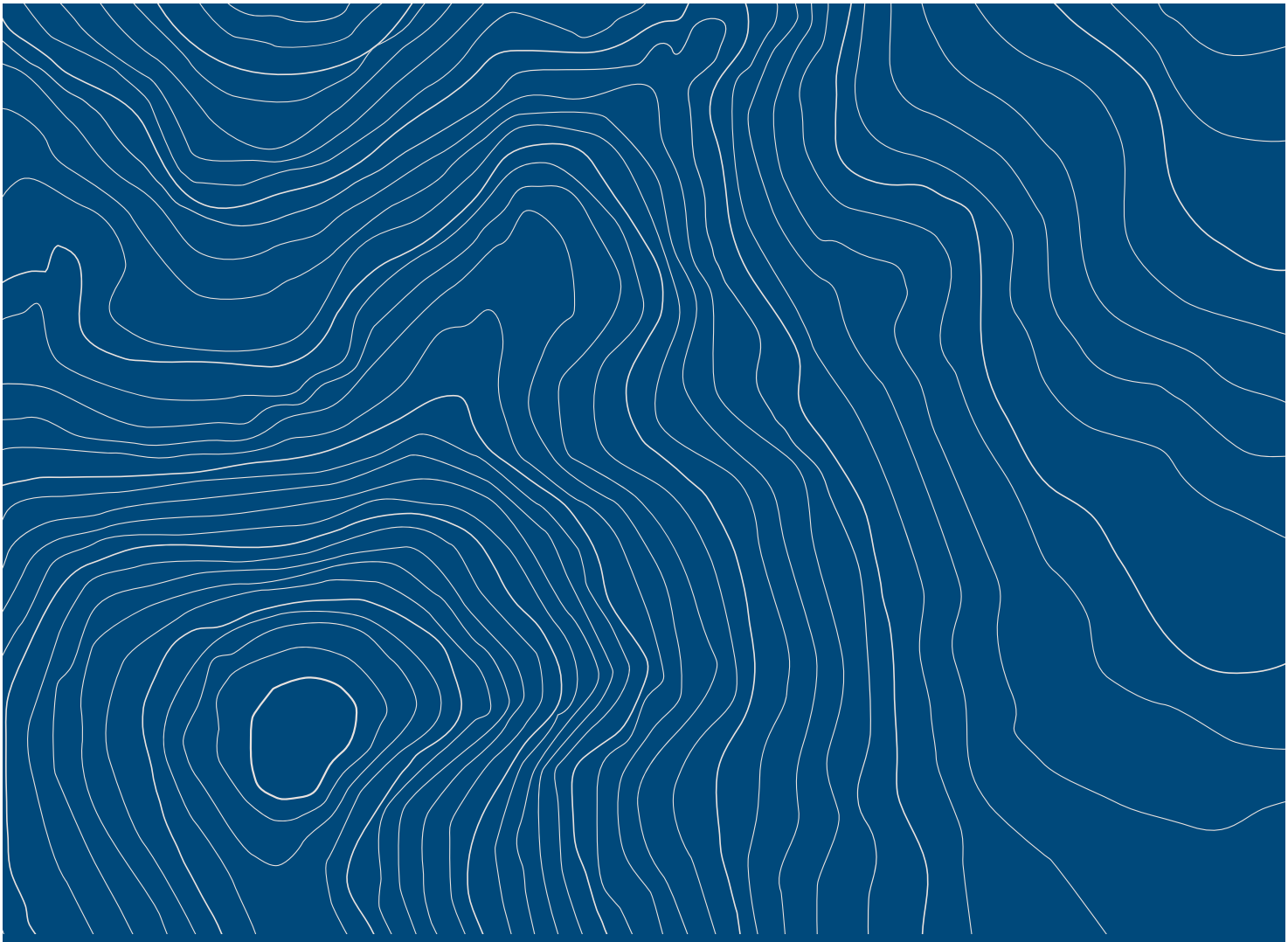

DublinArray
Generation for generations

EIAR Volume 2: Introductory Chapters Chapter 5: Consideration of Alternatives

Kish Offshore Wind Ltd.

RWE SLR GoBe APEM Group

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Dublin Array Offshore Wind Farm

Environmental Impact Assessment Report

Volume 2, Chapter 5: Consideration of Alternatives

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Glossary

Term	Definition
An Bord Pleanála (ABP)	Competent authority as defined by the Planning Acts to determine the application for development consent for Dublin Array and carry out the EIA and AA of the proposed development.
Applicant	Kish Offshore Wind Limited. Kish Offshore Wind Limited is making the application on behalf of and/or with the consent of the joint holders of the MACs for the maritime area to which the proposed development relates: Kish Offshore Wind Limited, Bray Offshore Wind Limited and DLRCC.
Appropriate Assessment (AA)	The statutory process which is set out in Article 6 of the Habitats Directive.
Array area	That part of the maritime area specified by MAC Reference 2022-MAC-003 and 004 within which it is proposed to locate the wind turbine generators (WTGs) and Offshore Substation Platform (OSP).
Bathymetry	The measurement of the depth of water bodies, including the ocean, seas, and lakes.
Climate Action Plan (CAP)	A strategic plan outlining actions to address climate change and reduce greenhouse gas emissions.
Dublin Array	Dublin Array Offshore Wind Farm. Where the context so provides within the EIAR, references to Dublin Array refer to all geographical areas of the proposed development, i.e. both offshore, onshore and including the proposed O&M Base.
Environmental Impact Assessment (EIA)	Assessment of the likely significant effects of a proposed project on the environment. The EIA will be carried out by An Bord Pleanála in this instance.
Environmental Impact Assessment Report (EIAR)	As defined in the Planning and Development Act 2000, as amended: "environmental impact assessment report" means a report of the effects, if any, which proposed development, if carried out, would have on the environment and shall include the information specified in Annex IV of the Environmental Impact Assessment Directive.
Geotechnical survey	A geotechnical survey is an investigation of the physical and mechanical properties of the seabed and subsurface soils. This survey involves sampling and testing sediment layers to assess soil strength, composition, and stability.
Gravity base structure	A type of foundation that relies on its own weight to remain stable on the seabed.
Grid connection	The process of connecting a power-generating facility to the electrical grid.
Grid Implementation Plan (GIP)	A plan for the development and enhancement of the electrical grid infrastructure.

Term	Definition
Horizontal Directional Drilling (HDD)	A trenchless construction method used to install underground utilities such as pipelines, cables, and conduits. HDD involves drilling a horizontal borehole along a predetermined path, allowing for minimal surface disruption, and is commonly used in environmentally sensitive or urban areas.
Marine archaeology	The study of human interaction with the sea, lakes, and rivers through the investigation of submerged sites and artifacts.
Marine Protected Area (MPA)	A region of the ocean designated for conservation and protection of natural resources.
Monopile foundation	A type of foundation used for offshore wind turbines, consisting of a single large-diameter steel tube driven into the seabed.
Offshore Renewable Energy (ORE)	Energy generated from renewable sources located in the ocean, such as wind, waves, and tides.
Renewable Energy Directive (RED)	European Union legislation aimed at promoting the use of renewable energy sources.
Seabed morphology	The study of the structure and features of the ocean floor.
Seabed preparation	The process of preparing the ocean floor for the installation of offshore structures.
Seascape	The view of an expanse of sea, often considered in terms of its aesthetic appeal.
Suction bucket foundation	A type of foundation for offshore structures that uses suction to anchor the structure to the seabed.
Transition Joint Bay (TJB)	The proposed infrastructure at the landfall location where the offshore and onshore cables connect.
Wind Turbine Generator (WTG)	All the components of a wind turbine, including the tower, nacelle and rotor.

Acronyms

Term	Definition
AA	Appropriate Assessment
AEZ	Archaeological Exclusion Zone
AIS	Air Insulated Switchgear
ALARP	As Low as Reasonably Practicable
BAT	Best Available Technologies
BAoI	Broad Area of Interest
CAP	Climate Action Plan
CD	Chart Datum
CDP	County Development Plan
CER	Commission for Energy Regulation
COP	Conference of the Parties
CO_2	Carbon Dioxide
CRU	Commission for Regulation of Utilities
CTV	Crew Transfer Vessel
CVI	Coastal Vulnerability Index
DAFM	Department of Agriculture, Food, and the Marine
DCCAE	Department of Communications, Climate Action and Environment
DCHG	Department of Culture, Heritage and the Gaeltacht
DECC	Department of the Environment, Climate and Communications
DHLGH	Department of Housing, Local Government and Heritage
DLRCC	Dún Laoghaire-Rathdown County Council
DLRCDP	Dún Laoghaire-Rathdown County Development Plan
ECC	Export Cable Corridor
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EIHA	Environmental Impact of Human Activities
EMRA	Eastern and Midland Regional Assembly
EPA	Environmental Protection Agency
ESB	Electricity Supply Board

Term	Definition
EU	European Union
GCA	Grid Connection Assessment
GES	Good Environmental Status
GHG	Greenhouse Gas
GIP	Grid Implementation Plan
GIS	Gas Insulated Switchgear
GW	Gigawatt
Ha	Hectares
HDD	Horizontal Directional Drill
ICES	International Council for the Exploration of the Sea
IFP	Instrument Flight Procedure
IMP	Integrated Maritime Policy
IPCC	Intergovernmental Panel on Climate Change
IRCG	Irish Coastguard
IWEA	Irish Wind Energy Association
LAT	Lowest Astronomical Tide
LSA	Local Study Area
MAC	Maritime Area Consent
MAP	Maritime Area Planning Act
MARA	Maritime Area Regulatory Authority
MARPOL	International Convention for the Prevention of Pollution from Ships
MCA	Maritime and Coastguard Agency (UK)
MHPLG	Minister for Housing, Planning and Local Government
MHWS	Mean High Water Springs
MPA	Maritime Protected Areas
MSFD	Marine Strategy Framework Directive
MSPD	Marine Spatial Planning Directive
MTBM	Micro-Tunnel Boring Machine
MW(h)	Megawatts (per hour)
(p)NHA	(proposed) Natura Heritage Area
NBAP	National Biodiversity Action Plan
NDC	Nationally Determined Contributions

Term	Definition
NDP	National Development Plan
NECP	National Energy and Climate Plan
NIS	Natura Impact Statement
NMPF	National Marine Planning Framework
NPF	National Planning Framework
NPO	National Planning Objective
NSO	National Strategic Outcome
NZIA	Net Zero Industrial Act
O&M	Operations and Maintenance
OILPOL	Convention for the Prevention of Pollution of the Sea by Oil
OMPPs	Overarching Marine Planning Policies
ORE	Offshore Renewable Energy
OREDP	Offshore Renewable Energy Development Plan
ORESS	Offshore Renewable Energy Support Scheme
OSP	Offshore Substation Platform
OSS	Onshore Substation
RED	Renewable Energy Directive
R&D	Research and Development
RESS	Renewable Energy Support Scheme
RoRo	Roll-on Roll-off
RSES	Regional Spatial and Economic Strategy
SACs	Special Areas of Conservation
SAR	Search and Rescue
SEA	Strategic Environmental Assessment
SEAI	Sustainable Energy Authority of Ireland
SMPPs	Sectoral Marine Planning Policies
SOLAS	Safety of Life at Sea
SOV	Service Operations Vessel
SPA	Special Protected Areas
SDZ	Strategic Development Zone
TDP	Transmission Development Plan
TJB	Transition Joint Bay

Term	Definition
TLAF	Transmission Loss Adjustment Factor
UK	United Kingdom
UN	United Nations
UNCBD	UN Convention on Biological Diversity
UNCCD	UN Convention to Combat Desertification
UNCLOS	UN Convention on the Law of the Sea
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
WAM	With Additional Measures
WEM	With Existing Measures
WFD	Water Framework Directive
WSA	Wider Study Area
WTG	Wind Turbine Generator
WWTP	Waste Water Treatment Plant

5 Consideration of Alternatives

5.1 Introduction

5.1.1 This chapter of the Environmental Impact Assessment Report (EIAR) outlines the reasonable alternatives considered for the Dublin Array Offshore Wind Farm (Dublin Array) and its associated onshore infrastructure.

5.1.2 As noted in the Environmental Protection Agency (EPA) 'Guidelines on the information to be contained in Environmental Impact Assessment Reports' published May 2022 (EPA Guidelines, 2022), the avoidance of environmental effects is principally achieved by consideration of alternatives.

'The objective is to adopt the combination of options that presents the best balance between avoidance of significant adverse environmental effects and achievement of the objectives that drive the project.'

5.1.3 Alternatives are identified at many levels and stages during the evolution of a project, from project concepts and site locations, through site layouts, technologies or operational plans and on to mitigation and any monitoring measures.

5.2 Regulatory background

5.2.1 The Environmental Impact Assessment Directive 2011/92/EC as revised by Directive 2014/52/EU (revised EIA Directive), notes in Recital (31) that an EIAR *'should include a description of reasonable alternatives studied by the developer which are relevant to that project, including, as appropriate, an outline of the likely evolution of the current state of the environment without implementation of the project (baseline scenario), as a means of improving the quality of the environmental impact assessment process and of allowing environmental considerations to be integrated at an early stage in the project's design.'*

5.2.2 Accordingly, Article 5(1) of the revised EIA Directive requires the following information to be included in the EIAR: a description of the project (including the site, design, size and other relevant features of the project); a description of the features of the project and/or measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment; a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment; and any additional information (specified in Annex IV of the revised EIA Directive) relevant to the specific characteristics of the project (or type of project) and to the environmental features likely to be affected.

5.2.3 Annex IV of the revised EIA Directive requires the EIAR to include the following information, where relevant: 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.

5.2.4 Alternatives include the 'do nothing' scenario, or baseline scenario, which is related to the requirement in Annex IV of the revised EIA Directive to include in the EIAR a description of the relevant aspects of the current state of the environment and an outline of the likely evolution thereof without implementation of the project as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge.

5.2.5 At a national level, Article 94 of the Planning and Development Regulations 2001, as amended (Planning Regulations) requires an EIAR to include the information specified in Part 1 of Schedule 6 and in Part 2 of Schedule 6 insofar as is relevant to the project or type of project concerned. These provisions give full effect to the EIA Directive.

5.2.6 Schedule 6, Part 1 of the Planning Regulations includes:

'(c) A description of the features, if any, of the proposed development and the measures, if any, envisaged to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment of the development.

(d) A description of the reasonable alternatives studied by the person or persons who prepared the EIAR, which are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the proposed development on the environment.'

5.2.7 Schedule 6, Part 2 of the Planning Regulations includes:

'(b) a description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the person or persons who prepared the EIAR, which are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects;

(c) a description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge'...

5.2.8 In terms of Guidance, this chapter has been prepared substantially in accordance with the EPA Guidelines, 2022. Regard has also been had to the following relevant guidance:

- European Commission Guidance on the preparation of the Environmental Impact Assessment Report (European Commission, 2017a);
- European Commission EIA Guidance on Scoping (European Commission, 2017b); and
- European Commission Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (European Commission, 2013).

5.2.9 As noted in the EPA's Guidelines, 2022, presenting and evaluating reasonable alternatives is a key aspect of the EIA process. The EPA Guidelines, 2022, defines 'alternatives' for the purposes of the EIA process as *'a description of other options that may have been considered during the conception of a project; these include alternative locations, alternative designs and alternative processes.'* The consideration of alternatives inherently involves the site selection process, and the consideration of the 'do nothing' or baseline scenario. The EC Guidance, 2017, describes 'alternatives' as the different ways of carrying out the proposed development in order to meet the agreed objective. The EC Guidance, 2017, refers to the benefits of considering alternatives at the Scoping stage, as set out in the EC Scoping Guidance, 2017.

5.2.10 At the level of legislation, strategic planning and planning policy, the **objectives of avoidance and prevention of significant adverse environmental effects** that have informed the consideration of alternatives and site selection include:

- The Planning and Development (Amendment) Act 2018, which transposed (in part) the Marine Spatial Planning Directive 2014/89/EU, and gave legal effect to the adoption of:
  - The National Marine Planning Framework (NMPF), 2021 (Government of Ireland, 2021a), including:
    - The Overarching Marine Planning Policies (OMPPs) and activity-specific or Sectoral Marine Planning Policies (SMPPs) set out in the NMPF:
    - The Appropriate Assessment of the draft NMPF carried out by the Minister under S.I. No. 477 of 2011 – EC (Birds and Natural Habitats) Regulations 2011, as amended; and
    - The Strategic Environmental Assessment of the draft NMPF carried out by the Minister under S.I. No. 435/2004 – European Communities (Environmental Assessment of Certain Plans and Programmes) Regulations 2004, as amended;

- The incorporation within the NMPF of the objectives of the Offshore Renewable Energy Development Plan, 2014 (OREDP), including the non-statutory SEA and AA of the OREDP, and the OREDP Review undertaken in 2018[1];

- S.I. No. 249/2011 - European Communities (Marine Strategy Framework) Regulations 2011, as amended, which transposed the Marine Strategy Framework Directive 2008/56/EC, and plans and policies developed under this legislation including:

  - Ireland's (updated) 2020 Marine Strategy Part 1: Article 8, 9 and 10 Assessment of the Marine Environment and determination of Good Environmental Status and the establishment of Environmental Targets and Indicators2;
  - Ireland's Marine Strategy Part 2: Monitoring Programmes/strategy as reviewed in 2021;
  - Ireland's Marine Strategy Part 3: Programme of Measures as updated in 2022, including:
    - The General Scheme of a Marine Protected Areas Bill 2022;
    - The commitment to 30% of Ireland's maritime area being subject to legal protection by 2030;

- The Climate Action and Low Carbon Development Act 2015, as amended, and the Climate Action Plans 2019, 2023 and the latest adopted Climate Action Plan 2024, including the SEA and AA for those plans;

- S.I. No. 477/2011 – EC (Birds and Natural Habitats) Regulations 2011, as amended, which transposed the Habitats Directive 1992/43/EEC, and the Birds Directive 2009/147/EC (in parallel with the transposition of these Directives, for planning purposes, under Part XAB of the Planning Acts and corresponding provisions of the Planning Regulations), and including:

  - The designation and proposed designation of European sites (SPAs and SACs) for Annex II habitats and species and for Annex I species of wild birds and for marine /migratory bird species;
  - The strict protection measures for Annex IV(a) species and Annex IV(b) plants and habitats, and the general protection measures for wild birds;
  - The conservation plans and measures adopted by the State for habitats and species; and
  - The inclusion of certain sites as 'Marine Protected Areas' for the purposes of Ireland's contribution to North Atlantic marine conservation measures under the OSPAR Convention;

- The Wildlife Act 1976, as amended, including:

[1] A draft OREDP II is in preparation following public consultation in 2024. It is noted in the draft OREDP II that initially Ireland's offshore wind targets for 2030 will be primarily met through fixed offshore wind in Ireland's eastern and southern coastal region (including the Phase 1 projects). The draft OREDP II is largely focussed on a proposed post-2030, plan-led enduring regime. To this extent the draft OREDP II does not contain any substantive policy of relevance to the Dublin Array project and therefore is not considered further in this chapter.
[2] A consultation on a further update to the Marine Strategy Part 1 was undertaken in July 2024.

  - The designation and proposed designation of natural heritage areas (NHAs and pNHAs) under the Wildlife (Amendment) Act 2000, for the conservation and protection (primarily through planning process) of certain species, communities, habitats, landforms and geological or geomorphological features, and for the diversity of natural attributes in the designated area; and
  - The adoption on a statutory basis under the Wildlife (Amendment) Act 2023 of the National Biodiversity Action Plan 2023-2030;
- The National Monuments Acts, as amended (including by the Historic and Archaeological Heritage and Miscellaneous Provisions Act 2023, which by December 2024 is only commenced in part), with respect to the preservation and protection of underwater and terrestrial archaeology and cultural heritage;

- The Merchant Shipping (Safety Convention) Act 1952, as amended, which gives effect to the International Convention for the Safety of Life at Sea, 1948 (SOLAS) and the London Protocols (1978 and 1988), including subsequent amendments and rules made by the International Maritime Organisation, including the International Regulations for Preventing Collisions at Sea (COLREGS) which are given effect through Regulations made under section 418 of the Merchant Shipping Act, 1894, and all relevant applicable rules for the avoidance of collisions at sea;

- The Sea Pollution Acts, and the Dumping at Sea Acts, as amended, which give effect to MARPOL and the London Convention on the Prevention of Marine Pollution by Dumping at Sea, and all relevant applicable rules for the avoidance and prevention of marine pollution and marine waste;

- The rights and obligations conferred by the Common Fisheries Policy Regulation (EU) No 1380/2013, and the Fisheries Control Regulation (EU) 2023/2842 amending Regulation (EC) 1224/2009, as implemented through the Fisheries Acts and the Sea-Fisheries Acts, and the various regulations and the rights and obligations made under those Acts;

- Ensuring compliance with the principles and objectives of the Safety, Health and Welfare at Work Act 2005 and relevant construction safety regulations, and the NMPF Safety at Sea Policies 1-5;

- The objectives of the National Planning Framework, 2018 (NPF), including the non-statutory SEA and AA of the NPF, and the review of the NPF undertaken in 2024;

- The objectives and development management criteria contained in the Dún Laoghaire-Rathdown County Council County Development Plan 2022-2028 (DLRCC, 2022) and other relevant land-use plans and planning objectives, as discussed more fully in the Planning Report, and the SEA and AA of the relevant plans; and

- The environmental factors required to be considered in the EIAR and the NIS of a proposed project under the Planning Acts and the Planning Regulations, including specifically in relation to the EIA procedure: population, human health, biodiversity (for example fauna and flora), land (for example land take), soil (for example organic matter, erosion, compaction, sealing), water (for example, hydromorphological changes, quantity and quality), air, climate (for example greenhouse gas emissions, impacts relevant to adaptation), material assets, cultural heritage, including architectural and archaeological aspects, and landscape.

5.2.11 The **principal objectives and drivers of the proposed Dublin Array project** that have informed the consideration of alternatives and site selection include:

- The aims and objectives of Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources (RED II, recast)[3], as partly transposed by S.I. No. 365/2020 - European Union (Renewable Energy) Regulations 2020, and the corresponding terms and conditions of Ireland's first Offshore Renewable Energy Support Scheme (ORESS 1), as approved by the European Commission in accordance with the EU Guidelines on State Aid for Climate, Energy and Environmental Aid Guidelines, which aims to achieve renewable energy ambitions at the lowest feasible cost to electricity customers;

- The aims and objectives of the Climate Action and Low Carbon Development Act 2015, as amended, including:

  - The actions and commitments in the latest adopted Climate Action Plan 2024, and the previous Climate Action Plans 2019 and 2023;
  - The Long-term Strategy on Greenhouse Gas Emissions Reduction 2024;
  - The National Energy Climate Plans submitted by the Government under Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action;
  - Ireland's Carbon Budgets, 2021-2025 (Carbon Budget 1) and 2026-2030 (Carbon Budget 2);

- The Maritime Area Planning Act 2021, as amended (MAP Act), and the Maritime Jurisdiction Act 2021, as amended, and the draft legislative proposals which led to the enactment of those Acts, including:

  - The General Scheme of a Maritime Area & Foreshore (Amendment) Bill 2013; and
  - The General Scheme of a Maritime Planning & Development Management Bill 2019, including:
    - The Annex 'Transition Protocol for Relevant Projects', and

[3] RED II (recast) is revised by Directive 2023/2413 (RED III) which is, in part, overdue for transposition in Ireland (with full transposition required by June 2025).

  - The updated 'Further Information on the Marine Planning & Development Management Bill (2020)';
- The Government's non-statutory Marine Planning Policy Statement, 2019;
- The Overarching Marine Planning Policies (OMPPs) and activity-specific or Sectoral Marine Planning Policies (SMPPs) adopted under the NMPF[4], including ORE Policy 2 which requires that proposed offshore wind projects must be consistent with national policy, including the OREDP and its successor, and that so-called 'Relevant Projects' under the Transition Protocol that can objectively enable delivery on the Government's 2030 targets will be prioritised for assessment under the new consenting regime;
- The objectives of the OREDP incorporated by the NMPF, and the SEA and AA of the OREDP, including co-existence, supporting coastal communities and adopting appropriate project-level mitigation measures, where required, whilst making maximum efficient use of the Maritime Area Consent under the MAP Act;
- The policies and plans of the Government and other State bodies with responsibility for the delivery of Ireland's renewable energy targets for 2030, including for example:
  - Policy Statement on the Framework for Ireland's Offshore Electricity Transmission System 2021 (Government of Ireland, 2021b);
  - Offshore Phase 1 Projects Grid Connections Assessment March 2021 (EirGrid); and
  - Offshore Grid Connection Assessment – Phase 1 Projects, 2022 (CRU, Direction CRU/2022/14).

5.2.12 The assessment of alternatives has been a key consideration in the development of the project to date and is described in the following sections below:

- Section 5.3 'Do Nothing' Alternative;
- Section 5.4 Constraints on Alternatives;
- Section 5.5 Alternative Locations;
- Section 5.6 Review of Dublin Array Site Selection;
- Section 5.7 Alternative Project Design;
- Section 5.8 Alternative Electricity Transmission Grid Connection Locations;

[4] The NMPF contains Overarching Marine Planning Policies supplemented by Sectoral Marine Planning Policies. The assessment of the Dublin Array project against each of the relevant policy objectives from the NMPF has been included in the Planning Report submitted with this application. Where relevant to the considerations of alternatives, NMPF and NPF polices are referred to throughout this chapter.

- Section 5.9 Alternative Landfall Options and Submarine Export Cable Corridors;
- Section 5.10 Alternative Onshore Substation Options;
- Section 5.11 Alternative Onshore Cable Corridor Options; and
- Section 5.12 Alternative Operations and Maintenance (O&M) Base Locations.

5.3 'Do Nothing' alternative

5.3.1 According to the EPA Guidelines, 2022, the range of alternatives considered should include the 'do nothing' scenario. The 'do nothing' scenario is a baseline alternative in which the proposed offshore wind farm is not built. This option is critical in assessing the environmental, social, and economic impacts of proceeding with or abandoning the project. While this scenario avoids certain direct environmental disturbances and initial financial outlays associated with the construction and operation of the wind farm, it carries several significant implications that need to be considered holistically.

