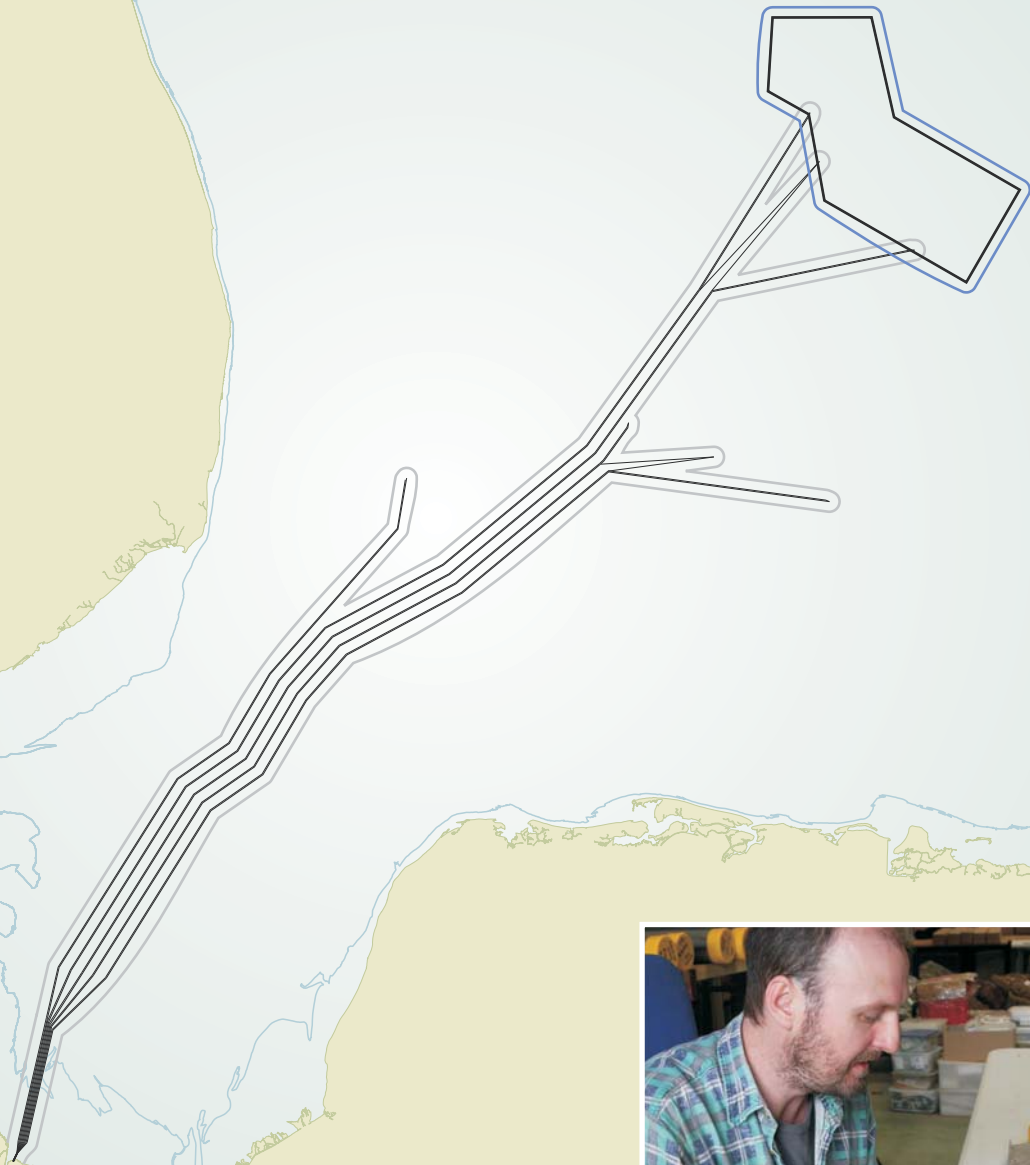




Race Bank Offshore Wind Farm

Stage 2 Geoarchaeological Recording of Borehole Samples



RACE BANK OFFSHORE WIND FARM

STAGE 2 GEOARCHAEOLOGICAL RECORDING OF BOREHOLE SAMPLES

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RACE BANK OFFSHORE WIND FARM

STAGE 2 GEOARCHAEOLOGICAL RECORDING OF BOREHOLE SAMPLES

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RACE BANK OFFSHORE WIND FARM

STAGE 2 GEOARCHAEOLOGICAL RECORDING OF BOREHOLE SAMPLES

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Summary

Wessex Archaeology was commissioned by Centrica Renewable Energy Ltd. to undertake Stage 2 geoarchaeological recording on borehole samples recovered from the proposed Race Bank Offshore Wind Farm site.

This Stage 2 recording follows on from recommendations made in the Stage 1 assessment report, and focuses on the potential for the preservation of archaeological and palaeoenvironmental material in the samples selected during the Stage 1 assessment.

Of the previously established stratigraphic sequence, it was found that sediments from Units 1c and 1d (terrestrial peat, organic clay and silt) contain potentially well-preserved organic material suitable for palaeoenvironmental analysis, and that an eroded and re-deposited section of Unit 2 could also contain similar material.

This report makes proposals for the Stage 3 geoarchaeological sub-sampling and assessment of 19 samples (51 sub-samples) taken from nine of the recorded samples from six cores, as Units 1c and 1d are deemed to be of possible archaeological and palaeoenvironmental importance.

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Acknowledgements

This report was commissioned by Centrica Renewable Energy Ltd. The geotechnical survey was carried out by the Danish Geotechnical Institute (GEO), and the geoarchaeological recording was carried out at their offices in Copenhagen, Denmark. Additional samples were acquired from Geolabs in Watford. Assistance from both parties is acknowledged in these respects.

David Howell carried out the geoarchaeological recording of the borehole samples and compiled this report. Kitty Brandon prepared the illustrations. The project was managed for Wessex Archaeology by Caroline Budd.

