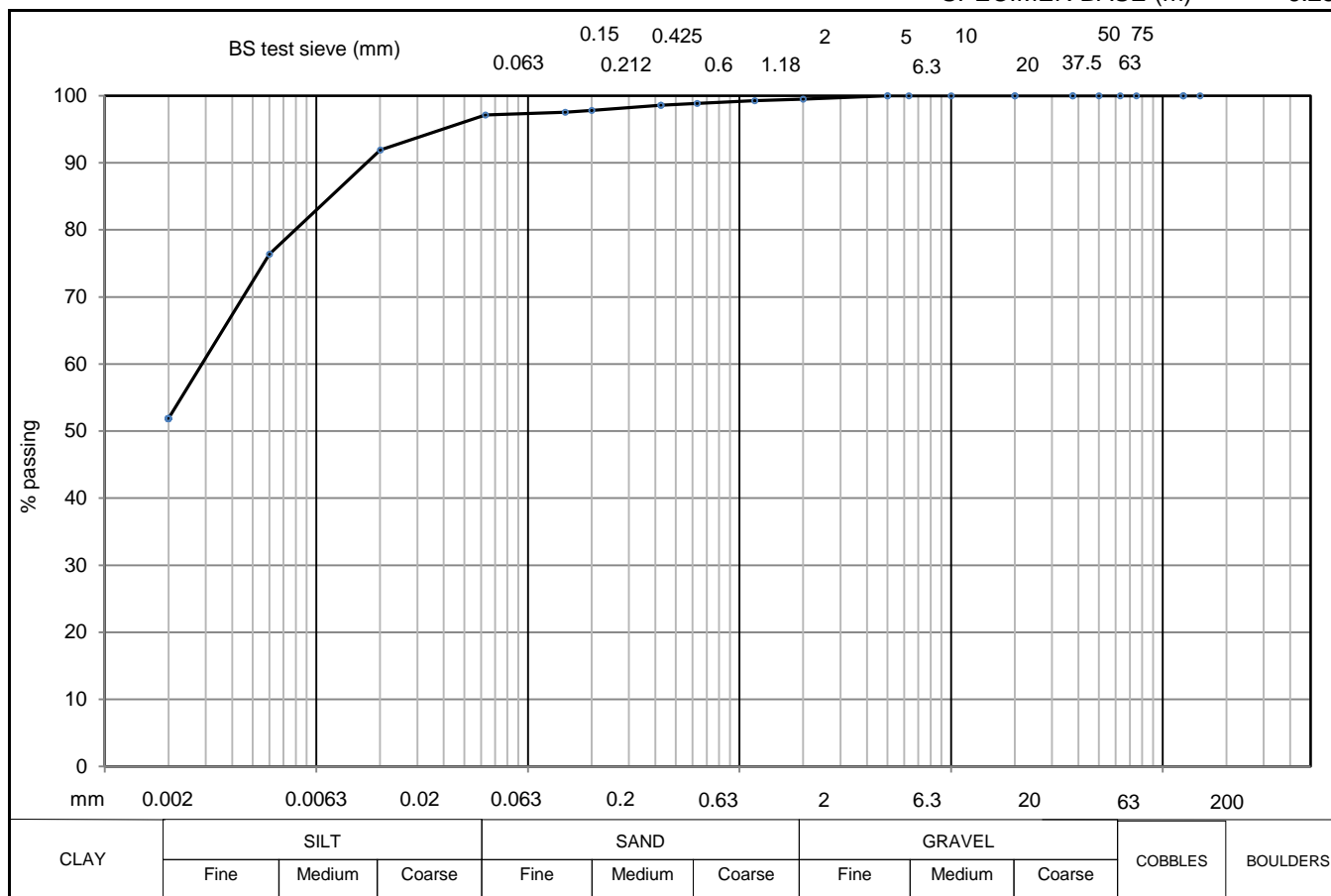
BH/TP No. BH07

SAMPLE No./TYPE 15P

SAMPLE DEPTH (m) 6.00

SPECIMEN TOP (m) 6.15

SPECIMEN BASE (m) 6.25



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
CLAY	52	150		5	100	20	92
SILT	45						
SILT & CLAY	97						
SAND	2						
GRAVEL	0						
COBBLE & BOULDER	0						
test method(s)	5.2 & 5.4	50		0.63	99		
test method		37.5		0.425	99		
5.2 - sieving		20		0.2	98		
5.3 - sedimentation by hydrometer		10		0.15	98		
5.4 - sedimentation by pipette		6.3		0.063	97		
remarks # denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3						<b>CONTRACT</b>  <b>35338</b>	<b>CHECKED</b>  <b>TB</b>

**DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES****BS.1377 : Part 5 : 1990 : 3**

CLIENT    CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH04

SITE        CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

7P

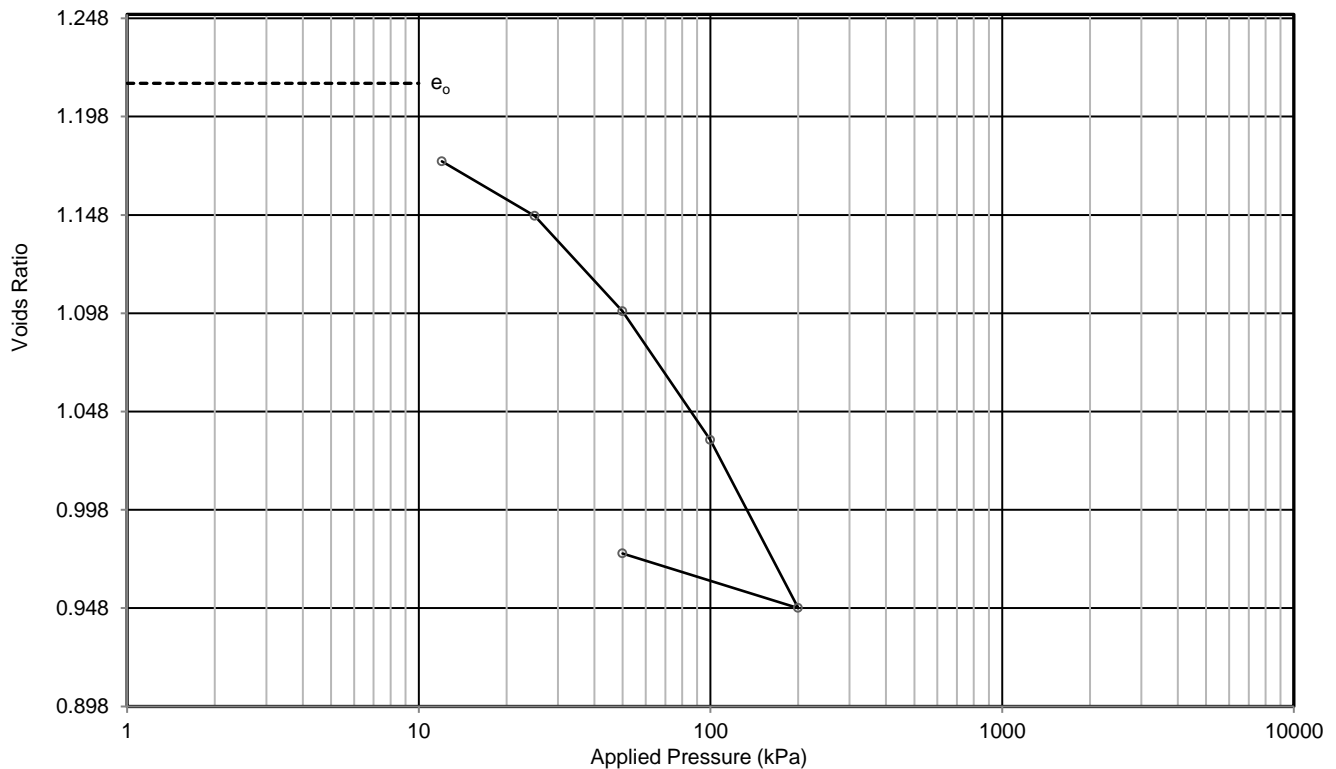
DESCRIPTION    Grey mottled brown slightly sandy silty organic CLAY

SAMPLE DEPTH (m)

1.20

SPECIMEN DEPTH (m)

1.90

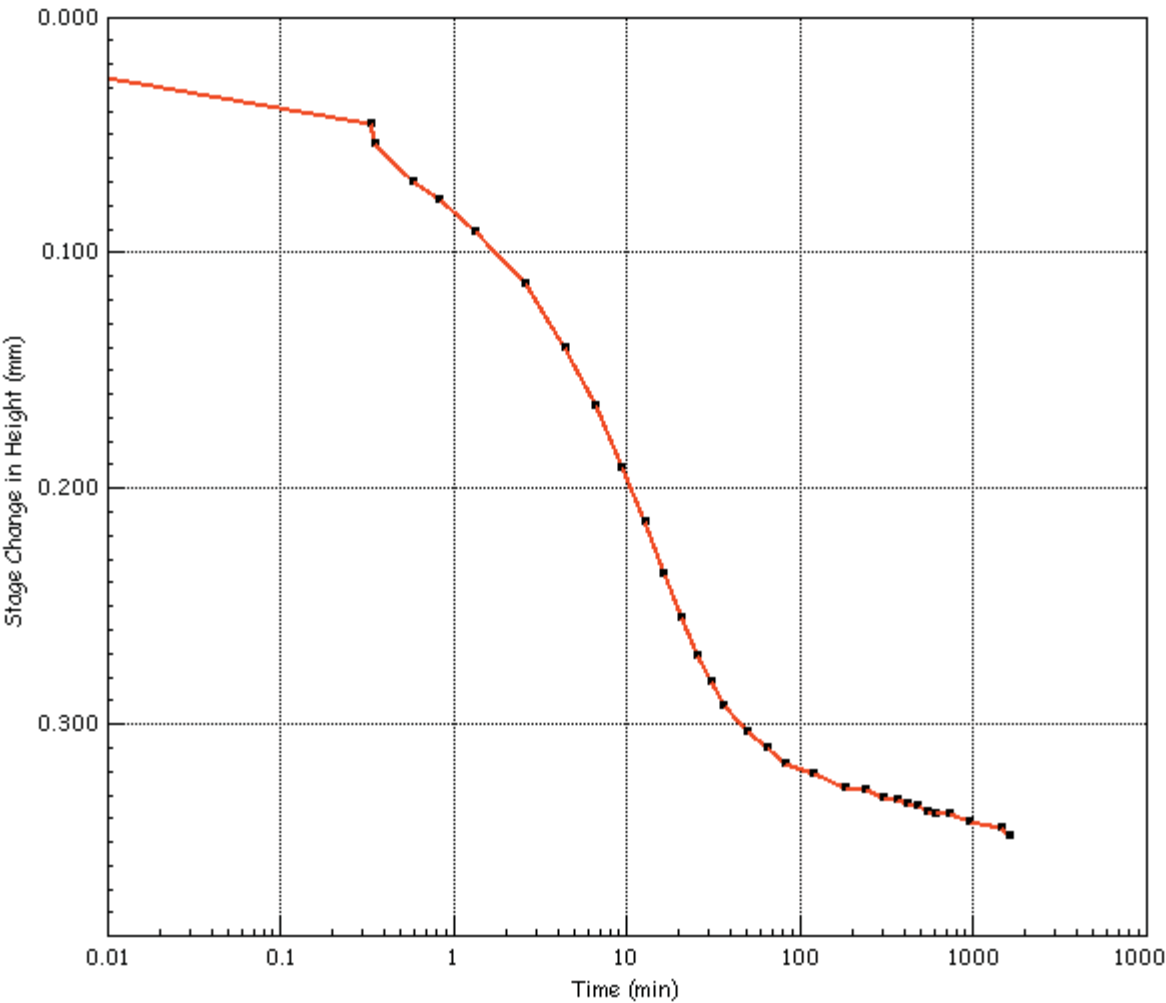



test and sample details			test results				
			pressure stage	voids ratio	laboratory coefficients of		
			(kPa)		compressibility mv (m <sup>2</sup> /MN)	consolidation Cv (m <sup>2</sup> /yr)	Csec (m <sup>2</sup> /yr)
specimen diameter	mm	63.40					
specimen height	mm	18.92					
initial moisture content	%	45.0					
final moisture content	%	37.2					
initial bulk density	Mg/m <sup>3</sup>	1.77	12	1.175	1.5	0.78	
initial dry density	Mg/m <sup>3</sup>	1.22	25	1.147	0.99	0.89	
initial voids ratio		1.215	50	1.099	0.9	0.85	
initial degree of saturation	%	100	100	1.033	0.62	0.96	0.0058
particle density	Mg/m <sup>3</sup>	#2.70	200	0.948	0.42	1	
swelling pressure	kPa	N/A	50	0.976	0.095		
P'o to P'o +100 kPa		-					
laboratory temperature	oC	20 ± 2					
method of time fitting		root time					
remarks	# denotes particle density has been assigned an assumed value load frame corrections applied				CONTRACT	CHECKED	
					35338	TB	



# Oedometer Consolidation Settlement Report

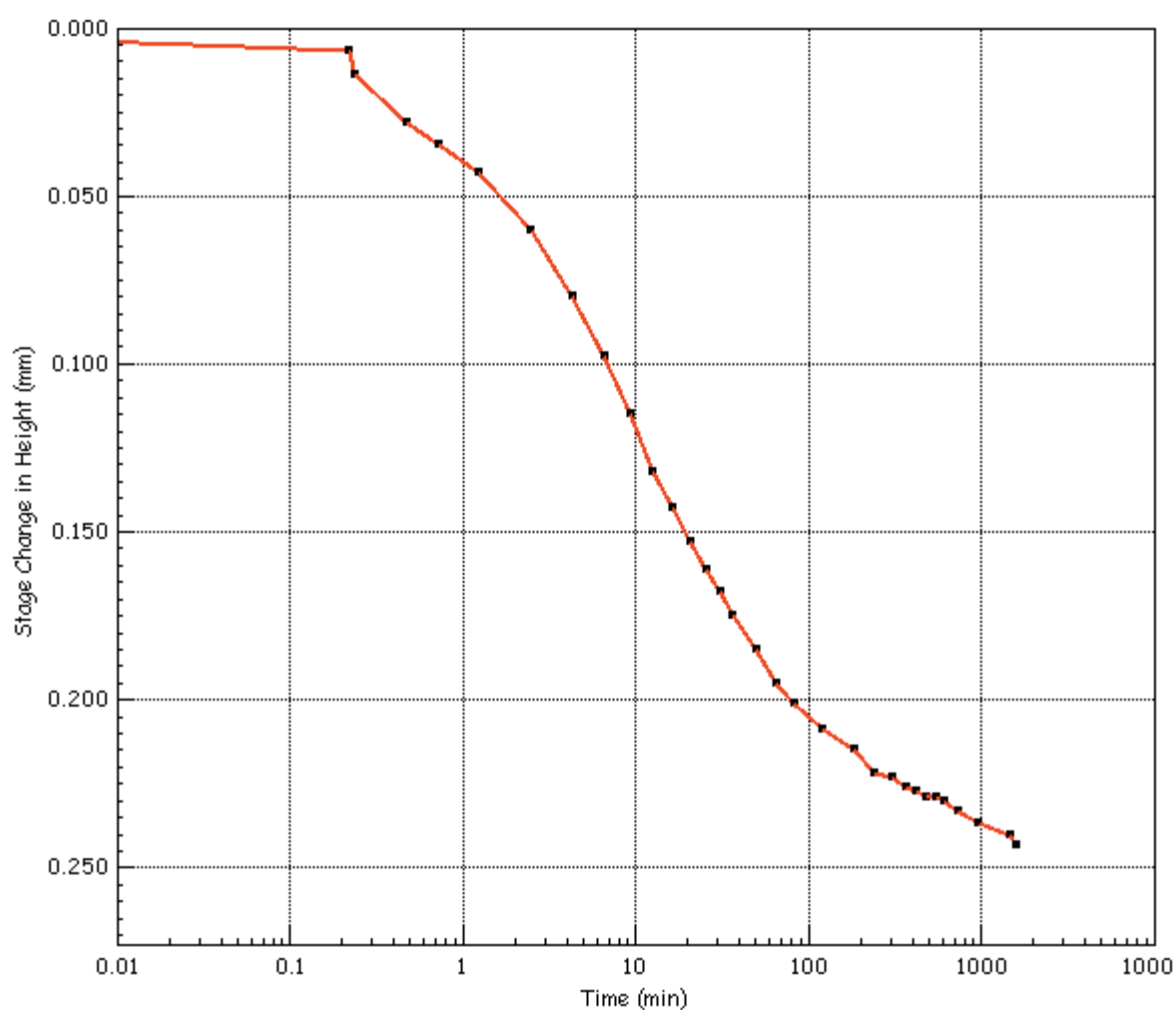
Vertical Stress	$\sigma'_i$	(kPa)	12.0
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.008
Height Settlement	$\Delta L_s$	(mm)	0.339
Voids Ratio	$e_f$	.	-0.148




	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 5	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	24/07/2019	
	Client	CARDFF PARKWAY		Sample	7P	
	Operator	TA/JT/JG	Checked	*	Approved	*

# Oedometer Consolidation Settlement Report

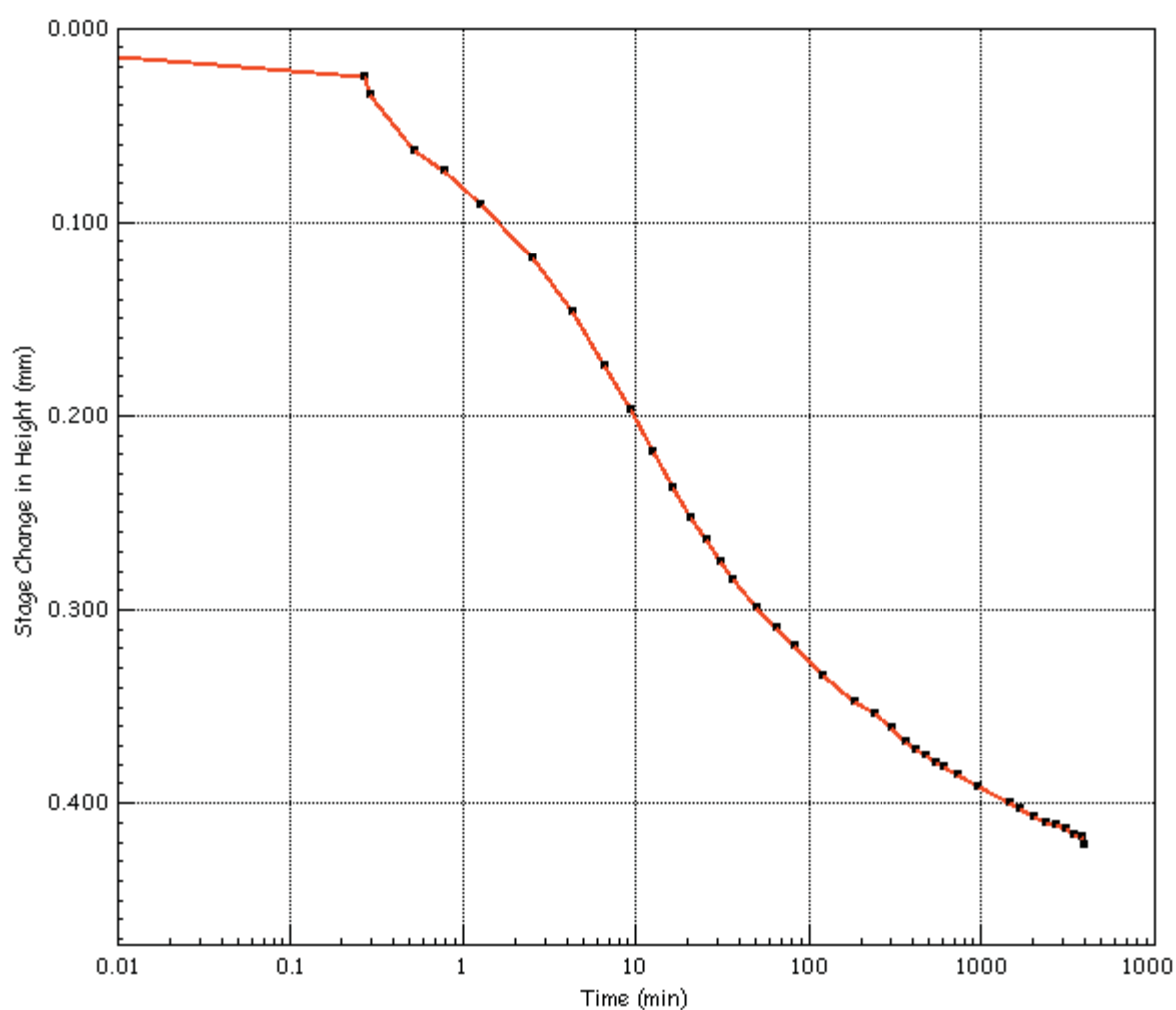
Vertical Stress	$\sigma'_i$	(kPa)	25
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.014
Height Settlement	$\Delta L_s$	(mm)	0.577
Voids Ratio	$e_f$	.	-0.158




	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 5	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	24/07/2019	
	Client	CARDFF PARKWAY		Sample	7P	
	Operator	TA/JT/JG	Checked	*	Approved	*

# Oedometer Consolidation Settlement Report

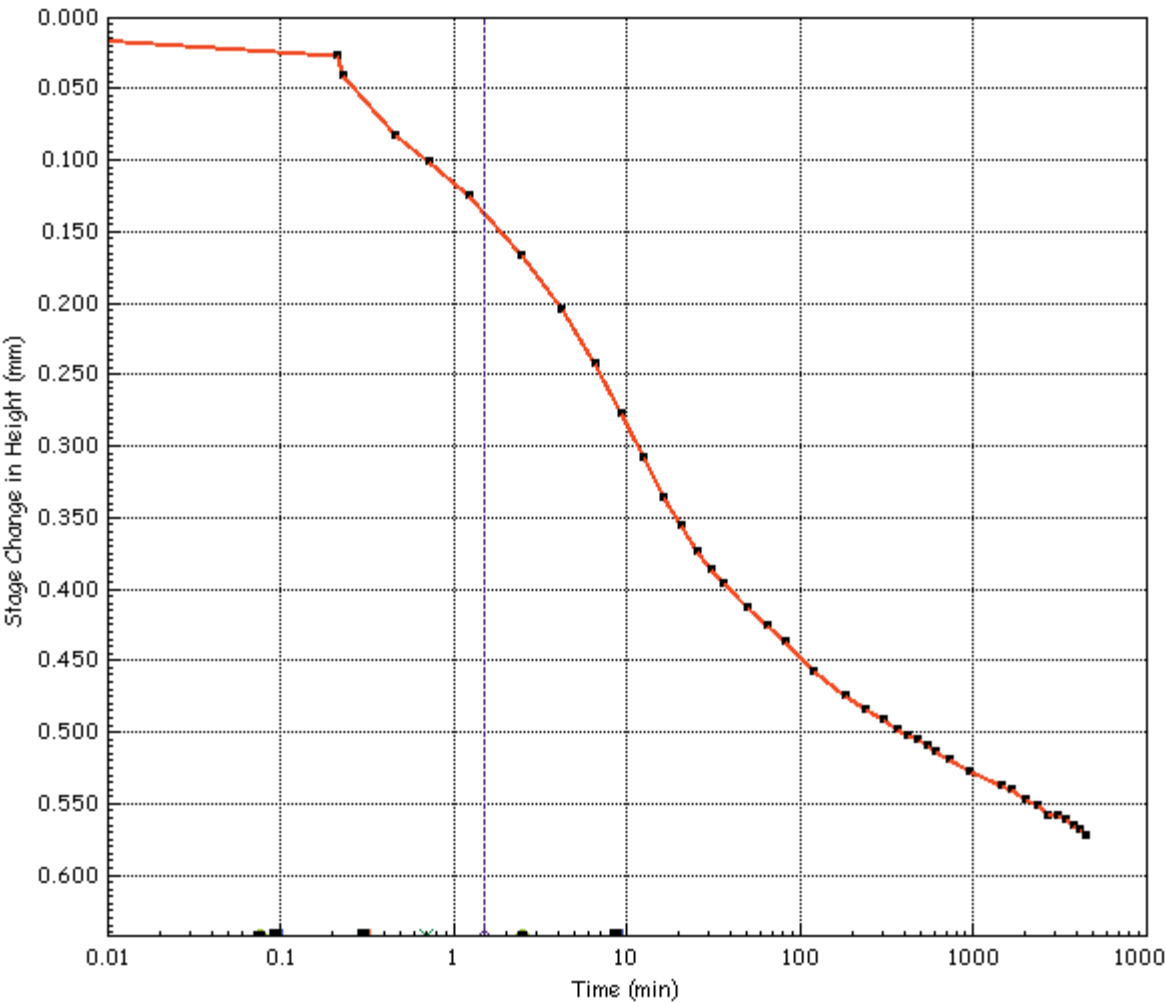
Vertical Stress	$\sigma'_i$	(kPa)	50
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.021
Height Settlement	$\Delta L_s$	(mm)	0.991
Voids Ratio	$e_f$	.	-0.176




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 5				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date				24/07/2019		
	Jobfile				Sample				7P		
	Client				Borehole				BH04		
	CARDFF PARKWAY										
Operator		TA/JT/JG		Checked		*		Approved		*	