5.3.2 As noted by the EPA Guidelines, 2022, the 'do nothing' analysis can be particularly useful when assessing effects caused by projects, such as Dublin Array, which are designed to alleviate environmental or infrastructural problems, including climate change. The EPA Guidelines, 2022, advise that the 'do-nothing' alternative should describe consequences that are reasonably likely to occur, but the EIAR should not exaggerate or catastrophise potential environmental consequences that may occur without the proposed project. It should cumulatively consider the effects of other projects which could proceed even if the proposed Dublin Array does not. The EC Guidance, 2017, notes that the number of potential alternatives to a proposed project is, in theory at least, infinite, but the alternatives assessment within an EIAR should address what is reasonable in the sense of being capable of accomplishing the objectives of the proposed project in a satisfactory manner, and feasible in terms of technical, economic, political, and other relevant criteria.

5.3.3 In this section, the 'do nothing' scenario is considered in the context of the effects on environmental factors that are required to be considered in the EIAR.

Population and human health

5.3.4 Without the Dublin Array project, it is anticipated that there would be no significant environmental effects on population or human health save in relation to human health impacts arising in connection with other environmental effects, for example, air emissions, climate change, and material assets, as discussed below.

5.3.5 In the 'do nothing' scenario, however, it is anticipated that the economic benefits associated with the Dublin Array project would not be realised. Offshore wind farms create significant job opportunities, both during the construction phase and throughout their operational lifespan. The local economy would benefit from direct and indirect employment, as well as the influx of investment into the area through community benefit funds. Furthermore, the project could stimulate the growth of the renewable energy sector and contribute to the acceleration and attainment of Ireland's green economy transition, as envisaged by, for example, the Irish Government's 'White Paper on Enterprise 2022-2030', and 'Powering Prosperity Ireland's Offshore Wind Industrial Strategy, 2024'.

5.3.6 Ireland is currently reliant on a mix of energy sources, including natural gas (domestic and imported), which is subject to price volatility and geopolitical risks. The Dublin Array project would enhance Ireland's energy security while the 'do nothing' scenario would maintain Ireland's vulnerability to external energy security factors and risks. As noted in the Government's 'Energy Security in Ireland to 2030 Energy Security Package November 2023',

'The CAP23 also commits to achieving at least 5 GW of installed offshore wind capacity by 2030 with an additional 2 GW earmarked for the production of green hydrogen and other non-grid uses. It also includes a suite of actions to realise Ireland's offshore renewable energy (ORE) potential. Government is overseeing a phased approach to Offshore wind, The Offshore Wind Delivery Taskforce has been established to drive delivery and capture the wider and longer-term economic and business opportunities associated with the development of offshore renewables in Ireland.'(DECC, 2022).

5.3.7 Without the Dublin Array project, Ireland would continue to be extensively reliant on imported fossil fuels, contrary to national and European climate goals and current national security of supply policies.

Biodiversity

5.3.8 Without the Dublin Array project, any immediate disruption to marine ecosystems and habitats that may occur during construction would be avoided. This would include underwater noise, seabed disturbance, and potential impacts on marine mammals, seabirds, and benthic communities. Construction activities, such as piling and cable laying, could affect marine fauna through noise emissions and sediment plumes. Any potential impact on seabirds and other species arising from the operation of the wind farm would also be avoided. In the 'do nothing' scenario, direct impacts on biodiversity would be avoided, at least in the short term.

5.3.9 However, in the context of global warming, including ocean warming and acidification, and the continued reliance on fossil fuel-generated electricity and other energy infrastructure on land, the 'do nothing' scenario does not equate to business as usual. The positive environmental benefits associated with the operation of an offshore wind farm at scale as part of Ireland's first phase of offshore renewable energy generation capacity, would not be realised in a 'do nothing' scenario. Instead, there would be economic and environmental costs directly associated with the continued reliance on fossil fuels, with cumulative increases in emissions which contribute to climate change, air pollution, water pollution, ocean acidification, and associated land use impacts on biodiversity.

Land, soils, water, air

5.3.10 Without the Dublin Array project, any immediate construction-phase disruption to land, seabed or substrate, water quality (including marine water quality) or air quality, would be avoided. However, the 'do nothing' scenario requires consideration of the alternative means by which Ireland would meet its electricity demand requirements if not from offshore renewables at scale, such as the Dublin Array project.

5.3.11 'Ireland's State of the Environment Report, 2024' (EPA, 2024), published by the EPA in October 2024, notes that whilst energy sector emissions decreased significantly between 2001 – 2022, reflecting the improved efficiency of modern gas-fired power plants which have replaced older peat- and oil-fired plants, and the positive effects of an increased share of renewables in the energy mix along with increased interconnectivity, energy-related emissions increased temporarily in 2021 by 19% compared with 2020 due to an increase in coal and oil use, driven by factors including the war in Ukraine. This was the context in which European Council Regulation (EU) 2022/2577 'laying down a framework to accelerate the deployment of renewable energy' (Accelerated Permitting Regulation[5]) and European Commission Communication 'REPowerEU: Joint European Action for more affordable, secure and sustainable energy' (COM/2022/108 final) were adopted, primarily for the purposes of boosting indigenous (and non-Russian) energy supplies including renewable electricity. Notably, the Accelerated Permitting Regulation states that renewable energy plants *'are crucial to fight climate change and pollution, reduce energy prices, decrease the Union's dependence on fossil fuels and ensure the Union's security of supply.'*

[5] As revised and extended by Council Regulation (EU) 2024/223 of 22 December 2023 amending Regulation (EU) 2022/2577 laying down a framework to accelerate the deployment of renewable energy.

5.3.12 As noted in the EPA's 'Air Quality in Ireland Report 2023', published in September 2024, air pollution can be a major environmental risk to people's health, Ireland is not on track to meet World Health Organisation air quality guideline limits by 2026, and meeting future more stringent targets by 2030 and 2040 will be very challenging. The main pollutants of concern are fine particulate matter ($PM_{2.5}$) from solid fuel combustion and nitrogen dioxide (NO_2) from vehicle emissions/traffic. As noted by the EPA in Ireland's State of the Environment Report, 2024 (EPA, 2024), the dominant sources of NO_2 are from transport, particularly diesel- and petrol-powered vehicles, and NO_2 pollution is particularly an issue in urban areas due to transport emissions. NO_2 pollution could be decreased by reducing overall traffic volumes in towns and cities, increasing the electrification of the fleet, and giving consideration to low emission zones in the largest urban centres. A key focus of RePower EU is the electrification of transport and industry, both of which depend on clean sources of renewable electricity at scale, such as electricity from offshore wind projects like Dublin Array.

Climate change

5.3.13 Ireland has committed to meeting increasingly ambitious renewable energy targets under the European Union's Green Deal (European Union, 2020) and the Paris Agreement (European Union, 2018), and more recently under the EU Climate Law and RED III. Offshore wind is a cornerstone of Ireland's strategy to reach the new renewable energy targets and to achieve greater security of supply of electricity. Under the Climate Action and Low Carbon Development Act 2015, as amended, Ireland has a legally binding national objective of transitioning to a low carbon, climate resilient and environmentally sustainable economy by 2050. This includes a reduction in emissions of 51% by 2030 when compared with 2018, which Ireland will aim to achieve via five-year carbon budget cycles with emissions ceilings set for each sector in each relevant budget cycle. As noted in the EPA's Ireland's State of the Environment Report, 2024, the sectoral ceilings for transport and industry will require extensive electrification of those sectors, which will in turn place immense pressure on the electricity sector to meet demand while keeping emissions below the ceiling set for that sector. According to the Climate Action Plan 2024 (DECC, 2024), the deployment rates of renewable energy and grid infrastructure required to meet the carbon budget programme for electricity is unprecedented and requires 'urgent action across all actors to align with the national targets.'

5.3.14 The Climate Action Plan 2024 confirms the need to connect 'at least' 5 GW of new offshore wind electrical generating capacity by 2030, which is key to delivering the target of providing 80% of electricity from renewables by 2030.

5.3.15 The first phase of offshore wind projects (Phase 1) are the only projects capable of delivering new renewable electricity generating capacity and infrastructure at the scale necessary to achieve this target. Through ORESS 1, the Government has awarded an offer quantity of new electrical generating capacity to four projects totalling 3,074 MW. Two additional 'merchant' Phase 1 projects could contribute up to 1,100 MW of potential additional capacity if they secure an alternative route to market. Each of these Phase 1 projects secured a Maritime Area Consent (MAC) and a grid connection assessment (GCA) and, subject to complying with the ORESS 1 terms and conditions or securing an alternative route to market, could be developed and operational by 2030 subject to planning and all other necessary consents.

5.3.16 The Dublin Array project, which secured an offer quantity of 824 MW, represents 26.8% of the total new offshore electricity generating capacity contracted by the Irish Government in ORESS1. The Dublin Array project represents 19.75% of the combined total capacity of all Phase 1 projects, which at 4,174 MW is less than the 5 GW target for 2030, as set out in the Climate Action Plan, 2024. Individually, Dublin Array has the potential to deliver more than 16% of the 5 GW target for 2030.

5.3.17 In this context, the 'do nothing scenario' would guarantee that Ireland will fall significantly short of the renewable energy electricity generation capacity needed to decarbonise the electricity, industrial and transport sectors in Ireland, and would further deny Ireland the benefit of significant electrical grid infrastructure development that is needed for these same purposes.

5.3.18 Ultimately, the 'Do Nothing' scenario would hinder Ireland's ability to meet its climate targets, ensure energy security, and foster sustainable economic growth.

Material assets

5.3.19 Without the Dublin Array, the economic opportunities identified above would be foregone, and reliance on imported energy, particularly fossil fuels, would persist. This would be particularly impactful on harder-to-abate sectors like transport, industry and agriculture which will rely on electrification and other measures to achieve the necessary emissions reductions.

5.3.20 In addition to benefits for Energy Security, the Energy Security Package, 2024, notes that Ireland's offshore energy potential makes it central to Europe's shared energy future.

'As well as strong cooperation with our fellow EU Member States on renewable energy, Ireland is working closely with other international partners to cooperate on the transition to a renewable electricity-led system and supporting cross border infrastructure. The British and Irish governments agreed a Memorandum of Understanding in September of 2023. This MOU aims to Increase high level cooperation and information sharing between Ireland and the UK, focused on the

energy transition and deployment of onshore and offshore renewable energy, including renewable/low carbon hydrogen. In addition, it also aims to increase cooperation specifically focused on exploring opportunities for further interconnection between the island of Ireland and Great Britain, including offshore hybrid asset projects, which can comprise offshore windfarms, offshore energy islands and hybrid/multi-purpose electricity interconnection.'

5.3.21 It has been estimated by the CRU (CRU, 2024) that the new critical grid transmission infrastructure to be developed by the Phase 1 project developers, and by EirGrid for the first project in the second phase of offshore renewable energy development, will require investment valued in excess of €5 billion. Without the Dublin Array project, a significant portion of this investment and infrastructure would not be realised.

5.3.22 The electricity transmission infrastructure proposed to be developed as part of the Dublin Array project is required to be transferred to EirGrid as the future asset owner where it will become part of the wider Dublin electricity transmission network. Dublin's electricity infrastructure is ageing and reaching its end of life. Work must be done now to transform and modernise the city's infrastructure so Dublin can continue to develop and thrive, while increasing the power from renewable sources (EirGrid, 2023).

Cultural heritage, landscape and seascape

5.3.23 In the 'do nothing' scenario, there would be no significant effect on cultural heritage, landscape or seascape. It is considered that the baseline scenario would continue unchanged.

5.4 Constraints on alternatives

5.4.1 In determining the parameters of **reasonable** and **feasible** alternative locations, alternative designs, alternative technologies, alternative layouts and scales, etc., there are certain regulatory, technological, environmental, physical, and financial constraints that apply. Table 1 summarises key constraints considered in this chapter of the EIAR.

Table 1 Project constraints

Constraint	Description	Parameters
Regulatory	▪ ORESS 1 Terms and Conditions for the Dublin Array. ▪ Project Milestones	▪ Electrical Export Capacity of 824 MW ▪ Submission of planning application within the deadline as imposed by the Maritime Area Consent(s) – March 2025.
	▪ CRU Policies and Regulatory Decisions.	▪ Development of electrical transmission infrastructure in

Constraint	Description	Parameters
		accordance with EirGrid policies and functional specifications due to the requirement to transfer the ownership and operational responsibility of the assets to EirGrid post commissioning and proving.
	▪ Grid Connection Assessment Terms and Conditions.	▪ Definition of infrastructure requirements for the connection to the existing electricity transmission network between the offshore wind farm and the existing Carrickmines 220 kV substation including the proposed onshore substation, underground electricity cable. infrastructure, submarine cables and offshore substation platform.
	▪ Dún Laoghaire-Rathdown County Development Plan 2022-2028 Objective EI19 Overhead Cables.	▪ Grid connections underground where possible.
	▪ Government policies for Phase 1 Offshore Wind Farm projects.	▪ Boundary of wind farm arrays for Phase 1 projects within their respective Maritime Area Consents to match the original Foreshore Lease applications boundaries.
	▪ Minimum separation distance between turbines for Search and Rescue (SAR) operations.	▪ MGN 654 (Maritime and Coastguard Agency, 2021) consistent lines of orientation for WTGs. ▪ Regularly orientated 500 m Search and Rescue Lane(s) through the wind farm layout.
	▪ Collision Risk to Birds, Bats and Marine Mammals, under the Habitats and Birds Directives.	▪ Reduce to nil or as low as reasonably practicable.
	▪ DLRCC Development Plan Objective EI19 Overhead Cables.	▪ Grid connections underground where possible.
Technology	▪ Fixed-bottom versus alternative floating WTG technology.	▪ Floating not available at commercial scale required to meet Government's ORE targets for 2030 for the Phase 1 projects, or for the first of Phase 2 projects. ▪ Water depths insufficient within Maritime Area Consent

Constraint	Description	Parameters
		for deployment of WTG floating technology design to achieve the project electrical output requirements.
	▪ Market availability of WTG model technology of appropriate scale.	▪ Market demands for efficiency has resulted in short production runs of each WTG model before production facilities are adapted for next more competitive model. ▪ WTG model specification and dimension uncertainty at the time in the future when such WTGs will be procured.
	▪ Technical requirements for WTGs, OSPs, Export Cables and Inter-array cables.	▪ OSP must be capable of increasing 66 kV to 220 kV for efficient transmission to national grid.
	▪ Functional requirements for OSP and WTGs foundations.	▪ Must securely support WTGs and OSP in vertical position while enduring physical forces at sea. ▪ Must have safe access to and from the WTG/OSP infrastructure.
	▪ Technical factors for onshore cable route, onshore substation, and onshore grid connection.	▪ Two 220 kV cable circuits. ▪ Cable joint bay infrastructure every 500-600 m approximately. ▪ EirGrid's specification 'OFS-CAB-101-R2 220 kV and 400 kV Underground Cable Function Specification' requires underground cables to be in the reserve of public roads where practical. ▪ See sections 5.10 and 5.11 later in this chapter.
	▪ Maximum distance between onshore substation and grid connection point at Carrickmines.	▪ 4 km (see Volume 6, Appendix 6.5.1-1 Carrickmines Substation Site Selection Report).
Environmental	▪ Candidate and designated SPAs and SACs (European sites).	▪ European site boundaries avoided wherever possible (see Part 4 Natura Impact Statement).
	▪ Presence of NHAs and other features of national biodiversity importance, under the Wildlife Acts and the National Biodiversity Action Plan.	▪ Planning application seeking permission to allow for micro-siting or locational 'limit of deviation' for OSP, WTGs and electricity cable infrastructure of 350 m to avoid impact wherever appropriate.

Constraint	Description	Parameters
	▪ Presence of known or suspected underwater archaeology, including wrecks.	▪ OREDP avoid sites of interest and exclusion zones for marine archaeology, wrecks. ▪ 100 m archaeological exclusion zone around known archaeological features (with 300 m around MA0302 at request of Underwater Archaeology Unit). ▪ Micro-siting or locational 'limit of deviation' for OSP and WTGs of 350 m is proposed.
	▪ Presence of UXO, other Marine Users and Infrastructure and other features to avoid.	▪ Micro-siting or locational 'limit of deviation' for OSP and WTGs of 350 m is proposed.
	▪ Potential future designation of Marine Protected Areas (MPAs).	▪ Evidence to date indicates future MPA designations will not overlap with Dublin Array project site. See section 5.6.3 and Figure 4
	▪ Visual Impact, Landscape & Seascape.	▪ No hard constraints.
	▪ Environmental and social factors for onshore cable route, onshore substation, and onshore grid connection.	▪ See sections 5.10 and 5.11 later in this chapter.
Physical	▪ Water depth.	▪ Currently depths of 13 m – 40 m LAT required for available fixed-bottom WTG and OSP technology. ▪ Current max approx. 60 m for fixed-bottom WTGs. ▪ Previous max approximately 40 m.
	▪ Seabed slope (bathymetry).	▪ Suitability of location for infrastructure installation based on technology limitations of installation vessels (jack-up and dynamic positioning system vessels).
	▪ Seabed conditions.	▪ OREDP, avoid areas where sediment transport pathways and coastal processes are highly sensitive to change.
	▪ Distance from Kish Lighthouse and North Kish (north cardinal mark).	▪ Minimum 1,320 m between Lighthouse and closest WTG to accommodate helicopter operations (see Volume 3, Chapter 12: Aviation and Radar and associated technical appendices).

Constraint	Description	Parameters
	▪ Aviation Constraints.	▪ Maximum blade tip elevation 311.7 m LAT (see Volume 3, Chapter 12: Aviation and Radar and associated technical appendices).
	▪ Minimum Blade Tip Clearance.	▪ MGN 654 requires minimum clearance of 26.6 m LAT between the sea surface and the WTG rotor (see Volume 3, Chapter 10: Shipping and Navigation). ▪ Increased to 31.6 m LAT to minimise bird collision risk (see Volume 3, Chapter 6: Offshore and Intertidal Ornithology).
	▪ Minimum land requirement for new onshore substation.	▪ GIS (gas insulated switchgear) requires approximately 1.6 ha – 2.4 ha site (for 2-circuit grid connection required to deliver approx. 824 MW); ▪ AIS (air insulated switchgear) requires significantly larger area for the same connection capacity (see section 5.10.3).
	▪ Trenchless cable installation technique requirements onshore.	▪ Typical compound requirement 45 m x 45 m on the drill entry pit side of the crossing subject to space availability. The drill exit pit will require a smaller compound (see Volume 2, Chapter 6: Project Description).
	▪ O&M Base.	▪ Max 1 hour vessel transit time to wind farm. ▪ Moorings for min/max Crew Transfer Vessels (CTVs). ▪ Jetty or pier infrastructure to facilitate loading & unloading of O&M equipment and parts, and personnel. ▪ 24/7 unrestricted access. ▪ Minimum berth depth of at least 2 m at LAT. ▪ Internal storage of minimum 1,000 m^2.
Commercial	▪ Wind Capacity.	▪ See Section 5.6 Wind Capacity ▪ Good wind resource (7 to 11 m per second mean).
	▪ Shipping and Navigation.	▪ See Figure 5 and Figure 6 for location of existing

Constraint	Description	Parameters
		commercial shipping lanes, avoided in site selection.
	▪ Commercial Fisheries.	▪ OREDP spacing of turbines wide enough to permit use of mobile fishing gear. ▪ Minimise restriction of access to existing fishing grounds.
	▪ Existing Marine Infrastructure and Other Users.	▪ Minimise third party cable and pipeline crossings, and where necessary, aim to cross at 90 degrees where possible. ▪ Minimum separation distances of 30 metres between cables and pipelines (see Volume 2, Chapter 6: Project Description).
	▪ Proximity to energy demand and existing grid connection infrastructure.	▪ EirGrid 'East Coast Opportunity Assessment' identified 220 kV connection nodes that would not require significant works to the electricity transmission network. ▪ EirGrid 'Shaping our Electricity Future' identified need for East Coast projects, close to energy demand, reducing network constraints and the scale and quantity of required network reinforcements (see section 5.6.24 and Figure 7). ▪ Electricity Transmission losses. ▪ Cost of Connection. ▪ Extent of new onshore transmission infrastructure required.
	▪ Commercial factors for onshore cable route, onshore substation, and onshore grid connection.	▪ Project costs. ▪ See Table 5-19 (Comparative Cost Assessment).

5.5 Alternative locations

Background to site selection

5.5.1 In the late 1990s, Saorgus Energy Ltd (Saorgus) explored various options for offshore wind farm locations, turbine layouts, foundation technologies, and onshore and offshore cable routes. The main goal of the site selection process was to identify project areas that were feasible for construction of an offshore wind farm and associated infrastructure whilst avoiding or minimising the potential for environmental effects.

5.5.2 In 2001 the Minister for the Marine and Natural Resources published a policy document on the regulation of offshore wind and wave electricity generating stations 'Offshore Electricity Generating Stations – Note for Intending Developers' (DCMNR, 2001). The policy document provided a list of information to be provided in an Environmental Impact Statement, including the reasons for non-selection of alternative locations. The document also stated that:

'Offshore generating stations will not, as a general rule, be allowed within 5 km offshore but applicants may make a case for such if they consider that the proposed construction will not interfere unduly with the visual amenity of the area in question (both landscape and seascape). Such applications will be subject to special consultation procedures in the light of potential for excessive visual impact.'

5.5.3 In addition to the above, the site selection process undertaken by Saorgus (as documented in the two foreshore lease applications made by Kish Offshore Wind Limited and Bray Offshore Wind Limited in 2006 and updated thereafter), considered several constraints including:

- Water depth and metocean conditions;
- Wind capacity;
- Environmental designations;
- Shipping and navigation activity; and
- Proximity to onshore grid infrastructure and areas of high energy demand.

Water depth and metocean conditions

5.5.4 As water depth increases rapidly with distance from shore, particularly along the west and south coasts of Ireland, areas of development opportunity are located in closer proximity to shore than the Irish Sea. The Irish Sea is characterised by a predominantly level basin, with water depths ranging from approximately -20 to -135 m below Chart Datum (CD). Several shallower areas and parallel sandbanks are located along the eastern coastline of Ireland, as recorded on Admiralty Charts. These sandbanks are located about 5 to 10 km off the east coast. Due to the relatively shallow waters around these banks, they were a primary focus for offshore wind development potential by Saorgus (and other wind farm developers at the time) during the early stages of site selection.

5.5.5 At the time of the original site selection process, wind turbine foundation technology limited the economic viability of projects to water depths of up to 40 m below CD enabled by monopile foundation technology. This restriction excluded the west and southwest coasts further than 5 km from shore, where water depths increase rapidly with distance from the shore. In addition, metocean conditions are more challenging along the west and southwest coasts due to their exposure to frequent Atlantic storms. On this basis, the east coast of Ireland was considered by Saorgus as more favourable for the development of an offshore wind project than the west or south coasts of Ireland.

5.5.6 The figure below indicates the distribution of water depths of 40 m or less around the coast of Ireland.

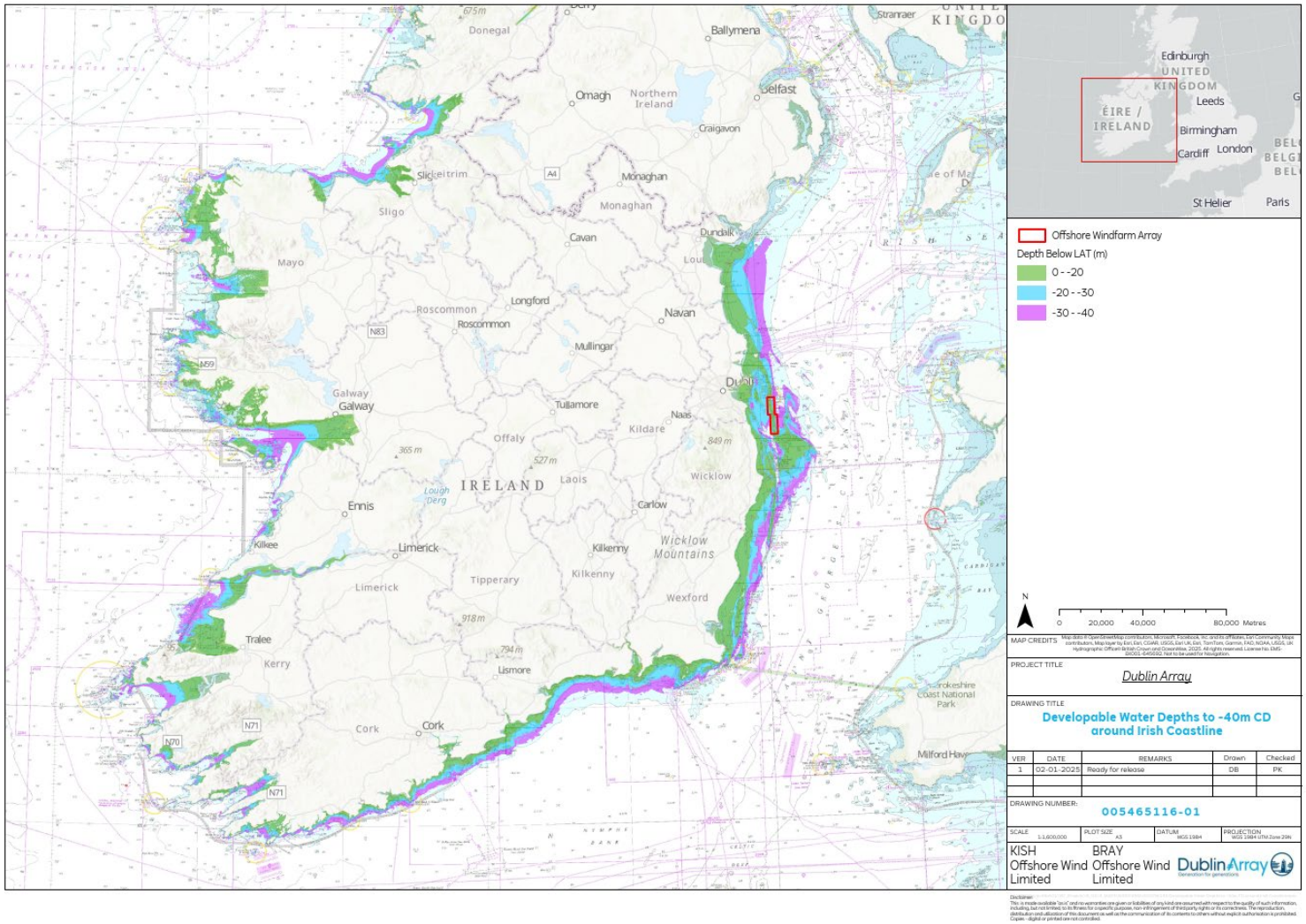

Figure 1 Developable water depths to -40 m CD around Irish coastline

Wind capacity

5.5.7 An assessment of the theoretical wind energy resource indicated significant potential, with predicted mean annual wind speeds ranging from 7 to 11 m/s at 100 m above Mean High-Water Springs (MHWS) across the majority of the area for which data was available.

