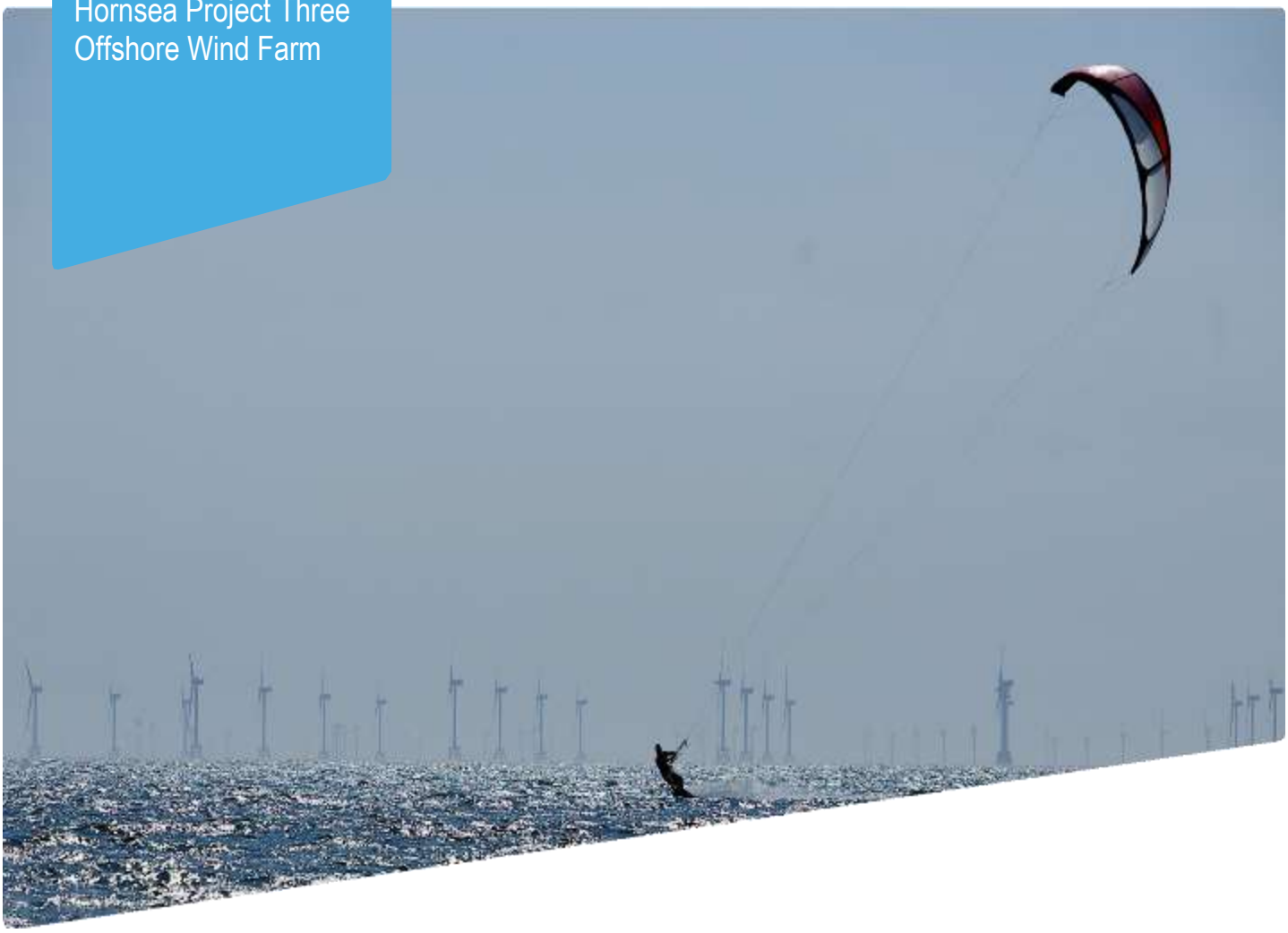
Hornsea Project Three
Offshore Wind Farm



Hornsea Project Three

Offshore Wind Farm

Appendix 26 to Deadline I submission – Onshore HVDC Converter/HVAC Substation Infiltration Report

Date: 7th November 2018

Hornsea 3
Offshore Wind Farm

Ørsted

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Front cover picture: Kite surfer near a UK offshore wind farm © Ørsted Hornsea Project Three (UK) Ltd., 2018.

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Acronyms

Acronym	Description
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
LLFA	Lead Local Flood Authority
M bgl	Metres below ground level

1. Introduction

Background

1.1 RPS was commissioned by Ørsted Hornsea Project Three (UK) Ltd (the Applicant) to undertake soil infiltration testing at the onshore HVDC converter/HVAC substation area. The onshore HVDC converter/HVAC substation forms part of the onshore infrastructure for the Hornsea Project Three Offshore Wind Farm (hereafter referred to as Hornsea Three).

1.2 In their Section 42 response, Norfolk County Council (as the Lead Local Flood Authority (LLFA)) requested an outline drainage strategy as part of the final application and further ground investigation work, including infiltration testing. A conceptual surface water drainage strategy for the onshore HVDC converter/HVAC substation was submitted as part of the Development Consent Order (DCO) application (Volume 6, Annex 2.1: Onshore Infrastructure Flood Risk Assessment of the Environmental Statement (Document Reference A6.6.2.1)) and included the option to discharge surface water run-off into ground via soakaways. Storage will be provided within the onshore HVDC converter/HVAC substation area for up to 1 in 100 year plus 40 % climate change event. Infiltration testing and ground investigations are typically undertaken post consent during the detailed design stage. However, to assist in discussions on the principles of the drainage strategy with the LLFA and to inform detailed drainage design for the onshore HVDC converter/HVAC substation, preliminary infiltration testing has been undertaken, the results of which are reported in this document.

Site description

1.3 The onshore HVDC converter/HVAC substation area is located at National Grid Reference TG 21000 03541 approximately 5.6 km south west of Norwich City Centre. Access to the onshore HVDC converter/HVAC substation is currently provided off the B1113 (Main Road). The onshore HVDC converter/HVAC substation and associated permanent infrastructure will occupy an area up to 14.9 ha.

1.4 The onshore HVDC converter/HVAC substation area comprises arable land and at the time of the investigation it was occupied by crop stubble. The onshore HVDC converter/HVAC substation is bounded by the Norwich Southern Bypass (A47) to the north, which bridges the B1113 at the north west corner. At this location, there is a steep embankment sloping down into the onshore HVDC converter/HVAC substation area at the boundary. The B1113 bounds the HVDC converter/HVAC substation area to the west.

1.5 The onshore HVDC converter/HVAC substation area generally slopes gently downwards towards the north west; the lowest points are in the north eastern corner adjacent to the B1113. A small depression on the eastern boundary approximately 2 m lower than the adjacent B1113 was observed. The base of the depression was dry and overgrown at the time of the investigation. No other drainage ditches or watercourses were observed. A filter drain extends parallel to the onshore HVDC converter/HVAC substation area's northern boundary. Several manhole grates were noted along the filter drain.

2. Infiltration Testing Methodology

Best Practice Guidance

2.1 The infiltration testing was undertaken in accordance with BRE Digest 365 Soakaway design (Garvin, 2016). The guidance recommends that test pits for infiltration testing are excavated in the locations where soakaways are proposed and that the pits should have vertical sides. The guidance does not specify the depth of the test pit but suggests that the depth should be in-line with the depth of the proposed soakaway and should also take into account the character of the underlying strata.

2.2 Test pits are then filled with water and allowed to drain three times and the lowest infiltration value is used to calculate the infiltration rate.

2.3 Infiltration is calculated by using the time taken for water to drain from 75% fill level to 25% fill level, based on equations in BRE Digest 365. The calculation assumes that the volume of the test pits remains consistent throughout the test, therefore, when sudden or catastrophic collapse of the pits occurs (i.e. due to the instability of the pits) the test is terminated.

2.4 In some cases, it may not be possible to undertake three tests as the water in the test pit does not drain away. This occurs where there is limited or no infiltration and repeated testing will not change the outcome. Equally if the test pit is found to be unstable then repeating the tests may not be practical.

Fieldwork

2.5 A total of ten trial pits were excavated for the purpose of undertaking infiltration testing between the 20 August 2018 and 22 August 2018. The location of the infiltration test pits was based on the indicative layout of the onshore HVDC converter/HVAC substation (as shown in Appendix B of Volume 6, Annex 2.1: Onshore Infrastructure Flood Risk Assessments (Document Reference A6.6.2.1)) and the potential location of soakaways.

2.6 Several pits around the location of SA1 partially or totally collapsed during testing due to instability of the underlying granular soils. As a result, three additional test pits were excavated in this area: SA1a, SA1b and SA1c.

