

Norfolk Boreas Offshore Wind Farm TerraConsult Ground Investigations Report Part 2 of 6

Applicant: Norfolk Boreas Limited
Document Reference: Exa.AS-3.D2.V1
Deadline 2

Date: December 2019 Revision: Version 1 Author: TerraConsult

Crossing 2

Photo: Ormonde Offshore Wind Farm





Norfolk Vanguard Offshore Wind Farm

The Applicant Responses to First Written Questions

Appendix 16.3 – TerraConsult 2017 Ground Investigations Report:

Crossing 2 (Q16.8)

Applicant: Norfolk Vanguard Limited
Document Reference: ExA;WQApp16.3;10.D1.3
Deadline 1

Date: January 2019

Photo: Kentish Flats Offshore Wind Farm











DRAINAGE STONE

ipping Area

tor Unsuitable

November 2017 Report No 3318-R002-2

East Anglia (North) Offshore Wind Farm Crossing 2 Site Investigation

Carried out for:

Gutteridge, Haskins and Davey Ltd (GHD)

TerraConsult

East Anglia (North) Offshore Wind Farm

Crossing 2 Site Investigation

Date: November 2017

Report No 3318-R002-2

Prepared for:



Gutteridge, Haskins & Davey Ltd The Studio, 51 Brookfield Road, Cheadle, SK8 1ES **Engineer:**



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DOCUMENT INFORMATION AND CONTROL SHEET

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	Crossing 2 Site Investigation

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Date:	01/11/17		

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DISCLAIMER

This site investigation contract was completed by TerraConsult Ltd on the basis of a specification and scope of works and terms and conditions agreed with the client. This report was compiled with all reasonable skill and care, bearing in mind the project objectives, the agreed scope of works, the prevailing site conditions, the budget, the degree of manpower and resources allocated to the project as agreed.

TerraConsult Ltd cannot accept responsibility to any parties whatsoever, following the issue of this report, for any matters arising which may be considered outwith the agreed scope of works.

This report is issued solely to the client and TerraConsult cannot accept any responsibility to any third parties to whom this report may be circulated, in part or in full, and any such parties rely on the contents at their own risk.





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East Anglia (North) Offshore Wind Farm

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East Anglia (North) Offshore Wind Farm

Crossing 2 Site Investigation

1 INTRODUCTION

TerraConsult Limited (TCL) was commissioned by Gutteridge, Haskins and Davey Ltd (GHD) to carry out a ground investigation for the proposed cable route crossing of the railway line near Hoe, Norfolk.

This report presents the factual records of the fieldwork and laboratory testing. The data is also presented separately in digital format following AGS4 (2011).

The scope of the investigation, which was specified by GHD, comprised:

- o Boreholes formed by cable percussive techniques;
- o In situ testing comprising of;
 - Standard penetration tests in boreholes;
 - Variable head permeability testing;
- o Post fieldwork monitoring and sampling;
- o Geotechnical laboratory testing;
- o Geoenvironmental laboratory testing;
- o Factual report (GIR) and AGS data.

The investigation was carried out in accordance with the contract specification and relevant standards (see References). The fieldwork was carried out between 18/07/17 and 26/07/17.

Whilst every attempt is made to record full details of the strata encountered in the exploratory holes, techniques of exploratory hole formation and sampling will inevitably lead to disturbance, mixing or loss of material in some soils and rocks.

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

2 SITE DESCRIPTION

2.1 Location and Topography

The site is located approximately 2 km north east of the centre of Dereham, Norfolk. The approximate location of Crossing 2 is located between Ordnance Survey National Grid Reference TG 992 153 and TG 996 154. A site location plan is presented as drawing reference 3318(C2)D001-1.

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2.2 **Published Geology**

The online British Geological Survey (BGS) 1:50,000 scale map shows the site to be underlain by the Weybourne Town Till Member glacial diamicton. Beneath these lies the White Chalk Subgroup.

3 **FIELDWORK**

3.1 General

Fieldwork was undertaken between 18/07/17 and 26/07/17. The scope of the works, as provided by GHD comprised:

Table 1: Scope of Intrusive Works and In Situ Testing										
Exploratory Hole/In Situ Test Type Proposed number										
Cable percussion, SPTs, variable head permeability test, install	BH17-C2-01									
Cable percussion, SPTs, variable head permeability test	BH17-C2-02									
Cable percussion, SPTs, variable head permeability test, install	BH17-C2-03									
Cable percussion, SPTs, variable head permeability test	BH17-C2-04									

The exploratory hole locations were selected by GHD. The locations were set out by the GHD site representative prior to commencement.

3.2 **Exploratory Holes**

The exploratory holes were logged by an engineer in accordance with the recommendations of BS5930:2015, which incorporates the requirements of BS EN ISO 14688-1, 14688-2 and 14689-1. Methods of formation and geological descriptions, together with sample records, in situ test results and observations made during formation of the exploratory hole are given in the logs presented in Appendix A and should be read in conjunction with the Key included therein. Sample photographs are presented in Appendix B.

A summary of the exploratory holes formed is listed in the following table.

Table 2: Summ	ary of Explo	ratory Posi	tions				
Exploratory position:	Type:	Final depth (m):	Easting (mE):	Northing (mN):	Level (mAOD):	Start date:	End date:
BH17-C2-01	CP	20	599332.97	315346.00	58.92	18/07/2017	19/07/2017
BH17-C2-02	CP	20	599394.14	315347.46	58.41	20/07/2017	21/07/2017
BH17-C2-03	CP	20	599547.92	315352.43	58.79	24/07/2017	25/07/2017
BH17-C2-04	CP	20	599596.68	315324.32	59.60	25/07/2017	26/07/2017

Type: CP – cable percussion;

Prior to commencement, all exploratory positions were checked for services by reference to available plans, visual inspection and CAT survey. Inspection pits were excavated by hand and rechecked with a CAT at all borehole locations.

An exploratory hole location plan is presented as drawing 3318(C2)D002-2.

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3.3 **Sampling**

Samples for geotechnical and geoenvironmental testing and strata description were taken during the formation of the exploratory holes in general accordance with the specification, BS5930:2015, BS10175:2011 and BS EN ISO 22475-1:2006. Soil and water samples for geochemical analysis were taken in accordance with the specification and stored in cool boxes for despatch directly to Concept Life Sciences (Formerly Scientific Analysis Laboratories, SAL) in Braintree, Essex.

A summary of water samples taken from monitoring installations is presented in Appendix D.

3.4 In Situ Testing

In situ testing was carried in accordance with BS 5930:2015, BS 1377-9 (1990), BS EN ISO 22282-1:2012 and BS EN ISO 22282-2:2012 unless otherwise stated. SPT results are presented on individual exploratory hole logs. Information relating to the identification and calibration of SPT hammers can also be found on the individual borehole logs. Hammer calibration certificates are presented in Appendix G.

Falling head tests were carried out in suitable strata in the boreholes upon instruction from GHD. Results are presented in Appendix C.

3.5 **Instrumentation and Monitoring**

Details of instrumentation installed is presented on the exploratory hole logs. A summary of the installed instrumentation is listed in the following table.

Table 3: Sumr	nary of Instr	umentation					
Exploratory position:	Instrument type:	Instrument reference:	Internal diameter (mm):	Installed depth (m bgl):	Depth (m AOD):	Top of response zone (m bgl):	Base of response zone (m bgl):
BH17-C2-01	Standpipe	BH17-C7-01	50	19	39.92	15.0	19
BH17-C2-03	Standpipe	BH17-C7-03	50	20	38.79	15.0	20

Records of monitoring and gas/groundwater sampling carried out by TerraConsult during and after the fieldwork period to the date of issue of this report are presented in Appendix D. Calibration certificates are presented in Appendix G.

3.6 **Surveying**

On completion of the fieldworks, all exploratory positions were surveyed by use of GPS. Coordinates and reduced levels to Ordnance Survey are provided on the exploratory hole logs.

4 LABORATORY TESTING

4.1 **Geotechnical Testing**

The testing was scheduled by GHD and was carried out by GEO Site Testing Services Ltd (GSTL), Llanelli, Camarthenshire, in accordance with BS 1377 (1990) and BRE SD1 unless otherwise stated. The testing is summarised below and the results are presented in Appendix E.

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Table 4: Summary of Geotech	Table 4: Summary of Geotechnical Laboratory Testing											
Lab test:	Number undertaken:	Method:	Remarks:									
Atterburg Limit 4 Point Method	2	BS1377: Part 2: 4.3 & 5.3										
Particle size Distribution	2	BS1377: Part 2: 9.2										
BRE SD1 Suite	1	BRE SD1										
One dimensional consolidation	1	BS1377: Part 5: 3										
Triaxial 100mm single stage	2	BS1377: Part 7: 8										

Geoenvironmental Testing 4.2

The testing was scheduled by GHD and carried out by Concept Life Sciences. The results are presented in Appendix F.

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5 REFERENCES

AGS: 2010: Electronic transfer of geotechnical and geoenvironmental data (Edition 4 including addendum 3, 2011). Association of Geotechnical and Geoenvironmental Specialists.

BRE Special Digest 1: 2005 Concrete in aggressive ground.

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

BS 5930: 2015: Code of practice for site investigation. British Standards Institution.

BS 10175: 2011: Investigation of potentially contaminated sites - Code of Practice. British Standards Institution

BS EN 1997-1: 2004 : Eurocode 7 – Geotechnical Design – Part 1: General rules. Including UK National Appendix of November 2007.

British Standards Institution.

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

BS EN ISO 14688-2 : 2004 : Geotechnical investigation and testing – Identification and classification of soil – Part 2: Principles for a classification. British Standards Institution.

BS EN ISO 14689-1 : 2003 : Geotechnical investigation and testing – Identification and classification of rock – Part 1: Identification and description. British Standards Institution.

BS EN ISO 22282-1: 2012 Geotechnical investigation and testing. Geohydraulic testing Part1: General Rules

BS EN ISO 22282-2 : 2012 Geotechnical investigation and testing. Geohydraulic testing Part 2: Water Permeability Tests in a borehole using open systems

BS EN ISO 22475-1 : 2006 : Geotechnical investigation and testing – Sampling methods and groundwater measurements – Part 1: Technical principals for execution (July 2011 reprint). British Standards Institution.

BS EN ISO 22476-3: 2005: Geotechnical investigation and testing - Field Testing - Part 3: Standard penetration test

6 LICENCES

British Geological Survey Reproduction Licence Number: IPR/187-68CF CO8/053-CSL

Ordnance Survey Reproduction Licence Number. 100035365

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DRAWINGS

3318(C2)D001-1 Site Location Plan 3318(C2)D002-2 Exploratory Hole Location Plan

3318-R001-1 November 2017

Site Location Plan

TerraConsult



Address: East Anglia

AGS FINAL Issue: Scale: 1:25000

East Anglia (North) Offshore Wind Farm Project:

Project No: 3318 GHD Ltd Client:

Drawing No:

3318(C2)D001-1

Exploratory Hole Location Plan

TerraConsult



CP Locations By Type - CP



AGS Issue: Scale:

FINAL 1:3000 Project: East Anglia (North) Offshore Wind Farm

Project No: 3318
Client: GHD Ltd

Drawing No:

3318(C2)D002-1

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APPENDIX A Exploratory Hole Records

Key sheet

Boreholes

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Exploratory Hole Key Sheet

TerraConsult

SAMPLES:

Undisturbed:

U Driven tube sample
UT Thin wall driven tube sample
TW Pushed thin wall tube sample
P Pushed piston sample

Liner sample (from windowless or similar sampler), full recovery unless otherwise stated

CBR CBR mould sample BLK Block sample

C Core sample (from rotary core) taken for laboratory testing

Disturbed:

D Small sample
B Bulk sample
AMAL Amalgamated sample

Environmental:

ES Environmental soil sample
EW Environmental water sample

Comments: Sample reference numbers are assigned to every sample taken. A sample reference of 'NR' indicates that an attempt was made

to take a tube sample; however, there was no recovery. Sample recovery is given as a percentage.

TESTS:

SPT S or SPT C Standard Penetration Test, open shoe (S) or solid cone (C)

The Standard Penetration Test is defined in BS EN ISO 22476-3 (2005). The incremental blow counts are given in the Field Records column; each increment is 75mm unless stated otherwise and any penetration under self weight in mm (SW) is noted. Where the full 300mm test drive is achieved the total number of blows for the test drive is presented as N = ** in the Test column. Where the test drive blows reach 50 (either in total or for a single

increment) the total blow count beyond the seating drive is given (without the N = prefix).

ICBR In situ CBR

IV In situ vane shear strength, peak (p) and remoulded (r), kPa HV Hand vane shear strength, peak (p) and remoulded (r), kPa PP Pocket penetrometer test, converted to shear strength, kPa

KFH, KRH, KPI Variable head permeability tests (KFH = falling head test, KRH = rising head test, KPI = packer test), permeability value

PID/FID Photo-ionisation detector/Flame-ionisation detector

Test results provided in Field Records column

DRILLING RECORDS:

The mechanical indices (TCR/SCR/RQD & If) are defined in BS 5930: 2015 and BS EN ISO 22575-1 (2006)

TCR Total Core Recovery, % SCR Solid Core Recovery, % RQD Rock Quality Designation, %

f Fracture spacing, mm. Minimum, typical and maximum spacings are presented.

NI Non intact is used where the core is fragmented.

CRF Core recovered (length in m) in the following run

AZCL Assessed zone of core loss

NR Not recovered

GROUNDWATER:	DEPTH REMARKS:

Groundwater strike SoS EoBH

Groundwater level after standing period

INSTRUMENTATION: EXPLORATORY HOLE TYPE:

Details of installations are given on the Record. Legend column shows installed instrument depths including slotted pipe section or tip depth, response zone filter material type and layers of backfill. The type of instrument installed is

indicated by a code adjacent to the Legend column at the base of the instrument.

