Environmental Statement
Chapter 12
Marine and Intertidal Ecology

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<th>Royal HaskoningDHV</th>
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<td>Adam Pharaoh</td>
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1 Introduction

1.1.1 This chapter of the Environmental Statement (ES) describes the existing environment with regard to marine and intertidal ecology and assesses the potential impacts of Dogger Bank Creyke Beck during the construction, operation and decommissioning phases. Where potential for significant impacts are identified, mitigation measures and residual impacts are presented.

1.1.2 Other chapters within the ES that are closely linked to marine and intertidal ecology are:

- Chapter 8 Designated Sites;
- Chapter 9 Marine Physical Processes;
- Chapter 10 Marine Water and Sediment Quality; and
- Chapter 13 Fish and Shellfish Ecology.

1.1.3 A disposal site characterisation document, to inform the decision making process with regard to proposed marine disposal, is provided at Appendix 12J.

1.1.4 The assessment of impacts on European sites (i.e. those designated under the Habitats Directive (92/43/EEC)) has been informed by a Habitats Regulations Assessment (HRA) process, including an HRA Screening Report and, where necessary, the provision of information to inform an Appropriate Assessment, presented in the HRA Report. All information relating to the on-going HRA process has been submitted and is available alongside this ES.

1.1.5 Throughout this chapter, the discussion in each section is presented in order from the offshore area to the intertidal as follows:

- Tranche A and the Dogger Bank Creyke Beck project areas;
- Export cable corridor (offshore to the nearshore); and
- Intertidal.
2 Guidance and Consultation

2.1 Legislation, policy and guidance

2.1.1 The assessment of potential impacts upon marine and intertidal ecology has been made with specific reference to the relevant National Policy Statements (NPS). These are the principal decision making documents for Nationally Significant Infrastructure Projects (NSIP). Those relevant to Dogger Bank Creyke Beck are:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a); and

2.1.2 The specific assessment requirements for marine and intertidal ecology, as detailed in the NPS, are summarised in Table 2.1, together with an indication of the paragraph numbers of the ES chapter where each is addressed. Where any part of the NPS has not been followed within the assessment an explanation as to why the requirement was not deemed relevant, or has been met in another manner, is provided.

Table 2.1 NPS assessment requirements

<table>
<thead>
<tr>
<th>NPS requirements</th>
<th>NPS reference</th>
<th>ES reference</th>
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<tbody>
<tr>
<td>An assessment of the effects of installing cable across the intertidal zone should include information, where relevant, about:</td>
<td>Section 2.6.81 of NPS EN-3</td>
<td>Chapter 5 Project Description</td>
</tr>
<tr>
<td>- any alternative landfall sites that have been considered by the applicant during the design phase and an explanation for the final choice;</td>
<td></td>
<td>Chapter 9</td>
</tr>
<tr>
<td>- any alternative cable installation methods that have been considered by the applicant during the design phase and an explanation for the final choice;</td>
<td></td>
<td></td>
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<tr>
<td>- potential loss of habitat;</td>
<td></td>
<td></td>
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<tr>
<td>- disturbance during cable installation and removal (decommissioning);</td>
<td></td>
<td></td>
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<tr>
<td>- increased suspended sediment loads in the intertidal zone during installation; and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- predicted rates at which the intertidal zone might recover from temporary effects.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applicants are expected to have regard to guidance issued in respect of Food and Environmental Protection Act (FEPA) [now Marine Licence] requirements.</td>
<td>Section 2.6.83 NPS EN-3</td>
<td>Throughout this chapter</td>
</tr>
<tr>
<td>Where necessary, assessment of the effects on the subtidal environment should include:</td>
<td>Section 2.6.113 of NPS EN-3</td>
<td>Chapter 5</td>
</tr>
<tr>
<td>- loss of habitat due to foundation type including associated seabed preparation, predicted scour, scour protection and altered sedimentary processes;</td>
<td></td>
<td>Chapter 9</td>
</tr>
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### NPS requirements

<table>
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<tr>
<th>NPS requirements</th>
<th>NPS reference</th>
<th>ES reference</th>
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<tr>
<td>• environmental appraisal of inter-array and cable routes and installation methods;</td>
<td></td>
<td></td>
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<tr>
<td>• habitat disturbance from construction vessels’ extendible legs and anchors;</td>
<td></td>
<td></td>
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<tr>
<td>• increased suspended sediment loads during construction; and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• predicted rates at which the subtidal zone might recover from temporary effects.</td>
<td></td>
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</table>

Construction and decommissioning methods should be designed appropriately to minimise effects on subtidal habitats, taking into account other constraints. Mitigation measures which the Infrastructure Planning Commission (IPC) (now the Planning Inspectorate) should expect the applicants to have considered may include:

- surveying and micrositing of the export cable route to avoid adverse effects on sensitive habitat and biogenic reefs;
- burying cables at a sufficient depth, taking into account other constraints, to allow the seabed to recover to its natural state; and
- the use of anti-fouling paint might be minimised on subtidal surfaces, to encourage species colonisation on the structures.

Where cumulative effects on subtidal habitats are predicted as a result of the cumulative effects of multiple cable routes, it may be appropriate for applicants for various schemes to work together to ensure that the number of cables crossing the subtidal zone is minimised and installation/decommissioning phases are coordinated to ensure that disturbance is reasonably minimised.

#### Section 2.6.119 of NPS EN-3

#### Section 2.6.120 of NPS EN-3

Section 10 of this chapter

### 2.1.3 The principal guidance documents used to inform the baseline characterisation and the assessment of impacts are as follows:

- Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Centre for Environment Fisheries and Aquaculture Science (Cefas) May 2012);
- Joint Nature Conservation Committee (JNCC) Marine Monitoring Handbook (Wyn & Brazier 2001);
- Guidance on the Assessment of Effects on the Environmental and Cultural Heritage from Marine Renewable Developments (Marine Management Organisation (MMO) et al. 2010);
- Guidance for the Conduct of Benthic Studies at Marine Aggregate Extraction Sites (Ware and Kenny 2011); and
- Guidelines for ecological impact assessment in Britain and Ireland (Institute of Ecology and Environmental Management (IEEM) 2010).
2.1.4 Due regard has also been given to the biodiversity considerations set out in EN-1 and EN-3, as well as the Marine Policy Statement (MPS).

2.2 Consultation

2.2.1 To inform the ES, Forewind has undertaken a thorough pre-application consultation process, which has included the following key stages:

- Scoping Report submitted to the IPC (October 2010);
- Scoping Opinion received from the IPC (November 2010);
- First stage of statutory consultation (in accordance with sections 42 and 47 of the Planning Act 2008) on Preliminary Environmental Information (PEI) 1 (report published November 2011); and
- Second stage of statutory consultation (in accordance with sections 42, 47 and 48 of the Planning Act 2008) on the draft ES designed to allow for comments before final application to the Planning Inspectorate.

2.2.2 In between the statutory consultation periods, Forewind consulted specific groups of stakeholders on a non-statutory basis to ensure that they had an opportunity to inform and influence the development proposals. Consultation undertaken throughout the pre-application development phase has informed Forewind’s design decision making and the information presented in this document. Further information detailing the consultation process is presented in Chapter 7 Consultation. A Consultation Report is also provided alongside this ES, as part of the overall planning submission.

2.2.3 A summary of the consultation carried out at key stages throughout the project, of particular relevance to marine and intertidal ecology is presented in Table 2.2. This table only includes the key items of consultation that have defined the assessment. A considerable number of comments, issues and concerns raised during consultation have been addressed in meetings with consultees and hence have not resulted in changes to the content of the ES. In these cases, the issue in question has not been captured in Table 2.2. A full explanation of how the consultation process has shaped the ES, as well as tables of all responses received during the statutory consultation periods, is provided in the Consultation Report.
### Table 2.2 Summary of key consultation and issues raised by consultees

<table>
<thead>
<tr>
<th>Date and form of consultation</th>
<th>Consultee</th>
<th>Summary of issue</th>
<th>ES reference</th>
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<tbody>
<tr>
<td>November 2010 (scoping response, statutory)</td>
<td>IPC</td>
<td>With regard to intertidal ecology at the landfall: We welcome the intent to refine the potential landfall area and to consult with the relevant statutory bodies.</td>
<td>Chapter 6 Site Selection and Alternatives Section 4.2</td>
</tr>
<tr>
<td>November 2010 (scoping response, statutory)</td>
<td>IPC</td>
<td>Geophysical and benthic surveys: The terms of reference for these surveys should be agreed with the MMO and the JNCC/Natural England.</td>
<td>This was agreed through consultation prior to undertaking the surveys, as indicated in the records in this table</td>
</tr>
<tr>
<td>November 2010 (scoping response, statutory)</td>
<td>IPC &amp; MMO</td>
<td>The effects of sea bed disturbance should be considered on the following: Increased suspended sediments and smothering; Changes to water quality; Accidental release of contaminants; and Noise and vibration disturbance.</td>
<td>Throughout Chapters 9, 10 Appendix 5A and this chapter</td>
</tr>
<tr>
<td>November 2010 (scoping response, statutory)</td>
<td>JNCC &amp; Natural England</td>
<td>The consultees raised the following issues as requiring investigation: Scour effects; Physical/coastal processes; Loss of habitat; Use of the Humber Regional Environmental Characterisation (REC) project to inform the baseline; Transboundary effects; and Implications for the Habitat Regulations Assessment (HRA) and other designated sites including Dogger Bank considered Special Area of Conservation (cSAC), Berwickshire &amp; North Northumberland Coast SAC and Humber Estuary SAC.</td>
<td>Considered throughout this chapter, the HRA Report and Chapter 9</td>
</tr>
<tr>
<td>November 2010 (scoping response, statutory)</td>
<td>MMO</td>
<td>The consultees raised the following issues as requiring investigation: Scour effects; Conservation issues; and Survey methodologies.</td>
<td>Throughout this chapter</td>
</tr>
<tr>
<td>Date and form of consultation</td>
<td>Consultee</td>
<td>Summary of issue</td>
<td>ES reference</td>
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</tr>
<tr>
<td>12 April 2011 (meeting, non-statutory)</td>
<td>Natural England, JNCC, MMO &amp; Cefas</td>
<td>A meeting was held between the consultees and Forewind to discuss the following: Benthic sampling locations; Acoustic Ground Discrimination System (AGDS) analysis; and Sample planning.</td>
<td>N/A</td>
</tr>
<tr>
<td>13 April 2011 (email, non-statutory)</td>
<td>Natural England</td>
<td>Natural England would like justification of the number of sample locations used to characterise Tranche A and the export cable route, and would like clarification from Forewind to justify the relatively low number of samples taken compared to other offshore wind projects (see below).</td>
<td>Section 3.2</td>
</tr>
<tr>
<td>16 May 2011 (email, non-statutory)</td>
<td>JNCC</td>
<td>Comments made in relation to the benthic survey strategy, specifically that JNCC is satisfied that the benthic array is adequate to identify benthic habitats and communities.</td>
<td>Section 3.2</td>
</tr>
<tr>
<td>6 July 2011 (email, non-statutory)</td>
<td>JNCC</td>
<td>The consultee noted that Forewind should: Be aware that the proposed benthic survey is not suitable for developing a baseline data set for monitoring; Provide details of how it is intended to characterise the most eastern sections of the cable corridor; Provide clarification on the Standard Operating Procedures for the drop down video tows; and Be aware that towed bottom sampling equipment should be avoided in areas of potential sensitive features.</td>
<td>Noted as required</td>
</tr>
<tr>
<td>7 July 2011 (email, non-statutory)</td>
<td>Natural England, JNCC, MMO &amp; Cefas</td>
<td>The consultee would like clarification from Forewind on the lack of samples in the eastern section of the export cable corridor.</td>
<td>See Section 3. Note that the data was initially delayed but has now been provided and is included in the assessment (and was also included in the draft ES).</td>
</tr>
<tr>
<td>12 July 2011 (email, non-statutory)</td>
<td>Cefas</td>
<td>The consultee would like to confirm the approach adopted by Forewind is a good example of how to plan and conduct a characterisation survey and that there are no further comments at this time.</td>
<td>N/A</td>
</tr>
<tr>
<td>14 July 2011 (email, non-statutory)</td>
<td>Natural England</td>
<td>Natural England has no additional comments to those of JNCC on consultation regarding the Forewind benthic campaign on the export cable corridor sampling methodology and final sample sites.</td>
<td>N/A</td>
</tr>
<tr>
<td>Date and form of consultation</td>
<td>Consultee</td>
<td>Summary of issue</td>
<td>ES reference</td>
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<tr>
<td>23 August 2011 (email, non-statutory)</td>
<td>Cefas</td>
<td>Cefas would like to recommend a minimum Hamon grab sample volume in benthic survey in Tranche A.</td>
<td>Noted and incorporated in to survey protocol, see Appendix 12B and 12 C</td>
</tr>
<tr>
<td>9 September 2011 (email, non-statutory)</td>
<td>Natural England</td>
<td>Natural England are aware that the survey is not intended as a baseline survey, however it does not fully address all biotopes at a level which will give a robust data set; Natural England are pleased to see that a landfall site has been chosen which is outside any designated areas; and No reference has been made that any industry guidance has been used and where the methodology has been derived from.</td>
<td>Section 3.2</td>
</tr>
<tr>
<td>7 October 2011 (email, non-statutory)</td>
<td>Natural England</td>
<td>The intertidal survey is adequate to characterise the export cable corridor if proposed changes provided on 9 September 2011 (above) by Natural England are included.</td>
<td>As above</td>
</tr>
<tr>
<td>21 October 2011 (email, non-statutory)</td>
<td>MMO &amp; Cefas</td>
<td>The MMO and Cefas feel that the data used within the intertidal survey methodology is robust and the methodology used in the intertidal survey is satisfactory.</td>
<td>N/A</td>
</tr>
<tr>
<td>21 December 2011 (email, non-statutory)</td>
<td>MMO &amp; Cefas</td>
<td>The MMO feel that the approach to acoustic survey to inform further ground-truthing is fit for purpose. If a more detailed evaluation is needed the MMO and Cefas would request to have sight of the report.</td>
<td>N/A</td>
</tr>
<tr>
<td>10 April 2012 (workshop, non-statutory)</td>
<td>MMO &amp; Cefas</td>
<td>Various comments and feedback were provided in the workshop and clarified in a letter received 19 April 2012, covering the benthic ecology characterisation survey, specifically: Camera procedure; Day grab procedure; and Particle size and contaminant analysis.</td>
<td>Section 3.2</td>
</tr>
<tr>
<td>4 July 2012 (letter, non-statutory)</td>
<td>MMO &amp; Cefas</td>
<td>The MMO and Cefas would like to make Forewind aware that sediment particles &gt;5mm should be retained along with the &gt;1mm particles and not discarded.</td>
<td>Section 3.2 of this chapter</td>
</tr>
<tr>
<td>12 September 2012 (email, non-statutory)</td>
<td>MMO &amp; Cefas</td>
<td>The MMO would like clarifications with regard to benthic ecology in conjunction with Cefas mentioning fairy liquid not being a proven cleaning method and this could lead to skewed contamination levels found during sampling.</td>
<td>Contaminants are covered in Chapter 10</td>
</tr>
<tr>
<td>Date and form of consultation</td>
<td>Consultee</td>
<td>Summary of issue</td>
<td>ES reference</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>June 2013 (section 42 consultation on the draft ES, statutory)</td>
<td>MMO &amp; Cefas</td>
<td>We suggest the use of Oslo/Paris convention (for the Protection of the Marine Environment of the North-East Atlantic) (OSPAR) “Joint Assessment and Monitoring Programme (JAMP) guidelines for monitoring contaminants in sediments” to establish the most suitable equipment.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The MMO notes the ES assessment (negligible) related to colonisation of new hard substrates in operational phase. Justification for this assessment appears to be based on insufficient knowledge on potential long-term effects of colonisation of introduced substrates rather than on tangible evidence that any effects are definitely negligible.</td>
<td>Updated impact assessment in Section 7.6 and updated section on operational phase impact monitoring (Section 7.9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Introduced substrates are colonised by species not naturally present in surrounding sedimentary habitats, and those species persist for decades until after the receptor habitat has been returned to its natural state following decommissioning. As such, the impact of introduced substrate is not negligible for the duration of the development being in operation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Long-term monitoring throughout the period of operation is the only means to provide evidence to ascertain how long-term presence of introduced substrate and its colonisers influences the surrounding sedimentary habitats.</td>
<td></td>
</tr>
<tr>
<td>June 2013 (section 42 consultation on the draft ES, statutory)</td>
<td>MMO &amp; Cefas</td>
<td>Proposed monitoring programme (paragraph 7.9.4 and section 8.5): seems to be based on the FEPA monitoring scheme requiring three years of post-construction monitoring and surveys after decommissioning. Under (deemed) Marine Licences it is possible to carryout monitoring over the lifetime of the project and the MMO advises that monitoring should be conducted at more infrequent, regular intervals throughout the lifetime of the development.</td>
<td>Updated Sections 6.9, 7.9 and 8.5</td>
</tr>
<tr>
<td>June 2013 (section 42 consultation on the draft ES, statutory)</td>
<td>MMO &amp; Cefas</td>
<td>Proposed methodology for sampling the benthos in future monitoring surveys (paragraph 6.8.5): includes three sample replicates for fauna, and an additional fourth sample for Particle Size Analysis (PSA) at each sampling site. Best practice for PSA sample acquisition is to subsample the faunal sample, rather than to take a fourth replicate at the same station (Ware &amp; Kenny, 2011, section A4).</td>
<td>Updated paragraph, see Section 6.10</td>
</tr>
<tr>
<td>June 2013 (section 42 consultation on the draft ES, statutory)</td>
<td>JNCC &amp; Natural England</td>
<td>Further clarification needed on how the biotopes produced in the Emu report (Chapter 12 Appendix D) relate to those in the Envision report (Chapter 12 Appendix G).</td>
<td>Clarification added to “Biotope classification methodology” heading in Section 3</td>
</tr>
<tr>
<td>June 2013</td>
<td>JNCC &amp; Natural</td>
<td>Queries related to definition of receptor sensitivity</td>
<td>Clarification added</td>
</tr>
<tr>
<td>Date and form of consultation</td>
<td>Consultee</td>
<td>Summary of issue</td>
<td>ES reference</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------</td>
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<td>--------------</td>
</tr>
<tr>
<td>(section 42 consultation on the draft ES, statutory)</td>
<td>England</td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 2013 (section 42 consultation on the draft ES, statutory)</td>
<td>JNCC &amp; Natural England</td>
<td>Queries related to definition of magnitude of effect</td>
<td>to “receptor sensitivity” heading in Section 3</td>
</tr>
<tr>
<td>June 2013 (section 42 consultation on the draft ES, statutory)</td>
<td>JNCC &amp; Natural England</td>
<td>Queries re: <em>Mytilus</em> reef habitat in export cable corridor and whether this constitutes Annex I habitat</td>
<td>Clarification added to “magnitude of effect” heading in Section 3 and updated Table 3.4</td>
</tr>
<tr>
<td>June 2013 (section 42 consultation on the draft ES, statutory)</td>
<td>JNCC &amp; Natural England</td>
<td>The direct loss of individuals during the construction phase (via seabed preparation) and the impacts this could have on benthic communities and recovery times has not been considered. JNCC would expect to see this considered further within the ES.</td>
<td>NA – existing impacts do cover this issue – see Section 6.2</td>
</tr>
<tr>
<td>June 2013 (section 42 consultation on the draft ES, statutory)</td>
<td>JNCC &amp; Natural England</td>
<td>Aggregate used for seabed preparation may result in temporary changes in surface sediment characteristics</td>
<td>NA – temporary changes via use of aggregate are not assessed as within a short period of time, there will be permanent habitat loss via foundation installation, which will be the worst case. This is assessed in Section 7.1.</td>
</tr>
<tr>
<td>June 2013 (section 42 consultation on</td>
<td>JNCC &amp; Natural England</td>
<td>Clarification and further detail on use of VERs vs biotopes</td>
<td>Clarification added to “receptor sensitivity” heading</td>
</tr>
<tr>
<td>consultation on</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date and form of consultation</td>
<td>Consultee</td>
<td>Summary of issue</td>
<td>ES reference</td>
</tr>
<tr>
<td>-------------------------------</td>
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</tr>
<tr>
<td>the draft ES, statutory)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 2013 (section 42 consultation on the draft ES, statutory)</td>
<td>JNCC &amp; Natural England</td>
<td>Cumulative effects of introduction of hard substrate into sedimentary environments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>JNCC &amp; Natural England</td>
<td>A detailed assessment of the indirect impacts to designated sites is lacking. A further detailed assessment is needed in order to fully consider the worst case scenario.</td>
<td></td>
</tr>
<tr>
<td>18th and 19th June 2013 (workshops to discuss the section 42 consultation responses, non-statutory)</td>
<td>JNCC, Natural England, MMO and Cefas</td>
<td>As above</td>
<td></td>
</tr>
<tr>
<td>June 2013 (section 42 consultation on the draft ES, statutory)</td>
<td>The Wildlife Trusts</td>
<td>Request to minimise the loss of habitat as much as possible. Limit use of scour protection as much as possible.</td>
<td></td>
</tr>
</tbody>
</table>
3 Methodology

3.1 Study area

3.1.1 The study area encompasses the Dogger Bank Zone, export cable corridor and the landfall site up to Mean High Water Spring (MHWS) (Figure 4.1). Specific survey extents are described in Section 3.2.

3.1.2 The area above MHWS is considered in Chapter 25 Terrestrial Ecology.

3.2 Characterisation of existing environment – methodology

3.2.1 The existing environment has been characterised by means of desk study as well as site specific surveys. These have been carried out in line with the guidance identified in Section 2.1.3.

Desk study

3.2.2 A desk study of available information was undertaken both to inform the initial survey design and to provide regional characterisation information for the assessment. Sources included, but were not limited to:

- Dogger Bank Zonal Characterisation (Forewind 2011);
- Published and unpublished literature;
- Marine Life Information Network (MarLIN);
- The Mapping European Seabed Habitat (MESH) project;
- Dogger Bank SAC Selection Assessment (JNCC 2012); and
- Consultation responses (Section 2).

Site specific surveys

3.2.3 A number of site specific surveys were commissioned to characterise the existing environment for marine and intertidal ecology. The following sections give a brief description of the methodologies used during the surveys; full details are available in the corresponding survey reports (Appendices 12A – 12G). The scope and specification of all surveys were subject to consultation with stakeholders, as previously identified in Table 2.2.

3.2.4 Table 3.1 and Figure 3.1 provide a summary of the surveys and reporting that has been conducted and how the outputs of each have contributed to the assessment process for marine and intertidal ecology.

Table 3.1 Summary of surveys and reporting

<table>
<thead>
<tr>
<th>Date</th>
<th>Survey type / analysis</th>
<th>Contractor</th>
<th>Key outputs</th>
<th>Appendix</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Geophysical survey: side scan sonar, swath bathymetry, AGDS</td>
<td>Geotechnical Engineering and Marine Surveys Ltd. (GEMS)</td>
<td>Geophysical data used to inform design of benthic grab sampling survey and in biotope classification</td>
<td>N/A</td>
</tr>
<tr>
<td>Date</td>
<td>Survey type / analysis</td>
<td>Contractor</td>
<td>Key outputs</td>
<td>Appendix</td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>2010</td>
<td>Physical data processing from geophysical survey</td>
<td>GEMS</td>
<td>Seabed sediment and bathymetry maps</td>
<td>Appendix 12A</td>
</tr>
<tr>
<td>2011 - 2012</td>
<td>Benthic grab sampling campaign, including drop down video (DDV)</td>
<td>Gardline</td>
<td>Sediment particle size (Particle Size Distribution (PSD) analysis) and benthic macrofaunal data</td>
<td>Appendix 12 B and C</td>
</tr>
<tr>
<td>2011</td>
<td>2m epibenthic beam trawl survey</td>
<td>Precision Marine Survey Ltd. (PMSL) / Brown &amp; May Marine</td>
<td>Epibenthic macrofaunal data, producing an epifaunal survey report</td>
<td>Appendix 12E</td>
</tr>
<tr>
<td>2011 - 2012</td>
<td>Benthic grab sample and drop down video analysis</td>
<td>EMU Ltd.</td>
<td>Data for statistical (PRIMER) analysis and benthic community identification, producing a benthic characterisation report</td>
<td>Appendix 12D</td>
</tr>
<tr>
<td>2010</td>
<td>Geophysical data review and statistical (PRIMER) analysis</td>
<td>Envision</td>
<td>Habitat and biotope classification, producing a habitat mapping report</td>
<td>Appendix 12G</td>
</tr>
<tr>
<td>2011</td>
<td>Intertidal walk over survey</td>
<td>Royal HaskoningDHV / PMSL</td>
<td>Habitat identification and species occurrence, producing an intertidal survey report</td>
<td>Appendix 12F</td>
</tr>
</tbody>
</table>

**Geophysical survey**

3.2.5 AGDS, side scan sonar and multibeam bathymetric data were collected across Tranche A and the export cable corridor between August 2010 and January 2011 using two vessels, the *Kommander Jack* and *Aquarius*. Full details of the survey specification and data outputs are presented in the GEMS survey report, Appendix 12A.

**Sublittoral survey**

3.2.6 Using the geophysical data obtained through the GEMS survey, a benthic survey of Tranche A and the export cable corridor was designed to inform the Environmental Impact Assessment (EIA). The design of this survey was undertaken by Envision (Envision 2011a) and used AGDS to produce a sample campaign to ground truth the geophysical surveys. The survey comprised grab sampling and drop down video/stills photography work and was undertaken by Gardline between May 2011 and January 2012. The survey methods and the field report are presented in Appendix 12B and 12C.

3.2.7 The data from the benthic survey was provided to EMU for laboratory processing, data analysis and reporting, with the full results written up and presented in The Dogger Bank Offshore Wind Farm (Tranche A, Cable Route and Nearshore) Benthic Ecology Characterisation Survey Report (EMU 2012) (see Appendix 12D).
3.2.8 Data collated from the survey was also provided to Envision to be used alongside the geophysical data to inform the habitat mapping and biotope classification process (see ‘biotope classification methodology’ below and Appendix 12G).

3.2.9 In addition, an epibenthic beam trawl survey was conducted across Tranche A and the export cable corridor (reported in Appendix 12E). The data from this survey has been used to add further data to and support the characterisation of benthic ecological conditions as reported in EMU 2012 – see below for further details.

Grab sampling

3.2.10 Through interpretation of the geophysical data, 147 sampling sites were selected for sampling (103 in Tranche A and 44 in the export cable corridor) (Figure 3.2). At each site a video recording was made using a drop down camera as a precautionary measure to avoid damage to potential Annex 1 habitats and to provide further visual evidence for biotope and habitat classification.

3.2.11 A modified 0.1m² Mini Hamon grab with a stainless steel bucket was used to obtain benthic sediment samples (147 successful grabs). The samples were sieved using a 1mm sieve and sent to the laboratory for faunal identification to species level and PSD analysis (see ‘particle size distribution analysis’ below).

3.2.12 A separate set of sediment samples was gathered for chemical analysis for sediment quality purposes (27 successful grabs from Tranche A and the export cable corridor). This was done using a modified, stainless steel 0.1m² Day grab. Further details on sediment quality are provided in Chapter 10.

Particle size distribution analysis

3.2.13 PSD analysis was undertaken at EMU’s United Kingdom Accreditation Service (UKAS) accredited sediment laboratory using in-house methods based on dry sieving and laser diffraction. The latter method was used when the fine fraction of sediment (<63μm) comprised >5% of the total sample by weight.

3.2.14 Representative sub samples of each sediment sample were oven dried to constant weight at 105 ±5°C before routinely wet sieving to remove silt and clay sized particles of <63μm (unless there was no sample cohesion after drying, where dry sieve analysis only was undertaken). The remaining coarser material was again oven dried to constant weight at 105 ±5°C, followed by dry sieving through a series of mesh apertures corresponding to 0.5 phi units, as described by the Wentworth scale. The weight of the sediment fraction retained on each mesh was subsequently measured and recorded, and merged with the laser diffraction data where appropriate.

Drop down camera

3.2.15 Pictures were taken of the seabed within Tranche A (103 stations) and along the export cable corridor (109 stations) (Figure 3.2) using a drop down camera with a fresh water lens. These pictures were used to assist in faunal identification and sediment type classification and can be found in Appendix 12D (representative images in Section 3.1 and additional images in the appendices). The images that best represented the habitat and community conditions at a station were scored for species abundance to inform an assessment of epibenthic communities.
Epibenthic beam trawl

3.2.16 An epibenthic beam trawl survey was undertaken to establish the abundance and composition of epifaunal communities (including demersal fish, which is reported in Chapter 13). The surveys were undertaken using a 2m beam trawl with a headline height of 55cm and 5mm cod end mesh. The trawls were performed over a distance of around 500m each. A total of 62 trawls were performed (45 in and around Tranche A and 17 in the export cable corridor), in October and November 2011 by PMSL (Figure 3.3).

Statistical analysis

3.2.17 The PRIMER v6 (Plymouth Routines in Multivariate Ecological Research) suite of programs (Clarke and Gorley 2006; Clarke and Warwick 2001) was used to analyse the data obtained from the grab surveys described above to help characterise the benthic communities and habitats within the main site and export cable corridor (Appendices 12D and 12G). The raw data from the grab survey was also reassessed with PRIMER v6 by Envision, alongside review of DDV and stills images and geophysical data, to inform the biotope and habitat classification work as described below ('biotope classification methodology').

Intertidal survey

3.2.18 An intertidal walkover survey was undertaken by Royal HaskoningDHV and PMSL to characterise the communities present at the site and to identify any species or habitats of national or international conservation importance for the purpose of the EIA.

3.2.19 The survey methodology used was based on guidance in the JNCC Marine Monitoring Handbook (Wyn & Brazier 2001) after consultation with the MMO, Cefas and Natural England.

3.2.20 The survey was conducted at Ulrome and Barmston beach on the 13th and 14th September 2011. At the time of the survey, the exact landfall location had not been determined. Ulrome has since been selected as the preferred site and therefore only the results relevant to the Ulrome site have been taken forward in this chapter.