5.5.8 Generally, wind speed is predicted to increase with distance from the coast. The west and southwest coasts are expected to have the greatest wind resource, as they face prevailing westerly winds, unconstrained by land, arriving at the continental shelf from Atlantic weather systems.

5.5.9 Figure 2 provides a visual representation of the predicted wind speeds off the coast of Ireland. As can be seen there is good wind speed around the coast of Ireland (1 knot equals 0.514 metres per second).

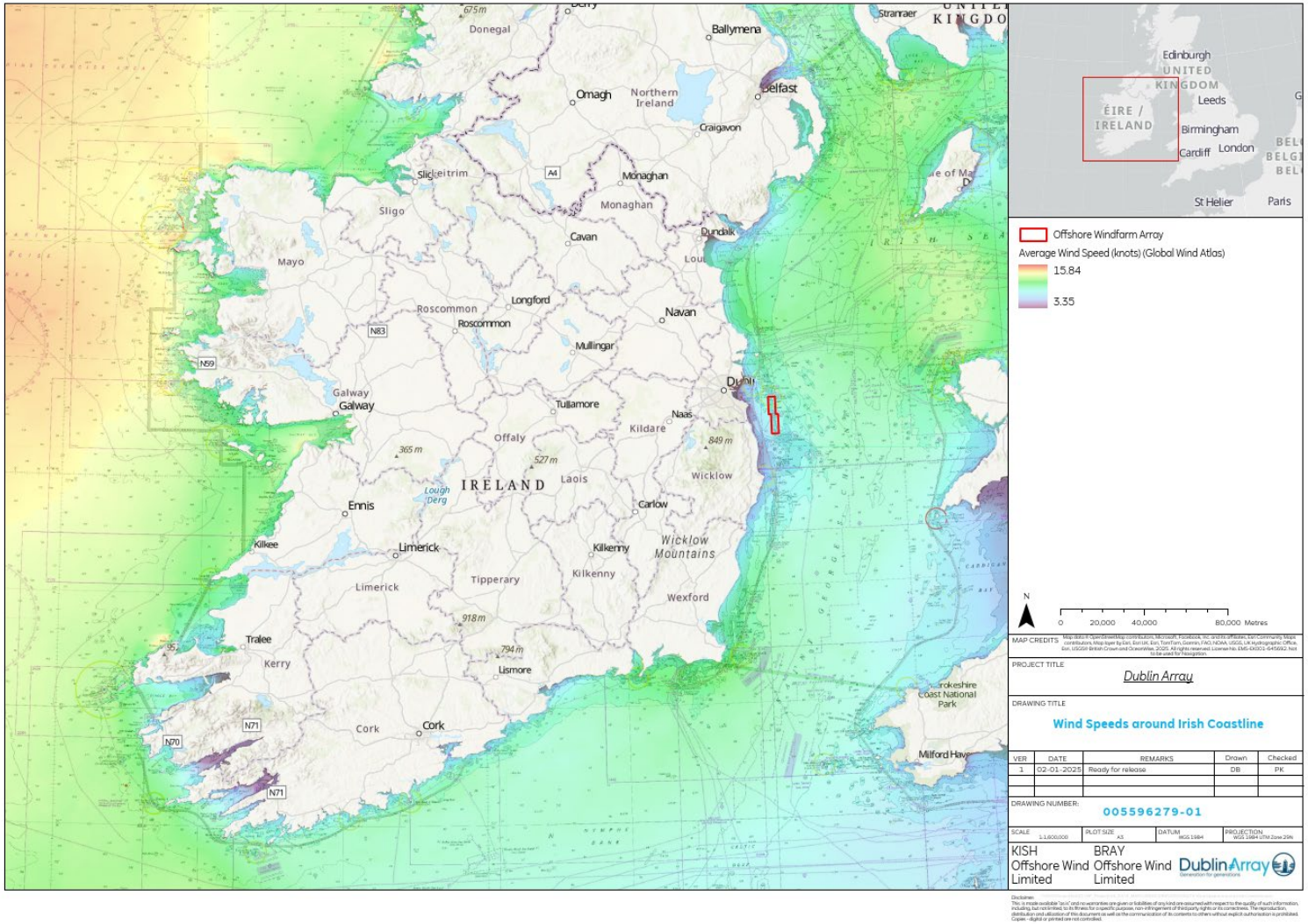

Figure 2 Wind speeds around Irish coastline

Environmental designations and ecologically sensitive areas

5.5.10 The site assessment process carried out by Saorgus in the late 1990s and early 2000s sought to avoid designated ecologically sensitive sites, such as European sites and NHAs, and sites proposed for designation under the Habitats and Birds Directives and the Wildlife Acts. Sites have been designated and proposed for designation following the lease applications made by Saorgus under the Foreshore Acts, as noted below, however, these designations/proposed designations under S.I. No. 477/2011 – European Communities (Birds and Natural Habitats) Regulations 2011, as amended, do not overlap with the proposed Dublin Array wind farm array (where wind turbines are located) development area.

Shipping and navigation review

5.5.11 Shipping routes are typically regarded as firm restrictions for offshore wind farms, and developers strive to avoid these areas whenever feasible. If an offshore wind site intersects with existing shipping lanes, rerouting may be required.

5.5.12 The Irish Sea functions as a critical maritime route with heavy vessel traffic. Its strategic importance lies in its role as a key shipping passage that connects Ireland with the UK and mainland Europe. Ports such as Dublin and Belfast on Ireland's eastern shore significantly contribute to this high traffic volume, facilitating the transport of goods, passengers, and freight.

5.5.13 Analysis of the defined shipping lanes was carried out to determine the areas of high vessel densities on regularly used shipping routes. Naturally, these shipping lanes generally avoided areas of seabed with shallower water, such as sandbanks. This was factored into the site selection process.

Proximity to grid

5.5.14 When considering the proposed site location for the offshore wind farm during the early development stages of the project, the proximity to onshore grid connection infrastructure was a major consideration for Saorgus. Grid connection infrastructure is significantly more developed along the east coast. By contrast, the west and south coast have limited opportunities for a significant offshore wind farm to connect to the grid. Locating an offshore wind farm off the coast of Dublin would significantly reduce transmission losses that occur when electricity is transported over long distances. Proximity to the grid allows for a more direct connection minimising the need for additional onshore transmission infrastructure.

Alternative Dublin Array sites considered by Saorgus

5.5.15 Saorgus originally identified (as documented in the two foreshore lease applications made by Kish Offshore Wind Limited and Bray Offshore Wind Limited in 2006 and updated thereafter) several potential offshore development areas for further consideration, including the Codling Bank, the India Bank, the Arklow Bank, the Blackwater Bank, the Kish Bank and the Bray Bank.

Table 2 Alternative locations considered

Locations Considered	Description
Codling Bank	The Codling Bank is located approximately 13 km east of Greystones and Wicklow Head and extends for approximately 5 km in an east west direction. Water depths over the bank are between -2 m to -9 m below CD with water depths of below -20 m in the surrounding area. The Admiralty Chart identified overfalls in poor weather on the Codling Bank. The Sustainable Energy Authority of Ireland (SEAI) Wind Atlas indicates wind speeds in the order of 9 m/s at 100 m. The water depths and wind speeds at the Codling Bank were identified as being favourable for offshore wind development, however, at the time, the wave and tidal environment were considered to be challenging from the perspective of construction, operation and maintenance. The waters in the vicinity to the Codling Bank were under investigation by Codling Wind Park Ltd during the time period Saorgus were undertaking their assessment. In September 2005, Codling Wind Park Ltd. successfully obtained a foreshore lease for the construction of 220 turbines on the Codling Bank.
India Bank	The India Bank is located approximately 7.5 km to the south of the Codling Bank, approximately 10 km off the Wicklow Coast. It extends for approximately 4 km in a north-south direction and less than 1 km east-west. Water depths are in the range -3.5 to -7.8 m below CD. Comparatively, the India Bank is considerably smaller than the Codling Bank and the combined area of the Kish and Bray Banks. As a result, it was determined that the available developable area with a shallow water depth below -40 m CD would not be sufficient to accommodate an economically viable offshore wind energy project. This determination took account of the then-available technological capabilities in the market.
Arklow Bank	The Arklow Bank is located 13 km east of Arklow off the Wicklow coast. It extends for approximately 27 km in a north-south direction and is approximately 2.5 km wide. Water depths are in the range -0.6 to -4.0 m on the bank increasing rapidly to -20 to -30 m on either side. Wave and tidal climates are similar to those for

Locations Considered	Description
	the Kish and Bray Banks and the SEAI Wind Atlas indicates 100 m wind speeds in the order of 9 m/s. Considering the size of the developable area around the Arklow Bank, along with favourable water depths and wind speeds, the bank was identified as a suitable location for proposed wind farm development. In 2002 a foreshore lease was granted to develop an offshore wind farm on the Arklow Bank. GE Energy and SSE Renewables (formerly Airtricity) installed 7 No. 3.6 MW turbines on the bank in 2004, with plans for a second phase of development at this location.
Blackwater Bank	The Blackwater Bank is located approximately 5 km east of the Wexford Coast. It extends for approximately 17 km in a north-south direction and is approximately 3 km wide. Water depths are in the range 10 to 15 m on the west of the bank increasing to in excess of 30 m on the eastern side. The SEAI Wind Atlas indicates 100 m wind speeds in the order of 9 m/s. Given the extent of the bank and the relatively favourable water depths and wind speeds, the Blackwater Bank offered a suitable location for wind farm development. However, when assessed with the other options under consideration it was not identified as a preferred site due to its distance from major electricity demand centres and the availability/capacity of existing electricity transmission infrastructure at the time.
Kish and Bray Bank	The area of the Kish and Bray Banks that was identified for exploration extends approximately 18 km north-south and 3 km east-west. The banks are located approximately 10 km from the coast of Dublin at the nearest point. Proximity to shore is beneficial to avoid loss of generated power from the offshore wind farm to the proposed onshore substation at the proposed landfall site. A bathymetric survey undertaken on behalf of the Marine Institute in November 1998 (Wheeler et al. 2000) showed that the Kish and Bray Banks were located in 20 – 30 m of water rising in places to within two metres of the surface towards the centre of the axis that runs north-south along the banks.

5.5.16 The desktop studies highlighted potential sites in the Irish Sea, with Kish and Bray Banks identified by Saorgus as a preferred location given proximity to areas of high electricity demand, avoidance of significant shipping routes, favourable site conditions, and the avoidance of ecologically designated sites.

Background to application

5.5.17 Two foreshore lease applications were made by Kish Offshore Wind Limited and Bray Offshore Wind Limited in 2006, for the Dublin Array offshore wind project in the vicinity of the Kish and Bray banks. The applications included an Environmental Impact Statement. The applications were updated in 2012 with additional addendum information provided in 2013, including a Natura Impact Statement. A non-statutory consultation process was undertaken at that time.

5.5.18 In 2013, the Government announced an intention to prepare a new maritime consent architecture with the publication of the General Scheme of a Maritime Area and Foreshore (Amendment) Bill 2013, and to facilitate marine site investigations for offshore renewable energy developments but not to accept any new applications for development consent pending the adoption of the new legislation.

5.5.19 In February 2014 the Department of Communications, Energy and Natural Resources published the OREDP, which sought to establish an initial framework for the sustainable development of Ireland's offshore renewable energy (ORE) potential. The preparation, adoption, and subsequent review in 2018 of the OREDP were informed by a Strategic Environmental Assessment (SEA) and Appropriate Assessment (AA). The OREDP considered proposed projects (both commercial and R&D) that were under consideration at the time, including the two lease applications for the Dublin Array project. The northern section of Dublin Array (Kish Bank) was included in the assessment area East Coast (North) and the southern section of Dublin Array (Bray Bank) was included in assessment area East Coast (South). The conclusion of the assessment of the OREDP was that, in the assessment area of East Coast (North), there was the potential to develop 1,200 MW to 1,500 MW without any likely significant adverse effects on the environment and other marine activities/users. In the assessment area East Coast (South) the potential was identified as 3,000 to 3,300 MW without any likely significant adverse effects. This was based on a total number of wind turbine generators that was significantly greater than is currently proposed by Phase 1 projects in this area of the Irish Sea, reflecting the improvements in technology and efficiency of technology developed over the intervening period.

5.5.20 In 2019 the Government published the General Scheme of a Maritime Planning and Development Management Bill, 2019. In addition to the Heads of the Bill, it included by way of an Appendix, a 'Transition Protocol for Relevant Projects', being those projects recognised to be at an advanced stage in the development consent process, including the Dublin Array project's two pending foreshore lease applications. That same year, the Government adopted the first Climate Action Plan 2019 in accordance with the Programme for Government. Under the Transition Protocol and Climate Action Plan 2019, the Government's stated objective was to facilitate 'Relevant Projects' (now Phase 1 projects) to progress under the intended new maritime consent architecture, when enacted.

5.5.21 In 2020, the Government published 'Further Information on the Marine Planning & Development Management Bill (2020)', and ultimately these steps led to the adoption at the end of 2021 of the Maritime Area Planning Act 2021 (MAP Act) (Government of Ireland, 2021a) and the Maritime Jurisdiction Act 2021 (Government of Ireland, 2021b), both of which have been amended since 2021. Under the MAP Act, special provision was made for projects that, due to their advanced stage, could apply at the invitation of the Minister for Environment, Climate and Communications, for a Maritime Area Consent (MAC) and make a corresponding surrender of the lease areas which had been granted or applied for under the Foreshore Acts. The MAC for the Dublin Array project was granted by the Minister at the end of 2023 and the MAC boundary was defined by the original boundary of the foreshore lease applications made by Saorgus under the Foreshore Acts.

5.5.22 Meanwhile the Government had also prepared and adopted the National Marine Planning Framework (NMPF) and a non-statutory Marine Planning Policy Statement. The NMPF was published together with the reports informing the AA and SEA of the NMPF.

5.5.23 The Department of Environment, Climate and Communications adopted a Policy Statement on the Framework for Ireland's Offshore Electricity Transmission System in 2021. This designated EirGrid as the Transmission System Operator (TSO) and asset owner for Ireland's offshore transmission system. In October 2021, the CRU issued a Proposed Decision (CRU/21/112 – Offshore Grid Connection Assessment – Phase 1 Projects) concerning the allocation of grid capacity to offshore wind projects. Ultimately, EirGrid issued a Grid Connection Assessment (GCA) confirming that the point of connection of the Dublin Array project is to the existing Carrickmines 220 kV substation.

5.5.24 In 2022, under the Programme of Measures adopted under the Marine Strategy Framework Directive, the Government announced an intention to progress a General Scheme of Marine Protected Areas Bill, 2022[6]. In July 2023, the Minister of State for Heritage announced a new candidate North-West Irish Sea Special Protection Area (National Parks & Wildlife Service, n.d.), extending over more than 230,000 ha of coastal and marine waters off the coast of Louth, Meath and Dublin. The Minister noted:

'We are working hard as a Government to ensure we have robust protections in place for nature as we work to deliver on our offshore renewable energy objectives. Biodiversity action and climate action must go hand in hand.'

5.5.25 In January 2024, a new candidate Seas Off Wexford SPA was announced (National Parks & Wildlife Service, n.d.), extending over 305,000 ha of marine waters off the coast of Wexford, increasing to almost 10% the percentage of Ireland's maritime area legally protected for biodiversity. Ireland has committed to 30% marine protected areas by 2030. The Minister noted:

'At 305,000 hectares, the Seas off Wexford SPA is bigger than County Wexford itself and the largest ever area to be protected for birds in the history of the State. I'm delighted to be able to announce this significant step forward for nature, and particularly for marine seabirds. This Government is working hard to ensure robust biodiversity protections, just as we are working hard to deliver on our offshore renewable energy objectives. Biodiversity action and climate action must go hand in hand, and we must continue to work together to protect nature while delivering a swift transition to more sustainable and renewable forms of energy.'

5.5.26 In 2019, RWE Renewables Ireland Limited (formerly innogy Renewables Ireland Limited) acquired an interest in Kish Offshore Wind Limited and Bray Offshore Wind Limited (the Applicant). The Applicant has undertaken a full review of the original site selection and has undertaken significant additional desk and site surveys and assessments which have confirmed the suitability of the site selection for the Dublin Array project in the light of international experience, current scientific knowledge and technological advancement.

[6] The NPWS in the meantime had submitted a list of existing legally protected SACs in the maritime area as Marine Protected Areas (MPAs) under the OSPAR Convention Marine Protected Areas submitted to the OSPAR Convention

5.6 Review of Dublin Array site selection

5.6.1 The Applicant has reviewed the original site selection and undertaken additional surveys and assessments to confirm the suitability of the Kish and Bray Banks for the construction of an offshore wind farm with an initial target electricity generating capacity of 900 MW. Having regard to the original site selection criteria, the considerations in relation to Water Depth and Metocean Conditions, Wind Speed and Shipping and Navigation remain valid, particularly Proximity to Grid and Environmental Designations and Ecologically Sensitive Areas.

5.6.2 The alternative of floating offshore wind technology instead of fixed-bottom technology was also considered, together with water depths and distance from shore, in light of the existing factual, regulatory and commercial circumstances.

Fixed-bottom wind turbine technology

5.6.3 While floating wind technology potentially allows for development further from the coast in deeper water, those technologies are currently significantly more expensive and less established than fixed-bottom technology. Floating technology is not currently available at the commercial scale required to meet the Government's offshore wind targets for 2030. By prioritising fixed-bottom technology projects for the first phase of offshore renewable energy projects, Government policy has ensured the most cost-effective deployment of offshore wind in Ireland is secured for the benefit of Irish consumers, as evidenced by the results of the ORESS 1 auction in 2023. The auction results demonstrated the benefits of these cost efficiencies to the Irish electricity consumers with a competitive price of *'at an average of €86.05/MWh — which is one of the lowest prices paid by an emerging offshore wind market in the world. For comparison, the average wholesale electricity price in Ireland over the past 12 months was in excess of €200/MWh.'* gov.ie - Minister Ryan welcomes hugely positive provisional results of first offshore wind auction

Distance from shore

5.6.4 The majority of operational wind farms are located within 12 nautical miles (nm) of the coastline. The research paper 'Foundations in Offshore Wind Farms: Evolution, Characteristics and Range of Use, Analysis of Main Dimensional parameters in Monopile Foundations' (Journal of Marine Science and Engineering, 2019) shows offshore wind farms in operation classified by depth and distance from the coast at the end of 2018.

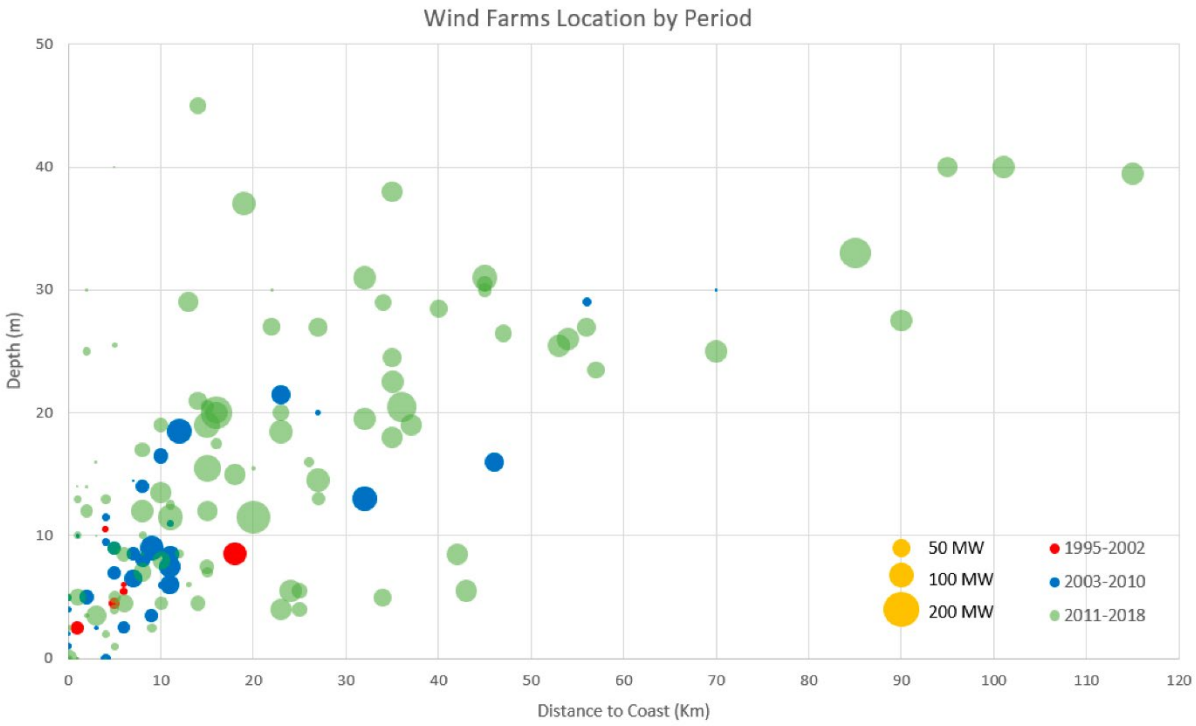

Figure 3 Offshore wind farms in operation classified by depth and distance to coast (https://www.mdpi.com/2077-1312/7/12/441)

5.6.5 Wind Energy Ireland published a briefing paper in 2021 entitled 'Briefing paper on proposals to block fixed-bottom wind turbines' (WEI, 2021). This paper concludes that 'as of the end of 2020, there were 7.8 GW of offshore wind capacity installed in Europe with 65 offshore wind farms located closer than 22 km [12 nm] from the coastline. Another 16 GW of projects within that distance either have planning permission or have applied for it'. As recently as 2023, the Awel y Mor offshore wind farm project secured development consent off the Welsh coast. This project is located 10.5 kilometres from the shore with a maximum of 50 wind turbines with a maximum tip height of 332 m.

Water depth

5.6.6 As noted in section 5.5.5 whereas in the late 1990s and early 2000s WTG technology could be developed in water depths of approximately up to 40 m CD, advances in the development of fixed bottom technology and its associated supply chain have increased this to approximately 60 m CD (The Crown Estate, 2019).

Shipping and navigation

5.6.7 The principal shipping and navigation routes into and out of Dublin Port and transiting the Irish Sea to and from Belfast Port continue to represent a significant constraint to the east of the Kish and Bray banks, in deeper waters.

Wind capacity and metocean conditions

5.6.8 SEAI Wind Maps (2013) as available on Ireland's Marine Atlas (https://atlas.marine.ie/), show sufficient wind speeds for the development of offshore wind around the coastline of Ireland with mean wind speeds in excess of 8.5 metres per second (m/s). This demonstrates that, on the basis of wind speed, there is potential for offshore wind development around the entire coastline of Ireland and therefore it is not considered to be a material influence on the consideration of alternative sites.

5.6.9 In June 2021, the Applicant deployed a floating LiDAR to record wind data. The LiDAR was initially deployed close to the Kish lighthouse to enable calibration with the wind measurement equipment mounted on the lighthouse. The LiDAR was subsequently relocated to the west of the Bray bank to provide wind data representative of the southern end of the proposed site. The LiDAR buoy was removed from the site in January 2023. Two additional metocean buoys were deployed in June 2021, one on the east side of the Kish Bank, the other to the west side of the Bray Bank. These buoys recorded wave and current data and were removed in June 2022.

5.6.10 A wind yield assessment study was commissioned to determine the expected long-term wind yield of the wind farm, using wind data from the Kish Lighthouse. The wind yield assessment evaluated the long-term energy yield, risk factors on annual yield, and 50-year extreme wind conditions for the wind farm in the waters around the Kish and Bray Banks. The results confirmed that the site's wind resource is highly suitable for a wind farm, with long-term mean wind speeds exceeding 8.7 m/s at a 100 m hub height.

Environmental designations and ecologically sensitive areas

5.6.11 Since the original site selection process was completed additional European sites (SPAs, SACs) have been designated or identified as candidate sites for designation. The array area is not located within any European site or designated conservation area. There is a small overlap (0.16 km^2) between the proposed offshore export cable corridor and Rockabill to Dalkey Island SAC however within this area of overlap there is no Annex I reef habitat (see planning application Part 4 Habitats Directive Assessments).

5.6.12 Ireland has committed to protecting 30% of marine waters by 2030. The proposed designation of two new maritime SPAs - the North-west Irish Sea cSPA and the Seas off Wexford cSPA – will bring the total area designated or proposed for designation under the Habitats and Birds Directives in the maritime area to approximately 10% of Ireland's large maritime area.

5.6.13 In 2020, the MPA Advisory Group completed an ecological sensitivity analysis of the Irish Sea to:

- Identify areas of higher and lower sensitivity to human pressures;
- Engage with key stakeholders;
- Inform decisions about siting of Offshore Renewable Energy; and
- Develop methods for identifying future Marine Protected Areas.

5.6.14 The MPA Advisory Group's Report 'Expanding Ireland's Marine Protected Area Network' was published by the Department of Housing, Local Government and Heritage in October 2020 (Marine Protected Area Advisory Group, 2020).

5.6.15 The MPA Report helps identify zones where MPAs can be established to safeguard ecologically sensitive habitats while allowing offshore wind projects to proceed in less vulnerable areas. This ensures that biodiversity, such as important fish breeding grounds and marine mammal habitats, is preserved.

5.6.16 The MPA Report identified 40 biological and environmental features that could be recommended for spatial protection in the western Irish Sea under future MPA legislation. Selected features included species and habitats classified as threatened or declining on national and/or international lists, species and habitats of ecological importance, areas of high biodiversity and features with high potential for restoration.

5.6.17 Figure 4 (Figure 1 from the MPA Report) identified areas of comparatively higher priority for potential protection for the selected ecological features. The MPA Report concluded that suitable MPAs could be selected from these areas. Areas of lower priority for potential protection for the selected features are shown in white.

