

**BURBO BANK
EXTENSION
OFFSHORE
WIND FARM**



Burbo Bank Extension Offshore Wind Farm

*Summary of Geotechnical Investigations for the Burbo
Bank Extension project and comparison of these to
preliminary geophysical survey and interpretation*

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1. Introduction

DONG Energy has submitted a trio of consent applications to extend the existing and operational Burbo Bank offshore wind farm; this will be known as the Burbo Bank Extension offshore wind farm ('the Project'). These applications include:

- Development Consents Order application to the Planning Inspectorate for elements of the Project in English territorial waters;
- Welsh Marine Licence application to the Welsh Government Marine Consents Unit (now amalgamated within Natural Resources Wales) for elements of the Project in Welsh territorial waters up to mean high water mark (MHWM) at the North Wales cable landfall; and,
- Onshore Planning application to Denbighshire County Council for elements of the Project on Welsh land from mean low water mark (MLWM) at the North Wales cable landfall to the grid connection at the National Grid substation in Bodelwyddan.

The existing Burbo Bank wind farm consists of 25 Siemens Wind Turbine Generators (WTG's), each with a capacity of 3.6 MW, therefore having a total capacity of 90 MW.

The Project is located west of the existing Burbo Bank offshore wind farm, approximately 7 km north of Hoylake and Meols in the Wirral, 8.5 km from Crosby beach and 12.2 km from the Point of Ayr in Wales. To the northeast it is bordered by the Queens Channel navigation channel into the Port of Liverpool. The offshore wind turbines, offshore substation and part of the export cable are located within English territorial waters (within 12 nautical miles (nm) of the coast).

The Project would occupy an area of up to approximately 40 km² with a maximum installed capacity of 258 MW. The Project application has allowed for up to 69 WTG's, each with a capacity of between 3 MW – 7.5 MW.

The site is shown in Figure 1. The water depth at the area has been recorded in the offshore site area ranging from 3.5 m to 17 m below Lowest Astronomical Tide (LAT); it is most shallow at the peak of the two sand banks, and deepest towards the west. A relatively flat channel deepening towards the west, separates the two sand banks. Seabed gradients are in generally <1°.

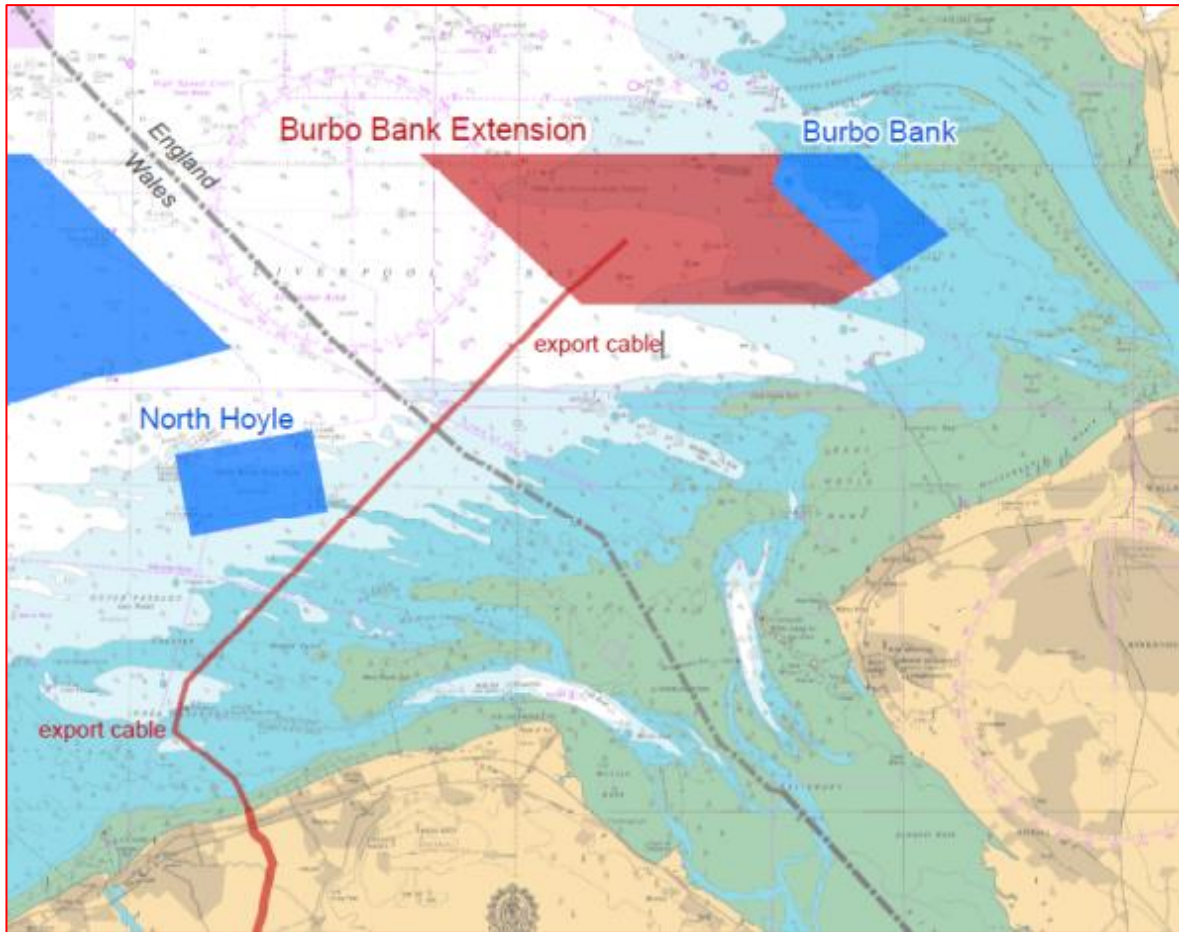


Figure 1: The proposed Burbo Bank Extension offshore wind farm (shown in red) in relation to the existing Burbo Bank site to the east and North Hoyle site to the west.

2. Aim and objective

The aim of this report is to summarise the most essential parts of the geotechnical Investigations that have been undertaken at the Project site in late 2012 responding to the concerns raised by the statutory nature conservation bodies (SNCBs) related to the preliminary interpretation of the geophysical data obtained at the site. The summary provided herein includes:

- A description of the geophysical investigations performed at the site (Section 3.1; Gardline Geosurvey Limited, April 2011, January 2012, October 2012).
- A description of the geotechnical investigations performed at the site (Section 3.2; Fugro Geoconsulting Limited 2013, GEO 2012).
- A description of soil stratigraphy (Section 3.3).
- Reference to the geophysical survey data (Gardline Geosurvey Limited, April 2011, January 2012, October 2012) and a summary of the site investigation data (Fugro Geoconsulting Limited 2013, GEO 2012) (Section 4).
- A summary of the applicability of geotechnical results for different foundation types (Section 5).

It should be noted that the statements set out in this report are based on results and conclusions given in the reports stated within the References section.

3. Field investigations

This section describes the geophysical and geotechnical surveys performed at the site. The geophysical survey was performed in 2010 by Gardline Geoscience limited, with an additional survey of the export cable corridor undertaken in June 2012. Geotechnical investigations were executed by GEO in 2012 (CPTs and shallow vibrocores) and by Fugro Geoconsulting Limited in 2013 (deep boreholes).

3.1 Geophysical investigations

Geophysical investigations were required to identify any environmental sensitivities in or around the Project site, to determine the nature of the seabed with respect to cable installation assessments (buriability) and in order to identify soil stratigraphy/type.

The geophysical data of the wind farm was obtained through a variety of survey methodologies (listed below), and the analysis and preliminary interpretation was mainly based on expected ground conditions described by British Geological Survey (BGS) maps (these are included in the Geophysical Annex of the Environmental Statement, document number 5.1.5.8). Geophysical data have been interpreted with reference to BGS charting for the area as follows:

- Liverpool Bay 53°N - 04°W
- British Geological Survey 1:250 000 Series published by Ordnance Survey.

