RAMPION OWF

GEOTECHNICAL SURVEY

REVISION 2

FINAL RESULTS REPORT

JUNE 2016

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ISSUE AND APPROVAL CONTROL SHEET

FINAL REPORT

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ABBREVIATIONS

Abbreviation	Meaning
CD	Chart Datum
CPT	Cone Penetration Test
CPTU	Piezocone Penetration Test
CRP	Common Reference Point
DGPS	Differential Global Positioning System
EC	Export Cable
EGSi	EGS International Ltd
FLO	Fisheries Liaison Officer
HIRA	Hazard Identification and Risk Assessment
HSE	Health, Safety & Environmental
HW	High Water
IAC	Inter-Array Cable
I.D.	Identification name / number
km	Kilometre
KP	Kilometre Point
kPa	Kilo-Pascal
LAT	Lowest Astronomical Tide
LW	Low Water
m	Metre
MAG	Magnetometer
N/A	Not Applicable
OOW	Officer Of the Watch
OSGB36	Ordnance Survey Great Britain 1936
OSS	Offshore Sub Station
QC	Quality Control
ROWF	Rampion Offshore Wind Farm
UXO	Unexploded Ordnance
VC	Vibrocore

1. INTRODUCTION

1.1. PROJECT INFORMATION

Client:	E.ON Climate & Renewables UK Rampion Offshore Wind Ltd
Survey Area:	English Channel, south of Worthing (See figures 1, 2 and 3)
Survey Type:	Geotechnical
Survey Vessels:	INNE K (offshore) and VOE JARL (Inshore)
Client Project Manager:	Patrick Clark (patrick.clark@rampionoffshore.com)
Contractor Project Manager:	John Bartle (jbartle@egssurvey.co.uk)
Survey Equipment INNE K:	C-Nav 2000 Positioning System, LA100 CPT rig, MWD Winch, Rod tension winch, 10ft x 10ft CPT operations container, 6m Vibrocorer.
Survey Equipment VOE JARL:	6m Vibrocorer, C-Nav 2000 Positioning System, Hemisphere V131 Vector GNSS Heading Sensor.

1.2. PROJECT OVERVIEW

The Rampion Offshore Windfarm (ROWF) requires pre-construction geotechnical survey work to be undertaken within the offshore site, and along the Export Cable (EC) route.

The aim of the shallow geotechnical investigation is to provide additional information at specific areas in order to enable final route engineering and to investigate proposed construction jack-up vessel positions on selected turbine locations and at the OSS.

The original scope of works consisted of 8 VC and 33 CPTU locations, however in various stages a further 5 CPTU's and 1 VC were added, followed by an additional 12 CPTU's, resulting in totals of 9 VC's and 50 CPTU's. The survey vessels were instructed to demobilise before completion of the full programme, so this report details the result for 7 VC and 43 CPTU locations. The final sampling locations are shown in Figures 1-3 below; these location charts are also included in larger A3 format in Appendix A (CPTU) and Appendix F (VC).

VC locations fall along the two EC routes (Figure 1); five of the locations are at the shallow end of the EC route two are at the offshore end of the EC corridor. Some CPTU locations on the EC are co-located with the VC's (e.g. VC2 at Location 3 and CPT3) while others were sited at other points of interest (Figure 2).

Offshore CPT locations are focussed around a selection of planned wind turbine generator (WTG) locations and the OSS site (Figure 3).