3.2.21 The study area encompassed a 1km wide corridor in which five sample transects were laid out at 200m spacing (Figure 3.4). Each transect was sampled, using quadrats, at the lower shore (visited at low water during spring tide), the mid shore and at the upper shore. At all of the sampling locations, two spade loads (approximately 0.02m³) of sediment were taken up to a depth of 20cm before sieving through a 2mm mesh sieve. Three replicate samples were collected. At each site the following were recorded:

- Sediment type;
- Surface features; and
- Species found.

3.2.22 Photographs (Appendix 12F) were taken of each quadrat and the shore profile sketched at each transect identifying substrate type, sampling stations and the additional points of interest mentioned above (Appendix 12F). Figure 3.5 provides an example of a quadrat taken from Appendix 12F.
Figure 3.2 Benthic sampling stations

Data Source:
- Dogger Bank Zone
- Tranche boundary
- Dogger Bank Creyke Beck A
- Dogger Bank Creyke Beck B
- Export cable corridor
- Temporary works area

LEGEND
- Chemical sample site
- Grab sample site
- Video sample site

**DRAWING TITLE**
DOGGER BANK CREYKE BECK

**DRAWING NUMBER**
F-OFc-MA-217

**VER DATE**
1 23/10/2012 Initial
2 16/01/2013 Draft GC LC
3 11/03/2013 Field GC LC
4 15/07/2013 Final ES FK LC

**SOURCE**
1:700,000

**COORDINATE SYSTEM**
WGS84

**REMARKS**
Export cable corridor, Dogger Bank Creyke Beck B, Tranche boundary, Chemical sample site, Grab sample site, Video sample site.
Figure 3.3 Epibenthic beam trawl sampling sites

Data Source:
Epifaunal Sites © PMSL, 2012,
Round 3 offshore wind farm boundary © Crown Copyright, 2013
Background bathymetry image derived in part from TCarta data © 2009

LEGEND
- Dogger Bank Zone
- Tranche boundary
- Dogger Bank Creyke Beck A
- Dogger Bank Creyke Beck B
- Export cable corridor
- Temporary works area
- Epifaunal sampling site
  - Export route inshore
  - Export route offshore
  - Inside Tranche A
  - Outside Tranche A

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Figure 3.4 Intertidal survey study area

Export cable corridor

Target note

• LR. HLR.MuB
• LR. FLR. Eph.BliX
• LR. MLR.BF
• LS.LSa. MoSa.Ol
• LS.LRa. MuB
• LS.LSa. MoSa.Ol
• LS.LCS
• LS.LSa.BarSa

Data Source: Ordnance Survey data © Crown copyright, All rights reserved, 2010. Licence number 0100031673

OSGB BNG A3
1:5,000

DRAWING TITLE
DOGGER BANK CREYKE BECK

F-OFC-MA-216

VER DATE REMARKS
1 29/01/2013 Draft LW RZ
2 21/02/2013 PEI3 LW RZ
3 15/07/2013 Final ES FK RZ
3.2.23 Further sample analysis was carried out in the laboratory including:

- Species identification (where this could not be achieved in the field the individuals (less than 10) were taken back to the laboratory for identification under a microscope); and

- Chemical analysis for metals, organotins, polyaromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) (see Chapter 10).

3.2.24 The intertidal environment has been classified into biotopes, based on the composition of the samples. The method for the biotope classification is provided below.

**Biotope classification methodology**

3.2.25 Biotope classification for Tranche A and the export cable corridor was undertaken by Envision following detailed habitat mapping work (Appendix 12G). Whilst there was some biotope classification work undertaken by EMU as part of the initial benthic characterisation study, these biotope classifications were not used to inform this assessment.

3.2.26 The over-arching objective of the habitat mapping work (and eventual biotope classification) was to derive a set of habitat classes that could be used for ground truthing acoustic data from Tranche A and the export cable corridor acquired via the project-specific geophysical surveys. This approach was somewhat different from other statistical analyses of sample data where the objectives of alternative analyses may be to describe and measure diversity and the range of variation amongst a dataset. In contrast, for this study the emphasis in the analysis was to derive a small set of classes that described the range of more broadly defined habitats and the commonality between them.
3.2.27 The grab sample datasets for Tranche A and the Creyke Beck project areas were typical of the southern North Sea in that the majority of samples have relatively few individuals and many of the most abundant species are also the most frequently found amongst the samples. Thus, a large overlap between the ground truth samples was expected and this also held true for the mapping units.

3.2.28 The habitat classes identified via the initial analysis also needed to be based on the general form and function of the community with an emphasis on those elements that were most likely to have a direct relevance to the reflectance properties of the sea bed, i.e., the epifaunal and the larger particle sizes of the sediment (gravel and cobble). Therefore, the infaunal analysis was followed by the incorporation of epifaunal data to create a single ground truth dataset for Tranche A and the Creyke Beck export cable corridor.

3.2.29 The sample data (grab samples, video/stills, bathymetry data and PSA) and their positions were collated from a variety of input formats provided into a master Excel spread sheet (note that the sampling area for the hamon grab was 0.1m$^2$ and, therefore, this does not fully represent the habitat scale relevant to the interpretation of acoustic data (metres). The still images compensate for this as they provide qualitative information at the habitat scale. However, the visual information is only reliable for identifying coarse sediment (gravel, cobble and boulders) and conspicuous epifaunal species).

3.2.30 For the most part, the video records were coincident with grab sample data. However, grab data were not collected for all sample locations and this meant that assigning faunal classes to many of the sample stations was not possible and were left out of the ground truth selection. This was a particular issue with sections of the export cable corridor, which left a large gap in the ground truth dataset close to the junction with Tranche A, and where the sidescan images indicated a patchy distribution of different ground types. In this case, five extra ground truth points were added based on the video data alone to cover the gap in the data.

3.2.31 The primary tool for the statistical analysis of the infaunal data was the PRIMER software package. The CLUSTER/SIMPROF routine was used to identify objectively defined classes at the 5% significance level. This analysis resulted in more groups than was desirable for interpretation and the average species abundances for the groups were returned for a second pass through the CLUSTER/SIMPROF procedure, resulting in many of the groups being joined because of their similarity. This reduced number of broader classes was taken forward to the next stage of inclusion of video/stills information.

3.2.32 The final classes were based on the outputs from the quantitative analysis of the infaunal samples unless there was a significant component of gravel, pebble and boulder, in which case the epifaunal community took precedence. The samples classified by infauna alone had sediments ranging from sand to fine sand whilst those based on epifauna were composed of mixtures of gravel and sand or boulders, cobble and sand.

3.2.33 Finally, the habitat class descriptions were matched to the Marine Habitats Classification using the published biological comparative tables (Connor et al. 2004 v4.05) and the biotope descriptions. It was considered that the locally relevant statistical habitat classes identified by Envision best described the areas of interest.
across the study area. This approach was in line with the science-led strategy adopted by Cefas for characterisation (e.g. the East Coast Regional Ecological Characterisation project (Limpenny et al. 2011)).

3.2.34 The methodology for assigning biotopes in the intertidal was based on Procedural Guideline No. 3-1 “In situ intertidal biotope recording” from the JNCC Marine Monitoring Handbook (Wyn & Brazier 2001). Data from photographs and sediment samples were all used to assign key biotopes, with the biotope code allocations also based on the current UK Marine Classification System v4.05 (Connor et al. 2004).

3.3 Assessment of impacts – methodology

3.3.1 The assessment of impacts includes: (a) the definition of the sensitivity of any receptor; (b) the definition of the magnitude of effect; and (c) the interaction between these two parameters to inform the overall level of impact (see Chapter 4 EIA Process).

3.3.2 Underpinning the approach to the marine and intertidal ecology impact assessment is the concept of Valued Ecological Receptors (VERs). The concept of assigning value to marine ecological receptors is set out within “Guidelines for Ecological Impact Assessment in Britain and Ireland – Marine and Coastal” (IEEM 2010).

Valued Ecological Receptors (VERs)

3.3.3 The value of ecological features is dependent upon their biodiversity, social and economic value within a geographic framework of appropriate reference (IEEM 2010). The most straightforward context for assessing ecological value is to identify those habitats and species that have a specific biodiversity value recognised through international or national legislation or through local, regional or national conservation plans (e.g. Annex I habitats under the Habitats Directive, Biodiversity Action Plans (BAPs), existing and recommended Marine Conservation Zones (MCZs and rMCZs, respectively)).

3.3.4 However, only a very small proportion of marine habitats and species fall within the legislative or policy framework and, therefore, evaluation must also assess value according to the functional role of the habitat or species. For example, some features may not be protected under conservation legislation in their own right, but may be functionally linked to a feature of high conservation value.

3.3.5 In the marine environment, the assessment of status / conservation value within a geographic framework is more difficult, particularly at the local scale. The best available method identified is that of professional judgement and consensus through peer review. For this assessment, ‘County’ and ‘District’ levels have been combined into a single ‘Local’ category. Table 3.2 shows the criteria applied to determining the ecological value of VERs within the geographic frame of reference applicable to the Dogger Bank Creyke Beck study area.
Table 3.2  Geographic frame of reference applied to valuing ecological receptors in the Dogger Bank study area

<table>
<thead>
<tr>
<th>Value of VER</th>
<th>Criteria to define VER</th>
</tr>
</thead>
<tbody>
<tr>
<td>International</td>
<td>Internationally designated sites. Habits (and species) protected under international law (i.e. Annex I habitats within an SAC boundary).</td>
</tr>
<tr>
<td>National</td>
<td>Nationally designated sites. Habits protected under national law. Annex I habitats not within an SAC boundary. UK Biodiversity Action Plan (UK BAP) priority habitats and species and Nationally Important Marine Species that have nationally important populations within study area, particularly in the context of species/habitat that may be rare or threatened in the UK.</td>
</tr>
<tr>
<td>Regional</td>
<td>UK BAP priority habitats or Nationally Important Marine Species that have regionally important populations within the study area i.e. are locally widespread and/or abundant. Habitats and species that are listed as conservation priorities in regional plans. Habitats or species that provide important prey items for other species of conservation or commercial value.</td>
</tr>
<tr>
<td>Local</td>
<td>Habitats and species which are not protected under conservation legislation but which form a key component of the benthic ecology within the study area and which may also be a functional component of a feature of conservation value (e.g. BAP priority habitat).</td>
</tr>
</tbody>
</table>

Receptor sensitivity

3.3.6  As outlined above, the key receptors defined for benthic ecology are the VERs, which are comprised of groups of similar biotopes. The criteria used to classify the sensitivity of the VERs (Table 3.3) are based on a combination of the actual ecological sensitivity of the biotopes within the VER (based on sensitivity assessments produced by MarLIN guidelines (MarLIN 2012)) and the importance/value of the VER. MarLIN classifies biotopes on a six-point scale of sensitivity (ranging from very high to not sensitive). The sensitivity of a biotope is assessed through the intolerance and recoverability of the species/community/habitat combination which make up the overall biotope.

3.3.7  The underlying rationale for adopting VERs as the receptor against which any subsequent effect has been assessed, as opposed to just biotopes, is that the VER approach enables different “values” (see Table 3.2) to be assigned to the same biotope, dependent on the status of this biotope, i.e. within or outside the boundary of a designated site.

3.3.8  By way of example, the SS.SSs.IFsSa.NcirBat biotope was recorded throughout the Dogger Bank Creyke Beck study area, both within the main site (i.e. within the Dogger Bank cSAC site boundary) and within the export cable corridor (outside the Dogger Bank cSAC site boundary). Without use of the VER approach, the sensitivity of this biotope (in EIA terms) to any effects would be based solely on ecological sensitivity (as defined by MarLIN). Therefore, the same overall sensitivity (in EIA terms, not ecological terms) to a specific effect would be applied to this biotope irrespective of whether the effect was occurring within or outside the cSAC boundary.

3.3.9  However, to reflect the increased value/importance of this biotope due to its location within the Dogger Bank cSAC, compared to the same biotope outside the cSAC boundary, it has been given a greater (EIA) sensitivity rating, even though the ecological sensitivity of this biotope to any given effect will be the same.
3.3.10 Importantly and as part of the worst case approach to the assessment, where biotopes within a single VER have slightly different sensitivities to certain effects (or ‘factors’, as defined by MarLIN), the most sensitive biotope to the effect being assessed has always been used as the receptor for assessment. **Appendix 12H** summarises the sensitivities of all the relevant biotopes within each VER to the range of effects/factors predicted to arise during the construction, operation and decommissioning phases of the project.

**Table 3.3** Marine and intertidal ecology criteria for classifying the sensitivity of the receptor to the effect

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Very High</strong></td>
<td>• Nationally and internationally important receptors with high vulnerability and no or limited ability for recovery.</td>
</tr>
</tbody>
</table>
| **High** | • Regionally important receptors with high vulnerability and no or limited ability for recovery.  
• Nationally and internationally important receptors with high vulnerability and low recoverability. |
| **Medium** | • Locally important receptors with high vulnerability and no ability for recovery.  
• Regionally important receptors with medium to high vulnerability and low recoverability.  
• Nationally and internationally important receptors with medium vulnerability and medium recoverability. |
| **Low** | • Locally important receptors with medium to high vulnerability and low recoverability.  
• Regionally important receptors with low vulnerability and medium to high recoverability.  
• Nationally and internationally important receptors with low vulnerability and high recoverability. |
| **Negligible** | • Receptor is not vulnerable to impacts regardless of value/importance.  
• Locally important receptors with low vulnerability and medium to high recoverability. |

**Magnitude of effect**

3.3.11 The magnitude of effect has been considered in terms of the spatial extent, duration and timing (seasonality and / or frequency of occurrence) of the effect in question. Expert judgment was used to consider and evaluate the likely effect on the species, population or habitat identified as a VER. The magnitude of effect was subsequently identified from a four point scale as presented in **Table 3.4**.
Table 3.4  Marine and intertidal ecology criteria for classifying the magnitude of effect

<table>
<thead>
<tr>
<th>Magnitude of effect</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>- Effects occur over large spatial extent (&gt;10% of the wider study area)</td>
</tr>
<tr>
<td></td>
<td>- Effects occur over long term (&gt;2 years)</td>
</tr>
<tr>
<td></td>
<td>- Effects occur continually over long-term</td>
</tr>
<tr>
<td></td>
<td>- Baseline conditions are significantly altered (defined here as change in several pre-existing biotope types due to effect in question)</td>
</tr>
<tr>
<td>Medium</td>
<td>- Effects occur over medium spatial extent (5-10% of wider study area)</td>
</tr>
<tr>
<td></td>
<td>- Effects occur over medium term (1-2 years)</td>
</tr>
<tr>
<td></td>
<td>- Effects occur frequently over medium term</td>
</tr>
<tr>
<td></td>
<td>- Baseline conditions are altered (defined here as change in at least one pre-existing biotope due to effect in question)</td>
</tr>
<tr>
<td>Low</td>
<td>- Effects occur over small spatial extent (1-5% of wider study area)</td>
</tr>
<tr>
<td></td>
<td>- Effects occur over short term (&lt; 1 year)</td>
</tr>
<tr>
<td></td>
<td>- Effects occur intermittently over short-term</td>
</tr>
<tr>
<td></td>
<td>- Baseline conditions show slight change (overall biotope distribution remains as per baseline)</td>
</tr>
<tr>
<td>Negligible</td>
<td>- Effects occur over limited spatial extent (&lt;1% of wider study area)</td>
</tr>
<tr>
<td></td>
<td>- Effects occur over very short term (days)</td>
</tr>
<tr>
<td></td>
<td>- Effects occur infrequently / single event</td>
</tr>
<tr>
<td></td>
<td>- No change in baseline conditions</td>
</tr>
</tbody>
</table>

Overall impact

3.3.12 The overall impact is based on the interaction between the magnitude of the effect and the sensitivity of the receptor, and expert judgement (see Chapter 4). Table 3.5 presents the matrix used to derive the overall impacts on marine and intertidal ecology receptors. In this case, the sensitivity of the receptor is also linked to the value of the VER as defined in Table 3.2.

Table 3.5  Overall impact matrix using magnitude and sensitivity in combination

<table>
<thead>
<tr>
<th>Sensitivity of receptor</th>
<th>Magnitude of effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>High</td>
<td>Major</td>
</tr>
<tr>
<td>Very High</td>
<td>Major</td>
</tr>
<tr>
<td>High</td>
<td>Moderate or Major*</td>
</tr>
<tr>
<td>Medium</td>
<td>Moderate or Major*</td>
</tr>
<tr>
<td>Low</td>
<td>Minor or Moderate*</td>
</tr>
<tr>
<td>Negligible</td>
<td>Minor</td>
</tr>
</tbody>
</table>

* In these instances the impact was determined by the professional judgement of the author, applying a precautionary approach

3.3.13 Potential impacts identified within the assessment as major or moderate can be regarded as significant in terms of the EIA regulations. In these cases, appropriate mitigation has been identified, where possible, in consultation with the regulatory authorities and relevant stakeholders. The aim of mitigation measures is to avoid, reduce or offset the overall impact to determine a residual impact upon a given receptor.
3.3.14 Where relevant, mitigation measures that are incorporated as part of the project
design process and/or can be considered to be industry standard practice (referred to
as 'embedded mitigation') are considered throughout the chapter and are reflected in
the outcome of the impact assessment.
4 Existing Environment

4.1 Tranche A and the export cable corridor

Regional context

Physical environment

4.1.1 The majority of Tranche A is within a depth range of 20m to 30m relative to lowest astronomical tide (LAT), but includes a small number of banks with localised depths of less than 20m and one relatively small area in the southern corner with a localised depth of 30m to 40m.

4.1.2 Water depths in the export cable corridor reach a maximum of 98m, in the northwest sector. Approximately 10km from the coastline, the bathymetry begins to shallow from approximately 50m deep to the foreshore (EMU 2010).

4.1.3 Tidal ranges are interpreted to be between 1 and 2m across the Dogger Bank Zone, with those to the west (towards Tranche A) higher than those in the east. Tidal stream speed maxima for the eastern area of the Dogger Bank Zone are between 0.2 and 0.6m/s. Higher speeds are present in the west, associated with the flow of water around the western edge of the Dogger Bank (EMU 2010), as indicated by the presence of active sand bodies in the Sand Hills on Dogger Bank. Admiralty charts indicate that tidal stream speed maxima for the Dogger Bank Zone are between 0.2 and 0.6m/s.

4.1.4 Bed forms around Dogger Bank are limited, with sediments ranging from gravels to mixtures of sands and gravels to clayey sands (Gardline 2011).

Biological environment

4.1.5 The Dogger Bank Zone lies within the southern North Sea and contains a variety of benthic community types associated with the strongly thermally mixed waters present all year round (EMU 2010).

4.1.6 The MESH project is developing seabed habitat maps for northwest Europe. The offshore area of Tranche A has broadly been characterised as ‘Infralittoral fine sand’ or ‘Infralittoral muddy sand’, although the European Nature Information System (EUNIS) classification of ‘Infralittoral coarse sediment’ also occurs. Further studies that have broadly characterised the North Sea benthos and the associated habitats include:

- Glémarec (1973);
- Kröncke and Reiss (2007); and
- Rees et al. (2007).

4.1.7 The dominant biotope associated with the Dogger Bank is SS.SSa.IFiSa.NcirBat (Nephtys cirrosa and Bathyporeia spp. in infralittoral sand) (EMU 2010) which appears to be found across the majority of the Dogger Bank Zone, this may also include areas comprising more mixed sediment types based on habitat maps published in Diesing et al. (2009) as well as the EUNIS map.
4.1.8 These community types correspond well with the ‘Bank’ community described by Wieking and Krönke (2001) which occupies the flat shallow seabed areas on top of the Dogger Bank and overlaps central and southern areas (e.g. the area of Tranche A) of the Dogger Bank Zone (EMU 2010).

4.1.9 The habitats found on the Dogger Bank are among the most common habitats found below Mean Low Water Spring (MLWS) around the coast of the United Kingdom and correspond with the UK BAP habitat “subtidal sands and gravel” (UK BAP - see Maddock 2008). This habitat occurs in a range of environmental conditions, and the mix of sand or gravel, and any bedforms present on the surface of the seabed, depends on factors such as tidal and wave strengths. The Annex I habitat ‘Sandbanks which are slightly covered by sea water all the time’, designated under the cSAC of Dogger Bank (site code UK0030352), corresponds with this UK BAP habitat (see Section 4.4).

4.1.10 The Dogger Bank candidate SAC (cSAC) boundary (Figure 4.1) covers the majority of the Dogger Bank Zone, where the primary habitat interest feature of conservation importance is “sandbanks that are slightly covered by sea water all the time” (Connor et al. 2004). Other conservation areas that are located near the Dogger Bank cSAC include a Dutch Site of Community Interest (SCI) and a German SCI. The landfall is also located near the Flamborough Head SAC, with the Humber Estuary SAC further to the south (Figure 4.1).

**Sediment composition**

4.1.11 The sediment samples taken from Tranche A and the export cable corridor by the grab were subjected to PSD analysis, to identify the principal sediment components. The sediments across the site were dominated by sand. The proportions of the principal sediment components, expressed as percentages of all samples, was as follows:

- Sand 90% (mainly fine sands);
- Gravel < 10%; and
- Mud < 2.5%.

4.1.12 Full results of the particle size distribution analyses are presented in Appendix 12D.

4.1.13 Figure 4.2 illustrates the distribution of these three principal sediment components across Tranche A and the export cable corridor, based on the data collected via grab sampling. The predominantly sandy nature of the majority of sites across the study area is evident. One high mud content site was located centrally in Tranche A, while the export cable corridor can be seen to comprise of relatively uniform sandy sediments over most of its length, with some mixing with gravels and muds noted at either end.

4.1.14 Figure 4.3 presents an additional overview of sediment types across the study area. The sediment types illustrated in Figure 4.3 are based on evidence from stills photography collected as part of the DDV survey campaign. This is distinct from the analysis of PSD, collected by grab, on which Figure 4.2 is based. However, both interpretations of sediment distribution demonstrate the range of sediment data used to inform the assessment, and clarify the point that in terms of the biotope classification process (see Sections 3.2.24 – 3.2.28), it was sediment data from the
stills photography, coupled with biological data from the grabs and geophysical data that was used to inform the process.

**Contaminants**

4.1.15 Sediment samples for contaminant analysis were collected from 12 export cable corridor sites and 15 sites within Tranche A itself. Contaminant concentrations were compared, where available; with both Cefas (2003) Action levels and OSPAR Effects Range Low (ERL) and Effects Range Medium (ERM) levels. At all sampling stations the PAH levels were below the available assessment criteria. An indication of the number of sites found to exceed guidance levels (metals) can be found in Table 4.1. The contaminant levels and results are discussed in full in Chapter 10.

4.1.16 An assessment of the potential for sediment disturbance during the construction phase (via cable installation and seabed preparation) to impact on benthic receptors is provided in Section 6. Although sediments may continue to be mobilised in the operational phase (via scour), no assessment of potential sediment contaminant mobilisation in this phase is presented as no impacts are predicted. This conclusion is based on the assumption that any sediment contaminants that are present within the project area would have been mobilised via construction activities.

**Table 4.1** Sediment metal concentrations: number of sites in exceedence of the assessment criteria

<table>
<thead>
<tr>
<th>Metal</th>
<th>Cefas Action Levels (AL)</th>
<th>OSPAR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AL 1</td>
<td>AL 2</td>
</tr>
<tr>
<td>Arsenic</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Cadmium</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Chromium</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Nickel</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Numbers indicate the amount of sites that were in exceedance of the limits.

**Plankton**

4.1.17 Phytoplankton production on the Dogger Bank occurs throughout the year supporting a high biomass of species at higher trophic levels year-round, creating a region that is biologically unique in the North Sea (Kröncke & Knust 1995). Studies carried out during the winter 1987 – 88 (Richardson *et al.* unpublished data, cited in Nielsen *et al.* 1993) concluded that, because of the shallow depth of Dogger Bank, primary production is high throughout the winter. Richardson *et al.* (unpublished data, cited in Nielsen *et al.* 1993) have shown that primary production during the winter in the Dogger Bank region is higher than for all other regions of the North Sea. The shallowness of the area also causes the spring phytoplankton bloom to be initiated months before thermal stratification triggers the spring bloom in the northern North Sea. In the context of this environmental assessment this is important because the phytoplankton form the base of the food chain of the Dogger Bank. Blooming early provides a food source for organisms in an area which otherwise would be barren, therefore the Dogger Bank can support larger numbers of organisms year round than other areas in a similar location but with deeper waters.
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Figure 4.2 Distribution of the principal sediment components in the study area

Data Source:
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Background bathymetry image derived in part from TCarta data © 2009

LEGEND
- Dogger Bank Zone
- Tranche boundary
- Dogger Bank Creyke Beck A
- Dogger Bank Creyke Beck B
- Export cable corridor
- Temporary works area

Main sediment fractions (%)
- Gravel
- Sand
- Mud

PROJECT TITLE
DOGGER BANK CREYKE BECK

DRAWING TITLE
Figure 4.2 Distribution of the principal sediment components in the study area

VER | DATE  | REMARKS | Drawn | Checked
--- | ------ | ------- | ----- | -------
1  | 29/01/2013 | DVR | UV | RZ
2  | 17/02/2013 | RZ | UV | RZ
3  | 15/07/2013 | Final ES | FK | RZ

DRAWING NUMBER:
F-OFC-MA-219

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LEGEND
- Dogger Bank Zone
- Tranche boundary
- Dogger Bank Creyke Beck A
- Dogger Bank Creyke Beck B
- Export cable corridor
- Temporary works area

Main sediment fractions (%)
- Gravel
- Sand
- Mud

PROJECT TITLE
DOGGER BANK CREYKE BECK

DRAWING TITLE
Figure 4.2 Distribution of the principal sediment components in the study area

VER | DATE  | REMARKS | Drawn | Checked
--- | ------ | ------- | ----- | -------
1  | 29/01/2013 | DVR | UV | RZ
2  | 17/02/2013 | RZ | UV | RZ
3  | 15/07/2013 | Final ES | FK | RZ

DRAWING NUMBER:
F-OFC-MA-219

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Figure 4.3 Distribution of seabed sediment types across Tranche A and the export cable corridor (interpretation by Envision, based on stills photography and sidescan).

Data Source:
Benthic sample locations from Envision survey (2012)
Round 3 offshore wind farm boundary © Crown Copyright, 2013, Background bathymetry image derived in part from TCarta data © 2009.
Figure 4.4 Distribution of total numbers of species/taxa per 0.1 m²

Data Source:
Figure 4.5  Distribution of total numbers of individuals per 0.1 m²

Data Source:
Round 3 offshore wind farm boundary © Crown Copyright, 2013,
Background bathymetry image derived in part from TCarta data © 2009

LEGEND

- Dogger Bank Zone
- Tranche boundary
- Dogger Bank Creyke Beck A
- Dogger Bank Creyke Beck B
- Export cable corridor
- Temporary works area

Total numbers of individuals per 0.1 m²

- 0.00
- 0.01 - 50.00
- 50.01 - 100.00
- 100.01 - 200.00
- 200.01 - 1000.00
- 1000.01 - 1200.00

Drawn 29/01/2013  DGR  UW  FM
2 21/02/2013  PK  UW  RZ
3 15/07/2013  Final ES  FK  RZ
Macrofaunal grab data (univariate data analysis)

4.1.18 Following data rationalisation (i.e. removal of algae, meiofauna, pelagic organisms and reconciliation of the same species recorded at different taxonomic levels), a total of 588 taxa were recorded from the grab samples.

4.1.19 Using the reconciled data (all fauna) the numbers of species / taxa per sample ranged between four and 107 per 0.1m², with an average value of 32 species per 0.1m². Abundances ranged between seven and 1,226 individuals per 0.1m² with an average of 130 individuals. The distribution of species number and abundance is presented in Figures 4.4 and 4.5 respectively.

4.1.20 Figure 4.5 takes into account that colonial epifauna were only registered as present or absent, i.e. with a maximum abundance of one. Maximum abundances of macrofauna were found in Tranche A, with 11 sites supporting more than 200 individuals per 0.1m² and in the inshore export cable corridor where 13 sites supported more than 200 individuals per 0.1m².

4.1.21 In percentage terms the most frequently occurring species represented a variety of taxa (Figure 4.6), with the polychaete *Spiophanes bombyx*, found in 68% of sites. Mean densities in most cases were also low, with many of the most frequently occurring species found at densities below 0.02 individuals per 0.1m². The juvenile Spatangoida were found at the highest mean abundance with 6.5 individuals per 0.1m². Of the most frequently found species, only one colonial epifaunal species was identified, from the Campanulinida.

4.1.22 Many of the species found at individually large abundances were not recorded frequently. Only three of the 20 most frequently occurring species supported high individual abundances. These data provide further evidence of a number of discrete habitat (and community) types across Tranche A and the export cable corridor.