# Oedometer Consolidation Settlement Report

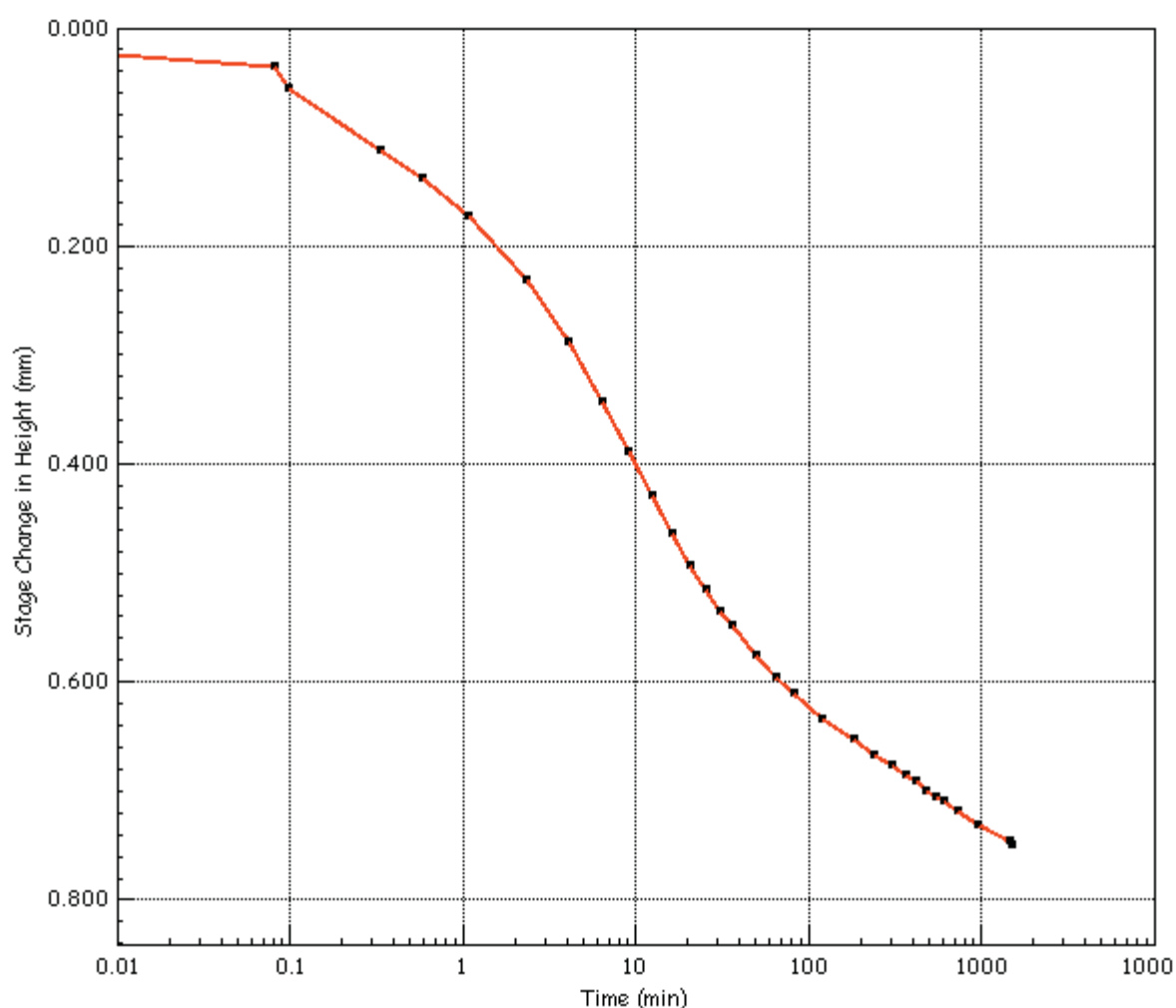
Vertical Stress	$\sigma'_i$	(kPa)	100
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.034
Height Settlement	$\Delta L_s$	(mm)	1.550
Voids Ratio	$e_f$	.	-0.200




	Test Method	BS1377 - 5 : 1990 : Clause 3	Test Name	FRAME 5
	Site Reference		Database:	.\SQLEXPRESS \ GEL
	Jobfile	35338	Test Date	24/07/2019
	Client	CARDFF PARKWAY	Sample	7P
	Operator	TA/JT/JG	Borehole	BH04
Checked *			Approved *	

# Oedometer Consolidation Settlement Report

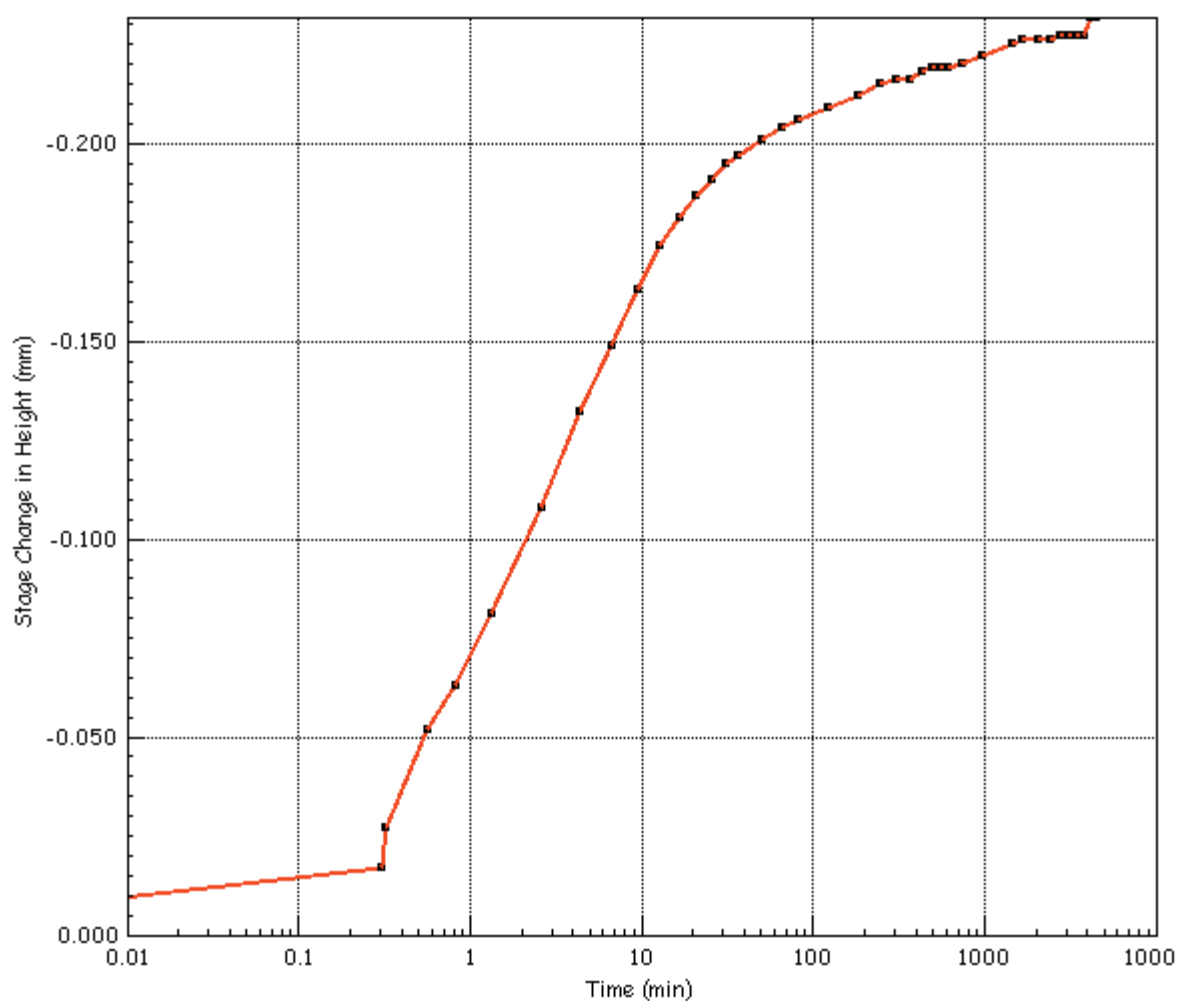
Vertical Stress	$\sigma'_i$	(kPa)	200
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.050
Height Settlement	$\Delta L_s$	(mm)	2.280
Voids Ratio	$e_f$	.	-0.232




	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 5	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	24/07/2019	
	Client	CARDFF PARKWAY		Sample	7P	
	Operator	TA/JT/JG	Checked	*	Approved	*

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_{i_1}$	(kPa)	50
Initial Temperature	$T_i$	(°C)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.056
Height Settlement	$\Delta L_s$	(mm)	2.043
Voids Ratio	$e_f$	.	-0.221



	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 5		
					Database: .\SQLEXPRESS \ GEL				
	Site Reference				Test Date		24/07/2019		
	Jobfile		35338		Sample		7P		
	Client		CARDFF PARKWAY		Borehole		BH04		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	

**DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES****BS.1377 : Part 5 : 1990 : 3**

CLIENT    CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH04

SITE        CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

12P

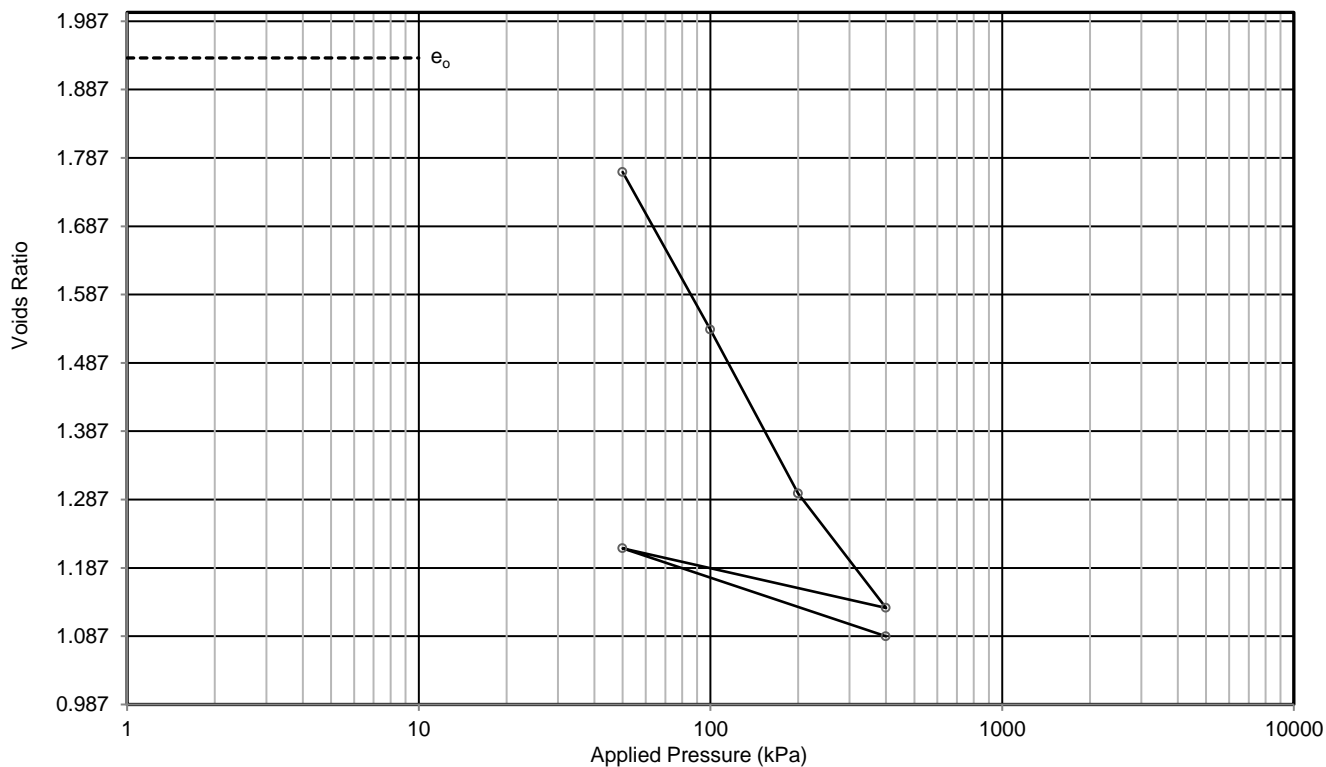
DESCRIPTION    Grey slightly sandy silty organic CLAY

SAMPLE DEPTH (m)

3.60

SPECIMEN DEPTH (m)

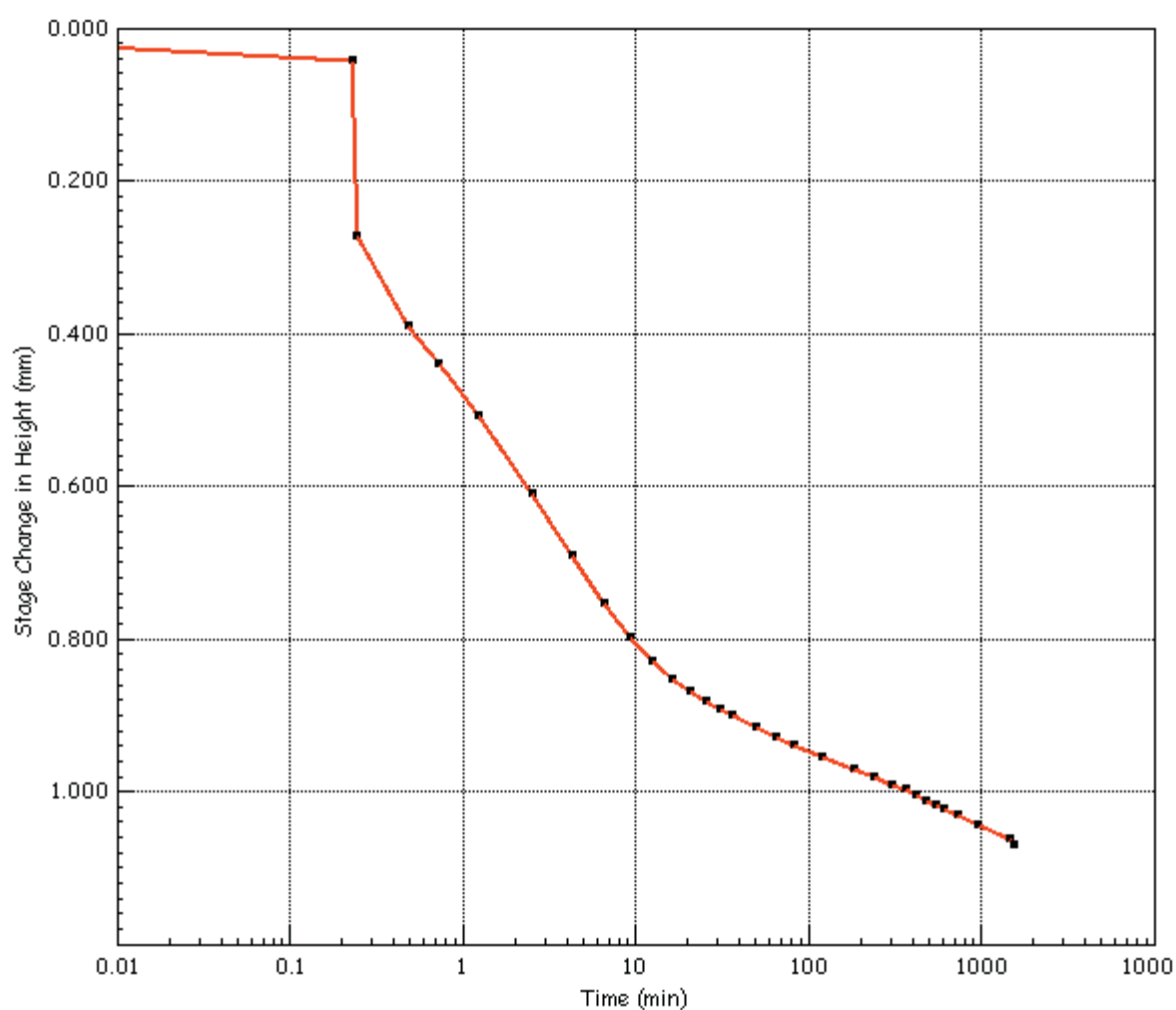
4.23




test and sample details			test results					
			pressure stage	voids ratio	laboratory coefficients of			
			(kPa)		compressibility mv (m2/MN)	consolidation Cv Csec (m2/yr)		
specimen diameter	mm	63.55						
specimen height	mm	17.79						
initial moisture content	%	71.8						
final moisture content	%	43.6						
initial bulk density	Mg/m3	1.58						
initial dry density	Mg/m3	0.92						
initial voids ratio		1.933						
initial degree of saturation	%	100						
particle density	Mg/m3	#2.70	50	1.216	0.12			
swelling pressure	kPa	N/A	400	1.087	0.17	1.7		
P'o to P'o +100 kPa		-						
laboratory temperature	oC	20 ± 2						
method of time fitting		root time						
remarks	# denotes particle density has been assigned an assumed value				CONTRACT		CHECKED	
	load frame corrections applied				35338		TB	

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	50
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.056
Height Settlement	$\Delta L_s$	(mm)	1.013
Voids Ratio	$e_f$	.	-0.177

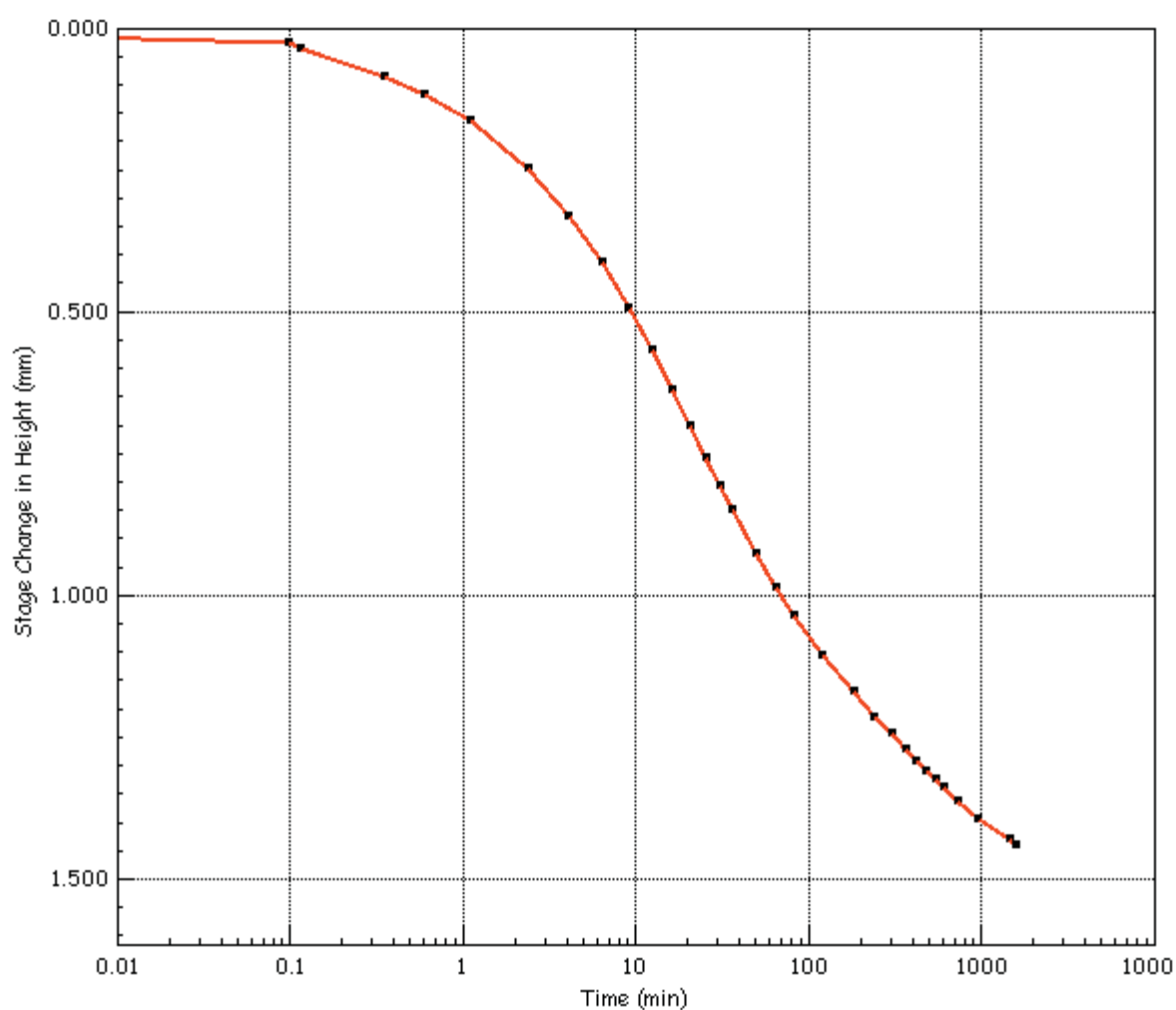



	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 4				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date				24/07/2019		
	Jobfile				Sample				12P		
	Client				Borehole				BH04		
	CARDFF PARKWAY										
Operator		TA/JT/JG		Checked		*		Approved		*	



# Oedometer Consolidation Settlement Report

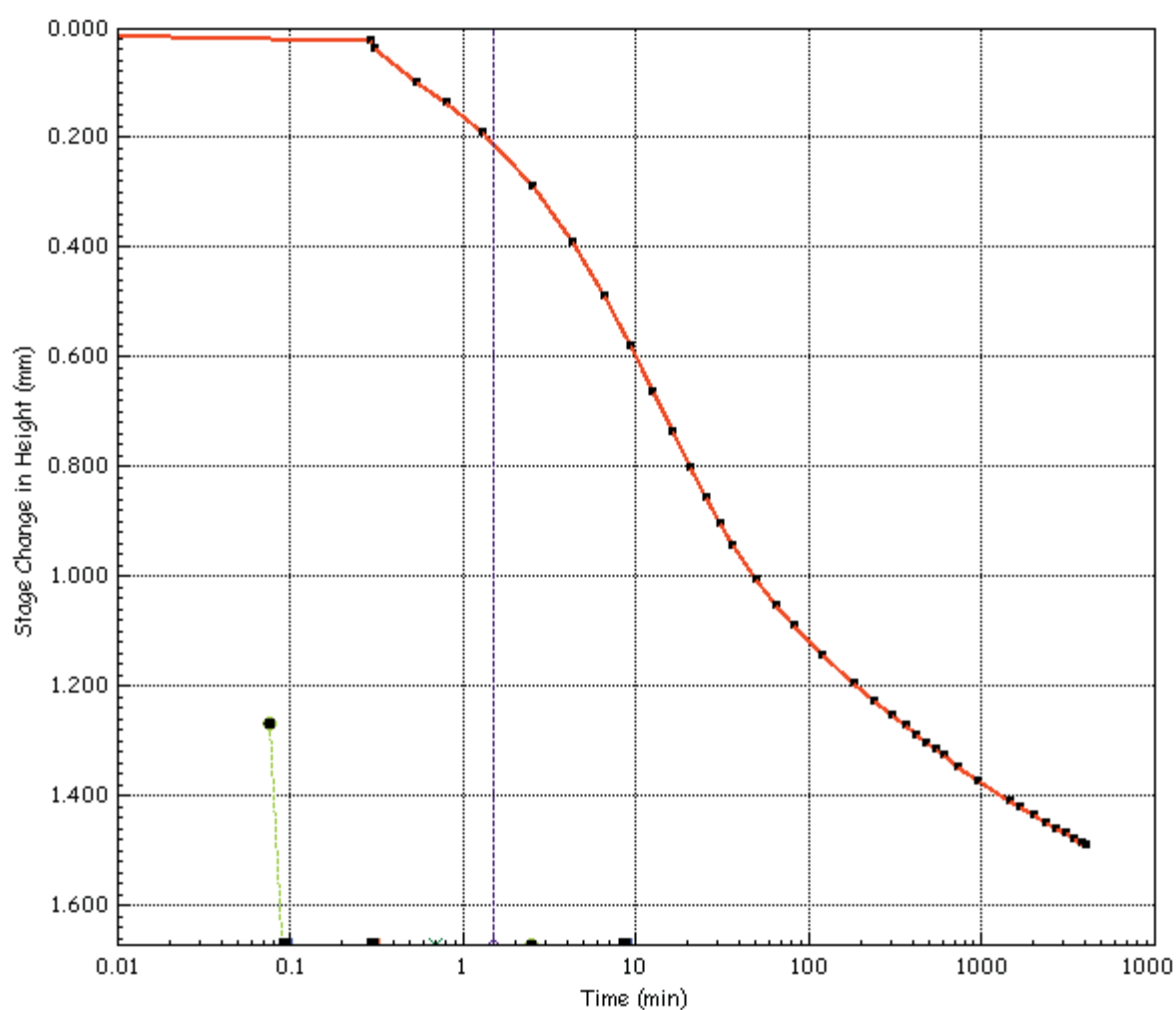
Vertical Stress	$\sigma'_i$	(kPa)	100
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.083
Height Settlement	$\Delta L_s$	(mm)	2.413
Voids Ratio	$e_f$	.	-0.237




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 4				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date				24/07/2019		
	Jobfile				Sample				12P		
	Client				Borehole				BH04		
	CARDFF PARKWAY										
Operator		TA/JT/JG		Checked		*		Approved		*	

# Oedometer Consolidation Settlement Report

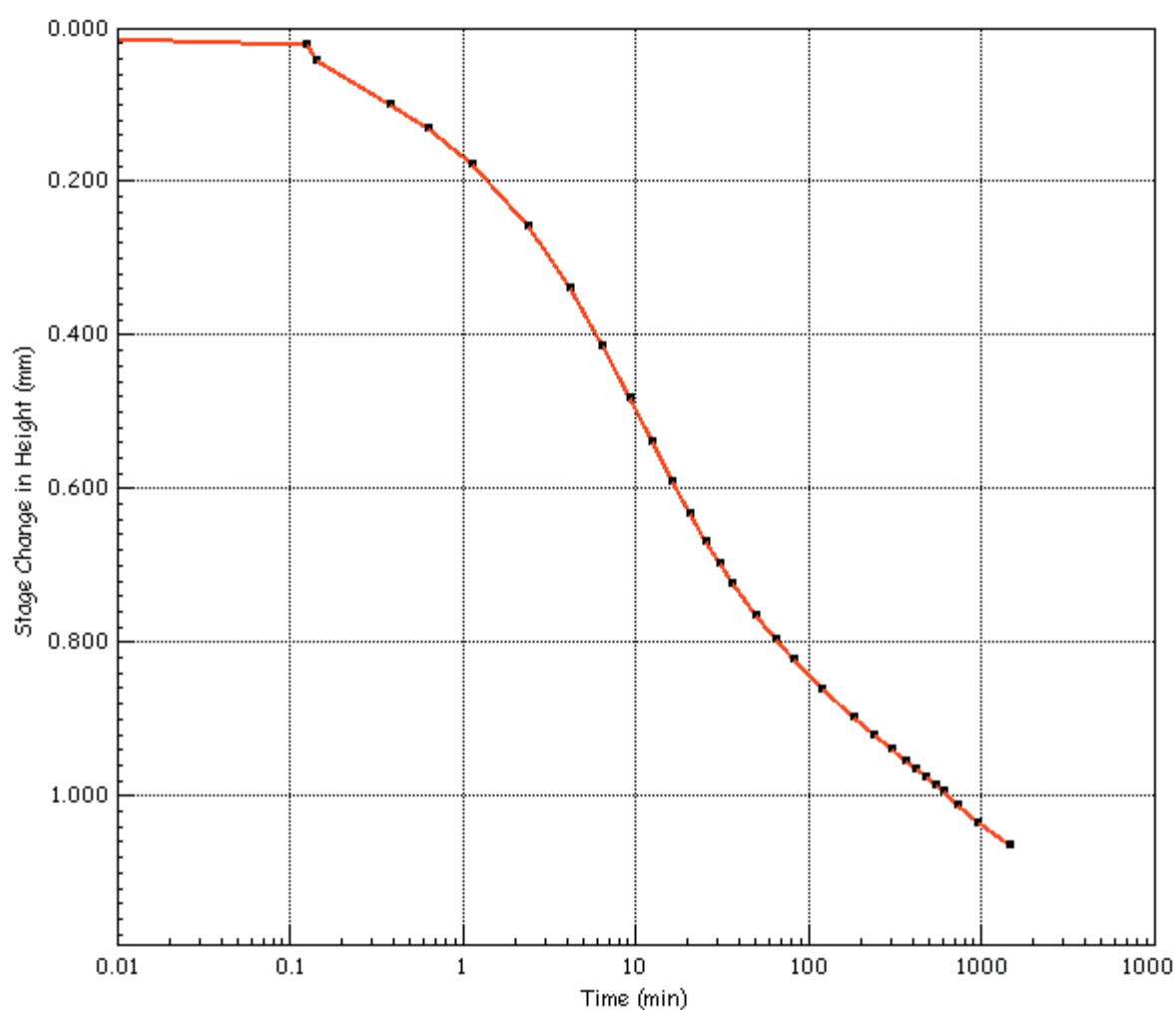
Vertical Stress	$\sigma'_i$	(kPa)	200
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.118
Height Settlement	$\Delta L_s$	(mm)	3.866
Voids Ratio	$e_f$	.	-0.300




