Environmental Impact Assessment Report

Volume 2

Chapter 4 Project Description

codling wind park

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Abbreviations

Abbreviation	Term in full
ABP	An Bord Pleanála
AC	Alternating current
ASL	Above sea level
BS	British Standard
CEMP	Construction Environmental Management Plan
CLV	Cable lay vessel (ship or barge)
CO_2	Carbon dioxide
CPS	Cable protection system
CTV	Crew transfer vessel
CWP	Codling Wind Park
CWPE	Codling Wind Park Extension
CWPL	Codling Wind Park Limited
DP	Dynamic positioning
DPFPV	Dynamic positioned fall pipe vessel
EC	European Commission
EDF R	Électricité De France Renewables
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMP	Environmental Monitoring Plan
ESB	Electricity Supply Board
ESBN	ESB Networks
EU	European Union
FOS	Fred. Olsen Seawind
FRA	Flood risk assessment
GHG	Greenhouse gas
GIS	Gas-insulated switchgear
HDD	Horizontal directional drilling
HV	High voltage
HWM	High water mark
INNS	Invasive non-native species
kJ	Kilojoule

km	Kilometre
kV	Kilovolt
LAT	Lowest astronomical tide
l/s	Litres per second
+m OD	Metres above ordnance datum
MAC	Maritime Area Consent
MAP	Maritime Area Planning
MEC	Maximum export capacity
MFE	Mass flow excavation
mm	Millimetre
MSP	Mid-support pontoon
MW	Megawatts
OECC	Offshore export cable corridor
OfTI	Offshore transmission infrastructure
O&M	Operations and maintenance
OMB	Operations and maintenance base
OOS	Out of service
OSS	Offshore substation structure
OWF	Offshore wind farm
PLGR	Pre-lay grapnel run
rpm	Revolutions per minute
ROV	Remotely operated vehicle
SAC	Special Area of Conservation
SCADA	Supervisory control and data acquisition
SPA	Special Protection Area
SuDS	Sustainable urban drainage system
TBM	Tunnel boring machine
TJB	Transition joint bay
TP	Transition piece
TSHD	Trailing suction hopper dredger
UXO	Unexploded ordnance
WTG	Wind turbine generator

Definitions

Glossary	Meaning
alternating current (AC)	A flow of electrical current which reaches maximum in one direction, decreases to zero, then reverses itself and reaches maximum in the opposite direction. The cycle is repeated continuously and the number of cycles per second is equal to the frequency. The Irish electrical system is an AC network that uses a frequency of 50 Hz.
the Applicant	The developer, Codling Wind Park Limited (CWPL).
array site	The red line boundary area within which the wind turbine generators (WTGs), inter-array cables (IACs) and the Offshore Substation Structures (OSSs) are proposed.
Codling Wind Park (CWP) Project	The proposed development as a whole is referred to as the Codling Wind Park (CWP) Project, comprising of the offshore infrastructure, the onshore infrastructure and any associated temporary works.
Codling Wind Park Limited (CWPL)	A joint venture between Fred. Olsen Seawind (FOS) and Électricité de France (EDF) Renewables, established to develop the CWP Project.
Compound A	A temporary construction compound, support area and storage facility for the landfall works, and to support the installation of the onshore export cables. It will operate as a hub for the onshore construction works as well as acting as a staging post and secure storage for equipment and component deliveries.
Compound B	A temporary construction compound / laydown area for general cable route and onshore substation construction activities.
Compound C	A temporary construction compound for the onshore substation site. Contractor welfare facilities will be located in this compound as well as some material storage space.
Compound D	A temporary construction compound and laydown area to facilitate the construction of the bridge over the cooling water channel.
EirGrid	State-owned electric power transmission system operator in Ireland and nominated Offshore Transmission Asset Owner.
ESB Networks (ESBN)	Owner of the electricity distribution system in the Republic of Ireland, responsible for carrying out maintenance, repairs and construction on the grid.
ESBN network cables	Three onshore export cable circuits connecting the onshore substation to the proposed ESBN Poolbeg substation, which will then transfer the electricity onwards to the national grid.
Environmental Impact Assessment (EIA)	A systematic means of assessing the likely significant effects of a proposed project, undertaken in accordance with the EIA Directive and the relevant Irish legislation.
Environmental Impact Assessment Report (EIAR)	The report prepared by the Applicant to describe the findings of the EIA for the CWP Project.

export cables	The cables, both onshore and offshore, that connect the offshore substations with the onshore substation.
generating station	Comprising the wind turbine generators (WTGs), inter-array cables (IACs) and the interconnector cables.
high water mark (HWM)	The line of high water of ordinary or medium tides of the sea or tidal river or estuary.
horizontal directional drilling (HDD)	HDD is a trenchless drilling method used to install cable ducts beneath the ground through which onshore export cables from can be pulled. HDD enables the installation of cables beneath obstacles such as roads, waterways and existing utilities.
inter-array cables (IACs)	The subsea electricity cables between each WTG and between the OSSs.
interconnector cables	The subsea electricity cables between OSSs.
landfall	The point at which the offshore export cables are brought onshore and connected to the onshore export cables via the transition joint bays (TJB). For the CWP Project The landfall works include the installation of the offshore export cables within Dublin Bay out to approximately 4 km offshore, where water depths that are too shallow for conventional cable lay vessels to operate.
limit of deviation (LoD)	Locational flexibility of permanent and temporary infrastructure is described as a LoD from a specific point or alignment.
Maritime Area Consent (MAC)	A Maritime Area Consent (MAC) provides State authorisation for a prospective developer to undertake a maritime usage and occupy a specified part of the maritime area. A MAC is required to be in place before planning consent can be sought.
Maritime Area Planning (MAP) Act 2021	The MAP Act 2021 regulates the maritime area, by means of a National Marine Planning Framework, maritime area consents for the occupation of the maritime area for the purposes of maritime usages that will be undertaken for undefined or relatively long periods of time (including any such usages which also require development permission under the Planning and Development Act 2000) and licences for the occupation of the maritime area for maritime usages that are minor or that will be undertaken for relatively short periods of time. The MAP Act also creates a new regulatory authority, and a regime for designating protected marine areas.
metocean	Meteorological and oceanographic data (for example, metocean data or metocean conditions).
offshore development area	The total footprint of the offshore infrastructure and associated temporary works including the array site and the OECC.
offshore export cables	The cables which transport electricity generated by the wind turbine generators (WTGs) from the offshore substation structures (OSSs) to the TJBs at the landfall.
offshore export cable corridor (OECC)	The area between the array site and the landfall, within which the offshore export cables cable will be installed along with cable protection and other temporary works for construction.

offshore infrastructure	The permanent offshore infrastructure, comprising of the WTGs, IACs, OSSs, interconnector cables, offshore export cables and other associated infrastructure such as cable and scour protection.
offshore substation structure (OSS)	A fixed structure located within the array site, containing electrical equipment to aggregate the power from the wind turbine generators (WTGs) and convert it into a more suitable form for export to shore.
OSS topside	This is the offshore substation topside structure located on the OSS monopile foundation and housing all electrical and ancillary equipment. This includes all systems such as electrical, SCADA, safety and mechanical equipment.
OSS monopile foundation	The bottom fixed structure piled in to the seabed supporting the OSS topside.
offshore transmission infrastructure (OfTI)	The offshore transmission assets comprising the OSSs and offshore export cables. The EIAR considers both permanent and temporary works associated with the OfTI.
onshore development area	The entire footprint of the OTI and associated temporary works that will form the onshore boundary for the development consent application.
onshore transmission infrastructure (OTI)	The offshore transmission assets comprising the OSSs and offshore export cables. The EIAR considers both permanent and temporary works associated with the OfTI.
onshore substation	Site containing electrical equipment to enable connection to the national grid.
onshore substation site	The area within which permanent and temporary works will be undertaken to construction the onshore substation.
Operations and maintenance (O&M) activities	Activities (e.g. monitoring, inspections, reactive repairs, planned maintenance) undertaken during the O&M phase of the CWP Project.
O&M phase	This is the period of time during which the CWP Project will be operated and maintained.
parameters	Set of parameters by which the CWP Project is defined and which are used to form the basis of assessments.
Phase 1 Project	Under the special transition provisions in the Maritime Area Planning Act 2021, as amended (the MAP Act), the Minister for the Department of Environment, Climate and Communications (DECC) has responsibility for assessing and granting a Maritime Area Consent (MAC) for a first phase of offshore wind projects in Ireland. The Phase 1 Projects include Oriel Wind Park, Arklow Bank II, Dublin Array, North Irish Sea Array, Codling Wind Park and Skerd Rocks. A MAC has since been granted by DECC for each of the Phase 1 Projects.
planning application boundary	The area subject to the application for development consent, including all permanent and temporary works for the CWP Project.
Poolbeg 220kV substation	This is the ESBN substation that the ESBN network cables connect into from the onshore substation. This substation will then transfer the electricity onwards to the national grid.
revetment	A facing of impact-resistant material applied to a bank or wall in order to absorb the energy of incoming water and protect it from erosion.

sheet piles	Sections of sheet materials with interlocking edges that are driven into the ground to provide earth retention and excavation support. Sheet piling is used in construction to provide both temporary and permanent walls.
temporary cofferdam	A barrier to tidal inundation while the existing stone covered foreshore is temporarily removed to install the landfall cable ducts.
transition joint bay (TJB)	This is required as part of the OTI and is located at the landfall. It is an underground bay housing a joint which connects the offshore and onshore export cables.
transition zone	The section between the offshore end of installed intertidal cable ducts, approximately 350 m from the high water mark (HWM), and the limit of operability for the cable lay vessel (CLV), approximately 4 km offshore. This zone represents the section of the OECC where water depths would be unsuitable for the draft of a typical offshore CLV.
tunnel	The onshore export cables will be installed within a tunnel that extends from within Compound A, near the landfall, to the onshore substation site.
tunnel shaft	Located within the temporary tunnel compounds, the tunnel shafts will facilitate the two tunnel drives required to complete the construction of the tunnel.
wind turbine generator	All the components of a wind turbine, including the tower, nacelle and rotor.

4 PROJECT DESCRIPTION

4.1 Introduction

1. Codling Wind Park Limited (hereinafter 'the Applicant') is proposing to develop the Codling Wind Park (CWP) Project, a proposed offshore wind farm (OWF) located in the Irish Sea approximately 13–22 km off the east coast of Ireland, at County Wicklow. The CWP Project has an expected generating capacity of 1300 MW. A 10-year planning permission is sought, with an operational lifetime of 25 years. The 25-year operational lifetime shall commence on full commercial operation of the project.

2. This chapter of the Environmental Impact Assessment Report (EIAR) presents a description of the offshore and onshore components of the CWP Project, which includes:

- The **generating station**, which comprises the wind turbine generators (WTGs), inter-array cables (IACs) and interconnector cables (**Section 4.6**);
- **Transmission Component 1:** The offshore transmission infrastructure (OfTI), which comprises the offshore substation structures (OSSs) and offshore export cables (**Section 4.7**);
- **Transmission Component 2:** the landfall, which describes the point at which the offshore export cables are brought onshore (**Section 4.8);** and
- **Transmission Component 3:** the onshore transmission infrastructure (OTI), which comprises the onshore export cables, the onshore substation and associated infrastructure (**Section 4.9**).

3. **Plate 4-1** illustrates these project components and how they relate to each other.

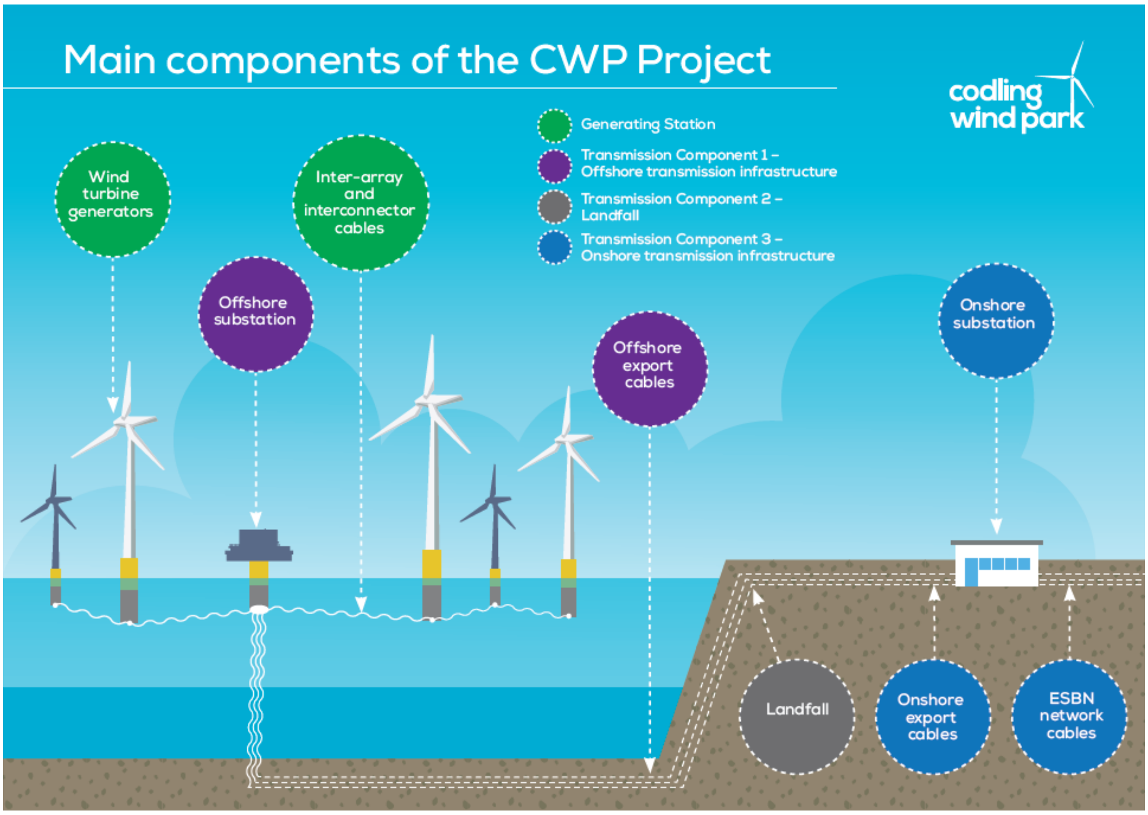


Plate 4-1 CWP Project components

4.1.1 Project boundaries and key terms

4. The CWP Project consists of a single **array site**, within which the WTGs, IACs, interconnector cables and the OSSs are proposed. An **offshore export cable corridor** (OECC) connects the array site to the landfall location at Poolbeg and represents the area below the high water mark (HWM) within which the **offshore export cables** will be installed.

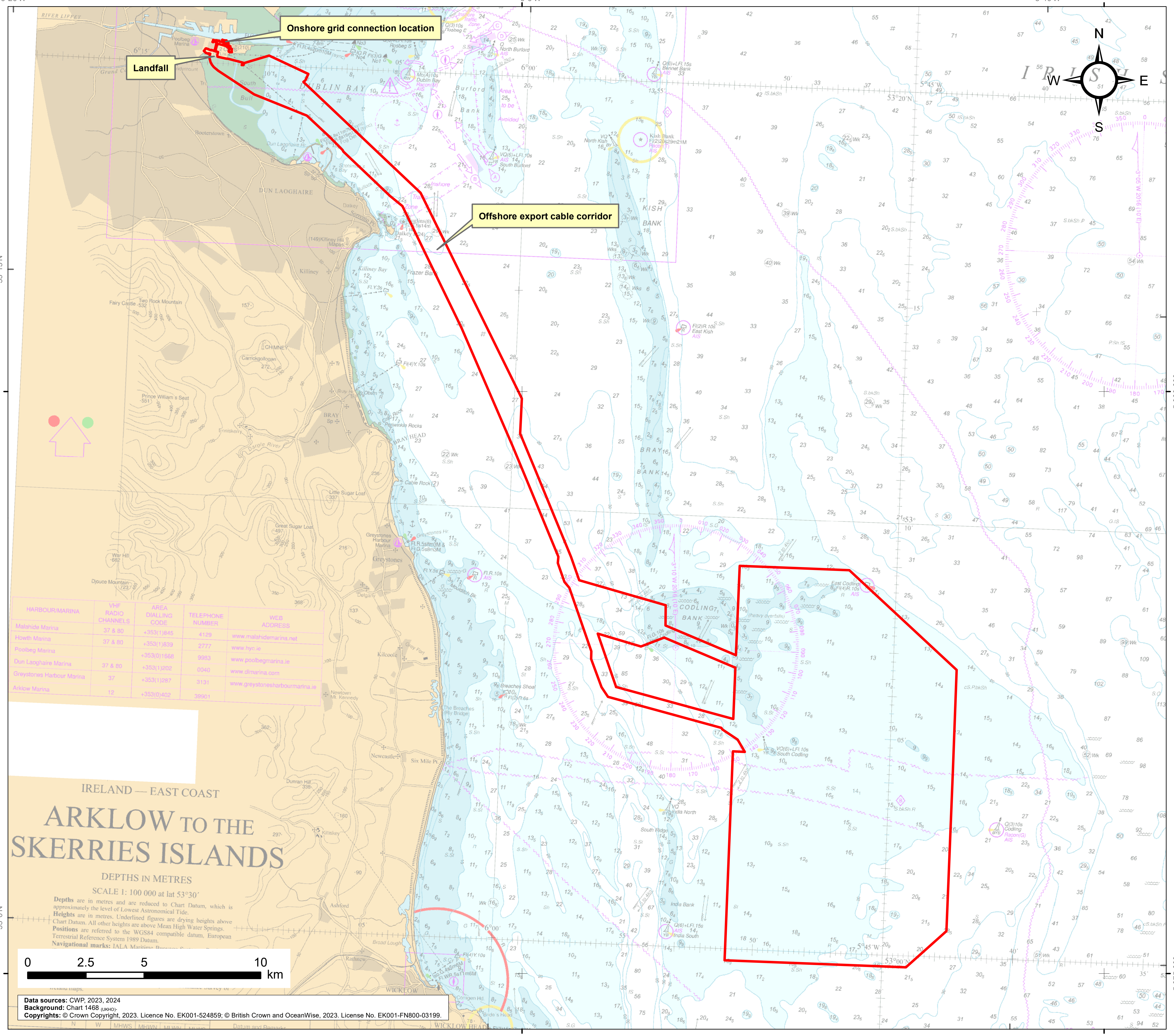
5. At the **landfall**, the offshore export cables are connected to the **onshore export cables** in **transition joint bays** (TJBs). This marks the termination of the OfTI and the start of the OTI. The onshore export cables are then routed north across the Poolbeg Peninsula to an **onshore substation** located on the south bank of the River Liffey.

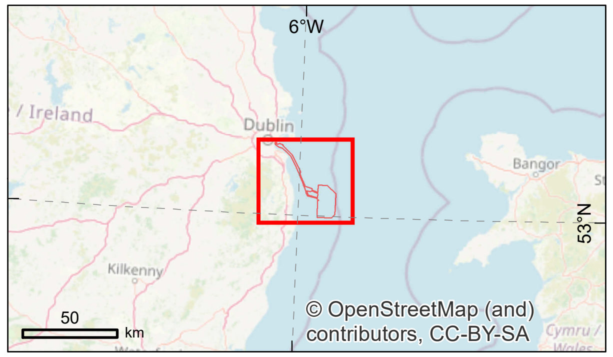
6. For the purposes of the EIAR, the boundary between offshore and onshore project infrastructure is defined by the HWM. The **offshore development area** includes infrastructure seaward of the HWM. The **onshore development area** includes infrastructure landward of the HWM, including all components of the OTI. The **landfall** includes works that span the HWM, as shown on planning drawing **0016 Intertidal Works Layout Plan**.

7. The **planning application boundary** for the CWP Project is provided in **Figure 4-3**. This includes the array site, the OECC and the onshore development area. The planning application boundary includes the space required for temporary works associated with the permanent and temporary infrastructure for which planning consent is being sought.

8. To ensure the safety of marine users during the construction phase of the CWP Project, the Applicant will deploy temporary demarcation buoys around the perimeter of the array site in a **maritime safety demarcation area** (MSDA). This temporary buoyage will indicate a safe direction of navigation to all marine users in the area. No permanent infrastructure will be installed in the MSDA. The planning application boundary also accounts for the MSDA around the array site.

9. **Figure 4-1** is supported by **Figure 4-2**, showing the array site and MSDA, and **Figure 4-3**, which shows the onshore development area. Planning drawing **0022 Onshore Development Area - Site Layout Plan - Permanent Works** provides further detail.





Data sources: CWP, 2023, 2024
Background: Chart 1468 (UKHO)
Copyrights: © Crown Copyright, 2023. Licence No. EK001-524859; © British Crown and OceanWise, 2023. License No. EK001-FN800-03199.

Legend

Planning application boundary

codling wind park

Project: Codling Wind Park

Contractor:

Website:

Figure 4.1
Planning application boundary

CWP doc. number: CWP-CWP-ENG-08-01-MAP-1584

Internal descriptive code: WE - PAB - - (UKHO.1468..EIAR.FIG.04.01)

Size: A3

Scale: 1:160,000

CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
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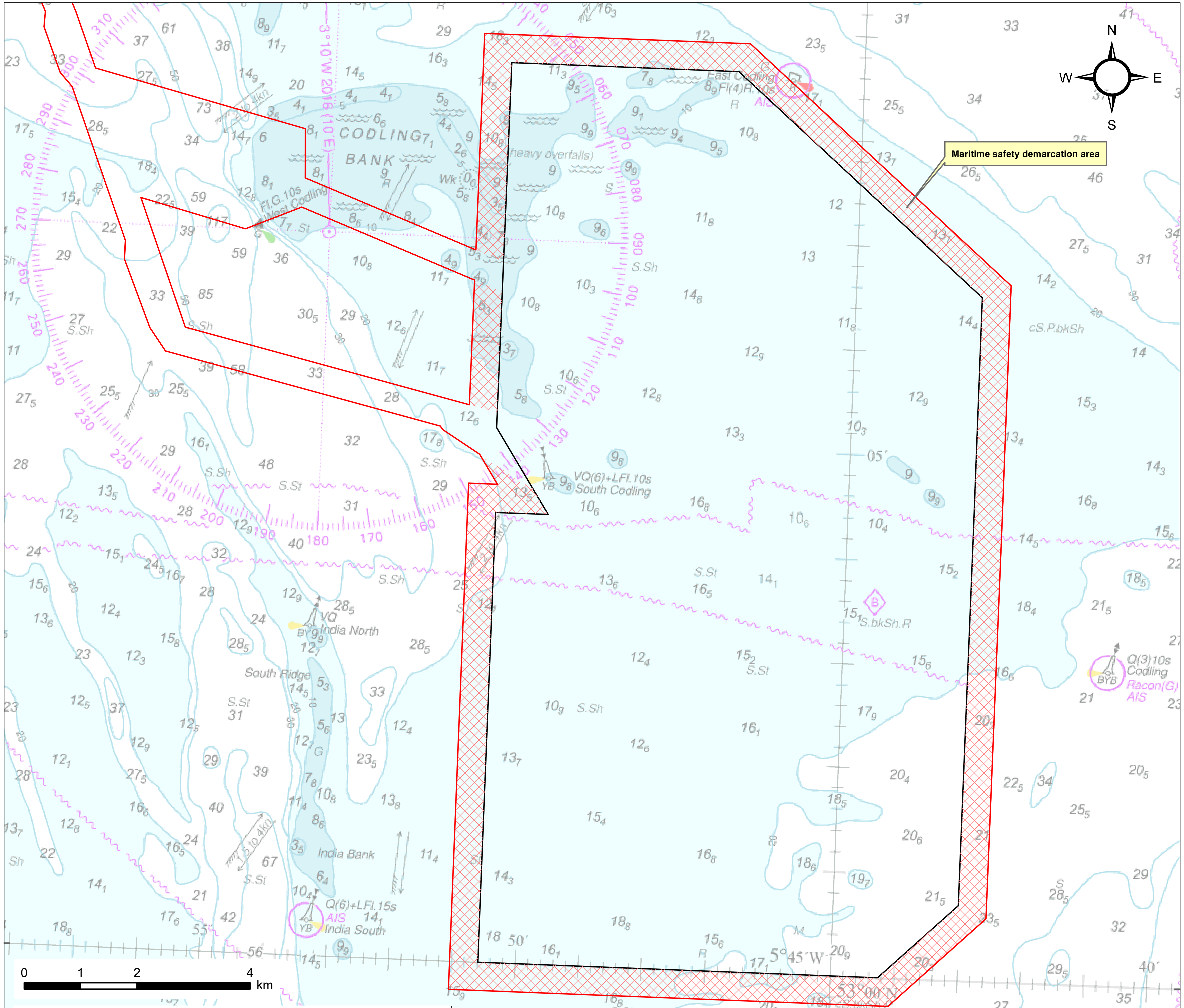
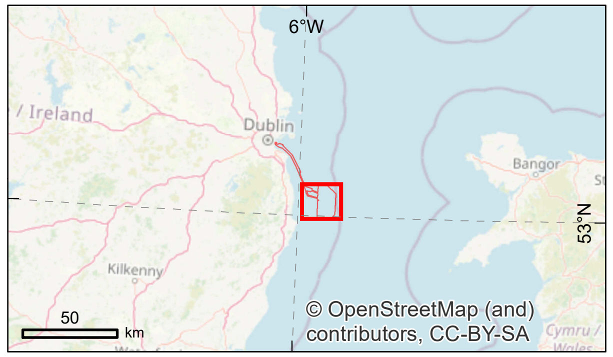


Data sources: CWP, 2005, 2009, 2024
Background: Chart 1468 (UKHO).



Legend

- Planning application boundary
- Maritime safety demarcation area (MSDA)
- Array site

codling wind park

Project: Codling Wind Park

Contractor:

Website:

Figure 4.2
Array site and maritime safety demarcation area

CWP doc. number: CWP-CWP-ENG-08-01-MAP-1585

Internal descriptive code: WF - PAB..WF.RLB..MSDA - - (UKHO.1468..EIAR.Vol.03.Ch.04.FIG.02)	*Size:* A3 *Scale:* 1:67,000	*CRS:* EPSG 25830

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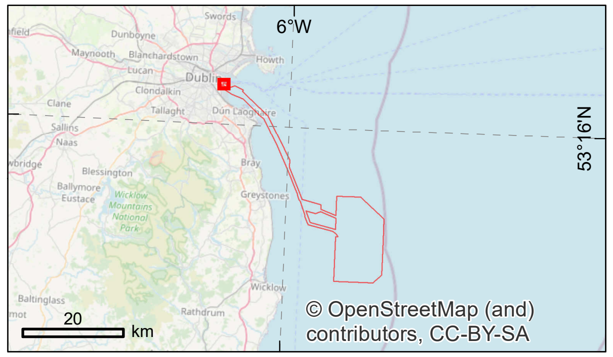

Legend

- Planning application boundary
- Onshore substation site
- Poolbeg 220kV substation
- Transition joint bay
- High water mark

codling wind park

Project: Codling Wind Park

Contractor:

Website:

Figure 4.3
Onshore development area

CWP doc. number: CWP-CWP-ENG-08-01-MAP-1707

Internal descriptive code: PB - PAB..TJBs6..SS.PP.PL - FUT.SS.ESBN..HWM - (OSM..EIAR.Vol.03.Ch.04.FIG.03)

Size: A3

Scale: 1:6,000

CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
00	Final for issue	2024/08/15	JM	CD	ES

4.1.2 Chapter structure

10. Both the offshore and onshore components of the CWP Project are described in detail within this chapter, the contents of which form the basis for the assessment of impacts presented in the technical chapters of this EIAR (**Chapters 6 to 32**).

11. The remainder of this chapter is set out as follows:

- **Section 4.2** Site location and characteristics
- **Section 4.3** Project design approach
- **Section 4.4** Construction programme
- **Section 4.5** Offshore pre-installation activities
- **Section 4.6** Generating station
- **Section 4.7** Transmission component 1 - Offshore transmission infrastructure
- **Section 4.8** Transmission component 2 - Landfall
- **Section 4.9** Transmission component 3 - Onshore transmission infrastructure
- **Section 4.10** Offshore construction vessels
- **Section 4.11** Operations and maintenance
- **Section 4.12** Decommissioning

12. A detailed description of the site selection process that has resulted in the selection of the locations of project infrastructure and routes taken is also provided as part of the EIAR in **Chapter 3 Site Selection and Consideration of Alternatives**.

4.2 Site location and characteristics

4.2.1 Offshore site location and characteristics

13. The CWP Project array site is located approximately 13–22 km off the east coast of Ireland between Greystones and Wicklow Town and covers an area of 125 km^2. The OECC covers an area of 40.1 km^2 and connects the array site with the landfall location at Poolbeg.

14. The key physical characteristics of the offshore development area are described below. More detailed descriptions of the existing environment within the offshore development area are presented in the technical chapters of this EIAR (EIAR **Chapters 6 to 32).**

Bathymetry

15. Water depths across the CWP array site range from approximately -28 m to -6 m, relative to the lowest astronomical tide (LAT). The deeper water levels are observed towards the southeast of the array site, with shallower water observed towards the northwest. The central part of the array site generally sits at depths of between -15 mLAT and -18 mLAT.

16. Water depths along the OECC vary greatly, with depths of up to -120 mLAT near the array site where the OECC intersects a topographic depression on the seabed known as the Codling Deep. Approximately 6 km offshore, the route passes through a field of large bedforms (sand waves with wave heights up to approximately 4 m, with superimposed megaripples). The seabed gradient reduces until it reaches a depth of less than -10 mLAT,c. 8 km from the landfall.

