Beatrice Offshore Wind Farm Consent Plan

Cable Plan (Wind Farm)

November 2016

Beatrice
Offshore Windfarm Ltd

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Project Title / Location	Beatrice Cable Plan (Wind Farm)
Project Reference Number	LF000005-PLN-183
Date:	November 2016

Beatrice Offshore Wind Farm

Cable Plan

(Wind Farm)

Pursuant to Section 36 Consent Condition 19

For the approval of the Scottish Ministers

Rev	Prepared By	Sign Off	Checked By	Sign Off	Approved By	Sign Off	Date of Issue
3.0	Steve Bellew GoBe Consultants	[redacted]	Jonathan Wilson, Consenting and Stakeholder Manager, BOWL	[redacted]	Steven Wilson, Senior PM, BOWL	[redacted]	4/11/2016

Cable Plan (Wind Farm) Overview

Purpose and objectives of the Plan

This Wind Farm Cable Plan (CaP) has been prepared to address the specific requirements of the relevant condition attached to Section 36 Consent issued to Beatrice Offshore Windfarm Limited (BOWL).

The overall aim of this Wind Farm CaP is to set out the procedures for the installation of the inter-array cables (noting that a separate Offshore Transmission Works CaP will set out the equivalent for the offshore export cables (including the inter-connector cable between the Offshore Transformer Modules (OTMs)).

This Wind Farm CaP confirms that the construction procedures to be employed align with those considered in the original Application, and that construction-related mitigation measures detailed in the Application will be applied during installation.

All relevant method statements developed by contractors involved in the Beatrice Project must comply with the procedures set out in this Wind Farm CaP.

Scope of the Plan

This Wind Farm CaP covers, in line with the requirements of the Section 36 Consent condition, the following:

- Details of the location and cable laying techniques for the inter-array cables, including the method of burial and protection;
- The results of survey work including geophysical, geotechnical and benthic surveys which will help inform cable routing, and methodologies for future survey work during the operational life of the wind farm;
-The technical specification of inter-array cables, a burial risk assessment and measures to address exposure of inter-array cables; and
- Confirmation that the construction methods described within this Wind Farm CaP align with those considered in the original Application.

Structure of the Plan

This Wind Farm CaP is structured as follows:

Sections 1 and 2 set out the scope and objectives of the CaP, set out statements of compliance and identify Key Contractors and their roles.

Section 3 sets out the process for making updates and amendments to this document.

Section 4 provides an overview of the Development.

Section 5 provides detail on the inter-array cable routes and key constraints considered. It also provides detail on the geophysical, geotechnical and benthic surveys conducted to inform cable routing.

Section 6 details the location and layout of inter-array cables and the micro-siting tolerances.

Section 7 provides the technical specification of the inter-array cables and their components. The results of electromagnetic field assessments are also detailed.

Section 8 details the results of the Cable Burial Risk Assessments

Section 9 provides detail of the installation procedures and cable laying methodology.

Section 10 describes the inspection procedures and maintenance surveys to be carried out after installation and during operation.

Section 11 provides information to demonstrate compliance with the original Application, and how the mitigation proposed in the Application will be delivered.

Appendix A provides full details of the cable locations; Appendix B demonstrates compliance with the original Application and mitigation set out in the ES and SEIS, and Appendix C details the ES and SEIS commitments relevant to this CaP.

Plan Audience

This Wind Farm CaP is intended to be referred to by relevant personnel involved in the construction of the Beatrice Project, including BOWL personnel, Key Contractors and Subcontractors. Compliance with this CaP will be monitored by BOWL and reported to the Marine Scotland Licensing and Operations Team.

Plan Locations

Copies of this Wind Farm CaP are to be held in the following locations:

- At BOWL Head Office;

- At the premises of any agent, Key Contractor or Subcontractor (as appropriate) acting on behalf of BOWL;

- At the BOWL Marine Coordination Centre at Wick; and

- By the Ecological Clerk of Works (ECoW(s)).

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List of Abbreviations and Definitions

Term	Definition / Description
AHT	Anchor Handling Tug.
Application	The application letters and Environmental Statement submitted to the Scottish Ministers by BOWL on 23 April 2012 and Supplementary Environmental Information Statement submitted to the Scottish Ministers by BOWL on 29 May 2013.
BOWL	Beatrice Offshore Windfarm Limited (Company Number SC350248) and having its registered office at Inveralmond House, 200 Dunkeld Road, Perth, PH1 3AQ.
bml	Below mudline (seabed).
CBRA	Cable Burial Risk Assessment.
CLV	Cable Lay Vessel.
CMS	Construction Method Statement as required for approval under Condition 11 of the Section 36 Consent and Condition 3.2.2.4 of the OfTW Marine Licence (Partial).
CoP	Construction Programme as required for approval under Condition 10 of the Section 36 Consent and Condition 3.2.2.3 of the OfTW Marine Licence.
CPS	Cable Protection System.
Development	The Wind Farm and the OfTW.
DOL	Depth of Lowering (of buried cables).
ECoW	Ecological Clerk of Works as required for approval under Condition 30 of the Section 36 Consent and Condition 3.2.2.12 of the OfTW Marine Licence.
EMP	Environmental Management Plan as required for approval under Condition 15 of the Section 36 Consent and Condition 3.2.1.2 of the OfTW Marine Licence.
EPCI	Engineering, Procurement, Construction and Installation.
ES	The Environmental Statement submitted to the Scottish Ministers by the Company on 23 April 2012 as part of the Application as defined above.
HVAC	High Voltage Alternating Current.
Inter-array cables/cabling	The AC electrical cables that connect the WTGs to the OTMs.
Interconnector cable	The HVAC electrical cable that connects the OTMs to one another.
ISV	Installation Support Vessel.

Term	Definition / Description
Key Contractors	The Contractors appointed for the individual work steams of marine installation; transmission; and WTGs.
LAT	Lowest Astronomical Tide.
Licensing Authority	The Scottish Ministers.
Marine Coordination	The management and surveillance of people, vessels and offshore structures to ensure the safe preparation and execution of offshore activities, in order to minimise the probability of an incident, and to provide effective response if an incident does occur.
Marine Licences	The Wind Farm Marine Licence and the OfTW Marine Licence.
MCA	Maritime and Coastguard Agency.
MSBL	Mean Sea Bed Level.
MS–LOT	Marine Scotland Licensing Operations Team.
OfTW	The Offshore Transmission Works. The OfTW includes the transmission cable required to connect the Wind Farm to the OnTW. This covers the OTMs and the cable route from the OTMs to the Mean High Water Springs (MHWS) at the landfall west of Portgordon on the Moray coast.
OfTW CaP	Cable Plan as required for approval under Condition 3.2.2.10 of the OfTW Marine Licence.
OfTW CMS	The Construction Method Statement in respect of the export cable installation and OTM commissioning required for approval under Condition 3.2.2.4 of the OfTW Marine Licence.
OfTW Marine Licence	The written consent for the OfTW granted by the Scottish Ministers under Section 20(1) of the Marine (Scotland) Act 2010 and Section 65 of the Marine and Coastal Access Act 2009, issued on 2 September 2014, as revised by the issue of licence 04461/16/0 on 27 April 2016.
OnTW	Onshore Transmission Works. The onshore transmission works from landfall, consisting of onshore buried export cables to the onshore substation and connection to the National Grid network.
OTM	Offshore Transformer Module means an alternating current (AC) offshore platform which is a standalone modular unit that utilises the same substructure and foundation design as a wind turbine generator.
PLGR	Pre-Lay Grapnel Run.
ROV	Remotely Operated Vehicle.

Term	Definition / Description
Section 36 Consent	Consent granted by the Scottish Ministers under Section 36 of The Electricity Act 1989 to construct and operate the Beatrice Offshore Wind farm electricity generating station, dated 19th March 2014.
SEIS	The Supplementary Environmental Information Statement submitted to the Scottish Ministers by the Company on 29 May 2013 as part of the Application as defined above.
SHE	Safety, Health and Environment.
SHL	Seaway Heavy Lifting Offshore Contractors B.V.
Subcontractor	Subcontractors to the Key Contractors.
VMP	Vessel Management Plan as required for approval under Condition 16 of the Section 36 Consent and Condition 3.2.2.8 of the OfTW Marine Licence.
Wind Farm	The offshore array development as assessed in the ES including wind turbines, their foundations, inter-array cabling and meteorological masts.
Wind Farm CaP	Cable Plan as required for approval under Condition 19 of the Section 36 Consent.
Wind Farm Marine Licence	The written consent for the Wind Farm granted by the Scottish Ministers under Section 20(1) of the Marine (Scotland) Act 2010, issued on 2 September 2014, as revised by the issue of licence 04462/16/0 on 27 April 2016.
WTG	Wind Turbine Generator.

1 Introduction

1.1 Background

1.1.1 The Beatrice Offshore Wind Farm received consent under Section 36 of the Electricity Act 1989 from the Scottish Ministers on 19 March 2014 (Section 36 Consent) and was issued two Marine Licences from the Scottish Ministers, for the Wind Farm and associated Offshore Transmission Works (OfTW), dated 2nd September 2014 (the Marine Licences) and revised by the issue of licences on 27 April 2016 (Reference: 04461/16/0 and 04462/16/0 respectively.

1.2 Objectives of this Document

1.2.1 The Section 36 Consent and Marine Licences contain a variety of conditions that must be discharged through approval by the Scottish Ministers prior to the commencement of any offshore construction works.

1.2.2 One such requirement of the Section 36 Consent is the approval of a Cable Plan (CaP) (in relation to the Wind Farm inter-array cables).

1.2.3 The relevant condition setting out the requirement for a Wind Farm CaP for approval, and which is to be discharged by this CaP, is set out in full in Table 1.1.

1.2.4 A separate OfTW CaP has been prepared in relation to export cables and interconnector cable connecting the Offshore Transmission Modules (OTMs).

Table 1.1 - Consent Condition to be discharged by this Wind Farm CaP

Consent Document	Condition Reference	Condition Text	Reference to relevant Section of this CaP
Section 36	Condition 19	The Company must, no later than 6 months prior to the Commencement of the Development, submit a Cable Plan ("CaP") in writing, to the Scottish Ministers for their written approval.	This document sets out the CaP for approval by the Scottish Ministers
		Such approval may only be granted following consultation by the Scottish Ministers with the JNCC, SNH, MCA, and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers.	Consultation to be undertaken by the Scottish Ministers
		The CaP must be in accordance with the ES.	Section 11 and Appendices B and C
		The Development must, at all times, be constructed and operated in accordance with the approved CaP (as updated and amended from time to time by the Company).	Section 2

Consent Document	Condition Reference	Condition Text	Reference to relevant Section of this CaP
		Any updates or amendments made to the CaP by the Company must be submitted, in writing, by the Company to the Scottish Ministers for their written approval.	Section 3
		The CaP must include the following: a. Details of the location and cable laying techniques for the inter-array cables	Section 6 and 9 and Appendix A
		b. The results of survey work (including geophysical, geotechnical and benthic surveys) which will help inform cable routing	Section 5
		c. Technical specification of inter-array cables, including a desk based assessment of attenuation of electro-magnetic field strengths and shielding;	Section 7
		d. A burial risk assessment to ascertain if burial depths can be achieved. In locations where this is not possible then suitable protection measures must be provided;	Section 8
		e. Methodologies for over trawl surveys of the inter-array cables through the operational life of the wind farm where mechanical protection of cables laid on the sea bed is deployed; and	Section 10
		f. Measures to address exposure of inter-array cables.	Section 10
		Reason: To ensure all environmental and navigational issues are considered for the location and construction of the inter array cables.	

1.3 Linkages with Other Consent Plans

1.3.1 This Wind Farm CaP sets out the layout of inter-array cables and the methods for their installation. However, ultimately it will form part of a suite of approved documents that will provide the framework for the construction process – namely the other Consent Plans required under the Section 36 Consent and OfTW Marine Licence.

1.3.2 The consent conditions that require the development of a CaP do not explicitly identify linkages between this and other Consent Plans. However, other conditions require that several other Consent Plans be consistent with the CaP; these plans are identified in Table 1.2.

Table 1.2 – Wind Farm CaP linkages with other Consent Plans

Other Consent Plan	Consistency with and linkage to CaP
The Construction Method Statement (CMS) (required under Section 36 Consent Condition 11 and OfTW Marine Licence Condition 3.2.2.4)	The purpose of the approved CMS is to detail the methods that will be implemented during the construction of the Development. The CaP must, so far as is reasonably practicable, be consistent with the CMS.
Operation and Maintenance Programme (OMP) (required under Section 36 Consent Condition 17 and OfTW Marine Licence Condition 3.2.3.2)	The OMP will set out the procedures and good working practices for the operational and maintenance (O&M) phase of the Development. The OMP must be, so far as is reasonably practicable, consistent with the CaP.

1.4 Structure of this CaP

1.4.1 In response to the specific requirements of the Section 36 Consent condition, this Wind Farm CaP has been structured so as to be clear that each part of the specific requirements have been met and that the relevant information to allow the Scottish Ministers to approve the CaP has been provided. The document structure is set out in Table 1.3.

Table 1.3 – Wind Farm CaP document structure

Section	Title	Overview
1	Introduction	Background to consent requirements and overview of the CaP scope and structure; and Identifies those other Consent Plans relevant to the construction/installation process and provides a statement of consistency between the CaP and those plans.
2	BOWL Statements of Compliance	Sets out the BOWL statements of compliance in relation to the CaP Consent Conditions and the broader construction process.
3	Updates and amendments to this CaP	Sets out the procedures for any required updating to or amending of the approved CaP and subsequent further approval by the Scottish Ministers.
4	Development Overview	Provides an overview of the project and identifies the Key Contractor responsible for inter-array cable installation.
5	Cable Route and Installation Considerations	Provides information on the inter-array cable routes and key constraints considered. It also provides detail on the geophysical, geotechnical and benthic surveys conducted to inform cable routing.
6	Location and Layout of Inter-Array Cables	Provides detail on the location of the inter-array cables and micro-siting.
7	Technical Specification of Inter-Array Cables	Details the inter-array cable specifications and the results of an electromagnetic field modelling study.
8	Cable Burial Risk Assessment	Provides details of the cable burial risk assessment conducted to determine installation procedures.
9	Inter-Array Cable Installation Methodology	Summarises the installation procedures associated with the inter-array cabling.
10	Inter-Array Cable Operation and Maintenance	Sets out the approach to operation and maintenance of the inter-array cables, including the approach to over-trawl surveys and remedial procedures in the event that cables become exposed.
11	Compliance with the Application, ES and SEIS	Sets out confirmation that the details set out in this CaP are in accordance with those assessed in the ES; and how the mitigation measures related to construction identified in the ES are to be delivered.

2 BOWL Statements of Compliance

2.1 Introduction

2.1.1 The following section is intended to re-affirm the BOWL commitment to ensuring that the Development is constructed in such a manner as to meet the relevant legislative requirements set out by the Section 36 Consent and Marine Licences.