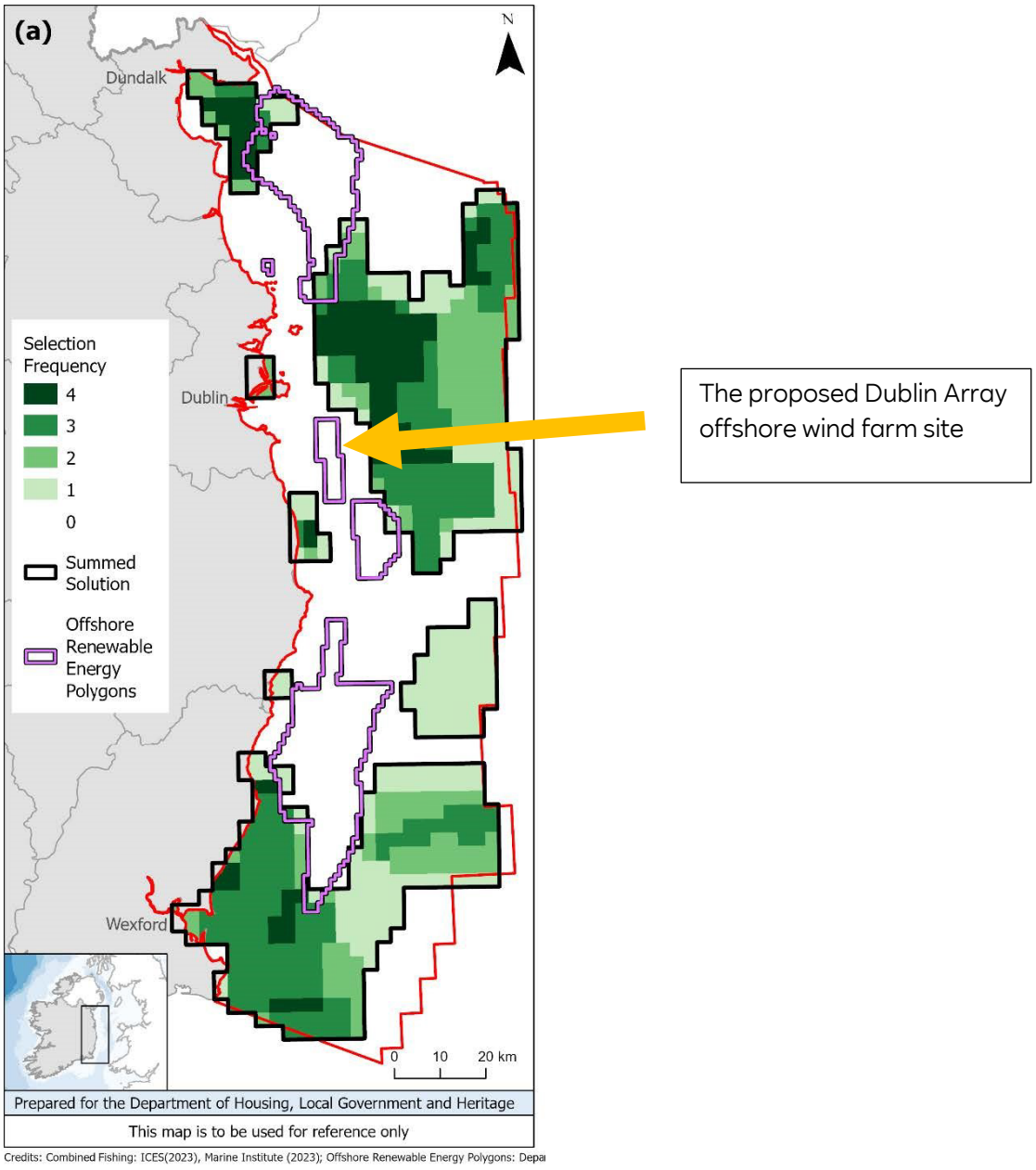

Figure 4 Ecological sensitivity analysis of the Irish Sea

(gov.ie - Ecological Sensitivity Analysis of Irish Sea – Main Report (www.gov.ie))

5.6.18 As can be seen above the proposed Dublin Array offshore wind farm site is located in an area not identified as a priority for future MPA designation or legal protection.

5.6.19 The MPA Report also considered spatial overlap and wider ecosystem functioning between priority locations identified and their interaction with the Natura 2000 network of European sites (including candidate sites) to promote ecological coherence and mutual benefit. The proposed Dublin Array offshore wind farm site avoids priority areas identified for future protection.

Shipping and navigation review

5.6.20 The Kish and Bray banks extend for a combined distance of approximately 15 km (10 nautical miles) in a north-south direction and have an average width of approximately 1 km (0.5 nautical miles). The northern extent is marked by the North Kish (north cardinal mark) and is further marked by the Kish Bank Lighthouse.

5.6.21 The area in the vicinity of the Kish and Bray Banks is busy for both commercial shipping as well as marine leisure craft. Vessel traffic has been assessed in full within the Navigational Risk Assessment included in Volume 3, Chapter 10: Shipping and Navigation of this EIAR. The main navigation routes in the vicinity of the proposed area are associated with harbour traffic in and out of Dublin Port. Passenger vessels make up most of the marine traffic density in the area navigating at the closest point just to the north of the site boundary (see Figure 5 and Figure 6) Cargo vessels also make up a high density of the marine traffic in and out of Dublin Port and the surrounding area to the west of the site boundary.

5.6.22 Due to the nature of the shallow water (<2 m in places around the banks at low tide) and the wave climate around the banks, the Kish and Bray Banks themselves do not see any commercial shipping activity. Therefore, the preferred development location continues to be suitable for the development of an offshore wind farm. Recreational craft and some shallow drafted fishing vessels can access the area. Such third-party transits over the banks will not be excluded, however advisory safe passing distances will be utilised around vessels engaged in sensitive maintenance operations to ensure the safety of both project and third-party vessels. Any such areas will be temporary, and limited spatially to the waters surrounding the operations, and as such no notable displacement for smaller vessels accessing the banks is anticipated.

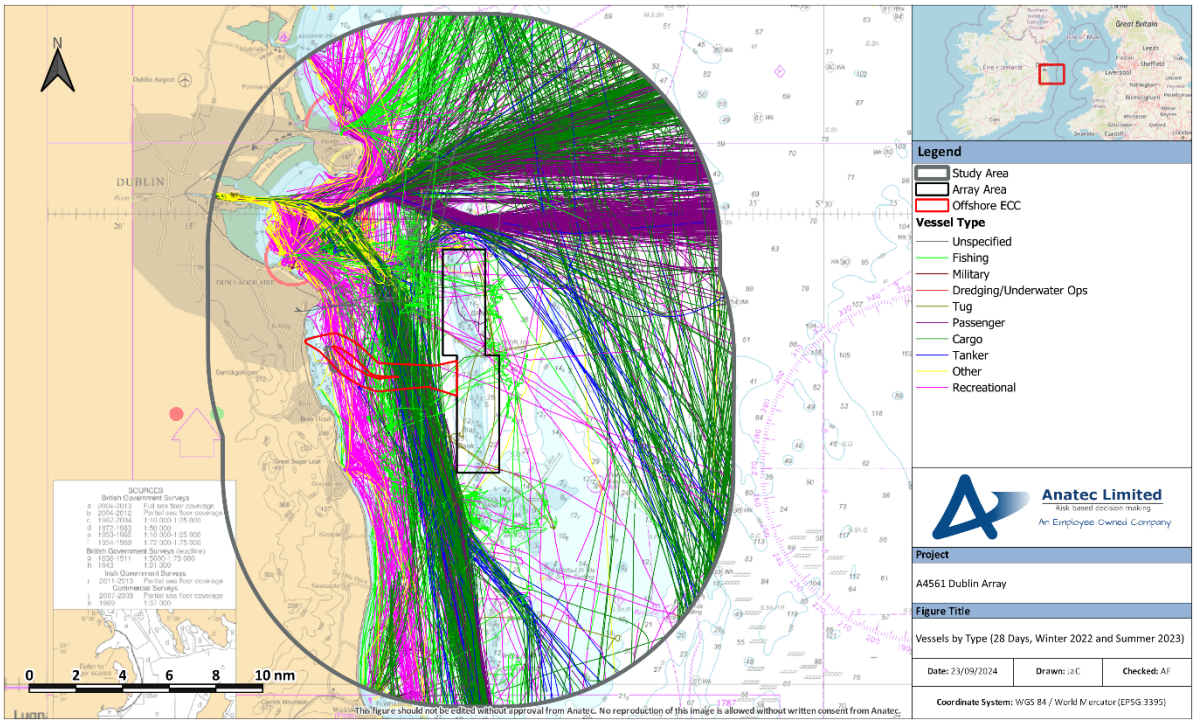

Figure 5 Marine traffic data winter 2022 and summer 2023 (vessel type)

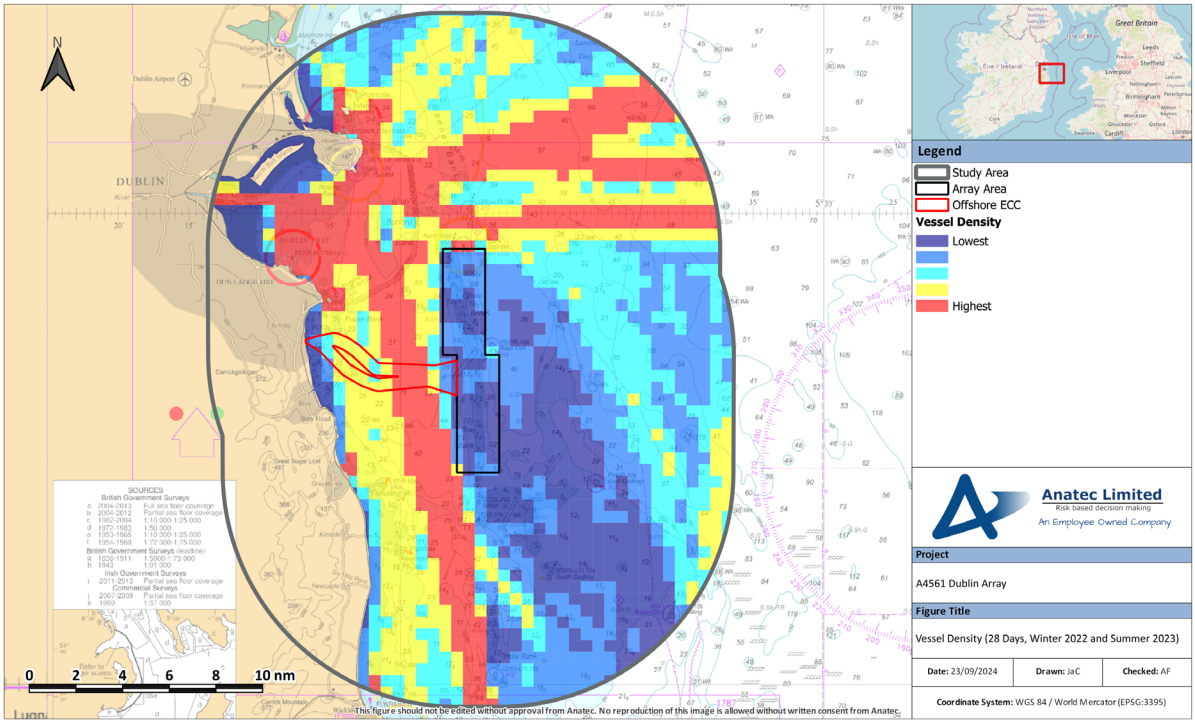

Figure 6 Marine traffic data winter 2022 and summer 2023 (vessel density)

Proximity to grid review

East Coast opportunity assessment (EirGrid, 2019)

5.6.23 EirGrid published the East Coast Opportunity Assessment in 2019. This report presented the analysis completed by EirGrid to identify opportunities for connecting new power generation sources in the East coast region of Ireland from a grid capacity perspective. The results of the assessment concluded that locations close to the Dublin load centre and/or with multiple 220 kV connections into the Dublin Area had the best opportunities for new generation capacity. The report identified the locations with greatest opportunity for offshore wind connection before requiring significant works to the electricity transmission network included Woodland, Poolbeg North, Poolbeg South, Finglas and Carrickmines.

Shaping our electricity future (EirGrid, 2023)

5.6.24 EirGrid published Shaping our Electricity Future in 2023 (EirGrid, 2023). This report sets out EirGrid's strategy for delivering electricity transmission infrastructure which meets renewable electricity targets, carbon budgets and actions from the Climate Action Plan (2023). It states that *'offshore wind is expected to emerge as a key contributor to delivering the Renewable Ambition. Strong progress is being made to set the required regulatory frameworks and connection principles and methods in place. The initial focus leading up to 2030 is on developments on the east coast which places the generation close to the largest centre of demand, again reducing network constraints and scale and quantity of network reinforcements required. The figure below from the roadmap, shows that electricity grid constraints exist in the west, south-west and south of Ireland.'*

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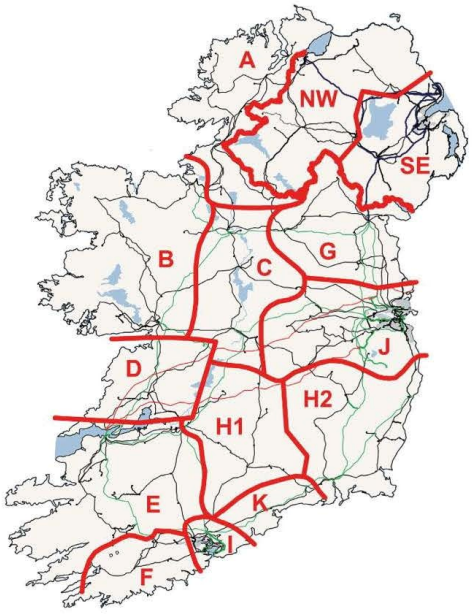


Area	Offshore wind (MW)
IE AREA A	0
IE AREA B	0
IE AREA C	0
IE AREA D	0
IE AREA E	390
IE AREA F	0
IE AREA G	370
IE AREA H1	0
IE AREA H2	1,170
IE AREA I	350
IE AREA J	2,720
IE AREA K	0
NI SE	500
NI NW	0

Figure 7 Summary of assumed 2030 renewable generation capacities by area in Ireland (Shaping our Electricity Future Roadmap, EirGrid, 2023)

5.6.25 The report demonstrates that 'area J', encompassing the greater Dublin region, is planned to have the greatest capacity for the connection of future offshore wind generation projects.

5.6.26 The Department of Environment, Climate and Communications adopted a Policy Statement on the Framework for Ireland's Offshore Electricity Transmission System in 2021. This designated EirGrid as the Transmission System Operator (TSO) and asset owner for Ireland's offshore transmission grid. The initial processing of offshore wind generation applications was undertaken by EirGrid following the CRU's direction (CRU/20/020). In October 2021, the CRU issued a Proposed Decision (CRU/21/112 – Offshore Grid Connection Assessment – Phase 1 Projects) concerning the allocation of grid capacity to offshore wind projects. EirGrid's publication 'Offshore Phase 1 Projects – Grid Connections Assessment' (published accompanying CRU/21/112a) identified a number of nodes with potential capacity available for the proposed Dublin Array project.

5.6.27 The grid connection methods considered were based on information provided by EirGrid in Offshore Phase 1 Projects – Grid Connection Assessments, EirGrid June 2021, East Coast Generation Opportunity Assessment Feb 2019 amongst other publications[7]. In the CRU's Final Decision Paper (CRU/2022/14) EirGrid issued a Grid Connection Assessment (GCA) confirming that the point of connection of the Dublin Array project is to the existing Carrickmines 220 kV substation.

5.6.28 The grid proximity reasons for the selection of the location of the Dublin Array project therefore remain valid, having regard to the most up-to-date policy, commercial, technical and environmental information.

5.7 Alternative project design

Alternative Wind Turbine Generator (WTG) models

5.7.1 Over the course of the project development the Applicant has considered a wide range of WTG models, each with a differing rotor size and electrical generating capacity. The selection of WTG model is intrinsically linked to the number of WTG proposed and to the layout of the array infrastructure, which includes the WTGs and OSP as well as connecting electricity cables (inter-array cables).

5.7.2 Engagement with prospective wind turbine suppliers has confirmed that the latest wind turbine options currently available on the market are likely to be phased out by 2030, being replaced by newer more efficient models. The Applicant, in discussion with WTG suppliers has identified the WTG models currently in development and those which are anticipated to be available at the time of construction of the project. The Applicant will not procure the specific WTG model until the development permission is secured thus it may be possible to avail of technology which is more effective or efficient than available at the time of making of this application The Applicant is therefore seeking a permission that provides for three options in relation to the size of the rotor diameter. The three options are:

- Option A – 236 m rotor diameter WTG;
- Option B – 250 m rotor diameter WTG; and
- Option C – 278 m rotor diameter WTG.

5.7.3 The following section describes the process that was undertaken to arrive at the selection of these options including the consideration of alternative WTG models and the main reasons for discounting these.

5.7.4 The principal planning policies that have informed the preferred model and number of WTGs are summarised in Table 3.

[7] Draft Transmission Development Plan 2020-2029 (EirGrid), Poolbeg 220kV Substation Shunt Reactance Coil – Planning & Environmental Considerations Report 2014 (planning register reference 2789/14) and the EirGrid publication 'ECP-2-1-Solar-and-Wind-Constraints-Report ECP Constraint Reports | Customer Information | EirGrid)

Table 3 Summary of planning policy of relevance to consideration of alternative model and number of WTGs

Policy	Relevant considerations
National Marine Planning Framework 2021	The NMPF has a number of overarching marine planning policies (OMPPs) which are applicable to 'all proposals capable of having impacts in the maritime area'. The OMPPs are supplemented with sectoral marine planning policies (SMPPs). OMPP that are of relevance to the consideration of alternative WTG models and numbers are listed below: ▪ Biodiversity Policy 1; ▪ Biodiversity Policy 4; ▪ Protected Marine Sites Policy 4; and ▪ Seascape and Landscape Policy 1.

5.7.5 The selection process of WTG options and numbers has taken into consideration the need to avoid or minimise the impact on relevant receptor groups and is therefore consistent with the requirements of the NMPF OMPP.

5.7.6 The constraints analysis in Table 1 sets out the various constraints applicable to the selection of potential WTG models. The most significant constraint defining selection of the WTG option is market availability. As described above, the Applicant has engaged with WTG suppliers to gain in depth knowledge of the models which are predicted to be available at the time of construction.

5.7.7 A range of WTG model options have been considered during the development stage of the Dublin Array project to date. At the time of EIAR scoping (September 2020) and consultation held in November 2020, preliminary market engagement completed by the Applicant indicated that the WTG options that would be available at the time of construction would have rotor diameters ranging from 220 m to 285 m.

5.7.8 In 2022 engagement with WTG suppliers confirmed that the 220 m rotor diameter turbine would be phased out before 2030 and replaced by more efficient models. Market engagement also provided information on the predicted development timelines for future models, indicating that WTGs with rotor diameters in excess of 300 m may be developed for commercial deployment by 2030.

5.7.9 In addition, in 2020 Osprey Consulting Services Limited (Osprey) completed an Instrument Flight Procedures (IFP) assessment to determine the maximum WTG blade tip height that could be accommodated within the proposed wind farm without affecting any published IFPs relevant to the airspace above the Array area. The location of the array has the potential to affect IFPs from Dublin Airport, Weston Airport and Casement Aerodrome. The IFP Assessment concluded that a maximum blade tip elevation of 309.6 m msl (311.7 m LAT) would not affect safe flights operations. The restriction on maximum WTG blade tip height to 311.7 m LAT therefore eliminated any further consideration of WTG rotor diameters of greater than 280 m. For further details on the IFP assessment see Volume 4, Appendix 4.3.12-1 of the EIAR.

5.7.10 Therefore, the largest WTG model predicted to be available in 2030 that could be accommodated within the maximum blade tip height aviation constraint has a predicted rotor diameter of 278 m.

5.7.11 Reasonable alternative WTG options therefore included:

- 236 m rotor diameter WTG;
- 250 m rotor diameter WTG;
- 259 m rotor diameter WTG;
- 270 m rotor diameter WTG; and
- 278 m rotor diameter WTG.

Alternative WTG – minimum blade tip clearance

5.7.12 The minimum blade tip clearance (the distance between the turbine blades and the sea surface) for WTGs of a fixed rotor diameter, determines the height of the WTG hub and the upper blade tip. A number of technical and environmental considerations inform the selection of the minimum blade tip clearance. These are discussed in more detail below.

5.7.13 The principal planning policies that have informed the minimum blade tip clearance are summarised in Table 4.

Table 4 Summary of planning policy relevant to consideration of minimum blade tip clearance

Policy	Relevant Considerations
National Marine Planning Framework 2021	The NMPF has a number of overarching marine planning policies (OMPPs) which are applicable to '*all proposals capable of having impacts in the maritime area*'. The OMPPs are supplemented with sectoral marine planning policies (SMPPs). OMPP that are of relevance to the consideration of alternative WTG minimum blade clearance: ▪ Biodiversity Policy 1; ▪ Biodiversity Policy 4; ▪ Protected Marine Sites Policy 4;

Policy	Relevant Considerations
	▪ Co-existence Policy 1; ▪ Seascape and Landscape Policy 1; and ▪ Safety at Sea Policy 5.

5.7.14 The WTG minimum blade clearance has taken into consideration the need to avoid or minimise the impact on relevant receptor groups and is therefore consistent with the requirements of the NMPF.

Identification of reasonable alternatives – WTG minimum blade clearance

5.7.15 The technical factors which need to be considered when determining the minimum blade tip clearance include safe clearance of the blade tip at its lowest point with the Main Access Platform (MAP). Sufficient clearance must be designed in, notably for safe use of a davit crane lifting materials from service vessels (SOVs[8] or crew transfer vessels) or the deployment of such vessels 'walk to work' systems to access the MAP. The safe height of the MAP above sea level is governed by the predicted wave regime and consideration of protection from wave slap and the wave, current and wind loading on the structure. The minimum blade tip to allow sufficient clearance of the MAP is 22.5 m LAT.

5.7.16 The UK Maritime and Coastguard Agency (MCA) Guidance for offshore renewable energy and navigational safety, Marine Guidance Note 654 requires a minimum clearance of 23 m MHWS (26.6 m LAT) between the sea surface and the WTG rotor. In the absence of specific Irish guidance, relevant prescribed bodies have indicated that MGN 654 should be followed. See Volume 3, Chapter 10: Shipping and Navigation. At the time of EIA Scoping (2020) a minimum airgap of 27.6 m LAT was adopted, incorporating the requirements of MGN 654 with a 1 m contingency.

5.7.17 To minimise bird collision risk, the minimum air gap was increased to 31.6 m LAT. This degree of increase in minimum blade clearance also ensures the availability of vessels with sufficient crane height to cater for the development of the wind farm.

5.7.18 The principal environmental constraints of relevance to the selection of WTG model included:

- The visual impact of the WTG options;
- The potential level of bird and bat mortality as a factor of rotor diameter, blade tip clearance, and number and alignment of WTGs;
- The potential level of marine mammal collision risk as a factor of number and alignment of WTGs;

[8] SOV service operation vessels are used for offshore wind farm maintenance.

- Impacts to aviation procedures; and
- Minimum blade tip clearance requirements (as discussed above).

5.7.19 Due to the inter-relationship of WTG model, number of WTGs and OSPs and wind farm layout the environmental consideration of these factors are presented below in Section 5.7.34.

Alternative numbers of WTGs, offshore substation platforms and array layout options

5.7.20 The number of WTGs proposed is a direct function of the WTG rotor diameter and corresponding power output. WTGs with larger rotor diameters typically have a higher generating capacity, and therefore fewer larger WTGs would need to be installed to meet the proposed development's target electricity generating capacity. To achieve the same generating capacity from smaller rotors would therefore require a greater number of WTGs.

5.7.21 WTG selection is a fundamental input into wind farm design. The WTG option selected influences the layout of the windfarm having regard to factors such as optimising wind yield and maintaining acceptable separation distance between turbines for search and rescue operations. The number of OSPs is linked to the target generating capacity and the size and number of transformers required to step up the power voltage for transmission to shore via export cables.

5.7.22 The principal planning policies that have informed the alternative array layouts (WTGs and OSP) are summarised in Table 5.

Table 5 Summary of planning policy relevant to consideration of alternative array layouts (WTG and OSP)

Policy	Relevant Considerations
National Marine Planning Framework 2021	The NMPF has a number of overarching marine planning policies (OMPPs) which are applicable to '*all proposals capable of having impacts in the maritime area*'. The OMPPs are supplemented with sectoral marine planning policies (SMPPs). OMPP that are of relevance to the consideration of alternative WTG layouts: ▪ Biodiversity Policy 1; ▪ Biodiversity Policy 4; ▪ Protected Marine Sites Policy 4; ▪ Co-existence Policy 1; ▪ Heritage Assets Policy 1; ▪ Seascape and Landscape Policy 1; and ▪ Safety at Sea Policy 5. ORE Policy 2 incorporates the objectives and aims of the OREDP.

Policy	Relevant Considerations
Offshore Renewable Energy Development Plan 2014	OREDP suggested project-level mitigations of relevance to the consideration of alternative WTG layouts, including: ▪ Changes in hydrodynamic/ coastal processes and seabed morphology ▪ Avoidance of placement of devices in areas where sediment transport pathways are modelled as highly sensitive to change; ▪ Avoidance of placement of devices within zones where coastal processes are modelled as highly sensitive to change ▪ Marine birds and marine mammals bats (collision risk): ▪ Alignment of turbines in rows parallel to the main migratory direction. ▪ Marine and Coastal Archaeology and Wrecks: ▪ Avoid sites of interest and exclusion zones for marine archaeology. ▪ Commercial Fisheries: ▪ Consider spacing of turbines wide enough to permit use of mobile fishing gear and avoid sensitive areas.

Identification of reasonable alternatives – numbers of WTGs and OSPs and array layout options

5.7.23 As described above the number of WTGs required to meet the project target electrical capacity is a function of the size and therefore capacity of the WTG options. The number of WTGs that can be accommodated within the array boundary is also a factor of the rotor diameter of the WTGs and other constraints.

5.7.24 Constraints on the array layout limit the maximum number of each WTG option which can be installed, including the minimum separation between WTGs to maximise wind yield, minimum distance and alignment for search and rescue (SAR) lanes, and archaeological exclusion zones, shipping and navigation routes, and safe separation distance from the Kish Lighthouse. Other factors including water depth, bathymetry, and metocean conditions have also been considered to determine the optimum areas of the site for placement of WTGs.

5.7.25 A wind resource and energy yield assessment was undertaken to inform the wind farm layout, principally the spacing between structures. Site-specific wind data has been collected from a LiDAR installed on the Kish lighthouse between January 2020 and February 2023 and from a floating LiDAR gathering data on site from August 2021 to December 2022. Modelled wind data sets were compared with the measured site data to select the best-performing models to provide longer-term wind predictions and extrapolate over the whole site area.

5.7.26 The wind measurement data has been used to calculate the predicted energy yield associated with each WTG option layout. This process models the wake effects of WTGs. Wake effects are losses of energy capture of a turbine positioned in the wind shadow of an upwind turbine. Overall yield is increased with increasing separation distances between WTGs. The Applicant has sought to optimise inter-turbine spacing within the constraints of the array site as defined by the Maritime Area Consent array boundary.