Metocean and seabed conditions

17. A full wind measurement campaign at the CWP Project array site has been ongoing since May 2021, including one fixed lidar and two floating lidars that have been validated as per industry recognised guidelines. Long-term wind-modelled data has been calibrated with on-site measurements so that the wind speed and direction estimate is representative of the long term.

18. **Plate 4-2** provides a wind rose diagram indicating the wind speed and direction that is typically expected at the array site. Wind direction across the array site is predominantly from the south-southwest (SSW).

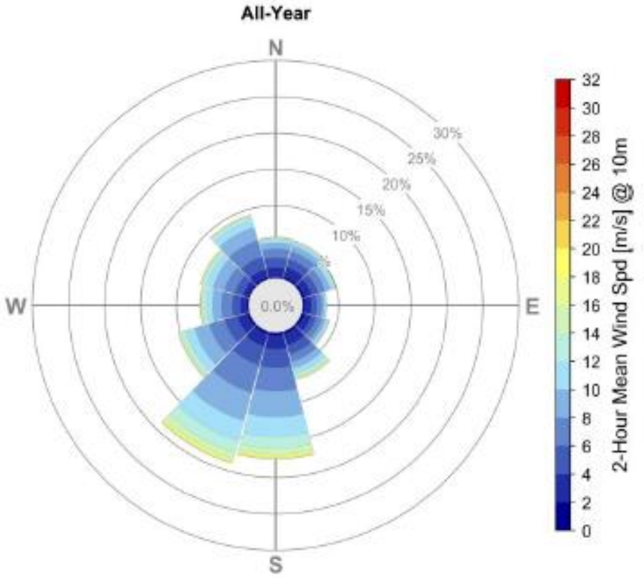

Plate 4-2 All-year rose plot of wind speed and direction at 10 m ASL (centre of array site)

19. Oceanographic surveys within the array site have also been undertaken to record wave, current and water level data. Long-term metocean modelled data has been calibrated with the survey data collected for the CWP Project.

20. The dominant tidal current direction across the array site is north-northeast (NNE) during flood tides and south-southwest (SSW) during ebb sites.**Table** 4-1 presents tidal depth averaged current speeds recorded at the array site. A detailed description of the metocean conditions at the array site and OECC is provided in EIAR **Chapter 6 Marine Geology, Sediments and Coastal Processes**.

Table 4-1 Tidal depth average current speed descriptors (southwest of array site)

Description	Flood (m/s)	Ebb (m/s)
Minimum astronomical tide	0.59	0.57
Mean neap tide	0.85	0.86
Mean tide	1.15	1.19
Mean spring tide	1.35	1.43
Maximum astronomical tide	1.54	1.65

21. A series of geotechnical and geophysical surveys was conducted across the array site in 2013, with further surveys conducted from April to August 2021 in the array site and within the OECC, and an offshore geotechnical campaign across the array site between May and August 2023.

22. Seabed sediments within the offshore development area are predominantly comprised of sand, with areas comprising a veneer of finer grained sands over a broad expanse of sandy gravels. Several isolated areas of boulders and cobbles have also been observed.

23. Codling Bank, upon which the array site is located, is one of the largest banks in the Irish Sea. It forms part of a series of coast-parallel, north–south trending, offshore banks. Uniquely within the context of these banks, Codling Bank is a stable formation. The lower mobilisation frequency for Codling Bank can be explained by the fact that the seabed substrate in the area is coarser (sandy gravel to gravel) than at other banks, resulting in a higher threshold for sediment mobilisation.

4.2.2 Onshore site location and characteristics

24. The landfall and the OTI are proposed to be located on Poolbeg Peninsula on the east side of Dublin city. Much of the peninsula is built on land reclaimed from the River Liffey and is underlain by silty clay and sandy gravel alluvial deposits overlying stiff-to-hard gravelly clay (i.e. the Dublin boulder clay), which in turn overlies limestone bedrock.

25. The peninsula is bounded by the River Liffey to the north and Dublin Bay to the south. The Great South Wall extends approximately 4 km seawards to the east of the peninsula, marking the entrance to Dublin Port.

26. Poolbeg Peninsula is characterised primarily by commercial and industrial development associated with Dublin Port Company (DPC) and with other industries, including power generation, wastewater treatment, aggregate manufacturing, oil storage and metal recycling.

27. The closest residential properties to the onshore development area are located on Strand Road, approximately 650m from the planning application boundary.

28. Detailed descriptions of the existing environment within the onshore development area are presented in the technical chapters of this EIAR (**Chapters 6 to 32**).

4.3 Project design approach

4.3.1 Background

29. Complex, large-scale infrastructure projects with a terrestrial and marine interface, such as the CWP Project, are consented and constructed over extended timeframes. The ability to adapt to changing supply chain, policy or environmental conditions, and to make use of the best available information to feed into project design, promotes environmentally sound and sustainable development. This ultimately reduces project development costs and therefore electricity costs for consumers and reduces CO_2 emissions.

30. In this regard, the approach to the design development of the CWP Project has sought to introduce flexibility where required, among other things, to enable the best available technology to be constructed and to respond to dynamic maritime conditions, while at the same time to specify project boundaries, project components and project parameters wherever possible, having regard to known environmental constraints.

31. This chapter, in conjunction with EIAR **Chapter 3 Site Selection and Consideration of Alternatives**, describes the design approach that has been taken for each component of the CWP Project. Wherever

possible, the location and detailed parameters of the CWP Project components are identified and described in full within the EIAR. However, for the reasons outlined above, certain design decisions and installation methods will be confirmed post-consent, requiring a degree of flexibility in the planning consent.

32. Under section 287A of the Planning and Development Act, as amended, an applicant may request an opinion from An Bord Pleanála under section 287B with regard to design flexibility for a proposed development. The Applicant procured an opinion from An Bord Pleanála under 287B to confirm that it was appropriate that this application be made and determined before certain details of the development are confirmed. An Bord Pleanála issued that opinion on 22 March 2024 (ABP-318588-23), as amended on 25 April 2024 (ABP-318588M). Further details on the background and process for seeking design flexibility are included in EIAR **Chapter 5 EIA Methodology** and the **Planning Report**.

33. All the design elements within the scope of Sections 287A and B are described in the planning application by way of options, parameters or a combination of options and parameters. It also uses parameters to describe two kinds of flexibility: dimensional flexibility, where the range of dimensions is described using a minimum to maximum range, and locational flexibility, whereby flexibility in the location of infrastructure is described as a limit of deviation (LoD) from a specific point or alignment. The LoD is the furthest distance that a specified element of the CWP Project can be constructed.

34. The Section 287B opinion confirms the details, or groups of details, of the CWP Project that may be confirmed after the proposed application has been made and decided. These details or groups of details are limited and have been summarised in the sections below, and are confirmed for the purposes of the planning application in **Form 22 Supplementary information to accompany an application accompanied by an opinion on flexibility** (see **Planning Documents**).

35. In addition, the application for permission relies on the standard flexibility for the final choice of installation methods and O&M activities.

36. Notwithstanding the flexibility in design and methods, the EIAR identifies, describes and assesses all the likely significant impacts of the CWP Project on the environment. The approach taken by the Applicant to achieve this across all EIA topics is presented in EIAR **Chapter 5 EIA Methodology**.

4.3.2 Generating station

- The Applicant is seeking limited flexibility on the size, and therefore the number, of wind turbine generators (WTGs) that will be installed. Two WTG layout options are proposed:
    - WTG Layout Option A, consisting of 75 WTGs with a rotor diameter of 250 m; and
    - WTG Layout Option B, consisting of 60 WTGs with a rotor diameter of 276 m.
- The Applicant is seeking planning permission for both WTG layout options, but only one of them will be constructed (and therefore not both or a combination of both). The WTG parameters for each option are described as specific. These parameters include WTG hub height, blade tip height, rotor diameter, tower diameter and blade chord.
- The preferred location of the WTGs for each of the two WTG layout options, including foundation scour protection, is described with a LoD around the centre point of each WTG.
- Flexibility is sought in relation to the dimension of the monopile foundations in respect of height, diameter, length, embedment depth and grout volume.
- The preferred alignment of the IACs and interconnector cables for each of the two WTG layout options is described within a defined LoD.
- The length of the IACs and the interconnector cables is described within defined parameters (i.e. a minimum to maximum range).

37. The details associated with the flexibility sought are described clearly in **Section 4.6**.

4.3.3 Transmission Component 1 - Offshore transmission infrastructure

- Flexibility is sought in relation to the dimension of the OSS monopile foundations in respect of height, diameter, length, embedment depth and grout volume.
- Preferred locations for the OSSs, including foundation scour protection, are described, and these are the same as for the two WTG layout options. However limited locational flexibility is sought in the form of a LoD around the centre point of each OSS.
- Similarly, preferred alignments for the offshore export cables are described, with limited locational flexibility sought in the form of a defined LoD.
- The length of the offshore export cable is described within defined parameters (i.e. a minimum to maximum range).

38. The details associated with the flexibility sought are described clearly in **Section 4.7**.

4.3.4 Transmission Component 2 - Landfall

- The offshore export cables will be joined to the onshore export cables in separate underground chambers known as TJBs. Preferred locations of the TJBs are described within a defined LoD.
- The preferred alignment of the landfall cable ducts, intertidal cable ducts and intertidal offshore export cables (non-ducted sections) are described as specific within a defined LoD.

39. The details associated with the flexibility sought are described clearly in **Section 4.8** of this chapter.

4.3.5 Transmission Component 3 - Onshore transmission infrastructure

- The preferred location of the onshore substation revetment at the interface with the River Liffey is described within a defined LoD.

40. The details associated with the flexibility sought are described clearly in **Section 4.8.6**.

4.4 Construction programme

41. The construction programme for the CWP Project is dependent on a number of factors which may be subject to change, including the determination of the application for development consent and the availability and lead-in times associated with procurement and installation of project components.

42. An indicative construction programme for the CWP Project is presented in **Plate 4-3** below, which assumes construction over a four-year period, including commissioning.

43. Construction of the offshore components for the CWP Project will be completed in a number of stages. These may not necessarily be consecutive, and some flexibility is required in the construction process to account for changing construction programmes due to, for example, fabrication delays or vessel availability. Offshore construction will take place 24 hours per day.

44. Construction of the onshore components for the CWP Project will commence with the onshore substation preliminary works, including the establishment of access roads, site preparation and temporary compounds.

45. Onshore construction activity will mostly take place during daytime hours from Monday to Friday (7am to 7pm) and a half day on Saturdays (up to 2pm).

46. Evening, night-time and Sunday working will be required during certain periods to facilitate landfall works at low tide, tunnelling and horizontal directional drilling (HDD) activities onshore that, due to their

nature, cannot be limited to daytime hours only. Seasonal restrictions will be in place for landfall works (as described in **Section 4.8.6**) and the onshore substation site (as described in **Section 4.9.3**).

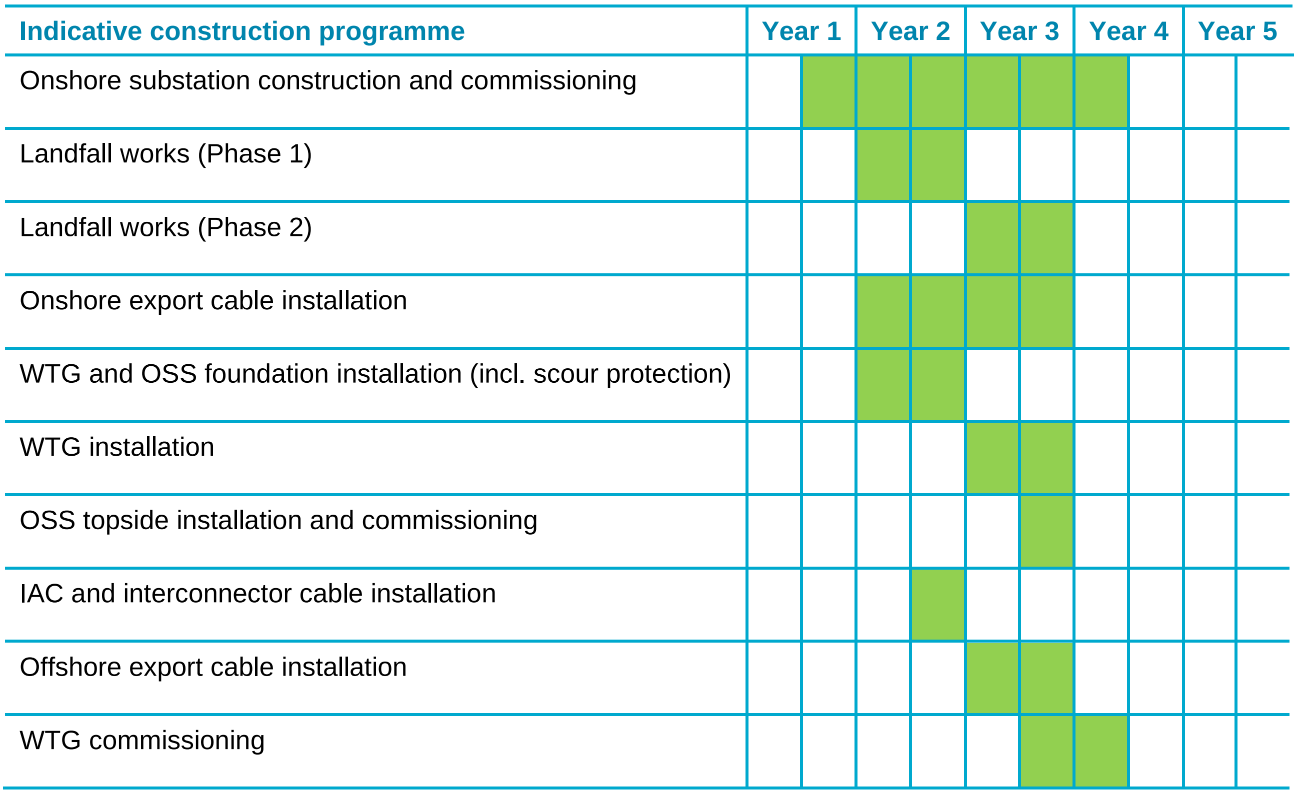

Plate 4-3 Indicative construction programme

4.5 Offshore pre-installation activities

47. A number of pre-installation activities will be required in the CWP Project array site and OECC prior to the commencement of construction. An overview of these activities is provided in the following sections.

4.5.1 Pre-construction surveys

48. Prior to the installation of any type of foundation, substructure or cable, a pre-construction survey will be undertaken to identify, in detail, seabed conditions and morphology and the presence or absence of any potential obstructions.

49. These surveys will consist of geophysical and geotechnical surveys and will be conducted across the CWP Project offshore development area. If obstructions such as boulders or sand waves are identified, the area will be cleared and prepared for the intended installation activity. Depending on the survey results, the following seabed preparation activities may be undertaken:

- Unexploded ordnance clearance;
- Boulder clearance;
- Removal of existing out of service cables; and

- Pre-sweeping / sand wave levelling.

50. The following sections describe these and the typical methods that may be used to prepare the seabed for installation.

4.5.2 Unexploded ordnance clearance

51. There is potential for unexploded ordnance (UXO) originating from World War I or World War II to be present within the offshore development area. This poses a health and safety risk where it coincides with the planned location of infrastructure and associated vessel activity. It is therefore necessary to survey for and carefully manage UXOs. If UXOs are found, they are either avoided (which will be the preferred course of action in all cases), removed or detonated in situ.

52. UXO clearance requirements will be informed by the results of the pre-construction surveys and once the location of all offshore infrastructure is confirmed.

53. In line with MARA's *Guidance for Consent Holders on the identification of UXO in the Maritime Area*, in the event that a UXO is identified, the Applicant will notify MARA and the Gardai. [1] It is noted that An Garda Síochána will, in such circumstances, request military assistance be provided to deal with the UXO and that the Naval Service Dive Section is responsible for dealing with any UXO within Irish territorial waters. In those circumstances, the Applicant will engage with An Garda Síochána and the Naval Service Dive Section to ensure that they are aware of the requirements to carry out UXO disposal activities in accordance with the mitigation measures in this EIAR and the conditions of the permission.

54. While the requirement for UXO clearance in unknown until pre-construction surveys have been undertaken, detonation of UXO is a source of additional noise in the marine environment and therefore requires consideration in the assessment of potential impacts for certain receptors, notably marine mammals (see EIAR **Chapter 11 Marine Mammals**).

55. To inform the EIA, a UXO desktop study for the CWP Project has been completed which considers the likelihood of encountering various types and sizes of UXO within the offshore development area. The UXO items considered most likely to be encountered within the offshore development area are listed below:

- Mines (Allied);
- Mines (German);
- Large bombs (500lb or larger);
- Small bombs (250lb or smaller);
- Large projectiles (6-inch–16-inch);
- Small projectiles and rockets (smaller than 6-inch);
- Chemical munitions;
- Depth charges and torpedoes;
- Land service ammunition; and
- Small arms ammunition.

56. The desktop study found that encountering all types of the above UXOs is at most 'unlikely', which means that some evidence exists of UXO in the wider region, but it would be unusual for it to be encountered.

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[1] As per MARA Guidance for Consent Holders on the identification of Unexploded Ordnance (UXO) in the Maritime Area, available at: [Guidance-for-Consent-Holders-on-the-identification-of-Unexploded-Ordnance-UXO-in-the-Maritime-Area.pdf (maritimeregulator.ie)]

57. Despite the very low risk of encountering a UXO that requires detonation in situ, the underwater noise modelling for **Chapter 11 Marine Mammals** has applied a conservative estimate of up to ten UXO requiring clearance, with a maximum charge weight of up to 525 kg net explosive quantity (NEQ) for a 2,000 lb (907.2 kg) UXO.

4.5.3 Boulder clearance

58. If left in situ, boulders can obstruct WTG, OSS or cable installation equipment or may cause damage, resulting in delays to installation. Furthermore, boulders pose a risk to the successful burial of cables, resulting in the need for additional cable protection such as rock placement or concrete mattresses. Boulders identified within the offshore development area will be avoided where possible. However, where this is not feasible due to the presence of a large volume of boulders, it may be necessary to clear these prior to construction.

59. The two methods used to clear boulders are the displacement plough or the subsea grab (see **Plate 4-4**.

60. The displacement plough displaces boulders from the route using a V-shaped design configured with a boulder board and forming a swathe clear of small boulders. For sections of the array site and OECC that are densely populated by surface boulders, a displacement plough is the most likely method that will be employed to clear the area ready for WTG, OSS or cable installation activities.

61. However, the displacement plough may not be effective in highly sloped areas or where the tool encounters a considerable force (e.g. very large boulders). As a result of these limitations, this technique is often used in combination with a subsea grab.

62. With the support of a remotely operated vehicle (ROV), the subsea grab uses a mechanical arm to relocate boulders outside the clearance area. The subsea grab may also be used in instances where boulders are present in small numbers and are scattered over a relatively wide area.

Plate 4-4 Displacement plough (Source: Global Marine Group)

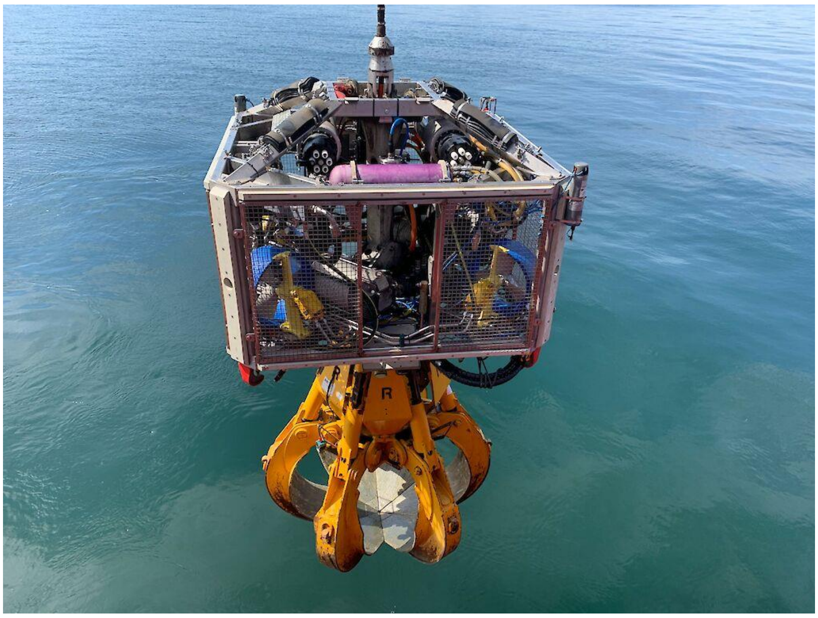

Plate 4-5 Subsea boulder grab (Source: Hughes subsea)

63. **Table 4-2** presents the design parameters for boulder clearance within the CWP Project offshore development area. While the presence, position and nature of the boulders will need to be confirmed through pre-construction surveys, the parameters presented in **Table 4-2** will not be exceeded.

Table 4-2 Boulder clearance details for the CWP Project offshore development area

Detail	WTG Layout Option A	WTG Layout Option B
Array site seabed clearance corridor width per cable (m)	20	20
Array site length of IAC, interconnector and export cables (km)	142–163	134–154
Array site seabed clearance area (m^2)[1]	2,556,000–2,934,000	2,494,000–2,772,000
OECC seabed clearance corridor width per export cable (m)	20	20
OECC total length of export cables (km)	111–132	111–132
OECC seabed clearance area (m^2)[2]	2,220,000–2,616,000	2,220,000–2,616,000

[1]Within the CWP Project array site, geophysical data has been used to identify boulders and it is estimated for the purposes of EIA that 90% of the array, interconnector and export cables within the array site would require boulder clearance.

[2]Within the OECC, geophysical data has been used to identify boulders and it is estimated for the purposes of EIA that 100% of each export cable within the OECC would require boulder clearance.

4.5.4 Pre-lay grapnel run (PLGR)

64. Following pre-construction surveys and boulder clearance works, a pre-lay grapnel run (PLGR) will be undertaken along the proposed cable routes within the offshore development area to clear any identified obstacles and debris.

65. PLGR operations are typically carried out by a specially mobilised and fitted-out vessel capable of sustaining good slow-speed positional control with sufficient bollard pull capability. The mobilised vessel will tow one or an array or grapnels (see **Plate 4-6**) along the proposed route. Usually, a single tow is made along the route but in areas where other marine activities or debris amounts are high, additional runs may be made, and may be carried out in the opposite direction and offset from the original grapnel run.

66. The vessel moves at a speed that ensures that the grapnel(s) stay in continuous contact with the seabed at a penetration depth of approximately 40–80 cm. The width of seabed disturbance along the PLGR is estimated to be 3 m, which would be encompassed by the 15 m width of seabed disturbance for the cable installation works (see **Section 4.6.4** and **Section 4.7.5**).

67. The grapnels are retrieved to the vessel at regular intervals for inspection, or when a large tension is registered by the vessel, as this will indicate that an obstacle has been hooked. Where required, seabed inspection and recovery of hazards to the vessel deck will be completed and returned to shore for proper disposal.

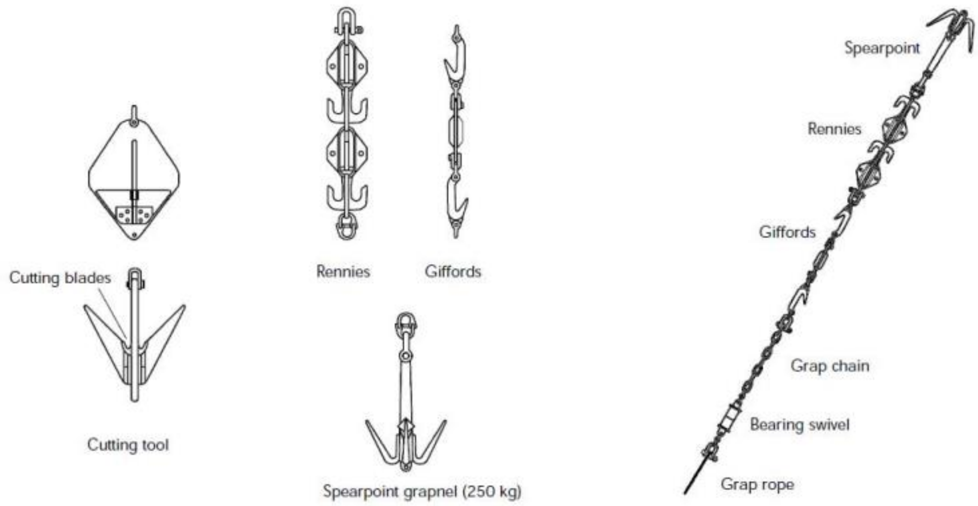

Plate 4-6 Typical PLGR apparatus

4.5.5 Removal of existing out-of-service cables

68. Pre-construction surveys will establish and confirm positions of out-of-service (OOS) cables that may need to be removed from the offshore development area. The OOS cables are removed to form a clear corridor for cable installation.

69. Based on an existing desktop study, it is anticipated that approximately 18 km of OOS cable within the array site will need to be removed. No OOS cables have been identified within the OECC.

70. The operational success of the recovery is highly dependent on the age and burial depth of the cable being removed. Where possible, the cable is removed in a single activity, but is likely that multiple operations will be required and, in some cases, complete removal is not achievable.

71. The typical cable removal procedure is described below:

- The removal vessel will position itself perpendicular to the OOS cable, ideally at a location where the cable is known to be unburied or buried at a shallow depth.
- A de-trenching grapnel (DTG) is lowered from the vessel stern.
- The vessel moves towards the cable, allowing the fluke of the DTG to penetrate the seabed and hook / unbury the cable.
- The vessel will manoeuvre until the cable is exposed and then broken, leaving the two ends on the seabed.
- The vessel will either repeat PLGRs (see **Section 4.5.4**) to retrieve a cable end for recovery or use an ROV to clamp a line to the end of the exposed cable ready for recovery to the vessel deck.
- Once the cable end is recovered to the vessel deck, a suitably controlled recovery of the cable along its route will be carried out. The intention will be to continue until the required clearance corridor is achieved for cable and foundation installation.
- The remaining cable will be cut by an ROV equipped with cutting tools, and suitable clump weights attached and deployed to the remaining cable end(s). The process will be repeated for the other exposed cable end(s).
- Any recovered cable will be handled safely and brought onshore for proper disposal.

4.5.6 Pre-sweeping / sand wave levelling

72. An assessment of the pre-construction survey data will be undertaken to identify sand waves and similar bedforms that may need to be removed or reduced prior to cable and foundation installation.

73. Sand waves are generally mobile in nature and may present a risk to the cable burial process either by preventing the cable burial tools from operating efficiently, or by resulting in exposure and scouring of the cable once installed. In some cases, this could result over time in the cable being left 'freespanning' over the seabed. This presents a risk to other marine users and would result in a large amount of strain being placed on the cables, increasing the likelihood of cable failure.

74. Cables must be buried beneath the level where natural sand wave movement would uncover them. Sometimes this can only be done by removing the mobile sediments before installation takes place, a process known as sand wave levelling or sand wave reduction.

75. Sand wave reduction is typically undertaken via trailing suction hopper dredger (TSHD) or mass flow excavation (MFE) (see **Plate 4-7**).

76. A TSHD operates by lowering a dredging arm to the seabed, where the trailing drag head is in contact with the seabed, as the vessel is in motion. High-pressure water pumps flush water into the seabed, loosening the sediment, which is suctioned up and into the hopper on board the vessel. Sediment is then disposed of where required (e.g. by direct release from the hopper to the seabed or by fluidising the sediment and discharging it at an appropriate disposal location). Alternatively, the TSHD can place the dredged material adjacent to the dredged area without the need to collect, transport and dispose the material elsewhere. The second technique, if feasible, has the advantage of keeping the material within the area from where it is dredged. Disposal in the water column or on the seabed is regulated by the Dumping at Sea Act 1996 (see EIAR **Chapter 2 Policy and Legislative Context** for further detail).

77. A MFE may be used for sand wave or megaripple pre-sweeping for post-lay burial operations. An MFE module is lowered towards the seabed from a vessel and can be used in a combination of modes to either fluidise the seabed beneath the cable and allow it to sink further into the trench beneath, or to jet the seabed soils at an angle, pushing sediment across and into the cable trench to increase the depth of cover in loose sandy conditions.