2.2 Statements of Compliance

2.2.1 BOWL in undertaking the construction of the project will require compliance with this Wind Farm CaP as approved by the Scottish Ministers (and as updated or amended from time to time following the procedure set out in Section 3 of this CaP).

2.2.2 Where updates or amendments are required to this CaP, BOWL will require that the Scottish Ministers are informed as soon as reasonably practicable and where necessary the CaP will be updated or amended (see Section 3 below).

2.2.3 BOWL in undertaking the construction of the project will require compliance with other, relevant Consent Plans as approved by the Scottish Ministers including, as set out in Section 1.3 above.

2.2.4 BOWL in undertaking the construction of the project will require compliance with the limits defined by the original application and the project description defined in the Environmental Statement (ES) and Supplementary Environmental Information Statement (SEIS) and referred to in Annex 1 of the Section 36 Consent except in so far as amended by the terms of the Section 36 Consent (unless otherwise approved in advance by the Scottish Ministers) (see Section 11 and Appendix B (Compliance with ES/SEIS Rochdale Envelope Parameters) and Appendix C (ES/SEIS Commitments)).

2.2.5 BOWL will, in undertaking the construction of the project, require compliance with all other relevant legislation and require that all necessary licences and permissions are obtained by the key contractors and sub-contractors through conditions of contract and by an appropriate auditing process.

3 Updates and Amendments to this CaP

3.1.1 This Wind Farm CaP sets out the proposed methods for installation of the offshore inter-array cables.

3.1.2 S36 Consent Condition 19 recognises that updates or amendments to this Wind Farm CaP may be required, stating that:

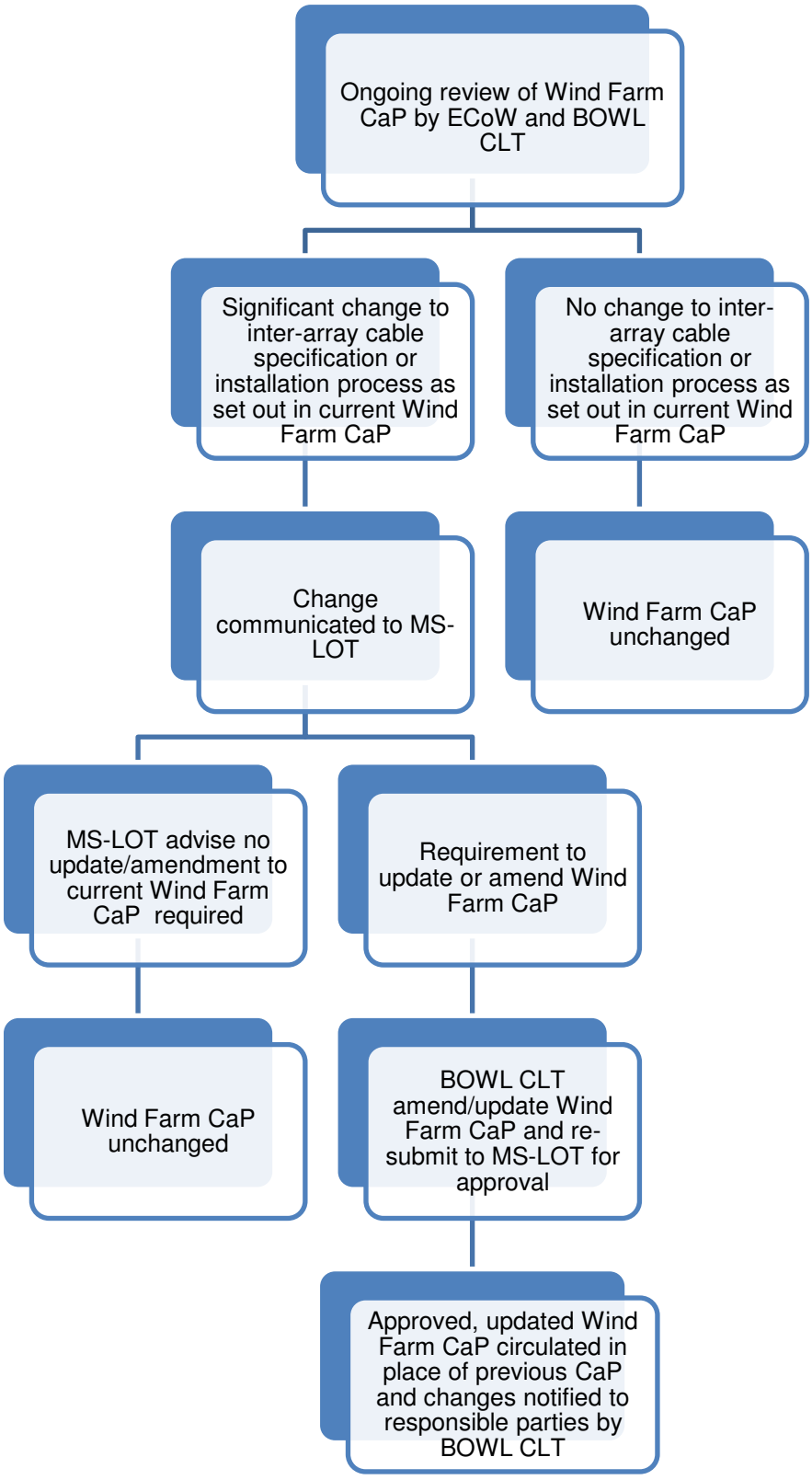
The Development must, at all times, be constructed and operated in accordance with the approved CaP (as updated and amended from time to time by the Company [BOWL]). Any updates or amendments made to the CaP by the Company [BOWL] must be submitted, in writing, by the Company [BOWL] to the Scottish Ministers for their written approval.

3.1.3 The main approach to the installation process is described in this CaP including:

- Location, number and specification of cables (including constraints and data used to inform inter-array location and installation);
- Inter-array Cable Burial Risk Assessment; and
- Installation procedures.

3.1.4 Where it is necessary to update this Wind Farm CaP in the light of any significant new information, related to the inter-array cables, BOWL propose to use the change management process set out in Figure 3.1 in identifying such information, communicating such change to the Scottish Ministers, re-drafting the CaP if required, seeking further approval for the necessary amendments or updates and disseminating the approved changes/amendments to responsible parties.

Figure 3.1 - Wind Farm CaP Change Management Procedure



4 Development Overview

4.1 Introduction

4.1.1 This section of this Wind Farm CaP provides an overview of the Development and summarises the timing of the offshore construction works. It identifies the Key Contractors and Subcontractors responsible for installation of the inter-array cables.

4.2 Development Overview

4.2.1 The Development will consist of the following main components:

- A total generating capacity of not less than 588MW;
- Up to 84 wind turbines of 7MW rated generating capacity;
- Jacket foundations each installed on four piles driven into the seabed;
- Two AC substation platforms, referred to as offshore transformer modules (OTMs) to collect the generated electricity and convert the electricity from 33kV to 220kV for transmission to shore;
- A network of circa 140km of inter-array, buried or (if burial is not possible) mechanically protected, subsea cables to connect strings of turbines together and to connect the turbines to the OTMs;
- Two buried, or (if burying is not possible, protected) subsea export cables, totalling circa 140km in length, to transmit the electricity from the OTMs to the land fall at Portgordon and connecting to the onshore buried export cables for transmission to the onshore substation and connection to the National Grid network;
- One interconnector cable of circa 1.2km in length that links the OTMs to one another; and
- Minor ancillary works such as the deployment of met buoys (if required) and aids to navigation.

4.2.2 The Development is located approximately 13.5 km offshore from its nearest point to the east Caithness coastline in the Moray Firth (Figure 4.1).

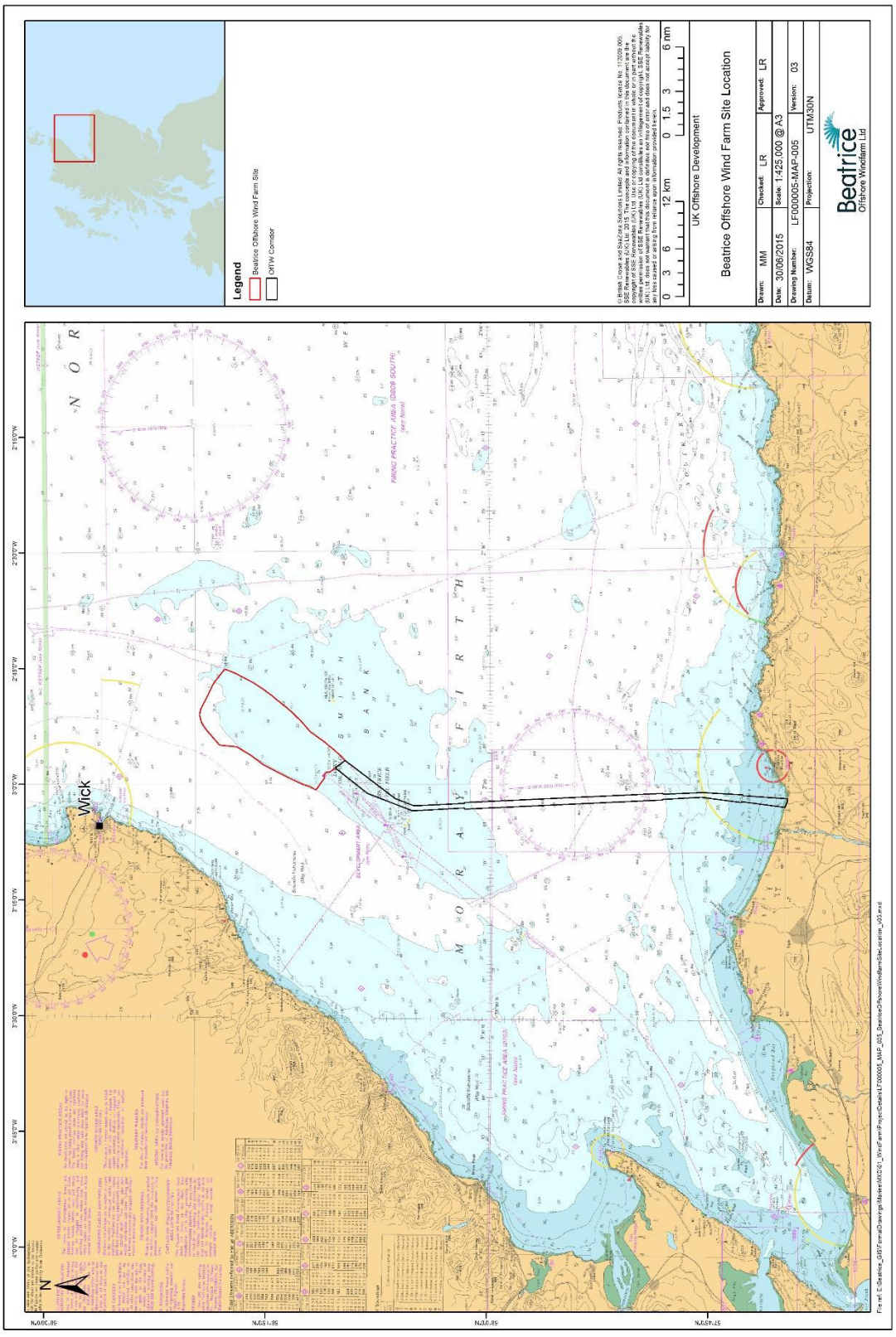


Figure 4.1 – Development general location map

4.3 Timing of Construction Works

4.3.1 Details of the construction programme are provided in the approved Construction Programme (CoP) (required under Condition 10 of the Section 36 Consent and Condition 3.2.2.3 of the OfTW Marine Licence). It is currently anticipated that the offshore construction works will be carried out year-round and around the clock (i.e. 24 hour working, 7 days a week unless noted otherwise.

4.4 Key Contractors

4.4.1 BOWL has identified the preferred Key Contractor responsible for marine installation as Seaway Heavy Lifting Offshore Contractors B.V. (SHL).

4.4.2 SHL is a leading offshore contractor in the global Oil & Gas and Renewables industries, offering tailored Transport and Installation (T&I) and Engineering, Procurement, Construction and Installation solutions (EPCI). SHL operates globally and services a diverse client portfolio including the major operators in the offshore Oil & Gas and Offshore Renewables industry.

4.4.3 Previous projects in Renewables include T&I for wind turbine foundations at Riffgat, Gwynt y Môr and Sheringham Shoal and offshore substation T&I at Sheringham Shoal, Galloper, Thanet and Greater Gabbard.

4.4.4 SHL is a Subsea 7 joint venture company and as such benefits from the consolidation of Subsea 7's Renewable Energy business into SHL through adopting Subsea 7's EPCI systems and processes across the organisation and secondment of Subsea 7 personnel into the project team. This reflects their extensive EPCI experience of deep water Oil & Gas projects. Details on SHL's organisational structure and the key roles during the construction of the Project are set out in Section 4 of the Wind Farm CMS (Ref: LF000005-PLN-045).

4.5 Subcontractors

4.5.1 The Key Contractor will be responsible for identifying and contracting subcontractors such as may be required to provide services for the completion of the works. Inter-array cable installation will be undertaken by Siem Offshore Inc. on behalf of SHL and inter-array cables will be manufactured by JDR Cables. Examples of other services that may need to be subcontracted include support vessels, guard vessels, survey services, transport services, supply of minor components, waste services, vessel provisioning and bunkering services, and provision of equipment to be used in the construction works.

5 Cable Route and Installation Considerations

5.1 Introduction

5.1.1 S36 Consent Condition 19 requires that this Wind Farm CaP includes the following:

> *The results of survey work (including geophysical, geotechnical and benthic surveys) which will help inform cable routing*

5.1.2 This section provides information on the key constraints that have determined cable routing, installation and protection methods derived from relevant survey work.

5.2 Key Layout Constraints

5.2.1 Figure 5.1 identifies a small number of physical spatial constraints within the Wind Farm 'developable area' (defined by the blue boundary shown in Figure 5.1), which infrastructure, including the inter-array cables, will avoid. These constraints are summarised as follows:

- A single plugged and abandoned wellhead;
- Several features of potential archaeological interest, identified by geophysical survey, and their associated Archaeological Exclusion Zones (AEZs).

5.2.2 All inter-array cables will lie within the 'developable area' boundary, which has been defined taking account of the following constraints, also shown in Figure 5.1:

- A 2.5km buffer zone around the Beatrice Alpha, Bravo, Charlie and Jacky oil platforms to preclude the construction of any wind turbines (as required by Condition 38 of the Section 36 Consent), and a 500m buffer around the same platforms to preclude the installation of any cables (as required by Condition 3.2.2.9 of the Wind Farm Marine Licence).
- A 100m buffer from the site lease boundary (as required under the terms of The Crown Estate Agreement for Lease);
- A 770m buffer from the Moray Firth Round 3 Zone boundary (as required under the terms of The Crown Estate Agreement for Lease); and
- An avoidance of water depths in excess of 55m below Lowest Astronomical Tide (LAT) (for reasons of BOWL engineering feasibility).

