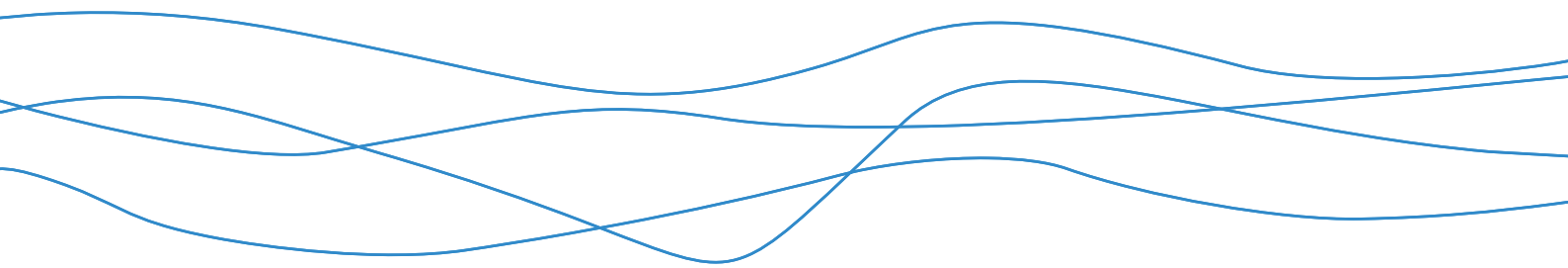




Bowdun Offshore Wind Farm, Report to Inform Appropriate Assessment

Part 1 - Introduction

TWP-BOW-RPS-ENV-REP-00013 | April 2026



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Glossary

Defined term	Definition
Additional Mitigation	Also referred to as secondary mitigation, which is defined by The Institute of Sustainability and Environmental Professionals (ISEP) (formerly Institute of Environmental Management and Assessment (IEMA)) as: Actions that will require further activity in order to achieve the anticipated outcome. These may be imposed as part of the planning consent, or through inclusion in the Stage 2 RIAA (sic).
Annex I Habitats	Natural habitats of community interest (in danger of disappearance in their natural range and/or for which there is a particular responsibility to conserve) as identified in Annex I of the Habitats Directive (Council Directive 92/43/EEC) whose conservation requires the designation of Special Areas of Conservation (SACs).
Annex I Birds	A list of protected bird species, as identified in Annex I of the Birds Directive (Council Directive 2009/147/EC), whose conservation requires the designation of Special Protection Areas (SPAs).
Annex II	Species of community interest whose conservation requires the designation of Special Areas of Conservation (SACs) as identified in Annex II of the Habitats Directive (Council Directive 92/43/EEC).
Applicant (the)	Bowdun Offshore Wind Farm Limited (BOWFL).
Appropriate Assessment (AA)	An assessment to determine the implications of a plan or project for a European Site in view of that site's conservation objectives. An Appropriate Assessment (AA) forms part of the Habitats Regulations Appraisal (HRA) and is required when a plan or project (either alone or in-combination with other plans or projects) is likely to have a significant adverse effect on the integrity of a European Site.
Array Area	The Array Area is the area in which the Offshore Generation Assets will be located.
Bowdun Offshore Wind Farm Limited (BOWFL)	A Special-Purpose Vehicle (SPV) (legal entity) for the purpose of developing the Project. BOWFL are the Applicant for the Offshore Application.
Competent Authority	The term derives from the Habitats Regulations and relates to the duties that the Regulations impose on public bodies and individuals. Regulation 6(1) defines Competent Authorities as 'any Minister, government department, public or statutory undertaker, public body of any description or person holding a public office'. In the case of the Proposed Development, the Competent Authority is Marine Directorate-Licensing Operations Team (MD-LOT) acting on behalf of the Scottish Ministers.
Crown Estate Scotland	Public corporation accountable to Scottish Government, responsible for the management of land and property, including marine assets in Scotland owned by the monarch.

Defined term	Definition
Embedded Mitigation	<p>Measures that are adopted as part of the Proposed Development and have been assessed within this AA. Embedded mitigation for the Proposed Development includes both primary mitigation and tertiary mitigation. These are defined by the ISEP as follows:</p> <p>Primary: Modifications to the location or design of the development made during the pre-application phase that are an inherent part of the project, and do not require additional action to be taken.</p> <p>Tertiary: Actions that would occur with or without input from the EIA feeding into the design process. These include actions that will be undertaken to meet other existing legislative requirements, or actions that are considered to be standard practices used to manage commonly occurring environmental effects.</p>
Environmental Impact Assessment (EIA)	Process for the assessment of likely significant environmental effects of a project on the physical, biological, and human environment during construction, Operations and Maintenance (O&M) and decommissioning.
European Sites	This term recognises SACs, candidate SACs (cSACs), Sites of Community Importance (SCIs), Special Protection Areas (SPAs), possible SACs (pSACs), potential SPAs (pSPAs) and Ramsar sites (where also designated as another European Site), which protect species and habitats shared across Europe and were originally designated under European legislation.
Export Cable Corridor	The area of seabed seaward of Mean High-Water Springs (MHWS) which connects the Array Area with the Landfall within which the Offshore Export Cables will be installed.
Grid Connection Point (GCP)	Location where the Offshore Export Cables connect to the electrical grid.
Habitats Regulations	A term that refers to the collective legislation that translates the Habitats Directive into specific legal obligations in Scotland, namely: The Conservation (Natural Habitats, &c.) Regulations 1994; The Conservation of Habitats and Species Regulations 2017; and The Conservation of Offshore Marine Habitats and Species Regulations 2017 (in each case as amended).
Habitats Regulations Appraisal (HRA)	An assessment carried out under the Habitats Regulations to determine if a plan or project proposal could adversely affect the integrity of a European Site.
Inter-Array Cables (IAC)	Cables which link the Wind Turbines to each other and with the Offshore Substation Platforms (OSPs).
Interconnector Cables	Cables which will connect individual OSPs to each other to provide redundancy against cable failure elsewhere.
Intertidal Area	The area between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS).
Landfall	The area in which the Offshore Export Cables make landfall and is also the transitional area between the Offshore Transmission Assets and the Onshore Transmission Assets. Located in the Intertidal Area at Benholm.

Defined term	Definition
Likely Significant Effect (LSE)	A significant effect on a designated site that has the potential to occur within the Proposed Development (as determined by the LSE Screening Report). Where an LSE cannot be ruled out, further assessment is needed as part of the AA.
Marine Directorate (MD)	The Marine Directorate of the Scottish Government, formerly known as Marine Scotland. The planning and licensing authority for Scotland's seas and custodian of Scotland's National Marine Plan (NMP). The Marine Directorate - Licensing and Operations Team (MD-LOT) are specifically responsible for managing Section 36 Consent and Marine Licence Applications seaward of MHWS.
Marine Licence	A Marine Licence permits the undertaking of different activities in the marine environment, including construction, the deposition or removal of substances or objects, and dredging. The Marine (Scotland) Act 2010 requires Marine Licences to be obtained for licensable activities taking place within Scottish Territorial Waters (MHWS to 12 nm). The Marine and Coastal Access Act (MCAA) 2009 requires a Marine Licence to be obtained for licensable marine activities within the Scottish offshore region (12 nm – 200 nm).
Mean High Water Springs (MHWS)	The average tidal height throughout the year of two successive high waters during those periods of 24 hours when the range of the tide is at its greatest.
Mean Low Water Springs (MLWS)	The average tidal height throughout the year of two successive low waters during those periods of 24 hours when the range of the tide is at its greatest.
Mitigation	Measures to avoid, prevent, reduce or control effects on the environment. See also definitions for Embedded Mitigation and Additional Mitigation.
National Site Network	The National Site Network comprises European Sites located in the UK, designated (or proposed) on European (EU)-Exit day, as well as any new sites designated under the Habitats Regulations under an amended designation process.
Offshore Export Cables	Subsea cables used to transmit electricity generated offshore by the wind turbines from the OSPs to shore. The Transition Joint Bay is the location where the Offshore Export Cables terminate, and the onshore cabling begins.
Offshore Generation Assets	The infrastructure of the Proposed Development required to generate electricity comprising of the Wind Turbines, Wind Turbines foundations and associated infrastructure (e.g. IACs).
Offshore Infrastructure	All of the Offshore Infrastructure associated with the Proposed Development that is located seaward of MHWS, comprising the Offshore Generation Assets and the Offshore Transmission Assets.
Offshore Substation Platform(s) (OSPs)	OSPs comprise the support structure, topside and electrical components used for collecting and/or converting electricity generated by the Wind Turbines for transmission by the Offshore Export Cables.
Offshore Transmission Assets	The infrastructure of the Proposed Development required to transmit the generated electricity comprising the OSPs, Offshore Export Cables and associated infrastructure up to MHWS.
Onshore Transmission Assets	The transmission infrastructure associated with the Project above MLWS, which is subject to a separate onshore HRA RIAA submitted to The Highland Council.

Defined term	Definition
Option Lease Agreement	An agreement between Crown Estate Scotland and a developer, permitting the future development of offshore wind within an agreed area.
Plan Option Area (POA)	A location identified in the Sectoral Marine Plan (SMP) as a preferred area for commercial scale offshore wind development.
Project (the)	An overarching term for the Bowdun Offshore Wind Farm (Bowdun OWF) comprising the offshore and onshore infrastructure required to generate and transmit electricity from the Array Area to the onshore Grid Connection Point (GCP). The Project includes the Offshore Generation Assets, the Offshore Transmission Assets and the Onshore Transmission Assets.
Project Design Envelope (PDE)	A description of the range of possible elements that make up the design options for the Proposed Development under consideration when the exact engineering parameters are not yet known.
Proposed Development	Term used to define the Offshore Infrastructure associated with the Project seaward of MHWS for which consent is being sought. Further details of the parameters are included in Section 4.
Qualifying Features	The features for which a European Site has been officially designated to protect.
Ramsar Site	Wetlands of international importance, designated under the Ramsar Convention on Wetlands of International Importance 1971.
Report to Inform Appropriate Assessment (RIAA)	The RIAA provides detailed information to support the process of AA (undertaken by the competent authority) as part of the HRA, which evaluates the potential impacts of a project or plan on protected European Sites.
Safety Zones	An area extending a maximum of 500 m from the central point of a subsea installation in which other vessels are prohibited from entering, except in circumstances outlined within Section 96 of the Energy Act, 2004.
Scoping Workshop	A series of sessions preceding the finalisation of the Offshore Scoping Report to provide an opportunity for the Applicant to consult on the draft scope and for stakeholders to request additional information on key issues.
Scottish Ministers (the)	The decision makers with regard to Marine Licence(s) and Section 36 Consent applications in Scottish Offshore Waters and Scottish Marine Areas.
Scottish Offshore Waters	The area of sea beyond 12 nm but within the Scottish Exclusive Economic Zone (EEZ) up to 200 nm from the coast.
Scottish Territorial Seas	The territorial waters of Scotland that extend out from MHWS to 12 nm.
ScotWind Leasing Round	A seabed leasing round run by Crown Estate Scotland (CES) to grant property rights for the seabed in Scottish waters for new commercial scale offshore wind project development. ScotWind Leasing must be sited within POA of the SMP.
Section 36 Consent	Scottish Ministers' consent under Section 36 of the Electricity Act 1989 required to permit the generation and operation of an energy generation station.
Sectoral Marine Plan (SMP)	A plan developed by the Scottish Government which provides the strategically planned spatial footprint for offshore wind development in Scotland.

Defined term	Definition
Sectoral Marine Plan Iterative Plan Review (SMP IPR)	The iterative plan review process as new information becomes available (e.g. consented projects, environmental data, cumulative effects assessment, etc.).
Site Boundary	The boundary within which all elements of the Proposed Development will be located. The Site Boundary comprises the Array Area and Export Cable Corridor which ends at MHWS.
Special Areas of Conservation (SACs)	SACs are areas designated for the conservation of certain plant and animal species listed in the Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.
Special Protection Areas (SPAs)	SPAs are sites that are designated to protect rare or vulnerable birds (as listed on Annex I of the Directive 2009/147/EC on the conservation of wild birds), as well as regularly occurring migratory species.
Statutory Nature Conservation Body (SNCB)	A statutory adviser to the UK and Scottish Governments on Scottish, UK and international nature conservation.
Thistle Wind Partners (TWP)	Company established for the development of the Project.
Wind Turbines	Structures comprising of a tubular tower, rotor blades, and a nacelle which houses the Wind Turbine generator.

Acronyms

Acronym	Definition
AA	Appropriate Assessment
BOWFL	Bowdun Offshore Windfarm Limited
CBRA	Cable Burial Risk Assessment
CES	Crown Estate Scotland
CJEU	Court of Justice of the European Union
CPS	Cable Protection Systems
cSAC	Candidate Special Area of Conservation
CTV	Crew Transfer Vessel
DEFRA	Department for Environment Food and Rural Affairs
DSV	Dive Support Vessel
EC	European Commission
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EU	European Union
FCS	Favourable Conservation Status
GCP	Grid Connection Point
HDD	Horizontal Directional Drilling
HRA	Habitats Regulations Appraisal
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IAC	Inter-Array Cable
LAT	Lowest Astronomical Tide
LSE	Likely Significant Effects
MD	Marine Directorate
MD-LOT	Marine Directorate-Licensing Operations Team
MDS	Maximum Design Scenario
MHWS	Mean High Water Spring
MLWS	Mean Low Water Springs
MPCP	Marine Pollution Contingency Plan
NEQ	Net Explosive Quantity
O&M	Operation and Maintenance
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
PDE	Project Design Envelope
PE	Polyethylene
PLGR	Pre-Lay-Grapple-Run
POA	Plan Option Area

Acronym	Definition
pSAC	Possible Special Area of Conservation
pSPA	Potential Special Protection Area
PU	Polyurethane
RIAA	Report to Inform Appropriate Assessment
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SCI	Site of Community Importance
SNCBs	Statutory Nature Conservation Bodies
SOV	Service Operation Vessel
SPA	Special Protection Area
TJB	Transition Joint Bay
TWP	Thistle Wind Partners Limited
UK	United Kingdom
USV	Uncrewed Surface Vessel
UXO	Unexploded Ordnance

Table of Units

Units	Definition
GW	GigaWatt
kg	Kilogram
kJ	Kilojoule
km	Kilometre
km ²	Square kilometres
kV	Kilovolt
m	Metre
m ²	Square metres
m ³	Cubic metres
mm	Millimetre
MW	Megawatt
nm	Nautical mile
°	Degrees
%	Percentage

1 Introduction

1.1 Overview

1.1.1 This Habitats Regulations Appraisal (HRA) Stage 2 Report to Inform Appropriate Assessment (RIAA) supports Bowdun Offshore Wind Farm Limited's (BOWFL; hereafter referred to as the 'Applicant') application submission to the Marine Directorate – Licensing and Operations Team (MD-LOT), acting on behalf of Scottish Ministers, for the offshore elements of the Bowdun Offshore Wind Farm (OWF) (hereafter referred to as the 'Proposed Development'). The regulations under which this HRA Stage 2 RIAA is being prepared are The Conservation (Natural Habitats, & C.) Regulations 1994 (as amended), The Conservation of Habitats and Species Regulations 2017 and The Conservation of Offshore Marine Habitats and Species Regulations 2017. These regulations are collectively referred to as the Habitats Regulations and require that an Appropriate Assessment (AA) must be carried out on all plans and projects that are likely to have a significant effect on the integrity of a European Site.

1.1.2 This RIAA has been prepared by Tetra Tech RPS Energy and Tetra Tech RPS Consulting on behalf of the Applicant to support the HRA of the Proposed Development in the determination of the implications upon European Sites. This document constitutes Part 1 of the RIAA and provides an introduction to the Proposed Development and the HRA process. This document is structured as follows:

- Section 1: Introduction (this section) which describes the Proposed Development and establishes the requirement for, the purpose, and the structure of the RIAA;
- Section 2: The HRA Process, which sets out the process, principles, tests, and guidance applied to the RIAA;
- Section 3: Consultation, which provides a summary of the relevant consultation undertaken to date of relevance to the RIAA; and
- Section 4: Information on the Proposed Development, which provides information about the design of the Proposed Development relevant to the RIAA, including relevant maximum design parameters and any design updates since the HRA Stage 1 LSE Screening (Appendix 1A: Habitats Regulations Appraisal Stage 1 Likely Significant Effects Screening Report).

1.2 Scotwind Leasing Round

1.2.1 Following the ScotWind leasing round, in 2022, Thistle Wind Partners (TWP), as the development company for BOWFL, were successful in securing the option to develop a commercial scale OWF project in the E3 Plan Option Area (POA) as defined in the Scottish Government's Sectoral Marine Plan for Offshore Wind Energy (Scottish Government, 2020a). BOWFL entered into an Option to Lease Agreement with Crown Estate Scotland (CES), to secure the rights to develop within the POA. The Proposed Development will be situated in the E3 POA with further information on the Proposed Development, and the Project as a whole, provided in Section 1.3.

1.3 Overview of the Project and the Proposed Development

- 1.3.1 The Proposed Development, which for the purpose of this HRA Stage 2 RIAA refers to the Offshore Infrastructure only, is located seaward of Mean High Water Springs (MHWS) out to Scottish Offshore Waters.
- 1.3.2 The Project is an estimated 1 GW OWF. The Array Area of the Proposed Development is located approximately 38 km off the Aberdeenshire coast at the closest point to the mainland, with a total lease area of 187 km². The Site Boundary comprises the Array Area and the Export Cable Corridor, as shown in Figure 1.1. The Export Cable Corridor will include a maximum of three High Voltage Alternating Current (HVAC) Offshore Export Cables, each with a length of up to 70 km and will make Landfall at Benholm, Aberdeenshire.
- 1.3.3 Key components of the Proposed Development include the following with a detailed project description provided in Section 4:
- Offshore Generation Assets:
 - up to 67 Wind Turbines on fixed foundations, which will be located within the Array Area (each comprised of three rotor blades, a nacelle housing the generating unit, hub and tower section) and associated supporting structures which will be fixed foundations;
 - a network of up to 167 km of Inter-Array Cables (IACs) which will be static cables;
 - up to 36 km of Interconnector Cables; and
 - Scour Protection, cable protection and utility crossings (as required).
 - Offshore Transmission Assets:
 - up to three Offshore Substation Platforms (OSPs) with fixed foundations and supporting infrastructure including Scour Protection (as required);
 - up to three Offshore Export Cables totalling approximately 210 km in length; and
 - cable protection and utility crossings where required.
- 1.3.4 Electricity will be transmitted to the onshore Grid Connection Point (GCP), which forms part of the National Electricity Transmission System. However, the GCP does not form part of this consent submission as it is landward of Mean Low Water Springs (MLWS) and forms part of the Onshore Transmission Assets and so is outside of the Proposed Development Site Boundary.
- 1.3.5 Construction activities associated with the Proposed Development are anticipated to last for a period of five years and are expected to commence in 2031. Pre-construction surveys, such as geophysical and geotechnical investigations, would be undertaken in advance of construction activities. The Applicant is seeking consent for an operational period of up to 30 years. The decommissioning process will follow a similar programme to construction, although in a reverse manner.