2.7 In addition, a single trial pit was excavated to a depth of 3.2 m bgl to confirm the geological sequence. Based on the strata encountered in this location (i.e. less granular and therefore, potentially more stable), an additional test pit SA8 was excavated to the south of SA1.

2.8 Infiltration test pits were excavated to a maximum depth of 3.6 m bgl: most of the pits (seven) were excavated to 3.4 m bgl, one pit was 3.3 m bgl; one pit was 3.6 m bgl; and the shallowest pit was 2.2 m bgl. A shallower depth was used in this location (SA8) to coincide with the depth of the less granular strata in order to confirm if infiltration was feasible.

2.9 The pits were backfilled with the excavation arisings upon completion of the infiltration testing.

2.10 The location of the onshore HVDC converter/HVAC substation area, and the infiltration test pits/trial pit are shown in Figure 1.1 and Figure 1.2 respectively.

3. Results

Ground conditions

3.1 The ground conditions encountered were consistent with the anticipated geology based on the British Geological Survey online mapping and as outlined in Volume 3, Chapter 1: Geology and Ground Conditions of the Environmental Statement (Document Reference A6.3.1). Ground conditions encountered during the infiltration testing comprised:

- Topsoil/Made Ground – encountered beneath the vegetation to a depth of 0.2 and 0.3 m below existing ground level (bgl). This generally comprised soft dark brown sandy slightly gravelly organic rich SILT. Gravel size constituents comprised flint and chalk with localised brick fragments and pottery.
- Lowestoft Formation – encountered in all trial pits beneath the topsoil/ Made Ground but not fully penetrated in any location. This was generally a firm to stiff yellow brown sandy slightly gravelly silt which is underlain by a medium dense to dense yellow brown slightly silty locally slightly gravelly, sand.

3.2 No groundwater was encountered during the infiltration testing.

3.3 Trial pit logs are included in Appendix A.

Infiltration testing

3.4 A total of three infiltration test pits were excavated in the south west of the onshore HVDC converter/HVAC substation area: SA1a, SA1b and SA1c. Testing in pits SA1b and SA1c was terminated due to collapse of the pits. Water levels in pit SA1a failed to drop below the 25% level after five hours and the test pit was closed due to the instability of the soil.

3.5 Tests in SA2, SA3, SA4, SA5, SA6 and SA7 failed to drain below the 75% level. Two of the tests were run for a period of 24 hours to allow the opportunity for the water drain away. This approach was applied because very slow/no infiltration had been recorded in multiple test pit locations and because there is no public access on the onshore HVDC converter/HVAC substation area.

3.6 Test pit SA8, located in the south west of the onshore HVDC converter/HVAC substation area, recorded an infiltration rate of 5.87×10^{-06} ms. Whilst soakaway drainage is not proposed in this area (based on the indicative layout of the onshore HVDC converter/HVAC substation), strata was encountered during the excavation of the trial pit which suggested that infiltration may be feasible. Therefore, a single test was run to give an indication of infiltration potential in this area.

3.7 The findings of the fieldwork are presented in Appendix B.

4. Conclusion

4.1 As reported in paragraph 3.1, variable amounts of sand and gravel were encountered within the silt superficial deposits across the onshore HVDC converter/HVAC substation area. Limited infiltration rates were identified during the testing across the majority of the onshore HVDC converter/HVAC substation area indicating that traditional shallow soakaways are unlikely to be viable at these locations. An indicative infiltration rate was obtained for the south west corner of the onshore HVDC converter/HVAC substation area (test pit SA8), however, the granular materials in this location became unstable when wet meaning that soakaways are not viable as they are likely to collapse.

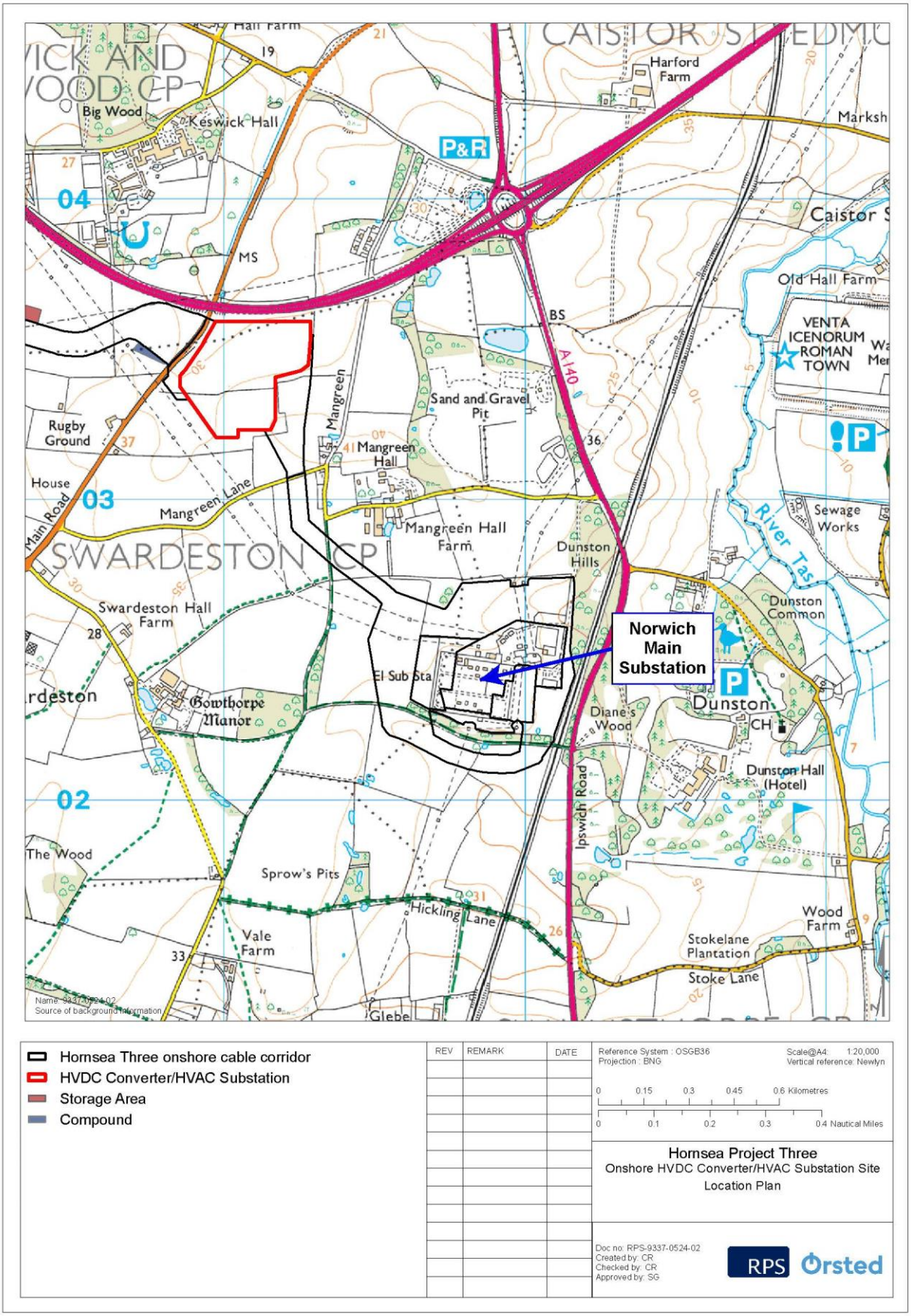


Figure 1.1: Site Location Plan.