4.1.23 Contribution to biomass by taxa is illustrated in Figure 4.7 and the distribution of total biomass is presented in Figure 4.8. Levels were generally low across the study area with the majority of the sites, particularly those in the export cable corridor, supporting 4mg or less ash free dry weight (AFDW)/0.1m². The majority of the high biomass sites were located in several well defined areas of Tranche A, particularly to the west of the area, and a group of high biomass levels located in a line from the south east corner to the northern edge. Maximum biomass levels in excess of 10mg (AFDW)/0.1m² per site were noted in these areas. Complete biomass analysis results are presented in Appendix 12D.
Figure 4.6  Individual taxa makeup

% of individual taxa

- Echinodermata: 32.1%
- Annelida: 10.5%
- Mollusca: 22.1%
- Crustacea: 20.8%
- Other: 5.3%
- Bryozoa: 4.9%
- Cnidaria: 4.3%

Figure 4.7  Summary of main contributors to biomass per taxon

% Biomass per taxon

- Echinodermata: 54%
- Annelida: 22%
- Mollusca: 19%
- Crustacea: 1%
- Other: 4%
Figure 4.8  Distribution of macrofaunal biomass g/0.1 m²

- Dogger Bank Zone
- Tranche boundary
- Dogger Bank Creyke Beck A
- Dogger Bank Creyke Beck B
- Export cable corridor
- Temporary works area

Total biomass AFDW/g/ 0.1 m²

0.00
0.01 - 2.00
2.01 - 4.00
4.01 - 6.00
6.01 - 8.00
8.01 - 10.00
10.01 - 20.00

Data Source:
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DOGGER BANK CREYKE BECK

DRAWING NUMBER:
F-OFC-MA-223

VER DATE REMARKS
1 29/01/2013 DVR
2 21/02/2013 PEI3 LW RZ
3 15/07/2013 Final ES FK RZ

DRAWING TITLE

Figure 4.8  Distribution of macrofaunal biomass g/0.1 m²

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Macroinfauna (multivariate data analysis)

4.1.24 PRIMER analysis on the benthic data set identified a series of discrete clusters. The different clusters are summarised below:

- **Cluster (a)** – Very high diversity and high abundance community, dominated by mixture of polychaetes including encrusting species such as *Pomatoceros* spp. and the reef building species *Sabellaria spinulosa*. Sediments suggest mixture of gravels, sands and silt;

- **Cluster (b)** – Transitional sand based community with components of both clusters (d) and (g) most typically represented by the robust, disturbance tolerant polychaete *Ophelia borealis*;

- **Cluster (c)** – High diversity, high abundance, dominated by robust and coarse sand dwelling polychaetes, with increased diversity due to mixture of gravels and silts;

- **Cluster (d)** – Moderate diversity, high abundance, dominated by a characteristic group of coarse sediment tolerant polychaeta and echinoderms, with the additional and notable presence of the lancelet *Branchiostoma lanceolatum*;

- **Cluster (e)** – Very low diversity, low abundance, sand based polychaete and crustacean dominated community. Fauna typical of mobile sands in relatively shallow waters;

- **Cluster (g)** – Deep water sandy sediments with small percentage of fine sediment. Moderately high species number and generally moderate abundance. Typified by burying echinoderms (*Amphiura filiformis* and heart urchins), as well as a diverse range of sand dwelling phoronids, polychaetes, crustacea and bivalve molluscs;

- **Cluster (i)** – Shallow water sandy habitat, with low diversity and low abundance, supporting species tolerant of mobile sands, characterised by *Bathyporeia elegans* and *Magelona johnstoni* with the robust bivalve *Fabulina fabula* also evident in abundance; and

- **Outlier sites** mostly typified by *Mytilus edulis* and associated diverse epifauna.

4.1.25 Clusters f and h were identified via the initial cluster analysis but were then discounted as they were judged to be representative of transitional / gradient type habitats as opposed to actual discrete habitats.

4.1.26 Clusters (i) and (d) were the dominant clusters across Tranche A, with small areas characterised by cluster (c). Mixed in with the sites from cluster (i) in Tranche A were numerous sites from cluster (d) and cluster (c), where the side scan sonar data indicates a degree of variability in seabed composition.

4.1.27 The offshore parts of the export cable corridor were dominated by cluster (g), with a distinct group of sites further inshore along the export cable corridor, occupied by cluster (a) sites, where sediments were mixed and the fauna diverse as a consequence. Adjacent to this group of sites were the transitional sand habitats of cluster (b), with the inshore end of the cable supporting cluster (e), which was comprised of very low diversity mobile sand fauna. The mussel based outlier sites were located inshore between the mobile sand habitats.
4.1.28 These clusters are broadly comparable to the habitat classes and resultant biotopes identified by Envision from their habitat mapping study, which was based on this EMU benthic data-set and also images from DDV and stills and geophysical data (see Table 4.3, Section 4.3).

**EpiBenthos**

4.1.29 EpiBenthic communities across the entire study area were characterised by a series of 2m scientific beam trawl surveys and also data collected via the DDV surveys undertaken as part of the wider benthic survey campaign.

4.1.30 A summary of the range of faunal groups collected during the 2m beam trawl survey has been provided both for the survey (2m beam trawls) as a whole, and for each survey area, based on standardised abundance per unit area. These are provided in Appendix 12E.

4.1.31 Overall, decapod crustacea and fish made up the majority of individuals collected across the whole survey area (46% and 37% respectively). Other important groups include polychaetes (14%), amphipods (10%) (notably *Lysianassidae* sp.), bivalves (*Pelecypoda*) (24%) and echinoderms (11%). However, the numbers of polychaetes and bivalves are likely to be biased to some extent by higher derived abundances collected at one sample site (BT17).

4.1.32 As might be expected decapod crustacea and fish species were primarily the dominant groups at the individual survey areas although decapods made a lower contribution at the sites outside Tranche A. Echinoderms made a notable contribution at the sites along the export cable corridor whilst polychaetes and bivalves made a higher contribution within Tranche A, although these are primarily related to higher numbers of such species collected at one sample site (BT17).

4.1.33 In total around 150 invertebrate taxa were recorded for the survey as a whole. Aside from higher numbers of the bivalve *Gari tellinella* and the lancelet recorded at one site (BT17), the most dominant invertebrate species included the prawn *Pandalina brevirostris*, *Lysianassidae* amphipod spp., the swimming crab *Liocarcinus pusillus*, the polychaete *Glycera lapidum*, the brown shrimp *Crangon crangon*, common starfish *Asterias rubens*, squat lobster *Galathea intermedia*, velvet swimming crab *Necora puber*, the sand star *Astropecten irregularis*, common brittle star *Ophiothrix fragilis* and the shrimp *Crangon allmanni* collectively which made up 50% of the total abundance.

4.1.34 Whilst there were some minor differences in epibenthic assemblages identified via the DDV survey (Gardline) and 2m beam trawl surveys (BMM & PMSL), overall, the data showed a good correlation in terms of species composition and distribution of key epibenthic communities across Tranche A and the export cable corridor. Key species recorded in these two areas are summarised below (Table 4.2).
### Table 4.2
Characterising epibenthic species recorded in DDV survey

<table>
<thead>
<tr>
<th>Study area</th>
<th>Characterising epibenthic species recorded via DDV survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tranche A</td>
<td>Asterias rubens, Astreopsis irregularis, Buglossidium luteum, Hydroid/bryozoan turf, Ophiura sp., Pleuronectiformes, Corystes cassivelaunus, Ophiura ophiura, Paguridae, Flustra foliacea, Pomatoceros sp.</td>
</tr>
</tbody>
</table>

### 4.2 Intertidal

#### General

4.2.1 The landfall site at Ulrome is located within the Holderness coastline of the East Riding of Yorkshire. This area is dominated by an almost continuous line of cliffs, broken by low ground in places such as Barmston and Tunstall. In these lower lying areas the agricultural land behind it is protected from seawater entering by tidal defences. The rate of cliff erosion in the undefended areas is the highest in Europe (Euroson 2012) which prohibits colonisation by anything but ruderal vegetation.

4.2.2 The landfall site was selected using a number of criteria. Of relevance to marine ecology is the fact that this location was chosen in order to avoid a large area of potential cobble reef (Annex I habitat) located in the subtidal zone to the south of Ulrome.

4.2.3 The infauna of the beaches of southern Holderness is species poor, which is typical for the prevailing sediment type. Fauna has been found to mainly consist of polychaete worms and amphipods.

4.2.4 The intertidal environment at the landfall was characterised using a series of beach transects during a walkover survey (Section 3).

4.2.5 The landfall site consists of cliffs at the upper shore, ranging in height from around 1.5m – 6m. The top of the cliff is colonised by maritime grasses (Chapter 25) and fronted by a thin veneer of sand, forming a beach (Figure 4.9). The beach is homogenous in appearance, with some patches of shingle and sand (Humber Estuary Coastal Authorities Group (HECAG) 2009). This type of beach is typical of the Holderness coast area. Shore profiles and photographs are presented in Appendix 12F.
Sediment composition

4.2.6 The intertidal zone at the landfall is characterised by long, clean sandy beaches, with cliff at the upper shore (Figure 4.9). All transects consisted of barren sand. The JNCC describes these areas as highly mobile and subject to high degrees of drying between tides. As a result, few species are able to survive in this environment (Connor et al. 2004). Amongst the sand, patches of shingle and gravel were also recorded at transects two and five whilst, in transect four, concrete blocks were recorded at the mid and lower shore stations, with a breakwater to the north (Appendix 12F).

Contaminants

4.2.7 Chemical analysis was undertaken for metals, organotins, PAHs and PCBs (Section 3.2). Across the sampling site contaminant levels were found to be below the relevant levels of concern (discussed in full in Chapter 10).

Macroinfauna

4.2.8 Both species diversity and abundance throughout the site was found to be very low, with some samples from the sand based areas not containing any individuals. This low diversity and abundance is typical for mobile sandy substrate. The sand was characterised by sedimentary species. The most abundant species are listed below:

- Bathyporeia sp. (amphipod);
- Nephtys cirrosa (polychaete worm);
- Spiophanes bombyx (polychaete worm); and
4.2.9 It should be noted that species abundances were very low, with *Nephtys cirrosa* being the most abundant at 13 occurrences.

4.2.10 As would be expected a different species assemblage was recorded at the concrete blocks found at the site, these included *Fucus spiralis* (brown seaweed), *Littorina saxatilis* (periwinkle), *Mytilus edulis* (common mussel), *Patella sp.* (limpet) and *Semibalanus balanoides* (barnacle).

4.2.11 A species matrix with specimens listed per sample can be found in Appendix 12F.

4.3 Biotopes and habitats

General

4.3.1 Based on the outputs of the Envision habitat mapping and biotope classification process, distinct habitat classes and related biotopes were identified across Tranche A and the export cable corridor. There was considerable overlap in species composition between the habitat classes identified. As a result, the classes should not be regarded as discrete but as convenient nodal points along a continuum of species distributions, which are used for area description and as units for mapping.

4.3.2 A description of these habitat classes and associated biotopes is provided below, with a fuller summary in Table 4.3, which also includes details on the distribution of these habitats/biotopes across Tranche A and the export cable corridor (including the landfall based on the walkover survey undertaken in this area).

4.3.3 Maps showing the distribution of these biotopes across Tranche A and the export cable corridor are presented in Appendix 12G. Distribution maps of VERs based on these biotopes are provided below (Figures 4.10, 4.11 and 4.12).

Biotope classification – Tranche A

4.3.4 The habitats in Tranche A consisted of mobile sand with sparse infauna ("Bathyporeia/Spiophanes") mixed spatially with habitats with coarser sediments ("Faunal crusts & turf", "Faunal crusts" and "Echinocyamus"). The deeper water in the south east section supported the "Spatangus" habitat, which was also found commonly on the export cable corridor.

4.3.5 The predominant habitat on the flat sand areas in Tranche A was "Bathyporeia/Spiophanes" (biotopes CFiSa.NcirBat/IMuSa.FfabMag) with "Spatangus" in areas of slightly deeper water (biotopes CFiSa.ApriBatPo/IMuSa.FfabMag).

4.3.6 Sand waves within Tranche A with heights of up to 2.5m and oriented north west to south east supported "Faunal crusts & turf (Cobble)" habitats in the north eastern sector (SS.SMx.CMx.FluHyd) and "Faunal crust (Gravel)" habitats in the south eastern sector (SS.SMx.OMx.PoVen/SS.SMx.CMx.MysThyMx). "Echinocyamus" habitats (CFiSa.EpusOborApi) were located in the sandy sediments close to the gravel troughs and "Fabulina" habitats (IMuSa.FfabMag/CSaMu.LkorPpel) were also found close to these troughs.

- *Urothe brevicornis* (amphipod).
Biotope classification – export cable corridor

4.3.7 The eastern part of the export cable corridor was dominated by the *Spatangus* habitat class (SS.SSa.CFiSa.ApriBatPo/SS.SSa.IMuSa.FlabMag) with discrete areas of *Polygordius* habitat (SS.SCS.CCS.Blan).

4.3.8 There were also notable areas of *Bathyporeia/Nephtys* habitat (SS.SSa.IFisSa.NcirBat) approximately 50km along the export cable corridor from Tranche A as well as patches of the *Amphiura* habitat (SS.SMx.CMx.MysThyMx/SS.SMu.CSaMu.AfilNten) which likely reflect the slightly more silty habitats that are associated with deeper water.

4.3.9 Approximately 40km from landfall, the habitats and associated biotopes along the export cable corridor change from those described above to one dominated by *Melinna* & faunal turf habitat (CMx.MysThyMx/CMx.FluyHyd) with *Bathyporeia/Nephtys* (SS.SSa.IFisSa.NcirBat) closer inshore.

4.3.10 The *Mytilus* habitat (SS.SBR.SMu.MytSS) was recorded closer inshore in two discrete areas (approximately 0.5km offshore to 5km offshore and 6km to 7.5km offshore across the entire width of the export cable corridor).

Biotope classification – landfall

4.3.11 The dominant biotope recorded at the landfall (Ulrome beach) was barren littoral sand (MoSa.BarSa). The sandy beach fauna recorded in the intertidal samples was typical of the biotope complex “Barren or amphipod-dominated mobile sand shores” (LS.LSA.MoSa), falling close to the biotope “Amphipods and *Scolelepis* spp. in Littoral medium-fine Sand” (LS.LSa.MoSa.AmSco) and more specifically the sub-biotope “*Eurydice pulchra* in littoral mobile sand” (LS.LSa.MoSa.AmSco.Eur).

4.3.12 The upper shore of transects two and five had some shingle and gravel content as well as sand. These sites were classified as littoral coarse sediment (LS.LCS).

4.3.13 An area of concrete blocks is present between the mid shore and lower shore stations of transect 4. These were dominated by barnacles and the blue mussel *Mytilus edulis* and were characterised as mussel and/or barnacle communities (LR.HLR.MusB). A breakwater, protecting an outfall, is present to the north of this site and was also characterised as LR.HLR.MusB.

4.3.14 An area in between the breakwater and transect two (to the north of the site) was found to have a number of lugworm *Arenicola marina* casts on the sediment surface. This area was characterised as oligochaetes in littoral mobile sand (LS.LSa.MoSa.Oi).
Table 4.3  Benthic biotopes identified within Tranche A, export cable corridor and intertidal

<table>
<thead>
<tr>
<th>Habitat (Envision)</th>
<th>JNCC Marine Habitats Classification (V04.05) biotope codes</th>
<th>Biotope description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tranche A</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fabulina</td>
<td>SS.SSa.IMuSa.FfabMag</td>
<td><em>Fabulina fabula</em> and <em>Magelona mirabilis</em> with venerid bivalves and amphipods in infralittoral compacted fine muddy sand.</td>
<td>Dominant biotope found across the majority of Tranche A in areas of flat, fine sand, often in association with SS.SSa.IMuSa.FfabMag.</td>
</tr>
<tr>
<td></td>
<td>SS.SMu.CSaMu.LkorPpel</td>
<td><em>Lagis koreni</em> and <em>Phaxas pellucidus</em> in circalittoral sandy mud.</td>
<td>Discrete patch in south western part of Tranche A which probably represents a deep water pocket of stable, sandy mud.</td>
</tr>
<tr>
<td>Bathyporeia/Spiophanes</td>
<td>SS.SSa.IFiSa.NcirBat</td>
<td><em>Nephtys cirrosa</em> and <em>Bathyporeia spp.</em> in infralittoral sand.</td>
<td>Dominant biotopes found across the majority of Tranche A in areas of flat, fine sand.</td>
</tr>
<tr>
<td>Faunal crusts &amp; turf (cobble)</td>
<td>SS.SMx.CMx.CMx.FluHyd</td>
<td><em>Flustra foliacea</em> and <em>Hydrallmania falcata</em> on tide swept circalittoral mixed sediment.</td>
<td>Associated with north west/south east orientated sand waves in western part of Tranche A.</td>
</tr>
<tr>
<td>Spatangus</td>
<td>SS.SSa.CFiSa.ApriBatPo</td>
<td><em>Abra prismatica</em>, <em>Bathyporeia elegans</em> and polychaetes in circalittoral fine sand.</td>
<td>Found in deeper water in western part of Tranche A (transitioning into export cable corridor).</td>
</tr>
<tr>
<td></td>
<td>SS.SSa.IMuSa.FfabMag</td>
<td>See above.</td>
<td>Part of mosaic with SS.SSa.CFiSa.ApriBatPo in western part of Tranche A.</td>
</tr>
<tr>
<td>Echinocyamus</td>
<td>SS.SSa.CFiSa.EpusOborApr</td>
<td><em>Echinocyamus pusillus</em>, <em>Ophelia borealis</em> and <em>Abra prismatica</em> in circalittoral fine sand.</td>
<td>Associated with sandy sediments close to gravel troughs and “Fabulina” habitats in the south-eastern and north-western parts of Tranche A.</td>
</tr>
<tr>
<td>Faunal crusts (gravel)</td>
<td>SS.SMx.OMx.PoVen</td>
<td>See above.</td>
<td>Both biotopes associated with sand waves in the south-eastern part of Tranche A.</td>
</tr>
<tr>
<td></td>
<td>SS.SMx.CMx.MysThyMx</td>
<td><em>Mysella bidentata</em> and <em>Thyasira spp.</em> in circalittoral muddy mixed sediment.</td>
<td></td>
</tr>
</tbody>
</table>
### Export cable corridor (biotopes recorded in order of location from site boundary to intertidal region)

<table>
<thead>
<tr>
<th>Habitat (Envision)</th>
<th>JNCC Marine Habitats Classification (V04.05) biotope codes</th>
<th>Biotope description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polygordius</td>
<td>SS.SCS.CCS.Blan</td>
<td><em>Branchiostoma lanceolatum</em> in circalittoral coarse sand with shell gravel</td>
<td>Found in the deeper waters where Tranche A transitions into the export cable corridor.</td>
</tr>
<tr>
<td>Faunal crusts (gravel)</td>
<td>SS.SMx.OMx.PoVen</td>
<td>See above</td>
<td>Ribbon strands running North-South on the central approaches to Tranche A, closely mirrored with SS.SMx.OMx.PoVen; Closely mirrored to the distribution of SS.SMu.CSaMu.AfilNten on the Export cable corridor to the Western end.</td>
</tr>
<tr>
<td></td>
<td>SS.SMx.CMx.MysThyMx</td>
<td>See above</td>
<td>Small discrete patches associated with gravels along export cable corridor.</td>
</tr>
<tr>
<td>Amphiura</td>
<td>SS.SMx.CMx.MysThyMx</td>
<td>See above</td>
<td>Discrete patches approximately 50km along the export cable corridor from Tranche A which likely indicate slightly more silty habitats associated with deeper water.</td>
</tr>
<tr>
<td></td>
<td>SS.SMu.CSaMu.AfilNten</td>
<td><em>Amphiura filiformis</em> and <em>Nuculoma tenuis</em> in circalittoral and offshore sandy mud</td>
<td></td>
</tr>
<tr>
<td>Spatangus</td>
<td>SS.SSa.CFiSa.ApriBatPo</td>
<td>See above</td>
<td>Dominant biotopes in the eastern part of the export cable corridor along with SS.SSa.IFiSa.NcirBat.</td>
</tr>
<tr>
<td></td>
<td>SS.SSa.IMuSa.FlabMag</td>
<td>See above</td>
<td></td>
</tr>
<tr>
<td>Bathyporeia/ Ophelia</td>
<td>SS.SSa.CFiSa.EpusOborApri</td>
<td>See above</td>
<td>Dominant biotopes approximately 40-70km offshore from landfall.</td>
</tr>
<tr>
<td>Melinna &amp; faunal turf</td>
<td>SS.SMx.CMx.MysThyMx</td>
<td>See above</td>
<td>Dominant biotope between approximately 15-40km from landfall.</td>
</tr>
<tr>
<td>Echinocyamus</td>
<td>SS.SSa.CFiSa.EpusOborApri</td>
<td>See above</td>
<td>Discrete patches approximately 15km offshore from landfall.</td>
</tr>
<tr>
<td>Bathyporeia/ Nephtys</td>
<td>SS.SSa.IFiSa.NcirBat</td>
<td>See above</td>
<td>Discrete patches located approximately 50km along the export cable corridor from Tranche</td>
</tr>
<tr>
<td>Habitat (Envision)</td>
<td>JNCC Marine Habitats Classification (V04.05) biotope codes</td>
<td>Biotope description</td>
<td>Location</td>
</tr>
<tr>
<td>-------------------</td>
<td>----------------------------------------------------------</td>
<td>---------------------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>Mytilus</strong></td>
<td>SS.SBR.SMus.MytSS</td>
<td><em>Mytilus edulis</em> beds on sublittoral sediment</td>
<td>Located in the inshore part of the export cable corridor near the intertidal/subtidal boundary.</td>
</tr>
<tr>
<td><strong>Landfall (Intertidal)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>MoSa.BarSa</td>
<td>Barren littoral coarse sand</td>
<td>Dominant biotope for entire landfall location.</td>
</tr>
<tr>
<td>N/A</td>
<td>LS.LSA.MoSa</td>
<td>Barren or amphipod-dominated mobile sand shores</td>
<td>Areas of sand at landfall location.</td>
</tr>
<tr>
<td>N/A</td>
<td>LS.LSa.MoSa.AmSco</td>
<td>Amphipods and <em>Scolelepis</em> spp. in littoral medium-fine sand</td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>LS.LCS</td>
<td>Littoral coarse sediment</td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>LR.HLR.MusB</td>
<td>Mussel and/or barnacle communities</td>
<td>Area of concrete blocks present between the mid shore and lower shore stations of transect four and also breakwater protecting outfall.</td>
</tr>
<tr>
<td>N/A</td>
<td>LS.LSa.MoSa.Ol</td>
<td><em>Oligochaetes</em> in littoral mobile sand</td>
<td>Area between the breakwater and transect two.</td>
</tr>
<tr>
<td>N/A</td>
<td>LR.MLR.BF</td>
<td>Barnacles and fucoids on moderately exposed shores</td>
<td>Artificial blocks in upper shore region.</td>
</tr>
</tbody>
</table>
4.3.15 As per the approach to identifying VERs outlined in Section 3.3, the biotopes identified across the site and listed above in Table 4.3 have been grouped into VERs according to their general ecology and species richness, their conservation status/interest and their ecological sensitivity to the effects likely to be experienced at this site. In total, seven VERs have been identified across the main site, export cable corridor and landfall parts of the study area. Details of these VERs are provided in Table 4.5 and their spatial distribution across Tranche A and the export cable corridor shown in Figures 4.10, 4.11 and 4.12.

4.4 Habitats and species of conservation importance

Annex I Habitats

4.4.1 The key habitats of conservation importance that occur within the study area are those that form component parts of the Annex I habitat “subtidal sandbanks which are slightly covered by seawater at all times” for which the Dogger Bank cSAC has been proposed for designation by the UK Government. A brief summary of the reason for this cSAC designation (from the Dogger Bank SAC Selection Assessment Document, Version 9.0, August 2011 JNCC) is provided below.

4.4.2 The Dogger Bank is located within the Southern North Sea 125km off the east coast of Yorkshire (Figure 4.1). This site represents an offshore non-vegetated sandy mound, composed of moderately mobile, clean sandy sediments (sands and gravelly sands) in full salinity. In general the biological communities on the Dogger Bank are typical of fine sand and muddy sand sublittoral sediments. Species typical of these communities include the polychaetes Nephtys cirrosa and Magelona sp., mobile amphipods of the genus Bathyporeia, the brittlestar Amphiura filiformis, and bivalve molluscs such as Tellina fabula (formerly Fabulina fabula) and Mysella bidentata (Wieking & Kröncke 2001). Epifaunal species include the hermit crab Pagurus bernhardus, sandeels Ammodytes spp., plaice Pleuronectes platessa and the starfish Asterias rubens. The grade for the feature is A as it is a typical example of this type of Annex I sandbank habitat (JNCC 2010).

4.4.3 The project-specific benthic grab survey, which was also used to ground-truth geophysical survey data, identified a range of biotopes within Tranche A that corresponded to biotopes identified by previous surveys commissioned by JNCC when defining the Dogger Bank cSAC. Therefore, it is possible to state that all of Tranche A (and some parts of the export cable corridor) contain Annex I habitats.

4.4.4 The characterisation surveys undertaken for the EIA also identified the mussel (Mytilus edulis) based biotope complex (SS.SBR.SMUs) in the nearshore part of the export cable corridor. Mytilus reefs can represent Annex I biogenic reef habitat in certain forms, quantity and quality, therefore this area of habitat has been identified as a VER with an Value category (see Table 3.2) of National, i.e. Annex I habitat outside SAC boundary. It should be noted however that this assignment of value is very precautionary as there is currently no evidence that this Mytilus biotope represents Annex I biogenic reef habitat.

4.4.5 Although not overlapping any part of Dogger Bank Creyke Beck A or B, the boundary of Flamborough Head SAC is approximately 2km to the north of the export cable corridor. The screening exercise undertaken as part of the ongoing Habitats Regulations Assessment (HRA) process identified the potential for indirect impacts
on this site during the construction phase.

4.4.6 The Flamborough Head SAC is designated due to presence of the following Annex I habitats:

- Vegetated sea cliffs of the Atlantic and Baltic coasts;
- Reefs; and
- Submerged and partially submerged sea caves.

4.4.7 Of the three habitats listed above, only reefs and sea caves have been included in the ongoing assessment (vegetated sea cliffs of the Atlantic and Baltic coasts are screened out due to a lack of pathway for any effect to arise from Dogger Bank Creyke Beck.

4.4.8 The benthic impact assessments presented within this chapter do not include an assessment of the potential for the favourable conservation status or achievement of conservation objectives of any SAC (or its features) to be compromised. Rather, the assessment presented within this section enables the magnitude of effects, and subsequent significance of impacts on benthic habitats that lie within SAC boundaries to be determined. These conclusions have been taken forward in the HRA Report, which assesses potential impacts on the conservation objectives of SACs potentially affected by Dogger Bank Creyke Beck.

UK BAP Habitats

4.4.9 Many of the biotopes identified across Tranche A and the export cable corridor are judged to represent the UK BAP habitat ‘subtidal sands and gravel’ (JNCC 2010), though some crossover with the Annex I habitat ‘sandbanks which are slightly covered by sea water at all times’ exists. Sand and gravel habitats are widespread around the British Isles. They occur in a range of environmental conditions, which determine the type of faunal communities found in this habitat.

4.4.10 Offshore gravel and sand habitats around the British Isles support internationally important commercial fisheries, such as those for scallops and flatfish, and industrial fisheries, such as sandeels. They can also be important nursery grounds for the young of commercial fish species such as flatfish, bass, skates and rays, as well as sharks (Maddock, 2008).

4.4.11 Deeper waters within the export cable corridor also support certain biotopes (e.g. SS.SMu.CSaMu.LkorPpel and SS.SMu.CSaMu.AfilNten) which are considered to fall within the UK BAP habitat ‘mud habitats in deep water’.

Marine Conservation Zones

4.4.12 MCZs will augment the Natura 2000 network for species and habitats that are either not covered by the Habitats Directive, or for which the Directive might not cover adequately, providing added protection to marine ecosystems, ecological processes, habitats and species.

4.4.13 Two rMCZs were screened into the Dogger Bank Creyke Beck assessment:

- Holderness Inshore rMCZ; and
- Holderness Offshore rMCZ.
4.4.14 Details of these rMCZs are provided below in Table 4.4 with the locations in relation to the Dogger Bank Creyke Beck project areas shown in Figure 4.1.

**Table 4.4**  
Recommended MCZ sites relevant to Dogger Bank Creyke Beck

<table>
<thead>
<tr>
<th>MCZ sites</th>
<th>Distance from Dogger Bank Creyke Beck (km)</th>
<th>Site Features</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Export cable corridor</td>
<td>Wind Farm Site</td>
</tr>
<tr>
<td>Holderness Inshore</td>
<td>2km+</td>
<td>141km+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holderness Offshore</td>
<td>11km+</td>
<td>112km+</td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**The OSPAR List**

4.4.15 Certain habitats and species listed on Part I (species) and Part II (habitats) of the OSPAR List of Threatened and/or Declining Species and Habitats may occur within the boundaries of Dogger Bank Creyke Beck A and/or B (main site and export cable corridor).

4.4.16 With respect to OSPAR Part I species, the only species of potential relevance to Dogger Bank Creyke Beck is the ocean quahog (*Arctica islandica*). However, only one juvenile of this species was recorded within Tranche A (site TA_CAM_031), and therefore it is not judged to be at risk from the proposed development.