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 4				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date				24/07/2019		
	Jobfile				Sample				12P		
	Client				Borehole				BH04		
Operator		TA/JT/JG		Checked		*		Approved		*	

# Oedometer Consolidation Settlement Report

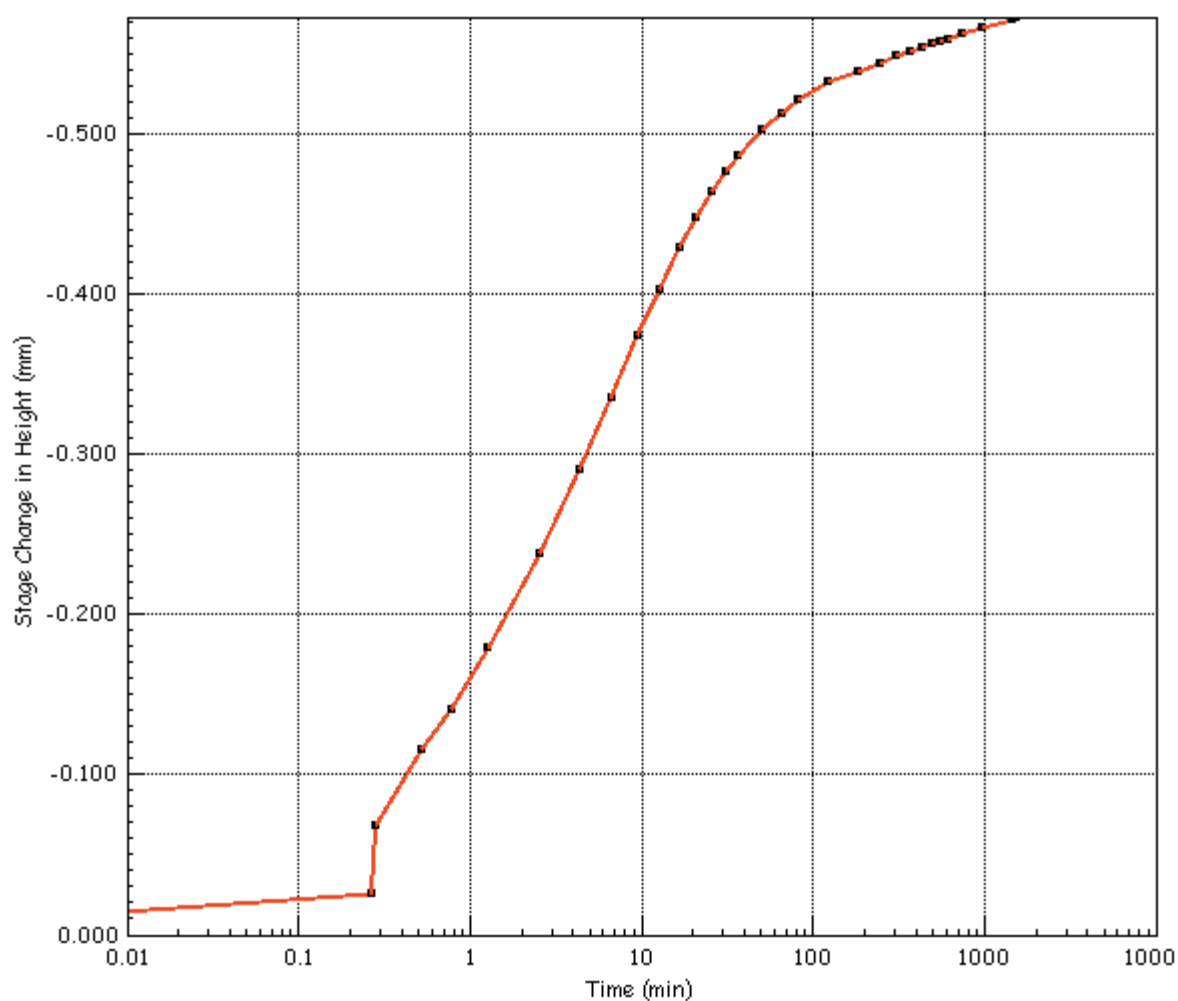
Vertical Stress	$\sigma'_i$	(kPa)	400
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.156
Height Settlement	$\Delta L_s$	(mm)	4.882
Voids Ratio	$e_f$	.	-0.344




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 4						
					Database: .\SQLEXPRESS \ GEL								
	Site Reference				Test Date				24/07/2019				
	Jobfile				Sample				12P				
	Client				Borehole				BH04				
	Operator				TA/JT/JG		Checked		*		Approved		*

# Oedometer Consolidation Settlement Report

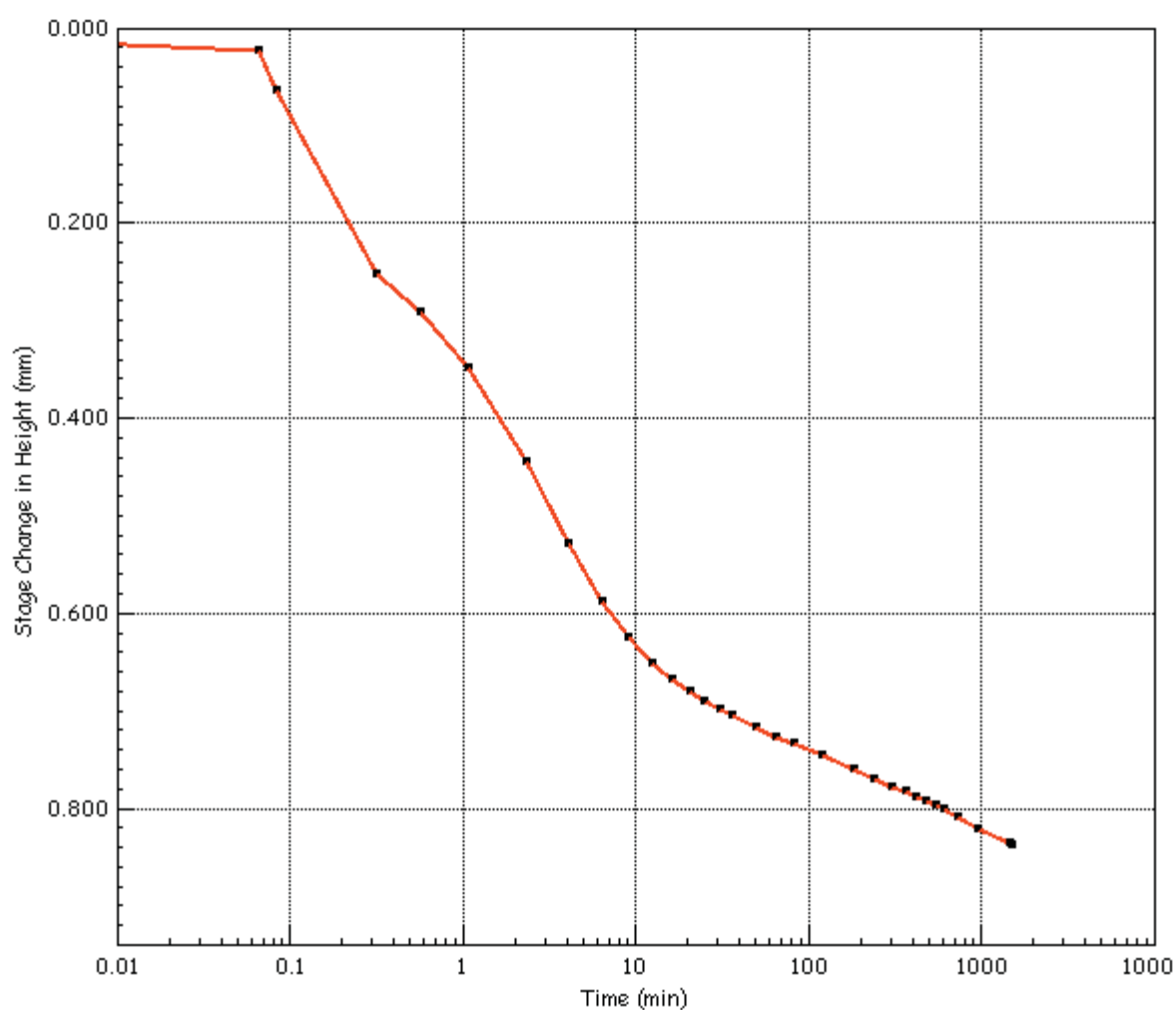
Vertical Stress	$\sigma'_i$	(kPa)	50
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.108
Height Settlement	$\Delta L_s$	(mm)	4.352
Voids Ratio	$e_f$	.	-0.321




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 4						
					Database: .\SQLEXPRESS \ GEL								
	Site Reference				Test Date				24/07/2019				
	Jobfile				Sample				12P				
	Client				Borehole				BH04				
	Operator				TA/JT/JG		Checked		*		Approved		*

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	400
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.156
Height Settlement	$\Delta L_s$	(mm)	5.134
Voids Ratio	$e_f$	.	-0.355



	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 4				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date				24/07/2019		
	Jobfile				Sample				12P		
	Client				Borehole				BH04		
	CARDFF PARKWAY										
Operator		TA/JT/JG		Checked		*		Approved		*	

**DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES****BS.1377 : Part 5 : 1990 : 3**

CLIENT    CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH05

SITE        CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

13UT

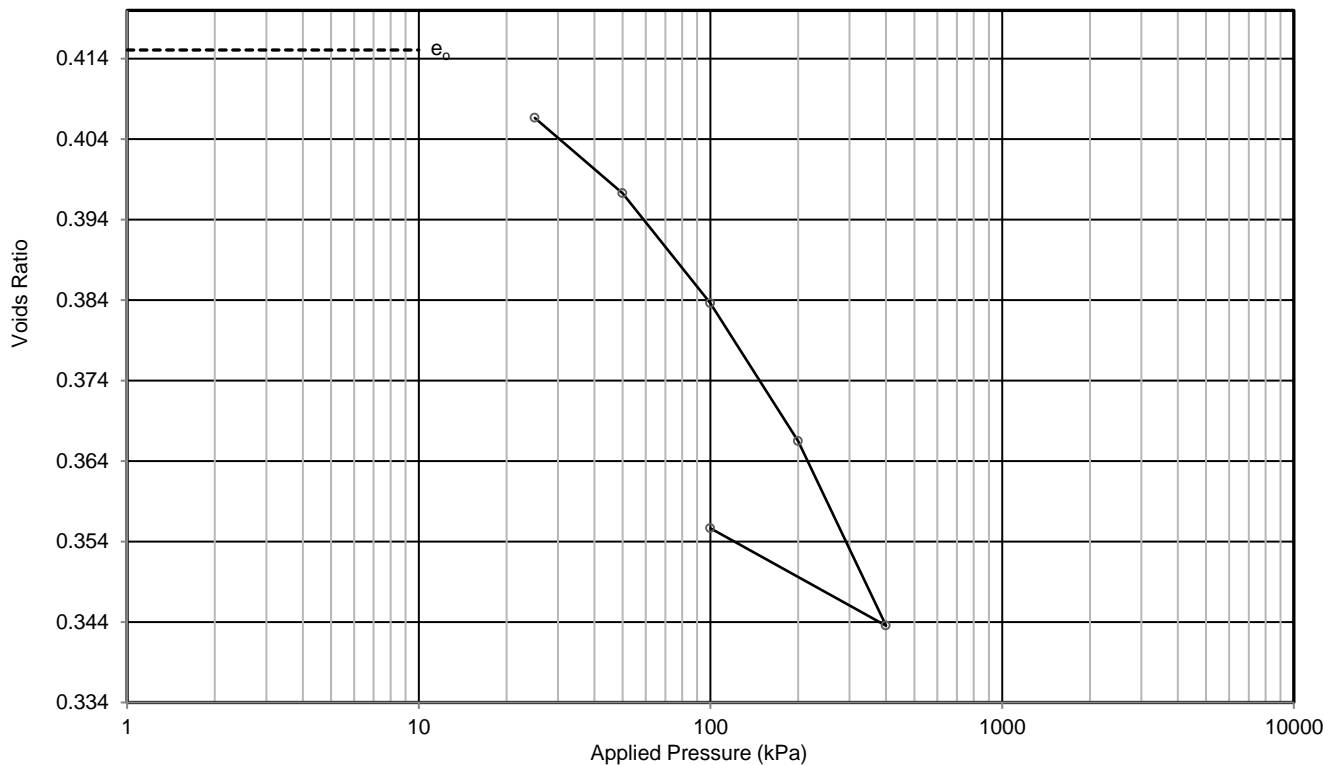
DESCRIPTION    Reddish brown mottled grey slightly sandy clayey SILT

SAMPLE DEPTH (m)

3.20

SPECIMEN DEPTH (m)

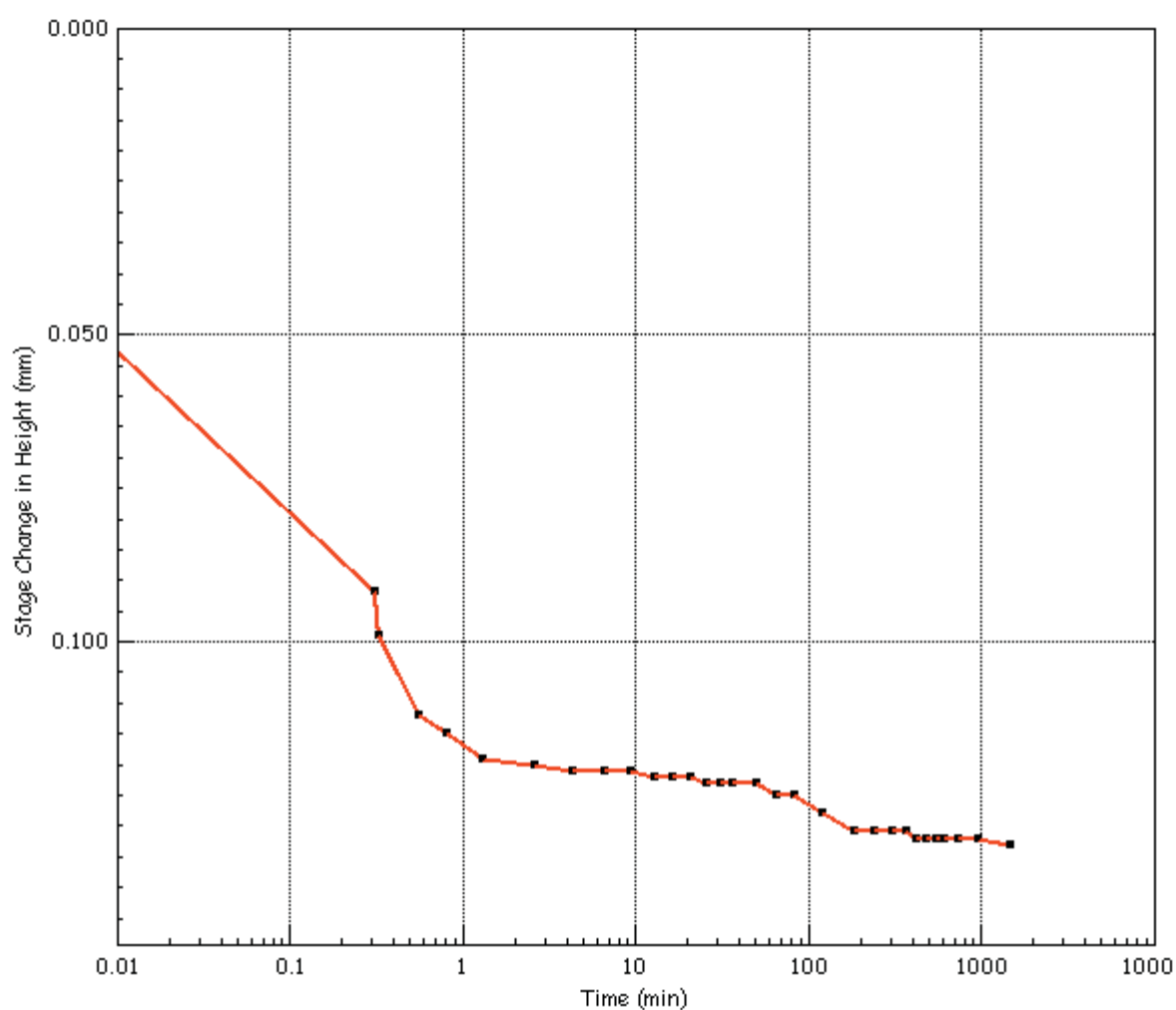
3.35




test and sample details			test results			
			pressure stage (kPa)	voids ratio	laboratory coefficients of compressibility mv (m <sup>2</sup> /MN)	consolidation Cv (m <sup>2</sup> /yr)
specimen diameter	mm	63.34				
specimen height	mm	18.93				
initial moisture content	%	15.1				
final moisture content	%	15.9				
initial bulk density	Mg/m <sup>3</sup>	2.20	25	0.407	0.24	16
initial dry density	Mg/m <sup>3</sup>	1.91	50	0.397	0.27	7
initial voids ratio		0.415	100	0.384	0.2	4.7
initial degree of saturation	%	98	200	0.366	0.12	3.2
particle density	Mg/m <sup>3</sup>	#2.70	400	0.344	0.084	7.5
swelling pressure	kPa	N/A	100	0.356	0.03	
P'o to P'o +100 kPa		-				
laboratory temperature	oC	20 ± 2				
method of time fitting		root time				
remarks	# denotes particle density has been assigned an assumed value load frame corrections applied				CONTRACT <b>35338</b>	CHECKED <b>TB</b>

# Oedometer Consolidation Settlement Report

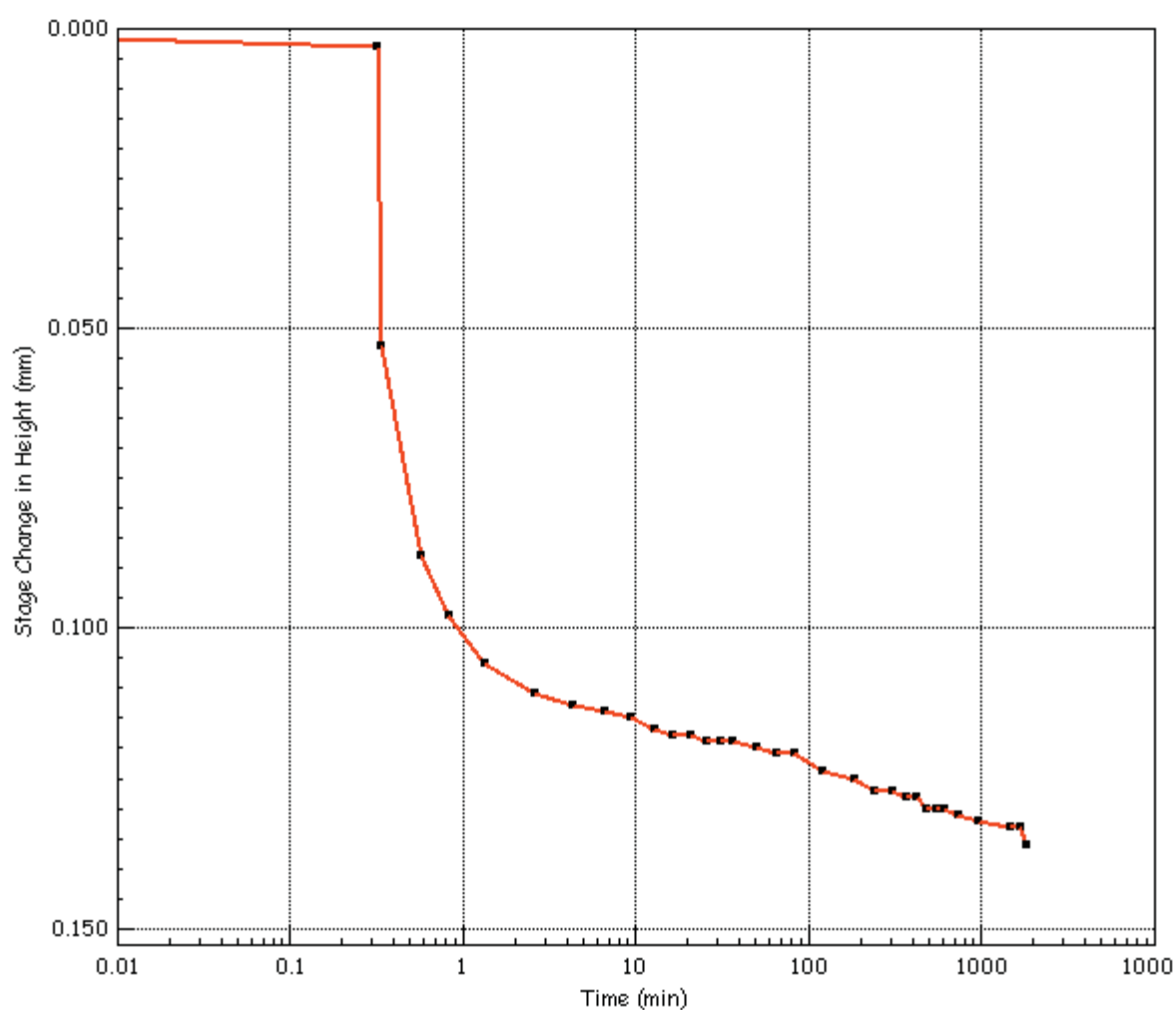
Vertical Stress	$\sigma'_i$	(kPa)	25
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.020
Height Settlement	$\Delta L_s$	(mm)	0.113
Voids Ratio	$e_f$	.	-0.138




	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 6	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	24/07/2019	
	Client	CARDFF PARKWAY		Sample	13UT	
	Operator	TA/JT/JG		Borehole	BH05	
Checked			*		Approved	
			*			

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	50
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.031
Height Settlement	$\Delta L_s$	(mm)	0.238
Voids Ratio	$e_f$	.	-0.143

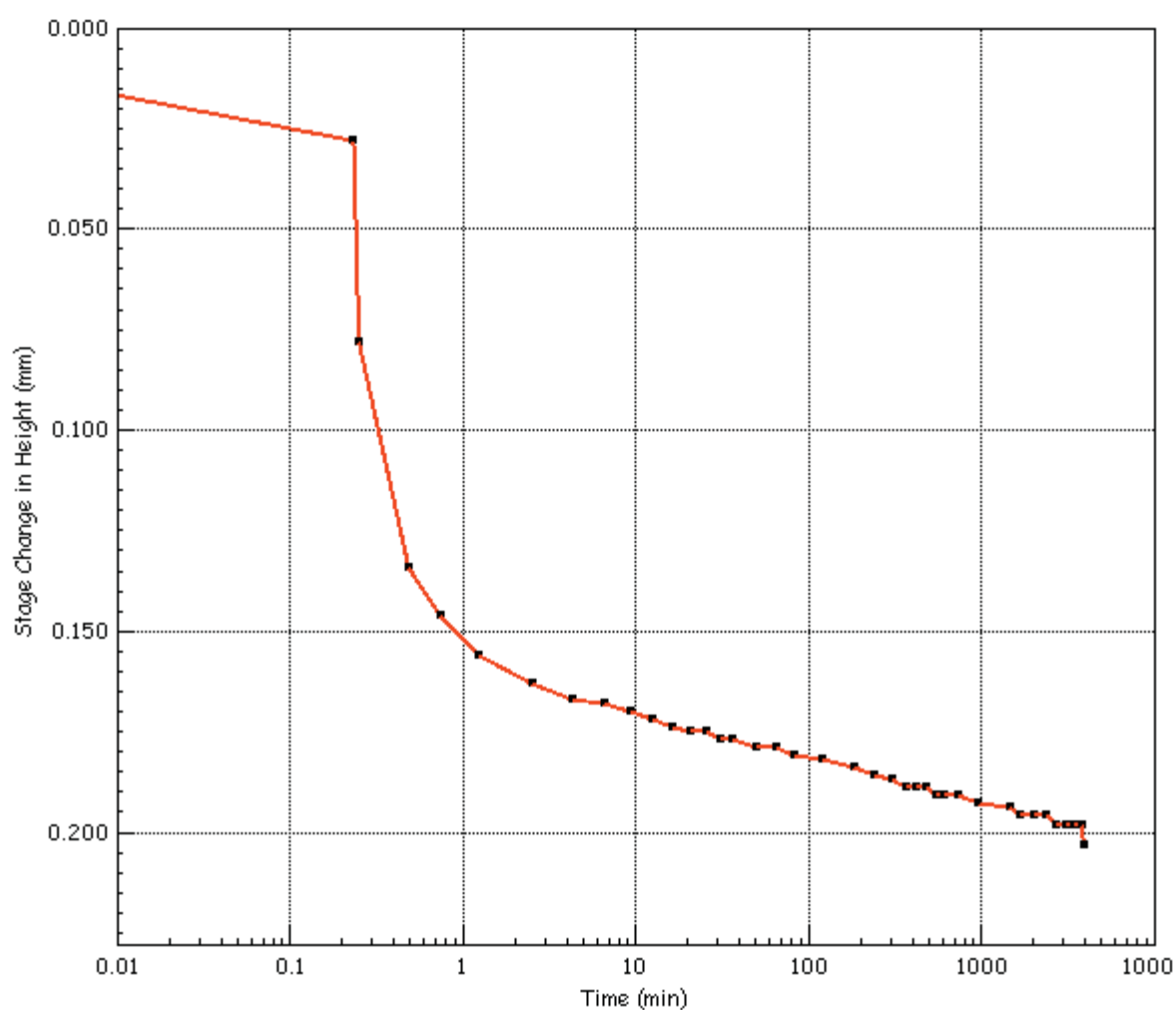



	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 6	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	24/07/2019	
	Client	CARDFF PARKWAY		Sample	13UT	
	Operator	TA/JT/JG	Checked	*	Approved	*



