Chapter 4
Consideration of Alternatives

C1 - Public

ORIEL WIND FARM PROJECT

Environmental Impact Assessment Report
Chapter 4: Consideration of Alternatives

MDR1520B
EIAR – Chapter 4
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4 CONSIDERATION OF ALTERNATIVES

4.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) provides a description of the alternatives considered by the Project developers, Oriel Windfarm Limited (hereafter referred to as 'the Applicant'), during the development of the Oriel Wind Farm Project (hereafter referred to as 'the Project').

Alternatives are different ways of conducting a project in order to meet its agreed objective. The consideration of alternatives is an important step in determining, and where possible avoiding, the effects of a project on the environment through spatial and technical adjustments.

The description of alternatives, and consideration of their environmental effects, is required by EU and national legislation, namely the EIA Directive 2011/92/EU (as amended by Directive 2014/52/EU and the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296/2018). Further details on these requirements are outlined in section 4.3.

The Project will comprise both offshore and onshore infrastructure including offshore wind turbine generators (WTGs), associated foundations and inter-array cabling, an offshore substation, an offshore export cable within a defined offshore cable corridor, a Transition Joint Bay (TJB) (where the offshore export cable connects to the onshore cable), an onshore cable route and an onshore substation for connection to the electricity transmission network.

The consideration of alternatives sets out:

- Relevant national planning legislation, guidance and policy (see section 4.3);
- An overview of the Project requirements (section 4.4);
- A 'Do Nothing' or Baseline Scenario (see section 4.5);
- Consideration of alternatives for the project location on a national and then regional basis (see section 4.6) and the location for an operational and maintenance base (see section 4.7);
- Alternative options for the project infrastructure (both offshore and onshore) (see sections 4.8 to 4.10); and
- Alternatives in the project design and technology (see section 4.11).

A detailed description of the Project including the construction, operational and maintenance and decommissioning phases is provided in chapter 5: Project Description.

Spatial consideration alternatives for the siting of individual wind turbines that best addressed the effects of the Project from a landscape and visual perspective were considered and a final design was brought forward. The consideration of various options for the wind turbine layout are discussed in section 4.8.

The consideration of alternatives is supported by information provided in the following appendices:

- Appendix 4-1: Preliminary Landscape Assessment of Design Options; and
- Appendix 4-2: Landfall Options – Survey Report.

4.2 Background

The Project has seen a level of progress by the Applicant over the past 17 years. This time period has allowed for the careful consideration of technical and spatial alternatives for the critical project components required for an offshore wind farm. This chapter describes the iterative process that was undertaken in the consideration of alternatives for the Project since its conception in 2001 to the submission of an application for consent.

The alternatives for the Project were originally considered in the Environmental Impact Statement (EIS) in 2007 prepared by Aqua-Fact International Services Ltd (hereafter referred to as the 2007 EIS) as part of an application for a Foreshore Lease under the Foreshore Act, for the offshore aspects of the project. The 2007 EIS gave detailed consideration to the selection of the offshore location (see section 4.4) and while it did evaluate possible landfall locations, and substation locations, it only gave cursory consideration to the onshore cable route connecting the offshore development from the landfall to the grid connection point. This was the approach taken at the time as the onshore infrastructure would have been considered separately under the Planning and Development Act 2000. Development associated with the actual installation of an onshore cable was, at that time, considered exempted development. Following the receipt of a grid connection offer from EirGrid, the Applicant commissioned a further study in 2010 to assess options for an onshore cable connection and substation location, which are required to connect the Project to the existing electricity transmission network. A *Substation Site and Route Corridor Constraints Report*[1] was prepared by TOBIN Consulting Engineers in 2011 (hereafter referred to as the TOBIN report). The report has provided a valuable framework for the consideration of alternatives of the onshore components for this Project and the findings of this report have subsequently been updated and incorporated into this chapter.

4.3 Legislation and guidance

4.3.1 Legislation

The consideration of alternatives is required under the existing EIA Directive 2011/92/EU (as amended by Directive 2014/52/EU), transposed into Irish law by The European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296/2018), which states:

> "*A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects*."

The consideration of reasonable alternatives for this Project has been undertaken in accordance with this legislation.

4.3.2 Guidance

The consideration of alternatives is supported in a range of guidance documents in relation to the environmental impact assessment process, with specific guidance in relation to offshore renewable energy projects. The guidance considered most relevant to this chapter includes:

- The Department of Housing, Planning and Local Government Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment August 2018 (DHPLG, 2018);
- The EU Commission's Environmental Impact Assessment of Projects Guidance on the Preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU) (European Union, 2017);
- Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIARs) (EPA, 2022); and
- Guidance on EIS and NIS Preparation for Offshore Renewable Energy Projects (DCCAE, 2017).

[1] TOBIN Consulting Engineers (2011). Substation Site and Route Corridor Option Constraints Report for Oriel Windfarm Ltd. Volume I – Main Text.

The 2018 DHPLG Guidelines state that the *"type of alternatives will depend on the nature of the project proposed and the characteristics of the receiving environment ….. It is generally sufficient for the developer to provide a broad description of each main alternative studied and the key environmental issues associated with each. A 'mini- EIA' is not required for each alternative studied."*

The description of alternatives includes consideration of the avoidance, prevention, reduction, or offsetting of adverse environmental effects, which may be described at a number of levels including:

- Those assessed at plan stage (which the EU guidance (2017) states "*it would likely be unnecessary to consider them again*"); and
- Those assessed at project or design stage (which the EU guidance (2017) describes as "*alternatives or variants of Project components in order to mitigate significant environmental impacts that emerge during assessment*").

The DCCAE (2017) guidance notes "*A do-nothing or baseline scenario without the project must be an appropriate consideration, as it facilitates an assessment of the other alternatives against the baseline*."

4.4 Overview of Project requirements

A detailed description of the Project is presented in chapter 5: Project Description. For the purpose of consideration of alternatives, an overview of the requirements for an offshore wind farm is presented below.

The Project will comprise an offshore wind farm area which will have a number of wind turbine generators (WTGs) located within a defined maritime area. The number of turbines is determined by a range of project factors including the available grid export capacity and financial and technical considerations. The turbines will be spaced apart with the spacing determined by the WTG blade length and technical factors such as seabed type.

The WTGs will be mounted on foundations and connected by subsea inter-array cables to an offshore substation (OSS) also located within the offshore wind farm area. The OSS will be mounted on a foundation similar to the WTGs. The OSS will transform the generated electricity to a higher voltage for export through a marine offshore export cable to a landfall site at the coast where it will connect to onshore cables. The corridor for the offshore export cable is determined by the location of the offshore wind farm area and the landfall.

The offshore export cable will be connected to onshore cables in a transition joint bay (TJB) above the high water mark (HWM). This is a buried chamber constructed with concrete walls, floor and a concrete lid. After cable installation, the TJB will be recovered by soil/sand and the original surface will be reinstated.

An underground cable connection is required to connect the offshore export cable in the TJB to the onshore substation. The underground cable connection will comprise of three buried high voltage alternating current power cables and one or more communications cables. The communications cable(s) will consist of multicore fibre-optic cables, for the purpose of communicating between the onshore substation and offshore wind farm in order to control the wind farm equipment.

The cables are manufactured in lengths of up to 700 m and during installation, each cable length is jointed to the next cable at intervals of 700 m in a cable joint bay. The cable joint bays are buried and not visible. At the cable joint bay locations, the copper cable screens are also jointed in link box chambers, which have a surface access pit lid. The total number of cable joint bays is dependent on the distance between the selected sites for the landfall and the onshore substation.

The onshore substation will comprise various electrical installations, structures and buildings. The substation will provide the connection of the wind farm generated power to the existing 220 kV transmission grid.

The substation will consist of two compounds: Compound 1 which is connected to the existing transmission grid to deliver grid-compliant electricity and Compound 2 which receives, filters, monitors and controls the electricity generated from the wind farm. Compound 1 will be owned by EirGrid and operated by the ESB Networks as Transmission System Operator (TSO). Compound 2 will be owned and operated by EirGrid as the offshore TSO. Both compounds will be securely fenced with a second property fence at 5 m beyond the compound fences, to allow screening, if required. The substation will not generally be manned, although regular maintenance checks are anticipated.

The Project will be operated from an operations and maintenance base. The base will require office and warehouse space and boat access at an existing harbour within a suitable proximity to the offshore wind farm. The requirements for the base are described further in chapter 5: Project Description.

4.5 'Do nothing' baseline scenario

Under a 'do nothing' or baseline scenario, the Project would not be developed.

Many of the natural environment aspects (soils and coastal processes, biodiversity, landscape, water quality etc.) and built environment aspects (fisheries, heritage, marine traffic etc.) would remain unchanged in the absence of the Project and commercial processes would continue to operate as usual. A description of the likely evolution of the baseline environment if the Project did not proceed is provided in each of the topic assessments chapters (volumes 2B and 2C).

The Climate Action and Low Carbon Development (Amendment) Act 2021 requires plans from the Government to pursue the transition to a climate resilient, biodiversity rich and climate neutral economy by no later than the end of year 2050. This includes an annual update to a climate action plan which is consistent with the carbon budget. The first two carbon budgets proposed by the Climate Change Advisory Council provide for a total reduction of 51% in greenhouse gas emissions over the period to 2030, relative to a baseline of 2018. Large scale renewable energy generation will form a significant measure to address this target.

The *Climate Action Plan 2023* (CAP 2023), published by the Department of the Environment, Climate and Communications (DECC) is the annual update to Ireland's Climate Action Plan. The CAP 2023 implements the carbon budgets and sectoral emission ceilings and sets out a roadmap for taking decisive action to halve our emissions by 2030 and reach net zero no later than 2050, to align with the programme for Government. As stated in CAP 2023, Ireland's electricity sector can play a vital role in the decarbonisation of other sectors through electrification, including transport, heating and industry. The plan proposed a measure to increase the proportion of renewable electricity to up to 80% by 2030 and a target of 9 GW from onshore wind, 8 GW from solar and at least 5 GW of offshore wind energy by 2030.

The *Climate Action Plan 2024* (CAP 2024) was published by the DECC in December 2023 and is approved by Government, subject to Strategic Environmental Assessment and Appropriate Assessment. CAP 2024 builds upon CAP 2023 by refining and updating the measures and actions required to deliver the carbon budgets and sectoral emissions ceilings.

A vital vehicle for achieving such ambitious targets is the widespread development of offshore wind energy. As such, the Project is crucial in supporting Ireland to meet its near-term targets and transition to a low carbon economy. In addition to the political gains of pursuing this development, greenhouse gas emissions would be reduced through the displacement of fossil fuel-related energy usage. Energy demand is increasing across all sectors in Ireland. However, in order to become sustainable and carbon neutral, these energy demands need to be offset by electricity generated from renewable sources.

Furthermore, key national plans such as the National Planning Framework and the National Development Plan 2018 – 2027, are calling for increased electrification of the heat and transport sectors. Schemes such as the Renewable Electricity Support Scheme (RESS) aims to decarbonise electricity generation and supports up to 4.5 GW of additional renewable electricity by 2030 (offshore wind and other). This would strengthen Ireland's overall performance in terms of sustainable development, in line with the United Nations Sustainable Development Goals – particularly Goal 7 (Affordable and Clean Energy) and Goal 13 (Climate Action) (UN, 2015), inevitably leading to improved environmental and societal wellbeing.

Finally, from an economic perspective, the EU Blue Growth Study identifies wind development to be an increasingly important area for employment, growing 30% annually between 2007-2010 and achieving €2.4 bn in investment in 2011 (EC, 2012). The National Marine Planning Framework (adopted 1 July 2021) supports offshore renewable energy development and recognises it as a pathway to decarbonisation. The deployment of indigenous renewable energy generation also supports Ireland's energy security in the long-term.

Therefore, and in conclusion, the absence of the Project would translate into long-term challenges for Ireland's ability to meet its CO_2 targets and achieve sustainable development and would contribute to the following effects:

1. Ireland would be tasked with a greater challenge in terms of achieving its climate goals;

2. Ireland would continue to degrade its atmosphere and environment through the continued use of finite fossil fuels;

3. Ireland could miss out on the employment and investment from the Project; and

4. Ireland could have to continue paying EU fines for missing the 2020 renewable energy targets.

4.6 Alternative offshore wind farm locations

This section describes the alternative locations considered for the offshore wind farm area i.e. the area to locate the WTGs. The evaluation criteria to select the location are described in section 4.6.1 and a description of the process and assessments undertaken to locate the offshore wind farm area is provided in section 4.6.2.

4.6.1 Evaluation criteria

There are several critical parameters recognised for the development of an offshore wind farm project. These parameters include wind capacity, water depth, wave and current loading, suitable seabed sediments, onshore grid capacity, the avoidance of environmentally sensitive areas and disturbance to other marine-based activities such as fisheries and shipping traffic.

Table 4-1 outlines the criteria used to evaluate the Project locations and the relevant data sources. This provides a common framework to provide transparency in the assessment of these alternative options.

Table 4-1: Evaluation criteria and data sources used to evaluate the offshore wind farm locations.

Topic	Criteria	Data Source Utilised
Metocean	Wind resource > 9 m/s.	Project wind resource assessments.
	Shelter from high wave loads.	Irish Weather Buoy Network (IMOS) – M2 Buoy Irish Sea.
Marine Processes	Suitable seabed sediments.	INFOMAR mapping.
	Low tidal streams (< 0.5 m/s max).	UKHO Tidal Current Predictions. UKHO Admiralty Chart Nose of Howth to Ballyquintin Point.
	Bathymetry water depths of < 30 m.	INFOMAR mapping.
Benthic Subtidal and Intertidal Ecology	Sensitive seabed habitats to be avoided, where possible.	Ireland Marine Atlas.
Fish and Shellfish Ecology	Nursery spawning grounds to be avoided, where possible.	Ireland Marine Atlas, International Council for the Exploration of the Sea (ICES)[2].
Marine Mammals and Megafauna	European Designated Sites to be avoided.	NPWS mapping.
Offshore Ornithology	European Designated Sites to be avoided.	NPWS mapping.
Commercial Fisheries	Areas of limited fishing activity preferred.	Vessel AIS (Automatic Identification System) mapping

[2] 'In May 2023 the 'Ecological sensitivity analysis of the western Irish Sea to inform future designation of marine protected areas (MPAs)' was published. This includes further information on spawning grounds, which is considered in chapter 9: Fish and Shellfish Ecology.

Topic	Criteria	Data Source Utilised
		and consultation with local fisheries stakeholders.
Shipping and Navigation	Areas of limited shipping traffic preferred. Not within shipping lane.	Shipping AIS mapping.
Infrastructure, Marine Recreation and Other Users	Low density of recreational marine users Avoidance of existing marine infrastructure.	Irish Sailing recreational mapping. Ireland Marine Atlas.
Material Assets	Potential landing points with proximity to existing high voltage transmission grid network.	OS Discovery Mapping 1:50k.
	Proximity to ports suitable for construction and operation and maintenance.	OS Discovery Mapping 1:50k.

4.6.2 Assessment of offshore wind farm locations

A staged approach from national to local level was undertaken to select a preferred location for the offshore wind farm as described below.

National assessment

The Applicant first conducted a national assessment of suitable areas for offshore wind development using the evaluation parameters in Table 4-1.

The wind capacity of the Atlantic coast (West coast) and the Celtic Sea (South coast) is excellent (SEAI Wind Atlas, 2003, accessed at https://gis.seai.ie/wind/). However, these areas have a number of features that make them less suitable for proven fixed bottom offshore wind technology available for commercial scale deployment in Ireland. These features include steep seabed slopes resulting in deep water depths close to shore, bedrock exposed at the seabed surface and extreme wave loads. These features may make the areas more suited to floating wind turbine technology if it becomes technically and economically feasible in the future. Furthermore, the available electricity transmission capacity and existing infrastructure is severely limited along most of the Atlantic coast. Significant grid infrastructure development across the country would be required to enable electricity generated in these locations to be transmitted to the main demand centres on the east coast.

Given the above constraints the focus of the Applicant moved towards the Irish Sea (East coast) of Ireland as a preferred location to develop an offshore wind farm project. The east coast of Ireland also has excellent wind resources (> 9 m/s), particularly when compared to the rest of Europe, and is subject to a much less severe wave climate to that on the Atlantic coast or Celtic Sea. Furthermore, water depths are within the limits of suitability for fixed bottom offshore construction. The presence of marine sediments at the seabed surface also enables the emplacement of foundation structures and cable burial. Dublin and the Leinster region has a higher demand for electricity than the south or west of Ireland and offshore wind farm sites within the Irish Sea would be located closer to this location of high demand. There is also good electricity grid infrastructure at the higher transmission system voltage of 110 kV and 220 kV along the east coast.

Irish Sea assessment

Following the national level assessment outlined above, the area of consideration focused on the Irish Sea to assess suitable offshore wind farm site locations.

Sites on the long narrow sand banks along the Wicklow and Wexford coast, south of Dublin Bay, were considered (i.e. Kish, Bray, Codling, India and Blackwater banks). These are located in reasonable proximity to the shoreline for an export grid connection (5-10 km). However, the capacity within the grid infrastructure for these locations, without significant upgrade, is limited.

The area north of Dublin has available grid capacity for a suitable scale of offshore wind farm. There is up to 400 MW of grid capacity available on the Louth to Woodlands 220 kV transmission grid. Within this area, north of Dublin, there were also a number of possible locations with extensive water depths suitable for the construction of current (fixed bottom) offshore wind technology and which provided opportunities to locate wind turbines to minimise environmental effects.

The north Irish Sea area was evaluated against detailed constraint mapping of the critical parameters such as metocean, bathymetry, existing fisheries and grid access. This is presented in the assessment in section 4.6.2.

Regional assessment

The assessment then focused on a regional area between the entrance to Drogheda Harbour and the border with Northern Ireland to identify a suitable offshore wind farm area and offshore cable corridor. An offshore wind farm area of approximately 30 km^2 is required to generate the capacity available at the grid connection point (Woodlands to Louth 220 kV OHL).

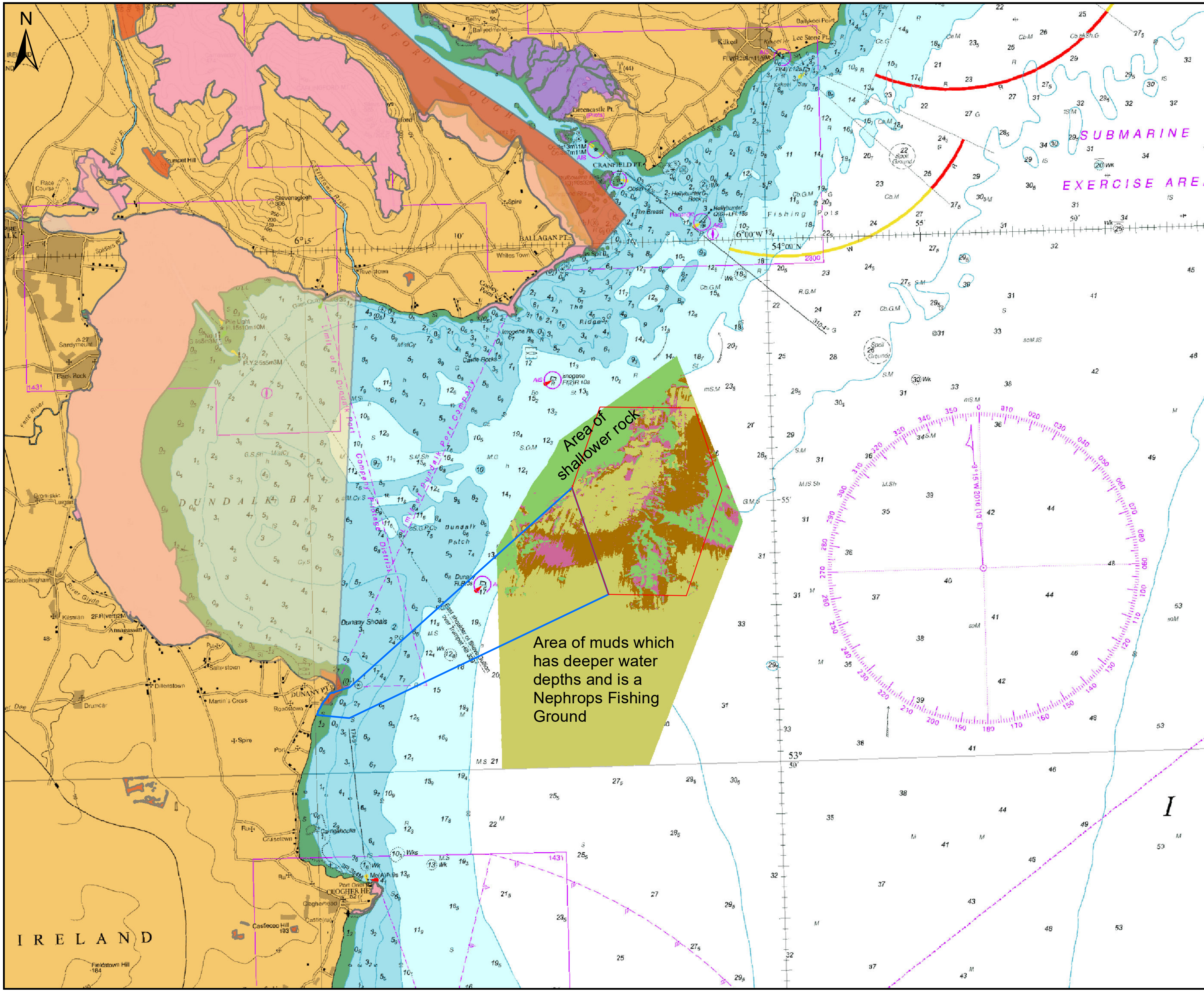
An evaluation of the criteria to determine a regional location suitable for consideration of an offshore wind farm is presented in Table 4-2. Mapping of the evaluation criteria are presented in Figures 4-1 to 4-5.