4.4.17 In terms of habitats, there are 16 habitats on Part II of the OSPAR List, of which none are recorded as occurring within Dogger Bank Creyke Beck.
<table>
<thead>
<tr>
<th>VER</th>
<th>Envision habitat class</th>
<th>Representative biotopes (Envision)</th>
<th>Faunal community (as identified in Dogger Bank Site Selection Assessment – Aug 2011)</th>
<th>Protection status</th>
<th>Actual conservation interest</th>
<th>Importance/value within study area and justification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bathyporeia / Spiophanes</td>
<td>SS.Sa.IFiSa.NcirBat SS.Sa.IMuSa.FfabMag</td>
<td>N/A</td>
<td>(b) Mud habitats in deep waters</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spatangus*</td>
<td>CfIsa.ApriBatPo IMuSa.FfabMag</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Echinocyamus</td>
<td>SS.Sa.CfIsa.EpusOborApri</td>
<td>Group I</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fabulina</td>
<td>SS.Sa.IMuSa.FfabMag SS.SMu.CSaMu.LkorPpel</td>
<td>Group K</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Coarse sediments with medium to high diversity benthic communities which form part of the Annex I</td>
<td>Faunal crusts (Gravel)</td>
<td>SS.SMx.OMx.PoVen SS.SMx.CMx.MysThyMx</td>
<td>Group E</td>
<td>Annex I Habitats Directive UK BAP Habitats (a) Subtidal sands and gravels</td>
<td>Annex I Habitat ‘sandbanks that are slightly covered by seawater all the time’. Qualifying features of the Dogger Bank cSAC</td>
<td>International/High</td>
</tr>
<tr>
<td></td>
<td>Faunal crusts &amp; turf (Cobble)</td>
<td>SS.SMx.CMx.FluHyd</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Polygordius</td>
<td>SS.SMx.OMx.PoVen SS.SCS.CCS.Blan</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VER</td>
<td>Envision habitat class</td>
<td>Representative biotopes (Envision)</td>
<td>Faunal community (as identified in Dogger Bank Site Selection Assessment – Aug 2011)</td>
<td>Protection status</td>
<td>Actual conservation interest</td>
<td>Importance/value within study area and justification</td>
</tr>
<tr>
<td>-----</td>
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<td>----------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
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<td>-----------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>Sandbank Feature</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dogger Bank cSAC. (Certain elements may also be representative of the UK BAP habitats) Subtidal sands and gravels and Mud habitats in deep waters</td>
</tr>
<tr>
<td>C. Sandy sediment supporting relatively low diversity benthic communities (outside boundary of cSAC)</td>
<td>Spatangus</td>
<td>SS.SSa.CFiSa.ApriBatPo SS.SSa.IMuSa.FlabMag</td>
<td>N/A</td>
<td>None</td>
<td>UK BAP Habitat Subtidal sands and gravels</td>
<td>Regional/Medium Biotopes fall within descriptions of UK BAP Priority Habitat “subtidal sands and gravels”</td>
</tr>
<tr>
<td></td>
<td>Fabulina</td>
<td>SS.SSa.IMuSa.FlabMag</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bathyporeia/ Nephtys</td>
<td>SS.SSa.IFiSa.NcirBat</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Echinocystis</td>
<td>SS.SSa.CFiSa.EpusOborApri</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Coarse sediments with medium to high diversity benthic communities (outside boundary of cSAC)</td>
<td>Amphiuma</td>
<td>SS.SMx.CMx.MysThyMx</td>
<td>N/A</td>
<td>None</td>
<td>UK BAP Habitat (Subtidal sands and gravels)</td>
<td>Regional/Medium Biotopes fall within descriptions of UK BAP Priority Habitat “subtidal sands and gravels”</td>
</tr>
<tr>
<td></td>
<td>Melinna &amp; faunal turf habitat</td>
<td>SS.CMx.MysThyMx SS.Smx.CMx.FluHyd</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Polygordius</td>
<td>SS.SCS.CCS.Blan</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VER</td>
<td>Envision habitat class</td>
<td>Representative biotopes (Envision)</td>
<td>Faunal community (as identified in Dogger Bank Site Selection Assessment – Aug 2011)</td>
<td>Protection status</td>
<td>Actual conservation interest</td>
<td>Importance/value within study area and justification</td>
</tr>
<tr>
<td>-----</td>
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<td>---------------------------------------------------</td>
</tr>
<tr>
<td>E.</td>
<td>Muddy sand sediments in deeper water (along export cable corridor)</td>
<td>Fabulina</td>
<td>SS.SMuc.SMa.M.Lkor.Ppel</td>
<td>N/A</td>
<td>None</td>
<td>UK BAP Habitat Mud habitats in deep waters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Amphiura</td>
<td>SS.SMuc.SMa.Afil.Nten</td>
<td>N/A</td>
<td>None</td>
<td>Regional/Medium Biotopes fall within descriptions of UK BAP Priority Habitat “mud habitats in deep water”</td>
</tr>
<tr>
<td>F.</td>
<td>Mussel-based habitats in inshore export cable corridor</td>
<td>Mytilus</td>
<td>SS.SBR.SMuc.MytSS</td>
<td>N/A</td>
<td>None</td>
<td>Potential Annex I habitat UK BAP Habitat (Subtidal sands and gravels) National/High Mytilus edulis habitat may represent potential Annex I biogenic reef habitat</td>
</tr>
</tbody>
</table>
Figure 4.10 Spatial distribution of VERs across Tranche A

Data Source:
Habitat data © Envision, 2012
Round 3 offshore wind farm boundary © Crown Copyright, 2013,
Background bathymetry image derived in part from TCarta data © 2009

LEGEND
- Dogger Bank Zone
- Tranche boundary
- Dogger Bank Creyke Beck A
- Dogger Bank Creyke Beck B
- Export cable corridor
- Temporary works area

Valued Ecological Receptor (VER)
- A
- B
- C
- E

VER | DATE | REMARKS | Drawn | Checked
--- | --- | --- | --- | ---
1 | 29/01/2013 | DVR | UV | RJ
2 | 27/03/2013 | PEI3 | LV | RJ
3 | 15/07/2013 | Final ES | FK | RJ

DRAWING NUMBER: F-OFC-MA-224
Figure 4.12 Spatial distribution of VERs across the inshore part of the export cable corridor

Data Sources:
- Habitat data © Envision, 2012
- Offshore wind farm boundaries © Crown Copyright, 2013
- Background bathymetry image derived in part from TCarta data © 2009

LEGEND
- Export cable corridor
- Temporary works area
- Dogger Bank (offshore wind farm zone)
- Special Area of Conservation (SAC)
- Valued Ecological Receptor (VER)

VER
1 29/01/2013
2 10/02/2013
3 15/07/2013

DRAWING NUMBER: F-OFC-MA-226

VER DATE REMARKS Drawn Checked
1 29/01/2013
2 10/02/2013
3 15/07/2013

DRAWING TITLE: DOGGER BANK CREYKE BECK

PROJECT TITLE: WGS84 UTM31NA3 1:300,000
5 Assessment of Impacts – Worst Case Definition

5.1 General

5.1.1 This section establishes the realistic worst case scenario for each category of impact as a basis for the subsequent impact assessment. For this assessment this involves both a consideration of the construction scenarios (i.e. the manner in which the two Dogger Bank Creyke Beck projects will be built out), as well as the particular design parameters of each project (such as the maximum construction footprint at the landfall) that define the Rochdale\(^1\) envelope.

5.1.2 Full details of the range of development options being considered by Forewind are provided within Chapter 5. For the purpose of the marine and intertidal ecology impact assessment, the key project parameters which form the realistic worst case are set out in Table 5.1.

5.1.3 Only those design parameters with the potential to influence the level of impact are identified. Therefore, if the design parameter is not described, it is not considered to have a material bearing on the outcome of the assessment.

5.1.4 The realistic worst case scenarios identified here are also applied to the Cumulative Impact Assessment. When the worst case scenarios for the project in isolation do not result in the worst case for cumulative impacts, this is addressed within the cumulative Section of this chapter (see Section 10) and summarised in Chapter 33 Cumulative Impact Assessment.

5.2 Construction scenarios

5.2.1 There are a number of key principles relating to how the projects will be built, and that form the basis of the Rochdale Envelope (see Chapter 5). These are:

- The two projects may be constructed at the same time, or at different times;
- If built at different times, either project could be built first;
- If built at different times, the duration of the gap between the end of the first project to be built, and the start of the second project to be built may vary from overlapping, to up to 2.5 years;
- Offshore construction will commence no sooner than 18 months post consent, but must start within seven years of consent (as an anticipated condition of the development consent order); and
- Assuming a maximum construction period per project of six years, and taking the above into account, the maximum construction period over which the construction of Dogger Bank Creyke Beck A and B could take place is 11 years and six months.

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\(^1\) As described in Chapter 5 the term ‘Rochdale Envelope’ refers to case law (R.V. Rochdale MBC Ex Part C Tew 1999 “the Rochdale case”). The ‘Rochdale Envelope’ for a project outlines the realistic worst case scenario or option for each individual impact, so that it can be safely assumed that all lesser options will have less impact.
5.2.2 To determine which offshore construction scenario is the worst realistic case for a given receptor, two types of effect exist with the potential to cause a maximum level of impact on a given receptor:

- Maximum duration effects; and
- Maximum peak effects.

5.2.3 To ensure that the Rochdale Envelope incorporates all of the possible construction scenarios (as outlined in Chapter 5), both the maximum duration effects and the maximum peak effects have been considered for each receptor. Furthermore, the option to construct each project in isolation is also considered (‘Build A in isolation’ and ‘Build B in isolation’), enabling the assessment to identify any differences between the two projects. The three construction scenarios for Dogger Bank Creyke Beck A and B considered within the marine and intertidal ecology assessment are, therefore:

- Build A or Build B in isolation;
- Build A and B concurrently – provides the worst ‘peak’ impact and maximum working footprint; and
- Build A, gap of up to 2.5 years, Build B (sequential) – provides the worst duration of impact.

5.2.4 Any differences between the two projects, or differences that could result from the manner in which the first and the second projects are built (concurrent or sequential and the length of any gap) are identified and discussed in the impact assessment section of this chapter (Section 6).

5.2.5 For each potential impact only the worst case construction scenario for two projects is presented, i.e. either concurrent or sequential. The justification for what constitutes the worst case is provided, where necessary, in Section 6.

5.2.6 As such, the construction scenarios presented within the impact assessment are:

- i) Single project (Dogger Bank Creyke Beck A or B in isolation); and
- ii) Two projects – concurrent or sequential (Dogger Bank Creyke Beck A and B together).

5.3 Operation scenarios

5.3.1 Chapter 5 provides details of the operational scenarios for Dogger Bank Creyke Beck. Flexibility is required to allow for the following three scenarios:

- Dogger Bank Creyke Beck A to operate on its own;
- Dogger Bank Creyke Beck B to operate on its own, and
- For the two projects to operate concurrently.

5.3.2 Only one assessment is presented for the single project scenario, although any differences between Dogger Bank Creyke Beck A and B are clearly identified in the discussion.
5.4 Decommissioning scenarios

5.4.1 Chapter 5 provides details of the decommissioning scenarios for Dogger Bank Creyke Beck. Exact decommissioning arrangements will be detailed in a Decommissioning Plan (which will be drawn up and agreed with DECC prior to construction); however, for the purpose of this assessment it is assumed that decommissioning of Dogger Bank Creyke Beck A & B could be conducted separately, or at the same time.

5.5 Realistic worst case scenarios

5.5.1 Table 5.1 identifies the key design parameters for the impact assessment. The parameters identified have been derived from a desktop review and through consultation with stakeholders.
Table 5.1 Key design parameters forming the realistic worst case scenario for the assessment of impacts on marine and intertidal ecology

<table>
<thead>
<tr>
<th>Impact</th>
<th>Key design parameters forming the realistic worst case scenario</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical disturbance to habitat and species and temporary habitat loss (each project)</td>
<td>Maximum footprint of temporary disturbance (main site and export cable corridor plus temporary working areas of 1km around wind farm sites and 750m around export cable corridor) during construction assessed as <strong>21.53km²</strong> (Dogger Bank Creyke Beck A) or <strong>20.97km²</strong> (Dogger Bank Creyke Beck B) which represents 1.82% of the overall area of Dogger Bank Creyke Beck A and 2.15% of Creyke Beck B.</td>
<td>The worst case scenario for temporary physical disturbance to benthic habitats during the construction phase was established by defining the maximum amount (spatial extent) of habitat disturbance produced by the various elements of construction (as detailed left). Permanent loss of habitat via the presence of foundations and cable/scour protection is discussed in the operational phase section.</td>
</tr>
</tbody>
</table>

- Seabed prepared area for 300 x GBS foundations (1.15km²);
- Seabed prepared areas for 5 x met-masts (0.019km²);
- Seabed prepared area for 4 x collector stations (0.032km²);
- Seabed prepared area for 1 x converter station (0.016km²);
- Seabed prepared area for 2 x accommodation platforms (0.032km²);
- Footprint of drill arisings from 12m concrete monopiles (0.99km²);
- Jack up barge seabed footprint for 300 turbines (1.512km²);
- Anchor footprint for installation of foundations (0.559km²);
- Anchor footprint for installation of topside (0.140km²);
- Installation of up to 950km of inter array cables (with worst-case disturbance width (via jetting) of 10m) = disturbance footprint of 9.5km²;
- Installation of up to 320km of inter platform cables (with worst-case disturbance width (via jetting) of 10m) = disturbance footprint of 3.2km²;
- Installation of up to 420km (Dogger Bank Creyke Beck A) or 378km (Dogger Bank Creyke Beck B) of export cables (with worst-case disturbance width (via jetting) of 10m) = disturbance footprint of 4.20km² |
### Impact

<table>
<thead>
<tr>
<th>Key design parameters forming the realistic worst case scenario</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Dogger Bank Creyke Beck A) or 3.78km² (Dogger Bank Creyke Beck B);</td>
<td>Increases in suspended sediment concentration, modelled based on the worst case scenario for installation presented in Chapter 9. In summary, the plume model assumes that all sediment removed for seabed preparation is mobilised into a plume and subsequently deposited. This is a precautionary worst-case as the coarser elements of any sidecast material will not be mobilised and will remain in situ. The effect of any residual material that is not mobilised is assessed in the temporary habitat disturbance impact assessment.</td>
</tr>
<tr>
<td>• Anchor footprint for installation of export cables (0.176km²); and</td>
<td></td>
</tr>
<tr>
<td>• Cofferdams in intertidal area (0.002km²).</td>
<td></td>
</tr>
</tbody>
</table>

**Increased suspended sediment concentration and sediment deposition**

Release of sediments into water column (and subsequent re-deposition) resulting from following activities:

- Disposal of *in situ* drill arisings from drilled 12m monopiles; and
- Installation of array and export cables via trenching.

With modelled outputs as detailed below:

**Suspended sediment concentration**

- Maximum predicted suspended sediment concentration of greater than 200mg/l occurring up to approximately 11km from the centre of the layout in a northwest direction;
- Maximum distance from the centre of the foundations to where background concentration of 2mg/l is reached is 45km to the south;
- Predicted average suspended sediment concentration between 20mg/l and 50mg/l extends up to approximately 12km from the centre of the layout in a northwest direction;
- Maximum predicted suspended sediment concentration is generally below 20mg/l along the export cable corridor, except closer to the coast, where it is up to 100mg/l;
- Only small changes in average suspended sediment concentration predicted along the export cable corridor;
- Near-bottom (5m) suspended sediment concentration concentrations within

In order to define the realistic worst case scenario for release of suspended sediments during the foundation installation and cable laying processes a conservative approach was adopted. In this approach, 24 conical GBS or monopole foundations, a set of inter-array cables connecting them and one export cable were all installed together within a 30-day period. It is considered that this provided a conservative representation of the possible construction process (see Chapter 9).

The location of the 24 foundations was selected in the western part of the site, close to sensitive ecological habitats.
<table>
<thead>
<tr>
<th>Impact</th>
<th>Key design parameters forming the realistic worst case scenario</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Release of sediment contaminants resulting in potential effects on benthic ecology</td>
<td>As above</td>
<td>As above</td>
</tr>
<tr>
<td>Increased suspended sediment concentration leading to impacts on plankton and primary productivity</td>
<td>As above</td>
<td>As above</td>
</tr>
<tr>
<td>Physical disturbance to intertidal habitats and species during landfall works</td>
<td>Up to four (two per project) small cofferdams (requiring removal of 1,200m³ of beach sediment) or two (one per project) large cofferdams (900m³ of beach sediment) over a four-month period.</td>
<td>Required to support the Horizontal Directional Drilling (HDD) works at landfall.</td>
</tr>
</tbody>
</table>
### Impact

**Permanent loss of habitat via placement of project infrastructure** (foundations, cable protection, scour protection, vessel moorings etc.)

### Operation

**Key design parameters forming the realistic worst case scenario**

- Maximum footprint of permanent habitat loss assessed as 5.01km² (Dogger Bank Creyke Beck A) and 4.91km² (Dogger Bank Creyke Beck B) which represents 0.58% and 0.55% of the overall areas of Dogger Bank Creyke Beck A and B respectively (main site and export cable corridor).

  - 300 x Gravity Base Structure (GBS) #1 foundations * (1.397km²);
  - GBS foundations for 5 x met-masts (0.023km²);
  - Jacket foundations with suction cans for 4 x collector stations (0.058km²);
  - Jacket foundations with suction cans for 1 x converter station (0.021km²);
  - GBS foundation for 2 x accommodation blocks (0.042km²);
  - Footprint of 10 x vessel moorings and buoy chains (0.472km²);
  - Inter-array cable protection (incl. cable ends) (0.556km²);
  - Inter-array cable crossings (Dogger Bank Creyke Beck A = 0.026km²; Dogger Bank Creyke Beck B = 0.00km²);
  - Inter-platform cable protection (1.000km²);
  - Inter-platform cable crossings (Dogger Bank Creyke Beck A = 0.012km²; Dogger Bank Creyke Beck B = 0.00km²);
  - Export cable protection (Dogger Bank Creyke Beck A = 1.340km²; Dogger Bank Creyke Beck B = 1.22km²); and
  - Export cable crossings (Dogger Bank Creyke Beck A = 0.061km²; Dogger Bank Creyke Beck B = 0.123km²).

* all footprints for foundations inclusive of scour protection.

**Rationale**

- The scenario described gives rise to the greatest area of permanent seabed habitat loss.
- Any other development scenario or installation technique considered would result in no greater or less habitat loss.
<table>
<thead>
<tr>
<th>Impact</th>
<th>Key design parameters forming the realistic worst case scenario</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary impact on benthos due to physical disturbance caused by maintenance activities</td>
<td>Maximum footprint of temporary habitat disturbance due to jacking-up activities required during operational phase of project = 0.904km² in each project site, which equates to 0.18% of the overall area of Dogger Bank Creyke Beck A (main site only) and 0.15% of Dogger Bank Creyke Beck B (main site only).</td>
<td>Direct impact on benthos due to physical disturbance caused by maintenance activities.</td>
</tr>
<tr>
<td>Change in hydrodynamics and inter-related effects on benthos</td>
<td>Maximum change in current velocity during operational phase produced by installation scenario of 300 x 4MW GBS foundations at 700m spacing.</td>
<td>The maximum adverse case for changes to waves and tides has been described and justified Chapter 9.</td>
</tr>
</tbody>
</table>
| Increase in suspended sediment concentration due to scour associated with foundations | **After One-Year Operation (1yr storm scenario) – see Chapter 9 for more details**  
Maximum suspended sediment concentration ranges from 50-100mg/l (as patches along the eastern sides of both Dogger Bank Creyke Beck A & B).  
Maximum suspended sediment concentration gradually reduce with distance from the foundations until they are 2mg/l approximately 45km southeast of the Dogger Bank Creyke Beck A southern boundary and 20km north of the Dogger Bank Creyke Beck B northern boundary.  
Average suspended sediment concentration in the bottom layer in range 10mg/l - 20mg/l.  
Average suspended sediment concentration in bottom layer reduces to 2mg/l approximately 30km south of the Dogger Bank Creyke Beck A southern boundary and 8km north of the Dogger Bank Creyke Beck B northern boundary. | 300 x 4MW conical GBS foundations in each project.  
Minimum spacing (700m) with a wider spaced grid of foundations across the bulk of each project.  
In addition to the foundations, set of seven platforms (four collector, one converter and two accommodation), five meteorological masts and ten vessel moorings in each project have been incorporated in the layout for modelling.  
Maximum and average changes in suspended sediment concentration in the bottom layer and sediment thickness deposited from the plume based on 30-30-day model run after one year (a one-year storm is applied to one project (300 foundations) and a run of the model after two years (assuming both projects have been built 600 foundations are struck by a 50-year storm). |
<p>|                                                                        | <strong>After Two-Years Operation (50yr storm scenario).</strong> Maximum suspended sediment concentration ranges from &gt; 200mg/l across the western third of Dogger Bank Creyke Beck A and in patches across the southwest part of Dogger Bank Creyke Beck B and up to 8km to the west of each projects western |                                                                                                                                                                                                      |</p>
<table>
<thead>
<tr>
<th>Impact</th>
<th>Key design parameters forming the realistic worst case scenario</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>boundary. Across the whole of both projects, suspended sediment concentration are &gt;100mg/l.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suspended sediment concentrations reduce to 2mg/l approximately 55km southeast of the Dogger Bank Creyke Beck A southern boundary and 37km north of the Dogger Bank Creyke Beck B northern boundary.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average suspended sediment concentration in the bottom layer are between 50mg/l and 100mg/l across the western part of Dogger Bank Creyke Beck A and the southern part of Dogger Bank Creyke Beck B, and for 20km to the south of both projects. Concentrations reduce to 2mg/ up to approximately 50km south of the Dogger Bank Creyke Beck A southern boundary and 25km north of Dogger Bank Creyke Beck B northern boundary.</td>
<td></td>
</tr>
</tbody>
</table>

**Increase in sediment deposition following increase in suspended sediment concentration due to scour associated with foundations**

**After One-Year Operation (1yr storm scenario) - see Chapter 9 for more details**

- Maximum deposition is predicted to be within confines of Dogger Bank Creyke Beck A and B with range of 0.5mm - 5mm;
- Outside the boundaries of the projects, the maximum deposition falls to below 0.1mm approximately 33km from the southern boundary of Dogger Bank Creyke Beck A and 18km from the northern boundary of Dogger Bank Creyke Beck B;
- Average deposition is predicted to be less than 0.5mm within the confines of Dogger Bank Creyke Beck A and B, reducing to less than 0.1mm outside their boundaries; and
- In terms of persistency of deposited sediment, model predicts that deposition depth will be 0 (i.e. returning to baseline) by end of 30-day model period (therefore, no “additive” effect of sediment deposition via numerous events).

**300 x 4MW conical GBS foundations in each project.**

Minimum spacing (700m) with a wider spaced grid of foundations across the bulk of each project.

In addition to the foundations, set of seven platforms (four collector, one converter and two accommodation), five meteorological masts and ten vessel moorings in each project have been incorporated in the layout for modelling.

Maximum and average changes in suspended sediment concentration in the bottom layer and sediment thickness deposited from the plume based on 30-day model run after one year (a one-year storm is applied to one project (300 foundations) and a run of the model after two years (assuming both projects have been built and 600 foundations are struck by a 50-year storm).
### Impact

<table>
<thead>
<tr>
<th>Key design parameters forming the realistic worst case scenario</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>After Two-Years Operation (50yr storm scenario)</strong></td>
<td></td>
</tr>
<tr>
<td>- Occasional patches within both Dogger Bank Creyke Beck A and B and to their west reach maximum thicknesses of 10-50mm;</td>
<td></td>
</tr>
<tr>
<td>- Over the vast majority of each project and to 24km north of the Dogger Bank Creyke Beck B boundary and 33km south of the Dogger Bank Creyke Beck A boundary, the predicted maximum thickness is between 1mm and 5mm;</td>
<td></td>
</tr>
<tr>
<td>- Thicknesses reduce to below 0.1mm approximately 45km from the southern boundary of Dogger Bank Creyke Beck A and 35km from the northern boundary of Dogger Bank Creyke Beck B;</td>
<td></td>
</tr>
<tr>
<td>- Average deposition is predicted to be less than 5mm in northwest-southeast swathe across both projects and approximately 9km to the west of the Dogger Bank Creyke Beck B western boundary;</td>
<td></td>
</tr>
<tr>
<td>- Predicted average deposition reduces to less than 0.1mm approximately 37km to the south of the Dogger Bank Creyke Beck A southern boundary and 30km to the north of the Dogger Bank Creyke Beck B northern boundary; and</td>
<td></td>
</tr>
<tr>
<td>- In terms of persistency of deposited sediment, model predicts that deposition depth will be &lt;0.1mm (i.e. returning to baseline) by end of 30-day model period for most locations modelled, apart from location Q1 where sediment thickness after 30-day period was 0.14mm.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Introduction of new habitat from colonisation of the foundation structures</th>
<th>The introduction of new hard structures with a maximum surface area provided by the following project infrastructure:</th>
<th>The exact surface area (km²) available for colonisation is not able to be calculated but it will be greater than the figure presented for “footprint” of impact as the former is a 3-D metric, whilst the latter is 2-D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 300 x GBS #1 foundations;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Key design parameters forming the realistic worst case scenario

- GBS foundations for 5 x met-masts;
- GBS foundations for 4 x collector stations;
- GBS foundation for 1 x converter station;
- GBS foundation for 2 x accommodation blocks;
- Inter-array cable protection (incl. cable ends);
- Inter-platform cable protection;
- Inter-platform cable crossings;
- Export cable protection; and
- Export cable crossings.

### Decommissioning

<table>
<thead>
<tr>
<th>Impact</th>
<th>Key design parameters forming the realistic worst case scenario</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased suspended sediment concentration and sediment deposition</td>
<td>As per details (above) for increased suspended sediment concentration and sediment deposition during construction (although predicted to be much less in reality – see comment under rationale).</td>
<td>Any effects produced during decommissioning will be less than those described during the construction phase due to absence of seabed preparation or pile drilling, which are the main sources of increased suspended sediment concentration during the construction phase.</td>
</tr>
<tr>
<td>Loss of species colonising hard structures</td>
<td>As per details (above) for loss of permanent habitat during operation.</td>
<td>Assumed that all project infrastructure above seabed level will be removed during decommissioning.</td>
</tr>
<tr>
<td>Temporary disturbance to habitats via removal of cables</td>
<td>• Removal of up to 950km of inter array cables;</td>
<td>Assumed that all cables will be removed during decommissioning.</td>
</tr>
</tbody>
</table>

* All footprints for foundations inclusive of scour protection.
6 Assessment of Impacts during Construction

6.1 General

6.1.1 Within the Development Consent Order (DCO) the construction scenarios for Dogger Bank Creyke Beck A & B are set out as described in Section 5 to allow for flexibility in the programme. This flexibility is taken into account in the assessment of impacts during the construction phase.

6.1.2 As all of the impact assessments presented within Section 6 (construction phase), Section 7 (operation) and Section 8 (decommissioning) rely on sensitivity assessments provided by MarLIN (www.marlin.ac.uk), the relevant “factors” as defined by MarLIN are listed within each impact assessment. This provides a clear link between the impact statements presented below and these factors.

6.1.3 As outlined in Section 3, the most sensitive biotope to the relevant effect/factor being assessed has been used as the basis of assessment at all times. A full listing of which biotope sensitivity assessments have been used to inform this chapter is provided in Appendix 12H.

6.2 Physical disturbance to habitats and species and temporary habitat loss

Creyke Beck A or B in isolation

6.2.1 Works during construction required for installation of the offshore wind farm and the associated infrastructure (array cables, converters, substations, met masts, GBS foundations, export cables etc.), will result in the physical disturbance of benthic habitats and species within the study area. This will include the physical disturbance of habitats due to the introduction of side-cast and/or drill arising material from seabed preparation/foundation drilling works (note that a disposal site characterisation document is provided at Appendix 12J).

6.2.2 Based on the Marine Physical Processes assessment (Chapter 9), the worst-case scenario with respect to amounts of material released into the water column from seabed preparation and/or drilling of foundations (and subsequent formation of residual mounds of this material on the seabed), arises via installation of 12m monopole foundations.

6.2.3 This method of foundation installation will result in a worst case volume of 6,220 m³ of drill arisings being released at the sea surface, of which 42% (2,612 m³) is expected to settle rapidly to the seabed without entering any sediment plume.

6.2.4 Results from geotechnical assessments of the surface sediments show that the friction angle of the top 15-20cm of seabed sediment is around 30°, exemplary of that applying to loose granular sand (Appendix 9A). Immediately beneath the loose upper layer, the friction angle quickly rises indicatively to 45-50°.

6.2.5 An assumption is made that the non-suspended sediment initially forms a cone on the seabed with a friction angle of 30°. In its undisturbed state this would produce a 9m high cone with a circular seabed footprint of about 850 m² (diameter approximately 32m). However, due to subsequent reworking of the sediment pile by
waves and tidal currents, it will be reduced in height and distributed over a wider area of seabed.

6.2.6 The predominant tidal current directions are north and south, and the predominant wave direction is from the north, and so the sediment pile will be redistributed mainly in those directions to form a 32m wide (assuming little transport in other directions) sand wave. Natural sand waves across Tranche A have an average wavelength of 100m (range 50-150m) and average crest height of 0.5m (maximum 2m).

6.2.7 Therefore, for 12m monopole foundations, if a sand wave is assumed to form from 2,612m$^3$ of sediment, that is 100m wavelength and 30m wide, it will have a crest height of about 1.7m and an overall footprint of approximately 3,200m$^2$.

6.2.8 For the purpose of this assessment, it is judged that this deposition of drill arising material and subsequent formation of sandwaves of similar scale and form to those that already exist in parts of Tranche A represents temporary habitat disturbance as opposed to permanent habitat loss. Therefore, the overall footprint of these areas of sediment re-distribution are included in the overall amounts of temporary habitat disturbance assessed within this specific impact assessment.

6.2.9 The MarLIN factor relevant to this impact, and, therefore, used to inform this assessment is “physical disturbance and abrasion”.

6.2.10 The largest source of this temporary disturbance will be the installation of up to 950km of inter-array cables (assumed worst-case impact width of 10m giving impact footprint of 9.5km$^2$), with disturbance via installation of inter-platform cables (3.2km$^2$) and jacking-up of vessels (2.6km$^2$) and export cables (4.38km$^2$ for Creyke Beck A) and 3.96km$^2$ for Creyke Beck B) also being key elements of temporary disturbance during this phase. This figure of 2.6km$^2$ also includes any temporary disturbance of habitats that may occur due to pre-construction geotechnical surveys, both in the subtidal and intertidal environment.

6.2.11 Based on information presented in Section 5, a number of calculations were made to illustrate the specific maximum losses of each VER within each area of the development. Table 6.1 illustrates these maximum losses of VERs for Dogger Bank Creyke Beck and the export cable corridor.

6.2.12 In the absence of a finalised project layout showing exact locations of project infrastructure, the approach that has been adopted to assess potential impacts on benthic habitats has been to calculate the % of each habitat (VER) in both the main site and export cable corridor (and temporary working areas around these site boundaries) and then to apportion the overall footprint of any disturbance effects using the same proportions.

6.2.13 As an example, of the two VERs identified within Dogger Bank Creyke Beck A, VER A represents 77% of the overall site area, with VER B comprising the remaining 23%.