Information was also obtained from:

- Kingfisher Information Service - Cable Awareness
- UK Deal Database
- "The Geology of the Irish Sea", HMSO, London.

The following survey equipment was used during the geophysical surveys to gather information on the seabed and sub-seabed:

- Multi-beam echo-sounder (MBES);
- Side scan sonar (SSS);
- Magnetometer;
- Deep sub-bottom profiler = Sparker (penetrating to approximately 50 m below seabed, only used on main site area);
- Shallow sub-bottom profiler = Pinger (penetrating to approximately 5-10 m below seabed).

Comprehensive geophysical investigations have been undertaken as part of the Environmental Impact Assessment (EIA) of the Project (document number 5.1.2.8 of Development Consents Order application). Survey data have been collected over two survey campaigns, Gardline undertook the first in 2010 (main site and initial cable route) and Osiris undertook the second in 2012 (revised cable route that is now being applied for). The technical reports (provided in the Environmental Statement (ES) Annex '5.1.5.8.1' and ES Annex '5.1.5.8.2') provide the data for initial assessments and interpretations, please note the initial cable route (surveyed in 2010) has since been dropped/alterd and therefore geophysical assessment and further assessments in this ES have focussed on the revised route (surveyed in 2012).

All height-referenced data are referred to in terms of the Lowest Astronomical Tide (LAT) in meters (m), and all data have been interpreted and reported by Gardline Geosurvey at the main offshore wind farm site and by Osiris along the revised export cable route.

The preliminary interpretation of the geophysical data was in certain areas obscured, as shown in Figure 2. These 'blanking effects' were initially interpreted to be shallow gas or peat deposits. It should be noted that even low amounts of gas or organic contents will decrease the acoustic transparency and in some cases cause unusable geophysical data, i.e. acoustic masking. However in the areas where acoustic masking has not been an issue, the results are estimated to be of reasonable quality and are well correlated with data obtained through geotechnical investigations.

For further discussions regarding geophysical data please refer to Section 3.1.

Burbo Bank Extension Offshore Wind Farm
Geotechnical Summary Report

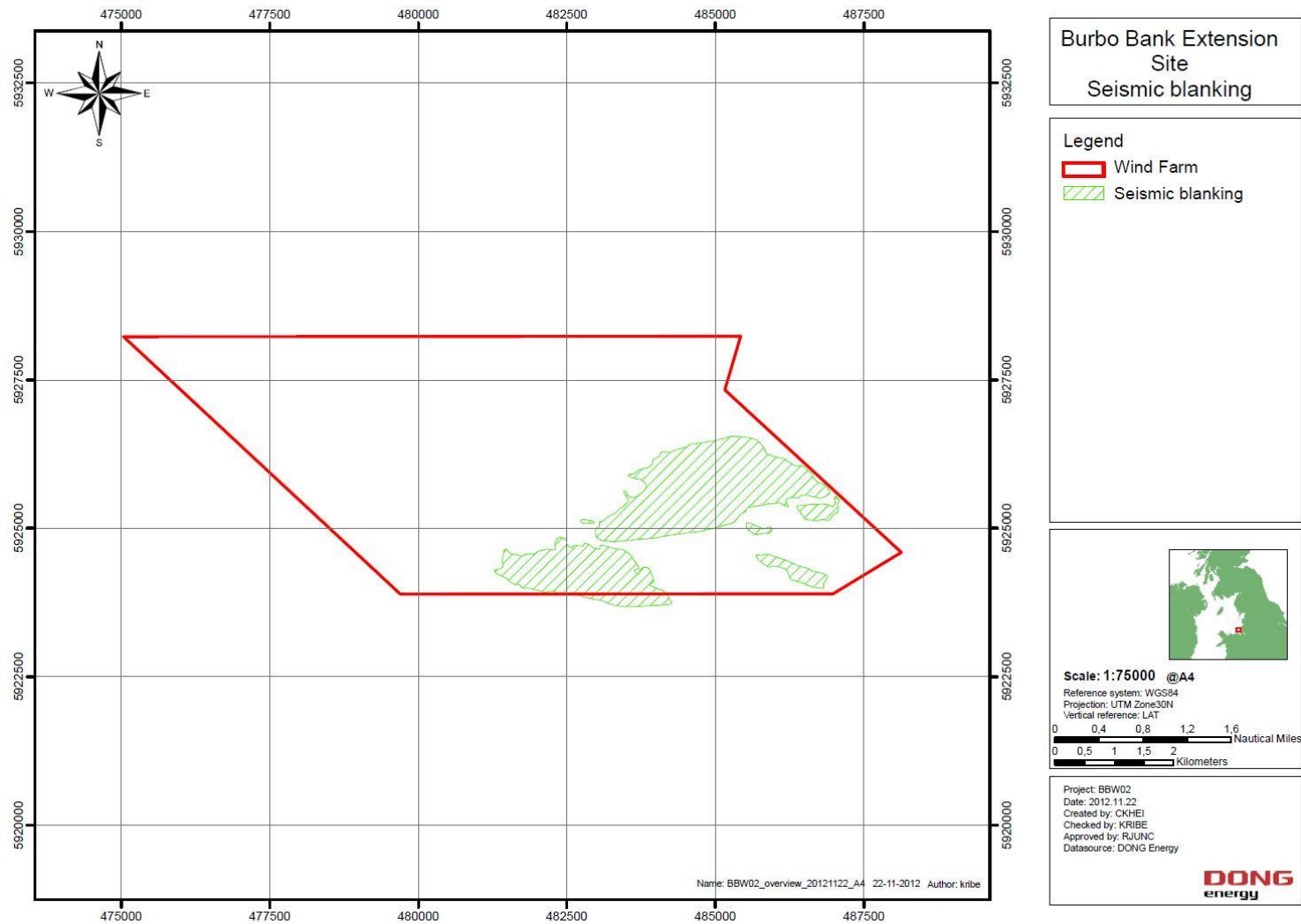


Figure 2: Chart of observed seismic blanking, caused by shallow organic silt and/or gyttja near seabed in the south-eastern part of the site (taken from Environmental Statement Doc 5.1.2.8).

3.2 Geotechnical investigations

The geotechnical investigations performed by GEO in late 2012 comprised a total of 33 investigations, comprising; 32 shallow seafloor cone penetration tests (CPT's) as well as 29 vibrocores to maximum depths of 8 m below the seafloor (BSF). The majority of investigations were carried out along the cable route and the remaining tests executed within the wind farm (see Figure 3 for location of CPTs and Vibrocores in relation to the Project). It should be noted that the vibrocore tests in the wind farm site were performed in areas where poor geophysical data was obtained (partly related to geophysical results highlighting a degree of acoustic masking). Figure 3 presents the spatial distribution of geotechnical investigations (CPTs and Vibrocores) in relation to the Project Site.