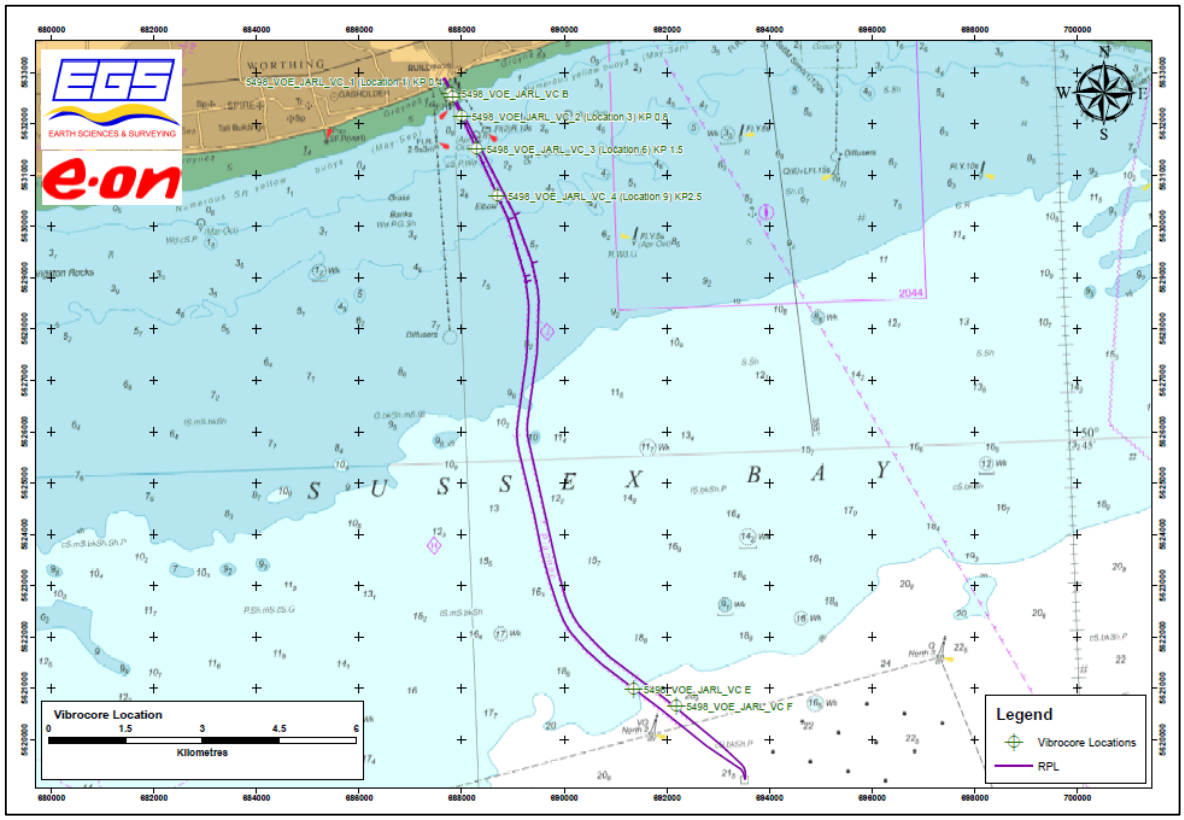

FIGURE 1: EXPORT CABLE VC LOCATIONS

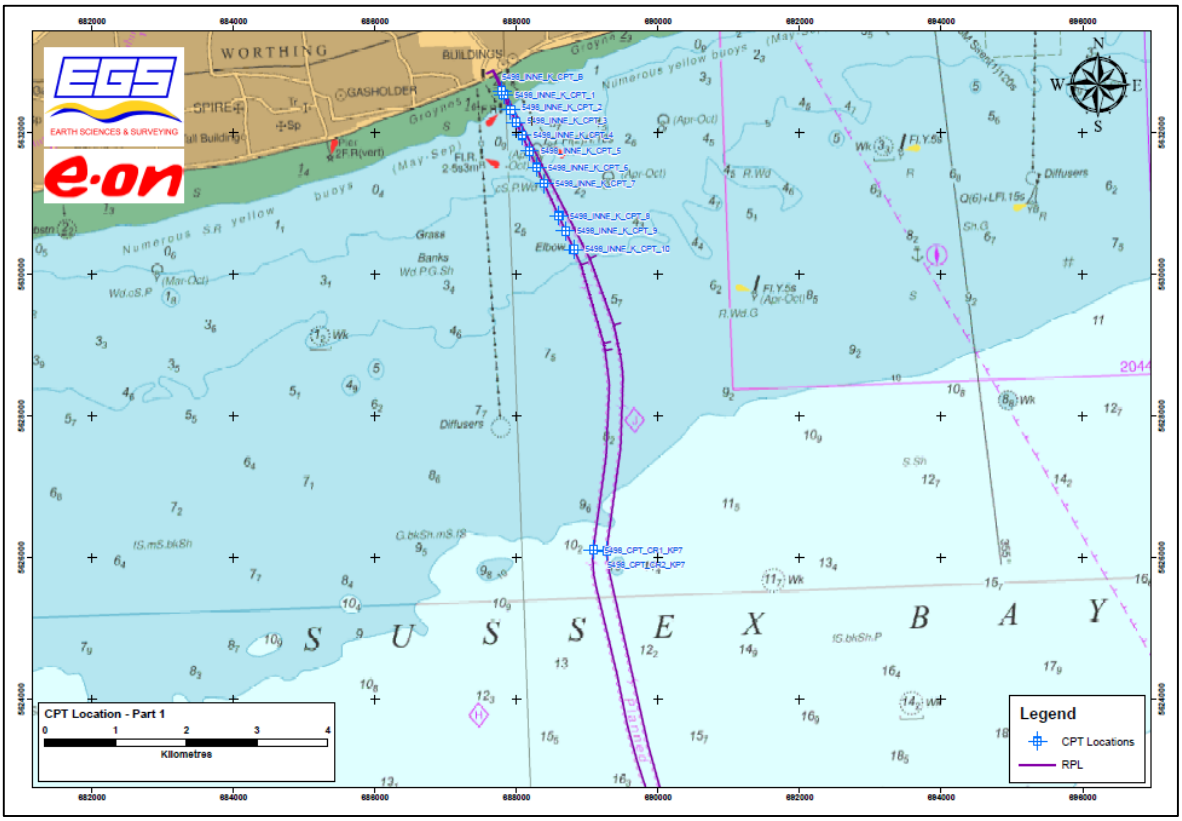

FIGURE 2: EXPORT CABLE CPTU LOCATIONS

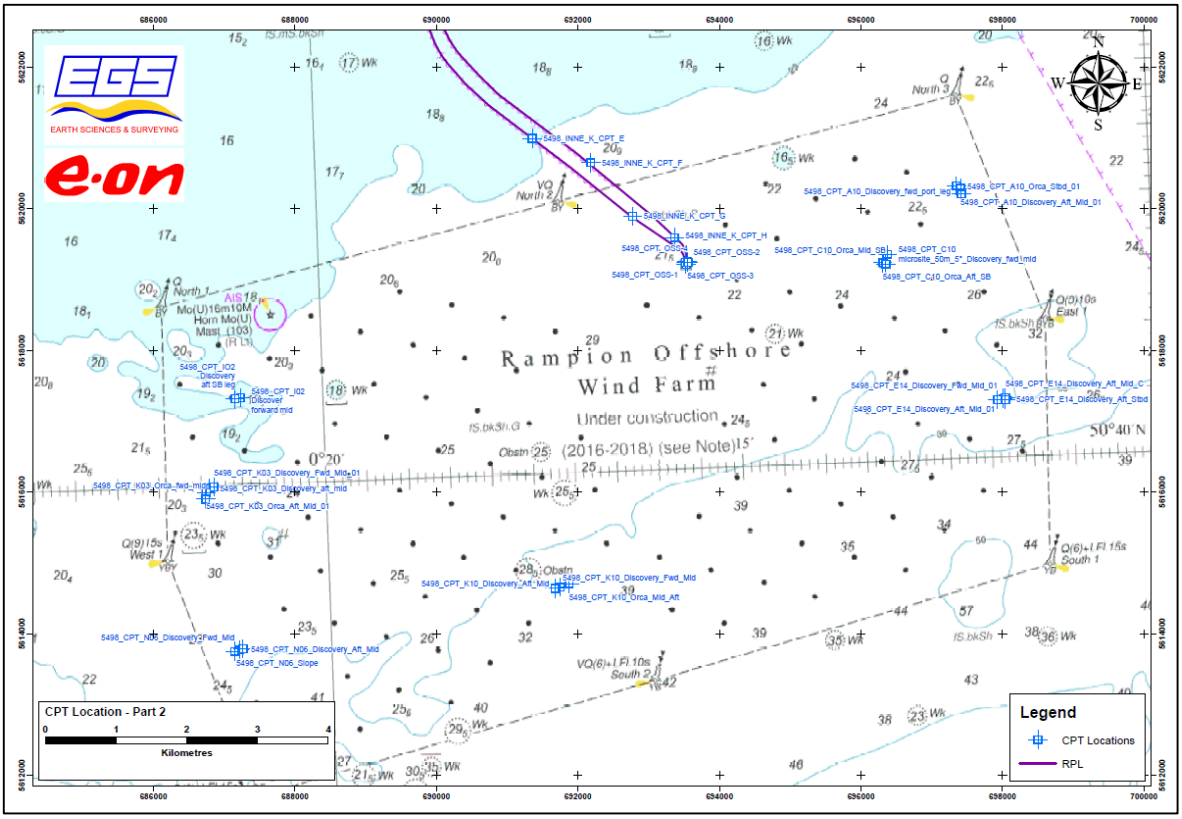

FIGURE 3: WTG AND OSS CPTU LOCATIONS

1.3. PROJECT SCHEDULE

For this project two vessels were utilised. For further details please consult the Demobilisation Report: 5498 E.ON - Rampion Geotech Demobilisation Report VOE JARL and INNE K_Rev0.