6.2.14 The worst-case scenario for physical disturbance during the construction phase amounts to 17.15km$^2$ within the main Creyke Beck A site. Therefore, for the purpose of this assessment, it is assumed that for Dogger Bank Creyke Beck A, 77.3% of this footprint (13.26km$^2$) will affect VER A and the remaining 22.7% (3.89km$^2$) will affect VER B. Using these assumptions, a realistic worst case assessment can be made as to the relative impact on these two habitat types for Dogger Bank Creyke Beck A or B in isolation.
Table 6.1  Proportion of VER habitats affected by temporary disturbance during the construction phase

<table>
<thead>
<tr>
<th>VER</th>
<th>Dogger Bank Creyke Beck A</th>
<th>Dogger Bank Creyke Beck B</th>
<th>Dogger Bank Creyke Beck A and B combined</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total area (km²) of VER</td>
<td>% of area covered by VER</td>
<td>Area (km²) of VER potentially affected (% of total area affected)</td>
</tr>
<tr>
<td><strong>Main Site</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A</td>
<td>459.18</td>
<td>77.32</td>
<td>13.26</td>
</tr>
<tr>
<td>Group B</td>
<td>134.69</td>
<td>22.68</td>
<td>3.89</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>593.87</td>
<td>100.00</td>
<td><strong>17.15</strong> (2.88% of main site)</td>
</tr>
<tr>
<td><strong>Export Cable</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A*</td>
<td>82.94</td>
<td>14.19</td>
<td>0.62</td>
</tr>
<tr>
<td>Group B*</td>
<td>53.05</td>
<td>9.08</td>
<td>0.40</td>
</tr>
<tr>
<td>Group C</td>
<td>236.29</td>
<td>40.43</td>
<td>1.77</td>
</tr>
<tr>
<td>Group D</td>
<td>77.05</td>
<td>13.18</td>
<td>0.58</td>
</tr>
<tr>
<td>Group E</td>
<td>110.92</td>
<td>18.98</td>
<td>0.83</td>
</tr>
<tr>
<td>Group F</td>
<td>22.53</td>
<td>3.85</td>
<td>0.17</td>
</tr>
<tr>
<td>Group G</td>
<td>1.70</td>
<td>0.29</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>584.48</td>
<td>100.00</td>
<td><strong>4.38</strong> (0.75% of export cable corridor)</td>
</tr>
</tbody>
</table>

* These values take account of the areas of VER in the different export cable corridors for Dogger Bank Creyke Beck A & B up to the point where the corridors merge.
6.2.15 From Table 6.1 it can be noted that when looking at total area affected by temporary disturbance in the main site boundaries of Dogger Bank Creyke Beck A & B (inclusive of the temporary working areas of 1km around each site), the main VER affected will be VER A which is the dominant group within the main site boundary of both sites.

6.2.16 Using the assumption outlined above with respect to the proportion of this VER that will be affected by temporary disturbance within the main site, it is predicted that 13.26km² of VER A in the main site of Dogger Bank Creyke Beck A will be impacted. 3.89km² of VER B will also be impacted. In Dogger Bank Creyke Beck B, it is predicted that 11.40km² of VER A will be affected by temporary disturbance as well as 5.61km² of VER B. These areas of temporary habitat disturbance amount to 2.88% and 2.51% of the overall area of Creyke Beck A and Creyke Beck B main sites respectively.

6.2.17 All of the biotopes within VERs A and B comprise species that are adapted to high energy environments and are therefore naturally subject to, and tolerant of, high levels of physical disturbance, i.e. they show high levels of recoverability. However, temporary habitat disturbance from construction works may result in the exposure of previously buried infauna, which in turn may increase the vulnerability of these species to predation from other organisms, such as fish and/or echinoderms (starfish). Even if there is some limited predation, and thus mortality of species, significant declines in overall species richness are unlikely to be seen. The recoverability of these communities is, therefore, assessed as high (Budd 2008a; Rayment 2008a) and overall (ecological) sensitivity to physical disturbance and abrasion is assessed as low.

6.2.18 In terms of predicting the impact, although the value of VER A and VER B are defined as international (see Table 3.2 and 4.4), the actual (EIA) sensitivity of these VERs is classed as low (Table 3.3), as they both exhibit low vulnerability and high recoverability to this effect (physical disturbance and abrasion). In terms of the magnitude of the effect in question, based on the criteria in Table 3.4, this is judged to be low, as the effects have a limited spatial extent (1-5% of the study area) and there will only be a slight change to existing conditions (i.e. the existing biotope distribution is not predicted to change as a result of this effect). Therefore, with low sensitivity and low magnitude, a negligible impact on VERs A and B within the main site is predicted via temporary disturbance during construction for both Dogger Bank Creyke Beck A & B.

6.2.19 With respect to the export cable corridor, all seven VERs are recorded within this area, with VERs C and E representing the most widely distributed groups in this area. In terms of impacts via temporary physical disturbance and abrasion on these VERs, the overall (EIA) sensitivity of VERs A and B is still low, as per the reasons outlined in the preceding paragraph. VERs C, D, E and G are also judged to have a low sensitivity to this effect based on information provided by MarLIN. Based on Table 3.4, the overall magnitude of this effect on VERs C, D, E and G is predicted to be low as the spatial extent of effect is small (within the 1-5% of the wider study area affected category) and only a slight change in baseline conditions is expected. Therefore, the low sensitivity and low magnitude of effect as identified for the main site, results in a prediction of negligible impact on these VERs due to temporary disturbance via export cable installation.
6.2.20 For VER F (potential *Mytilus* based biogenic reef), if this biotope is confirmed to be present as indicated in **Figure 4.12**, it will be subject to temporary disturbance due to it being identified as occurring across the entire width of the export cable corridor. In terms of the value of this VER, this has been assigned as national, since although this habitat does not lie within a SAC boundary, the component biotope can represent Annex I habitat (biogenic reef).

6.2.21 With respect to the sensitivity of this biotope, the most relevant MarLIN factor for this effect is considered to be “displacement”, as whilst cable installation may result in some limited direct mortality of any subtidal mussels, it is more likely that installation of the cables will result in the displacement of mussels from disturbed areas to adjacent areas. The SS.SBR.SMus.MytSS biotope that comprises this VER has a low (ecological) sensitivity to displacement as this biotope has high recoverability to this effect. Therefore, based on the criteria presented in **Table 3.3** to define sensitivity of receptors, this VER is judged to have an overall (EIA) sensitivity of low with respect to displacement.

6.2.22 With respect to magnitude of effect, the installation of cables through this habitat will result in a low magnitude of effect (see **Table 3.5**) as only 0.17km$^2$ of the 22.53km$^2$ of this habitat recorded within the export cable corridor of either project will be affected, equating to 0.8% of the overall extent of this particular habitat. It is likely that the extent of this habitat also extends beyond the boundaries of the surveyed area; therefore, the 0.8% of overall habitat affected is likely to be a conservative (i.e. maximum) value. If the entire extent of this habitat was mapped, the area affected as a proportion of overall habitat, would be expected to be less than 0.8%. Therefore, the low sensitivity of this VER and low magnitude of effect combine to create a **negligible** impact via displacement caused by the temporary disturbance from cable installation.

6.2.23 For the small proportion of mussels that may be expected to suffer mortality as a result of cable installation, the sensitivity of the same receptor (VER F) to this effect is judged to be very high as the feature has a national value with no ability for recovery once mortality has occurred.

6.2.24 Due to the much smaller proportion of mussels that are predicted to experience mortality compared to displacement, the magnitude of effect is judged to be negligible as the spatial extent of any mortality will be very limited and the wider baseline conditions (the SS.SBR.Smus.MytSS biotope) are expected to remain unchanged.

6.2.25 Therefore, the combination of very high sensitivity and negligible magnitude results in a **minor adverse** impact on mussels that form a component part of this biotope due to direct mortality from cable installation in this nearshore part of the export cable corridor.

**Creyke Beck A and B together**

6.2.26 If both Dogger Bank Creyke Beck A & B are constructed together, the increased amount of project infrastructure will result in an increased footprint of temporary disturbance across the two projects, as shown in **Table 6.1**. All calculations for the main site (excluding the export cable corridor) were based on 300 x 4MW turbines, and a similar inter-array cable layout.
6.2.27 From Table 6.1, it can be noted that 34.16km² of the total area of Dogger Bank Creyke Beck A & B combined (1,270.20km²) will be affected by temporary disturbance during the construction phase. This equates to 2.68% of the total main site(s). As noted above, the only VERs present in both sites are VERs A and B, both of which have been assessed as having a low sensitivity to physical disturbance. With the low magnitude of effect, a similar conclusion of negligible impact is predicted.

6.2.28 For the export cable corridor, the footprint of effect is greater for both projects combined due to the installation of more export cables. However, the proportions of VERs along the export cable corridor affected by temporary disturbance remain small, with the 8.34km² of disturbance representing 1.28% of the total habitats within the export cable corridors of Dogger Bank Creyke Beck A & B.

6.2.29 As per the assessment of each project in isolation, the sensitivity of all of these VERs is judged to be low, based on information provided by MarLIN, which, coupled with the same low magnitude of effect as identified for the main site, will result in a prediction of negligible impact on these VERs due to temporary disturbance via export cable installation associated with both projects.

6.3 Increased suspended sediment concentration and sediment deposition

Creyke Beck A or B in isolation

6.3.1 During the construction phase, there will be temporary increases in suspended sediment concentration and subsequent deposition of sediment as a result of a range of activities, including cable installation, seabed preparation for foundation installation and jacking-up activities. The worst-case scenario for this impact, as defined in Table 5.1 (above) is based on the installation of 24 x 12m diameter monopile foundations via drilling, with subsequent release of drill arisings into the water column and also installation of inter-array and export cables within a 30-day period. The location of these 24 foundations in terms of the modelling process was chosen as the western part of the site, due to the proximity of more sensitive benthic receptors and also sandeel habitat.

6.3.2 The MarLIN factors relevant to this impact, and therefore used to inform this assessment are “increased suspended sediment concentrations” and “smothering”. Data from the physical process modelling relevant to these factors are presented below, with outputs related to suspended sediment concentrations presented first, followed by outputs relevant to sedimentation (smothering).

6.3.3 Outputs of plume modelling have been used to define this effect, with levels of suspended sediment concentration above background levels (assessed as <2mg/l, based on Eisma and Kalf 1987) generated for a range of scenarios. Based on the worst-case scenario with respect to suspended sediment concentration outlined above in Table 5.1, a maximum suspended sediment concentration (depth-averaged) of >200mg/l is predicted from source of effect to approximately 11km in a northwest direction.
6.3.4 The model outputs also predict that the maximum distance from the source that depth-averaged suspended sediment concentration will remain above background levels (of 2mg/l) is approximately 45km to the south.

6.3.5 Whilst depth-averaged suspended sediment concentration is of interest, with respect to benthic and epibenthic communities, it is near-bed (within 5cm of the seabed) suspended sediment concentration values that are of particular relevance, as this is the area in which benthic and epibenthic communities exist. Near-bed suspended sediment concentration was predicted as being between 20mg/l and 50mg/l above background, within the confines of the 24 foundations modelled and extending approximately 9km to the northwest of the source of the effect. Near-bed suspended sediment concentration reduces to background (2mg/l) within 14km east and 45km to the south of the source of effect.

6.3.6 With respect to the export cable corridor, only small increases in the near-bed suspended sediment concentration above background were predicted as a result of cable installation.

6.3.7 Sedimentation values generated by the modelling work indicate that an average deposition depth of 1-5mm will occur within the confines of the foundations and up to 14km north of the source of the effect, decreasing to <0.5mm more than 15km away.

6.3.8 In terms of the persistence of deposited sediment, time series analysis of sediment thickness at several discrete points within and outside the site indicate that within the modelled foundation layout, deposited sediment will persist at thicknesses greater than 1mm for a continuous period of up to 178 hours at any time throughout the 30 day modelling period. Thicknesses of greater than 10mm could persist for a maximum continuous period of 26 hours. To the west of the layout (in the vicinity of the sandeel habitat), deposition at any one time throughout the 30-day simulation period was predicted to not exceed 0.4mm. The predicted bed thickness at the end of the 30-day simulation was equal to or less than 0.1mm across the whole of the footprint. This latter statement is important because it indicates the lack of potential for any “additive” effect of sediment deposition in parts of the site and, therefore, the maximum depths outlined above represent the actual maximum values predicted to arise.

6.3.9 In terms of impact on benthic and epibenthic communities, any increase in suspended sediment concentration (and sedimentation) would have different effects depending on the nature of the species affected. Deposit feeders, including many polychaetes, are likely to favour an increase in sedimentation as this can often lead to introduction of organic materials from a greater proportion of fine sediments in the substrate. In contrast, suspension (filter) feeders, which will form part of more diverse epibenthic communities within the site, will be more sensitive to increased suspended sediment concentration as this may have adverse impacts on fitness (due to clearing fine sediment from pores and canals (Jackson & Hiscock 2008).

6.3.10 Based on sensitivity assessments provided by MarLIN, of the two main VERs identified within the main site boundary, both VERs A and B comprise biotopes that have a very low (ecological) sensitivity to increased suspended sediment concentrations. This is due to the low intolerance and high recoverability of the biotopes within these VERs (FlabMag for VER A and MoeVen and MedLumVen for VER B) to this effect or factor.
6.3.11 In terms of actual impact, although the values of VER A and VER B are defined as International (see Table 4.3), the actual sensitivity of these VERs is classed as low, as they both exhibit low vulnerability to increased suspended sediment concentration and high recoverability to any such effects. In terms of the magnitude of the effect in question, based on the criteria in Table 3.4, this is judged to be high as the spatial extent of the plumes will cover >10% of the wider study area and will occur over the long term (>2 years). Therefore, with low sensitivity and high magnitude, a minor adverse impact on VERs A and B is predicted via increased suspended sediment concentration in the main site.

6.3.12 In terms of the remaining VERs C to G, i.e. those present within the Creyke Beck B export cable corridor and outside the boundary of the cSAC, these also exhibit either very low or no sensitivity to increased suspended sediments, and based on criteria in Table 3.3, are judged to have a negligible (EIA) sensitivity to this effect.

6.3.13 In terms of the magnitude of the effect in question, based on the criteria in Table 3.4, this is judged to be low for all of the VERs, resulting in a negligible impact on all of the VERs along the export cable corridor via increased suspended sediment concentration.

6.3.14 With respect to sedimentation, the relevant MarLIN factor here is smothering. VERs A and B comprise mainly infaunal biotopes and have a very low (ecological) sensitivity to this effect/factor due to a low intolerance and high recoverability. The biotopes that comprise VERs A and B are considered to be tolerant of occasional smothering (on account of naturally occurring storm events) and also from exposure to bottom trawling activity.

6.3.15 In terms of the magnitude of effect, this is also judged to be low based on the criteria in Table 3.4, resulting in a negligible impact on VERs A and B via smothering.

6.3.16 With respect to the export cable corridor, the same conclusions apply with regard to sensitivity. The magnitude of effect is also assessed as low, although it is noted that any sedimentation effects via cable installation will be even less than those noted within the main site via foundation and cable installation. Therefore, a negligible impact is predicted on benthic habitats within the export cable corridor due to sedimentation produced via the construction process.

Creyke Beck A and B together

6.3.17 As set out in Chapter 5, Dogger Bank Creyke Beck A & B may either be constructed simultaneously or sequentially with an up to 2.5 year gap between construction. Should construction of both projects take place at the same time, there is the potential for increased levels of effect due to the potential interaction of sediment plumes and their deposition on the seabed.

6.3.18 However, given the conclusions drawn from the modelling studies for each project in isolation (namely that any increases in suspended sediment concentration and sedimentation will be low level and short-lived, and the receptors are of low sensitivity to the effect), additional impacts from the construction of both projects together are unlikely. Any impacts are predicted to remain as negligible.
6.4 Release of sediment contaminants resulting in potential effects on benthic ecology

Creyke Beck A or B in isolation

6.4.1 The mobilisation of sediments via the same processes outlined in the preceding impact assessments, i.e. cable installation, seabed preparation and foundation installation, could lead to the release of any contaminants that may be present within the sediments.

6.4.2 Data on contaminant levels within the Dogger Bank Creyke Beck project areas and the export cable corridor were obtained via site-specific surveys. These data (see Table 4.1, also Chapter 10) indicate that the levels of contaminants, particularly in the offshore area where sediment re-suspension concentrations are predicted to be the largest, is relatively low i.e. the majority of the contaminant levels are below the Cefas Action Level 1 and Canadian Sediment Quality Guidelines TEL values.

6.4.3 In the export cable corridor, concentrations of contaminants are generally higher but still below Cefas Action Level 2 and Canadian Sediment Quality Guidelines PEL. The exception is Site 8 where concentrations of lead and arsenic are above the PEL. Increased concentrations of suspended solids resulting from the installation of the export cables are, however, predicted to be significantly less than that for the foundations and therefore the risks of re-suspending significant amounts of contaminants are reduced.

6.4.4 Within the main Dogger Bank Creyke Beck A & B sites, the two VERs present both comprise biotopes that have a moderate sensitivity to contamination via heavy metals, hydrocarbons and synthetic compounds. Based on criteria in Table 3.3, the overall sensitivity of these receptors is judged to be medium as although they are internationally important habitats, they will exhibit at least a medium recoverability to this effect should it arise.

6.4.5 The magnitude of this effect is judged to be negligible due to the low level of contaminants recorded within the main sites, therefore, an overall impact of negligible significance is predicted on the benthic receptors (VER A and B) within the main sites due to contamination from sediments mobilised in the construction phase.

6.4.6 Compared to the very low levels of sediment contaminant levels within the Dogger Bank Creyke Beck project areas, levels are greater in places within the export cable corridor, in particular in the nearshore areas, with sampling station 8 in particular having concentrations of lead and arsenic above the PEL.

6.4.7 Contaminant sampling station 8 is located in the part of the export cable corridor characterised by VER D (coarse sediments with medium to high diversity benthic communities which form part of the Annex I Sandbank Feature - outside boundary of cSAC). The biotopes within VER D have a moderate sensitivity to sediment contamination (as defined by MarLIN) but have been assigned an overall sensitivity of low (based on the criteria in Table 3.3).

6.4.8 The magnitude of any potential contaminant re-mobilisation effect is judged to be low due to the low levels of sediments likely to be mobilised via construction in this area (sediment release from export cable installation will be much less than that within the
main site via seabed preparation) – see Table 5.1. Therefore, a negligible impact is predicted on benthic receptors along the export cable corridor via sediment contaminant re-mobilisation.

6.5 Increased suspended sediment concentration leading to impacts on plankton and primary productivity

Creyke Beck A or B in isolation

6.5.1 Phytoplankton production on the Dogger Bank occurs throughout the year supporting a high biomass of species at higher trophic levels year-round (Section 4).

6.5.2 As outlined in the previous impact statement, the construction phase of this project will lead to an increase in suspended sediment concentration via foundation installation and cable installation within the main site and cable installation within the export cable corridor.

6.5.3 Whilst the potential impacts of these effects on benthic habitats are assessed above, this assessment addresses the potential for increased suspended sediment concentration, and the consequent increase in turbidity produced as a result, to create adverse impacts on phytoplankton and hence, primary productivity.

6.5.4 A detailed assessment of the impact on increased suspended sediment concentration and related turbidity on phytoplankton production in the Dogger Bank region is not possible due to a lack of specific data on the sensitivity of phytoplankton assemblages to different levels of suspended sediment concentration. However, it is possible to state, in a relatively broad sense that increased suspended sediment concentration, and the resultant increase in turbidity, can adversely affect phytoplankton productivity, due to the reduction in light penetration through the water column. From the outputs of the modelling work done in relation to suspended sediment concentration, increases of >200 mg/l above baseline suspended sediment concentration can be noted in the construction phase, which has the potential to create adverse effects on phytoplankton.

6.5.5 However, the spatial extent of any such increases are small when compared to the wider North Sea region, or even the wider Dogger Bank feature itself, which is noted to be a particular focus for primary production, even in winter months. As such, any temporary increases created via the construction phase are predicted to create a negligible impact.

Creyke Beck A and B together

6.5.6 If Dogger Bank Creyke Beck A &B are built together the spatial extent of any increases in suspended sediment concentration (and turbidity) will be greater than when either project is built in isolation. However, when built together only half the number of wind turbines would be constructed at the same time in each individual site. From this it follows that the actual increase in suspended sediment concentration (and turbidity) are likely to be lower in both sites when Dogger Bank Creyke Beck A & B are built together than when either project is built alone. Taking the above in to account the same predictions of negligible impact that were predicted for the in isolation scenario apply for the build together scenario.
6.6 Physical disturbance to intertidal habitats and species during landfall works

Creyke Beck A or B in isolation

6.6.1 HDD will be undertaken at the landfall in order that marine export cables and terrestrial export cables can be joined. There will also be a need to construct a joint transition bay to enable cable jointing works to take place. The main uncertainties in the construction methodology are where and how the HDD component of the onshore cables will be connected to the landing points of the export cables at the coast.

6.6.2 There are three potential exit points for HDD in the nearshore zone:

- On the beach, above the high water mark;
- In the intertidal zone between the low water and high water marks; and
- Offshore in the subtidal zone seaward of the low water mark.

6.6.3 Whichever option is chosen, there will be temporary disturbance to intertidal habitats at the landfall via construction of these joint transition bays, which are likely to be maintained by the use of temporary cofferdams.

6.6.4 Scenarios for a single project only (Dogger Bank Creyke Beck A or B) are assumed to require installation of either two small cofferdams (10m x 10m x 3m) or one large cofferdam (15m x 10m x 3m) over a two-month period.

6.6.5 Up to 600m$^3$ of beach sediment and underlying till would be excavated to create two 10m x 10m x 3m cofferdams, whereas a larger 15m x 10m x 3m cofferdam would require excavation of up to 450m$^3$ of sediment.

6.6.6 A single VER has been assigned to cover all of the intertidal biotopes (VER G), which has been classed as having a negligible (EIA) sensitivity (as per criteria in Table 3.3) due to VER G comprising of locally important receptors with low vulnerability to the effect in question (physical disturbance and abrasion), and having a medium to high recoverability. The magnitude of effect is assessed as low (0.01km$^2$ which represents 0.5% i.e. a very small area); therefore a negligible impact on intertidal habitats as a result of proposed landfall works is predicted.

Creyke Beck A and B together

6.6.7 For the development of Dogger Bank Creyke Beck A & B together, the scenario is the same as above, but with a larger area of effect due to a need for either four small cofferdams (1,200m$^3$ of beach sediment) or two large cofferdams (900m$^3$ of beach sediment) over a four-month period. This longer duration between construction and removal of the cofferdams is considered the worst case scenario for the landfall. However, the same conclusions with respect to the sensitivity of the intertidal VER and magnitude of effect apply, and a negligible impact is predicted.
6.7 Potential construction phase impacts on the Dogger Bank cSAC

Creyke Beck A or B in isolation

6.7.1 A detailed assessment of the potential for impacts on benthic habitats within the Dogger Bank cSAC to affect the conservation objectives of this site, and therefore, the integrity of the overall site, is presented in the HRA Report. Therefore, the following assessment acts as a link between the construction phase marine ecology impacts described up to this point and potential effects of these on the Dogger Bank cSAC, as assessed under the Habitats Regulations in the HRA Report.

6.7.2 The previous impact assessments have focussed on VERs within the main site and export cable corridor, in terms of the amount of these habitats affected as a proportion (%) of the overall habitats in the site/corridor and the overall ecological sensitivity of the habitats. For this impact assessment, the footprint of effects is defined in the context of the Dogger Bank cSAC site boundary, as defined in the latest SAC Selection Assessment Document (JNCC Version 9.0, August 2011).

6.7.3 The total area of the Dogger Bank cSAC is given as 12,331km². A summary of the areas (km²) of Dogger Bank Creyke Beck A & B that lie within the boundaries of the cSAC are provided below in Tables 6.2 and 6.3, with the predicted footprint of construction phase effects as identified in preceding impact statements, presented as a proportion of the cSAC in Tables 6.4 and 6.5.

Table 6.2 Dogger Bank Creyke Beck A as a proportion of the Dogger Bank cSAC

<table>
<thead>
<tr>
<th>Area</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of cSAC</td>
<td>12,331km²</td>
</tr>
<tr>
<td>Area of Dogger Bank Creyke Beck A main site within cSAC boundary</td>
<td>593.87km²</td>
</tr>
<tr>
<td>Area of Dogger Bank Creyke Beck A export cable corridor in cSAC boundary</td>
<td>79.53km²</td>
</tr>
<tr>
<td>Total area of Dogger Bank Creyke Beck A (main site and export cable corridor) within cSAC boundary</td>
<td>673.4km²</td>
</tr>
<tr>
<td>Total area of Dogger Bank Creyke Beck A (main site and export cable corridor) within cSAC boundary as % of overall cSAC</td>
<td>5.46%</td>
</tr>
</tbody>
</table>

Table 6.3 Dogger Bank Creyke Beck B as a proportion of the Dogger Bank cSAC

<table>
<thead>
<tr>
<th>Area</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of cSAC</td>
<td>12,331km²</td>
</tr>
<tr>
<td>Area of Dogger Bank Creyke Beck B main site within cSAC boundary</td>
<td>676.33km²</td>
</tr>
<tr>
<td>Area of Dogger Bank Creyke Beck B export cable corridor in cSAC boundary</td>
<td>27.8km²</td>
</tr>
<tr>
<td>Total area of Dogger Bank Creyke Beck B (main site and export cable corridor) within cSAC boundary</td>
<td>704.13km²</td>
</tr>
<tr>
<td>Total area of Dogger Bank Creyke Beck B (main site and export cable corridor) within cSAC boundary as % of overall cSAC</td>
<td>5.71%</td>
</tr>
</tbody>
</table>
Table 6.4  Dogger Bank Creyke Beck A construction phase effect footprints as a proportion of the Dogger Bank cSAC

<table>
<thead>
<tr>
<th>Area</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of cSAC</td>
<td>12,331km²</td>
</tr>
<tr>
<td>Maximum footprint of construction phase effects (temporary disturbance) within Dogger Bank Creyke Beck A main site / cSAC</td>
<td>17.15km²</td>
</tr>
<tr>
<td>Maximum footprint of construction phase effects (temporary disturbance) within Dogger Bank Creyke Beck A export cable corridor * / cSAC</td>
<td>0.94km²</td>
</tr>
<tr>
<td>Total footprint of construction phase effects (temporary disturbance) within Dogger Bank Creyke Beck A and export cable corridor * / cSAC</td>
<td>18.09km²</td>
</tr>
<tr>
<td>Construction phase effect footprint as % of overall cSAC</td>
<td>0.15%</td>
</tr>
</tbody>
</table>

* Only the footprint of effect within the parts of the export cable corridor that lie within the cSAC boundary are listed here.

Table 6.5  Dogger Bank Creyke Beck B construction phase effect footprints as a proportion of the Dogger Bank cSAC

<table>
<thead>
<tr>
<th>Area</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of cSAC</td>
<td>12,331km²</td>
</tr>
<tr>
<td>Maximum footprint of construction phase effects (temporary disturbance) within Dogger Bank Creyke Beck B main site / cSAC</td>
<td>17.01km²</td>
</tr>
<tr>
<td>Maximum footprint of construction phase effects (temporary disturbance) within Dogger Bank Creyke Beck B export cable corridor * / cSAC</td>
<td>0.34km²</td>
</tr>
<tr>
<td>Total footprint of construction phase effects (temporary disturbance) within Dogger Bank Creyke Beck B and export cable corridor * / cSAC</td>
<td>17.35km²</td>
</tr>
<tr>
<td>Construction phase effect footprint as % of overall cSAC</td>
<td>0.14%</td>
</tr>
</tbody>
</table>

* Only the footprint of effect within the parts of the export cable corridor that lie within the cSAC boundary are listed here.

6.7.4  From Table 6.2, it can be noted that the entire area of Dogger Bank Creyke Beck A/B and relevant parts of the export cable corridor that lie within the cSAC boundary totals 673.4/704.13km² (5.46/5.71% of the overall cSAC area). However, in terms of actual footprint of construction phase effects via direct disturbance, this totals just 18.09/17.35km², which represents approximately 0.15% and 0.14% of the overall cSAC area for Dogger Bank Creyke Beck A & B respectively. Whilst noting the very small proportion of the overall cSAC that would be affected by temporary disturbance during construction, it is also important to note that the majority of habitats that would be affected within the cSAC boundary also have a low sensitivity to disturbance.

6.7.5  With respect to effects of suspended sediment concentration and sedimentation, the spatial extent of this effect footprint is greater than that for direct physical disturbance but will still be a relatively small proportion of the overall cSAC area. As outlined in the preceding impact assessments, the habitats present within the Dogger Bank cSAC (VERs A and B) also exhibit a low sensitivity to suspended sediment concentrations and sediment deposition.

6.7.6  An assessment of the significance of these impacts on the Dogger Bank cSAC under the Habitats Regulations is presented in the HRA Report.
Creyke Beck A and B together

6.7.7 Table 6.6 indicates a total footprint of temporary disturbance from both Dogger Bank Creyke Beck A & B of 0.29% of the cSAC, representing a very small proportion of the overall habitats within the cSAC (which can be expected from the information available to be similar to those recorded in the study area). Therefore, the same conclusions made above in relation to Dogger Bank Creyke Beck A or B in isolation and the conservation objectives of the cSAC are predicted to remain valid for Dogger Bank Creyke Beck A & B together.

Table 6.6 Dogger Bank Creyke Beck A and B construction phase effect footprints as a proportion of the Dogger Bank cSAC

<table>
<thead>
<tr>
<th>Area</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of cSAC</td>
<td>12,331km²</td>
</tr>
<tr>
<td>Maximum footprint of construction phase effects (temporary disturbance) within Dogger Bank Creyke Beck A &amp; B main sites / cSAC</td>
<td>34.16km²</td>
</tr>
<tr>
<td>Maximum footprint of construction phase effects (temporary disturbance) within Dogger Bank Creyke Beck A &amp; B export cable corridor * / cSAC</td>
<td>1.28km²</td>
</tr>
<tr>
<td>Total footprint of construction phase effects (temporary disturbance) within Dogger Bank Creyke Beck A &amp; B and export cable corridors * / cSAC</td>
<td>35.44km²</td>
</tr>
<tr>
<td>Construction phase effect footprint as % of overall cSAC</td>
<td>0.29%</td>
</tr>
</tbody>
</table>

* Only the footprint of effect within the parts of the export cable corridor that lie within the cSAC boundary listed here.