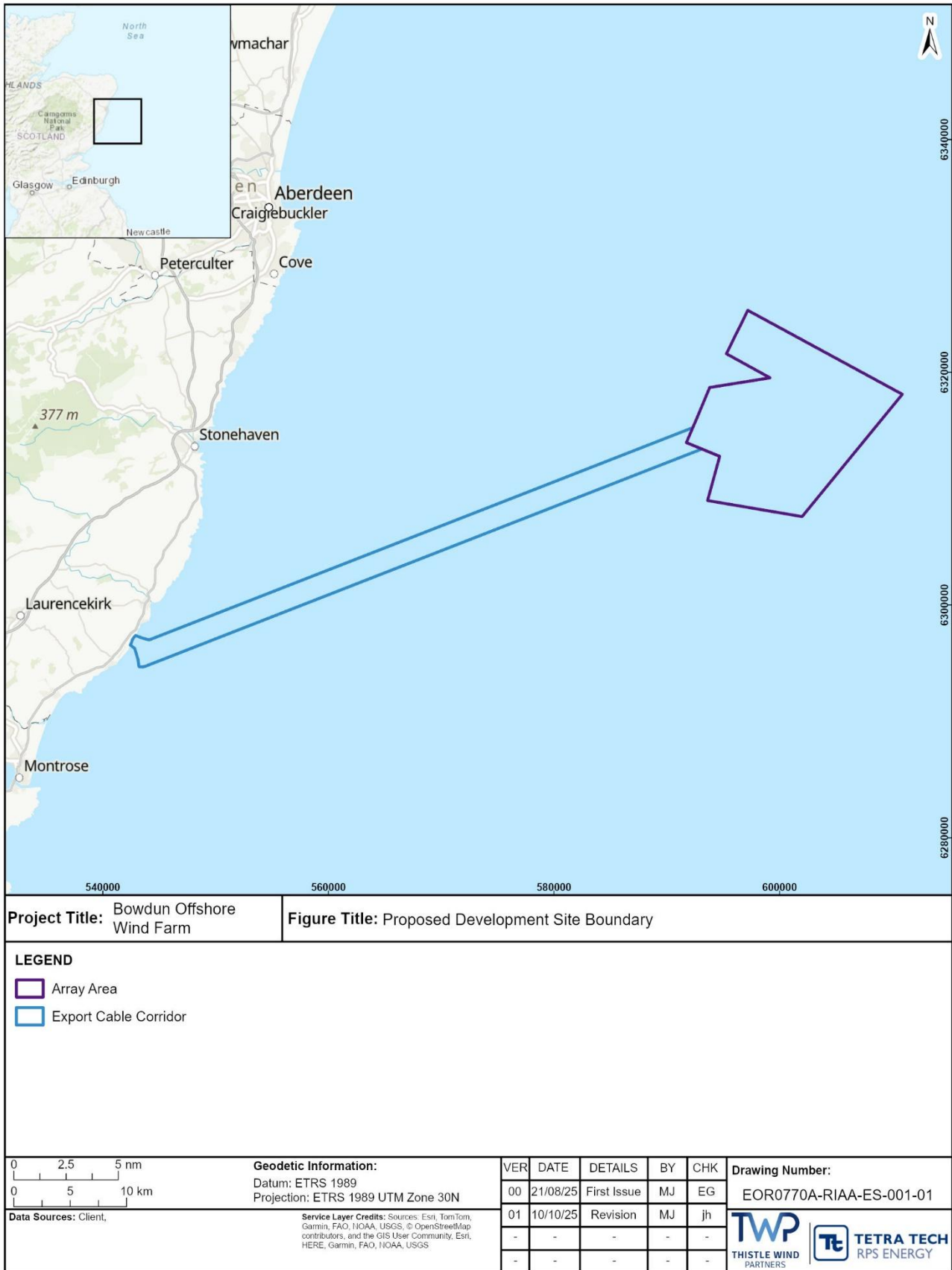


Figure 1.1: Proposed Development Site Boundary

1.4 Consents, Licences and Permissions

1.4.1 The Applicant is applying for separate consents for the onshore and offshore assets of the Project. The Applicant is seeking the following consent, licences and permissions for the Proposed Development, supported by Environmental Impact Assessment (EIA) and HRA Stage 2: AA:

- Section 36 Consent under the Electricity Act 1989 for an offshore generating station;
- Marine Licence covering the Offshore Generation Assets; and
- Marine Licence covering the Offshore Transmission Assets.

1.4.2 The Applicant may also apply later for further consents, licences and permissions, including but not limited to:

- Safety Zone declarations during construction and operation under the Energy Act 2004; and
- Decommissioning scheme under the Energy Act 2004.

1.5 Overview of the HRA

1.5.1 The requirement for the consideration of potential impacts of the Proposed Development upon European Sites is derived from the European Union's (EU's) Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (OJ L 206/7 22.7.1992) hereafter referred to as 'the Habitats Directive'. The land and marine aspects of the Habitats Directive and certain elements of the Council Directive (2009/147/EC) on the conservation of wild birds (the 'Birds Directive') are transposed into domestic law by the Habitats Regulations.

1.5.2 The Habitats Regulations require that an AA must be carried out on all plans and projects that are likely to have a significant effect on a European Site. European Sites include Special Areas of Conservation (SACs), candidate SACs (cSACs), Sites of Community Importance (SCIs), Special Protection Areas (SPAs) and, as a matter of policy (Scottish Government, 2020b), possible SACs (pSACs), potential SPAs (pSPAs) and Ramsar Sites (listed under the Ramsar Convention on Wetlands of International Importance – where also designated as a European site).

1.5.3 The European Commission's (EC's) (2021) guidance 'Commission Notice. Assessment of plans and projects in relation to Natura 2000 sites – Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC' identifies a staged process to the assessment of plans and projects on European Sites:

- Stage 1: Screening;
- Stage 2: The AA; and
- Stage 3: Derogation from Article 6(3) of the Habitats Directive under certain conditions.

1.5.4 Further details on the staged approach are included in Section 2.3.

1.6 Purpose of this RIAA

- 1.6.1 This RIAA builds upon Appendix 1A: Habitats Regulations Appraisal Stage 1 Likely Significant Effects Screening Report completed and submitted to MD-LOT in October 2024. It also incorporates advice from stakeholders from an EIA Scoping Workshop held in April 2024, and a post-workshop written response from NatureScot in July 2024, as well as subsequent advice in the Scoping Opinion received from MD-LOT in November 2024 (MD-LOT, 2024). These responses have informed the scope of the HRA, and they are discussed in Section 3. This RIAA represents Stage 2 of the HRA process and assesses the Likely Significant Effects (LSEs) of the Proposed Development as they relate to the integrity of the relevant European Sites. This RIAA will provide the Competent Authority with the information required to undertake a HRA Stage 2 AA (see Section 2 for more detail on the HRA process).
- 1.6.2 The scope of this RIAA covers all relevant European Sites and relevant Qualifying Features where LSEs have been identified due to impacts arising from the Proposed Development. This includes both ‘offshore’ European Sites and features (seaward of MHWS), and potential impacts of Offshore Infrastructure seaward of MHWS on ‘onshore’ European Sites (landward of MLWS). The onshore elements of the Project have been given due consideration in the in-combination assessments presented in Sections 5.4 and 6.4 of the RIAA Part 2: Special Areas of Conservation and Section 5.4 of the RIAA Part 3: Special Protection Areas and Ramsar Site Assessments.

1.7 Progress to Date

- 1.7.1 A HRA Stage 1 LSE Screening Report was produced for the Proposed Development in accordance with the Habitats Regulations (Appendix 1A: Habitats Regulations Appraisal Stage 1 Likely Significant Effects Screening Report). The purpose of the LSE screening exercise was to determine whether the Proposed Development could result in a LSE on any European Site, with reference to the European Site’s conservation objectives. The LSE screening exercise determined that LSEs from impacts associated with the Proposed Development could not be discounted at Stage 1, and European Sites where LSEs could not be ruled out were carried forward to Stage 2.
- 1.7.2 The purpose of the LSE screening exercise presented in Appendix 1A: Habitats Regulations Appraisal Stage 1 Likely Significant Effects Screening Report is summarised below:
- identification of the relevant European Sites which may include Qualifying Features (e.g. Annex I Habitats, ornithology features, Annex II diadromous fish, and Annex II marine mammals (including otter)) which may be sensitive or vulnerable to potential impacts arising from all phases of the Proposed Development;
 - consideration of the Qualifying Features of relevant European Sites and identification of those which are not considered likely to be at risk of significant effects arising from the Proposed Development, either alone or

in-combination with other plans and projects, so that they could be eliminated from further assessment within the HRA process;

- consideration of Qualifying Features of relevant European Sites and identification of those which are considered likely to be at risk of significant effects so that they could be carried forwards to HRA Stage 2 AA in this RIAA; and
- consideration of which of the potential impacts arising from the Proposed Development (alone or in-combination with other plans and projects) were likely to result in LSEs to Qualifying Features of European Sites and which impacts could be eliminated from further assessment in the HRA process¹.

1.7.3 The HRA process is iterative. Since the Proposed Development HRA Stage 1 LSE Screening Report (Appendix 1A) was shared with consultees in October 2024, aspects of the design of the Proposed Development have evolved (see Section 4). Consultation representation and advice with respect to the Proposed Development HRA Stage 1 LSE Screening Report was received in November 2024 (MD-LOT, 2024). The potential implications of design changes on the LSE screening exercise have been considered and a summary of the LSE screening exercise for the Proposed Development is provided in the relevant sections of this RIAA (i.e. Part 2 for SACs and Part 3 for SPAs and Ramsar Sites). Any changes to the LSE screening outcomes presented in Appendix 1A: Habitats Regulations Appraisal Stage 1 Likely Significant Effects Screening Report that have been made as a result of consultation are highlighted in the relevant Parts of the RIAA, with all consultation to date presented, where relevant in Part 2: Special Areas of Conservation and Part 3: Special Protection Areas and Ramsar Site Assessments.

1.8 Structure of this RIAA

1.8.1 For clarity and ease of navigation, this RIAA has been structured and reported as follows:

- Part 1 (this document): Introduction;
- Part 2: SAC Assessments; and
- Part 3: SPA and Ramsar Site Assessments.

¹ Recognising the potential for non-significant effects to accumulate or act in-combination.

2 The HRA Process

2.1 Legislative Context

2.1.1 The Habitats Directive, together with the Birds Directive, provide the EU's legal framework for the protection of wild fauna and flora and establishes a network of internationally important sites, designated for their ecological status. This network of designated sites is comprised of the following:

- SACs, which are designated under the Habitats Directive and promote the protection of flora, fauna and habitats; and
- SPAs, which are designated under the Birds Directive in order to protect rare, vulnerable and migratory birds.

2.1.2 SACs are designated for the conservation of Annex I Habitats (including priority habitat types which are in danger of disappearing) and Annex II Species (including diadromous fish and marine mammals). SPAs are designated for the conservation of Annex I Birds and other regularly occurring migratory birds and their habitats. The habitats and species that a European Site is designated to protect are referred to as its 'Qualifying Features'. The conservation objectives of a European Site are set for each Qualifying Feature of each site and aim to ensure that a qualifying habitat or species is maintained or restored in a Favourable Conservation Status (FCS).

2.1.3 Following the United Kingdom's (UK's) departure from the EU on 31 December 2020 (EU Exit), the UK is no longer an EU Member State. Notwithstanding, the Habitats Directive, as implemented by the Habitats Regulations, continues to provide the legislative backdrop for the domestic HRA regime. The changes implemented by The Conservation (Natural Habitats, &c.) (EU Exit) (Scotland) (Amendment) Regulations 2019 (hereafter referred to the EU Exit Habitats Regulations) have made only minor changes to the HRA regime. These changes are considered to have no material implications on the requirement or process for a HRA for the Proposed Development.

2.1.4 The HRA process implemented under the Habitats Regulations continues to apply and the UK is still bound by HRA judgments handed down by The Court of Justice of the EU (CJEU) prior to 31 December 2020. Additionally, post EU Exit, the Habitats Regulations continue to refer to Annexes I and II of the Habitats Directive and Annex I of the Birds Directive and as such, reference is made to the annexes of the Habitats and Birds Directives in this report.

2.1.5 In addition to sites formally defined as European Sites in the Habitats Regulations, Scottish Government policy acknowledges that Ramsar sites are afforded the same protection as if they were also designated as a European Site (Scottish Government, 2020b). The Scottish Government also states that authorities should afford the same level of protection to pSACs and pSPAs (i.e. sites that have been approved by Scottish Ministers for formal consultation but have not yet been designated) as they do to sites that have been designated (Scottish Government, 2020b).

2.1.6 Under the Habitats Regulations, before granting approval (i.e. planning permissions, licences and consents) for a development that is likely to have a significant effect on a European Site, an AA must be made by the Competent Authority. This assesses the proposed plan or project's potential for adverse effects on integrity of the site in view of that European Site's conservation objectives. In the case of the Proposed Development, the Competent Authority is MD-LOT acting on behalf of the Scottish Ministers.

2.2 European Sites (Post EU Exit)

2.2.1 In this Stage 2 RIAA, and in accordance with the Scottish Government's EU Exit guidance, the term 'European Site' has been retained to refer to SACs, SCIs, and SPAs (Scottish Government, 2020b).

2.2.2 The National Site Network consists of European Sites in the UK that were already designated (i.e. they were established under the Habitats Directive) on 31 December 2020 or were proposed to the EC before that date. It also includes any new sites that were designated under the Habitats Regulations through an amended designation process.

2.3 Staged Process

2.3.1 The HRA process is generally recognised as a progressive, multi-stage process built around the wording of Article 6(3) and 6(4) of the Habitats Directive (as transposed by the Habitats Regulations), with the outcome at each stage defining the requirement for, and scope of, the next. Compliance with the requirements of the HRA Regulations can be demonstrated if the stages are followed in the correct and particular sequence. These stages are summarised in Figure 2.1.

2.3.2 Article 6(3) of the Habitats Directive requires that: *"Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon either individually or in-combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and if appropriate, after having obtained the opinion of the general public"*.

2.3.3 The Department for Environment, Food and Rural Affairs (Defra) *et al.* (2023) guidance 'Habitats Regulations Assessments: protecting a European Site' describes that the process can have up to three stages, with the first two stages as per Article 6(3) and the third as per Article 6(4). These stages are also described in the EC's 2021 guidance. The three stages are outlined below:

- 1) Screening – the first stage involves a screening for LSE which is an assessment to check or screen if a plan or project:
 - a) is directly connected with or necessary for the conservation management of a European Site; and

- b) risks having a significant effect on a European Site on its own or in-combination with other plans or projects, in the absence of mitigation specifically intended to avoid or reduce harmful effects to a European site.
 - 2) AA – the second stage is an AA, which must be carried out if it is decided that there is a risk of an LSE on a European Site or if there is not enough evidence to rule out a risk. The AA should assess the LSE of the plan or project on the integrity of the site and its conservation objectives, taking into account Embedded Mitigation, and consider further ways to avoid or reduce (mitigate) any potential for an ‘adverse effect on the integrity of the site’, known as the ‘integrity test’.
 - 3) Derogations - the third stage is known as a derogation where, in certain circumstances, a plan or project that has failed the integrity test may be approved. To decide if the plan or project qualifies for a derogation, three legal tests must be applied. All three tests must be passed in sequence for a derogation to be granted:
 - a) Test 1: Assessment of Alternative Solutions – there are no feasible alternative solutions;
 - b) Test 2: Assessment of Imperative Reasons of Overriding Public Interest – the plan or project needs to be carried out for Imperative Reasons of Overriding Public Interest; and
 - c) Test 3: any necessary compensatory measures can be secured to secure the coherence of the National Site Network.
- 2.3.4 The Habitats Regulations make it clear that the Applicant for the consent for the plan or project must provide such information as the Competent Authority may reasonably require for the purposes of the assessment. It is intended that this RIAA provides this information.
- 2.3.5 This RIAA is concerned with the second stage of the process (i.e. the AA shown in Figure 2.1), which seeks to assess and decide whether a plan or project, alone or in-combination with other projects or plans, will have an adverse effect on the integrity of a European Site. This RIAA also summarises the conclusions of Appendix 1A: Habitats Regulations Appraisal Stage 1 Likely Significant Effects Screening Report, and updates made to the screening conclusions since this was published in October 2024, to account for feedback received from stakeholders during consultation.
- 2.3.6 Management objectives for the National Site Network are established in the EU Exit Habitats Regulations and are referred to as the network objectives. The objectives in relation to the National Site Network are to:
 - maintain or restore certain habitats and species listed in the Habitats Directive to FCS; and
 - contribute to ensuring the survival and reproduction of certain species of wild bird in their area of distribution and to maintaining their populations at levels which correspond to ecological, scientific, and cultural

requirements, while taking account of economic and recreational requirements.

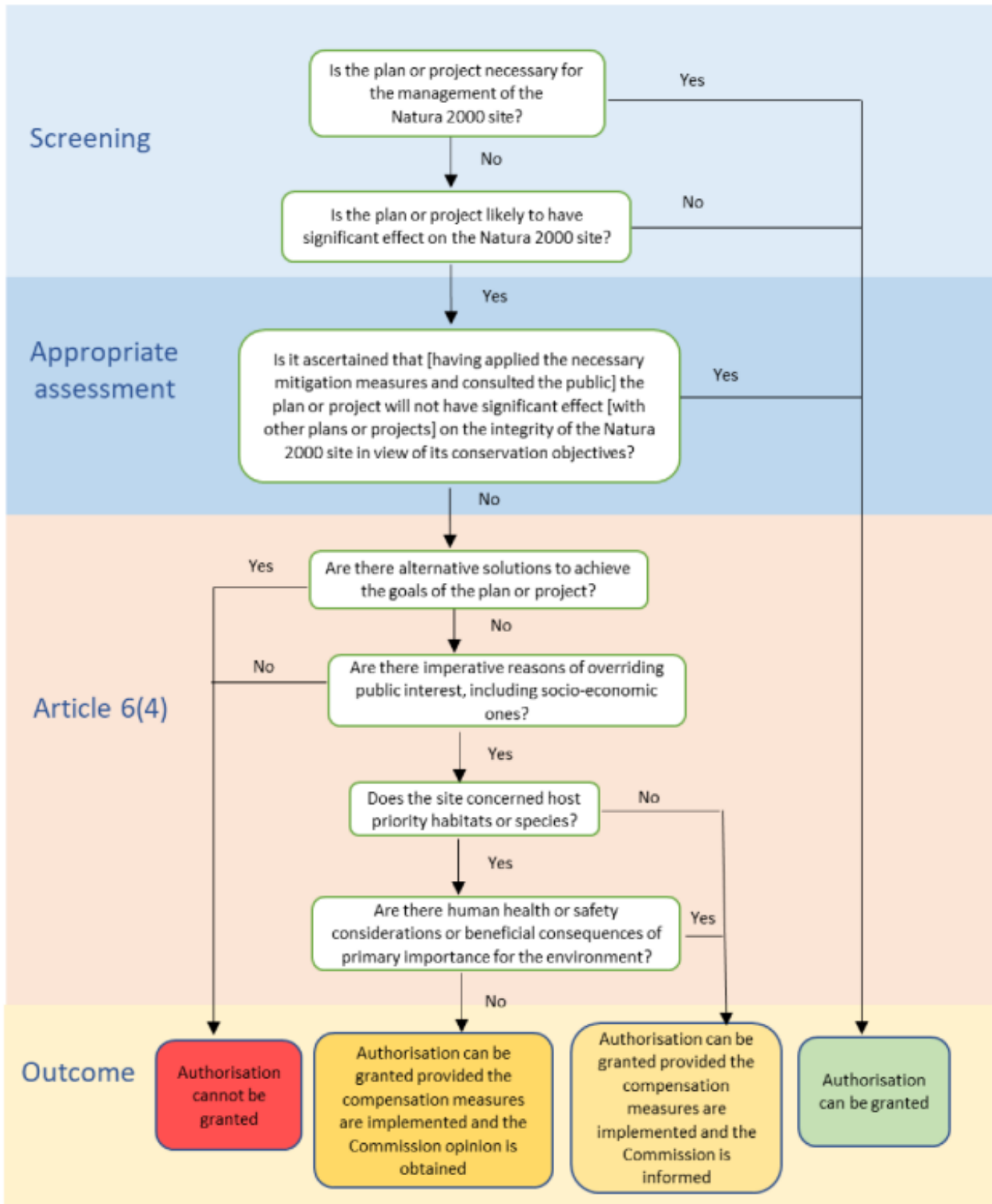


Figure 2.1: Stages in the HRA Process (Adapted from EC, 2021)

2.4 Guidance

2.4.1 Following the UK's departure from the EU, reference to EC guidance on the interpretation of HRA concepts continues to apply. The EU Exit Habitats Regulations in Scotland state that in the longer term, guidance may be updated and/or new guidance may be produced, to replace guidance by the EC (Scottish Government, 2020b). However, at the time of writing, existing guidance continues to apply and should still be used. Therefore, this RIAA is undertaken in accordance with the following guidance documents:

- HRA of Local Development Plans - Guidance for planning authorities in Scotland (NatureScot, 2023a);
- European Site Casework Guidance: How to consider plans and projects affecting SACs and SPAs (NatureScot, 2023b);
- The Habitats Regulations Assessment Handbook (Tyldesley and Chapman, 2021);
- Assessment of plans and projects in relation to Natura 2000 sites - Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC (EC, 2021);
- Guidance document on wind energy developments and EU nature legislation (EC, 2020);
- Guidance Note - The handling of mitigation in Habitats Regulations Appraisal – the People Over Wind CJEU judgement (NatureScot, 2025);
- Managing Natura 2000 sites. The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC (EC, 2019);
- HRA on the Firth of Forth A Guide for developers and regulators (NatureScot, 2024);
- Marine Scotland Consenting and Licensing Guidance for Offshore Wind, Wave and Tidal Energy Applications (Scottish Government, 2018);
- HRA Advice Sheet 1 - Aligning Development Planning procedures with Habitats Regulations Appraisal requirements (Scottish Government, 2012);
- Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EE. Clarification on the Concepts of: Alternative Solutions, Imperative Reasons of Overriding Public Interest, Compensatory Measures, Overall Coherence, Opinion of the Commission (EC, 2007); and
- Nature and Biodiversity Cases Ruling of the European Court of Justice (EC, 2006).

2.4.2 This RIAA has also been undertaken in accordance with the following publications that seek to explain the changes made to the Habitats Regulations from 01 January 2021:

- EU Exit: The Habitats Regulations in Scotland (Scottish Government, 2020b);

- Policy Paper - Changes to the Habitats Regulations 2017 (Defra, 2021); and
- Habitats Regulations Assessments: protecting a European Site (Defra *et al.*, 2023).

2.4.3 The Statutory Nature Conservation Bodies (SNCBs) have produced conservation advice for European Sites under their statutory remit. This conservation advice provides information on sites and features and guidance on how to achieve FCS. Conservation advice is discussed further, where relevant, in Part 2: Special Areas of Conservation and Part 3: Special Protection Areas and Ramsar Site Assessments of the RIAA.