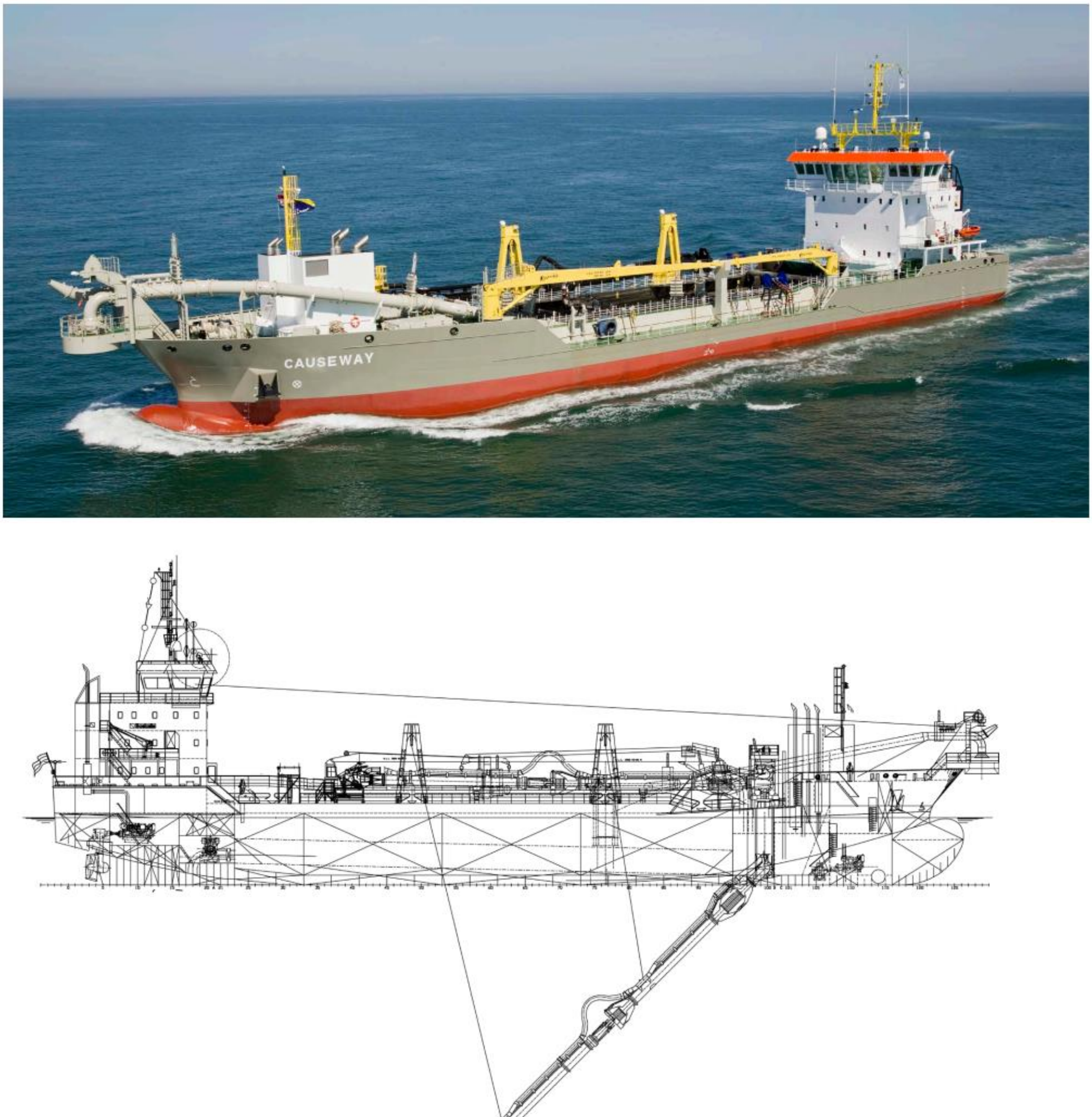

Plate 4-7 Trailing suction hopper dredging (Source: Boskalis)

Plate 4-8 Mass flow excavation for sand wave clearance (Source: JBS Group)

78. Within the offshore development area, bathymetry data has been used to identify sand waves that may require clearance for cable and foundation installation.

79. Sand wave clearance volumes within the offshore development area are provided in **Table 4-3**, assuming a disturbance width of 50 m per cable.

Table 4-3 Sand wave clearance parameters for the CWP Project offshore development area

Detail	WTG Layout Option A	WTG Layout Option B
Array site sand wave clearance corridor width per cable (m)	50	50
Array site length of cables interacting with sand waves (m)	4,105–5,185	4,400–5,550
Array site sand wave clearance total area (m^2)	205,250–259,250	220,000–277,500
Array site typical depth of sand waves (m)	3	3
Array site volume of material disturbed by sand wave clearance (m^3)	615,750–777,750	660,000–832,500
OECC sand wave clearance corridor width per cable (m)	50	50
OECC length of cables interacting with sand waves (m)	3,143–3,971	3,143–3,971
OECC sand wave clearance total area (m^2)	157,150–198,550	157,150–198,550
OECC typical depth of sand waves (m)	3	3
OECC volume of material disturbed by sand wave clearance (m^3)	471,450–595,650	471,450–595,650

4.6 Generating station

80. The design and installation details for the components of the generating station are presented in the sections below. These parameters form the basis for the assessment of impacts presented in the technical chapters of this EIAR (**Chapters 6 to 32**).

81. As described in **Section 4.3,** the CWP Project generating station will comprise either WTG Layout Option A or WTG Layout Option B. The details associated with both options are described in full.

82. Each WTG will be installed on a transition piece (TP) on top of a monopile foundation piled or drilled into the seabed. The installation details are described later in this section.

4.6.1 Wind turbine generator (WTG)

Infrastructure design

WTG details

83. The design details for both WTG Layout Option A and WTG Layout Option B are presented in **Table 4-4**

84. For both options, conventional three-bladed, horizontal axis WTGs will be used, as illustrated in planning drawings **0058 Layout Option A - Wind Turbine Generator (WTG) Details** and **0059 Layout Option B - Wind Turbine Generator (WTG) Details** for WTG Layout Option A and WTG Layout Option B respectively. The WTGs will comprise the following key components:

- Rotor – comprising the blades and hub;
- Nacelle – housing the electrical generator, transformer, the control electronics and the drive system; and
- Structural support – including the tower, switchgear and rotor yaw mechanism which enables the rotor and nacelle to turn to face into the wind.

85. The WTG nacelle section will hold the power generation equipment, including the drive system, generator, transformer(s), converters and brake as illustrated in **Plate 4-9**. A transformer converts the electrical power output generated to the desired distribution voltage. A monitoring and control system is also housed in the nacelle. The nacelle is mounted on a yaw ring seated at the top of the WTG tower to enable the rotor to respond to changes in wind direction.

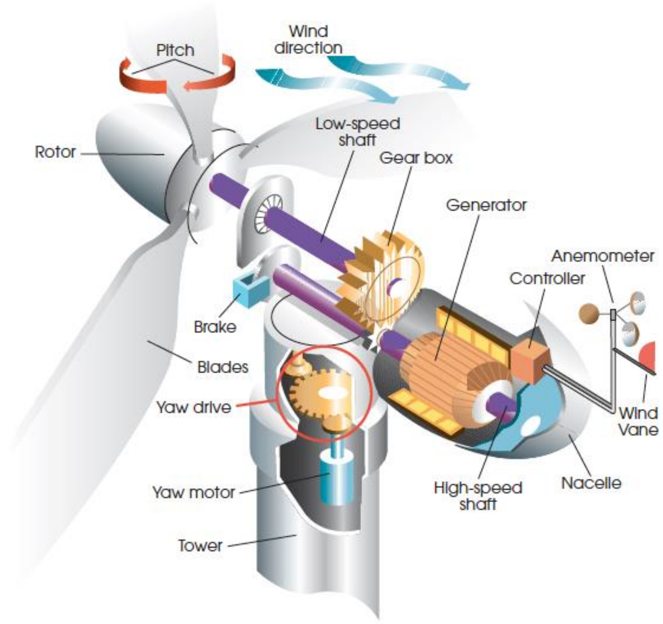

Plate 4-9 Typical wind turbine nacelle cross-section (Source: https://link.springer.com/chapter/10.1007/978-1-4471-2488-7_2)

86. The WTG tower will be a tubular steel column, dimensions of which are presented in **Table 4-4**. The transition piece, if required, connects the tower to the substructure (monopile foundation). WTG electrical and communication equipment will be housed in the WTG foundation and/or the WTG tower.

87. For WTG Layout Option A and WTG Layout Option B, the rotor, nacelle, blades and upper tower section will be painted the industry-standard semi-matt pale grey colour, as is standard for offshore WTGs.

Table 4-4 Wind turbine generator components and parameters

Detail	WTG Layout Option A	WTG Layout Option B
Number of WTGs	75	60
WTG rotor diameter (m)	250	276
Hub height above LAT (m)*	162.72	175.72
Tip height above LAT (m)*	287.72	313.72
Blade tip clearance above LAT (m)	37.72	37.72
WTG tower diameter (m)	8	9
Blade chord (width) (m)	7	7.9
Rotor swept area per turbine (m^2)	49,087	59,829
Total rotor swept area of project (m^2)	3,681,554	3,589,710

*For the purposes of EIAR **Chapter 15 Seascape, Landscape and Visual Impact Assessment**, **Chapter 17 Aviation, Military and Radar** and **Chapter 22 Archaeology, Architectural and Cultural Heritage**, WTG hub height and tip height have been rounded up to the nearest meter.

88. WTGs and the associated equipment require lubricating oils, hydraulic oils and coolants for their safe use and operation. This typically includes:

- Grease;
- Hydraulic oil;
- Gear oil;
- Nitrogen;
- Transformer silicon / ester oil;
- Diesel fuel;
- Glycol / coolants; and
- Batteries

89. A **Construction Environment Management Plan (CEMP)** for the CWP Project has been prepared to ensure that the potential for contaminant release is strictly controlled and to provide protection to marine life across all phases of the CWP Project. The CEMP includes pollution incident response plans in the unlikely event of accidental spills and potential contaminant release, and will include key emergency contact details.

WTG layouts

90. Planning drawings **0007 Offshore Site Layout Master Plan - Option A (75 WTGs)** and **0011 Offshore Site Layout Master Plan - Option B (60 WTGs)** present WTG Layout Option A and WTG Layout Option B, respectively. Positions of the OSSs are also depicted in these drawings. The design details of the OSSs are further described in **Section 4.7** of this document.

91. Positions of WTGs and OSSs have been informed by a wide range of site-specific data, including metocean data (e.g. wind speed and direction), geophysical and geotechnical survey data (e.g. bathymetry), environmental data (e.g. benthic surveys and archaeological assessment) and stakeholder consultation.

92. Designing and optimising the layout of the WTGs has considered a number of constraints identified from analysis of the above datasets, alongside the consideration of layout principles taken from relevant guidance on the design of OWFs. Details of the key constraints and principles that have informed the layouts for both WTG Options A and B are provided in **Chapter 3 Site Selection and Consideration of Alternatives.**

Limit of deviation (LoD)

93. The preferred locations of WTGs and OSSs and the LoD around these are shown in planning drawings **0008 Offshore Site Layout Plan - Option A (75 WTGs) - Sheet 1 of 3** and **0009 Offshore Site Layout Plan - Option A (75 WTGs) - Sheet 2 of 3** (for WTG Layout Option A); and planning drawings **0012 Offshore Site Layout Plan - Option B (60 WTGs) - Sheet 1 of 3** and **0013 Offshore Site Layout Plan - Option B (60 WTGs) - Sheet 2 of 3** (for WTG Layout Option B).

94. A LoD in the form of a 100m buffer from the centre point of each WTG and OSS location is proposed. The LoD will allow for small adjustments to be made to the structure locations. This is required for the following reasons:

- To accommodate for detailed ground conditions data, acquired during pre-construction geotechnical surveys.
- To accommodate for pre-construction UXO surveys.

- To avoid and minimise adverse impacts on ephemeral benthic habitats, such as *Sabellaria spinulosa* reef, identified during pre-construction surveys.
- To enable the opportunity to optimise the WTG layout pre-construction, by reducing wake losses and maximising the energy yield from the array.

95. EIAR **Chapter 5 EIA Methodology** describes the approach for assessing WTG and OSS locations and their LoD within the EIA.

WTG lighting and marking requirements

96. A **Lighting and Marking Plan (LMP)** has been prepared for the purposes of the planning application to capture construction and O&M phase lighting requirements for the offshore infrastructure and demarcation of the offshore development area such as construction buoy requirements.

97. The **LMP** will be implemented by the Applicant and its appointed contractor(s) and will be secured through conditions of the development consent. It will be a live document which will be updated and submitted to the relevant authority, prior to the start of construction.

Installation

98. The WTG components will be fabricated at a dedicated onshore fabrication facility owned and operated by an external supplier. The exact supplier and the fabrication location is unknown at this stage and will be confirmed post-consent once all commercial, technical and supply chain decision-making processes have concluded.

99. Once fabricated, the components will be transported via a marshalling harbour or directly to the array site by one of the following methods:

- Transportation on the deck of a self-propelled installation vessel (Jack-up vessel (JUV) or Dynamic Positioning (DP) 3 vessel) from the marshalling harbour or fabrication yard to the array site (see **Plate 4-10 Blue Wind jack-up vessel** and **Plate 4-11 DP3 offshore installation vessel**); or
- Transportation on a feeder vessel from marshalling harbour or the fabrication yard to the array site (see **Plate 4-12 Feeder vessel barge** and **Plate 4-13 Heavy lift vessel**).

Plate 4-10 Blue Wind jack-up vessel (Source: Fred. Olsen Windcarrier)

Plate 4-11 DP3 offshore installation vessel (Source: DEME Offshore)

Plate 4-12 Feeder vessel barge (Source: interestingengineering.com)

Plate 4-13 Heavy lift vessel (Source: Jumbo Maritime)

100. Once on site, the most likely method of installing the WTGs is a ‘stick build’ approach, which comprises the installation of individual WTG components, each requiring a separate offshore lift. This will be undertaken using either a JUV or floating vessel.

101. JUVs are installation vessels that are capable of lowering three or more legs onto the seabed and lifting themselves out of the water to provide a stable platform when craning heavy infrastructure such as WTG and OSS components. The vessel will jack up to create an airgap between the hull and the sea, thereby making the vessel less affected by the sea conditions. Where water depths are too shallow, the vessel may require assistance from supporting tugs for positioning, as the dynamic positioning system cannot be used in the shallow waters.

102. Alternatively, a floating vessel may be used. Again, in shallower water, a dynamic positioning vessel may require anchors to assist with positioning. Supporting anchor handling tug vessels will be needed to assist with anchor positioning and possibly also vessel manoeuvring.

103. WTG components that arrive on installation vessels will be lifted by the vessel's crane onto the transition piece. For each WTG, the tower would be installed first, followed by the nacelle, and then the blades. Offshore technicians will then bolt the components together as they are lifted into place.

104. Alternatively, WTG components may be installed by an installation vessel that remains on site throughout the installation campaign, loading components brought to the array site by feeder vessels (see **Plate 4-12**)

105. Installation of each WTG is expected to take approximately one day, assuming no weather delays. This does not include WTG foundation installation, which is described in more detail in **Section 4.6.2**

106. Anticipated vessel numbers associated with WTG installation are presented in **Section 4.10**, alongside a description of JUV and anchoring operations.

4.6.2 WTG Monopile foundation

Infrastructure design

107. The concept design, informed by assessments of ground conditions, water depth, wind and wave loading and WTG vibration characteristics has shown that a monopile foundation, which consists of a single tubular section of steel, would be optimal for the CWP Project.

108. The required dimensions of the monopile foundation depend on the size of the WTG, hub height above LAT, water depth, metocean conditions and the ground conditions at each location.

The WTG tower will be bolted to a transition piece which will be attached to the monopile foundation as illustrated in **Plate 4-14** and planning drawings **0058 Layout Option A - Wind Turbine Generator (WTG) Details** and **0059 Layout Option B - Wind Turbine Generator (WTG) Details**.

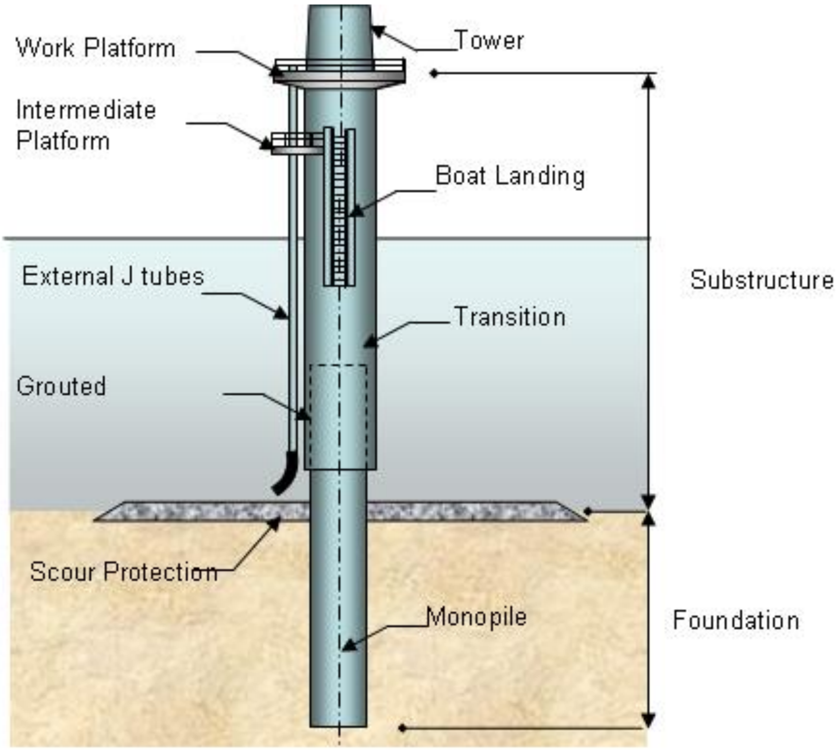

Plate 4-14 Typical WTG monopile foundation design for illustrative purposes (Source: wind-energy-the-facts.org)

109. **Table 4-5** presents the monopile parameters associated with WTG Layout Options A and B. In the assessment of monopile foundations, the option with the potential for the greatest impact on the environment, protected sites and features or third parties is considered and clearly presented within each topic assessment.

Table 4-5 WTG monopile parameters

Detail	WTG Layout Option A	WTG Layout Option B
Number of structures	75	60
Height of monopile above LAT prior to TP installation (m)	6.5	6.5
Height of transition piece above LAT (m)	31.1	31.1
WTG monopile diameter at mudline (m)	9	9.5
WTG monopile length (m)	68.5	69.5
WTG monopile embedment depth (m)	36.0	36.5
WTG monopile seabed area footprint per WTG (m^2)	64	71
Monopile grout volume (m^3)	25	26.5

Installation

110. The process of transporting monopile foundations to the array site is as described above for the WTG components. In addition to these described methods, the monopile foundations may be transported by sealing the ends, and floating and towing them to site, where they would be upended by the installation vessel for installation. Once on site, monopile foundations will be installed using either a JUV or floating vessel.

111. Anticipated vessel numbers associated with WTG foundation installation are presented in **Section 4.10** alongside a description of JUV and anchoring operations.

112. The chosen installation vessel will use a lifting tool to upend the monopile and pass it through the pile gripper. The correct orientation of the monopile is aided by painted installation markings. Once the orientation and alignment are correct, the tip of the monopile is lowered, penetrating the seabed. Depending on the soil conditions, the monopile may penetrate a significant distance into the seabed under its own weight.

Installation Option 1 – Monopile driving (piling)

113. Monopiles within the CWP Project array site will be driven by a hydraulic hammer using a maximum hammer energy through (ENTHRU) of 4400 kJ. However, the hammer energy required to drive individual monopiles will depend on seabed conditions at each location. It should be noted that hydraulic hammers with a maximum hammer energy rating of greater than 4400 kJ may be used; however, the piling equipment will be programmed at a maximum pile driving energy of 4400 kJ (ENTHRU) and will not be exceeded during monopile driving operations.

114. For the driving of monopile foundations, larger hammer spreads (the hammer and associated equipment) are more efficient and are likely to reduce the overall installation time and number of blows required to install each pile, and thus reduce potential impacts on the environment.

115. Although a maximum pile driving energy of 4,400 kJ (ENTHRU) is required to maximise the opportunity to successfully drive all piles, the actual energy used when piling will be significantly lower most of the time. The exact hammer energy required will not be known until piling operations commence at each WTG and OSS location. However, for the purposes of the EIA, the maximum pile driving energy of 4,400kJ (ENTHRU) has been used to ensure that all potential impacts have been assessed.

116. The pile-driving process for each monopile is summarised below:

- Each pile-driving event shall commence with a soft start at a lower hammer energy and low blow rate, followed by a gradual ramp-up to the maximum hammer energy required to install the monopile at each location.
- The monopile is driven while continuously measuring the vertical alignment of the structure. Any misalignment is rectified using the hydraulic rams in the pile gripper.
- The monopile is driven until its target depth is achieved, at which point the hydraulic hammer is placed back on the ship deck.

117. Between piling of individual monopiles, vessel movements and pile-handling operations will take place. As a result, each vessel will typically install up to one monopile per day. It may, however, be possible to install up to two monopiles over a 24-hour period, noting that pile driving will take place 24 hours per day.

118. Hammer energy and the frequency of piling installations is a key influence on the noise generated from monopile driving, which in turn is a key consideration in EIA and is assessed within the relevant chapters of the EIAR including **Chapter 8 Subtidal and Intertidal Ecology**, **Chapter 9 Fish, Shellfish and Turtles Ecology**, **Chapter 11 Marine Mammals** and **Chapter 24 Noise and Vibration.**

119. **Table 4-6** presents the monopile installation parameters associated with WTG Layout Options A and B. These parameters form the basis for the assessment of impacts presented in the abovementioned technical chapters of this EIAR.

Table 4-6 WTG monopile driving (piling) installation parameters

Detail	WTG Layout Option A	WTG Layout Option B
No. of monopile foundations	75	60
Hammer energy (kJ)	440–4400	440–4400
Total hours of piling per monopile	3.5	3.5
Total no. of monopiles installed in 24 hours	1–2	1–2
Total no. of piling days	75	60
Total piling hours	262.5	210
Number of piles being installed simultaneously at any one time	1	1

Installation Option 2 – Monopile drilling

120. While pile driving is the most likely installation method, in the event that ground conditions prove to be unsuitable for piling, monopiles may be drilled, or both drilled and driven, into the seabed. Unsuitable ground conditions may be associated with denser areas of seabed, such as gravel deposits, buried obstructions such as boulders and rock and/or bedrock. Monopile drilling results in two primary impacts: the noise associated with the drill (which is notably lower than noise associated with monopile piling), and materials arising from drilling. The remainder of this sub-section considers the arisings rather than underwater noise.

121. Drilling will be by a bespoke reverse circulation drill that utilises seawater to mobilise drill arisings, which are deposited adjacent to the WTG foundation. No drilling fluids are required besides seawater.

122. The drill will remove the obstruction or unplug the pile internally. In this way, drilling will ease the hard pile-driving conditions and protect the foundation from excessive pile driving-induced stresses that may damage the pile or reduce its design life.

123. Pre-construction geotechnical surveys within the array site will seek to confirm the presence of ground conditions that may be unsuitable for pile driving, with deviation from the preferred WTG locations undertaken (within the specified LoD) to avoid such conditions, where possible.

124. At this stage, based on currently available seabed data, it is estimated that up to 15% of the monopile locations, including OSS locations, for each layout option may require drilling. Assessment parameters associated with drilling of monopile foundations are presented in **Table 4-7**.

Table 4-7 WTG monopile drilling parameters

Detail	WTG Layout Option A	WTG Layout Option B
No. of monopile foundations	75	60
Number of locations that may require drilling (including OSS locations)	12	10
Drill diameter (m)	8.5	9
Drill penetration depth (m)	36.0	36.5
Volume of drill arisings per WTG foundation (m^3)	2,043	2,322
Total volume of drill arisings (m^3)	24,516	23,220

Installation Option 3 – Monopile vibropiling

125. It may also be possible that the piles are installed via vibropiling, where the pile is embedded via vibration rather than hammering or drilling.

126. This method has the benefit of reduced noise emissions compared to hammering but may not be suitable due to the ground conditions within the array site.

127. The use of this method will be investigated further and confirmed post-consent once pre-construction geotechnical surveys are complete.

Installing the transition piece

128. As set out above, the WTG foundation will consist of a monopile upon which a transition piece is attached.

129. The transition pieces are brought to the array site by a feeder vessel or on the installation vessel and lifted into place on top of the installed monopile. The monopile and transition piece are connected by means of a bolted and/or grouted connection.

130. During any grouting operations, grout is pumped to the required location while being carefully monitored and the flow is stopped once the required volumes are in place. Methods are adopted which are designed to minimise grout loss to the surrounding environment. Spillage of grout will be minimised using either inflatable or wiper seals located at the base of the transition piece. The potential spillage of grout or other pollution events is assessed within EIAR **Chapter 7 Marine Water Quality**.

131. When the installation vessel returns to the port, the empty grout containers will be replaced with fresh grout containers. Waste grout skips, used to contain grout waste from the equipment cleaning process, are also discharged for proper disposal.

4.6.3 WTG monopile scour protection

Infrastructure design

132. Scour protection is required to ensure that erosion of the seabed around the monopile foundation does not affect the stability or integrity of the structure.

133. For the CWP Project, monopile foundation scour-protection design will consist of a standard rock armour solution – graded stones placed on or around the monopile foundation with a thicker armour layer and a filter layer beneath.

134. The rock used is normally imported from land quarries, although sea aggregates from licensed extraction sites can also be used where suitable, with grain sizes tailored to achieve the necessary protection. Based on existing data, it is currently expected that all WTG locations will require the installation of monopile scour protection.

135. The arrangement of scour protection around the base of the WTG and OSS foundations are shown in planning drawings **0058 Layout Option A - Wind Turbine Generator (WTG) Details**, **0059 Layout Option B - Wind Turbine Generator (WTG) Details**, **0060 Layout Option A - Offshore Substation Structure (OSS) Details** and **0061 Layout Option B - Offshore Substation Structure (OSS) Details**.

136. **Table 4-8** presents the parameters for scour protection associated with WTG Layout Options A and B.

Table 4-8 WTG scour protection parameters

Detail	WTG Layout Option A	WTG Layout Option B
Number of locations (WTGs) where scour protection is required	75	60
Area of scour protection per location (including monopile footprint) (m^2)	3,640	3,640
Total WTG monopile seabed area take (with scour protection) across the array site (m^2)	273,000	218,400
Height of scour protection above seabed (m)	3.1	3.1
Volume of scour protection per location (m^3)	5,365	5,365

Installation

137. For standard rock-based scour protection, early prevention measures against the development of a local scour hole immediately following monopile installation must be deployed. Therefore, the scour protection must be installed in the following order:

- A filter layer will be installed prior to monopile installation. The filter layer is a relatively fine-grained composition of stone and gravel that will prevent the seabed soil from eroding, in essence protecting against scour development. The filter layer will be exposed to hydrodynamic impact for a certain time before the installation of the armour layer.
- After installing the monopile and any work associated with the installation of IACs, an armour layer will be installed. The armour layer is composed of larger rocks that will prevent the filter layer from eroding.

138. The rock placement will be achieved using a dynamic positioned Fall Pipe Vessel (FPV) or a vessel with a side-tipping system. A typical FPV, which is designed for rock placement in a controlled and accurate manner, is shown for information in **Plate 4-15**.

139. Rocks are stored in a series of holds and discharged using a conveyor belt and a chute into the fall pipe and onto the seabed. The fall pipe system is normally deployed through a moonpool at the centre

of the vessel. The system consists of various pipe sections, allowing it to extend and retract depending on the water depth. The fall pipe discharge point will be controlled by an ROV.

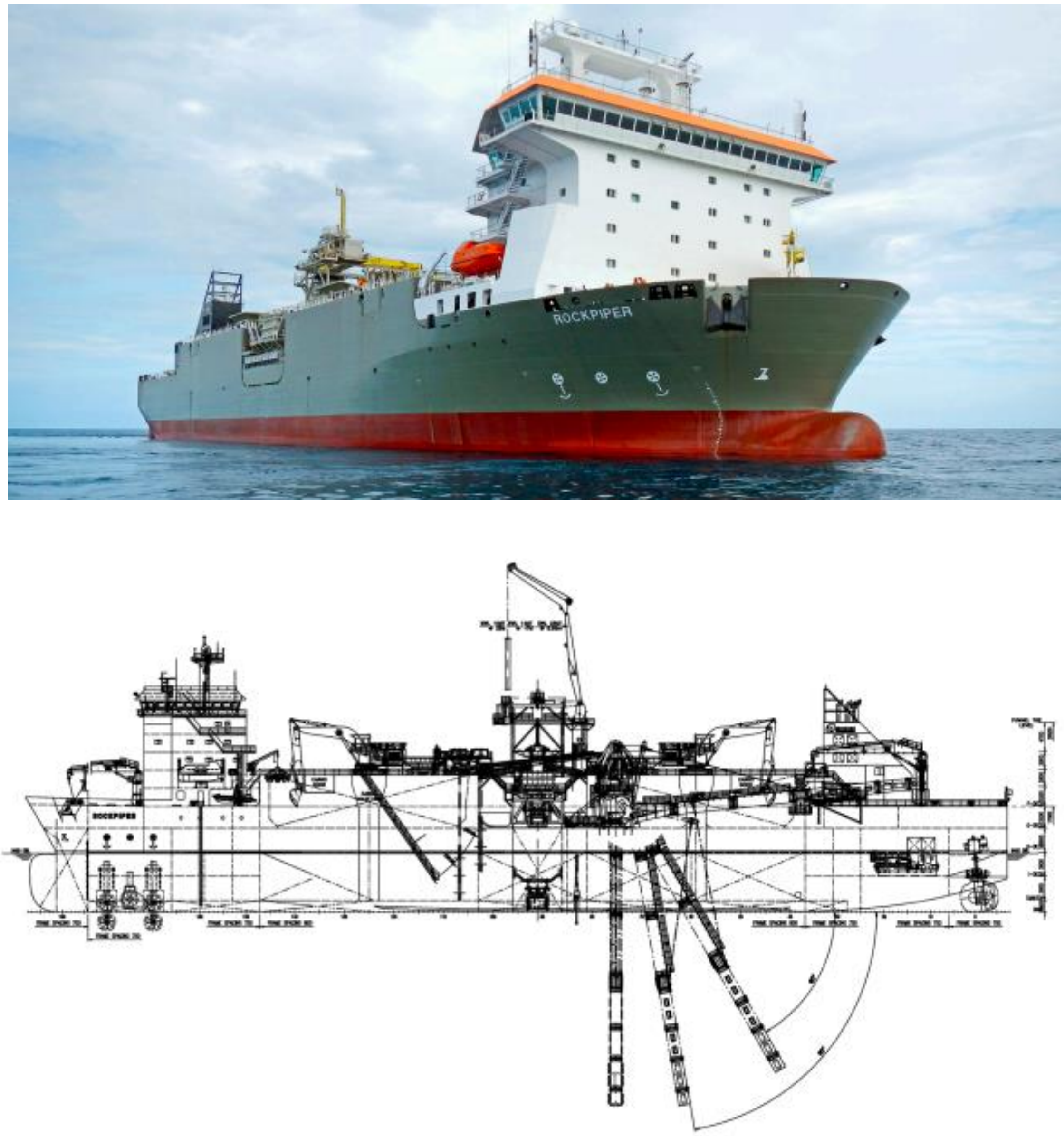

Plate 4-15 Typical fall pipe vessel for installing scour protection (Source: Boskalis)

140. Following installation, the foundation area and the base of the structure will be resurveyed to confirm that the required coverage and rock profile has been achieved.