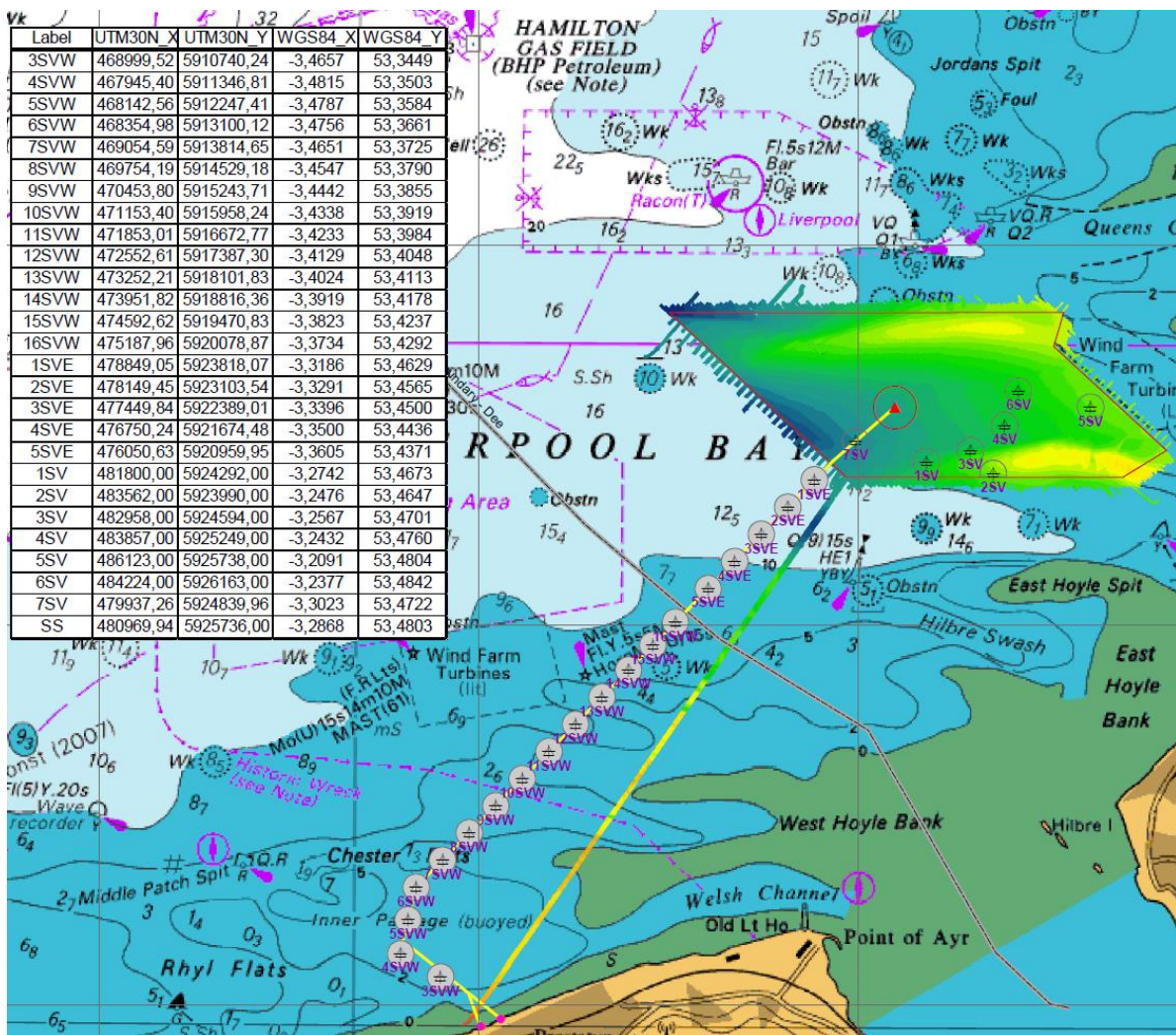


Figure 3: Geotechnical investigations performed by GEO (note red triangle denotes possible location of offshore substation – this is yet to be finalised)

The geotechnical investigations performed by Fugro Geoconsulting Limited in late 2012 were a parallel geotech campaign to the GEO work, using a different vessel for deeper water heavy duty coring. This sampling comprised of nine sample boreholes advanced by means of cable percussive and rotary coring techniques (seven penetrated to approximately 45 m, and two went deeper to 60 m) as well as downhole CPT's within the wind farm area. These tests were executed to maximum depths of approximately 60 m. Figure 4 shows the locations of the tests carried out by Fugro.

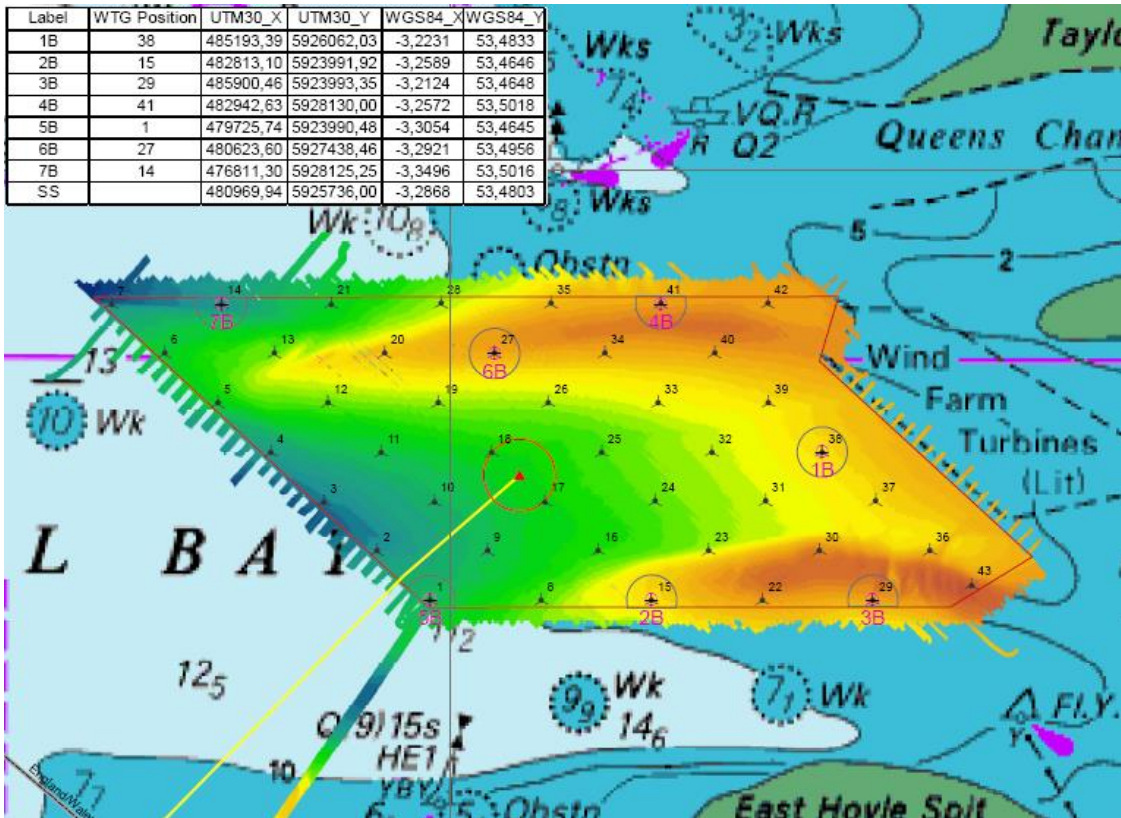


Figure 4: Geotechnical investigations performed by Fugro Geoconsulting Limited (note the 43 WTG positions shown on the figure are purely indicative at this stage and are one of a number of options the Project is considering within the Design Envelope)

The different vibrocores and boreholes performed within the wind farm site itself are summarised in Table 1.

Table 1: Summary of vibrocore and borehole site investigations inside the wind farm site

Investigations performed by GEO	
Vibrocore identification	Depth
1SVa	6.00 m
2SV	6.00 m
3SV	6.00 m
4SV	6.00 m
5SV	6.00 m
6SV	6.00 m
7SV	6.00 m
Investigations performed by Fugro	
Borehole identification	Depth
BH1B	45.00 m
BH2B	41.50 m
BH3B	41.00 m
BH4B	40.50 m
BH5B	41.00 m
BH6B	45.00 m
BH7B	45.20 m
BHSS	60.00 m
BHSSC	60.00 m

3.3 Soil stratigraphy

The geological formations recorded at the site are summarised in Table 2 and a description of the different formation soil types is presented in Table 3.