6.7.8 As outlined above, an assessment of the potential for these impacts to affect the integrity of the cSAC, from a Habitats Regulations perspective, is contained in the HRA Report. The HRA Report provides sufficient information to enable a competent authority to undertake an Appropriate Assessment of the proposals. The Appropriate Assessment process will formally consider any marine ecological impacts (and other impacts) against the structure and function and conservation objectives of the Dogger Bank cSAC (as well as other SAC/SPA sites) so that a determination of potential effects on the integrity of these sites can be undertaken.

6.8 Potential construction phase impacts on the Flamborough Head SAC

Creyke Beck A or B in isolation

6.8.1 Whilst the potential for construction activities to cause marine ecological impacts on the Dogger Bank cSAC has been the focus of the assessment up to this point, the screening exercise undertaken as part of the HRA process also identified the potential for indirect impacts from the construction phase on habitats within the Flamborough Head SAC, specifically, reefs and submerged and partially submerged sea caves.

6.8.2 Unlike the Dogger Bank cSAC, there is no scope for direct impacts during the construction phase as the boundary of the Flamborough Head SAC does not overlap with the project boundary.
6.8.3 Therefore, the only potential source of impact will be increased suspended sediment concentrations and subsequent deposition on the SAC features during export cable installation. Based on the worst-case scenario for export cable installation (see Table 5.1), peak suspended sediment concentrations are predicted to increase between 5mg/l and 8mg/l above background levels for no more than three days. Background concentrations of suspended sediments in this area can range from 5mg/l to 85mg/l, therefore, these predicted increases based on peak concentrations produced via export cable installation are judged to be within the range of natural variability.

6.8.4 When depth-averaged mean suspended sediment concentrations are assessed, these values indicate that increased concentrations will not occur within the boundaries of the SAC.

6.8.5 A full assessment, under the Habitats Regulations, of potential impacts on Flamborough Head SAC, including marine ecological effects, is provided in the HRA Report.

Creyke Beck A and B together

6.8.6 Dogger Bank Creyke Beck A & B may either be constructed simultaneously or sequentially with an up to 2.5 year gap between construction. Should construction of both projects take place at the same time, there is the potential for increased levels of effect due to the potential interaction of sediment plumes and their deposition on the seabed.

6.8.7 However, given the conclusions drawn from the modelling studies for each project in isolation (namely that any increases in suspended sediment concentration and sedimentation will be low level and short-lived), additional impacts on Flamborough Head SAC from the construction of both projects together are unlikely.

6.9 Potential construction phase impacts on sites of marine conservation interest

Creyke Beck A or B in isolation

6.9.1 The preceding impact assessments have discussed the potential for construction activities to produce effects that may impact benthic habitats in the Dogger Bank Creyke Beck study area. The benthic habitats have been grouped into VERs as per the approach set out in Section 3.3, with these VERs representing the receptors against which impacts have been assessed.

6.9.2 This particular impact assessment discusses the effects on benthic habitats described previously in the context of the following sites of marine nature conservation interest, for which examples occur within and around the Dogger Bank Creyke Beck study area;

- UK BAP Habitats;
- Recommended Marine Conservation Zones (rMCZs); and
- OSPAR habitats and species.
6.9.3 It is important to note that potential impacts on the ecological elements of the sites of marine conservation interest listed above have already been assessed via the individual impact assessments presented up to this point. Therefore, to avoid repetition in the assessment process, the assessment of potential construction phase impacts on sites of marine conservation interest are presented below as a series of summary tables which make reference to the conclusions of previous impact assessments.

6.9.4 It should also be recognised that the preceding impact assessments have all been undertaken via an assessment of the sensitivity of receptors and the magnitude of effect. For the benthic receptors (VERs), the overall EIA sensitivity has been determined via a combination of ecological sensitivity of the receptor to a particular effect, as well as the value of the receptor, for example, whether or not it represents Annex I habitat. The value element of receptor sensitivity (see Table 3.2) already takes account of whether or not a habitat or species may be of conservation interest, which is therefore inherent within the assessment methodology.

6.9.5 The “receptor” heading in the following tables refers to the habitat/species of marine conservation interest (BAP Habitats in Table 6.7 and rMCZs in Table 6.8) with the column headed “relevant VERs” identifying the VERs (as defined in Table 4.4) that apply to those habitats/species. The impact descriptions are those assessed previously via individual impact assessments, with any relevant mitigation and the residual impact from these previous impact assessments also presented.

Table 6.7 Potential construction phase impacts on BAP habitats

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Relevant VERs (see Table 4.4)</th>
<th>Impact description</th>
<th>Mitigation</th>
<th>Residual impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Subtidal sands and gravels” BAP Habitat and “Mud habitats in deep water” BAP Habitat</td>
<td>A, B, C, D and E</td>
<td>Physical disturbance to habitats and species, and temporary habitat loss</td>
<td>None</td>
<td>Negligible</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increased suspended sediment concentration and sediment deposition</td>
<td>None</td>
<td>Minor adverse (VERs A and B) Negligible (VERs C, D and E)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Release of sediment contaminants resulting in potential effects on benthic ecology</td>
<td>None</td>
<td>Negligible</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increased suspended sediment concentration leading to impacts on plankton and primary productivity</td>
<td>None</td>
<td>Negligible</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physical disturbance to intertidal habitats and species during landfall works *</td>
<td>NA *</td>
<td>NA *</td>
</tr>
</tbody>
</table>

* This impact (intertidal) not relevant to the two subtidal and deep water BAP habitats relevant to the study area. Therefore, no residual impact listed.

6.9.6 Based on the previous impact assessments conducted on the benthic receptors (VERs) that are also representative of these two BAP habitats, it is concluded that, overall, there will be a negligible impact on the two marine BAP habitats within the Dogger Bank Creyke Beck study area (Table 6.7).
### Table 6.8  Potential construction phase impacts on rMCZs

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Relevant VERs (see Table 4.4)</th>
<th>Impact description</th>
<th>Mitigation</th>
<th>Residual impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holderness Inshore rMCZ</td>
<td>C and F</td>
<td>Physical disturbance to habitats and species and temporary habitat loss</td>
<td>None</td>
<td>Negligible</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increased suspended sediment concentration and sediment deposition</td>
<td>None</td>
<td>Negligible</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Release of sediment contaminants resulting in potential effects on benthic ecology</td>
<td>None</td>
<td>Negligible</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increased suspended sediment concentration leading to impacts on plankton and primary productivity</td>
<td>None</td>
<td>Negligible</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physical disturbance to intertidal habitats and species during landfall works *</td>
<td>None</td>
<td>Negligible</td>
</tr>
<tr>
<td>Holderness Offshore rMCZ</td>
<td>C, D and F</td>
<td>Same as above apart from physical disturbance to intertidal habitats</td>
<td>As above</td>
<td>As above</td>
</tr>
</tbody>
</table>

6.9.7 Based on the previous impact assessments conducted on the benthic receptors (VERs) that are also representative of features within the two rMCZs relevant to this project (see Table 4.4), it is concluded that, overall, there will be a negligible impact on the features of either the Holderness Inshore rMCZ and/or the Holderness Offshore rMCZ as a result of construction associated with the Dogger Bank Creyke Beck project (Table 6.8).

6.9.8 With respect to potential impacts on OSPAR threatened species and habitats, no such species or habitats are recorded within the Dogger Bank Creyke Beck study area, therefore, no impacts are predicted.

**Creyke Beck A and B together**

6.9.9 The previous VER based impact assessments concluded that even if Dogger Bank Creyke Beck A and B were constructed together, there would be no change in the level of any of the impacts predicted via either project being constructed in isolation. Therefore, the conclusions with respect to potential impacts on BAP habitats and rMCZs presented above are also relevant to this scenario.

### 6.10 Monitoring of construction phase impacts

6.10.1 Although no significant adverse impacts are predicted on marine and intertidal ecology from the construction phase of the project, it is proposed that monitoring of benthic communities is undertaken to confirm these predictions.

6.10.2 The objectives and design of benthic monitoring programmes for offshore wind farm developments are well established and it is expected that the elements of the benthic monitoring programme for Dogger Bank Creyke Beck A and/or B will be similar to other programmes on existing offshore wind farms.
6.10.3 A pre-construction survey will be carried out no more than 12 months prior to the start of offshore construction. This survey will also be used to confirm whether the *Mytilus* based biotope complex (SS.SBR.SMus) identified in the nearshore export cable corridor (Section 4.4) constitutes Annex I reef habitat, as requested in consultation with JNCC and Natural England (see Table 2.2).

6.10.4 The data from this survey will represent the formal baseline against which future changes will be monitored via post-construction surveys in the operational phase. The exact time-frame/frequency of post-construction monitoring will be decided via consultation with key regulatory bodies but it is noted that under (deemed) Marine Licences it is possible to carry out monitoring over the lifetime of the project. Therefore, it is expected that post-construction monitoring of marine ecological habitats will be conducted at more infrequent, regular intervals throughout the lifetime of the development (in contrast to previous FEPA requirements for surveys in years one to three post-construction only).

6.10.5 It is proposed that sampling stations will include several locations within the main wind farm site(s), several locations outside of the wind farm(s), but within the near-field and several locations that are outside of the area of influence of the wind farm(s) to act as controls. The selection of sampling locations will also take account of the outputs of the physical process modelling work undertaken as part of the EIA.

6.10.6 Each sampling location will include a minimum of three grab-sampling (mini-hamon grab) replicates for infaunal invertebrate analysis with sub-sampling of one of these samples for particle size analysis. Grab sampling will be preceded by a DDV survey to record epibenthic flora and fauna and to ensure that the grab is not deployed over sensitive benthic habitats. The outputs of these surveys will also be used to monitor condition status of the Dogger Bank cSAC.

6.10.7 The final objectives, design and methodology of this survey will be issued to statutory bodies for review and sign-off prior to the survey commencing.
7 Assessment of Impacts during Operation

7.1 Permanent loss of habitat via placement of project infrastructure (foundations, cable protection, scour protection)

Creyke Beck A or B in isolation

7.1.1 Long-term habitat loss will occur directly under all foundation structures and associated scour protection, and also under all inter-array and export cables where secondary cable protection is required for the lifetime of the project.

7.1.2 Based on the worst-case scenario of 300 x GBS foundations, along with all other related project infrastructure (see Table 5.1), a total permanent habitat loss of 5.01 km² is predicted for Dogger Bank Creyke Beck A, of which 3.61 km² will occur within the main site boundaries (foundations, array cable protection, scour protection and vessel mooring) and the remaining 1.40 km² will occur within the export cable corridor (via cable protection and cable crossings). Note that when the area (km²) of the main site and export cable corridors are referred to in terms of operational phase impacts, these areas do not include the temporary works areas that were included in the overall site/cable corridor values in the construction phase impact assessments.

7.1.3 For Dogger Bank Creyke Beck B, similar permanent habitat loss figures of 3.57 km² (main site) and 1.34 km² (export cable corridor) apply but the percentage of the overall area is slightly different, due to the differing sizes of the main sites and export cable corridors for the two projects. Using the same approach as outlined in Section 6, of the overall footprint of impact being allocated on a percentage basis in line with the percentage coverage of the study area by the VERs, the permanent habitat losses within the main site and export cable corridor are expressed as percentage of the total VERs below in Table 7.1.

7.1.4 In terms of the two VERs identified within the main site of Dogger Bank Creyke Beck A, it is predicted that 2.75 km² of VER A would be lost along with 0.87 km² of VER B, representing a total of 3.62 km² habitat loss (0.70% of the entire site). For Creyke Beck B, 2.39 km² of VER A would be lost and 1.18 km² of VER B, representing a total of 3.57 km² (0.60% of the entire site).

7.1.5 As outlined in the construction phase impact section, when using sensitivity assessments provided by MarLIN to assess the sensitivity of the component biotopes of VER A and VER B to this effect, it is important to link the effect in question to the relevant MarLIN “factor” against which sensitivity assessments are made. With regard this effect, the relevant factor within MarLIN that has been used to inform this impact assessment is the “substratum loss” factor. However, in addition to just assessing substratum loss as an isolated effect on the VERs within the study area, the potential for this substratum (habitat) loss to result in habitat fragmentation is also considered.
7.1.6 Within VER A, the FfabMag biotope is judged to be the most sensitive biotope to substratum loss, with a moderate (ecological) sensitivity. VER B has a low (ecological) sensitivity to this effect, based on similar biotopes to those found in these areas. Based on the criteria within Table 3.3, VER A is judged to have an overall (EIA) sensitivity of high, as the biotopes in this VER are internationally important (Annex I habitats in a SAC) which have a moderate sensitivity to this effect. VER B is judged to have an overall (EIA) sensitivity of low, as although it is an internationally important receptor, it has a low vulnerability to this effect.

7.1.7 The small proportions of habitat that will be subject to substratum loss, compared to the amount of similar habitats within the overall Dogger Bank Creyke Beck A & B site boundaries result in the conclusion of a low magnitude of effect based on the criteria in Table 3.4. Therefore, a prediction of minor adverse impact on VER A and negligible impact on VER B within the main site boundary due to permanent habitat (substratum) loss is concluded.

7.1.8 In terms of potential habitat fragmentation, this phenomenon is more recognised in terrestrial environments, whereby anthropogenic activities, such as clearance of certain habitats, or construction of roads across discrete areas can result in a reduction in overall biodiversity due to certain ecological niches being lost.

7.1.9 In the context of the introduction of wind farm project infrastructure to the Dogger Bank area, whilst this will result in some form of habitat fragmentation, the relatively uniform nature of the habitats across the Dogger Bank region, and the small proportion of these habitats that will be lost to project infrastructure, means that significant fragmentation of the existing habitats in this area is not expected to arise.

7.1.10 With respect to the export cable corridor, permanent habitat (substratum) loss will arise through the placement of export cable protection and material for cable crossings. For Dogger Bank Creyke Beck A this has been calculated as totalling 1.40km², which represents 0.4% of the entire export cable corridor (347.49km²). For Dogger Bank Creyke Beck B a similar amount is lost (1.34km²), representing 0.45% of the export cable corridor. As for the main site, the distribution of this habitat loss across the seven VERs that occur within the export cable corridor will vary, depending on the final cable route but for the purpose of this assessment, it has been assumed that the impact will be spread across all VERs in the same proportion as they appear in the corridor.

7.1.11 For example for Dogger Bank Creyke Beck A, VER C, which is the most common of VERs along the export cable corridor, will experience a permanent habitat loss of 0.57km² whilst VER E will lose 0.27km².

7.1.12 VERs A and B also occur within the export cable corridor, as the boundary of the SAC overlaps with the export cable at the most eastern section. As per the assessment for the main site, the (EIA) sensitivity of VER A and B within the export cable corridor is assessed as high and low respectively, which, coupled with a low magnitude of effect (due to the small amount of permanent habitat loss), results in a minor impact on VER A and a negligible impact on VER B within the export cable corridor. For VERs C, D, E and G, the sensitivity of these receptors is defined as low based on the criteria in Table 3.3. When combined with a low magnitude of effect a negligible impact is predicted.
7.1.13 For VER F (*Mytilus* based biotope – potential Annex I habitat), the sensitivity of this receptor is judged to be high as it is of national level importance (Annex I habitat outside an SAC boundary) with low recoverability to permanent habitat loss. The magnitude of this effect is judged to be low, taking into account the small amount of this habitat that would potentially be lost (0.05km$^2$) from either Dogger Bank Creyke Beck A or B cable corridors and the fact that this represents just 0.37% of the overall habitat represented by VER F in the export cable corridor. This results in a minor adverse impact.
### Table 7.1 Proportion of VER habitats affected by permanent habitat loss during the operational phase

<table>
<thead>
<tr>
<th>VER</th>
<th>Dogger Bank Creyke Beck A</th>
<th>Dogger Bank Creyke Beck B</th>
<th>Dogger Bank Creyke Beck A and B combined</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total area (km²) of VER</td>
<td>% of area covered by VER</td>
<td>Total area (km²) of VER</td>
</tr>
<tr>
<td><strong>Main Site</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A</td>
<td>391.47</td>
<td>75.98</td>
<td>2.75</td>
</tr>
<tr>
<td>Group B</td>
<td>123.73</td>
<td>24.02</td>
<td>0.87</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td><strong>515.20</strong></td>
<td><strong>100.00</strong></td>
<td><strong>3.62 (0.70% of main site)</strong></td>
</tr>
<tr>
<td><strong>Export Cable</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A*</td>
<td>47.99</td>
<td>13.81</td>
<td>0.19</td>
</tr>
<tr>
<td>Group B*</td>
<td>31.54</td>
<td>9.08</td>
<td>0.13</td>
</tr>
<tr>
<td>Group C</td>
<td>141.22</td>
<td>40.64</td>
<td>0.57</td>
</tr>
<tr>
<td>Group D</td>
<td>46.14</td>
<td>13.28</td>
<td>0.19</td>
</tr>
<tr>
<td>Group E</td>
<td>66.20</td>
<td>19.05</td>
<td>0.27</td>
</tr>
<tr>
<td>Group F</td>
<td>13.40</td>
<td>3.86</td>
<td>0.05</td>
</tr>
<tr>
<td>Group G</td>
<td>1.00</td>
<td>0.29</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td><strong>347.49</strong></td>
<td><strong>100.00</strong></td>
<td><strong>1.4 (0.40% of export cable corridor)</strong></td>
</tr>
</tbody>
</table>

*These values take account of the areas of VER in the different export cable corridors for Dogger Bank Creyke Beck A and B up to the point where the corridors merge.*
Creyke Beck A and B together

7.1.14 The combined permanent habitat loss across Dogger Bank Creyke Beck A & B if both projects were built is shown in Table 7.1. Loss of 7.19km$^2$ of the total main site area of 1114.10km$^2$ represents 0.65% of the overall habitat in the two sites combined.

7.1.15 In terms of overall impact, as per the assessment of each project in isolation, the sensitivity of VER A and B (both within the main site and in the offshore section of the export cable corridor that overlaps with the SAC boundary) to this effect is judged to be high. The magnitude of effect is judged to be low, based on the fact that only 0.56% of habitats represented by VER A and B in the main site will be affected.

7.1.16 Therefore, a prediction of **minor adverse** impact on existing benthic habitats within the main site boundary due to permanent habitat loss is concluded via Dogger Bank Creyke Beck A & B together.

7.1.17 With respect to the combined export cable corridors, loss of 2.74km$^2$ from a total area of 646.32km$^2$ represents a loss of 0.42% of overall habitats within the export cable corridor. Therefore, a low magnitude effect is predicted.

7.1.18 VERs A and B exist in the export cable corridor and are assigned a high sensitivity to this effect. Coupled with a low magnitude of effect, a **minor adverse** impact on VER A and B that lie within the export cable corridor is predicted via permanent habitat loss.

7.1.19 For VERs C, D, E and G the sensitivity of these receptors to the effect of permanent habitat loss is defined as low based on the criteria in Table 3.3. When combined with a low magnitude of effect a **negligible** impact is predicted.

7.1.20 For VER F (Mytilus biotope – potential Annex I habitat), the sensitivity of this VER remains as high with a low magnitude of effect. Although the footprint of permanent habitat loss from both projects combined will be greater than for one project in isolation, the area of this VER affected (0.11km$^2$, which represents 0.41% of this habitat within the corridor) is still a small proportion of the overall habitat in the corridor, resulting in a low magnitude effect. Therefore, a **minor adverse** impact is predicted.

### 7.2 Temporary impact on benthos due to physical disturbance caused by maintenance activities

Creyke Beck A or B in isolation

7.2.1 During the operation of the wind farm, there will be the need for regular and unplanned maintenance from jack up vessels and other heavy offshore equipment. This will cause localised disturbance to benthos within the site.

7.2.2 Based on information provided in Chapter 5, a worst-case scenario for maintenance activities in relation to benthic impacts has been provided. This predicts a maximum footprint of temporary habitat disturbance due to jacking-up activities during the operational phase of a project of 0.904km$^2$ which equates to 0.15% of the overall area (main site) of Dogger Bank Creyke Beck A. For Dogger Bank Creyke Beck B the same area is impacted (0.904km$^2$) equating to 0.13% of the overall area (main site).
7.2.3  As per the impact assessment presented previously with regard to temporary disturbance during the construction phase, the key effects on benthic communities within the main site will be temporarily increased suspended sediment concentration, sediment deposition and direct physical disturbance. Both the VERs present within the main site are classed as International/High Value but are assigned an overall sensitivity of low, as they both exhibit low vulnerability to increased suspended sediment concentration and high recoverability to any such effects. In terms of the magnitude of the effect in question, based on the criteria in Table 3.4, this is judged to be low as the effects are not predicted to affect the conservation status of the site although it is accepted that there will be some minor effect on these habitats. Therefore, with low sensitivity and low magnitude, a negligible impact on VERs A and B is predicted through maintenance activities in the operational phase.

Creyke Beck A and B together
7.2.4  With both projects in operation, the potential for temporary disturbance to benthic habitats would be greater than for one project in isolation.

7.2.5  Based on the worst-case scenarios identified via the project description, the amount of habitat that could be affected across both projects amounts to 1.808 km², which represents 0.14% of the total 1,270.2 km² area of the Dogger Bank Creyke Beck A & B sites (excluding export cable corridors) combined.

7.2.6  Due to the relatively low sensitivity of benthic habitats within the sites to physical disturbance and high recovery from impacts, and the low proportion of overall habitat that would be impacted, a negligible impact is predicted on benthic habitats within Dogger Bank Creyke Beck A & B together due to vessel interactions with the seabed (anchoring/jacking-up) during the operational phase of these projects.

7.3  Change in hydrodynamics and inter-related effects on benthos

Creyke Beck A or B in isolation
7.3.1  During the operational phase of the project, the presence of physical structures within the site, including foundations, scour protection and vessel moorings, has the potential to change existing hydrodynamic conditions within the site. The existing benthic communities are distributed mainly according to sediment type, which is itself linked to over-arching hydrodynamic processes so any change in the latter could result in eventual changes to benthic communities.

7.3.2  Based on the worst-case scenario for this effect predicted by physical process modelling (300 x 4MW GBS foundations at 700m spacing), a maximum change in current velocity of 7% from existing levels within the site, reducing to <2% up to 30km from the site is predicted.

7.3.3  To put these predicted changes into context, the mean baseline tidal current velocities within Creyke Beck A & B are 0.4m/s, therefore, a change in tidal current of up to 7% would result in mean tidal currents increasing to 0.428m/s or decreasing to 0.372m/s.
7.3.4 In terms of the potential impacts of these changes on benthic communities, the sensitivity of the key habitats within the main site to changes in hydrodynamic processes needs to be understood.

7.3.5 Of the two VERs (A and B), identified within the main sites, the FabMag biotope within VER A is the most sensitive to changes in tidal currents (or "change in water flow rate" as defined by MarLIN), being ascribed a moderate sensitivity to this effect (factor). However, the benchmark increase in water flow rate required to trigger this Moderate sensitivity to this factor is a change of at least two classes from the existing "Weak" flow rate (<0.5m/s - typical tidal currents are less than 0.4m/s in the study area) to "Strong" (1.5 – 3m/s). Such increases in tidal currents are not predicted to arise at Dogger Bank Creyke Beck A & B during the operational phase, with the maximum change in current velocity approximately 7% within the main sites.

7.3.6 With respect to changes in wave exposure, predicted changes in wave exposure/height of no more than 8% around the existing baseline conditions is predicted in the operational phase. The FabMag biotope is again the most sensitive biotope within either VER A or B to this effect. However, as with tidal current effects, the benchmark increase in wave exposure required to trigger this Moderate sensitivity to this factor is much greater than the changes in wave exposure/height predicted to arise at Creyke Beck during the operational phase.

7.3.7 Overall, it is predicted that there will be a negligible impact on benthic habitats within the main site, as a result of changes to hydrodynamic processes in the operational phase.

7.3.8 Changes in hydrodynamic processes due to the potential presence of export cable protection are judged to be negligible and, as such, any subsequent impacts on benthic communities in the export cable corridor are also judged to be negligible.

Creyke Beck A and B together

7.3.9 The physical process modelling undertaken as part of the EIA has assumed a highly precautionary worst-case scenario that assumes the whole developable area of Tranche A (the area in which Dogger Bank Creyke Beck A & B are both located) is filled with foundations. Therefore, the results and predictions relevant to benthic ecology presented above also apply to both projects operating together and the impact is predicted to remain as negligible.

7.4 Increase in suspended sediment concentration due to scour associated with foundations

Creyke Beck A or B in isolation

7.4.1 During the operational phase of the project, the presence of foundation structures for wind turbines and other project infrastructure (converter stations, accommodation platforms etc.) will lead to the formation of scour around these structures.

7.4.2 The material scoured from each foundation location will become liberated into the water column and lead to increased suspended sediment concentration. The worst-case scenario for this effect is presented in Table 5.1 and is based on two 30-day model runs after (i) end of year 1 operation (300 x turbine foundations subjected to a 1-in-1 year storm event) and (ii) end of year 2 operation (600 x turbine foundations subjected to a 1-in-50 year storm event). This modelling scenario is actually based...
on Dogger Bank Creyke Beck A and B being constructed together (600 turbine foundations in total, 300 constructed each year; 150 in Creyke Beck A and B respectively). Therefore, the findings presented below with regard to benthic ecology represent the worst-case and any effects for Dogger Bank Creyke Beck A or B built in isolation will be less than those described in reality.

7.4.3 The outputs of the modelling work indicated a maximum increase in suspended sediment concentration of >200mg/l across the western third of Dogger Bank Creyke Beck A after two years of operation, when all existing infrastructure (600 x foundations plus seven platform foundations) were subjected to a 1-in-50 year storm event. Similar maximum values were noted in patches across the south-western part of Dogger Bank Creyke Beck B and up to 8km to the west of both the projects western boundary.

7.4.4 With respect to average suspended sediment concentration in the bottom layer (seabed to 5cm above seabed), a value of between 50mg/l to 100mg/l across the western part of Dogger Bank Creyke Beck A and the southern part of Dogger Bank Creyke Beck B was predicted. Suspended sediment concentration reduced to 2mg/l approximately 50km south of Dogger Bank Creyke Beck A and 25km north of Dogger Bank Creyke Beck B.

7.4.5 These maximum values are similar to those predicted for increased suspended sediment concentration during the construction phase, although the range of average bottom layer suspended sediment concentration predicted following two years of operation (50mg/l – 100mg/l across western part of Dogger Bank Creyke Beck A) are greater than those predicted during the construction phase (20mg/l – 50mg/l within confines of the main site, extending approximately 9km northwest). Therefore, assuming that the key benthic habitats exist in the construction and operational phases, the fact that the suspended sediment concentration effects are broadly similar means that it is possible to conclude that the overall impact will be similar.

7.4.6 As discussed with respect to the impact assessment of increased suspended sediment concentration in the construction phase, the two VERs identified in the main site (VER A and B) are judged to have an overall low sensitivity, as although they are high value VERs (due to forming part of the Dogger Bank cSAC), from an ecological perspective they exhibit low vulnerability and high recoverability to the effects of suspended sediment concentration. In terms of the magnitude of the effect in question, based on the criteria in Table 3.4, this is, as per the construction phase, judged to be low as the effects are not predicted to affect the conservation status of the site although it is accepted that there will be some minor effect on these habitats.

7.4.7 Therefore, with low sensitivity and low magnitude, a negligible impact on VERs A and B is predicted, due to increased suspended sediment concentration via the liberation of sediments via scour.

7.4.8 With respect to the export cable corridor, where different VERs exist to the main site, increases in suspended sediment concentration from scour effects, arising from the sediment plume in the development area, would arise. These would however be at lower levels than at the source. The modelling work indicated that for bottom-layer values, an increase of between 50mg/l – 100mg/l above baseline would occur up to 9km from the main site boundary in a northwest direction. Therefore, it is predicted that benthic habitats in this area would also experience a low magnitude effect from
increased suspended sediment concentration. Coupled with a low sensitivity of those VERs in the export cable corridor up to 9km from the main site, a negligible impact on all VERs within the export cable corridor from increased suspended sediment produced by scour within the main site is predicted.

Creyke Beck A and B together

7.4.9 With Dogger Bank Creyke Beck A & B operating together, there is the potential for increased levels of effect due to the potential interaction of sediment plumes. However, given the conclusions drawn from the modelling studies for each project in isolation (namely that any increases in suspended sediment concentration will be low level and short-lived, and the receptors are of low sensitivity to the effect), additional impacts from the operation of both projects together are unlikely. As such, any impacts associated with both Dogger Bank Creyke Beck A & B, and the export cable corridor, are predicted to remain as negligible.

7.5 Increase in sediment deposition following increase in suspended sediment concentration due to scour associated with foundations

Creyke Beck A or B in isolation

7.5.1 The increased suspended sediment concentration via scour that will occur in the operational phase, as detailed above, will result in a related increase in sediment deposition. Based on the same modelling scenarios as per suspended sediment concentration (after year one operational and after year two operational), the outputs of the modelling work indicated that, in discrete patches within Dogger Bank Creyke Beck A & B, sediment deposition of between 10-50mm may occur. However, over the majority of both Dogger Bank Creyke Beck A & B, and up to 24km north of B and 33km south of A, the predicted maximum thickness will be between 1-5mm.

7.5.2 Thickness then reduces to <0.1mm, approximately 45km from the southern boundary of Dogger Bank Creyke Beck A and 35km from the northern boundary of Dogger Bank Creyke Beck B.

7.5.3 In terms of average deposition values, these are predicted to be <5mm in a north-west/south-east swathe across both projects and approximately 9km to the west of the western boundary of Dogger Bank Creyke Beck B western boundary. This average deposition value then reduces to <0.1mm approximately 37km to the south of the Dogger Bank Creyke Beck A southern boundary and 30km to the north of the Dogger Bank Creyke Beck B northern boundary.