SP Standpipe

SPIE Standpipe piezometer
PPIE Pneumatic piezometer
EPIE Electronic piezometer
HPIE Hydraulic piezometer
GMP Gas monitoring standpipe

GMP Gas monitoring standpipe (xx) Internal diameter

ICE Biaxial inclinometer

ICM Inclinometer tubing for use with probe

SLIP Slip indicator

ESET Electronic settlement cell/gauge
ETM Magnetic extensometer settlement point

ETR Rod extensometer

	i i i i i i i i i i i i i i i i i i i	
Electronic settlement cell/gauge		
Libertonio comonicini com gadgo		

EoS

DCP HA

OP

PC

RC

RO

SH

TP

SNC

TRAV

WLS

WS

End of Shift

Start of Shift

End of Borehole

Cable percussion

Dynamic cone penetrometer

Windowless (dynamic) sample

Window (dynamic) sample

Observation pit/trench

Dynamic probe

Hand auger

Rotary core

Shaft

Traverse

Inspection pit

Pavement core

Rotary open hole

Sonic (resonance)

Trial pit/trench

Project: East Anglia (North) Offshore Wind Farm Reference

Project No: 3318
Client: GHD Ltd

KEY SHEET

TerraConsult

Bore	hole	e forr	nation	details	s:											Location details:
Type: IP CP	0	rom: 0.00 0.00	To: 1.20 20.00	Start d 18-07 18-07	-17 18-07-17	Crew: TM TM	Plant: Hand tools Dando 2000	Barrel type: n/a n/a	Drill Bit: n/a n/a	Logged: 18-07-17 19-07-17	Logg V: V:	s	Remarks SPT han	: nmer ID: SI 4 E(i	r)% 74	mE: 599332.93 mN: 315346.00 mAOD: 58.92 Grid: OSGB
Instal'n	Water- strike	Legend	Level	Depth (thick-			Stratum	Description						Samples	& In Situ Te	esting
š⊆ :	s ω	<u> </u>		ness)	Soft dark ora	ngish br	own slightly gr	avelly slightly	sandy CLA	Y. Gravel of	- 1	Water	Casing	Depth	Type & No	Results/Remarks
			E0 E0	(0.40) 0.40			inded fine to co									
			58.52		Firm to stiff da		ngish brown slig							0.50 0.50	D1 ES1	
				(0.60)	Occasionally (TILL)			Ja. 55 a. 14						0.50 - 1.00	B1	
			57.92	1.00 - (0.50)	<u> </u>	ght oran	gish brown mo	ottled dark orar		m: Becomes fin n slightly	m]/			1.00 1.00	D2 ES2	
			57.42	1.50 -	coarse white	chalk ar	y CLAY. Grave nd occasional f					Dry		1.50	С	N=27 (3,4/6,6,7,8)
					and light grey (TILL)						_/	•		1.50 1.50 - 1.95	ES3 B2	, ,
				-			rey occasional slightly sandy				Ţ			2.00 2.00	D3 ES4	
					subrounded f (TILL)	ine to co	parse white cha	alk and occasi						2.00	201	
				(0.50)					2.00 - 4.00	m: Becomes st	iff _					
				(2.50)	-									3.00 - 3.45	D4	75 (40%)
					- - -									3.00 - 3.45	U1	70 (4070)
				-	_						H					
					-						-					
			54.92	4.00 -			led dark grey a							4.00	D5	
					chalk and occ		el of subangula flint.	r to subrounde	d fine to co	oarse white	-		0.00	4.50		N 07 (0 0/0 0 7 0)
	▼			(1.20)	(TILL)						1	Dry	3.00	4.50 4.50 - 4.95	S B3	N=27 (3,6/6,6,7,8)
				_	- - -						1					
		. —. —.	53.72	5.20			mottled dark of							5.30	D6	
				-	occasional fli		angular to subr	ounded fine to	coarse wh	ite chalk ar	nd :					
				(1.50)_	(TILL)						1					
		 -		(1.50)_	-						1			6.00 - 6.45 6.00 - 6.45	D7 U2	80 (80%)
				-	-						1					
			52.22	6.70	Stiff dark orar	ngish br	own mottled da	ark reddish bro	wn slightly	sandy	_			6.70	D8	
				(0.50)_	gravelly CLA	ſ. Grave	el of subangula flint. Occasion	r to subrounde	d fine to co					7.00	D9	
			51.72	7.20	(TILL)			7. <u>00 m: D</u>	ark orangish b	orown sand laye	er /					
				-	subrounded f	ine to co	slightly sandy parse white cha					Dry	7.50	7.50 7.50 - 7.95	S D10	N=21 (1,5/5,4,5,7)
					dark orangish (TILL)	brown.					-					
				_	1						-					
				-							-					
					- - -						1					
				-							-			9.00 - 9.45 9.00 - 9.45	D11 U3	73 (90%)
											1			0.00 0.10		
				-												
					-						1					
rou	Inst ndwa	ater e	ntries:		Diameter	& casi	ng:	Depth related	d remarks	:		Water	Ť	Depth Chiselling det	Type & No	Results
Struc	k: R	cose to	o: Casin	ig: Sea	led: Dia (mm) 20 15	0 3	h: Casing: 3.00 5.50 9.50 19.50	From: To	:	Rema	arks:			From: to:	Duratio	on: Tool:
	Notes	s: For expla	anation of syml	bols and	Project:	East	Anglia (North)	Offshore Wind	d Farm				E	xploratory po	sition refere	ence:
AGS .og is			e Key Sheet. educed levels a	are in metres.	Project No	o: 3318	3									C2-01
cale:			1:50		Client:	GHD	Ltd									Sheet 1 of



ore	hol	e forr	nation	details	s:											Location details:
Гуре: IP CP	F	From: 0.00 0.00	To: 1.20 20.00	Start da 18-07- 18-07-	ate: End date: 18-07-17	Crew: TM TM	Plant: Hand tools Dando 2000	Barrel type: n/a n/a	Drill Bit: n/a n/a	Logged: 18-07-17 19-07-17	Logger VS VS		emarks	nmer ID: SI 4 E(r)		mE: 599332.9 mN: 315346.0 mAOD: 58.92 Grid: OSGB
Instal'n	Water- strike	Legend	Level	Depth (thick-			Stratum	Description							& In Situ Te	_
=	> " 			ness)							Wa	iter (Casing	Depth	Type & No	Results/Remarks
				(8.10)							- Di	ry	7.50	10.50 10.50 - 10.95	S D12	N=22 (2,4/4,5,6,7)
				-				12.00 - 1 <u>5.30 n</u>	n: Becomes da	rk greyish brov	vn			12.00 - 12.45 12.00 - 12.45	D13 U4	66 (80%)
				- - - -					13.50 - 15.30	m: Becomes fii	<u>m</u> Di	ry		13.50 13.50 - 13.95	S B4	N=23 (2,3/3,4,4,12
	∇		43.62	15.30	Light greyish sized pockets CLAY. (TILL)	brown c s of light	clayey fine to m greyish brown	edium SAND. mottled dark	Fine to co orangish b	arse gravel rown sandy	, -			15.30 - 16.00	B5	
			42.42	16.50 -	Medium dens Gravel of sub (TILL)	e dark y angular	yellowish browr to subrounded	n gravelly silty I fine to coarse	fine to coa e flint and o	irse SAND. :halk.	DI	ry 1	16.50	16.50 16.50 - 16.95	C D14	N=25 (2,2/4,5,7,9
	SP			(3.50)				18 <u>.00 - 2</u>	0.00 m: Becor	nes very grave	ily Di	ry 1	18.00	18.00 18.00 - 18.45	C D15	N=25 (2,2/4,5,7,9)
	51			-							Dı	ry 1	19.50	19.50 19.50 - 19.95	C D16	N=24 (1,2/2,4,7,11
	Inst ndw	ater c	38.92	20.00	Diameter		orehole ends at 2	20.00m (Target			Wa	iter C	Casing	Depth Chiselling deta	Type & No	Results
truc 15.	k: F		o: Casir	ng: Seal				From: To 18.0 18	5 B.4 Blow	Remaing sands.	arks:			From: to:	Duratio	on: Tool:
AGS og is	abbr All de	eviations se epths and re	anation of syn the Key Sheet. educed levels FINAL 1:50	nbols and are in metres.	Project: Project N Client:			Offshore Wind	d Farm				E	Exploratory pos		C2-01



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Boreho															Location details:
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Backfill/ Instal'n Water-	2 E	Legend	Level	Depth (thick-			Stratum	Description				Samples	esting		
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				(0.50)	subangular to		own slightly gr unded fine to co				1				
			57.91	0.50 -	(TOPSOIL) Firm to stiff d	ark orar	ngish brown oc	casionally mot	tled dark gr	evish brow	n -		0.50 0.50	D1 ES1	
	1				sandy slightly coarse chalk	gravell and flin	y CLAY. Grave t. Occasional b	l of subangula lack spots.	r to subrour	ded fine to)		0.50 - 1.00	B1	
	100			-	(TILL)			·			-		1.00 1.00	D2 ES2	
	100			(1.50)]		4.50		50 /5 44/50 for 005
				- - -							- Dry		1.50 1.50 1.50	C D3 ES3	50 (5,11/50 for 225mm
			56.41	2.00 -	0								1.50 - 1.95 2.00	B2 D4	
	100				Gravel of sub	angular	d dark orangish to subrounded						2.00	ES4	
	100			-	flint. Occasio (TILL)	nal blac	k spots.				-				
	1]				
											-		3.00 - 3.45 3.00 - 3.45	D5 U1	70 (70%)
							2.40	5.50 m: Becomes	firm and mattle	l voddiah hvou	_				
				-			3.40 -	5.50 III. Bec <u>omes</u>	iirm and mottiet	readisti brow					
	1			(3.50)											
	100										-				
	100			-							Dry	3.00	4.50	S	N=13 (1,3/3,3,3,4)
													4.50 - 4.95	D6	
	2 to 1			_							+				
											-				
	100		52.91	5.50 -			rey occasionall								
					chalk and oc		. Gravel of sub flint.	angular to sub	rounded fine	e to coarse	•]				
	100			-	(TILL)						-		6.00 - 6.45 6.00 - 6.45	D7 U2	80 (90%)
				-							1				
	1			_				7.00	- 10.30 m: Bec	omes dark gre	<u> </u>				
	100								70.00 777 200	omeo dam gro					
	100			- -							Dry	3.00	7.50 7.50 - 7.95	S D8	N=28 (4,5/6,6,7,9)
	100			(4.80)									7.50 - 7.95	D6	
		-		(4.00)							+				
	100			-							Ī				
	100			-									9.00 - 9.45	D9	90 (90%)
	1												9.00 - 9.45	U3	00 (0070)
	100			-							H				
	1 1														
Ins	it i										Wate	er Casing) Depth	Type & No	Results
Ground Struck:				a. Saci	Diameter ed: Dia (mm			Depth relate From: To		Rema	rke:	-	Chiselling deta From: to:	ails:	on: Tool:
Struck:	KOS	se to	: Casin	g: Seai	ed: Dia (mm 20 18	00	n: Casing: 3.00 9.00 9.00 19.00	From: 10).	Rema	rks:		From: to:	Duratio	on: 1001:
AGS at	otes: Fo	or explar	nation of symb Key Sheet. duced levels a	ools and re in metres.	Project:		Anglia (North)	Offshore Win	d Farm			ı	Exploratory pos		
_og issu			FINAL		Project N Client:	o: 3318 GHE							BH	117-	C2-02
Scale:			1:50		Oliefit.	OLIE	Liu								Sheet 1 of



Bore	hol	e fori	mation	details	 s:											Location details:
Type: IP CP	F	From: 0.00 0.00	To: 1.20 20.00	Start d 20-07- 20-07-	ate: End date:	Crew: TM TM	Plant: Hand tools Dando 2000	Barrel type: n/a n/a	Drill Bit: n/a n/a	Logged: 20-07-17 21-07-17	١	gger: VS VS	Remarks SPT han	: nmer ID: SI 4 E(r)	mE: 599394.14 mN: 315347.46 mAOD: 58.41 Grid: OSGB	
Backfill/ Instal'n	Water- strike	Legend	Level	Depth (thick-			Stratum	Description				Water	Casing	· · · · · ·	& In Situ Te	
m =	∀		48.11 47.71	10.30 (0.40) - 10.70	sandy gravelly chalk and occ (TILL) Firm dark gre to subrounded (TILL)	Firm dark grey slightly sandy slightly gravelly CLAY. Gravel of subangul to subrounded fine to coarse flint and chalk. (TILL) Firm to stiff dark grey occasionally mottled dark orangish brown slightly								10.50 10.50 - 10.95	C B3	Results/Remarks N=19 (2,3/3,4,5,7)
				- (4.10)		y CĽAÝ.	. Gravel of suba	ngular to sub	rounded fir					12.00 - 12.45 12.00 - 12.45	D11 U4	60 (90%)
				-								Dry	12.00	13.50 13.50 - 13.95	S D12	N=31 (4,9/7,7,8,9)
			43.61	14.80	subangular to	subrou	own slightly sar inded fine to co medium SAND	arse chalk an	avelly CLA d occasion	Y. Gravel of al flint. Rare	e -	Dry	15.00	14.80 15.00 15.00 - 15.45	D13 C B4	N=23 (3,4/4,6,6,7)
	•		41.91	16.50 -			own mottled ligi to subrounded					Dry	16.00	16.50 16.50 - 16.95	S D14	N=33 (3,3/5,6,10,12)
			40.41	18.00 -	coarse SAND and occasiona (TILL)	. Grave al flint.	nse dark orang el of subangular .00 m: fine to coarse	to subrounde	d fine to co	arse chalk	y. -	Dry	18.00	18.00 18.00 - 18.45	S D15	N=36 (4,5/7,7,10,12)
				-							- - - - - -	Dry	19.00	19.50 19.50 - 19.95	C D16	N=26 (3,5/5,6,7,8)
Grow	Inst ndw	ater e	ntries:	20.00	Diameter		orehole ends at 2	0.00m (Target				Water	Casing	Depth Chiselling deta	Type & No	Results
Struc 10.4 19.0	k: F 4 0		o: Casin 3.00	0 11.	ed: Dia (mm)			From: To		Rema	ırks:	:		From: to:	Duratio	on: Tool:
AGS Log is Scale	abbri All de	eviations se epths and r	anation of symble Key Sheet. educed levels a FINAL 1:50	ools and are in metres.	Project: Project No Client:			Offshore Wind	Farm				E	exploratory pos		C2-02 Sheet 2 of 2

TerraConsult

Borel	hole	e forr	nation	details):										He was the second control of the second cont	Location details:
Type: IP CP	0	rom: 0.00 0.00	To: 1.20 20.00	Start d: 24-07- 24-07-	17 24-07-17	Crew: TM TM	Plant: Hand tools Dando 2000	Barrel type: n/a n/a	Drill Bit: n/a n/a	Logged: 24-07-17 25-07-17	Logger: VS VS		marks: T ham	mer ID: SI 4 E(ı	mE: 599547.9 mN: 315352.4 mAOD: 58.79 Grid: OSGB	
Instal'n	strike	Legend	Level	Depth (thick-			Stratum	Description						Samples	& In Situ To	esting
3 ⊆ ≤ 	S 0	<u>ت</u> الا		ness)	Soft dark orar	naish br	own slightly gra	avelly slightly:	sandy CLA	Y Gravel of	Wa	ter Ca	asing	Depth	Type & No	Results/Remarks
			58.49	0.30	subangular to (TOPSOIL)	subrou	nded fine to co	parse flint. Occ	asional ro	otlets						
			57.99	0.50)			slightly gravelly parse flint and o		Gravel is s	subangular	10 -			0.50 0.50 0.50 - 1.00	D1 ES1 B1	
				-	Firm to stiff lig		ish brown and ngular to subro							1.00 1.00	D2 ES2	
				(1.20)							Dı	у		1.50 1.50 1.50 - 1.95	C ES3 B2	N=27 (4,4/6,7,7,7)
			56.79	2.00 -			rey slightly gra		avel is sub	angular to				2.00 2.00	D4 ES4	
				- -	(TILL)	ine to co	oarse chaik and	u IIIII.			-					
				(2.30)							-			3.00 3.00 - 3.45	D5 D6	44 (40%)
				-										3.00 - 3.45	U1	
				- -					4.00	m: Cobble of fli	nt _			4.00	D7	
			54.49	4.30	coarse flint ar		y CLAY. Grave	el is subangula	r to subrou	inded fine to	Di	у 3	3.00	4.50 4.50 - 4.95	S D8	N=24 (2,3/5,6,6,7)
	▼		(1.50)		(TILL)									5.00	D8	
				(1.00)												
	∇		52.99	5.80			wn slightly gra			. Gravel is		v 6	5.00	5.80 - 6.30 6.00	B3 C	N=21 (2,3/3,5,6,7)
			52.49	6.30	(TILL)		asionally stain			ly gravelly				0.00		11 21 (2,0/0,0,0,7)
				-	slightly sandy flint and chalk (TILL)	CLAY.	Gravel of suba sional black spo	ngular to subr ots	ounded fin	e to coarse	-					
				-												
				(2.70)							-			7.50 - 7.95 7.50 - 7.95	D10 U2	60 (80%)
				=												
				- -							-					
			49.79	9.00 -	Firm dark gre	y slightl	y gravelly sligh coarse chalk a	itly sandy CLA and flint.	Y. Gravel is	s subangula	ır .	у 7	7.50	9.00 9.00 - 9.45	S D11	N=35 (4,6/6,8,9,12)
				- -	(TILL)						- - - - - - -					
	Inst			(1.95)							Wa	ter Ca	asing	Depth	Type & No	Results
			ntries:		Diameter			Depth relate						hiselling det		
Struck 6.00		ose to 4.80	o: Casin 3.0			0 3	n: Casing: 3.00 6.00 9.50 19.50	From: To):	Rema	rks:		F	From: to:	Duratio	on: Tool:
AGS	Notes	s: For expla	anation of syml e Key Sheet. educed levels a	bols and	Project:	East	Anglia (North)	Offshore Wind	d Farm				E	xploratory pos		
og is: cale:	sue:		FINAL 1:50	are in metres.	Project No Client:	o: 3318 GHD								BH	117-	C2-03 Sheet 1 of