# Oedometer Consolidation Settlement Report

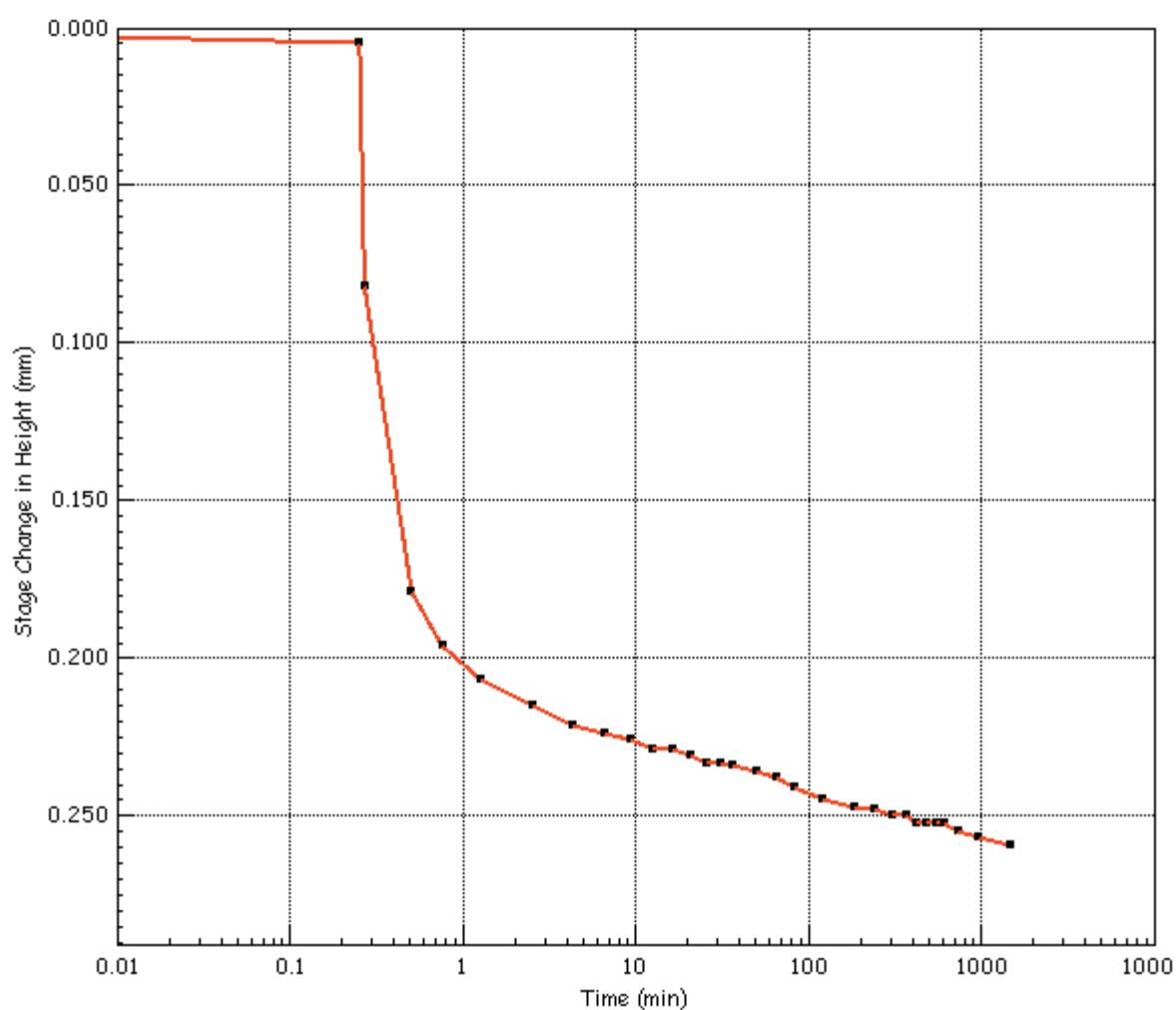
Vertical Stress	$\sigma'_i$	(kPa)	100
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.051
Height Settlement	$\Delta L_s$	(mm)	0.421
Voids Ratio	$e_f$	.	-0.151




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 6				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date				24/07/2019		
	Jobfile				Sample				13UT		
	Client				Borehole				BH05		
	CARDFF PARKWAY										
Operator		TA/JT/JG		Checked		*		Approved		*	

# Oedometer Consolidation Settlement Report

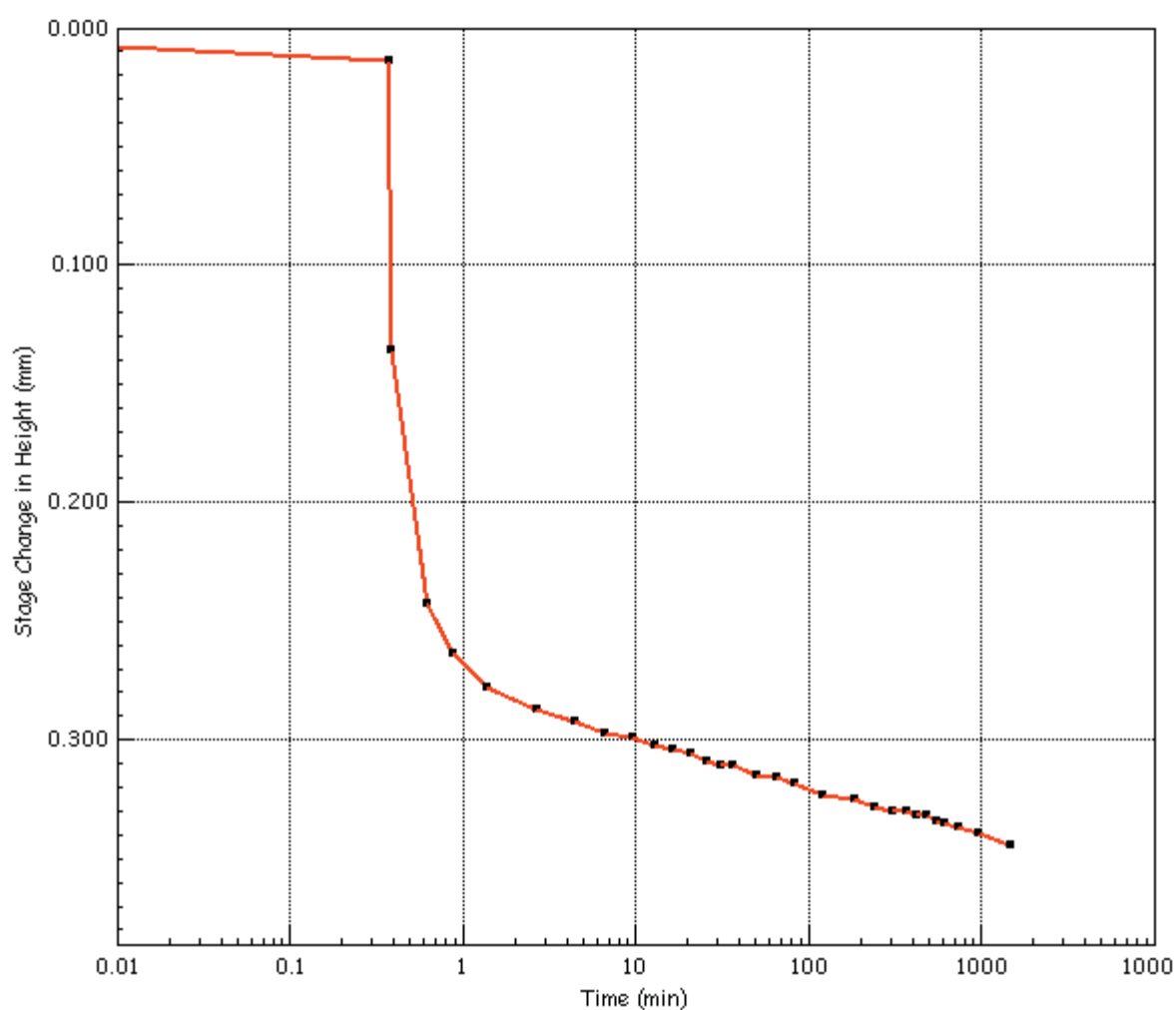
Vertical Stress	$\sigma'_i$	(kPa)	200
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.081
Height Settlement	$\Delta L_s$	(mm)	0.650
Voids Ratio	$e_f$	.	-0.161




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 6				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date				24/07/2019		
	Jobfile				Sample				13UT		
	Client				Borehole				BH05		
	CARDFF PARKWAY										
Operator		TA/JT/JG		Checked		*		Approved		*	

# Oedometer Consolidation Settlement Report

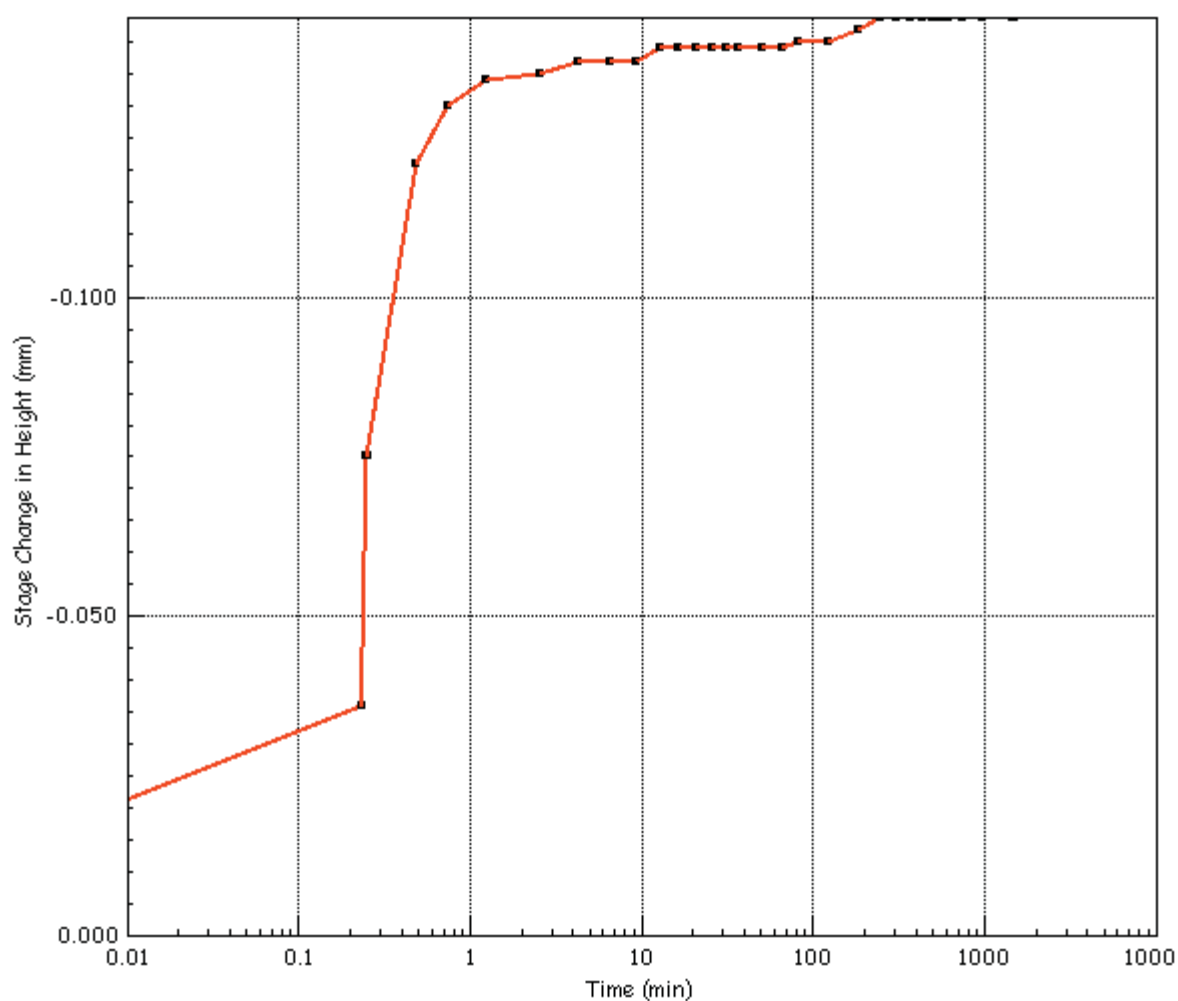
Vertical Stress	$\sigma'_i$	(kPa)	400
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.114
Height Settlement	$\Delta L_s$	(mm)	0.957
Voids Ratio	$e_f$	.	-0.174




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 6				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date				24/07/2019		
	Jobfile				Sample				13UT		
	Client				Borehole				BH05		
	CARDFF PARKWAY										
Operator		TA/JT/JG		Checked		*		Approved		*	

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	100
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.125
Height Settlement	$\Delta L_s$	(mm)	0.795
Voids Ratio	$e_f$	.	-0.167



	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 6				
					Database: .\SQLEXPRESS \ GEL						
	Site Reference				Test Date		24/07/2019				
	Jobfile		35338		Sample		13UT				
	Client		CARDFF PARKWAY		Borehole		BH05				
	Operator		TA/JT/JG		Checked		*		Approved		*

**DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES****BS.1377 : Part 5 : 1990 : 3**

CLIENT    CARDIFF PARKWAY DEVELOPMENTS LIMITED

BH/TP No.

BH07

SITE        CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

SAMPLE No./TYPE

15P

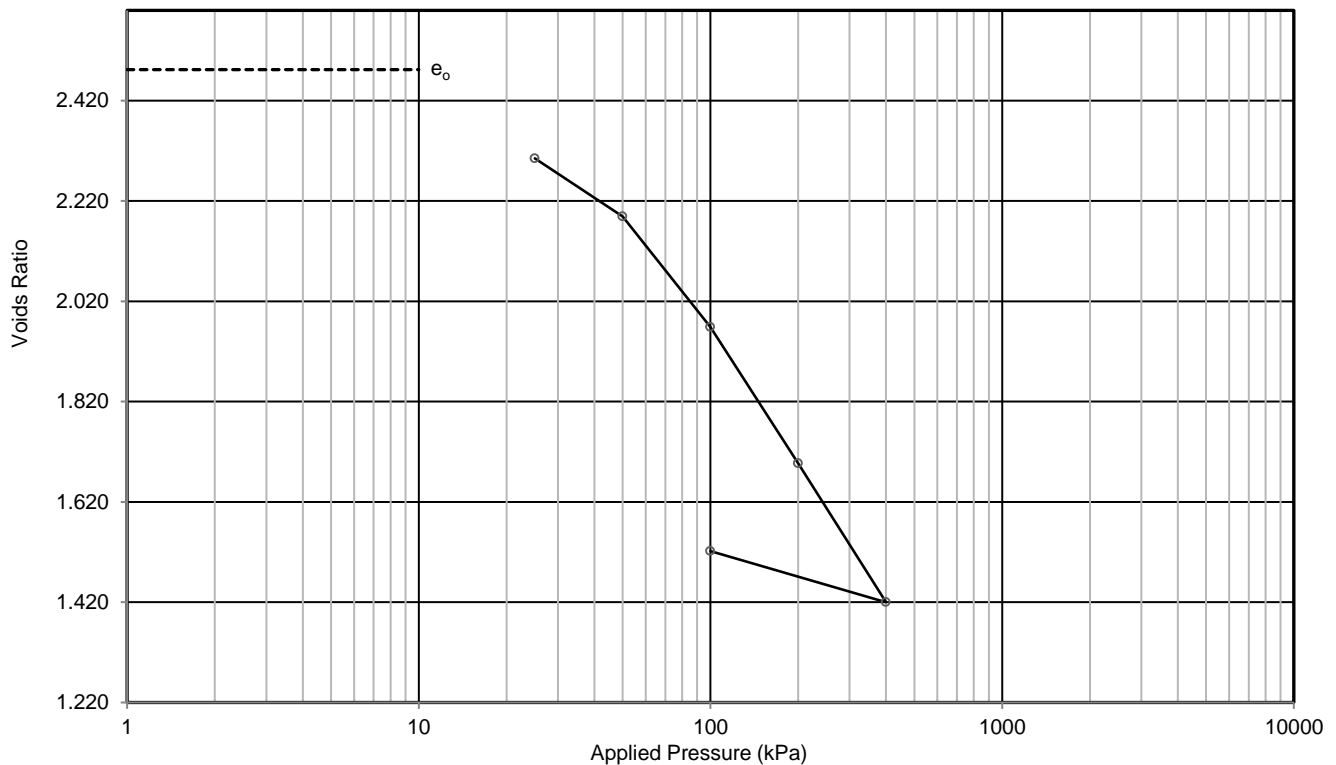
DESCRIPTION    Greyish brown slightly sandy silty organic CLAY

SAMPLE DEPTH (m)

6.00

SPECIMEN DEPTH (m)

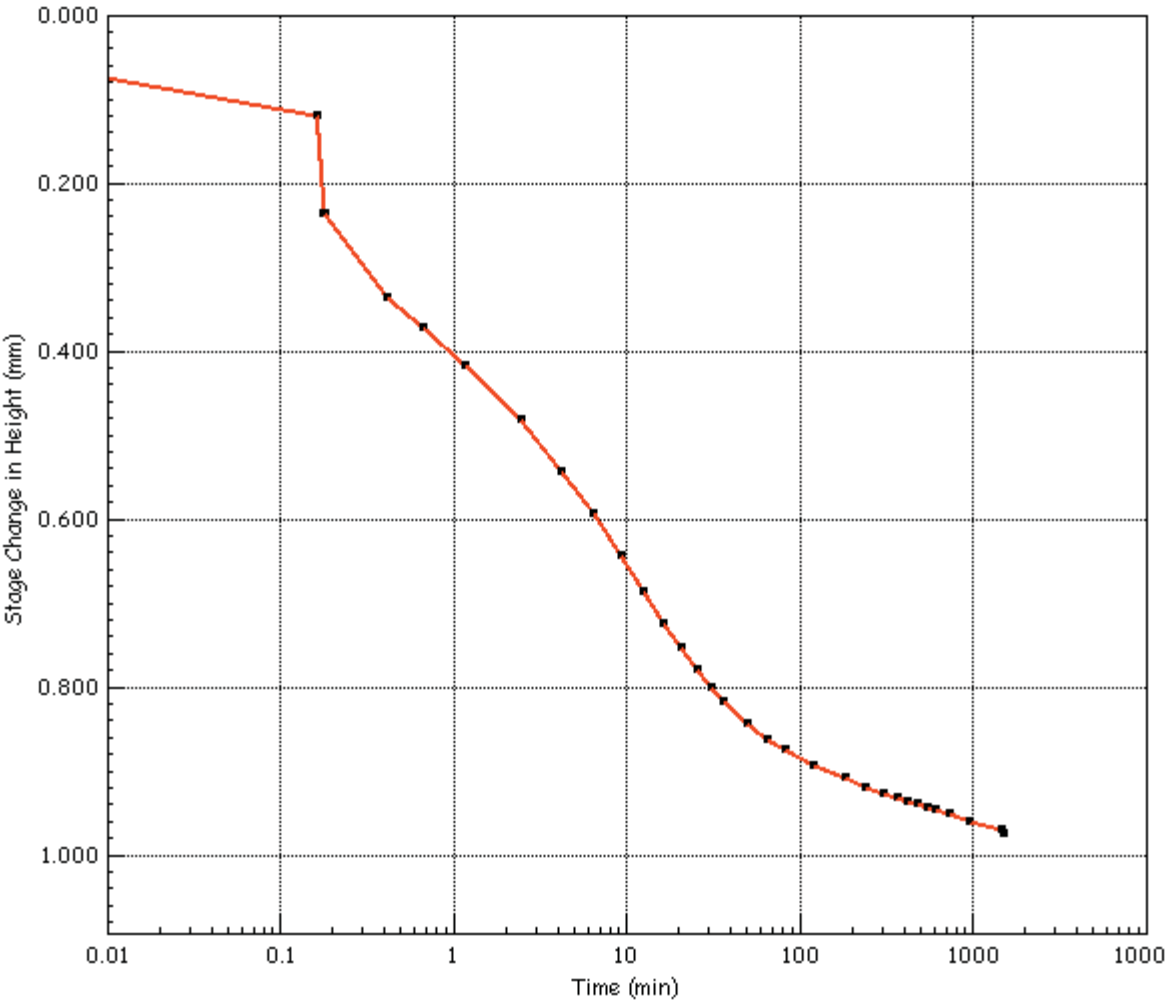
6.10




test and sample details			test results				
			pressure stage (kPa)	voids ratio	laboratory coefficients of compressibility mv (m <sup>2</sup> /MN)	consolidation Cv    Csec (m <sup>2</sup> /yr)	
specimen diameter	mm	63.44					
specimen height	mm	18.93					
initial moisture content	%	87.9					
final moisture content	%	57.2					
initial bulk density	Mg/m <sup>3</sup>	1.46	25	2.305	2	1.2	
initial dry density	Mg/m <sup>3</sup>	0.78	50	2.189	1.4	0.89	
initial voids ratio		2.482	100	1.968	1.4	0.67	
initial degree of saturation	%	96	200	1.697	0.92	0.3	
particle density	Mg/m <sup>3</sup>	#2.70	400	1.420	0.51	0.25	0.014
swelling pressure	kPa	N/A	100	1.522	0.14		
P'o to P'o +100 kPa		-					
laboratory temperature	oC	20 ± 2					
method of time fitting		root time					
remarks	# denotes particle density has been assigned an assumed value load frame corrections applied				CONTRACT <b>35338</b>	CHECKED <b>TB</b>	

# Oedometer Consolidation Settlement Report

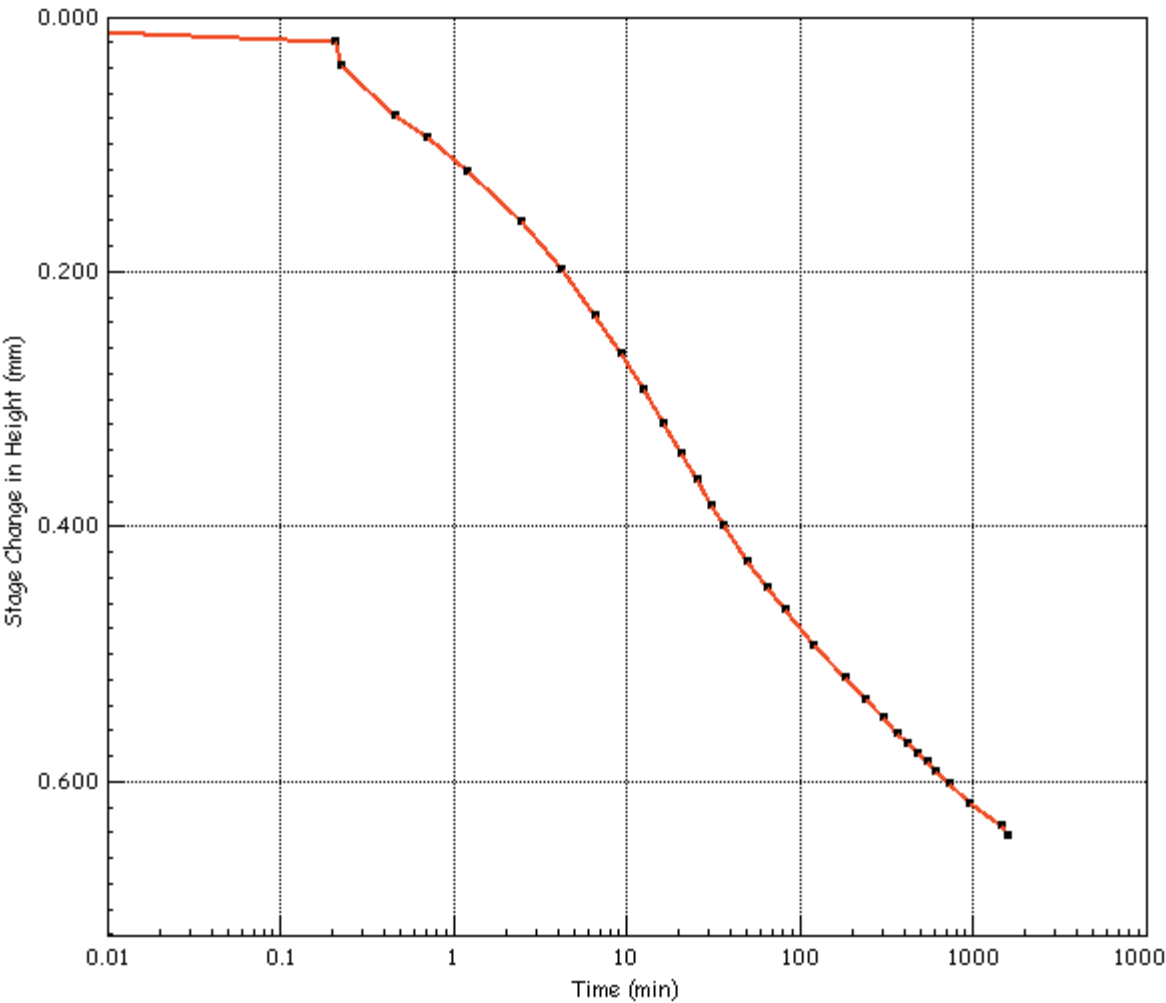
Vertical Stress	$\sigma'_i$	(kPa)	25
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.012
Height Settlement	$\Delta L_s$	(mm)	0.962
Voids Ratio	$e_f$	.	-0.175




	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 3	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	24/07/2019	
	Client	CARDFF PARKWAY		Sample	15P	
	Operator	TA/JT/JG	Checked	*	Approved	*

# Oedometer Consolidation Settlement Report

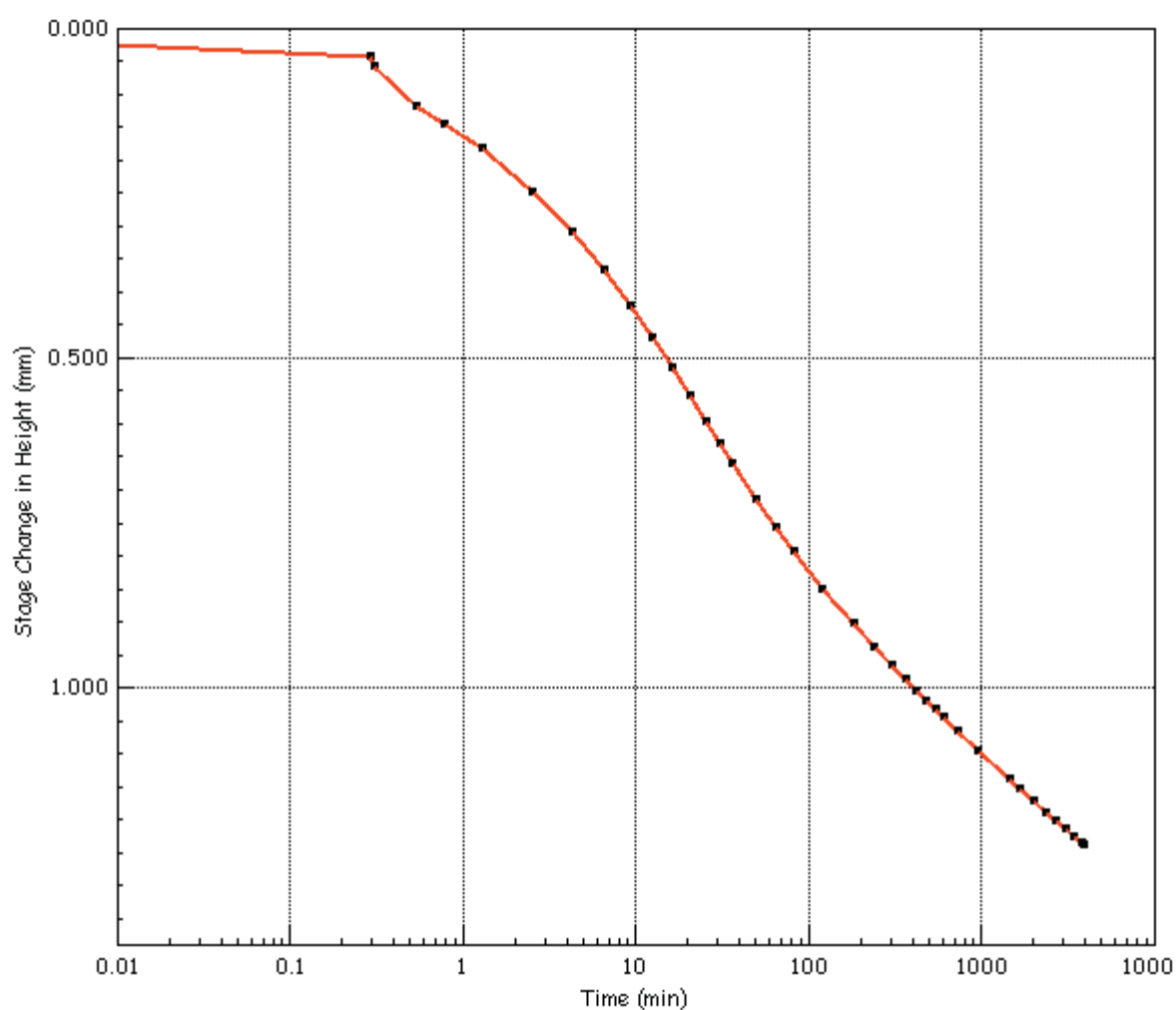
Vertical Stress	$\sigma'_i$	(kPa)	50
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.026
Height Settlement	$\Delta L_s$	(mm)	1.590
Voids Ratio	$e_f$	.	-0.202