5.7.27 SAR corridors in at least one line of orientation are required to minimise risks to SAR resources, including vessels and helicopters transiting through the array site. Navigation stakeholders, including the Irish Coastguard (IRCG), the Marine Survey Office (MSO) and Irish Lights have indicated in pre-application consultation that, in the absence of Irish guidance on safety of navigation around offshore renewable installations, the design and layout of the Dublin Array project should adhere to the requirements of the UK Maritime and Coastguard Agency's (MCA) Marine Guidance Note (MGN) 654. This guidance advises that a layout assessment should start with a layout option with at least two consistent lines of orientation and then be refined as appropriate for the project. Where a project is proposing one line of orientation, a safety justification must be prepared to support this reduction including sufficient information to enable the relevant prescribed body (IRCG) to adequately understand how the risks to navigation and SAR associated with the proposed layout have been reduced to ALARP. It is the intention of the Applicant that where a safety case and justification for a single line of orientation is necessary that this will be provided to the IRCG for approval, following confirmation of the WTG selection after planning permission (development consent) is granted.

5.7.28 In addition to the above key principles, alternative layout options have been informed by consideration of a range of data including geophysical, geotechnical and environmental survey data. Individual WTG locations and the OSP have been positioned to avoid known and suspected archaeological features and associated Archaeological Exclusion Zones (AEZs) which are areas of 100 m radii around the known or visible extent of archaeological features. One AEZ with a radius of 300 m has been placed around feature MA0302 at the request of the Underwater Archaeology Unit of the National Monuments Service (see Volume 3, Chapter 13: Marine Archaeology for further detail).

5.7.29 Some habitats including biogenic reef are ephemeral in nature and may be identified in pre-construction surveys. A limit of deviation for the WTG and OSP positions as set out in the planning drawings (Part 2 Planning Drawings of the planning application) of 350 m has been incorporated into the layout options to allow for avoidance of ecological and/or additional archaeological features that may be identified in pre-construction surveys.

5.7.30 At the time of EIAR Scoping (September 2020) between 45 and 61 WTGs were proposed and up to three OSPs. At that stage of the project development the number of turbines represented the maximum number of WTGs that could be accommodated within the array area adopting basic layout principles of a minimum separation distance between WTGs of 4.25 x rotor diameter to minimise wake effects, following as far as possible a grid layout with provision for SAR lines in two lines of orientation and avoidance of known archaeological constraints.

5.7.31 An assessment undertaken to identify the distance required between the Kish Tower helipad and the closest WTG for helicopter operations (specifically catering for the most adverse circumstance which could arise which is a helicopter experiencing engine failure following a take-off heading towards the wind farm. A buffer distance of 1,320 m was adopted around the Kish Tower within which WTGs will not be located.

5.7.32 A number of additional work streams were concluded in 2022. One such work stream was a logistics evaluation of the type and availability of vessels (both Jack-up and Dynamic Positioning vessels) capable of installing at different design depths and predicted to be available in 2030. This concluded that WTG and OSP positions would require a minimum water depth of 13 m LAT and a maximum of 40 m LAT and as a consequence this reduced the maximum number of WTGs in each of the options under consideration. Subsequent array layout adjustments to accommodate a single OSP and maintain the 500 m search and rescue (SAR) lanes led to a further reduction in the number of turbines.

Table 6 Reasonable alternative WTG options and numbers

Alternative ref.	WTG rotor diameter (m)	Number of WTGs (pre SAR lane refinement)	Number of WTGs (post SAR lane refinement)
1	236	52	50
2	250	48	45
3	259	45	44
4	270	42	40
5	278	-	39

5.7.33 At the time of EIAR Scoping (September 2020) up to three OSPs were under consideration. In 2022 alongside the rationalisation of WTG options the Applicant refined the maximum export capacity of the wind farm, which was reduced from 900 MW at the time of Scoping to 824 MW to match electrical grid connection capacity. As a consequence of this reduction, the need for three OSPs was reviewed. Having reviewed current market availability of OSP technology, efficiencies in the design process identified the ability to eliminate the need for multiples of common equipment across multiple OSP options, such as telecommunications equipment, auxiliaries such as cranes and mess rooms. Removing the need for such multiples meant that a single OSP solution is suitable for Dublin Array. A single OSP presents savings in the use of raw materials required for multiple OSPs in addition to a reduced seabed footprint than project alternatives with either two or three OSPs. A single OSP can be accommodated within each layout option in a position which maintains the 500 m SAR lanes within each layout. In addition, the fabrication and installation programme for single OSP is shorter than that for two or three OSPs. The Applicant is therefore applying for planning permission for a single OSP.

Comparison of environmental effects from alternative WTG models, number of WTGs and OSPs and array layouts

5.7.34 This section presents a comparison of the environmental effects of the reasonable alternative WTG options (Table 7).

Table 7 Summary comparison of Environmental Effects of WTG Options

Environmental effects	Alternative 1 (236 m rotor diameter) Alternative 2 (250 m r.d) Alternative 3 (259 m r.d.) Alternative 4 (270 m r.d.) Alternative 5 (278 m r.d.)
Impacts on known features of archaeological interest.	Archaeological Exclusion Zones (AEZ) have been adopted around known wreck sites, or around geophysical anomalies for which the available evidence suggests that these could represent archaeological material present on or in the seabed. All layouts associated with the alternative WTG options avoid placing infrastructure within an AEZ. For details see Volume 3, Chapter 13: Marine Archaeology.
Impacts on sensitive ecological biogenic reef habitat (e.g. *Sabellaria spinulosa* and *Modiolus modiolus*)	None of the alternative array layouts impact on areas of sensitive ecological habitat, specifically biogenic reef such as *Sabellaria spinulosa* or *Modiolus modiolus*.
Potential level of bird mortality as a factor of rotor diameter and number of WTGs	For all WTG options and associated numbers no significant effects (in EIA terms) to ornithological species are predicted, neither are adverse effects on site integrity for European designated sites predicted. Predicted number of collisions arising from the alternative WTG options are highest for Alternative 1 (236 m rotor diameter WTG) and lowest for Alternative 5 (278 m rotor diameter WTG) (refer to Volume 3, Chapter 6: Offshore and Intertidal Ornithology and associated appendices Volume 4, Appendices 4.3.6.-4 and 4.3.6-5).
Impacts on navigation, search and rescue capability	All the layouts associated with the alternative WTG options and a single OSP provide SAR lanes between discrete rows of wind farm structures of a minimum of 500 m width on a consistent line of orientation. Additional OSPs could only be accommodated if the number of WTGs are reduced.
Impacts on commercial fisheries	None of the layouts associated with the alternative WTG options prevent access to the array for the principal fishing activities which are currently undertaken, i.e. potting fishery (whelk, lobster, crab). Some loss of ground may occur due to tidal strengths and drift during hauling of fishing gear. The larger spacing and fewer turbines associated with the WTG options of largest rotor diameter increase the potential for coexistence. ▪ Alternative 1 (236 m r.d.):

Environmental effects	Alternative 1 (236 m rotor diameter) Alternative 2 (250 m r.d) Alternative 3 (259 m r.d.) Alternative 4 (270 m r.d.) Alternative 5 (278 m r.d.)
	▪ Minimum spacing between WTGs is 944 m (50 WTGs) ▪ Alternative 2 (250 m r.d.): ▪ Minimum spacing between WTGs is 1,000 m (45 WTGs) ▪ Alternative 3 (259 m r.d.): ▪ Minimum spacing between WTGs is1,036 m (45 WTGs) ▪ Alternative 4 (270 m r.d.): ▪ Minimum spacing between WTGs is 1,080 m (40 WTGs) ▪ Alternative 5 (278 m r.d.): ▪ Minimum spacing between WTGs is 1,112 m (39 WTGs)
Impacts on seascape, landscape and visual receptors are minimised.	All the layouts associated with the alternative WTG options include WTGs spaced out to maximise the array area with little discernible difference in terms of the horizontal extent that the WTGs would occupy when seen from surrounding receptors. A larger number of WTGs associated with the smaller range of the rotor diameters considered would represent a slightly denser appearance than the WTGs of larger rotor diameter, of which there would be fewer. However, the greater height of the larger turbines would be more notable. The difference in size between a single OSP or multiple OSPs would not be discernible from the coast. The greater number would present a greater number of visible structures but would not alter the scale of effect on visual receptors or seascape and landscape.
Impact on aviation	None of the reasonable alternative WTG options would affect safe flights operations for the published IFPs as the selection of alternatives adopted an upper blade tip ceiling of 311.7 m LAT below which no effects will occur. A horizontal separation distance of 1,320 m between the Kish Lighthouse and the closest WTG has also been incorporated into the layouts associated with each WTG option and therefore no impact is predicted for any of the alternative WTG options and associated layouts considered.

5.7.35 In conclusion it was considered that, whilst there are differences between the environmental effects from alternative WTG models and their associated layouts, such differences (with the exception of a decision to reduce the numbers of OSPs to one) do not result in such material differences that any of the alternatives should not be carried forward into the planning process.

5.7.36 Having engaged with the supply chain and technology providers, the Applicant has identified three appropriate WTG options (Table 8). The three WTG options and associated layouts were presented to An Bord Pleanála (the Board) during pre-application consultation under Section 287 and Section 287A of the Planning Acts. Consistent with the Opinion of the Board issued under Section 287B of the Planning Acts, three layout options (one for each of the three WTG options proposed in the planning application) are presented within Part 2 Planning Drawings of the planning application documentation (see Offshore Wind Farm Infrastructure Drawings/Offshore Site Layout Plans).

Table 8 WTG options

Option	WTG rotor diameter	Number of WTGs
A	236	50
B	250	45
C	278	39

Alternative Offshore OSP layouts

5.7.37 It is proposed to install a single OSP within the array area. The OSP will receive power from the WTGs via inter-array cables. Transformers located on the OSP will increase the voltage of the power received from the WTGs from 66 kV to 220 kV so that the electricity can be efficiently transmitted to shore and onwards to the existing national electricity transmission system via the existing Carrickmines 220 kV substation.

5.7.38 As part of the design process, alternative options were considered for the OSP:

- An option to exclude the use of an OSP was rejected as a significantly more extensive network of offshore cables would be required to connect the WTGs to the onshore grid network. The additional cables could potentially lead to higher energy losses due to resistance in the cable as well as more extensive environmental impacts in the marine environment due to the cable laying process required to bring the cables to shore; and
- The consideration of including two smaller OSPs was explored in significant detail during the early design stage. It was determined that this option would require extensive seabed preparation. Additionally, the installation of secondary cable protection, such as rock armour or mattresses, would be necessary. This is because the export cable corridor for the second OSP would have to traverse challenging ground conditions that also coincide with shipping lanes.

5.7.39 The single OSP option is preferable to the two OSP option, as it will result in the least potential for environmental impacts, in particular on seabed disturbance, seascape, landscape and visual impact, and benthic. The single OSP is proposed on the northwestern slope of the Bray Bank, approximately 13 km offshore at a water depth of approximately 19 m LAT.

Alternative foundation options

5.7.40 Foundation structures are required to securely support the WTGs and the OSP in a vertical position while withstanding physical forces from the wind and the marine environment. The foundation structures also provide means of safe access to and from the infrastructure.

5.7.41 A wide range of foundation options are available for the offshore infrastructure, and which continues to evolve through engineering and technological advances. The final foundation options will be chosen based on the selected WTGs and OSP taking account of key factors such as seabed conditions, water depth, wind, wave and current regime and economic factors.

5.7.42 A range of potential foundation options were considered in the early stages of the project, these included:

- **Steel monopile** – Steel monopiles are normally constructed from welded steel tubular sections. The monopiles are typically vibrated and/or impact driven into the seabed by a large crane mounted hammer and are designed to be driven to the desired penetration depth. The installed pile supports the weight of the WTG or OSP primarily by means of the frictional force between the pile walls and the seabed.

- **Multileg foundations (3 and 4 leg)** – The term multileg is used to refer to foundations with multiple legs or footings supporting foundation structures which comprise of several large tubulars, cross-bracing, or lattices. The multileg options which are under consideration for WTG foundations include three or four legged structures, either supported with driven/drilled piles or with suction bucket footings.

- **Multileg foundation (suction bucket)** – Multileg suction buckets are cylindrical, or near cylindrical-shaped structures, similar to inverted buckets, which are inserted into the seabed and attached to the base of the foundation main structure.

- **Gravity base structures** – A gravity base foundation is a type of WTG that relies on its own weight, along with the weight of any additional ballast, to remain stable on the seabed. Unlike piled foundations, which are anchored into the seabed, gravity base foundations rest on the seabed surface, held in place by their mass.

5.7.43 Gravity base foundations were initially considered viable for the project; however, on balance they were considered to present the worst performing environmental option. This is due to the potential for comparatively (compared with other foundation options) increased suspension of sediments from the necessary bed levelling and foundation installation, the potential for changes to tidal and wave regimes and related sedimentary processes from the structures in the water column/seabed and the consequential ecological impacts arising from same.

5.7.44 Therefore, planning permission is being sought for two principal foundation options for offshore infrastructure on the project, steel monopiles, steel multileg (or a combination of both).

5.7.45 Planning drawings have been included in the planning application (refer Part 2 Planning Drawings) to use either a monopile or multi-leg foundation solution.

5.8 Alternative electricity transmission grid connection locations

5.8.1 The connection of Dublin Array to the national electricity transmission grid is administered by the system operator (EirGrid). Offers for connection to the grid are made by the system operators under a process that is determined by the Commission for Regulation of Utilities (CRU).

5.8.1 The Department for Environment, Climate and Communications (DECC)'s 'Policy Statement on the Framework for Ireland's Offshore Electricity System' (Government of Ireland, 2021) designated EirGrid as the Transmission System Operator (TSO) and asset owner for Ireland's offshore transmission grid.

5.8.2 The initial processing of offshore wind generation applications was undertaken by EirGrid following the CRU's direction (CRU/20/020). In October 2021, the CRU issued a Proposed Decision (CRU/21/112 – Offshore Grid Connection Assessment – Phase 1 Projects) concerning the allocation of grid capacity to offshore wind projects. EirGrid's publication 'Offshore Phase 1 Projects – Grid Connections Assessment' (published accompanying CRU/21/112a) identified a number of nodes with potential electricity connection capacity available for the Dublin Array project.

5.8.3 The grid connection methods considered were based on information provided by EirGrid in Offshore Phase 1 Projects – Grid Connection Assessments (EirGrid, 2021), East Coast Generation Opportunity Assessment (EirGrid, 2019) amongst other publications[9] Based on the most likely connection points identified for Dublin Array in these documents the below connection methods were considered by the Applicant in the assessment.

- Option 1 Carrickmines via 2 no. 220 kV circuits;
- Option 2 Poolbeg via 2 no. 220 kV circuits;
- Option 3 Belcamp via 2 no. 220 kV circuits; and
- Option 4 Ballybeg via 2 no. 220 kV circuits.

[9] Draft Transmission Development Plan 2020-2029 (EirGrid), Poolbeg 220 kV Substation Shunt Reactance Coil – Planning & Environmental Considerations Report 2014 (planning register reference 2789/14) and the EirGrid publication 'ECP-2-1-Solar-and-Wind-Constraints-Report ECP Constraint Reports | Customer Information | EirGrid).

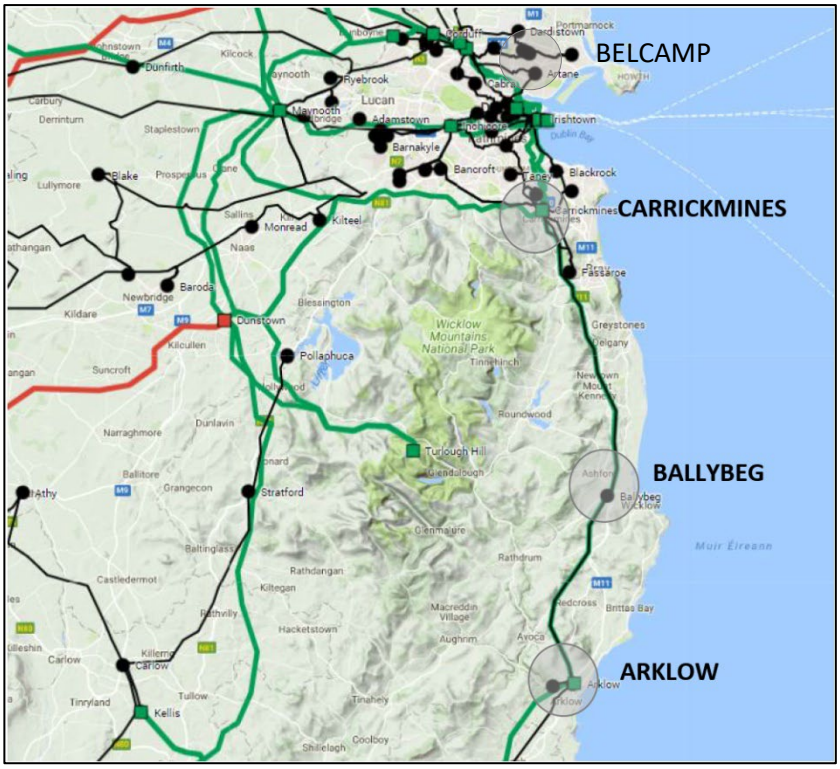


Figure 8 Alternative grid connection nodes

5.8.4 The assessment of alternative connection methods considered (i) the offshore cable routing and landfall, (ii) onshore cable routing and (iii) the onshore substation and grid connection point.

5.8.5 The assessment considered technical, environmental/social and economic factors. The technical and environmental/social factors considered are presented in Table 9 and Table 10.

Table 9 Technical factors

i) Technical factors offshore cable routing and landfall		
Transition Joint Bay	Land & Services	Availability of sufficient space for a transition joint bay and level of existing services in locality
Landfall (Horizontal Directional Drill – HDD)	Ground Profile	Slope and ground composition for the landfall area
Landfall	Coastal Vulnerability index	Coastal indicators such as, sea level rise, geomorphology, coastal orientation, slope erosion and wave height.
Landfall	Seabed Gradient	Suitability for submarine cable burial.
Landfall	Landfall Soil Characteristics	Suitability for trenchless installation technique (e.g. horizontal direction drill).

ii)	Technical factors onshore cable route	
Route constructability	Length and complexity	Length of cable route proximity to urban or residential areas.
Route constructability	Existing services/crossings	Level of existing services and significant crossings expected along the route.
Route approval	Stakeholders (Irish Rail, TII, etc.)	Level of external stakeholder approvals required along the route
iii)	**Technical factors OSS and grid connections**	
New Onshore Substation (OSS) Site	Space Constraints	Availability of sufficient land for new OSS based on requirements.
Grid connection	Shallow Reinforcements	Availability of bays in existing transmission substation to connect OSS.
Grid connection	Deep Reinforcements	Level of upgrades or new infrastructure required in existing wider transmission system to facilitate Dublin Array.
Grid connection	System Constraints	Expected level of localized dispatch down due to overloads in the transmission system.
Grid connection	Transmission Loss Adjustment Factor	Transmission Loss Adjustment Factor – scaling factor applied to energy production depending on proximity to demand

Table 10 Environmental and social factors

i)	Environmental and social factors offshore cable routing and landfall	
Ecology	Designated sites/protected species and habitats	Designated sites and protected species/habitats on the offshore cable route and landfall location
Social	Other marine uses	Commercial shipping routes, marine recreation etc. in the general area
Social	Land Use	Existing and previous land uses at the landfall which may impact development or construction
Cultural	Marine Archaeology	Archaeological sites on the offshore cable route and landfall location
Landfall	Landfall Soil Characteristics	Suitability for trenchless installation technique (e.g. horizontal direction drill).
ii)	**Environmental and social factors onshore cable route**	
Ecology	Designated sites/protected species	Designated sites and protected species/habitats on the onshore cable route

Social	Land Use	Existing and previous land uses along the cable corridor which may impact development or construction
Social	Traffic Management & Construction Noise	Areas along the cable corridor which may be subject to significant traffic or noise limitations
iii) Environmental and social factors OSS and grid connections		
Ecology	Designated sites/protected species	Designated sites and protected species/habitats at/in the proximity to the proposed OSS locations
Social	Land Use	Existing and previous land uses in the vicinity of the OSS which may impact development or construction

5.8.6 The scoring of the rating methodology applied in considering alternative grid connection locations is provided below (Table 11).

Table 11 Rating methodology

Rating methodology				
Impact		Probability		Rating
1	Low/Significantly Lower than other connection options	1	Low/Significantly Lower than other connection options	Rating = Impact x Probability
2	Medium/Similar to other connection options	2	Medium/Similar to other connection options	
3	High/Significantly Higher than other connection options	3	High/Significantly Higher than other connection options	

Option 1 Carrickmines via 2 no. 220 kV Circuits

5.8.7 In this option 2 no. 220 kV cable installations were considered from a landfall at Shanganagh Cliffs to a new OSS in the general proximity of the existing ESB/EirGrid Carrickmines 220 kV substation. The option was evaluated on the basis of a substation site at Ballyogan Recycling Park and a double circuit underground cable route from the transition joint bay infrastructure at the landfall to an OSS site.

Table 12 Technical considerations Carrickmines via 2 no. 220 kV circuits

Carrickmines via 2 no. 220 kV circuits						
				Impact	Probability	Rating
Offshore Export Cable & Landfall	TJB	Land & Services	Shanganagh waste water treatment plant storm water and long sea outfalls are in close proximity to proposed landfall requiring coordination with Irish Water. No other services identified. Land owned by DLRCC	2	2	4
	Landfall HDD	Ground Profile	The length of the Shanganagh coastline from adjacent the municipal wastewater treatment plant south towards the Cork Great Bay beach comprises of a cliff face at varying heights above mean sea level consisting of gravel, clay with cobbles and some boulders. Bedrock data sourced from Geological Survey Ireland indicates bedrock level around 30 m depth from ground level at the cliffs.	2	2	4
	Landfall HDD	Coastal Vulnerability index	Geological Survey Ireland maps provide an insight into the relative susceptibility of the Irish coast to adverse impacts of sea-level rise through the use of a Coastal Vulnerability Index (CVI). The method is based on physical parameters and coastal indicators such as, impacts of sea level rise, geomorphology, coastal orientation, slope erosion and wave height. The section of coastline along Shanganagh cliffs for the proposed cable landfall is rated Low to Moderate on the Coastal Vulnerability mapping at the proposed landfall location at Shanganagh Cliffs and Shanganagh Park.	2	1	2
	Landfall HDD	Seabed Gradient	The seabed gradient at Shanganagh is relatively flat leading to the intertidal zone, which is suitable for floatation and burial of the submarine cables.	1	1	1
	Landfall HDD	Landfall Soil Characteristics	Available geotechnical data from Geological Survey Ireland quaternary geology comprises glaciofluvial sands, gravels and till sediments at the landfall proposed locations. Information gathered from desk study suggested the area around the transition joint bay may consist of infill material from the earlier Shanganagh wastewater treatment plant construction works which may introduce additional engineering risks.	2	3	6
	Landfall HDD	Bedrock	Desk study information gathered from the Geological Survey Ireland indicates solid bedrock geology categorized as dark blue grey slate, phyllite and schist level around 30 m depth from ground level at the cliffs. Due to the depth bedrock geology is not considered an issue for the landfall trenchless installation techniques and construction activities. Geophysical investigation data at Shanganagh cliffs indicated bedrock	1	1	1

Carrickmines via 2 no. 220 kV circuits						
				Impact	Probability	Rating
			depth and quaternary geology consistent with information from Geological Survey of Ireland database.			
Onshore Cable Route	Route Constructability	Length & Complexity	The onshore cable route would be approximately 7.5 km long, largely in semi urban areas and passes through several residential areas. Compared to the other connection options the route is more constrained	3	3	9
	Route Constructability	Existing Services/Crossings	The route likely to include a very high number of existing services and a very high number of crossings (10). This is likely to increase design and construction schedules and costs.	2	3	6
	Route Approval	Stakeholders (Irish Rail, TII etc.)	The route likely to contains one proposed trenchless crossing of the DART/railway line which would require approval from Irish Rail. The route contains potential crossings of both the LUAS rail system and the M50.	2	3	6
Onshore Substation & Grid Connection	New OSS Site	Space Constraints	Given the suburban setting of the existing Carrickmines substation finding sufficient space in close proximity to cater for the expected equipment in the new OSS is challenging.	3	2	6
	Grid Connection	Shallow Connection	EirGrid have confirmed the availability of 2 bays on the existing 220 kV switchgear to connect 700 MW of offshore wind and 1 for the required reinforcement.	1	1	1
	Grid Connection	Deep Reinforcements	EirGrid have confirmed 700 MW MEC is not dependent on the reinforcement(s). Risk of additional reinforcement at some point above 700 MW.	2	2	4
	Grid Connection	Constraints	Based on ECP-2.1 Constraints Reports for Solar and Wind – Medium term constraints of 4%. Initial constraints likely to be equivalent to those with Poolbeg given the 220 kV connectivity.	2	2	4
	Grid Connection	Transmission Loss Adjustment Factor (TLAF)	2021/2022 Published TLAF for Carrickmines 220 kV is 0.989792 which is better than the Ballybeg TLAF but below that of Poolbeg and Belcamp.	1	3	3

Table 13 Environmental and social considerations Carrickmines via 2 no. 220 kV circuits

Carrickmines via 2 no. 220 kV circuits						
				Impact	Probability	Rating
Offshore Export Cable & Landfall	Ecology	Designated sites/protected species and habitats	Potential cable routing required through southern end of Rockabill to Dalkey SAC, qualifying interests (1170) Reefs and (1351) Harbour porpoise. Closest area of known intertidal and subtidal reef are around Dalkey Island approximately 1.5 km to the north of the export cable corridor boundary. Dalkey Island is also a designated SPA, qualifying interests are (A192) Roseate Tern, (A193) Common Tern and (A194) Arctic Tern. A section of the Dalkey Coastal Zone and Killiney Hill pNHA is in close proximity to the proposed landfall but avoided. Cable route and landfall are within Dublin Bay Biosphere Buffer Zone. Area of rock outcrop close to landfall has potential for Annex 1 habitat, rocky reef, effects on which could be minimised by employing trenchless technology for installation.	1	2	2
	Social	Other marine uses	Cable routes cross main North-South route for vessels into and out of Dublin Port but the intersection is clear of Traffic Separation Scheme, anchorage and pilot boarding areas. Area is popular for marine recreation including sailing, diving, rowing and angling. Potting for crab, lobster and whelk occurs across cable route, including nearshore. Scallop dredging activity in nearshore area.	2	2	4
	Social	Land Use	Land adjacent to Shanganagh waste water treatment plant owned by DLRCC but no high amenity value associated – the eastern boundary of the a likely Transition Joint Bay site is adjacent to recreational footpath adjacent the coastline.	1	1	1
	Cultural	Marine Archaeology	There are several known wrecks nearshore which will need to be avoided and potential for unknown archaeological material to discovered during pre-installation surveys or installation, requiring micro-siting of cable or archaeological investigation.	1	2	2
Onshore Cable Route	Ecology	Designated sites/protected species	No European designated sites for ecological conservation (e.g. Special Area of Conservation (SAC) or Special Protection Areas (SPA)), No nationally designated sites (e.g. National Heritage Areas (NHA)), Two pNHAs in close proximity but could be avoided, 1 County Geological Site (CGS) but could be avoided using trenchless installation technique (e.g. underground drilling). River/stream crossings 6/7, tree loss in amenity	1	2	2

Carrickmines via 2 no. 220 kV circuits						
				Impact	Probability	Rating
			areas, green areas of Cherrywood are being treated with a higher-than-normal level of sensitivity.			
	Social	Land Use	The cable route contains a significant proportion of both public amenity land and roads within residential areas.	3	3	9
	Social	Traffic Management & Construction Noise	Some sections of the cable route in roads are traffic sensitive and working in these areas will be highly controlled by the local authority and highly constrained. The proximity of drill/trenchless installation sites to residential properties creates a significant constraint with specific mitigation measures necessary to support same.	2	3	6
Onshore Substation & Grid Connection	Ecology	Designated sites/protected species	The Ballyogan Recycling Park/landfill area potential OSS site has no features of significant ecological conservation value.	1	1	1
	Social	Land Use	A potential OSS site is located adjacent to a former landfill but has not been used for landfilling. The site may present challenging ground engineering works due to proximity to the former landfill.	3	3	9

Option 2 Poolbeg via 2 no. 220 kV Circuits (Technical, Environmental and Social Assessment)

5.8.8 In this option 2 no. 220 kV cable installations were considered from a landfall at Poolbeg. This option was evaluated on the basis of a new OSS in the proximity of the existing ESB/EirGrid Poolbeg 220 kV Substation.