2.5 Relevant Case Law

2.5.1 The case law that defines key assessment parameters (such as the definition of “integrity” and “significance”, the consideration of *ex situ* effects and the consideration of mitigation measures) are discussed in the Paragraphs 2.5.2 to 2.5.14.

Consideration of Mitigation Measures

2.5.2 In case C-323/17 ‘People Over Wind and Sweetman v Coillte Teoranta’ (April 2018), the CJEU ruled that mitigation measures could not be taken into account at the screening stage. This judgment was taken into account in undertaking the screening exercise for the Proposed Development and no mitigation measures (Embedded or Additional Mitigation) were considered in Appendix 1A: Habitats Regulations Appraisal Stage 1 Likely Significant Effects Screening Report.

Adverse Effects on the Integrity of European Sites

2.5.3 The EC’s 2019 guidance on managing Natura 2000 sites advises that the purpose of the AA is to assess the implications of the plan or project in respect of a European Site’s conservation objectives, either individually or in-combination with other plans or projects. The conclusions should enable the relevant Competent Authorities to ascertain whether the plan or project will adversely affect the integrity of the European Site concerned. The focus of AA is therefore specifically on the species and/or the habitats for which the European Site is designated.

2.5.4 The EC (2019) also emphasises the importance of using the best scientific knowledge when carrying out the AA in order to enable the Competent Authorities to conclude beyond reasonable scientific doubt that there will be no adverse effects on the integrity of the European Site. This guidance notes that it is at the time of the decision authorising implementation of the project that there must be no reasonable scientific doubt remaining as to the absence of adverse effects on the integrity of the European Site in question.

2.5.5 The CJEU confirmed in its ruling in Case C-258/11 ‘Sweetman and Others v. An Bord Pleanála’ (April 2013) that: “Article 6(3) of the Habitats Directive must be interpreted as meaning that a plan or project not directly connected with or necessary to the management of a site will adversely affect the integrity of that site if it is liable to prevent the lasting preservation of the constitutive characteristics of the site that are connected to the presence of a priority natural

habitat whose conservation was the objective justifying the designation of the site in the list of SCIs, in accordance with the directive. The precautionary principle should be applied for the purposes of that appraisal” The EC (2019) advises that the logic of such an interpretation would also be relevant to non-priority habitat types and to habitats of species.

- 2.5.6 The “*integrity of the site*” can be usefully defined as the coherent sum of the European Site’s ecological structure, function and ecological processes, across its whole area, which enables it to sustain the habitats, complex of habitats and/or populations of species for which the site is designated (EC, 2019). In case C-258/11 noted above it was determined that the ecological structure and function of a European Site would be adversely affected with reference to the site’s overall ecological functions and “*the lasting preservation of the constitutive characteristics of the site.*” In a dynamic ecological context, it can also be considered as having the sense of resilience and ability to evolve in ways that are favourable to conservation (EC, 2019).
- 2.5.7 The EC (2019) notes that if the Competent Authority considers the mitigation measures are sufficient to avoid the adverse effects on site integrity identified in the AA, they will become an integral part of the specification of the final plan or project or may be listed as a condition for project approval.
- 2.5.8 The EC (2020) advises that it is for the Competent Authority, in the light of the conclusions made in the AA on the implications of a plan or project for the European Site concerned, to approve the plan or project. This decision can only be taken after they have concluded that the plan or project will not adversely affect the integrity of the site. That is the case where no reasonable scientific doubt remains as to the absence of such effects.
- 2.5.9 The EC (2020) also reaffirms that the authorisation criterion laid down in the second sentence of Article 6(3) of the Habitats Directive integrates the precautionary principle and makes it possible to effectively prevent the European Sites from suffering adverse effects on their integrity as the result of the plans or projects. A less stringent authorisation criterion could not as effectively ensure the fulfilment of the objective of site protection intended under that provision. The onus is therefore on demonstrating the absence of adverse effects rather than their presence, reflecting the precautionary principle. It follows that the AA must be sufficiently detailed and reasoned to demonstrate the absence of adverse effects, in light of the best scientific knowledge in the field.
- 2.5.10 In accordance with the decision of the CJEU in the Waddenzee case, C-127-02 ‘Landelijke Vereniging Tot Behoud Van De Waddenzee v Staatsecretaris Van Landbouw’ (September 2004), the measure of significance is made against the conservation objectives for which the European Sites were designated.
- 2.5.11 This Stage 2 RIAA, therefore, focuses on demonstrating the absence of adverse effects, with the measure of significance made against the relevant European Sites’ conservation objectives.

Consideration of *Ex Situ* Effects

- 2.5.12 The EC (2019) advises that Article 6(3) and Article 6(4) safeguards be applied to European Sites subject to LSEs from any development pressures, including those which are external to those European Site(s).
- 2.5.13 The CJEU developed this point when it issued a ruling in case C-461/17 ‘Brian Holohan and Others v An Bord Pleanála’ (November 2018) that determined *inter alia* that Article 6(3) of Directive 92/43/EEC must be interpreted as meaning that an AA must on the one hand, catalogue the entirety of habitat types and species for which a European Site is protected, and, on the other, identify and examine both the implications of the proposed project for the species present on that site, and for which that site has not been listed, and the implications for habitat types and species to be found outside the boundaries of that site, provided that those implications are liable to affect its conservation objectives.
- 2.5.14 In that regard, consideration has been given at screening, and where necessary, based on the outcomes of that screening, and in this RIAA to implications for habitats and species located both inside and outside of the European Sites with reference to their conservation objectives, where effects upon those habitats and/or species are liable to affect the conservation objectives of the sites concerned.

3 Consultation to Date

- 3.1.1 Consultation has been undertaken with relevant statutory stakeholders including MD-LOT, NatureScot and Natural England, alongside various other stakeholders, such as Fisheries Management Scotland and the Royal Society for the Protection of Birds Scotland, during key stages of the pre-application phase of the Proposed Development.
- 3.1.2 An EIA Scoping Workshop was held for the Proposed Development on 25 April 2024 which included presentation of the preliminary outputs of the HRA Stage 1 LSE Screening for Annex I Habitats, Annex II diadromous fish and marine mammals, and Annex II onshore species (bats and otters). In addition to the feedback received during the Scoping Workshop, written feedback was received from NatureScot in July 2024, which was considered in Appendix 1A: Habitats Regulations Appraisal Stage 1 Likely Significant Effects Screening Report. The Applicant submitted the HRA Stage 1 LSE Screening Report to MD-LOT on 02 October 2024. The Scoping Opinion (which included the response to the HRA Stage 1 LSE Screening Report) was received on 25 November 2024 (MD-LOT, 2024). The consultation undertaken to date has been taken into consideration as appropriate, and is summarised, where relevant to SACs in Part 2: Special Areas of Conservation and SPAs in Part 3: Special Protection Areas and Ramsar Site Assessments of this RIAA.
- 3.1.3 Based on the outcomes of the Proposed Development HRA Stage 1 LSE Screening Report, no potential significant transboundary effects, either alone or in-combination, were predicted for the Proposed Development. Therefore, no transboundary consultation has been carried out with respect to this RIAA.

4 Project Description

4.1 Introduction

Overview

- 4.1.1 This section of the Offshore RIAA provides a description of the various design elements associated with the Proposed Development, including the Offshore Infrastructure and activities to be undertaken throughout its construction, Operation and Maintenance (O&M), and decommissioning phases. This section is informed by design work carried out to date, as well as current understanding of the environment associated with the Proposed Development from the site-specific survey work undertaken by the Applicant.
- 4.1.2 The following Offshore Infrastructure components are covered by this Offshore RIAA:
- Wind Turbines;
 - Wind Turbine foundations (fixed bottom);
 - OSPs;
 - OSP foundations (fixed bottom);
 - Offshore cables (IACs, Interconnector Cables, and Offshore Export Cables); and
 - Scour Protection, cable protection and utility crossings.
- 4.1.3 An application for Planning Permission in Principle, under the Town and Country Planning (Scotland) Act 1997 (as amended), was submitted on the 27 November 2025 for the onshore elements of the Project, which includes transmission infrastructure landward of MLWS.
- 4.1.4 Where there is an overlap in jurisdiction of consenting and regulatory regimes (i.e. within the Intertidal Area), both this Offshore RIAA and the Onshore EIA Report (BOWFL, 2025) include the relevant technical assessments.
- 4.1.5 The design and engineering options available for the Proposed Development were influenced by the specific conditions and environmental factors within the Site Boundary. The Applicant has carried out several studies in the early development stage to address existing unknowns and to refine the design parameters. Further studies are expected to be completed beyond the planning phase and into procurement and contracting to acquire further site-specific information which will inform the final design of the Proposed Development. This includes determining final Wind Turbine numbers, size and layout, and fixed foundation design. The detailed design will be confirmed post-consent, subject to further site investigation and technical design studies.
- 4.1.6 Once additional information becomes available from further site investigations, the final detailed design will be further developed, with commercial availability of technologies also impacting future design. It should be noted that the final detailed design for the Proposed Development will be within the Project Design Envelope (PDE) parameters presented in this Offshore RIAA, a standard

approach for large scale energy projects, such as the Proposed Development and allows the design to address environmental considerations where practicable.

Project Design Envelope

- 4.1.7 The PDE approach (also known as the 'Rochdale Envelope') (Scottish Government, 2022) has been followed by the Applicant, meaning that the parameters for the Proposed Development (as included in this chapter) present the maximum extents of the design, and are the parameters used in order to assess the LSE of the Proposed Development. The PDE approach allows for a necessary degree of flexibility where certain details of a development are yet to be finalised at the time of application (for example, Wind Turbine and foundation types). Within this Offshore RIAA, the Applicant has determined the impacts that could occur from the Proposed Development for given receptor groups and has identified, from the ranges within the PDE, those parameters that present the greatest impact(s) on the specific receptor group (the 'Maximum Design Scenario (MDS)'). As a result, for each assessment, the Proposed Development's actual effects resulting from any design selected from the PDE will be equal to or less than those effects assessed.
- 4.1.8 As noted above, the PDE approach allows for a necessary degree of flexibility in cases where certain details of developments are yet to be finalised at the time of application and is referenced in guidance prepared by Marine Directorate and the Energy Consents Unit in June 2022 for applications under Section 36 of the Electricity Act 1989².
- 4.1.9 The PDE approach is based on assessing the maximum potential impact for each element of the Proposed Development's design through the specification of a range of design parameters. However, it is important that a sufficient level of detail is included, such as consideration of a range of possibilities, to allow assessment of the likely significant environmental effects on the integrity of the European Sites and any necessary mitigation measures (Scottish Government, 2022). For example, where the foundation types of a development are not yet confirmed, the PDE approach would consider the foundations with the largest footprint for habitat loss, as this is likely to have the greatest potential for impact on the seabed. If an impact assessment is undertaken on this basis and no LSE are identified, it can be assumed that any variations to project parameters equal to or less than the assessed parameter (i.e. within the assessed 'envelope') will not result in an LSE for the Qualifying Feature and impact under consideration.
- 4.1.10 The PDE has been used to develop the MDS for each impact pathway in order to determine the parameters (or combination of parameters) which are likely to result in the maximum impact (e.g. the MDS) on a particular receptor, while adhering to the Proposed Development technology design scenarios (e.g. infrastructure parameters associated with the largest Wind Turbine size). The

² <https://www.gov.scot/publications/guidance-applicants-using-design-envelope-applications-under-section-36-electricity-act-1989/>

PDE describes a range of parameters that apply to a specific technology design scenario. For example, Wind Turbine size and Wind Turbine number are inherently correlated so if larger Wind Turbines are selected, fewer Wind Turbines are likely to be required to achieve the same generating capacity. Therefore, each design parameter set out in this section is not considered independently.

4.1.11 It should be noted, however, that the largest parameters set out in this section will not necessarily comprise the MDS for any given Qualifying Feature and each of the impacts assessed within the RIAA Part 2: Special Areas of Conservation (Sections 5.3 and 5.4 for Annex II diadromous fish and Sections 6.3 and 6.4 for Annex II marine mammals) and RIAA Part 3: Special Protection Areas and Ramsar Site Assessments (Sections 5.4 and 5.5 for ornithological features).

4.1.12 The PDE was initially defined within the Bowdun OWF Offshore EIA Scoping Report (BOWFL, 2024) and presented in Appendix 1A: Habitats Regulations Appraisal Stage 1 Likely Significant Effects Screening Report. Since the submission of the Scoping and Screening reports, the Applicant has developed and refined the PDE for the Offshore EIA Report using the results of early engineering studies and information gained through stakeholder consultation. This PDE has been used to inform the RIAA. A description of the PDE refinements for the Proposed Development is provided within the Offshore EIA Report, Volume 1, Chapter 6: Site Selection and Consideration of Reasonable Alternatives (TWP-BOW-RPS-OFE-RPT-00005). However, in summary, the following parameters have changed:

- refinement in Wind Turbine foundations to fixed, with floating foundations no longer considered;
- reduction in fixed Wind Turbine foundation options to monopiles, piled jackets (3 or 4-legged), or suction bucket jackets (3-legged);
- refinement of piling parameters for Wind Turbine foundations and OSPs;
- increasing the Air Gap from 25.36 m to 33.12 m above Lowest Astronomical Tide (LAT); and
- refinement of Offshore Export Cable installation at Landfall to trenchless technology only (e.g. Horizontal Directional Drilling (HDD)).

Water Depths and Seabed within the Proposed Development

4.1.13 A geophysical survey covering the Array Area and part of the Export Cable Corridor was carried out in 2023 and 2024 to collect both geophysical and bathymetric data.

4.1.14 The bathymetry within the Export Cable Corridor ranges from 0 m in the nearshore area to a maximum depth of -113 m from LAT within the Export Cable Corridor. In the nearshore areas, bedrock outcrops create a complex terrain with significant slope variations, reaching up to 83° in some areas. Further offshore, average slopes are generally below 5°. Within the Array Area, water depths are typically in the range -54 m LAT to -91 m LAT. Overall, the Array Area is characterised by relatively flat terrain, although local gradients become steeper in areas where bedforms are present.

4.2 Proposed Infrastructure

Overview

- 4.2.1 The main components of the Proposed Development, are shown in Figure 4.1, which include the assets listed in Paragraph 1.3.3.

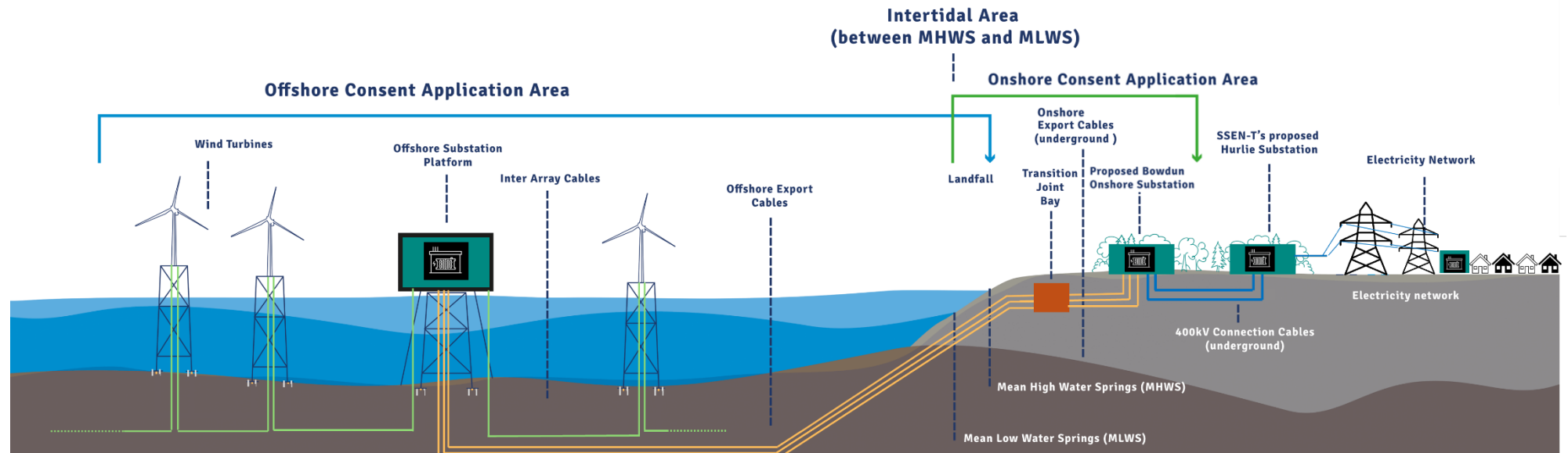


Figure 4.1: Project Overview

4.2.2 The following sections of this chapter provide further detail for each design aspect, along with the maximum and minimum scenarios that comprise the PDE. However, the high level parameters of the Proposed Development are summarised in Table 4.1.

Table 4.1: High Level Design Parameters of the Proposed Development

Parameter	Design
Estimated construction period	Up to 5 years
Array Area (km ²)	187
Distance of Array Area from the shore at closest point (km)	38
Maximum number of Wind Turbines	67
Wind Turbine maximum rotor diameter (m)	326
Wind Turbine maximum tip height from LAT (m)	359.12
Maximum number of OSPs	3
Maximum number of Offshore Export Cables	3
Export transmission system	HVAC

4.3 Offshore Generation Assets

Wind Turbines

- 4.3.1 The Proposed Development will comprise up to 67 Wind Turbines, however, the final number of Wind Turbines will be determined by the capacity of the individual Wind Turbines selected, as well as the results of the environmental and engineering surveys.
- 4.3.2 This PDE will consider a range of Wind Turbine parameters which account for varying generating capacities and will allow a degree of flexibility to account for anticipated technological developments in the future whilst allowing the MDS to be defined for each potential impact within the RIAA Part 2: Special Areas of Conservation and RIAA Part 3: Special Protection Areas and Ramsar Site Assessments. Therefore, the Wind Turbine parameters presented in this section, and for which consent is sought, represent the maximum Wind Turbine parameters as presented in the PDE, such as maximum rotor blade diameter and maximum blade tip height.
- 4.3.3 Table 4.2 presents the range of parameters considered for the Wind Turbines and considers both the maximum number of Wind Turbines and the largest Wind Turbines described within the PDE. Therefore, the parameters in combination do not represent a realistic design scenario, but the most likely range of Wind Turbine parameters that could be available post-consent/at the time of construction of the Proposed Development.
- 4.3.4 The Wind Turbines will consist of a tower section, nacelle, hub and three rotor blades, attached to a fixed foundation (these foundations are further discussed in Paragraphs 4.3.13 to 4.3.23).

- 4.3.5 The maximum rotor blade diameter will be no greater than 326 m, with a maximum blade tip height of up to 359.12 m above LAT and a minimum Air Gap of 33.12 m above LAT. The hub height will be no greater than 196 m above LAT. As part of the Lighting and Marking Plan (Offshore EIA Report, Volume 4, Appendix 31: Outline Lighting and Marking Plan (TWP-BOW-ERM-CON-RPT-00004)) the Applicant will develop a scheme for Wind Turbine lighting and navigation marking with the relevant consultees post-consent decision for approval by Scottish Ministers after consultation with appropriate consultees.
- 4.3.6 The Wind Turbine layout will be developed to effectively make use of the available wind resource, suitability of seabed conditions, whilst also ensuring that the environmental effects and potential impacts on other marine users (e.g. fisheries, shipping routes, and subsea cables) are mitigated. The Wind Turbine layout will take account of the agreed buffers with Scottish and Southern Electricity Network and National Grid for the Eastern Green Link 2 High Voltage Direct Current (HVDC) cable (Offshore EIA Report, Volume 2, Chapter 16: Infrastructure and Other Users (TWP-BOW-RPS-OFE-RPT-00037)).
- 4.3.7 Figure 4.2 presents an indicative Proposed Development layout for the 67 (15 MW) Wind Turbine locations, including three OSP locations and spare locations. The spare Wind Turbine locations provide alternative locations should seabed conditions be challenging for installation. The final layout will only be up to a maximum of 67 Wind Turbines and up to three OSPs, and will be confirmed prior to construction.
- 4.3.8 Figure 4.3 presents an indicative Proposed Development layout for the 40 (25 MW) Wind Turbine locations, including three OSP locations and spare locations.
- 4.3.9 The OSP locations shown in Figure 4.2 and Figure 4.3 are shown for illustrative purposes, and the final locations will be determined at the final design stage (post-consent). Further information on OSPs is provided in Paragraphs 4.4.1 to 4.4.7.