Bor	ohol	o for	mation	dotaile	.												Location details:
Type IP CP	e: F	e 1011 From: 0.00 0.00	To: 1.20 20.00	Start da 24-07- 24-07-	ate: En	d date: -07-17 -07-17	Crew: TM TM	Plant: Hand tools Dando 2000	Barrel type: n/a n/a	Drill Bit: n/a n/a	Logged: 24-07-17 25-07-17	Logger VS VS		Remarks SPT han	: nmer ID: SI 4 E(r))% 74	mE: 599547.92 mN: 315352.43 mAOD: 58.79
																Grid: OSGB	
Backfill/ Instal'n	Water- strike	Legend	Level	Depth (thick- ness)				Stratum	Description						Samples 8		
<u>м</u> =				ness)	Firm da	ark grey	slightly	y gravelly sligh	tly sandy CLA	Y. Gravel is	s subangula		ater	Casing	Depth	Type & No	Results/Remarks
			47.84	10.95	(TILL)			coarse chalk a							10.50 - 10.95 10.50 - 10.95	D12 U3	85 (80%)
					coarse	rk grey flint and	gravell d chalk	y CLAY. Grave	el is subangula	r to subrou	inded fine to	°]					
П				-	(TILL)					10.95 m.	: Cobble of cha	lk -					
П				-								1					
П				-								-	Ory	10.00	12.00 12.00 - 12.45	S D12	N=52 (5,8/10,12,13,17)
П															12.00 - 12.45	012	
П				(3.00)								-					
]					
П				-								1					
П				-								1			13.50 - 13.95	D14	80 (80%)
		<u> </u>										-			13.50 - 13.95	U4	33 (33 %)
			44.84	13.95	Stiff lig	ht orang	jish bro	own slightly gra	avelly slightly s	sandy CLA	Y. Gravel of	=					
П					subang (TILL)	gular to	subrou	nded fine to co	arse chalk an	d flint.]					
				(1.05)								-					
П				-								1					
	X	 	43.79	15.00 -	Mediun	n dense	light b	rown gravelly : I is subangular	slightly silty sli	ghtly claye	y fine to	-	ry	15.00	15.00 15.00 - 15.45	C B4	N=16 (3,3/3,4,4,5)
		× ×.		-	chalk (TILL)	SAND.	Giave	i is subaligulal	to subrounde	u iiile to co	arse ilirit ar						
		××		(1.50)	(TILL)]					
		××		-								-					
		×										1					
			42.29	16.50 -	Mediun	n dense	becon	ning very dens	e light brown	gravelly fine	e to coarse	ם	Ory	16.50	16.50	C B5	N=18 (2,3/3,4,5,6)
l: :				:	SAND. (TILL)	Gravel	is suba	angular to subr	ounded fine to	coarse flir	nt and chall	k. =			16.50 - 16.95	65	
				-	(**==)							-					
				-								-					
				-								-					
				-									Ory	18.00	18.00	С	N=39 (2,3/5,7,11,16)
				(3.50)					18. <u>00 - 20</u>	.00 m: Become	es greyish brow	<u>vn</u>	.,		18.00 - 18.45	D15	(2,0.0,1,1.1,1.0)
				-								H					
				-								-					
				-								D	Ory	19.50	19.50 19.50	C D16	50 (1,2/50 for 225mm)
	SP		38.79	20.00								-					
Gro	Inst undw	ater e	entries:	20.00	Dia	meter		rehole ends at 2	20.00m (Target Depth relate		:	Wa	ater	Casing	Depth Chiselling deta	Type & No	Results
Stru	ıck: F	Rose to	o: Casin	-	_	a (mm):			From: To) :	Rema	arks:			From: to:	Duratio	on: Tool:
15	5.8 0	15.1 0		5 0					0	5	ing sands. ing sands.						
AG		es: For exp	lanation of sym ee Key Sheet. educed levels a	bols and	Pro	oject:	East	Anglia (North)	Offshore Wind	d Farm				E	xploratory pos		
	issue		educed levels a	are in metres.		ject No									BH	17-	C2-03
Scal	le:		1:50		Clie	ent:	GHD	Lta									Sheet 2 of 2



Bore	hole	e forn	nation	details	5 :										Location details:
ype: IP CP	0	rom: 0.00 0.00	To: 1.20 20.00	Start di 25-07- 25-07-	17 25-07-17	Crew: TM TM	Plant: Hand tools Dando 2000	Barrel type: n/a n/a	Drill Bit: n/a n/a	Logged: 25-07-17 26-07-17	Logger: VS VS		ks: ammer ID: SI 4 E(r)% 74	mE: 599596.6 mN: 315324.3 mAOD: 59.60 Grid: OSGB
Instal'n	water- strike	Legend	Level	Depth (thick-			Stratum	Description					Samples	& In Situ T	esting
1= :	> °°		59.30	(0.30) 0.30	subangular to (TOPSOIL) Soft to firm or	subrou	own slightly granded fine to co	gravelly sandy	CLAY. Gra	ets	Wa	ter Casin	0.50 0.50	Type & No D1 ES1	Results/Remarks
				(1.20)	(TILL)						-		0.50 - 1.00 1.00 1.00	D2 ES2	
			58.10	1.50 -		of suba	d light orangisl ngular to subro				ly Di	у	1.50 1.50 1.50 1.50 - 1.95 2.00 2.00	C D3 ES3 B2 D4 ES4	N=18 (2,3/3,5,4,6)
			56.60	3.00							-		3.00	D5	42 (70%)
			56.15	(0.45) 3.45	CLAY. Gravel Rare shell fra (TILL) Stiff to very st	of suba gments.	mottled light g ngular to subro Rare black cla grey slightly sa nded fine to m	ounded fine to aystone andy gravelly C	coarse cha	alk and flint el of	. ; ; , , , , , , , , , , , , , , , , , ,		3.00 - 3.45 3.00 - 3.45	D6 U1	
	•			(1.85)							- Dı	ry 3.00	4.50 4.50 - 4.95 4.50 - 4.95	S D112 D7	N=23 (1,3/5,5,6,7)
	\square		54.30 54.00	5.30 (0.30) _ 5.60	slightly sandy	sliahtly	rey mottled dan gravelly CLAY nd occasional	. Gravel of sub			d -		5.30 - 5.60	В3	
				-	Stiff to very st		grey slight san coarse chalk a			of subangu	ar - - - - - - - -		6.00 - 6.45 6.00 - 6.45	D8 U2	78 (80%)
				(4.90)							- Dı	y 6.00	7.50 7.50 - 7.95 7.50 - 7.95	S D113 D9	N=37 (2,5/7,8,10,12
				- - - - - -									9.00 - 9.45 9.00 - 9.45	D10 U3	90 (80%)
<u>}}</u>	Inst							T			Wa	ter Casin	<u> </u>	Type & No	Results
	k: R		ntries: b: Casin 3.00): Depth 00 3		Pepth related From: To		: Rema	rks:		Chiselling det	t ails: Duration	on: Tool:
AGS og is	All de	pths and re	anation of symble Key Sheet. Induced levels a	ools and re in metres.	Project: Project No			 Offshore Wind	d Farm				Exploratory po		ence: C2-04 Sheet 1 of



Bor														Location details:		
Type IP CP		From: 0.00 0.00	To: 1.20 20.00	Start da 25-07- 25-07-	17 25-07-17	Crew: TM TM	Plant: Hand tools Dando 2000	Barrel type: n/a n/a	Drill Bit: n/a n/a	Logged: 25-07-17 26-07-17	Logger: VS VS	Remark SPT ha	s: mmer ID: SI 4 E(r	mE: 599596.68 mN: 315324.32 mAOD: 59.60		
≥ c	Ι.	T		Depth									Comples	Grid: OSGB		
Backfill/ Instal'n	Water-	Legend	Level	(thick- ness)			Stratum	Description			Wate	er Casing		& In Situ Te		
			49.10	10.50	to subrounded (TILL) Firm light grey	ish bro	grey slight sand o coarse chalk a own mottled darl to subrounded	ind occasiona	l flint.	velly CLAY.	ılar-		10.50 10.50 - 10.95 10.50 - 10.95	S D11 D114	Results/Remarks N=23 (4,5/5,5,6,7)	
			47.15]			onally mottled c						12.00 - 12.45 12.00 - 12.45	D12 U4	73 (80%)	
			46.30 46.10	13.30	subrounded fi (TILL) Firm light brow	ne to co	slightly gravelly parse chalk and ntly sandy slight o coarse chalk a	l occasional fl	int. .AY. Gravel	_	Dry	13.50	13.30 13.50 13.50 - 13.95	D13 C B4	N=13 (2,3/3,2,3,5)	
			44.60	15.00			orangish brown angular to subr					15.00	15.00 15.00 - 15.45	C B5	N=13 (1,2/2,3,4,4)	
			43.10	16.50	Medium dens subangular to (TILL)	e light t subrou	prown silty gravi	elly fine to coa arse chalk an	arse SAND d flint.	. Gravel of		16.50	16.50 16.50 - 16.95	C D14	N=23 (3,4/4,5,6,8)	
				(3.50)				1	8.00 m: Becon	nes very gravel	Dry	18.00	18.00 18.00 - 18.45	C D15	N=23 (1,1/2,4,7,10)	
	Inst	× × × × × × × × × × × × × × × × × × ×	-39.60	20.00		Br	orehole ends at 2	rn nnm (Target	(depth)		- Dry		19.50 - 19.95	C D16	N=25 (2,3/4,6,6,9) Results	
Gro		_	ntries:		Diameter			Depth relate		:	vvate		Chiselling deta		Results	
1	3.0 0	15.3 0	anation of symb	O O		: Dept		From: To): 	Rema	arks:		From: to:	Duratio		
AG	ab All	breviations se depths and r	e Key Sheet. educed levels a	re in metres.	Project:			OHOLOUE WILL	u i allii						C2-04	
Log Scal		੮ .	FINAL 1:50		Client:	GHE) Ltd								Sheet 2 of 2	

APPENDIX B Photographs

November 2017 Report No 3318-R002

BH17-C2-01



1.00 m



2.00 m



5.30 m



6.70 m



7.20 m



13.50 m



15.50 m



16.50 m

BH17-C2-02



1.00 m



2.00 m



6.45 m



10.50 m



11.00 m



16.50 m

BH17-C2-03



2.00 m



4.50 m



13.95 m



12.00 m



15.00 m



16.00 m

BH17-C2-04



3.45 m



5.30 m



9.45 m



13.50 m



15.00 m



16.50 m



18.00 m

APPENDIX C In Situ Testing Results

Variable head permeability test

November 2017 Report No 3318-R002

Bottom of Response Zone

TerraConsult

Static water level (m)
Internal Diameter (D)
Length of Standpipe below Ground Level (m)
Height of Water above Ground Level (m)
Length of Standpipe above Ground Level (m)
Water level at start of test (m)
Top of Response Zone

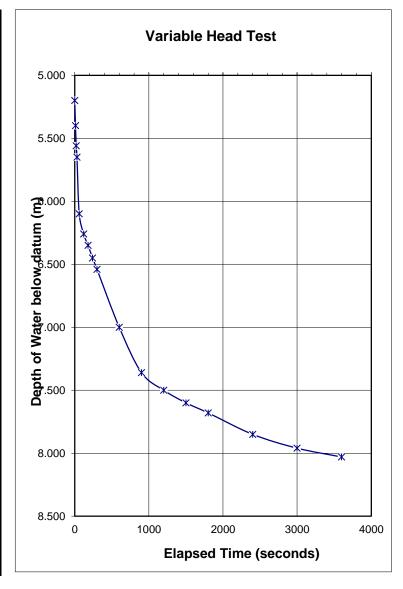
14.70	
0.15	
0.00	
0.00	
0.00	
5.20	
15.00	
15.50	

	Test 1
Time (t0)	0
Time (t)	3600
Head of Water	
Initial Head (h0) at (t0)	10.30
Final Head (h(t)) at (t)	7.47
Length of Response Zone (L)	0.50
Cross Sectional Area (S)	0.0177

Description

Clayey SAND

Description		
Elapsed	Water	Head of
Time	below	Water
(seconds)	Datum	vvalei
0	5.200	10.30
10	5.400	10.10
20	5.560	9.94
30	5.650	9.85
60	6.100	9.40
120	6.260	9.24
180	6.350	9.15
240	6.450	9.05
300	6.540	8.96
600	7.000	8.50
900	7.360	8.14
1200	7.500	8.00
1500	7.600	7.90
1800	7.680	7.82
2400	7.850	7.65
3000	7.960	7.54
3600	8.030	7.47



Shape Factor (F) calculated according to ISO 22282-1:2012

Equation for borehole permeability tests after BS EN ISO 22282-2:2012

$$F = \frac{2 \pi L}{\ln \left\{ (L/D) + \sqrt{\left((L/D)^2 + 1 \right)} \right\}}$$

$$= \frac{3.14}{1.90}$$

1.66

$$k = \frac{S \ln \left(h_0 / h(t) \right)}{F(t - t_0)}$$

k = 9.52E-07 m/s

Calculated by: JMT Project: East Anglia (North) Offshore Wind Farm Exploratory position reference:
Project No: 3318
Checked by: DD Client: GHD

Bottom of Response Zone

TerraConsult

Static water level (m)
Internal Diameter (D)
Length of Standpipe below Ground Level (m)
Height of Water above Ground Level (m)
Length of Standpipe above Ground Level (m)
Water level at start of test (m)
Top of Response Zone

	Test 1
Time (t0)	0
Time (t)	3600
Head of Water	
Initial Head (h0) at (t0)	6.87
Final Head (h(t)) at (t)	6.29
Length of Response Zone (L)	1.50
Cross Sectional Area (S)	0.0177

Description

Sandy gravelly CLAY.