RACE BANK OFFSHORE WIND FARM

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RACE BANK OFFSHORE WIND FARM

STAGE 2 GEOARCHAEOLOGICAL RECORDING OF BOREHOLE SAMPLES

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1. INTRODUCTION

1.1. PROJECT BACKGROUND

- 1.1.1. Wessex Archaeology (WA) was commissioned by Centrica Renewable Energy Limited to undertake geoarchaeological recording of borehole samples, collected by the Danish Geotechnical Institute (GEO) as part of the Race Bank Offshore Wind Farm (OWF) geotechnical investigation.
- 1.1.2. This recording programme is a continuation of the geoarchaeological investigation of the proposed wind farm site, and is based on the recommendations made during the Stage 1 geoarchaeological assessment of the borehole and CPT logs (WA 2010).

1.2. SITE LOCATION AND GEOLOGY

- 1.2.1. The proposed wind farm site lies within the southern North Sea, approximately 30km north of Wells-next-the-Sea, North Norfolk, and is mainly bounded by the Race Bank (to the south) and North Ridge (to the north) sand banks. The site location and proposed wind turbine positions are shown on **Figure 1**.
- 1.2.2. The geological bedrock throughout this entire area of the southern North Sea is Upper Cretaceous (Campanian) Chalk, the upper surface of which provides a distinctive lower boundary, on both seismic records and in boreholes, for the Pleistocene and more recent sequences present in the area.
- 1.2.3. The overlying Pleistocene sediments can be of varying thickness throughout the region, ranging from a thin veneer (and occasionally absent within major erosion features such as Silver Pit) to greater than 100m thick (Cameron *et al.* 1992). The nature of these sediments reflects the repeated glacial/interglacial cycles that have occurred in this area since the Anglian Period (c. 478,000 BP), which have resulted in the deposition of sequences of lodgement and ablation tills punctuated by episodes of erosion by glacial outwash and deposition of shallow marine sediments. These sequences are generally separated by marked erosion surfaces created by repeated ice sheet advance.
- 1.2.4. Sea level curves indicate that the wind farm site would have been completely inundated by the most recent marine transgression by approximately 6,000 BP (Shennan *et al* 2009). The erosive power of this most recent marine transgression will have been much less than during previous glacial advances, so the potential remains for the preservation of relict land surfaces, post-dating the last glacial maximum, across the survey area. This possibility is supported by the identification of scattered, relict palaeochannels within the survey area during the geophysical data assessment (WA 2008).

- 1.2.5. The recent seabed sediments of the area mainly comprise reworked deposits of sand and gravel, with the formation of large-scale stable bedforms such as Race Bank and North Ridge sandbanks.

2. STAGES OF GEOARCHAEOLOGICAL ASSESSMENT/RECORDING

2.1. INTRODUCTION

- 2.1.1. This report comprises Stage 2 geoarchaeological recording of the existing borehole samples within the following staged structure:

Stage	Method	Description
1	Assessment	A desk-based archaeological assessment of the borehole and CPT logs generated by geotechnical contractors aims to establish the likely presence of horizons of archaeological interest and broadly characterise them, as a basis for deciding whether and what Stage 2 archaeological recording is required. The Stage 1 report will state the scale of Stage 2 work proposed.
2	Geoarchaeological Recording	Archaeological recording of selected retained or new core samples will be undertaken. This will entail the splitting of the cores, with half of each core being cleaned and recorded. The Stage 2 report will state the results of the archaeological recording and will indicate whether any Stage 3 work is warranted.
3	Sampling and Assessment	Dependent upon the results of Stage 2, sub-sampling and palaeoenvironmental assessment (pollen, diatoms and foraminifera) may be required. Subsamples will be taken from one core-half, with the other core-half retained intact for further sub-sampling, should it be required. Assessment will comprise laboratory analysis of the samples to a level sufficient to enable the value of the palaeoenvironmental material surviving within the cores to be identified. Subsamples will also be taken and retained at this stage in case radiocarbon dating is required during Stage 4. The Stage 3 report will set out the results of each laboratory assessment together with an outline of the archaeological implications of the combined results, and will indicate whether any Stage 4 work is warranted.
4	Analysis and Dating	Full analysis of pollen, diatoms and/or foraminifera assessed during Stage 3 will be undertaken. Typically, Stage 4 will be supported by radiocarbon dating of suitable subsamples. Stage 4 will result in an account of the successive environments within the coring area, a model of environmental change over time, and an outline of the archaeological implications of the analysis.

5	Final Report	If required Stage 5 will comprise the production of a final report of the results of the previous phases of work for publication in an appropriate journal. This report will be compiled after the final phase of archaeological work, whichever phase that is.
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Table 1: Staged Geoarchaeological Assessment Structure

3. METHOD

- 3.1.1. Based on recommendations made during the Stage 1 borehole assessment, 29 samples from nine boreholes were geoarchaeologically assessed at GEO, Copenhagen, and WA, Salisbury (provided by Geolabs, Watford). The following samples were recorded (see **Figure 2** for their locations):

Borehole ID	Easting	Northing	Sample	Sample depths (metres below seabed)	Sample Origin
BH-CPT01	359483	5899409	1-ST	0.00 – 0.85	GEO
			2-B	1.10	
			3-ST	1.30 – 1.85	
			5-ST	3.30 – 3.80	
BH-CPT11	358583	5904620	1-ST	0.00 – 0.45	GEO
			3-ST	1.20 – 1.40	GEO & Geolabs
			12-ST	6.20 – 6.55	GEO
BH-CPT14	352699	5907228	20-ST	14.35 – 14.95	Geolabs
BH-CPT18	351208	5909832	26-HS	19.35 – 20.20	GEO
			12-ST	9.65 – 10.25	Geolabs
BH-CPT20	354201	5911136	6-ST	5.20 – 5.85	GEO
			10-ST	9.20 – 9.55	
			12-HS	10.20 – 11.10	
			14-ST	12.20 – 12.70	
			26-C	23.40 – 24.10	
			29-C	25.90 – 26.30	
			34-HS	31.50 – 32.50	
			40-C	38.40 – 38.95	
45-C	44.40 – 45.80				
BH-CPT26	352699	5905944	2-HS	1.10 – 2.00	GEO
			7-HS	6.10 – 6.70	
BH-G01	353905	5907279	6-HS	4.80 – 5.75	GEO
			10-HS	7.80 – 8.80	
BH-G03	357006	5900986	7-HS	4.00 – 5.00	GEO
			12-B	9.40	
			13-B	10.50	
			14-ST	1.10 – 11.95	
BH-G16a	356201	5905884	15-ST	12.00 – 12.60	GEO
			1-HS	0.00 – 0.50	

Table 2: List of samples Stage 2 Geoarchaeologically Recorded.