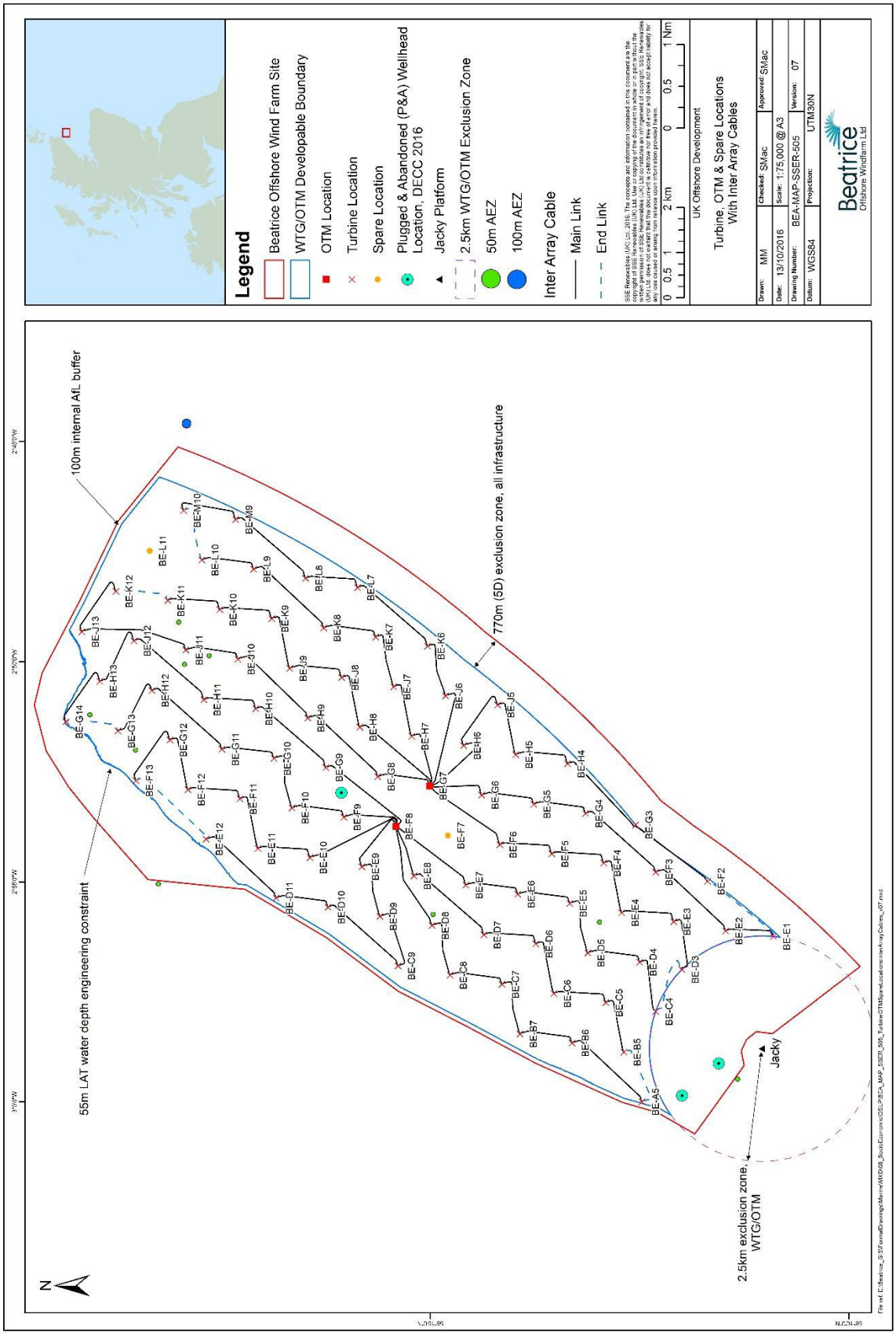


Figure 5.1 –Key constraints within the development area and Inter-array cable connection configuration

5.3 Constraints Identified by Survey

5.3.1 A series of geotechnical, geophysical and benthic surveys have been commissioned by BOWL to understand seabed conditions across the Wind Farm site. The results of these surveys have been considered in defining the inter-array cable routing and installation methods. A summary of the pre-construction surveys conducted is provided in Table 5.1 below.

Table 5.1 - Summary of pre-construction baseline surveys conducted across the Wind Farm

Date	Contractor	Survey Type and Spatial Coverage	Comments
2010	**CMACS** (Benthic)	84 Hamon grab samples 60 Drop Down Video (DDV) samples 14 epibenthic beam trawls	Benthic survey works completed in October and November 2010 across the Wind Farm site. The survey was undertaken to characterise benthic communities across the Wind Farm, to inform the original ES and SEIS.
2010	**Osiris** (Geophysical and Geotechnical)	Multi-beam echo sounder, side scan sonar, sub-bottom profiler 100% coverage of Wind Farm site	Osiris completed a geophysical site survey across the Beatrice OWF area during April and May 2010. The objectives were to assess detailed bathymetry, seabed features and shallow soil conditions. The survey was undertaken to characterise seabed conditions across the Wind Farm, to inform the original Beatrice ES and SEIS.
2011 2014 2015 2016	**Fugro** (Geophysical [including UXO] and Geotechnical)	Geophysical: Multi-beam echo sounder, side scan sonar, magnetometer Coverage of all turbine locations and along potential inter-array cable routes Geotechnical: Sampling boreholes and Cone Penetration Test (CPT) boreholes	Fugro have completed three survey campaigns across the Wind Farm during 2011, 2014 and 2015. The 2014 geotechnical campaign comprised 6 CPT boreholes, 7 sampling boreholes and 32 sampling and CPT boreholes. The 2015 geotechnical campaign comprised of 101 sampling boreholes with 83 also comprising CPTs. UXO survey identified potential unexploded ordnance (UXO) targets. The surveys were undertaken to inform Wind Farm detailed engineering design. A further campaign will be completed in 2016. This will confirm the presence of any UXO targets.
2015	**MMT** (Geophysical and Geotechnical)	Geophysical: Multi-beam echo sounder, side scan sonar, sub-bottom profiler, magnetometer, Remotely Operated Vehicle (ROV) imagery Coverage of all planned inter-array cable routes Geotechnical: Sampling boreholes and CPT boreholes	MMT completed a survey of the Wind Farm during August and September 2015. The geophysical survey comprised multibeam echo sounder, side scan sonar, transverse gradiometer, sub-bottom profiler, and ROV data acquisition techniques. As part of the geotechnical survey a total of 92 vibrocores and 92 CPTs were completed within the Wind Farm. The survey was undertaken to inform Wind Farm detailed engineering design.
2015	**APEM** (Benthic)	Grab samples at 10 locations across the Wind Farm site. Grab samples at 2 reference stations outside the Wind farm boundary	APEM undertook a benthic grab sampling survey in June 2015. The survey was undertaken to provide updated baseline information against which post-construction environmental monitoring can be compared.

5.3.2 The text below summarises the findings of these surveys as relevant to intended inter-array cable routing (as summarised in Section 6 of this Wind Farm CaP) or installation methods (as set out in Section 9 of this Wind Farm CaP).

Geophysical Surveys

5.3.3 The seabed along the intended inter-array cable routes has water depths varying between 34.2m and 60.4m. The seabed gradient along the route is irregular with gentle slopes; the average gradient along the inter-array cable routes is 0.5 degrees (Figure 5.2).

5.3.4 Surveys identified that the seabed displayed low to medium acoustic reflectivity along the inter-array cable routes, consistent with clayey or sandy sediments and areas of medium to high acoustic reflectivity which represents coarser material such as gravels and coarse sediments.

5.3.5 Evidence of seabed mobility was minimal; however, areas of ripples within the inter-array cable survey area were identified. The ripples were classed as less than 5.0m length with heights between 0.01 and 0.1m. The maximum ripple height of 0.1m has been considered when determining depth of lowering in relation to cable installation.

5.3.6 Other notable seabed features include surface channels which were observed throughout the area. Surface channels have a maximum depth of approximately 0.5m below the surrounding seabed.

5.3.7 Surveys have identified boulders across the Wind Farm (Figure 5.3). A significant number of boulders with a dimension greater than 0.2m were identified along sections of the intended inter-array cable routes, with boulders of up to 1.3m diameter recorded. There is the potential for subsurface boulders to also be present.

5.3.8 Survey for UXO across the Wind Farm identified 102 magnetic anomalies that were deemed to be of potentially anthropogenic origin. A pre-construction UXO survey, to be completed by the end of 2016, will confirm any UXO targets along the planned inter-array cable routes.

5.3.9 ***Geotechnical Surveys***

5.3.10 The geology of the Wind Farm generally comprises a surface Holocene sediment of up to 2m thickness comprising loose to medium dense fine to medium gravelly sand to sandy gravel. The Forth Formation underlies the Holocene sediments and is between 10m to 25m thick and comprises a mixture of sands, gravel and clay.

5.3.11 Soil conditions along the majority (~85%) of the inter-array route are anticipated to consist of Holocene very loose to dense sand over loose to medium dense to very dense fine to medium silty gravelly sand and sandy gravel in the top 2.0m below seabed level (Figure 5.4). Approximately 15% of the inter-array cable route may encounter very loose to very dense sand over soft to stiff clay within the top 2.0m below

seabed level. Further information on cable burial methods is provided in Section 8.