4.6.4 Inter-array and interconnector cables

Infrastructure design

141. The IAC network distributes the electrical power generated at the WTGs to the OSSs, where the combined generated power can be converted to a higher voltage for transmission to shore and connection to the onshore grid.

142. In addition to the IAC network, two interconnector cables will connect the northern and southern OSSs to the central OSS.

143. The IACs connect multiple WTGs together into 'strings'. These strings then connect the WTGs to the relevant OSS, with multiple strings connecting back to each OSS. The IACs and interconnector cables are included as part of the generating station, while the OSSs are included as part of the OfTI (as described in **Section 4.7**).

144. The IACs and interconnector cables will be AC and of 66 kV voltage. Each cable will comprise of three cores with copper or aluminium conductors and insulation / conductor screening. The three cores will be bound together and protected within a layer of steel armouring. The cable bundle will also include a fibreoptic communications cable for monitoring of the OWF and control.

Limit of deviation (LoD)

145. A LoD in the form of a 100 m buffer on either side of the preferred alignment of each IAC and interconnector cable is proposed to allow for small adjustments to be made to the cable alignments. This is required for the following reasons:
   - To accommodate for detailed ground conditions data, acquired during pre-construction geophysical surveys.
   - To accommodate for pre-construction UXO surveys.
   - To avoid and minimise adverse impacts on ephermal benthic habitats such as *Sabellaria spinulosa* reef, identified during pre-construction surveys.
   - To enable the opportunity to optimise the IAC layout in response to any potential changes in WTG and OSS locations.

146. Around the centre point of each WTG and OSS, the LoD for the cables is increased to 200 m

147. IAC layouts for WTG Layout Option A and Option B, including the required LoD, are provided on planning drawings **0008 Offshore Site Layout Plan - Option A (75 WTGs) - Sheet 1 of 3** and **0009 Offshore Site Layout Plan - Option A (75 WTGs) - Sheet 2 of 3** and planning drawings **0012 Offshore Site Layout Plan - Option B (60 WTGs) - Sheet 1 of 3** and **0013 Offshore Site Layout Plan - Option B (60 WTGs) - Sheet 2 of 3**, respectively. The OSS interconnector cable alignments for WTG Layout Option A and Option B are also illustrated in these planning drawings. The interconnector alignments are the same for both WTG layout options.

148. Taking into account the LoD factors described above, the total length of IACs and interconnector cables for both WTG Layout Option A and Option B are provided as a range (see **Table 4-9**).

Table 4-9 Inter-array and interconnector cable parameters

Detail	WTG Layout Option A	WTG Layout Option B
Number of IAC cable 'strings' per OSS	6	6
Length of inter-array cabling on the seabed (km)	120–139	112–130
Length of interconnector cabling on the seabed (km)	7.4–8.6	7.4–8.6

Installation

Pre-installation activities

149. Pre-construction surveys, as described in **Section 4.5** , will serve to validate the magnitude and extent of sand waves within the array site. The presence of boulders and other environmental constraints, such as the *Sabellaria spinulosa* reef, will also be confirmed.

150. A finalised IAC and interconnector cable layout for the chosen WTG option will confirm what level of seabed preparation is required to ensure the minimum depth of cover is achieved. In summary, the following seabed preparation methods, as described in **Section 4.5**, may be used to prepare the seabed for IAC and interconnector cable installation:

- Removal of OOS cables;
- UXO clearance;
- Boulder clearance and sand wave reduction, where necessary; and
- PLGR operations.

151. Cable burial trials may be conducted in advance of the main installation programme. These ensure that the chosen equipment is suitable for the ground conditions encountered and that minimum depth of cover can be achieved. If undertaken, this could involve varying tests to bury sections of trial cable or similar-sized rope, up to 1 km in length. Following the trials, the trial cable or rope will be removed from the seabed.

Installation methods

152. Cable burial requirements for the purpose of the EIA have been informed by a preliminary cable burial risk assessment, involving a peer review of environmental considerations, ground conditions and anticipated installation considerations.

153. The Applicant will, where practicable, bury all IACs and interconnector cables to a minimum depth of cover of 1 m, with a trench depth during installation of 1.5 m. This will provide the cables with protection against damage and reduce interference with fishing activities and other sea users. Where, following cable burial, the minimum depth of cover is inadequate, cable protection will be implemented as mitigation to avoid risks to other marine operations, as described in **Section 4.6.5.**

154. Typically, IACs and interconnector cable installation can be approached either by:

- Post-lay burial through separate cable lay and burial campaigns; or
- Simultaneous lay and burial through a single campaign.

155. IACs and interconnector cables will be installed using jetting, trenching or ploughing techniques as described in **Table 4-10**.

Table 4-10 Cable installation methods

Cable installation method	Description
Jetting	Where the seabed comprises predominantly soft sediments, cables can be buried using a post-lay jetting technique, supported from a vessel. The cable is laid on the seabed and an ROV fitted with jetting swords is deployed to the seabed and manoeuvred over the cable. The jetting swords are energised and water jetting commences, fluidising either side of the cable. The swords are lowered to create a narrow trench into which, as the ROV moves forward, the cable sinks under its own weight. The jetted sediments then settle back into the trench over the cable, and under typical tidal conditions the trench is covered after several tidal cycles. The advantage of this method is that the cable can be laid independently of burial, permitting cable installation to be a via single vessel with minimal restrictions on durations needed. Cables can subsequently be buried without constraints resulting from weather conditions, and the operation can be halted and resumed without impacting the cable. However, the performance of a jetting ROV is limited where sediments are more compacted. The jetting tool can either be pulled directly by a surface vessel or mounted onto self-propelled tracked vehicles which run along the seabed, taking power from a surface vessel.
Mechanical trenching	This method involves the excavation of a trench (either by pre-trenching or simultaneously with cable laying), with the excavated material placed alongside. The cable is then laid in the trench and the sediment returned to the trench to complete the burial of the cable, either mechanically or by natural processes.
Ploughing	Cable burial ploughs cut through the seabed, lifting the soil and forming a narrow trench into which the cable is laid. The material is temporarily lifted and supported and, after the plough shear has passed, falls back over the cable. The advantage of this method is that cables can be laid and buried simultaneously. However, the performance of a plough and the depth of burial which can be achieved are a function of plough geometry, seabed conditions and vessel-pulling capability, with dense or stiff soils providing the greatest challenge. Furthermore, ploughing is relatively slow and requires a complex operation for deployment and recovery which can be hampered if weather conditions are less favourable. The practicality of installing IACs with this technique is therefore limited, and ploughing is generally considered more appropriate for installing export cables over longer distances.

156. Due to ground conditions within the array site, IAC and interconnector cable burial is likely to be undertaken by mechanical trenching. However, a combination of cable burial methods may be used. The preferred approach will be confirmed on completion of the pre-construction geotechnical site investigation surveys.

157. The rate at which cables can be installed is dependent on many factors, including:

- The target cable burial depth;
- The selected installation technique and approach;
- The type and properties of soils encountered; and
- Operational constraints (e.g. weather conditions).

158. **Table 4-11** provides typical average cable installation rates for the three cable installation methods described in **Table 4-10.** It should also be noted that the installation methods described above and the associated cable burial parameters are the same for offshore export cables, which are described in **Section 4.7.5** of this chapter.

Table 4-11 Cable installation rates

Installation method	Soil description	Average ranges of cable installation (m/hr)
Jet trencher	Soft loose soils and soft clays	300–500
Mechanical trencher	Firm soils and clays, soft rock	50–150
Cable plough	Firm soils and clays	200–700

159. The assessment parameters for IAC and interconnector cable installation are presented in **Table 4-12** below, which draws on information presented above.

160. A 15 m temporary disturbance width is assessed in the EIA for cable installation, encompassing the PLGR, footprint of the burial tool on the seabed, trenching works and any spoil that may be generated at either side of the trench. The footprint for sand wave reduction (where required) would be additional to this, as detailed in **Table 4-3**.

Table 4-12 IAC installation parameters

Detail	WTG Layout Option A	WTG Layout Option B
Width of seabed affected by installation	15	15
Total seabed disturbed (m^2)	1,911,000–2,214,000	1,791,000–2,079,000
Number of IAC links and interconnector cables installed in 24 hours	1–2	1–2
Number of days to install IACs and interconnector cables[1]	40–77	32–62
Minimum depth of cover (m)	1	1
Trench depth (m)	1.5	1.5

[1]Excluding downtime and installation of cable

Typical installation sequence

161. Following seabed preparation, as described above, the typical sequence for IAC or interconnector cables is as follows. A Cable Lay Vessel (CLV) with a number of potential supporting vessels will be required to install the IACs into each WTG/OSS and subsequently into the seabed between the WTGs/OSSs. The CLV loaded with IACs will transit to the array site to carry out any planned trials and prepare to install cables.

162. The CLV takes up a position adjacent to a WTG or OSS foundation, where the first end of the cable is pulled into the structure and secured, allowing the CLV to commence laying activities. Depending on the method of laying and burial, cable burial (described in **Table 4-10**) may be undertaken simultaneously with laying, or an ROV may be utilised to monitor the cable placement during the surface laying.

163. The second end of the cable is pulled in and secured to another WTG or OSS foundation.

164. Cable laying for the interconnector cables between the OSSs will be as described for the IACs.

4.6.5 Inter-array and interconnector cable protection

Infrastructure design

165. As described in **Section 4.6.4**, the Applicant will, where practicable, bury all cables to a minimum depth of cover. In cases where depth of cover is inadequate, cable protection will be implemented as mitigation to avoid risks to other marine operations. It should be noted that cable burial is the preferred method of protection, and secondary cable protection will only be used where cable burial is not appropriate or achievable.

166. Secondary cable protection within the array site will be achieved by covering the exposed cables with rock placement. This ensures cables remain protected from natural movements of the seabed and from anthropogenic factors that may cause damage to a cable (e.g. trawling or anchors).

167. Rock placement is an established method for protecting cables. The rock used is normally imported from land quarries, although sea aggregates can also be used where suitable, with grain sizes tailored to achieve the necessary protection.

168. Typically, smaller stones are placed over the cable as a covering layer. This provides protection from any impact from the larger rocks that are then placed on top of this initial protective layer. The rock grading has a mean rock size of 90–125 mm, up to a maximum of 250 mm.

169. As described above, a preliminary cable burial risk assessment, involving a peer review of environmental considerations, ground conditions and anticipated installation considerations, has been undertaken to identify locations that may require cable protection. This exercise has determined the maximum extent and volume of cable protection within the array site, which has been used as a basis for the EIA. Locations of cable protection are provided in **Appendix 4.1 Cable Protection Locations.**

170. Cable protection parameters have been determined using details from the preliminary cable burial risk assessment. These are presented in **Table 4-13** and form the basis for the assessment of impacts presented in the technical chapters (EIAR **Chapters 6 to 32**)**.**

Table 4-13 IAC and interconnector cable protection design parameters

Detail	WTG Layout Option A	WTG Layout Option B
Length of inter-array and interconnector cabling requiring cable protection (km)	29.8	29.8
Width of cable protection on seabed (m)	7	7
Height of cable protection berm (m)	1.25	1.25
Total area of seabed covered by cable protection (m^2)	208,600	208,600
Number of cable crossings required	None	None

Cable protection system at IAC and interconnector ends

171. In addition to the cable protection measures set out above, a small section at either end of each length of IAC and interconnector cable may also be unburied to allow connection to the WTG or OSS through circular apertures directly on the monopile foundations and/or through external J-tubes attached to the transition piece and lowered to the seabed. J-tubes support and protect cables between the seabed and the top part of the monopile foundation, for both WTGs and OSSs.

172. The distance of the above cable entries to the seabed or top of scour protection is approximately 3 m, but will depend on the specification provided by the Cable Protection System (CPS) supplier. CPS – tubes made of polymer and/or cast-iron shells – will be designed to guard the cable bend radius and protect the cable against overbending within limited tension forces. The bending stiffness is tuned according to winch pull-in tension, marine cable lay operation and the cable minimum bending radius.

173. Based on existing data, it is expected that all IAC links and interconnector cables will require the installation of a CPS.

Installation

174. The rock placement installation process for cable protection is relatively quick and can be undertaken during less favourable weather conditions.

175. The installation method for rock for placement using an FPV is as described for the installation of rock armour as a form of WTG monopile scour protection, at **Section 4.6.3**.

4.7 Transmission Component 1 - Offshore transmission infrastructure

176. The key components of the OfTI include:

- Three OSSs, comprising monopile foundations, OSS topside components and associated structures;
- Scour protection at each OSS foundation;
- Three offshore export cables; and
- Cable protection for the offshore export cables (including at cable crossings).

177. As set out in **Section 4.11**, the ownership of the OfTI and OTI will be transferred to, and operated by, EirGrid post commissioning of the wind farm.

4.7.1 Offshore substation overview

178. The function of the OSS is to collect the incoming electricity from the WTGs and transform this to a higher voltage for transmission to the shore. The design of the CWP Project will require three OSSs, with each OSS fixed on top of a single monopile foundation with a transition piece bolted and/or grouted to the monopile. Planning drawings **0060 Layout Option A - Offshore Substation Structure (OSS) Details** and **0061 Layout Option B - Offshore Substation Structure (OSS) Details** provide the design details for the OSSs for WTG layout options A and B respectively.

4.7.2 OSS topside

Infrastructure design

179. The OSS topside unit is prefabricated in the form of a multilevel structure that is lowered and mounted on a foundation. Each OSS topside will accommodate the following components:

- Medium voltage (MV) to high-voltage (HV) power transformer;
- MV and HV switchgear;
- HV shunt reactor;
- Low-voltage (LV) systems;
- Instrumentation, metering equipment and control systems;
- Standby generator;
- Auxiliary and uninterruptible power supply systems;
- Marking and lighting;
- Emergency shelter or accommodation, including mess facilities;
- Material handling systems;
- Firefighting systems;
- Foam suppression units; and
- Control, LV and battery rooms.

180. The OSS drainage system will collect rainwater below bunded external equipment such as the transformers. The drainage system will incorporate a separation unit which separates any contamination from the collected water. The collected water is recirculated through the separator, with clean water being discharged and any contaminants stored for transportation to shore for controlled processing and/or disposal.

OSS layout

181. Planning drawings **0007 Offshore Site Layout Master Plan - Option A (75 WTGs)** and **0011 Offshore Site Layout Master Plan - Option B (60 WTGs)** present the WTG locations for WTG Layout Options A and B respectively. Positions of the OSSs are also depicted in these planning drawings, which are the same for both WTG Layout Options A and B.

182. Positions of OSSs have been informed by a wide range of site-specific data and design principles, which are described in detail in **Chapter 3 Site Selection and Consideration of Alternatives.**

Limit of deviation (LoD)

183. As with the WTGs, a LoD in the form of a 100 m buffer from the centre point of each OSS location is proposed, as illustrated in planning drawings **0008 Offshore Site Layout Plan - Option A (75 WTGs) - Sheet 1 of 3** and **0009 Offshore Site Layout Plan - Option A (75 WTGs) - Sheet 2 of 3** (for WTG Layout Option A); and **0012 Offshore Site Layout Plan - Option B (60 WTGs) - Sheet 1 of 3** and **0013 Offshore Site Layout Plan - Option B (60 WTGs) - Sheet 2 of 3** (for WTG Layout Option B) to allow for small adjustments to be made to the structure locations. This is required for the following reasons:

- To accommodate for detailed ground conditions data acquired during pre-construction geotechnical surveys.
- To accommodate for pre-construction UXO surveys.

- To avoid and minimise adverse impacts on ephemeral benthic habitats such as the *Sabellaria spinulosa* reef, identified during pre-construction surveys.

184. **Table 4-14** presents the OSS topside parameters, which are the same for both WTG Layout Option A and B, as detailed in planning drawings **0060 Layout Option A - Offshore Substation Structure (OSS) Details** and **0061 Layout Option B - Offshore Substation Structure (OSS) Details**.

Table 4-14 OSS topside parameters

Detail	WTG Layout Option A	WTG Layout Option B
Number of OSSs	3	3
Height of topside (m)	31	31
Length of topside (m)	45	45
Width of topside (m)	35	35
Height of topside above LAT (m)	55	55
Height of underside of topside above LAT (m)	24	24

Installation

185. Similar to the WTGs, the OSS topsides will be fabricated at a dedicated onshore fabrication facility owned and operated by an external supplier. The exact supplier and the fabrication location is unknown at this stage and will be confirmed post-consent during the detailed design stage.

186. Once fabricated, the topsides will be transported to the array site on the deck of an installation vessel or barge. The OSS topside will then be lifted onto the OSS foundation using either a JUV or floating vessel, as described for the WTGs in **Section 4.6.1**.

187. Once positioned, the OSS topside will be welded to four support points on the OSS foundation. The support points will be surveyed offshore and cut to the correct level prior to lifting the OSS topsides. After welding, the connection will be prepared and painted.

188. Following OSS topside installation, secondary connections such as stairs and cable containment will be completed. This will be followed by cable connections from the cable deck to the OSS topside.

4.7.3 OSS monopile foundation

Infrastructure design

189. A typical arrangement of the OSS monopile foundation is shown on planning drawings **0060 Layout Option A - Offshore Substation Structure (OSS) Details** and **0061 Layout Option B - Offshore Substation Structure (OSS) Details**.

190. OSS monopile design shall be as per the WTG monopile foundation but with some differences:

- The OSS transition piece will accommodate a cable deck and four support points for the OSS topside. The OSS topside will have a welded connection to the transition pieces at each of the support points.

- The OSS foundation will accommodate external J-tubes for support and protection for each of the IACs. In addition, the central OSS (see planning drawings **0007 Offshore Site Layout Master Plan - Option A (75 WTGs)** and **0011 Offshore Site Layout Master Plan - Option B (60 WTGs)**) will have two interconnector cable J-tubes. The other two OSS foundations will have a single interconnector cable J-tube each.
- For routing export cables, each of the OSS foundations will have an external J-tube. Alternatively, the OSS foundations may have a single-entry hole for routing export cables internally.
- A J-tube and anode support cage structure will be installed around each of the OSS foundation monopiles to extend the J-tubes to the seabed.
- OSS foundations will have two boat landings each for access.

191. **Table 4-15** Presents the OSS monopile parameters associated with WTG Layout Options A and B.

Table 4-15 OSS monopile foundation parameters

Details	WTG Layout Option A	WTG Layout Option B
Number of structures	3	3
OSS monopile diameter at mudline (m)	9	9.5
OSS monopile length (m)	68.5	69.5
OSS monopile embedment depth (m)	36	36.5
OSS monopile seabed area per OSS (m^2)	64	71
Monopile grout volume (m^3)	25	26.5

Installation

192. The OSS monopiles will be installed using the same installation methodology as described for the WTG monopile foundations in **Section 4.6.2**.

193. The OSS monopiles will have the same basic parameters as the WTG monopiles and will therefore be driven using the same method and using the same hammer energy of 440 to 4,400 kJ. Installation parameters for OSS monopile piling are included below, in **Table 4-16**.

194. Installation parameters for OSS monopile drilling are accounted for in **Table 4-7.**

Table 4-16 OSS monopile foundation piling installation parameters

Details	WTG Layout Option A	WTG Layout Option B
No. of monopile foundations	3	3
Hammer energy (kJ)	440–4400	440–4400
Total hours of piling per monopile	3.5	3.5
Total no. of monopiles installed in 24 hours	1–2	1–2
Total no. of piling days	3	3
Total piling hours	10.5	10.5

Installing the transition piece

195. As with the WTG foundation installation, once the monopile is installed, a transition piece will be lifted from the installation vessel deck and placed on top of the monopile and connected with a bolted and/or grouted connection.

196. For the installation of external J-tubes (for routing IAC, inter-array and/or export cables on the outside of the monopile foundation), once the monopile is installed and prior to installing the transition piece, an anode / J-tube cage will be installed around the monopile close to the seabed; this will form the lower section of the J-tubes as required in the design of the foundation. The transition piece will then be installed, creating continuity between the lower J-tubes previously installed and the upper J-tube sections attached to the transition piece.

197. IAC, interconnector and export cables will be pulled into the J-tubes and/or openings in the monopiles and up through the hang-offs on the OSS foundation cable deck; cable pulling is likely to be prior to installation of the OSS topsides.

4.7.4 OSS scour protection

198. OSS scour protection will be achieved using the same design of scour protection for the WTGs, i.e. rock armour and filter layer. The associated installation method for this type of scour protection is as described for the WTG monopiles in **Section 4.6.3**.

199. **Table 4-17** presents the parameters for OSS scour protection associated with WTG Layout Options A and B.

Table 4-17 OSS scour protection parameters

Details	WTG Layout Option A	WTG Layout Option B
Number of locations (OSSs) where scour protection is required	3	3
Area of scour protection per location (including monopile footprint) (m^2)	3,640	3,640
Total OSS monopile seabed area take (with scour protection) across the array site (m^2)	10,920	10,920
Height of scour protection above seabed (m)	3.1	3.1
Volume of scour protection per location (m^3)	5,365	5,365

4.7.5 Offshore export cables

Infrastructure design

200. The OECC connects the array site with the landfall location at Poolbeg. Three 220 kV offshore export cables will be installed within the OECC, which will transmit electricity generated by the WTGs via the OSSs and the onshore export cables to the onshore substation and ultimately to the Irish electricity grid.

201. Each offshore export cable will comprise three cores with copper conductors and insulation / conductor screening. The three cores will be bound together and protected within a layer of steel armouring. The cable bundle will also include a fibreoptic communications cable for OWF monitoring and control.

Offshore export cable layout

202. The preferred alignments for the offshore export cables within the OECC, is presented on planning drawing **0007 Offshore Site Layout Master Plan - Option A (75 WTGs)** (WTG Layout Option A) and planning drawing **0011 Offshore Site Layout Master Plan - Option B (60 WTGs)** (WTG Layout Option B). The preferred alignments are the same for both WTG options as the OSS locations are the same for both WTG options.

Limit of deviation (LoD)

203. As with the IACs and interconnector cables, during the detailed design stage, the final alignments of the offshore export cables may need to deviate from the preferred alignments. Therefore, for the purposes of the planning application and the EIA, the OECC represents the LoD, outside the array site, within which the three 220kV offshore export cables will be installed, as presented in planning drawings **0008 Offshore Site Layout Plan - Option A (75 WTGs) - Sheet 1 of 3**, **0009 Offshore Site Layout Plan - Option A (75 WTGs) - Sheet 2 of 3** and **0010 Offshore Site Layout Plan - Option A (75 WTGs) - Sheet 3 of 3** (for WTG Layout Option A)**;** and **0012 Offshore Site Layout Plan - Option B (60 WTGs) - Sheet 1 of 3**, **0013 Offshore Site Layout Plan - Option B (60 WTGs) - Sheet 2 of 3** and **0014 Offshore Site Layout Plan - Option B (60 WTGs) - Sheet 3 of 3** (for WTG Layout Option B).

204. In addition, there is an LoD in the form of a 250 m corridor on either side of the preferred alignment of each export cable within the array site, as presented in planning drawing **0008 Offshore Site Layout Plan - Option A (75 WTGs) - Sheet 1 of 3 (for WTG Layout Option A);** and **0012 Offshore Site Layout Plan - Option B (60 WTGs) - Sheet 1 of 3** (for WTG Layout Option B). This is required for the following reasons:

- To accommodate for detailed ground conditions data acquired during pre-construction geophysical surveys.
- To accommodate for pre-construction UXO surveys.
- To avoid and minimise adverse impacts on ephemeral benthic habitats such as the *Sabellaria spinulosa* reef, identified during pre-construction surveys.
- To enable the opportunity to optimise the IAC layout in response to any potential changes in WTG and OSS locations.

205. Each offshore export cable will be installed in a separate trench with a minimum spacing of approximately 50 m between the cable alignments. The OECC is between 500 m and 2000 m in width with a total area of 40.1 km^2.

206. The OECC has been defined to encompass cables and the adjacent area of seabed that may be subject to temporary works, such boulder clearance, sand wave reduction and trenching.

207. Taking into account the LoD factors described above, the total length of the offshore export cables is provided as a range (see **Table 4-18**).

Table 4-18 Offshore export cable parameters

Details	Value
Number of offshore export cables	3
Total length of offshore export cables (km)	126.0–146.0
Area of the offshore export cable corridor (OECC) (km^2)	40.1

Installation

Pre-installation activities

208. Pre-construction surveys as described in **Section 4.5** will serve to validate the magnitude and extent of sand waves within the OECC. The presence of boulders and other environmental constraints, such as the *Sabellaria spinulosa* reef, will also be confirmed.

209. In summary, the following seabed preparation methods as described in **Section 4.5** may be used to prepare the seabed for offshore export cable installation:

- UXO clearance;
- Boulder clearance;
- PLGR operations; and
- sand wave reduction, where necessary.

Installation methods

210. The Applicant will, where practicable, bury all offshore export cables to a minimum depth of cover of 1.4 m, with a trench depth during installation of 2.0 m. This will provide the cables with protection against damage and reduce interference with fishing activities and other sea users. Where, following cable burial, the minimum depth of cover is inadequate due to unforeseeable seabed conditions, cable protection will be implemented as mitigation to avoid risks to other marine operations, as described in **Section 4.7.6.**

211. As highlighted in planning drawing **0007 Offshore Site Layout Master Plan - Option A (75 WTGs)** (WTG Layout Option A) and planning drawing **0011 Offshore Site Layout Master Plan - Option B (60 WTGs)** (WTG Layout Option B), there is a proposed zone of greater burial depth east of Dún Laoghaire harbour. In this area, a trench depth of 3.0 m has been assumed for the purposes of the EIA.

212. Offshore export cables will be buried using jetting, trenching or ploughing techniques, as described for the IACs and interconnector cables in **Section 4.6.4**.

213. Due to ground conditions within the OECC, cable burial is likely to be undertaken by ploughing. However, a combination of cable burial methods may be used. The preferred approach will be confirmed on completion of the pre-construction geotechnical site investigation surveys.

Installation parameters

214. The assessment parameters for offshore export cable installation are presented in **Table 4-19**.

215. As for the IACs and interconnector cables, a 15 m temporary disturbance width is assessed for cable installation, encompassing the pre-grapnel run, footprint of the burial tool on the seabed, trenching works and any spoil that may be generated on either side of the trench. The footprint for sand wave reduction (where required) would be additional to this, as detailed in **Table 4-3.**

Table 4-19 Offshore export cable installation parameters

Details	Value
Minimum depth of cover (m)[1]	1.4
Trench depth (m)[1]	2
Width of seabed affected by installation	15
Total seabed disturbed (m^2)	1,890,000–2,187,000
Length of cable installed in 24 hours (km)	5–25
No. of days to install each cable circuit[2]	10–21

[1]Except the cable buried within the zone of greater burial depth adjacent to Dún Laoghaire harbour, which will have an increased minimum depth of cover and trench depth.

[2]Excluding downtime and installation of cable protection.

Typical installation sequence

216. The approach to laying the offshore export cables using a CLV will be as described for the IACs and interconnector cables (see **Section 4.6.4**) but over a greater distance.

217. The cables will be installed sequentially, with reloading of the CLV between each cable. It is anticipated that each cable circuit will take approximately three weeks to install, excluding cable protection installation and crossings.

218. The shallow water nearshore section of the offshore export cables will be installed separately to the sections of cable in waters deeper than 10 m due to vessel access limitations. This includes a section of the OECC, approximately 4 km in length, where water depths would be unsuitable for the draft of a typical offshore CLV.

219. This final section of the OECC will require different installation techniques and vessels with specialist capabilities, and will include the installation of cable across the intertidal mudflats associated with South Dublin Bay. These works, including the landing of the cables at Poolbeg, are described in **Section 4.8** as part of the landfall works.

Cable crossings

220. The OECC crosses a number of existing and future assets. These are described within **Appendix 4-2 Preliminary Offshore Cable Crossing Schedule**.