- 3.1.2. The core samples were examined and basic sedimentary characteristics recorded, including sediment type, depositional structure, texture and colour. A depth below seabed was assigned to each sediment horizon and the character, structure and form of the sediment described. Full descriptions of

the core samples are presented in **Appendix I**. No sub-samples of the cores were taken at this stage.

3.1.3. The sediments recorded were then compared by referencing their vertical and horizontal distribution to the unitary framework assigned to the sediments during the Stage 1 geoarchaeological assessment (WA 2010):

- **Sub-Unit 1a:** Shelly, gravelly sand (Holocene seabed sediment)
- **Sub-Unit 1b:** Sandy gravel (Holocene lag gravel)
- **Sub-Unit 1c:** Peat and organic clay (Holocene terrestrial deposit)
- **Sub-Unit 1d:** Organic sand and silt (Holocene terrestrial deposits)
- **Unit 2:** Sandy gravelly clay (Devensian Till)
- **Unit 3:** Shelly sand and gravel (Early Hoxnian shallow marine sediment)
- **Unit 4:** Laminated clay and silt (Early Hoxnian lagoon sediment)
- **Sub-Unit 5a:** Shelly sand and gravel (Pleistocene glaciofluvial sediment)
- **Sub-Unit 5b:** Laminated clay (Pleistocene glaciolacustrine sediment)
- **Sub-Unit 5c:** Gravelly sandy clay (Pleistocene re-deposited till)
- **Unit 6:** Chalk (Upper Cretaceous bedrock)

4. RESULTS

4.1.1. The detailed results of the geoarchaeological recording are given in **Appendix 1** and are summarised below.

4.1.2. The samples recorded were of various types and so differed in condition. The core samples (C) and hammer samples (HS) were stored within their core liners with way-up indicated. Short sections had been taken from these samples for geotechnical testing, but it was clear how much had been taken and from where.

4.1.3. The Shelby tube (ST) samples had been previously extruded, sections taken for geotechnical testing, and then stored in bags. Most had retained some structure, but others had deteriorated or partially moulded together. Although it is known from the core logs which sections were removed for testing, this could not be clearly related to the samples and there was no indication of way-up. The bag samples (B) were in a similar condition. Although these samples were good for determining the lithologies at certain intervals within the stratigraphy, the lack of way-up indications and precise depth measurements limits their utility for geoarchaeological work.

4.1.4. **Unit 6** was identified at the base of **BH-CPT14 (26-HS)**, confirming the presence of Cretaceous chalk at this depth (though the unit itself is not considered important archaeologically).

4.1.5. **Sub-Unit 5c** was identified at the base of **BH-CPT20 (45-C)** and was found to comprise dark greyish brown to dark grey, slightly to very gravelly clay. The gravel comprises mainly chalk, with occasional clasts of flint, red sandstone and black mudstone. The upper section of the sample was found to be layered, with two differing colours of clay. This is interpreted as the lowest member of the Swarte Bank Formation (SBK) as described in Cameron *et al* (1992), a unit of till deposited in sub-glacial valleys of Anglian age. The lower part of the sample appears to be a homogenous, possibly

in situ till deposit, whilst the strong layering apparent in the upper part suggests this section may be re-deposited, possibly in a glaciofluvial/glaciolacustrine environment.

- 4.1.6. **Sub-Unit 5b** was identified in **BH-CPT11 (12-ST)**, **BH-CPT20 (40-C and 34-HS)** and **BH-G03 (15-ST)**. This unit was found to comprise stiff dark grey to dark greyish brown clay, with occasional silt and fine sand lenses. Occasional black, possibly organic, streaks were observed in some samples. This is interpreted as the middle member of the Swarte Bank Formation (SBK) (Cameron *et al* 1992), a series of glaciolacustrine deposits of Late Anglian age.
- 4.1.7. **Sub-Unit 5a** was only identified in **BH-CPT20 (34-HS)** and was found to comprise alternating layers of dark grey clayey sand, sandy clay and clayey gravel. This has been attributed to the upper member of the Swarte Bank Formation (SBK) (Cameron *et al* 1992), and is interpreted as a series of glaciolacustrine/glaciomarine deposits of Late Anglian/Early Hoxnian age.
- 4.1.8. **Unit 4** was identified in **BH-CPT20 (26-C and 29-C)** and was found to comprise an approximately equal mixture of generally stiff (though in some places soft) dark grey and greyish brown silty clay. This colour difference could be natural, or could have arisen from partial drying out of the sample. This unit is interpreted as the Sand Hole Formation (SH), a series of shallow marine/lagoon deposits of Early Hoxnian age.
- 4.1.9. **Unit 3** was not identified in any of the examined samples. From previous work, this unit (Egmond Ground Formation) is a deposit of shelly, gravelly marine sand of Hoxnian age, and is expected to be only sporadically present across the proposed area and only thin where it does occur (WA 2010). A number of the other units encountered on the site have similar thin, sandy deposits within them, so determining precisely which belongs to Unit 3 is difficult without more sophisticated techniques.
- 4.1.10. **Unit 2** was identified in **BH-CPT01 (1-ST, 2-B, 3-ST, and 5-ST)**, **BH-CPT11 (3-ST)**, **BH-CPT20 (6-ST, 10-ST, 12-HS, and 14-ST)** and **BH-G03 (12-B, 13-B, and 14-B)** and was generally found to comprise stiff, dark greyish-brown, sandy, gravelly clay. This has been attributed to the Bolders Bank Formation, an extensive glacial till of Devensian age. Two samples (**BH-CPT01 3-ST** and **BH-CPT11 3-ST**) were much softer than usually expected for glacial till, and were found to contain areas of organic streaking and to be lacking in the gravel usually present in this formation. These could possibly represent a re-worked and re-deposited upper surface of the Bolders Bank formation.
- 4.1.11. **Sub-unit 1d** was identified in sample **BH-CPT14 (26-HS)**, and was found to comprise yellowish brown medium to coarse sand with numerous black inclusions. A large amount of these are likely to be grains of ferrous minerals, although some could be charcoal. The unit was also tentatively identified in **BH-G01 (10-HS)**, though here the sand was interbedded with areas of organic clay and probably represents a gradual transition between **sub-units 1d** and **1c**. This unit is interpreted as a terrestrial fluvial deposit, probably dated to the early Holocene.