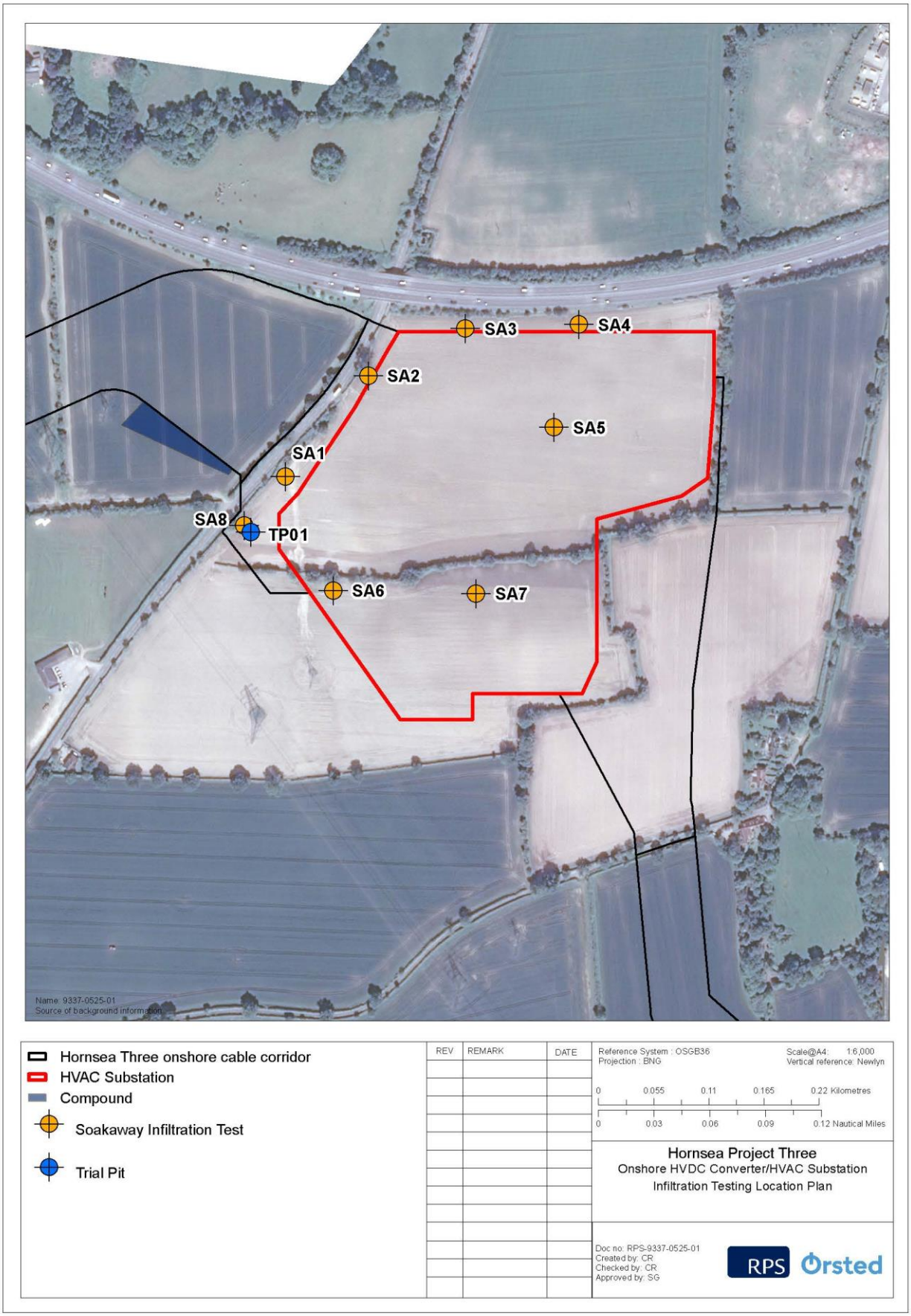


Figure 1.2: Onshore HVDC Converter/HVAC Substation Infiltration Testing Location Plan.

Appendix A Test/Trial Pit Logs

TRIAL PIT LOG

Pit No. **SA1a**

Sheet 1 of 1

Project Name:	Hornsea 3 Swardeston	Co-ordinates:		Date(s): 20/08/2018	Hole Type:
Project No:	RCEI64177a	Easting:	620860	Equipment:	TP
Location:	Norfolk	Northing:	303449	JCB 3CX	Pit Length: 2.00 m / Scale:
Client:	Orsted	Ground Level (mAOD):		Logged By: TF	Pit Width: 0.45 m / 1:50

Backfill	Water Strike(s)	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
					0.00					
					0.20	(0.20)			Soft dark brown sandy slightly gravelly organic rich SILT including rootlets. Gravel is fine to coarse, angular to well rounded of flint. (TOPSOIL)	
						(2.20)			Firm yellow brown sandy slightly gravelly SILT. (LOWESTOFT FORMATION)	1
					2.40					2
						(1.20)			Medium dense yellow brown slightly silty fine to medium SAND. (LOWESTOFT FORMATION)	3
									End of Pit at 3.60m	4
										5
										6
										7
										8
										9
										10

Remarks: 1) Trial pit terminated at 3.6m bgl. 2) Infiltration test undertaken.

Groundwater: None encountered

Stability: Stable

AGS

TRIAL PIT LOG

Pit No. **SA1b**

Sheet 1 of 1

Project Name:	Hornsea 3 Swardeston	Co-ordinates:		Date(s): 21/08/2018	Hole Type:
Project No:	RCEI64177a	Easting:	620860	Equipment:	TP
Location:	Norfolk	Northing:	303448	JCB 3CX	Pit Length: 2.00 m / Scale:
Client:	Orsted	Ground Level (mAOD):		Logged By: TF	Pit Width: 0.45 m / 1:50

Backfill	Water Strike(s)	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
					0.00	(0.20)			Soft dark brown sandy slightly gravelly organic rich SILT including rootlets. Gravel is fine to coarse, angular to well rounded of flint. (TOPSOIL)	
					0.20				Firm yellow brown sandy slightly gravelly SILT. Gravel is fine to coarse, sub-angular to well rounded of flint. (LOWESTOFT FORMATION)	
						(1.60)				1
					1.80				Loose yellow brown gravelly fine to medium SAND. Gravel is fine to medium, sub-rounded to well rounded of quartz and flint. (LOWESTOFT FORMATION)	2
						(1.60)			*From 2.4m to 3.0m including pockets of sandy SILT.*	3
									End of Pit at 3.40m	4
										5
										6
										7
										8
										9
										10

Remarks: 1) Trial pit terminated at 3.4m bgl. 2) Infiltration test undertaken.

Groundwater: None encountered

Stability: Unstable below 3.0m

AGS

TRIAL PIT LOG

Pit No. **SA1c**

Sheet 1 of 1

Project Name:	Hornsea 3 Swardeston	Co-ordinates:		Date(s): 21/08/2018	Hole Type:
Project No:	RCEI64177a	Easting:	620860	Equipment:	TP
Location:	Norfolk	Northing:	303447	JCB 3CX	Pit Length: 2.00 m
Client:	Orsted	Ground Level (mAOD):		Logged By: TF	Pit Width: 0.45 m
					Scale: 1:50

Backfill	Water Strike(s)	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
					0.00					
					0.20	(0.20)			Soft dark brown sandy slightly gravelly organic rich SILT including rootlets. Gravel is fine to coarse, angular to well rounded of flint, brick and pottery. (TOPSOIL)	
						(1.90)			Firm yellow brown slightly sandy gravelly SILT. Gravel is fine to coarse, sub rounded to well rounded of chalk and flint. (LOWESTOFT FORMATION)	1
					2.10					2
						(1.30)			Loose yellow brown fine to medium slightly gravelly SAND. Gravel is fine to medium, sub rounded to well rounded of flint. (LOWESTOFT FORMATION)	3
									End of Pit at 3.40m	4
										5
										6
										7
										8
										9
										10

Remarks: 1) Trial pit terminated at 3.4m bgl. 2) Infiltration test undertaken.

Groundwater: None encountered

Stability: Unstable below 3.0m

AGS

TRIAL PIT LOG

RPS

Pit No. **SA2**

Sheet 1 of 1

Project Name:	Hornsea 3 Swardeston	Co-ordinates:		Date(s): 20/08/2018	Hole Type:
Project No:	RCEI64177a	Easting:	620943	Equipment:	TP
Location:	Norfolk	Northing:	303550	JCB 3CX	Pit Length: 2.00 m / Scale:
Client:	Orsted	Ground Level (mAOD):		Logged By: TF	Pit Width: 0.45 m / 1:50

Backfill	Water Strike(s)	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
					0.00					
					0.20	(0.20)			Soft dark brown sandy slightly gravelly organic rich SILT including rootlets. Gravel is fine to coarse, angular to well rounded of flint. (TOPSOIL)	
						(1.30)			Firm brown silty slightly gravelly CLAY. Gravel is fine to coarse, very angular to rounded of chalk and flint. (LOWESTOFT FORMATION)	
									From 1.0m becoming gravelly	1
					1.50				*From 1.4m becoming very gravelly*	
						(1.20)			Firm brown sandy very gravelly SILT including low cobble content of flint. Gravel is fine to coarse, very angular to well rounded of chalk and flint. (LOWESTOFT FORMATION)	2
					2.70					
						(0.30)			Loose yellow brown silty gravel. Gravel is fine to medium, very angular to well rounded of flint and chalk. (LOWESTOFT FORMATION)	3
					3.00	(0.40)			Firm brown sandy very gravelly SILT including low cobble content of flint. Gravel is fine to coarse, very angular to well rounded of chalk and flint. (LOWESTOFT FORMATION)	
									End of Pit at 3.40m	4
										5
										6
										7
										8
										9
										10

Remarks: 1) Trial pit terminated at 3.4m bgl. 2) Infiltration test undertaken.