Table 4-2: Evaluation of criteria for the Project regional location.

Topic	Criteria	Evaluation
Metocean	Wind resource > 9 m/s.	The area achieves average wind speeds at hub height (150 m) > 9 m/s.
	Shelter from high wave loads.	The estimated annual average wave height in metres for the area of interest < 1 m.
Marine Processes	Suitable seabed sediments.	Figure 4-1. Area of interest is located principally on seabed of sands and gravels suitable for WTG foundations.
	Low tidal streams (< 0.5 m/s max).	The area has flows that are weak with spring tidal current speeds typically < 0.2 m/s.
	Bathymetry water depths of < 30 m.	Figure 4-2. Water depths of < 30 m extend to approximately 12 km from the County Louth coast.
Benthic Subtidal and Intertidal Ecology	Sensitive seabed habitats to be avoided, where possible.	Area has circalittoral coarse sediments and sands and circalittoral muds. Area avoids sensitive seabed habitats such as biogenic reef.
Fish and Shellfish Ecology	Nursery spawning grounds to be avoided, where possible.	A preferred wind farm area within the regional location would avoid higher intensity spawning grounds for fish.
Marine Mammals and Megafauna	European Designated Sites to be avoided.	Figure 4-1. A preferred wind farm area would avoid European designated sites for marine mammals. Closest are Rockabill to Dalkey Island SAC (Harbour Porpoise) and Murlough Bay SAC (Harbour Seal).
Offshore Ornithology	European Designated Sites to be avoided.	Figure 4-1. A preferred wind farm area would avoid European designated sites for Birds. The closest sites are the Dundalk Bay SPA. Since the site was selected, the North West Irish Sea cSPA[3] is the closest SPA.
Commercial Fisheries	Areas of limited fishing activity preferred.	Figure 4-3. A preferred wind farm area would avoid the more densely-used fishing grounds to the south and east of the area.
Shipping and Navigation	Areas of limited shipping traffic preferred. Not within shipping lane.	Figure 4-4Figure 4-4. AIS data indicates that the principal shipping traffic is to and from Carlingford Lough and takes an offshore route north to south. Limited commercial shipping into Dundalk takes an inshore route with traffic from Dundalk heading north, passing close to Imogene buoy. A preferred wind

[3] The North-West Irish Sea candidate SPA (cSPA) was first notified to the pubic in July 2023, and conservation objectives were published in October 2023. The Minister proposes to classify this site as a SPA following statutory periods of consultation.

Topic	Criteria	Evaluation
		farm area seeks to avoid the higher density routes offshore and inshore.
Infrastructure, Marine Recreation and Other Users	Low density of recreational marine users. Avoidance of existing marine infrastructure.	Figure 4-5. Marine recreation is principally close to the coast or within Carlingford Lough with some offshore yacht cruising from Dublin to Carlingford or up to Northern Ireland. No subsea power cables traverse the area. The Scotland to Ireland gas interconnector is located to the south of the area of interest.
Material Assets	Potential landing points with proximity to existing high voltage transmission grid network.	Landfall sites are evaluated in Section 4.10.3.
	Proximity to ports suitable for construction and operation and maintenance.	There are several ports on the east coast of Ireland or on the west coast of Great Britain with facilities suitable as a marshalling harbour for an offshore wind farm. There are several smaller ports and harbours on the east coast of Ireland with the potential to operate as an operational and maintenance base.



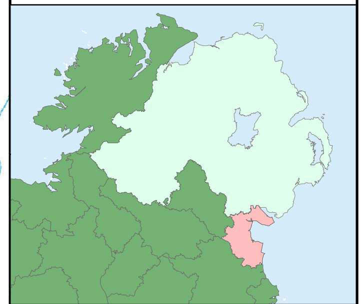
Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Proposed Natural Heritage Area (pNHA)
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- UK Marine SPAs

Sediment Type

- Class 1 mud to fine sane
- Class 2 fine to medium mud
- Class 3 coarse sand and gravel
- Class 4 rock and gravel

Data Sources (as of November 2020): OWL, OSi



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Title

Figure 4-1: Seabed Sediments and European Designated Sites

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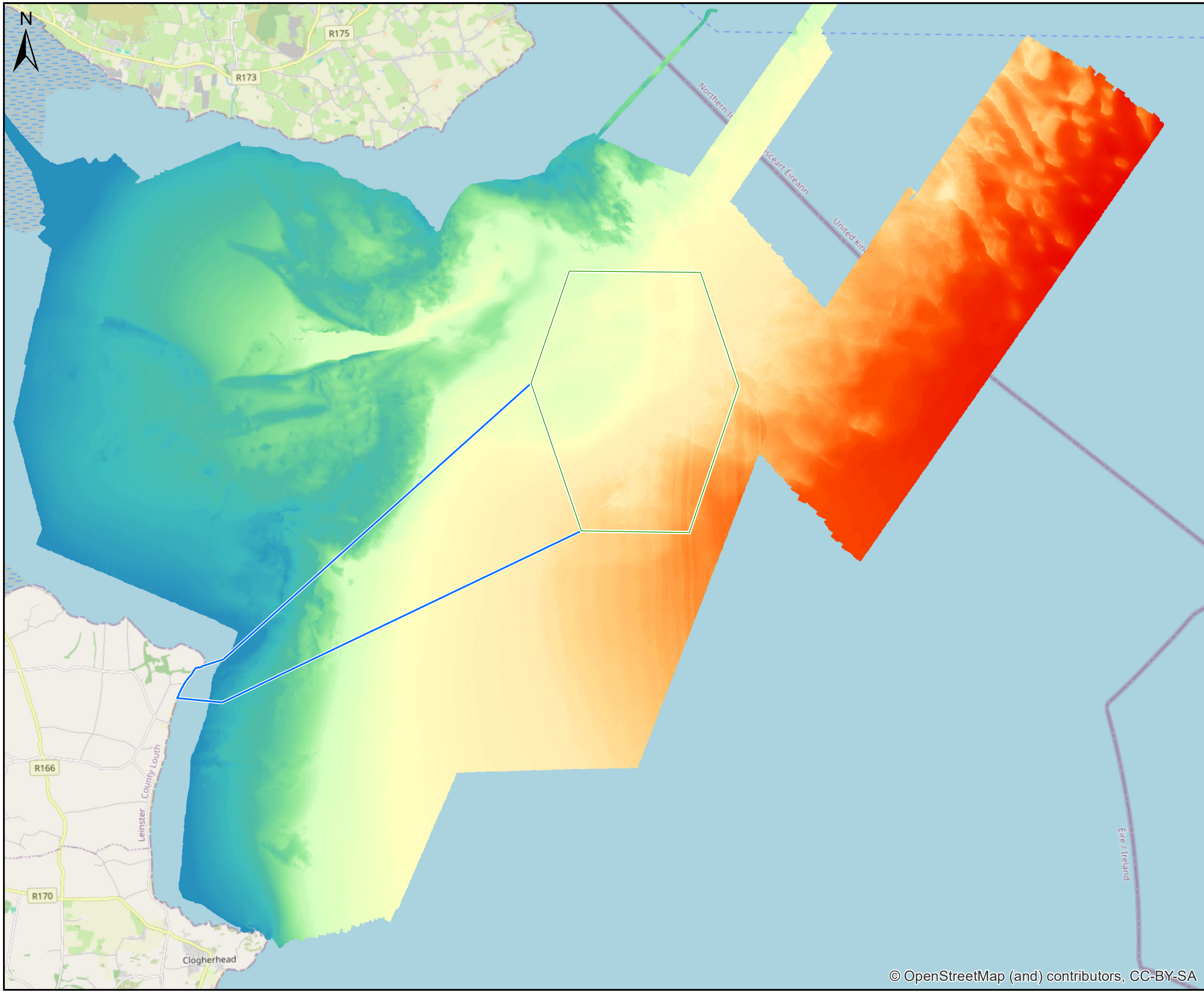

Legend

Offshore Wind Farm Area

Offshore Cable Corridor

Bathymetry

High : 4 metres above Chart Datum

Low : 41 metres below Chart Datum

Data Sources (as of December 2020): OWL, OSi

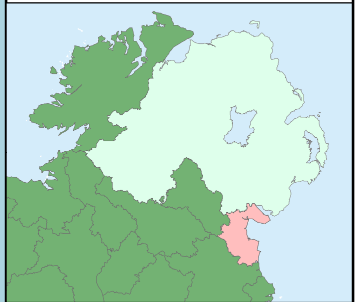

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Figure 4-2:

Bathymetry

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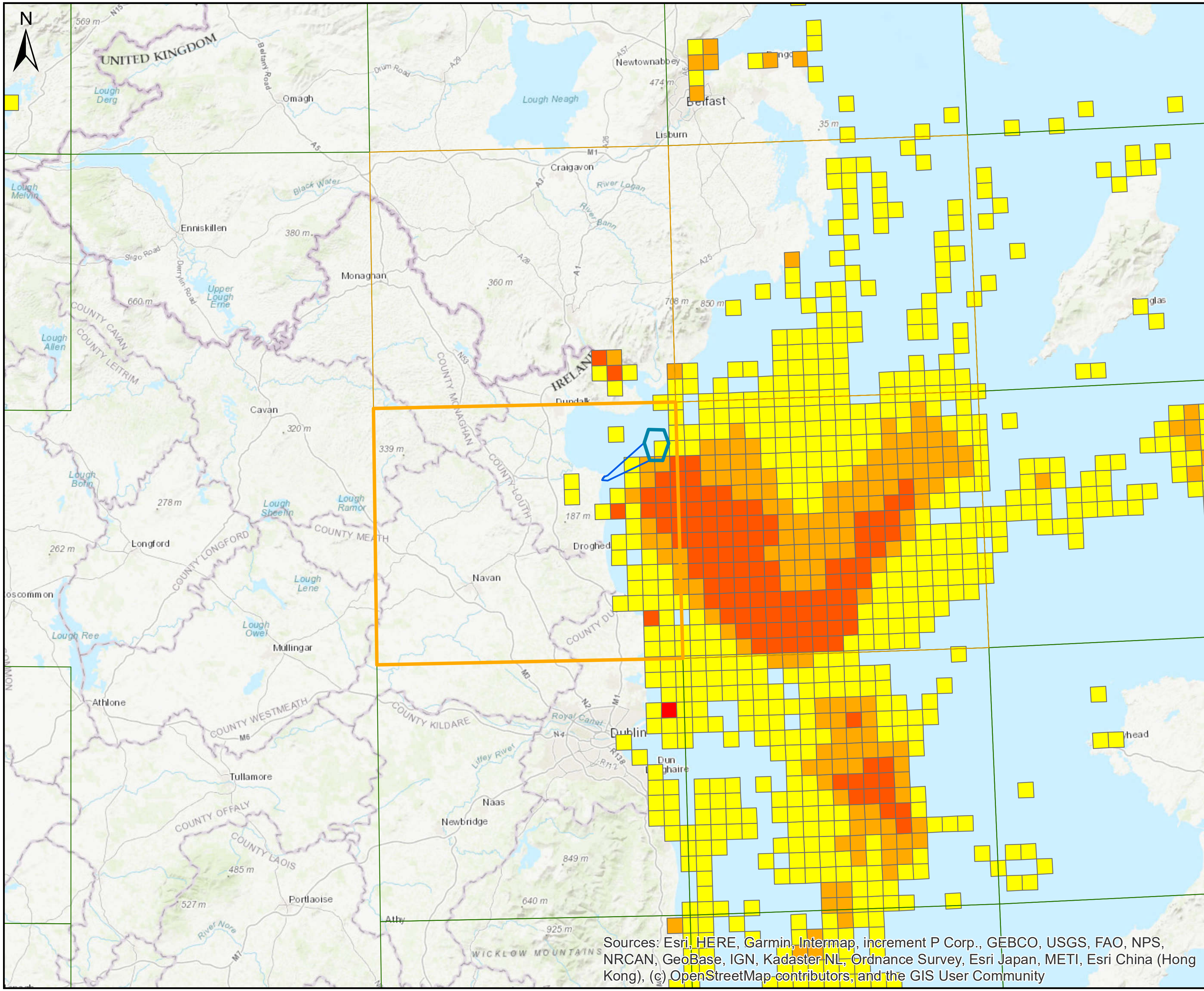

Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Commercial Fisheries Study Area
- Regional Commercial Fisheries Study Area
- ICES Statistical Rectangles

Data Sources (as of February 2020): OWL, ICES

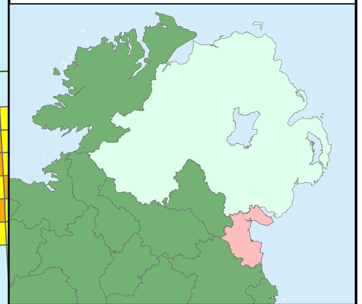

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Figure 4-3: Commercial Fishing Activity

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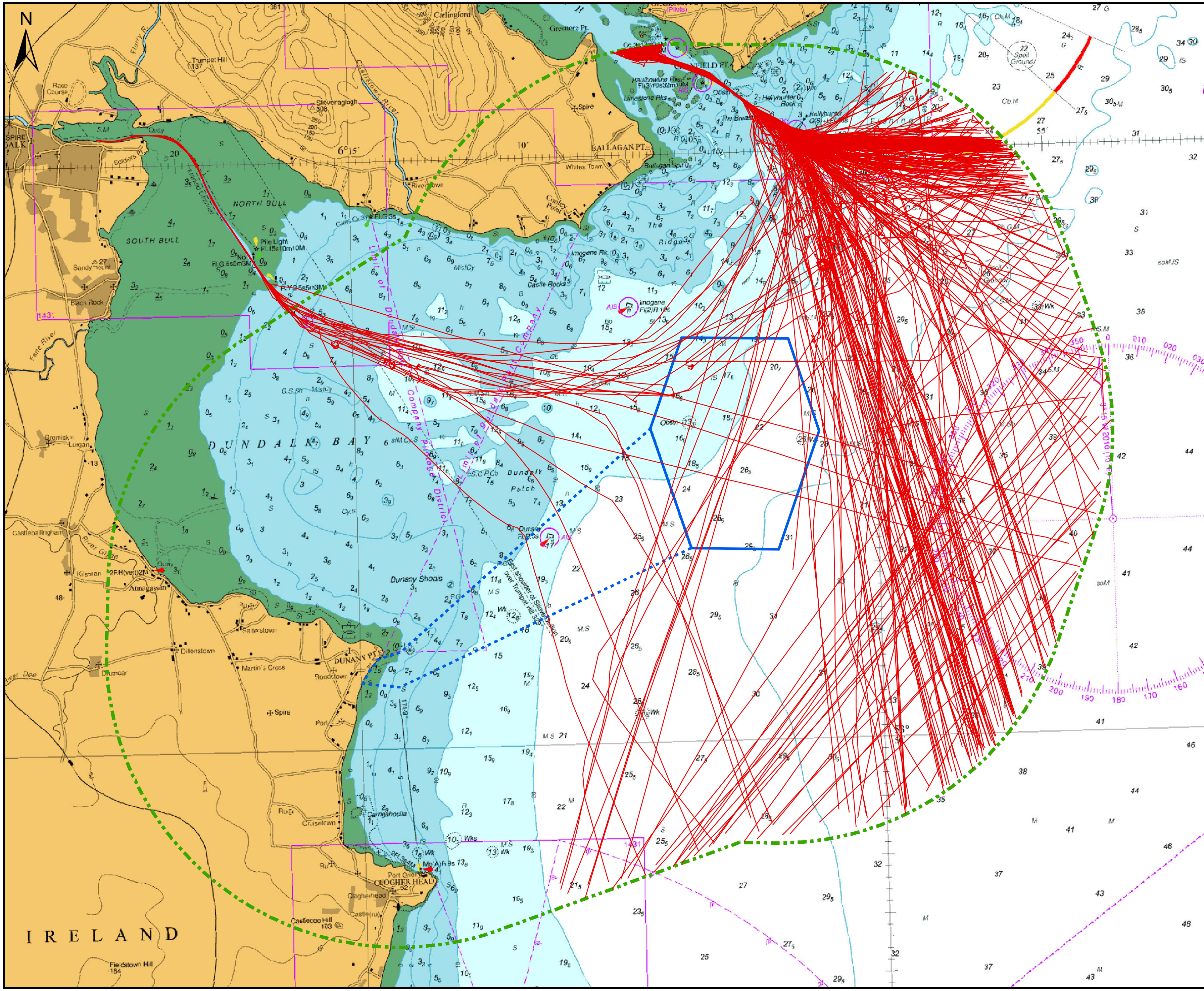

Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- NRA Study Area
- Cargo Vessel Tracks

Data Sources (as of September 2019): OWL, OSi

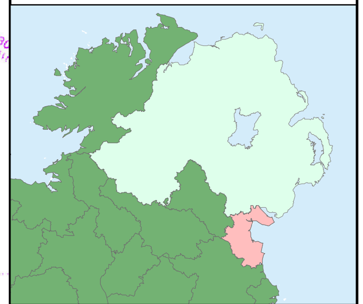

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Figure 4-4: Shipping and Navigation Routes

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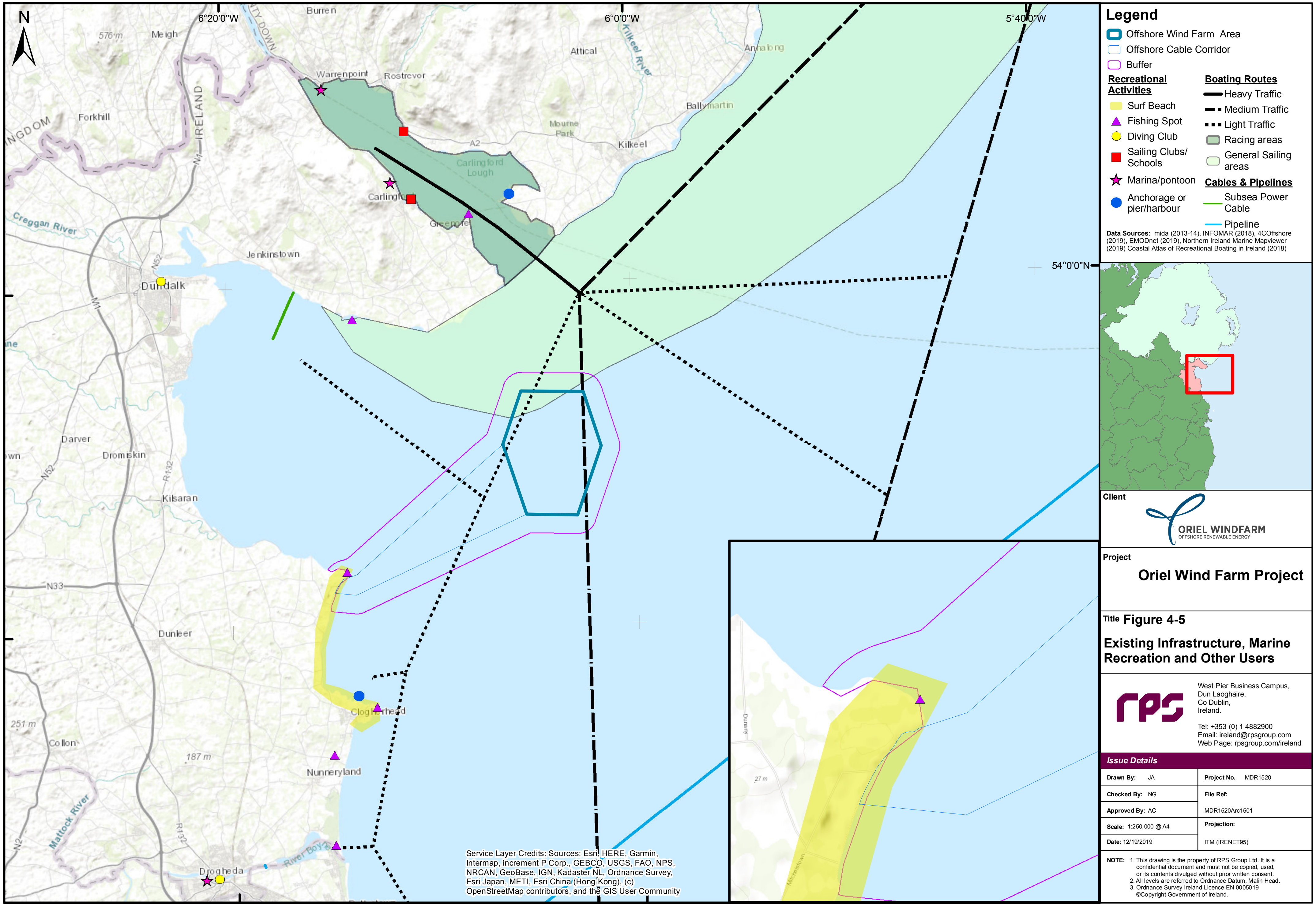


Title Figure 4-5

Existing Infrastructure, Marine Recreation and Other Users

Project site location assessment

An area in the North Irish Sea to the east of Dundalk Bay that met the criteria set out in Table 4-2 was identified as the preferred regional area of interest for the Project location. This area was extensive and required further detailed exploration to delineate a preferred site within this preferred strategic location that was best suited for the development of the Project.