- 4.1.12. **Sub-unit 1c** was identified in samples **BH-CPT01 (1-ST)**, **BH-CPT11 (1-ST)**, **BH-CPT14 (20-ST)**, **BH-CPT18 (12-ST)**, **BH-G01 (6-HS and 10-HS)**, and **BH-G16a (1-HS)**. This unit generally comprises dark greyish brown to black organic clay, with the other constituent parts differing between individual samples. **BH-CPT01 (1-ST)**, **BH-CPT11 (1-ST)** and **BH-G01 (10-HS)** have been found to contain wood fragments, plant remains and peat. While an internal structure to the unit is not always visible, samples **BH-CPT18 (12-ST)** and **BH-G01 (10-HS)** are clearly laminated, whilst **BH-CPT14 (20-ST)** is laminated with silt and has silty layers and partings, suggesting it is a transitional sample between **Sub-units 1c** and **1d**. This unit is interpreted as a coastal lowland/marsh deposit, probably created immediately prior to the Flandrian marine transgression in this area.
- 4.1.13. **Sub-unit 1b** was not identified in any of the examined samples. Found by previous work to be sporadically present across the Survey Area, this unit comprises sandy gravel and is interpreted to be a lag deposit from the Flandrian marine transgression (WA 2010).
- 4.1.14. **Sub-unit 1a** was identified in **BH-CPT26 (2-HS and 7-HS)** and **BH-G03 (7-HS)** and comprises a deposit of medium to coarse sand with occasional gravel and shell fragments. This is interpreted as modern seabed sediments.

5. ARCHAEOLOGICAL POTENTIAL

- 5.1.1. Following the Stage 2 geoarchaeological recording, **Unit 1c**, **Unit 1d** and some aspects of **Unit 2** have been found to have the highest archaeological potential.
- 5.1.2. As a glacial till, **Unit 2** is not generally regarded as archaeologically significant. However, the much softer sections of this unit identified in **BH-CPT01 (3-ST)** and **BH-CPT11 (3-ST)** exhibit features suggesting re-working and re-deposition of this unit, with the preservation of traces of organic matter and lack of gravel-sized inclusions also suggesting possible re-deposition. This increases the possible potential of this unit from a palaeoenvironmental perspective.
- 5.1.3. **Sub-units 1d** and **1c** have been found to gradually grade into each and are difficult to separate definitively. Both are terrestrial deposits, and record a gradual shift from a fluvial regime to lagoon and then marshland immediately prior to the Flandrian marine transgression. This is expected to cover a period of time from the late Palaeolithic to the early Mesolithic, so the deposits are of a high archaeological potential (WA 2010).
- 5.1.4. Furthermore, the highly organic nature of the samples recorded suggests these units are of potentially high importance to palaeoenvironmental studies. The presence of whole wood fragments and peat suggests other microscopic palaeoenvironmental indicators (e.g. pollen) could also be similarly well preserved. Analysis of organic material such as this could prove important in aiding environmental reconstruction of a period during which humans possibly inhabited the region around the Survey Area, and the climate was rapidly changing.

6. RECOMMENDATIONS

6.1.1. Following the Stage 2 Geoarchaeological Recording, it is recommended that further (Stage 3) sampling and laboratory assessment be carried out on the following samples:

Core	Sample	Target Unit	No. of Samples	No. of Sub-Samples	Sub-Sample Type
BH-CPT01	1-ST	1c	3	8	2 x Pollen, 2 x Diatoms, 2 x Forams & Ostracods. 1 x Plant macrofossils, insects, charcoal, molluscs & C-14
BH-CPT11	1-ST	1c	3	8	2 x Pollen, 2 x Diatoms, 2 x Forams & Ostracods. 1 x Plant macrofossils, insects, charcoal, molluscs & C-14
	3-ST	2	2	6	2 x Pollen, 2 x Diatoms, 2 x Forams & Ostracods.
BH-CPT14	20-ST	1c / 1d	2	6	2 x Pollen, 2 x Diatoms, 2 x Forams & Ostracods.
	26-HS	1d	2	4	1 x Pollen, 1 x Diatoms, 1 x Forams & Ostracods. 1 x Plant macrofossils, insects, charcoal & molluscs.
BH-CPT18	12-ST	1c	1	3	1 x Pollen, 1 x Diatoms, 1 x Forams & Ostracods.
BH-G01	6-HS	1c	3	7	2 x Pollen, 2 x Diatoms, 2 x Forams & Ostracods. 1 x Plant macrofossils, insects, charcoal & molluscs.
	10-HS	1c / 1d	2	6	2 x Pollen, 2 x Diatoms, 2 x Forams & Ostracods.
BH-G16a	1-HS	1c	1	3	1 x Pollen, 1 x Diatoms, 1 x Forams & Ostracods.