0.15

0.00

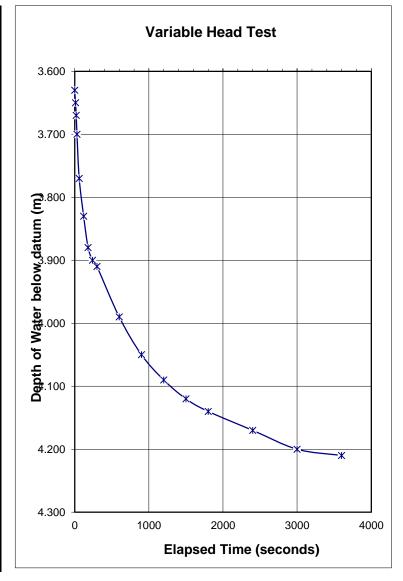
0.00

0.00

3.63 9.<u>00</u>

10.50

Boomption		
Elapsed Time (seconds)	Water below Datum	Head of Water
0	3.630	6.87
10	3.650	6.85
20	3.670	6.83
30	3.700	6.80
60	3.770	6.73
120	3.830	6.67
180	3.880	6.62
240	3.900	6.60
300	3.910	6.59
600	3.990	6.51
900	4.050	6.45
1200	4.090	6.41
1500	4.120	6.38
1800	4.140	6.36
2400	4.170	6.33
3000	4.200	6.30
3600	4.210	6.29
l	Ī	I



Shape Factor (F) calculated according to ISO 22282-1:2012

Equation for borehole permeability tests after BS EN ISO 22282-2:2012

$$F = \frac{2 \pi L}{\ln \left\{ (L/D) + \sqrt{\left((L/D)^2 + 1 \right)} \right\}}$$

$$= \frac{9.42}{\ln \left\{ (L/D) + \sqrt{\left((L/D)^2 + 1 \right)} \right\}}$$

3.00

$$k = \frac{S \ln \left(h_0 / h(t) \right)}{F(t - t_0)}$$

= 3.15

k = 1.38E-07 m/s

Calculated by:	JMT	Project:	East Anglia (North) Offshore Wind Farm	Exploratory position reference:
		Project No:	3318	BH17-C2-02
Checked by:	DD	Client:	GHD	BITT7-02-02

Bottom of Response Zone

TerraConsult

Static water level (m)
Internal Diameter (D)
Length of Standpipe below Ground Level (m)
Height of Water above Ground Level (m)
Length of Standpipe above Ground Level (m)
Water level at start of test (m)
Top of Response Zone

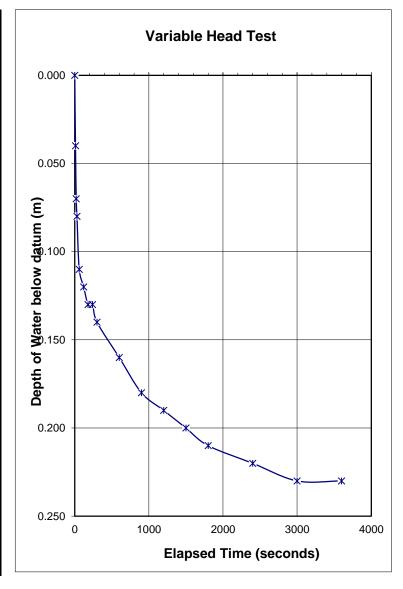
4.80	
0.15	
0.00	
0.00	
0.00	
0.00	
5.50	
6.00	

	Test 1
Time (t0)	0
Time (t)	3600
Head of Water	
Initial Head (h0) at (t0)	6.00
Final Head (h(t)) at (t)	5.77
Length of Response Zone (L)	0.50
Cross Sectional Area (S)	0.0177

Description

Slightly sandy slightly gravelly CLAY.

Description		
Elapsed Time (seconds)	Water below Datum	Head of Water
0	0.000	6.00
10	0.040	5.96
20	0.070	5.93
30	0.080	5.92
60	0.110	5.89
120	0.120	5.88
180	0.130	5.87
240	0.130	5.87
300	0.140	5.86
600	0.160	5.84
900	0.180	5.82
1200	0.190	5.81
1500	0.200	5.80
1800	0.210	5.79
2400	0.220	5.78
3000	0.230	5.77
3600	0.230	5.77



Shape Factor (F) calculated according to ISO 22282-1:2012

Equation for borehole permeability tests after BS EN ISO 22282-2:2012

$$F = \frac{2 \pi L}{\ln \left\{ (L/D) + \sqrt{\left((L/D)^2 + 1 \right)} \right\}}$$

$$= \frac{3.14}{1.90}$$

$$= 1.66$$

$$k = \frac{S \ln \left(\frac{h_0}{h(t)} \right)}{F(t - t_0)}$$

k = 1.16E-07 m/s

Calculated by:	JMT	Project:	East Anglia (North) Offshore Wind Farm	Exploratory position reference:
		Project No:	3318	BH17-C2-03
Checked by:	DD	Client:	GHD	BITT7-02-03

Bottom of Response Zone

TerraConsult

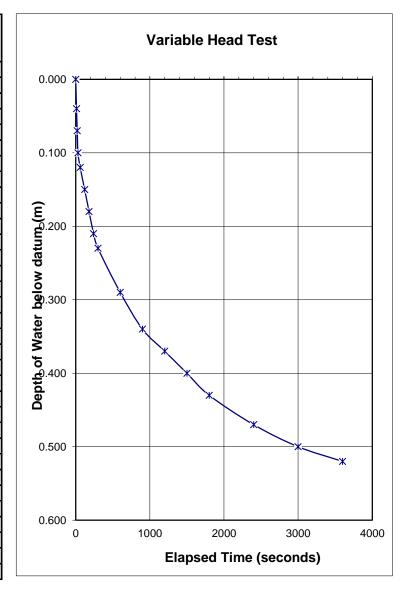
Static water level (m)
Internal Diameter (D)
Length of Standpipe below Ground Level (m)
Height of Water above Ground Level (m)
Length of Standpipe above Ground Level (m)
Water level at start of test (m)
Top of Response Zone

4.55		Test 1
0.15	Time (t0)	0
0.00	Time (t)	3600
0.00	Head of Water	
0.00	Initial Head (h0) at (t0)	5.50
0.00	Final Head (h(t)) at (t)	4.98
5.00	Length of Response Zone (L)	0.50
5.50	Cross Sectional Area (S)	0.0177
	•	

Description

Slightly sandy slightly gravelly CLAY.

Description		
Elapsed	Water	Head of
Time	below	Water
(seconds)	Datum	vvalei
0	0.000	5.50
10	0.040	5.46
20	0.070	5.43
30	0.100	5.40
60	0.120	5.38
120	0.150	5.35
180	0.180	5.32
240	0.210	5.29
300	0.230	5.27
600	0.290	5.21
900	0.340	5.16
1200	0.370	5.13
1500	0.400	5.10
1800	0.430	5.07
2400	0.470	5.03
3000	0.500	5.00
3600	0.520	4.98



Shape Factor (F) calculated according to ISO 22282-1:2012

Equation for borehole permeability tests after BS EN ISO 22282-2:2012

$$F = \frac{2 \pi L}{\ln \left\{ (L/D) + \sqrt{\left((L/D)^2 + 1 \right)} \right\}}$$

$$= \frac{3.14}{1.90}$$

1.66

$$k = \frac{S \ln \left(h_0 / h(t) \right)}{F(t - t_0)}$$

k = 2.94E-07 m/s

Calculated by: JMT Project: East Anglia (North) Offshore Wind Farm Exploratory position reference:
Project No: 3318
Checked by: DD Client: GHD

APPENDIX D Instrumentation Sampling and Monitoring Records

November 2017 Report No 3318-R002

No: 3318 GROUNDWATER AND GROUND GAS MONITORING

TerraConsult

Site: East Anglia OWF

GROUND GAS AND GROUNDWATER MONITORING DATA

			Well Details			Groundwater					Gas									Weath	ner		
Location	Date	Monitored by	Standpipe diameter (mm)	Depth to Base (m bgl)	Water Depth (m bgl)	Water Sample Taken?	Water Temp oC	Odour			Atmospher ic Pressure Comment		Flow (I/h)	CH ₄ (% v/v)	GSV CH ₄ (l/hr)	CO ₂ (% v/v)	GSV CO ₂ (I/hr)	O ₂ (% v/v)	CO (ppm)	H2S (ppm)	VOC (ppm)	Conditions	Ambient Temp °C
	11/08/17	KW	51	19.19	15.19	Υ				1011	NM	-33	-5.4	0.0	0.0000	0.3	-0.0162	18.0	0	0	NM	Sunny, dry	21
BH17-C2-01	22/08/17	VS	51	19.20	15.23	N				1015	NM	0.0	0.0	0.0	0.0000	3.8	0.0000	7.7	0	0	NM	Sunny, dry	21
DH 17-02-01	31/08/17	VS	51	19.00	15.28	N				1008	NM	0.0	0.0	0.0	0.0000	4.5	0.0000	7.8	0	0	NM	Sunny, dry	19
	15/09/17	VS	51	18.95	15.29	N				1004	NM	0.0	0.0	0.0	0.0000	5.0	0.0000	10.2	0	0	NM	Sunny spells	16

	11/08/17	KW	51	18.31	14.81	Υ			1010	NM	0.0	0.0	0.0	0.0000	0.4	0.0000	20.6	0	0	NM	Sunny, dry	21
BH17-C2-03	22/08/17	VS	51	18.10	14.90	Ν			1014	NM	0.0	0.0	0.0	0.0000	0.1	0.0000	20.7	0	0	NM	Sunny, dry	21
BH17-C2-03	31/08/17	VS	51	17.96	14.96	Ν			1009	NM	-2.0	-0.3	0.0	0.0000	0.6	-0.0018	19.4	0	0	NM	Sunny, dry	18
	15/09/17	VS	51	17.96	14.96	N		·	1005	NM	0.0	0.0	0.0	0.0000	0.3	0.0000	19.5	0	0	NM	Sunny Spells	16

[grey] = Below detection limit..

APPENDIX E Geotechnical Laboratory Test Results

Report References: GSTL 35625

CLS 684646

November 2017 Report No 3318-R002

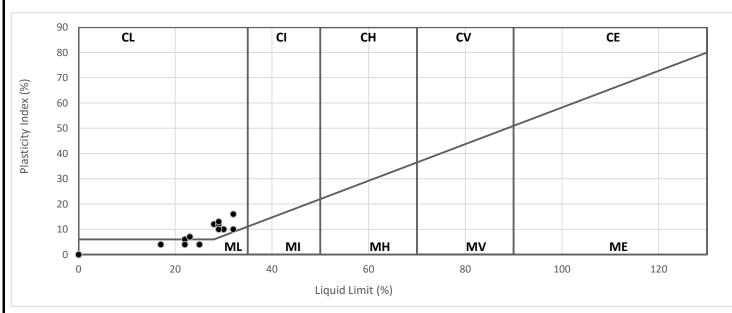
GSTI	LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX	
GOIL	(BS 1377 : Part 2 : 1990 Method 5)	
Contract Number	36525	
Site Name	E Anglia Wind Farm - Cable Route	

Hole Reference	Sample Number	Sample Type	D	epth (r	m)	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity index %	Passing .425mm %	Remarks
BH17-C2-02	7	D	6.00	-	6.45	17	28	16	12	77	CL Low Plasticity
BH17-C2-03	6	D	3.00	-	3.45	19	32	16	16	72	CL Low Plasticity
				-							
				-							
				-							
				-							
				-							
				-							
				-							

Symbols: NP : Non Plastic

: Liquid Limit and Plastic Limit Wet Sieved

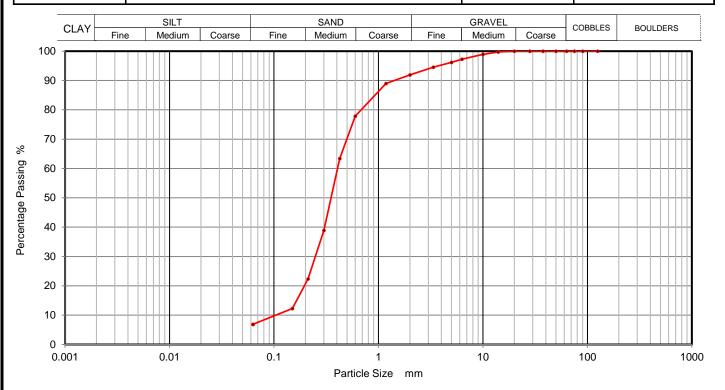
PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION BS 5930:1999+A2:2010



Operators	Checked	20/09/2017	Sean Penn
DB	Approved	21/09/2017	Ben Sharp



CCTI	PARTICLE SIZE DISTRIBUTION	Contract Number	36525
GOIL	BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Borehole/Pit No.	BH17-C2-01
Site Name	E Anglia Wind Farm - Cable Route	Sample No.	14
Soil Description	Brown slightly silty slightly fine to medium gravelly fine to coarse	Depth Top	16.50
	SAND	Depth Base	16.95
		Sample Type	D



Siev	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	99		
6.3	97		
5	96		
3.35	95		
2	92		
1.18	89		
0.6	78		
0.425	63		
0.3	39		
0.212	22		
0.15	12		
0.063	7		

Sample Proportions	% dry mass			
Cobbles	0			
Gravel	8			
Sand	85			
Silt and Clay	7			

Grading Analysis	
Uniformity Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	20/09/2017	Sean Penn
RO/MH	Approved	21/09/2017	Ben Sharp





CCTI	PARTICLE SIZE DISTRIBUTION	Contract Number	36525
GOIL	BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Borehole/Pit No.	BH17-C2-04
Site Name	E Anglia Wind Farm - Cable Route	Sample No.	5
Soil Description	Brown fine to medium gravelly silty fine to coarse SAND	Depth Top	15.00
	Brown line to median gravery sitty line to coarse SAND	Depth Base	15.45
		Sample Type	В



Siev	ving	Sedime	entation
Particle Size	% Passing	Particle Size	% Passing
mm	70 T assiring	mm	70 T assirig
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	99		
6.3	95		
5	93		
3.35	90		
2	88		
1.18	86		
0.6	82		
0.425	76		
0.3	62		
0.212	47		
0.15	33		
0.063	21		

Sample Proportions	% dry mass
Cobbles	0
Gravel	12
Sand	67
Silt and Clay	21

Grading Analysis	
Uniformity Coefficient	

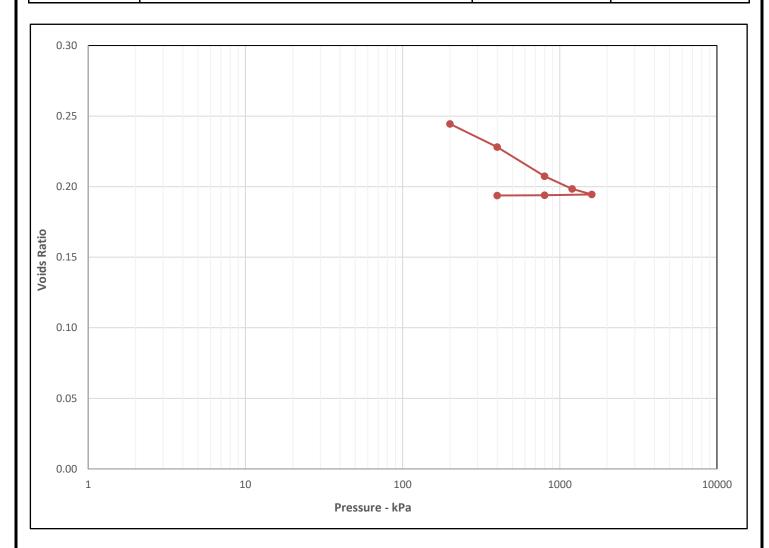
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	20/09/2017	Sean Penn
RO/MH	Approved	21/09/2017	Ben Sharp



CCTI	ONE DIMENSIONAL CONSOLIDATION TEST	Contract Number	36525
GOIL	BS1377:Part 5:1990, clause 3	Borehole/Trialpit No.	BH17-C2-02
Site Name	E Anglia Wind Farm - Cable Route	Sample No.	4
Soil Description	Grey fine to medium gravelly sandy silty CLAY	Depth Top (m)	12.00
	Grey line to medium gravelly salidy sitty CLAT	Depth Base (m)	12.45
Lab Temperature	20°c	Sample Location	Middle
Remarks	Cv Calculated Using T90	Sample Type	U