Table 4.2: PDE for the Wind Turbines

Parameter	Maximum Design		
	Option 1	Option 2	Option 3
Maximum number of Wind Turbines	67	50	40
Minimum Air Gap above LAT (m)	33.12		
Maximum blade tip height above LAT (m)	269.12	309.12	359.12
Maximum hub height above LAT (m)	151	171	196
Maximum rotor diameter (m)	236	276	326
Maximum number of blades	3		
Minimum Wind Turbine spacing (m), measured perpendicular to the prevailing wind direction	1,038	1,259	1,467

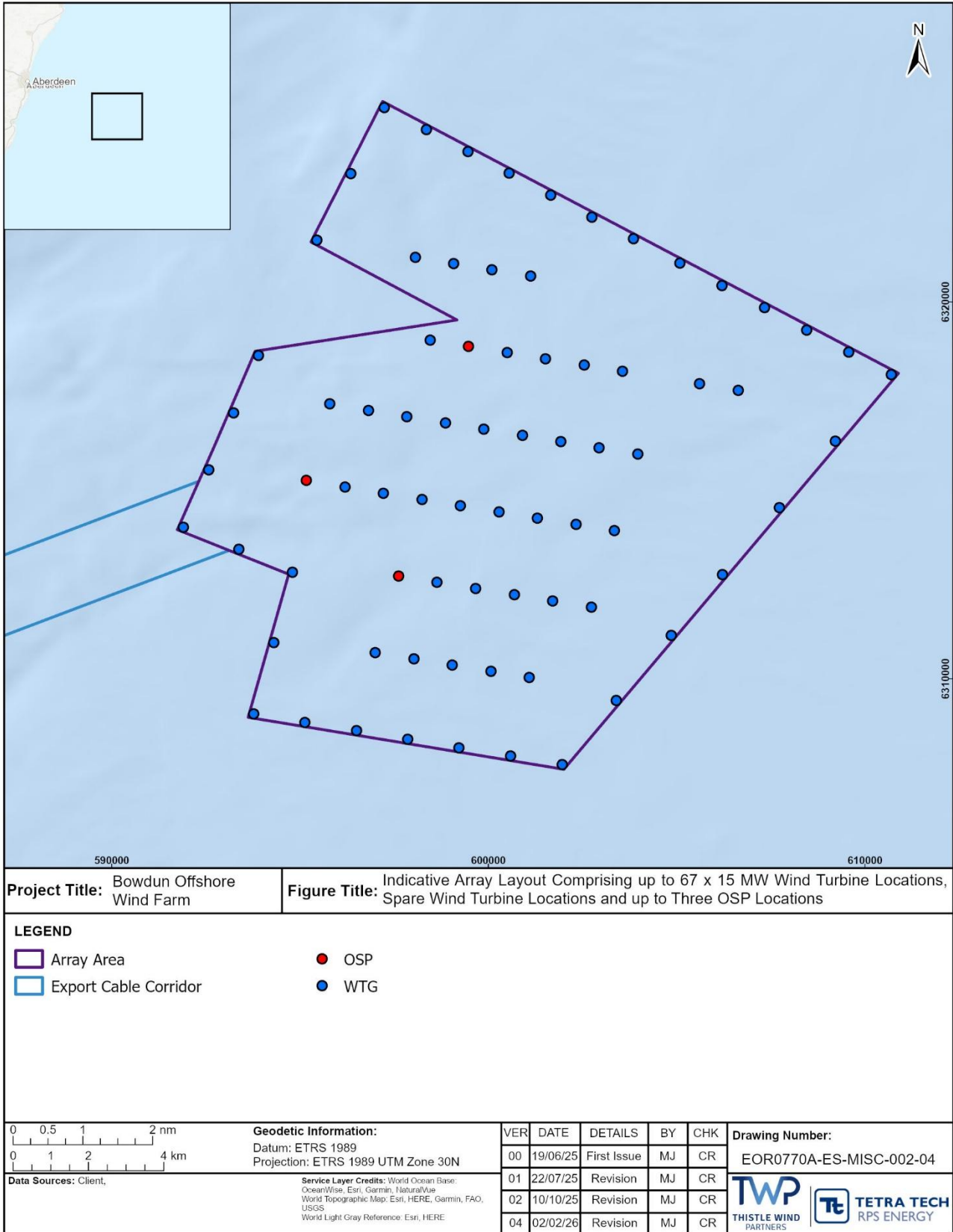


Figure 4.2: Indicative Array Layout Comprising up to 67 x 15 MW Wind Turbine Locations, Spare Wind Turbine Locations and up to Three OSP Locations

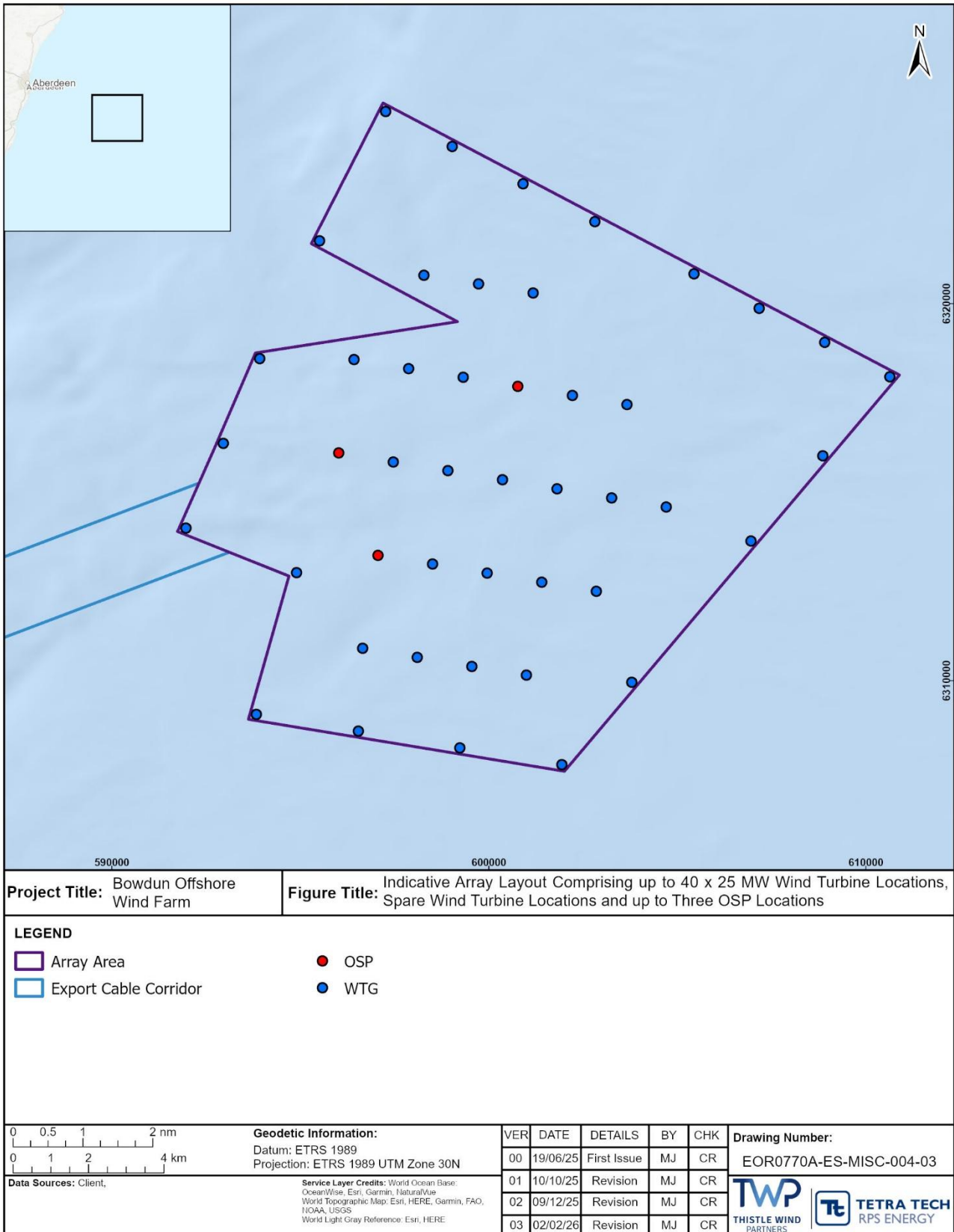


Figure 4.3: Indicative Array Layout Comprising up to 40 x 25 MW Wind Turbine Locations, Spare Wind Turbine Locations and up to Three OSP Locations

4.3.10 A number of consumables will be required throughout the Proposed Developments lifecycle to improve operation, productivity and reduce wear on parts of Wind Turbines. These may include:

- grease;
- synthetic oil;
- hydraulic oil;
- gear oil;
- lubricants;
- nitrogen;
- water/glycerol;
- transformer silicon/ester oil;
- diesel fuel;
- Sulphur Hexafluoride; and
- glycol/coolants.

4.3.11 Required quantities of each consumable will be dependent upon the final design of the Wind Turbines selected. Any potential release of chemicals into the marine environment via an accidental pollution event during the construction, O&M and decommissioning phases will be reduced as far as reasonably practicable through implementation of appropriate controls and mitigation as set out in an Environmental Management Plan (EMP), including a Marine Pollution Contingency Plan (MPCP), and the Decommissioning Programme. An outline EMP, including an MPCP, is presented in the Offshore EIA Report, Volume 4, Appendix 24: Outline Environmental Management Plan (TWP-BOW-ERM-CON-RPT-00001).

Wind Turbine Foundations and Support Structures

4.3.12 The Proposed Development will consist of Wind Turbines supported by fixed foundations. The following subsections describe the PDE for the fixed foundations.

Fixed Foundations

4.3.13 To allow for flexibility in foundation choice, monopile, piled jacket (three or four legs), or suction bucket jacket (three legs) foundations are being considered for the Proposed Development. The Proposed Development's final design will be dependent on the type of Wind Turbine used as well as the results of environmental and site investigation surveys.

4.3.14 It is anticipated that foundations will be fabricated onshore before specialist vessels are used to transport and install the foundations within the Array Area. Scour Protection (typically rock) may be required on the seabed and will be installed before and/or after foundation installation (see Paragraph 4.3.27 to 4.3.29).

4.3.15 The following sections provide an overview of the design parameters associated with each fixed foundation type being considered for the Wind Turbines within the PDE for the Proposed Development.

Monopile

4.3.16 Monopile foundations are comprised of a solitary steel tubular, which is piled into the seabed at a singular point. These foundation types are often accompanied by a transition piece, which covers part of the pile and acts to level the Wind Turbine and allows for the installation of additional substructures, such as ladders or boat landings (Figure 4.4).

4.3.17 The installation of monopile foundations will be undertaken using one of two primary methods, either piling, or drive-drill-drive. The choice of method will depend on factors such as seabed conditions and the dimensions of the monopiles. Piling typically involves the use of hydraulic hammers or vibration techniques, while the drive-drill-drive method incorporates piling, followed by drilling to penetrate hard seabed layers and potentially further piling to achieve the required depth. Paragraphs 4.6.11 to 4.6.15 provide further information on the piling installation methodology. These activities are generally conducted from jack-up or floating vessels. Any drilling spoil will typically be deposited adjacent to the drill site. Paragraphs 4.6.17 to 4.6.18 provide further information on the drilling installation methodology. Installation equipment may operate above or below the sea surface. A combination of these methodologies may be employed across the Array Area.

4.3.18 The PDE for the Proposed Development includes a maximum of 67 monopiles. At present, it is anticipated that up to two vessels may be utilised to install up to two monopiles concurrently with a maximum hammer energy of 6,250 kJ.

4.3.19 To mitigate potential acoustic impacts from piling, which were determined by the Subsea Noise modelling undertaken (Offshore EIA Report, Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report (TWP-BOW-RPS-OFE-RPT-00015)), a 'soft start' procedure would be implemented. This procedure involves beginning the process of piling with reduced hammer energy before slowly ramping up to the maximum hammer energy within an agreed timescale.

4.3.20 Table 4.3 outlines the maximum PDE for the key design parameters of monopile foundations within the Proposed Development, and an illustrative monopile foundation is shown in Figure 4.4.

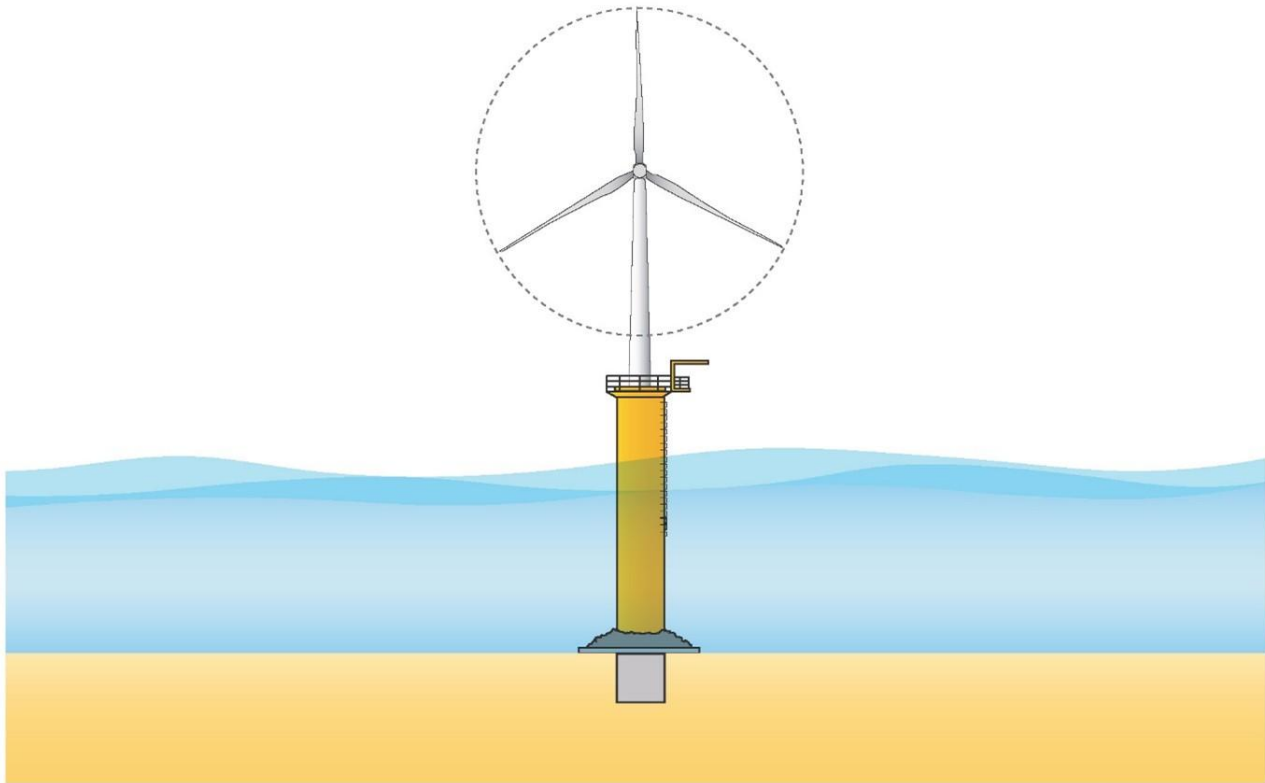


Figure Not to Scale

Figure 4.4: Monopile Foundation Design

Table 4.3: PDE for Monopile Foundations

Parameter	Maximum Design	
	15 MW Wind Turbines	25 MW Wind Turbines
Maximum number of monopile foundations	67	40
Monopile diameter at seabed (m)	13	15
Maximum monopile/transition piece diameter at interface (m)	8	9
Total monopile length	123	
Transition piece length (m)	26	
Total length (tower interface to bottom of monopile)	149	
Maximum pile penetration depth (m)	45	
Maximum seabed footprint per foundation (m ²)	132.7	176.7
Maximum seabed footprint for the Array Area (m ²)	8,893	7,069

Parameter	Maximum Design	
	15 MW Wind Turbines	25 MW Wind Turbines
Maximum Scour Protection footprint (per foundation) (m ²)	3,318	4,418
Maximum area foundation footprint (per foundation) (m ²) including Scour Protection ³	3,318	4,418
Maximum seabed footprint for the Array Area (m ²) (foundation and Scour Protection)	222,327	176,715
Maximum hammer energy (kJ) (maximum energy theoretically possible)	6,250	6,250

³Scour protection is usually pre-installed. The foundation is then installed through the scour protection, so the total footprint remains the same as with scour protection only.

Piled or Drilled Jacket Foundations

- 4.3.21 Jacket foundations consist of steel tubular members welded together to form a lattice like structure with three or four legs. The structure is typically fixed to the seabed with driven and/or drilled pin piles (see Figure 4.5). The diameters of the pin piles associated with piled jacket foundations are lower than monopile foundations, however similar technology is utilised for their installation: hydraulic hammers, vibration, and drilling into the seabed. A combination of piling and drilling, including drive-drill-drive scenarios may be required.
- 4.3.22 The PDE for the Proposed Development is based on a maximum of 67 jacket foundations being required, with options for three or four legs per foundation and one pile per leg. It is expected that up to two vessels will be utilised to install pin piles concurrently, using a maximum hammer energy of 4,500 kJ. During jacket installation, grout will be used to fill the gap between the jacket legs and the piles to ensure structural integrity. This grouting process may require the use of a separate vessel dedicated to grout operations.
- 4.3.23 The PDE for parameters of piled jacket foundations installations for Wind Turbines within the Proposed Development is detailed in Table 4.4, which includes both three and four leg foundation options.

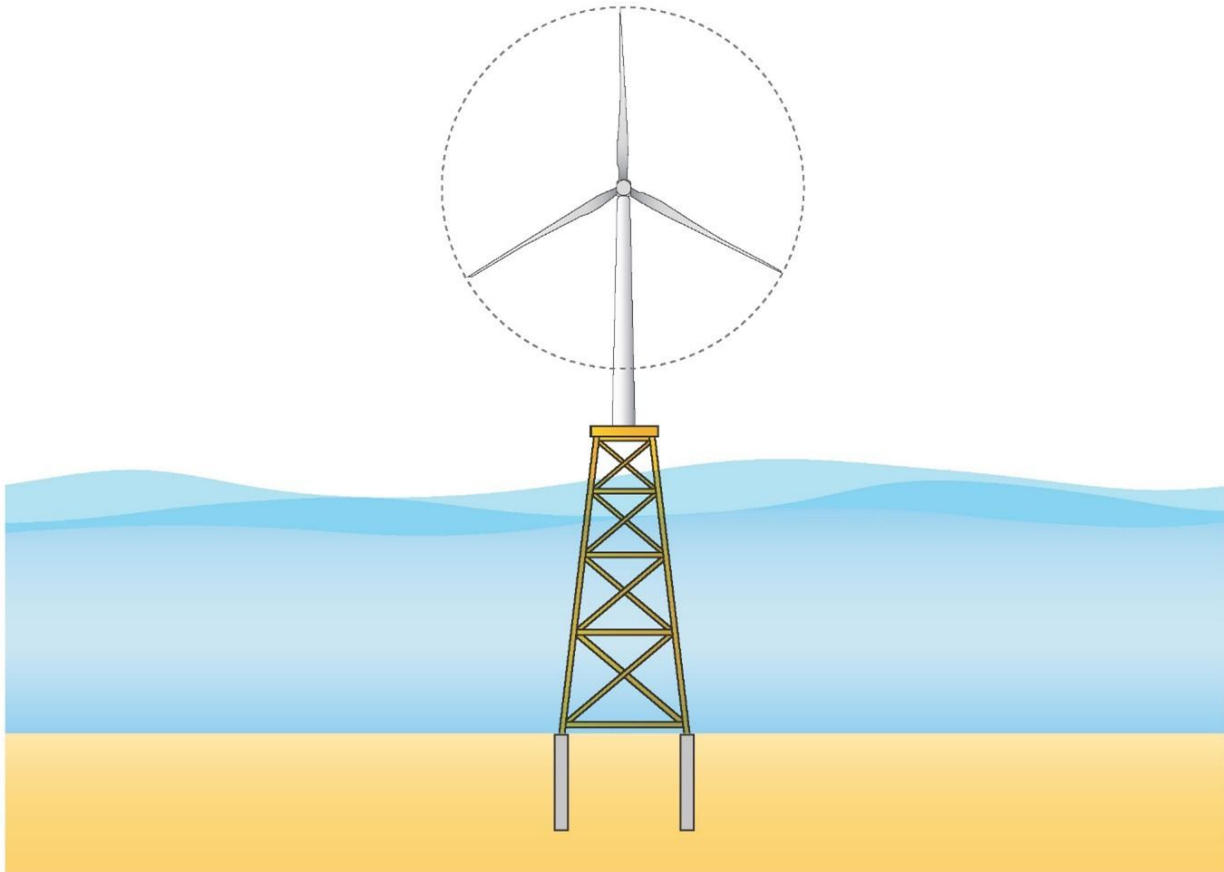


Figure Not to Scale

Figure 4.5: Piled Jacket Foundation Design

Table 4.4: PDE for Piled Jacket Foundations

Parameter	Maximum Design (3-legged)		Maximum Design (4-legged)	
	15 MW Wind Turbines	25 MW Wind Turbines	15 MW Wind Turbines	25 MW Wind Turbines
Maximum number of jacket foundations	67	40	67	40
Maximum number of piles per leg	1	1	1	1
Maximum number of piles	201	120	268	160
Maximum diameter of jacket leg (m)	3.3	4.5	3.1	4.3
Maximum diameter of piles (m)	4.1	5.0	3.8	5.0
Concurrent piling events	2	2	2	2
Maximum expected pile penetration depth (m)	70	85	65	80

Parameter	Maximum Design (3-legged)		Maximum Design (4-legged)	
	15 MW Wind Turbines	25 MW Wind Turbines	15 MW Wind Turbines	25 MW Wind Turbines
Maximum seabed footprint per jacket (m ²)	39.6	58.9	45.4	78.5
Maximum seabed footprint for all jacket foundations (m ²)	2,654	2,356	3,039	3,142
Maximum Scour Protection footprint (per jacket) (m ²)	2,206	3,054	2,606	4,072
Maximum area foundation footprint (per jacket) (m ²) including Scour Protection ⁴	2,206	3,054	2,606	4,072
Maximum seabed footprint for the Array Area (m ²)	147,819	122,145	174,586	162,860
Maximum hammer energy (kJ) (maximum energy theoretically possible)	4,500	4,500	4,500	4,500
Realistic maximum average hammer energy (kJ)	4,275	4,275	4,275	4,275

⁴Scour protection is usually pre-installed. The pile is then installed through the scour protection, so the total footprint remains the same as with scour protection only.