7.5.4 In terms of persistency of deposited sediment, the model predicts that deposition depth will be <0.1mm (i.e. returning to baseline) by the end of the 30-day model period for most locations modelled, apart from location Q1 where sediment thickness after 30-day period was 0.14mm. In reality, this removes the potential for any “additive” effect of sediment deposition in parts of the site and, therefore, the maximum depths outlined above represent the actual maximum values predicted to arise.

7.5.5 Based on these values and the behaviour of any deposited sediment over a 30-day model period, together with the sensitivity of VERs within the main sites and export cable corridor, a negligible impact is predicted via sediment deposition on benthic
habitats during the operational phase of the project.

**Creyke Beck A and B together**

7.5.6 With Dogger Bank Creyke Beck A & B operating together, there is the potential for increased levels of effect due to the potential interaction of sediment plumes and their subsequent deposition on the seabed.

7.5.7 However, given the conclusions drawn from the modelling studies for each project in isolation (namely that any increases in suspended sediment concentration and sedimentation will be low level and short-lived, and the receptors are of low sensitivity to the effect), additional impacts from the operation of both projects together are unlikely. As such, any impacts are predicted to remain as negligible.

**7.6 Introduction of new habitat in the form of foundation structures, leading to potential colonisation**

**Creyke Beck A or B in isolation**

7.6.1 All project infrastructure that has a sub-surface element will represent a suitable surface for colonisation by marine fauna and flora, including species that may not currently be found within the existing environment. This is of particular note in sedimentary environments like Dogger Bank where current substrates for colonisation by encrusting epifauna are very limited.

7.6.2 Therefore, the presence of foundations for wind turbines, accommodation platforms etc. will represent new areas for such colonisation, with potential to change the nature of benthic communities in the study area.

7.6.3 Based on the worst-case scenario for this impact presented in Table 5.1, up to a total of 5.37 km² of hard substrate will be introduced via installation of either Dogger Bank Creyke Beck A or B in isolation, via the range of project infrastructure including foundations, vessel moorings, scour and cable protection etc.

7.6.4 Noting the presence of epifaunal species and colonising fauna within discrete parts of the site and export cable corridor already (associated with coarser sediments), it is predicted that colonisation of any introduced hard substrates will occur. Although exact species assemblages are difficult to predict, it is likely that fairly common species will colonise these areas, including species of bryozoans, ascidians and bivalve molluscs.

7.6.5 Whether such a change represents an adverse or beneficial impact in terms of the wider benthic ecological status of the study area is difficult to determine. It is possible that the colonisation of hard substrates by certain flora and fauna will produce an additional food source for some marine species, including commercially exploited fish. When coupled with any potential “reef” effect of the foundation structures, this may represent a beneficial impact to certain fish and shellfish species (see Chapter 13 for more discussion on this issue). However, in contrast, the introduction of hard substrate in an area currently characterised as a sedimentary environment may create habitat that could be colonised by alien marine species, such as the Pacific marine midge *Telmatogeton japonicus* and the Japanese skeleton shrimp *Caprella mutica*. 
Although not currently listed as an alien species in the UK (Non-Native Species Secretariat (NNSS) 2010), an increase in a population of *T. japonicus* has been noted from on-going monitoring studies of the Danish Horns Rev offshore wind farm in the North Sea (Bioconsult 2006).

The issue of potential colonisation of hard substrate by alien species, and in effect these structures acting as “stepping-stones” for introduction of these species into UK coastal waters has been raised by consultees on other offshore wind farm projects but it is not possible to assign a clear impact to this potential issue. However in 2009 Cefas conducted a review of the state of the benthic ecology around round one wind farms (Cefas 2009), in this review no invasive or alien species were observed though monitoring was recommended throughout the life span of the wind farms.

As per previous impact assessments, it is important to link this effect with the most relevant MarLIN factor, which in this instance, is the “introduction of non-native species” factor. All the component biotopes of the seven VERs identified in the study area are judged to be either not sensitive to this effect/factor or there is insufficient evidence to base any sensitivity assessment. Therefore, it is concluded that, in the absence of any clear beneficial or adverse impact with respect to this issue, a negligible impact is predicted. However, this conclusion is not based on any firm, tangible evidence of the long-term impact (or lack of) of colonisation of hard substrates in predominantly sedimentary environments as will occur within this area.

Of potential note is a recent inspection by Envision of video footage from a dive survey of the Dogger Bank region (including a number of wrecks) undertaken by Dutch divers in summer 2011. The review by Envision showed that the species associated with the wrecks appeared to be typical of a North Sea rocky reef in a moderate to strong current. Dominant species were *Alcyonium digitatum*, *Metridium senile*, *Gadus morhua*, *Homarus gammarus*, *Cancer pagurus*, *Spirobranchus* sp. and various ascidians.

These communities differ from those occurring on the Dogger Bank itself (which are predominantly sediment-dwelling species), and those which characterise the cSAC.

Some of the species recorded during the expedition, such as the sea slug *Polycera faroensis*, the sea squirt, *Acidia mentula*, and the cowrie *Trivia* sp. were at the time thought to be newly recorded for the Dutch marine fauna. However, these are not unusual for the UK North Sea fauna. Subsequently, however, it has been discovered that not all of these are new for Holland. A scientific paper subsequently written up from the expedition noted that two sea slugs, *Polycera faroensis* and *Doto dunnei*, were newly recorded for the Dutch marine fauna (Gittenberger *et al*. 2011).

This brief review of this 2011 dive survey indicated that the fauna that are likely to colonise turbine subsea structures are those that already occur commonly in the region on comparable substrates.

Long-term monitoring during the period of operation will be the only means to provide evidence to ascertain how long-term presence of introduced substrate and its colonisers influences the surrounding sedimentary habitats (see Section 7.9).
Creyke Beck A and B together

7.6.14 With Dogger Bank Creyke Beck A & B operating together, the potential area of hard substrate available for colonisation would increase due to the larger number of foundations and associated structures. However, the same conclusions and the difficulty in predicting whether this represents a beneficial or adverse impact remains (as outlined above), therefore the impact is predicted to remain as **negligible**.

7.7 **Potential operational phase impacts on the Dogger Bank cSAC**

Creyke Beck A or B in isolation

7.7.1 A detailed assessment of the potential for impacts on benthic habitats within the Dogger Bank cSAC to affect the conservation objectives of this site, and therefore, the integrity of the overall site, is presented in the HRA Report. Therefore, the following assessment acts as a link between the operational phase marine ecology effects described up to this point and potential impacts of these on the Dogger Bank cSAC, as assessed under the Habitats Regulations in the HRA Report for Dogger Bank Creyke Beck.

7.7.2 The previous impact assessments have focussed on VERs within the main site and export cable corridor, in terms of the amount of these habitats affected as a proportion (%) of the overall habitats in the site/corridor and the overall ecological sensitivity of the habitats. For this impact assessment, the footprint of effects is defined in the context of the Dogger Bank cSAC site boundary, as defined in the latest SAC Selection Assessment Document (JNCC, Version 9.0, August 2011).

7.7.3 A summary of the areas (km²) of Dogger Bank Creyke Beck A & B that lie within the boundaries of the cSAC is provided in Table 7.2. The predicted footprint of operational phase effects as identified in preceding impact statements are presented as a proportion of the cSAC in Table 7.2.

**Table 7.2** Dogger Bank Creyke Beck A and B operational phase permanent habitat footprints vs. cSAC

<table>
<thead>
<tr>
<th>Area</th>
<th>Creyke Beck A / B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of cSAC</td>
<td>12,331km²</td>
</tr>
<tr>
<td>Maximum footprint of operational phase effects (permanent loss) within Dogger Bank Creyke Beck A/B main site / cSAC</td>
<td>3.62km² / 3.57km²</td>
</tr>
<tr>
<td>Maximum footprint of operational phase effects (permanent loss) within Dogger Bank Creyke Beck A/B export cable corridor * / cSAC</td>
<td>0.32km² / 0.12km²</td>
</tr>
<tr>
<td>Total footprint of operational phase effects (permanent loss) within Dogger Bank Creyke Beck A/B and export cable corridor * / cSAC</td>
<td>3.94km² / 3.69km²</td>
</tr>
<tr>
<td>Operational phase effect footprint as % of overall cSAC</td>
<td>0.03% / 0.03%</td>
</tr>
</tbody>
</table>

* Only the footprint of effect within the parts of the export cable corridor that lie within the cSAC boundary are listed here.
7.7.4 From Table 7.2, it can be noted that in terms of actual footprint of operational phase effects (via permanent habitat loss), this totals a maximum of $3.62\text{km}^2$/$3.57\text{km}^2$ of habitat within the cSAC boundary (for the Dogger Bank Creyke Beck A/B sites project), which represents 0.03% of the overall cSAC area, irrespective of which project is built in isolation.

7.7.5 With respect to effects of suspended sediment concentration and sedimentation during the operational phase (via scour), the spatial extent of this effect footprint is greater than that for direct physical disturbance but will still be a relatively small proportion of the overall cSAC area.

7.7.6 As outlined above, as per the construction phase impacts related to the Dogger Bank cSAC, a detailed assessment of the potential for operational phase impacts on marine ecology described above to affect the integrity of the Dogger Bank cSAC is provided in the HRA Report that has been produced as part of the wider DCO application process. The HRA Report provides sufficient information to enable a competent authority to undertake an Appropriate Assessment of the proposals.

7.7.7 The Appropriate Assessment process will formally consider any marine ecological impacts (and other impacts) against the structure, function and conservation objectives of Dogger Bank cSAC (as well as other SAC/SPA sites) so that a determination of potential effects on the integrity of these sites can be undertaken.

**Creyke Beck A and B together**

7.7.8 Table 7.3 indicates the total footprint of operational phase effects on both Dogger Bank Creyke Beck A & B in relation to the cSAC. 0.06% of the cSAC boundary would be affected were these projects operating at the same time, which still represents a very small proportion of the overall habitats within the cSAC (and which are expected to be similar to those recorded in Dogger Bank Creyke Beck A & B). Therefore, the same conclusions made above in relation to Dogger Bank Creyke Beck A or B in isolation and the conservation objectives of the cSAC are predicted to remain valid for both projects operating together.

<table>
<thead>
<tr>
<th>Area</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of cSAC</td>
<td>12,331km$^2$</td>
</tr>
<tr>
<td>Maximum footprint of operational phase effects within Dogger Bank Creyke Beck A &amp; B main sites / cSAC</td>
<td>7.19km$^2$</td>
</tr>
<tr>
<td>Maximum footprint of operational phase effects within Dogger Bank Creyke Beck A &amp; B cable corridor * / cSAC</td>
<td>0.44km$^2$</td>
</tr>
<tr>
<td>Total footprint of operational phase effects between Dogger Bank Creyke Beck A and B and export cable corridors * / cSAC</td>
<td>7.63km$^2$</td>
</tr>
<tr>
<td>Construction phase effect footprint as % of overall cSAC</td>
<td>0.06%</td>
</tr>
</tbody>
</table>

* Only the footprint of effect within the parts of the export cable corridor that lie within the cSAC boundary are listed here.
7.8 **Potential operational phase impacts on Flamborough Head SAC**

No operational phase impacts from either Dogger Bank Creyke Beck A or B in isolation or Dogger Bank Creyke Beck A & B together are predicted as there is no spatial overlap of project infrastructure with the habitats within this cSAC (therefore no scope for direct impacts on the cSAC habitats, and no far-field effects via increased suspended sediment plumes and deposition are also predicted.

7.9 **Potential operational phase impacts on sites of marine conservation interest**

**Creyke Beck A or B in isolation**

7.9.1 The preceding impact assessments have discussed the potential for operational activities to impact benthic habitats in the Dogger Bank Creyke Beck study area. The benthic habitats have been grouped into VERs as per the approach set out in Section 3.3, with these VERs representing the receptors against which impacts have been assessed.

7.9.2 This particular impact assessment discusses the effects on benthic habitats described previously in the context of the following site of marine nature conservation interest, for which examples occur within and around the Dogger Bank Creyke Beck study area;

- UK BP Habitats;
- Recommended Marine Conservation Zones (rMCZs); and
- OSPAR habitats and species.

7.9.3 It is important to note that potential impacts on the ecological elements of the sites of marine conservation interest listed above have already been assessed via the individual impact assessments presented up to this point. Therefore, to avoid repetition in the assessment process, the assessment of potential operational phase impacts on sites of marine conservation interest are presented below as a series of summary tables which make reference to the conclusions of previous impact assessments.

7.9.4 The “receptor” heading in the following tables refers to the habitat/species of marine conservation interest (BAP habitats in Table 7.4 and rMCZs in Table 7.5) with the column headed “relevant VERs” identifying the VERs (as defined in Table 4.4) that apply to those habitats/species. The impact descriptions are those assessed previously via individual impact assessments, with any relevant mitigation and the residual impact from these previous impact assessments also presented.
### Table 7.4  Potential operational phase impacts on BAP habitats

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Relevant VERs (see Table 4.4)</th>
<th>Impact description</th>
<th>Mitigation</th>
<th>Residual impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Subtidal sands and gravels” BAP Habitat and “Mud habitats in deep water” BAP Habitat</td>
<td>A, B, C, D and E</td>
<td>Permanent loss of habitat via placement of project infrastructure (foundations, cable protection, scour protection)</td>
<td>None</td>
<td>Negligible impact on VERs B, C, D and E Minor adverse impact on VER A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Temporary impact on benthos due to physical disturbance caused by maintenance activities</td>
<td>None</td>
<td>Negligible impact on VERs A and B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change in hydrodynamics and inter-related effects on benthos</td>
<td>None</td>
<td>Negligible impact on VERs A and B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increase in suspended sediment concentration due to scour associated with foundations</td>
<td>None</td>
<td>Negligible impact on VERs A and B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increase in sediment deposition following increase in suspended sediment concentration due to scour associated with foundations</td>
<td>None</td>
<td>Negligible impact on VERs A and B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Introduction of new habitat in the form of foundation structures, leading to potential colonisation</td>
<td>None</td>
<td>Negligible impact on VERs A and B</td>
</tr>
</tbody>
</table>

7.9.5 Based on the previous impact assessments conducted on the benthic receptors (VERs) that are also representative of these two BAP habitats, it is concluded that, overall, there will be a **negligible/minor adverse** impact on the two marine BAP habitats within the Dogger Bank Creyke Beck study area (Table 7.4).

### Table 7.5  Potential operational phase impacts on rMCZs

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Relevant VERs (see Table 4.4)</th>
<th>Impact description</th>
<th>Mitigation</th>
<th>Residual impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holderness Inshore rMCZ</td>
<td>C and F</td>
<td>Permanent loss of habitat via placement of project infrastructure (foundations, cable protection, scour protection)</td>
<td>None</td>
<td>Negligible impact on VER C Minor adverse impact on Mytilus based VER F</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Temporary impact on benthos due to physical disturbance caused by maintenance activities</td>
<td>None</td>
<td>No impact on VERs C and F</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change in hydrodynamics and inter-related effects on benthos</td>
<td>None</td>
<td>No impact on VERs C and F</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increase in suspended sediment concentration due to scour</td>
<td>None</td>
<td>No impact on VERs C and F</td>
</tr>
<tr>
<td>Receptor</td>
<td>Relevant VERs (see Table 4.4)</td>
<td>Impact description</td>
<td>Mitigation</td>
<td>Residual impact</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------</td>
<td>--------------------</td>
<td>------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Holderness Offshore rMCZ</td>
<td>C, D and F</td>
<td>Introduction of new habitat in the form of foundation structures, leading to potential colonisation</td>
<td>None</td>
<td>Negligible impact on VERs C, D and F</td>
</tr>
</tbody>
</table>

7.9.6 Based on the previous impact assessments conducted on the benthic receptors (VERs) that are also representative of features within the two rMCZs relevant to this project (see Table 4.4), it is concluded that, overall, there will be a **negligible** impact on the features of the Holderness Inshore rMCZ represented by VER C and a **minor adverse** impact on the features represented by VER F (Table 7.5).

7.9.7 For the Holderness Offshore rMCZ, a **negligible** impact is predicted on the VERs (C, D and F) which are deemed representative of the habitats in this rMCZ via operational phase impacts (Table 7.5). Specifically, the potential introduction of hard substrates in the form of cable protection will result in an impact on any sedimentary habitats in this rMCZ, albeit of negligible significance due to the small proportion of habitat affected compared to the extent of similar habitat in the wider area.

7.9.8 With respect to potential impacts on OSPAR threatened species and habitats, no such species or habitats are recorded within the Dogger Bank Creyke Beck study area, therefore, no operational phase impacts are predicted.

**Creyke Beck A and B together**

7.9.9 The previous VER based impact assessments concluded that even if Dogger Bank Creyke Beck A and B were in operation together, there would be no change in the level of any of the impacts predicted via either project operating in isolation. Therefore, the conclusions with respect to potential impacts on BAP habitats and rMCZs presented above are also relevant to this scenario.

**7.10 Monitoring of operational phase impacts**

7.10.1 Potential operational phase impacts on benthic ecology include direct loss of habitat, indirect loss/alteration of benthic habitats due to changes in local hydrodynamic processes, increased suspended sediments and deposition due to scour effects and colonisation of structures.

7.10.2 The benthic monitoring outlined in Section 6.9 will be designed in a way that enables these potential operational phase impacts to be determined. The location of sampling stations within close proximity to installed foundations will ensure that any near-field changes in benthic habitats will be identified. Any monitoring programme will also include assessment of selected foundation structures in order to gather data on the long-term behaviour of colonising species on these structures.
7.10.3 Post-construction annual benthic grab and DDV survey data will be compared against pre-construction baseline data to determine any statistically significant changes in benthic habitats. These data will be combined with sidescan data from geophysical surveys to monitor any broad-scale benthic habitat changes.

7.10.4 The exact time-frame and frequency of post-construction monitoring will be decided via consultation with key regulatory bodies but it is noted that under (deemed) Marine Licences it is possible to carry out monitoring over the lifetime of the project. Therefore, it is expected that post-construction monitoring of marine ecological habitats will be conducted at more infrequent, regular intervals throughout the lifetime of the development (in contrast to previous FEPA requirements for surveys in years one to three post-construction only).
8 Assessment of Impacts during Decommissioning

8.1 Increased suspended sediment concentration and sediment deposition

Creyke Beck A or B in isolation

8.1.1 During the decommissioning phase of the project the worst case scenario is for all components of the project to be removed, i.e. foundations, scour protection etc. During removal of these project components there will be short-term increases in suspended sediment concentration (and subsequent deposition) from the plume generated by the disturbance of the seabed required to remove these structures. Based on the outputs of the physical process modelling work, any effects produced during decommissioning are considered to be less than those described during the construction phase due to absence of seabed preparation or pile drilling, which are the main sources of increased suspended sediment concentration during the construction phase.

8.1.2 Assuming that the general benthic habitats and communities of the site remain as per the existing environment, with the same sensitivities to suspended sediment concentration and sediment deposition, this decommissioning impact will be no greater than that assessed in the construction phase. Therefore, a negligible impact on benthic habitats via increased suspended sediment concentration and sediment deposition during the decommissioning phase is predicted.

Creyke Beck A or B together

8.1.3 As for Dogger Bank Creyke Beck A or B in isolation above, a negligible impact is predicted on benthic habitats via increased suspended sediment concentration and sediment deposition during the decommissioning phase.

8.2 Loss of species colonising hard structures

Creyke Beck A or B in isolation

8.2.1 Removal of all structures that represent hard substrate from the boundaries of the main site and export cable corridor (foundations, scour protection, cable protection etc.) will lead to a loss of habitat for any colonising species that may have utilised these hard substrates. Based on the worst-case scenario of permanent habitat loss defined in the operational phase impact Section, it can be noted that 5.57 km² of hard substrate will be lost via the decommissioning phase. Following removal of these structures, areas of bare, un-colonised sediment will be created, which will be similar in nature to areas subjected to activities such as marine aggregate extraction. Based on data on recovery of benthic communities from this activity, and noting that the dominant hydrodynamic and sedimentary processes in the wider study area are assumed to remain following decommissioning, it is predicted that recovery of these areas of un-colonised sediment to communities found pre-construction will occur within five years (e.g. Newell et al. 1998) of the end of decommissioning.
8.2.2 Due to the localised nature and limited extent of the loss of species colonising the hard substrate foundations, and the high recoverability of the subsequently exposed substrate and communities associated with VER A and B back to their pre-construction state (i.e. within five years), it is predicted that the impact will be negligible.

Creyke Beck A or B together

8.2.3 The same effects as outlined above are predicted to arise for the decommissioning phase of both Dogger Bank Creyke Beck A & B together, with the only difference being a greater amount of hard substrate lost (11.14km²). A negligible impact is predicted.

8.3 Temporary disturbance to habitats via removal of cables

Creyke Beck A or B in isolation

8.3.1 The specific removal of buried cables, which during the operational phase were covered by sediment that will have supported benthic communities, will result in a temporary loss of these habitats, with subsequent impact on these benthic communities. As per the temporary disturbance impacts assessed during the construction phase, these will be localised and will only affect a small proportion of habitats that are widespread throughout this region. As any temporary disturbed areas will return to pre-disturbance levels within a period of between six months to five years, this impact is judged to be negligible.

Creyke Beck A or B together

8.3.2 The same effects as outlined above are predicted to arise for the decommissioning phase of both Dogger Bank Creyke Beck A & B together, with the only difference being a greater area of disturbance to benthic habitats as a result of having to remove a greater amount of export and array cables for the two projects together. A minor adverse impact is predicted.

8.4 Potential decommissioning phase impacts on Dogger Bank cSAC and Flamborough Head SAC

8.4.1 Decommissioning phase impacts on the Dogger Bank cSAC and Flamborough Head SAC are predicted to be no greater than those predicted during the construction phase. A full assessment of the potential for decommissioning impacts to adversely affect the integrity of these sites under the Habitats Regulations is provided in the HRA Report.

8.5 Monitoring of decommissioning phase impacts

8.5.1 In order to monitor potential decommissioning phase impacts, a similar survey design and programme as developed in the pre-construction and operational phase will be developed during decommissioning.

8.5.2 A pre-decommissioning survey will be undertaken to determine the baseline conditions prior to decommissioning, followed by a minimum of one survey once all decommissioning works are completed.
9 Inter-relationships

9.1.1 In order to address the environmental impact of the proposed development as a whole, this section establishes the inter-relationships between marine and intertidal ecology and other physical, environmental and human receptors. The objective is to identify where the accumulation of residual impacts on a single receptor, and the relationship between those impacts, gives rise to a need for additional mitigation.

9.1.2 Table 9.1 summarises the inter-relationships that are considered of relevance to marine and intertidal ecology and identifies where they have been considered within this ES. No inter-relationships have been identified where an accumulation of residual impacts on marine and intertidal ecology, and the relationship between those impacts, gives rise to a need for additional mitigation.

9.1.3 Chapter 31 Inter-relationships provides a holistic overview of all the inter-related impacts associated within the proposed development.

Table 9.1 Inter-relationships relevant to the assessment of marine and intertidal ecology

<table>
<thead>
<tr>
<th>Inter-relationships</th>
<th>Section where addressed</th>
<th>Linked chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impacts on benthos due to a change in hydrodynamics.</td>
<td>Impacts on benthos are discussed throughout sections 6 – 8 of this chapter</td>
<td>Chapter 9</td>
</tr>
<tr>
<td>Impacts on benthos due to the potential release of pollutants from sediment and accidental spillages as well as an increase in turbidity.</td>
<td>As above</td>
<td>Chapter 10</td>
</tr>
<tr>
<td>Impacts on benthos in context of prey item for ornithological resources.</td>
<td>As above</td>
<td>Chapter 11 Marine and Coastal Ornithology</td>
</tr>
<tr>
<td>Impacts on benthos/benthic habitat in context of (a) prey items for fish species and (b) spawning/nursery habitats for fish.</td>
<td>As above</td>
<td>Chapter 13</td>
</tr>
<tr>
<td>Effects on benthos / benthic habitats as a result of potential changes in commercial fishing activity within the project site.</td>
<td>An assessment of the effects of commercial fishing activity on the benthos is beyond the scope of this assessment. However, it is noted that if there was a reduction in trawling and dredging activity around the wind farm areas (note that this is not confirmed as being the case), there could be a positive effect on the benthic environment in general.</td>
<td>Chapter 15 Commercial Fisheries</td>
</tr>
</tbody>
</table>
10 Cumulative Impacts

10.1 CIA strategy and screening

10.1.1 This section describes the cumulative impact assessment (CIA) for marine and intertidal ecology taking into consideration other plans, projects and activities. A summary of the CIA is presented in Chapter 33.

10.1.2 Forewind has developed a strategy (the ‘CIA Strategy’) for the assessment of cumulative impacts in consultation with statutory stakeholders including the MMO, the JNCC, Natural England and Cefas. Details of the approach to cumulative impact assessment adopted for this ES are provided in Chapter 4.

10.1.3 In its simplest form the Strategy involves consideration of:

- Whether impacts on a receptor can occur on a cumulative basis between the wind farm project(s) subject to the application(s) and other wind farm projects, activities and plans in the Dogger Bank Zone (either consented or forthcoming); and

- Whether impacts on a receptor can occur on a cumulative basis with other activities, projects and plans outwith the Dogger Bank Zone (e.g. other offshore wind farm developments), for which sufficient information regarding location and scale exist.

10.1.4 In this manner, the assessment considers (where relevant) the potential for cumulative impacts in the following sequence:

- With the second phase of development in the Dogger Bank Zone, known as Dogger Bank Teesside A & B;

- With the above, plus any other activities, projects and plans in the Dogger Bank Zone; and

- With all of the above, in addition to any other activities, projects and plans outwith the Dogger Bank Zone.

10.1.5 It should be noted that the third phase of development in the Dogger Bank Zone, known as Dogger Bank Teesside C & D, is screened out on account of low confidence in both the projects details (project design details, including project boundaries, are yet to be confirmed) and the project data (baseline data gathering has not been completed).

10.1.6 The strategy recognises that data and information sufficient to undertake an assessment will not be available for all potential projects, activities, plans and / or parameters, and seeks to establish the ‘confidence’ Forewind can have in the data and information available.

10.1.7 In order to identify the activities, projects and plans to take forward in the detailed assessment that follows, a two-step screening process is undertaken:

- Impact screening (Table 10.1): consideration of the potential for each impact, as assessed for Dogger Bank Creyke Beck in isolation, to contribute to a cumulative impact both within and outwith the Dogger Bank Zone. This step
also involves an appraisal of the confidence in the information available to inform the screening decision (following the methodology set out in Chapter 4).

- Project screening (**Table 10.2**): the identification of the actual individual plans, projects and activities that may result in cumulative impacts for inclusion in the CIA. In order to inform this, Forewind has produced an exhaustive list of plans, projects and activities occurring within a very large study area encompassing the greater North Sea and beyond (referred to as the ‘CIA Project List’, see Chapter 4). The list has been appraised, based on the confidence Forewind has in being able to undertake an assessment from the information and data available, enabling individual plans, projects and activities to be screened in or out.

10.1.8 For marine and intertidal ecology, the potential for cumulative impacts is identified in relation to direct habitat loss and / or disturbance (via placement of project infrastructure), indirect impacts via increased suspended sediment concentration and sediment deposition, indirect impact via changes in hydrodynamic processes and the introduction of hard substrate leading to colonisation.

**Table 10.1** Potential cumulative impacts (impact screening)

<table>
<thead>
<tr>
<th>Impact</th>
<th>Dogger Bank Zone and export cable corridor (within 1km)</th>
<th>Beyond 1km from the Dogger Bank Zone and export cable corridor</th>
<th>Rationale for where no cumulative impact is expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct impact via habitat disturbance and/or loss (due to placement of project infrastructure)</td>
<td>Yes</td>
<td>High</td>
<td>Yes</td>
</tr>
<tr>
<td>Indirect impact via increased suspended sediment concentration and sediment deposition (construction phase)</td>
<td>Yes</td>
<td>Medium-High</td>
<td>Yes</td>
</tr>
<tr>
<td>Direct impact via permanent habitat loss (presence of project infrastructure in operational phase)</td>
<td>Yes</td>
<td>High</td>
<td>Yes</td>
</tr>
<tr>
<td>Indirect impact via increased suspended sediment concentration and sediment deposition (via scour in operational phase)</td>
<td>Yes</td>
<td>Medium-High</td>
<td>Yes</td>
</tr>
<tr>
<td>Direct impact via vessel activity (jacking-up and anchoring) in operational phase for operation and maintenance activities</td>
<td>Yes</td>
<td>High</td>
<td>Yes</td>
</tr>
<tr>
<td>Direct impact of introduction of hard substrate leading to colonisation</td>
<td>Yes</td>
<td>High</td>
<td>Yes</td>
</tr>
</tbody>
</table>
10.1.9 The plans, projects and activities relevant to marine and intertidal ecology are presented in Table 10.2 and Figure 10.1 along with the results of the screening exercise that identifies whether there is sufficient confidence to take these forward in a detailed cumulative assessment.

10.1.10 It should be noted that:

- Where Forewind is aware that a plan, project or activity could take place in the future, but has no information on how the plan, project or activity will be executed, it is screened out of the assessment; and

- Existing projects, activities and plans are already having an impact and so are part of the existing environment as it has been assessed throughout this ES. Therefore these projects have not been included in the cumulative assessment. This includes commercial fishing, whereby the benthic habitats that currently exist within the Dogger Bank Zone and wider North Sea region are already widely influenced by this activity.

10.1.11 The potential impacts identified during the construction, operation and decommissioning phases of Dogger Bank Creyke Beck (Sections 6 to 8) that could result in cumulative impacts are described below.

10.2 Temporary disturbance to marine habitats during construction (seabed preparation, cable installation, vessel jacking-up etc.)

10.2.1 The impact assessment for Dogger Bank Creyke Beck concluded that there would be a negligible residual impact on existing marine habitats within the Dogger Bank Creyke Beck project area(s) and export cable corridor as a result of temporary disturbance during the construction phase. This conclusion was based on the fact that a maximum of 2.72% of each of the two sites (and export cable corridor) would be subject to temporary disturbance, with the habitats affected having a low sensitivity to this type of effect and a high recoverability.