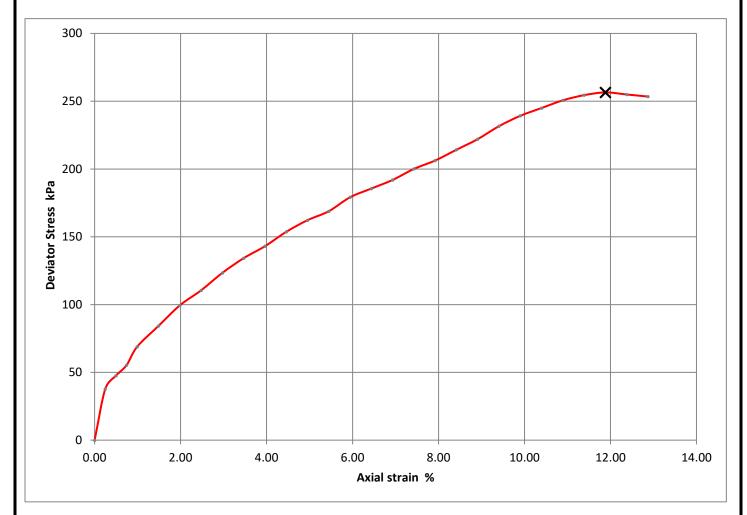
Initial Sample Conditi	ons	Pres	sure R	ange	Mv m2/MN	Cv m2/yr	Pres	sure F	Range	Mv m2/MN	Cv m2/yr
Moisture Content (%)	12	0	-	200	0.16	16		-			
Bulk Density (Mg/m3)	2.30	200	-	400	0.066	12		-			
Dry Density (Mg/m3)	2.06	400	-	800	0.042	12		-			
Voids Ratio	0.2848	800	-	1200	0.0	7.6		-			
Degree of saturation	108.0	1200	-	1600	0.0081	4		-			
Height (mm)	19.96	1600	-	800	-0.00061	19		-			
Diameter (mm)	50.05	800	-	400	-0.0004	13		-			
Particle Density (Mg/m3)	2.65		-					-			

Operators	Checked	20/09/2017	Sean Penn	
LG	Approved	21/09/2017	Ben Sharp	





CCTI	Single Stage Unconsolidated-Undrained Triaxial Test BS 1377 : 1990 Part 7 : 8		36525
GOIL			BH17-C2-04
Site Name	E Anglia Wind Farm - Cable Route	Sample No.	2
Soil Description	Light brown fine to coarse gravelly sandy silty CLAY	Depth Top (m)	6.00
	Light brown line to coarse gravelly sality stry CLA1	Depth Base (m)	6.45
		Sample Type	U



Moisture Content (%)	19
Bulk Density (Mg/m ³)	2.15
Dry Density (Mg/m ³)	1.81
Specimen Length (mm)	202
Specimen Diameter (mm)	103
Cell Pressure (kPa)	120
Deviator Stress (kPa)	256
Undrained Shear Strength (kPa)	128
Failure Strain (%)	11.9
Mode Of Failure	Plastic
Membrane Used/Thickness	Rubber/0.3mm
Rate of Strain (%/min)	3.00

Specimen Post Test	Sample Split
PICTURE NOT AVAILABLE	PICTURE NOT AVAILABLE

Checked	20/09/2017	Sean Penn	
Approved	21/09/2017	Paul Evans	





Concept Life Sciences is a trading name of Concept Life Sciences Analytical & Development Services Limited registered in England and Wales (No 2514788)

Concept Life Sciences Certificate of Analysis

3 Crittall Drive Springwood Industrial Estate Braintree Essex CM7 2RT

Tel: 01376 560120 Fax: 01376 552923

Report Number: Supplement 1B to Report Number

684646-1

Date of Report: 23-Oct-2017

Customer: TerraConsult (South) Limited

Suite F17 Dugard House

Peartree Road Colchester Essex CO3 0UL

Customer Contact: Victoria Smith

Customer Job Reference:

Customer Site Reference: Happisburgh/East Anglia

Date Job Received at Concept: 05-Sep-2017
Date Analysis Started: 26-Sep-2017
Date Analysis Completed: 29-Sep-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
Tests covered by this certificate were conducted in accordance with Concept Life Sciences SOPs
All results have been reviewed in accordance with Section 25 of the Concept Life Sciences, Analytical Services Quality Manual





Report checked and authorised by : Chelsea Entwistle Senior Customer Service Advisor Issued by : Aislinn Arthey Customer Service Adv



Project Site: Happisburgh/East Anglia

Customer Reference:

Soil Analysed as Soil

BRE SD1 (SE)

			Conce	ot Reference	684646 004
	17-C2-04 D1 @ 0.50m				
			D	ate Sampled	25-JUL-2017
				Matrix Class	Clay
Determinand	Method	Test Sample	LOD	Units	
(Water soluble) Ammonia expressed as NH4	T710	AR	0.01	g/l	<0.01
(Water soluble) CI-	T710	A40	0.01	g/l	<0.01
Magnesium	T112	A40	1	mg/l	1
(Water soluble) NO3	T710	A40	0.01	g/l	<0.01
рН	T7	A40			8.2
(Water Soluble) SO4 expressed as SO4	T242	A40	0.01	g/l	0.02
SO4(Total)	T102	A40	0.02	%	0.03
Sulphur (total)	T6	A40	0.01	%	0.01
Moisture @105C	T162	AR	0.1	%	15
Retained on 2mm	T2	A40	0.1	%	1.0

Index to symbols used in Supplement 1B to Report Number 684646-1

Value	Description			
AR	As Received			
A40 Assisted dried < 40C				
M	Analysis is MCERTS accredited			
N	Analysis is not UKAS accredited			

Notes

Retained on 2mm is removed before analysis

Supplement 1B Report reissued to include only sample 004

Method Index

Value	Description
T6	ICP/OES
T7	Probe
T242	2:1 Extraction/ICP/OES (TRL 447 T1)
T2	Grav
T102	ICP/OES (HCI extract)
T112	ICP/OES (SIM)(Water Extract)
T162	Grav (1 Dec) (105 C)
T710	2:1 Extraction / Discrete Analyser

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	Concept References
(Water soluble) Ammonia expressed as NH4	T710	AR	0.01	g/l	N	004
(Water soluble) CI-	T710	A40	0.01	g/l	N	004
Magnesium	T112	A40	1	mg/l	N	004
(Water soluble) NO3	T710	A40	0.01	g/l	N	004
pH	T7	A40			М	004
(Water Soluble) SO4 expressed as SO4	T242	A40	0.01	g/l	М	004
SO4(Total)	T102	A40	0.02	%	М	004
Sulphur (total)	T6	A40	0.01	%	М	004
Moisture @105C	T162	AR	0.1	%	N	004
Retained on 2mm	T2	A40	0.1	%	N	004

APPENDIX F Geoenvironmental Laboratory Test Results

Report References: 672447

675177

November 2017 Report No 3318-R002



Concept Life Sciences is a trading name of Concept Life Sciences Analytical & Development Services Limited registered in England and Wales (No 2514788)

Concept Life Sciences Certificate of Analysis

3 Crittall Drive Springwood Industrial Estate Braintree Essex CM7 2RT

Tel: 01376 560120 Fax: 01376 552923

Report Number: Supplement 1E to Report Number

672447-1

Date of Report: 23-Oct-2017

Customer: TerraConsult Limited

Unit 34

Bold Business Centre

Bold Lane Sutton St Helens WA9 4TX

Customer Contact: Mr Derek Daniels

Customer Job Reference: 3318

Customer Purchase Order: PO-001748

Customer Site Reference: Norfolk Vanguard Cable Route

Date Job Received at Concept: 13-Jul-2017

Date Analysis Started: 03-Aug-2017

Date Analysis Completed: 11-Aug-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
Tests covered by this certificate were conducted in accordance with Concept Life Sciences SOPs
All results have been reviewed in accordance with Section 25 of the Concept Life Sciences, Analytical
Services Quality Manual





Report checked and authorised by : Claire Brown Crociquia Customer Service Manager Issued by : Aislinn Arthey Customer Service Advi



Project Site: Norfolk Vanguard Cable Route

Customer Reference: 3318

Soil Analysed as Soil

Miscellaneous

			672447 045	672447 050		
		BH17-C2-01 ES1 @ 0.50m	BH17-C2-02 ES2 @ 1.00m			
			18-JUL-2017	20-JUL-2017		
		Sandy Soil	Clay			
Determinand	Method	Test Sample	LOD	Units		
Arsenic	T257	A40	2	mg/kg	13	17
Barium	T257	A40	2	mg/kg	49	53
Beryllium	T245	A40	0.5	mg/kg	1.2	1.3
Boron (water-soluble)	T82	A40	1	mg/kg	<1	<1
Cadmium	T257	A40	0.1	mg/kg	0.2	0.4
Chromium	T257	A40	0.5	mg/kg	28	29
Copper	T257	A40	2	mg/kg	27	22
Lead	T257	A40	2	mg/kg	18	17
Mercury	T245	A40	1.0	mg/kg	<1.0	<1.0
Nickel	T257	A40	0.5	mg/kg	29	42
Selenium	T257	A40	3	mg/kg	<3	<3
Vanadium	T257	A40	0.1	mg/kg	44	49
Zinc	T257	A40	2	mg/kg	60	63
Soil Organic Matter	T287	A40	0.1	%		0.5
Moisture @105C	T162	AR	0.1	%	18	14
Retained on 2mm	T2	A40	0.1	%	3.7	2.8

Concept Reference: 672447

Project Site: Norfolk Vanguard Cable Route

Customer Reference: 3318

Soil Analysed as Soil

3011		Allalyseu	as Juli		
Asbestos					
			Conce	ot Reference	672447 049
		Custor	ner Samp	le Reference	BH17-C2-02 ES1 @ 0.50m
			D	ate Sampled	20-JUL-2017
Determinand	Method	Test Sample	LOD	Units	
Asbestos ID	T27	A40			Asbestos not

Project Site: Norfolk Vanguard Cable Route

Customer Reference: 3318

Soil Analysed as Soil
Total and Speciated USEPA16 PAH (SE) (MCERTS)

			Conce	pt Reference	672447 050
		Custon	ner Samp	le Reference	BH17-C2-02 ES2 @ 1.00m
			D	ate Sampled	20-JUL-2017
				Matrix Class	Clay
Determinand	Method	Test Sample	LOD	Units	
Naphthalene	T16	AR	0.1	mg/kg	<0.1
Acenaphthylene	T16	AR	0.1	mg/kg	<0.1
Acenaphthene	T16	AR	0.1	mg/kg	<0.1
Fluorene	T16	AR	0.1	mg/kg	<0.1
Phenanthrene	T16	AR	0.1	mg/kg	<0.1
Anthracene	T16	AR	0.1	mg/kg	<0.1
Fluoranthene	T16	AR	0.1	mg/kg	<0.1
Pyrene	T16	AR	0.1	mg/kg	<0.1
Benzo(a)Anthracene	T16	AR	0.1	mg/kg	<0.1
Chrysene	T16	AR	0.1	mg/kg	<0.1
Benzo(b)fluoranthene	T16	AR	0.1	mg/kg	<0.1
Benzo(k)fluoranthene	T16	AR	0.1	mg/kg	<0.1
Benzo(a)Pyrene	T16	AR	0.1	mg/kg	<0.1
Indeno(123-cd)Pyrene	T16	AR	0.1	mg/kg	<0.1
Dibenzo(ah)Anthracene	T16	AR	0.1	mg/kg	<0.1
Benzo(ghi)Perylene	T16	AR	0.1	mg/kg	<0.1
PAH(total)	T16	AR	0.1	mg/kg	<0.1

Concept Reference: 672447

Project Site: Norfolk Vanguard Cable Route

Customer Reference: 3318

Soil Analys	ed as Soil				
TPH CWG					
			Conce	ot Reference	672447 050
		Custon	ner Sampl	e Reference	BH17-C2-02 ES2 @ 1.00m
			D	ate Sampled	20-JUL-2017
				Matrix Class	Clay
Determinand	Method	Test Sample	LOD	Units	-
Benzene	T209	AR	10	μg/kg	<10
Toluene	T209	AR	10	μg/kg	<10
EthylBenzene	T209	AR	10	μg/kg	<10
M/P Xylene	T209	AR	10	μg/kg	<10
O Xylene	T209	AR	10	μg/kg	<10
Methyl tert-Butyl Ether	T54	AR	1	μg/kg	<10
TPH (C5-C6 aliphatic)	T54	AR	0.010	mg/kg	<0.010
TPH (C6-C7 aromatic)	T54	AR	0.010	mg/kg	<0.010
TPH (C6-C8 aliphatic)	T54	AR	0.010	mg/kg	<0.010
TPH (C7-C8 aromatic)	T54	AR	0.010	mg/kg	<0.010
TPH (C8-C10 aliphatic)	T54	AR	0.010	mg/kg	<0.010
TPH (C8-C10 aromatic)	T54	AR	0.010	mg/kg	<0.010
TPH (C10-C12 aliphatic)	T219	AR	2	mg/kg	<2
TPH (C10-C12 aromatic)	T219	AR	2	mg/kg	<2
TPH (C12-C16 aliphatic)	T219	AR	2	mg/kg	<2
TPH (C12-C16 aromatic)	T219	AR	2	mg/kg	<2
TPH (C16-C21 aliphatic)	T219	AR	2	mg/kg	<2
TPH (C16-C21 aromatic)	T219	AR	2	mg/kg	<2
TPH (C21-C35 aliphatic)	T219	AR	2	mg/kg	<2
TPH (C21-C35 aromatic)	T219	AR	2	mg/kg	<2
TPH (C35-C40 aliphatic)	T219	AR	2	mg/kg	<2
TPH (C35-C40 aromatic)	T219	AR	2	mg/kg	<2
TPH (Aliphatic+Aromatic) C10-C25 (Sum)	T85	AR	4	mg/kg	(62) <5
TPH (Aliphatic+Aromatic) C25-C40 (Sum)	T85	AR	4	mg/kg	(62) <5

Project Site: Norfolk Vanguard Cable Route

Customer Reference: 3318

Soil Analysed as Soil

Organochlorine insecticides

			Conce	ot Reference	672447 050
		Custon	ner Samp	le Reference	BH17-C2-02 ES2 @ 1.00m
			D	ate Sampled	20-JUL-2017
				Matrix Class	Clay
Determinand	Method	Test Sample	LOD	Units	
Hexachlorocyclohexane	T16	AR	0.01	mg/kg	<0.01
Hexachlorobenzene	T1	AR	0.01	mg/kg	<0.01
Heptachlor	T16	AR	0.01	mg/kg	<0.01
Aldrin	T16	AR	0.01	mg/kg	<0.01
Heptachlor epoxide	T16	AR	0.01	mg/kg	<0.01
Chlordane	T16	AR	0.01	mg/kg	<0.01
Endosulphan	T16	AR	0.01	mg/kg	<0.01
DDE	T16	AR	0.01	mg/kg	<0.01
Dieldrin	T16	AR	0.01	mg/kg	<0.01
Endrin	T16	AR	0.01	mg/kg	<0.01
DDD	T16	AR	0.01	mg/kg	<0.01
DDT	T16	AR	0.01	ma/ka	< 0.01

Concept Reference: 672447

Project Site: Norfolk Vanguard Cable Route

Customer Reference: 3318

Soil Analysed as Soil

Organophosphorous insecticides

	672447 050				
	BH17-C2-02 ES2 @ 1.00m				
			D	ate Sampled	20-JUL-2017
				Matrix Class	Clay
Determinand	Method	Test Sample	LOD	Units	
Dichlorvos	T16	AR	0.01	mg/kg	<0.01
Mevinphos	T16	AR	0.01	mg/kg	<0.01
Dimethoate	T16	AR	0.01	mg/kg	<0.01
Diazinon	T16	AR	0.01	mg/kg	<0.01
Pirimiphos methyl	T16	AR	0.01	mg/kg	<0.01
Malathion	T16	AR	0.01	mg/kg	<0.01
Fenitrothion	T16	AR	0.01	mg/kg	<0.01
Parathion	T16	AR	0.01	mg/kg	<0.01
Azinphos methyl	T16	AR	0.01	ma/ka	< 0.01