	Test Method	BS1377 - 5 : 1990 : Clause 3		Test Name	FRAME 3	
	Site Reference			Database:	.\SQLEXPRESS \ GEL	
	Jobfile	35338		Test Date	24/07/2019	
	Client	CARDFF PARKWAY		Sample	15P	
	Operator	TA/JT/JG	Checked	*	Approved	*

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_{i1}$	(kPa)	100
Initial Temperature	$T_{i1}$	(°C)	20.0
Frame Correction	$L_{CORR}$	(mm)	0.061
Height Settlement	$\Delta L_s$	(mm)	2.792
Voids Ratio	$e_f$	.	-0.254

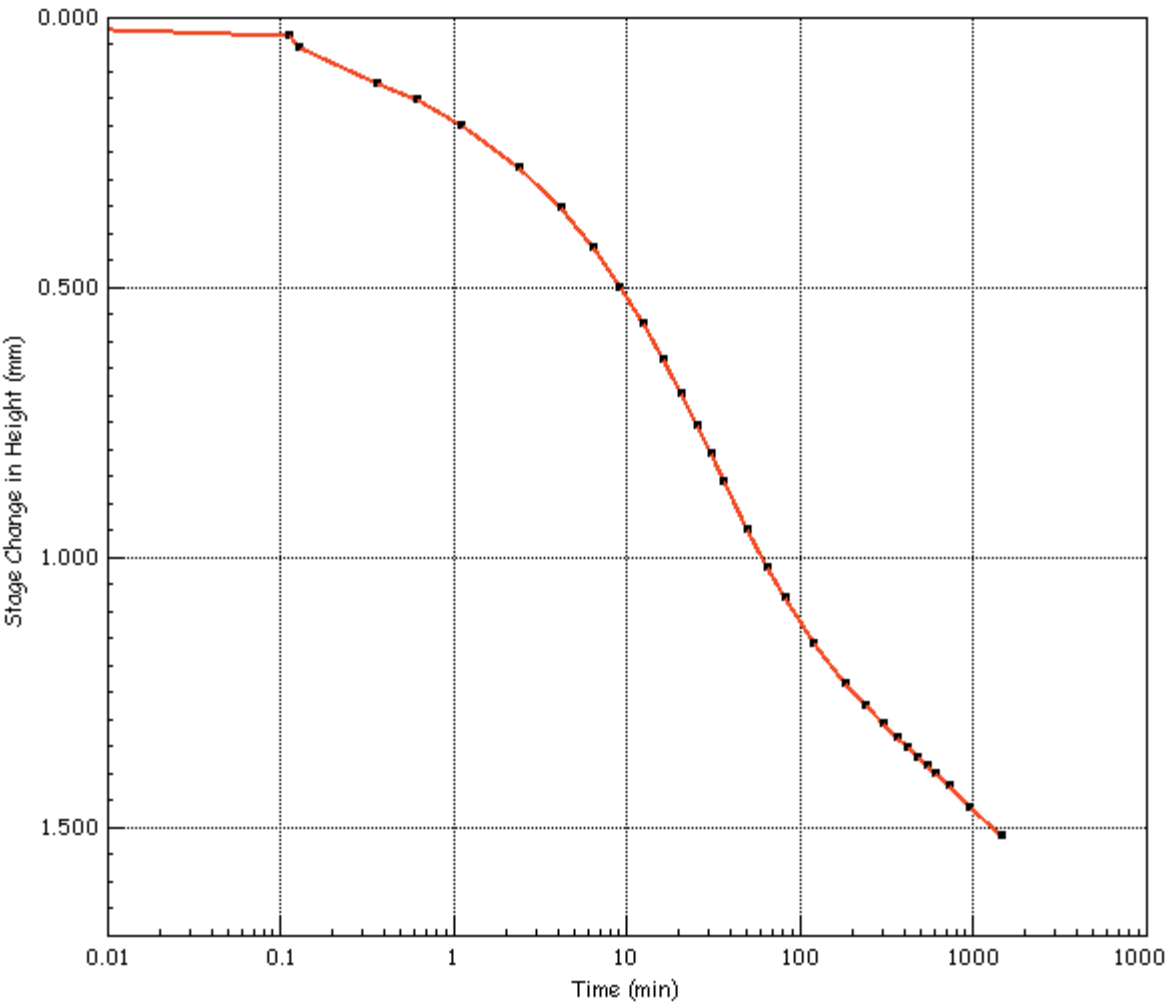



	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 3					
					Database: .\SQLEXPRESS \ GEL							
	Site Reference				Test Date				24/07/2019			
	Jobfile				35338				Sample		15P	
	Client				CARDFF PARKWAY				Borehole		BH07	
	Operator		TA/JT/JG		Checked		*		Approved		*	



# Oedometer Consolidation Settlement Report

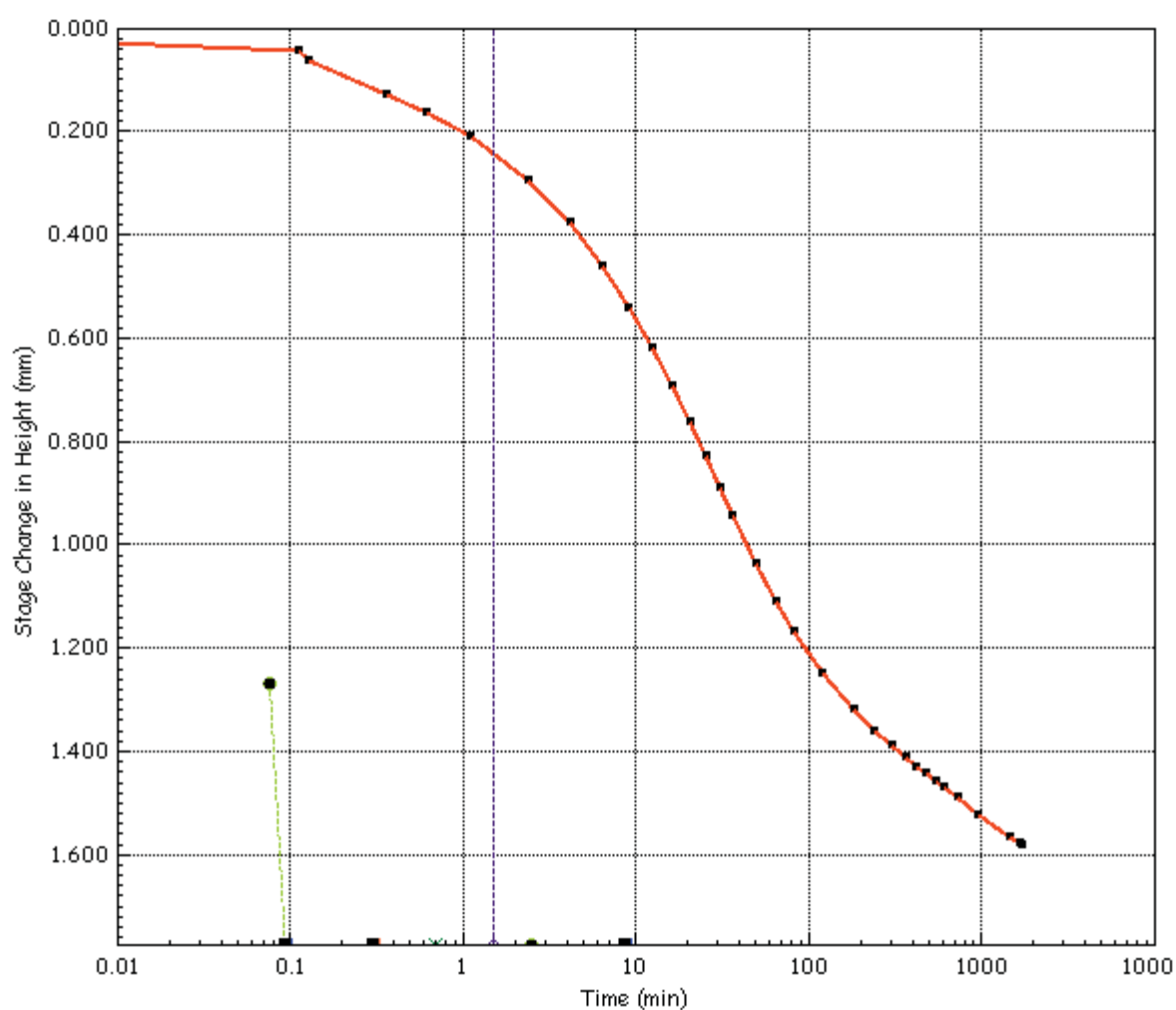
Vertical Stress	$\sigma'_i$	(kPa)	200
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.104
Height Settlement	$\Delta L_s$	(mm)	4.269
Voids Ratio	$e_f$	.	-0.318




	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 3		
					Database:		.\SQLEXPRESS \ GEL		
	Site Reference				Test Date		24/07/2019		
	Jobfile		35338		Sample		15P		
	Client		CARDFF PARKWAY		Borehole		BH07		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	

# Oedometer Consolidation Settlement Report

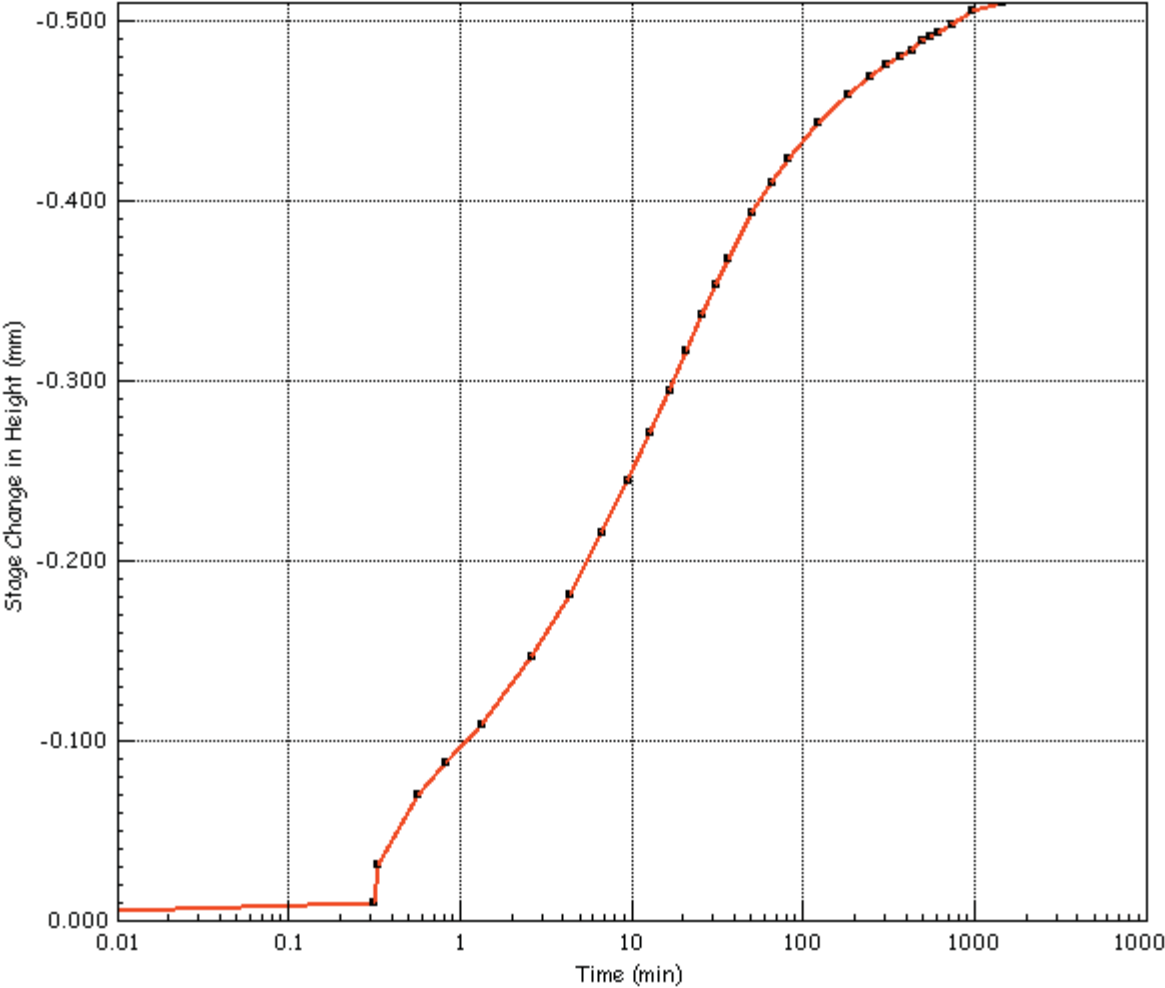
Vertical Stress	$\sigma'_i$	(kPa)	400
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.179
Height Settlement	$\Delta L_s$	(mm)	5.774
Voids Ratio	$e_f$	.	-0.383




	Test Method	BS1377 - 5 : 1990 : Clause 3	Test Name	FRAME 3
	Site Reference		Database:	.\SQLEXPRESS \ GEL
	Jobfile	35338	Test Date	24/07/2019
	Client	CARDFF PARKWAY	Sample	15P
	Operator	TA/JT/JG	Borehole	BH07
Checked			*	Approved
				*

# Oedometer Consolidation Settlement Report

Vertical Stress	$\sigma'_i$	(kPa)	100
Initial Temperature	$T_i$	(oC)	20.0
Frame Correction	L CORR	(mm)	0.224
Height Settlement	$\Delta L_s$	(mm)	5.218
Voids Ratio	$e_f$	.	-0.359



	Test Method		BS1377 - 5 : 1990 : Clause 3		Test Name		FRAME 3		
					Database:		.\SQLEXPRESS \ GEL		
	Site Reference				Test Date		24/07/2019		
	Jobfile		35338		Sample		15P		
	Client		CARDDFF PARKWAY		Borehole		BH07		
	Operator		TA/JT/JG		Checked		*		
						Approved		*	



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	sample		specimen depth (m)	code	moisture content		dimensions		density		cell pressure (kPa)	rate of strain (%/min)	deviator stress (kPa)	failure strain (%)	failure mode	shear strength* (kPa)	description and remarks		
	no./type	depth (m)			initial (%)	final (%)	length (mm)	diameter (mm)	bulk (Mg/m3)	dry (Mg/m3)									
BH04	7P	1.20	1.70	UU100	37.2	43.6	206	104	1.69	1.23	15	2.0	32	11.2	I	16	Grey mottled brown silty organic CLAY		
BH04	12P	3.60	4.00	UU100	65.7	64.9	206	104	1.52	0.92	65	2.0	21	7.3	I	10	Grey slightly sandy silty organic CLAY		
BH05	13UT	3.20	3.40	UU100	12.8	11.9	206	104	2.34	2.08	60	2.0	316	4.9	S	158	Reddish brown mottled grey slightly gravelly slightly sandy clayey SILT		
BH07	15P	6.00	6.20	UU100	83.8	68.3	206	104	1.48	0.81	125	2.0	46	4.9	B	23	Greyish brown slightly sandy silty organic CLAY		
general remarks:				code:		failure mode:		membrane type/thickness:										CONTRACT	CHECKED
* shear strength taken as half deviator stress at failure for each stage				UU - unconsolidated undrained		B - barrel (plastic failure)		latex membrane used (unless otherwise specified)										35338	TB
membrane correction applied				M - multi stage		S - shear (brittle failure)		38 - 0.2mm											
sample taken vertically (unless otherwise specified)				S - set of three		I - intermediate		70 - 0.4mm											
strain rate 2%/min (unless otherwise specified)				R - remoulded		O - other (see remarks)		100 - 0.4mm											



SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	sample		specimen depth  (m)	diameter D  (mm)	height H  (mm)	H/D	moisture content  (%)	bulk density  (Mg/m3)	loading rate  (kN/min)	time to failure  (min:sec)	UCS  (MPa)	description, codes and remarks
	no./type	depth (m)										
BH05	30Cs	19.70	19.75	88.6	273.6	3.09	3.3	2.61	5	04:20	6.00	Reddish brown motttled grey MUDSTONE, N, Sh. H/D ratio falls outside of ISRM specification Reddish brown SILTSTONE, N, Sh  Reddish brown MUDSTONE, N, Ot
BH07	27Cs	14.45	14.48	89.5	260.9	2.91	6.4	2.46	5	00:45	0.48	
BH07	31Cs	18.85	18.90	84.3	235.0	2.79	3.8	2.55	5	01:42	1.42	
<div>general remarks</div> <div>sample obtained from vertically drilled core (unless specified), test machine - VJT6000</div> <div><div>coding:</div><div>moisture condition</div><div>N - natural moisture content</div><div>F - fully saturated</div><div>S - soaked</div><div>P - air/partially dried</div></div> <div><div>sample storage</div><div>U - not wrapped</div><div>F - wrapped in cling film/foil</div><div>W - waxed</div><div>G - contained in sealed Geoline</div></div> <div><div>failure mode</div><div>Ax - axial cleavage</div><div>Ca - cataclasis</div><div>Sh - shear</div><div>Ex - explosive</div><div>Ot - other</div></div> <div><div>CONTRACT</div><div>35338</div></div> <div><div>CHECKED</div><div>TB</div></div>												

**POINT LOAD STRENGTH TEST**

I.S.R.M. Suggested Methods : 2007 Edition



CLIENT CARDIFF PARKWAY DEVELOPMENTS LIMITED

SITE CARDIFF PARKWAY INITIAL GROUND INVESTIGATION

borehole /trial pit no.	sample depth (m)	test type	test orien- tation	moisture condition	width  W (mm)	length  L (mm)	platen sep.  D (mm)	failure load  P (kN)	equiv. diam.  De (mm)	Is (MPa)	size factor	Is(50) (MPa)	description and remarks
BH04	14.00	D	Y	P		60	60	2.75	60.00	0.76	1.09	0.83	Reddish brown mottled grey MUDSTONE
BH04	14.00	A	X	P	60		55	3.61	64.82	0.86	1.12	0.97	Reddish brown mottled grey MUDSTONE
BH04	14.75	D	Y	P		70	85	1.28	85.00	0.18	1.27	0.22	Reddish brown mottled grey MUDSTONE
BH04	14.75	A	X	P	85		75	3.85	90.09	0.47	1.30	0.62	Reddish brown mottled grey MUDSTONE
BH05	6.95	A	X	P	85		40	1.18	65.80	0.27	1.13	0.31	Reddish brown MUDSTONE
BH05	13.20	D	Y	P		50	90	0.74	90.00	0.09	1.30	0.12	Reddish brown MUDSTONE
BH05	13.20	A	X	P	90		50	0.82	75.69	0.14	1.21	0.17	Reddish brown MUDSTONE
BH05	17.50	D	Y	P		60	90	2.19	90.00	0.27	1.30	0.35	Reddish brown mottled grey SANDSTONE
BH05	17.50	A	X	P	90		70	2.38	89.56	0.30	1.30	0.39	Reddish brown mottled grey SANDSTONE
BH05	20.70	D	Y	P		40	85	0.19	85.00	0.03	1.27	0.03	Reddish brown mottled grey SANDSTONE
BH05	20.70	A	X	P	85		45	0.31	69.79	0.06	1.16	0.07	Reddish brown mottled grey SANDSTONE
BH07	11.50	A	X	P	90		50	3.67	75.69	0.64	1.21	0.77	Reddish brown SILTSTONE
BH07	16.40	D	Y	P		60	85	5.96	85.00	0.82	1.27	1.05	Purplish brown SANDSTONE
BH07	16.40	A	X	P	85		55	5.17	77.15	0.87	1.22	1.06	Purplish brown SANDSTONE
BH07	21.20	D	Y	P		60	85	2.05	85.00	0.28	1.27	0.36	Purplish brown SANDSTONE
BH07	21.20	A	X	P	85		60	6.09	80.58	0.94	1.24	1.16	Purplish brown SANDSTONE
BH07	22.25	D	Y	N		70	90	8.94	90.00	1.10	1.30	1.44	Purplish brown SANDSTONE
BH07	22.25	A	X	N	90		70	7.31	89.56	0.91	1.30	1.18	Purplish brown SANDSTONE
general remarks tests carried out in accordance with I.S.R.M.(2007): Suggested Methods for Determining Point Load Strength test machine PLM02													
test type		test orientation relative to discontinuities				moisture condition				CONTRACT		CHECKED	
A - axial		X - perpendicular				N - natural moisture content				35338		TB	
D - diametral		Y - parallel				P - partially air dried							
I - irregular lump		Z - oblique				S - soaked							



2183

# Final Report

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**Report No.:** 19-25161-1

**Initial Date of Issue:** 31-Jul-2019

**Client** Geotechnical Engineering Ltd

**Client Address:** Centurion House  
Olympus Park  
Quedgeley  
Gloucester  
Gloucestershire  
GL2 4NF

**Contact(s):** GEL  
Wendy Jones

**Project** 35338D - Cardiff Parkway Initial Ground  
Investigation

**Quotation No.:** **Date Received:** 25-Jul-2019

**Order No.:** **Date Instructed:** 25-Jul-2019

**No. of Samples:** 9

**Turnaround (Wkdays):** 5 **Results Due:** 31-Jul-2019

**Date Approved:** 31-Jul-2019

**Approved By:**



**Details:** Martin Dyer, Laboratory Manager

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## Results - Soil

**Project: 35338D - Cardiff Parkway Initial Ground Investigation**

<b>Client: Geotechnical Engineering Ltd</b>	<b>Chemtest Job No.:</b>					19-25161	19-25161	19-25161	19-25161	19-25161	19-25161	19-25161	19-25161
Quotation No.:	<b>Chemtest Sample ID.:</b>					864047	864048	864049	864050	864051	864052	864053	864054
	Client Sample ID.:					5B	7P	12P	15D	6D	13UT	2D	15P
	Sample Location:					BH04	BH04	BH04	BH04	BH05	BH05	BH07	BH07
	Sample Type:					SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):					1.00	1.20	3.60	6.00	1.00	3.20	0.30	6.00
	Bottom Depth (m):					1.20	2.00	4.40	6.45	1.20	3.65	0.50	6.80
	Date Sampled:					23-Jul-2019	23-Jul-2019	23-Jul-2019	23-Jul-2019	23-Jul-2019	23-Jul-2019	23-Jul-2019	23-Jul-2019
<b>Determinand</b>	<b>Accred.</b>	<b>SOP</b>	<b>Units</b>	<b>LOD</b>									
Moisture	N	2030	%	0.020	26	69	26	9.7	61	13	24	53	2.3
pH	U	2010		N/A	8.0			8.5	7.1	8.2		7.1	9.1
Magnesium (Water Soluble)	N	2120	g/l	0.010	< 0.010			< 0.010	0.024	< 0.010		0.093	0.011
Sulphate (2:1 Water Soluble) as SO <sub>4</sub>	U	2120	g/l	0.010	0.079			0.11	0.17	0.013		1.2	0.030
Total Sulphur	U	2175	%	0.010	0.033			0.029	1.0	0.020		0.21	0.023
Chloride (Water Soluble)	U	2220	g/l	0.010	0.026			0.041	0.016	< 0.010		0.59	0.036
Nitrate (Water Soluble)	N	2220	g/l	0.010	< 0.010			< 0.010	< 0.010	< 0.010		< 0.010	< 0.010
Sulphate (Acid Soluble)	U	2430	%	0.010	0.046			0.023	0.45	< 0.010		0.42	< 0.010
LOI	U	2610	%	0.10		59	4.6						
Organic Matter	U	2625	%	0.40			1.6				3.1	< 0.40	



SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measurement by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.

## **Report Information**

### **Key**

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- 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, SVOCs, PCBs, Phenols

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

All Asbestos testing is performed at the indicated laboratory

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

### **Sample Deviation Codes**

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- 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
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

### **Sample Retention and Disposal**

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All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

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

[customerservices@chemtest.com](mailto:customerservices@chemtest.com)



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# **APPENDIX E**

## **CHEMICAL ANALYSES**

**Edward Crimp**

Geotechnical Engineering Ltd  
Centurion House  
Olympus Park  
Quedgeley  
Gloucester  
GL2 4NF

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i2 Analytical Ltd.  
7 Woodshots Meadow,  
Croxley Green  
Business Park,  
Watford,  
Herts,  
WD18 8YS

t: 01923 225404  
f: 01923 237404  
e: reception@i2analytical.com

## **Analytical Report Number : 19-45433**

<b>Project / Site name:</b>	Cardiff Parkway	<b>Samples received on:</b>	13/06/2019
<b>Your job number:</b>	35338	<b>Samples instructed on:</b>	13/06/2019
<b>Your order number:</b>		<b>Analysis completed by:</b>	20/06/2019
<b>Report Issue Number:</b>	1	<b>Report issued on:</b>	20/06/2019
<b>Samples Analysed:</b>	5 water samples		

**Signed:**

Rexona Rahman  
Head of Customer Services  
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

Iss No 19-45433-1 Cardiff Parkway 35338

This certificate should not be reproduced, except in full, without the express permission of the laboratory.

The results included within the report are representative of the samples submitted for analysis.