Table 2: Geological Formations (findings from geotechnical investigations)

Formation	Member	Facies	Seismostratigraphic unit
Surface Sands	Surface Sediments	Sand Bank (SURF SB)	Unit 1
	Coastal Deposits	Mud Facies (SURF CDM)	Unit 2
		Sand Facies (SURF CDS)	
	Channel Infill	Mud Facies (SURF CIM)	Unit 3
Sand Facies (SURF CIS)			
Western Irish Sea A	Channel Infill	Mud Facies (WIRS CIM)	Unit 4
		Sand Facies (WIRS CIS)	
		Gravelly Facies (WIRS CIG)	
Cardigan Bay	Glaciolacustrine Upper	Upper Laminated Mud Facies (CBAY UGL)	Unit 5
	Glaciolacustrine Lower	Lower Laminated Sand Facies (CBAY LGL)	
	Glaciofluvial	Sand Facies (CBAY GF)	
	Upper till	High Strength Diamictite A (CBAY UT)	
	Bedded and Infill Member	Gravelly Facies (CBAY IM)	
	Lower Till	High Strength Diamictite B (CBAY LT)	
Mercia Mudstone	Completely Weathered	Residual Soil (MMG CW)	Unit 6
	Weathered	Mudstone (MMG W)	

Table 3: Description of soil types found at project area

Facies	Geotechnical description
SURF SB	Grey sand with varied amounts of shells and shell fragments. Sand is fine to medium. Organic odour. Occasionally with thin beds to pockets of black organic clay.
SURF CDM	Interlaminated to interbedded silt and clay and occasionally clayey or silty fine sand, with occasionally shell fragments and slight organic odour.
SURF CDS	Silty sand with varied amounts of shell fragments and clayey or silty pockets to lamination. Sand is mainly fine to medium, occasionally laminations of coarse sand.
SURF CIM	Not sampled. Presence based on acoustic character Interlaminated to interbedded clay/silt and sand
SURF CIS	Silty sand with occasional shell fragments and laminations of soft silty clay and sandy silt.
WIRS CIM	Not sampled. Presence based on acoustic character Interlaminated to interbedded clay/silt.
WIRS CIS	Silty sand with lenses of black fine sand and sparse shell fragments, with black speckling. Sand is fine to medium. Possible wood fragments.
WIRS CIG	Silty gravelly sand. Sand is fine to coarse, gravel is subangular to subrounded, fine to medium and of mixed lithologies. With lamination of fine sand with black speckling.
CBAY UGL	Stiff clay with occasional sandy and gravelly pockets and lenses. Sand is fine, gravel is fine, rounded and of mixed lithologies.
CBAY LGL	Stiff, slightly sandy silty clay and slightly sandy clayey silt with laminations to thin beds of clayey sand, generally sandier with depth.
CBAY GF	Gravelly silty sand with rare laminae and beds of silty fine sand. Sand is fine to coarse, gravel is subangular and subrounded, fine to medium and of mixed lithologies.
CBAY UT	Stiff to very stiff, locally firm slightly sandy, slightly gravelly clay with rare cobbles. Gravel is angular to subrounded, fine to coarse and of mixed lithologies.
CBAY IM	Slightly clayey, very sandy gravel, sand is fine to coarse, gravel is subangular to well rounded, fine to coarse and of mixed lithologies.
CBAY LT	Very stiff, locally stiff, slightly sandy, slightly gravelly clay with rare cobbles. Gravel is subangular to well rounded, fine to coarse and of mixed lithologies.
MMG CW	Very stiff dark reddish brown clay occasionally with lithorelicts of extremely weak mudstone, and with pockets of gypsum. occasionally with bluish greenish grey reduction pockets.
MMG W	Very weak to weak, locally extremely weak dark reddish brown mudstone, locally partially to moderately weather to very stiff clay, with bluish greenish grey reduction pockets, with subhorizontal laminations of gypsum.

4. Correlation between geophysical and geotechnical findings

Within the Environmental Statement, submitted as part of both the DCO application to the Planning Inspectorate (22nd March 2013), Welsh marine licence application to Welsh Government Marine Consents Unit now amalgamated into Natural Resources Wales (25th March 2013) and the onshore planning application to Denbighshire County Council (25th March 2013), the following was summarised:

- Initial interpretations from the geophysical campaign suggested that blanking could be a result of shallow gas or peat being present. Since then the Project has completed its first geotechnical campaign (October – December 2012) and as part of this 6 vibrocores and 3 boreholes were collected in these areas to provide further information on the geological profile and to ground-truth the initial geophysical data.
- The Marine Management Organisation, Cefas and Natural England (amongst other stakeholders) have expressed an interest in receiving more information on the detailed findings. And these in themselves are not required to feed into the environmental impact assessment for other topics or sensitivities. The geotechnical reports and their findings are provided in this report in a summarised version to allow the above stakeholders to gain additional information on the geological environment in this area, with particular reference to concerns relating to potential peat presence from geophysical data interpretations, and is not to be provided as a necessity for the completion of the environmental impact assessment.
- Initial investigations focussed on this 'blanking' layer, which identified that the blanking is created by a thin layer of organic silt and/or gyttja near the seabed. Indicating that the geophysical interpretation of peat should in fact be attributable to other organic sediments, which are not related to peat. A 5 cm layer of peat has only been observed at one borehole location (3B), where it was 13.6 m beneath the seabed on the south eastern boundary of the wind farm site. No gas has been observed and no surface laying peat has been recorded. Further analysis of the cores (discussed within this report) have provided additional information, and the second geotechnical campaign, indicatively scheduled for 2013/2014, will seek to verify this with sample sites throughout the proposed project site

Based on the geophysical survey performed in 2010 by Gardline it was observed that geophysical blanking occurred locally, over approximately 20% of the SE corner of the offshore wind farm site at depths of approximately 6m on average. On the basis of the data available at that time, before the execution of the geotechnical campaign, it was anticipated that peat or shallow gas could be expected, and that this was causing the acoustic blanking. However this preliminary interpretation needed to be verified through a suitable borehole program, which was executed in October/November 2012 by Fugro Geoconsulting Limited who collected deep borehole samples from the offshore site (a report was issued in a finalised version to the Project in April 2013 (Fugro, 2013)), and a parallel program of vibrocores were collected by GEO in 2012 (GEO, 2012).

Regarding masking it should be noted that many areas in the Irish Sea, in particular those that feature glaciofluvial and fluvial deposits, are notorious for poor acoustic penetration. This is often attributable to the presence of interstitial gas or organic-rich sediments. Even relatively low contributions of organic material or gas may result in acoustic transparency and may be as extreme as causing entire wipe out of sub-bottom data. This is evident at the Burbo Bank Extension project offshore site in the SE corner of the offshore area site.

Based on the findings from the geotechnical surveys (GEO and Fugro) an internal reinterpretation of the geophysical data was made by the DONG Energy geoscience and structural foundation teams and this determined that preliminary geophysical interpretation, based on BGS maps, did not correlate very well with the geotechnical findings. The BGS maps are the expected depositions and stratigraphy based on an interpretation of the different time periods within the formation of the earth as we know it. These are not always unique (unambiguous) since local differences always occur because geological processes are complex and influenced by many factors. In some areas they are correlated with actual data and are therefore more precise. The geophysical data (Gardline, April 2011, and Gardline, January 2012) generally correlated well with horizons observed in the geotechnical boreholes, but the geological classification needed to be revised as a result of lack of conformity with BGS maps as stated previously.

The re-interpretation led to a revised geological model and cross sections showing the expected ground conditions across the wind farm area, presented in Appendix A, section 1 - 4.

The main conclusions from the geotechnical survey results (GEO 2012, Fugro 2013) and comparison to initial geophysical interpretation (Gardline, April 2011, and Gardline, January 2012) was:

- A re-interpretation of the initial geophysical data was needed and there was a generally poor correlation of expected stratigraphy based on BGS maps;
- There was no evidence of an individual peat layer covering the zone of acoustic blanking (this was limited to a thin layer at one borehole site).

In the SE corner of the wind farm site where acoustic blanking occurs, three boreholes were performed, 1B, 2B and 3B. None of these boreholes indicated an individual peat layer covering the acoustic masking area. However organic clays was observed, typically interbedded as lenses, at various depth from seabed down to approximately 15 metres below seabed. The soil type formations are listed further in relation to depth within Table 4, Table 5, and Table 6.