To undertake this more detailed exploration, a Foreshore Licence was applied for and granted in October 2005, by the then Minister for Communications, Marine and Natural Resources. This Foreshore Licence covered a wide area to the east of Dundalk Bay and enabled the Applicant to undertake a technical work programme to assess the suitability of the area for an offshore wind farm.

A further two years of investigations were undertaken to fully determine the suitability of the area for the Project. These investigations included:

- Geophysical surveying of the seabed;
- Benthic sampling;
- Offshore bird and marine mammal surveys;
- Visual impact assessment;
- Vessel traffic assessment; and
- Consultation with local communities and marine stakeholders, including fishing organisations.

The outcome of these investigations and consultations confirmed the suitability of the regional location for an offshore wind farm and allowed for the focused determination of a preferred site within the extensive Foreshore Licence Area (see Figure 4-6).

Four site options within the Foreshore Licence Area were brought forward for further consideration and are presented in Figure 4-7. The site options are evaluated against the project location criteria in Table 4-3 below.

Table 4-3: Evaluation for selection of the preferred site option.

Topic	Criteria	Option 1	Option 2	Option 3	Option 4
Metocean	Wind resource > 9 m/s.	All options achieve average wind speeds at hub height (150m) > 9 m/s.			
	Shelter from high wave loads.	All options are sheltered from higher wave loads. The estimated annual average wave height in metres for all options is < 1 m.			
Marine Processes	Suitable seabed sediments.	Yes	Options 2 and 3 extend into areas of rock to the northwest of the area which are less suitable for foundations.		Yes
	Low tidal streams.	All options are in areas with tidal flows that are weak with a spring tidal current speeds typically less than 0.2 m/s.			
	Bathymetry water depths of approximately 20-30 m.	Yes	Options 2 and 3 extend into shallower waters to the northwest of the area which are less suitable for foundations.		Yes
Benthic Subtidal and Intertidal Ecology	Sensitive seabed habitats to be avoided, where possible.	All options located on area of circalittoral coarse sediments and sands and circalittoral muds. Limited potential for biogenic reef habitat. Design of Project to include measures to avoid such areas should they be identified.			

Topic	Criteria	Option 1	Option 2	Option 3	Option 4
Fish and Shellfish Ecology	Nursery spawning grounds to be avoided, where possible.	All options have some potential impact on Herring spawning grounds within the area. Design of Project to include measures to minimise impacts on herring spawning[4].			
Commercial Fisheries	Avoid more densely fished areas and trawling areas (where possible).	Option 1 extends into more densely fished areas to the south.	Option areas are predominantly fished with static gear for shellfish. Options have limited potential to impact on commercial fishing by trawling and are in a less densely fished area.		
Seascape, Landscape and Visual Amenity	Development further from shore (where possible).	Options 1-3 extend closer to the nearest shoreline on the Cooley peninsula. Option 2 extends closer to the Dunany to Clogherhead shoreline than the other three options.			Option 4 is further from the Cooley peninsula and the Dunany to Clogherhead shore.
Shipping and Navigation	Areas of limited shipping traffic preferred. Not within shipping lane.	All options are not within a shipping lane and seek to avoid impedance of shipping traffic to Dundalk Harbour and Carlingford Lough.			

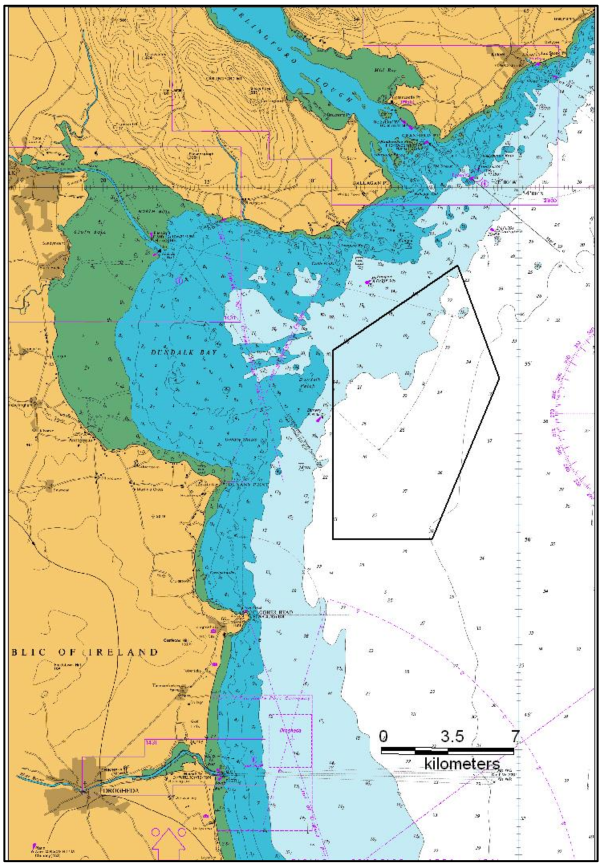
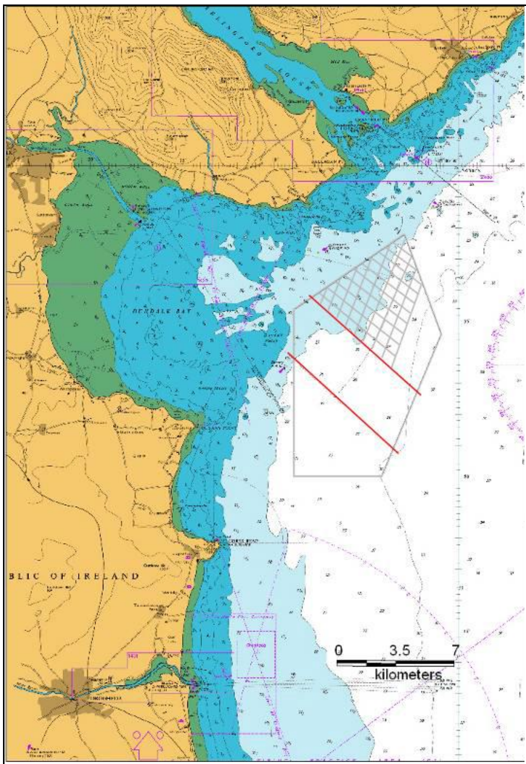
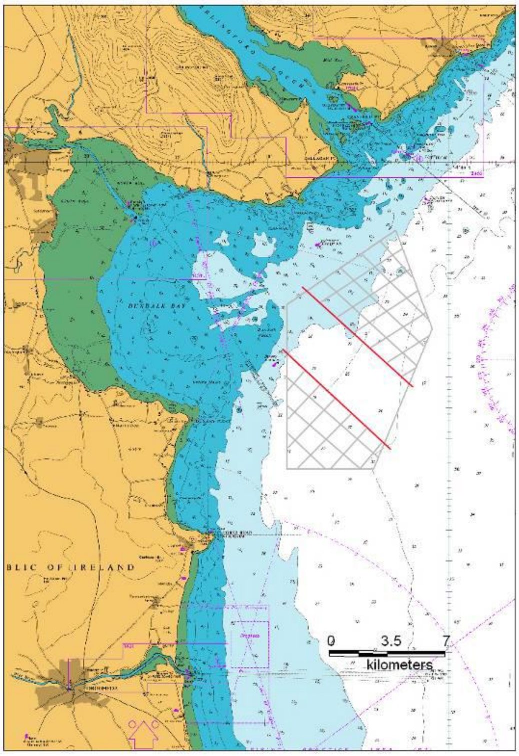


Figure 4-6: Foreshore Licence Area.

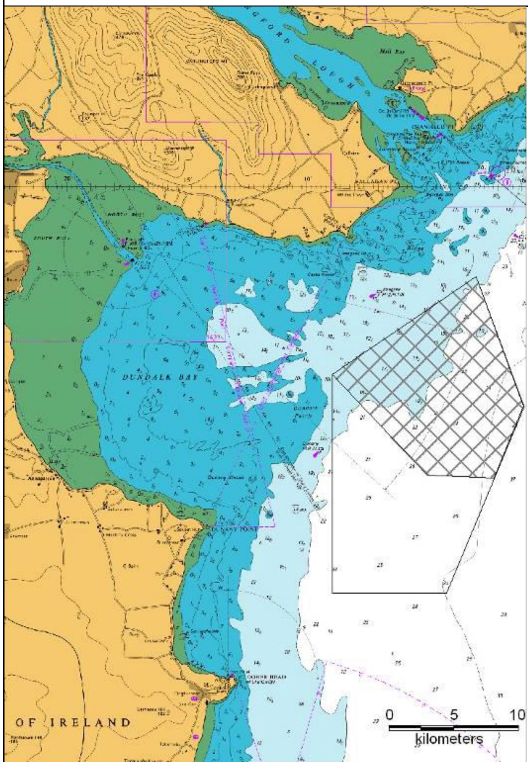
[4] On review of the additional information on spawning grounds published in 2023 ('Ecological sensitivity analysis of the western Irish Sea to inform future designation of marine protected areas (MPAs)') and completion of the assessment in chapter 9: Fish and Shellfish Ecology, the selection of the preferred location is still considered optimal as it will not result in significant effects on Herring spawning.



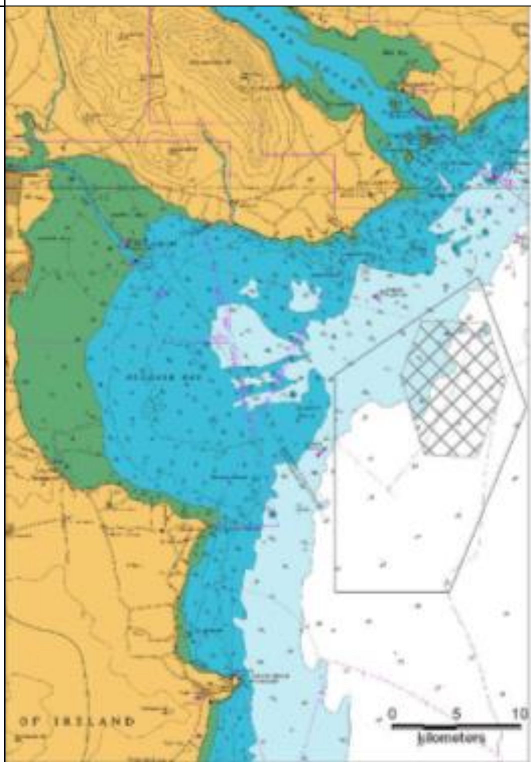
Offshore wind farm area - Option 1



Offshore wind farm area - Option 2



Offshore wind farm area - Option 3



Offshore wind farm area - Option 4

Figure 4-7: Offshore wind farm area options.

4.6.3 Preferred offshore wind farm location

On the basis of the evaluation presented in Table 4-3, Option 4 was selected. This option encompassed a smaller area in the northern part of the Foreshore Licence Area and was deemed the preferred option as it had the following advantages:

- Avoids areas of hard ground and shallower water to the northwest of the area;
- Avoids European designated sites[5];
- Avoids fisheries area in the mud beds to the south;
- Avoids shipping lanes;
- Has available grid capacity; and
- Is the appropriate size.

The preferred location was reviewed again in 2023-2024 as part of the development of the EIAR. On review of the assessments and information on the baseline environments included in the EIAR, along with relevant datasets and reports published since the location was first selected, the selected option is still considered the preferred option for the reasons set out above. There are no other factors which impact on the selected site.

4.7 Alternative locations for Operation and Maintenance Base

An operation and maintenance base is required to service and maintain the wind farm. It requires shore-side offices and warehouse facilities with relatively easy access to a berth for a crew transfer vessel (CTV). A CTV will take offshore staff to and from the wind farm on a regular basis during suitable weather conditions. The relevant evaluation criteria for a consideration of potential locations for an operation and maintenance base are presented in Table 4-4.

Table 4-4: Operation and maintenance base evaluation criteria.

Topic	Criteria	Data Source Utilised
Population and Human Health	Existing harbour or port with the necessary facilities for operation and maintenance.	OS Discovery Mapping 1:50k.
Shipping and Navigation	Existing shipping traffic routes to and from a potential base.	UKHO Admiralty Charts.
	Acceptable travel time to/from wind farm.	UKHO Admiralty Charts
	Allows access in a wide range of sea and weather conditions.	UKHO Admiralty Charts
	Allows access in all tidal conditions.	UKHO Admiralty Charts
Climate	Distance to/from wind farm.	UKHO Admiralty Charts.

There are a number of existing ports and harbours with the facilities to operate an offshore wind farm in the Irish Sea. As regular access is required to the wind farm, a shortest journey time is preferred. Potential existing ports and harbours (from south to north) include Dublin Port, Drogheda Port, Dundalk, Greenore Port, Warrenpoint, Kilkeel and Belfast Port. A high level assessment of the reasonable potential options is presented in Table 4-5 below.

[5] A new candidate SPA, named the North West Irish Sea cSPA was proposed in July 2023. The selected Option 4 offshore wind farm area does not overlap with this cSPA. A section of the offshore cable on the approach to the landfall will cross the cSPA.

Table 4-5: Operation and maintenance Base location evaluation.

Topic	Criteria	Dublin Port	Drogheda Port	Dundalk Harbour	Greenore Port	Warren-point	Kilkeel	Belfast Port
Population and Human Health	Existing harbour facilities.	0, Yes	0, Yes	1 Requires significant upgrade	0, Yes	0, Yes	0, Yes	0, Yes
Shipping and Navigation	Existing shipping routes to/from wind farm. Acceptable travel time. Access in a wide range of sea conditions. Access in all tidal conditions.	0, Yes 1, 2 hrs 1, Exposed route 0, Yes	0, Yes 0, < 1 hr 0, Short route 1, Tidal restrictions	0, Yes 0, < 1 hr 0, Short route 1, Tidal restrictions	0, Yes 0, < 1 hr 0, Short route 0, Yes	0, Yes 0, < 1 hr 0, Short route 0, Yes	0, Yes 0, < 1 hr 0, Short route 0, Yes	0, Yes 1, 2 hrs 1, Exposed route 0, Yes
Climate	Approximate distance to/from wind farm (nm).	1; > 40	0, 12	0, 10	0, 80;	0, 14	0, 10	1, > 70
Total Score	-	**3**	**1**	**2**	**0**	**0**	**0**	**3**

Note: A score of 0 is given where the criterion results in a positive outcome, and a score of 1 is given where criterion results a negative outcome

Preferred location for operation and maintenance base

On the basis of the evaluation in Table 4-5, the preferred locations for an operations and maintenance base would be Greenore Port, Warrenpoint or Kilkeel (score 0). These are preferred as they are in close proximity to the offshore wind farm area with an acceptable travel time for a crew transfer vessel. The harbours are not restricted by any tidal constraints and have existing facilities for the proposed activities.

The detailed requirements for the base are presented in chapter 5: Project description and the proposed activities are assessed within the relevant topic chapters in the EIAR.

4.8 Alternative wind turbine layouts

This section describes the alternative layouts considered for the selected offshore wind farm area (Option 4). The evaluation criteria to select the layout are described in section 4.8.1. A description of the assessments undertaken to select the wind farm layout are provided in section 4.8.3.

4.8.1 Evaluation criteria for wind turbine layouts

Approach

The assessment of layout options focused on the potential for impacts on landscape and seascape but was cognisant of other criteria particularly for offshore search and rescue access. The more favourable offshore layout option would generally feature the lowest number of wind turbines of shortest tip height. However, in the case of the Project, the options presented in Table 4-6 generally vary between a smaller number of taller wind turbines or a larger number of shorter wind turbines. The assessment is presented in detail in appendix 4-1: Preliminary Landscape Assessment of Design Options and the outcomes are summarised in the section below.

Criteria used in comparative assessment

The criteria used in the evaluation of layout options are outlined below.

Turbine size

The visibility of wind turbines will increase with increasing height. However, the relationship between turbine size and visual impact is not necessarily directly proportional.

The size of wind turbines is clearer when seen against a distinct landscape pattern that includes scale indicators. Larger wind turbines would appear out of scale and visually dominant in a smaller scale landscape or settled landscape characterised by the human scale of buildings and features.

Differences in turbine size may be less noticeable in offshore situations where they are seen against the sea horizon and where scale indicators in the surrounding coastline or land areas are less influential in terms of the overall effect. Where the turbines are viewed against an upland landscape or open seascape with coastline, they could appear to conflict with the expansive nature of these areas by introducing a scale factor which previously did not exist.

Turbine layout/array

The layout (or array) should relate to the particular characteristics of the seascape and landscape. The more favourable layouts tend to have fewer turbines arranged in a simpler layout. A more favourable layout will seek to minimise the horizontal spread of the turbines, as viewed from sensitive locations.

A reasonably balanced and consistent pattern of wind turbines across the array would ideally be achieved from sensitive viewpoint locations.

A regularly spaced grid layout can lead to a diverse range of visual effects as the viewer moves along the coastline. From one point on the coast, the turbines could be viewed in rows with the sea horizon visible in between turbines whilst at another point, the turbines could appear as a constant mass which may appear confused.

The layout should also be considered in terms of views from elevated locations to ensure that the layout does not appear clustered or confused from these viewpoints.

Turbine grouping

Turbines should be grouped to avoid gaps which are larger than the grid spacing on the perimeter of the wind farm. This could give the impression of a split in the wind farm into two groups or two wind farms.

The layout should avoid single outlier wind turbines.

Turbines should be spaced so that the sea horizon is visible. Clusters of turbines which appear as a continuous mass or cluster of tangled machines should be avoided.

Search and Rescue Access

In the absence of specific guidance from the Irish Coast Guard (IRCG), the Project layout should be compliant with the Search and Rescue (SAR) guidance from the UK Maritime and Coastguard Agency (MCA) and specifically the guidance given in the "Offshore Renewable Energy Installations: Requirements, Guidance and Operational Considerations for Search and Rescue Emergency Response (December, 2016).

The Project layout should be designed with a specific orientation for safe SAR helicopter and rescue boat operations.

4.8.2 Wind turbine layout options

Offshore wind turbines, by their nature, are large and exist in exposed areas. In most cases, they can easily be seen when viewed from shore and can be challenging to mitigate from a visual perspective due to their size and exposed position. Therefore, through a detailed design process with both the engineering team and landscape specialists, it was decided to design the wind turbine layout in a manner that minimised the effects on landscape while still maintaining reasonable wind energy yields.