10.2.2 Similar temporary disturbance of benthic habitats is predicted to arise via the development of both additional projects within the Dogger Bank Zone and also via other activities (including marine aggregate extraction and other offshore wind farm development such as Triton Knoll – see Table 10.2 above). Therefore, scope for cumulative impacts on benthic habitats exists.

10.2.3 Whilst not being in a position to define with complete accuracy the amounts of temporary habitat disturbance predicted from other projects both within the Dogger Bank Zone and wider region, it is possible to state that the proportion of the overall project areas affected by this type of effect are likely to be broadly similar to that noted for Dogger Bank Creyke Beck A & B. Adopting a worst-case figure that 2.8% of the spatial extent of all other project areas (within and outside the Dogger Bank Zone) is subjected to temporary disturbance (based on existing project assessment which predicts 2.72% of overall site affected by temporary habitat disturbance – see Table 5.1), it is concluded that there will be a minor cumulative impact on benthic habitats via temporary disturbance from all the projects listed in Table 10.2. This conclusion is based on the fact that many of the habitats potentially subjected to temporary disturbance are widespread throughout the southern North Sea and will
also exhibit a low sensitivity and high recoverability to temporary disturbance effects.
<table>
<thead>
<tr>
<th>Type of project</th>
<th>Project title</th>
<th>Project status</th>
<th>Predicted construction/development period</th>
<th>Distance from Dogger Bank Creyke Beck (km)</th>
<th>Confidence in project details</th>
<th>Confidence in project data</th>
<th>Carried forward to CIA</th>
<th>Rationale for not carrying into CIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offshore Wind Farm</td>
<td>Dogger Bank Teesside A &amp; B</td>
<td>Pre-Application</td>
<td>Construction may start from 2016</td>
<td>Teesside A approximately 35</td>
<td>High</td>
<td>Medium</td>
<td>Yes</td>
<td>N/A</td>
</tr>
<tr>
<td>Offshore Wind Farm</td>
<td>Dogger Bank Zone – other future developments</td>
<td>Potential</td>
<td>Not confirmed</td>
<td>Not confirmed</td>
<td>Low</td>
<td>Low</td>
<td>No</td>
<td>Low data confidence</td>
</tr>
<tr>
<td>Offshore Wind Farm</td>
<td>Hornsea Project One</td>
<td>Pre-Application</td>
<td>Project One may start construction 2015</td>
<td>66</td>
<td>High</td>
<td>Medium</td>
<td>Yes</td>
<td>N/A</td>
</tr>
<tr>
<td>Offshore Wind Farm</td>
<td>Hornsea Zone – other future development</td>
<td>Potential</td>
<td>Not confirmed</td>
<td>Not confirmed</td>
<td>Low</td>
<td>Low</td>
<td>No</td>
<td>Low data confidence</td>
</tr>
<tr>
<td>Offshore Wind Farm</td>
<td>Triton Knoll</td>
<td>Consented</td>
<td>Construction may start from 2017</td>
<td>74 to the Dogger Bank Creyke Beck export cable corridor and 141 to Dogger Bank Creyke Beck A</td>
<td>High</td>
<td>High</td>
<td>Yes</td>
<td>N/A</td>
</tr>
<tr>
<td>Oil and Gas</td>
<td>Cygnus gas field development (Alpha and Bravo)</td>
<td>Development (pre-production)</td>
<td>Ongoing – production to start in 2015</td>
<td>23 (Cygns Alpha) 16 (Cygns Bravo)</td>
<td>High</td>
<td>Medium</td>
<td>Yes</td>
<td>N/A</td>
</tr>
<tr>
<td>Aggregate extraction</td>
<td>Area 466/1</td>
<td>Application area</td>
<td>Decision expected 2013</td>
<td>3</td>
<td>High</td>
<td>Medium</td>
<td>Yes</td>
<td>N/A</td>
</tr>
<tr>
<td>Aggregate extraction</td>
<td>Area 485/1</td>
<td>Application area</td>
<td>Not confirmed</td>
<td>18 (south of export cable corridor) 23 (south west of Dogger Bank Creyke Beck A)</td>
<td>High</td>
<td>Medium</td>
<td>Yes</td>
<td>N/A</td>
</tr>
<tr>
<td>Aggregate extraction</td>
<td>Area 485/2</td>
<td>Application area</td>
<td>Not confirmed</td>
<td>As above</td>
<td>High</td>
<td>Medium</td>
<td>Yes</td>
<td>N/A</td>
</tr>
<tr>
<td>Type of project</td>
<td>Project title</td>
<td>Project status</td>
<td>Predicted construction/development period</td>
<td>Distance from Dogger Bank Creyke Beck (km)</td>
<td>Confidence in project details</td>
<td>Confidence in project data</td>
<td>Carried forward to CIA</td>
<td>Rationale for not carrying into CIA</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------------</td>
<td>----------------</td>
<td>--------------------------------------------</td>
<td>--------------------------------------------</td>
<td>-------------------------------</td>
<td>----------------------------</td>
<td>--------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Carbon Capture</td>
<td>Yorkshire and Humber CCS</td>
<td>Consultation</td>
<td>2014-2015</td>
<td>Area of Search overlaps nearshore 65km of export cable corridor</td>
<td>Low</td>
<td>Low</td>
<td>No</td>
<td>Low data confidence in proposal and distance between Dogger Bank Creyke Beck infrastructure and this proposal</td>
</tr>
</tbody>
</table>
Figure 10.1 Other plans, projects and activities screened in to the cumulative impact assessment

Data Sources:
- Oil & Gas © DECC 2013,
- Aggregate dredging areas © The Crown Estate, 2013,
- Offshore wind farm boundaries © Crown Copyright, 2013,
- Background bathymetry image derived in part from TCarta data © 2009.
10.3 Increased suspended sediment concentration and sediment deposition during construction phase

10.3.1 The impact assessment for Dogger Bank Creyke Beck concluded that there would be a negligible impact on benthic habitats due to increased suspended sediment concentration and sediment deposition produced during the construction phase of the project. Cumulative impacts of suspended sediment concentration and sediment deposition will only arise if there is both a spatial and temporal overlap of project construction stages and the resultant sediment plumes generated via different projects overlap to produce a cumulative impact.

10.3.2 Based on the physical processes CIA undertaken as part of this EIA, the following conclusions can be reached with respect to potential spatial and temporal overlap of sediment plumes (and resultant deposition) from Dogger Bank Creyke Beck and other developments in the Dogger Bank Zone and wider region.
### Table 10.3 Conclusions of physical processes CIA relevant to marine and intertidal ecology

<table>
<thead>
<tr>
<th>Project</th>
<th>Scope for interaction of sediment plume/sediment deposition</th>
<th>Justification</th>
<th>Conclusion of physical processes CIA (predicted cumulative impact on marine and intertidal ecology)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dogger Bank Teesside A &amp; B</td>
<td>Yes</td>
<td>Potential worst case construction programme has Dogger Bank Creyke Beck and Dogger Bank Teesside A &amp; B being built simultaneously, cumulative effects may arise if the construction of foundations in different projects is synchronous and the plumes that are created by the construction overlap spatially.</td>
<td>If a similar construction sequence is adopted for sets of foundations in other projects at the same time as Dogger Bank Creyke Beck B, then there is the likelihood that the respective plumes would interact, to create a larger overall plume with higher suspended sediment concentration and potentially a greater depositional footprint on the seabed. Given that the maximum thickness of sediment that remained deposited on the seabed at the end of the 30-day simulation period for Dogger Bank Creyke Beck was about 0.1mm (for conical GBS, 12m monopole and 10m monopole scenarios), the potential for accumulating thick sequences of sediment due to plume interaction are considered to be small. This assumes that the worst case methodology used for Dogger Bank Creyke Beck B is duplicated for Dogger Bank Teesside A &amp; B. <strong>Negligible cumulative impact</strong></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Project</th>
<th>Scope for interaction of sediment plume/ sediment deposition</th>
<th>Justification</th>
<th>Conclusion of physical processes CIA (predicted cumulative impact on marine and intertidal ecology)</th>
</tr>
</thead>
</table>
| Hornsea offshore wind farm                  | Unlikely                                                   | - substrate at Hornsea will only release a limited amount of suspended sediment through seabed preparation because it is predominantly sand and gravel that will only travel a short distance;  
  - main axis of the Dogger Bank Creyke Beck construction plume is north west to south east with deposition from the plume predominantly to the north and west. This distribution provides limited potential for convergence with the Hornsea Zone;  
  - shortest distance between the two developments is approximately 65km and construction plumes containing high suspended sediment concentration are unlikely to interact over this distance; and  
  - there is a low probability that construction of the Dogger Bank Creyke Beck projects will overlap with construction of Project One of Hornsea. | No cumulative impact                                                                       |
| Westermost Rough, Humber Gateway and Triton Knoll Wind Farms | Yes                                                        | There is a possibility that the plumes created during construction of the Dogger Bank Creyke Beck export cable could interact with the construction plumes of Westermost Rough (139km to the south west), if both are synchronous. | Given that maximum deposition at any time from the Dogger Bank Creyke Beck export cable is generally less than 1mm and extends less than 20km to the south of the export cable corridor, it is unlikely to have an effect on the plume from construction of the wind farm. In addition, the maximum sediment thickness at the end of the 30-day simulation towards the landward end of the export cable corridor was less than 0.05mm (for conical GBS, 12m monopole and 10m monopole scenarios).  
  No cumulative impact                                                                       |
<p>| H2-20 Offshore Wind Farm (German sector)    | No                                                         | The proposed site is approximately 150km east-northeast of the Dogger Bank Creyke Beck projects. Given this distance the likelihood of interaction with Creyke Beck is low.                                                                 | No cumulative impact                                                                       |</p>
<table>
<thead>
<tr>
<th>Project</th>
<th>Scope for interaction of sediment plume/sediment deposition</th>
<th>Justification</th>
<th>Conclusion of physical processes CIA (predicted cumulative impact on marine and intertidal ecology)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marine Aggregate Area 466</td>
<td>Yes</td>
<td>Area 466 is located at the northern boundary of Tranche A and may become licensed during the lifetime of the Dogger Bank development. The aggregate area is located within the extent of the maximum and average footprints of the plume generated from construction and operation. Aggregate extraction activities have the potential to release further suspended sediment into the water column which could interact with construction phase plumes from Dogger Bank Creyke Beck, which would give rise to cumulative effects.</td>
<td>Greatest scope for cumulative impact when construction activities are taking place along the northern part of Dogger Bank Creyke Beck B, which is closest to Area 466, and the dredging activities in Dogger Bank Creyke Beck B and in Area 466 are coincident. EMU Ltd (2009) showed that, for Area 466, suspended sediment concentration above 5mg/l are confined to the relatively small dredge path and dredge area. For the majority of the dispersed plume, the concentrations are less than 5mg/l. If interaction with the Dogger Bank Creyke Beck plume were to occur, the result will be: - short-term; given a dredger will only visit Area 466 once a week; - localised; given the limited extent of relatively high (&lt;greater than 5mg/l) suspended sediment concentration values for Area 466; and - small; given that the predominant suspended sediment concentration in the Area 466 plume is 5mg/l or less. <strong>Minor adverse cumulative impact</strong></td>
</tr>
<tr>
<td>Marine Aggregate Area 485</td>
<td>Yes</td>
<td>Area 485 is located approximately 25km to the southwest of Dogger Bank Creyke Beck A and 20km south of the export cable corridor. No information is available on this potential application; however, the same conclusions drawn for Area 466 apply, assuming that the dredging process and sequencing at Area 485 is similar to that at Area 466.</td>
<td>Magnitude of any interaction will be less because of the larger distance from the Dogger Bank Creyke Beck projects compared to Area 466. <strong>Negligible cumulative impact</strong></td>
</tr>
<tr>
<td>Project</td>
<td>Scope for interaction of sediment plume/sediment deposition</td>
<td>Justification</td>
<td>Conclusion of physical processes CIA (predicted cumulative impact on marine and intertidal ecology)</td>
</tr>
<tr>
<td>---------</td>
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<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Marine Aggregate Areas 448 and 449</td>
<td>Yes</td>
<td>Both Areas 448 and 449 are approximately 150km from the western perimeter of the Dogger Bank Zone and so there will be no interaction with plumes created by foundation installation or operation of the wind farm. The only potential interaction will be with plumes generated by excavation of the Dogger Bank Creyke Beck export cable which is approximately 50km to the north of Areas 448 and 449.</td>
<td>There is unlikely to be any interaction of sediment plumes from Dogger Bank Creyke Beck export cable installation and dredging in these areas, given the small size of the plume generated by the cable and the low likelihood that the cable will be excavated on the same day as the aggregate extraction is being undertaken. <strong>Negligible cumulative impact</strong></td>
</tr>
</tbody>
</table>
10.4 Permanent loss of marine habitats via installation of project infrastructure associated with offshore wind farm development and other activities

10.4.1 A cumulative effect of permanent loss of habitats due to the construction of foundations and associated project infrastructure, such as scour and cable protection and vessel mooring is predicted via additional projects in the Dogger Bank Zone and other activities / development outside the zone, including further offshore wind developments such as Hornsea and Triton Knoll. Under the scenario where Dogger Bank Creyke Beck A & B were constructed together, the worst-case permanent loss of habitat has been predicted to be 9.93km$^2$, which amounts to 0.66% of the total 1492.47km$^2$ of the Dogger Bank Creyke Beck A and B sites (including export cable corridors) combined. Assuming that the other planned projects in the Dogger Bank Zone and outside the zone (e.g. Hornsea, Triton Knoll) will result in a similar amount of permanent habitat loss, it can be noted that, although there will be a cumulative impact of permanent habitat loss of benthic habitats as a result of multiple projects in the wider region, the overall amount of any loss still represents a small percentage of the overall benthic habitats across the southern North Sea region.

10.4.2 It is also assumed that (a) the majority of this permanent habitat loss will arise in habitat types that are widespread across the region and as such, any permanent loss via project developments will not lead to the loss of a discrete habitat type from the southern North Sea and (b) that permanent loss of any particularly sensitive benthic habitats (e.g. Annex I reef) has been avoided by the project-specific EIA processes, which should have identified any such habitats and proposed appropriate mitigation measures (micro-siting) to avoid damage to these habitats.

10.4.3 Therefore, in conclusion, it is predicted that there will be a negligible cumulative impact on benthic habitats across the wider southern North Sea region via permanent habitat loss from projects within the Dogger Bank Zone and other projects outside the zone, including offshore wind developments such as Hornsea and Triton Knoll.

10.5 Increased suspended sediment concentration and sediment deposition during operational phase

10.5.1 Increased suspended sediment plumes produced during the operational phase of Dogger Bank Creyke Beck may interact with similar plumes produced during the operational phases of other developments in the wider region. With respect to potential operational phase suspended sediment interactions between Dogger Bank Creyke Beck and the Dogger Bank Teesside A & B projects if there is an overlap (or partial overlap) in sequencing of these projects then cumulative effects will arise with respect to suspended sediment concentration. A one-year storm and/or a 50-year storm could affect the projects at the same time, resulting in a cumulative release of suspended sediment through scour processes.
10.5.2 The results for Dogger Bank Creyke Beck (A or B) show that maximum suspended sediment concentration can reach 50-100mg/l for a one-year storm (after one year of operation), and greater than 200mg/l for a 50-year storm (after two years of operation). These higher concentrations are generally confined to within the boundaries of the projects. Predictions of suspended sediment concentration outside the project boundaries are lower and are aligned predominantly along a northwest to southeast axis, partially extending over the proposed location of Dogger Bank Teesside B. The plume created by the Dogger Bank Creyke Beck projects is reduced to background suspended sediment concentration marginally short of the boundary of Dogger Bank Teesside B. However, there is a high probability that the two operational phase plumes (from Dogger Bank Creyke Beck and Dogger Bank Teesside A & B) will overlap.

10.5.3 If it is assumed that a similar volume and extent of suspended sediment is released during the operational phase of both the Dogger Bank Creyke Beck and Dogger Bank Teesside A & B projects, then it is likely that suspended sediment concentration will be increased where the plumes overlap. It is possible that maximum suspended sediment concentration could be more than doubled across the lower concentration areas of the plume footprint (areas where the Dogger Bank Creyke Beck suspended sediment concentrations are predicted to be less than 50mg/l for a one-year storm and less than 100mg/l for a 50-year storm), if the right conditions exist. However, the highest suspended sediment concentration for Dogger Bank Creyke Beck will be unlikely to interact with the highest suspended sediment concentration for Dogger Bank Teesside A & B because of distance between these two project areas.

10.5.4 Therefore, a minor cumulative impact is predicted due to the interaction of operational phase plumes from the Dogger Bank Creyke Beck and Dogger Bank Teesside A & B projects as the benthic fauna exposed to the cumulative interaction of these plumes will be adapted to temporary high suspended sediment loads.

10.5.5 With respect to cumulative impacts via operational phase plumes from Dogger Bank Creyke Beck and Dogger Bank Teesside A & B with other developments, the following key conclusions have been reached via the physical process modelling work.

- **Hornsea Project One**: The worst case plume and deposited sediment from the plume for the operation of Dogger Bank Creyke Beck are predicted to extend up to within 30km of the northern boundary of Project One. Assuming that a similar sized plume would occur for Dogger Bank Teesside A & B, it is unlikely that the Project One construction plume will interact with the Dogger Bank plume because the latter is created by a 50-year storm during which time it is unlikely that any construction at Project One will be possible.

- **Area 466 Marine Aggregate Extraction**: The plume from aggregate extraction in Area 466 would be very small in comparison to the operational plume from the Dogger Bank Creyke Beck and Dogger Bank Teesside A & B projects. Hence, inclusion of the short-lived Area 466 plume within the operational plumes of the Dogger Bank Creyke Beck and Dogger Bank Teesside A & B projects will have little effect on its overall size and will be essentially unchanged in terms of suspended sediment concentration and distribution. Therefore, a **negligible** cumulative impact on benthic ecology is predicted via interaction of sediment plumes from the Dogger Bank Creyke Beck and Dogger Bank Teesside A & B.
Bank Teesside A & B projects and Area 466; and

- **Area 485 Marine Aggregate Extraction**: The same conclusions as outlined above with respect to Area 466 apply to potential interaction between plumes from Area 485 and the Dogger Bank Creyke Beck and Dogger Bank Teesside A & B projects. Therefore, a negligible cumulative impact on benthic ecology is predicted via interaction of sediment plumes from the Dogger Bank projects and Area 485.

10.5.6 No additional scope for cumulative impacts has been identified between the operational phase sediment plumes of Dogger Bank Creyke Beck and Dogger Bank Teesside A & B on other developments in the wider region.

### 10.6 Direct impact via vessel activity (jacking-up and anchoring in operational phase)

10.6.1 For Dogger Bank Creyke Beck A and B built (and operated) together, the worst-case impact scenario for temporary disturbance due to maintenance vessels over the lifetime of the project was a disturbance footprint of 4.66km² over a combined project area of 1114.10km² (0.41% of overall project area).

10.6.2 As per the rationale outlined above with respect to permanent habitat loss during the operational phase, it is assumed that the footprint of temporary disturbance at other sites within the Dogger Bank Zone and also projects outside the zone will be similar to that calculated for Dogger Bank Creyke Beck A and B. Therefore, it is concluded that approximately 0.4% of each project site will be affected by temporary habitat disturbance in the operational phase due to vessel activities. Whilst these individual amounts of disturbance do represent a cumulative impact on benthic habitats across the wider region when considered together, this impact is predicted to be negligible. This conclusion is reached by noting the same factors as outlined above for permanent habitat loss, such as the widespread nature of much of these habitats throughout the southern North Sea, but also noting the fact that the majority of habitats that will be subject to this particular effect will have a low sensitivity to disturbance and a high recoverability.

### 10.7 Cumulative impact of introduction of hard substrates in form of foundations/scour & cable protection into a mainly sedimentary environment (southern North Sea)

10.7.1 Colonisation of hard substrates (introduced in form of foundations and scour/cable protection) will occur on all projects within the Dogger Bank Zone and also other wind farm development projects outside the zone. The amount of hard substrate introduced to the wider region via these developments will be broadly similar as a proportion (%) of the existing sedimentary environment as that discussed above with regard to the cumulative impact of permanent habitat loss. Of the two types of effect described in the earlier impact assessment section for Dogger Bank Creyke Beck A and B, namely “reef” effects and potential “stepping-stones” for colonisation by invasive species, these are both predicted to arise at each individual site. However there are already areas of hard substrate within the area in the form of ship wrecks, therefore, it is likely that species colonising the foundations and scour/cable
protection will not be new species to the area.

10.7.2 However, if these effects do actually arise in reality (which is uncertain), the spatial scale of them will be very localised and due to the distance between the various structures associated with the projects identified in this CIA, it is not predicted that there will be any form of cumulative impact between different projects.

10.8 Cumulative impact on the Dogger Bank cSAC and Flamborough Head SAC

10.8.1Scope exists for an adverse effect on the integrity of the Dogger Bank cSAC and Flamborough Head SAC via cumulative impacts during construction from Dogger Bank Creyke Beck, Dogger Bank Teesside A & B and other projects. Such impacts will include temporary habitat disturbance, increased suspended sediment concentrations and sediment deposition.

10.8.2 These individual cumulative impacts are assessed above, with a full assessment of the potential for the interaction of these impacts from various projects to affect the integrity of the Dogger Bank cSAC and Flamborough Head SAC presented in the HRA Report.

10.8.3 The assessment in the HRA Report takes the form of a formal in-combination assessment as required under the Habitats Regulations. Any plans and projects that may result in the same or similar effect on the Dogger Bank cSAC or Flamborough Head SAC and/or its relevant features have been identified.
11 Transboundary Effects

11.1.1 This section of the chapter considers the potential for transboundary effects (effects across international boundaries) to occur on benthic and epibenthic resources as a result of the construction, operation or decommissioning of Dogger Bank Creyke Beck. For the purpose of this assessment, two types of transboundary effects are defined:

- i) those that might arise within the Exclusive Economic Zone (EEZ) of other European Community states; and
- ii) those that may arise on the interests of other European Community states, e.g. a non UK fishing vessel operating legitimately within UK waters.

11.1.2 With respect to the first type of potential transboundary effect, all impacts on the benthos during the construction, operation and decommissioning phases of all the projects (whether built in isolation or together), will be limited to direct habitat loss or disturbance caused by the placement of project infrastructure such as cables, foundations and scour protection and/or activity of vessels involved in the construction and operational phases (via jacking-up and anchoring) and indirect impacts due to the effect of increased suspended sediment concentration and sediment deposition.

11.1.3 Increased suspended sediment concentration created during the construction phase (due to cable and foundation installation) and operational phase (via sediment liberated as a result of scour effects) are noted to occur outside the site boundary. However the physical process modelling done on the worst-case scenario indicates that increased suspended sediment concentrations and sediment deposition do not impact non-UK waters. The areas that are affected outside Tranche A are still located within UK territorial waters, albeit outside the main Dogger Bank Zone. Therefore, there is no scope for direct or indirect transboundary impacts of type (i) listed above, i.e. impacts within the EEZ of other European Community states.

11.1.4 There is also no scope for transboundary impacts of type (ii) listed above, e.g. a non UK fishing vessel operating legitimately within UK waters. The impacts on benthic ecology within UK waters predicted as a result of this development (Dogger Bank Creyke Beck A or B in isolation or both built together) will not result in any wider impacts on activities, such as commercial fishing, that are undertaken by non UK vessels, in UK-waters.

11.1.5 A summary of the likely transboundary effects of Dogger Bank Creyke Beck can be found in Chapter 32 Transboundary Effects.
12 Summary

12.1.1 This chapter of the ES has provided a characterisation of the existing environment for marine and intertidal ecology based on both existing and site specific survey data, which has established that there will be some negligible and minor adverse residual impacts on marine ecology during construction, operation and decommissioning phases of Dogger Bank Creyke Beck.

12.1.2 The marine subtidal and intertidal habitats recorded across the main Dogger Bank Creyke Beck A & B sites and export cable corridors are typical for the central North Sea, with a range of biotopes recorded which have been grouped into seven VERs based on the sensitivity of the various biotopes.

12.1.3 Some of the subtidal benthic habitats correspond to the Annex I habitat “sandbanks slightly covered by seawater at all times” and lie within the boundary of the Dogger Bank cSAC. The sensitivity of the habitats identified within the study area to the impacts predicted via construction, operation and decommissioning of Dogger Bank Creyke Beck range from low to high, with the magnitude of effects generally negligible to low due to the small spatial extent of effect compared to the wider distribution of similar habitats.

12.1.4 This has resulted in the majority of impacts being assessed as negligible to minor adverse.

12.1.5 A discrete VER (VER F) located in the nearshore section of the export cable corridor has been identified as potentially supporting Annex I biogenic (Mytilus) reef and as such the sensitivity of this receptor to effects produced via cable installation and operation has been judged to be high. However, the magnitude of any effects on this VER are judged to be low, resulting in a prediction of minor adverse impact.

12.1.6 The impact assessment has also considered the potential for impacts on subtidal habitats that correspond to the boundary of the SAC (VERs A and B) to adversely affect the integrity of the Dogger Bank cSAC. Based on the assessment no such adverse effects are predicted. More details on the cSAC are provided in the HRA Report.

12.1.7 Due to the lack of significant impacts on marine subtidal or intertidal habitats, no specific mitigation is proposed and the monitoring proposals are typical of those for existing UK OWF projects, with a formal pre-construction baseline survey to be carried out in the future followed by a number of annual post-construction surveys. The design of these surveys will take account of the impact predictions made in the ES in order that the monitoring data can test the predictions of the ES.

12.1.8 Table 12.1 provides a summary of the potential impacts on marine and intertidal ecology arising from the realistic worst case scenarios set out in Table 5.1 earlier in the chapter.
### Table 12.1 Summary of predicted impacts of Dogger Bank Creyke Beck on marine and intertidal ecology

<table>
<thead>
<tr>
<th>Impact</th>
<th>Mitigation</th>
<th>Residual impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical disturbance to habitats and species and temporary habitat loss</td>
<td>Potential micro-siting of export cables in and around area of Mytilus based VER in inshore part of export cable corridor</td>
<td><strong>Negligible</strong> impact (Dogger Bank Creyke Beck A and/or B main site and export cable corridor) <strong>Minor adverse</strong> impact on small proportion of mussels (Mytilus) within VER F due to direct mortality.</td>
</tr>
<tr>
<td>Increased suspended sediment concentration and sediment deposition</td>
<td>None</td>
<td><strong>Minor adverse</strong> impact from increased suspended sediment concentrations on VER A and B within main sites of Dogger Bank Creyke Beck A &amp; B <strong>Negligible</strong> impact on all other VERs from increased suspended sediment concentrations</td>
</tr>
<tr>
<td>Release of sediment contaminants resulting in potential effects on benthic ecology</td>
<td>None</td>
<td><strong>Negligible</strong> impact (Dogger Bank Creyke Beck A and B and export cable corridor)</td>
</tr>
<tr>
<td>Increased suspended sediment concentration leading to impacts on plankton and primary productivity</td>
<td>None</td>
<td><strong>Negligible</strong> impact (Dogger Bank Creyke Beck A and B and export cable corridor)</td>
</tr>
<tr>
<td>Physical disturbance to intertidal habitats and species during landfall works</td>
<td>None</td>
<td><strong>Negligible</strong> impact (export cable corridor)</td>
</tr>
<tr>
<td><strong>Operation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permanent loss of habitat via placement of project infrastructure (foundations, cable protection, scour protection)</td>
<td>None</td>
<td><strong>Negligible</strong> impact on VERs B, C, D, E and G (Dogger Bank Creyke Beck A main site and export cable corridor) <strong>Minor adverse</strong> impact on VER A (Dogger Bank Creyke Beck A &amp; B together and export cable corridor) <strong>Minor adverse</strong> impact on Mytilus based VER F</td>
</tr>
<tr>
<td>Temporary impact on benthos due to physical disturbance caused by maintenance activities</td>
<td>None</td>
<td><strong>Negligible</strong> impact on VERs A and B (Dogger Bank Creyke Beck A and B main site only))</td>
</tr>
<tr>
<td>Change in hydrodynamics and inter-related effects on benthos</td>
<td>None</td>
<td><strong>Negligible</strong> impact (Dogger Bank Creyke Beck A and B main site and export cable corridor)</td>
</tr>
<tr>
<td>Increase in suspended sediment concentration due to scour associated with foundations</td>
<td>None</td>
<td><strong>Negligible</strong> impact (Dogger Bank Creyke Beck A and B main site and export cable corridor)</td>
</tr>
<tr>
<td>Increase in sediment deposition following increase in suspended sediment concentration due to scour associated with foundations</td>
<td>None</td>
<td><strong>Negligible</strong> impact (Dogger Bank Creyke Beck A and B main site and export cable corridor)</td>
</tr>
<tr>
<td>Introduction of new habitat in the form of foundation structures, leading to potential colonisation</td>
<td>None</td>
<td><strong>Negligible</strong> impact (Dogger Bank Creyke Beck A and B main site and cable corridor)</td>
</tr>
<tr>
<td>Impact</td>
<td>Mitigation</td>
<td>Residual impact</td>
</tr>
<tr>
<td>--------------------------------------------</td>
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<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Decommissioning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased suspended sediment concentration</td>
<td>None</td>
<td><strong>Negligible</strong> impact (Dogger Bank Creyke Beck A and B main site and export cable corridor)</td>
</tr>
<tr>
<td>and sediment deposition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of species colonising hard structures</td>
<td>None</td>
<td><strong>Negligible</strong> impact (Dogger Bank Creyke Beck A and B main site and export cable corridor)</td>
</tr>
<tr>
<td>Temporary disturbance to habitats</td>
<td>None</td>
<td><strong>Negligible</strong> impact (Dogger Bank Creyke Beck A main site and export cable corridor)</td>
</tr>
<tr>
<td>via removal of cables</td>
<td></td>
<td><strong>Minor adverse</strong> impact (Dogger Bank Creyke Beck A &amp; B together and export cable corridor)</td>
</tr>
</tbody>
</table>
13 References


Marlin (2012) [Online]. Marlin, the Marine Life Information Network. Available at: www.marlin.ac.uk