Page 1 of 4



Analytical Report Number: 19-45433

Project / Site name: Cardiff Parkway

Lab Sample Number				1244139	1244140	1244141	1244142	1244143
Sample Reference				SW1	SW2	SW3	SW4	SW5
Sample Number				1	1	1	1	1
Depth (m)				0.00	0.00	0.00	0.00	0.00
Date Sampled				12/06/2019	12/06/2019	12/06/2019	12/06/2019	12/06/2019
Time Taken				1115	1045	1130	1100	1050
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					

#### General Inorganics

pH	pH Units	N/A	ISO 17025	7.7	7.6	8.0	7.4	7.9
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	280	< 15	52	36	16
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	3.96	7.89	5.10	4.86	6.91
Nitrate as N	mg/l	0.01	ISO 17025	1.45	0.04	0.99	0.01	0.02
Nitrite as N	µg/l	1	ISO 17025	80	6.4	78	8.1	9.2
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	12	13	8.0	13	9.3
Total Oxidised Nitrogen (TON)	mg/l	0.3	NONE	1.5	< 0.3	1.1	< 0.3	< 0.3
Hardness - Total	mgCaCO <sub>3</sub> /l	1	ISO 17025	137	111	142	83.8	111

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
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#### Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

#### Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16
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#### Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	1.20	1.30	1.11	1.01	1.94
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.04	< 0.02	0.02	< 0.02	< 0.02
Calcium (dissolved)	mg/l	0.012	ISO 17025	29	24	31	21	23
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.5	0.4	0.4	0.5	0.4
Copper (dissolved)	µg/l	0.5	ISO 17025	4.8	4.8	5.8	3.3	8.8
Lead (dissolved)	µg/l	0.2	ISO 17025	1.2	0.3	0.6	0.2	< 0.2
Magnesium (dissolved)	mg/l	0.005	ISO 17025	16	12	16	7.8	13
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	0.5	< 0.5	0.7	0.6	0.6
Phosphorus (dissolved)	µg/l	20	ISO 17025	205	56.4	118	93.3	46.1
Selenium (dissolved)	µg/l	0.6	ISO 17025	0.8	< 0.6	0.8	< 0.6	< 0.6
Zinc (dissolved)	µg/l	0.5	ISO 17025	10	1.8	6.0	2.4	3.4



Analytical Report Number: 19-45433

Project / Site name: Cardiff Parkway

Lab Sample Number				1244139	1244140	1244141	1244142	1244143
Sample Reference				SW1	SW2	SW3	SW4	SW5
Sample Number				1	1	1	1	1
Depth (m)				0.00	0.00	0.00	0.00	0.00
Date Sampled				12/06/2019	12/06/2019	12/06/2019	12/06/2019	12/06/2019
Time Taken				1115	1045	1130	1100	1050
Analytical Parameter (Water Analysis)				Units	Limit of detection	Accreditation Status		

#### Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

#### Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample



**Analytical Report Number : 19-45433**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Chemical Oxygen Demand in Water (Total)	Determination of total COD in water by reflux oxidation with acidified K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> followed by colorimetry. Accredited matrices: SW, PW, GW.	HACH DR/890 Colorimeter Procedures Manual (48470-22) (Ref 0170.2)	L065-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L078-PL	W	ISO 17025
Nitrite as N in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry). Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
pH at 20°C in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
Total oxidised nitrogen in water	Calculation from nitrate and nitrite.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton & Polish Standard Method PN-82/C-04579.08	L078/82-PL	W	NONE
TPH in (Water)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE

**For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.**

**For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.**

**Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30°C.**

Iss No 19-45433-1 Cardiff Parkway 35338

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The results included within the report are representative of the samples submitted for analysis.

Page 4 of 4

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## **Analytical Report Number : 19-47292**

<b>Project / Site name:</b>	Cardiff Parkway	<b>Samples received on:</b>	27/06/2019
<b>Your job number:</b>	35338	<b>Samples instructed on:</b>	27/06/2019
<b>Your order number:</b>		<b>Analysis completed by:</b>	03/07/2019
<b>Report Issue Number:</b>	1	<b>Report issued on:</b>	03/07/2019
<b>Samples Analysed:</b>	5 water samples		

**Signed:** karolina marek

Karolina Marek  
Technical Reviewer (Reporting Team)  
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

Iss No 19-47292-1 Cardiff Parkway 35338.XLS

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The results included within the report are representative of the samples submitted for analysis.

Page 1 of 5





Analytical Report Number: 19-47292

Project / Site name: Cardiff Parkway

Lab Sample Number				1253977	1253978	1253979	1253980	1253981
Sample Reference				SW1	SW2	SW3	SW4	SW5
Sample Number				2	2	2	2	2
Depth (m)				0.00	0.00	0.00	0.00	0.00
Date Sampled				26/06/2019	26/06/2019	26/06/2019	26/06/2019	26/06/2019
Time Taken				1135	1125	1045	1025	1105
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					

#### General Inorganics

pH	pH Units	N/A	ISO 17025	7.3	7.5	7.6	7.4	7.5
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	920	89	370	37	34
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	8.29	7.92	7.13	8.58	7.70
Nitrate as N	mg/l	0.01	ISO 17025	0.21	0.11	0.59	0.14	0.11
Nitrite as N	µg/l	1	ISO 17025	19	15	170	6.2	6.6
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	200	23	25	52	21
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1	ISO 17025	21	5.3	4.8	3.7	3.4
Total Oxidised Nitrogen (TON)	mg/l	0.3	NONE	< 0.3	< 0.3	0.8	< 0.3	< 0.3
Hardness - Total	mgCaCO <sub>3</sub> /l	1	ISO 17025	168	103	161	200	146

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
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#### Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

#### Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16
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#### Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	1.99	3.38	1.02	0.82	1.13
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.10	< 0.02	< 0.02	< 0.02	< 0.02
Calcium (dissolved)	mg/l	0.012	ISO 17025	46	25	39	52	37
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.7	0.5	0.4	0.4	0.4
Copper (dissolved)	µg/l	0.5	ISO 17025	7.7	4.6	3.0	4.7	3.1
Lead (dissolved)	µg/l	0.2	ISO 17025	2.1	0.6	0.5	< 0.2	0.4
Magnesium (dissolved)	mg/l	0.005	ISO 17025	13	9.8	15	17	13
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	0.8	< 0.5	< 0.5	< 0.5	< 0.5
Phosphorus (dissolved)	µg/l	20	ISO 17025	280	35.2	206	35.3	34.3
Selenium (dissolved)	µg/l	0.6	ISO 17025	0.7	< 0.6	0.6	0.7	< 0.6
Zinc (dissolved)	µg/l	0.5	ISO 17025	20	5.6	8.0	0.9	2.5



Analytical Report Number: 19-47292

Project / Site name: Cardiff Parkway

Lab Sample Number				1253977	1253978	1253979	1253980	1253981
Sample Reference				SW1	SW2	SW3	SW4	SW5
Sample Number				2	2	2	2	2
Depth (m)				0.00	0.00	0.00	0.00	0.00
Date Sampled				26/06/2019	26/06/2019	26/06/2019	26/06/2019	26/06/2019
Time Taken				1135	1125	1045	1025	1105
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					

#### Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

#### Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
<b>TPH-CWG - Aliphatic (C5 - C35)</b>	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
<b>TPH-CWG - Aliphatic (C5 - C44)</b>	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
<b>TPH-CWG - Aromatic (C5 - C35)</b>	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
<b>TPH-CWG - Aromatic (C5 - C44)</b>	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample



**Analytical Report Number : 19-47292**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Biological oxygen demand (total) of water	Determination of biochemical oxygen demand in water (5 days). Accredited matrices: SW, PW, GW.	In-house method based on standard method 5210B.	L086-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Chemical Oxygen Demand in Water (Total)	Determination of total COD in water by reflux oxidation with acidified K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> followed by colorimetry. Accredited matrices: SW, PW, GW.	HACH DR/890 Colorimeter Procedures Manual (48470-22) (Ref 0170.2)	L065-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Nitrite as N in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry). Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
Total oxidised nitrogen in water	Calculation from nitrate and nitrite.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton & Polish Standard Method PN-82/C-04579.08	L078/82-PL	W	NONE
TPH in (Water)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE

Iss No 19-47292-1 Cardiff Parkway 35338.XLS

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The results included within the report are representative of the samples submitted for analysis.

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**Analytical Report Number : 19-47292**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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## **Analytical Report Number : 19-50413**

<b>Project / Site name:</b>	Cardiff Parkway	<b>Samples received on:</b>	18/07/2019
<b>Your job number:</b>	35338	<b>Samples instructed on:</b>	18/07/2019
<b>Your order number:</b>		<b>Analysis completed by:</b>	24/07/2019
<b>Report Issue Number:</b>	1	<b>Report issued on:</b>	24/07/2019
<b>Samples Analysed:</b>	5 water samples		

**Signed:**

Katarzyna Lewicka  
Head of Reporting Section  
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :	soils	- 4 weeks from reporting
	leachates	- 2 weeks from reporting
	waters	- 2 weeks from reporting
	asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.



Analytical Report Number: 19-50413

Project / Site name: Cardiff Parkway

Lab Sample Number				1270398	1270399	1270400	1270401	1270402
Sample Reference				SW1	SW2	SW3	SW4	SW5
Sample Number				2	2	2	2	2
Depth (m)				0.00	0.00	0.00	0.00	0.00
Date Sampled				17/07/2019	17/07/2019	17/07/2019	17/07/2019	17/07/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					

#### General Inorganics

pH	pH Units	N/A	ISO 17025	7.6	7.5	7.8	7.5	7.5
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	22	17	43	< 15	15
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	7.17	9.60	6.70	6.28	11.8
Nitrate as N	mg/l	0.01	ISO 17025	0.17	0.21	0.18	0.16	0.17
Nitrite as N	µg/l	1	ISO 17025	< 1.0	4.9	< 1.0	< 1.0	2.8
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	38	38	40	120	76
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1	ISO 17025	11	8.9	4.2	6.1	12
Total Oxidised Nitrogen (TON)	mg/l	0.3	NONE	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Hardness - Total	mgCaCO <sub>3</sub> /l	1	ISO 17025	277	177	243	248	167

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
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#### Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

#### Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16
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#### Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	4.40	3.45	1.26	1.29	2.52
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Calcium (dissolved)	mg/l	0.012	ISO 17025	74	44	63	64	39
Chromium (dissolved)	µg/l	0.2	ISO 17025	< 0.2	0.2	0.5	0.6	0.3
Copper (dissolved)	µg/l	0.5	ISO 17025	1.7	2.4	10	3.3	3.9
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	3.8	0.6	0.4	0.6
Magnesium (dissolved)	mg/l	0.005	ISO 17025	22	16	21	21	17
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	1.3	1.3	1.2	0.8	1.9
Phosphorus (dissolved)	µg/l	20	ISO 17025	191	158	605	269	201
Selenium (dissolved)	µg/l	0.6	ISO 17025	0.7	< 0.6	< 0.6	< 0.6	1.3
Zinc (dissolved)	µg/l	0.5	ISO 17025	1.6	7.3	14	4.5	8.9



Analytical Report Number: 19-50413

Project / Site name: Cardiff Parkway

Lab Sample Number				1270398	1270399	1270400	1270401	1270402
Sample Reference				SW1	SW2	SW3	SW4	SW5
Sample Number				2	2	2	2	2
Depth (m)				0.00	0.00	0.00	0.00	0.00
Date Sampled				17/07/2019	17/07/2019	17/07/2019	17/07/2019	17/07/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					

#### Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

#### Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample



**Analytical Report Number : 19-50413**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Biological oxygen demand (total) of water	Determination of biochemical oxygen demand in water (5 days). Accredited matrices: SW, PW, GW.	In-house method based on standard method 5210B.	L086-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L0738-PL	W	ISO 17025
Chemical Oxygen Demand in Water (Total)	Determination of total COD in water by reflux oxidation with acidified K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> followed by colorimetry. Accredited matrices: SW, PW, GW.	HACH DR/890 Colorimeter Procedures Manual (48470-22) (Ref 0170.2)	L065-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 *for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Nitrite as N in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry). Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
Total oxidised nitrogen in water	Calculation from nitrate and nitrite.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton & Polish Standard Method PN-82/C-04579.08	L078/82-PL	W	NONE
TPH in (Water)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE

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The results included within the report are representative of the samples submitted for analysis.

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**Analytical Report Number : 19-50413**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

**Edward Crimp**

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## **Analytical Report Number : 19-52227**

<b>Project / Site name:</b>	Cardiff Parkway	<b>Samples received on:</b>	31/07/2019
<b>Your job number:</b>	35338	<b>Samples instructed on:</b>	31/07/2019
<b>Your order number:</b>		<b>Analysis completed by:</b>	06/08/2019
<b>Report Issue Number:</b>	1	<b>Report issued on:</b>	06/08/2019
<b>Samples Analysed:</b>	5 water samples		

**Signed:** *Karolina Marek*

Karolina Marek  
Technical Reviewer (Reporting Team)  
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :	soils	- 4 weeks from reporting
	leachates	- 2 weeks from reporting
	waters	- 2 weeks from reporting
	asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.



Analytical Report Number: 19-52227

Project / Site name: Cardiff Parkway

Lab Sample Number	1279524	1279525	1279526	1279527	1279528
Sample Reference	SW1	SW2	SW3	SW4	SW5
Sample Number	1	1	1	1	1
Depth (m)	0.00	0.00	0.00	0.00	0.00
Date Sampled	30/07/2019	30/07/2019	30/07/2019	30/07/2019	30/07/2019
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		

#### General Inorganics

pH	pH Units	N/A	ISO 17025	7.7	7.4	7.4	7.4	7.4
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	110	150	1000	86	910
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	7.36	7.31	7.14	7.75	6.47
Nitrate as N	mg/l	0.01	ISO 17025	2.01	0.48	0.38	0.45	0.56
Nitrite as N	µg/l	1	ISO 17025	55	13	7.9	8.2	4.5
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	31	21	20	26	22
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1	ISO 17025	2.8	3.2	5.0	7.6	3.7
Total Oxidised Nitrogen (TON)	mg/l	0.3	NONE	2.1	0.5	0.4	0.5	0.6
Hardness - Total	mgCaCO3/l	1	ISO 17025	154	125	148	160	180

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
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#### Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

#### Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16
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#### Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.78	3.88	1.20	4.63	1.34
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.05	0.02	0.03	0.04	< 0.02
Calcium (dissolved)	mg/l	0.012	ISO 17025	45	35	42	45	51
Chromium (dissolved)	µg/l	0.2	ISO 17025	2.4	0.4	0.3	0.7	0.5
Copper (dissolved)	µg/l	0.5	ISO 17025	13	4.5	16	4.7	6.9
Lead (dissolved)	µg/l	0.2	ISO 17025	1.7	0.5	1.5	1.8	0.3
Magnesium (dissolved)	mg/l	0.005	ISO 17025	9.9	9.1	10	12	13
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	1.0	1.0	1.0	1.3	1.0
Phosphorus (dissolved)	µg/l	20	ISO 17025	156	131	477	143	340
Selenium (dissolved)	µg/l	0.6	ISO 17025	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
Zinc (dissolved)	µg/l	0.5	ISO 17025	16	2.1	12	21	5.1



Analytical Report Number: 19-52227

Project / Site name: Cardiff Parkway

Lab Sample Number	1279524	1279525	1279526	1279527	1279528
Sample Reference	SW1	SW2	SW3	SW4	SW5
Sample Number	1	1	1	1	1
Depth (m)	0.00	0.00	0.00	0.00	0.00
Date Sampled	30/07/2019	30/07/2019	30/07/2019	30/07/2019	30/07/2019
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		

#### Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

#### Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample



**Analytical Report Number : 19-52227**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Biological oxygen demand (total) of water	Determination of biochemical oxygen demand in water (5 days). Accredited matrices: SW, PW, GW.	In-house method based on standard method 5210B.	L086-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L0738-PL	W	ISO 17025
Chemical Oxygen Demand in Water (Total)	Determination of total COD in water by reflux oxidation with acidified K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> followed by colorimetry. Accredited matrices: SW, PW, GW.	HACH DR/890 Colorimeter Procedures Manual (48470-22) (Ref 0170.2)	L065-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 *for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Nitrite as N in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry). Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
Total oxidised nitrogen in water	Calculation from nitrate and nitrite.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton & Polish Standard Method PN-82/C-04579.08	L078/82-PL	W	NONE
TPH in (Water)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE

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The results included within the report are representative of the samples submitted for analysis.

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**Analytical Report Number : 19-52227**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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## **Analytical Report Number : 19-52685**

<b>Project / Site name:</b>	Cardiff Parkway	<b>Samples received on:</b>	02/08/2019
<b>Your job number:</b>	35338	<b>Samples instructed on:</b>	02/08/2019
<b>Your order number:</b>		<b>Analysis completed by:</b>	09/08/2019
<b>Report Issue Number:</b>	1	<b>Report issued on:</b>	09/08/2019
<b>Samples Analysed:</b>	4 water samples		

**Signed:** Karolina Marek

Karolina Marek  
Technical Reviewer (Reporting Team)  
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

Iss No 19-52685-1 Cardiff Parkway 35338

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The results included within the report are representative of the samples submitted for analysis.

Page 1 of 6



Analytical Report Number: 19-52685

Project / Site name: Cardiff Parkway

Lab Sample Number				1281935	1281936	1281937	1281938	
Sample Reference				BH02	BH03	BH04	BH05	
Sample Number				1	1	1	1	
Depth (m)				0.88	1.03	1.13	1.22	
Date Sampled				30/07/2019	30/07/2019	30/07/2019	30/07/2019	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Water Analysis)								
	Units	Limit of detection	Accreditation Status					

#### General Inorganics

pH	pH Units	N/A	ISO 17025	7.5	7.6	7.6	7.7	
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	110	830	1500	330	
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	3.85	8.08	12.4	10.5	
Nitrate as N	mg/l	0.01	ISO 17025	0.35	0.24	0.27	0.57	
Nitrite as N	µg/l	1	ISO 17025	15	14	11	14	
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	1700	50	74	1900	
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1	ISO 17025	2.4	< 1.0	1.0	2.9	
Total Oxidised Nitrogen (TON)	mg/l	0.3	NONE	0.4	< 0.3	< 0.3	0.6	
Hardness - Total	mgCaCO <sub>3</sub> /l	1	ISO 17025	255	159	362	291	

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	
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#### Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	

#### Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16	
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#### Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.68	1.16	0.82	1.09	
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.04	< 0.02	< 0.02	< 0.02	
Calcium (dissolved)	mg/l	0.012	ISO 17025	66	28	83	44	
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.2	0.5	0.4	0.2	
Copper (dissolved)	µg/l	0.5	ISO 17025	6.1	6.9	6.7	2.6	
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	0.2	< 0.2	< 0.2	
Magnesium (dissolved)	mg/l	0.005	ISO 17025	22	22	37	44	
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	0.64	
Nickel (dissolved)	µg/l	0.5	ISO 17025	3.1	3.1	3.0	4.3	
Phosphorus (dissolved)	µg/l	20	ISO 17025	< 20.0	30.2	< 20.0	23.5	
Selenium (dissolved)	µg/l	0.6	ISO 17025	1.5	3.9	3.9	17	
Zinc (dissolved)	µg/l	0.5	ISO 17025	2.1	4.7	1.3	< 0.5	





Analytical Report Number: 19-52685

Project / Site name: Cardiff Parkway

Lab Sample Number				1281935	1281936	1281937	1281938	
Sample Reference				BH02	BH03	BH04	BH05	
Sample Number				1	1	1	1	
Depth (m)				0.88	1.03	1.13	1.22	
Date Sampled				30/07/2019	30/07/2019	30/07/2019	30/07/2019	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					

#### Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	

#### Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	24	
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	95	
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	1700	
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	300	
<b>TPH-CWG - Aliphatic (C5 - C35)</b>	µg/l	10	NONE	< 10	< 10	< 10	1800	
<b>TPH-CWG - Aliphatic (C5 - C44)</b>	µg/l	10	NONE	< 10	< 10	< 10	2100	

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	
<b>TPH-CWG - Aromatic (C5 - C35)</b>	µg/l	10	NONE	< 10	< 10	< 10	< 10	
<b>TPH-CWG - Aromatic (C5 - C44)</b>	µg/l	10	NONE	< 10	< 10	< 10	< 10	

U/S = Unsuitable Sample I/S = Insufficient Sample



**Analytical Report Number : 19-52685**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Biological oxygen demand (total) of water	Determination of biochemical oxygen demand in water (5 days). Accredited matrices: SW, PW, GW.	In-house method based on standard method 5210B.	L086-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Chemical Oxygen Demand in Water (Total)	Determination of total COD in water by reflux oxidation with acidified K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> followed by colorimetry. Accredited matrices: SW, PW, GW.	HACH DR/890 Colorimeter Procedures Manual (48470-22) (Ref 0170.2)	L065-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Nitrite as N in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry). Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
Total oxidised nitrogen in water	Calculation from nitrate and nitrite.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton & Polish Standard Method PN-82/C-04579.08	L078/82-PL	W	NONE
TPH in (Water)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE

Iss No 19-52685-1 Cardiff Parkway 35338

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The results included within the report are representative of the samples submitted for analysis.

Page 4 of 6



**Analytical Report Number : 19-52685**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

# Sample Deviation Report



Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
BH02	1	W	19-52685	1281935	c	Biological oxygen demand (total) of water	L086-PL	c
BH03	1	W	19-52685	1281936	c	Biological oxygen demand (total) of water	L086-PL	c
BH04	1	W	19-52685	1281937	c	Biological oxygen demand (total) of water	L086-PL	c
BH05	1	W	19-52685	1281938	c	Biological oxygen demand (total) of water	L086-PL	c

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## **Analytical Report Number : 19-52892**

<b>Project / Site name:</b>	Cardiff Parkway	<b>Samples received on:</b>	02/08/2019
<b>Your job number:</b>	35338	<b>Samples instructed on:</b>	02/08/2019
<b>Your order number:</b>		<b>Analysis completed by:</b>	12/08/2019
<b>Report Issue Number:</b>	1	<b>Report issued on:</b>	12/08/2019
<b>Samples Analysed:</b>	6 water samples		

**Signed:**

Vineetha Meethale-Vettil  
Reporting Manager  
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.



Analytical Report Number: 19-52892

Project / Site name: Cardiff Parkway

Lab Sample Number	1282924	1282925	1282926	1282927	1282928
Sample Reference	BH01	BH03	BH04	BH05	BH06
Sample Number	1	1	1	1	1
Depth (m)	1.14	1.60	0.91	1.21	1.42
Date Sampled	01/08/2019	01/08/2019	01/08/2019	01/08/2019	01/08/2019
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		

#### General Inorganics

pH	pH Units	N/A	ISO 17025	7.5	7.7	7.6	8.0	7.1
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	97	22	1200	410	44
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	2.77	5.21	1.18	7.26	9.02
Nitrate as N	mg/l	0.01	ISO 17025	0.11	0.13	0.10	0.10	0.10
Nitrite as N	µg/l	1	ISO 17025	25	16	16	14	16
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	28	74	26	730	210
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1	ISO 17025	3.1	8.5	2.5	62	3.5
Total Oxidised Nitrogen (TON)	mg/l	0.3	NONE	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Hardness - Total	mgCaCO3/l	1	ISO 17025	279	214	170	126	228

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
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Analytical Report Number: 19-52892

Project / Site name: Cardiff Parkway

Lab Sample Number	1282924	1282925	1282926	1282927	1282928
Sample Reference	BH01	BH03	BH04	BH05	BH06
Sample Number	1	1	1	1	1
Depth (m)	1.14	1.60	0.91	1.21	1.42
Date Sampled	01/08/2019	01/08/2019	01/08/2019	01/08/2019	01/08/2019
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		

#### Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

#### Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16
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Analytical Report Number: 19-52892

Project / Site name: Cardiff Parkway

Lab Sample Number	1282924	1282925	1282926	1282927	1282928
Sample Reference	BH01	BH03	BH04	BH05	BH06
Sample Number	1	1	1	1	1
Depth (m)	1.14	1.60	0.91	1.21	1.42
Date Sampled	01/08/2019	01/08/2019	01/08/2019	01/08/2019	01/08/2019
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		

#### Heavy Metals / Metalloids

	µg/l	0.15	ISO 17025	0.66	1.22	1.71	1.12	1.14
Arsenic (dissolved)	µg/l	0.02	ISO 17025	0.03	< 0.02	0.02	0.04	0.16
Cadmium (dissolved)	mg/l	0.012	ISO 17025	71	51	38	25	30
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.5	0.6	0.4	1.2	2.1
Copper (dissolved)	µg/l	0.5	ISO 17025	18	10	3.6	6.0	14
Lead (dissolved)	µg/l	0.2	ISO 17025	0.4	< 0.2	< 0.2	1.9	1.3
Magnesium (dissolved)	mg/l	0.005	ISO 17025	25	21	18	16	38
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	0.19	< 0.05	0.07	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	1.4	2.7	1.4	3.1	3.8
Phosphorus (dissolved)	µg/l	20	ISO 17025	< 20.0	< 20.0	25.4	< 20.0	46.8
Selenium (dissolved)	µg/l	0.6	ISO 17025	1.2	1.7	2.8	2.2	2.2
Zinc (dissolved)	µg/l	0.5	ISO 17025	0.6	2.2	2.7	15	1.4





Analytical Report Number: 19-52892

Project / Site name: Cardiff Parkway

Lab Sample Number				1282924	1282925	1282926	1282927	1282928
Sample Reference				BH01	BH03	BH04	BH05	BH06
Sample Number				1	1	1	1	1
Depth (m)				1.14	1.60	0.91	1.21	1.42
Date Sampled				01/08/2019	01/08/2019	01/08/2019	01/08/2019	01/08/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)				Units	Limit of detection	Accreditation Status		

#### Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

#### Petroleum Hydrocarbons



Analytical Report Number: 19-52892

Project / Site name: Cardiff Parkway

Lab Sample Number				1282924	1282925	1282926	1282927	1282928
Sample Reference				BH01	BH03	BH04	BH05	BH06
Sample Number				1	1	1	1	1
Depth (m)				1.14	1.60	0.91	1.21	1.42
Date Sampled				01/08/2019	01/08/2019	01/08/2019	01/08/2019	01/08/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					
TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
<b>TPH-CWG - Aliphatic (C5 - C35)</b>	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
<b>TPH-CWG - Aliphatic (C5 - C44)</b>	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
<b>TPH-CWG - Aromatic (C5 - C35)</b>	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
<b>TPH-CWG - Aromatic (C5 - C44)</b>	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample



Analytical Report Number: 19-52892

Project / Site name: Cardiff Parkway

Lab Sample Number				1282929				
Sample Reference				BH10				
Sample Number				1				
Depth (m)				0.90				
Date Sampled				01/08/2019				
Time Taken				None Supplied				
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					

#### General Inorganics

pH	pH Units	N/A	ISO 17025	8.0				
Total Cyanide	µg/l	10	ISO 17025	< 10				
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	430				
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	6.81				
Nitrate as N	mg/l	0.01	ISO 17025	0.11				
Nitrite as N	µg/l	1	ISO 17025	11				
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	270				
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1	ISO 17025	16				
Total Oxidised Nitrogen (TON)	mg/l	0.3	NONE	< 0.3				
Hardness - Total	mgCaCO3/l	1	ISO 17025	413				

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10				
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Analytical Report Number: 19-52892

Project / Site name: Cardiff Parkway

Lab Sample Number				1282929				
Sample Reference				BH10				
Sample Number				1				
Depth (m)				0.90				
Date Sampled				01/08/2019				
Time Taken				None Supplied				
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					

#### Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01				
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01				
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01				
Fluorene	µg/l	0.01	ISO 17025	< 0.01				
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01				
Anthracene	µg/l	0.01	ISO 17025	< 0.01				
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01				
Pyrene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01				
Chrysene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01				
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01				
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01				

#### Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16				
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Analytical Report Number: 19-52892

Project / Site name: Cardiff Parkway

Lab Sample Number				1282929				
Sample Reference				BH10				
Sample Number				1				
Depth (m)				0.90				
Date Sampled				01/08/2019				
Time Taken				None Supplied				
Analytical Parameter (Water Analysis)				Units	Limit of detection	Accreditation Status		

**Heavy Metals / Metalloids**

Arsenic (dissolved)	µg/l	0.15	ISO 17025	2.89				
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.12				
Calcium (dissolved)	mg/l	0.012	ISO 17025	94				
Chromium (dissolved)	µg/l	0.2	ISO 17025	2.3				
Copper (dissolved)	µg/l	0.5	ISO 17025	16				
Lead (dissolved)	µg/l	0.2	ISO 17025	6.9				
Magnesium (dissolved)	mg/l	0.005	ISO 17025	43				
Mercury (dissolved)	µg/l	0.05	ISO 17025	0.12				
Nickel (dissolved)	µg/l	0.5	ISO 17025	7.9				
Phosphorus (dissolved)	µg/l	20	ISO 17025	1010				
Selenium (dissolved)	µg/l	0.6	ISO 17025	4.0				
Zinc (dissolved)	µg/l	0.5	ISO 17025	26				



Analytical Report Number: 19-52892

Project / Site name: Cardiff Parkway

Lab Sample Number				1282929				
Sample Reference				BH10				
Sample Number				1				
Depth (m)				0.90				
Date Sampled				01/08/2019				
Time Taken				None Supplied				
Analytical Parameter (Water Analysis)				Units	Limit of detection	Accreditation Status		

#### Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0				
Toluene	µg/l	1	ISO 17025	< 1.0				
Ethylbenzene	µg/l	1	ISO 17025	< 1.0				
p & m-xylene	µg/l	1	ISO 17025	< 1.0				
o-xylene	µg/l	1	ISO 17025	< 1.0				
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0				

#### Petroleum Hydrocarbons



Analytical Report Number: 19-52892

Project / Site name: Cardiff Parkway

Lab Sample Number				1282929				
Sample Reference				BH10				
Sample Number				1				
Depth (m)				0.90				
Date Sampled				01/08/2019				
Time Taken				None Supplied				
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					
TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10				
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10				
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10				
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10				
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10				
<b>TPH-CWG - Aliphatic (C5 - C35)</b>	µg/l	10	NONE	< 10				
<b>TPH-CWG - Aliphatic (C5 - C44)</b>	µg/l	10	NONE	< 10				
TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10				
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10				
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10				
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10				
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10				
<b>TPH-CWG - Aromatic (C5 - C35)</b>	µg/l	10	NONE	< 10				
<b>TPH-CWG - Aromatic (C5 - C44)</b>	µg/l	10	NONE	< 10				

U/S = Unsuitable Sample I/S = Insufficient Sample



**Analytical Report Number : 19-52892**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Biological oxygen demand (total) of water	Determination of biochemical oxygen demand in water (5 days). Accredited matrices: SW, PW, GW.	In-house method based on standard method 5210B.	L086-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L0738-PL	W	ISO 17025
Chemical Oxygen Demand in Water (Total)	Determination of total COD in water by reflux oxidation with acidified K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> followed by colorimetry. Accredited matrices: SW, PW, GW.	HACH DR/890 Colorimeter Procedures Manual (48470-22) (Ref 0170.2)	L065-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 *for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Nitrite as N in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry). Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
Total oxidised nitrogen in water	Calculation from nitrate and nitrite.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton & Polish Standard Method PN-82/C-04579.08	L078/82-PL	W	NONE
TPH in (Water)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE

Iss No 19-52892-1 Cardiff Parkway 35338

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The results included within the report are representative of the samples submitted for analysis.