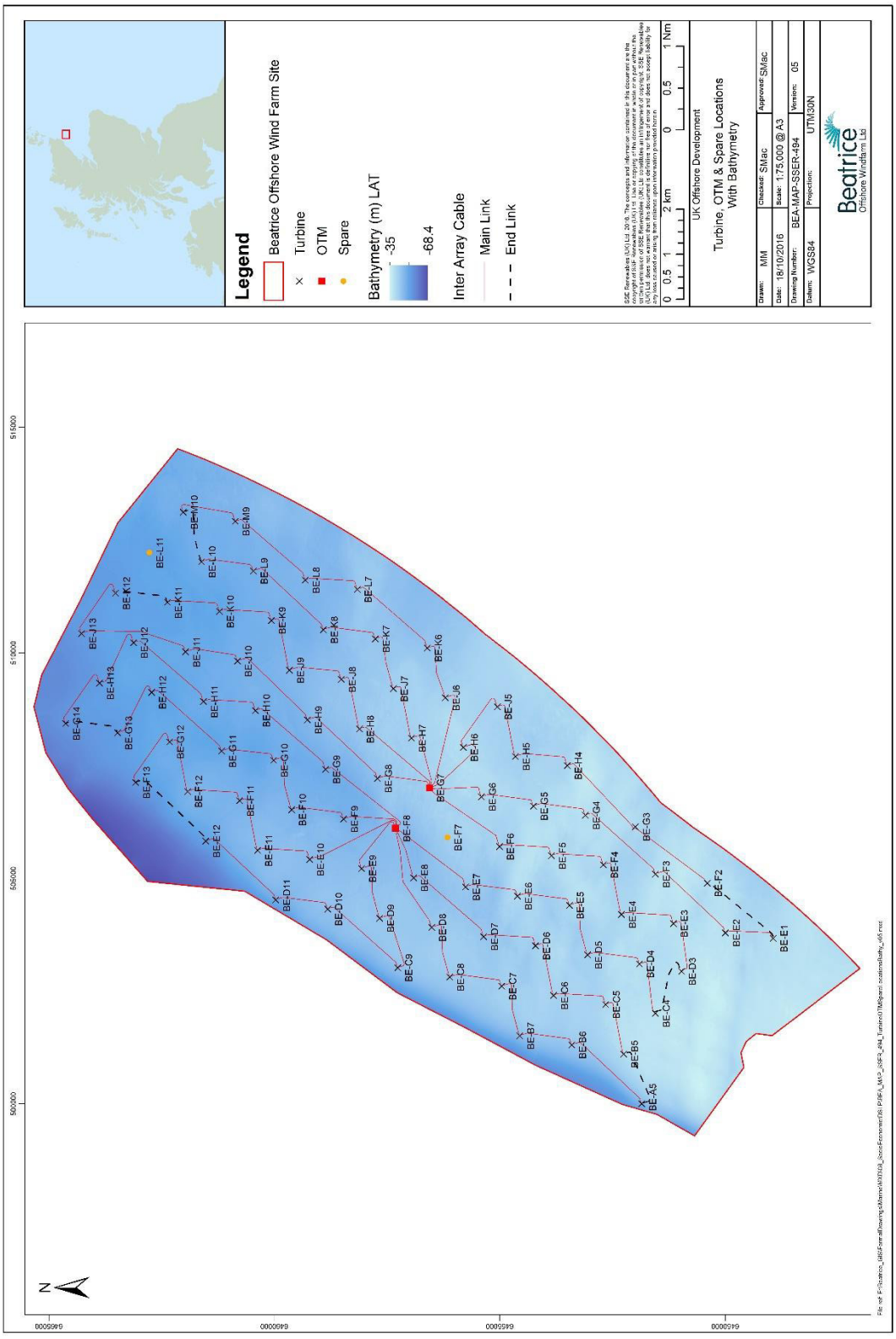


Figure 5.2 – Bathymetry across the development area

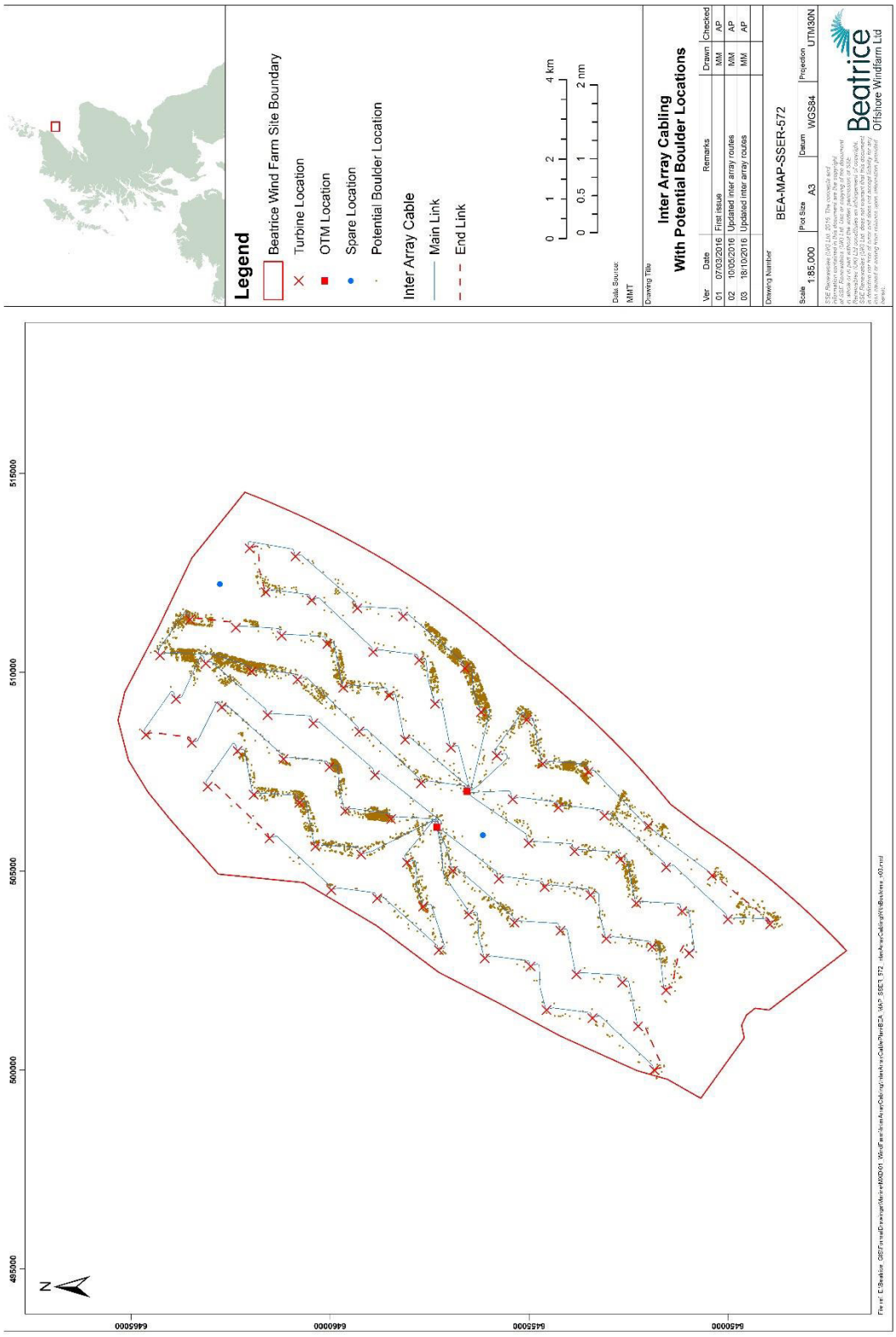


Figure 5.3 – Boulder locations along the inter-array cable corridor

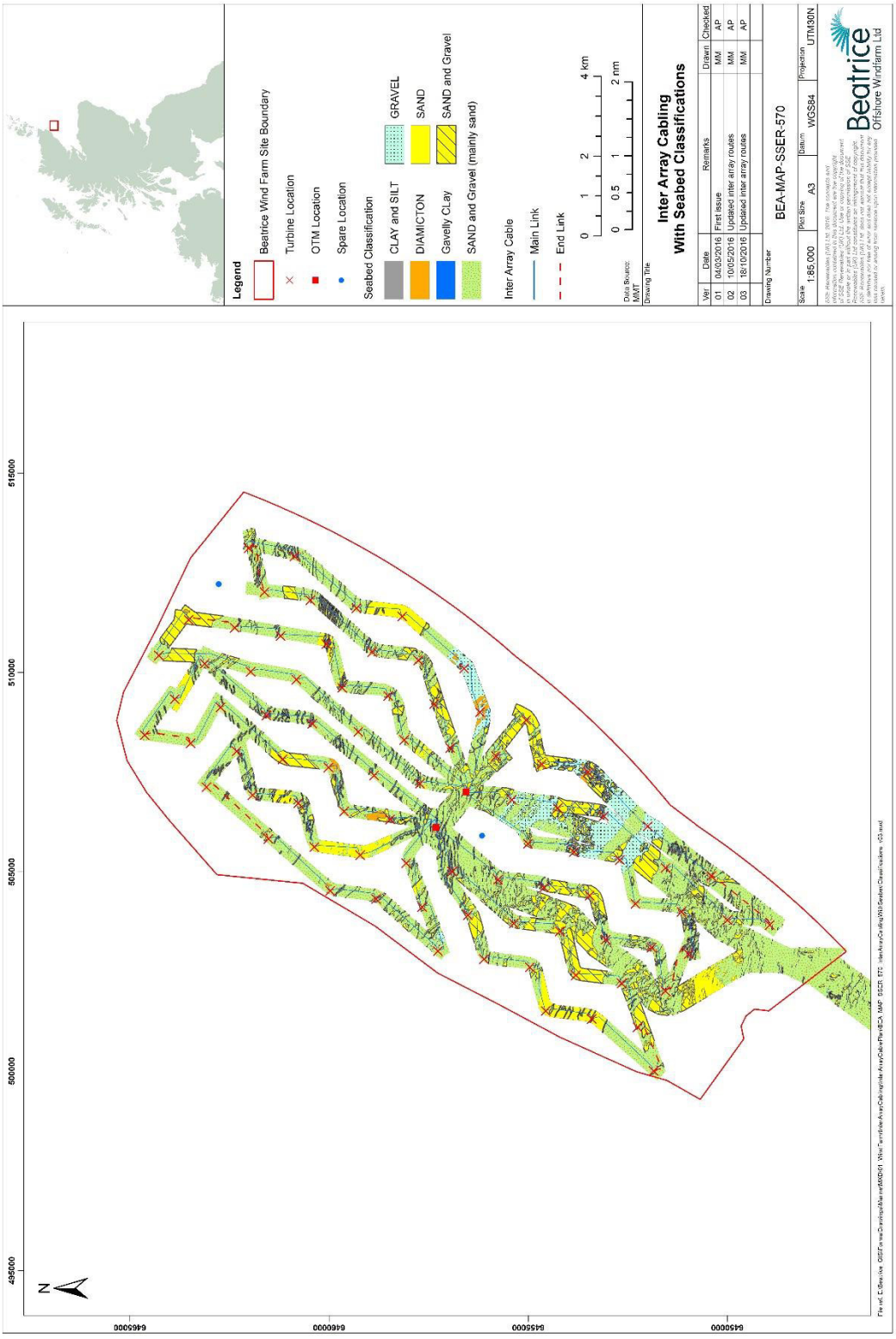


Figure 5.4 – Seabed classification and sediment type along the inter-array cable corridor

Benthic Surveys

5.3.12 BOWL has conducted benthic surveys to characterise the biotopes within the Wind Farm site and determine the presence of Priority Marine Features (PMF) in the area.

5.3.13 The survey in 2010 identified a range of biotopes across the Wind Farm. The four main biotopes, or biotope complexes, were identified from the infaunal data, two of which were reported as extensive within the survey area (SS.SCS.ICS.MoeVen Moerella spp. with venerid bivalves in infralittoral gravelly sand biotope and SS.SSSA.CfiSa Circalittoral fine sand biotope complex), with a further more limited in extent (a *Glycera lapidium* dominated version of the MoeVen biotope, and a variant of SS.SCS.CCS.MedLumVen Mediomastrus fragilis, *Lumbrinereis* spp. and venerid bivalves) in circalittoral coarse sand or gravel with high abundance of the fanworm *Jasmineira caudata*). The SS.SCS.ICS.MoeVen biotope, a Scottish PMF, was a new record for this biotope in deeper waters (i.e., waters of up to 50 m).

5.3.14 A small patch of cobble and boulder reef dominated mostly by tubeworms and barnacles ascribed to the biotope SS.SCS.CCS.PomB *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles was identified in the north west of the area, totalling 0.021 km2, and it seems likely that one or two smaller patches of less distinct (i.e. less easily detected on sidescan sonar) similar habitat occur elsewhere on the north western boundaries of the Wind Farm site and towards the eastern boundary.

5.3.15 APEM undertook benthic grab sampling in the Wind Farm site in June 2015 with the aim of looking specifically at the MoeVen biotope (identified as a PMF) to provide a pre-construction benthic survey baseline. Sampling locations corresponded with locations sampled during 2010. The same key species were recorded across the survey area and any variations observed in taxon abundance between the 2015 and 2010 surveys were considered to be within the range of natural variability for the benthic communities present. The sediment composition data was broadly similar. A reallocation of biotopes at some locations arose due to a combination of minor differences in the relative abundances of particular taxa and to subtleties in the definitions of the biotopes, which allowed for differences in interpretation between analysts. Details of further post-construction benthic monitoring surveys are set out in the Project Environmental Monitoring Programme (PEMP).

5.3.16 The only species of conservation importance recorded in both surveys was the ocean quahog (*Arctica islandica*); a bivalve listed as a Scottish PMF and listed as an OSPAR threatened / declining species.

5.4 Summary of Key Constraints Identified

5.4.1 The geophysical and geotechnical surveys have indicated that in some areas of the Wind Farm site stiff or dense sediments are present which may inhibit cable installation. The approach to installation is set out in Section 9 and takes account of potentially challenging ground conditions; Section 9.2 presents information on cable protection where burial cannot be achieved.

5.4.2 The high frequency of boulders identified along particular sections of the inter-array cable route may also disrupt cable burial and in these locations boulders will be relocated away from cable routes prior to installation

5.5 Additional Inter-Array Cable Routing Constraints

5.5.1 To minimise disturbance and potential damage to installed inter-array cables, dedicated works areas have been established on the seabed around each wind turbine and OTM foundation location. These are areas of the seabed which represent the intended location and footprint of the jack-up vessel that will be used to install Wind Farm infrastructure.

5.5.2 The indicative final layout of inter-array cables, taking account of all constraints discussed above, is presented in the following section.

6 Location and Layout of Inter-Array Cables

6.1 Introduction

6.1.1 S36 Consent Condition 19 requires that this Wind Farm CaP include the following:

*Details of the **location** and cable laying techniques for the inter-array cables.*

6.1.2 This section describes the layout and location of the inter-array cables within the Wind Farm, taking into the account the constraints identified in Section 5.

6.2 Location and Layout

6.2.1 The wind turbines will be connected at a voltage of 33kV by inter-array cabling in 'strings'. There will be fourteen strings and six wind turbines per string. The first wind turbine in a string is connected by an inter-array cable to an OTM. The strings are cross-connected at the ends in pairs. These cross connections are to provide auxiliary power to the string in the event of an outage on a string. There are a total of 91 inter-array cables to be installed throughout the site.

6.2.2 The arrangement of the cables between the wind turbines and the connections to the OTMs is set out in Figure 6.1. Note that this inter-array cable layout takes into account the need for the cables to deviate around working areas adjacent to the wind turbines (as noted under Section 5.5 above). In addition, there is the possibility that the 'spare' turbine locations are utilised, which will result in minor modifications to array layout as shown in Figure 6.1. Appendix A provides a list of the cable string arrangements and lengths.

6.2.3 The total length of inter-array cabling to be installed in the seabed is approximately 140km. The inter-array cables will be buried beneath the surface of the seabed. Currently, a minimum Depth of Lowering (DOL) of 0.6m as measured between the top of the cable and mean seabed level is anticipated. Where the DOL cannot be achieved and cables are insufficiently covered, then appropriate means of additional protection, such as rock dumping or concrete mattressing, will be employed to safeguard the cables. Installation and protection are further described in Sections 8 and 9.Exposed cables adjacent to the WTGs and OTMs (where cables emerge from burial beneath the seabed to connect with WTGs or OTMs) will be protected using a Cable Protection System (CPS) (See Section 9.2).

6.3 Route Refinement and Micrositing

6.3.1 The final location and layout of the inter-array cables presented in Figure 6.1 remains subject to possible further minor route refinement. The Key Contractor will complete a further detailed route engineering study prior to construction commencing, which will include a detailed review of all geophysical and geotechnical survey data. This technical review will further consider the extent to which stiff ground conditions and frequent boulder occurrence may act as a constraint to cable installation. Depending

upon the outcome of the review, further, minor modifications to the location and protection of inter-array cables may be proposed. These will not constitute significant changes to this CaP.

6.3.2 In addition, immediately prior to the inter-array cable installation, a pre-installation survey will be completed by the Key Contractor using an ROV to confirm there are no additional, unknown hazards present (such as boulders and UXO). Should any hazards be identified, further, minor modifications to the location or protection of inter-array cables may be proposed. Again these will not constitute significant changes to this CaP. These minor modifications are referenced to as cable micro-siting.

6.3.3 A tolerance of 4% of the total route length has been allowed for micro-siting, this tolerance is in addition to the route lengths provided in Appendix A.

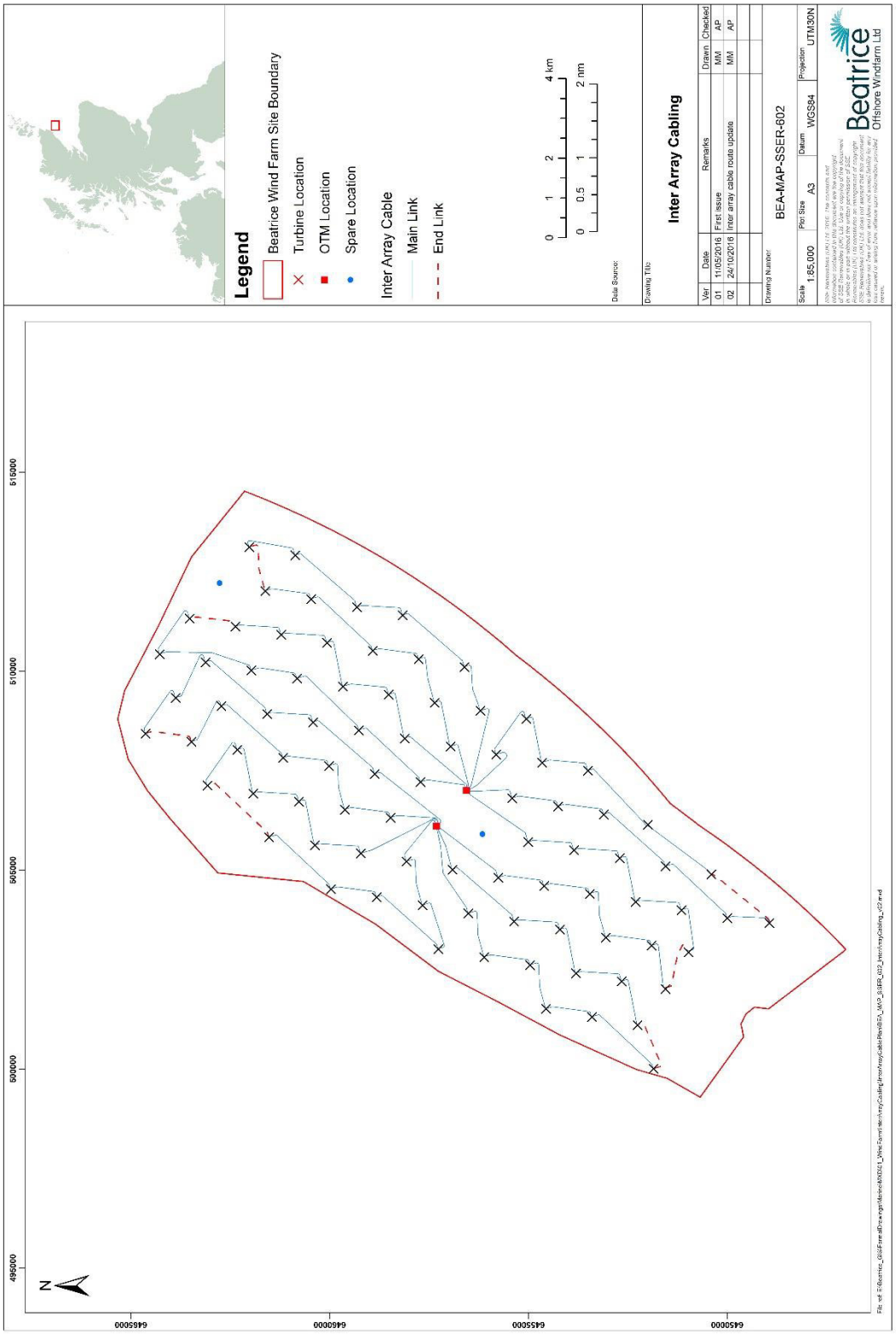


Figure 6.1 – Inter-array cable layout and connection configuration

7 Technical Specification of Inter-Array Cables

7.1 Introduction

7.1.1 S36 Consent Condition 19 requires that this Wind Farm CaP include the following:

Technical specification of inter-array cables, including a desk based assessment of attenuation of electro-magnetic field strengths and shielding;