Groundwater: None encountered

Stability: Stable

AGS

TRIAL PIT LOG

Pit No. **SA3**

Sheet 1 of 1

Project Name:	Hornsea 3 Swardeston	Co-ordinates:		Date(s): 20/08/2018	Hole Type:
Project No:	RCEI64177a	Easting:	621039	Equipment:	TP
Location:	Norfolk	Northing:	303597	JCB 3CX	Pit Length: 2.00 m / Scale:
Client:	Orsted	Ground Level (mAOD):		Logged By: TF	Pit Width: 0.45 m / 1:50

Backfill	Water Strike(s)	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
					0.00	(0.30)			Soft dark brown sandy slightly gravelly organic rich SILT including rootlets. Gravel is fine to coarse, angular to well rounded of flint and chalk. (TOPSOIL)	
					0.30	(3.10)			Firm light brown slightly sandy gravelly SILT. Gravel is fine to coarse, sub-angular to well rounded of flint and chalk. (LOWESTOFT FORMATION)	
									End of Pit at 3.40m	

Remarks: 1) Trial pit terminated at 3.4m bgl. 2) Infiltration test undertaken.

Groundwater: None encountered

Stability: Stable

TRIAL PIT LOG

Pit No. **SA4**

Sheet 1 of 1

Project Name:	Hornsea 3 Swardeston	Co-ordinates:		Date(s): 21/08/2018 - 22/08/2018	Hole Type:
Project No:	RCEI64177a	Easting:	621152	Equipment:	TP
Location:	Norfolk	Northing:	303601	JCB 3CX	Pit Length: 2.00 m / Scale:
Client:	Orsted	Ground Level (mAOD):		Logged By: TF	Pit Width: 0.45 m / 1:50

Backfill	Water Strike(s)	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
					0.00	(0.30)			Soft dark brown sandy slightly gravelly organic rich SILT including rootlets. Gravel is fine to coarse, angular to well rounded of flint, chalk brick and pottery. (MADE GROUND)	
					0.30	(3.10)			Firm yellow brown slightly sandy gravelly SILT. Gravel is fine to coarse, sub-rounded to well rounded of flint and chalk. (LOWESTOFT FORMATION)	
									From 2.0m becoming sandy including pockets of fine to medium sand.	
									End of Pit at 3.40m	

Remarks: 1) Trial pit terminated at 3.4m bgl. 2) Infiltration test undertaken.

Groundwater: None encountered

Stability: Stable

TRIAL PIT LOG

Pit No. **SA5**

Sheet 1 of 1

Project Name:	Hornsea 3 Swardeston	Co-ordinates:		Date(s): 22/08/2018	Hole Type:
Project No:	RCEI64177a	Easting:	621128	Equipment:	TP
Location:	Norfolk	Northing:	303498	JCB 3CX	Pit Length: 2.00 m / Scale:
Client:	Orsted	Ground Level (mAOD):		Logged By: TF	Pit Width: 0.45 m / 1:50

Backfill	Water Strike(s)	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
					0.00	(0.30)			Soft dark brown sandy slightly gravelly organic rich SILT including rootlets. Gravel is fine to coarse, angular to well rounded of flint, chalk, brick and pottery. (MADE GROUND)	
					0.30	(0.70)			Soft brown sandy slightly gravelly SILT. Gravel is fine to medium, sub-angular to well rounded of sandstone and quartzite. (LOWESTOFT FORMATION)	
					1.00	(2.30)			Firm light yellow brown slightly sandy gravelly SILT including low cobble content of flint and chalk. Gravel is fine to coarse, sub-angular to well rounded of flint and chalk. (LOWESTOFT FORMATION)	
									End of Pit at 3.30m	

Remarks: 1) Trial pit terminated at 3.3m bgl. 2) Infiltration test undertaken.

Groundwater: None encountered

Stability: Stable

TRIAL PIT LOG

Pit No. **SA6**

Sheet 1 of 1

Project Name:	Hornsea 3 Swardeston	Co-ordinates:		Date(s): 21/08/2018 - 22/08/2018	Hole Type:
Project No:	RCEI64177a	Easting:	620907	Equipment:	TP
Location:	Norfolk	Northing:	303336	JCB 3CX	Pit Length: 2.00 m
Client:	Orsted	Ground Level (mAOD):		Logged By: TF	Pit Width: 0.45 m
					Scale: 1:50

Backfill	Water Strike(s)	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
					0.00	(0.30)			Soft dark brown sandy slightly gravelly organic rich SILT including rootlets. Gravel is fine to coarse, angular to well rounded of flint. (TOPSOIL)	
					0.30				Medium dense slightly silty gravelly fine to medium SAND. Gravel is fine to coarse, sub-angular to rounded of flint and chalk. (LOWESTOFT FORMATION)	1
						(2.70)				
									From 2.0m becoming silty	2
					3.00	(0.40)			Firm brown mottled grey very sandy SILT. (LOWESTOFT FORMATION)	3
									End of Pit at 3.40m	4
										5
										6
										7
										8
										9
										10

Remarks: 1) Trial pit terminated at 3.4m bgl. 2) Infiltration test undertaken.

Groundwater: None encountered

Stability: Stable

AGS

TRIAL PIT LOG

Pit No. **SA7**

Sheet 1 of 1

Project Name:	Hornsea 3 Swardeston	Co-ordinates:		Date(s): 22/08/2018	Hole Type:
Project No:	RCEI64177a	Easting:	621050	Equipment:	TP
Location:	Norfolk	Northing:	303333	JCB 3CX	Pit Length: 2.00 m / Scale:
Client:	Orsted	Ground Level (mAOD):		Logged By: TF	Pit Width: 0.45 m / 1:50

Backfill	Water Strike(s)	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
					0.00	(0.20)			Soft dark brown slightly sandy slightly gravelly organic rich SILT including rootlets. Gravel is fine to coarse, angular to well rounded of flint. (TOPSOIL)	
					0.20				Firm light brown mottled grey slightly sandy gravelly CLAY. Gravel is fine to coarse, sub-rounded to rounded of chalk and flint. (LOWESTOFT FORMATION)	
									From 1.5m including pockets of orangey brown fine to medium sand.	
						(3.20)			*From 2.5m becoming slightly gravelly.*	
									From 3.0m clay becoming soft, pale and chalky.	
									End of Pit at 3.40m	

Remarks: 1) Trial pit terminated at 3.4m bgl. 2) Infiltration test undertaken.

Groundwater: None encountered

Stability: Stable

AGS

TRIAL PIT LOG

Pit No. **SA8**

Sheet 1 of 1

Project Name:	Hornsea 3 Swardeston	Co-ordinates:		Date(s): 22/08/2018	Hole Type:
Project No:	RCEI64177a	Easting:	620819	Equipment:	TP
Location:	Norfolk	Northing:	303402		Scale:
Client:	Orsted	Ground Level (mAOD):		Logged By:	1:50

Backfill	Water Strike(s)	Samples & In Situ Testing			Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results						
					0.00	(0.20)			Soft dark brown sandy slightly gravelly organic rich SILT including rootlets. Gravel is fine to coarse, angular to well rounded of flint. (TOPSOIL)	
					0.20				Stiff yellow brown slightly sandy slightly gravelly SILT. Gravel is fine to coarse, sub-angular to rounded flint. (LOWESTOFT FORMATION)	
						(1.90)				
					2.10	(0.10)			Loose yellow brown fine to medium slightly gravelly SAND. Gravel is fine to medium, sub-angular to rounded of flint. (LOWESTOFT FORMATION)	
									End of Pit at 2.20m	

Remarks: 1) Trial pit terminated at 2.2m bgl. 2) Infiltration test undertaken.

Groundwater: None encountered

Stability:

AGS

TRIAL PIT LOG

RPS

Pit No. **TP1**

Sheet 1 of 1

Project Name:	Hornsea 3 Swardeston	Co-ordinates:		Date(s): 20/08/2018	Hole Type:
Project No:	RCEI64177a	Easting:	620818	Equipment:	TP
Location:	Norfolk	Northing:	303401	JCB 3CX	Pit Length: 2.00 m / Scale:
Client:	Orsted	Ground Level (mAOD):		Logged By: TF	Pit Width: 0.45 m / 1:50

Backfill	Water Strike(s)	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
					0.00	(0.20)			Soft dark brown sandy slightly gravelly organic rich SILT including rootlets. Gravel is fine to coarse, angular to well rounded of flint. (TOPSOIL)	
					0.20	(1.90)			Stiff yellow brown slightly sandy slightly gravelly SILT including low cobble content of flint. Gravel is fine to coarse, angular to well rounded of flint. (LOWESTOFT FORMATION)	1
					2.10	(1.10)			Loose yellow brown fine to medium slightly gravelly SAND. Gravel is fine to medium, sub angular to rounded of flint. (LOWESTOFT FORMATION)	2
									End of Pit at 3.20m	3
										4
										5
										6
										7
										8
										9
										10

Remarks: 1) Trial pit terminated at 3.2m bgl following partial collapse of base. 2) Backfilled with arisings in reverse order of excavation upon completion.