221. The design and methodology of these crossings will be confirmed in agreement with the asset owners. However, it is likely that concrete mattresses will be placed over the existing asset to form a separation layer. The export cable will be laid across these concrete mattresses at an angle close to 90 degrees. The export cable will then be covered by a second mattress to secure the cables in place and ensure that they remain protected.

222. The cable protection at cable crossings will be inspected during the life of the project and may need to be replenished with additional protection, depending on their condition.

4.7.6 Offshore export cable protection

Design

223. As described in the section above, cable protection within the OECC will be required at cable crossing locations using concrete mattresses.

224. Mattresses are generally made of concrete elements formed on a mesh of polypropylene rope, which will conform to changes in seabed morphology. Bevelled elements are used on the edges to create a lower profile to encourage, for example, trawl gear to roll over the mattress. Where appropriate, mattresses fitted with polypropylene 'fronds' can be used to enhance the protection. The fronds encourage sediment deposition, creating a protective bank.

225. Elsewhere, the Applicant will, where practicable, bury all cables to a minimum depth of cover. In cases where depth of cover is inadequate, cable protection will be implemented as mitigation to avoid risks to other marine operations.

226. Secondary cable protection for the offshore export cables will be achieved by covering the exposed cables with rock placement, as described for the IACs and interconnector cables in **Section 4.6.5**. This ensures cables remain protected from natural movements of the seabed and from anthropogenic factors that may cause damage to a cable (e.g. trawling or anchors).

227. A preliminary cable burial risk assessment, taking into consideration the location of cable crossings, has been undertaken to identify locations that may require cable protection. This exercise has determined the maximum extent and volume of cable protection within the OECC, which has been used as a basis for the EIA. Locations of cable protection are provided in **Appendix 4.1 Cable Protection Locations**

228. Cable protection parameters for the offshore export cable are presented in **Table 4-20** and form the basis for the assessment of impacts presented in the technical chapters (EIAR **Chapters 6 to 32).**

Table 4-20 Export cable protection parameters

Details	Value
Total length of export cables requiring cable protection (km)	15
Width of cable protection on seabed (m)	7
Total area of seabed covered by export cable protection (m^2)	105,000
Height of cable protection berm (m)	1.5
Number of cable crossings required	24

Installation

229. For the concrete mattresses at cable crossing locations, installation will require placement by a suitable installation vessel with a crane and ROV support, as shown in **Plate 4-16**. Once positioning over the cable has been confirmed, the frame-release mechanism will be triggered and the mattress deployed.

230. The installation of rock placement is as described in **Section 4.6.5**.

Plate 4-16 Concrete mattress for offshore export cable protection (Source: Pipeshield)

4.8 Transmission Component 2 - Landfall

4.8.1 Overview

231. The landfall, on the southern edge of Poolbeg Peninsula, describes the point at which the offshore export cables (forming part of the OfTI) are brought onshore and connected at three transition joint bays (TJBs) to the onshore export cables (part of the onshore transmission infrastructure (OTI)).

232. The landfall represents a complex interaction between land and the marine environment. For the CWP Project, this includes the installation of the offshore export cables within the shallow waters and intertidal area of Dublin Bay. Therefore, the Applicant has included the following activities in the scope of 'landfall works', extending from the TJB onshore to approximately 4 km offshore:

- Ducted offshore export cable laying, referred to as the landfall cable ducts, extending from the TJBs onshore to the intertidal area, just below the HWM;
- Ducted offshore export cable laying, referred to as the intertidal cable ducts, from the seaward extent of the landfall cable ducts, just below the HWM to approximately 350 m from the HWM; and
- Non-ducted offshore export cable laying in the intertidal area, from approximately 350 m from the HWM to the limits of vessel operability (approximately 4km from the HWM). This area is referred to as the transition zone, as installation methods transition from land-based techniques to shallow water and marine based.

233. This section describes the design and installation for each of the main components that make up the landfall works, described in order following the construction sequence, including:

- TJBs;
- Landfall cable ducts (and associated offshore export cables within the ducts);
- Intertidal cable ducts (and associated offshore export cables within the ducts); and
- Intertidal non-ducted offshore export cables.

234. The location of each of these components is presented on planning drawing **0016 Intertidal Works Layout Plan**.

4.8.2 Transition joint bays (TJBs)

Infrastructure design

235. The three offshore export cables will be joined to the onshore export cables in three separate TJBs, located onshore (one TJB per export cable). TJBs are pits excavated and lined with concrete, within which the offshore and onshore export cables will be joined together. They are constructed to ensure that the jointing can take place in a clean and dry environment, and to protect the joints once completed. The chambers will be underground and will have plan dimensions of 18 m x 4 m x 3 m deep.

236. Alongside each TJB will be two separate below-ground chambers, an earth link box and fibreoptic chamber, housing electrical items and communication fibres. The link boxes will have dimensions of 2 m x 2 m x 3 m deep, with individual manhole covers.

237. As shown on planning drawing **0023 Onshore Development Area - Site Layout Plan - Temporary Works**, the TJBs will be located immediately adjacent to Compound A, in the strip of land between Compound A and the existing footpath that runs adjacent to Dublin Bay between Sandymount and the Great South Wall.

238. This area, landward of the existing footpath, consists of two pre-existing embankments. The first (hereinafter referred to as the ‘front berm’), closest to the HWM, is approximately +8.00 m above ordnance datum (OD). A depression separates this from a second, slightly taller embankment (hereinafter referred to as the ‘rear berm’), within which the TJBs will be located. This rear berm, approximately +9.00 m OD, is known to have been created during the construction of the adjacent hardstanding area.

239. Two service roads positioned between the TJBs will be constructed to facilitate safe access to the TJBs during the operational phase. These roads are shown on planning drawing **0020 Landfall Site Layout as Installed** and will be constructed with imported gravel, such as type 804 crushed stone. Operational access to the TJBs will be via DPC-owned lands and facilitated by two vehicle gates installed within the existing fence line.

240. **Table 4-21** below presents the key assessment parameters for the TJBs design.

Table 4-21 TJB design parameters

Details	Value
Number of TJBs	3
Cable distance from front of TJBs to the HWM (m)	40
TJB chamber dimensions (L x W x D) (m)	18 x 4 x 3

Details	Value
Number of link box and fibreoptic chambers	6
Link box dimensions (L x W x D) (m)	2 x 2 x 3
Link box manhole cover dimensions (L x W) (m)	1.2 x 1.2
Total length of each TJB access road (m)	30
Width of TJB permanent access road (m)	4.5
Total volume of excavated material from construction of the TJBs and link boxes (m^3)	1,992
Total volume of excavated material from construction of the TJBs and link boxes removed offsite for disposal (m^3)	1,992
Total footprint of permanent above ground infrastructure (m^2)	1,200

Limit of deviation (LoD)

241. During the detailed design stage, the final location of the TJBs may need to deviate from the preferred location. Therefore, for the purposes of the planning application and the EIA, limited locational flexibility is sought in the form of a defined LoD of 0.5 m on either side (i.e. east / west) of the preferred TJB location. This is required for the following reasons:

- To accommodate for detailed ground conditions data, acquired during further site investigation works.
- To respond to changes in the alignment of the offshore export cables.

Installation

242. The construction of the TJBs is expected to be phased in line with the installation phases of the offshore and onshore export cables, typically in the following sequence:

- Excavation of the TJB construction area;
- Installation of landfall cable ducts (described in the **Section 4.8.3**);
- Construction of TJB base structures;
- Pulling of the onshore and offshore export cables into the TJBs and the jointing of the cables;
- Completion of the TJB structures; and
- Backfill of excavations, reinstatement of construction areas and construction of the operational service road.

243. As shown on planning drawing **0018 Landfall Details, Construction Sequence - (Open cut) - Sheet 2 of 2**, the TJB construction will follow the installation of the landfall cable ducts, as described in **Section 4.8.3** below.

Excavation of the TJB construction area

244. The rear berm will be excavated to create a construction area for the three TJBs and to facilitate the laying of the cable ducts towards the intertidal area.

245. As the nature of the excavated material is unknown, it is currently assumed that the material will not be suitable for reuse and will therefore be taken off site for disposal. However, during the detailed

design stage, maximising beneficial reuse of the excavated material on site will be prioritised over offsite disposal.

Construction of TJB base structures

246. TJB construction will commence following the installation of the landfall cable ducts (described in **Section 4.8.3**). Temporary sheet piles will be installed in a rectangular shape to provide temporary support to the ground as the excavation progresses down to the target level. The sheet pile walls will be installed using an excavator-mounted vibratory piling tool. It is anticipated that piling for each of the TJB excavations will take approximately one day to complete and three days in total.

247. The concrete walls and base of the TJB will then be constructed within the area formed by the temporary sheet piles.

Pulling of the onshore and offshore export cables into the TJBs and the jointing of the cables

248. Once the concrete TJB base structure has been constructed, the offshore export cables will be pulled into the TJB and the connection made. In order to pull the cables through the cable ducts and into the TJBs, a temporary winch platform composed of hardstanding, such as compact aggregate, will be required to the north of the TJBs (within Compound A). Sheet piles may be driven into the ground in order to anchor the winches. These sheet piles will be removed following completion of the cable-pulling operation. As above, these will be installed using a leader rig with vibratory hammer and will take approximately one day to install.

Completion of the TJB structures

249. The TJB will be backfilled with a suitable material, such as thermal cement-bound sand, to provide the correct thermal resistivity.

Backfilling of excavations, reinstatement of construction areas and construction of the operational service road

250. To ensure safe access to the TJBs during the operational phase of the CWP Project, the land above will be backfilled to a level of +5.0 LAT. This will result in a permanent reduction in the height of the rear berm of approximately 4.0 m, over a plan length of 70 m. The planned post-construction levels are shown on planning drawing **0021 Landfall Sections at TJB & High Water Mark**.

251. As part of the rear berm reinstatement, the TJBs will be covered with topsoil and replanted with grass. The link boxes and the service road will remain as the only permanent areas of new hardstanding.

4.8.3 Landfall cable ducts (and associated offshore export cables within the ducts)

Infrastructure design

252. Cable ducts will be installed by open cut trenching. This will require the excavation of a single swathe with three cable trenches between the TJBs and the intertidal area, within which landfall cable ducts for each of the three cable circuits will be laid and buried. Landfall cable ducts will be 50 m in length.

253. Prior to the commencement of open cut cable duct installation, a temporary cofferdam will be installed to act as a barrier against tidal inundation while the existing stone-covered foreshore is temporarily removed and the ducts installed. The cofferdam will be installed in such a way as to permit open cut trenching from the onshore area to the intertidal area, allowing a dry working area below the HWM. Planning drawing **0016 Intertidal Works Layout Plan** shows the likely extent of the temporary cofferdam, consisting of two side walls, 40 m in length, and a wide front wall, 75 m in length. The height of the cofferdam will be +3.0 mOD.

254. A water- or sand-filled cofferdam, as shown in **Plate 4-17**, is likely to be a viable option, taking into account the low tidal pressures. Alternatively, the cofferdam would be constructed of steel sheet piles. An example of the type of sheet piling that would be used for the intertidal cofferdam is shown in **Plate 4-18**.

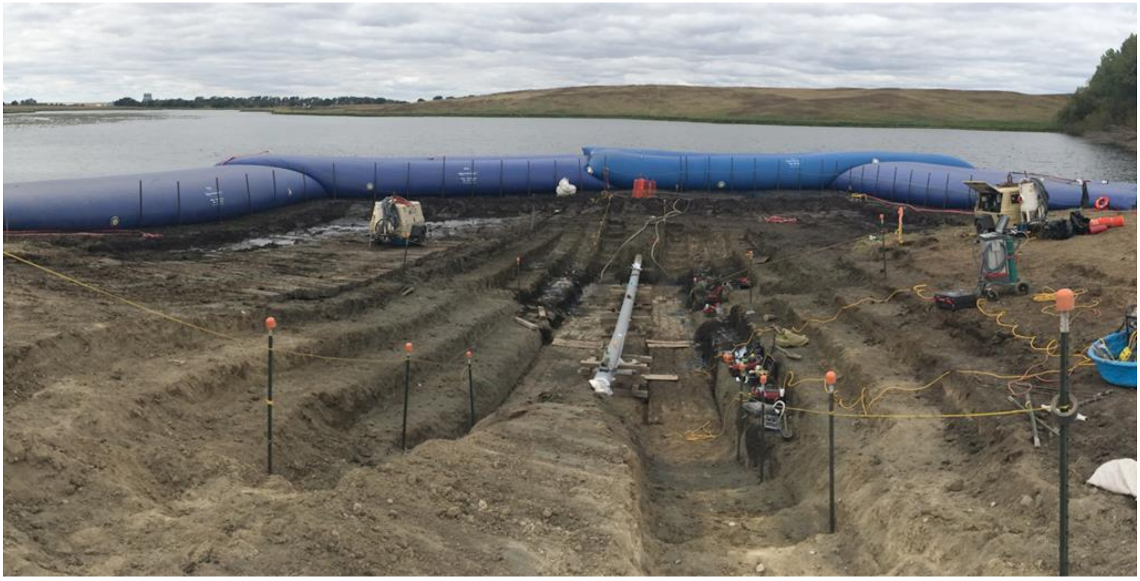

Plate 4-17 Example cofferdam filled with sand / water (Ref. Aqua Barrier, Construction Dewatering Applications | HSI Services, Waller, TX (aquabarrier.com)

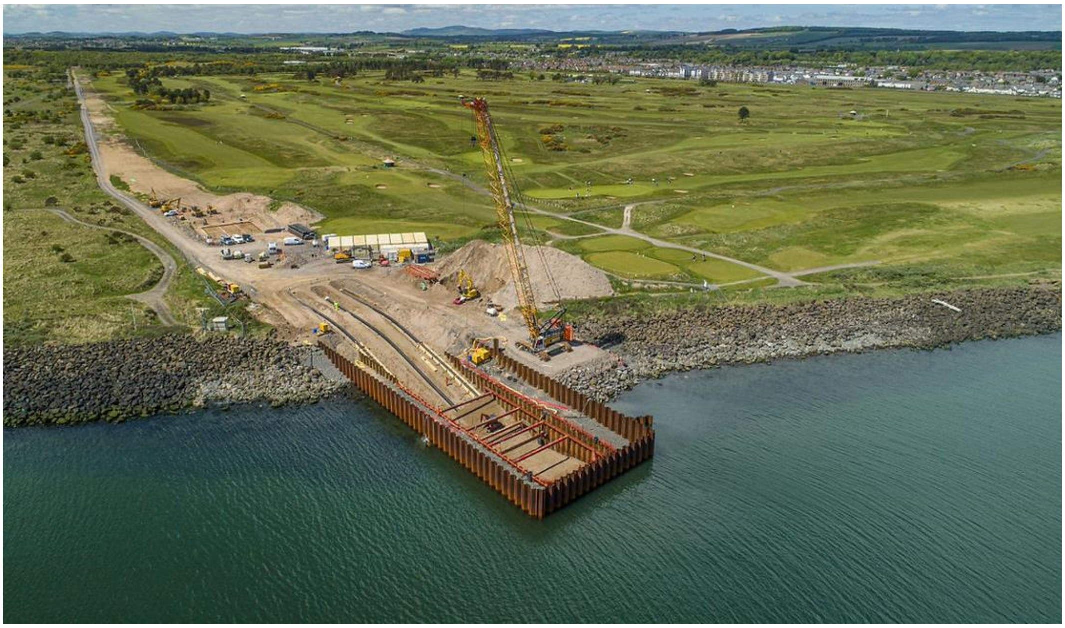

Plate 4-18 Example of cofferdam sheet piling (Source: https://www.seagreenwindenergy.com/post/landfall-works-completed-for-scotland-s-biggest-offshore-wind-farm)

255. It is anticipated that equipment and vehicle access will be required from the seaward side of the existing footpath. This will be achieved by a temporary construction access gravel ramp from above the HWM to the intertidal area.

Limit of deviation (LoD)

256. The horizontal alignment of the landfall cable ducts is directly linked to the location of the TJBs, which is subject to a LoD, as described above. Therefore, for the purposes of the planning application and the EIA, limited locational flexibility is sought in the horizontal alignment of the landfall cable ducts in the form of a defined LoD. Between the TJBs and the HWM, the landfall cable ducts will be installed within a defined LoD boundary with a width of 30–55 m.

257. **Table 4-22** presents the key assessment parameters for the landfall cable duct design, including the temporary cofferdam.

Table 4-22 Landfall cable duct design parameters

Details	Value
No. of landfall cable ducts	3
Length of landfall cable ducts (m)	50
Dimensions of temporary access ramp (including route from main compound) (L x W) (m)	60 x 10
Area of site clearance for temporary access ramp (m^2)	600
Temporary cofferdam dimensions (L x W) (m)	40 x 75

Installation

258. In summary, open cut cable duct installation will require the following activities, as illustrated on planning drawings **0017 Landfall Details, Construction Sequence - (Open cut) - Sheet 1 of 2**, **0018 Landfall Details, Construction Sequence - (Open cut) - Sheet 2 of 2** and **0019 Landfall Details, Construction Sequence - (Open cut) - Sheet 2 of 3**:

- Site clearance between the TJBs and the HWM;
- Construction of a temporary access ramp onto the intertidal area;
- Excavation of the rear berm (described in **Section 4.8.2**);
- Excavation of the front berm and temporary diversion of the adjacent footpath;
- Construction of a temporary cofferdam;
- Removal of the existing coastal revetment;
- Installation of open cut cable duct between the repositioned footpath and the intertidal area;
- Backfill of trenches and reinstatement of the footpath to its original position;
- Reinstatement of the existing coastal revetment;
- Removal of the temporary cofferdam;
- Complete installation of onshore open cut cable duct to TJBs (within the front berm);
- Backfill of trenches and reinstatement of the front berm; and
- Landscaping of disturbed areas between HWM and TJBs.

259. Each of the above activities are described in more detail below, followed by **Table 4-23**, which presents the key assessment parameters for landfall cable duct installation.

Site clearance between the TJBs and the HWM

260. Site clearance works will involve the removal of any unwanted features on site within the extent of the planned excavation works, as shown on planning drawing **0017 Landfall Details, Construction Sequence - (Open cut) - Sheet 1 of 3**.

261. This will include vegetation that would interfere with construction activities. These clearance activities have the potential to result in the spread of invasive alien species (IAS), which have been identified within the onshore development area. As such, the Applicant has prepared an **Onshore Invasive Species Management Plan**, which includes management options to prevent any accidental spread of IAS.

262. In addition, soil will be stripped and stockpiled within Compound A or exported off site for reuse or disposal as appropriate.

Construction of a temporary access ramp onto the intertidal area

263. The location of the access ramp is shown on planning drawing **0015 Temporary Access Ramp on the Intertidal Area**.

264. A managed footpath crossing will be provided as part of this temporary access ramp design. It is anticipated that this will be required for 24 months, although there will be periods of time within this 24-month window when there will be no works in progress on either side of the footpath. During these periods, it is intended that secure temporary fencing will be installed to provide safe, clear, unobstructed access across the temporary access ramp.

265. A typical methodology for the installation of the ramp is provided below:

- Where possible, the existing shore protection at the HWM will be left in place and covered with a geotextile layer to provide a base for the ramp material. Alternatively, the existing shoreline material may need to be removed locally and stockpiled for later reinstatement (likely at the main compound).
- If required, a drainage pipe will be installed in the ramp to allow water to drain away from the ramp and prevent pooling.
- 1 t woven bags filled with clean sand will then be placed on the sides of the ramp to contain the ramp material.
- Gravel material will be placed on the geotextile and between the sandbags to provide a safe and durable access ramp to the intertidal area.
- Ramp construction will be by a 30 t excavator supported by 25 t or 30 t articulated dump trucks and/or standard road tipper trucks.

266. Construction of the access ramp is expected to take two weeks and will be operational during phase one and phase two of the landfall works. Following completion of the landfall works, care will be taken to ensure simple removal of the temporary ramp and minimum reinstatement works.

Berm removal and footpath diversion

267. The open cut excavation between the TJBs and the HWM will consist of a single swathe 40 m in length and 70 m wide. A trench for each cable circuit 3 m deep and 3 m wide (1 m at base) within this swathe. The extent of the planned excavation works is shown on planning drawing **0017 Landfall Details, Construction Sequence - (Open cut) - Sheet 1 of 3**.

268. Firstly, the rear berm and front berms will be excavated. This will form part of the excavation of the TJB construction area, as described in the **Section 4.8.2**. The berms will be excavated using land-based equipment such as excavators, wheeled dumpers and bulldozers.

269. A temporary haul road will be established within the swathe. This will provide an access route between Compound A and the intertidal area for plant and equipment.

270. A temporary footpath diversion will be provided to maintain public / recreational access while the landfall cable ducts are installed and the trenches backfilled. The alignment for the footpath diversion is shown on planning drawing **0017 Landfall Details, Construction Sequence - (Open cut) - Sheet 1 of 3**. It is anticipated that this temporary footpath diversion will be in place for eight weeks. It is possible that some work activities will require short periods of restricted access along the footpath while the footpath diversion is established. For the purposes of the EIA, it is assumed that access to the footpath may be closed for up to one day at a time and up to two days in total; however, it is likely that works can be undertaken in such a way that will avoid any need to close the footpath.

Construction of a temporary cofferdam

271. As described above, a water- or sand-filled cofferdam is likely to be a viable option, taking into account the low tidal pressures. Alternatively, the cofferdam would be constructed of steel sheet piles. For the purposes of the EIA, it is assumed that the temporary sheet-piled cofferdam, if required, will be installed using vibropiling. A typical methodology for a sheet-piled cofferdam installation is provided below:

- Access to the cofferdam working area will be from the haul road within the open cut swathe. Access along the diverted footpath will be maintained by means of a controlled crossing point.
- To install the cofferdam walls, an area of the existing revetment approximately 1–1.5m wide will be stripped. Rock armour will be removed during the low tide cycle using 30 t or 45 t excavators and set aside adjacent to the cofferdam for reuse. The stripped area will then be overfilled with the imported granular material to form the piling platforms above the tide level.

- The piling platforms will be constructed above the HWM using 35 t and 45 t excavators, 25 t dumpers and rollers. The cofferdam sheet-pile walls will then be installed first using a leader rig with vibratory hammer (such as a MRZV 30 VV), together with a 50 t crawler crane.
- The temporary fill material for the construction of the piling platforms will be transported using 25 t or 30 t articulated dump trucks via the haul road.
- Once the cofferdam wing walls are installed through the revetment, the removed rock armour will be placed against the outside face of the cofferdam for further protection of the previously exposed area.
- The cofferdam walls will be extended, with piling undertaken from the existing beach level during the low tide cycle. The final phase of the piling works will involve the construction of the front face of the cofferdam.
- Once the cofferdam is in place, the remaining rock armour within the cofferdam footprint will be removed using the long reach with grab. Material will be loaded onto dumpers and removed from the work front and set aside for reuse.

272. It is expected that the works to complete the cofferdam will take approximately six weeks, including a total piling duration of two weeks. All piling from within the intertidal area will be undertaken during the low tide cycle, with an anticipated four hours of piling per day.

273. To ensure a safe working operation, installation of the temporary cofferdam will be required to take place during the low tide cycle (twice per day), which varies each day. Therefore, flexibility regarding the time of day that this work takes place is required, with some days requiring working outside of core working hours. This may include sheet-piling works for the temporary cofferdam, including during night-time hours. Assessment of the noise and vibration impacts of this piling activity is described in EIAR **Chapter 24 Noise and Vibration**,

274. Works will be lit by localised task lighting, which will minimise the potential impact of light pollution at night.

Open cut cable duct installation between the TJBs and the intertidal area

275. After installation of the temporary cofferdam, open cut trenching and cable duct installation will commence between the repositioned footpath and the intertidal area (within the cofferdam).

276. A trench for each circuit up to 3 m in depth will be excavated using a backhoe and / or 360° excavator, with access provided via the haul road.

277. As the nature of the excavated material is unknown, it is currently assumed that the material above the HWM will not be suitable for reuse and will therefore be taken off site for disposal. However, during the detailed design stage, maximising beneficial reuse of the excavated material on site will be prioritised over offsite disposal.

278. Available space within the cofferdam and within the open cut swathe (above the HWM) will be used to stockpile excavated material that can be reused alongside designated material stockpiling areas within the main compound.

279. Once the required depth for the trench is achieved, the cable ducting for each of the three cable circuits will be installed. The trench can then be backfilled and the ground above reinstated.

Backfilling of trenches and reinstatement of the front berm

280. Once cable duct installation between the repositioned footpath and the intertidal area is complete, the footpath will be reinstated to its original position. Trenching and cable duct installation will be completed for the remaining section of cables above the HWM, up to the TJBs. This will follow the

same process as described above and will conclude with reinstatement of the impacted area, including reinstatement of the front berm.

281. At this point, the existing coastal revetment can also be reinstated and the temporary cofferdam removed. The existing coastal revetment will be reinstated simultaneously to the cofferdam being removed. The revetment will be restored to its previous state using a combination of the existing rock armour, where it is approved for reuse, and newly imported rock armour.

Landscaping of disturbed areas between HWM and TJBs

282. The berm at the landfall will be reinstated once the construction works are completed at this location. This will incorporate the replanting of vegetation at the landfall site following the completion of the works, including a mix of native trees (see planning drawing **0057 Onshore Landscaping Plan**). The mix of native tree species will include bat-friendly scented species such as dog rose, guilder rose and hazel, which will attract and benefit bat species.

Table 4-23 Landfall cable duct installation parameters

Details	Value
Construction of a temporary access ramp onto the intertidal area	
Typical duration of temporary access ramp (months)[1]	24
Site clearance between the TJBs and the HWM	
Area of site clearance at the TJBs (m^2)	2,200
Area of site clearance between TJBs and the HWM (m^2)	2,200
Total area of site clearance (m^2)[2]	5,000
Berm removal, footpath diversion and installation of temporary cofferdam	
Total piling duration for temporary cofferdam (weeks)	2
Duration of temporary cofferdam once constructed (weeks)	4
Duration of temporary footpath diversion (weeks)	8
Total seabed disturbed by cofferdam (m^2)[3]	6,100
Open cut cable duct installation between the TJBs and the intertidal area	
No. of open cut trenches within open cut swathe	3
Width of open cut trenches (m)	3 (1 m at base)
Depth of open cut trenches between TJBs and the HWM (m)	3
Typical volume of excavated material between the TJBs and the HWM (m^3) (includes 220 m^3 for access ramp)	4,224
Typical quantity of excavated material between the TJBs and the HWM to be removed off site for disposal (m^3) (includes 220 m^3 for access ramp)	4,224

[1]Access ramp operational from April to August (inclusive).

[2]Includes TJB area and temporary access ramp.

[3]Includes 20 m working area around footprint of cofferdam for installation and subsequent removal.

4.8.4 Intertidal cable ducts (and associated offshore export cables within the ducts)

Infrastructure design

283. Intertidal cable ducts are those located in the intertidal area, from the seaward end of the landfall cable ducts to the transition zone, approximately 350 m from the HWM.

284. The key design parameters for the intertidal cable ducts are described in **Table 4-24** below.

Limit of deviation (LoD)

285. The horizontal alignment of the intertidal cable ducts corresponds directly with the alignment of the offshore export cables. The LoD for the intertidal offshore export cables also therefore applies to the intertidal cable ducts, within which the cables will be installed.

Table 4-24 Intertidal cable duct key design parameters

Details	Value
Number of intertidal cable ducts	3
Length of intertidal cable ducts (from end of landfall cable ducts to approximately 350m from HWM) (m)	300

Installation

286. Following removal of the temporary cofferdam for the landfall cable ducts installation, as described in **Section 4.8.3**, intertidal trench excavation will continue seaward, to approximately 350 m from the HWM for installation of the intertidal cable ducts. This will be undertaken by means of elevated and conventional 360° excavators.

287. Single trenches up to 3 m in depth and 18 m wide (1 m at base) will be established, with cable ducts laid in sections, connected and stabilised using concrete weighted collars (see **Plate 4-19**). The trench will be backfilled with the end of the ducts capped and buried, ready for the cables to be pulled through the installed ducts.

288. For or the purposes of assessing temporary disturbance from cable duct installation between the cofferdam and the transition zone in the EIA, a width of 40 m of seabed is used. This encompasses the trenching works, the footprint for associated excavators and any spoil that is be generated at either side of the trench.

289. The installation of the cable ducts will require the crossing of three existing assets. The asset crossings (described within **Appendix 4.2 Preliminary Offshore Cable Crossing Schedule**) will require the installation of cable protection in the form of concrete mattresses.

290. To achieve a separation layer, a concrete mattress will be placed over the existing asset. The cable duct will then be laid across this at an angle close to 90 degrees. The cable duct will then be covered by a second mattress, to ensure a minimum depth of cover of 1.2 m, to secure the cables in place and ensure that they remain protected. **Plate 4-20** provides an example of this form of mattress protection.

291. Excavation and burial of the cable ducts (including installation of cable protection) is expected to take two to three weeks per circuit and therefore six to nine weeks in total.