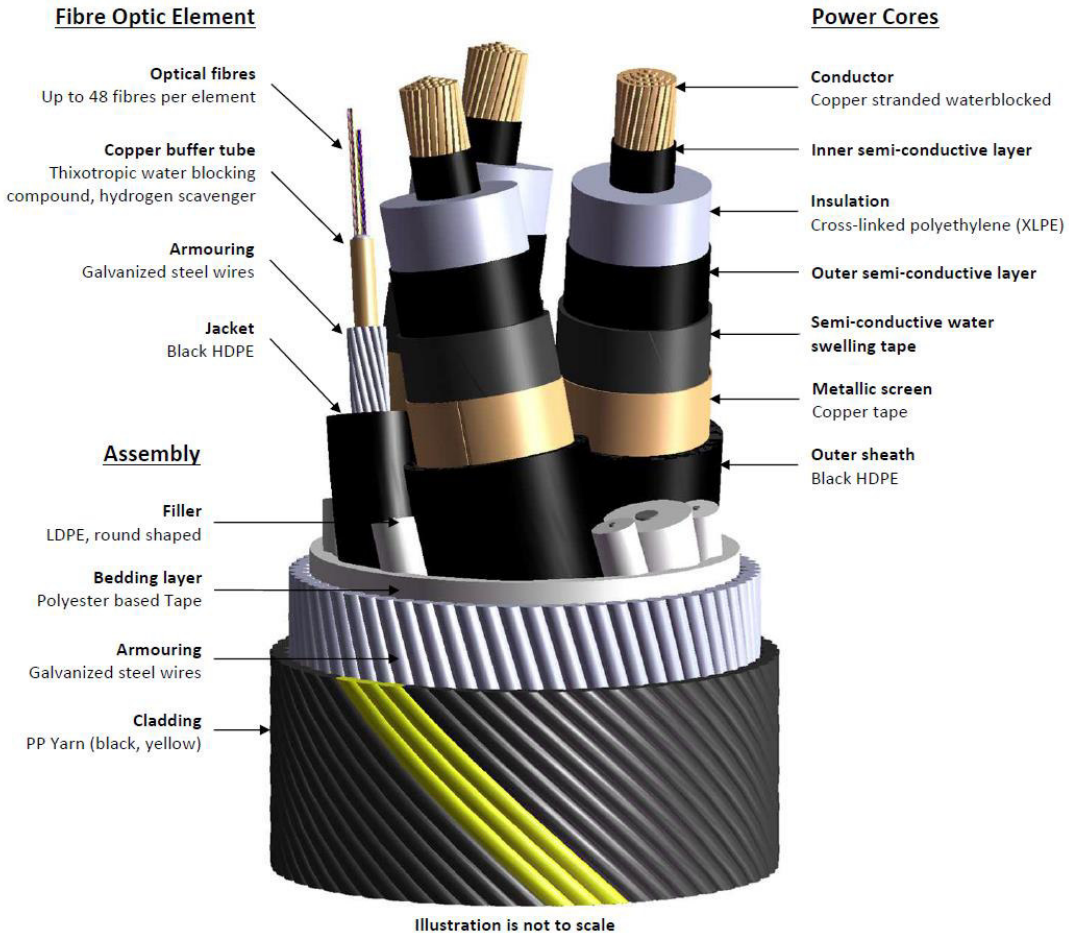
7.1.1 The inter-array cables will be 3 core 33kV armoured submarine power cables of a type typically used to support medium voltage connections between offshore installations.

7.1.2 There will be a total of 91 inter-array cables, of two different sizes (two sizes of cable are used to allow for tapering of cable capacity away from the OTMs), installed across the Development as follows:

- 28 lengths of Type 1 cable (indicatively 630mm^2 cores and a total cable outer diameter of 147mm);
- 63 lengths of Type 2 cable (indicatively 300mm^2 cores and a total cable outer diameter of 123mm).

7.1.3 Technical cable requirements have been determined by BOWL, and BOWL require that the cables meet the specifications described below. Figure 7.1 shows the key components of the inter-array cables.

Figure 7.1 - Typical design components of inter-array cables



7.2 Cable Components

7.2.1 The main components of the typical design of inter-array cables, as shown in Figure 7.1 above, are described briefly below.

Power Cores

7.2.2 The cables will be comprised of three copper power cores. The cross-sectional area of each core will be indicatively 630mm^2 or 300mm^2. The cores will be insulated with cross-linked polyethylene (XLPE) or ethylene propylene rubber (EPR).

Fibre Optic Element

7.2.3 The inter-array cables will be fitted with a fibre optic cable to provide the necessary functionality for the wind turbine control and instrumentation systems. The fibre optic cable will be suitable for communication rates required for wind turbine arrays. Spare fibres will be provided in each inter-array cable for future use.

Assembly

7.2.4 Appropriate filler materials (e.g. ropes or extruded polymeric profiles) shall be included within the cable interstices to provide a robust and stable circular base for the application of armouring.

7.2.5 The array cables shall be provided with a galvanised steel wire armour layer protected from corrosion using a bitumen based compound. The armour layer shall enclose the cores, the fibre optic cable and any fillers that may be incorporated by the manufacturer. A serving wrapped over the armour layer will comprise polypropylene yarns appropriately specified and sized to meet installation and operational requirements.

7.2.6 A coloured pattern will be included to enable the cable to be readily monitored subsea both visually and by cameras during installation. Use of different marking options for better differentiation of cable sizes will be specified. Metre marks will be applied at 100m intervals along the length of each inter-array cable.

7.3 Electromagnetic Fields

7.3.1 This section summarises the results of a desk based assessment carried out on behalf of BOWL on the attenuation of electromagnetic fields (EMF) associated with the inter-array cables.

7.3.2 The study calculated the magnetic field magnitudes at a given distance from the 33kV AC inter-array cables at trench depths of 0.6m and 1m. The insulation and sheathing of the cable power cores, and the burial of the cables, encourage shielding of EMF.

7.3.3 The magnetic field generated by a single conductor at a given point was calculated using the Biot-Savart Law. When there are 3 conductors (a 3 core cable) such as the inter array cables being used in the Wind Farm, the magnetic field can be calculated using the superposition of fields of a single conductor.

7.3.4 EMF attenuation from the inter array cables is shown in Figures 7.2 and 7.3 below. The x axis indicates distance from the cable centre (metres) and the y axis indicates the magnetic field strength (µTesla). The plots also show the magnitude of magnetic field at multiple heights above the seabed (0m, 5m and 10m).

7.3.5 The magnetic fields generated from a 630mm^2 AC 33kV inter-array cable at a trench depth of 1m, are expected to reach a maximum value of 11.2uT. The magnetic fields generated from a 630mm^2 AC 33kV cable at a trench depth of 0.6m is expected to reach a maximum value of 30uT. It was observed that the magnetic field decreases rapidly with vertical distance from the seabed and also reduces significantly with horizontal distance from the cable.

7.3.6 In all cases, the predicted magnetic field of the inter-array cables at the seabed is expected to be lower than the earth's magnetic field (assumed to be ~50uT).

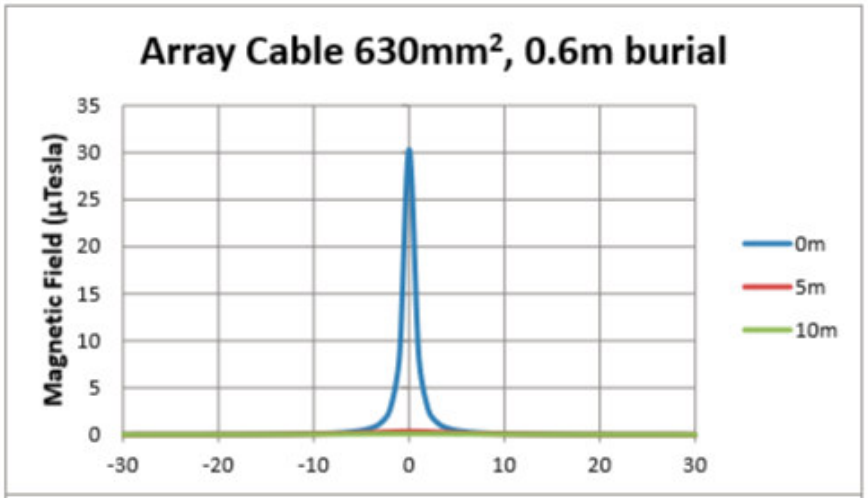


Figure 7.2 – the magnetic field expected from 630mm² AC 33kV inter array cable assuming 0.6m trench depth.

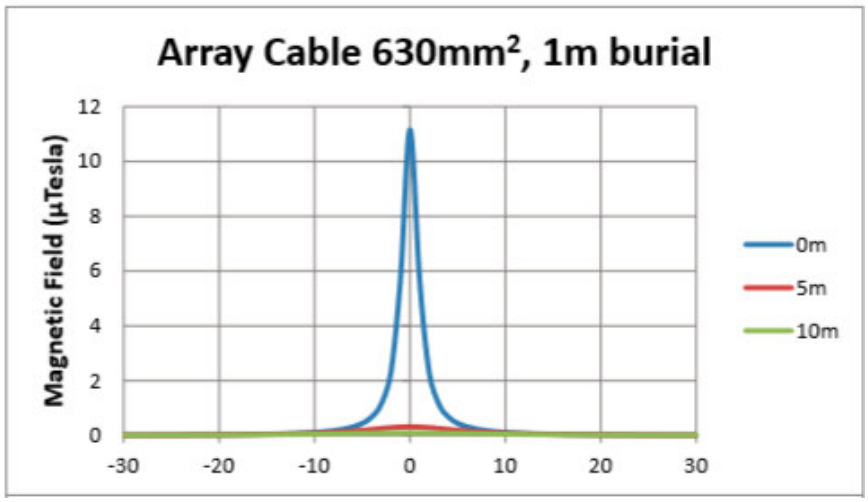


Figure 7.3 – the magnetic field expected from 630mm² AC 33kV inter array cable assuming 1m trench depth.

8 Cable Burial Risk Assessment

8.1 Introduction

8.1.1 S36 Consent Condition 19 requires that this CaP includes the following:

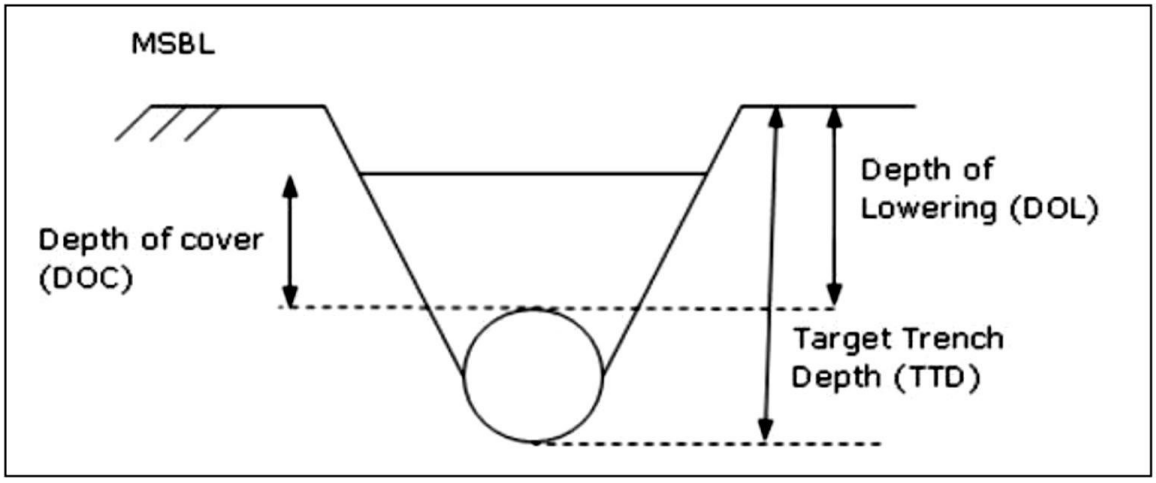
> *A **burial risk assessment** to ascertain if burial depths can be achieved. In locations where this is not possible then suitable protection measures must be provided;*

8.1.2 This section provides a summary of the results of the Inter-Array Cable Burial Risk Assessment (CBRA) commissioned by BOWL (Geomarine, 2016), and an equivalent CBRA carried out by SHL (2016). Consideration of suitable protection measures where sufficient burial of cables is not achieved is addressed in Section 9.2.

8.1.3 The CBRAs considered a suite of potential hazards that will determine the necessary Depth of Lowering (DOL) for the inter-array cables. The DOL is the depth at which the top of the cable is below the seabed. An adequate DOL must be determined to ensure minimal interference with potential hazards such as vessel anchors or fishing gear that may cause damage to cables. The assessment also details the preferred method of cable burial and trenching specification in order to provide adequate protection. BOWL has determined the intended DOL for the inter-array cables based upon the outcomes of the CBRAs.

8.1.4 Terms used to define the trenching specifications are presented in Figure 8.1 below.

Figure 8.1 - Trenching specifications for cable burial



8.2 Commercial Fishing

8.2.1 A hazard assessment of the site determined that commercial fishing vessels and commercial and marine service vessels are the most common operators within the vicinity of the Wind Farm.

8.2.2 Of the methods currently in use, scallop dredging represents the greatest threat to cables with trawling and bottom set fixed fishing gear also posing a significant risk.

8.2.3 Publicly available information identified in the Geomarine burial risk assessment indicates that fishing gear such as that used in the Moray firth (scallop dredges, demersal trawl nets, pelagic trawls, beam trawls, pots and traps) do not normally penetrate into the seabed beyond 0.3m even in very soft clays. Applying a precautionary approach, a minimum depth of lowering of 0.6m was therefore determined. However, this is considered conservative as the dominant sand and gravel surface sediments throughout the Development area mean the penetration of any fishing gear is likely to be less than 0.3m.

8.2.4 Note that the intensity of fishing activity was analysed by Geomarine using AIS vessel data from August 2014 to July 2015. Based on the available survey and AIS data for commercial fishing, it is considered that there is a limited risk of fishing gear interaction with the proposed inter-array cables due to the level of seabed contacting fishing activity taking place in the Wind Farm area.