1.3.1. INNE K

- Mobilisation of equipment: 06th January to 08th January 2016
- Testing of equipment: 08th January 2016
- Survey operations: 08th January to 19th February 2016
- Demobilisation: 20th February 2016

1.3.2. VOE JARL

- Mobilisation of equipment: 11th February 2016
- Testing of equipment: 11th February 2016
- Survey operations: 11th February to 16th February 2016
- Demobilisation: 16th February 2016

2. OPERATION OVERVIEW

2.1. GENERAL OPERATIONS

The vessels operated out of Shoreham Port which has tidal restrictions to locking in and out centred on HW time.

Forty three CPTU locations were completed onboard the INNE K with 24 repeats undertaken. Seven locations were not tested, these included one from the first Variation Order of five additional and six from the second Variation Order of 12 additional. A full survey log of all CPTU locations and test positions can be found in Appendix A: CPTU Survey Logsheet & Location Plans.

Seven VC tests were completed on board the VOE JARL with five repeats. Two locations were not tested. A full log of the VC planned locations and test positions can be found in Appendix F: VC Survey Logsheet & Location Plan.

The observed water depths were taken from the vessel's single-beam echo sounder. The corrected water depths to LAT (lowest astronomical tide) were taken from the bathymetric dataset surveyed by EGSi in the summer of 2015.

The corrected water depths range from a minimal depth of -0.6m LAT at CPT B to a maximum depth of 32.1m LAT at CPT K10 Orca Mid Aft.

2.2. VESSELS

2.2.1. INNE K

The Roson LA100 Wheel driven CPT and EGS 6m Vibrocorer were mobilised to the vessel INNE K, a large Multicat type workboat with full DP2 capabilities. The vessel has a large deck space and elevated wheelhouse. The deck equipment includes two Heila HLRM cranes, one forward capable of lifting 20.5 tonnes at 14.05m extension and one aft capable of lifting 10.3 tonnes at 16.5m extension. Also onboard are a variety of winches with various load ratings of 125 tonnes, 50 tonnes and 2 x 15 tonnes.

VESSEL SPECIFICATIONS: INNE K			
Length Overall	34.0m	**Classification**	BV 1 HULL MACH (Dynapsos AM/AT) Special Service/Support Vessel & FIFI 1
Beam	13.0m	**Call Sign**	PCBS
Draught	3.0m	**Flag State**	Holland
Displacement	499t	**MMSI**	9732735
Free Deck Space	236.6 m^2	**Fuel Capacity**	220 m^3
Deck Loading	8.5 t/m^2	**Water Capacity**	87 m^3
Speed	10 knots	**Operator**	JIFMAR

TABLE 1: SUMMARY OF VESSEL SPECIFICATIONS INNE K

For efficiency during survey operations and to best utilise the available deck space, the CPT was mobilised forward, in line with the 50 tonne winch, and the Vibrocorer was mobilised aft, using the 15 tonne winch and the long reach crane.

The Vibrocorer was mobilised to the vessel with the legs extended and positioned on the aft roller with the extended legs hanging over the roller. The Vibrocorer container was positioned in the aft port corner of the vessel in order to be near to the vessel power supply. The Vibrocorer spare barrels and sleeves were mobilised further forward in order to have a safe working area around the Vibrocorer during deployments (Figure 5). Issues with deployment from the stern position were encountered due to the central position of the aft deck crane. Various work arounds were put in place to allow Vibrocorer deployment from the stern, but in the end all VC samples were taken from the VOE JARL.

The CPT operations container and winches were installed onto the deck using the deck beams as weld points. The container was positioned in away that allowed the winch wire to run safely between it and the winches (Figure 6).

The navigation suite was installed by EGSi during the mobilisation. The C-Nav 2000 antenna was mounted onto the wheelhouse roof, with a heading string taken from the vessel gyrocompass.