2005 Proposal

An initial proposal for 55 WTGs of 6 MW capacity was made in the EIS prepared for the Project in 2007. This followed a gridded pattern across the full area identified in the original Foreshore Lease application. This grid basis sought to present a "transparent and symmetrical effect from the [viewpoint] locations assessed" (EIS 2007, section 13.9). The turbines proposed in 2005 for the Project are no longer available and therefore, a comparative assessment of layout options for the currently available wind turbine technology was prepared. This is presented in the section below.

2019/23 Comparative assessment

A preliminary comparative assessment of layout options for potential offshore wind turbines within the identified offshore wind farm area (Option 4) from a landscape, seascape and visual amenity perspective was prepared. This assessment is detailed in appendix 4-1: Preliminary Landscape Assessment of Design Options and a summary of the findings is provided below.

The purpose of this assessment was to present preliminary findings in regard to likely significant effects associated with key landscape, seascape and visual receptors and to present a comparative analysis of turbine options for the Project.

Seven plan layouts in grid and irregular spacing of turbines were assessed from a number of viewpoints (as outlined in appendix 4-1: Preliminary Landscape Assessment of Design Options). These vary in terms of turbine type, capacity, number and tip height above Lowest Astronomical Tide (LAT). The seven preliminary layouts considered are set out in Table 4-6.

Table 4-6: Information on wind farm layout options.

Plan Layout	Wind Turbine Capacity	Number of Turbines	Hub Height above LAT	Blade Tip Height above LAT
Layout 1 – regular grid.	14 MW	27	133	243
Layout 2 – irregular grid.	14 MW	27	133	243
Layout 3 – regular grid.	10 MW	34	107	189
Layout 4 – irregular grid.	10 MW	33	107	189
Layout 5a – refined layout.	10 MW	33	107	189
Layout 5b – refined layout.	14 MW	33	133	243
Layout 6 – refined layout.	15 MW	25	150	270

4.8.3 Wind turbine layout assessment

The comparative assessment considered the wind turbines associated with each of the options presented in Table 4-6. The comparative assessment is detailed in appendix 4-1. It is supported and informed by graphic outputs as follows:

- Zone of Theoretical Visibility for each wind turbine size; and
- Wireline outputs using wind farm software from selected viewpoint locations.

The assessment of the seven layouts from the viewpoints indicated a number of outcomes for consideration in the final layout:

- The 25 turbine layout appeared more compact from a number of viewpoints. The removal of turbines from the northwest of the site reduced the energy yield from the wind farm but increased the distance of the nearest wind turbine to the closest shore and viewpoint by 20%.
- The 25 turbine layout was defined along a specific orientation of 021°N for Search and Rescue access. The final layout required a limited deviation from this alignment due to soil conditions for the foundations. The range of this deviation was from 0 to 188m.
- The 10 MW turbines appeared slightly smaller to the viewer than the 14 and 15 MW turbines from a number of viewpoints, but higher in density.

The preliminary assessment determined that the most favourable layout, as seen from the maximum number of viewpoints, will have the following:

- Consistent and simple pattern with consistent spacing between individual wind turbines and avoiding gaps which appear to split the wind farm;
- Minimal clustering of wind turbines which present in the view as a dense grouping of structures that would be more visible than single turbines aligned in a line; and
- General alignment of turbines along a specific orientation for Search and Rescue access.

4.8.4 Preferred wind turbine layout

A 25 turbine layout (option 6) which adheres to the following principles was selected:

Principle 1	All surface offshore infrastructure will be confined within the area defined by the Maritime Area Consent.

Principle 2	A minimum spacing of 4 x maximum rotor diameter (i.e. greater than 944 m) will be maintained between the centre points of all wind turbines.
Principle 3	The layout is cognisant of standard practice for Search and Rescue access and maintains at least one orientation for access.
Principle 4	The wind turbine layout will, where possible, avoid clustering of wind turbines from sensitive viewpoints.
Principle 5	The wind turbine layout will, where possible, avoid visual overlap with land, particularly the Cooley Peninsula, from southern viewpoints.
Principle 6	The offshore cable will be located within the offshore cable corridor from the south western side of the wind farm area to a landfall location south of Dunany Point.

4.9 Alternative offshore cable corridor options

4.9.1 Evaluation criteria for offshore cable corridor options

An offshore cable is required to connect the offshore wind farm to the landfall. At this location the offshore cable connects to the onshore cables. This cable is buried within the seabed where possible. Where hard ground is encountered, the cable is surface laid and protected by rock armour.

The offshore cable corridor is constrained by the selected location of the wind farm area (presented in section 4.6.3) and the preferred locations for the landfall, onshore substation and onshore cable route (detailed in sections 4.10.3, 4.10.5 and 4.10.7, respectively).

The relevant evaluation criteria for the consideration of the potential offshore cable corridors are presented in Table 4-7.

Table 4-7: Offshore cable corridor evaluation criteria.

Topic	Criteria	Data Source Utilised
Marine Processes	Suitable seabed sediments.	INFOMAR mapping.
	Low tidal streams.	UKHO Tidal Current Predictions.
	Bathymetry.	UKHO Admiralty Chart Nose of Howth to Ballyquintin Point.
Benthic Subtidal and Intertidal Ecology	Sensitive seabed habitats to be avoided, where possible.	INFOMAR mapping.
Fish and Shellfish Ecology	Nursery spawning grounds to be avoided, where possible. Potential for herring spawning in the area of interest,	INFOMAR mapping.
Marine Mammals and Megafauna	Special Areas of Conservation (European Designated Sites) to be avoided.	NPWS mapping.
Offshore Ornithology	Special Protection Areas (European Designated Sites) to be avoided, where possible.	NPWS mapping.
Commercial Fisheries	Areas of limited fishing activity preferred.	Vessel AIS mapping and consultation with local fisheries stakeholders.
Shipping and Navigation	Areas of limited shipping traffic preferred. Not within shipping lane.	Shipping AIS mapping.
Infrastructure, Marine Recreation and Other Users	Low density of recreational marine users. Avoidance of existing marine infrastructure.	Irish Sailing recreational mapping. Ireland Marine Atlas.
Material Assets	Potential landing points with proximity to existing high voltage transmission grid network.	OS Discovery Mapping 1:50k.

4.9.2 Offshore cable corridor options

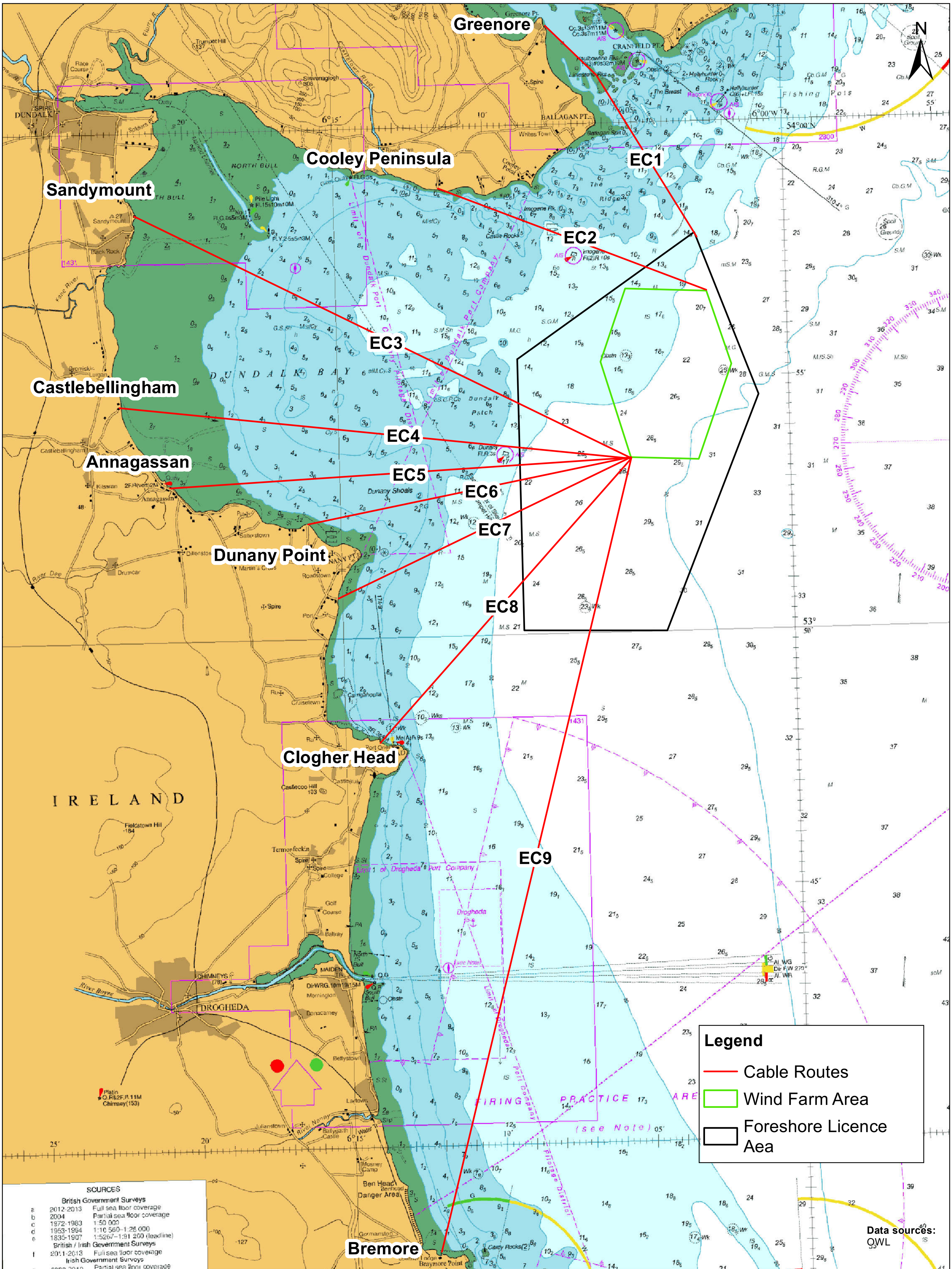
A number of offshore cable corridor options had been considered in section 2.4.1 of the 2007 EIS and a summary of these options are outlined in Table 4-8 below.

Table 4-8: Description of offshore cable corridor options.

Site Option ID	Route	Description of Cable Corridor
EC1	North North West to Greenore	The seafloor in this area is predominantly gravelly rock. As this cable route approaches Greenore, it enters Carlingford Lough. Carlingford Shore is a candidate Special Area of Conservation (cSAC) (site code 002306) and to the west of the landfall site is Carlingford Lough Special Area of Protection (SPA) (site code 004078). The landfall is not in close proximity to a suitable grid connection point.
EC2	North West to Cooley Peninsula	The seafloor in this area is predominantly rock. The cable corridor would run close to the Carlingford Shore cSAC. The landfall is not in close proximity to a suitable grid connection point.
EC3	North West to Sandymount	The seafloor in this area is predominantly sand. This option would transect the Dundalk Bay SPA and Dundalk Bay SAC and the well-established salt marshes in the area. The Dundalk substation is not a viable option for connection to the national grid.
EC4	West to Castlebellingham	The seafloor in this area is predominantly sand. This option would transect the Dundalk Bay SPA and Dundalk Bay SAC and the well-established salt marshes in the area. The Dundalk substation is not a viable option for connection to the national grid.
EC5	West to Annagassaun	The seafloor in this area is predominantly sand. This option would transect the Dundalk Bay SPA and Dundalk Bay SAC and the well-established salt marshes in the area. The Dundalk substation is not a viable option for connection to the national grid.
EC6	West to Dunany Point North	The seafloor in this area is predominantly sand. This option would transect the Dundalk Bay SPA and the Dunany Point pNHA (site code: 001856).
EC7	West to Dunany Point South	The seafloor in this area is predominantly sand, gravels and cobbles. This option avoids the Dundalk Bay SPA but has a short 1 km cable section through the North West Irish Sea SPA (site code: 004236) and the Dunany Point pNHA (site code: 001856).
EC8	South West to Clogher	This option runs in a SW direction for approximately 14 km towards the landfall site located, approximately 0.75 km north of Clogher Head town. The seafloor in this area is predominantly mud. The option would transect the NW Irish Sea SPA and the Clogher Head SAC (001459). It is also a considerable distance from a suitable grid connection point.
EC9	South South West to Bremore	This option runs in a SW direction for approximately 30 km towards the potential landfall site located approximately 1 km west of Bremore Point. The seafloor in this area ranges from sand to fine sand to gravel. This option would be the longest cable route and would transect the NW Irish Sea cSPA for much of its length.

4.9.3 Offshore cable corridor assessment

An evaluation of the options for the offshore cable corridor is presented in Table 4-9. A score of 1 is given where the offshore cable corridor could interact negatively with the topic criteria. A score of 0 is given where there is no potential for interaction.



Title

Figure 4-8:

Offshore cable corridor alternative options

Client

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

Oriel Wind Farm Project

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A TETRA TECH COMPANY
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Issue Details

Drawn By:	NR	Project No.	MDR1520b
Checked By:	CC	File Ref:	MDR1520bArc3134F02
Approved By:	CC		
Scale:	1:180,000 @ A4	Projection:	ITM (IRENET95)
Date:	19/03/2024		

NOTE: 1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.

Table 4-9: Offshore cable corridor evaluation.

Topic	Criteria	EC1	EC2	EC3	EC4	EC5	EC6	EC7	EC8	EC9
Marine Processes	Suitable seabed sediments.	1 Rock	1 Rock	0	0	0	0	0	0	0
	Low tidal streams.	0	0	0	0	0	0	0	0	0
	Bathymetry.	0	0	0	0	0	0	0	0	0
Benthic Subtidal and Intertidal Ecology	Sensitive seabed habitats to be avoided, where possible.	1 Potential for biogenic reef	1 Potential for biogenic reef	1 Saltmarsh	1 Saltmarsh	1 Saltmarsh	0	0	0	0
Fish and Shellfish Ecology	Nursery spawning grounds to be avoided, where possible. Potential for herring spawning across all routes.	1	1	1	1	1	1	1	1	1
Marine Mammals and Megafauna	Special Areas of Conservation (European Designated Sites) to be avoided.	1 Carlingford Shore SAC	1 Carlingford Shore SAC	1 Dundalk Bay SAC	1 Dundalk Bay SAC	1 Dundalk Bay SAC	0	0	1 Clogher Head SAC	0
Offshore Ornithology	Special Protection Areas (European Designated Sites) to be avoided, where possible.	1 Carlingford Lough SPA	0	1 Dundalk Bay SPA	1 Dundalk Bay SPA	1 Dundalk Bay SPA	1 Dundalk Bay SPA	0[6]	0	0
Commercial Fisheries	Areas of limited fishing activity preferred.	0	0	0	0	0	0	0	1 Nephrops trawling	1 Nephrops trawling
Shipping and Navigation	Areas of limited shipping traffic preferred. Not within shipping lane.	1 Close to Imogene Buoy	1 Close to Imogene Buoy	1 Crosses Dundalk Port pilotage area	1 Crosses Dundalk Port pilotage area	1 Crosses Dundalk Port pilotage area	0	0	0	0
Infrastructure, Marine Recreation & Other Users	Low density of recreational marine users. Avoidance of existing marine infrastructure.	1 Carlingford Lough	0	0	0	0	0	0	0	0
Material Assets	Potential landing points with proximity to existing high voltage transmission grid network.	1 Not close to grid	1 Not close to grid	1 Not close to grid	1 Not close to grid	0	0	0	1 Not close to grid	0
Total Score		**8**	**6**	**6**	**6**	**5**	**2**	**1**	**4**	**2**

[6] A new candidate SPA, named the North West Irish Sea cSPA, was proposed in July 2023. This didn't exist when the corridors were selected.

4.9.4 Preferred offshore cable corridor

On the basis of the evaluation, offshore cable option EC7 is preferred (as it has the lowest score). Geophysical mapping indicated that suitable sediments for burial were present between the offshore wind farm area and the landfall. Some limited laying of cable on the seabed and protection by rock armour will be required. Low tidal currents (< 0.5 m/s) are present throughout the area and water depths of < 30 m are present throughout the offshore cable corridor. No sensitive benthic habitats were identified. Nursery spawning grounds for Herring were identified in the area but are limited to the offshore cable corridor. No SACs are present.

Approximately 2 km of the offshore cable corridor overlaps with the North West Irish Sea cSPA. However, the proposed construction works are temporary and the extent of the cable corridor within the SPA is minimal (0.09%[7]). Although the North West Irish Sea cSPA was not designated when the offshore cable corridor evaluation was undertaken, option EC7 would still be considered the most favourable. EC6 (the second lowest score) traverses Dundalk Bay SPA which is designated for wading birds and therefore, disturbance of the sediments from cable laying could result in a greater potential for negative effects than the short offshore export cable section within the North West Irish Sea cSPA, which is designated for foraging by offshore seabirds. The fisheries are limited to static fishing in the proposed offshore cable corridor with no significant trawling. The offshore cable corridor is not within a shipping lane and there is no existing marine infrastructure. There is limited use of the area for marine recreation (see chapter 16: Infrastructure, Marine Recreation and Other Users).

The preferred corridor was reviewed again in 2023-2024 as part of the development of the EIAR. On review of the assessments and information on the baseline environment outlined in the EIAR, along with relevant datasets and reports published since the corridor was first selected, the selected option is still considered the preferred option for the reasons set out above. There are no other factors which impact on the preferred offshore cable corridor. Also, the section of the corridor which overlaps with the cSPA was narrowed on the approach to the landfall.

4.10 Alternative onshore infrastructure options

4.10.1 Evaluation criteria for the onshore layout

Table 4-10 outlines the criteria and constraints considered to evaluate the onshore elements of the Project, with the relevant data sources and references. This provides a common framework to provide transparency in the assessment of these alternative options.

These criteria have been utilised to evaluate the potential options for the landfall, substation location, and onshore cable route alternatives as appropriate in sections 4.10.2 to 4.10.7 below. The results of the evaluations outline a preferred alternative for each onshore element of the Project.

Table 4-10: Onshore evaluation criteria.

Topic	Criteria	Data Source Utilised
Population/Human Health/Nuisances (Air/Noise)	Number of dwelling within 50 m	GeoDirectory
	Settlement Envelopes	CSO
	Ribbon Development	GeoDirectory
Land Use/Zoning	Area of site/ corridor traversing land zoned for: (a) high amenity/(b) development/(c) specific development	MyPlan
	Louth County Development Plan (CDP) Land Zoning	Louth CDP 2015-2021
Biodiversity	SPA/SAC/Ramsar	NPWS/ Ramsar
	NHA/pNHA	NPWS

[7] The extent of works within the offshore cable corridor will be much less than this, as described in chapter 5: Project Description.

Topic	Criteria	Data Source Utilised
	National Survey of Native Woodland	NPWS
	Annex I Habitats	NPWS
Land and Agriculture	Area of land take (Option length proxy)	Area of 50 m Buffer
	Land Cover (Corine)	EPA
Landscape	Landscape Designations	Louth County Council
	Landscape Character Area traversed (km)	Louth County Council
	Length of route within or adjoining an ‘Area of High Scenic Quality’ (km)	Louth County Council
	Length of route designated as a ‘Scenic Road’ (km)	Louth County Council
	Area of Outstanding Natural Beauty (AONB)	Louth County Council
Soils, Geology and Hydrogeology	Areas of Peat	EPA/Teagasc Soils Map 2006
	Areas of bedrock outcrop (groundwater vulnerability rated Extreme)	GSI
	Geological Heritage Area/County Geological Site	GSI
	Karst Features (No.)	GSI
Hydrology and Flood Risk	Water Body Crossings (No.)	EPA
	Current Flood Risk (No. Current Fluvial & Coastal Risk Categories)	OPW Flood maps
Material Assets - Other	No. of National Primary Roads Crossings (No.)	OSi 50k Discovery Mapping
	No. of National Secondary Roads Crossings (No.)	OSi 50k Discovery Mapping
	Railway Crossings (No.)	OSi 50k Discovery Mapping
	Underground Electrical Cable Crossings (No.)	ESB
	Gas Pipeline Crossings (all pressures) (No.)	GNI
	Water Mains Crossings (No.)	Uisce Éireann (formerly Irish Water)
	Telecommunications Masts (No.)	ComReg
	Distance to 220 kV Transmission Line	ESB
Cultural Heritage – Archaeology	Recorded Monuments and Places (RMP) (No.)	National Monuments Service
	Sites and Monuments Record SMR (No.)	National Monuments Service
Cultural Heritage – Architectural	National Inventory of Architectural Heritage (NIAH) (No.)	Buildings of Ireland
	Architectural Conservation Areas	Louth County Development Plan 2015-2021
	Historic Houses and Demesnes	Dept. Culture, Heritage & the Gaeltacht
Vulnerability to the risk of major accidents	Presence of Seveso Site (consultation radius)	HSA/Louth County Development Plan 2015-2021
Waste	Historic Landfills Register	Eastern-Midlands Regional Waste Management Plan 2015-2021

A number of guiding principles were used in the selection process for the landfall, onshore substation and onshore cable route to minimise potential impacts on the environment. These principles were as follows:

- Population centres to be avoided where possible;
- Proximity to residential dwellings to be minimised where possible;
- European designated sites to be avoided where possible;

- National designated sites to be avoided where possible; and
- Regional/local designated sites to be avoided/impacts minimised where possible.