Jacket Foundations with Suction Buckets

- 4.3.24 Jacket foundations with suction buckets consist of steel tubular members welded together to form a lattice like structure with three legs. The end of each leg is attached to a suction bucket (typically a hollow, steel cylinder, capped on the upper end), which affixes the structure to the seabed (illustrated in Figure 4.6)
- 4.3.25 Suction bucket foundations do not require noisy installation measures, such as piling. Rather, after the foundations have been transported to the Array Area and lowered to the seabed, water is pumped from each of the buckets, which creates a suction that pulls the foundation legs into the seabed. When the desired burial depth is reached, the void is filled with a thin layer of grout, which is injected under the top side of the bucket. This also ensures contact between the seabed substrate within the bucket and the top of the bucket itself.
- 4.3.26 The PDE is based on a maximum of 67 suction jacket foundations being required with three legs per foundation. The key parameters included in the PDE for the

installation of suction bucket jacket foundations within the Proposed Development are detailed in Table 4.5.

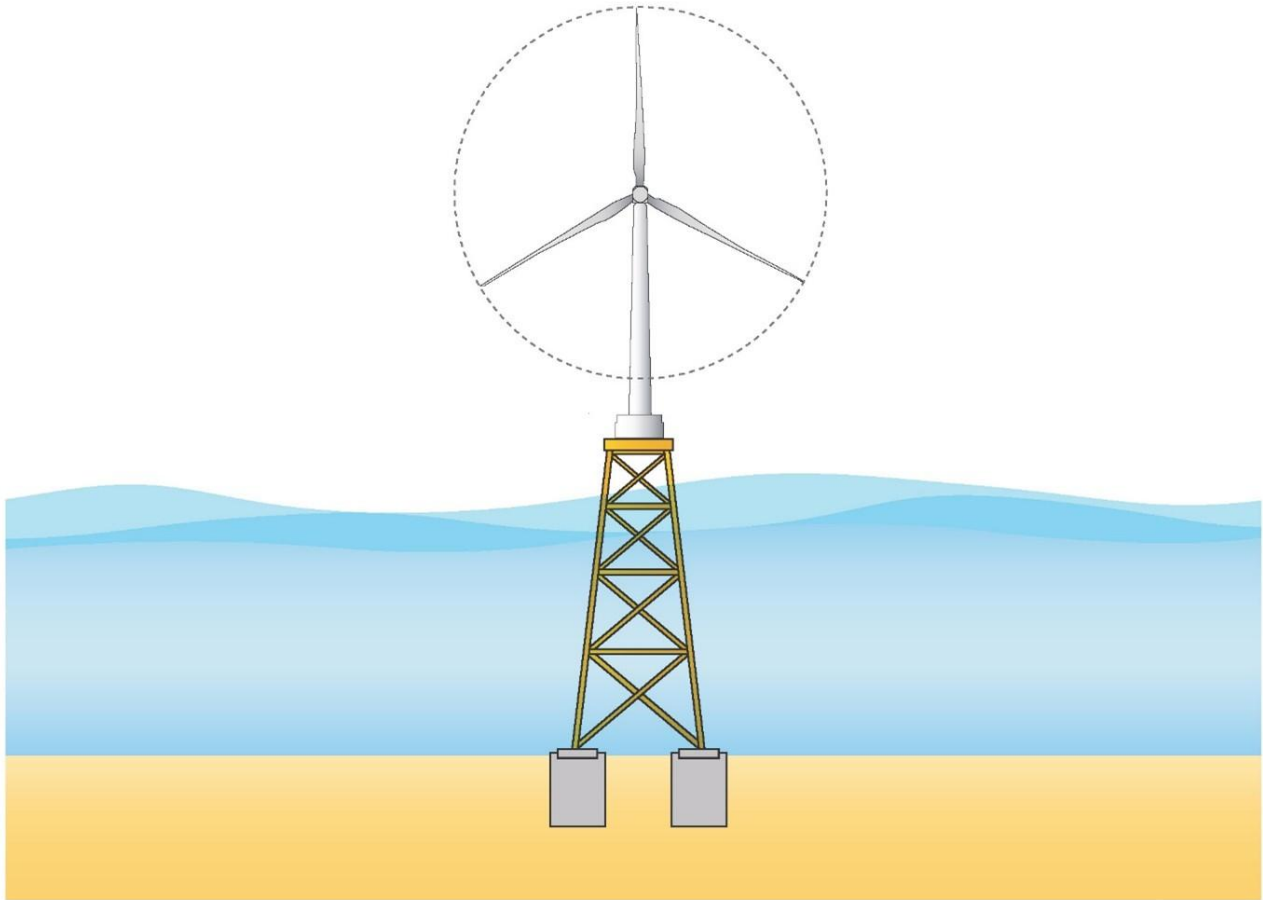


Figure Not to Scale

Figure 4.6: Jacket Foundations with Suction Buckets Design

Table 4.5: PDE for Jacket Foundations with Suction Buckets

Parameter	Maximum Design (3-legged)	
	15 MW Wind Turbines	25 MW Wind Turbines
Maximum number of jacket foundations	67	40
Maximum number of suction cans per leg	1	1
Total suction bucket height (m)	19	23
Maximum diameter of jacket leg (m)	3.3	4.5
Maximum diameter of suction buckets (m)	17.0	19.0
Suction bucket penetration depth (m)	15	19
Suction bucket stick up (void height) (m)	1.5	1.5
Grout volume per suction bucket (m ³)	340.5	425.3
Grout volume for Array Area (m ³)	68,434	51,035
Maximum seabed footprint per jacket (m ²)	680.9	850.6

Parameter	Maximum Design (3-legged)	
	15 MW Wind Turbines	25 MW Wind Turbines
Maximum seabed footprint for all jacket foundations (m ²)	45,623	34,023
Maximum Scour Protection footprint (per jacket) (m ²)	3,300	3,600
Maximum seabed footprint for the Array Area (m ²)	221,100	144,000

Scour Protection for Foundations

4.3.27 The hydrodynamic processes and associated sedimentary movements within the Site Boundary may result in seabed erosion and the formation of ‘scour holes’ around the Wind Turbine foundations. A number of factors influence the development of scour, including the shape of structures on the seabed, seabed sedimentology, and site-specific metocean conditions (e.g. storms, waves, and currents). Commonly used Scour Protection types include:

- rock: the most frequently used Scour Protection method. Layers of graded stones placed on and/or around structures (e.g. foundation structures) to inhibit erosion, or rock filled mesh fibre bags which adapt to the shape of the seabed/structure as they are lowered on to it; or
- concrete mattresses: cast of articulated concrete blocks, several metres wide and long and linked by a polypropylene rope lattice, which are placed on and/or around structures to stabilise the seabed and inhibit erosion.

4.3.28 The type and volume of Scour Protection required will vary depending on the various Wind Turbine foundation options. The final parameters will be decided once the design of these is finalised. This decision will consider a range of aspects including geotechnical data, meteorological and oceanographical data, water depth, foundation type, maintenance strategy and cost.

4.3.29 Table 4.6 presents the PDE for Scour Protection required for the Wind Turbine foundation options described in Paragraphs 4.3.16 to 4.3.26.

Table 4.6: PDE for Scour Protection for Foundation Options

Parameter	Maximum Design		
	Monopile with transition piece	4-legged piled or drilled Wind Turbine jacket foundations	3-legged Wind Turbine jacket foundations with suction buckets
Maximum number of Wind Turbines	67	67	67
Scour Protection type	Rock and concrete mattresses	Rock and concrete mattresses	Rock and concrete mattresses
Maximum height of Scour Protection (m)	1	1	1
Maximum diameter of Scour Protection (per pile for jacket foundations) (m)	65.0	28.8	38.0

Parameter	Maximum Design		
	Monopile with transition piece	4-legged piled or drilled Wind Turbine jacket foundations	3-legged Wind Turbine jacket foundations with suction buckets
Maximum area of Scour Protection per foundation (excluding pile area) (m ²)	3,318	2,606	3,300
Maximum volume of Scour Protection per foundation (m ³)	3,318	2,606	3,300
Maximum volume of Scour Protection for Proposed Development (m ³)	222,327	174,586	221,100

Inter-Array Cables

- 4.3.30 The electrical current produced by the Wind Turbines will be carried to the OSPs via IACs. Typically, several Wind Turbines will be grouped together on the same cable ‘string’, which connects the Wind Turbines to an OSP. Multiple cable ‘strings’ will then connect back to each OSP.
- 4.3.31 There may also be an IAC backlink introduced to connect Wind Turbines at the end of two strings, which will allow for partial re-routing of power in case of cable failure. The backlink may also be used to supply power (backup supply) to the ancillaries of the Wind Turbines in the affected string. The exact location and lengths of the IACs, along with the possible backlinks, will be dependent on the final design of the Proposed Development and will be considered in parallel to the final Wind Turbine layout.
- 4.3.32 The Proposed Development PDE currently considers the use of static IACs. The static IACs will enter and exit potential jacket foundations (both Wind Turbine and OSPs) through J-tubes, and enter and exit potential monopile foundations through I-tubes or cable entry holes. Between the Wind Turbines and OSPs, static IACs are laid directly on the seafloor and/or buried.
- 4.3.33 Where the IACs are laid on the seabed, they will be buried to an appropriate target burial depth. Cable burial depths will be informed by a Cable Burial Risk Assessment (CBRA) but based on current information it is anticipated that target burial depths will be 1.5 m (subject to further design), with greater burial depths targeted in specific areas as informed by the CBRA. In cases where such burial is not feasible (e.g. the foundation entry points, or where the cable is expected to cross areas of bedrock/hard ground, pipelines, or other existing cables), alternative protection methods will be employed, such as Polyurethane (PU), Polyethylene (PE), steel, or iron Cable Protection Systems (CPS) at the exit/entry of J-tubes, rock protection, grout bags, concrete mattresses, and/or protective sleeves. Additionally, Scour Protection may be installed over cables and CPS at the base of turbine foundations. See Paragraph 4.3.43 for further information on external cable protection. The CBRA will be prepared as a post-consent commitment (and finalised prior to construction) and its findings will inform the target burial depths, any required alternative protection

measures and the Cable Plan, this commitment is recorded in the Offshore EIA Report, Volume 3, Technical Appendix 4.6: Schedule of Mitigation and Commitments (TWP-BOW-RPS-OFE-RPT-00009).

- 4.3.34 The need for additional external protection will be subject to whether minimum target cable burial depths recommended for protection from the external threats can be achieved. Additional external protection will also be required at cable crossings, where cables cross existing assets. Seabed conditions, sedimentology, naturally occurring physical processes and potential interactions with human activities, such as vessel anchoring and bottom-trawl fishing gear, are all factors that can influence the requirement for the need of additional protection.
- 4.3.35 Although a minimum target burial depth is identified, where burial to that target is not achievable cables may be protected above the seabed using the full range of feasible protection measures; the PDE therefore includes both the target burial depths and the full range of above-seabed protection options so that each assessment has considered the worst-case combination of burial depth and above-seabed protection.
- 4.3.36 Installation of the IACs may be undertaken using pre-lay plough, plough, trenching, cutting, and/or jetting techniques. Fundamentally, these techniques all involve the displacement of sediments (either by mechanical tools or water jets) on or above the seabed. This creates a trench into which the cable(s) may be lowered. The target burial depth for the IACs is typically 1.5 m below the undisturbed seabed level, with a minimum target burial depth of 0.5 m where achievable and subject to the outcomes of the CBRA and O&M requirements. In areas of high seabed mobility, deeper burial depths may be required to ensure long-term cable stability.
- 4.3.37 In specific locations identified through the CBRA, such as crossings of existing pipelines, cables, or other subsea infrastructure, or where hard seabed conditions are encountered, cables may be installed directly on the seabed without burial. In such cases, external protection measures such as rock bags or concrete mattresses would be employed to safeguard the cables. Additionally, in high-risk areas such as shipping lanes, burial depths may be greater to mitigate the risk of anchor strikes or to accommodate potential future seabed deepening.
- 4.3.38 Section 4.5 covers site preparation activities that may be required in order to provide a relatively flat seabed surface for the installation of cables and allow the burial of IACs to the target burial depths.
- 4.3.39 The cable burial methodology and potential external cable protection will be identified at the final design stage (post-consent). The PDE for IACs is presented in Table 4.7.

Table 4.7: PDE for Inter-Array Cables

Parameter	Maximum Design
Maximum voltage (kV)	132
Maximum total cable length (km)	167

Parameter	Maximum Design
Maximum external cable diameter (mm)	315
Minimum external cable diameter (mm)	250
Maximum length of cable on the seabed (km)	151
Maximum length of cable in the water column (km)	N/A
Cable burial methodology	Lay then burial and/or simultaneous lay and burial. Ploughing/jetting/cutting Multiple installation techniques to be achieved using hybrid installation equipment.
Target burial depth (m)	1.5
Minimum burial depth (m)	0.5 (subject to CBRA)
Maximum width of cable trench (m)	6
Maximum width of seabed affected from installation tool per cable (m)	25

Interconnector Cables

- 4.3.40 Interconnector cables will be required to connect the OSPs to each other in order to provide redundancy in the case of failures within the electrical transmission system. Each OSP will be connected to the other OSP(s) within the Array Area using Interconnector Cables.
- 4.3.41 Where practicable the cables will be buried to an appropriate target burial depth. Cable burial depths will be informed by a CBRA but based upon current knowledge, target burial depths will be 1.5 m, with greater burial depths targeted in specific areas (e.g. in areas of increased shipping density). In cases where such burial is not feasible (e.g. the foundation entry points, or where the cable is expected to cross areas of bedrock, pipelines, or other existing cables), alternative protection methods will be employed, such as PU, PE, steel, or iron CPS, rock placement, rock/grout bags, concrete mattresses, and/or protective sleeves.
- 4.3.42 Interconnector Cables will be installed by the same methodologies proposed for IACs, with final methodology determined during the Proposed Development’s final design phase. The PDE for Interconnector Cables is provided in Table 4.8.

Table 4.8: PDE for Interconnector Cables

Parameter	Maximum Design
Maximum number of Interconnector Cables	3
Maximum total cable length (km)	36
Maximum external cable diameter (mm)	250
Cable burial methodology	Lay then burial and/or simultaneous lay and burial.

Parameter	Maximum Design
	Ploughing/jetting/cutting Multiple installation techniques to be achieved using hybrid installation equipment.
Target burial depth (m)	1.5 with greater burial depths targeted in specific areas (e.g. in areas of increased shipping density)
Minimum burial depth (m)	0.5 (subject to CBRA)
Maximum width of cable trench (m)	6
Maximum width of seabed affected from installation tool per cable (m)	25

External Cable Protection

- 4.3.43 Where minimum target cable burial depth cannot be achieved, external cable protection methods will be employed to restrict movement and prevent exposure over the lifetime of the Proposed Development. This will protect cables from activities such as fishing, anchor placement or dropped objects, limit effect of heat and/or electromagnetic fields, and safeguard other seabed users from potential hazards posed by the cables. External CPS include PU, PE, steel, or iron CPS, rock protection, grout bags, concrete mattresses, and/or protective sleeves.
- 4.3.44 The final solution(s) chosen at final design stage (post-consent) will be dependent upon seabed conditions and any potential interactions with human activities which may occur within the Proposed Development. Table 4.9 presents the PDE for external cable protection for IACs and Interconnector Cables.

Table 4.9: PDE for External Cable Protection for IACs and Interconnector Cables

Parameter	Maximum Design	
	IACs	Interconnector Cables
Type	CPS (typically made of cast-iron, steel, PU/PE (e.g. articulated split pipes, uraduct or protective sleeves)), rock placement, grout bags, rock berms, rock bags, and concrete mattresses	
Maximum cable protection height (m) above seabed	2	
Maximum cable protection width (m)	10	
Maximum percentage of cables which may require cable protection (%)	50	
Maximum length of cables which may require cable protection (m)	75,500	18,000
Maximum total cable protection footprint area for Array Area (m ²)	755,000	180,000

Parameter	Maximum Design	
	IACs	Interconnector Cables
Maximum total cable protection volume for Array Area (m ³)	1,510,000	360,000

Rock Placement and Rock/Grout Bags

- 4.3.45 Rock placement may be utilised as a form of external cable protection for IACs and Interconnector Cables and at cable crossings (see Paragraph 4.3.50). Rock is placed on top of cables either by creating a berm or using rock bags (Figure 4.7).
- 4.3.46 Rock berm creation will utilise a vessel with equipment such as a ‘fall pipe’ so that rock can be placed close to the seabed. Rock may be placed to a maximum height of 2 m and width of 10 m (see Table 4.9 for cable protection). The berm created will be designed to provide protection from anchor strike and anchor dragging, and to reduce risk of snagging by towed fishing gear as far as practicable in line with best practice guidance. Depending on expected scour, the cross section of the berm may vary, and the length of the berm will be dependent on the length of the cable which requires protection.
- 4.3.47 Alternatively, pre-filled rock/grout bags may be used which will be placed above the IACs and Interconnector Cables or cable crossings using installation beams. Rock bags consist of various sized rocks contained within a rope or wire net which are lowered to the seabed and deployed into the correct position (similar to installation of concrete mattresses, see Paragraphs 4.3.48 to 4.3.49). The number of rock bags which may be required will be dependent on the length of cable which requires protection. Grout bags are similar to rock bags but filled with grout.

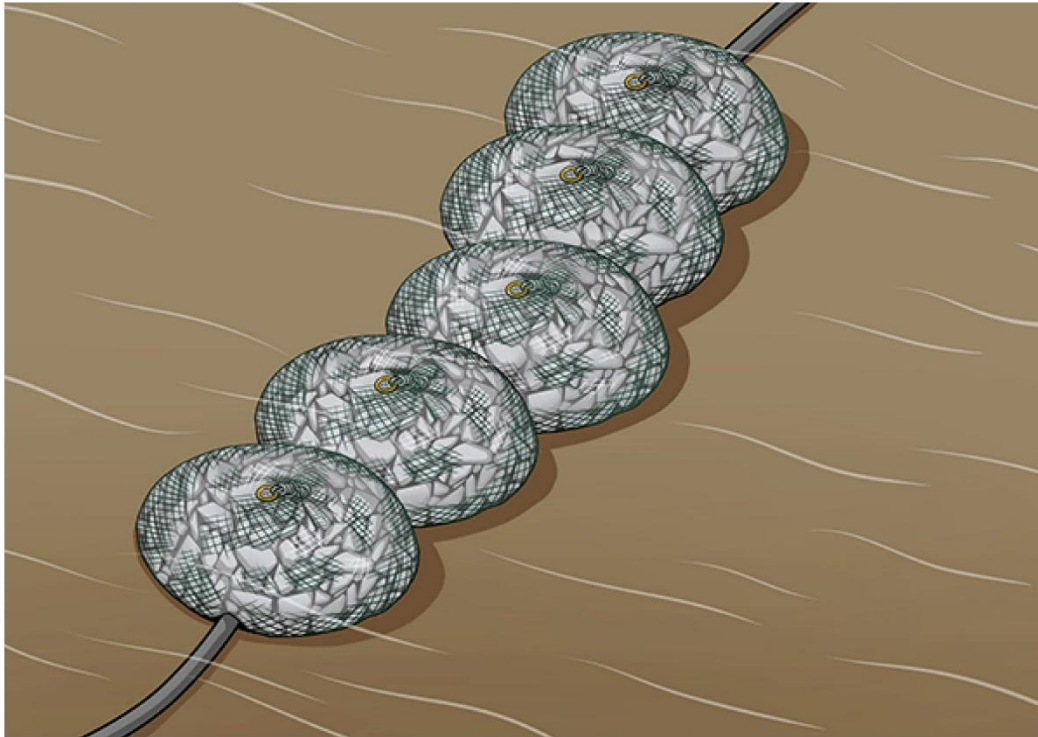


Figure 4.7: Rock Cable Protection Methods (Top: Rock Bags, Bottom: Rock Placement)

Concrete Mattressing

4.3.48 Concrete mattresses, comprising high strength concrete blocks and ultraviolet stabilised polypropylene rope, may be used as a means of external cable protection for IACs and Interconnector Cables and at cable crossings (Paragraph 4.3.50). The size, density, and shape of units may vary (within the parameters presented in Table 4.9 for cable protection and Table 4.10 for cable crossings), for example, by tapering edges of units for use in high current

environments, or using denser concrete, so that they are engineered for and bespoke to the locality in which they are installed.