FIGURE 4: SURVEY VESSEL – INNE K

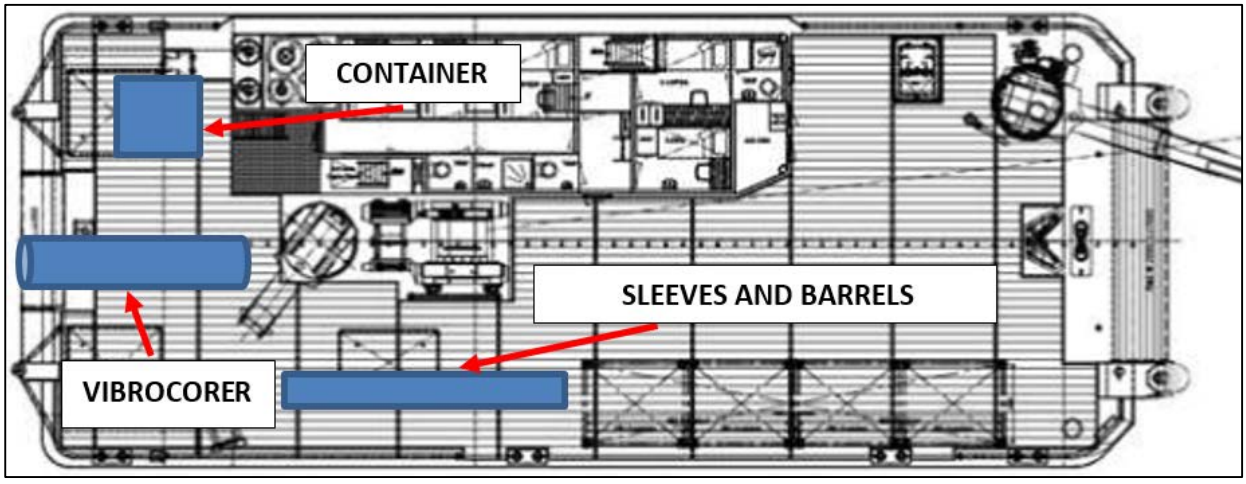

FIGURE 5: INNE K DECK LAYOUT VIBROCORER

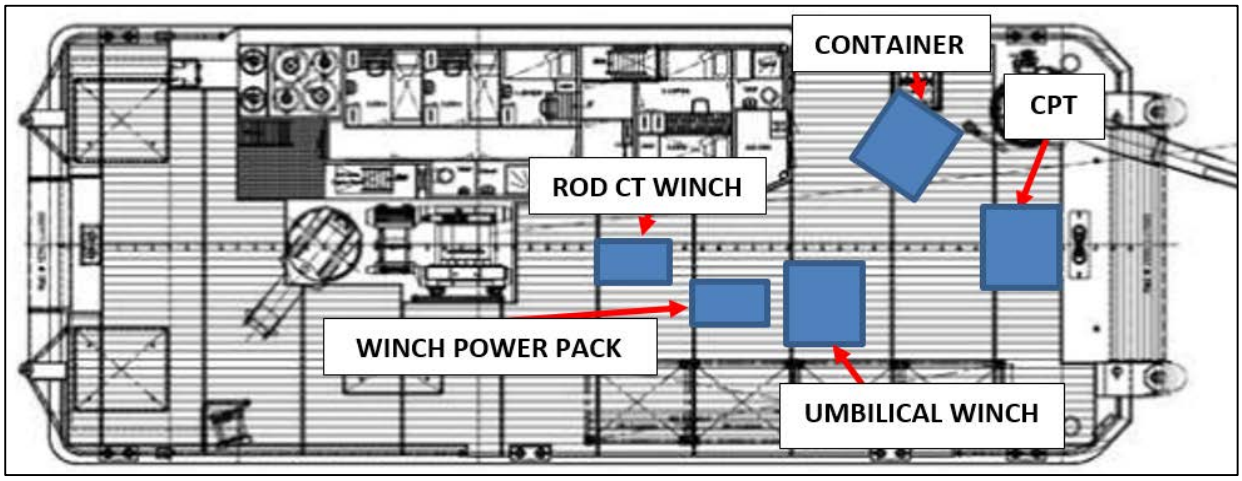

FIGURE 6: INNE K DECK LAYOUT CPT

2.2.2. VOE JARL

The EGS 6m Vibrocorer was mobilised to the vessel VOE JARL, a smaller Multicat type workboat than the INNE K. The vessel has an open deck space and elevated wheelhouse. The deck equipment includes two Effer 3S cranes, both capable of lifting 10.5 tonnes at 16m extension and a variety of winches with various load ratings of 100 tonnes, 50 tonnes and 2 x 13 tonnes.

VESSEL SPECIFICATIONS: Voe Jarl			
Length Overall	26.0m	**Classification**	Bureau Veritas Hull MACH Tug MCA Workboat
Beam	11.50m	**Call Sign**	MSBB3
Draught	2.25m	**Flag State**	UK
Displacement	515 ton (m)	**MMSI**	235.055.168
Free Deck Space	160m²	**Fuel Capacity**	110m³
Deck Loading	10 t/m²	**Water Capacity**	52m³
Speed	10 knots	**Operator**	Delta - Marine

TABLE 2: SUMMARY OF VESSEL SPECIFICATIONS VOE JARL

The Vibrocorer was mobilised to the vessel with the legs extended and positioned on the bow roller with the extended legs hanging over the roller. The Vibrocorer container was positioned in the forward port corner of the vessel in order to be near to the vessel power supply. The Vibrocorer spare barrels and sleeves were mobilised aft in order to have a safe working area around the Vibrocorer during deployments (Figure 8).

FIGURE 7: SURVEY VESSEL – VOE JARL

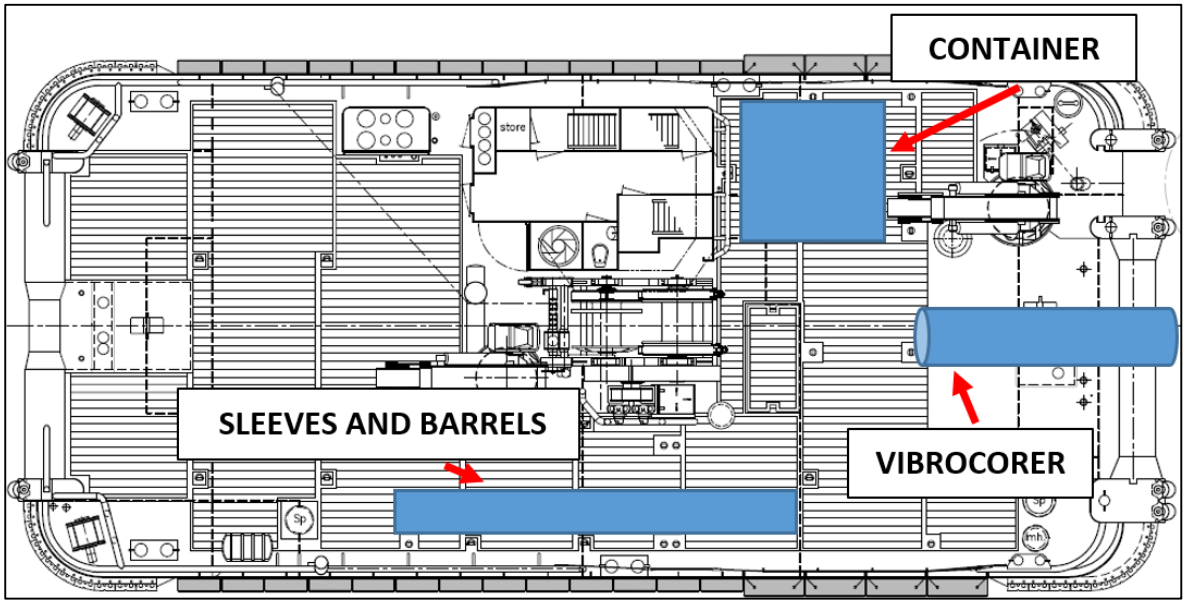

FIGURE 8: VOE JARL DECK LAYOUT VIBROCORER

2.3. EQUIPMENT

2.3.1. INNE K

EGSi and Gardline (CPT subcontractors) mobilised the following items of equipment to the vessel INNE K.

SURVEY EQUIPMENT REQUIRED	NO., MAKE & MODEL
NAVIGATION	
GPS	C-Nav 2000 DGPS
Navigation software	QPS QINSy
Heading sensor	Vessel gyro-compass (used for DP2 system)
SAMPLERS	
Vibrocorer	1 x EGS high powered Vibrocorer with 6m core barrels
CPT SYSTEM	
CPT system	1 x LA100, ROSON 100kN Wheel drive CPT
	12 x 10cm² cones
WINCHES	
Rod tension winch (Constant tension)	10mm Kevlar rope, 300mm bend radius 2000kg MBL
Umbilical Winch (Constant tension)	25mm Umbilical, 300mm bend radius, 1500kg MBL.

TABLE 3: OVERVIEW OF GEOTECHNICAL EQUIPMENT INNE K

In addition, small items and consumables required for the geotechnical survey were mobilised to the vessel. An 8ft x 8ft container containing the smaller items was installed stern of the wheelhouse and secured to the deck using chain binders.

The calibration certificates for the CPT cones are included as Appendix D.

2.3.2. VOE JARL

EGSi mobilised the following items of equipment to the vessel VOE JARL.

SURVEY EQUIPMENT REQUIRED	NO., MAKE & MODEL
NAVIGATION	
GPS	C-Nav 2000 DGPS
Navigation software	QPS QINSy
Heading sensor	V131 Vector GNSS Heading Sensor
SAMPLERS	
Vibrocorer	1 x EGS high powered Vibrocorer with 6m core barrels

TABLE 4: OVERVIEW OF GEOTECHNICAL EQUIPMENT VOE JARL

In addition, small items and consumables required for the geotechnical survey were mobilised to the vessel. An 8ft x 8ft container containing the smaller items was installed forward of the wheelhouse and secured to the deck using ratchet straps.