Plate 4-19 Open cut cable duct excavation (Source: Photo by S. Wheel EWIP Project)

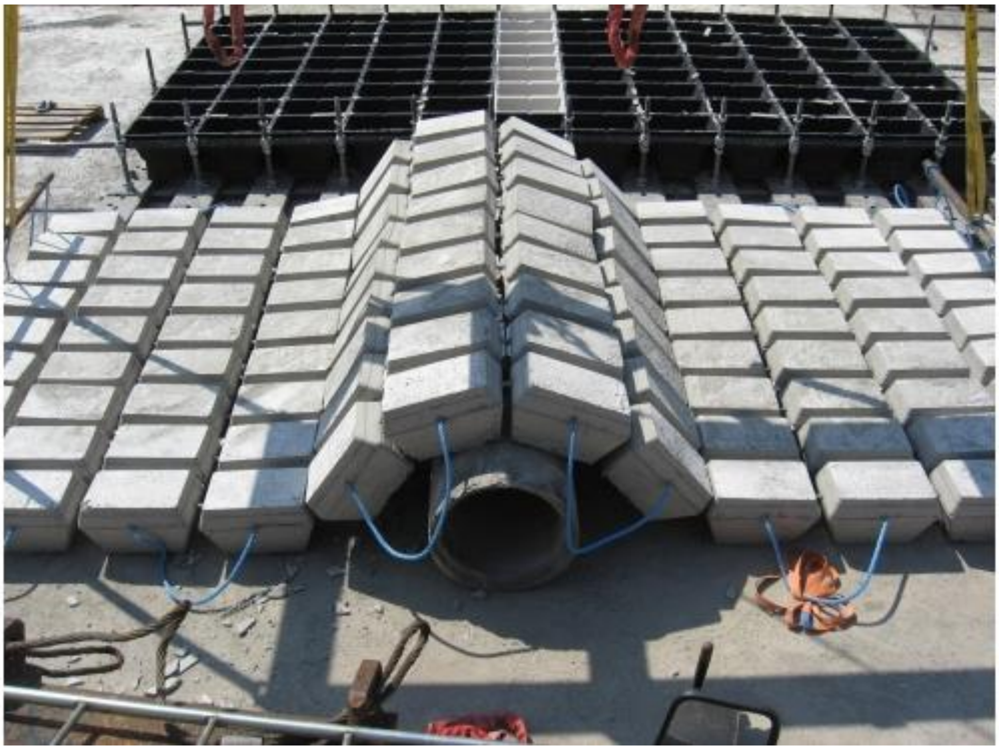

Plate 4-20 Concrete mattresses for cable protection (Source: Maccaferri)

292. **Table 4-25** presents the key assessment parameters for intertidal cable duct installation.

Table 4-25 Open cut intertidal cable duct installation parameters

Details	Value
Number of open cut cable duct trenches from cofferdam to the transition zone	3
Length of open cut cable duct trenches (m)[1]	300
Width of open cut cable duct trenches (m)	18
Minimum depth of cover (m)	1.4
Trench depth (m)	2
Width of seabed affected by installation (m)	40
Total seabed disturbed (m^2)	36,000

[1]Assumes open cut cable duct installation within cofferdam to 50 m from the HWM.

4.8.5 Intertidal offshore export cables (non-ducted sections)

Infrastructure design

293. Within the transition zone, intertidal offshore export cable installation will involve free-lay of three non-ducted export cables followed by post-lay cable burial. Both activities will take place during Phase 2 of the landfall works; see **Table 4-27.** The shallow-water transition zone section of the offshore export cables will therefore be installed separately to the sections of the offshore export cables in deeper water, as described in **Section 4.7.5.**

Limit of deviation

294. The horizontal alignment of the intertidal non-ducted sections of the offshore export cables is as described in **Section 4.7.5** above, with specific locations presented with an LoD in the form of the OECC.

Installation

Support structures

295. To lay the cables over the tidal flats prior to burying them, a number of support structures will be installed to help guide the cables towards the shoreline. The equipment required is described in the following sections.

Mid-support pontoon

296. A mid-support pontoon (MSP) (see **Plate 4-21**) may be installed at the seaward end of the transition zone to guide the pulling of the cable from the CLV towards the intertidal area. The MSP is a pontoon that is floated into position and stabilised with anchors or mooring pins. The structure will sit on top of the mudflats during the low tide cycle.

297. The MSP is expected to be held in position by four anchors deployed from the MSP, or more likely by two spud poles (a steel pole that is lowered through the vessel to secure itself to the bottom).

298. The MSP will function as a point to keep the cable from floating too far out of the cable route, ensuring a safe and controlled operation. The MSP will also include an additional pulling winch for the first pulling operation between the CLV and MSP.

299. The MSP is expected to be in place for approximately six months, including its relocation following the installation of each cable circuit.

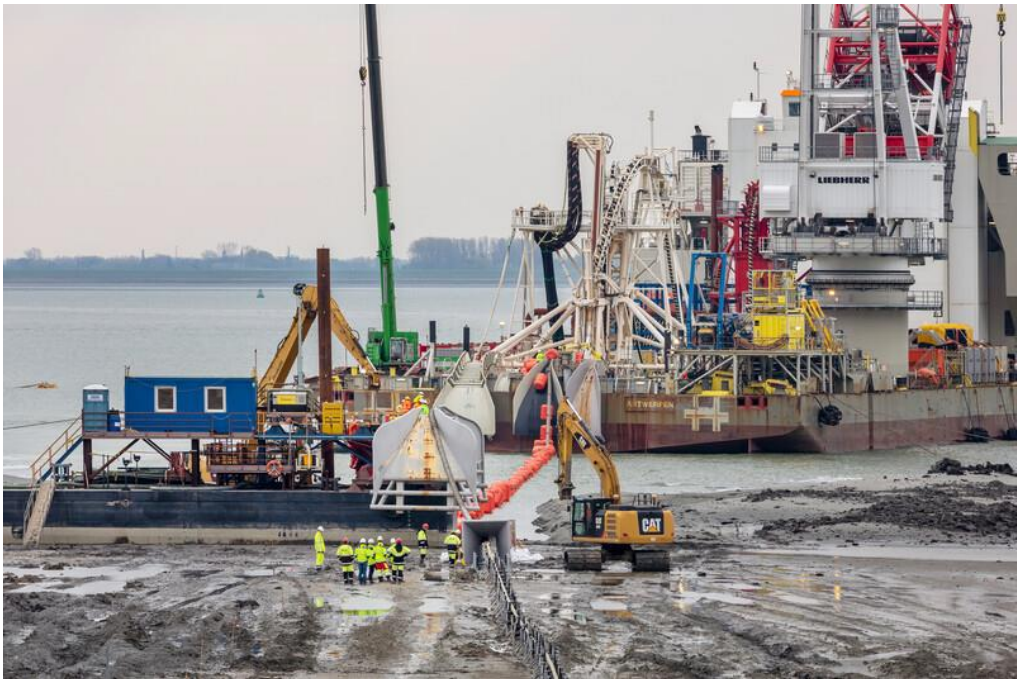

Plate 4-21 Mid-support pontoon (MSP) (Source: Boskalis)

Tensioner platforms, rollers and raised equipment storage platform

300. Three tensioners on raised platforms may be installed to accommodate the required pull-in length on the tidal flat. If they are static (i.e. not floating), the raised platforms will be of a height to ensure the platform remains above the high water level. The tensioner platforms are expected to be at 1 km spacings from the TJB along the alignment of the offshore export cables, with up to three platforms required for each cable circuit.

301. To accommodate the pulling forces generated by the tensioner, a sheet-piled wall may be installed in front of the raised platform (see **Plate 4-22**). For the purposes of EIA, it is assumed that a temporary sheet-piled wall will be installed for each of the three tensioner platforms using vibropiling. This is expected to require one day of sheet-piling activity for each platform and therefore nine days in total for three cable circuits. Piling for the tensioner platforms will be undertaken using an excavator-mounted vibratory piling tool during the low tide cycle.

Plate 4-22 Tensioner platform (Source: Boskalis)

302. Rollers will be installed at suitable spacings, typically 8–10 m, from the MSP or tensioner platforms to the landfall duct entry points. The roller track will accommodate the cable pull-in and ensure safe and efficient handling of the cable during the pull-in on the tidal flats. At the start of the roller track or where the cable changes direction, a beach chute may be positioned to guide the cable.

303. For the purposes of EIA, it is assumed that all rollers (400 per cable circuit) will be installed using short 2–3 m circular piles, installed and removed using an excavator-mounted vibratory piling tool. Piling for the rollers will be undertaken using during the low tide cycle only.

304. A separate raised equipment storage platform or barge (see **Plate 4-23**) may also be anchored within the transition zone to enable the storage of land-based plant and equipment during high water. This will enable transition zone plant and equipment to be kept on site during the high water cycle, reducing the number of trips to and from the main compound for storage. The platform / barge would utilise a ramp to on / offload the plant and equipment onto the intertidal area.

Plate 4-23 Equipment storage barge (Source: Boskalis)

305. The raised equipment storage platform will be held in position by four anchors deployed from the platform, or more likely by two spud poles (a steel pole that is lowered through the vessel to secure itself to the bottom).The tensioner platforms, rollers and equipment storage platform are expected to be in place for approximately five months, including the relocation of the support structures following the installation of each cable circuit. For a single cable pull it would be envisaged that a support structure will be in position for approximately two to three weeks.

Cable pull-in

306. After the beach equipment is mobilised the cable float-out/pull-in will be prepared.

307. The cables will be pulled to shore by a winch, located behind the TJB in the construction compound, connected to a pulling in head on the cable.

308. The CLV will connect the MSP pulling wire to the cable. The winch, located at the TJB will begin to pull the cable landwards, with assistance provided by the MSP and intermediate platforms as necessary. Flotation devices will be attached to the cable, as shown in **Plate 4-24**.

309. The float-out will continue up to the MSP, where the cable will be guided through the tensioner at the MSP and over the roller track. The cable will be guided over the rollers using an excavator and a sling to lift the pulling arrangement over the roller.

310. For the final section, the cables will be pulled through the pre-installed intertidal cable ducts and landfall cable ducts.

Plate 4-24 Flotation devices to support cable pull-in (Source: Photo by S. Wheel)

311. The cable will be pulled beyond the TJB to accommodate cut offs during the jointing and then safely secured. After the pull-in operation is complete, the cable will be lifted from the MSP, tensioner platforms and rollers onto the beach using excavators.

312. All pull-in support structures will be removed after the cable pull-in for each cable circuit is complete. Where possible, the tensioners will be suitably located to support multiple cable pulls. However, they may require relocation to ensure correct cable installation is achieved. The MSP will also require relocation for each cable circuit.

Plate 4-25 Rollers for cable pull-in across intertidal areas (Source: Boskalis)

Cable burial

313. Two methods of cable burial are likely to be applied within the transition zone.

314. From the landward end of the non-ducted intertidal offshore export cables up to approximately 2km, the cable will be buried by excavators and support vehicles. The excavators will excavate a trench of approximately 100–150 m long at a time to a depth of 2 m. After the correct depth has been achieved, the cable will be lifted and lowered into the trench, also using an excavator.

315. For the next section, it is anticipated that cable burial using a shallow-water wheeled or tracked, jet or mechanical trenching system will be required over a distance of approximately 2 km to the location at which the CLV is able to commence conventional cable burial, as described in **Section 4.6.4** of this document.

316. The shallow-water trencher will be supported by several workboats which have the power and support equipment installed to operate the shallow-water trencher. Support personnel will assist the tool during the low tide cycle and confirm that the required burial depth is being achieved. Alternative post-burial methods using ROV equipment may also be considered post-consent by the appointed cable contractor.

Plate 4-26 Example shallow-water trenching tool (Source: Jan De Nul)

317. **Table 4-26** below presents the key assessment details for the installation of the non-ducted sections of the intertidal offshore export cables.

Table 4-26 Intertidal offshore export cable installation details

Detail	Value
Minimum depth of cover (m)	1.4
Trench depth (m)	2
Support structures	
Number of MSPs	1
MSP dimensions (m)	20 x 50
Number of tensioner platforms	3
Tensioner platform dimensions (m)	15 x 10
Approximate number of rollers per cable circuit	400
Number of intertidal equipment storage platforms	1
Intertidal equipment storage platform dimensions (m)	70 x 25
Total area of seabed in transition zone affected by support structures (m^2)[1]	6,900
Transition zone cable pull-in / burial	
Distance within the transition zone over which cables will be buried in open cut trenches (km)	1.7

Detail	Value
Width of seabed in transition zone affected by installation of cables using open cut trenching (m)	40
Distance within the transition zone over which cables will be buried using a shallow-water trenching tool (km)	2
Width of seabed in transition zone affected by installation of cables using a shallow-water trenching tool (m)[2]	20
Total area of seabed in transition zone affected by installation of cables using either open cut trenching or a shallow-water trenching tool (m)[2]	108,000
Total area of seabed disturbed	
Total area of seabed disturbed in the transition zone (m^2)	114,900

[1]Assumes that support structures are repositioned for each cable circuit.

[2]Assumes rollers to be encompassed within the width of seabed disturbed by either open cut trenching or shallow-water trenching.

4.8.6 Indicative phasing of landfall works

318. In order to mitigate potential disturbance to overwintering ornithological features of the adjacent South Dublin Bay and River Tolka Special Protection Area (SPA), it is proposed that the landfall works are undertaken in two phases. Activities proposed in each of these phases include but are not limited to those listed in **Table 4-27**.

319. The total duration of landfall works across each phase (including restricted and non-restricted activities) is expected to be 10–12 months.

Table 4-27 Indicative phasing of landfall works

Phase	Activity
Phase 1	Site clearance from TJBs to HWM
	Construction of temporary access ramp
	Excavation of rear berm (TJB)
	Construction of temporary cofferdam
	Open cut cable duct installation
	Backfilling of trenches and reinstatement works
	Landscaping of disturbed areas between HWM and TJB working area
Phase 2	Set up required equipment in transition zone for cable pull-in
	Pull offshore export cable across transition zone through landfall cable ducts to TJB
	Burial of offshore export cable in transition zone
	Jointing of offshore export cables to onshore export cables within the TJBs
	Removal of temporary access ramp
	Reinstatement of land above TJBs and landscaping

4.9 Transmission Component 3 - Onshore transmission infrastructure

4.9.1 Overview

320. This section describes the OTI comprising:

- the onshore export cables; and
- the onshore substation and associated infrastructure.

4.9.2 Onshore export cables

Infrastructure design

321. Three 220kV HVAC onshore export cable circuits will connect to the offshore export cables at the TJBs and will transfer the electricity onwards to the onshore substation proposed by the Applicant.

322. Each cable circuit will comprise three cores with copper or aluminium conductors and insulation / conductor screening. As with the offshore export cables, the cable bundle will also include a fibreoptic communications cable for OWF monitoring and control and a cable for earthing. The key design parameters associated with the onshore export cables are described in **Table 4-28**.

323. The onshore export cables between the landfall and the onshore substation will be installed within an underground tunnel that extends from Compound A, near the landfall, to the proposed onshore substation site.

324. The tunnel will be constructed to house the ducting for the three 220kV onshore export cable circuits, alongside three additional spare ducts. **Table 4-28** presents the key design parameters for the tunnel.

325. From the landfall, the onshore export cable tunnel will be routed north, approximately 0.7 km across Poolbeg Peninsula, to the proposed onshore substation located on the south bank of the River Liffey (see planning drawing **0022 Onshore Development Area - Site Layout Plan - Permanent Works**).

326. Two tunnel drives are expected to be required to complete the works:

- The first will comprise a tunnel driven from a launch shaft at the onshore substation site for a distance of 330 m to the Shellybanks Road reception shaft; and
- The second will comprise a tunnel driven from a launch shaft within the Compound A for a distance of 410 m to the reception shaft on Shellybanks Road.

327. The tunnel will be installed beneath the following manmade structures:

- Old Harbour Wall, which runs along the southern boundary of the proposed onshore substation;
- Stormwater tanks associated with the Ringsend Wastewater Treatment Plant;
- Cooling water discharge channel;
- Ballast Wall; and
- Pigeon House Road.

328. In addition to the above, the tunnel will be installed beneath a number of existing utilities.

Table 4-28 Onshore export cable design parameters

Details	Value
Number of onshore export cable circuits	3
Number of cables per circuit	5
Number of ducts required per circuit	5
First tunnel drive distance (m)	330
Second tunnel drive distance (m)	410
Tunnel total length (m)	740
Tunnel inner diameter (m)	3.0
Tunnel outer diameter (m)	3.6

Installation

Tunnel boring

329. The preferred method of tunnel construction is pipe jacking, which utilises a tunnel boring machine (TBM).

330. The selection of a TBM for the tunnel construction will be subject to further detailed ground investigations. However, based on the geology likely to be encountered, a slurry TBM is likely to be most appropriate. Slurry TBMs are designed for operation in cohesionless soil and are used in areas where ground movement control is essential.

331. The tunnel itself will be constructed using precast concrete jacking pipes. The TBM will be launched initially, followed by the pipes. Each pipe will be lowered into the launch shaft and pushed in behind the TBM by hydraulic rams. The TBM will cut a slightly larger bore than the trailing pipes. Once the hydraulic rams reach their full extension, they are retracted, and the next pipe is positioned ready for installation. The process is then repeated until the tunnel drive is complete.

332. On completion of the first tunnel drive, the TBM is removed from the reception shaft and the remaining equipment stripped from within the tunnel to allow for grouting. The equipment, including the TBM, will then be serviced and relocated to the Compound A launch shaft for the second drive (described in more detail below).

Launch shafts

333. Planning drawings **0024 Onshore Export Cable - General Arrangement - Sheet 1 of 3** and **0026 Onshore Export Cable - General Arrangement - Sheet 3 of 3** show the arrangements of the launch shafts at both Compound A and the onshore substation site.

334. The launch shaft dimensions at the onshore substation site will be 12.5 m in diameter (internal) with a depth of 28.63 below mOD, and the launch shaft dimensions at Compound A will be 12.5 m in diameter (internal) with a depth of 27.5 below mOD.

335. The shaft dimensions have been developed to take account of the requirements of the TBM and also considering the minimum cable bending radius requirement.

336. It is anticipated that the method of construction for the launch shaft, considering both the geology and groundwater, will be wet caisson construction with a concrete plug. The plug will provide a working base for each tunnel drive to allow safe pipe-jacking operations.

337. A reinforced concrete thrust wall will also be constructed on the opposite side of the shaft to the tunnel launch direction. This will distribute the tunnelling thrust loads safely into the ground behind. A headwall will be constructed in the shaft lining to provide support, enabling the installation of an opening through which the tunnelling machine will be launched.

338. The launch sites will require a compound area for shaft installation, TBM preparation and launch, and for ongoing tunnelling operations including spoil handling and possible treatment, pipe stringing and installation.

339. It is anticipated that site preparation for the onshore substation launch shaft will be completed as part of the works to build the site platform for the onshore substation, to be completed in advance of the tunnel construction. Likewise, it is anticipated that site preparation for Compound A will be completed in advance of establishing the tunnel launch shaft at this location.

340. Planning drawings **0028 Onshore Export Cable - Temporary Tunnel Compound 1 (Launch)** and **0030 Onshore Export Cable - Temporary Tunnel Compound 3 (Launch)** provide the compound layout drawing for each of the launch shafts. In summary, each launch shaft compound area will require:

- Office and welfare facilities;
- Car parking;
- Security huts;
- Material laydown and storage areas;
- Plant / equipment laydown areas;
- Slurry plant;
- Workshops;
- Waste and muck-handling areas;
- Waste water storage and treatment;
- Bentonite farm; and
- Grout plant

341. In addition, a high-voltage (HV) substation alongside generators / compressors will be installed to support the shaft and tunnel construction and provide power to the abovementioned facilities.

Reception shaft

342. The Shellybanks Road reception shaft is located approximately 410 m north of the launch shaft at Compound A and 330 m southwest of the onshore substation site. The purpose of the reception shaft is to allow an intervention point for retrieval of the slurry TBM following completion of the individual drives.

343. Planning drawing **0025 Onshore Export Cable - General Arrangement - Sheet 2 of 3** details the conceptual design. The reception shaft dimensions will be 8.2 m in diameter (internal), with a depth of 27.5 below mOD to facilitate the tunnelling construction.

344. The shaft dimensions have been developed to take account of the requirements of the TBM retrieval and considering the minimum cable bending radius requirement.

345. Similar to the launch shafts, it is anticipated that the method of construction for the reception shaft is by wet caisson with a ‘tremied’ base plug. As the base of the reception shaft will be just within the Dublin Boulder Clay and cut off may not be achieved, there will be a requirement to install a concrete plug to resist hydrostatic forces in the temporary state.

346. The plug will provide a working base to receive the machine for retrieval. Headwalls will be constructed in the shaft lining to provide support, enabling the installation of openings through which the tunnelling machine will be received.

347. Planning drawing **0029 Onshore Export Cable - Temporary Tunnel Compound 2 (Reception)** provides a typical compound layout for the reception shaft.

348. The site comprises a private road locally known as Shellybanks Road, which provides access to the electrical substation and auxiliary plant belonging to ESB and secondary access to the Covanta Waste to Energy plant. There may be some temporary requirements to close Shellybanks Road and temporary traffic management plans would be put in place to facilitate access via the South Bank Road in those instances.

349. Local vegetation clearance of hedgerow and trees would also need to be undertaken at the site (see **Chapter 21 Onshore Biodiversity**). However, this vegetation will be reinstated once the works are complete. On Shellybanks Road, landscape mitigation proposals involve native shrub planting over the locations of the onshore export cables (see planning drawing **0057 Onshore Landscaping Plan**).

TJB connection

350. A short section of open cut cable installation will be required between the Compound A launch shaft and the TJBs, with all works undertaken within Compound A. An open cut trench will be formed from the TJBs to the invert level of the launch shaft using temporary trench supports. Ducts will be prelaid, extended into the launch shaft and backfilled ready for pulling cables, as described in the following sections.

351. The key parameters associated with this section of cable installation are presented in **Table 4-29** below.

Tunnel reinstatement and cable installation

352. To reduce the risk of structural deterioration and to eliminate any maintenance requirements for the life of the CWP Project, it is proposed that the tunnel will be grouted up in sections using temporary bulkheads to ensure it is completely backfilled.

353. On completion of the tunnel works, the reception and launch shafts will be backfilled with suitable as-dug material or granular material placed and compacted to an appropriate depth before reinstatement of the ground surface.

354. Cable installation will involve a cable drum, set up on a trailer at the onshore substation end of the tunnel, with a cable winch set up at the landfall end. The winch pulls the cables through the previously installed underground ducts.

355. Each onshore export cable will be pulled into the cable ducts in a single length, therefore avoiding the need for jointing of cables along the tunnel route.

Tunnel installation parameters

356. The key installation parameters for tunnel are presented in **Table 4-29** below.

Table 4-29 Onshore export cable tunnel installation parameters

Details	Value
Tunnel shafts	
Number of tunnel shafts	3
Onshore substation launch shaft dimensions (m) (D (below ODM) x ID x OD)	28.63 x 12.5 x 13.2
Main compound launch shaft dimensions (m) (D (below ODM) x ID x OD)	27.5 x 12.5 x 13.2
Shellybanks Road reception shaft dimensions (m) (D (below ODM) x ID x OD)	27.5 x 8.2 x 8.7
Tunnel invert level (m) (below ODM)	-25.300m
TJB connection	
Length of open cut trench (m)	39
Width of open cut trench (m)	1
Depth of open cut trench (m)	3.5
Material quantities associated with tunnel construction	
Total volume of excavated material (m^3)	22,085
Total volume of material exported from site (m^3)	22,085
Total volume of material imported to site (m^3)	9,356
Duration of works	
Overall duration to complete tunnel construction and cable duct installation (months)	21

4.9.3 Onshore substation

Overview

357. The location and design of the onshore substation was subject to an extensive site selection and design process, accounting for various technical and environmental constraints.

358. The site selection process, described in EIAR **Chapter 3 Site Selection and Consideration of Alternatives**, identified SS11 as the preferred onshore substation site. The site is currently unused land on the southern bank of the River Liffey, reclaimed by DPC in the late 1990s / early 2000s. It is surrounded on three boundaries by water and then by a mixture of industrial uses.

359. The onshore substation will be a gas-insulated switchgear (GIS) design, where the HV equipment is designed to be insulated by pressurised gas.

360. In summary the onshore substation will include:

- Perimeter structures including upgraded revetements and coastal retaining walls;
- Land reclamation for the ESB building;
- Raised site platform;
- One GIS building;
- One ESB GIS building;
- One ESB MV building;

- Three shunt reactors (incorporated within the GIS building);
- One statcom building;
- Three harmonic filters;
- Upgrades to the existing access road from Pigeon House Road to the site entrance;
- New bridge to provide vehicle access across the cooling water discharge channel;
- New internal access road layout within the site boundary;
- Car parking;
- Drainage infrastructure; and
- Security and lighting.

361. A temporary construction compound will be required for the site (Compound C) as described further in **Section 4.9.5.**

Infrastructure design

362. The following sections provide a description of the design of the main components of the onshore substation. The key environmental, technical and stakeholder considerations that informed this design are described further in EIAR **Chapter 3 Site Selection and Consideration of Alternatives**.

363. The following planning drawings present the main components of the onshore substation:

- **0035 Onshore Substation - Site Layout Plan**
- **0038 Onshore Substation - Contiguous Elevations**
- **0039 Onshore Substation - Statcom Building; Floor & Roof Plans**
- **0040 Onshore Substation - Statcom Building; Elevations & Section**
- **0041 Onshore Substation - GIS Building Floor Plans**
- **0042 Onshore Substation - GIS Building Floor & Roof Plan & Section**
- **0043 Onshore Substation - GIS Building Elevations**
- **0044 Onshore Substation - ESB Building; Plan, Elevations & Section**
- **0045 Onshore Substation - ESB MV Building; Plan, Elevations & Section**
- **0051 Onshore Substation - Site Sections - Sheet 1 of 2**
- **0052 Onshore Substation - Site Sections - Sheet 2 of 2**

364. **Table 4-30** at the end of this section summarises the key design parameters for the onshore substation.

Perimeter structures

Revetments

365. New revetments are proposed along the northwest and western boundary of the site along the maritime interface of the River Liffey.

366. Revetments provide a natural economic solution at the marine interface of the site and will likely be armoured with rock. The primary function of the revetments is to provide coastal protection for the onshore substation by preventing the slopes from erosion and scour.

367. The overall length of the revetment will be 150 m and the width, from toe to crest, is anticipated to be 10 m. The crest of the revetement will have a height of +5.24 mOD, which takes account of flood risk considerations, explained in more detail below. Material to construct to revetment will be brought to site via roads. Planning drawing **0051 Onshore Substation - Site Sections - Sheet 1 of 2** illustrates a cross section of the onshore substation site, including the revetment.

368. The final design of the revetment may, if deemed appropriate within the receiving environment, incorporate nature-inclusive design. Nature-inclusive design examples may include structures attached to the revetment that support subtidal fish habitat. Inclusion of nature-inclusive design will be subject to consultation with the relevant regulators.

Limit of deviation (LoD)

369. A LoD in of 0.5–1 m in width is proposed to allow for small adjustments to be made to the location of the revetement. This is required to adapt to the dynamic nature of the River Liffey, which may influence the final required extent of the revetment at the time of construction. This will be informed by an up-to-date bathymetric survey prior to construction.

Coastal retaining wall (combi-wall)

370. The Applicant has been engaging closely with DPC throughout the design process and is committed to developing the onshore substation in such a way that does not conflict or interfere with the planned 3FM Project. This includes a proposal to construct a 325 m-diameter ship-turning circle within the River Liffey, immediately in front of the onshore substation site. The proposed turning circle will require the removal of part of the reclaimed land upon which onshore substation will be built.

371. Due to spatial constraints, revetments are not suitable adjacent to the future DPC 3FM Project dredged turning circle and instead a vertical retaining structure is needed to the northeast of the site and adjacent to the turning circle.

372. This retaining wall structure, also referred to as a combi-wall, will consist of tubular steel piles between which pairs of AZ sheet piles will be installed. The high-modulus wall will be anchored using horizontal tie-rods connected to a balanced anchorage behind. The anchor wall will be formed from AZ sheet piles with steel waling beams and raking steel bearing piles with concrete capping. Planning drawing **0051 Onshore Substation - Site Sections - Sheet 1 of 2** provides a cross section of the proposed combi-wall.

373. The combi-wall will have a total length of 230 m, of which 150 m will be installed directly into the seabed. The remaining section of the combi-wall will be installed within the existing reclaimed land, along the circumference of the future DPC dredged turning circle.

374. The northeast corner of the existing site that will be beyond the combi-wall and would fall within the future turning circle will be excavated from land down to +2.0m CD (-0.51 mOD). The future turning circle will be constructed by DPC at as part of the 3FM project by dredging from this level to the required depth.

Land reclamation for ESB building

375. To the east of existing site and south of the DPC dredged turning circle, it is proposed to reclaim 1,800 m^2 of land to create additional space within the onshore substation site.

376. The construction of the reclaimed land is likely to commence once the revetment and combi-wall piles to the northeast and turning circle have been installed. This is to help avoid the relatively small site from becoming too congested with construction activities.

377. The reclaimed area for the ESB building will be formed by gradually building up the platform with suitable earthworks materials to a sufficient level above the HWM and using a similar combi-wall construction described above. The length of this section of combi-wall is approximately 90 m.

Site platform (including flood risk considerations)

378. As noted, the site is located on the on the southern bank of the River Liffey, close to the mouth of the river, which is tidally influenced.

379. As part of the Flood Risk Assessment (FRA) for the site (EIAR **Appendix 20.3 Flood Risk Assessment)**, it has been determined that the 0.1% annual exceedance probability (AEP) (1:1,000-year return period) high-end future scenario (HEFS) flood level is +4.34 mOD. A minimum freeboard of 300 mm is to be provided resulting in a minimum site level of +4.64 mOD.