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**Analytical Report Number : 19-52892**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
BH01	1	W	19-52892	1282924	c	Ammoniacal Nitrogen as N in water	L082-PL	c
BH01	1	W	19-52892	1282924	c	Biological oxygen demand (total) of water	L086-PL	c
BH01	1	W	19-52892	1282924	c	pH at 20oC in water (automated)	L099-PL	c
BH03	1	W	19-52892	1282925	c	Ammoniacal Nitrogen as N in water	L082-PL	c
BH03	1	W	19-52892	1282925	c	Biological oxygen demand (total) of water	L086-PL	c
BH03	1	W	19-52892	1282925	c	pH at 20oC in water (automated)	L099-PL	c
BH04	1	W	19-52892	1282926	c	Ammoniacal Nitrogen as N in water	L082-PL	c
BH04	1	W	19-52892	1282926	c	Biological oxygen demand (total) of water	L086-PL	c
BH04	1	W	19-52892	1282926	c	pH at 20oC in water (automated)	L099-PL	c
BH05	1	W	19-52892	1282927	c	Ammoniacal Nitrogen as N in water	L082-PL	c
BH05	1	W	19-52892	1282927	c	Biological oxygen demand (total) of water	L086-PL	c
BH05	1	W	19-52892	1282927	c	pH at 20oC in water (automated)	L099-PL	c
BH06	1	W	19-52892	1282928	c	Ammoniacal Nitrogen as N in water	L082-PL	c
BH06	1	W	19-52892	1282928	c	Biological oxygen demand (total) of water	L086-PL	c
BH06	1	W	19-52892	1282928	c	pH at 20oC in water (automated)	L099-PL	c
BH10	1	W	19-52892	1282929	c	Ammoniacal Nitrogen as N in water	L082-PL	c
BH10	1	W	19-52892	1282929	c	Biological oxygen demand (total) of water	L086-PL	c
BH10	1	W	19-52892	1282929	c	pH at 20oC in water (automated)	L099-PL	c

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## **Analytical Report Number : 19-55080**

<b>Project / Site name:</b>	Cardiff Parkway	<b>Samples received on:</b>	19/08/2019
<b>Your job number:</b>	35338	<b>Samples instructed on:</b>	19/08/2019
<b>Your order number:</b>		<b>Analysis completed by:</b>	26/08/2019
<b>Report Issue Number:</b>	1	<b>Report issued on:</b>	26/08/2019
<b>Samples Analysed:</b>	5 water samples		

**Signed:** *Karolina Marek*

Karolina Marek  
Technical Reviewer (Reporting Team)  
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.



Analytical Report Number: 19-55080

Project / Site name: Cardiff Parkway

Lab Sample Number	1293663	1293664	1293665	1293666	1293667
Sample Reference	SW1	SW2	SW3	SW4	SW5
Sample Number	1	1	1	1	1
Depth (m)	0.00	0.00	0.00	0.00	0.00
Date Sampled	15/08/2019	15/08/2019	15/08/2019	15/08/2019	15/08/2019
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		

#### General Inorganics

pH	pH Units	N/A	ISO 17025	7.5	7.5	7.4	7.5	7.3
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	430	700	430	130	370
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	6.43	6.63	3.76	3.88	5.80
Nitrate as N	mg/l	0.01	ISO 17025	0.31	0.37	0.34	0.39	0.02
Nitrite as N	µg/l	1	ISO 17025	110	130	53	78	15
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	23	26	20	13	35
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1	ISO 17025	8.7	10	8.7	8.4	11
Total Oxidised Nitrogen (TON)	mg/l	0.3	NONE	0.4	0.5	0.4	0.5	< 0.3
Hardness - Total	mgCaCO3/l	1	ISO 17025	148	130	72.7	96.2	119

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
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#### Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

#### Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16
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#### Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	4.96	2.91	0.86	0.53	1.65
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.05	0.07	0.02	< 0.02	< 0.02
Calcium (dissolved)	mg/l	0.012	ISO 17025	43	37	22	28	35
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.6	0.6	0.8	0.9	0.4
Copper (dissolved)	µg/l	0.5	ISO 17025	11	10	6.6	6.0	4.2
Lead (dissolved)	µg/l	0.2	ISO 17025	2.1	2.3	1.2	0.3	< 0.2
Magnesium (dissolved)	mg/l	0.005	ISO 17025	9.9	8.9	4.6	6.4	7.9
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	1.0	1.5	1.0	0.7	1.2
Phosphorus (dissolved)	µg/l	20	ISO 17025	242	135	141	125	123
Selenium (dissolved)	µg/l	0.6	ISO 17025	0.7	< 0.6	< 0.6	< 0.6	< 0.6
Zinc (dissolved)	µg/l	0.5	ISO 17025	56	99	12	8.9	2.9



Analytical Report Number: 19-55080

Project / Site name: Cardiff Parkway

Lab Sample Number				1293663	1293664	1293665	1293666	1293667
Sample Reference				SW1	SW2	SW3	SW4	SW5
Sample Number				1	1	1	1	1
Depth (m)				0.00	0.00	0.00	0.00	0.00
Date Sampled				15/08/2019	15/08/2019	15/08/2019	15/08/2019	15/08/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)				Units	Limit of detection	Accreditation Status		

#### Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

#### Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample



**Analytical Report Number : 19-55080**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Biological oxygen demand (total) of water	Determination of biochemical oxygen demand in water (5 days). Accredited matrices: SW, PW, GW.	In-house method based on standard method 5210B.	L086-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L0738-PL	W	ISO 17025
Chemical Oxygen Demand in Water (Total)	Determination of total COD in water by reflux oxidation with acidified K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> followed by colorimetry. Accredited matrices: SW, PW, GW.	HACH DR/890 Colorimeter Procedures Manual (48470-22) (Ref 0170.2)	L065-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 *for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Nitrite as N in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry). Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
Total oxidised nitrogen in water	Calculation from nitrate and nitrite.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton & Polish Standard Method PN-82/C-04579.08	L078/82-PL	W	NONE
TPH in (Water)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE

Iss No 19-55080-1 Cardiff Parkway 35338

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The results included within the report are representative of the samples submitted for analysis.

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**Analytical Report Number : 19-55080**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
SW1	1	W	19-55080	1293663	c	Ammoniacal Nitrogen as N in water	L082-PL	c
SW1	1	W	19-55080	1293663	c	Biological oxygen demand (total) of water	L086-PL	c
SW1	1	W	19-55080	1293663	c	pH at 20oC in water (automated)	L099-PL	c
SW2	1	W	19-55080	1293664	c	Ammoniacal Nitrogen as N in water	L082-PL	c
SW2	1	W	19-55080	1293664	c	Biological oxygen demand (total) of water	L086-PL	c
SW2	1	W	19-55080	1293664	c	pH at 20oC in water (automated)	L099-PL	c
SW3	1	W	19-55080	1293665	c	Ammoniacal Nitrogen as N in water	L082-PL	c
SW3	1	W	19-55080	1293665	c	Biological oxygen demand (total) of water	L086-PL	c
SW3	1	W	19-55080	1293665	c	pH at 20oC in water (automated)	L099-PL	c
SW4	1	W	19-55080	1293666	c	Ammoniacal Nitrogen as N in water	L082-PL	c
SW4	1	W	19-55080	1293666	c	Biological oxygen demand (total) of water	L086-PL	c
SW4	1	W	19-55080	1293666	c	pH at 20oC in water (automated)	L099-PL	c
SW5	1	W	19-55080	1293667	c	Ammoniacal Nitrogen as N in water	L082-PL	c
SW5	1	W	19-55080	1293667	c	Biological oxygen demand (total) of water	L086-PL	c
SW5	1	W	19-55080	1293667	c	pH at 20oC in water (automated)	L099-PL	c



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## **Analytical Report Number : 19-55087**

<b>Project / Site name:</b>	Cardiff Parkway	<b>Samples received on:</b>	19/06/2019
<b>Your job number:</b>	35338	<b>Samples instructed on:</b>	19/08/2019
<b>Your order number:</b>		<b>Analysis completed by:</b>	26/08/2019
<b>Report Issue Number:</b>	1	<b>Report issued on:</b>	26/08/2019
<b>Samples Analysed:</b>	1 water sample		

**Signed:** *Karolina Marek*

Karolina Marek  
Technical Reviewer (Reporting Team)  
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.



Analytical Report Number: 19-55087

Project / Site name: Cardiff Parkway

Lab Sample Number				1293700				
Sample Reference				BH07				
Sample Number				1				
Depth (m)				1.05				
Date Sampled				15/08/2019				
Time Taken				None Supplied				
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					

#### General Inorganics

pH	pH Units	N/A	ISO 17025	6.9				
Total Cyanide	µg/l	10	ISO 17025	< 10				
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	800				
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	11.7				
Nitrate as N	mg/l	0.01	ISO 17025	0.07				
Nitrite as N	µg/l	1	ISO 17025	4.3				
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	27				
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1	ISO 17025	15				
Total Oxidised Nitrogen (TON)	mg/l	0.3	NONE	< 0.3				
Hardness - Total	mgCaCO3/l	1	ISO 17025	434				

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10				
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#### Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01				
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01				
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01				
Fluorene	µg/l	0.01	ISO 17025	< 0.01				
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01				
Anthracene	µg/l	0.01	ISO 17025	< 0.01				
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01				
Pyrene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01				
Chrysene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01				
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01				
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01				

#### Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16				
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#### Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	4.70				
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02				
Calcium (dissolved)	mg/l	0.012	ISO 17025	110				
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.8				
Copper (dissolved)	µg/l	0.5	ISO 17025	16				
Lead (dissolved)	µg/l	0.2	ISO 17025	0.6				
Magnesium (dissolved)	mg/l	0.005	ISO 17025	41				
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05				
Nickel (dissolved)	µg/l	0.5	ISO 17025	5.6				
Phosphorus (dissolved)	µg/l	20	ISO 17025	155				
Selenium (dissolved)	µg/l	0.6	ISO 17025	2.0				
Zinc (dissolved)	µg/l	0.5	ISO 17025	10				



Analytical Report Number: 19-55087

Project / Site name: Cardiff Parkway

Lab Sample Number				1293700				
Sample Reference				BH07				
Sample Number				1				
Depth (m)				1.05				
Date Sampled				15/08/2019				
Time Taken				None Supplied				
Analytical Parameter (Water Analysis)				Units	Limit of detection	Accreditation Status		

#### Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0				
Toluene	µg/l	1	ISO 17025	< 1.0				
Ethylbenzene	µg/l	1	ISO 17025	< 1.0				
p & m-xylene	µg/l	1	ISO 17025	< 1.0				
o-xylene	µg/l	1	ISO 17025	< 1.0				
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0				

#### Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10				
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10				
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10				
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10				
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10				
<b>TPH-CWG - Aliphatic (C5 - C35)</b>	µg/l	10	NONE	< 10				
<b>TPH-CWG - Aliphatic (C5 - C44)</b>	µg/l	10	NONE	< 10				

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10				
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10				
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10				
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10				
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10				
<b>TPH-CWG - Aromatic (C5 - C35)</b>	µg/l	10	NONE	< 10				
<b>TPH-CWG - Aromatic (C5 - C44)</b>	µg/l	10	NONE	< 10				

U/S = Unsuitable Sample I/S = Insufficient Sample



**Analytical Report Number : 19-55087**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Biological oxygen demand (total) of water	Determination of biochemical oxygen demand in water (5 days). Accredited matrices: SW, PW, GW.	In-house method based on standard method 5210B.	L086-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L0738-PL	W	ISO 17025
Chemical Oxygen Demand in Water (Total)	Determination of total COD in water by reflux oxidation with acidified K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> followed by colorimetry. Accredited matrices: SW, PW, GW.	HACH DR/890 Colorimeter Procedures Manual (48470-22) (Ref 0170.2)	L065-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 *for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Nitrite as N in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry). Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
Total oxidised nitrogen in water	Calculation from nitrate and nitrite.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton & Polish Standard Method PN-82/C-04579.08	L078/82-PL	W	NONE
TPH in (Water)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE

Iss No 19-55087-1 Cardiff Parkway 35338

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The results included within the report are representative of the samples submitted for analysis.

Page 4 of 6



**Analytical Report Number : 19-55087**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
BH07	1	W	19-55087	1293700	c	Ammoniacal Nitrogen as N in water	L082-PL	c
BH07	1	W	19-55087	1293700	c	Biological oxygen demand (total) of water	L086-PL	c
BH07	1	W	19-55087	1293700	c	pH at 20oC in water (automated)	L099-PL	c

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## **Analytical Report Number : 19-56806**

<b>Project / Site name:</b>	Cardiff Parkway	<b>Samples received on:</b>	29/08/2019
<b>Your job number:</b>	35338	<b>Samples instructed on:</b>	29/08/2019
<b>Your order number:</b>		<b>Analysis completed by:</b>	04/09/2019
<b>Report Issue Number:</b>	1	<b>Report issued on:</b>	04/09/2019
<b>Samples Analysed:</b>	10 water samples		

**Signed:** *Karolina Marek*

Karolina Marek  
Technical Reviewer (Reporting Team)  
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.



Analytical Report Number: 19-56806

Project / Site name: Cardiff Parkway

Lab Sample Number	1302759	1302760	1302761	1302762	1302763
Sample Reference	BH01	BH02	BH03	BH04	BH05
Sample Number	1	1	1	1	1
Depth (m)	1.00	0.58	1.37	0.79	1.10
Date Sampled	28/08/2019	17/08/2019	28/08/2019	17/08/2019	17/08/2019
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		

#### General Inorganics

pH	pH Units	N/A	ISO 17025	7.6	7.5	7.8	7.7	7.3
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	340	200	< 15	1400	280
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	2.40	2.91	3.78	4.42	8.36
Nitrate as N	mg/l	0.01	ISO 17025	0.49	0.37	0.10	0.30	0.35
Nitrite as N	µg/l	1	ISO 17025	24	14	24	14	16
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	6.3	11	46	20	25
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	1.4	5.8
Total Oxidised Nitrogen (TON)	mg/l	0.3	NONE	0.5	0.4	< 0.3	0.3	0.4
Hardness - Total	mgCaCO3/l	1	ISO 17025	209	239	201	130	295

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
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#### Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

#### Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16
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#### Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.63	1.32	1.18	1.21	1.04
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02	0.11	< 0.02	< 0.02	< 0.02
Calcium (dissolved)	mg/l	0.012	ISO 17025	49	62	50	31	66
Chromium (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	0.2	0.4	< 0.2
Copper (dissolved)	µg/l	0.5	ISO 17025	2.5	3.1	2.2	1.8	2.1
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	< 0.2	0.2	< 0.2
Magnesium (dissolved)	mg/l	0.005	ISO 17025	21	20	18	13	32
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	< 0.5	2.0	1.6	1.9	3.7
Phosphorus (dissolved)	µg/l	20	ISO 17025	< 20.0	< 20.0	< 20.0	< 20.0	21.3
Selenium (dissolved)	µg/l	0.6	ISO 17025	1.1	0.9	1.3	3.1	1.7
Zinc (dissolved)	µg/l	0.5	ISO 17025	0.7	1.6	2.4	1.4	6.9





Analytical Report Number: 19-56806

Project / Site name: Cardiff Parkway

Lab Sample Number				1302759	1302760	1302761	1302762	1302763
Sample Reference				BH01	BH02	BH03	BH04	BH05
Sample Number				1	1	1	1	1
Depth (m)				1.00	0.58	1.37	0.79	1.10
Date Sampled				28/08/2019	17/08/2019	28/08/2019	17/08/2019	17/08/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)				Units	Limit of detection	Accreditation Status		

#### Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

#### Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample



Analytical Report Number: 19-56806

Project / Site name: Cardiff Parkway

Lab Sample Number	1302764	1302765	1302766	1302767	1302768
Sample Reference	BH06	BH07	BH08	BH09	BH10
Sample Number	1	1	1	1	1
Depth (m)	1.01	1.02	1.12	0.76	0.70
Date Sampled	28/08/2019	17/08/2019	27/08/2019	27/08/2019	27/08/2019
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		

#### General Inorganics

pH	pH Units	N/A	ISO 17025	7.1	7.3	7.2	7.6	7.3
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	210	1000	1900	100	48
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	9.75	11.0	17.9	18.6	37.4
Nitrate as N	mg/l	0.01	ISO 17025	0.76	0.19	0.60	0.16	0.08
Nitrite as N	µg/l	1	ISO 17025	26	5.6	21	46	5.3
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	200	32	50	270	120
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1	ISO 17025	1.1	2.3	9.2	8.7	85
Total Oxidised Nitrogen (TON)	mg/l	0.3	NONE	0.8	< 0.3	0.6	< 0.3	< 0.3
Hardness - Total	mgCaCO3/l	1	ISO 17025	319	182	205	275	175

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	48
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#### Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

#### Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16
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#### Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	1.35	0.86	1.64	0.75	3.16
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.08	< 0.02	< 0.02	< 0.02	< 0.02
Calcium (dissolved)	mg/l	0.012	ISO 17025	47	40	47	56	55
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.2	0.3	1.2	0.3	< 0.2
Copper (dissolved)	µg/l	0.5	ISO 17025	9.2	5.5	4.5	2.5	0.7
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	0.6	< 0.2	< 0.2
Magnesium (dissolved)	mg/l	0.005	ISO 17025	49	20	21	33	9.0
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	0.14	0.11
Nickel (dissolved)	µg/l	0.5	ISO 17025	1.7	2.4	7.1	2.9	1.9
Phosphorus (dissolved)	µg/l	20	ISO 17025	38.2	30.4	27.5	< 20.0	193
Selenium (dissolved)	µg/l	0.6	ISO 17025	2.3	2.5	3.5	12	< 0.6
Zinc (dissolved)	µg/l	0.5	ISO 17025	1.7	1.7	2.6	< 0.5	1.0



Analytical Report Number: 19-56806

Project / Site name: Cardiff Parkway

Lab Sample Number				1302764	1302765	1302766	1302767	1302768
Sample Reference				BH06	BH07	BH08	BH09	BH10
Sample Number				1	1	1	1	1
Depth (m)				1.01	1.02	1.12	0.76	0.70
Date Sampled				28/08/2019	17/08/2019	27/08/2019	27/08/2019	27/08/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)				Units	Limit of detection	Accreditation Status		

#### Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

#### Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample



**Analytical Report Number : 19-56806**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Biological oxygen demand (total) of water	Determination of biochemical oxygen demand in water (5 days). Accredited matrices: SW, PW, GW.	In-house method based on standard method 5210B.	L086-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L0738-PL	W	ISO 17025
Chemical Oxygen Demand in Water (Total)	Determination of total COD in water by reflux oxidation with acidified K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> followed by colorimetry. Accredited matrices: SW, PW, GW.	HACH DR/890 Colorimeter Procedures Manual (48470-22) (Ref 0170.2)	L065-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 *for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Nitrite as N in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry). Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
Total oxidised nitrogen in water	Calculation from nitrate and nitrite.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton & Polish Standard Method PN-82/C-04579.08	L078/82-PL	W	NONE
TPH in (Water)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE

Iss No 19-56806-1 Cardiff Parkway 35338

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The results included within the report are representative of the samples submitted for analysis.

Page 6 of 8



**Analytical Report Number : 19-56806**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
BH02		1 W	19-56806	1302760	c	BTEX and MTBE in water (Monoaromatics)	L073B-PL	c
BH02		1 W	19-56806	1302760	c	Ammoniacal Nitrogen as N in water	L082-PL	c
BH02		1 W	19-56806	1302760	c	Biological oxygen demand (total) of water	L086-PL	c
BH02		1 W	19-56806	1302760	c	Metals in water by ICP-MS (dissolved)	L012-PL	c
BH02		1 W	19-56806	1302760	c	Metals in water by ICP-OES (dissolved)	L039-PL	c
BH02		1 W	19-56806	1302760	c	Nitrate as N in water	L078-PL	c
BH02		1 W	19-56806	1302760	c	Nitrite as N in water	L082-PL	c
BH02		1 W	19-56806	1302760	c	Total Hardness of water	L045-PL	c
BH02		1 W	19-56806	1302760	c	Total cyanide in water	L080-PL	c
BH02		1 W	19-56806	1302760	c	Total oxidised nitrogen in water	L078/82-PL	c
BH02		1 W	19-56806	1302760	c	pH at 20oC in water (automated)	L099-PL	c
BH04		1 W	19-56806	1302762	c	BTEX and MTBE in water (Monoaromatics)	L073B-PL	c
BH04		1 W	19-56806	1302762	c	Ammoniacal Nitrogen as N in water	L082-PL	c
BH04		1 W	19-56806	1302762	c	Biological oxygen demand (total) of water	L086-PL	c
BH04		1 W	19-56806	1302762	c	Metals in water by ICP-MS (dissolved)	L012-PL	c
BH04		1 W	19-56806	1302762	c	Metals in water by ICP-OES (dissolved)	L039-PL	c
BH04		1 W	19-56806	1302762	c	Nitrate as N in water	L078-PL	c
BH04		1 W	19-56806	1302762	c	Nitrite as N in water	L082-PL	c
BH04		1 W	19-56806	1302762	c	Total Hardness of water	L045-PL	c
BH04		1 W	19-56806	1302762	c	Total cyanide in water	L080-PL	c
BH04		1 W	19-56806	1302762	c	Total oxidised nitrogen in water	L078/82-PL	c
BH04		1 W	19-56806	1302762	c	pH at 20oC in water (automated)	L099-PL	c
BH05		1 W	19-56806	1302763	c	BTEX and MTBE in water (Monoaromatics)	L073B-PL	c
BH05		1 W	19-56806	1302763	c	Ammoniacal Nitrogen as N in water	L082-PL	c
BH05		1 W	19-56806	1302763	c	Biological oxygen demand (total) of water	L086-PL	c
BH05		1 W	19-56806	1302763	c	Metals in water by ICP-MS (dissolved)	L012-PL	c
BH05		1 W	19-56806	1302763	c	Metals in water by ICP-OES (dissolved)	L039-PL	c
BH05		1 W	19-56806	1302763	c	Nitrate as N in water	L078-PL	c
BH05		1 W	19-56806	1302763	c	Nitrite as N in water	L082-PL	c
BH05		1 W	19-56806	1302763	c	Total Hardness of water	L045-PL	c
BH05		1 W	19-56806	1302763	c	Total cyanide in water	L080-PL	c
BH05		1 W	19-56806	1302763	c	Total oxidised nitrogen in water	L078/82-PL	c
BH05		1 W	19-56806	1302763	c	pH at 20oC in water (automated)	L099-PL	c
BH07		1 W	19-56806	1302765	c	BTEX and MTBE in water (Monoaromatics)	L073B-PL	c
BH07		1 W	19-56806	1302765	c	Ammoniacal Nitrogen as N in water	L082-PL	c
BH07		1 W	19-56806	1302765	c	Biological oxygen demand (total) of water	L086-PL	c
BH07		1 W	19-56806	1302765	c	Metals in water by ICP-MS (dissolved)	L012-PL	c
BH07		1 W	19-56806	1302765	c	Metals in water by ICP-OES (dissolved)	L039-PL	c
BH07		1 W	19-56806	1302765	c	Nitrate as N in water	L078-PL	c
BH07		1 W	19-56806	1302765	c	Nitrite as N in water	L082-PL	c
BH07		1 W	19-56806	1302765	c	Total Hardness of water	L045-PL	c
BH07		1 W	19-56806	1302765	c	Total cyanide in water	L080-PL	c
BH07		1 W	19-56806	1302765	c	Total oxidised nitrogen in water	L078/82-PL	c
BH07		1 W	19-56806	1302765	c	pH at 20oC in water (automated)	L099-PL	c
BH08		1 W	19-56806	1302766	c	Biological oxygen demand (total) of water	L086-PL	c
BH09		1 W	19-56806	1302767	c	Biological oxygen demand (total) of water	L086-PL	c
BH10		1 W	19-56806	1302768	c	Biological oxygen demand (total) of water	L086-PL	c

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## **Analytical Report Number : 19-56810**

<b>Project / Site name:</b>	Cardiff Parkway	<b>Samples received on:</b>	29/08/2019
<b>Your job number:</b>	35338	<b>Samples instructed on:</b>	29/08/2019
<b>Your order number:</b>		<b>Analysis completed by:</b>	04/09/2019
<b>Report Issue Number:</b>	1	<b>Report issued on:</b>	04/09/2019
<b>Samples Analysed:</b>	5 water samples		

**Signed:**

Katarzyna Lewicka  
Head of Reporting Section  
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :	soils	- 4 weeks from reporting
	leachates	- 2 weeks from reporting
	waters	- 2 weeks from reporting
	asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.