Table 3: Sample Recommendations for Stage 3 Assessment

- 6.1.2. Selection of the above samples has been based on the archaeological and palaeoenvironmental potential of the described units, alongside the size and condition of the samples themselves.
- 6.1.3. Two kinds of sample are generally taken for Stage 3 analysis. In the first, a thin section of core of approximately 20cm³ is taken and divided to be used for pollen, diatom, foraminifera and ostracods analysis. The second sample is larger, approximately 100cm³ in volume, and is used for plant macrofossil, insect, charcoal and mollusc analysis. If suitable material is found within this sample, it can also be used for radiocarbon dating. It is recommended that two C14 dates are undertaken at this stage in order to fully assess the archaeological potential of the sediments.
- 6.1.4. The proposed sampling scheme will be used as an initial starting point for the sampling process. The exact scheme may change slightly during sampling depending on further information regarding sample condition and suitability.

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8. APPENDIX 1: SAMPLE DESCRIPTIONS**BH-CPT01**

Sample	Depth	Description	Unit
1-ST	0.00 - 0.40	5 Y 4/1 (dark grey) slightly sandy CLAY with large, medium - coarse sand pockets. Numerous organic inclusions and streaks, including small wood fragments and possible charcoal. Faint organic odour.	1c
		Black, slightly sandy, soft organic CLAY. Numerous organic streaks and pockets of light, fibrous, spongy plant remains / peat. Organic odour. Some small fine sand / silt lenses / pockets.	
	0.40 - 0.60	NOT INVESTIGATED	-
	0.60 - 0.85	Hard, 10 YR 4/2 (dark greyish brown), sandy, gravelly CLAY. Gravel is mainly chalk with some red sandstone and black mudstone.	2
2-B	1.10	10 YR 4/2 (dark greyish brown) stiff, sandy, slightly gravelly CLAY. Gravel is mainly chalk with occasional black mudstone.	2
3-ST	1.30 - 1.85	10 YR 4/2 (dark greyish brown) soft, slightly sandy, slightly gravelly, CLAY. Gravel is chalk. Very occasional black, possibly organic, streaks.	2
		10 YR 4/2 (dark greyish brown) soft, sandy, slightly gravelly CLAY. Large (approx. 3mm) medium - coarse sand layer with occasional organic streaks.	
		10 YR 4/2 (dark greyish brown) stiff, sandy, slightly gravelly, CLAY. Gravel is chalk.	
5-ST	3.30 - 3.80	10 YR 4/2 (dark greyish brown) stiff, sandy, slightly gravelly CLAY. Gravel is mainly chalk with occasional black mudstone.	2

BH-CPT11

Sample	Depth	Description	Unit
1-ST	0.00 - 0.45	Mixture of black organic, peaty clay and peat lumps, 5Y 5/1 (grey) CLAY, and medium SAND (probably seabed sediment).	1c
3-ST	1.20 - 1.30	10 YR 4/2 (dark greyish brown) soft CLAY. Some organic streaks and occasional grey-green batches and streaks. Very occasional gravel inclusions, faint organic odour (assumed top in sequence). Gradual transition to following lithology.	2
	1.30 - 1.40	10 YR 4/2 (dark greyish brown) slightly sandy, slightly gravelly stiff CLAY with very occasional black organic streaks. Gravel is chalk with occasional black mudstone.	
	1.40 - 1.50	MISSING	
	1.50 - 1.65	10 YR 4/2 (dark greyish brown) slightly sandy, slightly gravelly stiff CLAY. Gravel is chalk.	

Sample	Depth	Description	Unit
12-ST	6.20 - 6.55	2.5 Y 4/1 (dark grey) stiff CLAY, with layer (approx. 5mm) of 10 YR 5/3 (brown) slightly clayey, medium - coarse, gravelly, shelly SAND.	5b

BH-CPT14

Sample	Depth	Description	Unit
20-ST	14.40 - 14.43	10 YR 3/1 (very dark grey) soft, laminated CLAY with occasional sandy silt partings and organic streaks. Thin (<1mm) black, organic layer at the top	1c / 1d
	14.43 - 14.45	10 YR 4/2 (dark greyish brown) sandy, clayey, laminated SILT. Sand is fine. Separated from the overlying unit by a thin (<1mm) fine sand parting.	
	14.45 - 14.49	Black, soft, organic laminated CLAY with very occasional small, sandy silt pockets. Separated from the overlying unit by a thin (<1mm) fine sand parting.	
	14.49 - 14.51	10 YR 4/2 (dark greyish brown) sandy, clayey, laminated SILT with occasional organic streaks. Sand is fine. Separated from the overlying unit by a thin (<1mm) fine sand parting.	
	14.51 - 14.55	Black, soft, organic laminated CLAY with very occasional small, sandy silt pockets. Separated from the overlying unit by a thin (<1mm) fine sand parting.	
	14.55 - 14.60	Alternating bands of 10 YR 3/1 (very dark grey), soft, CLAY and 10 YR 4/2 (dark greyish brown) sandy, clayey SILT. Bands are up to 10mm thick.	
26-HS	19.35 - 19.50	10 YR 5/4 (yellowish brown) medium to coarse SAND with occasional small, black inclusions (possibly charcoal).	1d
	19.50 - 19.65	MISSING	
	19.65 - 19.77	10 YR 5/4 (yellowish brown) medium to coarse SAND with numerous small, black inclusions (possibly charcoal).	
	19.77 - 20.20	White CHALK.	6

BH-CPT18

Sample	Depth	Description	Unit
12-ST	9.91 - 10.05	Hard, 10 YR 2/1 (black) slightly silty CLAY. Probably organic but no associated odour, probably due to drying of the sample. Sample is occasionally laminated with 7.5 Y 3/1 (very dark grey) fine, clayey SAND / sandy CLAY. Laminations are approx. 1mm thick.	1c