380. To allow for local drainage gradients on site, it is necessary to create falls on the roads. The minimum site level will therefore grade upwards from +4.64 mOD to a typical site platform level of +5.00 mOD.

381. A wave action allowance in this area is conservatively assumed as 0.6 m. To protect the site against overtopping due to wave surge, the perimeter levels of the site shall be locally raised to +5.24 mOD (flood level of +4.34 mOD + 0.3 m freeboard + 0.6 m wave action) (see planning drawing **0051 Onshore Substation - Site Sections - Sheet 1 of 2**).

382. Following the removal of top soil from the site and grading to the necessary platform level, the site will be finished with a combination of stoned areas and concrete hardstanding in accordance with EirGrid requirements.

Site drainage and services

Surface water drainage

383. The onshore substation site will require a sustainable drainage system (SuDS) to manage stormwater runoff from new impermeable surfacing.

384. The site is a coastal site and is surrounded on three sides by water. There are no surface-water sewers within close proximity of the site and therefore it is necessary to discharge directly into the adjacent waterbody.

385. It is proposed that a new stormwater collection system is provided to drain runoff from new buildings, structures, hardstanding areas and access roads. The collection system will be divided into four discrete networks to minimise the depth of pipe installation and, consequently, to reduce the risk of the system being affected by high tides.

386. Each network will have its own dedicated outfall, located along the northern boundary of the site. These outfalls will be fitted with non-return valves to ensure that there is no ingress of seawater into the drainage system at times when the tide level is higher than the level of the outfall.

387. The FRA (EIAR **Appendix 20.3 Flood Risk Assessment**) has established that no restriction of discharge rates or provision of attenuation storage is required as the impact of discharging stormwater runoff to a tidally influenced water body such as the River Liffey will be negligible.

388. Regarding water quality, the following measures shall be implemented across the site to ensure water quality leaving the site is acceptable:

- All networks will include a silt trap chamber (catch-pit manhole) upstream of the outfall point to help remove any settleable solids which may have become entrained in rainfall runoff (e.g. silt, grit, dust, litter etc).
- All networks will include a Class 1 bypass oil / fuel interceptor upstream of the outfall point to remove any hydrocarbons which may have become entrained in runoff from on-site vehicle use.

- All oil / fuel interceptors will include a high-level alarm linked to the site telemetry / Supervisory Control and Data Acquisition (SCADA) system to notify site operators when the storage capacity of the units is approaching full.
- All networks will include an emergency shut-off valve (penstock) chamber upstream of the outfall point to prevent discharges during maintenance of the interceptors and silt traps, or in the unlikely event of a significant oil or fuel spillage occurring on site.
- The drainage system serving the transformer area adjacent to the GIS building will include the following additional measures:
  - Each transformer will be contained within a bund fitted with an oil-sensitive bund pump unit, which will cease to operate if oil is detected in the stormwater.
  - A Class 1 full retention oil / fuel interceptor will be located on the drainage system immediately downstream of the transformer bunds.

389. The proposed layout for the stormwater collection system including manholes, pipes, outfalls and water-quality control elements is shown on planning drawing **0036 Onshore Substation - Below Ground Drainage & Services Layout**.

Wastewater drainage

390. Wastewater loading from the onshore substation will be minimal, as the site will be unmanned / operated remotely most of the time. The only sources of wastewater on site will be basic welfare facilities (toilets and wash-hand basins).

391. Although the site is located in close proximity to the Ringsend Wastewater Treatment Plant records do not show any public sewers in close proximity to the site.

392. Separate gravity collection systems will be used to collect foul water from each of the GIS buildings and discharge this to sealed holding tanks.

393. Each tank will be fitted with a high-level alarm linked to the site telemetry / SCADA system to notify site operators when the storage capacity of the units is approaching full. Periodic emptying of the tanks will be carried out by a licensed wastewater disposal company.

Potable water requirements

394. Potable water demand at the new buildings will be minimal, as it is required to supply basic welfare facilities (toilet and wash-hand basin) only. Separate service connections are proposed for each of the EirGrid GIS and ESB buildings.

395. It is estimated that the typical water demand rate will be approximately 0.00148 litres/second (peak) or 217.5 litres/week for each building. This has been calculated based on design guidelines from the Irish Water Code of Practice for Water Infrastructure (IW-CDS-5020-03).

396. The closest water source, an existing 300 mm diameter watermain, is located within Pigeon House Road directly to the south of the site.

397. It is proposed that the site compound will be supplied by a new 100–150 mm watermain, which will be supplied from the existing 300 mm watermain. Smaller service connections (c. 25 mm diameter) will be taken from this pipeline to supply the buildings while the watermain will be looped around the compound to provide an emergency supply for firefighting.

Access

Construction access

398. Access and egress to the site at present is only possible via an existing road entering the site in the southeast corner (see **Plate 4-27** below).

399. The existing access road is accessible from Pigeon House Road, through an area of Dublin City Council land adjacent to Pigeon House Hotel. The road is approximately 2.75 m wide and consists of loose stone build up.

400. A passing bay will be added to the midpoint of the existing road to provide space for two vehicles to pass. It is also proposed to resurface the road with asphalt. However, during construction this access road may not be capable of facilitating large deliveries (i.e. transformers) to and from the site.

401. A structural condition survey and stability assessment will be carried out post consents on the existing seawall along this road to mitigate the risk of structural failure due to heavy loads induced by construction traffic. Upgrade works to the existing access road may be required in the form of new surfacing, widening (where feasible) and port wall upgrade works. See planning drawing **0046 Onshore Substation - Road Construction Details** for details on resurfacing.

Plate 4-27 Existing access road

402. Given the limitations associated with the existing access, it is proposed to install a new access bridge to the west of the site, which will provide vehicle access to site over the existing cooling water discharge channel. See planning drawing **0031 Proposed Bridge Details – Plan** for details.

403. This bridge will enable free-flowing traffic to and from the site and would reduce the reliance on the existing access road.

404. For large deliveries that enter the site via the bridge access, it may be necessary for vehicles to turn into the property yard to the west and reverse back into the site.

405. The bridge is proposed as part of the permanent access solution, so it would be beneficial to construct this at the beginning of the construction programme. However, it is unlikely that the permanent bridge across the channel would be constructed prior to the civil site works commencing, in which case a temporary bailey bridge may be installed to enable construction access until the permanent bridge has been constructed.

Permanent access

406. Permanent access to the substation site will be via the existing access road to the east and the new bridge to the west of the site, as shown in onshore substation layout plan (planning drawing **0035 Onshore Substation - Site Layout Plan**).There will be separate access to the ESB GIS Building and the CWP / EirGrid substation, access being from the existing access road to the east and the new bridge to the west of the site respectively.

407. Upon entering the site via the new bridge, a new access road 25 m in length will also be constructed within the Irish Water site, (see planning drawing **0047 Onshore Substation - Road Construction Details**). This access, which falls outside of the onshore substation operational area, will provide access for Irish Water to carry out maintenance works to the adjacent settlement tanks.

Buildings and electrical infrastructure

408. Planning drawing **0035 Onshore Substation - Site Layout Plan** illustrates the layout of the buildings within the substation.

409. The height of the GIS building is +35.20 mOD. Lightning rods on top of the GIS building will be the tallest feature within the onshore substation site at +38.20 mOD. The elevations of the GIS building are illustrated in planning drawing **0043 Onshore Substation - GIS Building Elevations**. As the site footprint is smaller than the typical substation site, it is necessary to incorporate the shunt reactors within the GIS building footprint.

410. A separate ESB GIS building is proposed in the southeast of the site to house GIS equipment to enable ESB's control of the onshore substation. This building will be fenced off from the remainder of the site and will be accessed via the eastern access road only, with separate parking facilities provided for ESB operatives. The height of the ESB GIS building is +23.10 mOD, with lightning rods on top of the building to +26.10 mOD. The elevations of the ESB building are illustrated in planning drawing **0044 Onshore Substation - ESB Building Plan, Elevations & Section**.

411. One statcom building will be located in the north of the site. The height of the building will be +29.50 mOD, with lightning rods to +32.50 mOD. The elevations of the statcom building are illustrated in planning drawing **0040 Onshore Substation - Statcom Building Elevations & Section**.

412. At present, the superstructure of the buildings is proposed as steel-framed lightweight cladded buildings, with the exception of the GIS building.

413. The GIS building will be in-situ concrete frame up to level 1, with a steel framed light weight cladded structure above. All suspended floors are proposed as composite concrete decks to enable rapid construction.

414. The design of the onshore substation has been developed to reduce the visual impact of the buildings where possible. It takes into account the need for the onshore substation buildings to achieve necessary engineering standards, while also recognising the importance of the surrounding buildings on Poolbeg Peninsula. Key considerations included:

- Material selection: The building facades have been designed to incorporate the architectural narrative of the past, present and future of the Poolbeg Peninsula, giving regard to the materials that currently surround the site: brick, stone and industrial metal.
- Visual massing: The massing of the buildings has been broken up by utilising two materials across the facade, creating an upper and lower layer. These layers are made up of a grey masonry base and metal clad top layer. The layers allow the onshore substation buildings to sit between and stitch together existing buildings in the Peninsula, from a historical and contemporary context.
- Colour selection: The selection of the grey colour was found to be less impactful to other colours and sits well with the blue-grey tones of the water frontage and Dublin sky.

415. Further details can be found in the **Onshore Substation Architectural Design Statement**, submitted as part of the planning application.

Security and lighting

416. Security fencing is required around the perimeter of the onshore substation to prevent unauthorised access to potentially dangerous areas. The height of the fencing will be 2.6 m. Planning drawing **0047 Onshore Substation - Gates, Fencing & Security Details** illustrates the onshore substation gates, fencing and security details.

417. The substation will be secured with CCTV. Lighting shall be provided for in the substation compound to facilitate operations during night-time as per relevant ESBN specification 'XDS-GFS-14-001 110/220/400 kV Substation General Requirements' and EirGrid specification OFS-SSS-400-R2 – OCC General Requirements.

418. External lighting of the substation during the operational phase will be only required for the following purposes:

- access and egress;
- security lighting;
- car park lighting; and
- repair/maintenance.

419. At night, substation lighting will be switched off as the substation will be unmanned. Lights will only be used during periods where and when work is to be carried out (i.e. maintenance) and lights will be positioned to suit the work.

420. The substation lighting system will be controlled manually via switches within the buildings. Exterior lighting to buildings will be controlled by PIR-based motion detectors (passive infrared). Luminaires selected will ensure reduction in spill light and glare and sky glow.

421. The onshore substation electrical infrastructure will be monitored remotely; however, there may be O&M staff visiting the site to undertake works on a regular basis (expected to be once per week). The onshore substation will not be manned, and lighting will only be required during O&M activities.

Onshore substation design parameters

422. The key design parameters for the onshore substation are presented in **Table 4-30** below.

Table 4-30 Design parameters for the onshore substation

Detail	Value
General	
Site area (m^2)	16,050
Perimeter structures (combi-wall)	
Total length of combi-wall (m)	230
Length of combi-wall below the HWM (requiring marine piling)	150
Length of combi-wall above the HWM (requiring terrestrial piling)	80
Perimeter structures (revetment)	

Detail	Value
Total length of new revetments (m)	150
Width of revetement from toe to crest (m)	10
Height of the revetments and perimeter capping beam (+mOD)	5.24
Land reclamation for ESB building (combi-wall)	
Area of reclaimed land (m^2)	1800
Site platform	
Platform level (+mOD)	5
Buildings and electrical infrastructure	
Number of buildings	4
Main GIS building dimensions (L x W x H) (m)	62.75 x 20.67 x 35.20 (+mOD)
ESB GIS building dimensions (L x W x H) (m)	35.97 x 15.95 x 23.10 (+mOD)
ESB MV building dimensions (L x W x H) (m)	10.14 x 5.64 x 8.07 (+mOD)
Statcom building dimensions (L x W x H) (m)	94.02 x 27.87 x 29.50 (+mOD)
Height of lightning protection masts above buildings (m)	3
Access	
Length of new access bridge (m)	25
Width of new access bridge (m)	9.5

Installation

423. The principal installation activities for the onshore substation infrastructure are described in the sections below. The key installation parameters are presented in **Table 4-31**, along with a description of the seasonal restrictions associated with the onshore substation works.

Perimeter structures

Revetments

424. The revetments will be constructed from its toe within the River Liffey, where a rock toe-bund will be installed using a long-reach excavator positioned on land and then profiled using a long-reach excavator at a stable angle towards its crest. The face of the revetment will be formed using core material to fill voids and soft spots before the secondary and primary rock is placed to armour the face and protect it from scour and erosion.

425. Installation of new revetment areas can commence at the same time as the installation of the combi-wall, working from the opposite side of the site towards the combi-wall. The installation of the revetment is expected to take a total of 10 weeks to complete.

Coastal retaining wall (Combi-wall)

426. Prior to installation of the combi-wall piles to the north of the site, some of the existing revetment rock may need to be removed. The revetment along the line of the new combi-wall will be excavated using a long-reach excavator to form a construction trench, removing potential obstacles to piling, decreasing the driven pile length and reducing installation friction. Material removed from the existing revetment will be screened and reused where possible within the construction of the site platform and / or as part of the new revetment.

427. Once the existing obstacles are removed, the combi-wall piles can then be installed.

428. The tubular piles (2.5 m in diameter) are typically installed first in groups of four to six piles using gates to maintain position accuracy. They will be 40 m long and will be driven to a maximum depth of -35mOD. These piles will be installed by means of impact driving.

429. Impact driving comprises a 300 Te crawler crane with an impact hammer attachment which strikes the top of the pile. This method is most commonly used for large-diameter or long-piling elements. It is also suitable for driving piles through the firm clays found underlying the onshore substation site.

430. Vibrodriving can also be used to drive tubular and sheet piles. The system works best in cohesionless soils but becomes ineffective in the firm clays and dense granular materials found underlying the onshore substation site. Vibrodriving is therefore not considered feasible as a standalone piling method but may be used in combination with impact driving where ground conditions are suitable. In this instance, vibrodriving would be used to drive tubular piles through the softer upper layers of sediment at the seabed before deploying impact driving for the deeper firmer layers.

431. The duration for installation of each pile will depend on a number of factors, such as the compaction of the ground and the extent to which the pile can initially be installed using the vibratory hammer. It is predicted that each group of four to six piles will take 24 hours to install. Typically, there is unlikely to be any more than eight hours per day of tubular-pile driving activity.

432. Where piling obstructions are encountered at a depth that prevents the piles achieving their as-designed levels, it may be necessary to advance a drill to clear the obstacle and continue piling. It is conservatively assumed that five tubular piles will require drilling.

433. Once all the tubular piles in a group are installed, the piling gate is advanced to the next sequence of piles and the steel sheet piles are then connected to the tubular piles and driven into place. Again, this is likely to be undertaken using a 300 Te crawler crane with vibratory hammer and impact hammer attachments.

434. For the purposes of the EIA, it is assumed that these piles will be driven into place as opposed to being vibrated. It is anticipated that two sheet piles will be installed between each pair of tubular piles and each sheet pile will take approximately two hours to drive, subject to the ground conditions encountered. Typically, there is unlikely to be any more than eight hours per day of sheet-pile driving activity.

435. The sequence is continued using one piling rig for the tubular piles and a second rig for the infill sheet piles, such that the combi-wall is gradually constructed from one end to the other. Based on this sequence, it is assumed that simultaneous impact driving may occur for the tubular and sheet pile installation, although this may not be possible due to the spatial constraints on site.

436. The piling sequence for the combi-wall will be confirmed post-consent once the main contractor for the onshore substation works has been appointed.

437. Once the tubular and sheet piles are installed, the anchor system will be installed. The first part of this will be to install the steel sheet-piled anchor wall, located approximately 20 m behind the front wall. This will be undertaken using a conventional sheet piling rig. Again, it is assumed that these piles will be driven into place as opposed to vibrated. It is anticipated each anchor wall sheet pile will take approximately one hour to drive, subject to the ground conditions encountered. Typically, there is unlikely to be any more than eight hours per day of anchor-wall sheet-pile driving activity.

438. The ground level between the sheet piles and the combi-wall will be excavated down to the tie level. The sheet piles will then be connected to the tubular king piles via steel tie-rods and the excavation filled up to proposed level with suitable granular fill material. The reinforced concrete capping beams will then be constructed to ensure the combi walls are stable.

439. A section of the combi-wall will require a more robust anchor wall utilising tubular steel raking piles. The raking piles will be driven into the ground by an impact driver similar to the combi-wall tubular piles. A reinforced concrete continuous capping beam will then be formed on top of the raking piles. The tie-rods in this case will be anchored into the capping beam on top of the raking piles.

440. The installation of the combi-wall is expected to take approximately 20 weeks to complete; the precise duration will be confirmed post-consent.

Land reclamation for ESB building

441. It is likely that the reclaimed area will be installed as part of the site platform civil works. This provides the opportunity to use suitable earthworks materials from other parts of the site in the land reclamation and will prolong the period over which the reclamation can settle and consolidate.

442. To avoid using marine construction plant, it is envisaged that a piling platform will be extended from the land using suitable granular fill material to form an initial perimeter and allow the piling operations to commence. An excavator will be used to place material in a controlled manner, gradually building up the platform to a sufficient level above the HWM. The size of this platform, and therefore the volume of material required, will be kept to a minimum.

443. The combi-wall for the area of land reclamation will then be constructed to a design depth that takes account of the future dredge level in front. As such, the future dredging will be accounted for in the quay wall design and selection of wall piles. The combi-wall will be constructed using land-based equipment as described above for the installation of the coastal retaining structures.

444. The anchor wall, tie-rods and capping beam will then be constructed as described above for the installation of the coastal retaining structures.

Site platform (including flood risk considerations)

445. Following the installation of the perimeter structures, the main cut and fill civil works to build the site platform will commence.

446. Proprietary vertical band drains will be installed within the central area of the site that is underlain by a clay layer to help release pore water pressures to accelerate consolidation of the clay layer as the new stone fill platform is installed. The new stone platform will be filled up to the proposed site level in compacted layers.

447. All below-ground proposed drainage will then be installed.

Access

448. The permanent access bridge will span over the existing cooling channel. It is to be constructed on new piled foundations with bridge-bearing bank seats forming the abutments on both the western and eastern sides.

449. New piling platforms will be formed as part of the works and the piles will be drilled and cast via the platform. Upon completion of the piling, reinforced steel will be introduced, and in-situ concrete poured at the piled abutment location to form the bank seats. On the eastern side, an additional piled bank seat will be constructed further east to enable precast concrete planks to bridge over the existing pipe culvert. Existing concrete planks over the pipe culvert will be removed and the height of the culvert will be reduced as necessary.

450. On the western side, the existing kerbing and vehicle restraint will be removed over the width of the bridge. There will be a localised reduction in the height of ground levels, which will include removal of an existing gabion wall over the width of the bridge. This will facilitate the installation of a new piled bridge-bearing beam at this location. The existing gabion wall beyond the proposed bridge will be retained, with some reinstatement directly proximate to the bridge, once the construction works are completed.

451. Once bank seats are constructed, the precast concrete bridge beams will be crane-lifted into place, deck steel and outside shuttering fixed, deck concrete poured and asphalt laid, metal parapets put into place and waterproofing completed.

452. New vehicle restraints will be installed to tie into the existing barrier system.

453. The site will be drained via gullies, with surface runoff into the River Liffey (as would naturally occur) via a headwall along the western edge of the site. A petrol interceptor is proposed to prevent inappropriate chemical outflows.

Buildings and electrical infrastructure

454. All buildings on site are proposed to be piled, with either precast concrete displacement-driven piles or steel-driven piles. For the purposes of noise considerations in the EIA, the piles are assumed to be precast concrete displacement-driven piles.

455. It is assumed that these piles will be driven into place using a top-driven hydraulic hammer such as a Liebherr LRH100 rig, of which there may be up to three in operation at any one time. The installation of the piles for all buildings and electrical infrastructure is expected to take approximately nine weeks, with an anticipated installation rate of 15 piles per day.

456. Continuous flight auger (CFA) or rotary-bored piles are also considered as alternative to precast concrete displacement-driven piles. Both CFA and rotary-bored piles are typically installed using a crawler rig with auger drill.

457. Onshore substation installation parameters **Table 4-31** summarises the main installation parameters for the onshore substation.

Table 4-31 Main installation parameters for the onshore substation

Details	Value
Perimeter structures (revetment)	
Duration of works to construct the revetment (weeks)	10
Perimeter structures (combi-wall)	
Duration of pile driving in a single day (hours)	0–8
Number of piling rigs in operation at any one time	2
Piling hammer energy (kJ)	400
Duration of works to construct combi-wall (weeks)	20
Land reclamation for ESB building (combi-wall)	
Duration of works to complete land reclamation (weeks)	15
Site platform	
Volume of excavated material (m^3)	44,129
Volume of excavated material requiring offsite disposal (m^3)	44,129
Volume of fill material (m^3)	102,228
Duration of civils work to establish substation platform (weeks)	31
Buildings and electrical infrastructure	
Duration of pile driving in a single day	0–8
Number of piling rigs in operation at any one time	3
Duration of work to construct substation buildings (months)	13

458. **Section 4.4** of this document presents an indicative construction programme for main components of the CWP Project.

459. In order to mitigate potential impacts to ornithological features, the following mitigation measures associated with the installation of the onshore substation and associated infrastructure will be implemented:

- Appropriately sized exclusion nets will be installed over the harbour wall prior to the sand martin and black guillemot breeding season (approximately April to September) to exclude birds from nesting holes, as a mitigation measure should it not be possible to avoid works on the harbour wall or reclamation work against the harbour wall for the onshore substation during this period. In addition, prior to any works, a suitably qualified ecologist will ensure there are no active sand martin or black guillemot nests. Full details of the measures proposed are provided in EIAR **Chapter 10 Ornithology**. A Breeding Tern Mitigation Strategy has been prepared to mitigate potential impacts to the tern colonies located close to the onshore substation site. The strategy details several mitigation measures, including restricted working periods, visual screening, construction sequencing, noise and lighting limits, and monitoring and response measures. Full details of the measures proposed are provided in EIAR **Chapter 10 Ornithology**.

460. In addition, piling works along the River Liffey channel will not be permitted between March and May to avoid noise impact during the salmon smolt run.

4.9.4 ESBN network cables

Infrastructure design

461. Three 220kV HVAC onshore export cable circuits will connect from the onshore substation to the Poolbeg 220kV substation, which will then transfer the electricity onwards to the Irish electricity grid. It should be noted that the Poolbeg 220kV substation that the ESBN network cables will connect to has not yet been constructed. The substation is an upgrade to the existing 220kV substation, proposed by EirGrid as part of the 'Powering up Dublin' programme to transform and modernise the city's electrical infrastructure, as well as being essential to facilitate the integration of new renewable energy projects. The construction of the substation has been assessed as part of the Cumulative Effects Assessment (CEA), as detailed in the EIAR CEA appendices for relevant topics.

462. Consequently, the exact location of the connection point for the ESBN network cables has not yet been determined, with the connection to be undertaken by EirGrid once the ESBN network cables have been installed.

463. Each of the cable circuits will comprise the same structure as detailed in **Section 4.9.2**. This will be three cores with copper or aluminium conductors and insulation / conductor screening and a fibreoptic communications cable for OWF monitoring and control.

464. The ESBN network cables will consist of two separate sections, with two distinct installation methods:

- Section A, which consists of cables installed by means of a standard open-cut trench arrangement; and
- Section B, which consists of cables installed by means of HDD.

465. Section A will be approximately 265 m in length from the onshore substation GIS building to an HDD compound, which will be located on Dublin City Council land within Compound C (see planning drawing **0054 ESBN Network Cables – Sections and Layout**). The cables are typically installed in a trefoil (cables bunded together in a triangular shape) or flat (cables laid adjacently and horizontally) formation, depending on detailed cable system design, with sufficient horizontal separation between circuits to ensure thermal separation, to a depth of cover of 1.2 m. A typical cross section for an open-cut section is shown in planning drawing **0048 Onshore Cable Trench and HDD Details** for illustrative purposes.

466. Section B will be approximately 135 m in length from the HDD compound to the Poolbeg 220 kV substation. HDD is a trenchless drilling method used to install cable ducts beneath the ground through which onshore export cables can be pulled. The main objective of the HDD at this location is to avoid a number of underground services / utilities and to avoid conflicts with future changes for the road network being proposed by DPC.

467. **Table 4-32** summarises the key design parameters for the ESBN network cables.

Table 4-32 Key design parameters for the ESBN network cables

Detail	Value
Number of onshore export cable circuits	3
Number of cables per circuit	5
Number of ducts required per circuit	5
Total length of ESBN network cable ducts and associated cables (m)	400
Depth of cover along open cut section (m)	1.2

Installation

468. As noted above, an open cut and HDD technique will be used to install the ESBN network cables.

469. These duct installation works will be undertaken at the start of construction phase, when works for the onshore export cables are being progressed. The actual cable installation and pulling works will be undertaken towards the end of the construction phase and aligned with wider commissioning activities for the OTI.

Open cut

470. Open cut cable circuit installation will involve trenching to install HDPE cable ducts, the trench backfilled and cables pulled through the pre-laid ducts.

471. The following methodology will be used to install the onshore export cables by means of open cut trenching:

- A working area shall be fenced off, within which all construction activities will be undertaken, plant and equipment operated, and materials stored during the working day.
- The trefoil or flatform trench will be excavated by a mechanical excavator to the required depth.
- The excavated material will be placed onto a truck in front of the excavated section of trench. All excavated material will be transported off site for disposal, to minimise the need for soil storage within the corridor.
- A bedding layer of backfill concrete material transported from the main construction compound will be placed in the trench.
- The cable ducts will be stored at the main construction compound. When the trench is ready, appropriate lengths of ducting will be transported from the compound and placed into the trench in the required formation.
- The ducts will then be surrounded by an appropriate cement-bound material to the specified minimum depth of cover.
- The remainder of the trench is then backfilled with a suitable engineered material and reinstated to match the existing environment, as required by the relevant authority.
- The open cut trenching works proceed in this manner along the cable route section until all the ducting is installed.

472. It is generally the case that the open cut cable ducts can be installed in a road at a rate of approximately 50 m per day. There is an existing Irish Water culvert on the route of the Section A open cut. However, site conditions will still allow for an open cut trench installation at this location without impacting on the existing culvert.

Horizonal directional drilling

473. HDD is now commonplace in municipal engineering projects for the installation of electrical cables, optical cables and potable water pipes. Specialist contractors are appointed to undertake the HDD works.

474. The exact methodology for the use of HDD will be confirmed post-consent following a detailed onshore ground investigation campaign and once the HDD contractor has been appointed. For the purposes of the EIA, a typical HDD methodology for the installation of the ESBN network cables is described below.

- The HDD will have a launch and reception pit, which requires the temporary installation of a level hardstanding area on a geotextile base. This will form part of a HDD compound, the requirements of which include:
    - o A launch or reception pit;
    - o HDD equipment, including a drilling rig;
    - o Material and waste storage;
    - o Car parking; and
    - o Welfare facilities
- For the ESBN network cables, the launch pit and drilling rig will be located within the HDD compound located within Compound C. The reception pit will be located within the HDD compound at the Poolbeg 220kV substation.
- The HDD process itself uses a drilling head controlled from the drilling rig to drill a pilot hole along a predetermined profile to the exit point. A typical HDD drilling rig is shown in **Plate 4-28**.
- After the initial pilot hole is completed, it will be widened in a number of passes using larger drilling heads to reach the required bore size to enable the cable ducts to be pulled through.
- Drilling fluid (typically containing bentonite) is pumped to the drilling head to stabilise the borehole, recover drill cuttings and ensure it does not collapse. A comprehensive closed-loop drilling fluid mixing and circulation system with recycling capability will be utilised to minimise the volume of fluids required on site.
- Once the drilling operation has taken place, the ducts are pulled through the drilled holes.
- Once the ducts are in place, the launch and/or reception pits may be temporarily backfilled until ready for cable pull through. The ducts will then need to be re-exposed to pull-in the cable (described below).
- On completion of the works, the launch and/or reception pits will be backfilled, and the stone and geotextile will be carefully removed using a backhoe or 360^{0} excavator and removed off site for disposal. The site will then be reinstated to its original condition.

Plate 4-28 Typical HDD rig (Source: AMS)

ESBN network cables installation parameters

475. **Table 4-33** summarises the key installation parameters for the ESBN network cables

Table 4-33 Key installation parameters for the ESBN network cables

Details	Value
No. of HDD sections	1
No. of drills per section	3
Total no. of drills	3
Total length of HDD section (m)	135
Material quantities associated with open cut/HDD installation (m^3)	3,650

4.9.5 Construction compounds

Infrastructure design

Compound A

476. Compound A will be used as a support area and storage facility for the landfall works, as described in **Section 4.8**. It will also be used to support the installation of the onshore export cables, providing an area within which smaller supporting compound will be established, including the launch shaft compound for the underground tunnel installation.

477. Compound A, located south of the Dublin Waste to Energy Plant, will have an area of 19,800 m^2 and will be accessed from Shellybanks Road (see planning drawing **0023 Onshore Development Area - Site Layout Plan - Temporary Works**). It will be established at the commencement of OTI construction works and will be in place until the OTI works are complete. This will be a period of approximately 30 months.