8.3 Commercial Shipping

8.3.1 To assess the potential impact of shipping on the proposed inter-array cable routes, the Geomarine assessment analysed AIS data for the Moray Firth for the period between August 2014 and July 2015 to gain an understanding of seasonal shipping frequencies (noting that monthly and yearly variation in shipping traffic is likely).

8.3.2 The data indicated that the Moray Firth is transited by a variety of vessels. There is a prominent route to the south of the Development which is parallel to the Scottish coastline. Vessels following this route are generally in transit to and from the ports of the Inner Moray Firth. In addition, a high frequency of vessels transiting from Buckie to the Beatrice Jacky Fields in the Moray Firth was noted. Detailed information on the type of vessels and their transit routes across the Development area is provided in the Vessel Management Plan (VMP) (LF000005-PLN-168) (required under Condition 16 of the Section 36 consent and Condition 3.2.2.8 of the OfTW Marine Licence).

8.3.3 Experience from other wind farms suggests that once constructed, the vast majority of vessels will not traverse through the wind farm area, but instead transit around the perimeter.

Anchor penetration depths

8.3.4 Being designed to penetrate the seabed to achieve a holding capacity, anchors can be particularly damaging to cable systems. Known or designated vessel anchoring sites are located outside the Wind Farm and therefore do not overlap with the location of the inter-array cables. Additional information on designated anchoring sites is detailed in the Navigational Safety Plan (NSP). The principal risk from anchoring lies in the occasions where a vessel is forced to anchor due to mechanical failure or the

need to prevent collision.

8.3.5 In selecting an appropriate DOL, consideration needs to be given to the percentage size distribution of vessels transiting through the area. The AIS data indicated that the majority of vessels crossing the Wind Farm site are less than 200 tonnes (40%), or between 5,000 to 15,000 tonnes (30%) (with only one vessel of 150,000 tonnes recorded).

8.3.6 The risk assessment considered Stockless anchors AC-14, Halls and Pool types anchors as these are all commonly used by commercial vessels. Pool N anchors have the greatest penetration into the seabed; these were used as the reference values for a conservative assessment of a target DOL.

8.3.7 The Geomarine anchor assessment suggests that a maximum fluke penetration of 1.0m below mudline (bml) would be anticipated for the largest vessels that currently cross the inter-array cable area. However, based on experience of vessel patterns adjacent to wind farms, it is considered that vessel traffic within the Wind Farm area is likely to significantly reduce once constructed.

8.3.8 Minor traffic through the Wind Farm comprising fishing vessels, supply vessels and other smaller vessels may potentially continue. It was therefore concluded that protection is required from errant anchoring of smaller vessels and limited fishing operations only.

8.3.9 The recommended minimum depth of lowering for protection from fishing and errant anchoring of smaller vessels (deemed the most likely threat) identified by Geomarine is 0.5 bml.

8.4 Target Depth of Lowering

8.4.1 Based on the information set out in the CBRAs, BOWL will aim to achieve a DOL for the inter-array cables of 0.6m to 0.8m as this is deemed to be an attainable depth that provides adequate protection to cables from the identified hazards.

9 Inter-Array Cable Installation Methodology

9.1 Introduction

9.1.1 S36 Consent Condition 19 requires that this CaP includes the following:

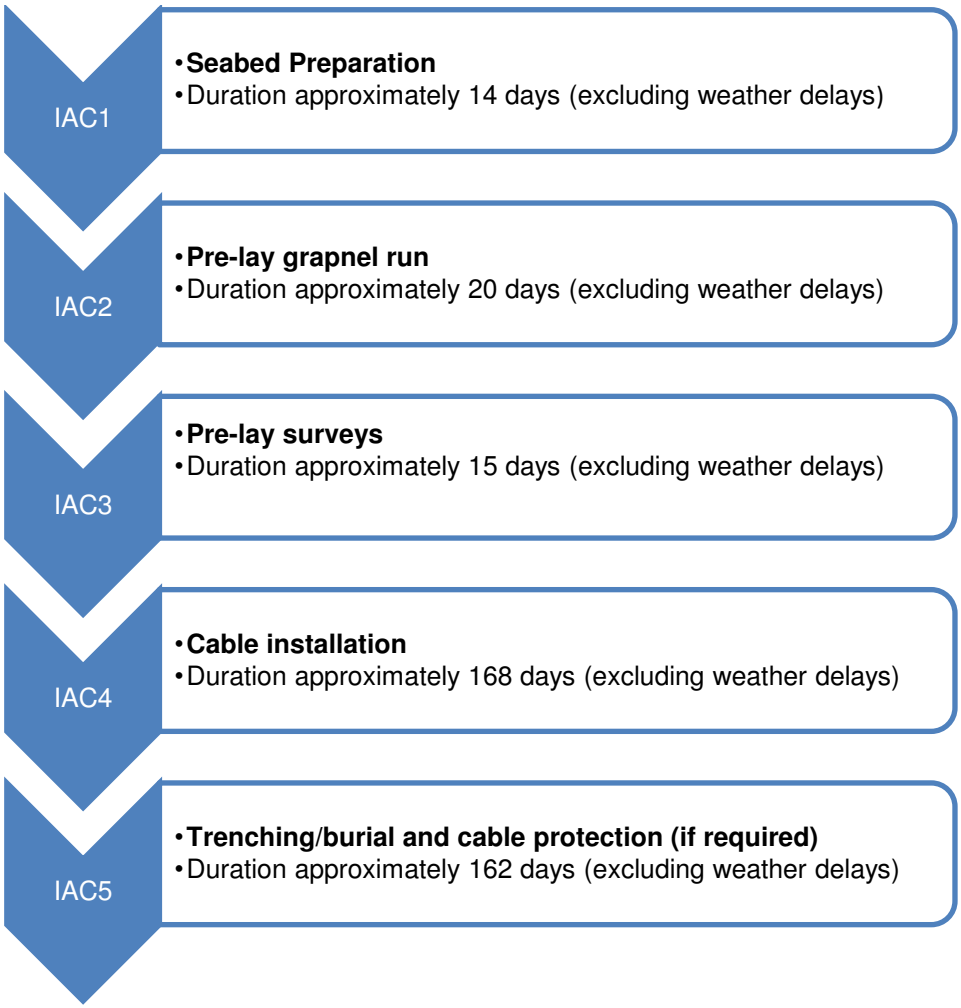
*Details of the location and **cable laying techniques** for the inter-array cables.*

9.1.2 This section sets out the cable laying techniques for the inter-array cables. Details of the location and layout of the inter-array cables are provided in Section 6.

9.1.3 An indicative inter-array cable installation sequence for all cables is presented in Figure 9.1, including approximate durations for the completion of each operation.

9.1.4 Greater detail on each of the stages in the Inter-Array Cable (IAC) installation process (IAC1 – IAC5) is then provided in the subsequent sections. Total duration for the installation of all of the inter-array cables is estimated to be circa 365 days excluding any weather delays. Installation will be completed in multiple campaigns across two construction seasons.

Figure 9.1 - Inter-array cable installation sequence



9.1.5 Inter-array cables will be delivered to site direct from the point of manufacture by sea transport.

9.1.6 Further details on the proposed construction vessels are set out in the VMP.

9.2 Inter-Array Cable Installation Operations

Inter-array Installation Stage IAC1 – Seabed Preparation

9.2.1 Detailed analysis of ground conditions has identified distinct areas where there is potential for boulder presence to affect construction activities. Boulders have the potential to disrupt or prohibit cable laying and burial.

9.2.2 In areas where boulder presence may inhibit cable installation a 'displacement plough' will be deployed to clear boulders from the intended inter-array cable route. A SCAR plough tool will be configured for boulder clearance and will be deployed from a Platform Supply Vessel (PSV) (or equivalent). The SCAR plough tool is capable of displacing boulders up to 2m in diameter although it is anticipated that the majority of boulders identified within the inter-array cable route area will be between 0.5 to 1.3m in diameter (See Figure 9.2).

Figure 9.2. SCAR plough configured for boulder clearance operations

9.2.3 Boulder displacement using a SCAR plough will be undertaken along circa 15% of the inter-array cable route lengths. Boulder boards will be attached to the SCAR plough and will be scraped along the seabed surface displacing boulders along either side of the 10m clearance path. Small temporary sediment berms of up to 20cm height will be formed by the plough. The SCAR plough campaign is expected to be completed within 2 weeks.

9.2.4 Boulders which are partially or wholly buried may not be displaced by the SCAR plough tool. Following deployment of the SCAR plough a Remotely Operated Vehicle (ROV) will be used to survey the ploughed path and identify any remaining boulders. Where these remaining boulders have the potential to disrupt cable installation an orange peel grab will be used to relocate boulders from the inter-array cable routes. Grabbed boulders will be relocated immediately adjacent to the inter-array cable routes, where boulders displaced by the plough will also be present.

9.2.5 Clearance of boulders by grab will be undertaken immediately following completion of SCAR plough operations. The duration of grab clearance activities will be dependent on the number of boulders remaining following SCAR plough operations.

9.2.6 Boulders will all be relocated within areas of existing high boulder density. If practicable, re-use of displaced boulders in cable protection may be considered.

Inter-array Installation Stage IAC2 – Pre-lay grapnel run

9.2.7 Seabed debris or features (for example scrap trawler warps or ships' crane wires that may have been jettisoned by vessels onto the seabed) can be detrimental to the cable trenching or burial tool. Therefore, after boulder clearance and before the start of cable laying operations the cable route will be cleared of any remaining obstructions by undertaking a pre-lay grapnel run (PLGR).

9.2.8 A specialised vessel will be mobilised together with any required survey and positioning equipment, and the chosen grapnel assembly. The grapnel rig will be set-up to accommodate any change in soil conditions covering the entire array cable routes.

9.2.9 The PLGR vessel will tow the grapnel rig along the centreline of the cable route with a tolerance of +/- 5m giving a 10m corridor. Any debris encountered will be recovered to the deck of the vessel for appropriate licensed disposal ashore.

Inter-array Installation Stage IAC3 – Pre-lay survey

9.2.10 The Cable Lay Vessel (CLV) will perform a pre-lay survey as part of the cable installations, this will be done after the vessel is loaded and has arrived at site to ensure no changes that will affect the cable installation has occurred since the previous surveys. An ROV will be used to carry out the pre-lay survey.

Inter-array Installation Stage IAC4 – Cable installation

9.2.11 Cable installation is undertaken by the CLV, which has been pre-loaded with the inter-array subsea cable lengths stored on cable carousels carried by the vessel. The cables are installed between the WTGs and between the WTGs and the OTMs to form the 'strings' of WTGs. The installation methodology from OTM to WTG is very similar to that of the WTG to WTG apart from the following aspects:

- OTM pull-in equipment will be mobilised onto the OTM onshore prior to the transport and installation works offshore; and,
- All OTM pull-ins will be performed as first end pull-ins as the OTM is a congested area due to multiple cable approaches and first end pull-ins allow greater control of the cable seabed approaches.

9.2.12 The CLV is positioned adjacent to the first WTG (or OTM) location. The position of the CLV will be held principally using a Dynamic Positioning (DP) system during installation

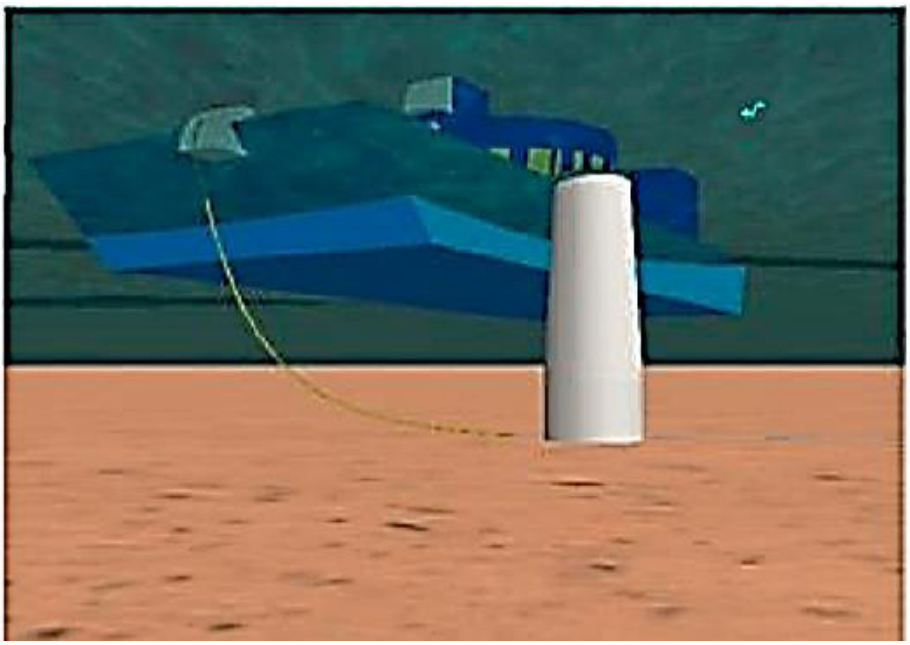
works. Indicative vessel specifications are presented in the VMP. Anchoring is not currently anticipated as part of routine cable installation operations. The following cable installation sequence will be followed:

First end pull-in:

9.2.13 Each first end pull in will consist of a direct transfer of the cable end from the CLV to the WTG (or OTM). A brief summary of cable first end pull-in operations is provided below:

- The Installation Support Vessel (ISV) will transfer pull-in equipment and personnel to the WTG or OTM (noting equipment will already be in place on the OTMs);
- Prior to pull-in, a CPS, which takes the form of a protective sleeve of polyurethane or ductile iron placed around the cable, will be fitted to the cable end on board the CLV. The CPS provides stability to the cable and protects its integrity both during and post-installation;
- The CLV will recover a pre-installed messenger wire using an ROV (pre-installed within the J-tube; for description of J-tube see below), winch the wire to deck and connect it to the CPS;
- The CLV will then pay out the cable as the pull-in team on the WTG/OTM pay in the messenger wire and the array cable on the winch;
- Cable payout from the CLV will continue until the CPS reaches the J-tube (or I-tube) bellmouth. J-tubes are steel tubes that allow the installation of cables by providing a conduit through which the cables can be pulled. The tubes run from the cable termination points on the WTG or OTM down the support structure and bend outwards in a 'J' shape terminating in a wide bell mouth at the seabed. An ROV will be used to monitor the position of the CPS in relation to the J-Tube bellmouth; and
- When the CPS is orientated correctly, payout from the CLV will continue until the cable end is accessible at the deck of the WTG or OTM.

Figure 9.3 - Example of first end pull-in



Cable free-lay

9.2.14 The cable is laid by the CLV away from the J-tube on the first WTG towards the J-tube on the second WTG (or OTM) along the previously cleared route. The lay speed, vessel speed, cable departure angle and tension will be monitored and checked to ensure the cable integrity is maintained throughout the lay.

Figure 9.4 - Example of a cable laying operation (cables first end being over-boarded from the cable laying vessel)

Cable cutting and sealing

9.2.15 On completion of the route length, the end of the cable is then cut, sealed and prepared for second end installation operations. Cutting will take place on the deck of the CLV.