2.4. SURVEY PERSONNEL

2.4.1. INNE K

The geotechnical team onboard the INNE K totalled seven personnel in total at any one time, consisting of the following:

EGS	Name	Date from	Date to
Party Chief	Mike Morgan	06/01/2016	25/01/2016
Party Chief	Lawrence Andrews	25/01/2016	29/01/2016
Party Chief	Mathew Edwards	29/01/2016	10/02/2016
Party Chief	Lawrence Andrews	10/02/2016	20/02/2016
Surveyor	Owen Thomas	06/01/2016	25/01/2016
Surveyor	Benjamin Waller	06/01/2016	11/01/2016
Surveyor	Lawrence Andrews	11/01/2016	25/01/2016
Surveyor	Tom Potter	29/01/2016	19/02/2016
Surveyor	Liam Flynn	29/01/2016	10/02/2016
Surveyor	Emma Le Marchant	10/02/2016	19/02/2016
Gardline	**Name**	**Date from**	**Date to**
Geotech In Charge	Sam Harvie	06/01/2016	19/02/2016
Geotechnical Engineer	Andy Price	06/01/2016	13/02/2016
Geotechnical Engineer	James Taylor	13/01/2016	19/02/2016
Geotechnical Operator	Neil Lyden	06/01/2016	19/02/2016
Geotechnical Operator	Bharat Devlia	06/01/2016	19/02/2016
Geotechnical Operator	Ashley Cutting	11/01/2016	14/01/2016
Geotechnical Operator	Bryan Barron	14/01/2016	19/02/2016
Geotechnical Operator	Andy Burt	11/01/2016	22/01/2016
Geotechnical Operator	Aaron Rogers	22/01/2016	19/02/2016
E.ON	**Name**	**Date from**	**Date to**
Client Representative	Dean Leach	09/01/2016	10/02/2016
FLO	Wesley Keenan	09/01/2016	10/02/2016

TABLE 5: SURVEY PERSONNEL ONBOARD INNE K

2.4.2. VOE JARL

The geotechnical team onboard the VOE JARL totalled four personnel in total at any one time, consisting of the following:

EGS	Name	Date from	Date to
Party Chief	Mathew Edwards	11/02/2016	12/02/2016
Surveyor/Party Chief	Liam Flynn	11/02/2016	16/02/2016
Geophysicist	Caroline Kirstein	11/02/2016	16/02/2016
Geotechnical Operator	Charles Page	11/02/2016	16/02/2016
Geotechnical Operator	Mike Morgan	15/02/2016	16/02/2016
E.ON	**Name**	**Date from**	**Date to**
Client Representative	Stephen Parry	11/02/2016	11/02/2016
Client Representative	Patrick Clark	16/02/2016	16/02/2016

TABLE 6: SURVEY PERSONNEL ONBOARD VOE JARL

2.5. MOBILISATION

2.5.1. INNE K

Mobilisation was carried out between the 06th and the 08th January 2016 at the lay-by berth in Shoreham Port. The job specific HSE meetings and safety inspections were conducted during this time.

The CPT trial lifts and wet testing were completed on the 8th of January with the vessel operational with the CPT from this point. Trial lifts for the VC were completed during this time however the procedure needed refining.

A full HIRA and E.ON induction was completed by all persons onboard on the 11th of January. The induction was given by Justin Hewlett from E.ON.

On the 10th February 2016, the INNE K was completely demobilised on order from EGSi, this was subsequently reversed and the vessel was remobilised with the navigation and CTP equipment only. At this point, the VC equipment was mobilised onto the VOE JARL.

2.5.2. VOE JARL

Mobilisation was carried out on the 11th February 2016 at the lay-by berth in Shoreham Port. The job specific HSE meetings and safety inspections were conducted on this day.

The VC trial lifts and wet testing were completed on the 11th of February with the vessel operational from this point.

A full HIRA and E.ON induction was completed by all persons on-board on the 11th of February. The induction was given by Stephen Parry from E.ON.

2.6. DIARY OF EVENTS

2.6.1. INNE K

Table 7 below, provides a diary of events for the INNE K during operations on the ROWF. A more detailed log of these events is available Appendix J: INNE K DPR's

Date	Time	Key Event
06th January 2016	08:00 – 20:00	Mobilisation of CPT and VC Vessel safety inspections
07th January 2016	08:00 – 22:00	Continued Mobilisation Pre-job safety meetings
08th January 2016	07:00 – 22:30	Continued Mobilisation CPT wet tested Trial deployment for VC
09th January 2016	08:00 – 12:00 12:00 – 24:00	Mobilisation completed Vessel on hire, standing by for weather.
10th January 2016	00:00 – 24:00	Vessel on weather standby Shoreham port
11th January 2016	00:00 – 24:00	Vessel on weather standby Shoreham port HIRA meeting completed
12th January 2016	00:00 – 24:00	Vessel on weather standby Shoreham port
12th January 2016	00:00 – 11:57 11:57 – 15:30 15:30 – 24:00	Vessel on weather standby Shoreham port Vessel on weather standby Rampion OWF Vessel on weather standby Shoreham port
13th January 2016	00:00 – 24:00	Vessel on weather standby Shoreham port
14th January 2016	00:00 – 24:00	Vessel on weather standby Shoreham port
15th January 2016	00:00 – 03:00 03:00 – 24:00	Vessel on weather standby Shoreham port Vessel on weather standby Rampion OWF
16th January 2016	00:00 – 09:51 12:15 12:44 14:58 20:33 20:49	Vessel on weather standby Rampion OWF CPT_10 Completed CPT_10_a Completed CPT_B Completed CPT_E Completed CPT_E_a Completed
17th January 2016	00:40 05:58 – 13:57 13:57 – 24:00	CPT_F Completed Vessel on weather standby Rampion OWF Vessel on weather standby Shoreham port
18th January 2016	00:00 – 21:35 21:35 – 24:00	Vessel on weather standby Shoreham port Vessel on weather standby Rampion OWF
19th January 2016	00:00 – 08:00	Vessel on weather standby Rampion OWF