Table 14 Technical considerations Poolbeg via 2 no. 220 kV circuits

Poolbeg via 2 no. 220 kV circuits						
				Impact	Probability	Rating
Offshore Export Cable & Landfall	TJB	Land & Services	Highly constrained for land with limited space for cable landfall construction. Gas pipelines and HV cables are located in parts of the road between the power station site and the beach.	3	2	6
	Landfall HDD	Ground Profile	Gentle sloped wide, marine beach sand, in front of low laying made ground land. Further geotechnical and site investigation data required in order to inform risk identification, the HDD design and TJB infrastructure design.	2	2	4
	Landfall HDD	Coastal Vulnerability index	The section of coastline along the Poolbeg peninsula for the proposed cable landfall is rated Low on the Coastal Vulnerability mapping at the proposed landfall location under consideration	1	1	1
	Landfall HDD	Seabed Gradient	The seabed gradient at Poolbeg is flat intertidal/subtidal leading to the water, which is suitable for floatation and burial of the submarine cable. Seasonal restraints could determine when cable installation is feasible, following completion of cable installation the assumption is the area is anticipated to recover quickly.	1	1	1
	Landfall HDD	Landfall Soil Characteristics	Available geotechnical data, suggest the area around the transition joint bay will be general infill material on the Poolbeg landfall which may present additional engineering challenges. Available geotechnical data from the Geological Survey of Ireland made ground comprises sands, gravels and grey clays at depths 13 m + at the Poolbeg landfall location. Further site GI required at this location if selected for further consideration.	2	3	6
	Landfall HDD	Bedrock	The borehole data available from the Geological Survey Ireland on the Poolbeg landfall suggest no bedrock between 5-10 m at potential landfall location.	1	1	1
Onshore Cable Route	Route Constructability	Length & Complexity	The onshore cable route is approximately 0.75 km long and completely within an industrial area. Compared to other connection options the route would be less constrained due to the short onshore cable length.	2	1	2
	Route Constructability	Existing Services/Crossings	The route is expected to contain some existing services in the road to be crossed. There is a significant access issue to bring the export cables and the grid cables into/out of the substation site. Likely to require non-standard solution with EirGrid e.g. HV Cable Bridge across road and 3rd party site.	2	3	6

Poolbeg via 2 no. 220 kV circuits						
				Impact	Probability	Rating
	Route Approval	Stakeholders (Irish Rail, TII etc.)	Depending upon the landfall location, HDD drill path likely to cross below High-pressure gas main and HV cables. This would require approval from Gas Network Ireland to cross beneath the pipe. Approval for cables crossing Irish Water infrastructure and site also required.	3	3	9
Onshore Substation & Grid Connection	New OSS Site	Space Constraints	Current preferred site is approx. 1.5 ha and will require a non-standard substation solution.	3	3	9
	Grid Connection	Shallow Connection	EirGrid confirmed that a new 220 kV substation is required to connect Offshore Wind. As a backup EirGrid has confirmed the option to connect on a temporary basis to the existing GIS substation, but this is dependent on upgrade works within the substation.	3	2	6
	Grid Connection	Deep Reinforcements	EirGrid confirmed that the 1400 MW MEC capacity is not dependent on the reinforcement works.	2	2	4
	Grid Connection	Constraints	Based on the Offshore Phase 1 Projects – Grid Connection Assessment (EirGrid, 2021) – Medium term constraints of 4%. Initial constraints likely to be on a par with Carrickmines given the 220 kV connectivity.	2	2	4
	Grid Connection	Transmission Loss Adjustment Factor	2021/2022 Published TLAF for Poolbeg 220 kV is 0.991583 which, along with Belcamp which has a very similar value, is the best performing of the connection options.	1	1	1

Table 15 Environmental and social considerations Poolbeg via 2 no. 220 kV circuits

Poolbeg via 2 no. 220 kV circuits						
				Impact	Probability	Rating
Offshore Export Cable & Landfall	Ecology	Designated sites/protected species and habitats	Cable routing through southern end of Rockabill to Dalkey SAC, qualifying interests (1170) Reefs and (1351) Harbour porpoise. Closest area of known intertidal and subtidal reef are around Dalkey Island approximately 1.5 km to the south of the export cable corridor boundary. Towards landfall cable route crosses the South Dublin Bay SAC, qualifying interests (1140) Mudflats and sandflats not covered by seawater at low tide, [1210] Annual vegetation of drift lines, [1310] Salicornia and other annuals colonising mud and sand and [2110] Embryonic shifting dunes. The cable installation will have a temporary, direct impact on the majority of these features. Access to the beach for plant and equipment will need to be managed to avoid impacts upon the dunes at the top of the beach. The cable route also passes through South Dublin Bay and River Tolka Estuary SPA [004024], qualifying interests include a range of waterbirds, wildfowl and gull species which over winter; tern species roost during post-breeding period (later summer). Seasonal restrictions likely. Dalkey Island is also a designated SPA, qualifying interests are (A192) Roseate Tern, (A193) Common Tern and (A194) Arctic Tern. A section of the Dalkey Coastal Zone and Killiney Hill pNHA is to the south of the proposed cable route but could be avoided. Part of the cable route likely to passthrough the Dublin Bay Biosphere Buffer Zone, nearshore the route would be likely to pass through the Core Zone. The transition joint bay location has not been confirmed and if this is to be sited in the SAC would increase the environmental risks associated with the delivery of this infrastructure.	2	3	6
	Social	Other marine uses	Cable route likely to intersect with the Inshore Traffic Zone and close to the Dublin Port Traffic Separation Scheme, anchorage and pilot boarding areas. Installation will need to be managed in consultation with Dublin Port to minimise safety risk and interruption to port operations. Cable route likely to cross ESAT 2 cable and Dublin Bay sewer, crossing agreements with BT Ireland and Irish Water required. Area is popular for marine recreation including sailing, diving, rowing and angling. Yacht racing buoys are present across the area from April - Oct. Potting for crab, lobster and whelk occurs in area.	2	3	6
	Social	Land Use	Transition Joint Bay location not identified at this stage - access for the public to areas of amenity value may be restricted during installation.	2	2	4

Poolbeg via 2 no. 220 kV circuits						
				Impact	Probability	Rating
	Cultural	Marine Archaeology	There are several known wrecks nearshore which will need to be avoided and potential for unknown archaeological material to discovered during pre-installation surveys or installation, requiring micro-siting of cable or archaeological investigation.	2	2	4
Onshore Cable route	Ecology	Designated sites/protected species	Beach is included within the South Dublin Bay SAC for ecological conservation, but impacts could be avoided assuming sufficient space is available landward side of beach.	3	1	3
	Social	Land Use	Not residential in nature but beach is public amenity	2	2	4
	Social	Traffic Management & Construction Noise	No significant traffic or noise restrictions anticipated due to very limited residential properties in the proximity and low traffic volumes.	2	1	2
Onshore Substation & Grid Connection	Ecology	Designated sites/protected species	Based on Poolbeg 220 kV Substation Shunt Reactance Coil – Planning & Environmental Considerations Report 2014 there are Bats in the proximity of the existing substation location. In addition, there is a mooring dolphin which is important habitat for Roseate and Arctic tern (qualifying interest for the neighbouring nature conservation site)	2	2	4
	Social	Land Use	The emerging preferred OSS location is on a site of reclaimed land referred to as 'Pigeon Park'. The site has some temporary storage facilities (shipping containers) stored thereon, serves no public amenity purpose and is located a considerable distance from potentially sensitive residential or amenity lands.	1	1	1

Option 3 Belcamp via 2 no. 220 kV Circuits (technical, environmental and social assessment)

5.8.9 In this option 2 no. 220 kV cable installations were considered from a landfall in Portmarnock. This option was evaluated on the basis of a new OSS in the proximity of the existing ESB/EirGrid Poolbeg 220 kV substation.

Table 16 Technical considerations Belcamp via 2 no. 220 kV circuits

Belcamp via 2 no. 220 kV circuits						
				Impact	Probability	Rating
Offshore Export Cable & Landfall	Transition Joint Bay	Land & Services	Whilst access is available, it does require construction traffic to pass through the busy seaside town which will cause disruption. No significant services at TJB location. Land is public amenity land owned by local authority.	3	3	9
	Landfall Trenchless Installation	Ground Profile	Gentle sloped wide, marine beach sand, in front of low laying unoccupied land. Good conditions for HDD.	1	1	1
	Landfall Trenchless Installation	Coastal Vulnerability index	The section of coastline along Portmarnock for the proposed cable landfall is rated Low on the Coastal Vulnerability mapping at the proposed landfall location at Portmarnock	1	1	1
	Landfall Trenchless Installation	Seabed Gradient	Desk studies have identified the seabed gradient at Portmarnock is relatively flat leading to the intertidal water zone, which is suitable for floatation and burial of the submarine cable	1	1	1
	Landfall Trenchless Installation	Landfall Soil Characteristics	Desk studies identified good conditions for trenchless installation techniques (e.g. HDD). Lithology profile landward side of the beach is Alluvium soil.	1	1	1
	Landfall Trenchless Installation	Bedrock	Desk studies have identified Bedrock level Dark blue-grey slate, phyllite & schist well below the HDD drill profile, which reduces engineering costs	1	1	1
Onshore Cable route	Route Constructability	Length & Complexity	The onshore cable route is approximately 8.5 km long, largely in urban areas and passes through a number of residential areas. Compared to other connection options the route is likely to present significant challenges in certain constrained sections due to pre-existing land-use constraints.	2	3	6
	Route Constructability	Existing Services/Crossings	The route is likely to contain a high number of existing services in urban sections and a small number of crossings (2). This is likely to increase design and construction schedules and costs within urban sections.	2	2	4
	Route Approval	Stakeholders (Irish Rail, TII etc.)	The route contains one trenchless crossing of the DART/railway line which will require approval from Irish Rail. The route contains will also likely interact with NISA cable route as well as existing and planned ESB HV cables entering Belcamp.	2	3	6
Onshore Substation &	New OSS Site	Space Constraints	The availability of land to cater for the expected equipment in the new OSS is expected to be better than other connection options but this depends on zoning and land owning in the area.	2	2	4

Belcamp via 2 no. 220 kV circuits						
				Impact	Probability	Rating
Grid Connection	Grid Connection	Shallow Connection	EirGrid have confirmed that a new 220 kV substation is required to connect Offshore Wind in excess of the planned NISA offshore wind farm project. This would require additional land in the proximity of the existing ESB substation - availability of land considered likely to provide more opportunities due to semi-rural location.	2	3	6
	Grid Connection	Deep Reinforcements	Based on Offshore Phase 1 Projects – Grid Connection Assessments (EirGrid, 2021) a large portion of the capacity at Belcamp is dependent upon the deep reinforcements. Also, the completion of the second 220 kV feeder at Belcamp has experienced a number of delays and the potential solutions for the required further reinforcement have not yet been considered.	3	3	9
	Grid Connection	Constraints	Based on the EirGrid publication ECP-2.1 Constraint Reports for Solar and Wind – Medium term constraints of 4%. Initial constraints likely to be worse than Poolbeg and Carrickmines given the 220 kV connectivity. In particular the fact that the reinforcement identified in Onshore Phase 1 Projects – Grid Connection Assessments (EirGrid, 2021) is in addition to the defined EirGrid project CP1021 (added to the fact the 2nd has been continuously delayed) increases the risk of significant constraints.	3	3	9
	Grid Connection	Transmission Loss Adjustment Factor	2021/2022 Published TLAF for Belcamp 220 kV is 0.991917 which, along with Poolbeg which has a very similar value, is the best performing of the connection options.	1	1	1

Table 17 Environmental and social considerations Belcamp via 2 no. 220 kV circuits

Belcamp via 2 no. 220 kV circuits						
				Impact	Probability	Rating
Offshore Export Cable & Landfall	Ecology	Designated sites/protected species and habitats	Potential cable routing through southern end of Rockabill to Dalkey SAC, qualifying interests (1170) Reefs and (1351) Harbour porpoise. Closest area of known intertidal and subtidal reef are around Howth Head and Irelands Eye, the cable route would be in close proximity to these habitats and likely to pass between the headland and offshore island. Howth Head is designated SAC and SPA and pNHA. Irelands Eye is also designated as SPA and SAC. There is no apparent pathway for effects on QI of Howth Head SAC or Irelands Eye SAC ([1230] Vegetated Sea Cliffs and [4030] Dry Heath, [1220] Perennial Vegetation of Stony Banks). The SPAs are designated for a range of breeding seabirds and are also breeding sites for Peregrine Falcon (Annex 1 species). Howth Head is also a pNHA. On approach to landfall the cable route would pass through Baldoyle Bay SAC and SPA. The designated area is a tidal estuarine bay protected from the open sea by a large sand-dune system. The QI of the SAC are [1140] Tidal Mudflats and Sandflats, [1310] Salicornia Mud, [1330] Atlantic Salt Meadows and [1410] Mediterranean Salt Meadows. Due to the relatively small size of the SAC significant effects upon tidal mudflats and sandflats and salicornia mud cannot be ruled out. The mapped extent of the salt meadows indicates that the options for landfall would be limited to an area to the south west of the bay in proximity to Baldoyle village. Baldoyle Bay is designated for wintering wildfowl and a range of breeding birds. The cable route would pass through both the Buffer and Core Zones of the Dublin Bay Biosphere.	3	3	9
	Social	Other marine uses	The likely cable route would traverse the busy E-W shipping route to Dublin Port and would need to avoid the northern Traffic Separation Scheme. To the north of Howth Head the cable route would either pass close to the entrance to Howth Harbour where sea room is restricted due to proximity of Irelands Eye to the north. Alternatively, the cable may be routed north of Irelands Eye. A number of submarine cables (~5 cross the cable route) and would be subject to cable crossing agreements with the operators. Area is popular for marine recreation including sailing, diving, rowing and angling. Potting for crab, lobster and whelk occurs across the southern portion of	2	2	4

Belcamp via 2 no. 220 kV circuits						
				Impact	Probability	Rating
			the cable route. There is an extensive area of scallop dredge to the north and east of Howth Head, which is a potential risk to cables.			
	Social	Land Use	Landfall is public amenity land.	2	2	4
	Cultural	Marine Archaeology	There are several known wrecks nearshore which will need to be avoided and potential for unknown archaeological material to discovered during pre-installation surveys or installation, requiring micro-siting of cable or archaeological investigation.	1	2	2
Onshore Cable route	Ecology	Designated sites/protected species	The road route is likely to run alongside and between two parts of the Baldoyle Bay pNHA.	2	2	4
	Social	Land Use	The route is likely to have an interface with Portmarnock Golf Course and possibly the Portmarnock parade. The land in the area is likely to have development potential and delivery of sections of the route through private lands is likely to be challenging.	2	2	4
	Social	Traffic Management & Construction Noise	Route likely to pass through both busy villages and residential areas so both traffic restrictions and limited working hours may impact construction.	3	2	6
Onshore Substation & Grid Connection	Ecology	Designated sites/protected species	No designated areas for ecological conservation in OSS likely search area.	2	1	2
	Social	Land Use	No significant issues expected based on anticipated greenfield site for OSS location. Zoning suitable for the development of a substation.	2	1	2

Option 4 Ballybeg via 2 no. 220 kV Circuits (technical, environmental and social assessment)

5.8.10 In this option 2 no. 220 kV cables are brought from a landing point in Wicklow to a new OSS in the proximity of a new ESB/EirGrid Ballybeg 220 kV Substation in the vicinity of the existing ESB/EirGrid Ballybeg 110 kV Substation.

Table 18 Technical considerations Ballybeg via 2 no. 220 kV circuits

Ballybeg via 2 no. 220 kV circuits						
				Impact	Probability	Rating
Offshore Export Cable & Landfall Onshore Cable route	Transition Joint Bay	Land & Services	Whilst access is likely to be available, it does require construction traffic to pass through a small village which will cause some disruption. Land ownership likely to be single private land owner and a sensitive site for construction (Murrough wetlands). No significant services expected.	2	2	4
	Landfall Trenchless Installation	Ground Profile	Desk studies have identified gentle sloped wide, marine beach sand, in front of low laying unoccupied land. Good conditions expected for trenchless installation techniques (e.g. HDD).	1	1	1
	Landfall Trenchless Installation	Coastal Vulnerability index	The section of coastline along Clonmannon for the proposed cable landfall is rated High on the Coastal Vulnerability mapping at the proposed landfall location under consideration.	3	3	9
	Landfall Trenchless Installation	Seabed Gradient	Desk studies have identified that the seabed gradient at Clonmannon is relatively flat leading to the intertidal water zone, which is suitable for floatation and burial of the submarine cable.	1	1	1
	Landfall Trenchless Installation	Landfall Soil Characteristics	Desk studies have identified good conditions for trenchless installation techniques (e.g. HDD). Lithology profile landward side of the beach is Alluvium soil. Further site ground investigations required at this location for detailed engineering.	1	1	1
	Landfall Trenchless Installation	Bedrock	Desk studies have identified Bedrock level to be dark blue-grey slate, phyllite & schist well below the anticipated trenchless installation technique (e.g. horizontal directional drill) profile.	1	1	1
	Route Constructability	Length & Complexity	The anticipated onshore cable route is approximately 4.7 km long, largely in rural areas and would require private land agreements with multiple route options and deviation potential foreseeable. Overall, the cable route is expected to be lesser constrained than other connections options.	2	2	4
	Route Constructability	Existing Services/Crossings	The route is expected to contain a small level of existing services and has a small number of crossings (2/3). This may have some impact on design and construction schedules and costs.	1	1	1
	Route Approval	Stakeholders (Irish Rail, TII etc.)	The route contains one proposed trenchless crossing of the railway line which will require approval from Irish Rail. The route also contains a crossing of both the M11 Motorway and the R752 regional road which will require approval from the relevant road authorities.	2	3	6
Onshore Substation &	New OSS Site	Space Constraints	The availability of land to cater for the expected equipment in the new OSS is expected to be better than other connections.	2	1	2

Ballybeg via 2 no. 220 kV circuits						
				Impact	Probability	Rating
Grid Connection	Grid Connection	Shallow Connection	East Coast Generation Opportunity Assessment (EirGrid, 2019) proposed a new 220 kV substation near Ballybeg to connect offshore wind. This would require additional land in the proximity of the existing ESB substation.	3	2	6
	Grid Connection	Deep Reinforcements	East Coast Generation Opportunity Assessment (EirGrid, 2019) indicated 500 MW capacity available at new 220 kV node however this did not take into account the connection of Arklow OWF i.e. 500 MW in total. To increase to 700 MW total, the East Coast Generation Opportunity Assessment (EirGrid, 2019) identified the need to upgrade 30 km of 220 kV overhead network. To go beyond 700 MW in total would require very extensive reinforcements. In November 2021 EirGrid confirmed no capacity available at Ballybeg	3	3	9
	Grid Connection	Constraints	Based on the EirGrid publication ECP-2.1 Constraint Repors for Solar and Wind – Medium term constraints of 5%. Initial constraints likely to be worse than Poolbeg and Carrickmines given the 220 kV connectivity. Given the probability of Arklow connecting to the south of Ballybeg any further capacity connecting at Ballybeg would very likely drive significantly high levels of constraints. The only planned reinforcement provides 700 MW of capacity in total thus leaving the significantly high constraints in place in the long term.	3	3	9
	Grid Connection	Transmission Loss Adjustment Factor	2021/2022 Published TLAF for Ballybeg 110 kV is 0.987042 which is the worst TLAF out of the connection options.	3	3	9

Table 19 Environmental and social considerations Ballybeg via 2 no. 220 kV circuits

Ballybeg via 2 no. 220 kV circuits						
				Impact	Probability	Rating
Offshore Export Cable & Landfall	Ecology	Designated sites/protected species and habitats	There are no designated sites on the offshore cable route, however the landfall location and installation would be constrained by the presence of a number of designated coastal sites. Murrough wetlands, designated as an SAC and SPA, is a large coastal wetland complex and covers a length of coastline of approximately 13 km. The site includes an area of marine water to a distance of 200 m from the low water mark. QIs of the SAC include [1210] Annual Vegetation of Drift Lines, [1220] Perennial Vegetation of Stony Banks, [1330] Atlantic Salt Meadows, [1410] Mediterranean Salt Meadows, [7210] Cladium Fens and [7230] Alkaline Fens. Making landfall within the SAC would be challenging particularly at the northern and southern ends of the site where saltmarsh is present. The Murrough SPA is an important site for wintering waterbirds and probably the most important site in the country for nesting Little Tern, which nest on the shingle ridge. Subtidal sabellaria reef to the north of Wicklow Head is the qualifying interest of Wicklow Reef SAC, indirect effects due to sediment deposition on this feature would need to be avoided during cable installation and landfall construction. Wicklow Head SPA is designated for a range of breeding seabirds and pair of breeding Peregrine Falcon, Annex 1 species. Wicklow Head, Wicklow Town and the Murrough are also pNHA.	3	3	9
	Social	Other marine uses	Area is popular for marine recreation including sailing, diving, rowing and angling. Potting for crab, lobster and whelk occurs across cable route, including nearshore. Scallop dredge also in nearshore area.	1	2	2
	Social	Land Use	Increased optionality for landfall compared to other connection options.	2	1	2
	Cultural	Marine Archaeology	There are several known wrecks nearshore which will need to be avoided and potential for unknown archaeological material to discovered during pre-installation surveys or installation, requiring micro-siting of cable or archaeological investigation.	1	2	2
Onshore Cable route	Ecology	Designated sites/protected species	The onshore route is likely to require a crossing of The Murrough SAC/SPA/pNHA sites. Seasonal restrictions are likely to apply to works in the SAC and land used by birds associated with it.	3	3	9

Ballybeg via 2 no. 220 kV circuits						
				Impact	Probability	Rating
	Social	Land Use	Predominantly agricultural with some forestry/woodland. Areas of forest would require a corridor clear of trees so should be avoided.	1	2	2
	Social	Traffic Management & Construction Noise	Given rural location, mainly cross-country route, and additional optionality no significant impacts expected	1	2	2
Onshore Substation & Grid Connection	Ecology	Designated sites/protected species	No designated areas for ecological protection in OSS likely search area.	2	1	2
	Social	Land Use	No significant issues expected based on anticipated greenfield site for OSS location. Zoning appropriate for development of a substation.	2	1	2

Economic assessment of alternative connection options

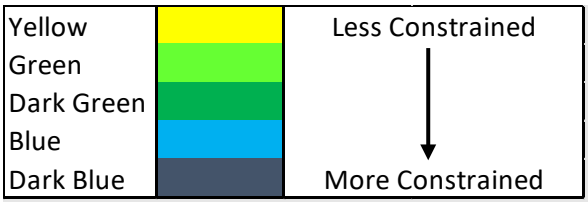
5.8.11 A comparative cost assessment of the individual connection options was completed on the basis of the key economic differentiating factors.

Table 20 Comparative cost assessment

	Carrickmines	Poolbeg	Belcamp	Ballybeg
No. of Circuits	2	2	2	2
Offshore Cable Distance (km) - Total for 2 circuits	27.6	45.2	57.2	51.1
Onshore Cable Distance (km) - Total for 2 circuits	15	3	17	9.32
Offshore Cable Cost Installed (€1 million per km of installed cable)	€27,600,000	€45,200,000	€57,200,000	€51,100,000
Onshore Cable Cost Installed (€1.5 million per km of installed cable)	€28,856,227	€4,544,144	€30,821,885	€13,896,788
High Level Additional Grid Costs	Not applicable	Not applicable	€10,000,000 (new 220 kV GIS substation required)	€10,000,000 (new 220 kV GIS substation required)
Total Comparative Cost	€56,456,227	€49,744,144	€98,021,885	€74,996,788

Summary constraints comparison

5.8.12 This section compares the constraints for each grid connection option under consideration. Each constraint is assessed and categorized using the scale below.



5.8.13 A comparison of the constraints of each grid connection option is provided in Table 21.

Table 21 Multi-criteria assessment summary table

		Carrickmines	Poolbeg	Belcamp	Ballybeg
Technical	Offshore				
	Onshore				
	Grid/OSS				
Env & Social	Offshore				
	Onshore				
	Grid/OSS				
Economic					
Overall					

5.8.14 The conclusions of the assessment are summarised below.

(i) Carrickmines was considered to be the best performing option because;

a. it has the shortest and least constrained offshore cable route.

b. it performs well from an economic perspective.

c. the onshore cable route is likely to have a high number of crossings and interfaces with existing services. However, there is good optionality for the onshore cable route.

d. the ground and soil profile at the landfall have detailed design engineering uncertainties however there are considered to be a number of options available to address same.

e. it performs well from a grid capacity, reinforcements and network constraints perspective.