Table 4: Soil stratigraphy at borehole 1B

Depth [m]	Layer thickness [m]	Soil type*	
0.00	2.00	SURF CIS	
2.00			
2.00	4.00		
6.00			
6.00	4.00		
10.00			
10.00	2.00		
12.00			
12.00	8.00		WIRS CIS
20.00			
20.00			
23.80	3.80	CBAY LGL	
23.80			
25.55	1.75	CBAY GF	
25.55			
26.70	1.15	CBAY LGL	
26.70			
26.70	0.50	CBAY LGL	

Depth [m]	Layer thickness [m]	Soil type*
27.20		
27.20	2.00	
29.20		
29.20	0.80	CBAY UT
30.00	0.75	
30.75		
30.75	2.05	MMG CW
32.80	4.20	
32.80		
37.00		
37.00	4.70	MMG W
41.70	3.30	
41.70		
45.00		

Table 5: Soil stratigraphy at borehole 2B

Depth [m]	Layer thickness [m]	Soil type*
0	1.55	SURF SB
1.55		
1.55	0.4	SURF CIM
1.95		
1.95	2.55	SURF CIS
4.5		
4.5	0.4	SURF CIM
4.9		
4.9	1.89	SURF CIS
6.79		
6.79		
8.9	2.11	SURF CIS
8.9		
11.67	2.77	
11.67	5.38	CBAY UGL
17.05		
17.05	1.45	CBAY GF
18.5		
18.5	3.35	CBAY LGL
21.85		
21.85	3.85	CBAY LGL
25.7		
25.7	4.2	CBAY UT
29.9		
29.9	0.1	CBAY IM
30		
31	1.1	CBAY LT
31		
34.4	3.4	CBAY LT
34.4		
35.5	1.1	CBAY LT
35.5		
35.5	0.65	CBAY LT
36.15		

Depth [m]	Layer thickness [m]	Soil type*
36.15	5.35	MMG W
41.5		

Table 6: Soil stratigraphy at borehole 3B

Depth [m]	Layer thickness [m]	Soil type*
0.00	7.50	SURF CIS
7.50		
7.50	3.70	WIRS CIS
11.20		
11.20	2.45	WIRS CIG
13.65		
13.65	0.40	CBAY GF
14.05		
14.05	0.97	
15.02		
15.02	1.70	
16.72		
16.72	1.78	
18.50		
18.50	1.00	
19.50		
19.50	2.20	
21.70		
21.70	0.80	
22.50		
22.50	0.55	
23.05		
23.05	2.20	
25.25		
25.25	2.25	CBAY UT
27.50		
27.50	2.50	MMG W
30.00		
34.30	4.30	
34.30		
37.55	3.25	
37.55		
39.50	1.95	
39.50		
39.50	1.50	
41.00		

* All soil types belonging to Surface (SURF), Western Irish Sea (WIRS) and Cardigan Bay (CBAY) formations all having organic content. The largest percentages have been observed in CBAY-GF

In borehole 3B there was a peat layer identified between 13.60 – 13.65 metres below seabed. Borehole 3B is included in cross sections 2 and 3 in Appendix A, however the observed peat is so thin (5 cm from 13.6m depth to 13.65m) that it is not shown in the overall stratigraphy. The observed 5 cm peat is placed at the bottom of the Western Irish Sea channel infill formation (borehole 3B is included in cross sections 2 and 3 in Appendix A). The organic content is in general between 0.1 – 3.2 % of the acoustic masking area, which clearly does not indicate peat.

During the cable route survey performed by GEO in 2012, seven vibrocores (1SV – 7SV) were retrieved from the sub-surface to confirm stratigraphy (see Figure 3 and Table 1). Most of these shallow investigations (vibrocores up to 8m deep, see GEO samples in Table 1) were performed within the acoustic masking area and they also show organic clays at various depths, but again no individual peat layer was observed. The organic content varied between 1.4 – 6.6 %, which is low and not an indication of an actual peat layer. Deposits with organic content were only observed within the wind farm site in central and south east areas, broadly correlated with the areas of blanking highlighted by the geophysical survey and not along the export cable route.

5. Suitability of geotechnical results for engineering

The geotechnical surveys performed in 2012 (GEO A/S 2012, Fugro 2013) and planned for future campaigns at the Burbo Bank Extension project site are an on-going process, and the results obtained still allows for various foundation types, such as gravity based foundations, monopiles or jacket structures. However only the first (phase 1) geotechnical surveys (the GEO 2012 & Fugro 2013) have been completed with a second detailed campaign planned for 2013/2014 when a final WTG and offshore substation layout is expected to be available; at that stage the existing survey data will be supplemented with further geotechnical investigations with more numerous deep borehole sampling being undertaken at the individual foundation positions.

6. Conclusions and recommendations

The original conclusion from the geophysical survey performed in 2010, that peat/shallow gas should be the root cause for acoustic blanking in the SE corner of the wind farm site, has not been confirmed through the geotechnical survey. Organic clays have been observed in the surface sediments, but the organic content clearly indicates that it is not peat. Though the presence of organic material within the subsurface stratigraphy has been noted at a number of locations and at various depths, peat has only been observed at BH3B at 13.6-13.65 as stated previously.

The conclusion is based on the available geophysical and geotechnical data, assessed that the acoustic blanking is most likely due to the presence of organic clays, with a limited content of organic material and maybe due to presence of gas caused by the degradation of plant remains within these deposits.

7. References

DONG Energy (March 2013), Environmental Statement; Volume 2 - Chapter 8: Geology Bathymetry and Seabed Features, Prepared for: DONG Energy Burbo Bank Extension (UK) Ltd, Document Reference 5.1.2.8

DONG Energy (March 2013), Environmental Statement; Annex 8 – Geology, Bathymetry & Seabed Features, Prepared for: DONG Energy Burbo Bank Extension (UK) Ltd, Document Reference 5.1.5.8a

DONG Energy (March 2013), Environmental Statement; Annex 8 – Geology, Bathymetry & Seabed Features, Prepared for: DONG Energy Burbo Bank Extension (UK) Ltd, Document Reference 5.1.5.8b

Fugro Geoconsulting Limited (1) (2013), Engineering Geological Consultancy Study - Burbo Bank Wind Farm Site, Liverpool Bay Irish Sea. Doc. No.: J31081-1(02). Doc. Date: 17/04/2013, Prepared for: DONG Energy Burbo Bank Extension (UK) Ltd*

GEO A/S (2012). Seabed CPT's and Vibrocores, Factual report, BBW02 Burbo Bank Investigation for export cable route and turbine area, Geotechnical investigation 2012, Part 2, GEO project no. 36050, Report 3, Rev. 1, 2012-12-07.*

Gardline Geosurvey Limited (April 2011), Burbo Bank Extension, Geophysical Survey 2010/2011, October-November 2010, Burbo Bank Extension Area Report, Prepared for: DONG Energy Burbo Bank Extension (UK) Ltd

Gardline Geosurvey Limited (January 2012), Burbo Bank Extension Inshore, Geophysical Survey 2010/2011, January 2012, Burbo Bank Extension Inshore Area Report, Prepared for: DONG Energy Burbo Bank Extension (UK) Ltd