Concept Reference: 672447

Project Site: Norfolk Vanguard Cable Route

Customer Reference: 3318

Soil Analysed as Soil

Triazines Suite

	672447 050							
	Customer Sample Reference							
			D	ate Sampled	20-JUL-2017			
				Matrix Class	Clay			
Determinand	Method	Test Sample	LOD	Units				
Simazine	T16	AR	0.01	mg/kg	⁽⁶⁴⁾ <0.01			
Atrazine	T16	AR	0.01	mg/kg	⁽⁶⁴⁾ <0.01			
Propazine	T16	AR	0.01	mg/kg	⁽⁶⁴⁾ < 0.01			
Trietazine	T16	AR	0.01	mg/kg	⁽⁶⁴⁾ < 0.01			
Prometryn	T16	AR	0.01	mg/kg	⁽⁶⁴⁾ < 0.01			
Terbutryn	T16	AR	0.01	mg/kg	⁽⁶⁴⁾ < 0.01			

Concept Reference: 672447 Project Site: Norfolk Vanguard Cable Route Customer Reference: 3318 Soil Analysed as Soil Urons Concept Reference 672447 050 **Customer Sample Reference** BH17-C2-02 ES2 @ 1.00m Date Sampled 20-JUL-2017 **Matrix Class** Clay Determinand Method LOD Units Chlorotoluron T310 0.01 < 0.01 AR mg/kg T310 AR 0.01 <0.01 Diuron mg/kg T310 AR 0.01 < 0.01 Isoproturon mg/kg T310 AR 0.01 <0.01 Linuron mg/kg T310 Monuron AR 0.01 mg/kg < 0.01

Concept Reference: 672447 Project Site: Norfolk Vanguard Cable Route Customer Reference: 3318 Soil Analysed as Soil Phenoxy Acetic acid herbicides 672447 050 **Concept Reference** Customer Sample Reference BH17-C2-02 ES2 @ 1.00m 20-JUL-2017 **Date Sampled** Matrix Class Clay Test Sample Determinand LOD T16 AR 0.01 mg/kg < 0.01 T16 AR 0.01 Phenoxy Acetic acid herbicide: MCPA <0.01 mg/kg Dichlorprop T16 AR 0.01 mg/kg <0.01 Phenoxy Acetic acid herbicide: 2,4-D T16 AR 0.01 < 0.01 mg/kg (36) < 0.02 Fenoprop T16 AR 0.01 mg/kg T16 (36) < 0.02 Phenoxy Acetic acid herbicide: 2,4,5-T AR 0.01 mg/kg

Concept F	Reference:	672447					
Pr	oject Site:	Norfolk V	Norfolk Vanguard Cable Route				
Customer F	Reference:	3318					
Soil Phenols (Speciated)		Analysed	as Soil				
			Concep	ot Reference	672447 050		
		Custor	ner Sampl	e Reference	BH17-C2-02 ES2 @ 1.00m		
			D	ate Sampled	20-JUL-2017		
			l	Matrix Class	Clay		
Determinand	Method	Test Sample	LOD	Units			
Resorcinol	T17	AR	0.05	mg/kg	<0.05		
Catechol	T17	AR	0.05	mg/kg	<0.05		
Phenol	T17	AR	0.1	mg/kg	<0.1		
Cresols	T17	AR	0.05	mg/kg	<0.05		
Xylenols	T17	AR	0.05	mg/kg	<0.05		
Naphthols	T17	AR	0.05	mg/kg	<0.05		
Trimethyl phenol	T17	AR	0.05	mg/kg	⁽⁶²⁾ < 0.10		
Total Phenols	T17	AR	0.1	mg/kg	<0.1		

Index to symbols used in Supplement 1E to Report Number 672447-1

Value	Description		
A40	Assisted dried < 40C		
AR	As Received		
64	Analysis was performed by an alternative technique		
36	LOD Raised due to low Matrix spike recovery		

62	LOD was raised due to the method performance of the analytical procedure used
S	Analysis was subcontracted
М	Analysis is MCERTS accredited
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Notes

050 - BTEX - Samples submitted for GC/MS (Headspace) analysis were submitted in inappropriate containers. It is possible therefore that the results provided may be compromised.

Speciated phenols - 050 - These samples have been analysed exceeding recommended holding times. It is possible therefore that the results provided may be compromised.

Supplement 1E report reissued to include only samples 045, 049 and 050

Asbestos subcontracted to REC Limited

OCP & OPP - 050 - These samples have been analysed exceeding recommended holding times. It is possible therefore that the results provided may be compromised.

Reported results on as received samples are corrected to a 105 degree centigrade dry weight basis except TPH c5-c35 aro/ali split, Urons, Triazines, OCP/OPP and PAAH

Retained on 2mm is removed before analysis

Urons and Triazines analysis transferred to Concept Life Sciences Cambridge

OCP, OPP and PAAH analysis transferred to Concept Life Sciences Manchester

Method Index

Value	Description
T245	ICP/OES (Aqua Regia Extraction)
T257	ICP/OES (SIM) (Aqua Regia Extraction)
T310	LC/MS/MS
T162	Grav (1 Dec) (105 C)
T16	GC/MS
T209	GC/MS (Head Space)(MCERTS)
T287	Calc TOC/0.58
T219	GC/FID (SE)
T2	Grav
T27	PLM
T82	ICP/OES (Sim)
T85	Calc
T1	GC/MS (HR)
T17	HPLC
T54	GC/MS (Headspace)

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	Concept References
Arsenic	T257	A40	2	mg/kg	М	045,050
Barium	T257	A40	2	mg/kg	U	045,050
Beryllium	T245	A40	0.5	mg/kg	U	045,050
Boron (water-soluble)	T82	A40	1	mg/kg	N	045,050
Cadmium	T257	A40	0.1	mg/kg	М	045,050
Chromium	T257	A40	0.5	mg/kg	М	045,050
Copper	T257	A40	2	mg/kg	М	045,050
Lead	T257	A40	2	mg/kg	М	045,050
Mercury	T245	A40	1.0	mg/kg	U	045,050
Nickel	T257	A40	0.5	mg/kg	М	045,050
Selenium	T257	A40	3	mg/kg	U	045,050
Vanadium	T257	A40	0.1	mg/kg	U	045,050
Zinc	T257	A40	2	mg/kg	М	045,050
Soil Organic Matter	T287	A40	0.1	%	N	050
Moisture @105C	T162	AR	0.1	%	N	045,050
Retained on 2mm	T2	A40	0.1	%	N	045,050
Asbestos ID	T27	A40			SU	049
Naphthalene	T16	AR	0.1	mg/kg	U	050
Acenaphthylene	T16	AR	0.1	mg/kg	U	050
Acenaphthene	T16	AR	0.1	mg/kg	М	050
Fluorene	T16	AR	0.1	mg/kg	М	050
Phenanthrene	T16	AR	0.1	mg/kg	U	050
Anthracene	T16	AR	0.1	mg/kg	М	050
Fluoranthene	T16	AR	0.1	mg/kg	N	050
Pyrene	T16	AR	0.1	mg/kg	N	050
Benzo(a)Anthracene	T16	AR	0.1	mg/kg	М	050
Chrysene	T16	AR	0.1	mg/kg	М	050
Benzo(b)fluoranthene	T16	AR	0.1	mg/kg	U	050

Determinand	Method	Test	LOD	Units	Symbol	Concept References
Benzo(k)fluoranthene	T16	Sample AR	0.1	mg/kg	N	050
Benzo(a)Pyrene	T16	AR	0.1	mg/kg	М	050
Indeno(123-cd)Pyrene	T16	AR	0.1	mg/kg	М	050
Dibenzo(ah)Anthracene	T16	AR	0.1	mg/kg	M	050
Benzo(ghi)Perylene	T16	AR	0.1	mg/kg	M	050
PAH(total) Benzene	T16 T209	AR AR	0.1 10	mg/kg µg/kg	U M	050 050
Toluene	T209	AR	10	μg/kg μg/kg	M	050
EthylBenzene	T209	AR	10	μg/kg	М	050
M/P Xylene	T209	AR	10	μg/kg	М	050
O Xylene	T209	AR	10	μg/kg	М	050
Methyl tert-Butyl Ether	T54	AR	1	μg/kg	U	050
TPH (C5-C6 aliphatic) TPH (C6-C7 aromatic)	T54 T54	AR AR	0.010	mg/kg mg/kg	N N	050 050
TPH (C6-C8 aliphatic)	T54	AR	0.010	mg/kg	N	050
TPH (C7-C8 aromatic)	T54	AR	0.010	mg/kg	N	050
TPH (C8-C10 aliphatic)	T54	AR	0.010	mg/kg	N	050
TPH (C8-C10 aromatic)	T54	AR	0.010	mg/kg	N	050
TPH (C10-C12 aliphatic)	T219	AR	2	mg/kg	N	050
TPH (C10-C12 aromatic) TPH (C12-C16 aliphatic)	T219 T219	AR AR	2	mg/kg mg/kg	N N	050 050
TPH (C12-C16 aiipnatic)	T219	AR	2	mg/kg	N	050
TPH (C16-C21 aliphatic)	T219	AR	2	mg/kg	N	050
TPH (C16-C21 aromatic)	T219	AR	2	mg/kg	N	050
TPH (C21-C35 aliphatic)	T219	AR	2	mg/kg	N	050
TPH (C21-C35 aromatic)	T219	AR	2	mg/kg	N	050
TPH (C35-C40 aliphatic) TPH (C35-C40 aromatic)	T219 T219	AR AR	2	mg/kg mg/kg	N N	050 050
TPH (Aliphatic+Aromatic) C10-C25 (Sum)	T85	AR	4	mg/kg	N	050
TPH (Aliphatic+Aromatic) C25-C40 (Sum)	T85	AR	4	mg/kg	N	050
Hexachlorocyclohexane	T16	AR	0.01	mg/kg	U	050
Hexachlorobenzene	T1	AR	0.01	mg/kg	U	050
Heptachlor	T16	AR	0.01	mg/kg	U	050
Aldrin Heptachlor epoxide	T16 T16	AR AR	0.01	mg/kg	U	050 050
Chlordane	T16	AR	0.01	mg/kg mg/kg	U	050
Endosulphan	T16	AR	0.01	mg/kg	U	050
DDE	T16	AR	0.01	mg/kg	U	050
Dieldrin	T16	AR	0.01	mg/kg	U	050
Endrin	T16	AR	0.01	mg/kg	U	050
DDD DDT	T16 T16	AR AR	0.01	mg/kg mg/kg	U	050 050
Dichlorvos	T16	AR	0.01	mg/kg	U	050
Mevinphos	T16	AR	0.01	mg/kg	U	050
Dimethoate	T16	AR	0.01	mg/kg	U	050
Diazinon	T16	AR	0.01	mg/kg	U	050
Pirimiphos methyl Malathion	T16	AR AR	0.01	mg/kg	U	050 050
Fenitrothion	T16 T16	AR	0.01	mg/kg mg/kg	U	050
Parathion	T16	AR	0.01	mg/kg	U	050
Azinphos methyl	T16	AR	0.01	mg/kg	U	050
Simazine	T16	AR	0.01	mg/kg	N	050
Atrazine	T16	AR	0.01	mg/kg	N	050
Propazine Trietazine	T16 T16	AR AR	0.01	mg/kg mg/kg	N N	050 050
Prometryn	T16	AR	0.01	mg/kg	N	050
Terbutryn	T16	AR	0.01	mg/kg	N	050
Chlorotoluron	T310	AR	0.01	mg/kg	N	050
Diuron	T310	AR	0.01	mg/kg	N	050
Isoproturon	T310	AR	0.01	mg/kg	N	050
Linuron	T310 T310	AR AR	0.01	mg/kg	N N	050 050
Monuron Mecoprop	T16	AR	0.01	mg/kg mg/kg	N N	050
Phenoxy Acetic acid herbicide: MCPA	T16	AR	0.01	mg/kg	N	050
Dichlorprop	T16	AR	0.01	mg/kg	N	050
Phenoxy Acetic acid herbicide: 2,4-D	T16	AR	0.01	mg/kg	N	050
Fenoprop	T16	AR	0.01	mg/kg	N	050
Phenoxy Acetic acid herbicide: 2,4,5-T	T16	AR	0.01	mg/kg	N	050
Resorcinol Catechol	T17	AR AR	0.05 0.05	mg/kg mg/kg	M N	050 050
Galebiloi	117	AR	0.03	mg/kg	IN	000

Determinand	Method	Test Sample	LOD	Units	Symbol	Concept References
Phenol	T17	AR	0.1	mg/kg	M	050
Cresols	T17	AR	0.05	mg/kg	М	050
Xylenols	T17	AR	0.05	mg/kg	М	050
Naphthols	T17	AR	0.05	mg/kg	N	050
Trimethyl phenol	T17	AR	0.05	mg/kg	M	050
Total Phenols	T17	AR	0.1	mg/kg	N	050





Concept Life Sciences is a trading name of Concept Life Sciences Analytical & Development Services Limited registered in England and Wales (No 2514788)

Concept Life Sciences Certificate of Analysis

3 Crittall Drive Springwood Industrial Estate Braintree Essex CM7 2RT

Tel: 01376 560120 Fax: 01376 552923

Report Number: Supplement 1D to Report Number

672447-1 A

Date of Report: 16-Oct-2017

Customer: TerraConsult Limited

Unit 34

Bold Business Centre

Bold Lane Sutton St Helens WA9 4TX

Customer Contact: Mr Derek Daniels

Customer Job Reference: 3318

Customer Purchase Order: PO-001748

Customer Site Reference: Norfolk Vanguard Cable Route

Date Job Received at Concept: 13-Jul-2017
Date Analysis Started: 03-Aug-2017
Date Analysis Completed: 11-Aug-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
Tests covered by this certificate were conducted in accordance with Concept Life Sciences SOPs
All results have been reviewed in accordance with Section 25 of the Concept Life Sciences, Analytical
Services Quality Manual





Report checked and authorised by : Claire Brown Crociquia Customer Service Manager Issued by :
Aislinn Arthey
Customer Service



Waste Acceptance Criteria

Customer Sample Reference: BH17-C2-02 ES2 @ 1.00m

SAL Sample Reference: 672447 050

Project Site: Norfolk Vanguard Cable Route

Customer Reference: 3318

Test Portion Mass (g): 175

Date Sampled: 20-JUL-2017

Matrix Class: Clay

Soil Summary						Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol				
pH	Probe			М	8.3		>6.0	
Loss on Ignition @450C	Ign @450C/Grav	0.1	%	М	4.0			10.0
Total Organic Carbon	OX/IR	0.1	%	N	0.3	3.0	5.0	6.0
BTEX (Sum)	Calc	0.040	mg/kg	U	<0.040	6.0		
TPH (C10-C40)	GC/FID (SE)	10	mg/kg	М	<10	500.0		
PAH (Sum)	Calc	1.6	mg/kg	N	<1.6	100.0		
Acid Neutralising Capacity (pH 7)	Titration	2.0	Mol/kg	N	4			
PCB EC7 (Sum)	Calc	0.00035	mg/kg	N	<0.14	1.0		
Moisture @105C	Grav (1 Dec) (105 C)	0.1	%	N	14			
Retained on 2mm	Grav	0.1	%	N	2.8			