	12:44	CPT_NO6_Disc_Aft_Mid Completed
	13:57	CPT_NO6_Disc_Fwd_Mid Completed
	17:59	CPT_K10_Disc_Fwd_Mid Completed
	18:11	CPT_K10_Fwd_Mid_a Completed
	20:02	CPT_K10_Disc_Aft_Mid Completed
	20:32	CPT_K10_Disc_Aft_Mid_a Completed
20th January 2016	00:17	CPT_E14_Disc_Aft Completed
	01:04	CPT_E14_Disc_Fwd Completed
	04:16	CPT_H Completed
	11:27	CPT_8 Completed
	11:58	CPT_8_a Completed
	12:44	CPT_9 Completed
	13:00	CPT_9_a Completed
	16:04	CPT_7 Completed
	16:45	CPT_7a Completed
	17:30	CPT_6 Completed
	18:11	CPT_6a Completed
	23:02	CPT_G Completed
21st January 2016	03:19	CPT_H Completed
	08:20	CPT_1 Completed
	08:35	Vessel on weather standby Rampion OWF
	12:28	Vessel on weather standby Shoreham port
22nd January 2016	00:00 – 24:00	Vessel on weather standby Shoreham port
23rd January 2016	00:00 – 07:50	Vessel on weather standby Shoreham port
	07:50 – 20:25	Vessel on weather standby Rampion OWF
	20:25 – 24:00	Vessel on weather standby Shoreham port
24th – 27th January 2016	00:00 – 24:00	Vessel on weather standby Shoreham port
28th January 2016	00:00 – 04:20	Vessel on weather standby Shoreham port
	04:20 – 07:40	Vessel on weather standby Rampion OWF
	09:33	CPT_K03_Orca_Mid_01 Completed
	10:21	CPT_K03_Disc_Aft_Mid Completed.
	11:48 – 15:08	Vessel on weather standby Rampion OWF
	15:08 – 24:00	Vessel on weather standby Shoreham port
29th – 30th January 2016	00:00 – 24:00	Vessel on weather standby Shoreham port
31st January 2016	00:00 – 03:12	Vessel on weather standby Shoreham port
	03:12 – 12:46	Vessel on weather standby Rampion OWF
	12:46 – 24:00	Vessel on weather standby Shoreham port
01st – 03rd February 2016	00:00 – 24:00	Vessel on weather standby Shoreham port
04th February 2016	00:00 – 19:04	Vessel on weather standby Shoreham port
	19:04 – 24:00	Vessel on weather standby Rampion OWF
05th February 2016	00:00 – 09:29	Vessel on weather standby Rampion OWF
	09:29 – 24:00	Vessel on weather standby Shoreham port
06th – 09th February 2016	00:00 – 24:00	Vessel on weather standby Shoreham port
10th February 2016	00:00 – 11:00	Vessel on weather standby Shoreham port
	11:00 – 14:45	CPT and VC fully demobilised

	14:45 – 22:00	CPT fully remobilised
	22:00 – 24:00	Vessel on weather standby Shoreham port
11th February 2016	00:00 – 02:16	Vessel on weather standby Shoreham port
	02:16 – 04:55	Vessel on weather standby Rampion OWF
	07:38	CPT_I02_Disc_Fwd_Mid Completed
	08:36	CPT_I02_Disc_Aft Stbd_leg Completed
	11:37	CPT_K03_Disc_Fwd_Mid_01 Completed
	12:33	CPT_K03_Orca_Fwd_Mid Completed
	14:38	CPT_N06_Slope Completed
	18:05	CPT_K10_Orca_Mid_Aft Completed
	23:50 – 24:00	Vessel on weather standby Rampion OWF
12th February 2016	00:00 – 24:00	Vessel on weather standby Rampion OWF
13th February 2016	00:00 – 14:29	Vessel on weather standby Rampion OWF
	14:29 – 24:00	Vessel on weather standby Shoreham port
14th February 2016	00:00 – 12:23	Vessel on weather standby Shoreham port
	12:23 – 14:00	Vessel on weather standby Rampion OWF
	14:28	CPT_3 Completed
	15:22	CPT_1_a Completed
	16:01	CPT_2 Completed
	16:36	CPT_4 Completed
	18:43 – 24:00	Vessel on weather standby Rampion OWF
15th February 2016	00:00 – 04:41	Vessel on weather standby Rampion OWF
	04:44	CPT_4_a Completed
	05:16	CPT_4_b Completed
	06:30	CPT_5 Completed
	11:55	CPT_A10_Orca_Stbd_01 Completed
	18:39	CPT_A10_Disc_Aft_Mid_01 Completed
	20:05	CPT_A10_Disc_Fwd_Port_leg Completed
	20:36	CPT_A10_Disc_Fwd_Port_leg_a Completed
	21:46	CPT_A10_Orca_Stbd_01_a Completed
	22:36	CPT_A10_Orca_Stbd_01_b Completed
	23:54	CPT_C10_Micro_50_5deg_Disco_Fwd_Mid Completed
16th February 2016	04:45	CPT_C10_Micro_50_5deg_Disco_Fwd_Mid_a Completed
	05:52	CPT_C10_Orca_Aft_SB Completed
	06:16	CPT_C10_Orca_Aft_SB_a Completed
	10:29	CPT_C10_Orca_Mid_SB Completed
	11:00	CPT_C10_Orca_Mid_SB_a Completed
	17:04	CPT_E14_Disc_Aft_Stbd Completed
	17:40	CPT_E14-Disc_Aft_Stbd_a Completed
17th February 2016	02:37	CPT_E14-Disc_Aft_Stbd_a Completed
	05:11 – 16:55	Vessel on weather standby Rampion OWF
	16:55 – 24:00	Vessel on weather standby Shoreham port
18th February 2016	00:00 – 06:14	Vessel on weather standby Shoreham port
	06:14 – 07:44	Vessel on weather standby Rampion OWF

	16:13	CPT_CR2_KP7 Completed
	16:59	CPT_CR1_KP7 Completed
	17:05	CPT_CR1_KP7_a Completed
19th February 2016	01:42	CPT_OSS_2 Completed
	06:36	CPT_OSS_2_a Completed
	07:02	CPT_OSS_3 Completed
	07:17	CPT_OSS_3_a Completed
	10:07	CPT_OSS_4 Completed
	10:15	CPT_OSS_4_a Completed
	10:50	CPT_OSS_1 Completed
	10:58	CPT_OSS_1_a Completed
	13:30 – 19:41	Vessel on weather standby Rampion OWF
	17:30	Instruction given to demobilise
	19:41 – 24:00	Vessel on weather standby Shoreham port
20th February 2016	00:00 – 08:00	Vessel on weather standby Shoreham port
	08:00 – 14:10	Vessel demobilised

TABLE 7: INNE K DIARY OF EVENTS

2.6.2. VOE JARL

Table 8 below, provides a diary of events for the VOE JARL during operations on the ROWF. A more detailed log of these events is available Appendix K, VOE JARL DPR's