BH-CPT20

Sample	Depth	Description	Unit
6-ST	5.20 - 5.85	10 YR 4/2 (Dark greyish brown) slightly gravelly, sandy, stiff CLAY. Gravel is mainly chalk and flint with occasional red sandstone. Sand lens at one end of sample, sand layer at the opposite end. Sand is medium with clay lumps, 10 YR 5/3 (Brown).	2
10-ST	9.20 - 9.55	10 YR 4/2 (Dark greyish brown) sandy, slightly gravelly stiff CLAY. Gravel is mainly chalk.	2
12-HS	10.20 - 10.50	7.5 YR 4/2 (Brown) very clayey GRAVEL / very gravelly CLAY. Gravel is mixed lithologies, angular to sub-rounded, with clasts up to approx. 25mm.	2
	10.50 - 10.65	7.5 YR 4/2 (Brown) stiff, slightly sandy CLAY.	
	10.65 - 10.90	MISSING	
	10.90 - 11.01	7.5 YR 4/2 (Brown) stiff, slightly sand CLAY with occasional fine sand lenses / layers.	
	11.01 - 11.10	7.5 YR 4/2 (Brown) stiff, very sandy, slightly gravelly CLAY. Gravel is small (approx 2mm) chalk with occasional red sandstone.	
14-ST	12.20 - 12.70	10 YR 4/2 (dark greyish brown) slightly sandy, slightly gravelly stiff CLAY. Gravel is chalk.	2
26-C	23.40 - 23.49	Approximately equal proportion of 2.5 YR 4/1 (Dark gray) and 2.5 Y 4/2 (Dark greyish brown), both soft slightly silty CLAY. 1 large inclusion, 10mm sub-rounded chalk clast. 1cm thick gravelly layer at 23.48m, gravel is coarse, sub-rounded, mostly chalk and quartz.	4
	23.49 - 23.77	2.5 Y 4/2 (Dark greyish brown) stiff, sandy, gravelly CLAY. Sand is coarse; gravel is mostly chalk and quartz. 2cm very gravelly layer at 23.75m, gravel is sub-angular to sub-rounded chalk.	
	23.77 - 24.10	Gradual change from above layer to an approximately equal proportion of 2.5 Y 4/1 (Dark grey) and 2.5 Y 4/2 (Dark greyish brown) stiff, slightly silty CLAY. 'Blocky' texture with occasional small (<3mm) chalk inclusions, with one large (approx. 15mm) inclusion seem at 24.10m.	
29-C	25.90 - 26.08	Approximately equal proportions of 2.5 Y 4/1 (Dark grey) and 2.5 Y 4/2 (Dark greyish brown) silty CLAY. Very 'blocky' texture.	4
	26.08 - 26.24	MISSING	
	26.24 - 26.30	Approximately equal proportions of 2.5 Y 4/1 (Dark grey) and 2.5 Y 4/2 (Dark greyish brown) silty CLAY. Very 'blocky' texture.	
34-HS	31.50 - 31.63	Alternating layers of 7.5 YR 4/1 (Brown) very clayey, medium SAND and 2.5 Y 4/1 (Dark grey) CLAY.	5a
	31.65 - 31.76	2.5 Y 4/1 (Dark grey) very clayey GRAVEL. Gravel is of mixed lithologies, sub-angular to sub-rounded, and generally approx. 20mm (one large chalk clast is approx. 40mm).	

Sample	Depth	Description	Unit
	31.76 - 32.02	MISSING	5b
	32.02 - 32.14	2.5 Y 4/1 (dark grey) stiff CLAY.	
	32.14 - 32.36	MISSING	
	32.36 - 32.50	2.5 Y 4/1 (Dark grey) stiff, slightly sandy CLAY with very small (<1mm) chalk inclusions and a very faint organic odour.	
40-C	38.40 - 38.53	2.5 Y 4/1 (Dark grey) stiff CLAY with some black, possibly organic streaks, and occasional 2.5 Y 4/2 (Dark greyish brown) clay mixed in.	5b
	38.53 - 38.58	10 YR 4/2 (Dark greyish brown) soft CLAY with occasional black, possibly organic, streaks.	
	38.58 - 38.95	2.5 Y 4/1 (Dark grey) stiff CLAY with occasional black, possibly organic streaks, and occasional 2.5 Y 4/2 (Dark greyish brown) clay mixed in.	
45-C	44.40 - 44.46	10 YR 5/2 (Greyish brown) hard CLAY.	5c
	44.46 - 44.51	Alternating layers of 10 YR 5/2 (greyish brown) and 10 YR 6/2 (light brownish grey) hard CLAY. Layers are generally approx. 1mm to approx. 5mm thick. Occasional clasts of chalk and red sandstone.	
	44.51 - 44.55	5 Y 6/1 (grey) hard CLAY, with bands of slightly lighter clay and occasional pockets of black clay / mudstone inclusions. Thin sandy layer at base.	
	44.55 - 44.73	Mix of 5 Y 4/1 (dark grey) and 5 Y 6/1 (grey) hard, slightly gravelly CLAY. Gravel is mainly chalk with occasional red sandstone.	
	44.73 - 44.76	Mix of 5 Y 4/1 (dark grey) and 5 Y 6/1 (grey) hard, very gravelly CLAY. Gravel is mainly chalk (up to 20mm) with occasional red sandstone and black mudstone.	
	44.76 - 45.32	MISSING	
	45.32 - 45.41	5 Y 6/1 (grey) hard CLAY with occasional clasts of chalk (up to approx. 10mm).	
	45.41 - 45.75	5 Y 6/1 (grey) hard, gravelly CLAY with numerous large (up to 20mm) clasts of chalk with occasional clasts of flint, red sandstone and black mudstone.	
	45.75 - 45.82	MISSING	
	45.82 - 46.00	5 Y 6/1 (grey) hard, gravelly CLAY with numerous chalk clasts (up to approx. 15mm).	