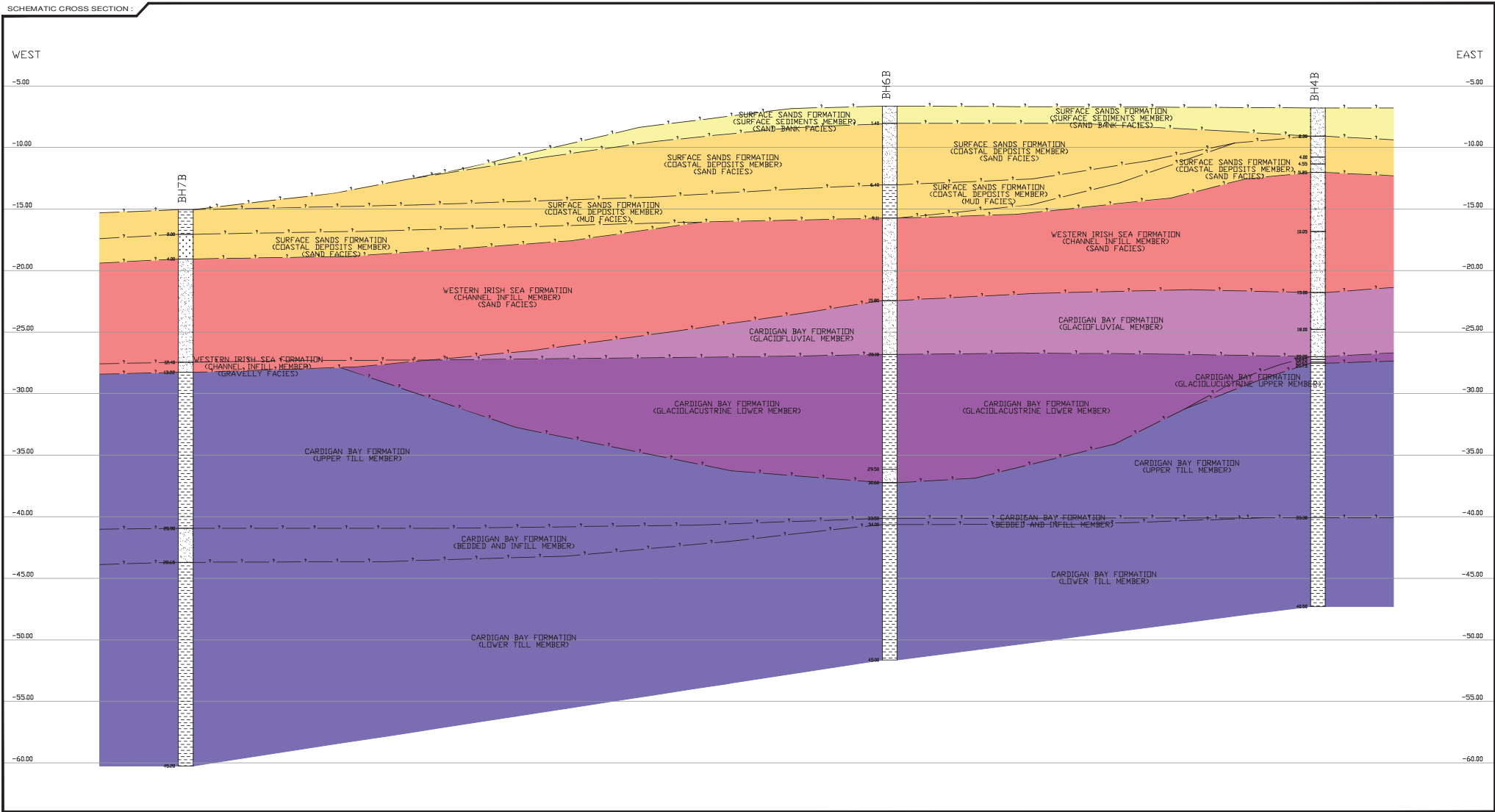
Osiris Projects, October 2012, Burbo Bank Extension Site, Cable Route & Irish Sea Metmast North, Offshore Geophysical Surveys 2012, Volume 3 – Export Cable Route Results Report C12023

** NOTE: All references relating to geotechnical documents are not publically available due to their commercially sensitive nature, however geophysical documents have been supplied with the initial Environmental Statement as part of the Annex (Document 5.1.5.8a and 5.1.5.8b)*

Appendix A: Cross sections from revised geological model with boreholes included. Section 1 – 4

See accompanying charts:

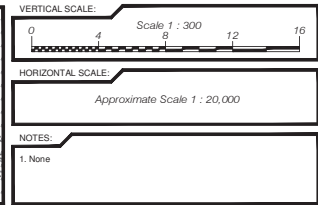
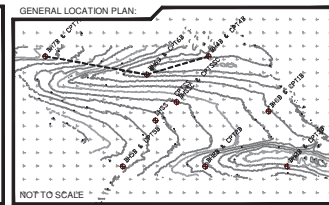
1. SCHEMATIC CROSS-SECTION OF GROUND CONDITIONS - SECTION 1, FIGURE No. : CS1; Boreholes 4B, 6B & 7B
2. SCHEMATIC CROSS-SECTION OF GROUND CONDITIONS - SECTION 2, FIGURE No. : CS2; Boreholes SSB, 2B, 3B, 6B & 7B
3. SCHEMATIC CROSS-SECTION OF GROUND CONDITIONS - SECTION 3, FIGURE No. : CS3; Boreholes 2B, 3B & 5B
4. SCHEMATIC CROSS-SECTION OF GROUND CONDITIONS - SECTION 4, FIGURE No. : CS4; Boreholes 1B, 3B & 4B



Chainage (m)	0.00	3812.41	6131.89
Elev. (mLAT)	-15.05	-6.63	-6.78

LEGEND :

	CLAY		ALIGNMENT OF CROSS-SECTION
	SILT		Surface Sands Formation - Surface Sediments Member
	SAND		Surface Sands Formation - Coastal Deposits Member
	GRAVEL		Surface Sands Formation - Channel Infill Member
	MUDSTONE		Western Irish Sea Formation - Channel Infill Member
	SANDSTONE		Cardigan Bay Formation - Glaciofluvial Member
	SILTSTONE		Cardigan Bay Formation - Glaciolacustrine (Upper & Lower) Member
	ASSUMED ZONE OF CONE LOSS		Cardigan Bay Formation - Upper Till, Lower Till and Bedded and Infill Members
			Mercia Mudstone Group - Completely Weathered and Weathered Members




CLIENT : **DONG ENERGY BURBO BANK EXTENSION (UK) LIMITED**

PROJECT : **BURBO BANK EXTENSION OFFSHORE WIND FARM (BBW02)**

TITLE : **SCHEMATIC CROSS-SECTION OF GROUND CONDITIONS - SECTION 1**

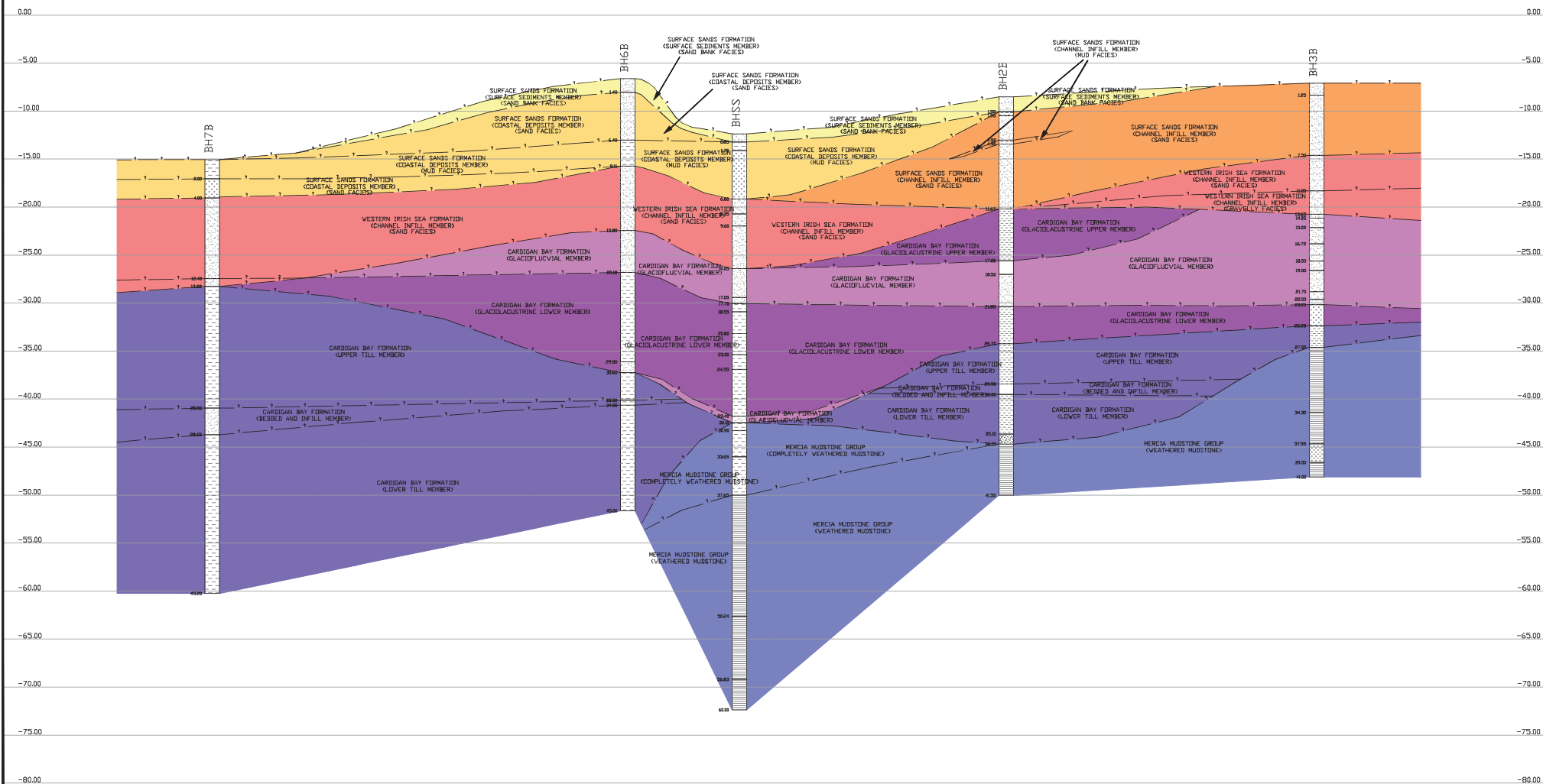
INTERP. BY :	GDF	DATE :	22/11/2012	DRAWN BY :	GHS	DATE :	02/04/2013
CHECKED BY :		DATE :		APPROVED BY :		DATE :	
CONTRACT REF. :		N122016U		FIGURE No. :		CS1	
CAD FILE NAME : N122016U_Schematic\Section_rev1.dwg							
PLOTTED DRAWING SIZE : A3 (420 X 297)							
FUGRO ENGINEERING SERVICES Fugro House, Hithercroft Road Wallingford, Oxfordshire, OX10 9RB Tel : +44 (0)1491 8204 00 Fax : +44 (0)1491 8204 99 Email : info@fes.co.uk www.fes.co.uk							