(ii) Poolbeg was considered to be the second best performing option because;

a. It performs well from a grid capacity perspective. It also performs well from an economic perspective.

b. The key constraint associated with Poolbeg is the lack of available land for an onshore substation and a very challenging onshore cable route. Both these space constraints have little optionality and carry significant risk.

c. Poolbeg has notable risks relating to the ground/soil profile at the landfall and the presence of existing NATURA 2000 sites likely to be required to be extensively crossed by export cable infrastructure.

(iii) Belcamp performs worse than both Carrickmines and Poolbeg because;

a. it is the worst performing of the options from an economic perspective. This is largely due to the long offshore route. The offshore route also has a high number of designated areas.

b. the onshore cable route is likely to traverse urban and residential areas with significant services interactions required.

c. despite having a location close to a major demand centre Belcamp did not perform well under grid reinforcements and network constraints due to its limited 220 kV connectivity.

(iv) Ballybeg performs worse than both Carrickmines and Poolbeg because.

a. it is the worst performing of the options from a grid capacity, reinforcements and network constraints perspective. This is due to its distance from the demand centre, limited capacity of the existing 220 kV network and the limited ability to increase the capacity with feasible upgrades or reinforcements.

b. it performs poorly from an economic perspective again due to the long offshore routes required.

c. it is the only onshore cable route likely to occur within a designated site as it is likely to be routed through the Murrough SAC.

5.8.15 In summary the Carrickmines connection option was considered to be the optimum connection point considering the technical, environmental, social and economic risks and constraints across the different options.

Grid connection confirmation

5.8.16 Following the identification of the Carrickmines connection options as being the preferred, and in accordance with CRU's Final Decision Paper (CRU/2022/14, February 2022), an updated application was issued to EirGrid (April 2022) based on the emerging design of the offshore wind farm and the anticipated capacity of the electricity transmission network. EirGrid deemed the application complete and issued a Grid Connection Assessment (GCA) to each to Kish Offshore Wind Limited and Bray Offshore Wind Limited - Dublin Array. The Applicants received confirmation from EirGrid in October 2022 that the point of connection for Dublin Array is to the existing Carrickmines 220 kV substation for a project with a maximum export capacity of 824 MW.

5.9 Alternative landfall options and submarine export cable corridors

Alternative landfall site options

5.9.1 With the identification of the existing Carrickmines 220 kV substation as the electricity grid connection point for the project alternative landfall options were considered. A broad search area was identified which extended from Killiney in the north to Bray in the south reflecting a search area of coastline of approximately 7 km in length.

5.9.3 No landfalls further north of Killiney were deemed to be viable for the following reasons;

- The coastline and the sub-sea approaches are unsuitable due to rocky outcrops and sheer cliffs with residential housing directly above;
- Access to the foreshore for construction plant and equipment is severely constrained;
- The area is densely populated and viable alternative onshore routes to the existing Carrickmines substation are not readily available;
- The route distance to the assigned grid connection point (existing Carrickmines 220 kV substation) increases;
- The roads are generally narrow suburban residential streets and are prone to heavy traffic congestion;
- Cable installation would be very disruptive with limited alternative options available due to underground services congestion.

5.9.4 Any landfalls further south of Bray northern urban boundary were considered to be not viable for the following reasons;

- Landing on the shoreline in Bray was not considered feasible due to the urban setting of the seafront and its extensive public amenity use with potential for major disruption to traffic as the onshore cable route progresses through the town and onwards to the grid connection point.
- The route distance to the assigned grid connection point (existing Carrickmines 220 kV substation) increases with no anticipated benefit compared with other alternatives.
- The area south of Bray is a strategic planning greenbelt area with limited available roads suitable for cable installation;

5.9.5 The landfall search area was sub-divided into four distinctive sub-zones as shown in Figure 9.

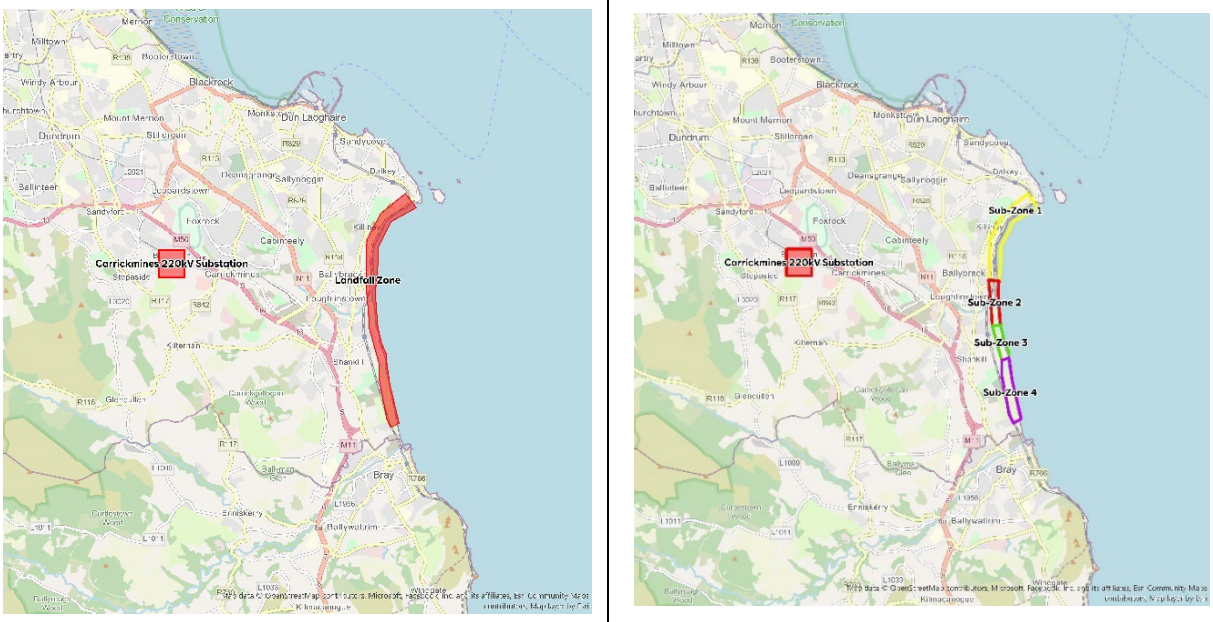


Figure 9 Landfall search area (and Sub-Zones)

Sub-Zone 1 – Killiney to Ballybrack

5.9.6 The subsea approaches along this zone were considered to be technically feasible for export cable installation. However, the coastline comprises a very narrow pebble beach abutted directly by the DART railway line behind which the ground rises steeply and is backed onto private residences. Access to the beach and potential landfall working space for construction operations is extremely restricted. A suitable area of open space to accommodate the Transition Joint Bay infrastructure was not identified.

5.9.7 Sub-zone 1 intersects the Dalkey Coastal Zone and Killiney Hill proposed natural heritage area (pNHA) and is adjacent to the Dalkey Islands SPA. Furthermore, feasible alternative terrestrial routes towards the existing Carrickmines 220 kV substation were not identified due to the narrowness of the prevailing road network in the general locality. This landfall sub-zone is not feasible (landside) and was not considered further.

Sub-Zone 2 – Ballybrack to Shanganagh Cliffs (North)

5.9.8 The subsea approaches along this zone are considered to be technically feasible for cable installation. The coastline is characterised by a low cliff with limited costal erosion evident. The cliff rises from almost 'at grade/beach level' at Ballybrack to approximately 10 m high at the Shanganagh Cliffs end of the sub-zone. With the exception of residential development and general amenity value land-use, from a land-use amenity perspective the presence of significant utility infrastructure (i.e. Shanganagh wastewater treatment plant is a dominant feature in this particular area).

5.9.9 Two locations were identified on public land directly to the north (2-A) and to the south (2-B) of the wastewater treatment plant that were considered potentially feasible for a landfall and the construction of transition joint bay infrastructure.

5.9.10 Zone 2-A and the wastewater treatment plant are directly abounded to the rear by the DART railway line. Zone 2-A is adjacent to the Dalkey Coastal Zone and Killiney Hill pNHA. Access to zone 2-A is restricted by a narrow pedestrian underpass of the DART railway line and a weight restricted bridge over the Shanganagh River. There is dense housing on the western side of the DART line at this location (Bayview Park and environs) which severely limits the trenchless crossing option design of the DART/railway crossing at this location

5.9.11 Zone 2-B is to the south of the wastewater treatment plant and its associated outfall. Zone 2-B would require the acquisition of a cable route in public lands through a community garden space up to the DART railway line. Public lands exist on the western side of the railway line at this location to facilitate a trenchless solution for crossing the DART line at grade. Access for construction plant and equipment was considered feasible at this location due to the existence of the main access road to/from Shanganagh Road for Clifton Park, Shanganagh Cliffs, Rathsallagh Drive/Rathsallagh Grove developments.

5.9.12 The cliff height at Zone 2-B is approximately 3 m and there is ample space to set back the TJB from the cliffs themselves to allow for coastal erosion where this occurs.

5.9.13 There was also an alternative site in this zone further to the south (2-C) which has very good access and set back from the foreshore and cliff edge. This site is directly adjacent to houses to the south at Seafield. This site would require a cable crossing of the DART/railway line and no feasible solution was identified for same due to capacity limitation in the existing bridge crossings of the DART/railway line and insufficient space being available for a trenchless crossing due to configuration of housing development in the local area.

5.9.14 Taking all factors into account, zone 2-B, directly to the south of the wastewater treatment plant was considered feasible within sub-zone 2 and was taken forward for further consideration.

Sub-Zone 3 –Southern Shanganagh Cliffs to Shanganagh Park

5.9.15 The sub-sea approaches along this sub-zone were considered to be favourable for cable installation. However, the cliff height along this zone increases to approximately 10 m. The northern half of this zone is heavily built upon and the land available between the cliff face and the housing is not sufficient for landfall works especially allowing for any future coastal erosion along the coastline.

5.9.16 The southern section of this zone comprises of Clontra house, a large Victorian estate house (which is in private ownership) with mature trees and park lands. This area is not considered viable for landfall works. The section of land in the middle of this zone may be suitable for landfall works and the installation of a TJB. However, a landfall at this site location would involve an overbridge rail crossing on Corbawn Lane with temporary access through a residential cul de sac or a low underbridge rail crossing on Quinn's Road both of which would be severely restrictive for plant and equipment movement.

5.9.17 A cable route from this zone to a substation at Carrickmines/Ballyogan would pass through densely populated residential suburbs, narrow estate roads and an urban centre (Shankill village) which was considered to be potentially extremely disruptive due to the traffic volumes locally. While this landfall site could be deemed to be feasible it was ranked less suitable and accordingly was not considered further. This is the only landfall identified in this sub-zone and therefore this sub-zone is not considered to be viable.

Sub-Zone 4 – Shanganagh Park to Bray North

5.9.18 The sub-sea approaches along this zone are technically feasible for cable installation. However, the cliff heights along this sub-zone are approximately 10 m.

5.9.19 Shanganagh Park is in the ownership of Dún Laoghaire–Rathdown County Council. The area around Shanganagh Park is the subject of significant proposed mixed-use development as indicated in the Shanganagh – Woodbrook Local Area Plan. Most of the land adjacent to the foreshore in this zone is occupied by Woodbrook Golf Club, which is a private amenity.

5.9.20 At the northern extents of this sub-zone, within Shanganagh Park, there is a large area of public open land that has sufficient space for landfall works and transition joint bay infrastructure. However, access to the site from the north along Quinn's Road is extremely limited and does not have the space to support the construction traffic and equipment required for the activities without enabling works such as pavement reinforcement and significant vegetation/tree clearance. A narrow underpass of the DART railway line on Quinn's Road results in a significant height restriction (<2.94 metres) on plant and equipment using this as an access road.

5.9.21 The southern section of this sub-zone comprises of Woodbrook Golf Club. A potential landfall site was considered in this area. However, the disruption to the operation of the golf club during the construction period would be significant and is not considered an optimum solution.

Summary of best performing option

5.9.22 Following the assessment of potential landfall zones, it was determined that sub-zones 2 (Ballybrack to Northern Shanganagh Cliffs) was a feasible landfall zone with sub-zone 2B adjacent to the Shanganagh wastewater treatment plant the best option. Sub-zones 1 (Killiney to Ballybrack), 3 (Southern Shanganagh Cliffs to Shanganagh Park) and 4 (Shanganagh Park to Bray North) were not considered to present any material advantage however they were characterised as having major access and infrastructure construction constraints.

Alternative landfall construction techniques

5.9.23 The deciding factors on the most appropriate method to being offshore subsea cables onshore is dependent on-site conditions, such as geological/geotechnical, environmental, topographical and cost constraints. Export electricity cables are typically required to be buried below existing ground/seabed conditions at the landfall site to protect them and to ensure environmental and economic security of the asset.

5.9.24 The two key different construction methods considered for the landfall associated with the proposed development are trenched (open cut) and trenchless (e.g. HDD or direct pipe methods).

5.9.25 Open cut trenching is effective for installations in areas where surface restoration is relatively simple, such as open fields or undeveloped land. However, in urban environments or areas with heavy traffic, it can cause significant disruption. It involves;

- The excavation of the surface material down to the required trench depth, through overburden and rock;
- Installation of the cable bedding material, export cable (cable ducts may also be installed);
- The backfilling of the trench with the appropriate engineering backfills; and,
- The reinstatement of the surface material.

5.9.26 Trenchless installation [e.g. HDD] is used to minimise surface disruption, making it suitable for installations under roads, rivers, or urban areas where traditional trenching would be impractical. It is known for its precision and ability to reduce environmental impact. It involves:

- A pilot hole being drilled from land using a rotating boring head, supported by a drilling fluid, along a guided path beneath the surface to a suitable distance offshore, to the extraction location;
- The pilot hole being enlarged using a reamer to the required diameter to accommodate the export cable ducts; and

- The pipe or conduit being pulled through the enlarged borehole.

5.9.27 The trenchless Direct Pipe method is efficient, combining the excavation and installation steps into one continuous process, which reduces construction time and increases accuracy. A Micro-Tunnel Boring Machine (MTBM) is used which has cutting wheels and high-pressure jetting nozzles. The process involves:

- An excavation launch pit being constructed onshore. From here, the MTBM uses hydraulic rams located within the launch pit to jack the casings along a guided path beneath the surface to a suitable distance offshore, to the extraction location;
- The arisings generated by the MTBM are then passed back along the casing, suspended in drilling mud, and processed for disposal or reuse where appropriate; and
- The casing forms the permanent ducting through which the export cables are installed.

5.9.28 Due to the elevation difference between the beach/inter-tidal area and ground level at the target transition joint bay infrastructure location adjacent to the Shanganagh waste water treatment plant, this would require a significant open-cut across the beach and through the cliff-face and result in a permanent change to the morphology of the cliffs at this location. The open cut method is therefore less preferable on the basis of potential significant environmental effects when compared with the other trenchless (i.e. below ground) techniques. Therefore, this method was excluded from further consideration.

Alternative submarine export cable corridors

5.9.29 The identification of potential offshore cable corridors followed a series of 'design principles' established by the Applicant and formed the basis for consultation during the scoping phase. These principles include:

- Routing options must connect to viable landfall locations;
- Routes should be as short as possible;
- Minimise the number of crossings over existing offshore cables and pipelines, and where necessary, ensure cables and pipelines are crossed at 90 degrees;
- Maintain required separation distances from other offshore cables and pipelines;
- Provide sufficient space for offshore cable installation (including the anchor spread of installation vessels) while maintaining a safety buffer from existing sub-sea cables and pipelines;

- Avoid historic wrecks;
- Minimise and avoid seabed aggregate dredging and dumping at sea where possible; and
- Minimise routing through designated nature conservation sites wherever practicable.

5.9.30 After applying these design principles, the process of identifying a suitable cable route began with the delineation of a broad area of interest (BAoI) for the offshore cable corridors, connecting the identified wind farm location to the proposed landfall zone. These BAoIs were defined by following the design principles, incorporating high-level engineering and environmental considerations such as international designations and existing offshore and onshore infrastructure to establish the boundaries of the area of interest.

5.9.31 The primary factor driving the identification of the offshore cable corridor was the location of the Dublin Array wind farm array, the preferred landfall location (Shanganagh coastline) and the presence of key ecological designations along the coastline to the north and south of the development area, including:

- South Dublin Bay and River Tolka SPA (Site Code 004024);
- South Dublin Bay SAC (Site Code 000210);
- Rockabill to Dalkey SAC (Site Code 003000);
- Bray Head SAC (Site Code 000714); and
- Dalkey Islands SPA (Site Code 004172).

5.9.32 The Applicant aimed to keep the offshore cable corridor as short as possible to minimise potential impacts. This resulted in an area of interest extending from the northern and southern extents of the Kish and Bray bank area to the Dublin and Wicklow coastline, avoiding the ecological designations listed above. A long list of indicative cable corridors was identified within this area of interest, which would be refined following detailed site investigation activities. Burying subsea cables is the preferred option in most environments, as it provides greater protection and reduces the risk of cable damage from vessel anchors or fishing equipment. The Applicant's preference is to bury all subsea cables where feasible and provide alternative protection where burial is not possible.

Offshore cable corridor routing considerations

5.9.33 Initially, the design team considered installing two OSPs on Dublin Array. Export cables were required to connect both OSPs to the TJB at Shanganagh. The following factors were considered in aligning the export cable corridor:

Bathymetry & seafloor morphology

5.9.34 The seabed between the array area and landfall at Shanganagh features variable morphology and water depths. Along the coastline, there is a fringe of exposed bedrock forming a platform offshore, stretching between Killiney Beach to the north and Woodbrook Golf Course to the south.

5.9.35 The Kish and Bray Bank sand bank is one of several similar features in the area. Two smaller sediment banks, Frazer Bank (which has a complex V-shape) and an unnamed elevated area between Frazer and the Kish and Bray Bank, also run parallel to the Kish and Bray Bank (see Figure 10).

5.9.36 The banks feature fields of sandwaves striking SE-NW, migrating northward based on their asymmetry. Sandwave heights range from 1 m to 7 m, with slopes as steep as 26 degrees, though typically between 10–15 degrees, and wavelengths between 25 m and 250 m.

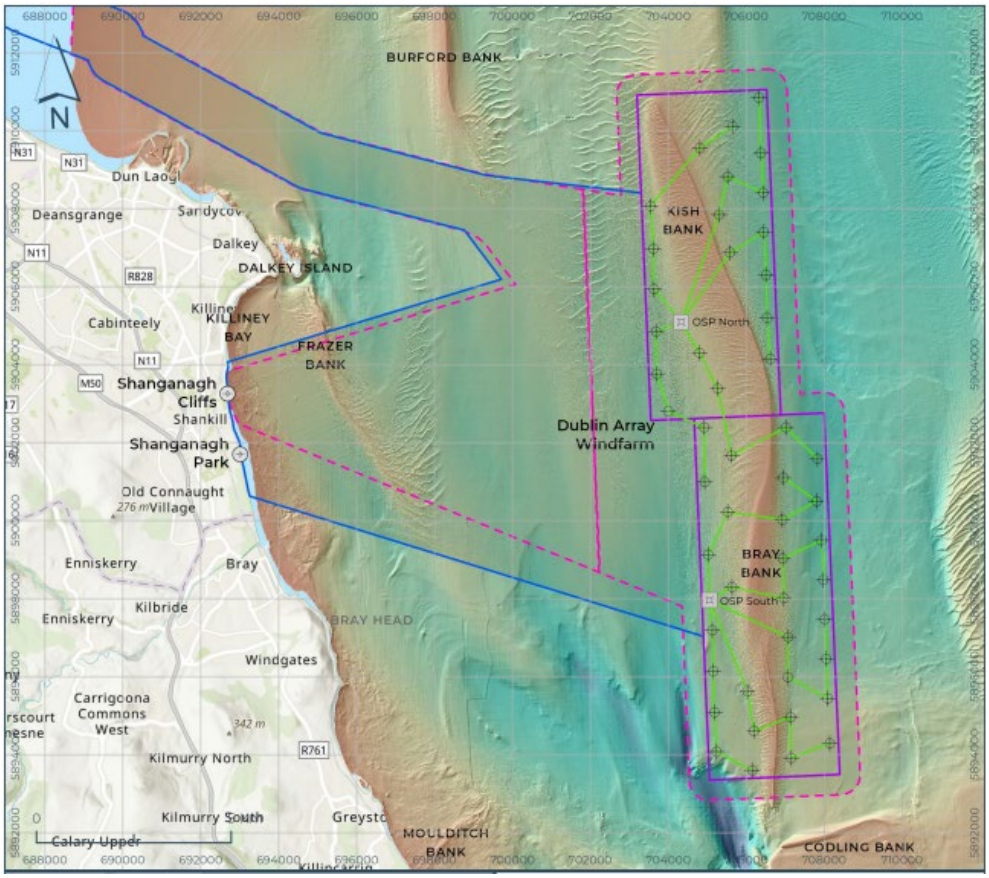


Figure 10 Local seabed bathymetry (Fugro and INFOMAR data)

Existing infrastructure

5.9.37 The only existing offshore infrastructure identified was a submarine pipeline visible on bathymetric data. This pipeline, running approximately 1.7 km north-east from the shoreline at Shanganagh, is associated with the Uisce Eireann waste water treatment plant. A manmade depression (approximately 355 m long by 170 m wide), likely the result of bedrock extraction, is also visible on the outcrop platform, south of the pipeline (see 'extraction area' in Figure 11).

Figure 11 Shaded relief bathymetry offshore Shanganagh Cliffs (green dashed line shows outline of buried/covered pipeline. Grey dashed line shows outcrop extent (Source - Fugro and INFOMAR data)

Archaeology

5.9.38 There are eight charted wrecks (identified as red triangles in the figure below, with the possibility of one more, identified through multiple sources (Maritime Archaeology, 2021). Wrecks older than 100 years and archaeological objects found underwater are protected under the National Monuments (Amendment) Acts 1987 and 1994.

5.9.39 Significant wrecks or objects younger than 100 years can be designated under an Underwater Heritage Order due to historical, archaeological, or artistic importance under section 3 of the National Monuments (Amendment) 1987 Act.

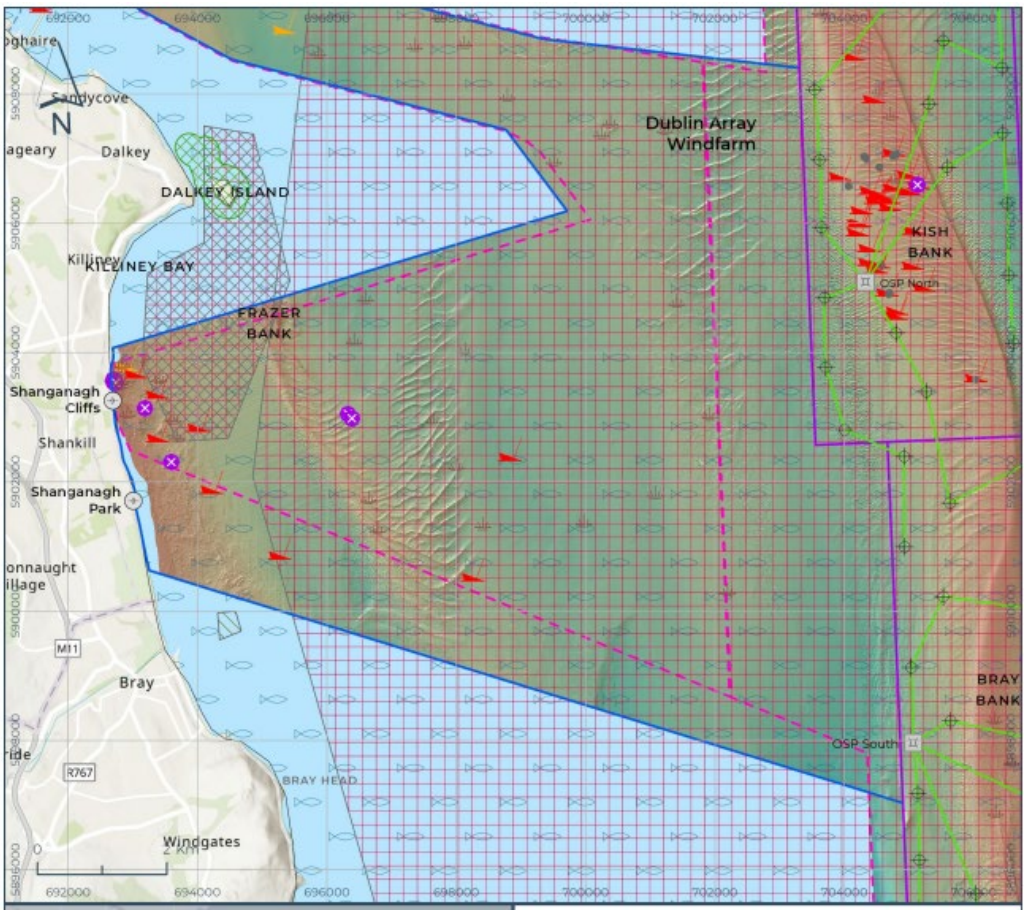


Figure 12 Identification of previously recorded archaeology and shipwrecks

Shipping and navigation

5.9.40 A busy shipping channel traverses the export cable corridor in a north–south direction, used by tankers, cargo ships, and passenger ships en-route to and from Dublin Port. Two navigation buoys, one near Shanganagh and another near Bray, must be considered.

5.9.41 An uncharted vessel holding area managed by Dublin Port Company lies within the area of interest for the export cable corridor, presenting a potential risk of anchor strikes on subsea cables.