9.2.16 The second end is temporarily laid down in readiness for pull-in through the J-tube of the second WTG structure.

Figure 9.5 - Typical cable cutting and sealing process

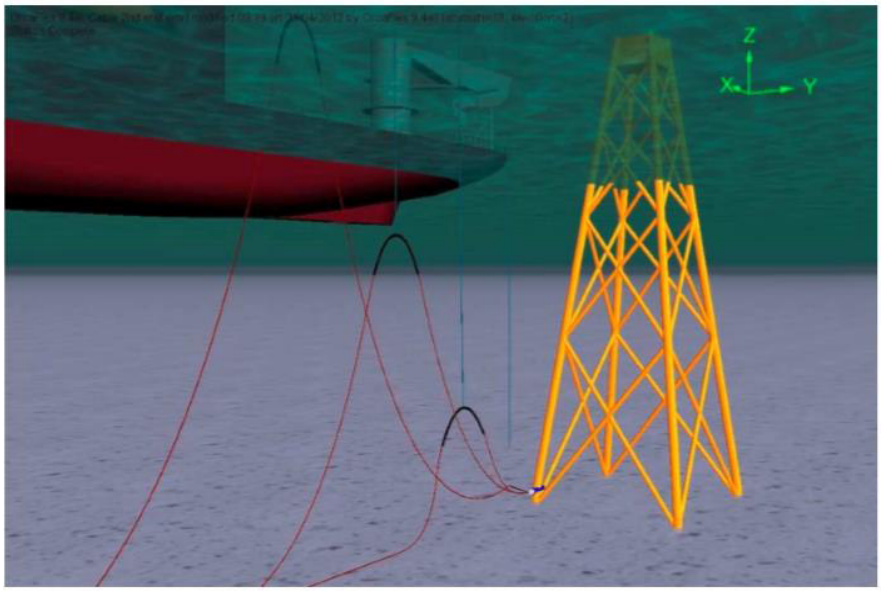
Second end lay-down and pull-in

9.2.17 Once the CLV reaches the WTG at the second end following procedure will be followed during second end pull-in operations:

- As with first end pull-in the pull-in equipment and personnel will be mobilised to the WTG (or OTM) from the Installation Support Vessel (ISV);
- The CPS will be installed on the cut and sealed cable end on board the CLV;
- The CLV then recovers the messenger wire from the second wind turbine and connects it to the cable end. The cable and subsea quadrant is then passed down the deck and over boarded;
- The cable is then fed through the J-tube bellmouth on the jacket structure and into the WTG (or OTM). The subsea quadrant is lowered as the cable is pulled in to the WTG (or OTM). Finally, the quadrant is tilted in order that the cable is laid to the seabed. The quadrant is retrieved and final bight of cable is pulled in to the WTG (or OTM).

9.2.18 Cable testing will be performed at various stages during the cable lay operations and post terminations.

Figure 9.6 - Example of the cable being lowered from the vessel during second-end pull-in (the bend in the cable will be maintained using a subsea quadrant)



9.2.19 This process is then repeated for the remaining inter-array cable lengths, connecting turbines together in 'strings' and those strings of turbines to the OTMs.

Inter-array Installation Stage IAC5 – Cable trenching/burial

9.2.20 Once the installation of surface laid inter-array cables is completed, they will then be trenched into the seabed to the target depth by a dedicated trenching support vessel.

9.2.21 Where cables are left exposed on the sea bed prior to trenching or mechanical protection guard vessel(s) will be strategically deployed along the cable route to deter vessels from the area that carry out activities that could damage the cables, or whose safety could be compromised by snagging on cables.

9.2.22 The seabed trenching tool will be launched from the cable trenching vessel. The surface laid cable will be loaded into the trencher. The seabed trenching tool then completes a first trenching run to bury the cable.

9.2.23 It is anticipated that cable burial will be primarily achieved by the use of a water jetting seabed trenching vehicle capable of performing jet trenching in the softer sediments that are present across the majority of the Development (see Figure 9.7). Such jet trenching vehicles will use nozzles mounted on jet swords to inject water at high pressure into the soil surrounding the cable which fluidises the seabed in the immediate vicinity allowing the cable to sink under its own weight, before the soil re-settles over the top. To maximise post-trenching cable cover and to minimise the disturbance of sediment away from the trench, site specific trencher settings will be derived based on the soil conditions to ensure disturbed sediment is monitored and managed efficiently throughout operations.

Figure 9.7 – Deployment of seabed water jetting cable trenching tool

Figure 9.8 - Examples of seabed water jetting cable trenching tools that may be used for inter-array cable installation

9.2.24 Based on the results of geotechnical investigation and CBRA (see Section 8), BOWL propose a minimum DOL of 0.6m as measured between the top of the cable and mean seabed level is anticipated. The seabed trenching tool will measure the trench depth.

Cable burial contingency

9.2.25 Cable burial by jet-trenching described above is considered the most reliable and cost effective form of cable protection. When seabed conditions are suitable it is also a relatively efficient process of installation. The majority of cables are expected to be installed by this method, however, in areas where jet-trenching may not be possible due to the presence of stiff sediments a hybrid tool capable of both chain cutting and jet trenching will be used.

9.2.26 Following the first trenching pass depressor depth data will be evaluated to determine whether the target DOL has been reached. If necessary, a second trenching pass will be completed in either jetting or cutting mode of the hybrid tool to ensure the cable is adequately buried.

9.2.27 Cable burial is BOWL's preferred method of inter-array cable protection. Burial is the most effective and economical means of protection. It is not currently anticipated that cable protection will be routinely applied. However, where the target DOL cannot be achieved due to resistant ground conditions, protection in the form of rock armouring

(rock dumping or use of rock bags) or concrete mattressing will be installed.

9.2.28 These methods would be used where necessary in the view of BOWL or its Key Contractors and where short lengths of exposed cable could not otherwise be buried.

9.2.29 To protect the array cables between the seabed and the J-tubes, it is anticipated that a CPS will be used (as described in Section 9.2.13). For the inter-array cable-OTM/WTG interface, a system consisting of split pipes that form a protective sleeve of polyurethane or ductile iron around the cable will be installed from the J-tube to where the cable is buried into the seabed to protect the cables from dropped objects (see Figure 9.9).

Figure 9.9 - Example of cable protection system at OTM or WTG J-tube

9.2.30 The design of the foundation support structures for the WTGs and OTMs means that it is unlikely scour protection will be required.

10 Inter-Array Cable Operation and Maintenance

10.1 Over Trawl Surveys

10.1.1 S36 Consent Condition 19 requires that this CaP includes the following:

Methodologies for over trawl surveys of the inter-array cables through the operational life of the Wind Farm where mechanical protection of cables laid on the sea bed is deployed.

10.1.2 Currently, as noted under Section 9.2 above, it is anticipated that the full length of the inter-array cables will be buried to a DOL determined through the burial risk assessment process set out in Section 8, to provide protection to both the cables and to other marine users (with the exception of short lengths where the inter-array cables approach the wind turbines and OTMs). In this event no over trawl surveys will be conducted.

10.1.3 As noted under Section 9.2, however, in the event that the target DOL is not achieved, additional protection for some sections of the inter-array cables, in the form of rock armouring or concrete mattressing may be required.

10.1.4 Where substantial amounts of additional cable protection measures are applied in an area of known fishing activity, BOWL propose to conduct further discussions with Marine Scotland with regard to the need for over trawl surveys, taking account of:

- The extent and location of the cable protection material;
- The design of the cable protection material (noting that these can be designed to minimise effects on towed fishing gear); and
- The amount of fishing activity observed within the operational wind farm.

10.1.5 Where considered necessary, over trawl surveys are likely to involve the charter of a fishing vessel with standard demersal trawl gear to undertake tows at the location of interest. The final methodology for over trawl surveys will be determined in consultation with MS-LOT and the local fishing industry.

10.2 Cable Inspection Procedures

10.2.1 S36 Consent Condition 19 requires that this CaP includes the following:

Measures to address exposure of any cables.

10.2.2 Following installation, an assessment will be completed identifying areas of cable at potential risk of exposure in the future. Monitoring of these ‘at-risk’ areas will be conducted annually initially. Subject to the findings of the surveys, the frequency of these will be adapted to the appropriate level of risk exposure.

10.3 Corrective Actions

10.3.1 In the event of cable failure or exposure, cable sections will most likely be replaced and re-buried or cable protection applied.

11 Compliance with the Application, ES and SEIS

11.1 Introduction

11.1.1 In addition to the conditions presented in Table 1.1, Condition 8 of the Section 36 Consent states:

The Development [Wind Farm] must be constructed and operated in accordance with the terms of the Application and related documents, including the accompanying ES, the SEIS and Annex 1 of this letter, except in so far as amended by the terms of this section 36 consent.

11.1.2 Sections 11.2 and 11.3 set out information from the ES/SEIS and original Application with regard to:

- Compliance with the inter-array cable installation details as assessed in the ES/SEIS; and
- Inter-array cable installation related mitigation measures detailed in the ES/SEIS.

11.2 Compliance with Installation Details Assessed in the ES/SEIS

11.2.1 The ES and SEIS described a range of specification and layout options that could be applied during the construction of the Development.

11.2.2 Since the Development consents were awarded, the design of the Development and approach to installation has been substantially refined to that described in this Wind Farm CaP (and in other relevant Consent Plans). In order to demonstrate compliance of this refined design, the installation methods and cable specifications described in the ES and SEIS are compared to the installation methods and specifications detailed within this Wind Farm CaP (see Appendix B).

11.3 Delivery of Mitigation Proposed in the ES/SEIS

11.3.1 The ES and SEIS detailed mitigation measures of relevance to the inter-array cable installation activities. The relevant mitigation measures are presented in full in Appendix C, which identifies where each commitment has been addressed within this Wind Farm CaP or within other BOWL Consent Plans where appropriate.

12 References

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CMACS (2011) Beatrice Benthic Technical Report. J3151.

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Fugro (2015) Part B Geotechnical Data, Beatrice Offshore Windfarm Interim Geotechnical Survey 2013. BOWL Document Reference: LF000005-REP-076

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Geomarine (2016) Beatrice Inter-Array Cable Burial Risk and Protection Assessment: LF000005-REP-873

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Osiris Projects Ltd. (2010) BOWL Geophysical Survey Report.

SHL (2015) Beatrice Offshore Wind Farm Inter-Array Cable Installation Method Statement. BOWL Document Reference. BOWL Document Reference: LF000005-REP-041

SHL (2016) Beatrice Offshore Wind Farm Inter-Array Cable – Cable Burial Risk Assessment Report. BOWL Document Reference: BOWL Document Reference: LF000005-REP-199

M. Slater, J. Richard and A. Schultz, (2014) “The prediction of electromagnetic fields generated by submarine power cables”, OWET Technical Report No. 0905-00-007,

Appendix A - Inter-array cable string arrangements and cable lengths

	Array layout		Start Point			End Point			Route length from J tube to J tube (m)	Comment
String	Start	End	Latitude (ddm WGS84)	Longitude (ddm) WGS84	Water Depth (m) LAT	Latitude (ddm) WGS84	Longitude (ddm) WGS84	Water Depth (m) LAT		
	BE-G7	BE-H6	58 15.004' N	2 52.834' W	-41.2	58 14.598' N	2 51.920' W	-40	**1647.1**	First Link
A	BE-H6	BE-J5	58 14.598' N	2 51.920' W	-40	58 14.192' N	2 51.005' W	-41.4	**1530.8**	
	BE-J5	BE-H5	58 14.192' N	2 51.005' W	-41.4	58 13.977' N	2 52.130' W	-41.9	**1296.9**	
	BE-H5	BE-H4	58 13.977' N	2 52.130' W	-41.9	58 13.356' N	2 52.339' W	-41.1	**1268.9**	
	BE-H4	BE-G3	58 13.356' N	2 52.339' W	-41.1	58 12.544' N	2 53.726' W	-40.5	**2073.0**	
	BE-G3	BE-F2	58 12.544' N	2 53.726' W	-40.5	58 11.685' N	2 55.005' W	-40.2	**2026.5**	
	BE-F2	BE-E1	58 11.685' N	2 55.005' W	-40.2	58 10.900' N	2 56.256' W	-38.8	**1892.3**	Closing Loop
	BE-G7	BE-G6	58 15.004' N	2 52.834' W	-41.2	58 14.384' N	2 53.044' W	-40.2	**1271.3**	First Link
B	BE-G6	BE-G5	58 14.384' N	2 53.044' W	-40.2	58 13.762' N	2 53.254' W	-39.7	**1234.1**	
	BE-G5	BE-G4	58 13.762' N	2 53.254' W	-39.7	58 13.142' N	2 53.464' W	-38.6	**1233.0**	
	BE-G4	BE-F3	58 13.142' N	2 53.464' W	-38.6	58 12.306' N	2 54.796' W	-38.7	**2083.5**	
	BE-F3	BE-E2	58 12.306' N	2 54.796' W	-38.7	58 11.470' N	2 56.128' W	-38.2	**2106.5**	
	BE-E2	BE-E1	58 11.470' N	2 56.128' W	-38.2	58 10.900' N	2 56.256' W	-38.8	**1086.5**	
	BE-G7	BE-F6	58 15.004' N	2 52.834' W	-41.2	58 14.168' N	2 54.169' W	-41.6	**2052.6**	First Link
C	BE-F6	BE-F5	58 14.168' N	2 54.169' W	-41.6	58 13.548' N	2 54.378' W	-39.7	**1261.5**	
	BE-F5	BE-F4	58 13.548' N	2 54.378' W	-39.7	58 12.927' N	2 54.588' W	-40.4	**1261.8**	
	BE-F4	BE-E4	58 12.927' N	2 54.588' W	-40.4	58 12.712' N	2 55.710' W	-40.7	**1295.6**	
	BE-E4	BE-E3	58 12.712' N	2 55.710' W	-40.7	58 12.090' N	2 55.920' W	-38.6	**1261.9**	
	BE-E3	BE-D3	58 12.090' N	2 55.920' W	-38.6	58 11.995' N	2 57.002' W	-38.3	**1313.4**	
	BE-F8	BE-E7	58 15.411'N	2 53.750'W	-45.7	58 14.575' N	2 55.084' W	-43.7	**2027.9**	First Link
D	BE-E7	BE-E6	58 14.575' N	2 55.084' W	-43.7	58 13.954' N	2 55.293' W	-40.7	**1234.5**	
	BE-E6	BE-E5	58 13.954' N	2 55.293' W	-40.7	58 13.333' N	2 55.502' W	-40.4	**1234.1**	
	BE-E5	BE-D5	58 13.333' N	2 55.502' W	-40.4	58 13.117' N	2 56.626' W	-41.8	**1358.7**	