10:1 Leachate					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol	II/U' YE'			
Antimony (Dissolved)	Calc / ICP/MS (Filtered)	0.010	mg/kg	N	<0.010	0.06	0.7	5.0
Arsenic (Dissolved)	Calc / ICP/MS (Filtered)	0.0020	mg/kg	N	0.0024	0.5	2.0	25.0
Barium (Dissolved)	Calc / ICP/MS (Filtered)	0.010	mg/kg	N	0.065	20.0	100.0	300.0
Cadmium (Dissolved)	Calc / ICP/MS (Filtered)	0.00020	mg/kg	N	<0.00020	0.04	1.0	5.0
Chloride	Calc / Discrete Analyser	10	mg/kg	N	28	800.0	15000.0	25000.0
Chromium (Dissolved)	Calc / ICP/MS (Filtered)	0.010	mg/kg	N	<0.010	0.5	10.0	70.0
Copper (Dissolved)	Calc / ICP/MS (Filtered)	0.0050	mg/kg	N	0.055	2.0	50.0	100.0
Dissolved Organic Carbon	Calc / OX/IR	10	mg/kg	N	62	500.0	800.0	1000.0
Fluoride	Calc / Discrete Analyser	0.50	mg/kg	N	5.6	10.0	150.0	500.0
Lead (Dissolved)	Calc / ICP/MS (Filtered)	0.0030	mg/kg	N	< 0.0030	0.5	10.0	50.0
Mercury (Dissolved)	Calc / ICP/MS (Filtered)	0.00050	mg/kg	N	<0.00050	0.01	0.2	2.0
Molybdenum (Dissolved)	Calc / ICP/MS (Filtered)	0.010	mg/kg	N	0.013	0.5	10.0	30.0
Nickel (Dissolved)	Calc / ICP/MS (Filtered)	0.010	mg/kg	N	0.011	0.4	10.0	40.0
Phenols(Mono)	Calc / Colorimetry (CF)	0.20	mg/kg	N	<0.20	1.0		
Selenium (Dissolved)	Calc / ICP/MS (Filtered)	0.0050	mg/kg	N	<0.0050	0.1	0.5	7.0
SO4	Calc / Discrete Analyser	5.0	mg/kg	N	22	1000.0	20000.0	50000.0
Total Dissolved Solids	Calc	100	mg/kg	N	630	4000.0	60000.0	100000.0
Zinc (Dissolved)	Calc / ICP/MS (Filtered)	0.020	mg/kg	N	0.034	4.0	50.0	200.0

From: EC Directive 99/31/EC and Landfill Regulations 2002 (as ammended)

Notes:- Cumulative release at L/S=10 (mg/kg of dry matter) in accordance with BS EN 12457. Soil leaching procedure is not covered by our UKAS accreditation

As detailed in- Waste Classification. Guidance on the classification and assessment of waste. Technical Guidance WM3:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/427077/LIT_10121.pdf

Landfill WAC analysis (specifically leaching test results) should not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Project Site: Norfolk Vanguard Cable Route

Customer Reference: 3318

Soil Analysed as Soil

Total and Speciated USEPA16 PAH (SE) (MCERTS)

	672447 050				
	BH17-C2-02 ES2 @ 1.00m				
			1	Test Sample	AR
			Da	ate Sampled	20-JUL-2017
				Matrix Class	Clay
Determinand	Method	LOD	Units	Symbol	
Naphthalene	GC/MS	0.1	mg/kg	U	<0.1
Acenaphthylene	GC/MS	0.1	mg/kg	U	<0.1
Acenaphthene	GC/MS	0.1	mg/kg	М	<0.1
Fluorene	GC/MS	0.1	mg/kg	М	<0.1
Phenanthrene	GC/MS	0.1	mg/kg	U	<0.1
Anthracene	GC/MS	0.1	mg/kg	М	<0.1
Fluoranthene	GC/MS	0.1	mg/kg	N	<0.1
Pyrene	GC/MS	0.1	mg/kg	N	<0.1
Benzo(a)Anthracene	GC/MS	0.1	mg/kg	М	<0.1
Chrysene	GC/MS	0.1	mg/kg	М	<0.1
Benzo(b)fluoranthene	GC/MS	0.1	mg/kg	U	<0.1
Benzo(k)fluoranthene	GC/MS	0.1	mg/kg	N	<0.1
Benzo(a)Pyrene	GC/MS	0.1	mg/kg	М	<0.1
Indeno(123-cd)Pyrene	GC/MS	0.1	mg/kg	М	<0.1
Dibenzo(ah)Anthracene	GC/MS	0.1	mg/kg	М	<0.1
Benzo(ghi)Perylene	GC/MS	0.1	mg/kg	M	<0.1
Polyaromatic Hydrocarbons (Total)	GC/MS	0.1	mg/kg	U	<0.1
Coronene	GC/MS (MCERTS)	0.1	mg/kg	N	<0.1

Concept Reference: 672447

Project Site: Norfolk Vanguard Cable Route

Customer Reference: 3318

Soil Analysed as Soil

BTEX

	672447 050						
		Customer Sample Reference B					
			1	est Sample	AR		
			Da	te Sampled	20-JUL-2017		
			ı	Matrix Class	Clay		
Determinand	Method	LOD	Units	Symbol			
Benzene	GC/MS (Head Space)(MCERTS)	10	μg/kg	М	<10		
Toluene	GC/MS (Head Space)(MCERTS)	10	μg/kg	М	<10		
EthylBenzene	GC/MS (Head Space)(MCERTS)	10	μg/kg	М	<10		
Meta/Para-Xylene	GC/MS (Head Space)(MCERTS)	10	μg/kg	М	<10		
Ortho-Xylene	GC/MS (Head Space)(MCERTS)	10	μg/kg	М	<10		

Project Site: Norfolk Vanguard Cable Route

Customer Reference: 3318

Soil Analysed as Soil

PCBs EC7 (SE)

	672447 050								
	Customer Sample Reference								
			7	est Sample	AR				
			Da	te Sampled	20-JUL-2017				
				Matrix Class	Clay				
Determinand	Method	LOD	Units	Symbol					
Polychlorinated biphenyl BZ#28	GC/MS	20	μg/kg	М	<20				
Polychlorinated biphenyl BZ#52	GC/MS	20	μg/kg	М	<20				
Polychlorinated biphenyl BZ#101	GC/MS	20	μg/kg	М	<20				
Polychlorinated biphenyl BZ#118	GC/MS	20	μg/kg	М	<20				
Polychlorinated biphenyl BZ#153	GC/MS	20	μg/kg	М	<20				
Polychlorinated biphenyl BZ#138	GC/MS	20	μg/kg	М	<20				
Polychlorinated biphenyl BZ#180	GC/MS	20	μg/kg	М	<20				

Index to symbols used in Supplement 1D to Report Number 672447-1 A

Value	Description
8:1	Leachate to BS EN 12457-3 (8:1)
A40	Assisted dried < 40C
AR	As Received
2:1	Leachate to BS EN 12457-3 (2:1)
110	LOD raised due to low internal standard recovery.
М	Analysis is MCERTS accredited
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Notes

Supplement 1D report reissued to include only sample 050					
050 - BTEX - Samples submitted for GC/MS (Headspace) analysis were submitted in inappropriate containers. It is possible therefore that the results provided may be compromised.					
pH, LOI & TOC were performed on assisted dried samples (<40 degree centigrade). All other results relate to samples as received.					
Reported results on as received samples are corrected to a 105 degree centigrade dry weight basis except ANC					
Retained on 2mm is removed before analysis					



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Concept Life Sciences Certificate of Analysis

3 Crittall Drive Springwood Industrial Estate Braintree Essex CM7 2RT

Tel: 01376 560120 Fax: 01376 552923

Report Number: Supplement 1A to Report Number

675177-1

Date of Report: 18-Oct-2017

Customer: TerraConsult (South) Limited

Suite F17 Dugard House

Peartree Road Colchester Essex CO3 0UL

Customer Contact: Victoria Smith

Customer Job Reference: 3318

Customer Site Reference: East Anglia OWF

Date Job Received at Concept: 11-Aug-2017

Date Analysis Started: 14-Aug-2017

Date Analysis Completed: 25-Aug-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
Tests covered by this certificate were conducted in accordance with Concept Life Sciences SOPs
All results have been reviewed in accordance with Section 25 of the Concept Life Sciences, Analytical
Services Quality Manual



Report checked and authorised by : Claire Brown Crociquia Customer Service Manager Issued by : Aislinn Arthey Customer Service Adv



Project Site: East Anglia OWF

Customer Reference: 3318

Water Analysed as Water

Heavy Metals (9)

	675177 001	675177 002				
	BH17-C2-01	BH17-C2-03				
	11-AUG-2017	11-AUG-2017				
Determinand	Method	Test Sample	LOD			
As (Dissolved)	T281	F	0.0002	mg/l	0.0002	0.0002
Cd (Dissolved)	T281	F	0.00002	mg/l	<0.00002	<0.00002
Cr (Dissolved)	T281	F	0.001	mg/l	<0.001	<0.001
Cu (Dissolved)	T281	F	0.0005	mg/l	0.0005	<0.0005
Pb (Dissolved)	T281	F	0.0003	mg/l	< 0.0003	< 0.0003
Hg (Dissolved)	T281	F	0.00005	mg/l	<0.0005	<0.00005
Ni (Dissolved)	T281	F	0.001	mg/l	0.001	0.001
Se (Dissolved)	T281	F	0.0005	mg/l	0.0006	0.0024
Zn (Dissolved)	T281	F	0.002	mg/l	<0.002	<0.002

Concept Reference: 675177

Project Site: East Anglia OWF

Customer Reference: 3318

Water Analysed as Water

Total and Speciated USEPA16 PAH (SE)

			Concep	t Reference	675177 001	675177 002
		Custon	ner Sampl	e Reference	BH17-C2-01	BH17-C2-03
			Da	ate Sampled	11-AUG-2017	11-AUG-2017
Determinand	Method	Test Sample	LOD	Units		
Naphthalene	T149	AR	0.01	μg/l	0.08	<0.01
Acenaphthylene	T149	AR	0.01	μg/l	0.04	<0.01
Acenaphthene	T149	AR	0.01	μg/l	0.05	<0.01
Fluorene	T149	AR	0.01	μg/l	0.03	<0.01
Phenanthrene	T149	AR	0.01	μg/l	0.02	<0.01
Anthracene	T149	AR	0.01	μg/l	0.01	<0.01
Fluoranthene	T149	AR	0.01	μg/l	0.01	<0.01
Pyrene	T149	AR	0.01	μg/l	0.01	<0.01
Benzo(a)Anthracene	T149	AR	0.01	μg/l	0.01	<0.01
Chrysene	T149	AR	0.01	μg/l	<0.01	<0.01
Benzo(b)fluoranthene	T149	AR	0.01	μg/l	<0.01	<0.01
Benzo(k)fluoranthene	T149	AR	0.01	μg/l	<0.01	<0.01
Benzo(a)Pyrene	T149	AR	0.01	μg/l	<0.01	<0.01
Indeno(123-cd)Pyrene	T149	AR	0.01	μg/l	<0.01	<0.01
Dibenzo(ah)Anthracene	T149	AR	0.01	μg/l	<0.01	<0.01
Benzo(ghi)Perylene	T149	AR	0.01	μg/l	<0.01	<0.01
PAH(total)	T149	AR	0.01	μg/l	0.25	<0.01

Concept Reference: 675177

Project Site: East Anglia OWF

Customer Reference: 3318

Water Analysed as Water

TPH (CWG) with MTBE & BTEX SE

			Conce	675177 001	675177 002	
		Custor	ner Sampl	le Reference	BH17-C2-01	BH17-C2-03
			D	ate Sampled	11-AUG-2017	11-AUG-2017
Determinand	Method	Test Sample	LOD	Units		
Benzene	T54	AR	1	μg/l	<1	<1
EthylBenzene	T54	AR	1	μg/l	<1	<1
M/P Xylene	T54	AR	1	μg/l	<1	<1
Methyl tert-Butyl Ether	T54	AR	1	μg/l	<1	<1
O Xylene	T54	AR	1	μg/l	<1	<1
Toluene	T54	AR	1	μg/l	<1	<1
TPH (C5-C6 aliphatic)	T54	AR	0.020	mg/l	<0.020	<0.020
TPH (C6-C7 aromatic)	T54	AR	0.020	mg/l	<0.020	<0.020
TPH (C6-C8 aliphatic)	T54	AR	0.020	mg/l	<0.020	<0.020
TPH (C7-C8 aromatic)	T54	AR	0.020	mg/l	<0.020	<0.020
TPH (C8-C10 aliphatic)	T54	AR	0.020	mg/l	<0.020	<0.020
TPH (C8-C10 aromatic)	T54	AR	0.020	mg/l	<0.020	<0.020
TPH (C10-C12 aliphatic)	T219	AR	0.01	mg/l	<0.01	<0.01
TPH (C10-C12 aromatic)	T219	AR	0.01	mg/l	<0.01	<0.01
TPH (C12-C16 aliphatic)	T219	AR	0.01	mg/l	<0.01	0.01
TPH (C12-C16 aromatic)	T219	AR	0.01	mg/l	<0.01	0.02
TPH (C16-C21 aliphatic)	T219	AR	0.01	mg/l	<0.01	0.01
TPH (C16-C21 aromatic)	T219	AR	0.01	mg/l	<0.01	<0.01
TPH (C21-C35 aliphatic)	T219	AR	0.01	mg/l	0.01	0.03
TPH (C21-C35 aromatic)	T219	AR	0.01	mg/l	0.02	0.03

Concept Reference: 675177

Project Site: East Anglia OWF

Customer Reference: 3318

Water Analysed as Water

Organochlorine insecticides

				- 25		
			Conce	ot Reference	675177 001	675177 002
		Custon	ner Sampl	le Reference	BH17-C2-01	BH17-C2-03
			D	ate Sampled	11-AUG-2017	11-AUG-2017
Determinand	Method	Test Sample	LOD	Units		
Hexachlorocyclohexane	T16	AR	0.01	μg/l	(100,36) < 0.04	(36) < 0.02
Hexachlorobenzene	T16	AR	0.01	μg/l	(100) < 0.02	<0.01
Heptachlor	T16	AR	0.01	μg/l	(100) < 0.02	<0.01
Aldrin	T16	AR	0.01	μg/l	(100) < 0.02	<0.01
Heptachlor epoxide	T16	AR	0.01	μg/l	(100) < 0.02	<0.01
Chlordane	T16	AR	0.01	μg/l	(100) < 0.02	<0.01
Endosulphan	T16	AR	0.01	μg/l	(100) < 0.02	<0.01
DDE	T16	AR	0.01	μg/l	(100) < 0.02	<0.02
Dieldrin	T16	AR	0.01	μg/l	(100) < 0.02	<0.01
Endrin	T16	AR	0.01	μg/l	(100,36) < 0.04	(36) < 0.02
DDD	T16	AR	0.01	μg/l	(100) < 0.02	<0.01
DDT	T16	AR	0.01	μg/l	(100,36) < 0.04	(36) < 0.01

Concept Reference: 675177 Project Site: East Anglia OWF Customer Reference: 3318 Water Analysed as Water Organophosphorous insecticides Concept Reference 675177 001 675177 002 Customer Sample Reference BH17-C2-01 BH17-C2-03 Date Sampled 11-AUG-2017 11-AUG-2017 Test Sample Method Determinand (100) < 0.02 T16 Dichlorvos AR 0.01 < 0.01 T16 (100) < 0.02 Mevinphos AR 0.01 <0.01 μg/l (100) < 0.02 Dimethoate T16 AR 0.01 <0.01 μg/l (100) < 0.02 Diazinon T16 AR 0.01 < 0.01 μg/l