Date	Time	Key Event
11th February 2016	08:00 – 09:15	Mobilisation of VC
	09:15	Vessel safety inspections
	09:20	Pre-job safety meetings
	13:30 – 14:03	VC wet tested
	17:28	VC_E Completed
	18:51	VC_E_a Completed
	20:01	VC_F Completed
	20:56	VC_F_a Completed
12th February 2016	10:54	Vessel transiting to site
	10:54 – 12:35	Vessel on weather standby Rampion OWF
	12:35 – 21:30	Vessel on weather standby Shoreham port
13th – 14th February 2016	08:00 – 20:00	Vessel on weather standby Shoreham port
15th February 2016	16:15	VC_B Completed
	17:06	VC_1 Completed
	17:38	VC_1_001 Completed
	18:11	VC_2 Completed
16th February 2016	07:11	VC_1_002 Completed
	08:07	VC_3 Completed
	08:42	VC_3_001 Completed
	09:27	VC_4 Completed
	09:42	Instruction given to demobilise
	17:04	Demobilisation complete

TABLE 8: VOE JARL DIARY OF EVENTS

2.7. DEMOBILISATION

2.7.1. INNE K

The instruction to demobilise the INNE K was received on the 19th February 2016. At the time the vessel was on weather standby on site, waiting for the lock into Shoreham Port. The weather forecast conditions looked poor for the upcoming period. The navigation software and equipment was demobilised during the locking-in period and the following transit to the berth whilst in the port. The CPT equipment was demobilised on the 20th February 2016 and all survey personnel departed the vessel by 14:10.

2.7.2. VOE JARL

The instruction to demobilise the VOE JARL was received on the 16th February 2016. At the time the vessel was on equipment downtime at sea. The vessel was fully demobilised on return to Shoreham.

2.8. HSE

2.8.1. INNE K

Prior to mobilisation commencing on the INNE K, the site safety file was submitted to EON for review and comment, no comments received. At the clients request the vessel underwent a pre-service audit on 31st December 2015 by their competent service provider whilst berthed at Gunwharf, Portsmouth.

On the 5th January 2016, a preliminary Health and Safety briefing was undertaken as part of the mobilisation kick off meeting by Mark Lyden (HSEQ Manager EGSi), attendees were: E.ON Representatives, the INNE K Marine Crew, Gardline and EGSi Surveyors. This meeting set a good standard for the way forward regarding safety, in particular heavy lifts. All site personnel were inducted onto the vessel and as required the EON Site Safety Induction was undertaken by all.

EGSi Site Safety Rules were implemented and administered by Supervisors to ensure that from the onset of the mobilisation that safety remained at the forefront of operations. Mobilisation processes included: Heavy Lifts, Hot Works and Equipment Preparation, as required “time out for safety” and a stop work policy was implemented to prevent injury or and damage. All individual lifts were subject to a lift plan reviewed by the Client Rep and approved by the Master, all lifts were successful and posed no risk to either people or equipment. During various lifts, it was observed that depending on the radius and the weight of the lift the forward crane “tripped out”, this was brought to the immediate attention of the Master and a competent service provider called to investigate the problem. Resetting the crane could take approximately 10 minutes. It was decided to mark the crane arm with a noticeable line to prevent operators nearing the point of ‘trip’. During mobilisation, several safety observation cards were raised and closed during various onboard meetings.

An onboard HIRA meeting was scheduled during mobilisation, prior to the operational phase of the project commencing. This was chaired by Mark Lyden (HSEQ Manager EGSi) in the form of a presentation the following agenda was covered and consulted amongst all attendees (EON, EGSi, Marine Crew and Subcontractors) Policy, PPE Project Risk Assessments, Reporting Procedures, Safe Systems of Work, Method Statements, Safety Observation Cards (Close Out) Emergency Response Plan Proactive and Reactive Safety Tools Organisation, Monitoring and Review and various site safety arrangements. The meeting was minuted and the HIRA adjusted to reflect further controls and inputs from all parties.

On completion of the meeting, all project personnel underwent a robust vessel induction on completion a series of "dry" survey equipment deployment and recovery exercises (CPT), which permitted a final review and verification of the Method Statements and identification of any further controls to prevent injury or damage.

After a period of weather standby the INNE K slipped ropes from Shoreham and proceeded through the lock to the ROWF site and commenced CPT Operations.

One HSE incident was recorded during operations; during a CPTU test, on 16th January 2016, the vessel lost DP2 positioning, this led to an emergency recovery of the CPT rig – all equipment was recovered and secured on deck.

EGSi IRF 01 2016 Summary and Close Out

Incident Summary:
Loss of DP2 on vessel INNE K due to loss of GPS to system. This has been reported to happen during the period of Sunrise/Midday and Sunset. Officer on Watch immediately took manual control of the vessel and maintained vessel in vicinity of CPT rig. Deck foreman Andy Burt ordered crane and deck operations for an emergency lift of the CPT rig from the seabed to prevent any potential damage or loss of rods and cone.

Initial Actions:
As noted above: Deck foreman Andy Burt ordered the crane operator to manoeuvre the crane so it was over head of the CPT using the angle of the 9m wire pennant as a reference point. Once the rod was fully retracted the CPT was immediately lifted from the seabed to prevent any damage. Possible damage/loss of CPT cone, rods and telemetry cable.

Preventative Measures Implemented
As required due to the technicality of this problem, this was incident was further followed-up by the EGSi project manager (John Bartle), the vessel Master and owner. Please note summary from JIFMAR/Master -Regarding the loss of position which happens on the 16th January at 12h42 UTC. "We had a 3,5mtrs off position, this happens due to a GPS jump, which happen often at noon time and also at sunset and sunrise. To avoid this happens again, we have reduce the rejection limit of GPS and in addition, to have a redundancy of satellite we have log the system on East satellite and AORE (Atlantic Ocean Region East) satellite. I had a long conversation with technician this morning, changing few settings on GPS receiver, he told me that with these new settings, it will not happen again."

2.8.2. VOE JARL

Towards the latter part of the project, it was decided to use a second vessel (VOE JARL) primarily to undertake VC works only. The VOE JARL was successfully mobilised. As with the previous mobilisation on the INNE K, the same health and safety protocols were implemented, monitored and reviewed. No further incidents were reported during this operation.

3. RESULTS

3.1. CPTU

3.1.1. GENERAL RESULTS

Seabed CPTU operations were carried out in accordance with ISO 22467-1:2012 Geotechnical Investigation and Testing – Field testing: Part 1. The majority of CPTUs carried out were within application Class 1, however there were a few with both application Class 2 and Class 3 depending on the soil conditions. All testing was completed using 10cm^2 CPTU piezo cones with a 100kn wheel drive CPT.

43 CPTU test locations were completed, with 24 repeats; Acquisition Log Sheets and Location Plans can be found in Appendix A.

Target penetration was 15m for the WTG locations and 4m in the EC route, repeat tests were required if the processed data achieved less than 12m and 3.5m respectively. One retest was carried out if the target penetration was not reached or the test was stopped. An additional retest was carried out if the initial or repeat test was stopped due to communication or equipment issues. Repeat are identified with the suffix "_a" and "_b". The retest positions are approximately 5m away from the original location.