BH-CPT26

Sample	Depth	Description	Unit
2-HS	1.10 - 2.00	10 YR 5/2 (greyish brown) medium - coarse SAND with occasional shell fragments. Numerous small (<1mm) black specks, possibly charcoal but very hard so probably mineral.	1a
7-HS	6.10 - 6.70	10 YR 5/2 (greyish brown) clean medium - coarse SAND.	1a

BH-G01

Sample	Depth	Description	Unit
6-HS	4.80 - 5.05	Mix of 10 YR 4/2 (dark greyish brown) soft CLAY, and 10 YR 3/1 (very dark grey) soft organic CLAY, both with occasional fine sand pockets, organic specks (possibly charcoal) and occasional large (approx. 10mm) subangular gravel clasts. No structure to the two different colours.	1c
	5.05 - 5.10	Mix of 10 YR 4/2 (dark greyish brown) soft very gravelly CLAY, and 10 YR 3/1 (very dark grey) soft, very gravelly, organic CLAY, both with occasional fine sand pockets and organic specks (possibly charcoal). Gravel is up to 30mm.	
	5.10 - 5.28	MISSING	
	5.28 - 5.53	Mix of 10 YR 4/2 (dark greyish brown) soft CLAY, and 10 YR 3/1 (very dark grey) soft organic CLAY, both with numerous fine sand pockets, organic specks (possibly charcoal) and occasional large (approx. 10mm) subangular gravel clasts. No structure to the two different colours.	
	5.53 - 5.66	MISSING	
	5.66 - 5.75	Mix of 10 YR 4/2 (dark greyish brown) soft CLAY, and 10 YR 3/1 (very dark grey) soft organic CLAY, both with numerous fine sand pockets, organic specks (possibly charcoal) and occasional large (approx. 10mm) subangular gravel clasts. No structure to the two different colours.	
10-HS	7.80 - 7.93	10 YR 4/1 (dark grey) clayey medium SAND with occasional pockets of darker organic CLAY. Slight organic odour.	1c / 1d
	7.93 - 8.26	10 YR 5/4 (yellowish brown) medium to coarse SAND with occasional gravel (up to approx. 10mm). Sand fines and becomes darker downwards.	
	8.26 - 8.37	10 YR 4/1 (dark grey) clayey medium SAND with occasional pockets of darker organic CLAY and pieces of charcoal. Large flint inclusion, approx. 20mm. Slight organic odour. Fines downwards to sandy CLAY.	
	8.37 - 8.57	MISSING	
	8.57 - 8.66	10 YR 4/1 (dark grey) soft, laminated CLAY.	
	8.66 - 8.83	10 YR 4/1 (dark grey) clayey medium SAND with occasional organic inclusions (wood fragments, charcoal).	
	8.83 - 8.88	10 YR 4/1 (dark grey) stiff, laminated clay with black organic content (charcoal).	

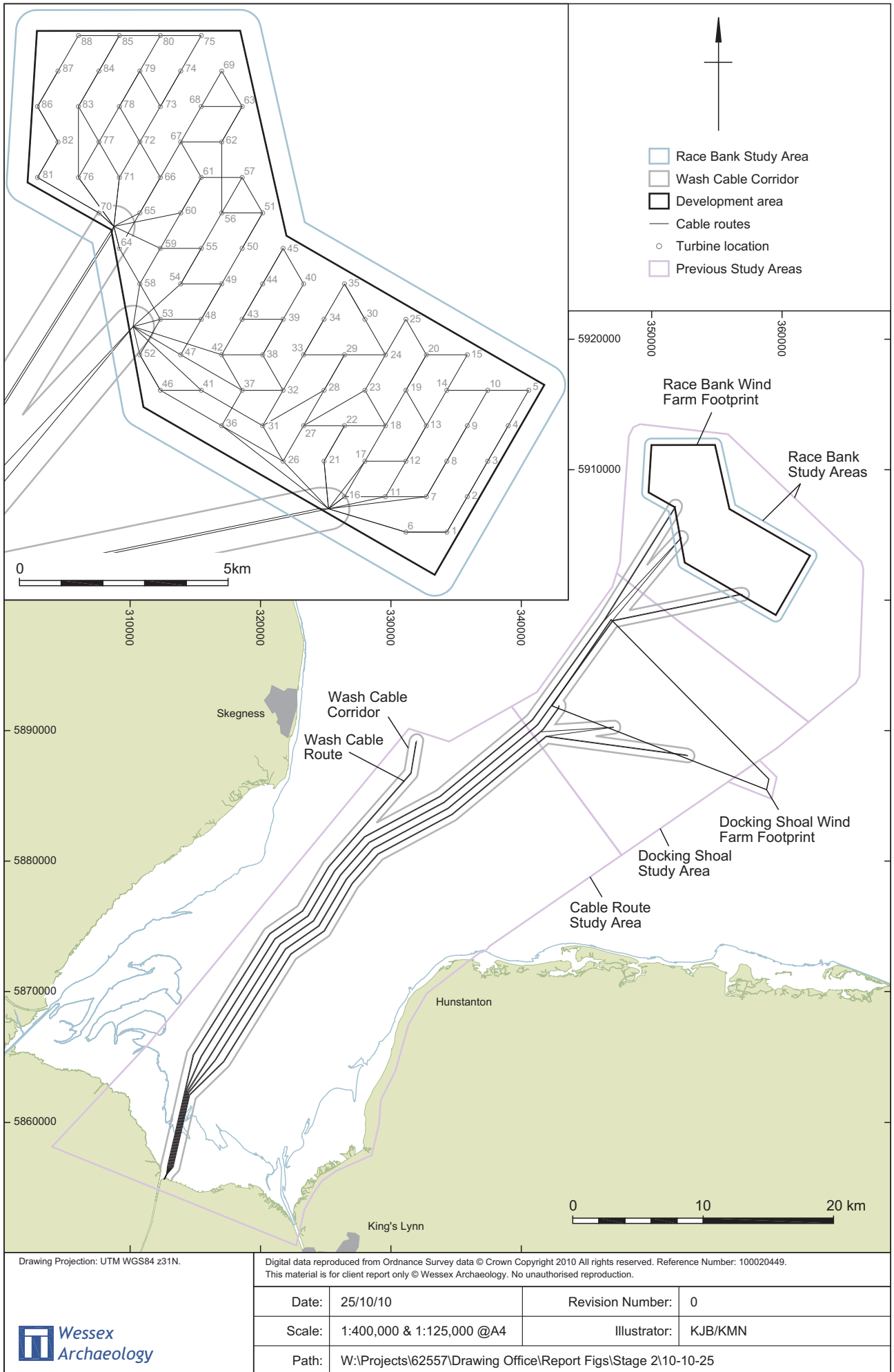
BH-G03

Sample	Depth	Description	Unit
7-HS	4.00 - 4.67	10 YR 5/2 (greyish brown), clean, medium - coarse SAND with very occasional gravel.	1a
	4.67 - 5.00	MISSING	