0.01

0.01

0.01

0.01

0.01

μg/l

μg/l

μg/l

Pirimiphos methyl

Malathion

Fenitrothion

Parathion

Azinphos methyl

T16

T16

T16

T16

T16

AR

AR

AR

AR

AR

Index to symbols used in Supplement 1A to Report Number 675177-1

<0.01

< 0.01

<0.01

<0.01

(36) < 0.02

(100) < 0.02

⁽¹⁰⁰⁾ <<u>0</u>.02

(100) < 0.02

(100) < 0.02

(100,36) < 0.04

Value	Description
F	Filtered
AR	As Received
110	LOD raised due to low internal standard recovery.
36	LOD Raised due to low Matrix spike recovery
100	LOD determined by sample aliquot used for analysis
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Notes

Supplement 1A report reissued to include only samples 001 and 002 OCP and OPP transferred to Concept Life Sciences Manchester

Method Index

Value	Description					
T219	GC/FID (SE)					
T281	ICP/MS (Filtered)					
T54	GC/MS (Headspace)					
T16	GC/MS					
T149	GC/MS (SIR)					

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	Concept References
As (Dissolved)	T281	F	0.0002	mg/l	U	001-002
Cd (Dissolved)	T281	F	0.00002	mg/l	U	001-002
Cr (Dissolved)	T281	F	0.001	mg/l	U	001-002
Cu (Dissolved)	T281	F	0.0005	mg/l	U	001-002
Pb (Dissolved)	T281	F	0.0003	mg/l	U	001-002
Hg (Dissolved)	T281	F	0.00005	mg/l	U	001-002
Ni (Dissolved)	T281	F	0.001	mg/l	U	001-002
Se (Dissolved)	T281	F	0.0005	mg/l	U	001-002
Zn (Dissolved)	T281	F	0.002	mg/l	U	001-002
Naphthalene	T149	AR	0.01	μg/l	U	001-002
Acenaphthylene	T149	AR	0.01	μg/l	U	001-002
Acenaphthene	T149	AR	0.01	μg/l	U	001-002
Fluorene	T149	AR	0.01	μg/l	U	001-002
Phenanthrene	T149	AR	0.01	μg/l	U	001-002
Anthracene	T149	AR	0.01	μg/l	U	001-002
Fluoranthene	T149	AR	0.01	μg/l	U	001-002
Pyrene	T149	AR	0.01	μg/l	U	001-002

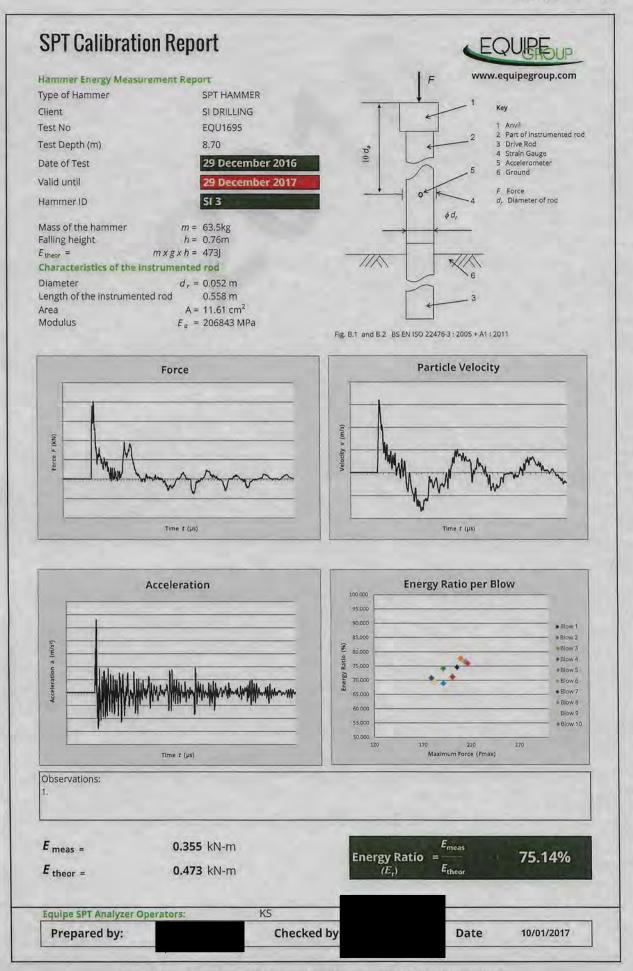
Determinand	Method	Test Sample	LOD	Units	Symbol	Concept References
Benzo(a)Anthracene	T149	AR	0.01	μg/l	U	001-002
Chrysene	T149	AR	0.01	μg/l	U	001-002
Benzo(b)fluoranthene	T149	AR	0.01	μg/l	N	001-002
Benzo(k)fluoranthene	T149	AR	0.01	μg/l	U	001-002
Benzo(a)Pyrene	T149	AR	0.01	μg/l	U	001-002
Indeno(123-cd)Pyrene	T149	AR	0.01	μg/l	U	001-002
Dibenzo(ah)Anthracene	T149	AR	0.01	μg/l	U	001-002
Benzo(ghi)Perylene	T149	AR	0.01	μg/l	U	001-002
PAH(total)	T149	AR	0.01	μg/l	N	001-002
Benzene	T54	AR	1	μg/l	U	001-002
EthylBenzene	T54	AR	1	μg/l	U	001-002
M/P Xylene	T54	AR	1	μg/l	U	001-002
Methyl tert-Butyl Ether	T54	AR	1	μg/l	U	001-002
O Xylene	T54	AR	1	μg/l	U	001-002
Toluene	T54	AR	1	μg/l	U	001-002
TPH (C5-C6 aliphatic)	T54	AR	0.020	mg/l	N	001-002
TPH (C6-C7 aromatic)	T54	AR	0.020	mg/l	N	001-002
TPH (C6-C8 aliphatic)	T54	AR	0.020	mg/l	N	001-002
TPH (C7-C8 aromatic)	T54	AR	0.020	mg/l	N	001-002
TPH (C8-C10 aliphatic)	T54	AR	0.020	mg/l	N	001-002
TPH (C8-C10 aromatic)	T54	AR	0.020	mg/l	N	001-002
TPH (C10-C12 aliphatic)	T219	AR	0.01	mg/l	N	001-002
TPH (C10-C12 aromatic)	T219	AR	0.01	mg/l	N	001-002
TPH (C12-C16 aliphatic)	T219	AR	0.01	mg/l	N	001-002
TPH (C12-C16 aromatic)	T219	AR	0.01	mg/l	N	001-002
TPH (C16-C21 aliphatic)	T219	AR	0.01	mg/l	N	001-002
TPH (C16-C21 aromatic)	T219	AR	0.01	mg/l	N	001-002
TPH (C21-C35 aliphatic)	T219	AR	0.01	mg/l	N	001-002
TPH (C21-C35 aromatic)	T219	AR	0.01	mg/l	N	001-002
Hexachlorocyclohexane	T16	AR	0.01	μg/l	N	001-002
Hexachlorobenzene	T16	AR	0.01	μg/l	N	001-002
Heptachlor	T16	AR	0.01	μg/l	N	001-002
Aldrin	T16	AR	0.01	μg/l	N	001-002
Heptachlor epoxide	T16	AR	0.01	μg/l	N	001-002
Chlordane	T16	AR	0.01	μg/l	N	001-002
Endosulphan	T16	AR	0.01	μg/l	N	001-002
DDE	T16	AR	0.01	μg/l	N	001-002
Dieldrin	T16	AR	0.01	μg/l	N	001-002
Endrin	T16	AR	0.01	μg/l	N	001-002
DDD	T16	AR	0.01	μg/l	N	001-002
DDT	T16	AR	0.01	μg/l	N	001-002
Dichlorvos	T16	AR	0.01	μg/l	N	001-002
Mevinphos	T16	AR	0.01	μg/l	N	001-002
Dimethoate	T16	AR	0.01	μg/l	N	001-002
Diazinon	T16	AR	0.01	μg/l	N	001-002
Pirimiphos methyl	T16	AR	0.01	μg/l	N	001-002
Malathion	T16	AR	0.01	μg/l	N	001-002
Fenitrothion	T16	AR	0.01	μg/l	N	001-002
Parathion	T16	AR	0.01	μg/l	N	001-002
Azinphos methyl	T16	AR	0.01	μg/l	N	001-002
Aziribinos meniki	110	AR.	0.01	μ9/1	IN	001-002

APPENDIX G Calibration Certificates

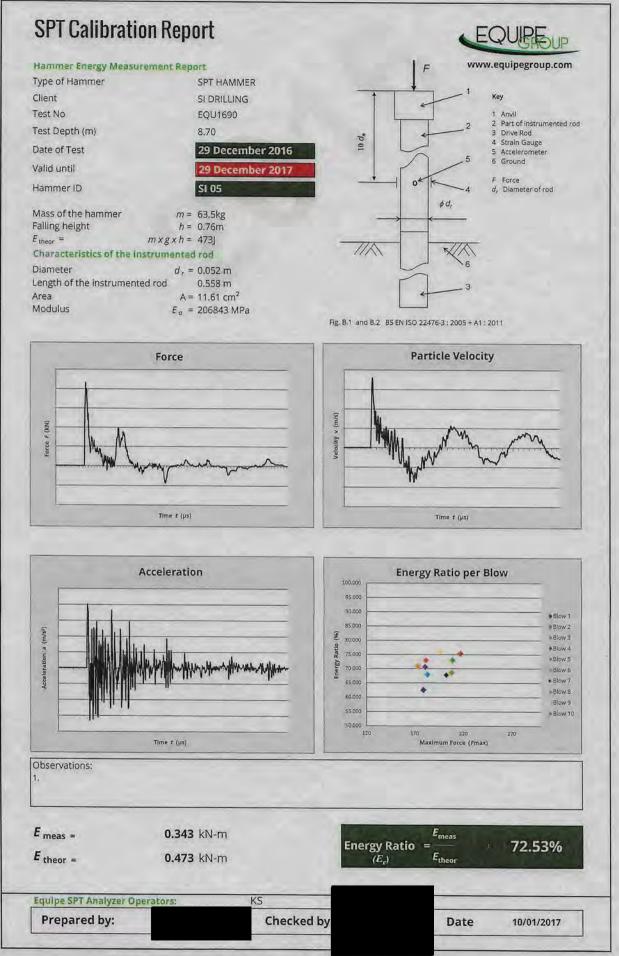
SPT hammer(s) SI 3, SI 4, SI 5

Gas monitor(s) GFM 435 s/n 11378

November 2017 Report No 3318-R002



SPT Calibration Report www.equipegroup.com Hammer Energy Measurement Report F Type of Hammer SPT HAMMER Key Client SI DRILLING EQU1694 Test No Part of instrumented rod 8.70 Drive Rod Test Depth (m) Strain Gauge 29 December 2016 Date of Test 6 Ground 29 December 2017 Valid until $\begin{array}{cc} F & \text{Force} \\ d_r & \text{Diameter of rod} \end{array}$ 4 CUT DOWN Hammer ID ød, m = 63.5 kgMass of the hammer h = 0.76m Falling height $m \times g \times h = 473$ /// Characteristics of the instrumented rod $d_r = 0.052 \,\mathrm{m}$ Length of the instrumented rod 0.558 m $A = 11.61 \text{ cm}^2$ Area Modulus $E_a = 206843 \text{ MPa}$ Fig. B.1 and B.2 BS EN ISO 22476-3: 2005 + A1: 2011 Particle Velocity Force Time t (µs) Time t (µs) **Energy Ratio per Blow** Acceleration 100,000 95.000 90 000 85.000 Blow 2 Blow 3 80.000 Blow 4 75,000 Blow 5 Energy F 70,000 Blow 6 · Blow 7 65:000 Blow 8 Blow 9 55.000 Blow 10 50.000 Maximum Force (Fmax) Time t (µs) Observations: E meas = 0.351 kN-m **Energy Ratio** 74.14% Etheor E theor = 0.473 kN-m Equipe SPT Analyzer Operators: KS Prepared by: Checked b 10/01/2017 Date



TEST DA	TE AND COND	ITIONS			
Date	21/06/2017				
Atmospheric P	997	mB			
Ambient Temp	23.0	°C			
Environics Seri	508	9			

GFM435 Final Inspection & Calibration Check Certificate



Customer	Terraconsult (South) Ltd
Certificate Number	119385
Order Number	317112

Serial Number	11378	Recalibration DUE Date
Software Version	G435-00.0024/0004	21/06/2018

		Instrum	ent Checks				
Keyboard		✓	Display Contrast	*			
Pump Flow In	400	Accept > 200 cc/min	Pump Flow @ -200mB	200	Accept > 200 cc/min		
Clock Set / Running	1		ng ✓ Labels Fitted		1		

			Gas Checks				
	CH	14	C	O_2	02		
	Instrument Gas Readings %	True Gas Value			Instrument Gas Readings %	True Gas Value	
	59.7	60	39.7	40	20.8	20.9	
	Accept +/- 3.0	00	Accept +/- 3.0	10	Accept +/- 0.5	2017	
	5.0	5	4.8	5	6.0	6	
	Accept +/- 0.3	9	Accept +/- 0.3	9	Accept +/- 0.3	Y	
Zero Reading	0.0	0.0	0.0	0.0	0.0	0.0	
100% N ₂	Accept +/- 0.0	0.0	Accept +/- 0.0	0.0	Accept + 0.1	0.0	

		Option	al Gas Check	CS				
Applied Gas & Range of GFM		Concentration	Instrument Readings (ppm)					
Gas Type	Range (ppm)	Tested @ (ppm)	Zer	o Reading	Instrument Gas Reading			
H2S	5000	1500	0	Accept +/-0.0	1500	Accept +/-5.0		
СО	2000	1000	0	Accept +/-0.0	1000	Accept +/-5.0		
				Accept +/-0.0		Accept +/-5.0		
				Accept +/-0.0		Accept +/-5.0		
Hexane	2.0%	2.0%	0	Accept +/-0.0	1.99	Accept +/-10.0		

			Cross C	as Effects				
Applied Gas (ppm)		Instrument Readings (ppm)						
Gas Type	Concentration	Toxic 1:	H2S	Toxic 2:	CO	Toxic 3:	Hex	Toxic 4:
H2S	1500	1500		0		0		
CO	1000	60 1000		0	0			
Hexane	2.0%	0		0		1.99		

	Pressure Checks				
Atr	nospheric Pressure [A	P] (mB)			
Current Atmospheric Pressure (mB)	Instrument Atmospheric Pressure Reading (mB)				
All Ports Open to Atmosphere	Open Ports	997	Accept +/- 2.0		
AP Port (Internal)	+800 mB	801	Accept +/- 5.0		
AP Port (Internal)	+1200nth	1199	Accept +/- 5.0		

Flow Checks								
Borehole Flow	Landard P.	P U (1/L)	Differential Pressure					
Applied Flow Reading (1/h)	Instrument Fi	ow Reading (l/h)	Instrument	DP Reading (Pa)	Applied DP Pressure (Pa)			
-30.0	-29.8	Accept+/-3.0	-272	Accept +/-50	-276			
-3.0	-3.1	Accept +/-1.0	-15	Accept +/-6.0	-14			
0.0	0.0	Accept +/-0.0	0.0	Accept +/-0.5	0.0			
+3.0	3.0	Accept +/-0.5	13	Accept +/-3.0	14			
+30.0	30.0	Accept +/-3.0	294	Accept +/-50	295			
+60.0	58.5	Accept +/-6.0	843	Accept +/-130	876			
+90.0	85.9	Accept +/-9.0	1616	Accept +/-250	1717			















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