SCHEMATIC CROSS SECTION :

NORTH WEST

SOUTH EAST



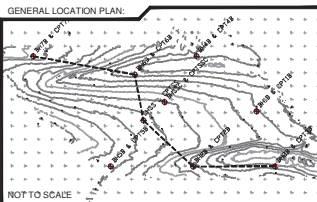
Chainage (m)	0.00	3754.96	4705.69	7177.49	9962.87
Elev. (mLAT)	-15.05	-6.63	-15.37	-8.53	-7.11

LEGEND

- CLAY
- SILT
- SAND
- GRAVEL
- MUDSTONE
- SANDSTONE
- SILTSTONE
- ASSUMED ZONE OF CONE LOSS

ALIGNMENT OF CROSS-SECTION

- Surface Sands Formation - Surface Sediments Member
- Surface Sands Formation - Coastal Deposits Member
- Surface Sands Formation - Channel Infill Member
- Western Irish Sea Formation - Channel Infill Member
- Cardigan Bay Formation - Glaciofluvial Member
- Cardigan Bay Formation - Glaciofluvial (Upper & Lower) Member
- Cardigan Bay Formation - Upper Till, Lower Till and Bedded and Infill Members
- Mercia Mudstone Group - Completely Weathered and Weathered Members



VERTICAL SCALE:

Scale 1 : 400

HORIZONTAL SCALE:

Approximate Scale 1 : 35,000

NOTES:

1. None

CLIENT :

DONG ENERGY BURBO BANK EXTENSION (UK) LIMITED

PROJECT :

BURBO BANK EXTENSION OFFSHORE WIND FARM (BBW02)

TITLE :

SCHEMATIC CROSS-SECTION OF GROUND CONDITIONS - SECTION 2

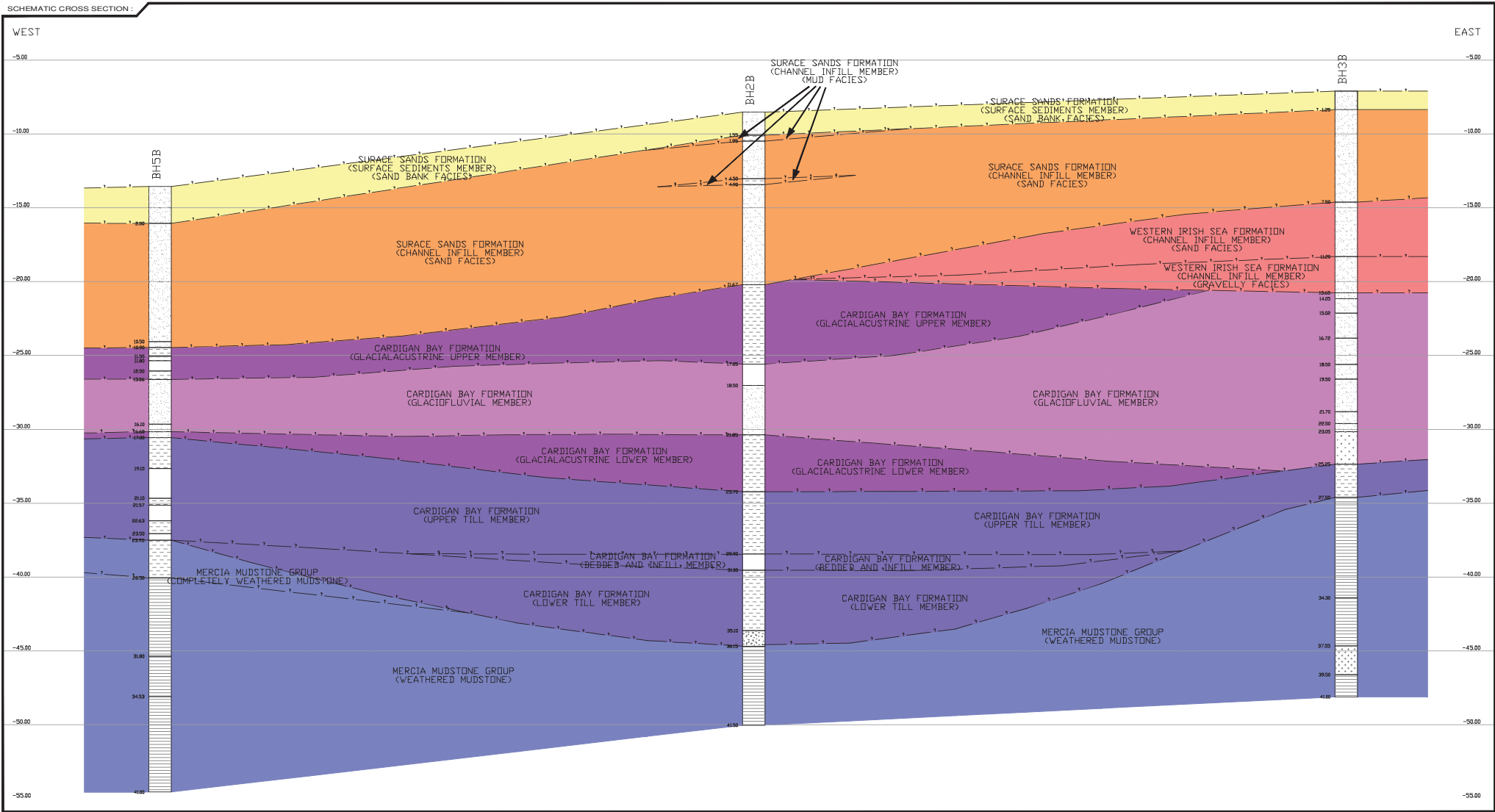
INTERP. BY : GDF **DATE:** 22/11/2012 **DRAWN BY:** GHS **DATE:** 02/04/2013

CHECKED BY : **DATE:** **APPROVED BY:** **DATE:**

CONTRACT REF.: N122016U **FIGURE No.:** CS2

CAD FILE NAME: N122016U_SchematicCrossSection_rev1.dwg
PLOTTED DRAWING SIZE: A3 (420 X 297)