Groundwater: None encountered

Stability: Minor instability below 2.1m

AGS

Appendix B Infiltration Test Results

RPS Group 8 Exchange Quay Salfrod M5 3EJ	**Soil Infiltration Test (BRE Digest 365)**		

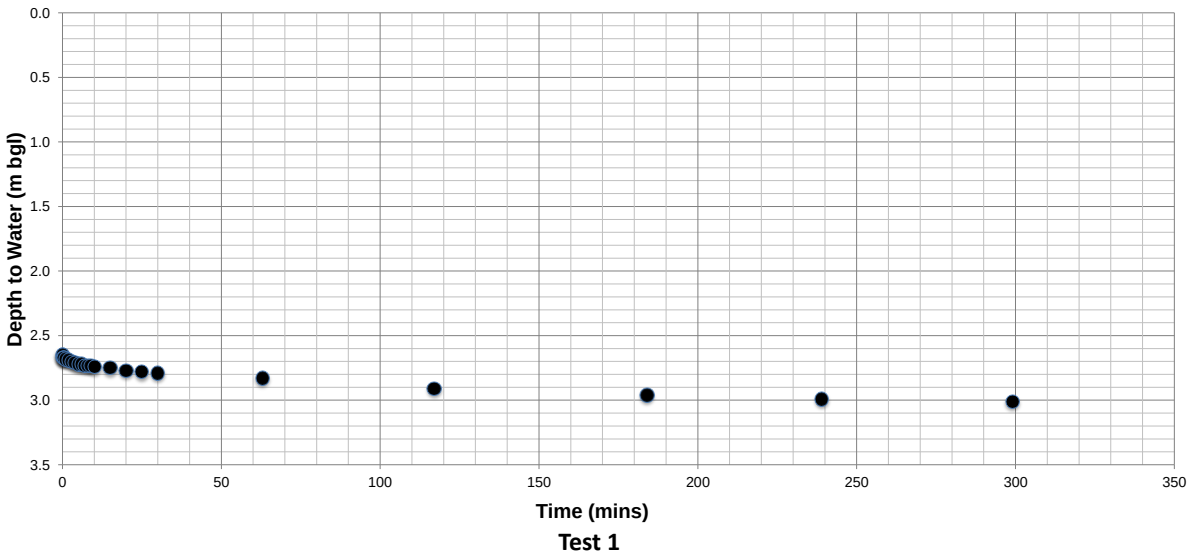
Client:	Orsted	Report Ref:	RCEI64177.002	**SA1a**
Site:	Hornsea 3 HVAC Substation	Date:	30 August 2018	

Soil Type: Lowestoft Formation
Groundwater: Not encountered
Drain Invert Level: Not Known
Sidewall Stability: Stable
Remarks: Limited infiltration encountered

Soil Infiltration Rate:

$$f = \frac{Vp75 - 25}{ap50 \times tp75 - 25}$$

		Test 1	Test 2	Test 3
Dimensions of Trial Pit:	Depth (m)	3.60	3.60	3.60
	Width (m)	0.45	0.45	0.45
	Length (m)	2.00	2.00	2.00
Effective Depth (m)		0.95	0.95	0.95
V_{p75-25}: volume of the trial pit between 75% and 25% of the effective depth (m^3)		0.43	0.43	0.43
a_{p50}: internal surface area of trial pit up to 50% effective depth (m^2)		3.23	3.23	3.23
t_{p75-25}: time for water to fall from 75% to 25% effective depth (secs)		Not achieved		
f: Soil Infitration Rate (ms^{-1})				



Test 1

RPS Group 8 Exchange Quay Salfrod M5 3EJ	**Soil Infiltration Test (BRE Digest 365)**		
Client:	Orsted	Report Ref:	RCEI64177.002
Site:	Hornsea 3 HVAC Substation	Date:	30 August 2018

SA1b

Soil Type: Lowestoft Formation

Groundwater: Not encountered

Drain Invert Level: Not Known

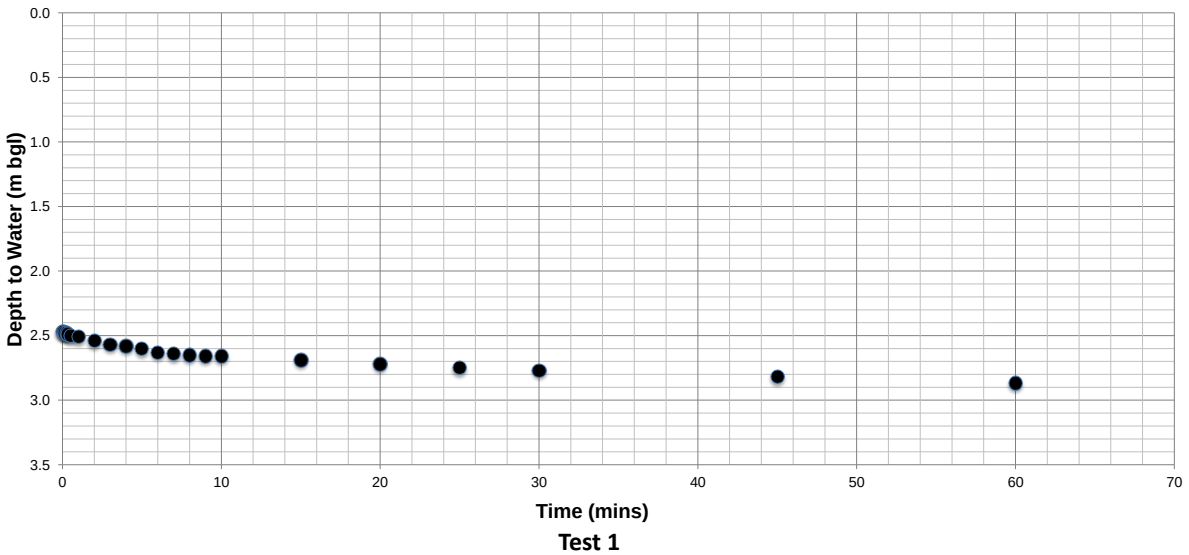
Sidewall Stability: Unstable

Remarks: Catastrophic collaspe terminates test after 1 hour

Soil Infiltration Rate:

$$f = \frac{Vp75 - 25}{ap50 \times tp75 - 25}$$

		Test 1	Test 2	Test 3
Dimensions of Trial Pit:	Depth (m)	3.40	3.40	3.40
	Width (m)	0.45	0.45	0.45
	Length (m)	2.00	2.00	2.00
Effective Depth (m)		0.93	0.93	0.93
V_{p75-25}: volume of the trial pit between 75% and 25% of the effective depth (m^3)		0.42	0.42	0.42
a_{p50}: internal surface area of trial pit up to 50% effective depth (m^2)		3.18	3.18	3.18
t_{p75-25}: time for water to fall from 75% to 25% effective depth (secs)		Not achieved		
f: Soil Infitration Rate (ms^{-1})				



Test 1

RPS Group 8 Exchange Quay Salfrod M5 3EJ	**Soil Infiltration Test (BRE Digest 365)**		
Client:	Orsted	Report Ref:	RCEI64177.002
Site:	Hornsea 3 HVAC Substation	Date:	30 August 2018