4.10.2 Landfall site options

A number of landfall locations were previously considered in the 2007 EIS (section 2.4.1) and a summary of these options, along with two options which were brought forward more recently under this application, are outlined in Table 4-11 below.

Table 4-11: Alternative landfall options.

Site Option ID	Townland Location	Location within the study area	Site Description
LF1	Greenore	Most northern and eastern landfall site in the study area	This site is located at Greenore point, north of the R175. In close proximity is Greenore Port and to the southwest of the site is Greenore Golf Club. Access to the R175 from the site is via Euston Street or Shore Road.
LF2	Templetown	North-east site in the study area	This site is located approximately 1.75 km south west of Cooley Point. The R173 runs north west of the site and is accessed via minor roads. To the north of the site is Templetown Transport Limited and a number of private properties.
LF3	Rathcor	Northern site in the study area	This site is located approximately 3.5 km west of Cooley Point. The R173 runs to the north west of the site and is accessed via minor roads. To the north of the site is a small cluster of private properties.
LF4	Mountbagnall	Northern site in the study area	This site is located to the east of Gyles Quay. The R173 runs north of the site and is accessed via minor roads. To the west of the site is Gyles Quay Caravan and Camping Park.
LF5	Haggardstown	Northern site in the study area	This site is located at Sandymount to the north of Blackrock. The R172 is located to the west of the site. Adjacent to the site are a cluster of private properties.
LF6	Castlebellingham	Northern site in the study area	This site is located approximately 1.75 km east of Dromiskin and approximately 2.5 km north east of Castlebellingham. The R132 is located to the west of the site and is accessed via the Sea Road.
LF7	Dillonstown	Northern site in the study area	This site is located north west of Annagassan. The R166 runs to the west of the site. The site is located in close proximity to the transitional waters (connected to the River Dee).
LF8	Dunany	Northern site in the study area	This site is located to the north east of the L223 and Coast Road in the area of Corstown. Access is via minor roads. Just south of the site are private properties.
LF9	Mitchelstown	Northern site in the study area	This site is located approximately 1.75 km south west of Dunany Point. The Coast Road is located along the west of the site.
LF10	Clogher	Central site in the study area	This site is located approximately 0.75 km north of Clogher Head. The site is accessed via the Harbour Road off the R166. In close proximity to the site is Oriel Marine Extracts, CR Adventure and Clogherhead Fish Co-Operative.
LF11	Knocknagin	Southern site in the study area	This site is located at Bremore Point, situated south-east of Gormanstown. The R132 is located to the west of the site and is accessed via minor roads.
Castlebellingham	Linns	Northern site in the study area	This site is located approximately 1.5 km to the north-east of Castlebellingham town. The site is accessed via local roads which link to the R132 and R166.

Site Option ID	Townland Location	Location within the study area	Site Description
Dunany	Salterstown	Northern site in the study area	This site is located to the south east of Annagassan. The R166 is to the west of the site and is accessed via the Strand Road. To the east of the site is Salterstown pier.
Dunany (North) (new option)	Dunany	Northern site in the study area	This site is located to the north east of the L223 and Coast Road and is accessed via minor roads.
Dunany (South) (new option)	Dunany	Northern site in the study area	This site is located south of Dunany point to the east of the Coast Road and is accessed via minor roads.

4.10.3 Landfall site assessment

Table 4-12 overleaf shows the evaluation of alternative options for the landfall based on the guiding principles and consideration of the environmental constraints and criteria outlined in Table 4-10 and presented in Figure 4-9.

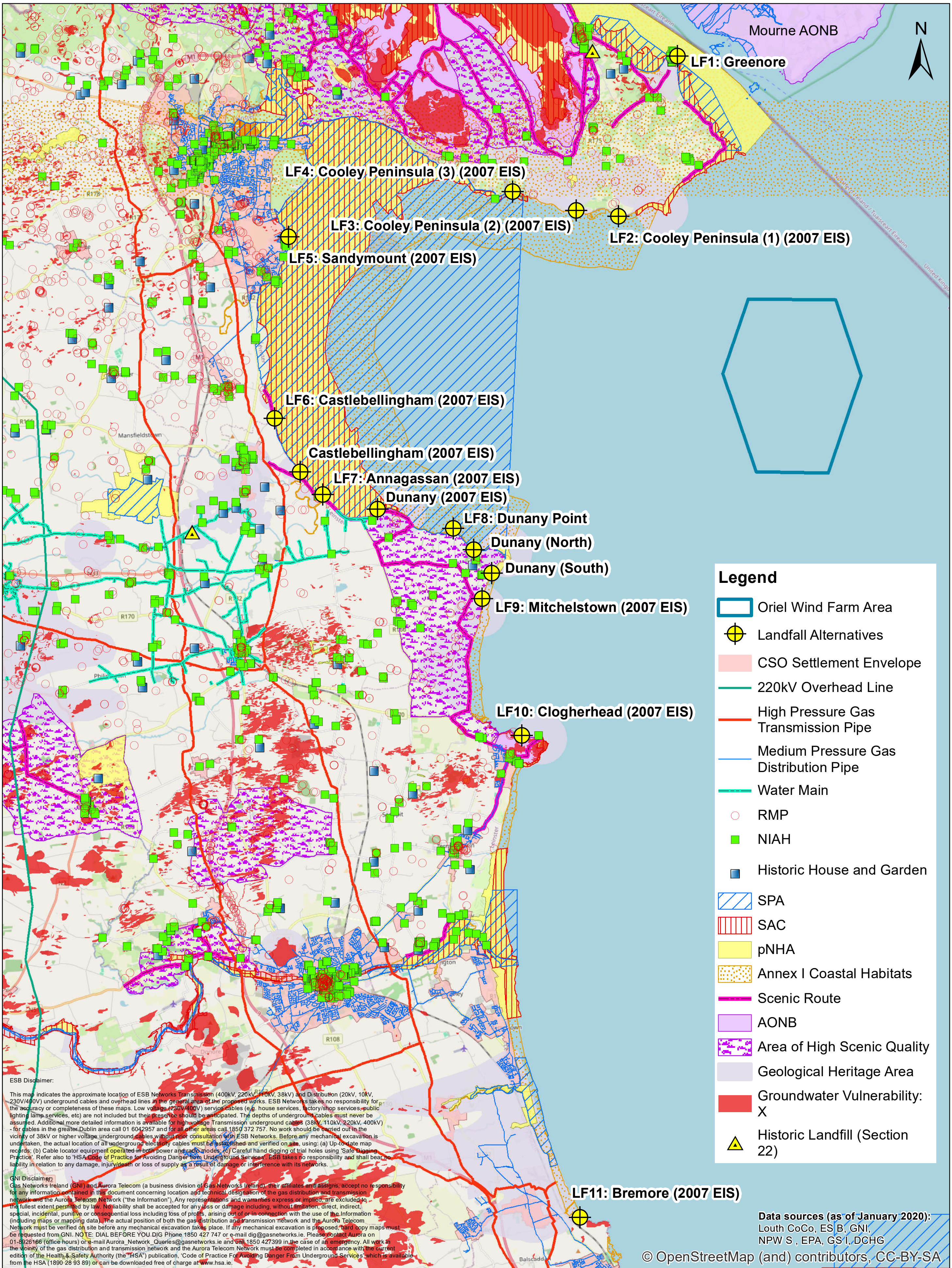
Table 4-12: Landfall site alternative options evaluation.

Topic	Criteria (within 50m of Landfall Site)	LF1	LF2	LF3	LF4	LF5	LF6	LF7	LF8	LF9	LF10	LF11	Castlebell-ingham	Dunany	Dunany (North)	Dunany (South)
Population/ Human Health/ Nuisances (Air/ Noise)	CSO settlements traversed by onshore cable to connect with landfall point	3 (Lordship, Jenkinstown, Dundalk)	3 (Lordship, Jenkinstown, Dundalk)	3 (Lordship, Jenkinstown, Dundalk)	3 (Lordship, Jenkinstown, Dundalk)	1 (Dundalk)	1 (Castlebell-ingham)	1 (Annagassan)	0	0	1 (Clogherhead)	0	1 (Castlebell-ingham)	0	0	0
Land use/ Zoning	Area (Ha) of site/route traversing land zoned for: (a) high amenity/(b) Development/(c) specific development (ha)	0	0	0	0	(a) 0 (b) 0.52 (c) 0.52	0	(a) 0 (b) 0.55 (c) 0.55	0	0	(a) 0 (b) 0.05 (c) 0	(a) 0.16 (b) 0.16 (c) 0.16	0	0	0	0
Biodiversity	SPA/SAC/Ramsar	0-1-0 (Carlingford Shore)	0	0	1-1-0 (Dundalk Bay)	1-1-1 (Dundalk Bay)	1-1-1 (Dundalk Bay)	1-1-1 (Dundalk Bay)	1-0-0 (Dundalk Bay)	0	0	0	1-1-1 (Dundalk Bay)	1-1-1 (Dundalk Bay)	1-0-0 (Dundalk Bay)	0
	Distance of SPA/SAC traversed by offshore cable (m)	0	0	0	SAC: 154 SPA: 694	SAC: 2,905 SPA: 9,742	SAC: 2,862 SPA: 9,147	SAC: 2,048 SPA: 7,151	SPA: 2,108	0	0	0	SAC: 2,450 SPA: 8,260	SAC: 395 SPA: 5,640	SPA: 1,269	0[8]
	pNHA	1 (Carlingford Lough)	0	0	0	1 (Dundalk Bay)	1 (Dundalk Bay)	1 (Dundalk Bay)	0	0	0	0	1 (Dundalk Bay)	1 (Dundalk Bay)	0	1 (Dunany Point)
	Annex I Habitat	2 (Mudflats and sandflats not covered by sea water at low tide, large shallow bays & inlets)	1 (large shallow bays & inlets)	1 (Mudflats and sandflats not covered by sea water at low tide)	1 (large shallow bays & inlets)	3 (Estuaries, Mudflats and sandflats not covered by sea water at low tide, Perennial vegetation of stony banks)	2 (Mudflats and sandflats not covered by sea water at low tide, Large shallow inlets and bays)	2 (Mudflats and sandflats not covered by sea water at low tide, Large shallow inlets and bays)	2 (Large shallow inlets and bays, Potential saltmarsh)	1 (Mudflats and sandflats not covered by sea water at low tide)	0	1 (Mudflats and sandflats not covered by sea water at low tide)	2 (Mudflats and sandflats not covered by sea water at low tide, Large shallow inlets and bays)	1 (Mudflats and sandflats not covered by sea water at low tide)	1 (large shallow bays & inlets)	1 (Mudflats and sandflats not covered by sea water at low tide)
Land and Agriculture	Land Cover (Corine)	2	2	2	2	2	2	2	3	2	2	2	2	1	2	3
Landscape	Landscape Designations	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1
	Landscape Character Area traversed (km)	0.50	0.39	0.56	0.66	0.77	0.77	0.77	0	0.77	0.71	0	0.54	0	0.37	0.77
	Area of 50m buffer of landfall site within or adjoining an 'Area of High Scenic Quality' (Ha)	0	0	0	0	0	0	0	0.22	0.47	0	0	0	0	0.49	0.46
	Length of onshore cable route designated as a 'Scenic Road' (km)	0	0	0	0	0	0.04	0	0	0	0	0	0	0	0	0

[8] At the time of the consideration of alternative landfall locations, the NWIS cSPA was not designated. However, the designation of this site does not amend the results of the assessment of reasonable alternatives carried out.

Topic	Criteria (within 50m of Landfall Site)	LF1	LF2	LF3	LF4	LF5	LF6	LF7	LF8	LF9	LF10	LF11	Castlebell-ingham	Dunany	Dunany (North)	Dunany (South)
	Area of Outstanding Natural Beauty (AONB)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Soils, Geology and Hydrogeology	Areas of bedrock outcrop (GW Vul. Rated X)	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
	Geological Heritage Area/County Geological Site	1 (Greenore Raised Beach)	0	1 (Rathcor Complex)	0	1 (Dundalk Bay)	1 (Dundalk Bay)	1 (Dundalk Bay)	0	0	1 (Clogherhead Wave Cut Platform)	0	2	1 (Dundalk Bay)	0	1 (Dunany Point)
Hydrology and Flood Risk	Water Body Crossings (No.)	0	0	1 (Ballynama-ghery_010)	0	0	0	0	0	0	0	0	0	0	0	0
	Current Flood Risk (No. Current Fluvial & Coastal Risk Categories)	Coastal and River risks	0	0	0	Coastal	Coastal	Coastal and River risks	0	0	0	Coastal	Coastal	Coastal	0	0
Material Assets - Other	Telecommunications Masts (No.)	4 proximal:	0	0	0	0	0	0	1 proximal	0	0	0	0	0	0	0
Cultural Heritage	SMR (No.)	0	0	0	0	1 (ID: R174293. Souterrain)	0	0	0	0	0	0	0	0	0	0

No constraints were noted for the following criteria: Biodiversity: NHA, National Survey of Native Woodland; Land and Agriculture: Area of land take; Soils, Geology & Hydrogeology: Areas of peat, karst features; Material Assets - Other: No. of National Primary Roads Crossings (No.), No. of National Secondary Roads Crossings (No.), Railway Crossings (No.), Underground Electrical cable Crossings (No.), Gas Pipeline Crossings [all pressures] (No.), Water Mains Crossings (No.); Cultural Heritage: RMP (No.); NIAH (No.), Architectural Conservation Areas, Historic Houses and Demesnes, Listed Buildings/Record of Protected Structures (No.); Vulnerability to the risk of major accidents: Presence of Seveso Site (consultation radius); Waste: Historic Landfills Register.



Title

Figure 4-9:

Landfall options and environmental constraints

Client: ORIEL WINDFARM OFFSHORE RENEWABLE ENERGY

Project: **Oriel Wind Farm Project**

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Issue Details

Drawn By: NR	**Project No.** MDR1520b
Checked By: CC	**File Ref:** MDR1520bArc3128F02
Approved By: CC	
Scale: 1:190,000 @ A4	**Projection:** ITM (IRENET95)
Date: 20/03/2024	

NOTE:
1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3.

Preferred landfall evaluation

The various landfall sites were evaluated by taking into account the criteria in the table above and the use of geographic information systems (GIS). The evaluation is presented below:

- For landfall points LF1, LF2, LF3 and LF4, the onshore cable route would need to traverse three settlements identified by the Central Statistics Office (CSO) in order to connect with the existing 220 kV high voltage transmission line. Therefore, these landfall locations are least preferred from a population perspective.
- For LF5, LF6, LF7, LF10 and the Castlebellingham 2007 EIS alternative, the onshore cable connecting each landfall site would traverse one CSO settlement in order to connect with the landfall point. Therefore, these landfall locations are least preferred from a population perspective, given the potential disturbance to settlement areas from the construction of a high voltage cable.
- Landfall sites LF8, LF9, LF11 and the Dunany landfall sites are preferred in relation to population.
- Landfall sites LF5, LF7, LF10 and LF11 are less preferred as they are located in areas zoned in the Louth CDP 2015-2021 for high amenity.
- LF1, LF4 to LF8, Castlebellingham (2007 EIS), Dunany (2007 EIS) and Dunany (North) are least preferred as they all impact on European site designations to a greater or lesser extent depending on their location onshore (such as LF1 and Carlingford Shore SAC) and the corresponding distance the offshore export cable must traverse the European site to reach the landfall site (through Dundalk Bay SPA/SAC for all other sites). Therefore, landfall sites LF2, LF3, LF9, LF10, LF11 and Dunany (South) are preferred in terms of avoiding impacts on European site designations.
- Given the significance of the European designations and the principle to avoid them, the remaining sites are considered against the other constraints. Landfall sites LF9, LF10 and Dunany (South) avoid population centres, with these sites also in more favourable land zoning. LF10 is situated in the Clogherhead AONB, which is a national landscape designation.
- In also considering technical aspects, Dunany (South) is preferred as it has more land available for accommodating temporary works and laydown area adjacent to the access road, where a cable duct can be installed and cable pull safely operated. Therefore, overall and on balance, Dunany (South) is considered to be the preferred landfall option in terms of environmental constraints. Further information on the baseline characterisation of the intertidal habitats at LF8 and Dunany (North) and Dunany (South) is provided in appendix 4-2: Landfall Options - Survey Report.
- In 2023, the North West Irish Sea cSPA was proposed which provides protection for foraging birds. A section of the offshore cable corridor of approximately 2 km passes through this proposed cSPA. The Dunany (South) landfall is still considered the preferred landfall, owing to its minimum interaction with the North West Irish Sea cSPA when compared to the Dunany (North) options, which interact to a greater extent with up to four European sites.

4.10.4 Onshore substation site options

The Transmission System Operator (TSO), EirGrid, instructed the Applicant that the most appropriate connection method for the Project would be a single circuit 220 kV connection looped into the existing 220 kV transmission circuit between the Woodland and Louth substations. Functional specifications provided by EirGrid of the infrastructure required to complete this connection indicated that a new 220 kV substation would be required in the vicinity of the existing 220kV line. These functional specifications have been reconfirmed during recent discussions with EirGrid as being the most suitable connection method.

With these grid constraints in mind, the main criteria for selection of a substation site was then directed towards environmental and community aspects, and included consideration of the following: visual amenity, topography, proximity to dwellings, proximity to cultural heritage sites, proximity to ecological designations, impact on mature hedgerows and impact on water quality. Eleven substation options were considered, covering both Air Insulated Switchgear (AIS) and Gas Insulated Switchgear (GIS) footprints. These are described in Table 4-13 and presented in Figure 4-10.

Table 4-13: Substation alternative options.

Site Option ID	Townland Location	Location within the study area	Site Description
A8	Stickillin	Western section of the study area, underneath the existing line, directly north of the N33 and west of a minor road.	This field site is located just below the road level of the N33 on relatively flat ground at the base of the river valley. Large mature tree lines divide substantial sized fields in the surrounding area. To the north east of the site is a substantial cluster of large rural sheds enclosed by mature trees. Access is gained to the N33 via a minor road.
G11	Stickillin	Western section of the study area, west of the existing line, directly south of the N33.	This field site lies just below the road level of the N33 with the land beyond inclining towards a low ridge to the south. The surrounding fields to the east, west and south of the site are large with relatively low hedgerows. To the north, a line of roadside vegetation separates the N33 from the adjacent Dee Valley walk, which in turn has an embankment and a line of screen planting separating it from the site.
G12	Stickillin	Western section of the study area, east of the existing line, directly south of the N33 and between two minor roads to the east of Site G13.	This field site lies just below the road level of the N33 with the land beyond inclining towards a low ridge to the south. The surrounding fields to the east, west and south of the site are large with relatively low hedgerows. To the north, a line of roadside vegetation separates the N33 from the adjacent Dee Valley walk, which in turn has an embankment and a line of screen planting separating it from the site.
G13	Stickillin	Western section of the study area, east of the existing line, directly south of the N33.	This field site lies just below the road level of the N33 with the land beyond inclining towards a low ridge to the south. The surrounding fields to the east, west and south of the site are large with relatively low hedgerows. To the north, a line of roadside vegetation separates the N33 from the adjacent Dee Valley walk, which in turn has an embankment and a line of screen planting separating it from the site.
G14	Stickillin	Western section of the study area, east of the existing line, north of N33 and north east of a minor road.	This field site is located to the north east of the intensive cluster of farm buildings. It is also enclosed by mature trees and roadside vegetation is located to the south of the site.
G15	Stickillin	Western section of the study area, east of the existing line, directly north of the N33 and east of a minor road.	This field site is located below the road level of the N33 on relatively flat ground at the base of the river valley. Large mature tree lines divide substantial sized fields in the surrounding area. To the north of the site is a substantial cluster of large rural sheds enclosed by mature tree. Access to the N33 is via a minor road.
G16	Stickillin	Western section of the study area, underneath the existing line, directly north of the N33 and located within Site A8.	This field site is located below the road level of the N33 on relatively flat ground at the base of the river valley. Large mature tree lines divide substantial sized fields in the surrounding area. To the north east of the site is a substantial cluster of large rural sheds enclosed by mature trees. Access to the N33 is via a minor road.
G17	Stickillin	Western section of the study area, east of the existing line and Site 24, north of the N33 and south of the River Dee.	This field site is located to the north of the intensive cluster of farm buildings. It is also enclosed by mature tree and roadside vegetation is located to the south of the site. Access to the N33 is via a minor road.
G19	Scogganstown	North western section of the study area, west of the existing line.	G19 sits at the top of a large field that declines southwards from the ridge to the road. A roadside boundary wall is located to the south of the site.
G20	Scogganstown	North western section of the study area, west of the existing line and opposite Site G19.	G20 lies on relatively flat ground at the top of the ridge and is enclosed along its road boundary by a large mature tree line. Lower but denser hedgerows enclose this site to the east and west.