4.3.49 Concrete mattresses are installed above the cables using a vessel and free-swimming installation frame. The mattresses are lowered to the seabed and the installation frame is released in a controlled manner once in the correct position to deploy the mattress on the seabed. This installation process is repeated for each mattress along the length of cable that requires external protection. Dependant on expected scour, mattresses may be gradually layered in a stepped formation on top of each other.

Cable Crossings

4.3.50 Up to nine IAC crossings and up to three Interconnector Cable crossings may be required across the Array Area. The IAC crossings considered at this stage are based on crossings with a third-party subsea cable, while the Interconnector Cable crossings are based on crossings with the IAC cables. Cable crossings may comprise several different methods as presented in Table 4.10, and additional cable protection will be installed at cable crossings. Table 4.10 presents the PDE for cable crossings, and accounts for additional protection required.

Table 4.10: PDE for Cable Crossing for IACs and Interconnector Cables

Parameter	Maximum Design	
	IACs	Interconnector Cables
Maximum number of crossings	9	3
Crossing material/method	Rock placement, grout/rock bags, rock berms, concrete bridges and concrete mattresses, and CPS (typically made of cast-iron, steel, PU/PE (e.g. articulated split pipes, uraduct or protective sleeves))	
Maximum height of crossing above seabed (m)	2.5	
Maximum width of crossing (m)	9	
Maximum length of each crossing (m)	500	
Maximum total length of crossings across the Array Area (m)	4,500	1,500
Maximum total area of crossings (m ²)	40,500	13,500
Maximum volume of protection material (per crossing) (m ³)	11,250	
Maximum total volume of crossing protection across the Array Area (m ³)	101,250	33,750

4.4 Offshore Transmission Assets

Offshore Substation Platforms

- 4.4.1 OSPs are required to receive electricity generated by the Wind Turbines and transform it to a higher voltage to allow the electricity to be transmitted efficiently to shore. The Proposed Development may require up to three OSPs which will be located within the Array Area.
- 4.4.2 The Proposed Development will use HVAC transmission technology. The final electrical layout for the Proposed Development will determine the final number, location(s) and specifications of each OSP, and will be confirmed during the Proposed Development detailed design phase (post application submission). All OSPs will be appropriately marked for aviation and navigation purposes, for example using necessary lighting and paint finish. An illustration detailing a typical OSP design is provided in Figure 4.8.
- 4.4.3 The PDE for the OSP topsides and foundations is presented in the following subsections.

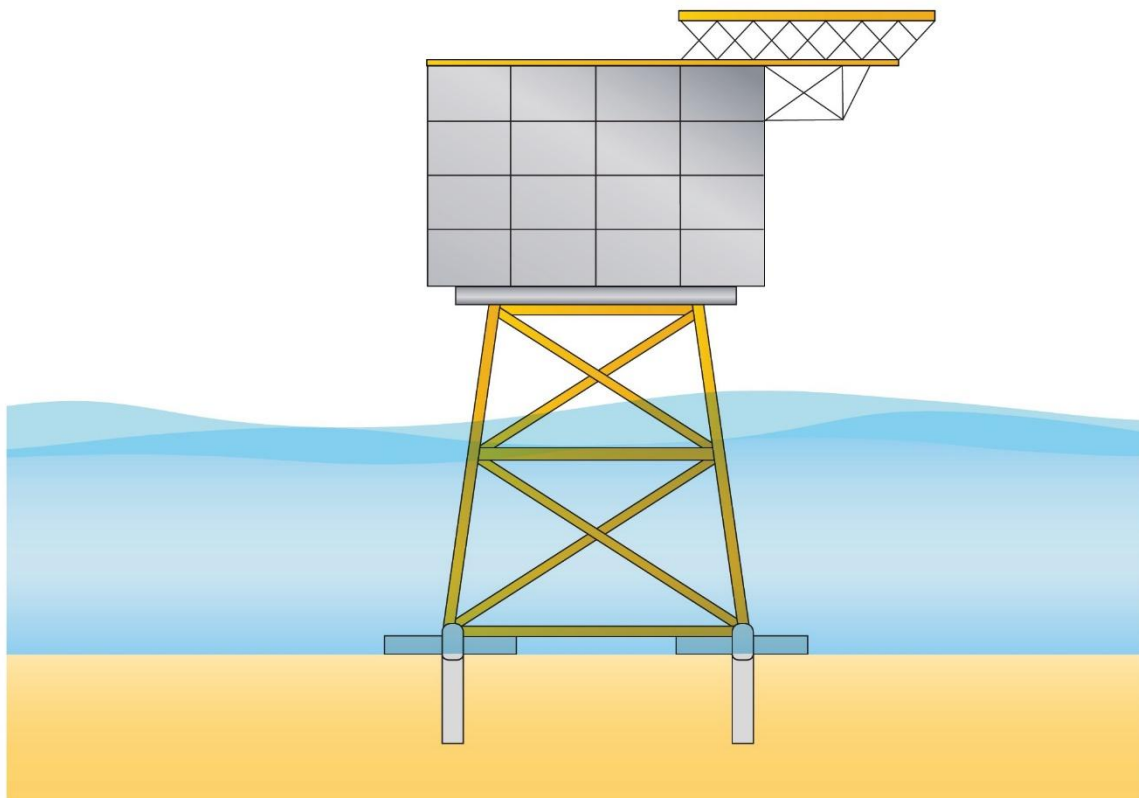


Figure Not to Scale

Figure 4.8: Illustrative OSP on a Jacket Foundation

Offshore Platform Topsides

4.4.4 Up to three OSP topsides will be installed with maximum dimensions of up to 100 m (length) by 80 m (width) and up to approximately 60 m in height (above LAT). This height excludes the lightning protection. The three options for the OSP topsides are presented Table 4.11.

Table 4.11: PDE for the OSP Topside Options

Parameter	Maximum Design		
	Option 1	Option 2	Option 3
Maximum number of OSPs	2	1	3
Maximum length of topside (m)	80	100	50
Maximum width of topside (m)	60	80	40
Maximum height of main structure above LAT (excluding lightning protection) (m)	60	60	60
Maximum height of lightning protection above LAT (m)	70	70	70

Offshore Platform Foundations

4.4.5 Each OSP will sit on a piled jacket foundation, with up to eight legs for the foundation(s). It is anticipated that foundations will be constructed onshore before specialist vessels are used to transport and install the foundations within the Array Area.

4.4.6 The diameters of the piles associated with piled jacket foundations are lower than monopile foundations, however similar technology may be utilised for their installation: hydraulic hammers, vibration, drilling into the seabed. The installation of foundations for the OSP(s) will be undertaken using one of two primary methods, either piling, or drive-drill-drive. The choice of method will depend on factors such as seabed conditions and the dimensions of the piles. Piling typically involves the use of hydraulic hammers or vibration techniques, while the drive-drill-drive method incorporates piling, followed by drilling to penetrate hard seabed layers and potentially further piling to achieve the required depth.

4.4.7 For OSP Option 1 (two OSPs), this results in a maximum of 18 piles required per foundation, and up to 36 piles will require piling for the two OSPs. For OSP Option 2 (one OSP), a maximum of 18 piles will be required for the foundation of a single OSP. For OSP Option 3 (three OSPs), there will be eight piles per OSP foundation, with up to 24 piles for the three OSPs (Table 4.12).

4.4.8 Scour Protection details for OSPs are the same as for the Wind Turbine foundations, presented in Paragraphs 4.3.27 to 4.3.29.

4.4.9 It is expected that one vessel will be utilised to conduct piling/drilling events for OSP foundations, using a maximum hammer energy of 4,500 kJ. Up to two piling operations may occur simultaneously at Wind Turbine or OSP locations; concurrent piling of OSP foundations is possible in the MDS where two or three OSPs are considered.

Table 4.12: PDE for the OSP Fixed Jacket Foundations

Parameter	Maximum Design		
	Option 1 – 6 leg jacket	Option 2 – 8 leg jacket	Option 3 – 4 leg jacket
Maximum number of OSPs	2	1	3
Maximum number of legs per foundation	6	6 ⁵	4
Maximum leg diameter (m)	3	3.5	3
Maximum number of driven piles per leg	3	3 ⁵	2
Maximum number of driven piles per platform foundation	18	18 ⁵	8
Maximum jacket leg spacing (at seabed) (m)	48 x 48	48 x 48	48 x 48
Maximum jacket leg spacing (at surface) (m)	25 x 30	36 x 54	25 x 30
Maximum driven pile diameter (m)	4.5		
Maximum driven pile length (m)	90		
Maximum driven pile penetration depth (m)	70		
Maximum dimensions of mud mats (if used) (m)	20 x 20		
Maximum seabed footprint per jacket foundation (m ²)	2,400	3,200	1,600
Maximum seabed footprint for the Proposed Development (m ²)	4,800	3,200	4,800
Maximum total number of driven piles requiring piling (all platforms)	36	18 ⁵	24
Maximum hammer energy (kJ)	4,500		
Scour Protection type	Rock		
Maximum height of Scour Protection (m)	1		
Maximum diameter of Scour Protection per jacket leg (including pile/anchor) (m)	40.0		29.0
Maximum area of Scour Protection per foundation (excluding pile area) (m ²)	7,500	10,000	5,000
Maximum volume of Scour Protection per foundation (m ³)	7,500	10,000	5,000
Maximum volume of Scour Protection for Proposed Development (m ³)	15,000	10,000	15,000

⁵The maximum design scenario assumes six legs, each supported by three piles, resulting in a total of 18 piles. An alternative configuration of eight legs may be considered only if it facilitates a reduction in the overall number of piles, for example, eight legs with two piles each, totalling 16 piles.

Offshore Export Cables

- 4.4.10 To transfer the energy from the OSPs located in the Array Area to Landfall (and to subsequent onshore transmission infrastructure), up to three HVAC cable circuits may be laid within the Export Cable Corridor (see Figure 1.1) with a maximum cable length of 70 km each. Landfall is located in Benholm, Aberdeenshire and a trenchless technique (e.g. HDD) will be used to bring the Offshore Export Cables ashore (see Figure 4.9 and Section 4.6). In the nearshore area the Export Cable Corridor narrows to align with Landfall. At the Array Area, the Export Cable Corridor runs along its western edge.



Figure 4.9: Location of Proposed Development Export Cable Corridor and Landfall at Benholm, Aberdeenshire

- 4.4.11 As with the IACs and Interconnector Cables, where practicable the Offshore Export Cables will be buried to an appropriate target burial depth to ensure they are protected, to reduce the need for cable protection and to reduce interaction with other sea users.
- 4.4.12 The ability to bury cables will be largely dependent on sediment types and ground conditions. Cable burial depths will be informed by a CBRA, but based upon current understanding, they will be installed to a minimum target burial depth of 1.5 m (subject to further design), with greater burial depths targeted in specific areas (e.g. in areas of increased commercial fisheries and shipping density).
- 4.4.13 Installation of the Offshore Export Cables may be through a range of methods including pre-lay plough, plough, trenching, cutting and/or jetting techniques. Considering the anticipated length of the Offshore Export Cables, and seabed conditions, a combination of burial and external cable protection methods will be required.
- 4.4.14 As previously mentioned in Paragraphs 4.3.43 to 4.3.49, whenever the minimum target cable burial depth is not achievable, external cable protection methods will be implemented to restrict any movement and prevent exposure over the lifetime of the Proposed Development. This will limit the effects of heat and/or electromagnetic fields and help to protect against human activities such as fishing, anchor placement or dropped objects. CPS that could be used by the Applicant include concrete masses, rock placement, cast-iron shells, or PU/PE sleeving. The Applicant will decide the final solution(s) at final design stage (post-consent) which will be dependent on seabed conditions as well as any potential interactions with human activities that may occur within the Proposed Development.
- 4.4.15 The PDE for the Offshore Export Cables is presented in Table 4.13, and the PDE for the external cable protection for the Offshore Export Cables is presented in Table 4.14.
- 4.4.16 Up to six Offshore Export Cable crossings may be installed along the Export Cable Corridor. Cable crossings may comprise several different methods as presented in Table 4.15, and additional cable protection will be installed at cable crossings. Table 4.15 presents the PDE for cable crossings, and accounts for additional protection required.

Table 4.13: PDE for the Offshore Export Cables

Parameter	Maximum Design
Export cable voltage (kV)	220-275
HVAC/HVDC	HVAC
Maximum total cable length (km)	210
Maximum external cable diameter (mm)	300
Cable burial methodology	Lay then burial and/or simultaneous lay and burial. Ploughing/jetting/cutting

Parameter	Maximum Design
	Multiple installation techniques to be achieved using hybrid installation equipment. A trenchless technique will be used at Landfall (e.g. HDD)
Target burial depth (m)	1.5 (subject to CBRA), with greater burial depths targeted in specific areas (e.g. in areas of increased shipping density)
Maximum width of cable trench (m)	6
Maximum width of seabed affected from installation tool per cable (m)	25

Table 4.14: PDE for the External Cable Protection for the Offshore Export Cables

Parameter	Maximum Design
Type	CPS (typically made of cast-iron, stell, PU/PE (e.g. articulated split pipes, uraduct or protective sleeves)), rock placement, grout or rock bags, rock berms, and concrete mattresses
Maximum cable protection height (m)	2
Maximum cable protection width (m)	10
Maximum percentage of cable which may require cable protection (%)	50
Maximum length of cables which may require cable protection (m)	105,000
Maximum total cable protection footprint area for Proposed Development (m ²)	1,050,000
Maximum total cable protection volume for Proposed Development (m ³)	2,100,000

Table 4.15: PDE for Cable Crossing for the Offshore Export Cables

Parameter	Maximum Design
Maximum number of crossings	6
Crossing material/method	CPS (typically made of cast-iron, stell, PU/PE (e.g. articulated split pipes, uraduct or protective sleeves)), rock placement, grout bags, rock berms, rock bags, and concrete bridges and concrete mattresses
Maximum height of crossing (m)	2.5
Maximum width of crossing (m)	9
Maximum length of each crossing (m)	500
Maximum total length of crossings along the Export Cable Corridor (m)	3,000
Maximum total area of crossings (m ²)	27,000

Parameter	Maximum Design
Maximum volume of protection material (per crossing) (m ³)	11,250
Maximum total volume of crossing protection along the Export Cable Corridor (m ³)	67,500

4.4.17 As mentioned in Paragraph 4.4.10, Landfall is located in Benholm, Aberdeenshire and trenchless technology will be used to bring the Offshore Export Cables ashore. The drilling required for the trenchless installation method will commence from above MHWS, span under the Intertidal Area and will punch out below MLWS. The PDE for the Offshore Export Cables at Landfall is presented in Table 4.16, with further detail on installation methodologies provided in in Section 4.6. The inclusion of up to four HDD cable ducts, despite only three export cables being proposed, allows for operational flexibility and risk management during installation and future maintenance.

Table 4.16: PDE for the Offshore Export Cables at Landfall

Parameter	Maximum Design
Type	Trenchless technology (e.g. HDD, pipe jacking tunnel)
Corridor width (m)	80
Maximum number of HDD cable ducts	4
Maximum HDD borehole diameter (m)	2.2
Indicative length of cable ducts (m)	755
HDD length in the Intertidal Area (m)	600
Minimum HDD burial depth in the Intertidal Area (m)	7
Maximum number of HDD pits	4
Indicative dimensions of exit pits (m)	2.2 x 50
Method of excavation at exit pits	<p>The transition profile of the HDD duct onto the seabed would be determined during the detailed design phase. In a scenario where a levelled transition cannot be achieved onto the seabed, excavation may be required. Excavation methods include the use of:</p> <ul style="list-style-type: none"> • Mass flow excavator; • Dredge dump; and • Cutter suction dredger. <p>These methods could be deployed from spud leg, anchored barge or jack-up vessel. Excavated material will be placed with the Site Boundary.</p>
Total indicative volumes of excavated material at HDD exit pits (m ³)	8,400

4.5 Site Preparation Activities

4.5.1 Prior to the installation of Offshore Infrastructure, it is likely that seabed preparation will be required, including pre-sweeping, seabed-levelling, sandwave clearance, boulder clearance, pre-cut trenching and the removal or avoidance of debris (e.g. fishing nets, out of service utilities, lost anchors, or Unexploded Ordnance (UXO)). Excavation may also be required to allow access and removal where debris is found to be present below the seabed surface. Furthermore, pre- and post-installation of rock berms, concrete mattresses and other CPSs (e.g. steel/rubber/PE/PU sleeves or tubes) may be needed in different configurations for installation of cable systems in locations where the cable(s) routing cannot avoid steep slopes or need to cross channels in the Array Area or Export Cable Corridor.

4.5.2 Site preparation activities will continue throughout the construction phase as required and, therefore, these activities can be undertaken at any point within the construction programme (see Paragraphs 4.6.45 to 4.6.46).

Pre-Construction Surveys

4.5.3 Pre-construction surveys, including geophysical and geotechnical surveys, will be carried out to provide further information on:

- seabed conditions and morphology;
- soil conditions and properties;
- presence or absence of any potential obstructions or hazards; and
- to inform progression of design for the Proposed Development.

4.5.4 Geophysical surveys will be undertaken within the Site Boundary to provide further information on UXO, bedforms and mapping of boulders, bathymetry, topography and sub-surface layers. Geophysical survey techniques to be employed include Multibeam Echosounder, magnetometer, Side-Scan Sonar, Sub-Bottom Profiler and Ultra-High Resolution Seismic.

4.5.5 Geotechnical surveys will be carried out at specific locations within the Site Boundary and will employ techniques such as Cone Penetration Tests, vibrocores, box cores, piston cores and boreholes.

Clearance of Unexploded Ordnance

4.5.6 UXO may be present within the Array Area and Export Cable Corridor (originating from World War I or World War II). Due to the health and safety risks posed by UXO, and potential interactions with planned locations of installed infrastructure and vessel activities, it is necessary for the potential presence of UXOs to be surveyed and if identified, managed carefully before the construction phase and installation of Offshore Infrastructure commences.

4.5.7 A desk-based study of the Proposed Development (Offshore EIA Report, Volume 3, Technical Appendix 19.2: Unexploded Ordnance Technical Report (TWP-BOW-RPS-OFE-RPT-00046)) reviewed the relevant military history in the vicinity of the Proposed Development and the likelihood of encountering UXO. Based on known military activity, the desk-based study concluded that there

was a varying low-moderate and moderate risk from encountering UXO within the Site Boundary. Further assessment of UXOs has been undertaken within the relevant EIA topic chapters (Offshore EIA Report, Volume 2, Chapters 7 to 23) RIAA Part 2: Special Areas of Conservation and RIAA Part 3: Special Protection Areas and Ramsar Site Assessments on the basis of the desk-based study (Offshore EIA Report, Volume 3, Technical Appendix 19.2: Unexploded Ordnance Technical Report (TWP-BOW-RPS-OFE-RPT-00046)).

4.5.8 Methodologies considered within the PDE to avoid/clear UXOs are as follows:

- avoid and leave *in situ*;
- micrositing of Offshore Infrastructure to avoid UXO;
- relocation of UXO to avoid detonation;
- low order clearance technique (e.g. deflagration); and
- high order detonation (with associated mitigation measures).

4.5.9 Due to the health and safety risks that UXOs pose, the Applicant would seek to either avoid UXOs entirely, avoid UXOs via micrositing, or relocate UXO where practicable. If methods cannot be employed to avoid or relocate UXOs, a specialist contractor will clear UXOs in advance of construction taking place. The preferred clearance method for UXO is use of a low order technique with a single donor charge of 0.25 kg Net Explosive Quantity (NEQ) for each clearance event. Up to 0.5 kg NEQ clearance shot will be required for neutralisation of residual explosive material at each location. Detailed design work would be required to confirm planned locations of infrastructure, prior to conducting any UXO surveys. The Applicant has estimated that up to 40 UXOs may require clearance based upon the desk-based study. As a risk remains that unintended high order detonation may occur, all of the clearance events have been assumed to have the potential to result in high order detonation, as this would result in the greatest impact (see Offshore EIA Report, Volume 2, Chapter 10: Marine Mammals (TWP-BOW-RPS-OFE-RPT-00018) and Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report (TWP-BOW-RPS-OFE-RPT-00015)).