Soil conditions for these tests varied greatly throughout the site and results were comprised of the following

- Loose to dense silty SAND
- Low to medium strength CLAY with rare gravel
- Dense to very dense CHALK (EC route area only)
- Lose to dense silty SAND
- Interbedded medium strength to extremely high strength CLAY and dense to very dense silty locally gravelly SAND
- Interbedded dense to very dense silty clayey locally gravelly SAND and high to extremely high strength sandy CLAY

Interpreted CPTU logs can be found in Appendix B. Interpretation methodology is given in Appendix C.

Cone calibration certificates and cone offset data is given in Appendix D and Appendix E respectively.

3.1.2. DISCUSSION OF RESULTS

The method of deployment used for the CPT rig restricted the number of complete deck-to-deck zero readings taken. Frequent downtime would have been accrued in dismantling the cables and rods to achieve deck offsets. As a result the CPT was only recovered to deck when

required to perform cone changes. A full log of the CPTU cone offsets and deck zeros acquired can be found as Appendix E.

The majority of CPTUs conducted were within application Class 1; however eight CPTUs conducted were within application Class 2. Five CPTUs conducted were within application Class 3. Generally if a test was completed and the application was Class 3 the cone was either changed or cleaned and maintained before conducting a re-test. In general, the zero reading offsets were good. The very dense sands, extremely high strength clay and chalk with gravel or flint pushed the CPT cones near to, or above, their normal working parameters. Often the cones recovered from within acceptable limits to calibrated zeroes after being allowed to stand idle for a period of time after the test. In the case where cone zeroes took a while to recover a new test was not conducted until the operator and engineer were satisfied the cone had returned to pre-test values. At locations CPT_H and CPT_4 unresponsive pore pressure readings were seen during the test are thought to be due to the impact of high pore pressures encountered in the previous tests. On completion of such tests the cone was changed and location re-tested. At all locations the cone resistance and sleeve friction measurements showed excellent responsiveness to layer changes and to the presence of small fragments of gravel or flint, indicative of good sensor response and sensitivity.

3.1.3. DATA PRESENTATION

The CPTU results are presented in the Interpreted Logs in Appendix B.

The Measured Plot presents the following data:

- Cone resistance – q_c
- Sleeve friction – f_s
- Pore pressure – u_2
- Ambient pore pressure
- Cone inclination – ^{o}
- Corrected cone resistance – q_t
- Sleeve friction – f_s
- Normalised friction ratio - F_r
- Pore pressure ratio - B_q

3.2. VIBROCORES

3.2.1. GENERAL RESULTS

7 locations were sampled with 5 repeat cores being taken. A Survey Logsheet and Location Plan can be found in Appendix F.

3.2.2. SITE RESULTS AND ANALYSIS

Preliminary descriptions of each core were logged onboard during survey operations. Table 27 summarises these results. Additionally, onboard unconfined compressive strength (pocket penetrometer), shear strength (torvane) and where possible temperature tests were carried out. These results are can also be found in the table below:

Core ID	Description
5498_VOE_JARL_VC 1 (Location 1)	Top: Brown coarse sand and gravel
	Only surface sediment recovered
5498_VOE_JARL_VC 1_001 (Location 1)	Top: Brown coarse sand and gravel
	Only surface sediment recovered
5498_VOE_JARL_VC 1_002 (Location 1)	Surface: Brown silty SAND with gravel (20cm) Bottom: Very fine grey silt/clay
	Strength (kg/cm^2): 0.25 (0-1m) 0.1 (1-2.25m)
	Shear (kN/m^2): 7.5 (0-1m) 3 (1-2.25m)
	Temp (W/MK): 6.31/2.72 (SD:0.2)
5498_VOE_JARL_VC B	Top/surface - brown coarse sand and gravel (20cm)
	Bottom- Soft grey clay.
	Strength (kg/cm^2): 1.5 (0-1m) 0 (1-2m) 0.5 (2-3m)
	Shear (kN/m^2): 4.5 (0-1m) 2.5 (1-2m) 3 (2-3m)
5498_VOE_JARL_VC 2 (Location 3)	Bottom: Very fine grey silt/clay
	Strength (kg/cm^2): 0.25 (0-1m) 0.1 (1-2.25m)
	Shear (kN/m^2): 7.5 (0-1m) 3 (1-2.25m)
	Temp (W/MK): 6.31/2.72 (SD:0.2)
5498_VOE_JARL_VC 3 (Location 6)	Surface: Brown silty SAND with gravel (20cm) - only top layer then white, soft CHALK
	Bottom: White, soft chalk.
	Strength (kg/cm^2): max - 4.5 (0-1m) 3.5 (1-1.5m)
	Shear (kN/m^2): Too much gravel to carry out test (0-1m) 8.5 (1-1.5m)
5498_VOE_JARL_VC 3_001 (Location 6)	Soft, white chalk from surface to 3m. 3m-3.8m - hard chalk.
	Strength (kg/cm^2): max - 4.5 (0-1m, 1-2m, 2-3m, 3-3.8m)
	Shear (kN/m^2): 4.5 (0-1m) 4.5 (1-2m) 6 (2-3m) max (3-3.8m)
5498_VOE_JARL_VC 4 (Location 9)	Soft Chalk with flint and harder chalk fragments
5498_VOE_JARL_VC E	Top - Very compact brown sand, shell fragments (1cm) and gravel (25cm)
	Bottom - Very dense/stiff grey clay
	Core catcher missing

	Analysis not taken
5498_VOE_JARL_VC E_001	Top - Coarse sand with shell fragments (1cm)
	Bottom - Dense/stiff/consolidated grey clay
	Analysis not taken
5498_VOE_JARL_VC F	Top - Coarse brown sand with shell fragments (1cm)
	Bottom- Fine grey/brown silty sand
	Water in sample
	Strength (kg/cm^2): 0 - wet sand
	Shear (kN/m^2): n/a
	Temp (W/MK): 8.32/11.28
5498_VOE_JARL_VC F_001	Failed sample - no sediment recovered

TABLE 9: SUMMARY OF PRELIMINARY CORE DESCRIPTIONS AND TEST RESULTS

On site temperature tests were not carried out on all cores as it was not possible to get the Hukseflux thermal conductivity probe to stabilise during some tests.

3.2.3. FULL SAMPLE DESCRIPTIONS & LABORATORY TESTS RESULTS

Core Logs with photographs and visual sample descriptions can be found in Appendix G. The front section of the appendix details the longer core sections, while the back section has descriptions of bag samples from very short cores, or from any sample retained in the cutting shoe.

Collated results between VC logs and co-located CPTU's are given in Appendix H. These also include summarised information on the laboratory tests.

Results of laboratory tests carried out on selected core sections are presented in Appendix I.