478. Compound A will include:

- Office and welfare facilities;
- Limited parking for construction personnel and construction vehicles;
- Laydown and storage areas for plant and equipment such as cable drums, cable ducts, aggregates and steel;
- Temporary waste management and storage areas; and
- Temporary storage of excavated material.

479. Access will be restricted to site personnel and authorised visitors only. Access via the compound will be provided for construction vehicles and equipment undertaking landfall works within the intertidal area. This access will be provided in the southeast corner of the compound.

480. At certain stages of the construction phase, the compound will be operational 24 hours per day and 7 days a week. This will be required for landfall activities such as cable pulling. Further details on this can be found in **Section 4.8**.

481. The compound will be hoarded off, lit (as required during working hours) and secured to ensure the safe storage of materials, plant and equipment. Site security and 24-hour security lighting will also be

required at the compound. It is expected that lighting will be in the form of mounted flood lights, angled downwards to minimise spillage from the compound.

482. The compound will be established with the appropriate services, including water, wastewater, electricity and telecommunications. These provisions will be organised and installed by the appointed contractor.

483. Any necessary waste management authorisations will be obtained by the appointed contractor prior to undertaking any temporary storage at the compound.

Compound B

484. Compound B (see planning drawing **0023 Onshore Development Area - Site Layout Plan - Temporary Works**) will provide an additional temporary construction compound/laydown area for general cable route and onshore substation construction activities.

485. Located southwest of the Dublin Waste to Energy Plant, Compound B consists of an area of 32,300 m^2 and will be accessed from Shellybanks Road.

486. The facilities required, as well as access and security arrangements will be as described for Compound A.

Compound C

487. Compound C, required to facilitate the onshore substation and ESBN networks cable works, will be located within the Dublin City Council land to the southeast of the onshore substation site (see planning drawing **0023 Onshore Development Area - Site Layout Plan - Temporary Works**), adjacent to the existing Pigeon House Hotel. Compound C will have an area of 3,350 m^2 and will be accessed from Pigeon House Road via a new temporary access (see planning drawing **0023 Onshore Development Area - Site Layout Plan - Temporary Works**).

488. Contractor welfare facilities will be located in this compound as well as some material storage space and a separate HDD compound for the ESBN network cables. Compound A will have a larger area for material storage and will be the location of the temporary storage of large elements.

Compound D

489. Compound D (see planning drawing **0023 Onshore Development Area - Site Layout Plan - Temporary Works**) will provide a temporary construction compound / laydown area for the construction of the permanent access bridge. Compound D, located adjacent to Hammond Lane metal recycling facility, will have an area of 360 m^2 and will be accessed from Pigeon House Road.

Construction compound design parameters

490. **Table 4-34** summarises the key design and construction parameters for the construction compounds.

Table 4-34 key design and construction parameters for the construction compounds

Parameter	Value
Temporary Compound A area (m^2)	19,800
Temporary Compound B area (m^2)	32,300
Temporary Compound C area (m^2)	3,350
Temporary Compound D area (m^2)	360
Height of main compound perimeter hoarding (m)	2.6

Installation

491. As part of the establishment of temporary construction compounds the following activities will be undertaken:

- Notification to all interested parties;
- Right of way and fencing;
- Topsoil stripping or surface preparation;
- Land drainage and service connection; and
- Site traffic management layout.

492. Heras fencing will be used to secure the compounds. Any topsoil will be stripped off and stockpiled and a hardstanding will then be created. Walkways will be tarmacked and suitably demarked.

4.10 Offshore construction vessel requirements

4.10.1 Construction vessel numbers and round trips

493. For the purposes of the EIA, indicative vessel numbers for offshore the construction phase have been calculated. The peak number of vessels operating within the offshore development area at any one time during the construction phase and the number of round trips between port and offshore development area are summarised in **Table 4-35**.

Table 4-35 Peak construction vessels and round trips to site

Vessel type	Peak vessels		Round trips	
	WTG Option A	WTG Option B	WTG Option A	WTG Option B
Foundations				
Seabed preparation vessels (including surveys, UXO investigation and boulder clearance)	4	4	20	20
WTG and OSS monopile installation vessels (includes installation vessel, feeder vessel and anchor handlers)	6	6	43	35
TP installation vessels	7	7	43	35

Vessel type	Peak vessels		Round trips	
	WTG Option A	WTG Option B	WTG Option A	WTG Option B
Scour protection installation vessels (including filter layer and seabed preparation)	7	7	107	86
WTGs and OSSs				
WTG installation vessels (includes installation vessel, feeder vessel and anchor handlers)	4	4	50	65
OSS topside installation vessels	4	4	20	20
Cable installation vessels				
Seabed preparation vessels (including TSHD for sand wave clearance and disposal off site, PLGR, OOS removal, boulder clearance, pre-crossing protection and survey vessel)	7	7	548	548
Array cable and interconnector installation vessels (includes support, cable protection and anchor handling vessels)	6	6	39	39
Export cable installation vessels (including at landfall) (includes support, cable protection and anchor handling vessels)	5	5	43	43
Nearshore export cable installation vessels (including at landfall) (includes barges, tugs and small work boats)	17	17	118	118
Commissioning vessels				
Commissioning vessels	2	2	48	48
Support vessels				
General support vessels (including guard vessel, project Service Operation Vessel (SOV) and work boats)	4	4	506	506
Crew transfer vessels	2	2	824	824
Total construction vessels				
Total construction vessels	75	75	2,409	2,387
Peak vessels on site simultaneously	38	38	N/A	

4.10.2 Jack-up operations and anchoring

494. As described above, JUVs are capable of lowering three or more legs onto the seabed and lifting themselves out of the water to provide a stable platform where craning can take place. Where they

are used, the feet of the JUVs (known as 'spud cans') will have a direct, temporary impact on the seabed.

495. Alternatively, multiple anchors may be used to position and secure the vessel, which will also have direct impacts on the seabed.

496. The assessment parameters for JUV operations and anchoring are provided in **Table 4-36** and **Table 4-37**.

Table 4-36 JUV operation parameters

Parameter	WTG Layout Option A	WTG Layout Option B
JUV operations		
Individual spud can footprint (m^2)	300	300
Seabed area per vessel (m^2)	1,200	1,200
Typical seabed penetration (m)	5–15m	5–15m
Total jack-up operations during construction	200	150
Seabed area impacted (m^2)	240,000	180,000

Table 4-37 Anchoring parameters

Parameter	WTG Layout Option A	WTG Layout Option B
WTG and OSS installation		
Number of anchors per deployment	8	8
Anchor footprint (deployment and recovery per anchor) (m^2)	225	225
Typical anchor penetration depth (m)	5	5
Number of deployments per location	2	2
Total seabed impact area (m^2)	280,800	237,600
Total seabed impact volume (m^3)	1,404,000	1,134,000
Inter-array and interconnector cable installation		
Number of anchors per deployment	8	8
Anchor footprint on seabed (deployment and recovery per anchor) (m^2)	180	180
Typical anchor penetration depth (m) on the seabed	5	5
Total number of deployments	258	195
Total seabed impact area (m^2)	371,520	280,800
Total seabed impact volume (m^3)	1,857,600	1,404,000
Offshore export cable installation		

Parameter	WTG Layout Option A	WTG Layout Option B
Number of anchors per deployment	9	9
Anchor footprint on the seabed (deployment and recovery per anchor) (m^2)	180	180
Typical anchor penetration depth (m) on the seabed	5	5
Total number of deployments	438	438
Total seabed impact area (m^2)	630,720	630,720
Total seabed impact volume (m^3)	3,153,600	3,153,600

4.11 Operations and maintenance (O&M)

497. This section describes the anticipated operations and maintenance (O&M) activities for the generating station, OfTI and OTI. The O&M information is based on the best available information at the time of writing, as well as regulatory requirements and industry best practice.

498. Once commissioned, the Applicant will be responsible for O&M of the CWP Project for a proving period, which is nominally 18 months. Beyond this date, the Applicant will maintain responsibility for O&M of the generating station and EirGrid will own, operate and maintain the OfTI and OTI. The Applicant will maintain O&M ownership of the IAC termination points, interconnector cables between OSSs and the 66 kV switchgear on the OSSs. For the purposes of the EIA, the Applicant has assessed the O&M requirements for the project as a whole. Ongoing compliance for the OfTI and OTI will be the responsibility of EirGrid upon transfer of the assets after the initial proving period.

499. Reliability and ease of maintenance are both crucial design considerations that are critical to address at the early stage of the project to both minimise the maintenance requirements, and safely facilitate maintenance, when required. The primary objectives of O&M will be to:

- Operate the offshore project components in a safe manner, causing minimal impact on the environment;
- Effectively convert wind energy to electricity and accurately measure and deliver electricity for sale;
- Maximise output while controlling operating expense;
- Safeguard the mechanical integrity of all facilities, substructures and installations;
- Maximise the use of appropriate technologies and processes to improve the efficiency, safety and effectiveness of all operations, transport technology and maintenance activities; and
- Minimise manning and personnel transport to appropriate levels (as far as is reasonably practicable).

4.11.1 Generating station

WTG maintenance

500. The WTGs will be designed to operate unmanned and are expected to be available to produce electricity for approximately 95% of their installed lifetime. Planned outages for a WTG will be triggered primarily by routine maintenance requirements, but also occasionally at the request of the Maritime Rescue Coordination Centre (MRCC) in support of search-and-rescue activities in the area, for

curtailment commissioning, testing and decommissioning. The WTGs will normally shut down during severe weather conditions to avoid damage to the WTG components. This will be controlled remotely, as described below.

501. The WTGs will be remotely monitored and controlled by a central SCADA system, connecting each WTG to the onshore control room(s) via a fibreoptic link. The SCADA system will enable the remote control of individual WTGs, as well as remote interrogation, information transfer, storage and the shutdown/restart of any WTG if required. Each WTG will also be controlled from within the WTG itself.

502. When required, technicians will be transported to the array site on crew transfer vessels (CTVs) to perform inspection and maintenance activities on the WTGs. CTVs are typically 26 m long and can transfer 12–24 technicians at one time to the offshore site and to the offshore assets in wave conditions up to 1.75 m H_s (significant wave height) Typically no more than one CTV is required per WTG or OSS visit to perform planned or unplanned maintenance.

503. CTVs will be deployed from the O&M base and will typically spend up to 12 hours offshore before returning to the port. Alternatively, they may be deployed from a service offshore vessel (SOV).

504. As scheduled maintenance, each WTG will undergo a full service, expected to be up to once per year. Scheduled maintenance that will take approximately six days to complete. Service tasks include (but are not limited to):

- Bolt inspections and torquing;
- Blade inspections;
- Cabling inspections;
- Oil and lubrication system inspection and replenishment;
- Cooling system inspection;
- Structural inspections;
- Anemometer inspection and calibration (if necessary);
- Inspection and testing of the safety functions (e.g. emergency stop);
- Testing of the turbine control system;
- Statutory pressure vessel inspections;
- Inspection and testing of the high-voltage (HV) equipment; and
- Statutory inspections of the lifting equipment.

505. The internal lift of each WTG will be inspected once every six months with each inspection, taking a day to complete. Scheduled maintenance will be planned to take place during low wind periods each year to minimise lost energy production.

506. If any part or component of a WTG fails or breaks, technicians will be deployed to undertake unscheduled maintenance to remedy the failed or broken part or component through repair, replacement or reset of the WTG (if the reset cannot be performed remotely via fibreoptic link). The duration of this maintenance will vary depending on the activity; for example, an in-situ blade repair can take up to three days to complete, whereas a turbine reset can be completed in under an hour. These activities will be undertaken all year round to maintain the availability of the generating station.

507. If a main component of a WTG completely fails and needs replacing (e.g. the generator) then a heavy lift vessel (HLV) will be deployed to remove the failed component and replace it with a new or refurbished part. When required, these activities will be scheduled to take place during low wind periods and will take approximately one day to complete per replacement. If a JUV is deployed to undertake a component replacement, a survey vessel will be deployed in advance to scan the soil and seabed conditions to ensure it is safe to deploy the JUV in the vicinity of the WTG.

WTG foundations and IAC / interconnector cables

508. The foundation of each WTG will be maintained as part of scheduled maintenance. The transition piece will be serviced each year by technicians, with each TP service taking approximately one day to complete. Tasks carried out include (but are not limited to):

- Structural inspections;
- Statutory inspections;
- Crane inspections;
- Coating system inspections;
- HV and low-voltage (LV) system inspections; and
- Removal of biofouling from the boat landing ladders.

509. If any part of the TP breaks or fails, technicians will be deployed to undertake unscheduled maintenance to remedy the damaged or defective part. In the rare event that a secondary structure, such as a boat landing, ladder or davit crane, fails and requires replacing, a HLV may be required.

510. The subsea section of the WTG foundations will be inspected at least once every five years, with 20% of the foundations being inspected each year. The frequency may be varied, if deemed necessary, to monitor any emerging issues as part of a risk-based inspection plan. These inspections will be performed using a ROV deployed from a vessel; tasks include (but are not limited to):

- Structural inspections;
- Seabed inspections;
- Marine growth measurement; and
- Measurement of the electromagnetic potential of the corrosion protection system.

511. If required, marine growth will be removed from the subsea structure using a pressure washer operated remotely from a CTV. In the rare event that a part or component of the subsea foundation fails, including the primary structure, J-tubes, scour protection or corrosion protection anodes, then unscheduled maintenance will be required to remedy the failure. This may require a special type of auxiliary vessel (e.g. for deploying rock bundles for scour protection) combined with an ROV deployed from the same vessel.

512. The IACs will be inspected to check that they remain buried and for evidence of movement that could affect their performance. These inspections will be performed remotely using a specialist vessel with hull-mounted survey equipment. As with the foundations, each cable will be inspected at least once every five years, with approximately 20% of the cables being inspected in a calendar year. The subsea inspections of the foundations and cables may be performed each year in one single campaign using one multipurpose survey and ROV vessel.

513. If an IAC fails and needs to be repaired, a cable repair vessel will be deployed to remove the cable from the seabed and lift it onto the vessel to be repaired in situ. Once repaired, the cable will be re-laid and buried.

4.11.2 OfTI

514. EirGrid will undertake scheduled and unscheduled maintenance on the OfTI.

515. For the OSSs, scheduled maintenance will include routine inspections (approximately twice per year per OSS) and its components / systems, and regular replacement of consumables (e.g. oils and lubricants) and minor components (approximately four visits per OSS per year). These tasks will be undertaken by technicians transferred to the OSSs by CTVs. In addition, and as part of the scheduled maintenance, the CWP Project will be taken out of service once each year to perform more complex testing and inspections of the OSSs and onshore substation. Maintenance will be completed in parallel

on the OSSs and the onshore substation reducing downtime to a minimum. This work will be performed by technicians and will take approximately three days to complete.

516. As with the WTGs, unscheduled maintenance will be carried out on the OSSs and onshore substation whenever a component / system fails or breaks, placing the assets in a suboptimal condition. This work will be performed by technicians (transferred by CTVs in the case of the OSSs) where possible. If a main component fails on an OSS, for example, a transformer a HLV will be deployed to undertake its removal and replacement.

517. The above-water and subsea sections of the OSS foundations will be maintained according to the same scope and methods as the WTG foundations. The above-water scheduled maintenance scope and the subsea inspection scope will be completed each year for each OSS. Unscheduled maintenance will be carried out as and when required.

518. The offshore export cables will be inspected for the same reasons as the IACs using the same methods. The export cable routes will be inspected once each year. If an export cable fails and needs to be repaired, a cable repair vessel will be deployed to remove the cable from the seabed and lift it onto the vessel to be repaired in situ. Once repaired, the cable will be re-laid and buried.

4.11.3 OTI

519. The onshore substation electrical infrastructure will be monitored remotely and the site is therefore unmanned; however, access would be required periodically for routine maintenance activities, estimated at an average of one visit per week.

520. There is no ongoing requirement for regular maintenance of the onshore export cables or ESBN networks cables following installation; however, access to the onshore export cables would be required to conduct emergency repairs, if necessary.

4.11.4 O&M vessel requirements

521. **Table 4-38** summarises the vessels likely to be used for the offshore O&M activities outlined in the sections above.

522. In terms of annual round trips and peak number of vessels in operation at any one time, for the purposes of the assessment, it has been assumed that there will be up to 12 O&M vessels operating during the operational phase at any one time.

523. The annual round trips and peak number of vessels during the O&M phase are expected to be very similar for both WTG layout options and the numbers presented in **Table 4-38** below are representative of both options.

524. The Applicant is not considering helicopters as a method for transferring technicians offshore to perform asset maintenance.

Table 4-38 Anticipated O&M vessel requirements

O&M Activity	Peak vessel numbers	Annual round trips
JUVs	2	3
Service operation vessel (SOV)	1	26
CTVs	6	1152

O&M Activity	Peak vessel numbers	Annual round trips
Cable maintenance vessel	2	1
Auxiliary vessel[1]	3	27
[1]Includes survey vessels, ROVs, AUVs, tug operations, cargo vessels, passenger vessels and scour replacement vessels		

4.11.5 Operations and maintenance base (OMB)

525. In November 2021, the Applicant confirmed Wicklow Port as the preferred location for the wind farm's OMB. This base would provide offices, warehousing, and vessel berthing facilities, as well as an operations control centre, and would be expected to provide 75 new, long-term, local jobs across maintenance, engineering, administration and other roles. There would also be the potential for training and apprenticeship opportunities in the local area, as well as opportunities for local businesses to support the planning, design, construction and ongoing operation of the new base. Developing an OMB at Wicklow Port provides significant advantages for CWP during the O&M phase; however, the two are not functionally interdependent. This is because an OMB at Wicklow Port is not required for the O&M of the wind farm.

526. For example, the control systems used for remotely controlling the OWF can be located anywhere (e.g. Wicklow, Dublin etc.) provided the location has a sufficient telecommunications connection to the SCADA equipment installed in the onshore substation. Similarly, the marine coordination systems (radios and software used for tracking vessels and personnel in the OWF) do not need to be in an OMB control centre in Wicklow. Marine coordination can be performed anywhere (e.g. Wicklow, Dublin etc.), provided the location has a sufficient telecommunications connection and has sufficient radio coverage of the OWF and vessel transit routes.

527. Furthermore, vessels required to transport personnel and cargo to the OWF to carry out service and maintenance tasks can berth in any port on the Irish east coast (e.g. Dublin, Dún Laoghaire, Greystones, Arklow, Wicklow), provided there is sufficient capacity and access. The requirement is that the personnel and cargo required for O&M are transported to the port where the vessels are berthed, as and when required.

528. An alternative O&M solution to an OMB may involve the use of an SOV, which enables OWF technicians to remain offshore without going back and forth on a daily basis from a shore-based OMB. The main purpose, therefore, is to host technicians, spare parts, consumables and repair facilities for a longer time offshore, allowing O&M tasks to be more efficiently conducted and avoiding longer transfer time. In practice, the SOV could berth at any port in Ireland with sufficient capacity and access when required to rotate personnel, refuel, and restock spare parts and consumables.

529. SOVs are capable of staying offshore during uninterrupted periods of typically two to three weeks, with associated vessel movements captured above in **Table 4-38**.

530. However, pending the identification of a suitable site, an OMB at Wicklow Port remains the preferred solution for the CWP Project. The EIAR therefore presents the information that is currently available to the Applicant in that regard, in line with the approach suggested by Advocate General Gulmann in Bund Naturschutz in Bayern (ECR 1994 I-03717). An OMB at Wicklow Port is also considered within the Cumulative Effects Assessment (CEA) longlist of other development, allowing for topic specific consideration of the likelihood of cumulative effects with the CWP Project considering the currently available information and its proximity to the CWP Project. It also provides a representative location for O&M activities associated with the CWP Project, which are assessed within the EIA.

531. The project team is working to identify and assess the most suitable location and design for the base, as well as engaging with Wicklow County Council, local businesses, landowners and other port users.

532. If and when a final decision is made on the location of the OMB, the Applicant will apply for planning permission separately. The OMB will also be subject to a separate period of public consultation once plans have been drafted, prior to the submission of a planning application. Details of this consultation process will be advertised extensively in advance.

4.11.6 Marine control and safety

Lighting, marking and signage

533. Marine lighting and marking during O&M will be discussed and agreed with Irish Lights, and will be in compliance with the relevant guidance, namely the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) O139 Recommendations on the Marking of Man-Made Offshore Structures (IALA, 2021) and IALA G1162 Guidance on the Marking of Man-Made Offshore Structures (IALA, 2021).

534. Aviation lighting requirements will be discussed and agreed with the Irish Aviation Authority (IAA) and will give due consideration to the most up-to-date IAA guidance in relation to marking of offshore wind farms, currently IAA ASAM No.18, Guidance Material on Offshore Wind Farms, Issue 2 (IAA, 2015).

535. WTGs will have unique alphanumeric identifiers (IDs) which will be clearly visible from a vessel and from the air. Lighting requirements for the IDs will be discussed with Irish Lights and IAA, noting that any such lighting will be designed to avoid confusion with navigation marks.

536. A **Lighting and Marking Plan** has been included with the application to present proposed plans for lighting and marking of the offshore components of the CWP Project.

Safety zones and anchorage

537. There is currently no legislative framework within the Irish system to implement statutory safety zones during construction. However, discussions will be ongoing with the Marina Survey Office (MSO) to determine whether these are applied for at a later date, and how any such safety zones would be implemented and subsequently monitored. It is intended that the CWP Project will utilise rolling advisory safe passing distances around ongoing construction or major maintenance works, including works associated with the cables. Details of such advisory safe passing distances will be promulgated to ensure third party mariners are aware of the ongoing works.

538. During the O&M phase, it is likely that a larger support vessel may be required for planned and unplanned maintenance activities. It is likely that several predetermined areas will be identified and marked as temporary anchorage areas, such that before manoeuvring into final position, an initial mobilisation point is widely known.

Marine Control Centre

539. A Marine Control Centre(s) for the OWF will have automatic identification systems (AIS), video surveillance and radar coverage which will identify vessels with AIS facilities entering into the rolling advisory safe passing distances during O&M activities. This will be in addition to any visual observation made by personnel on O&M vessels working within and around the area. Any vessel identified or observed to stray into the rolling advisory safe passing distances will be contacted by a designated member of the crew of the O&M vessels or from the Marine Control Centre(s) via multichannel very high frequency (VHF) radio, including digital selective calling, and warned that they have encroached

the rolling advisory safe passing distances. They will be instructed to divert their course out of the rolling advisory safe passing distances.

540. AIS and CCTV from Marine Control Centre(s) will be in place during operation of the WTGs, which will be used to monitor vessel movements within the offshore development area.

4.12 Decommissioning

541. The term of the MAC for the CWP Project is 45 years. The operation lifetime is expected to be 25 years, commencing on full commercial operation of the project. At the end of this 25-year period, the CWP Project could be repowered or decommissioned. If repowered during the period of the MAC, this would be subject to a new consent application supported by an EIAR.

542. The requirement to rehabilitate the maritime area of the CWP Project is a condition of the MAC, under which the Applicant is required to prepare a rehabilitation schedule for approval by the competent authority and set aside funds for the purposes of rehabilitation. This rehabilitation schedule will be updated as required and will consider the latest technological developments, legislation and environmental requirements at the time that the work is due to be carried out.

543. For the purposes of the current consenting framework and as a basis for this EIAR, a **Rehabilitation Schedule** has been prepared based on the current technological and regulatory framework. Throughout this EIAR, the assessments refer to the decommissioning of the project and the decommissioning phase; for the purposes of the EIAR ,this is synonymous with rehabilitation in the context of the rehabilitation schedule.

4.12.1 Decommissioning of WTGs

544. The removal of the WTG superstructure is expected to be the reverse of the installation procedure, as follows:

- Conduct assessment on potential hazards during the decommissioning work and pollutants to the environment that may result from the decommissioning work;
- Mobilise suitable vessels to the array site;
- Remove any potentially polluting or hazardous fluids / materials from the WTGs (if identified in the risk assessment);
- Remove rotor blades;
- Remove nacelle;
- Remove tower sections; and
- Transport all components to an onshore site, where they will be processed for reuse, recycling or disposal.

4.12.2 Decommissioning of OSS topsides

545. The methodology for removal of the OSS topsides is likely to be as follows:

- Conduct assessments on the potential hazards during the decommissioning work and pollutants to the environment that may result from the decommissioning work;
- Isolate / disconnect from the grid and SCADA;
- Remove any potentially polluting or hazardous fluids / materials (if identified in the risk assessment);
- Mobilise suitable HLVs to the array site;
- Detach the OSS Topsides from the OSS Foundations by cutting at the support points;

- Remove main topside structure; and
- Transport to an onshore site, where it will be processed for reuse, recycling or disposal.

4.12.3 Decommissioning of substructures and foundations

546. It is anticipated that, following WTG and OSS topside decommissioning and removal, the monopile foundations will be cut below the seabed level to a depth that will ensure the remaining foundation is unlikely to become exposed. This is likely to be approximately 1 m below the seabed, although the exact depth will depend upon the seabed conditions and site characteristics at the time of decommissioning.

547. The sequence for removal of the foundations consisting of monopiles and transition pieces is anticipated to be:

- Mobilise suitable vessel (likely to be a floating or jack-up HLV);
- Remove cable connections and make safe operating conditions for the crew;
- Cut the TP just above the grouted connection or unbolt the flange with the monopile and remove by crane using safe lifting / hoisting points;
- Deploy ROVs to inspect the foundation and reinstate lifting attachment if required;
- Excavate outside and inside of monopile to approximately 0.5 m below anticipated level of cutting (this will include removing any scour protection or debris around the base of the foundation);
- Cut the monopile using either a water-jet cutter or a mechanical cutter flush with the seabed;
- Lift foundation onto the transport vessel or the decommissioning vessel and transport to shore; and
- Process components with respect for maximum reuse, recycle and minimum disposal.

548. It may be preferable to leave any scour protection around the monopile bases or covering cables in situ, in order to preserve the marine habitat that has been established over the life of the CWP Project. This will be subject to discussions with regulators and advisors at the point of decommissioning. For the purposes of the EIA, it has been assumed that scour protection will be removed.

4.12.4 Decommissioning of IAC, interconnector and offshore export cables

549. Depending on whether the cables are exposed at the time of decommissioning, it may be preferable to leave the cables in situ or for them to be partially removed. Exposed cables are more likely to be removed to ensure they do not become hazards to other users of the seabed. At the time of decommissioning, the Applicant will engage with regulators and relevant stakeholders to agree the extent and methodology for the removal of cables and associated cable protection. For the purposes of the EIA, it is assumed that at the time of decommissioning all cables in the offshore environment will be wholly removed.

550. It is likely that equipment similar to that which is used to install the cables will be used to reverse the burial process and expose them. Therefore, the area of seabed impacted during the removal of the cables is anticipated to be the same as the area impacted during the installation of the cables. Divers and/or ROVs may be used to support the cable removal vessels.

551. An offshore cable removal programme will include the following:

- Identify the location where cable removal is required;
- Remove cables: Feasible methods include pulling the cable out of the seabed using a grapnel, pulling an under-runner using a steel cable to push the electrical cable from the seabed or jetting the seabed material; and
- Transport cables to an onshore site where they will be processed for reuse, recycling or disposal.

552. It is assumed that cable protection will also be wholly removed. If cable protection is to be removed using currently available technology, it will most likely be removed by a vessel using a dredger or grab. It is, however, likely that, due to technological advancements, there will be novel removal methods available and best practice at the time of decommissioning will be followed.

4.12.5 Decommissioning vessel activities

553. Decommissioning is currently anticipated to be a reverse of the construction and installation process for the CWP Project and the assumptions around the number of vessels is therefore the same as that described for the construction phase of the offshore components.

4.12.6 Landfall and OTI

554. It is recognised that legislation and industry best practice change over time. However, for the purposes of the EIA, at the end of the operation lifetime of the CWP Project, it is assumed that all OTI will be removed where practical to do so. In this regard, for the purposes of an assessment scenario for decommissioning impacts, the following assumptions have been made:

- The TJBs and onshore export cables (including the cable ducting) shall be completely removed;
- The landfall cable ducts and associated cables shall be completely removed;
- The underground tunnel, within which the onshore export cables will be installed, shall be left in situ and may be reused for the same or another purpose;
- The onshore substation buildings and electrical infrastructure shall be completely removed;
- The reclaimed land, substation platform, perimeter structures and the new access bridge at the onshore substation site will remain in situ and may reused for the same or another purpose; and
- The ESBN network cables (including the cable ducting) shall be completely removed.

555. The general sequence for decommissioning is likely to include:

- Dismantling and removal of electrical equipment;
- Removal of ducting and cabling, where practical to do so;
- Removal and demolition of buildings, fences, and services equipment; and
- Reinstatement and landscaping works.

556. Closer to the time of decommissioning, it may be decided that removal of certain infrastructure, such as the TJBs, landfall cable ducts and associated cables, onshore export cables and ESBN networks cables, would lead to a greater environmental impact than leaving the components in situ. In this case, it may be preferable not to remove these components at the end of their operational life. In any case, the final requirements for decommissioning of the OTI, including landfall infrastructure, will be agreed at the time with the relevant statutory consultees.

557. It is anticipated that, for the purposes of an assessment scenario, the impacts will be no greater than those identified for the construction phase.

4.14 References

558. IAA (2015) IAA Guidance Material on Off-Shore Wind Farms, ASAM No 18, Issue 2

559. IALA (2021) Recommendations O-139 on the Marking of Man-Made Offshore Structures

560. IALA (2021) Guidance G1162 on the Marking of Man-Made Offshore Structures Edition 1.1