Site Option ID	Townland Location	Location within the study area	Site Description
G24	Stickillin	Western section of the study area, underneath the existing line, north of the N33 and south of the River Dee.	This field site is located to the north west of the intensive cluster of farm buildings. It is also enclosed by mature tree and roadside vegetation is located to the south of the site.

4.10.5 Onshore substation site assessment

Table 4-14 outlines the evaluation of alternative options for the substation location based on the criteria outlined in Table 4-10 and presented on Figure 4-10.

Preferred substation location evaluation

The various substation locations were evaluated by taking into account the criteria in Table 4-10 above and the use of GIS. The following evaluation is presented below:

- All substation site options are located within agricultural grassland, generally within greenbelt zoning (Zone 4); site G20 is within Zone 5 (Agriculture, Rural & Critical Infrastructure). Renewable energy schemes are noted as being permitted in Zone 4 and there is no explicit exclusion of substation developments within Zone 4. Therefore these locations are considered feasible from a planning perspective[9].

- A straight line to the landfall is the most preferred as this reduces the length of the onshore cable as far as possible, taking account of any constraints which may be encountered along the onshore cable route (see section 4.10.6 below for further discussion). Option C was the shortest cable route, however, this option routed along narrow roads at the eastern end of the option and was therefore not preferred.

- Lands which are prone to flooding would not be desirable from the perspective of siting long-term infrastructure and planning for current and future resilience, particularly climate change. In this regard, options G17 and G24 were ruled out as they are located within current flood risk areas associated with the River Dee. These areas are also prone to future flooding under the OPW's Mid-Range Future Scenario and High End Future Scenario i.e. accounting for modelled likely increased precipitation levels and sea level rise. G14 is also located in very close proximity to all modelled flood risk areas and is also considered unsuitable.

- Proximity to properties is also a key consideration in relation to visual impact and disturbance during construction. Options G19 and G20 are in proximity to a property in the adjacent field. These options are also proximal to a cluster of properties approximately 210 m to the east; these are therefore ruled out. Options G15 and G16 are located on the northern side of the N33, while options G11, G12 and G13 are located on the southern side. In this regard, the latter options are more proximal (approximately 280 m) to the ribbon development further south along the local Richardstown road. G15 and G16 are located slightly further north, approximately 395 m from the ribbon development, giving these options a slight preference.

- The differentiating factor between G15 and G16 would then be the distance to the Woodland to Louth 220 kV overhead line which the preferred substation must tie-in to. G16 is therefore the preferred substation location, as the site sits directly beneath the Woodland to Louth 220 kV line.

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[9] The County Development Plan (CDP) has been updated since site selection, however all sites are still located within 'agricultural land' under the current CDP.

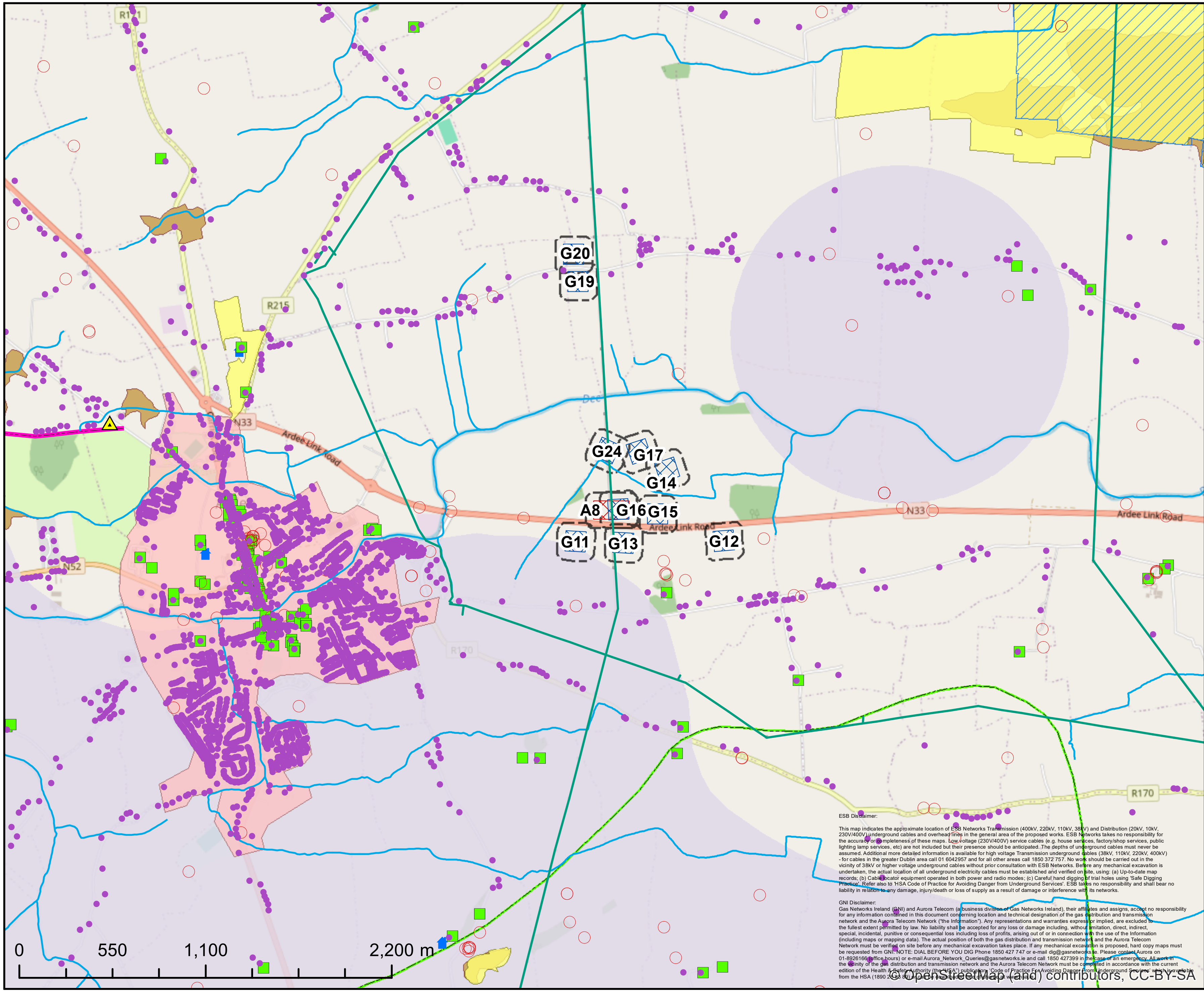
Table 4-14: Evaluation of alternative onshore substation locations.

Topic	Criteria[10]	A8	G11	G12	G13	G14	G15	G16	G17	G19	G20	G24
Population/ Human Health/ Nuisances (Air/Noise)	Number of dwellings within 50 m	0	0	0	0	0	0	0	0	1	1	0
	Distance to Ribbon Development (m)	395	280	280	280	634	395	395	774	210	210	774
Land use/ Zoning	Louth CDP 2015-2021	Zone 4 (Greenbelt)	Zone 4 (Greenbelt)	Zone 4 (Greenbelt)	Zone 4 (Greenbelt)	Zone 4 (Greenbelt)	Zone 4 (Greenbelt)	Zone 4 (Greenbelt)	Zone 4 (Greenbelt)	Zone 4 (Greenbelt)	Zone 5 (Agriculture, Rural Development & Critical Infrastructure)	Zone 4 (Greenbelt)
Land and Agriculture	Area of land take	2-3 ha	2-3 ha	2-3 ha	2-3 ha	2-3 ha	2-3 ha	2-3 ha	2-3 ha	2-3 ha	2-3 ha	2-3 ha
	Land Cover (Corine)	1	1	1	1	1	1	1	1	1	2	1
Landscape	Landscape Designations	1	1	1	1	1	1	1	1	1	1	1
	Landscape Character Area traversed (ha)	2.52	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44
Soils, Geology and Hydrogeology	Geological Heritage Area/County Geological Site	0	1 (Ardee-Newtown Bedform Field)	0	0	0	0	0	0	0	0	0
Hydrology and Flood Risk	Flood Extents (Risk Categories)	0	0	0	0	Close – All Risks (Current,	0	0	Low Risk	0	0	Low Risk

[10] Within 50m of the site boundary.

Topic	Criteria[10]	A8	G11	G12	G13	G14	G15	G16	G17	G19	G20	G24
						MRFS, HEFS)						
Material Assets - Other	Distance to 220 kV Transmission Line (m)	0	165	590	0	264	209	0	106	56	56	0
	Water Mains (No. Crossings)	0	0	0	0	0	0	0	0	1 (Distribution, along road centreline)	1 (Distribution, along road centreline)	0

No constraints were noted for the following criteria: Land use/Zoning: Area of site/route corridor traversing land zoned for (a) high amenity/(b) Development/(c) specific development; Biodiversity: SPA, SAC, Ramsar, NHA, National Survey of Native Woodland; Landscape: Length of onshore cable route within or adjoining an 'Area of High Scenic Quality' (km), Length of onshore cable route designated as a 'Scenic Road' (km); Soils, Geology & Hydrogeology: Areas of peat, Areas of bedrock outcrop (GW Vul. Rated X), Karst features; Hydrology and Flood Risk: Water body crossings; Material Assets - Other: No. of National Primary Roads Crossings (No.), No. of National Secondary Roads Crossings (No.), Railway Crossings (No.), Underground Electrical cable Crossings (No.), Gas Pipeline Crossings [all pressures] (No.), Telecommunications Masts (No.); Cultural Heritage: RMP (No.), SMR (No.); NIAH (No.), Architectural Conservation Areas, Historic Houses and Demesnes, Listed Buildings/Record of Protected Structures (No.); Vulnerability to the risk of major accidents: Presence of Seveso Site (consultation radius); Waste: Historic Landfills Register.



ESB Disclaimer:

This map indicates the approximate location of ESB Networks Transmission (400kV, 220kV, 110kV, 38kV) and Distribution (20kV, 10kV, 230V/400V) underground cables and overhead lines in the general area of the proposed works. ESB Networks takes no responsibility for the accuracy or completeness of these maps. Low voltage (230V/400V) service cables (e.g. house services, factory/shop services, public lighting lamp services, etc) are not included but their presence should be anticipated. The depths of underground cables must never be assumed. Additional more detailed information is available for high voltage Transmission underground cables (38kV, 110kV, 220kV, 400kV) - for cables in the greater Dublin area call 01 6042957 and for all other areas call 1850 372 757. No work should be carried out in the vicinity of 38kV or higher voltage underground cables without prior consultation with ESB Networks. Before any mechanical excavation is undertaken, the actual location of all underground electricity cables must be established and verified on site, using: (a) Up-to-date map records; (b) Cable locator equipment operated in both power and radio modes; (c) Careful hand digging of trial holes using 'Safe Digging Practice'. Refer also to 'HSA Code of Practice for Avoiding Danger from Underground Services'. ESB takes no responsibility and shall bear no liability in relation to any damage, injury/death or loss of supply as a result of damage or interference with its networks.

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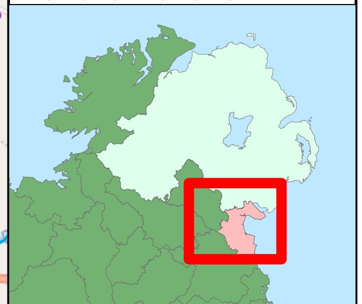
Legend

- AIS Substation Option
- GIS Substation Options
- Buffer of Option: 50m around Option
- CSO Settlement Envelope
- GeoDirectory (All Properties)
- RMP
- NIAH
- Historic House and Garden
- ESB HV Overhead Line
- High Pressure transmission pipelines
- Medium Pressure: Distribution Pipe
- WFD River Water Body
- SPA
- pNHA
- Landscape Character Area
- Geological Heritage Area
- Soils 2006 - Peat

Data Sources (as of January 2020): Louth CoCo, OWL, ESB, GNI, NPWS, EPA, GS I, DCHG.



Client

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

Oriel Wind Farm Project

Title

Figure 4-10:

Substation options and environmental constraints

A TETRA TECH COMPANY

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Issue Details

Drawn By: NR	**Project No.** MDR1520b
Checked By: CC	**File Ref:** MDR1520bArc3129F01
Approved By: CC	
Scale: 1:30,000 @ A4	**Projection:** ITM (IRENET95) Geographic Co-ordinates: ETRS89
Date: 12/02/2024	

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4.10.6 Onshore cable route options

A number of onshore cable route options were considered (Options A to I). A summary of these options is outlined in Table 4-15. All onshore cable route options require crossing the M1 motorway, the railway line and R132 as these run north to south in the area that was considered. In addition, all onshore cable route options cross a gas pipeline twice. All onshore cable route options commence at the existing 220 kV Woodland to Louth overhead transmission line circuit east of the town of Ardee and extend further eastwards to connect with the offshore cable in the vicinity of Dunany Point.

Table 4-15: Onshore cable route alternative options.

Route Option ID	Site Description
A1, A2 and A3	Approximately 20 km in length. It commences at the N33 at the existing line in the townland of Stickillin. The route continues in an easterly direction along the N33 crossing the River Dee, the M1, the R132, a high-pressure gas pipeline and a railway line. The route follows local roads and crosses the River White and a second high-pressure gas pipeline. It continues to follow local roads through the townlands of Drumcar, Corstown, Tullydonnell, Simonstown, Finvoy and Verdonstown before it divides into three route options, A1, A2 and A3, in close proximity to the landing point at Dunany Point.
B1 and B2	Approximately 20 km in length. It commences at a local road at the existing line in the townland of Scogganstown. The route continues in an easterly direction along local roads passing the village of Stabannan. It crosses the M1, the R132, two high-pressure gas pipelines, a railway line and the village of Kilsaran before crossing the River Glyde twice. In the village of Annagassan, it traverses in a south-easterly direction following the local route along the coast. Onshore cable route option B divides into two options, B1 and B2, in the townland of Salterstown in close proximity to the landing point at Dunany Point.
C	Approximately 19 km in length. It commences at the R170 at the existing line in the townland of Stickillin. The route continues in an easterly direction along the R170 turning north at Dromin Cross and crosses the M1, the R132, two high-pressure gas pipelines, a railway line and the River White twice. In the townland of Mullincross, the route joins onshore cable route option A1 and follows it to the landing point.
D	Approximately 19 km in length. It commences at the N33 at the existing line in the townland of Stickillin. Similar to onshore cable route option A, the route continues in an easterly direction along the N33 crossing the River Dee, the M1, the R132, a high-pressure gas pipeline and a railway line. In the townland of Mullincross, the route diverts in a northerly direction. In the village of Kilsaran, it joins onshore cable route option B2 and follows it to the landing point, crossing another pipeline and the River Glyde twice.
E	Approximately 22 km in length. Similar to onshore cable route option C, it commences at the R170 at the existing 220 kV transmission line in the townland of Stickillin. The route continues in an easterly direction along the R170. It crosses the M1 and turns immediately in a north-easterly direction. The route follows the local road crossing the R132, a high-pressure gas pipeline, a railway line and the River White twice. In the townland of Mullincross, the route joins onshore cable route option A1 and follows it to the landing point, crossing a second high-pressure gas pipeline.
F	Approximately 22 km in length. It commences at a local road at the existing 220 kV transmission line in the townland of Scogganstown. Similar to onshore cable route option B, the route continues in an easterly direction passing the village of Stabannan, the M1, the R132, a high-pressure gas pipeline and a railway line. In the townland of Bollies, the route turns in a south-easterly direction towards the townland of Mullincross, where it joins onshore cable route option A1 and follows it to the landing point, crossing the River White and a second high-pressure gas pipeline.
G	Approximately 21.4 km in length. It commences at the existing overhead line in the townland of Stickillin, then follows the N33 eastwards and crosses the River Dee. It crosses a high-pressure gas pipeline, the M1, then the Dublin to Belfast Rail Line, and the R132 at Mullincross. The route continues along local roads, then crosses the River Dee a second time at Drumcar Bridge and crosses another high-pressure gas pipeline. The route then heads eastwards and follows local roads through the townlands of Corstown, Finvoy, Verdonstown, Martins Cross and Johnstown. At Draghanstown, it angles southwards towards Mitchelstown before angling back north through the townland of Roadstown and follows local roads to the landfall point of Dunany (South).
H	Approximately 22.4 km in length. It commences at the existing overhead line in the townland of Stickillin, then continues eastwards along the N33 and crosses the River Dee. It crosses a high pressure gas pipeline, the M1, then the Dublin to Belfast Rail Line and the R132 at Mullincross. It

Route Option ID	Site Description
	continues along local roads then crosses the River Dee a second time at Drumcar Bridge and crosses another high-pressure gas pipeline. The route then heads eastwards and follows local roads through the townlands of Corstown, Finvoy, Verdonstown and Martins Cross before joining the R166 and heading southwards through Martinstown. It then heads eastwards on local roads through Wyanstown. At the townland of Port, the route angles northwards along local roads through the townlands of Roadstown and Mitchelstown to the landfall point of Dunany (South).
I	Approximately 20.3 km in length. It commences at the existing overhead line in the townland of Stickillin, then continues eastwards along the N33 and crosses the River Dee. It crosses a high-pressure gas pipeline, the M1, then the Dublin to Belfast Rail Line, and the R132 at Mullincross. It continues along local roads then crosses the River Dee a second time at Drumcar Bridge and crosses another high-pressure gas pipeline. The route then continues eastwards through Tullydonnell. At Keenan's Cross, it heads in a slight south-easterly direction following local roads through the townlands of Clonmore, Togher and Boycetown. It then heads northwards through the townlands of Port, Mitchelstown and Roadstown to the landfall point of Dunany (South).

4.10.7 Onshore cable route assessment

Table 4-16 presents the evaluation of alternative options for the onshore cable route based on the criteria outlined in Table 4-10 and presented in Figure 4-11.

Table 4-16: Evaluation of alternative onshore cable route options.