4.5.10 Table 4.17 presents the PDE for UXO clearance.

Table 4.17: PDE for Unexploded Ordnance Parameters

Parameter	Maximum Design
Theoretical maximum weight anticipated to be encountered (kg)	1,170
Maximum realistic charge weight (kg)	254
Maximum estimated number of UXOs to be identified	40
Maximum estimated number of UXOs to be cleared	40
Maximum number of detonation activities occurring within 24 hours	2
Maximum total duration of UXO clearance activities (days)	40

Sandwave Clearance

- 4.5.11 Prior to the installation of Offshore Infrastructure, existing sandwaves may need to be cleared in some areas of the Proposed Development. There are two main reasons for undertaking sandwave clearance:
- To provide a relatively flat seabed surface for cable installation and so that cable burial tools can work effectively: if cables are installed up or down a slope over a certain angle, or where the cable burial tool is working on a camber, the ability to meet target burial depths may be impacted.
 - In order for cables to be buried to the target burial depth and remain buried for the operational lifetime of the Proposed Development (30 years): as sandwaves are generally mobile in nature, the cable must be buried beneath the level where natural sandwave movement could uncover it. Therefore, for this to be achieved, mobile sediments may need to be removed before cables are installed and buried.
- 4.5.12 Seabed morphology varies across the Array Area. With north-east to south-west oriented sandwaves located in southern-central and eastern parts of the area, megaripples and ripples dominating the central, north-eastern, and north-western zones (see Offshore EIA Report, Volume 3, Technical Appendix 7.1: Physical Processes Baseline Environment (TWP-BOW-RPS-OFE-RPT-00010)). Along the Export Cable Corridor there are megaripples and sandwaves present in many areas along the route, with heights in excess of 6 m in place.
- 4.5.13 Sandwave clearance is likely to be required in specific discrete areas of the Proposed Development (e.g. along IACs, Interconnector Cables, and Offshore Export Cables) and could occur throughout the construction phase.
- 4.5.14 Sandwave clearance methods could include mass flow excavator or the use of a trailing suction hopper dredger, or a combination of both.
- 4.5.15 Excavated material will be preferentially deposited within the Site Boundary and as close as practicable to the excavation location. This approach aims to retain a broadly similar composition of sediment within the disposal area.
- 4.5.16 Table 4.18 presents the PDE for sandwave clearance. A geophysical survey campaign will be completed prior to construction which will allow the final parameters for sandwave clearance to be defined.

Table 4.18: PDE for Sandwave Clearance

Parameter	Maximum Design
Array Area	
Maximum width of sandwave clearance along IACs and Interconnector Cables (m)	58.6
Maximum percentage of total length of IACs and Interconnector Cables requiring sandwave clearance (%)	0.56
Maximum area of sandwave clearance along IACs (m ²)	49,552
Maximum volume of sandwave clearance along IACs (m ³)	197,955

Parameter	Maximum Design
Maximum area of sandwave clearance along Interconnector Cables (m ²)	11,814
Maximum volume of sandwave clearance along Interconnector Cables (m ³)	47,191
Maximum area of sandwave clearance for fixed foundations (m ²)	172,220
Maximum volume of sandwave clearance for fixed foundations (m ³)	724,273
Maximum area of sandwave clearance for OSP Scour Protection (m ²)	24,359
Maximum volume of sandwave clearance for OSP Scour Protection (m ³)	136,412
Export Cable Corridor	
Maximum width of sandwave clearance along Offshore Export Cables (m)	58.6
Maximum percentage of total length of Offshore Export Cables requiring sandwave clearance (%)	4.95
Maximum area of sandwave clearance along Offshore Export Cables (m ²)	609,147
Maximum volume of sandwave clearance along Offshore Export Cables (m ³)	3,411,223

Boulder Clearance

- 4.5.17 Boulder clearance will be required in some areas of the Proposed Development prior to installation of Offshore Infrastructure, in particular, along IACs and Offshore Export Cables. A boulder is defined as being over 256 mm (Wentworth Scale) in diameter and/or length.
- 4.5.18 Boulder clearance is required to aid cable installation and increase the success rate for achieving minimum target burial depth during cable burial, therefore, reducing the risk of further cables burial works and/or the need for cable protection. Boulder clearance also reduces the risk of cable damage during installation and subsequent burial. The PDE for boulder clearance for the Proposed Development is presented in Table 4.19.
- 4.5.19 Boulders may be cleared using one or a combination of the following:
- a boulder grabber or Remotely Operated Vehicle (ROV), where boulders would be picked up from the seabed and relocated to designated areas within the Site Boundary;
 - a displacement plough to clear boulders from the cable route creating a path for cable installation; and/or
 - pre-lay grapnel runs used to prepare the seabed before cable installation.

4.5.20 Geophysical and pre-construction surveys, and the parameters of any boulders present (e.g. size, density and location of boulders), will inform the boulder clearance methodology to be used.

Table 4.19: PDE for Boulder Clearance

Parameter	Maximum Design
Maximum width of boulder clearance along IACs, Interconnector Cables, and Offshore Export Cables (m)	25
Maximum area of boulder clearance along IACs (m ²)	98,150
Maximum percentage of total length of IACs and Interconnector Cables requiring boulder clearance (%)	2.6
Maximum area of boulder clearance along Interconnector Cables (m ²)	23,400
Maximum area of boulder clearance along Offshore Export Cables (m ²)	254,289
Maximum percentage of total length of Offshore Export Cables requiring boulder clearance (%)	4.9

Vessels for Site Preparation Activities

4.5.21 The PDE for vessels to be used during site preparation activities is presented in Table 4.20.

Table 4.20: PDE for Vessels for Site Preparation Activities

Parameter	Maximum Design	
	Maximum Total Number of Vessels on Site at any One Time	Maximum Total Movements (Return Trips Across Site Preparation Activities)
Export Cable Corridor		
Geophysical/geotechnical survey vessel	7	55
Boulder/UXO clearance vessel*	2	10
Array Area		
Geophysical/geotechnical survey vessel	7	55
Boulder/UXO clearance vessel*	2	20
Total	18	140

*Sandwave clearance will be during construction rather than site preparation.

4.6 Construction Phase

Methodology

4.6.1 Construction of the Proposed Development is expected to take place over a period of five years, following pre-construction surveys, and will proceed in accordance with the indicative construction sequence outlined below:

- Step 1 – Offshore Export Cables installation at Landfall;
- Step 2 – Wind Turbine fixed foundation transport and installation;
- Step 3 – Offshore Export Cables installation offshore, including cable burial and/or protection, where required;
- Step 4 – OSP topside and fixed foundation installation and commissioning;
- Step 5 – Interconnector Cable and IAC Installation, including cable burial and/or protection, where required; and
- Step 6 – Wind Turbine transport, installation and commissioning.

4.6.2 The following subsections summarise these steps.

Step 1 – Offshore Export Cables Landfall installation

4.6.3 Figure 4.9 shows the Export Cable Corridor as it reaches Landfall at Benholm, Aberdeenshire.

4.6.4 Installation parameters for the Offshore Export Cables at Landfall are presented in Table 4.16. Works landward of MLWS are described and assessed in the Onshore EIA Report (BOWFL, 2025) and are assessed cumulatively with the Proposed Development in this Offshore RIAA.

4.6.5 It is proposed that the Offshore Export Cables are installed in the Intertidal Area using trenchless technology (Figure 4.10), such as HDD. HDD involves drilling a hole (or holes) along an underground pathway from one point to another, through which the Offshore Export Cables are installed, without the need to excavate an open trench. The drilling installation will commence from above MHWS, with the HDD exit point (punch out location) located seaward of MLWS. As such, no above-ground construction works are planned to take place in Landfall.

4.6.6 The HDD works comprise of the following main stages:

- 1) A pilot hole is drilled from onshore to offshore.
- 2) Once the pilot hole is completed, the reaming process will commence, increasing the diameter of the pilot hole to accommodate the safe installation of HDD duct. The reaming process will continue back and forth for a number of passes to achieve a minimum bore diameter. During the drilling procedure, drilling fluid (such as Bentonite) is continuously pumped to the drill head to act as a lubricant. Solids are removed from the returning fluid, and the spoil is transported off site.
- 3) A spud leg, anchored barge or jack-up vessel will be used at the HDD exit point to create an HDD exit punch out. The transition profile of the HDD duct onto the seabed will be determined during the detailed design

phase. In a scenario where levelled transition cannot be achieved onto the seabed, excavation could be required. Excavation methods would include the use of mass flow excavator, dredge pump or cutter suction dredger.

- 4) The last forward HDD reamer exits the seabed at the HDD exit punch out.
- 5) The HDD reamer is then disconnected from the drill pipe and recovered.
- 6) The High-Density Polyethylene liner pipe will be pre-assembled and then floated in, connected to the drill pipe, and pulled onshore from the offshore end through the pre-drilled bore into position.
- 7) Steps 1 to 6 are then repeated for all the Offshore Export Cables.
- 8) Trenches are then excavated from the HDD entry points above the MHWS to the Transition Joint Bay (TJB) and ducts installed and backfilled (covered as part of the onshore submission).
- 9) HDD construction equipment and plant is then demobilised from site.
- 10) The ducts are then proved ready for cable pull in and messenger wires are installed.
- 11) Offshore Export Cables will then be installed in the ducts by pulling them from the offshore delivery vessel (below MLWS) through the installed ducts to the TJBs (at MHWS).

4.6.7 HDD drilling activities may be required to operate continuously over a 24-hour period until each bore is complete. Drilling may be carried out concurrently to accelerate the construction works programme. This will be subject to further construction planning and availability of drilling rigs.

4.6.8 Pull in techniques for HDD installation include direct pull in, where the cable vessel will sit a short stand-off distance from the HDD exit point, and the cable is pulled directly from the vessel. The other technique is floating pull in, where the vessel will stand-off at a suitable water depth for its safe operation and float the cable toward the duct, with a second vessel assisting located above the HDD exit point to guide the cable through the duct.

4.6.9 Bentonite comprises 95% water and 5% bentonite clay which is a non-toxic, natural substance. Bentonite drilling fluid is non-toxic and is commonly used offshore. Every endeavour will be made to avoid a breakout (loss of drilling fluid to the surface). The finalised EMP will provide information on the procedure for managing a breakout of Bentonite under the water.

4.6.10 As part of the detailed design work to inform the construction of the Offshore Export Cables at Landfall, the potential risks relating to cable exposure due to coastal recession and beach lowering will be considered in detail, including the effects of climate change over the O&M phase of the Proposed Development. Minimum trenchless burial depths in the Intertidal Area are provided in Table 4.16, but this is subject to further refinement post-consent.

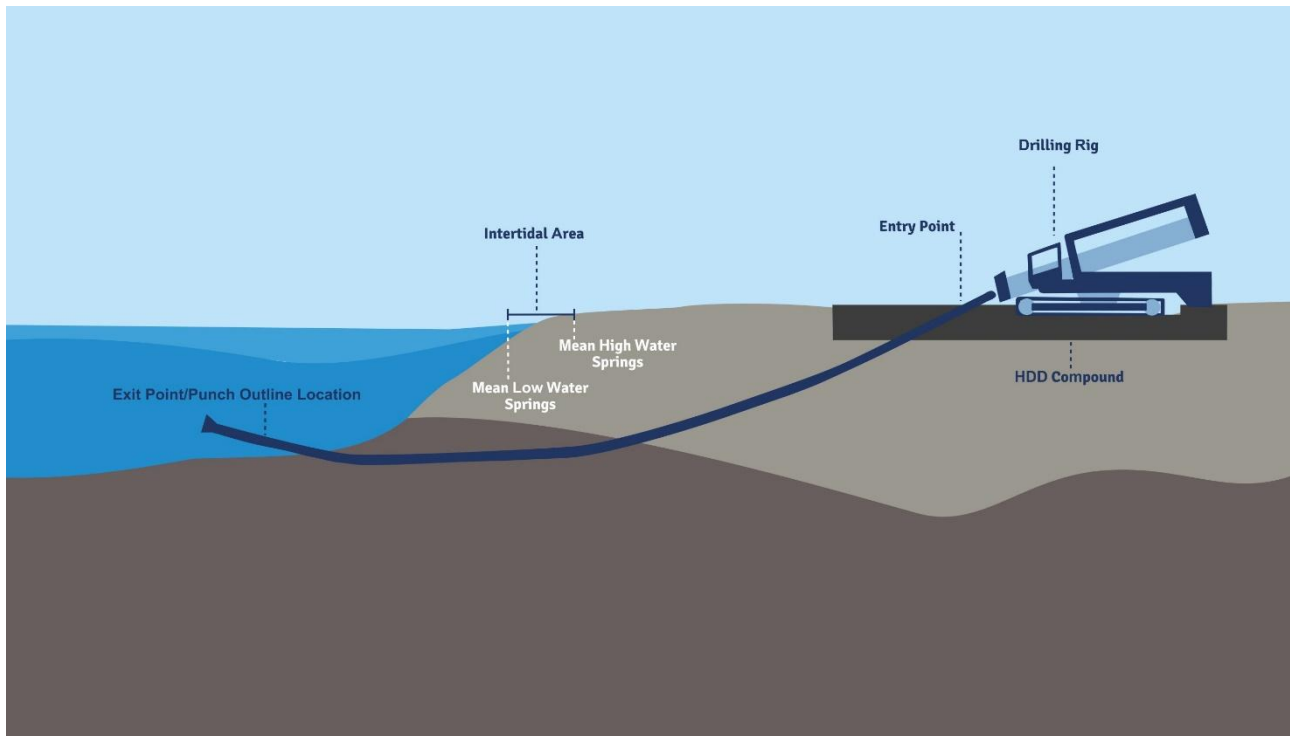


Figure 4.10: Cross Section Showing Trenchless Technology at Landfall

Step 2 – Wind Turbine Foundation Transport and Installation

- 4.6.11 The Proposed Development will use fixed bottom Wind Turbine foundations. Wind Turbine foundations will be transported to the Array Area by vessels. Paragraphs 4.6.38 to 4.6.40 present further details of vessels involved in installation activities within the Proposed Development.
- 4.6.12 Table 4.21 presents the piling characteristics required for the installation of the Wind Turbine foundations. It is assumed that a crane will be used to lower the pile to the seabed and will be kept in position using a pile gripper or a pile installation frame, which may be temporarily placed on the seabed and then moved to the next location once the piles are installed. Piles will be installed into the seabed using a hammer.
- 4.6.13 Detailed geotechnical data from the Array Area will inform a driveability assessment to determine the optimal hammer energy required at each location. This will ensure efficient installation while minimising energy use. It is anticipated that the maximum hammer energy will only be required at selected locations. Up to two piling operations may occur simultaneously at Wind Turbine or OSP locations; concurrent piling of OSP foundations is possible in the PDE where two or three OSPs are considered.
- 4.6.14 Where jacket foundations are used, piles may be pre-installed in advance of jacket installation. Jackets will then be transported to site by barge or heavy transport vessel, lowered onto the pre-installed piles using a crane, and secured in place using grout.
- 4.6.15 For suction bucket jacket foundations, the structure will be lowered to the seabed by crane and installed using suction-assisted penetration. This method

involves pumping water out of the buckets to create a pressure differential, drawing the foundation into the seabed.

- 4.6.16 If Scour Protection is required, it will generally be installed prior to foundation installation. However, in some cases, it may be installed following foundation placement, depending on site-specific conditions and installation sequencing.

Table 4.21: PDE for Wind Turbine Foundations – Driven Piling Characteristics

Parameter	Maximum Design	
	15 MW Wind Turbines	25 MW Wind Turbines
Maximum number of piles requiring piling	268	160
Maximum hammer energy (kJ)	6,250	
Soft start energy (% of maximum hammer energy)	15	
Maximum soft start duration (minutes)	20	
Maximum duration of piling per pile (hours)	12.4	15.2
Maximum number of piles installed over 24 hours	4	
Estimated average number of piles installed over 24 hours	2	
Maximum duration of piling per day over construction phase (hours)	22.0	
Maximum total number of days when piling may occur over construction phase	268	160
Maximum number of concurrent piling events	2	
Minimum distance between concurrent piling events (km)	1	
Maximum distance between concurrent piling events (km)	20	

- 4.6.17 If hard ground is encountered which makes pile driving unsuitable, a combination of drill and driven installation methods may be required. In this case, a drill would be used after initial piling to remove the seabed material inside the pile and continue to installation to the target penetration depth. Drilling characteristics are presented in Table 4.22.
- 4.6.18 Seabed material (drill arisings) will be released as a result of drilling activities. This material will be deposited adjacent to each drilled foundation location within the Array Area (see Offshore EIA Report, Volume 2, Chapter 7: Physical Processes (TWP-BOW-RPS-OFE-RPT-00011) for the assessment of drill arisings).
- 4.6.19 As shown in Figure 4.2 and Figure 4.3, there are a number of spare Wind Turbine locations within the Array Area. These spare locations have been identified should seabed conditions not be suitable for Wind Turbine installation. These spare locations will be taken forward as part of the detailed design, but the final layout will be for up to 67 Wind Turbines, dependant on final Wind Turbine selection.

Table 4.22: PDE for Wind Turbine Foundations – Drilling Characteristics

Parameter	Maximum Design	
	15 MW Wind Turbines	25 MW Wind Turbines
Maximum number of piles requiring drilling over the Proposed Development	268	160
Maximum (%) of all piles requiring drilling over the Proposed Development	100	
Maximum drilling rate (m/hour)	2	
Maximum drilling depth per pile (m)	32.5	40
Maximum drilling duration per pile (hours)	32.5	40
Maximum volume of drill arisings per pile (m ³)	737	1571
Maximum volume of drill arisings for the Proposed Development (m ³)	197,563	251,327
Maximum number of concurrent drilling events	2	
Minimum distance between concurrent drilling events (km)	1	
Maximum distance between concurrent drilling events (km)	20	

Step 3 – OSP Topside and Foundation Installation and Commissioning

- 4.6.20 The OSP jackets will be fixed to the seabed using piles. Piles will be transported to the Array Area by vessel from the fabrication site or port facility, and installed in the seabed at the installation locations (exact locations to be confirmed at final design stage (post-consent)), using methods described previously in Paragraphs 4.6.11 to 4.6.19.
- 4.6.21 Piling will commence with a lower hammer energy of 675 kJ and will slowly ramp up energy up to a maximum 4,500 kJ over a period of 30 minutes. Concurrent piling may occur between an OSP and a Wind Turbine location. However, there will only be a maximum two concurrent piling events.
- 4.6.22 The OSP jackets will be delivered to site by barge or delivery vessel and lowered to the seabed using a crane. This could occur before installing the piles (post-piled jacket) or after (pre-piled jacket). Once in place the jackets would be grouted onto the piles.
- 4.6.23 The PDE for the driven piles associated with the OSP foundations is presented in Table 4.23. Drilling characteristics are presented in Table 4.24.

Table 4.23: PDE for OSPs – Piling Characteristics

Parameter	Maximum Design
Maximum number of piles requiring piling	36
Maximum hammer energy (kJ)	4,500
Soft start energy (% of maximum hammer energy)	15
Maximum soft start duration (minutes)	20
Maximum duration of piling per pile (hours)	13.3
Maximum number of piles installed over 24 hours	4
Maximum duration of piling per day over construction phase (hours)	22
Maximum total number of days when piling may occur over construction phase	36
Maximum number of concurrent piling events	2
Minimum distance between concurrent piling events (km)	1
Maximum distance between concurrent piling events (km)	15

Table 4.24: PDE for OSPs – Drilling Characteristics

Parameter	Maximum Design
Maximum number of piles requiring drilling per foundation	36
Minimum drilling rate (m/hour)	1
Maximum drilling rate (m/hour)	2
Maximum drilling depth (m)	35
Maximum drilling duration (per pile) (hours)	35
Maximum drilling duration (days)	53
Maximum volume of drill arisings per pile (m ³)	1,113
Maximum volume of drill arisings (m ³)	40,079
Maximum number of concurrent drilling events	2

4.6.24 Once the jacket foundations are installed, the OSP topside(s) will be transported to the Array Area via vessel either from the fabrication yard or the port facility. It is likely this will be transported by the installation vessel or on a barge towed by a tug. Once on site, the OSP topside will be rigged up, seafastening cut, lifted and installed onto the foundation. The topside and foundation will then be welded or bolted together. Rigging, welding and bolting equipment will be available on board the installation vessel.

4.6.25 It is expected that commissioning works will be carried out using a dynamically positioned vessel. Assisting support and supply vessels will be used as required and Crew Transfer Vessels (CTVs) will be used for transfer of personnel to and from the installation vessel.

Step 4 – Interconnector Cable and IAC Installation, Including Cable Burial and/or Protection

4.6.26 A cable lay vessel will be used for installation (lay) of the IACs and Interconnector Cables using various equipment such as a carousel or reels, tensioners and cable lay spread. IACs and Interconnector Cables are typically surface laid prior to cable burial or installation of external cable protection post lay. Cable lay and cable burial can also be performed simultaneously.

4.6.27 There are several options which may be used to bury cables to the minimum target burial depth. Equipment that may be used to bury the static portion of the IAC and Interconnector Cables include:

- Jet trenchers or mass flow excavators which inject water at high pressure into the sediment surrounding the cable. Jet trenching tools use water jets to fluidise the seabed which allows the cable to sink into the seabed under its own weight.
- Mechanical trenchers, usually mounted on tracked vehicles, which use chain cutters or wheeled arms with teeth or chisels to cut a trench across the seabed.
- Cable ploughs are usually towed either from a vessel or vehicle on the seabed. There are two types of plough:
 - a displacement plough which creates a V shaped trench into which the cable can be laid; or
 - a non-displacement plough which simultaneously lift a share of seabed whilst depressing the cable into the bottom of the trench. As the plough progresses, the share of the seabed is replaced on top of the cable.