SA1c

Soil Type: Lowestoft Formation

Groundwater: Not encountered

Drain Invert Level: Not Known

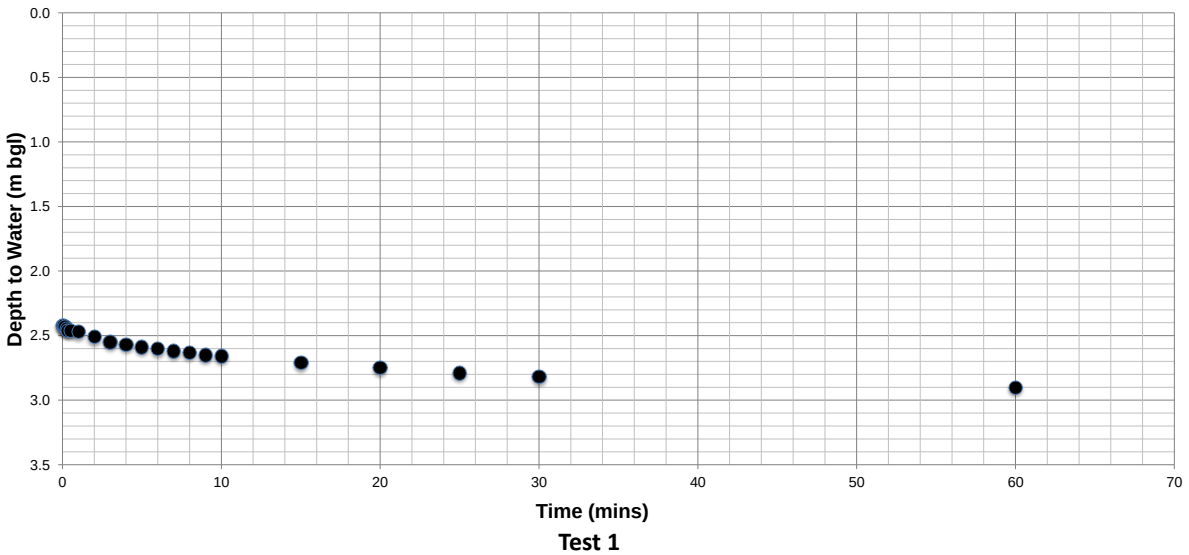
Sidewall Stability: Unstable

Remarks: Catastrophic collaspe terminates test after 1 hour

Soil Infiltration Rate:

$$f = \frac{Vp75 - 25}{ap50 \times tp75 - 25}$$

		Test 1	Test 2	Test 3
Dimensions of Trial Pit:	Depth (m)	3.40	3.40	3.40
	Width (m)	0.45	0.45	0.45
	Length (m)	2.00	2.00	2.00
Effective Depth (m)		0.98	0.98	0.98
V_{p75-25}: volume of the trial pit between 75% and 25% of the effective depth (m^3)		0.44	0.44	0.44
a_{p50}: internal surface area of trial pit up to 50% effective depth (m^2)		3.30	3.30	3.30
t_{p75-25}: time for water to fall from 75% to 25% effective depth (secs)		Not achieved		
f: Soil Infitration Rate (ms^{-1})				



Test 1

RPS Group
8 Exchange Quay
Salfrod
M5 3EJ

Soil Infiltration Test (BRE Digest 365)

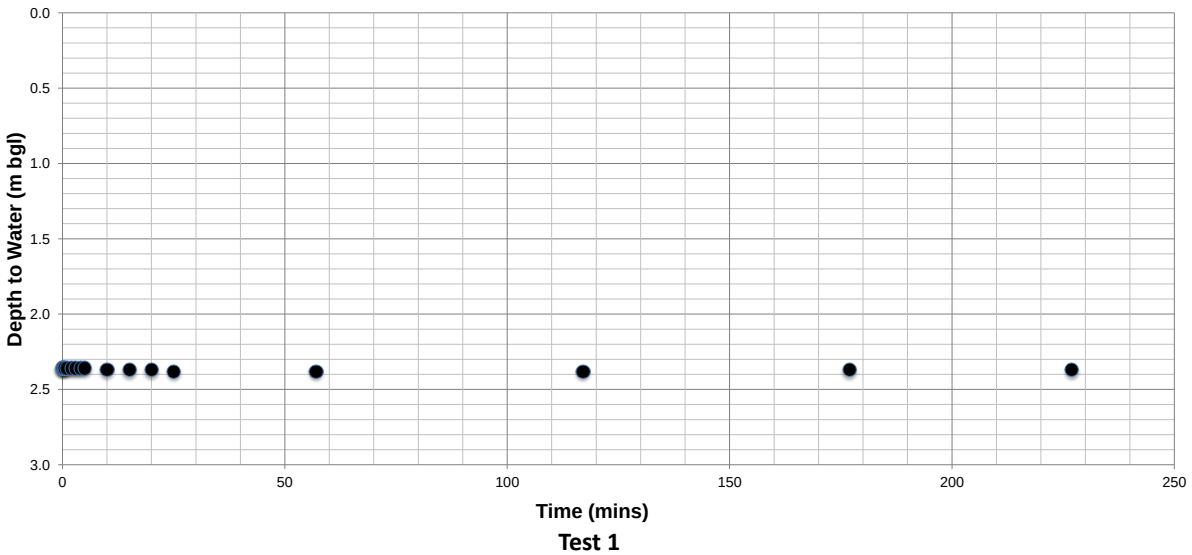
Client:	Orsted	Report Ref:	RCEI64177.002	**SA2**
Site:	Hornsea 3 HVAC Substation	Date:	30 August 2018	

Soil Type: Lowestoft Formation
Groundwater: Not encountered
Drain Invert Level: Not Known
Sidewall Stability: Stable
Remarks: Limited infiltration encountered

Soil Infiltration Rate:

$$f = \frac{Vp75 - 25}{ap50 \times tp75 - 25}$$

		Test 1	Test 2	Test 3
Dimensions of Trial Pit:	Depth (m)	3.40	3.40	3.40
	Width (m)	0.45	0.45	0.45
	Length (m)	2.00	2.00	2.00
Effective Depth (m)		1.04	1.04	1.04
$V_{p75\text{-}25}$: volume of the trial pit between 75% and 25% of the effective depth (m^3)		0.47	0.47	0.47
a_{p50}: internal surface area of trial pit up to 50% effective depth (m^2)		3.45	3.45	3.45
$t_{p75\text{-}25}$: time for water to fall from 75% to 25% effective depth (secs)		Not achieved		
f: Soil Infiltration Rate (ms^{-1})				



Test 1

RPS Group
8 Exchange Quay
Salfrod
M5 3EJ

Soil Infiltration Test (BRE Digest 365)

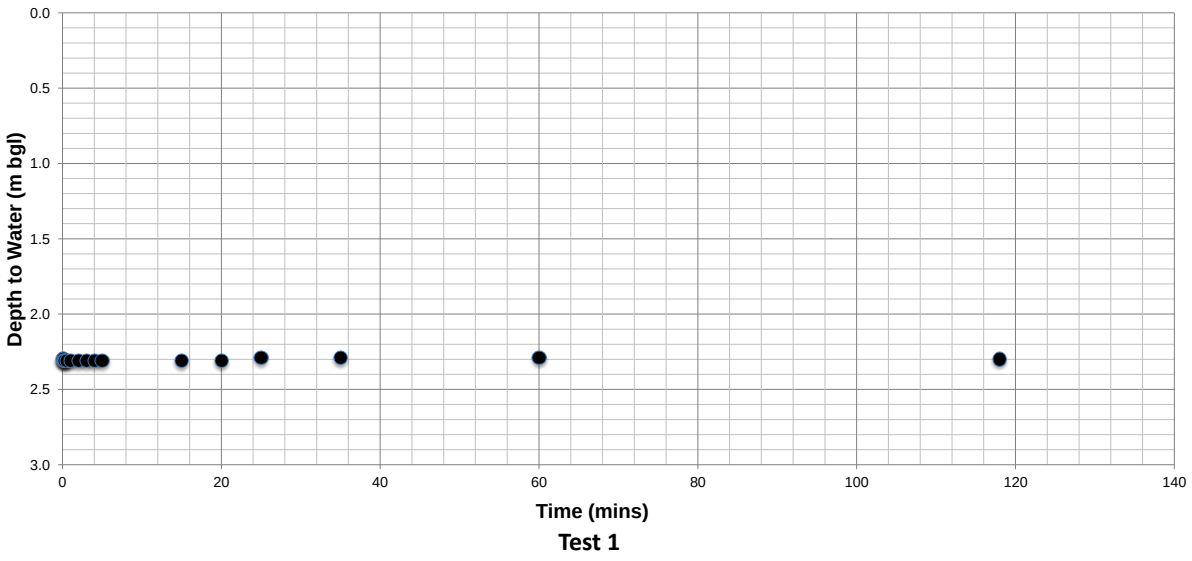
Client:	Orsted	Report Ref:	RCEI64177.002	**SA3**
Site:	Hornsea 3 HVAC Substation	Date:	30 August 2018	

Soil Type: Lowestoft Formation
Groundwater: Not encountered
Drain Invert Level: Not Known
Sidewall Stability: Stable
Remarks: Limited infiltration encountered

Soil Infiltration Rate:

$$f = \frac{Vp75 - 25}{ap50 \times tp75 - 25}$$

		Test 1	Test 2	Test 3
Dimensions of Trial Pit:	Depth (m)	3.40	3.40	3.40
	Width (m)	0.45	0.45	0.45
	Length (m)	2.00	2.00	2.00
Effective Depth (m)		1.10	1.10	1.10
$V_{p75\text{-}25}$: volume of the trial pit between 75% and 25% of the effective depth (m^3)		0.50	0.50	0.50
a_{p50}: internal surface area of trial pit up to 50% effective depth (m^2)		3.60	3.60	3.60
$t_{p75\text{-}25}$: time for water to fall from 75% to 25% effective depth (secs)		Not achieved		
f: Soil Infiltration Rate (ms^{-1})				