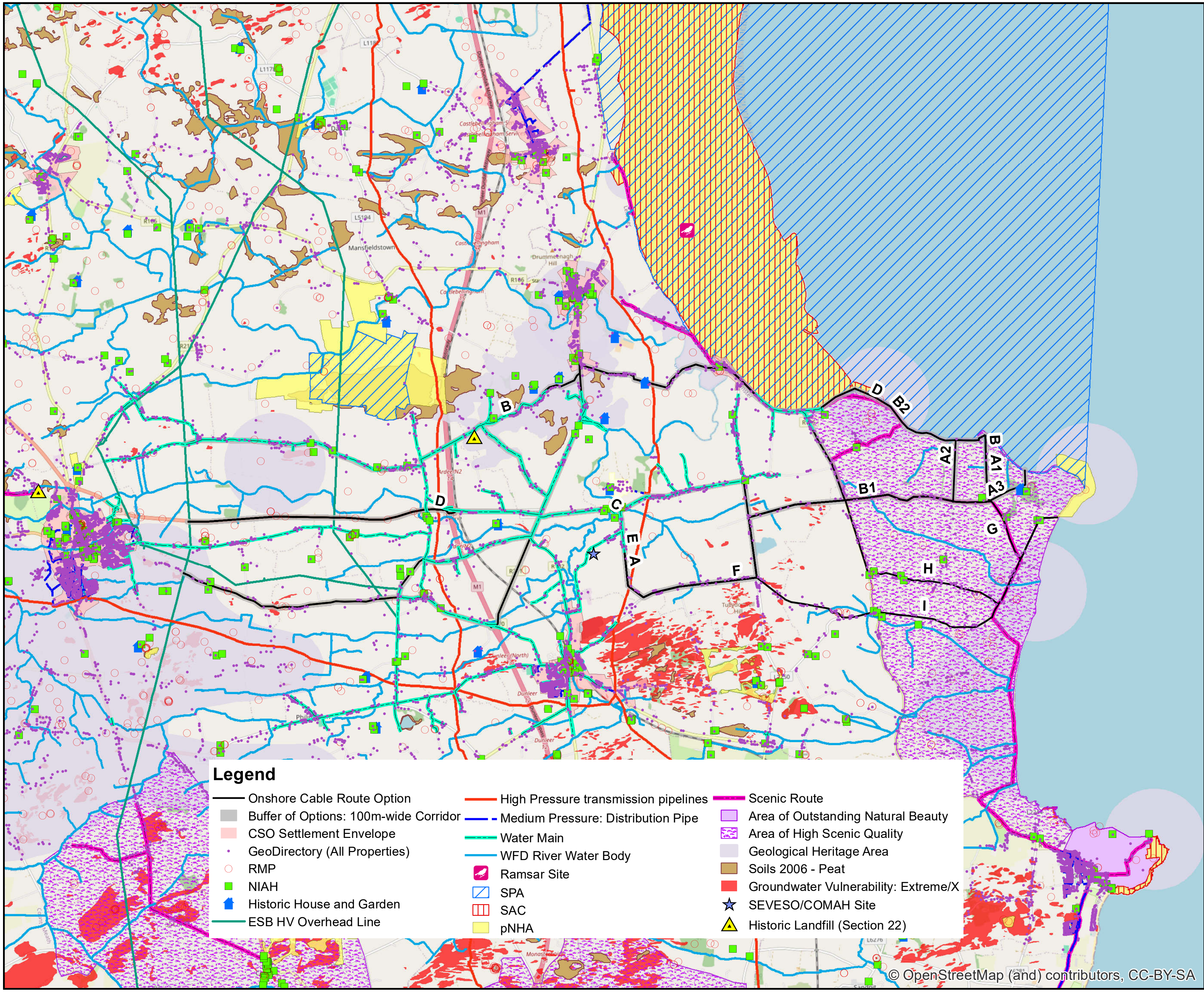
Topic	Criteria (within 100 m of cable route)	A1	A2	A3	B1	B2	C	D	E	F	G	H	I
Population/ Human Health/ Nuisances (Air/ Noise)	Number of properties within 50 m	118	116	115	292	245	181	174	154	199	131	173	148
	Number of dwellings within 50 m (Use = 'Residential, 'Both')	100	98	97	255	214	162	155	132	165	125	164	138
Land use/ Zoning	Area of site/route traversing land zoned for: (a) high amenity/ (b) Development/ (c) specific development	0	0	0	(a) 0 (b) 74.5ha (c) 60.56ha	(a) 0 (b) 74.5ha (c) 60.56ha	0	(a) 0 (b) 74.5ha (c) 60.56ha	0	0	0	0	0
Onshore Biodiversity	SPA/SAC/Ramsar (Dundalk Bay)	1-0-0	1-0-0	1-0-0	1-1-1	1-1-1	1-0-0	1-1-1	1-0-0	1-0-0	0-0-0	0-0-0	0-0-0
	pNHA (Dunany Point)	0	0	0	1	1	0	1	0	0	1	1	1
	National Survey of Native Woodland	1	1	1	0	0	0	1	0	0	1	1	1
Land and Agriculture	Area of approximate land take (Option length proxy)	20	20	20	20	18	19	19	22	22	21	22	20
	Land Cover Classes (Corine)	5	6	6	6	7	4	7	5	5	6		
Landscape	Landscape Designations	2	2	2	2	2	3	2	3	2	3	3	2
	Landscape Character Area traversed (km)	20	20	20	20	18	20	20	22	22	23	25	23
	Length of route within or adjoining	4.3	4.1	4.1	6.3	4.3	4.3	4.3	4.3	4.3	5.9	8.0	6.3

Topic	Criteria (within 100 m of cable route)	A1	A2	A3	B1	B2	C	D	E	F	G	H	I
	an 'Area of High Scenic Quality' (km)												
	Length of route designated as a 'Scenic Road' (km)	3.0	2.3	3.0	6.0	3.7	3.0	3.7	3.0	3.0	4.3	1.2	1.4
Soils, Geology and Hydro-geology	Areas of Peat (approximate ha)	0	0	0	0.8	0.8	0	0.8	0	0	0	0	0
	Areas of bedrock outcrop (GW Vul. Rated X)	5	5	5	1	3	7	2	7	6	5	5	5
	Geological Heritage Area/County Geological Site	0	0	0	4 (Ardee Moraine Ridges, Castlebellingham Morainic Complex, Linns Moraine, Dundalk Bay)	5 (Ardee Moraine Ridges, Castlebellingham Morainic Complex, Linns Moraine, Dundalk Bay, Salterstown Breccia)	1 (Ardee-Newtown Bedform Field)	4 (Castlebellingham Morainic Complex, Linns Moraine, Dundalk Bay, Salterstown Breccia)	1 (Ardee-Newtown Bedform Field)	2 (Ardee Moraine Ridges, Castlebellingham Morainic Complex)	1 (Dunany Point)	1 (Dunany Point)	2 (Dunany Point, Port Raised Beach)
Hydrology and Flood Risk	Water Body Crossings (No.)	7	7	7	2	2	9	4	9	5	6	6	7
	Current Flood Risk (No. Current Fluvial & Coastal Risk Categories)	Fluvial & Coastal Risks at 2 crossings	Fluvial & Coastal Risks at 2 crossings	Fluvial & Coastal Risks at 2 crossings	Fluvial & Coastal Risks at 1 crossing	Fluvial & Coastal Risks at 1 crossing	Fluvial & Coastal Risks at 2 crossings	Fluvial & Coastal Risks at 2 crossings	Fluvial & Coastal Risks at 2 crossings	Fluvial & Coastal Risks at 1 crossing	Fluvial & Coastal Risks at 2 crossings	Fluvial & Coastal Risks at 2 crossings	Fluvial & Coastal Risks at 2 crossings
Material Assets - Other	No. of National Primary Roads Crossings (No.)	1	1	1	1	1	1	1	1	1	1	1	1

Topic	Criteria (within 100 m of cable route)	A1	A2	A3	B1	B2	C	D	E	F	G	H	I
	No. of National Secondary Roads Crossings (No.)	1	1	1	0	0	0	1	0	0	1	1	1
	Railway Crossings (No.)	1	1	1	1	1	1	1	1	1	1	1	1
	Gas Pipeline Crossings, High Pressure (HP) and Low Pressures (LP) (No.)	2 (HP)	2 (HP)	2 (HP)	2 (HP)	2 (HP)	2 (HP)	2 (HP)	2 (HP)	2 (HP)	2 (HP)	2 (HP)	2 (HP)
	Telecommunications Masts (No.)	1 proximal LH093	1 proximal LH093	0	4 proximal LH093 LH091 3_LO0109	4 proximal LH093 LH091 3_LO0109	1 proximal LH093	4 proximal LH093 LH091 3_LO0109	3 proximal LH093, LO0118, 3_LO0118	3 proximal LH093 LH002 1620	0	0	0
	Water Mains (No. Crossings) All options have distribution mains, majority along road centreline.	2	2	2	2	2	2	3 1x Trunk	2	2 1x Trunk	2	2	2
Cultural Heritage - Archaeology	RMP (No.)	6	6	6	4	6	4	9	4	4	6	8	9
	SMR (No.)	3	3	3	4	6	5	8	5	2	3	5	5
Cultural Heritage – Architectural	NIAH (No.)	2	2	2	5	5	6	3	3	6	4	6	7
	Historic Houses and Demesnes	0	0	1 proximal (Dunany House)	1 (Maine House)	1 (Maine House)	0	1 (Maine House)	0	0	0	0	0
Vulnerability to the risk of major accidents	Presence of Seveso Site (Bak Bulk Services (nearest approximate	0.5	0.5	0.5	3.0	3.0	0.7	1.1	0.5	0.5	0.5	0.5	0.5

Topic	Criteria (within 100 m of cable route)	A1	A2	A3	B1	B2	C	D	E	F	G	H	I
	distance to route, km)												
Waste	Historic Landfills Register	0	0	0	1 (Low Risk Site)	1 (Low Risk Site)	0	0	0	1 (Low Risk Site)	0	0	0

No constraints were noted for the following criteria: Biodiversity: NHA; Soils, Geology & Hydrogeology: Karst features; Cultural Heritage: Architectural Conservation Areas, Listed Buildings/Record of Protected Structures (No.) [no digitised data]; Material Assets: Underground Electrical cable Crossings (No.).



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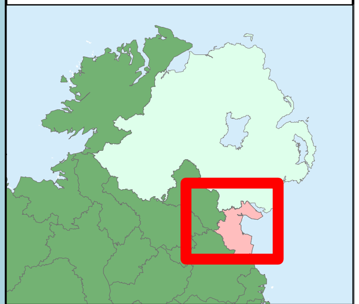

Client

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

Oriel Wind Farm Project

Title

Figure 4-11: Onshore cable route options and environmental constraints (in 2020)

A TETRA TECH COMPANY

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Preferred onshore cable route

The various onshore cable routes were evaluated by taking into account the criteria in the Table 4-16 above and the use of GIS. The evaluation is presented below:

- All onshore cable routes follow roads with limited landtake needed, with the exception of the siting of joint bays. A 50 m buffer either side of the option centreline (or a 100 m-wide corridor) is used as a proxy and indicates that all options have similar lengths and landtake requirements between the landfall and the substation site. Onshore cable route option B1 has the most residential properties within a 100 m corridor at 255. Options B2, C, D, E, F, G, H and have between 125 and 214 properties. The A options have the least number of properties at 100, 98 and 97 for options A1, A2 and A3, respectively. There is a primary school located on options B1, B2 and F (Scoil Naisiunta San Nioclas), and two schools along option C (Dromin and St Finian's National Schools), which make these least preferred.

- All options cross two high pressures gas pipelines and all options also cross the Dublin-Belfast railway line. All options cross flood risk areas twice, except options B1, B2 and F which cross flood risk areas once. All options also cross river water bodies, with the B options having the least number of total crossings at two, D and F having four and five crossings respectively, the A options and option I having seven crossings, and C and E having the most at nine total crossings each. All options, except for A3, G, H and I, are in close proximity to at least one telecommunications mast (A1, A2, C), with E and F proximal to three and the B options and D proximal to four.

- All onshore cable routes have cultural heritage features within 100 m, with between four and nine RMP sites and three to eight SMRs. All options have between two and six NIAH sites within a 100 m corridor. Options B1, B2 and D are also within 50 m of the historic Maine House.

- Options B1, B2 and D are least preferred overall, as they traverse land zoned for high amenity and other development and traverse areas which may have peat or peaty soils. All of the options, except for the A options, traverse through at least one geological heritage area, with B2 traversing the most at five sites, and B1 and D traversing four. The B options and D are also in proximity at the landfall site to all three international designations – Dundalk Bay SAC, SPA and Ramsar Site. These three options also encounter a low-risk historic landfill site along their length, which may yield waste or contaminated material during construction and is to be avoided. The A options and C, E and F are in proximity to just the SPA designation at landfall. Only options G, H and I are not in proximity to the SAC or SPA, which makes them generally preferred overall. In terms of technical considerations, option I is the shortest route of the three. It also follows a more straightforward route along the local roads compared to options G and H which, due to the local road configuration, must take sharp bends.

Option I was selected as the preferred onshore cable route because it passes a relatively low number of properties and does not pass any schools. Option I does not traverse land zoned for development and does not pass through any known areas of historic landfill or contamination. Option I is also the shortest route which predominantly uses wider local roads and avoids sharp bends in the route.

4.11 Alternative Project design and technology

4.11.1 Foundation options

The WTGs and OSS are attached to the seabed by foundation structures. Three alternative foundation types were considered for the Project: monopile, jacket and gravity based. Floating foundations were not considered for this Project due to water depths being appropriate for fixed bottom foundation types.

All three foundation options would be fabricated offsite and stored at a suitable port facility or fabrication yard with the appropriate consents and transported to site when required. Specialist vessels will transport and install the foundations.

The three foundation options are summarised in the sections below.

Monopile foundations

Monopile foundations typically consist of a single steel tubular section, consisting of a number of sections of rolled steel plate (called cans) which are welded together. A transition piece may be fitted over the monopile and secured via bolts or grout. Monopiles are transported to site and lifted into position and installed by driving with assistance from a hydraulic hammer up to a maximum resistance and then by drilling to the required embedment depth.

Seabed preparations for monopile installation are usually minimal. If pre-construction surveys show the presence of boulders or other seabed obstructions at foundation locations, these may be removed if the foundation cannot be re-sited to avoid the obstruction.

Jacket foundations

Jacket foundations are formed of a steel lattice construction (comprising tubular steel members and welded joints) with either three or four legs. The legs are secured to the seabed by hollow steel pin piles attached to the jacket feet. The piles rely on the frictional and end bearing properties of the seabed for support. The transition piece and ancillary structure is fabricated as an integrated part of the jacket. Pin piles are narrower than monopiles.

The overall footprint of a jacket foundation is greater than a monopile and greater preparation of the seabed for levelling is likely to be required. The jacket foundations are lifted into position from the installation vessel in a similar way to a monopile and three or four legs piled and drilled to the embedment depth. The duration for installation of the foundation would be expected to be greater than that for a monopile.

Gravity foundations

Gravity base foundations are heavy steel, concrete, or steel and concrete structures, sometimes including additional ballast, that sit on the seabed to support the wind turbine tower. Gravity bases vary in shape but are significantly wider at the base (at seabed level) than monopile or jacket foundations to provide support and stability to the structure. They then generally taper to a smaller width at or below seabed level.

Additional seabed preparation activities will take place prior to gravity base installation to prepare the seabed for the foundation. This will include dredging the seabed to remove a volume of sediment into which the foundation will then be placed. All sediment removed during dredging activities will be recovered to a dredging vessel and transferred to an appropriate licenced disposal site. A gravel layer is then installed into the dredged area to ensure proper load spreading.

Figure 4-12 presents a graphic which provides an illustration of the three foundation options.

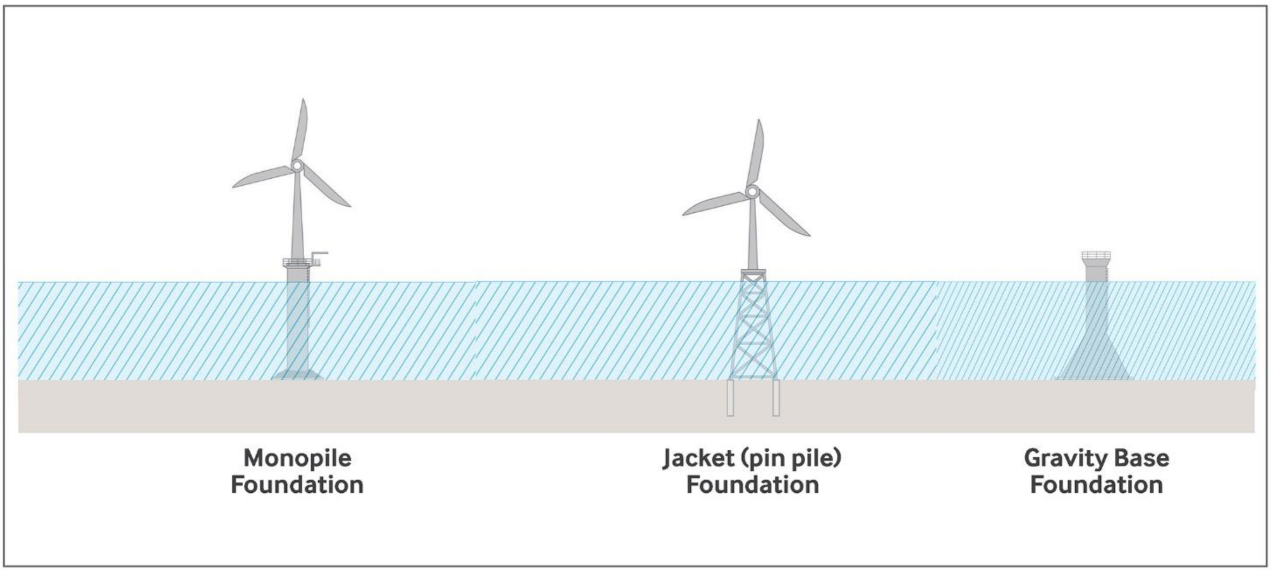

Figure 4-12: Graphic illustrating foundation options.

Evaluation of foundation options

An evaluation of the foundation options against the relevant offshore criteria is presented in Table 4-17.

Table 4-17: Evaluation of foundation options.

Topic	Criteria	Monopile Foundation	Jacket Foundation	Gravity Foundation	Evaluation
Marine Processes	Suitable seabed sediments.	3	2	1	The monopile foundation requires the least disturbance of seabed sediments. Gravity foundation requires more extensive seabed preparation.
	Low tidal streams (< 0.5 m/s max).	-	-	-	The area has flows that are weak, with a spring tidal current speeds typically <0.2 m/s.
	Bathymetry water depths of < 30 m.	2	2	1	Gravity foundations are less suitable for shallower water depths.
Benthic Subtidal and Intertidal Ecology	Sensitive seabed habitats to be avoided, where possible.	3	2	1	Installation of gravity foundations result in greatest disturbance of subtidal benthic ecology due to the largest footprint. All foundations can encourage benthic habitat in the longer term.
Marine Mammals and Megafauna	European Designated Sites to be avoided.	2	1	2	Piling for jacket foundations results in the greatest duration of disturbance for marine mammals and megafauna during construction.

Topic	Criteria	Monopile Foundation	Jacket Foundation	Gravity Foundation	Evaluation
Commercial Fisheries	Areas of limited fishing activity preferred.	2	2	2	All foundation options result in neutral preference for fisheries due to their limited size in comparison to the area available for commercial fisheries.
Climate	Total amount of embodied carbon.	3	2	1	The monopile foundation has the lowest mass and uses the least amount of steel and concrete.
Total Score		**15**	**11**	**8**	

1 – Least Preferred, 2 - Neutral Preference, 3 - Most Preferred

Preferred foundation

On the basis of the above assessment, the monopile foundation results in the most preferred score of the three foundation options for both the offshore substation and wind turbines. The monopile foundation option is presented in detail in chapter 5: Project Description and assessed in each of the offshore topics.

4.11.2 Management of drill arisings

Drill arisings during the installation of the foundations include soil and rock. It is proposed, as outlined in chapter 5: Project Description, that these drill arisings will be returned to the area adjacent to the foundation location below the sea surface. This will be undertaken through a fall pipe from the drilling vessel to minimise the dispersion within the water column. The Environmental Protection Agency (EPA) has indicated that this activity will require a Dumping at Sea Permit (obtained from the EPA).

The following alternative ways to manage the drill arisings were considered:

- Beneficial Re-use;
- Disposal on Land;
- Incineration; and
- Disposal at Sea.

Beneficial re-use of drill arisings

The options for beneficial re-use of the marine sediments mainly ranging from muddy sand to coarse gravel are limited. The potential uses for the marine sediments are:

- Engineering Uses:
  - Using the material as construction material;
  - Beach nourishment;
  - Land creation/reclamation/capping as part of port development; and
  - Flood and coast protection (above high water mark).
- Environmental Enhancement:
  - Wetland habitat creation/enhancement; and
  - Agricultural uses.

Engineering Uses: The physical characteristics of the marine sediments renders them unsuitable for forms of engineering works as the grading of the marine sediments are expected to be unsuitable for this type of use.

Environmental Enhancement – Wetland Habitat Creation/Enhancement: Fine material can be used for habitat creation and re-nourishment projects such as mudflat recharge or salt marsh restoration. However, these types of projects typically require small quantities of sediment (e.g. 1,000 m³ - 5,000 m³) (UKMSAC, 2001). It is unlikely that suitable sites for this type of beneficial re-use would exist along the coast in Co. Louth at the time of works.