4.6.28 Paragraph 4.3.50 describes cable crossings potentially required for the IACs and Interconnector Cables.

4.6.29 Cable protection will be used where the target burial depths are not achieved during cable installation and at cable crossings. CPS are also to be used as static IACs and Interconnector Cables approach and enter the Wind Turbines and OSPs.

4.6.30 Paragraphs 4.3.43 to 4.3.49 provide details on the external cable protection that may be required for IACs and Interconnector Cables.

4.6.31 Paragraph 4.4.16 describes cable crossings potentially required for the Offshore Export Cables.

Step 5 – Offshore Export Cable Installation, Including Cable Burial and/or Protection

- 4.6.32 Offshore Export Cable installation methods will follow the same methods as described for IACs and Interconnector Cables (see Paragraphs 4.6.26 and 4.6.31).
- 4.6.33 Paragraphs 4.4.14 to 4.4.15 provide details on the external cable protection that may be required for Offshore Export Cables.
- 4.6.34 Paragraph 4.4.16 describes cable crossings potentially required for the Offshore Export Cables.

Step 6 – Wind Turbine Transport, Installation and Commissioning

- 4.6.35 Wind Turbines (comprising nacelle, rotor blades, hub and towers) will be transported to the Array Area by vessel from the pre-assembly port where sub-assemblies (nacelle, rotor blades, and towers), assembly parts, tools and equipment will be loaded onto an installation or support vessel.
- 4.6.36 At the installation location, the Wind Turbines towers will be lifted onto the pre-installed foundation by the crane on the installation vessel. The nacelle and rotor blades will then be lifted into position. The exact methodology for the assembly will be dependent on the installation contractor and Wind Turbine type.
- 4.6.37 Static IACs are ‘pulled-in’ to the Wind Turbines using a cable laying vessel and connected to the Wind Turbine via J-tubes. Following connection to the necessary cabling, a process of testing and commissioning will be undertaken.

Installation Vessels and Helicopters

- 4.6.38 A number of installation vessels will be used during the construction phase including main installation vessels (e.g. dynamically positioned vessels with heavy lifting equipment), support vessels (including Service Operation Vessels (SOVs)), tugs and anchor handlers, cable installation vessels, guard vessels, survey vessels, CTVs and scour/cable protection installation vessels. Helicopters may also be used for crew transfers.
- 4.6.39 Table 4.25 presents the PDE for vessels and helicopters used for the construction phase. The number of vessels/helicopters on site at any one time and the total vessel/helicopter movements (return trips) during the entire construction phase are presented in this table. The vessel numbers presented in Table 4.25 are an estimated maximum for the PDE for the purposes of the EIA, and it is anticipated that the actual vessel and helicopter numbers will be less than those presented. The maximum number of vessels (including helicopters) in the Array Area and Export Cable Corridor at any one time is 30 and 16, respectively, and with up to a total of 2,387 return trips.

Table 4.25: PDE for Offshore Infrastructure Installation – Vessels and Helicopters

Parameter	Maximum Design			
	Total Vessels on site at any one time		Total Movements (Return Trips Across Installation Activities)	
	Array Area	Export Cable Corridor	Array Area	Export Cable Corridor
Main installation vessels (jack-up/dynamically positioned vessel)	2	N/A	97	N/A
Cargo barge/Heavy Transport Vessels (self-propelled)	2	N/A	97	N/A
Support vessels (including SOVs)	6	1	92	20
Scour Protection installation vessels (rock placement)	2	N/A	89	N/A
Grouting vessels	2	N/A	69	N/A
Rock placement vessels	N/A	1	N/A	30
Tug/anchor handlers	2	N/A	97	N/A
Cable installation vessels (laying)	1	1	23	18
Cable installation vessels (burial)	1	1	11	21
Guard vessels	6	4	164	128
Survey vessels	2	1	52	44
CTVs	6	1	770	69
Sandwave clearance vessels	1	1	55	30
Pre-Lay Grapnel Run (PLGR) vessels	1	1	10	17
Boulder/UXO clearance vessels	3	2	45	60
Trenchless (e.g. HDD) support vessels (spud leg, anchored barge or jack-up vessel)	N/A	1	N/A	6
Dive Support Vessels (DSVs)	N/A	1	N/A	6
Helicopters	1	1	130	137
Total	38	17	1,801	586
Total (excluding helicopters)	37	16	1,671	449
Total on site at any one time	25	16	N/A	N/A

4.6.40 Jack-up vessels or barges touch down on the seabed when their jack-up spud cans (base structure of each leg) are lowered into place. Jack-up vessel parameters are presented in Table 4.26.

Table 4.26: PDE for Jack-up Vessels

Parameter	Maximum Design
Maximum number of legs per vessel	4
Maximum individual leg diameter (m)	11
Maximum area of spud cans (m ²)	350
Maximum seabed footprint (m ²)	1,400
Maximum number of jack-up positions per OSP and foundation	2

Construction Ports

4.6.41 Fabrication of components for the Offshore Infrastructure is likely to occur at a number of manufacturing sites including those located within Scotland, the UK, Europe, the Middle East and the Far East. It is likely that components will be transported to final assembly yards on the east coast of Scotland for final fabrication or integration before being towed to the Proposed Development.

4.6.42 It is anticipated that all components will be transported to the Proposed Development for installation via sea transport using vessels and associated equipment. It is not anticipated that large components (e.g. Wind Turbine blades) will be transported via road.

4.6.43 At time of writing this Offshore RIAA, the Applicant is yet to determine which construction port(s) will be used for the storage, fabrication, pre-assembly and delivery of the Offshore Infrastructure. The Applicant will determine suitable ports based on the facilities available to handle and process components for the Proposed Development. Port selection will take into account logistics to reduce towing and transport distance of foundations and Wind Turbines as far as practicable. The Applicant anticipates that established port licences and operational controls will cover all activities associated with the Proposed Development which are carried out within port. In order to assess an MDS, the assessments within this Offshore RIAA consider a maximum number of vessels and vessel movements to/from site, where relevant from the east coast of Scotland or England.

4.6.44 Construction personnel will transit to the Proposed Development on the installation vessels or other vessels listed in Table 4.25. CTVs, SOVs, or helicopters operating from a licenced airfield may be used to transfer crew between the port facility and the Proposed Development during construction, O&M and decommissioning.

Construction Programme

4.6.45 The indicative construction programme for the Proposed Development is provided below for the jacket foundation option, which is assumed to represent the longest construction duration because the piling programme for jacket

foundations is longer than for monopiles, this programme therefore represents a conservative maximum duration within the PDE. This indicative construction programme, including the estimated commencement and completion dates, and estimated durations of activities, has been used within the technical chapter assessments of construction impacts.

- 4.6.46 The Proposed Development will be built out over a period of up to five years including site preparation works (see Figure 4.11). During the five-year construction programme separate campaigns (e.g. OSP installation, and Wind Turbine installation) will be undertaken for the relevant Offshore Infrastructure and are likely to occur concurrently across the construction period. It should be noted that construction activities will not occur continuously throughout the five-year construction period, rather, the programme indicates the period within which these activities could occur. Increased construction activity is anticipated within the spring to autumn months, with it likely that limited works would be undertaken during the winter period, as works will be weather dependant.
- 4.6.47 Site preparation activities will commence in Q2 2031, and Wind Turbine commissioning will be completed in Q1 2036. To account for part years, the Cumulative Effects Assessment period is considered over six years.

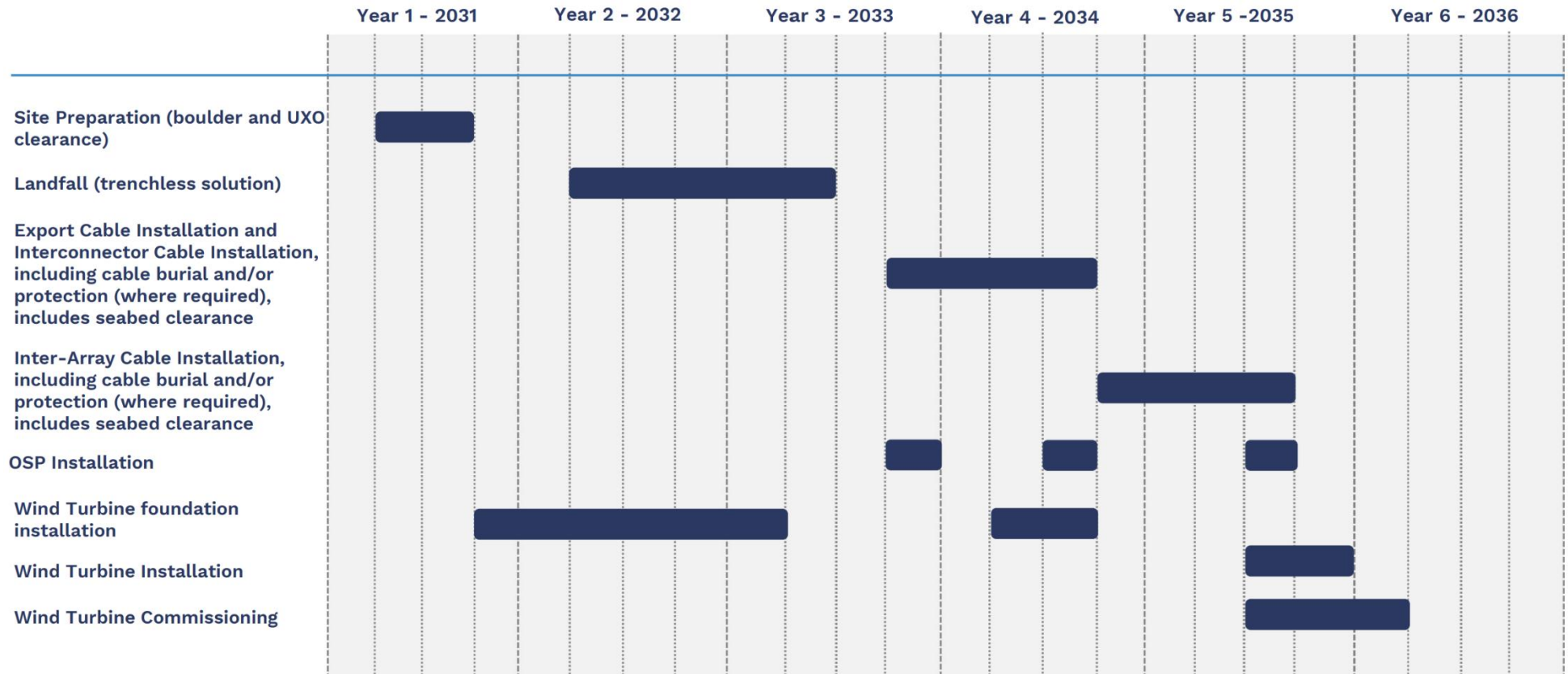


Figure 4.11: Indicative Construction Programme

4.7 Operation and Maintenance Phase

Methodology

4.7.1 The Proposed Development operational lifetime is up to 30 years. The overall O&M strategy will be finalised once the O&M base location and technical specification of the Proposed Development are known, including Wind Turbine type, electrical export option and final project layout. Therefore, this section provides an overview of the potential scheduled and unscheduled O&M activities within the Proposed Development which are reasonably foreseeable.

4.7.2 O&M activities will be conducted using SOVs, CTVs, and/or ROVs. Divers and DSVs may be utilised if required, although it is anticipated that driverless operations will be utilised as far as practicable. Jack-up and/or heavy lift vessels will be used for infrequent major maintenance campaigns associated with the OSPs. ROVs will be used to inspect foundations and cabling. A summary of the reasonably foreseeable O&M activities is provided in the following sections.

4.7.3 Offshore O&M will comprise both preventative and corrective activities.

Foundations and Wind Turbines

4.7.4 The following O&M activities are expected to occur in relation to the Wind Turbines, OSP foundations (including jacket and monopile types), and associated structures:

- routine inspections;
- geophysical surveys;
- repairs or replacements of navigational equipment and other ancillary equipment including condition monitoring equipment;
- removal of marine growth;
- repairs or replacements of corrosion protection anodes;
- blade coating and repairs;
- removal of fishing debris;
- minor repairs and replacements within Wind Turbines;
- major component replacement of Wind Turbines;
- painting or application of other protective coatings;
- replacement of access ladders and boat landings;
- statutory inspections;
- modifications to/replacement of J-tubes and other ancillary structures;
and
- replacement of Scour Protection.

4.7.5 It is assumed that the majority of these activities will be carried out using Uncrewed Surface Vessels (USVs), SOVs, CTVs, ROVs, heavy lift vessels, cable

repair vessels, jack-up vessels, and tug vessels, with appropriate equipment for the activity to be undertaken. Divers and DSV may be required if necessary. Although it is assumed that the majority of these O&M activities will be routinely scheduled throughout the lifetime of the Proposed Development, whilst repairs and replacements of navigational equipment, corrosion protection anodes and access ladders and boat landings, removal of marine growth and fishing debris, and painting are expected to be unscheduled. The frequency of these unscheduled activities will be dependent on the findings of routine inspections and will be carried out during other works as and when required.

OSP Topsides

4.7.6 The following O&M activities are expected to occur in relation to the OSP topsides:

- routine inspections;
- removal of marine growth;
- replacement of consumables and minor components;
- major component replacement; and
- painting or other coatings.

4.7.7 It is assumed that the majority of these activities will be carried out using SOVs and CTVs. Jack-up barges and/or heavy lift vessels may be required in the case of major component replacement. Although it is anticipated that the majority of these O&M activities will be routinely scheduled throughout the lifetime of the Proposed Development, replacement of consumables and minor components is an unscheduled activity which will occur as required, dependent upon the findings of routine inspections.

IACs and Interconnector Cables

4.7.8 The following O&M activities are expected to occur in relation to both the IACs and Interconnector Cables:

- routine inspections;
- geophysical surveys;
- IAC/Interconnector Cable repair;
- IAC ancillary equipment repair;
- IACs and Interconnector Cables reburial, de-burial (if cables have been further buried due to seabed mobility) and, reinstatement (remedial work) of cable protection (if required);
- removal of marine growth and/or fishing debris;
- modifications to/replacement of J-tubes; and
- replacement of Scour Protection.

4.7.9 In relation to IAC cable repairs and seabed interventions, it is anticipated that up to one cable repair per year may be required for static cables. These repairs

may involve the excavation and reburial of up to 4,915 m of cable annually, depending on the extent of damage and seabed conditions. In addition, remedial cable protection may be applied over a similar maximum annual length of 4,915 m.

4.7.10 For Interconnector Cable repairs and seabed interventions, it is anticipated that up to 0.18 cable repairs per year may be required. These activities may involve the excavation and reburial of up to 2,040 m of cable annually, depending on the nature and location of the fault. Similarly, remedial cable protection may be applied over a maximum annual length of 2,040 m.

4.7.11 It is assumed that the majority of these activities will be carried out using USVs, SOVs, CTVs, ROVs, cable repair vessels, and survey vessels, with appropriate equipment for the activity to be undertaken (including burial equipment). Divers and DSVs may be required if necessary. It is anticipated that the majority of these O&M activities will be routinely scheduled throughout the lifetime of the Proposed Development.

Export Cables

4.7.12 Export Cable repair and seabed intervention works are expected to involve up to one cable repair per year for static cables. These works may require the excavation and reburial of up to 6,390 m of cable annually. Remedial cable protection may be applied over a similar maximum annual length of 6,390 m.

Operation and Maintenance Vessels

4.7.13 Table 4.27 and Table 4.28 presents the PDE for vessels involved in O&M activities for the Proposed Development.

Table 4.27: PDE for Vessels with Annual Trips Required During the O&M Phase

Parameter	Maximum Design			
	Maximum Total Number of Vessels on Site at any One Time		Maximum Total Movements (Return Trips Annually Across O&M Phase)	
	Array Area	Export Cable Corridor	Array Area	Export Cable Corridor
SOV/workboats	3	1	43	20
CTVs	3	2	500	20
Cable repair vessels (laying)	1	1	2	20
Cable repair vessels (burial solution)	1	1	2	31
DSV	1	1	7	6
Other vessels (including heavy lift vessels)	1	N/A	6	N/A
Guard vessels	2	2	28	28
Helicopters	2	1	20	10
Total	14	9	608	135

Parameter	Maximum Design			
	Maximum Total Number of Vessels on Site at any One Time		Maximum Total Movements (Return Trips Annually Across O&M Phase)	
	Array Area	Export Cable Corridor	Array Area	Export Cable Corridor
Total (excluding helicopters)	12	8	588	125

Table 4.28: PDE for Vessels Without Annual Trips Required During the O&M Phase

Parameter	Maximum Design			
	Maximum Total Number of Vessels on Site at any One Time		Maximum Total Movements (Return Trips in Total Across O&M Phase)	
	Array Area	Export Cable Corridor	Array Area	Export Cable Corridor
Rock dumping vessels	1	1	70	41
Sandwave clearance vessels	1	1	12	12
Survey vessels	1	1	35	26
PLGR vessels	1	1	12	12
Boulder clearance vessels	1	1	12	12
UXO clearance vessels	1	1	5	5
Micro-tunnelling or HDD support vessels	N/A	1	N/A	6
Total	6	7	146	114

4.8 Decommissioning Phase

4.8.1 In line with the requirements under Section 105 of the Energy Act 2004 (as amended) (further detailed in the Offshore EIA Report, Volume 1, Chapter 2: Policy and Legislation (TWP-BOW-RPS-OFE-RPT-00003)) the Applicant will prepare a Decommissioning Programme for approval by the Scottish Ministers which will include anticipated costs and financial securities, and consider good industry practice, guidance and legislation relating to decommissioning at the time. A draft of the Decommissioning Programme will be submitted to MD-LOT prior to construction of the Proposed Development. The Decommissioning

Programme will be updated during the Proposed Development's lifetime to take account of changing good practice, new technologies and any changes to legislation.

- 4.8.2 At the end of the Proposed Development's operational lifetime, it is expected that all structures above the seabed will be fully removed where practicably feasible. Driven and/or drilled piles installed as part of the Wind Turbine foundations, the static IACs, Interconnector Cables, Offshore Export Cables, Scour Protection and cable protection are either expected to remain *in situ* or the method of decommissioning is yet to be determined. Legislation, guidance and good practice will be kept under review throughout the lifetime of the Proposed Development and will be followed at the time of decommissioning. Environmental conditions and sensitivities will also be considered since removal of structures may result in greater environmental impacts in comparison to leaving *in situ*.
- 4.8.3 The sequence of decommissioning is likely to be the reverse of the construction sequence, and similar types and numbers of vessels and equipment are expected to be involved. The Option for Lease agreement for the Bowdun OWF Project awarded by the CES requires the Proposed Development to be decommissioned at the end of its lifetime.

Wind Turbine Components

- 4.8.4 The fixed foundations will be removed from site by reversing the methods used to install them.

OSP Topsides

- 4.8.5 OSP topsides will be fully removed from site by reversing the methods used to install them.

OSP Fixed Jacket Foundations

- 4.8.6 Piles will be cut at seabed level and left *in situ*, depending on seabed mobility, to reduce further disruption of the seabed. This will be reviewed throughout the lifetime of the Proposed Development and the most up to date and good practice guidance at time of decommissioning will be followed. The MDS has been assessed for each SAC or SPA within this Offshore RIAA. Jackets will be fully removed from site.

Scour Protection

- 4.8.7 It is currently proposed that Scour Protection will be left *in situ* subject to the final material used. Good practice guidance at time of decommissioning will be followed. The MDS has been assessed for each SAC or SPA within this Offshore RIAA.

IACs and Interconnector Cables, Offshore Export Cables, Cable protection and Scour Protection

- 4.8.8 The approach for decommissioning the IACs, Interconnector Cables, Offshore Export Cables, cable protection/crossings and Scour Protection is yet to be determined. This will be reviewed throughout the lifetime of the Proposed Development and good practice guidance at time of decommissioning will be

followed. The most adverse scenario has been assessed for each SAC or SPA within this Offshore RIAA.

4.9 Repowering

- 4.9.1 Although it is standard procedure for sectors where a non-renewable resource is being exploited, such as oil and gas, for removal of all structures on the seabed as part of offshore decommissioning, the alternative option of repowering may be considered for offshore renewables – especially as, at the time of decommissioning, the need for the power generated will likely still exist.
- 4.9.2 The operational life of the Proposed Development is expected to be up to 30 years, during which there will be a requirement for upkeep and maintenance of the Proposed Development, as described in Section 4.7.
- 4.9.3 ‘Repowering’ of the Proposed Development at or near the end of its design life may be considered suitable, for example, where new technology becomes available. In this example, Wind Turbines and/or foundations may be reconstructed and replaced with those of a different specification or design. If the specifications and designs of the new Wind Turbines and/or foundations fell outside of the PDE, if the impacts associated with the construction, O&M, and/or decommissioning of the replacement Wind Turbines and/or foundations were to fall outside those considered by this Offshore RIAA, or if repowering would extend the operational lifetime beyond the maximum operational period defined in the PDE (30 years), further consent(s) (and potentially an EIA Report or RIAA) would be required for repowering. Therefore, this is outside of the scope of this Offshore RIAA.

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