Test 1

RPS Group
8 Exchange Quay
Salfrod
M5 3EJ

Soil Infiltration Test (BRE Digest 365)

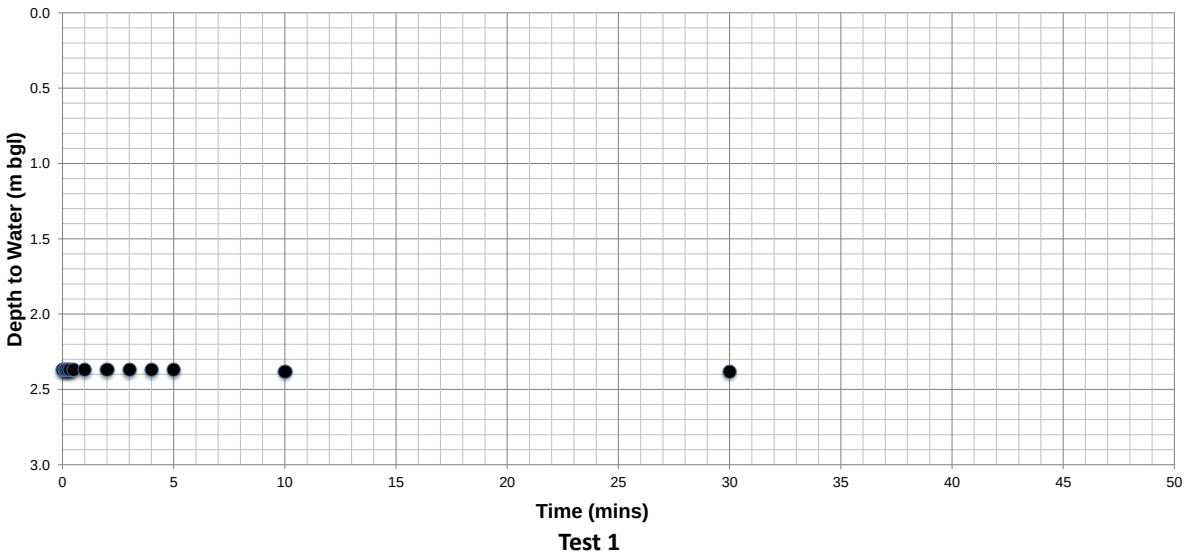
Client:	Orsted	Report Ref:	RCEI64177.002	**SA4**
Site:	Hornsea 3 HVAC Substation	Date:	30 August 2018	

Soil Type: Lowestoft Formation
Groundwater: Not encountered
Drain Invert Level: Not Known
Sidewall Stability: Stable
Remarks: Limited infiltration encountered

Soil Infiltration Rate:

$$f = \frac{Vp75 - 25}{ap50 \times tp75 - 25}$$

		Test 1	Test 2	Test 3
Dimensions of Trial Pit:	Depth (m)	3.40	3.40	3.40
	Width (m)	0.45	0.45	0.45
	Length (m)	2.00	2.00	2.00
Effective Depth (m)		1.03	1.03	1.03
$V_{p75\text{-}25}$: volume of the trial pit between 75% and 25% of the effective depth (m^3)		0.46	0.46	0.46
a_{p50}: internal surface area of trial pit up to 50% effective depth (m^2)		3.42	3.42	3.42
$t_{p75\text{-}25}$: time for water to fall from 75% to 25% effective depth (secs)		Not achieved		
f: Soil Infitration Rate (ms^{-1})				



Test 1

RPS Group
8 Exchange Quay
Salfrod
M5 3EJ

Soil Infiltration Test (BRE Digest 365)

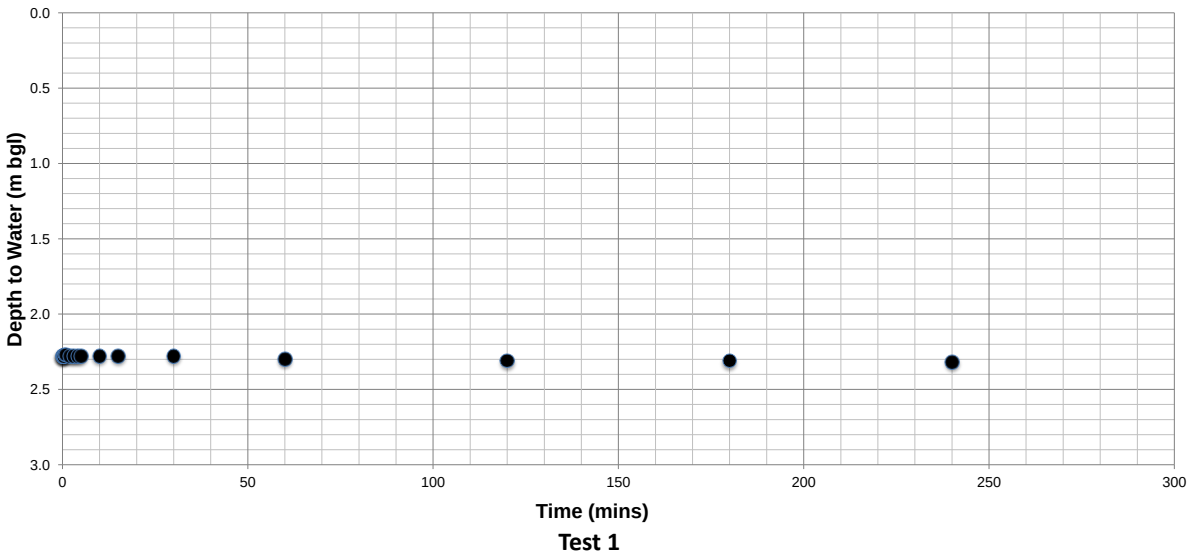
Client:	Orsted	Report Ref:	RCEI64177.002	**SA5**
Site:	Hornsea 3 HVAC Substation	Date:	30 August 2018	

Soil Type: Lowestoft Formation
Groundwater: Not encountered
Drain Invert Level: Not Known
Sidewall Stability: Unstable
Remarks: Liminted infiltration encountered

Soil Infiltration Rate:

$$f = \frac{Vp75 - 25}{ap50 \times tp75 - 25}$$

		Test 1	Test 2	Test 3
Dimensions of Trial Pit:	Depth (m)	3.30	3.30	3.30
	Width (m)	0.45	0.45	0.45
	Length (m)	2.00	2.00	2.00
Effective Depth (m)		1.02	1.02	1.02
V_{p75-25}: volume of the trial pit between 75% and 25% of the effective depth (m^3)		0.46	0.46	0.46
a_{p50}: internal surface area of trial pit up to 50% effective depth (m^2)		3.40	3.40	3.40
t_{p75-25}: time for water to fall from 75% to 25% effective depth (secs)		Not achieved		
f: Soil Infiltration Rate (ms^{-1})				



Test 1

RPS Group 8 Exchange Quay Salfrod M5 3EJ	**Soil Infiltration Test (BRE Digest 365)**		
Client:	Orsted	Report Ref:	RCEI64177.002
Site:	Hornsea 3 HVAC Substation	Date:	30 August 2018

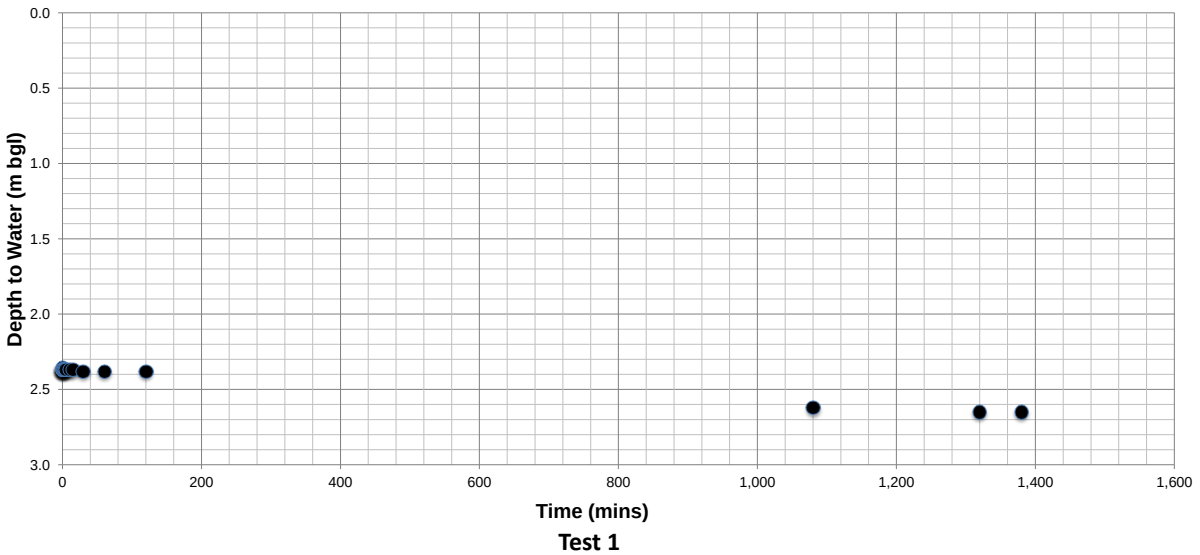
SA6

Soil Type: Lowestoft Formation
Groundwater: Not encountered
Drain Invert Level: Not Known
Sidewall Stability: Unstable
Remarks: Limited infiltration encountered