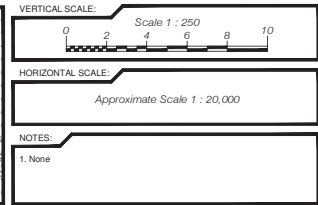
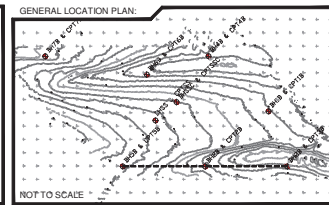
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Chainage (m)	0.00	3080.00	6174.37
Elev. (mLAT)	-13.56	-8.53	-7.11

LEGEND :

	CLAY		Surface Sands Formation - Surface Sediments Member
	SILT		Surface Sands Formation - Coastal Deposits Member
	SAND		Surface Sands Formation - Channel Infill Member
	GRAVEL		Western Irish Sea Formation - Channel Infill Member
	MUDSTONE		Cardigan Bay Formation - Glaciofluvial Member
	SANDSTONE		Cardigan Bay Formation - Upper Till, Lower Till and Bedded and Infill Members
	SILTSTONE		Cardigan Bay Formation - Upper Till, Lower Till and Bedded and Infill Members
	ASSUMED ZONE OF CONE LOSS		Mercia Mudstone Group - Completely weathered and weathered Members



CLIENT : DONG ENERGY BURBO BANK EXTENSION (UK) LIMITED

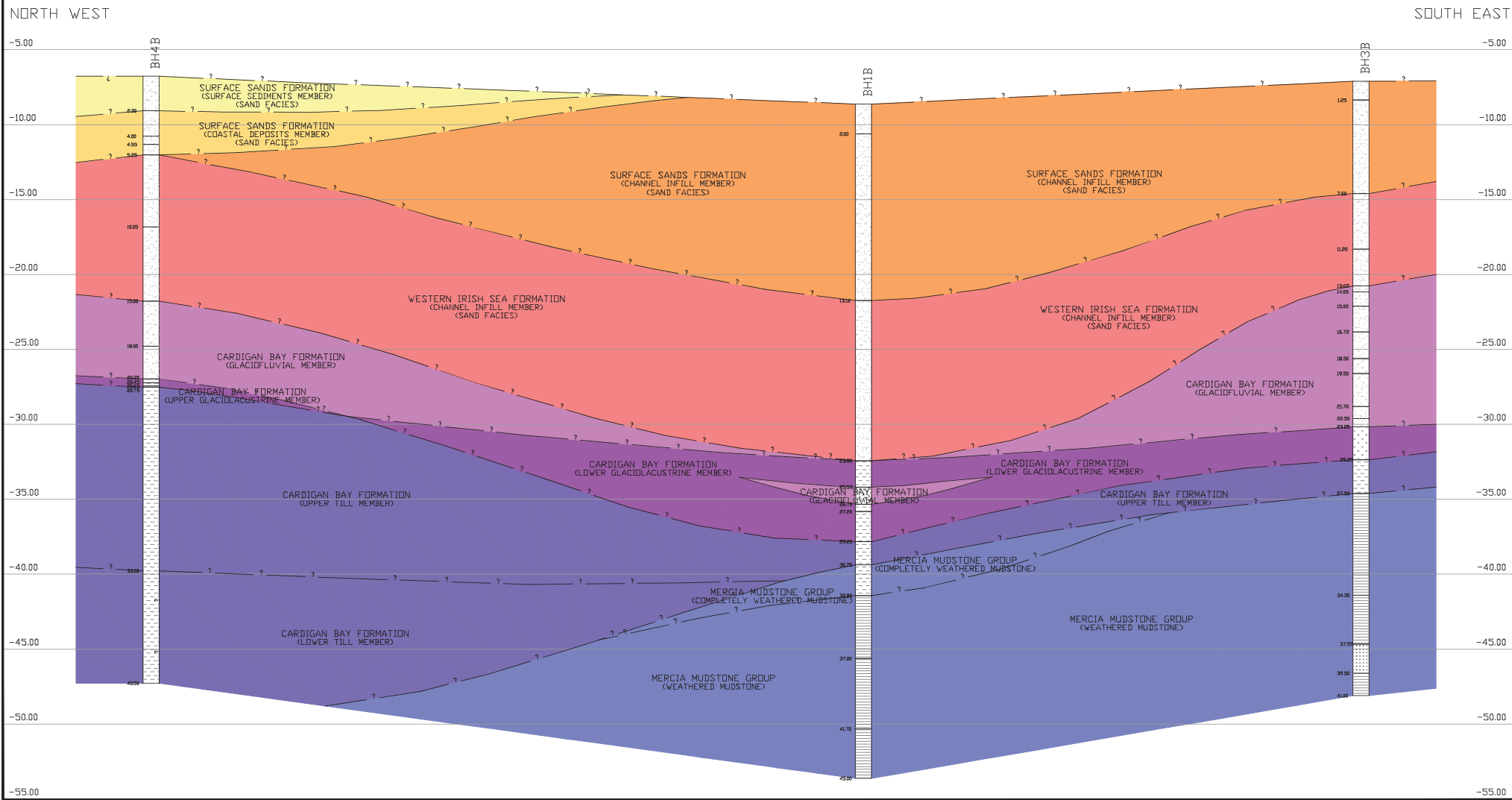
PROJECT : BURBO BANK EXTENSION OFFSHORE WIND FARM (BBW02)

TITLE : SCHEMATIC CROSS-SECTION OF GROUND CONDITIONS - SECTION 3

INTERP. BY : GDF	DATE : 22/11/2012	DRAWN BY : GHS	DATE : 02/04/2013
CHECKED BY :	DATE :	APPROVED BY :	DATE :
CONTRACT REF. : N122016U	FIGURE No. : CS3		
CAD FILE NAME : N122016U_Schematic\Section_rev1.dwg			
PLOTTED DRAWING SIZE : A3 (420 X 297)			
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SCHEMATIC CROSS SECTION :

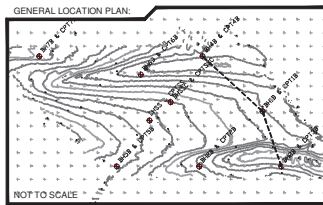


Chainage (m)	0.00	2983.18	5082.91
Elev. (mLAT)	-6.78	-8.63	-7.11

LEGEND :

	CLAY		Surface Sands Formation - Surface Sediments Member
	SILT		Surface Sands Formation - Coastal Deposits Member
	SAND		Surface Sands Formation - Channel Infill Member
	GRAVEL		Western Irish Sea Formation - Channel Infill Member
	MUDSTONE		Cardigan Bay Formation - Glacioluvial Member
	SANDSTONE		Cardigan Bay Formation - Glaciolacustrine (Upper & Lower) Member
	SILTSTONE		Cardigan Bay Formation - Upper Till, Lower Till and Bedded and Infill Members
	ASSUMED ZONE OF CONE LOSS		Mercia Mudstone Group - Completely Weathered and Weathered Members

ALIGNMENT OF CROSS-SECTION



VERTICAL SCALE:

Scale 1 : 250

HORIZONTAL SCALE:

Approximate Scale 1 : 16,000

NOTES:

1. None

CLIENT :

DONG ENERGY BURBO BANK EXTENSION (UK) LIMITED

PROJECT :

BURBO BANK EXTENSION OFFSHORE WIND FARM (BBW02)

TITLE :

SCHEMATIC CROSS-SECTION OF GROUND CONDITIONS - SECTION 4

INTERP. BY :	GDF	DATE :	22/11/2012	DRAWN BY :	GHS	DATE :	02/04/2013
CHECKED BY :		DATE :		APPROVED BY :		DATE :	

CONTRACT REF. : N122016U FIGURE No. : CS4

CAD FILE NAME : N122016U_SchematicSection_rev1.dwg
 PLOTTED DRAWING SIZE : A3 (420 X 297)

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