Analytical Report Number: 19-56810

Project / Site name: Cardiff Parkway

Lab Sample Number	1302779	1302780	1302781	1302782	1302783
Sample Reference	SW1	SW2	SW3	SW4	SW5
Sample Number	1	1	1	1	1
Depth (m)	0.00	0.00	0.00	0.00	0.00
Date Sampled	28/08/2019	28/08/2019	28/08/2019	28/08/2019	28/08/2019
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		

#### General Inorganics

pH	pH Units	N/A	ISO 17025	7.8	7.5	7.3	7.3	7.5
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	490	120	290	47	< 15
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	5.23	7.09	7.45	4.95	5.14
Nitrate as N	mg/l	0.01	ISO 17025	0.26	0.10	0.11	0.13	0.10
Nitrite as N	µg/l	1	ISO 17025	53	9.4	5.7	16	9.3
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	17	25	28	21	17
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1	ISO 17025	4.9	7.6	9.8	4.1	7.2
Total Oxidised Nitrogen (TON)	mg/l	0.3	NONE	0.3	< 0.3	< 0.3	< 0.3	< 0.3
Hardness - Total	mgCaCO3/l	1	ISO 17025	241	202	139	140	189

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
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#### Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

#### Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16
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#### Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	2.47	2.62	0.69	0.95	1.09
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02	0.04	0.02	< 0.02	< 0.02
Calcium (dissolved)	mg/l	0.012	ISO 17025	68	59	41	40	56
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.5	0.4	0.3	0.3	0.3
Copper (dissolved)	µg/l	0.5	ISO 17025	4.3	6.2	4.8	3.4	4.2
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	0.5	0.2	< 0.2	0.2
Magnesium (dissolved)	mg/l	0.005	ISO 17025	17	13	8.7	9.7	12
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	0.9	0.8	0.6	< 0.5	< 0.5
Phosphorus (dissolved)	µg/l	20	ISO 17025	135	104	93.7	75.6	58.4
Selenium (dissolved)	µg/l	0.6	ISO 17025	0.7	< 0.6	< 0.6	< 0.6	< 0.6
Zinc (dissolved)	µg/l	0.5	ISO 17025	3.0	8.0	6.4	1.5	5.7





Analytical Report Number: 19-56810

Project / Site name: Cardiff Parkway

Lab Sample Number				1302779	1302780	1302781	1302782	1302783
Sample Reference				SW1	SW2	SW3	SW4	SW5
Sample Number				1	1	1	1	1
Depth (m)				0.00	0.00	0.00	0.00	0.00
Date Sampled				28/08/2019	28/08/2019	28/08/2019	28/08/2019	28/08/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					

#### Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

#### Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample



**Analytical Report Number : 19-56810**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Biological oxygen demand (total) of water	Determination of biochemical oxygen demand in water (5 days). Accredited matrices: SW, PW, GW.	In-house method based on standard method 5210B.	L086-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L0738-PL	W	ISO 17025
Chemical Oxygen Demand in Water (Total)	Determination of total COD in water by reflux oxidation with acidified K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> followed by colorimetry. Accredited matrices: SW, PW, GW.	HACH DR/890 Colorimeter Procedures Manual (48470-22) (Ref 0170.2)	L065-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 *for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Nitrite as N in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry). Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
Total oxidised nitrogen in water	Calculation from nitrate and nitrite.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton & Polish Standard Method PN-82/C-04579.08	L078/82-PL	W	NONE
TPH in (Water)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE

Iss No 19-56810-1 Cardiff Parkway 35338

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The results included within the report are representative of the samples submitted for analysis.

Page 4 of 5



**Analytical Report Number : 19-56810**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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## **Analytical Report Number : 19-59416**

<b>Project / Site name:</b>	Cardiff Parkway	<b>Samples received on:</b>	13/09/2019
<b>Your job number:</b>	35338	<b>Samples instructed on:</b>	13/09/2019
<b>Your order number:</b>		<b>Analysis completed by:</b>	20/09/2019
<b>Report Issue Number:</b>	1	<b>Report issued on:</b>	20/09/2019
<b>Samples Analysed:</b>	5 water samples		

**Signed:** *Karolina Marek*

Karolina Marek  
Technical Reviewer (Reporting Team)  
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.



Analytical Report Number: 19-59416

Project / Site name: Cardiff Parkway

Lab Sample Number				1315154	1315155	1315156	1315157	1315158
Sample Reference				SW1	SW2	SW3	SW4	SW5
Sample Number				1	1	1	1	1
Depth (m)				0.00	0.00	0.00	0.00	0.00
Date Sampled				12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					

#### General Inorganics

pH	pH Units	N/A	ISO 17025	7.7	7.5	7.3	7.3	7.5
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	350	33	62	270	39
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	6.37	5.89	5.69	4.95	5.59
Nitrate as N	mg/l	0.01	ISO 17025	0.77	0.29	0.30	0.30	0.26
Nitrite as N	µg/l	1	ISO 17025	93	6.1	5.1	46	7.4
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	25	24	31	20	23
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1	ISO 17025	2.3	1.4	6.9	1.4	1.4
Total Oxidised Nitrogen (TON)	mg/l	0.3	NONE	0.9	< 0.3	0.3	0.3	< 0.3
Hardness - Total	mgCaCO3/l	1	ISO 17025	163	192	189	192	167

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
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#### Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

#### Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16
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#### Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	2.11	1.75	0.82	0.82	1.60
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.02	< 0.02	0.03	< 0.02	0.06
Calcium (dissolved)	mg/l	0.012	ISO 17025	43	53	51	51	46
Chromium (dissolved)	µg/l	0.2	ISO 17025	1.0	0.5	0.5	0.5	0.8
Copper (dissolved)	µg/l	0.5	ISO 17025	6.3	4.6	3.7	3.2	8.4
Lead (dissolved)	µg/l	0.2	ISO 17025	0.8	< 0.2	6.2	0.6	< 0.2
Magnesium (dissolved)	mg/l	0.005	ISO 17025	14	15	15	16	13
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	0.7	0.8	0.9	0.7	0.9
Phosphorus (dissolved)	µg/l	20	ISO 17025	174	110	119	174	146
Selenium (dissolved)	µg/l	0.6	ISO 17025	< 0.6	< 0.6	0.6	< 0.6	< 0.6
Zinc (dissolved)	µg/l	0.5	ISO 17025	5.9	4.8	6.7	11	1.7



Analytical Report Number: 19-59416

Project / Site name: Cardiff Parkway

Lab Sample Number				1315154	1315155	1315156	1315157	1315158
Sample Reference				SW1	SW2	SW3	SW4	SW5
Sample Number				1	1	1	1	1
Depth (m)				0.00	0.00	0.00	0.00	0.00
Date Sampled				12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)				Units	Limit of detection	Accreditation Status		

#### Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

#### Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample



**Analytical Report Number : 19-59416**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Biological oxygen demand (total) of water	Determination of biochemical oxygen demand in water (5 days). Accredited matrices: SW, PW, GW.	In-house method based on standard method 5210B.	L086-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L0738-PL	W	ISO 17025
Chemical Oxygen Demand in Water (Total)	Determination of total COD in water by reflux oxidation with acidified K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> followed by colorimetry. Accredited matrices: SW, PW, GW.	HACH DR/890 Colorimeter Procedures Manual (48470-22) (Ref 0170.2)	L065-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 *for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Nitrite as N in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry). Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
Total oxidised nitrogen in water	Calculation from nitrate and nitrite.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton & Polish Standard Method PN-82/C-04579.08	L078/82-PL	W	NONE
TPH in (Water)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE

Iss No 19-59416-1 Cardiff Parkway 35338

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The results included within the report are representative of the samples submitted for analysis.

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**Analytical Report Number : 19-59416**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.



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## **Analytical Report Number : 19-59418**

<b>Project / Site name:</b>	Cardiff Parkway	<b>Samples received on:</b>	13/09/2019
<b>Your job number:</b>	35338	<b>Samples instructed on:</b>	13/09/2019
<b>Your order number:</b>		<b>Analysis completed by:</b>	20/09/2019
<b>Report Issue Number:</b>	1	<b>Report issued on:</b>	20/09/2019
<b>Samples Analysed:</b>	6 water samples		

**Signed:** *Karolina Marek*

Karolina Marek  
Technical Reviewer (Reporting Team)  
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.



Analytical Report Number: 19-59418

Project / Site name: Cardiff Parkway

Lab Sample Number	1315162	1315163	1315164	1315165	1315166
Sample Reference	BH02	BH04	BH05	BH07	BH08
Sample Number	1	1	1	1	1
Depth (m)	0.64	0.88	1.20	1.08	1.18
Date Sampled	12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		

#### General Inorganics

pH	pH Units	N/A	ISO 17025	7.4	7.8	7.5	7.4	7.5
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	68	1200	74	1000	2100
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	3.58	2.00	9.87	9.18	26.2
Nitrate as N	mg/l	0.01	ISO 17025	0.65	0.45	0.30	0.36	0.39
Nitrite as N	µg/l	1	ISO 17025	18	11	12	2.3	16
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	100	53	1700	34	140
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1	ISO 17025	< 1.0	< 1.0	1.2	8.4	1.8
Total Oxidised Nitrogen (TON)	mg/l	0.3	NONE	0.7	0.5	0.3	0.4	0.4
Hardness - Total	mgCaCO3/l	1	ISO 17025	302	186	299	205	231

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
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#### Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

#### Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16
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#### Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.82	1.77	1.27	1.05	3.36
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.17	< 0.02	< 0.02	0.04	0.03
Calcium (dissolved)	mg/l	0.012	ISO 17025	76	44	55	38	29
Chromium (dissolved)	µg/l	0.2	ISO 17025	< 0.2	0.8	0.4	0.4	0.5
Copper (dissolved)	µg/l	0.5	ISO 17025	5.8	0.9	1.3	2.5	3.1
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	< 0.2	0.6	0.3
Magnesium (dissolved)	mg/l	0.005	ISO 17025	28	19	40	27	38
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	0.12	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	2.4	1.2	3.7	2.4	2.7
Phosphorus (dissolved)	µg/l	20	ISO 17025	< 20.0	25.5	< 20.0	20.8	39.7
Selenium (dissolved)	µg/l	0.6	ISO 17025	0.9	3.8	8.7	3.9	9.4
Zinc (dissolved)	µg/l	0.5	ISO 17025	4.7	2.1	2.9	3.4	2.3



Analytical Report Number: 19-59418

Project / Site name: Cardiff Parkway

Lab Sample Number				1315162	1315163	1315164	1315165	1315166
Sample Reference				BH02	BH04	BH05	BH07	BH08
Sample Number				1	1	1	1	1
Depth (m)				0.64	0.88	1.20	1.08	1.18
Date Sampled				12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)				Units	Limit of detection	Accreditation Status		

#### Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

#### Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample



Analytical Report Number: 19-59418

Project / Site name: Cardiff Parkway

Lab Sample Number				1315167				
Sample Reference				BH09				
Sample Number				1				
Depth (m)				0.89				
Date Sampled				12/09/2019				
Time Taken				None Supplied				
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					

#### General Inorganics

pH	pH Units	N/A	ISO 17025	7.6				
Total Cyanide	µg/l	10	ISO 17025	< 10				
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	170				
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	15.1				
Nitrate as N	mg/l	0.01	ISO 17025	0.34				
Nitrite as N	µg/l	1	ISO 17025	11				
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	1500				
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1	ISO 17025	1.6				
Total Oxidised Nitrogen (TON)	mg/l	0.3	NONE	0.3				
Hardness - Total	mgCaCO3/l	1	ISO 17025	326				

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10				
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#### Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01				
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01				
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01				
Fluorene	µg/l	0.01	ISO 17025	< 0.01				
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01				
Anthracene	µg/l	0.01	ISO 17025	< 0.01				
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01				
Pyrene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01				
Chrysene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01				
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01				
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01				

#### Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16				
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#### Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	1.16				
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02				
Calcium (dissolved)	mg/l	0.012	ISO 17025	61				
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.3				
Copper (dissolved)	µg/l	0.5	ISO 17025	3.8				
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2				
Magnesium (dissolved)	mg/l	0.005	ISO 17025	42				
Mercury (dissolved)	µg/l	0.05	ISO 17025	0.15				
Nickel (dissolved)	µg/l	0.5	ISO 17025	4.1				
Phosphorus (dissolved)	µg/l	20	ISO 17025	< 20.0				
Selenium (dissolved)	µg/l	0.6	ISO 17025	20				
Zinc (dissolved)	µg/l	0.5	ISO 17025	9.5				



Analytical Report Number: 19-59418

Project / Site name: Cardiff Parkway

Lab Sample Number				1315167				
Sample Reference				BH09				
Sample Number				1				
Depth (m)				0.89				
Date Sampled				12/09/2019				
Time Taken				None Supplied				
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					

#### Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0				
Toluene	µg/l	1	ISO 17025	< 1.0				
Ethylbenzene	µg/l	1	ISO 17025	< 1.0				
p & m-xylene	µg/l	1	ISO 17025	< 1.0				
o-xylene	µg/l	1	ISO 17025	< 1.0				
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0				

#### Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10				
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10				
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10				
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10				
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10				
<b>TPH-CWG - Aliphatic (C5 - C35)</b>	µg/l	10	NONE	< 10				
<b>TPH-CWG - Aliphatic (C5 - C44)</b>	µg/l	10	NONE	< 10				

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0				
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10				
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10				
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10				
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10				
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10				
<b>TPH-CWG - Aromatic (C5 - C35)</b>	µg/l	10	NONE	< 10				
<b>TPH-CWG - Aromatic (C5 - C44)</b>	µg/l	10	NONE	< 10				

U/S = Unsuitable Sample I/S = Insufficient Sample



**Analytical Report Number : 19-59418**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Biological oxygen demand (total) of water	Determination of biochemical oxygen demand in water (5 days). Accredited matrices: SW, PW, GW.	In-house method based on standard method 5210B.	L086-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L0738-PL	W	ISO 17025
Chemical Oxygen Demand in Water (Total)	Determination of total COD in water by reflux oxidation with acidified K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> followed by colorimetry. Accredited matrices: SW, PW, GW.	HACH DR/890 Colorimeter Procedures Manual (48470-22) (Ref 0170.2)	L065-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 *for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Nitrite as N in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry). Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
Total oxidised nitrogen in water	Calculation from nitrate and nitrite.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton & Polish Standard Method PN-82/C-04579.08	L078/82-PL	W	NONE
TPH in (Water)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE

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The results included within the report are representative of the samples submitted for analysis.

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**Analytical Report Number : 19-59418**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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## **Analytical Report Number : 19-59606**

<b>Project / Site name:</b>	Cardiff Parkway	<b>Samples received on:</b>	16/09/2019
<b>Your job number:</b>	35338	<b>Samples instructed on:</b>	16/09/2019
<b>Your order number:</b>		<b>Analysis completed by:</b>	23/09/2019
<b>Report Issue Number:</b>	1	<b>Report issued on:</b>	23/09/2019
<b>Samples Analysed:</b>	4 water samples		

**Signed:** 

Zina Abdul Razzak  
Senior Quality Specialist  
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.





Analytical Report Number: 19-59606

Project / Site name: Cardiff Parkway

Lab Sample Number	1315976	1315977	1315978	1315979	
Sample Reference	BH01	BH03	BH06	BH10	
Sample Number	1	1	1	1	
Depth (m)	0.97	1.50	1.06	1.10	
Date Sampled	12/09/2019	12/09/2019	12/09/2019	12/09/2019	
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		

#### General Inorganics

pH	pH Units	N/A	ISO 17025	7.6	7.8	7.1	8.0	
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	93	< 15	62	85	
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	2.13	3.28	10.5	10.9	
Nitrate as N	mg/l	0.01	ISO 17025	0.35	0.07	0.64	0.11	
Nitrite as N	µg/l	1	ISO 17025	14	14	23	32	
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	16	610	110	180	
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1	ISO 17025	< 1.0	1.2	< 1.0	1.9	
Total Oxidised Nitrogen (TON)	mg/l	0.3	NONE	0.4	< 0.3	0.7	< 0.3	
Hardness - Total	mgCaCO3/l	1	ISO 17025	250	244	379	315	

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	
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#### Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	

#### Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16	
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#### Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.36	0.82	0.90	1.47	
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02	0.03	0.06	0.04	
Calcium (dissolved)	mg/l	0.012	ISO 17025	60	58	50	44	
Chromium (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	< 0.2	0.6	
Copper (dissolved)	µg/l	0.5	ISO 17025	8.2	1.7	7.1	13	
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	< 0.2	< 0.2	
Magnesium (dissolved)	mg/l	0.005	ISO 17025	24	24	62	50	
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05	
Nickel (dissolved)	µg/l	0.5	ISO 17025	< 0.5	1.3	1.4	1.9	
Phosphorus (dissolved)	µg/l	20	ISO 17025	< 20.0	< 20.0	22.4	55.6	
Selenium (dissolved)	µg/l	0.6	ISO 17025	1.3	1.1	1.2	1.6	
Zinc (dissolved)	µg/l	0.5	ISO 17025	2.9	0.6	0.8	0.6	



Analytical Report Number: 19-59606

Project / Site name: Cardiff Parkway

Lab Sample Number	1315976	1315977	1315978	1315979	
Sample Reference	BH01	BH03	BH06	BH10	
Sample Number	1	1	1	1	
Depth (m)	0.97	1.50	1.06	1.10	
Date Sampled	12/09/2019	12/09/2019	12/09/2019	12/09/2019	
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		

#### Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	5.4	
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	

#### Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	
TPH-CWG - Aliphatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	5.4	
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	
TPH-CWG - Aromatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10	

U/S = Unsuitable Sample I/S = Insufficient Sample



**Analytical Report Number : 19-59606**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Biological oxygen demand (total) of water	Determination of biochemical oxygen demand in water (5 days). Accredited matrices: SW, PW, GW.	In-house method based on standard method 5210B.	L086-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L0738-PL	W	ISO 17025
Chemical Oxygen Demand in Water (Total)	Determination of total COD in water by reflux oxidation with acidified K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> followed by colorimetry. Accredited matrices: SW, PW, GW.	HACH DR/890 Colorimeter Procedures Manual (48470-22) (Ref 0170.2)	L065-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 *for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Nitrite as N in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry). Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
Total oxidised nitrogen in water	Calculation from nitrate and nitrite.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton & Polish Standard Method PN-82/C-04579.08	L078/82-PL	W	NONE
TPH in (Water)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE

Iss No 19-59606-1 Cardiff Parkway 35338

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The results included within the report are representative of the samples submitted for analysis.

Page 4 of 6



**Analytical Report Number : 19-59606**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
BH01	1	W	19-59606	1315976	c	Ammoniacal Nitrogen as N in water	L082-PL	c
BH01	1	W	19-59606	1315976	c	Biological oxygen demand (total) of water	L086-PL	c
BH01	1	W	19-59606	1315976	c	pH at 20oC in water (automated)	L099-PL	c
BH03	1	W	19-59606	1315977	c	Ammoniacal Nitrogen as N in water	L082-PL	c
BH03	1	W	19-59606	1315977	c	Biological oxygen demand (total) of water	L086-PL	c
BH03	1	W	19-59606	1315977	c	pH at 20oC in water (automated)	L099-PL	c
BH06	1	W	19-59606	1315978	c	Ammoniacal Nitrogen as N in water	L082-PL	c
BH06	1	W	19-59606	1315978	c	Biological oxygen demand (total) of water	L086-PL	c
BH06	1	W	19-59606	1315978	c	pH at 20oC in water (automated)	L099-PL	c
BH10	1	W	19-59606	1315979	c	Ammoniacal Nitrogen as N in water	L082-PL	c
BH10	1	W	19-59606	1315979	c	Biological oxygen demand (total) of water	L086-PL	c
BH10	1	W	19-59606	1315979	c	pH at 20oC in water (automated)	L099-PL	c

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## **Analytical Report Number : 19-62279**

<b>Project / Site name:</b>	Cardiff Parkway	<b>Samples received on:</b>	24/09/2019
<b>Your job number:</b>	35338	<b>Samples instructed on:</b>	24/09/2019
<b>Your order number:</b>		<b>Analysis completed by:</b>	02/10/2019
<b>Report Issue Number:</b>	1	<b>Report issued on:</b>	02/10/2019
<b>Samples Analysed:</b>	5 water samples		

**Signed:** 

Zina Abdul Razzak  
Senior Quality Specialist  
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.



Analytical Report Number: 19-62279

Project / Site name: Cardiff Parkway

Lab Sample Number				12687	12688	12689	12690	12691
Sample Reference				SW1	SW2	SW3	SW4	SW5
Sample Number				1	1	1	1	1
Depth (m)				0.00	0.00	0.00	0.00	0.00
Date Sampled				24/09/2019	24/09/2019	24/09/2019	24/09/2019	24/09/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					
WATERS								

#### General Inorganics

pH	pH Units	N/A	ISO 17025	8.0	7.5	7.3	7.5	7.4
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	150	93	92	120	46
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	6.84	5.32	9.10	4.29	4.54
Nitrate as N	mg/l	0.01	ISO 17025	1.76	0.35	0.20	0.28	0.22
Nitrite as N	µg/l	1	ISO 17025	60	65	21	13	3.4
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	25	36	24	20	37
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1	ISO 17025	3.7	2.1	8.2	2.3	2.2
Total Oxidised Nitrogen (TON)	mg/l	0.3	NONE	1.8	0.4	< 0.3	< 0.3	< 0.3
Hardness - Total	mgCaCO3/l	1	ISO 17025	168	198	208	266	247

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
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Analytical Report Number: 19-62279

Project / Site name: Cardiff Parkway

Lab Sample Number				12687	12688	12689	12690	12691
Sample Reference				SW1	SW2	SW3	SW4	SW5
Sample Number				1	1	1	1	1
Depth (m)				0.00	0.00	0.00	0.00	0.00
Date Sampled				24/09/2019	24/09/2019	24/09/2019	24/09/2019	24/09/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)				Units	Limit of detection	Accreditation Status		
<b>Speciated PAHs</b>								
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
<b>Total PAH</b>								
Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16





Analytical Report Number: 19-62279

Project / Site name: Cardiff Parkway

Lab Sample Number				12687	12688	12689	12690	12691
Sample Reference				SW1	SW2	SW3	SW4	SW5
Sample Number				1	1	1	1	1
Depth (m)				0.00	0.00	0.00	0.00	0.00
Date Sampled				24/09/2019	24/09/2019	24/09/2019	24/09/2019	24/09/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)				Units	Limit of detection	Accreditation Status		
<b>Heavy Metals / Metalloids</b>								
Arsenic (dissolved)	µg/l	0.15	ISO 17025	1.06	1.57	0.58	0.73	0.89
Boron (dissolved)	µg/l	10	ISO 17025	15	< 10	< 10	11	< 10
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.03	0.02	< 0.02	< 0.02	< 0.02
Calcium (dissolved)	mg/l	0.012	ISO 17025	51	58	61	79	70
Chromium (dissolved)	µg/l	0.2	ISO 17025	2.3	0.9	0.4	0.8	0.6
Copper (dissolved)	µg/l	0.5	ISO 17025	12	8.5	7.4	3.0	7.1
Lead (dissolved)	µg/l	0.2	ISO 17025	1.9	0.8	0.6	0.3	0.4
Magnesium (dissolved)	mg/l	0.005	ISO 17025	9.8	13	14	17	17
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	1.2	0.8	0.8	0.8	0.8
Phosphorus (dissolved)	µg/l	20	ISO 17025	259	174	295	278	315
Selenium (dissolved)	µg/l	0.6	ISO 17025	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
Zinc (dissolved)	µg/l	0.5	ISO 17025	20	18	19	5.7	2.8



Analytical Report Number: 19-62279

Project / Site name: Cardiff Parkway

Lab Sample Number				12687	12688	12689	12690	12691
Sample Reference				SW1	SW2	SW3	SW4	SW5
Sample Number				1	1	1	1	1
Depth (m)				0.00	0.00	0.00	0.00	0.00
Date Sampled				24/09/2019	24/09/2019	24/09/2019	24/09/2019	24/09/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)				Units	Limit of detection	Accreditation Status		
<b>Monoaromatics &amp; Oxygenates</b>								
Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

#### Petroleum Hydrocarbons



Analytical Report Number: 19-62279

Project / Site name: Cardiff Parkway

Lab Sample Number				12687	12688	12689	12690	12691
Sample Reference				SW1	SW2	SW3	SW4	SW5
Sample Number				1	1	1	1	1
Depth (m)				0.00	0.00	0.00	0.00	0.00
Date Sampled				24/09/2019	24/09/2019	24/09/2019	24/09/2019	24/09/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					
TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
<b>TPH-CWG - Aliphatic (C5 - C35)</b>	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
<b>TPH-CWG - Aliphatic (C5 - C44)</b>	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
<b>TPH-CWG - Aromatic (C5 - C35)</b>	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
<b>TPH-CWG - Aromatic (C5 - C44)</b>	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample



**Analytical Report Number : 19-62279**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Biological oxygen demand (total) of water	Determination of biochemical oxygen demand in water (5 days). Accredited matrices: SW, PW, GW.	In-house method based on standard method 5210B. Samples received > 24 hrs after sampling, data may not be valid and should be interpreted with care.	L086-PL	W	ISO 17025
Boron in water	Determination of boron in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW	In-house method based on MEWAM	L039-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Chemical Oxygen Demand in Water (Total)	Determination of total COD in water by reflux oxidation with acidified K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> followed by colorimetry. Accredited matrices: SW, PW, GW.	HACH DR/890 Colorimeter Procedures Manual (48470-22) (Ref 0170.2)	L065-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Nitrite as N in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry). Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
Total oxidised nitrogen in water	Calculation from nitrate and nitrite.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton & Polish Standard Method PN-82/C-04579.08	L078-PL	W	NONE
TPH in (Water)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L070-PL	W	NONE

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The results included within the report are representative of the samples submitted for analysis.

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**Analytical Report Number : 19-62279**

**Project / Site name: Cardiff Parkway**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE

**For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.**

**For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.**

**Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.**