Soil Infiltration Rate:

$$f = \frac{Vp75 - 25}{ap50 \times tp75 - 25}$$

		Test 1	Test 2	Test 3
Dimensions of Trial Pit:	Depth (m)	3.40	3.40	3.40
	Width (m)	0.45	0.45	0.45
	Length (m)	2.00	2.00	2.00
Effective Depth (m)		1.04	1.04	1.04
V_{p75-25}: volume of the trial pit between 75% and 25% of the effective depth (m^3)		0.47	0.47	0.47
a_{p50}: internal surface area of trial pit up to 50% effective depth (m^2)		3.45	3.45	3.45
t_{p75-25}: time for water to fall from 75% to 25% effective depth (secs)		Not achieved		
f: Soil Infiltration Rate (ms^{-1})				



Test 1

RPS Group
8 Exchange Quay
Salfrod
M5 3EJ

Soil Infiltration Test (BRE Digest 365)

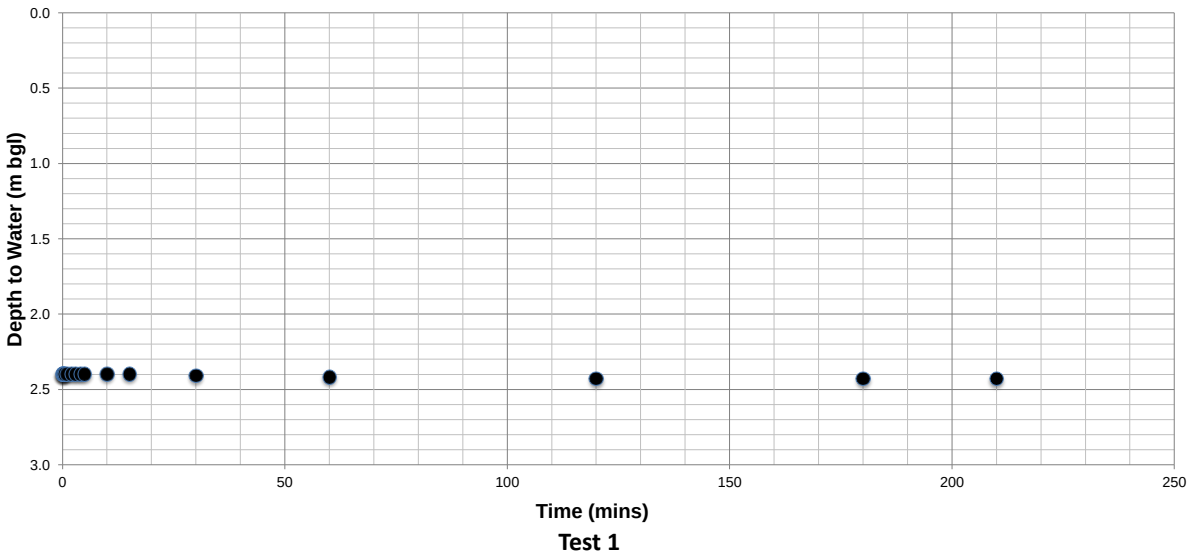
Client:	Orsted	Report Ref:	RCEI64177.002	**SA7**
Site:	Hornsea 3 HVAC Substation	Date:	30 August 2018	

Soil Type: Lowestoft Formation
Groundwater: Not encountered
Drain Invert Level: Not Known
Sidewall Stability: Unstable
Remarks: Limited infiltration encountered

Soil Infiltration Rate:

$$f = \frac{Vp75 - 25}{ap50 \times tp75 - 25}$$

		Test 1	Test 2	Test 3
Dimensions of Trial Pit:	Depth (m)	3.40	3.40	3.40
	Width (m)	0.45	0.45	0.45
	Length (m)	2.00	2.00	2.00
Effective Depth (m)		1.00	1.00	1.00
$V_{p75\text{-}25}$: volume of the trial pit between 75% and 25% of the effective depth (m^3)		0.45	0.45	0.45
a_{p50}: internal surface area of trial pit up to 50% effective depth (m^2)		3.35	3.35	3.35
$t_{p75\text{-}25}$: time for water to fall from 75% to 25% effective depth (secs)		Not achieved		
f: Soil Infiltration Rate (ms^{-1})				



Test 1

RPS Group 8 Exchange Quay Salfrod M5 3EJ	**Soil Infiltration Test (BRE Digest 365)**		
Client:	Orsted	Report Ref:	RCEI64177.002
Site:	Hornsea 3 HVAC Substation	Date:	30 August 2018

SA8

Soil Type: Lowestoft Formation

Groundwater: Not encountered

Drain Invert Level: Not Known

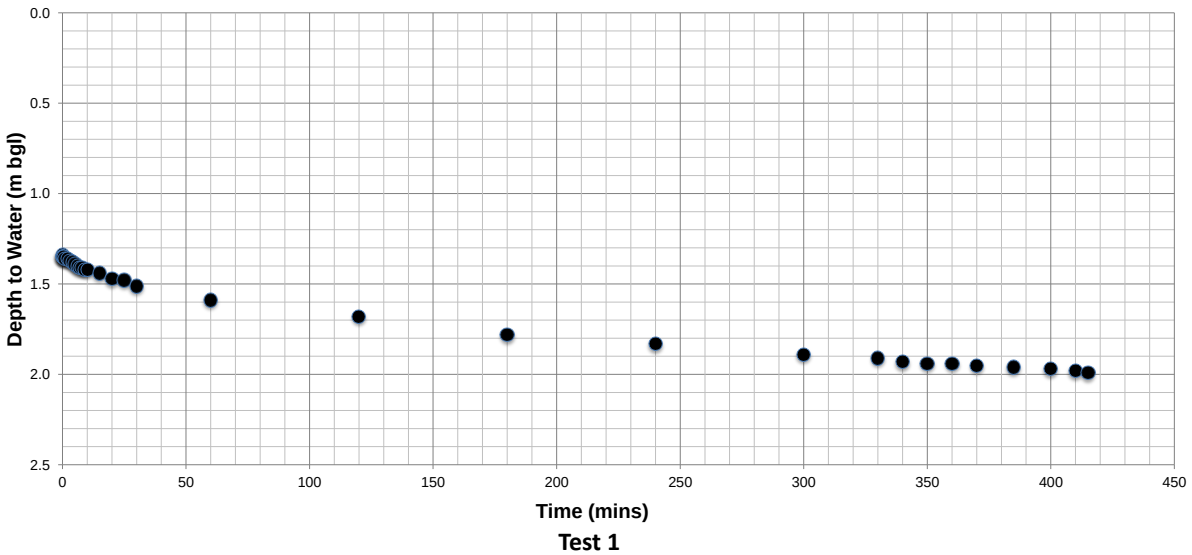
Sidewall Stability: Unstable

Remarks: Test rerun not possible due to instablilty and time constraints

Soil Infiltration Rate:

$$f = \frac{Vp75 - 25}{ap50 \times tp75 - 25}$$

		Test 1	Test 2	Test 3
Dimensions of Trial Pit:	Depth (m)	2.20	2.20	2.20
	Width (m)	0.45	0.45	0.45
	Length (m)	2.00	2.00	2.00
Effective Depth (m)		0.86	0.86	0.86
V_{p75-25}: volume of the trial pit between 75% and 25% of the effective depth (m^3)		0.39	0.39	0.39
a_{p50}: internal surface area of trial pit up to 50% effective depth (m^2)		3.01	3.01	3.01
t_{p75-25}: time for water to fall from 75% to 25% effective depth (secs)		21938		
f: Soil Infitration Rate (ms^{-1})		5.87E-06		



Test 1