12-B	9.40	10 YR 4/2 (dark greyish brown) slightly sandy, slightly gravelly stiff CLAY. Gravel is generally chalk, with some black mudstone and occasional sandstone.	2
13-B	10.50	10 YR 4/2 (dark greyish brown) stiff, sandy, gravelly CLAY. Gravel is mainly chalk with occasional black mudstone.	2
14-ST	11.10 - 11.95	10 YR 4/2 (dark greyish brown) sandy to very sandy, slightly gravelly CLAY. Occasional fine - medium sand lens. Gravel is generally up to approx 5mm, and is chalk with occasional black mudstone and red sandstone. One very large chalk clast (approx. 30mm) identified.	2
15-ST	12.00 - 12.60	10 YR 4/2 (dark greyish brown) stiff CLAY with occasional fine sand / silt lenses / layers.	5b

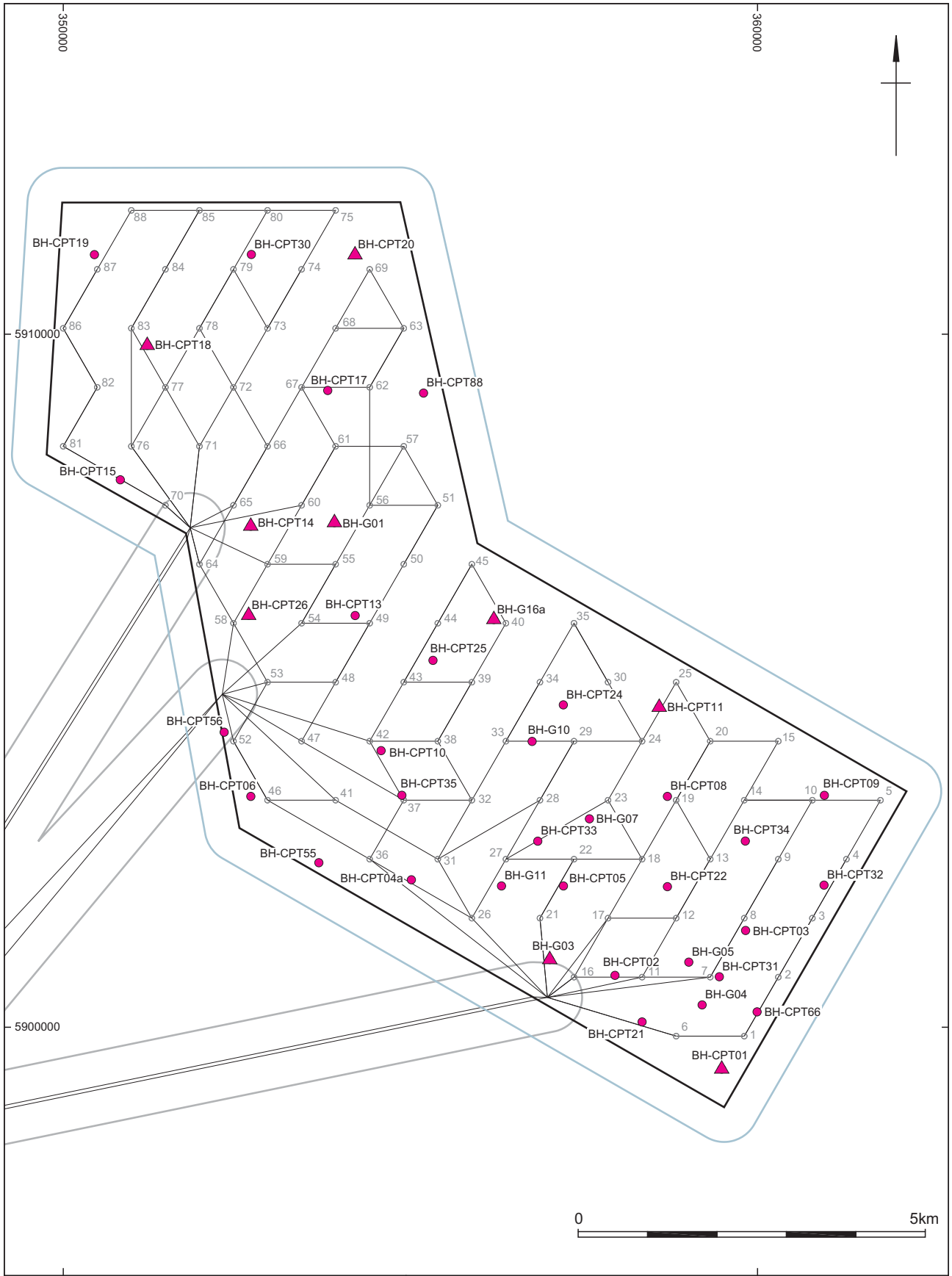
BH-G16a

Sample	Depth	Description	Unit
1-HS	0.41 - 0.47	2.5 Y 2.5/1 (black) soft, silty, slightly sandy organic CLAY. Sand is fine, no internal structure (e.g. laminations) visible.	1c
	0.47 - 0.50	Mix of 2.5 Y 2.5/1 (black) and 2.5 Y 3/1 (very dark grey) soft, silty, slightly sandy organic CLAY. Becoming sandier towards the base.	



Site location and proposed wind turbine positions

Figure 1



	<ul style="list-style-type: none"> Race Bank Study Area Wash Cable Corridor Development area — Cable routes ○ Turbine location ● Borehole location ▲ Boreholes used for Stage 2 Geoarchaeological recording 	Drawing Projection: UTM WGS84 z31N. This material is for client report only © Wessex Archaeology. No unauthorised reproduction.		
	Date: 25/10/10	Revision Number: 0		
	Scale: 1:80,000 @A4	Illustrator: KJB/KMN		
	Path: W:\Projects\62557\Drawing Office\Report Figs\Stage 2\10-10-25			

Borehole locations

Figure 2



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