Environmental Enhancement – Agricultural Use: The physical characteristics of the marine sediments make them unsuitable for agricultural use. Furthermore, this management option would require bringing the material ashore by barge, which would then require temporary storage in a designated hard standing or lagoon area to allow for dewatering/drying before subsequent transfer by road to a site. This would result in potential for impacts on land use, water quality, traffic impacts, etc. Due to the large quantity of material arising from the activities, this option is considered to be unfeasible on a technical and environmental basis.

Disposal at landfill

Even following a period of settlement, the sediment would likely be considered a wet material for the purposes of land-filling. Landfill space is in very short supply and it is often the case that landfill sites are only licensed to receive relatively small volumes of wet waste (e.g. 500 m³) per week. Due to the large quantity of material arising from the activities, this option is considered to be unfeasible on a technical basis.

Incineration

There are no suitable incineration facilities in Ireland capable of accepting the proposed type or quantity of marine sediments spoil. The dredge spoil would therefore need to be transported to mainland Europe. This option is considered to be unreasonable and has been ruled out due to prohibitive cost and having regard to the proximity principle.

Disposal at Sea

Although site specific sediment contamination levels are unknown at this time, they are very likely to all be in compliance with the Marine Institute sediment quality guidance levels which are similar to the levels in the MarESA benchmark listed above (Cronin *et al*., 2006). There are few large infrastructure projects and there is currently no identified source of contamination. In addition, sediments within large parts of the offshore wind farm area and offshore cable corridor are composed of sand and coarse sediment, with low levels of fine sediments (i.e. muds) onto which contaminants would adhere. This further reduces the risk of contamination in these areas. The marine sediments are therefore suitable for disposal at sea, subject to obtaining a Dumping at Sea Permit. This option was selected as the preferred option and has been assessed as part of the project description outlined in chapter 5: Project Description (volume 2A). The likely environmental effects from the disposal of drill arisings are assessed in chapter 7: Marine Processes and related chapters.

4.11.3 Offshore cable construction at the landfall

Two options were considered for the installation of the offshore cable on the approach to the landfall as follows.

1. **Horizontal directional drilling (HDD*)*** this is a technique whereby a hole is drilled from land under the coastal features such as the sea cliff and beach, to a point a suitable distance offshore. HDD involves pushing a steerable rotating boring head, supported by a drilling fluid, through the ground. When the pilot bore is completed it is enlarged to the required diameter by pulling a reamer back towards the drilling machine and pulling the duct into place. A pipe will be inserted into the drilled hole, the pipe will then be used as a duct into which the cables are installed.

2. **Temporary trenching activities** this involves excavating a narrow trench to the required trench depth of 3.0m and supporting the trench sides, if necessary. Excavated material is temporarily stored to the side of the trench and once the cable is laid, the excavated material is reinstated.

From an design perspective, the HDD method at the landfall was not deemed suitable for two reasons. Firstly, the HDD requires the installation of the offshore cable into a tunnelled duct which limits the electrical and thermal operating efficiency of the cable. This results in constraints on the output from the wind farm.

Secondly, the depths of water where the HDD exit pit would be required (typically > 5m below chart datum) results in a drill length at the limit of feasibility for the required cable diameter.

From a biodiversity perspective, although HDD methods would avoid direct impacts on the cliff and the beach at Dunany, trenching was considered preferable as the works to install an open trench can be undertaken within a narrow working area, are temporary in nature and all excavated material can be reinstated. Furthermore, trenching avoids the need for an entrance pit (on land) and an exit pit in the subtidal environment. As trenching does not result in a constraint to the thermal properties of the cable and can be undertaken without resulting in signficant environment effects as outlined in chapter 7: Marine Processes and chapter 8: Benthic Subtidal and Intertidal Ecology (volume 2B), this option was selected as the preferred option.

4.11.4 Alternative TJB construction methods

A number of options for the construction of TJB options 1 and 2 were considered to minimise impacts on the Dunany Point CGS and also to avoid the need for coastal protection.

TJB option 1 was initially located at the foot of the sea cliff within the Dunany Point CGS. However, construction of the TJB was resulting in the need to excavate into the sea cliff. As a result the positioning of the TJB was adjusted to minimise impact on the sea cliff while also maintaining the engineering requirements for the TJB and removing the requirement for coastal protection.

Excavation of an open trench through the sea cliff at the Dunany Point CGS for option 2 was initially proposed. However, to minimise the impact on the habitat, it was proposed to minimise the open trench using sheet piling and also installing rocks within the trench to allow the profile of the cliff to be reinstated and the habitat to revegetate. This method also removes the requirement for any further coastal protection requirements.

Further details on the TJB are provided in appendix 21-1: Coastal Erosion Assessment Report (volume 2C).

4.11.5 Onshore cable technology options

Each power cable will have cross-linked polyethylene (XLPE) insulated electrical conductors, surrounded by a copper screen and high density polyethylene, with a diameter of approximately 10 cm. XLPE was the only cable considered as this complies with the EirGrid requirements. The operating voltage of these cables will be 220 kV.

Two options were considered for the arrangement of the cable:

- Trefoil arrangement: three cables may be laid flat or in a triangular (trefoil) arrangement. A trefoil cable arrangement requires a trench width of 0.7 m; and
- Flat arrangement: cable laid flat. A flat cable arrangement requires a trench width of up to 1.5 m width.

The insulated cables will be enclosed in protective plastic ducts, which are then protected by being buried, typically at a depth of 1.2 m for a flat arrangement and 1.425 m for a trefoil arrangement, with a protective concrete surround and hardcore backfill up to the reinstated surface.

The trefoil arrangement was selected as the preferred option for the following reasons:

- It results in a narrower trench requirement within the public road. At crossing locations a flat cable arrangement may be required;
- It also results in less environmental impacts because the working area and the area of disturbance is narrower; and
- It is a more economically viable option.

4.11.6 Substation alternative design options

Three alternative types of substation designs are available for the connection of the Project to the national grid: an AIS substation or GIS substation or a hybrid of both.

Technically, both AIS and GIS substation types are considered acceptable to EirGrid for the requirements of the Project. However, it is EirGrid policy to ensure that whichever substation type is chosen that sufficient future proofing of the substation is provided to cater for the future needs of the region if required.

AIS substation

An AIS substation uses atmospheric air as the phase-to-ground insulation for the switchgear of an electrical substation and, therefore, all of the high voltage plant and equipment are outdoors in a switchyard.

A larger site footprint is required to provide the clearances for insultation between electrical equipment (in comparison to GIS). The outdoor equipment for a 220 kV AIS typically measures up to 10 m in height (AIS busbar). If an AIS substation footprint is to be used for this project, then the area required, including the Reactive Power Compensation Equipment and tree planting, will be approximately 5 ha.

The main disadvantage to the AIS substation type is its overall size. These substations have a larger footprint than a GIS substation and therefore a greater land and agricultural impact. They also require sensitive siting in a rural environment.

GIS substation

In contrast to an AIS substation, a GIS substation is located within a building. The technology uses SF_6 gas for insulation around the electrical equipment, SF_6 has a tension strength higher than air which provides the phase-to-ground insulation for the substation's electrical switchgear. The conductors and contacts are insulated by the pressurised gas, meaning that the clearances for insultation between electrical equipment required are smaller than that of AIS substations.

The main advantages of the GIS substation are that this phase-to-phase spacing can be reduced significantly, resulting in a substation with comparable load capacity to an AIS substation, but with a much smaller compound footprint. However, the GIS components must be located in a building. GIS buildings typically have an industrial/agricultural appearance (dependent on architectural finishing) and range in height from 10 to 12 m but may be larger depending on the building design i.e. the building can be elevated to permit access to equipment, which may add up to an additional 4 m in height.

Hybrid substation

Following assessment of substation requirements, a hybrid substation option was also proposed which would comprise a GIS substation for the connection compound to the transmission grid (compound 1) with an AIS substation for the connection to the offshore wind farm substation (compound 2). Compound 2 could require a number of elements to ensure grid compliance, including a reactive power compensation equipment, also known as a statcom. These are located outside and adjacent to the other substation components. A hybrid option combines the benefits of a reduced footprint for the Compound 1 with the flexibility of the AIS for Compound 2.

Substation design evaluation

A high level assessment was undertaken of the AIS, GIS and hybrid substations types The evaluation process that the Project Team went through is outlined in Table 4-18 below.

Table 4-18: Evaluation of preferred substation type.

Factor	AIS	GIS	Hybrid (AIS and GIS)	Evaluation
Population and Human Health	×	✓	✓	The GIS substation is better screened (enclosed) and noise is reduced compared to AIS substation. The hybrid substation screens dwellings and road (N33) to the south with the building. The closest dwellings to the north are > 1 km from the substation.
Biodiversity	×	✓	✓	The GIS substation requires less land take, having the potential for reduced biodiversity impacts. The hybrid substation is a compromise on land take and can avoid proximity to woodland to the west.
Land	×	✓	✓	The GIS substation requires less land take, having a reduced potential impact in terms of land area. The hybrid substation is a compromise and limits agricultural land take to the area east of the existing 220kV OHL.
Soil	×	✓	✓	The GIS substation requires less land take and a reduced quantity of soil is removed. The hybrid substation is a compromise on soil removal from site.
Water	×	✓	✓	The GIS substation results in reduced impermeable areas and limited surface run-off. The hybrid substation is a compromise.
Air	-	-	-	Air quality impacts are considered to be comparable between AIS and GIS substations.
Climate	✓	×	-	AIS substations are preferred in terms of climate as they are air insulated compared to GIS, which require the sulphur hexafluoride (SF_6) gas for insulation (a greenhouse gas).
Material Assets	-	-	-	AIS and GIS substations are generally considered comparable in terms of material assets.
Cultural Heritage	-	-	-	This is based on the location of known cultural heritage features. Therefore, there is no preference in terms of technology.
Landscape	×	✓	✓	GIS substations are preferred, due to the reduced visual impact of enclosing the electrical equipment and their smaller size. The hybrid substation enables screening from the south of the AIS compound by the GIS building.

Preferred substation

Following the evaluation of the three options, the hybrid of an AIS substation for the customer compound and a GIS substation for the EirGrid compound was selected as the preferred option because it results in a lesser land take than full AIS whilst being a compromise on the use of SF_6 gas for insulation. The GIS building provides screening of the AIS compound for properties to the south of the site.

4.12 Conclusion and summary

The consideration of alternatives has been undertaken and refined by starting with the consideration of possible offshore locations on a whole-of-Ireland basis first. Once a general location had been identified, the selection process then moved to explore the suitability of this location under a Foreshore Licence. The resulting data from this exploration narrowed the licenced area down to the more defined offshore project area. At this stage the strategic spatial consideration of alternatives was concluded and brought into focus the consideration of alternatives at project level. Detailed consideration of wind turbine layouts were undertaken to minimise visual effects while still achieving a reasonable wind energy yield. The potential impacts from the preferred layout option on other environmental topics are then considered in the relevant EIAR chapters.

The consideration of alternatives then moved onshore, looking at specific onshore elements of the Project and documenting the selection of the preferred option for each of the landfall site, onshore cable route and the onshore substation type and site.

The process and selection of the preferred alternative for each Project element is summarised in Table 4-19 below.

Table 4-19: Summary of alternatives considered and selected options.

Project element	Summary of alternative options considered	Selected option
Project location assessment		
National, Irish Sea and regional assessment	**West coast of Ireland:** • Excellent wind capacity; • However, suitability of the electrical grid infrastructure in this region is poor; • Rapid increase of water depth with distance from the coast; and • High energy open seas. **East coast of Ireland:** • Excellent wind resource also; • Subject to a much less severe wave climate compared to the west coast; • Water depths more favourable to offshore construction; • Good grid connection locations to the high voltage transmission system; and • Large demand for electricity in the east coast region.	East coast – Dundalk Bay area in the north-east Irish sea on the east coast of Ireland was selected as a preferred location for the following reasons: • Excellent wind resource > 9 m/s; • Water depths of 15 to 30 m; • Sand and gravel sediments; • Shelter from high wave loads; • Low tidal streams (< 0.5 m/s max); • Located close to strategic grid; • Infrastructure on the east coast; • Close to demand centres; and • Close to ports suitable for construction and operations.
Offshore wind farm area	Four options within the Foreshore Licence Area were brought forward for further consideration of a suitable lease area to develop a wind farm: • **Option 1:** Split the Foreshore Licence Area to enable a shipping channel traverse between the development; • **Option 2:** Considered the area north of the shipping channel and in the western part of the Foreshore Licence Area; • **Option 3**: Considered the entire northern section of the Foreshore Licence; and • **Option 4**: This area encompasses a smaller area in the northern part of the Foreshore Licence area.	Option 4 was deemed the preferred option as it minimised the effects on the following: • Visual impact from the wind turbines; • Trawled fishing areas; • Shipping lanes; and • Most compact size and therefore less areas for potential disturbance.
Consideration of alternatives for the offshore Project layout		
Project level offshore alternatives	Seven wind turbine layouts were considered**:** • Through an iterative process with both the engineering team and landscape specialists to design the layout to minimise effects on landscape while maintaining reasonable wind energy yields; and • This design process went through a number of alternative iterations before a final layout was agreed.	• A 25 turbine layout was selected and this is detailed in chapter 5: Project Description.
Offshore cable corridor	Nine offshore cable corridors were examined against a set of criteria.	• On the basis of the evaluation, offshore cable option EC7 was selected as the preferred corridor as it avoided designated areas, shipping lanes and spawning

Project element	Summary of alternative options considered	Selected option
		grounds. Since selection, the NWIS cSPA was designated. However, this does not amend the selection of EC7 as the preferred corridor.
Operation and maintenance bases	Potential existing ports and harbours (from south to north) which would be able to provide access and the shortest journey times to the offshore wind farm area including Dublin Port, Drogheda Port, Dundalk, Greenore Port, Warrenpoint, Kilkeel, Belfast Port were examined	• Greenore Port, Warrenpoint or Kilkeel were selected as the preferred locations for an operation and maintenance base as they are in close proximity to the offshore wind farm area with an acceptable travel time for a crew transfer vessel. The harbours are not restricted by any tidal constraints and have existing facilities for the proposed activities.
Consideration of alternatives for the onshore Project layout		
Landfall site	Fifteen landfall sites were considered from the various project development stages: • **LF1:** Greenore; • **LF2:** Templetown; • **LF3:** Rathcor; • **LF4:** Mountbagnall; • **LF5:** Haggardstown; • **LF6:** Castlebellingham; • **LF7:** Dillonstown; • **LF8:** Dunany; • **LF9:** Mitchelstown; • **LF10:** Clogher; • **LF11:** Knocknagin; • **Castlebellingham (2007 EIS):** Linns; • **Dunany (2007 EIS):** Salterstown; • **Dunany (North):** Dunany; and • **Dunany (South):** Dunany.	Through a screening process, the principle of avoiding European designations was applied and the remaining sites were considered against the other constraints. In consideration of constraints such as population centres, dwellings, landscape designations and technical aspects, Dunany (South) is the preferred landfall site.
Onshore Substation Site		
Substation site	Ten substation site options were considered: • **A8:** Stickillin, western section of the study area, underneath the existing line, directly north of the N33 and west of a minor road; • **G11:** Stickillin, western section of the study area, west of the existing line, directly south of the N33; • **G12:** Stickillin, western section of the study area, east of the existing line, directly south of the N33 and between two minor roads to the east of Site G13; • **G13:** Stickillin, western section of the study area, east of the existing line, directly south of the N33; • **G14:** Stickillin, western section of the study area, east of the existing line, north of N33 and north east of a minor road; • **G15:** Stickillin, western section of the study area, east of the existing line, directly north of the N33 and east of a minor road; • **G16:** Stickillin, western section of the study area, underneath the existing line,	Option G16 was chosen as the preferred substation site for the following reasons: • Located slightly further away from the ribbon development, which is preferred in terms of reducing disturbance during construction and visual impact during operation; and • The site sits directly beneath the Woodland to Louth 220 kV line.

Project element	Summary of alternative options considered	Selected option
	directly north of the N33 and located within Site A8; • **G17:** Stickillin, western section of the study area, east of the existing line and Site 24, north of the N33 and south of the River Dee; • **G19:** Scogganstown, north western section of the study area, west of the existing line; • **G20:** Scogganstown, north western section of the study area, west of the existing line and opposite Site G19; and • **G24:** Stickillin, western section of the study area, underneath the existing line, north of the N33 and south of the River Dee.	
Onshore Cable		
Onshore cable route	Twelve onshore cable route options leading from the vicinity of Dunany Point were considered: • **Route Option A1, A2 and A3:** Commences at the N33 at the existing line in the townland of Stickillin; divides into three Route Options A1, A2 and A3 in close proximity to the landing point at Dunany Point; • **Route Option B1 and B2:** Commences at a local road at the existing line in Scogganstown; divides into two options, B1 and B2 in Salterstown in close proximity to the landing point at Dunany Point; • **Route Option C:** Commences at the R170 at the existing line in the Stickillin; in Mullincross the route joins Option A1 and follows it to the landing point; • **Route Option D:** Commences at the N33 at the existing line in Stickillin; in Kilsaran it joins Option B2 and follows it to the landing point; • **Route Option E:** Commences at the R170 at the existing 220 kV transmission line; in Mullincross it joins Option A1 and follows it to the landing point crossing a second gas pipeline; • **Route Option F:** Commences at a local road at the existing 220 kV transmission line in Scogganstown; in Mullincross it joins Option A1 and follows it to the landing point; • **Route Option G:** Commences at the existing overhead line in the townland of Stickillin; it angles north through the townland of Roadstown and follows local roads to the landfall point of Dunany (South); • **Route Option H:** Commences at the existing overhead line in Stickillin; at the townland of Port, it angles northwards	• All onshore cable route options follow roads within the area, and all have similar lengths and landtake requirements between the landfall and the substation site; • All route options cross similar constraints, including two high pressures gas pipelines, the Dublin-Belfast railway line, all cross the River Dee; • On balance, only options G, H and I are not in proximity to European sites (Dundalk Bay SAC and SPA) which makes them generally preferred overall; and • In terms of technical considerations, option I is the shortest route of the three. It follows a more straightforward routeing along the local roads compared to options G and H) (which must take sharp bends. In considering a balance of all criteria, option I is the preferred onshore cable route.

Project element	Summary of alternative options considered	Selected option
	along local roads to the landfall point of Dunany (South); and • **Route Option I:** Commences at the existing overhead line in Stickillin; heads mostly eastwards then angles northwards at Port to the landfall point of Dunany (South).	
Consideration of alternative Project design and technology		
Offshore foundations	Three foundation types were considered: • Monopile; • Jacket; and • Gravity based.	The monopile foundation results in the least disturbance of seabed sediments, requires less piling duration than the jacket foundation and has a lower mass using the least amount of steel and concrete resulting in a lower carbon footprint than the other two options. This is the preferred option.
Management of drill arisings	The following alternative ways to manage the drill arisings were considered: • Beneficial Re-use; • Disposal on Land; • Incineration; and • Disposal at Sea.	Disposal at Sea was selected as the preferred option as it results in the least environmental impacts because marine sediments are more suitable for disposal at sea than on land.
Onshore cable technology	Two options for onshore cable arrangement were considered a trefoil arrangement where the cables are laid in a triangular form or a flat cable arrangement	The trefoil arrangement is preferred as it results in a narrower trench within the public road allowing more space for traffic management. At off-road crossing locations (Port Stream, River Dee, M1 and Rail line), a flat cable arrangement may be required.
Alternative cable construction at the landfall	Two options were considered: Trenchless method of HDD or trenching	Trenching was selected as the preferred option as it is feasible from a design perspective and avoids significant effects in the intertidal/subtidal environment at Dunany Beach due to the narrow working area and reinstatement of excavated material.
Alternative TJB construction options	Construction methods for TJB options 1 and 2 included excavation of the cliff and the option to use sheet piling to minimise extent of excavation.	The option to use sheetpiling, which minimises excavation into the Dunany Point CGS were selected to minimise impact on the CGS. T
Substation type	A high level assessment was undertaken of the three substation options: AIS, GIS and hybrid configurations.	Following the evaluation of the three options, the hybrid of an AIS substation for the customer compound and a GIS substation for the EirGrid compound was selected as the preferred option because it results in a lesser land take than full AIS whilst being a compromise on the use of SF_6 gas for insulation. The GIS building provides screening of the AIS compound for properties to the south of the site.

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