	Array layout		Start Point			End Point			Route length from J tube to J tube (m)	Comment
String	Start	End	Latitude (ddm WGS84)	Longitude (ddm) WGS84	Water Depth (m) LAT	Latitude (ddm) WGS84	Longitude (ddm) WGS84	Water Depth (m) LAT		
	BE-D5	BE-D4	58 13.117' N	2 56.626' W	-41.8	58 12.497' N	2 56.834' W	-39.4	**1232.3**	
	BE-D4	BE-C4	58 12.497' N	2 56.834' W	-39.4	58 12.307' N	2 57.948' W	-38	**1256.5**	
	BE-C4	BE-D3	58 12.307' N	2 57.948' W	-38	58 11.995' N	2 57.002' W	-38.3	**1483.3**	Closing Loop
	BE-F8	BE-E8	58 15.411' N	2 53.750' W	-45.7	58 15.196' N	2 54.875' W	-46	**1149.8**	First Link
E	BE-E8	BE-D7	58 15.196' N	2 54.875' W	-46	58 14.359' N	2 56.209' W	-44	**2091.5**	
	BE-D7	BE-D6	58 14.359' N	2 56.209' W	-44	58 13.739' N	2 56.417' W	-42.2	**1260.9**	
	BE-D6	BE-C6	58 13.739' N	2 56.417' W	-42.2	58 13.524' N	2 57.541' W	-41.4	**1296.6**	
	BE-C6	BE-C5	58 13.524' N	2 57.541' W	-41.4	58 12.902' N	2 57.749' W	-40.4	**1261.6**	
	BE-C5	BE-B5	58 12.902' N	2 57.749' W	-40.4	58 12.687' N	2 58.873' W	-39.7	**1297.2**	
	BE-B5	BE-A5	58 12.687' N	2 58.873' W	-39.7	58 12.471' N	2 59.996' W	-47.7	**1483.6**	Closing Loop
	BE-F8	BE-D8	58 15.411' N	2 53.750' W	-45.7	58 14.981' N	2 55.999' W	-43.8	**2373.8**	First Link
F	BE-D8	BE-C8	58 14.981' N	2 55.999' W	-43.8	58 14.766' N	2 57.124' W	-43.3	**1358.2**	
	BE-C8	BE-C7	58 14.766' N	2 57.124' W	-43.3	58 14.144' N	2 57.332' W	-42.3	**1233.5**	
	BE-C7	BE-B7	58 14.144' N	2 57.332' W	-42.3	58 13.929' N	2 58.456' W	-46.4	**1358.1**	
	BE-B7	BE-B6	58 13.929' N	2 58.456' W	-46.4	58 13.308' N	2 58.664' W	-44	**1233.5**	
	BE-B6	BE-A5	58 13.308' N	2 58.664' W	-44	58 12.471' N	2 59.996' W	-47.7	**2107.6**	
	BE-F8	BE-E9	58 15.411' N	2 53.750' W	-45.7	58 15.817' N	2 54.665' W	-46	**1461.1**	First Link
G	BE-E9	BE-D9	58 15.817' N	2 54.665' W	-46	58 15.602' N	2 55.790' W	-44.4	**1358.2**	
	BE-D9	BE-C9	58 15.602' N	2 55.790' W	-44.4	58 15.386' N	2 56.915' W	-45.5	**1474.5**	
	BE-C9	BE-D10	58 15.386' N	2 56.915' W	-45.5	58 16.223' N	2 55.582' W	-45.3	**2083.6**	
	BE-D10	BE-D11	58 16.223' N	2 55.582' W	-45.3	58 16.844' N	2 55.373' W	-50.1	**1234.0**	
	BE-D11	BE-E12	58 16.844' N	2 55.373' W	-50.1	58 17.680' N	2 54.037' W	-52.9	**2106.8**	

	Array layout		Start Point			End Point			Route length from J tube to J tube (m)	Comment
String	Start	End	Latitude (ddm WGS84)	Longitude (ddm) WGS84	Water Depth (m) LAT	Latitude (ddm) WGS84	Longitude (ddm) WGS84	Water Depth (m) LAT		
	BE-E12	BE-F13	58 17.680' N	2 54.037' W	-52.9	58 18.516' N	2 52.701' W	-54.2	**2107.2**	Closing Loop
	BE-F8	BE-E10	58 15.411' N	2 53.750' W	-45.7	58 16.438' N	2 54.456' W	-46.6	**2228.2**	First Link
H	BE-E10	BE-E11	58 16.438' N	2 54.456' W	-46.6	58 17.059' N	2 54.247' W	-46.6	**1260.9**	
	BE-E11	BE-F11	58 17.059' N	2 54.247' W	-46.6	58 17.274' N	2 53.120' W	-48.8	**1293.3**	
	BE-F11	BE-F12	58 17.274' N	2 53.120' W	-48.8	58 17.894' N	2 52.911' W	-48.6	**1260.7**	
	BE-F12	BE-G12	58 17.894' N	2 52.911' W	-48.6	58 18.109' N	2 51.784' W	-50.5	**1297.5**	
	BE-G12	BE-F13	58 18.109' N	2 51.784' W	-50.5	58 18.516' N	2 52.701' W	-54.2	**1526.4**	
	BE-F8	BE-F9	58 15.411' N	2 53.750' W	-45.7	58 16.031' N	2 53.540' W	-49	**1322.9**	First Link
J	BE-F9	BE-F10	58 16.031' N	2 53.540' W	-49	58 16.653' N	2 53.330' W	-48.2	**1234.4**	
	BE-F10	BE-G10	58 16.653' N	2 53.330' W	-48.2	58 16.867' N	2 52.204' W	-49.4	**1358.1**	
	BE-G10	BE-G11	58 16.867' N	2 52.204' W	-49.4	58 17.488' N	2 51.994' W	-51.1	**1230.1**	
	BE-G11	BE-H12	58 17.488' N	2 51.994' W	-51.1	58 18.324' N	2 50.657' W	-51.8	**2083.4**	
	BE-H12	BE-G13	58 18.324' N	2 50.657' W	-51.8	58 18.730' N	2 51.574' W	-53.4	**1417.0**	
	BE-G13	BE-G14	58 18.730' N	2 51.574' W	-53.4	58 19.351' N	2 51.362' W	-54.9	**1232.8**	Closing Loop
	BE-F8	BE-G9	58 15.411' N	2 53.750' W	-45.7	58 16.247' N	2 52.415' W	-49.9	**2239.4**	First Link
K	BE-G9	BE-H10	58 16.247' N	2 52.415' W	-49.9	58 17.082' N	2 51.079' W	-49.6	**2091.7**	
	BE-H10	BE-H11	58 17.082' N	2 51.079' W	-49.6	58 17.703' N	2 50.867' W	-50.2	**1261.0**	
	BE-H11	BE-J12	58 17.703' N	2 50.867' W	-50.2	58 18.538' N	2 49.530' W	-52.2	**2091.6**	
	BE-J12	BE-H13	58 18.538' N	2 49.530' W	-52.2	58 18.944' N	2 50.446' W	-53.4	**1512.7**	
	BE-H13	BE-G14	58 18.944' N	2 50.446' W	-53.4	58 19.351' N	2 51.362' W	-54.9	**1525.6**	

	Array layout		Start Point			End Point			Route length from J tube to J tube (m)	Comment
String	Start	End	Latitude (ddm WGS84)	Longitude (ddm) WGS84	Water Depth (m) LAT	Latitude (ddm) WGS84	Longitude (ddm) WGS84	Water Depth (m) LAT		
	BE-G7	BE-G8	58 15.004' N	2 52.834' W	-41.2	58 15.625' N	2 52.625' W	-45.2	**1230.2**	First Link
L	BE-G8	BE-H9	58 15.625' N	2 52.625' W	-45.2	58 16.461' N	2 51.289' W	-47.8	**2106.9**	
	BE-H9	BE-J10	58 16.461' N	2 51.289' W	-47.8	58 17.296' N	2 49.952' W	-49.5	**2123.2**	
	BE-J10	BE-J11	58 17.296' N	2 49.952' W	-49.5	58 17.917' N	2 49.741' W	-50.8	**1235.6**	
	BE-J11	BE-J13	58 17.917' N	2 49.741' W	-50.8	58 19.159' N	2 49.319' W	-54.2	**2429.3**	
	BE-J13	BE-K12	58 19.159' N	2 49.319' W	-54.2	58 18.752' N	2 48.403' W	-53.1	**1542.0**	
	BE-K12	BE-K11	58 18.752' N	2 48.403' W	-53.1	58 18.131' N	2 48.614' W	-52	**1228.2**	Closing Loop
	BE-G7	BE-H8	58 15.004' N	2 52.834' W	-41.2	58 15.840' N	2 51.499' W	-44.2	**2118.7**	First Link
M	BE-H8	BE-J8	58 15.840' N	2 51.499' W	-44.2	58 16.055' N	2 50.373' W	-45.5	**1296.3**	
	BE-J8	BE-J9	58 16.055' N	2 50.373' W	-45.5	58 16.675' N	2 50.163' W	-47.8	**1266.3**	
	BE-J9	BE-K9	58 16.675' N	2 50.163' W	-47.8	58 16.890' N	2 49.036' W	-48.6	**1296.7**	
	BE-K9	BE-K10	58 16.890' N	2 49.036' W	-48.6	58 17.510' N	2 48.825' W	-51.5	**1260.9**	
	BE-K10	BE-K11	58 17.510' N	2 48.825' W	-51.5	58 18.131' N	2 48.614' W	-52	**1261.6**	
	BE-G7	BE-H7	58 15.004' N	2 52.834' W	-41.2	58 15.219' N	2 51.709' W	-42.5	**1338.0**	First Link
N	BE-H7	BE-J7	58 15.219' N	2 51.709' W	-42.5	58 15.433' N	2 50.585' W	-42.7	**1294.7**	
	BE-J7	BE-K7	58 15.433' N	2 50.585' W	-42.7	58 15.648' N	2 49.459' W	-44.3	**1298.8**	
	BE-K7	BE-K8	58 15.648' N	2 49.459' W	-44.3	58 16.269' N	2 49.247' W	-47.6	**1233.5**	
	BE-K8	BE-L9	58 16.269' N	2 49.247' W	-47.6	58 17.104' N	2 47.910' W	-49.4	**2106.7**	
	BE-L9	BE-L10	58 17.104' N	2 47.910' W	-49.4	58 17.724' N	2 47.698' W	-49.6	**1232.9**	
	BE-L10	BE-M10	58 17.724' N	2 47.698' W	-49.6	58 17.938' N	2 46.571' W	-49.9	**1358.2**	Closing Loop
	BE-G7	BE-J6	58 15.004' N	2 52.834' W	-41.2	58 14.812' N	2 50.795' W	-41.5	**2325.3**	First Link

	Array layout		Start Point			End Point			Route length from J tube to J tube (m)	Comment
String	Start	End	Latitude (ddm WGS84)	Longitude (ddm) WGS84	Water Depth (m) LAT	Latitude (ddm) WGS84	Longitude (ddm) WGS84	Water Depth (m) LAT		
P	BE-J6	BE-K6	58 14.812' N	2 50.795' W	-41.5	58 15.027' N	2 49.669' W	-44.6	**1307.6**	
	BE-K6	BE-L7	58 15.027' N	2 49.669' W	-44.6	58 15.862' N	2 48.333' W	-44.5	**2091.4**	
	BE-L7	BE-L8	58 15.862' N	2 48.333' W	-44.5	58 16.482' N	2 48.122' W	-47.8	**1261.0**	
	BE-L8	BE-M9	58 16.482' N	2 48.122' W	-47.8	58 17.317' N	2 46.784' W	-49	**2091.0**	
	BE-M9	BE-M10	58 17.317' N	2 46.784' W	-49	58 17.938' N	2 46.571' W	-49.9	**1464.0**	

Appendix B - Compliance with ES/SEIS

Table B1 presents a comparison of consented project parameters relevant to the inter-array installation process set out in the ES/SEIS, against the details set out in this Wind Farm CaP.

Table B1 – Comparison of ES/SEIS Rochdale Envelope and Wind Farm CaP inter-array cable installation parameters

Construction related parameter	**ES/SEIS**	**CaP**
Inter-array cabling		
Voltage range	33kV – 66kV AC	33kV
Maximum length	Max. 350km	~140km
Length buried	Buried where possible	Buried where possible (except at the J-tubes)
Trench depth range	0m – 2.5m	Depth of Lowering of 0.6 to 0.8m
Maximum extent of cable protection	0.48km^2	Possible requirement for protection for sections where DOL is not achieved; anticipated to be significantly lower than 0.48km^2
Installation method	Ploughing Trenching Jetting	Trenching Jetting
Protection method	Concrete blanket / mattressing Rock net / gabion Rock placement No protection	Close fitting protection at cable ends only where cables leave the seabed to enter the jacket substructure J-tubes; potential use of additional protection (most likely rock armour or concrete mattress) where DOL is not achieved
Cable installation procedure	Cable brought to site stored on carousels Cable laid by cable installation vessel Surface laid cables buried by specialist trenching vessel Cable protection applied where needed	Seabed preparation Pre-lay grapnel run Cable brought to site stored on carousels and pre-lay survey conducted Cable laid by cable installation vessel Surface laid cables buried by specialist trenching vessel Cable protection applied where needed.

Appendix C - ES and SEIS Commitments

Table C1 presents the commitments made by BOWL in the ES and SEIS to mitigation measures relative to inter-array cable installation process set out in this Wind Farm CaP. The table provides details of the commitments and a cross-reference to where each commitment is implemented.

Table C1 - ES and SEIS Construction-related Mitigation relevant to the Wind Farm CaP

Source	Reference (ES or SEIS chapter)	Details of Commitment	Implementation
ES	Commercial Fisheries	BOWL will develop an approach in consultation with the fishing industry to ensure that the safety risks posed to fishing vessels as a result of the installation and operation of inter-array cables are within an appropriate and reasonable standard determined in consultation with the fishing industry, and remain within, acceptable limits throughout the construction/decommissioning and operation phases of the development.	Section 9 – Burial Risk Assessment Section 11 – Over trawl Surveys (if required) Section 11 – Monitoring of cable burial
ES	Commercial Fisheries	Cables will be buried to a target depth of one metre, where it is reasonably practicable to do so. In instances where alternative protection is required, then the developer will seek where feasible to install appropriate and reasonable protection.	Section 6 and 7
ES	Shipping and Navigation	The subsea inter-array cable routes will be subject to periodic inspection.	Section 11
SEIS	Fish and Shellfish Ecology	A post installation survey is likely to be undertaken following completion of cable installation and protection works trenching and rock dumping, depending on the final construction plans.	Section 11
SEIS	Residual Effects	Embedded industry standard mitigation including the following: • Burial or protection of inter-array cables where feasible; • Liaison to ensure information circulated to mariners; and • The Wind Farm and associated inter-array cables will be charted by the UK Hydrographic Office in Admiralty Charts.	Section 10

Source	Reference (ES or SEIS chapter)	Details of Commitment	Implementation
ES	Commercial Fisheries	The surface-laying of inter-array cables will be minimised	Section 8
SEIS	Fish and Shellfish Ecology	Inter-array cable burial/protection proposed where feasible to increase the separation between species and the cables to potentially reduce EMF effects.	Section 7