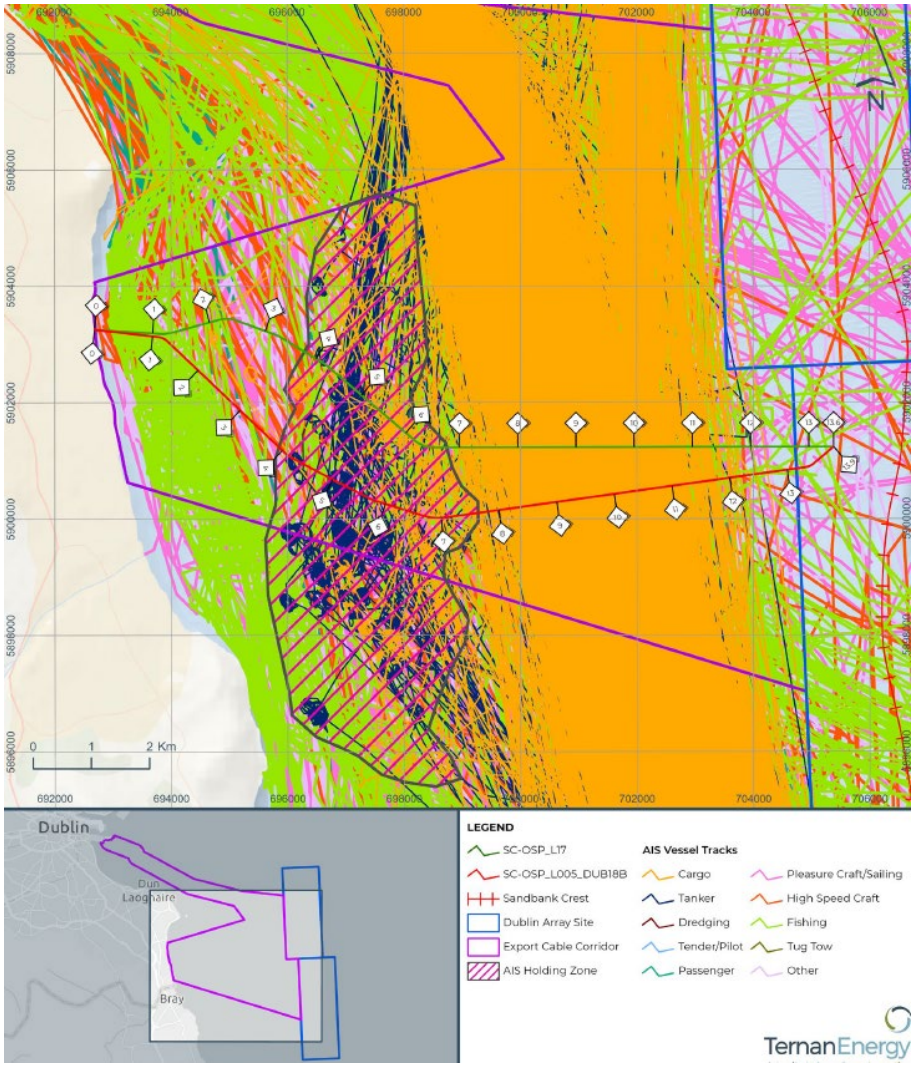


Figure 13 Shipping constraints

Initial alternative offshore cable corridor options

5.9.42 In the early design stage of the project, two OSPs and four potential export cable routes were identified between the two proposed OSPs and the proposed landfall at Shanganagh Cliffs.

5.9.43 These routes were optimised by considering potential hazards and constraints related to cable installation and protection. The export cable routes ranged between approximately 11 km and 15 km in length. The shortest routes followed a direct alignment but crossed the coastal bedrock platform at an angle, increasing the amount of bedrock likely to be encountered and, as a result, increasing the need for additional rock armour protection to safeguard the cable infrastructure due to challenges with burial techniques.

5.9.44 The longer routes crossed Frazer Bank at points where it is narrower, with less pronounced topography and deeper waters, potentially simplifying installation and reducing protection requirements.

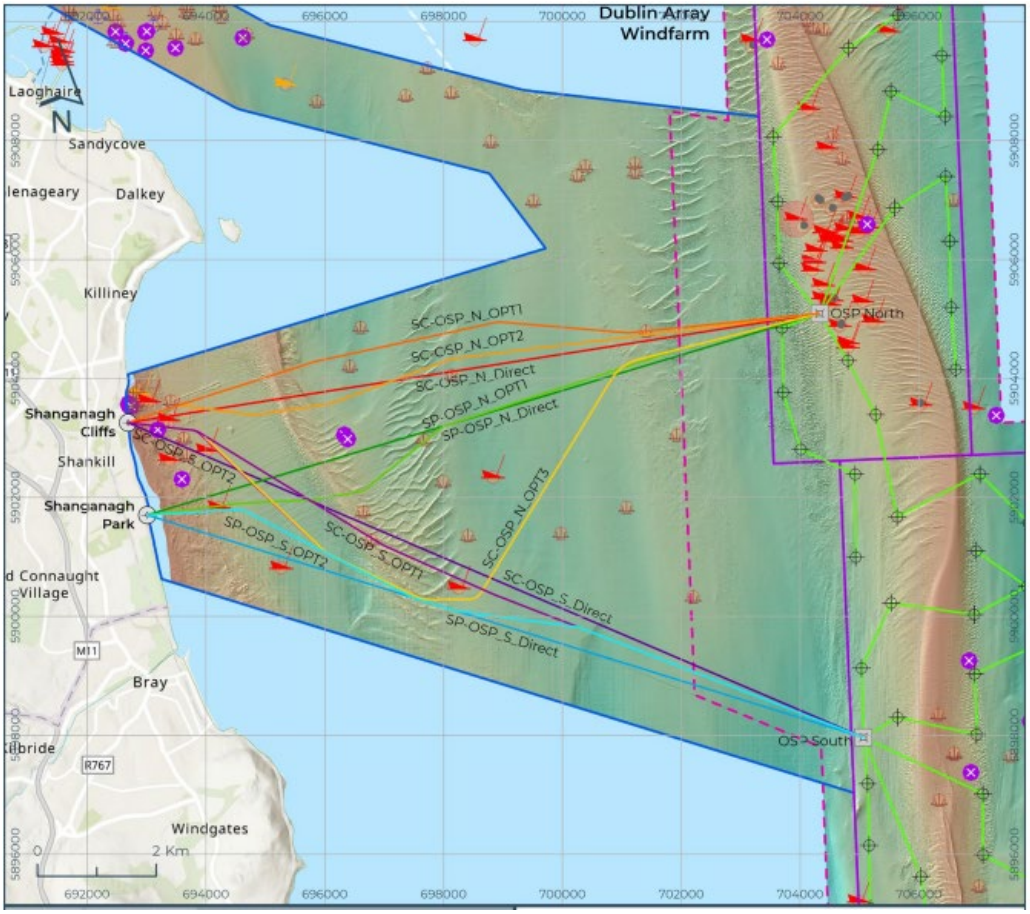


Figure 14 Offshore Export Cable Route options – 2 OSPs

Further optimisation of the preferred Export Cable Corridor (ECC)

5.9.45 As the design progressed, following a decision to proceed with a single OSP (see section 5.7.39), this resulted in a design requirement for two electricity cables to be installed connecting the OSP to the TJB at Shanganagh Cliffs. Planning permission is therefore being sought for two cable corridor options—one north and one south within one of which both submarine export cables will be located.

5.9.46 The geology along the cable corridor has been characterized based on the nature of surface sediments and geophysical survey data. The top 5 m (the depth of interest for cable burial) contain mobile sand, gravelly sand, and potentially low- or high-strength clay, depending on the specific location.

5.9.47 The export cable routes were designed to minimise contact with mobile sediments, where feasible, to reduce the need for seabed preparation activities.

5.9.48 The northern cable corridor (approximately 1 km in width) measures 13.6 km in length and traverses Frazer Bank, which features a slightly elevated area near the approach to the Offshore Substation. The shallowest part of this route, over the crest of Frazer Bank, is 11 m LAT below the sea surface, with deeper waters of nearly 30 m LAT on either side of an unnamed bank.

5.9.49 The southern cable corridor (approximately 1 km in width) route spans 13.9 km and crosses the nearshore bedrock platform before extending over a relatively featureless seafloor for 3.7 km. The route then curves eastward, crossing Frazer Bank, which is 1.5 km wide in this location, with water depths of 20.5 m. Beyond Frazer Bank, the route continues over largely featureless seafloor until it reaches the OSP.

5.9.50 By maintaining the flexibility in the planning application of including both corridor options means that during pre-construction verification surveys the optimum cable alignment, installation and protection strategy can be implemented in a manner which uses the most up-to-date survey data prioritising minimisation of seabed clearance and maximising the potential for avoidance of sensitive archaeological and environmental features with the most up to date information.

5.10 Alternative onshore substation options

5.10.1 In order to connect the electricity from offshore wind farm to the existing Carrickmines 220 kV substation a new onshore substation is required. This new onshore substation will be the location at which the electricity cables coming from the offshore windfarm can be safely connected to, and disconnected from, the existing electricity transmission system. The new onshore substation is also required to facilitate the connection of ancillary equipment to ensure the offshore windfarm can comply with the technical requirements of EirGrid. On completion of construction and commissioning the onshore transmission system will be transferred from the Applicant to EirGrid, the Offshore Transmission Operator in accordance with Policy Statement on the Framework for Ireland's Offshore Electricity Transmission System, DECC, 2021.

5.10.2 The substation site selection process is documented in the Carrickmines Substation Site Selection Report (004283496-02, RWE, September 2022) included in Volume 6, Appendix 6.5.1-1 of the EIAR. A synopsis of this report is presented hereunder.

5.10.3 There were a number of fundamental design considerations to consider in relation to the new onshore substation, particularly (1) the use of Air Insulated Switchgear (AIS) or Gas Insulated Switchgear (GIS) for the main High Voltage switchgear in the substation and (2) the use of overhead line infrastructure or underground cable infrastructure for the connection to the existing Carrickmines 220 kV substation.

5.10.4 In the case of the first consideration (the use of AIS switchgear or Gas Insulated switchgear) a decision was taken that due to the more significant land requirements for AIS technology when compared with GIS technology that to minimise the footprint of the substation GIS technology was the preferred technology choice. A GIS switchgear-based solution requires approximately one third of the land requirements for an AIS switchgear based solution. A GIS substation for a 2-circuit grid connection (2 circuits being required to deliver approximately 824 MW) requires a site area of between 4 acres (1.6 ha) and 6 acres (2.4 ha) depending on layout, to accommodate the necessary structure, plant, equipment and ancillary infrastructure. For each bay in a substation (10 required in total) using GIS technology means that each bay is approximately 1.5 metres wide, 3 metres long and 3 metres high. If AIS technology is used each bay would be approximately 12 metres wide, 30 metres long and 7 metres high. An AIS substation would therefore be materially larger than a GIS substation and therefore switchgear technology choice is an important consideration. In the case of the second consideration (overhead line connections or underground cable connections) it was decided that to minimise the visual impact of the proposed development that underground cable infrastructure would be used thereby removing the requirement for new overhead line tower infrastructure to be developed for the project (consistent with objective EI19 Overhead Cables of the Dún Laoghaire-Rathdown County Development Plan).

5.10.5 Through the grid connection process EirGrid confirmed that the existing 220 kV substation at Carrickmines was a suitable connection point for up to 824 MW of offshore wind, the project team defined the essential requirements for the onshore substation site based on its experience in the delivery of similar infrastructure internationally. One of the main functions of the proposed onshore substation is to regulate 'power quality' factors of the electricity being connected to the electricity transmission network in compliance with EirGrid's Grid Code at the intended grid connection point.

5.10.6 Long lengths of cable create an imbalance of active and reactive power, so the maximum connection distance between the proposed onshore substation and the intended external substation for connection to the existing electricity transmission network was determined to be a maximum of 4 kilometres with a preference to be as close as possible. Figure 15 depicts a 4-kilometre radial search area from the existing 220 kV substation at Carrickmines. This area is referred to as the 'Wider Study Area'.

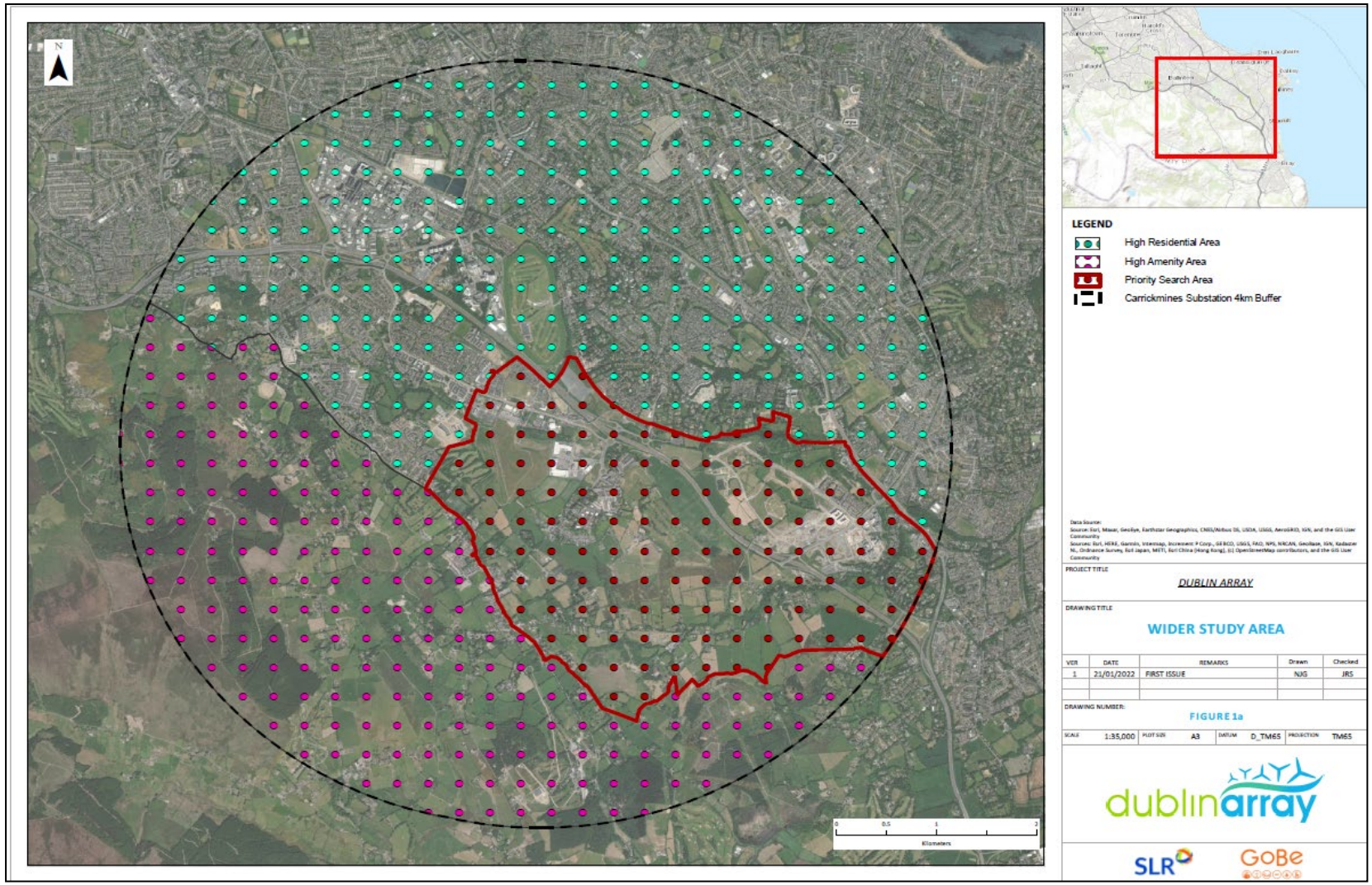


Figure 15 A 4 km radial search area (the Wider Study Area) from the existing 220 kV substation at Carrickmines

5.10.7 To identify suitable sites within the initial search area, an initial screening assessment of the study area was undertaken to identify sites or areas of significant constraint/opportunity. This initial screening process included a review of existing land-uses, assessment of potential site access and availability of sites for acquisition.

5.10.8 The minimum site size requirement ranges between approximately 4 acres (1.6 ha) and 6 acres (2.4 ha) dependent on the configuration (dimensions). Once a range of sites were identified for comparison they were be assessed under the following criteria;

- Technical criteria;
- Economic performance;
- Environmental criteria; and
- Socio-Economic criteria.

5.10.9 The technical criteria taken into consideration were safety, access, distance to the connection node (existing Carrickmines 220 kV substation), extent of enabling and construction works requirements. The economic performance criteria included the distance to the connection node (existing Carrickmines 220 kV substation) and key utility infrastructure costs. The environmental impact criteria included impact assessment on Biodiversity/Flora/Fauna, Landscape and Visual, Archaeology/Architectural/Cultural Heritage, Water Resources/Flood Risk, Soils/Geology/Hydrogeology, Noise/Air. The socioeconomic performance criteria included Population/Landuse/Communities and Recreation/Tourism.

5.10.10 With the identification of the substation site search area and the definition of the minimum site size requirement (between approximately 4 acres/1.6 ha and 6 acres/2.4 ha) a desk-based and targeted field inspection was undertaken to identify potentially suitable substation sites. Within the target search area, an initial potential development site identified process was completed in the general Ballyogan and environs and Cherrywood areas. A long list of 17 potential sites were identified. The sites have been grouped into general geographical areas and given the following prefixes:

- CM = Carrickmines/Ballyogan/Glenamuck;
- LT = Leopardstown;
- CW = Cherrywood;
- KT = Kiltiernan; and
- BC = Ballycorus.

5.10.11 Each site on the long list was assessed to confirm whether it would be considered suitable for development as a substation. This involved a review of the County Development Plan and other relevant plans (e.g. Ballyogan and Environs Local Area Plan and Cherrywood Strategic Development Zone Planning Scheme). This evaluation is set out in Table 22.

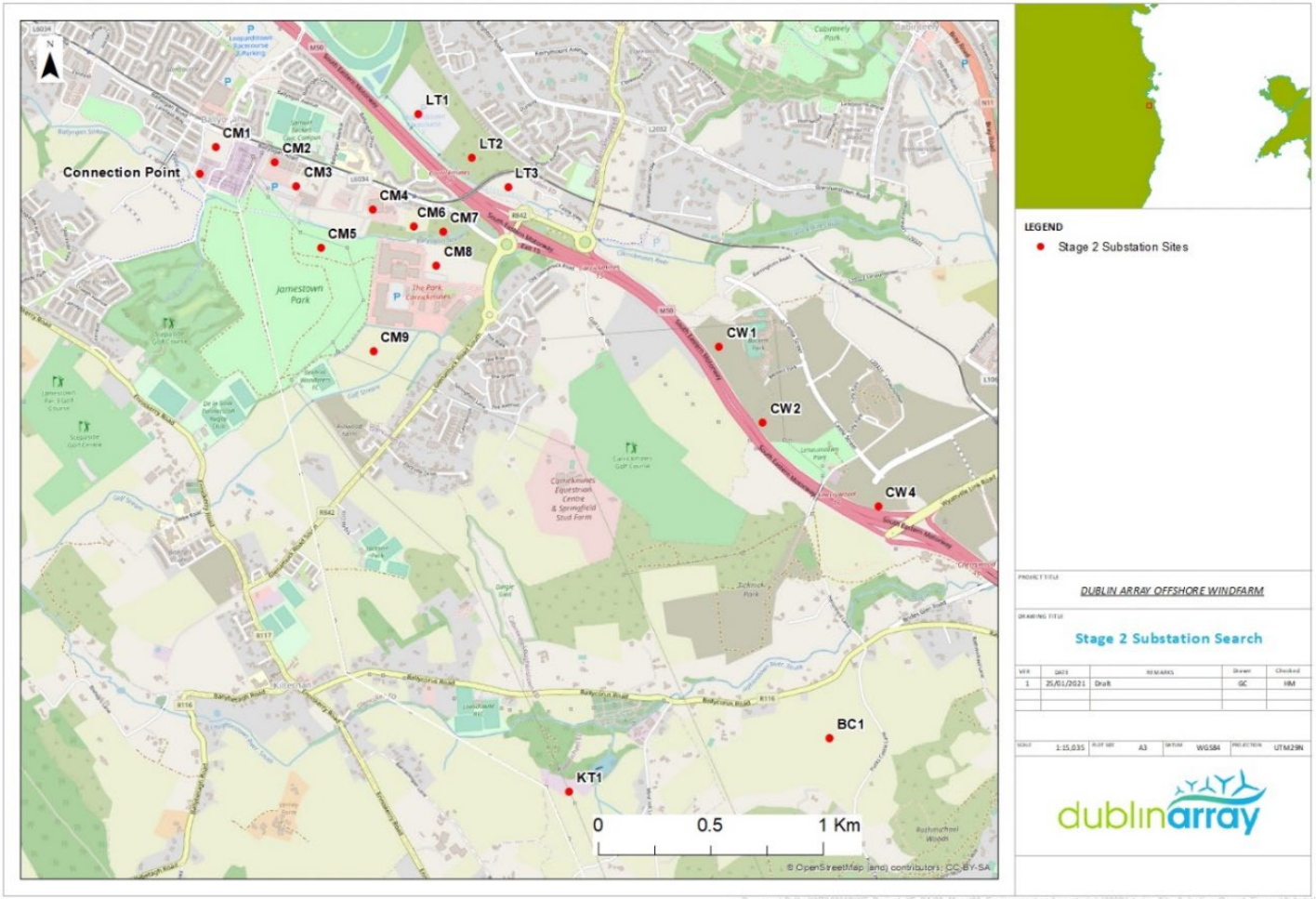


Figure 16 Long-list sites for initial screening

Table 22 Initial screening

	Site description	Comment	Screened in further assessment (Yes/No)
CM1	ESB Carrickmines Substation Landholding	EirGrid have advised that there is no land available for potential substation development within the existing landholding.	No
CM2	Ballyogan Business Park	Business Park fully occupied – no development opportunity identified	No
CM3	DLRCC Depot	Depot site fully occupied- no development opportunity	No
CM4	DLRCC Former Waste Baling Station (now Ballyogan Regional Temporary Rest Centre)	DLRCC have advised that the site is not available for development. Future waste management opportunities are being sought by DLRCC at this location.	No
CM5	DLRCC Recycling Park	Potential site development opportunity	Yes
CM6	DLRCC Land East of Waste Baling Station (now Ballyogan Regional Rest Centre)	Site size below minimum requirements	No
CM7	Park Development Lands – The Park	Planning permission has been secured for other purposes and site is now under development	No
CM8	Park Development Lands – Northern Area and Site Access	Planning permission has been secured for other purposes and site is now under development	No
CM9	Glenamuck Road – Future Employment Lands	Potential site development opportunity	Yes
LT1	Leopardstown Racecourse (car park)	Future residential development land – development zoning not consistent with large scale utility infrastructure.	No
LT2	Leopardstown Racecourse (site north of M50 LUAS Crossing)	Future residential development land – development zoning not	No

	Site description	Comment	Screened in further assessment (Yes/No)
		consistent with large scale utility infrastructure.	
LT3	Leopardstown Racecourse (site East of M50 LUAS Crossing)	Future residential development land – development zoning not consistent with large scale utility infrastructure.	No
CW1	Cherrywood Commercial Use Area 1	Potential site development opportunity	Yes
CW2	Cherrywood Commercial Use Area 2	Site size below minimum requirements	No
CW4	Cherrywood Commercial Use Area 4	Site size below minimum requirements	No
KT1	Kiltiernan Quarry	Potential site development opportunity within confines of former quarry works area	Yes
BC1	Ballycorus Road – Greenfield site	Development zoning to protect and improve rural amenity and to provide for the development of agriculture. Development zoning not consistent with large scale utility infrastructure.	No

5.10.12 On the basis of the initial screening assessment included in Table 22 above, the following locations were carried forward for detailed comparison;

- Option A – CM5 DLRCC Recycling Park;
- Option B – CM9 Glenamuck Road – Future Employment Lands;
- Option C – CW1 Cherrywood – Commercial Use Area 1; and
- Option D – KT1 Kiltiernan Quarry.

Figure 17 Short-list sites for initial screening

Option A – DLRCC Recycling Park

5.10.13 The site was located on land which was previously associated with the Ballyogan Landfill/Ballyogan Recycling Park and comprises of previously disturbed ground. The landfill operations have now ceased, and the landfill has been capped. The only operational activity still ongoing was as a recycling centre (Waste Licence No. W0015-01).

5.10.14 The site was approximately 50 hectares, 43 of which were previously used for landfilling. The remaining area consists of the site entrance and service roads, site compound, wetland and other services. The Ballyogan Recycling Park occupies a further 9 hectares. Land at Option A was previously used as settlement ponds for the landfill site however they have since been removed and the ground has been reinstated.

5.10.15 The straight-line distance to the existing Carrickmines substation is less than 300 m which will minimise the electrical losses and the risk of any potential for additional equipment. Notable features on site included two 38 kV/MV underground cables at the northern boundary of the site and two 110 kV overhead lines which traverse the site, however, this existing utility infrastructure was not considered to be a major impediment to the development of the site.

5.10.16 It was considered that Option A should be brought forward for further consideration. Technical issues with the site relate to the potential enabling works requirement associated with existing overhead line electricity transmission infrastructure crossing the site, road access upgrade works within the site boundary and ground conditions for civil works. However, on balance it is considered that these risks could be effectively managed through engagement with DLRCC, ESB/EirGrid and prudent engineering design.

Option B – Glenamuck Road Future Employment Lands

5.10.17 This site was located adjacent to the former Ballyogan Landfill site which lies to the west which in this area is categorised under zoning objective F 'To preserve and provide for open space with ancillary active recreational amenities'. The Carrickmines Park retail park is immediately to the north of the site. Several residential properties are located within 100 m to the east along Glenamuck Road, separated from the site by an agricultural field, trees and hedgerows. This area is zoned in the Kiltiernan Local Area Plan (LAP) (DLRCC, 2023) as mixed/higher density residential development and is therefore likely to be further developed for housing over the lifetime of the plan. Further housing is located beyond this toward the northern end of Glenamuck Road.

5.10.18 On the western edge of the new Glenamuck Road District Roads Scheme, the LAP notes a future provision of additional mixed-use development which will change the agricultural area over the life of the LAP.

5.10.19 The Option B site would need have to have road access from the Glenamuck District Distributor Road Scheme or the Carrickmines Retail Park. A new section of engineered road into the proposed substation site would have to be constructed with appropriate surface water drainage and utility services capacity.

5.10.20 The straight-line distance to the existing Carrickmines substation was approximately 1 km which is relatively short and will help minimise the electrical losses and the risk of any potential for additional equipment.

5.10.21 Whilst the site performed well under technical and economic criteria it scored less favourably on environmental and socio-economic matters due to the location of the proposed site and its proximity to potentially sensitive receptors. In addition, the general land development (ongoing and planned) in the area is for further intensification of residential development which increases the potential for the substation site to create a nuisance potential, particularly during the construction stage. This site was not considered any further as a result.

Option C – Cherrywood Commercial Use Area 1

5.10.22 Option C is located within zoning objective E 'To provide for economic development and employment' in the Dún Laoghaire-Rathdown County Development Plan 2016 – 2022 and is located in the Cherrywood Strategic Development Zone. The provision of a new substation is not open for consideration within the land-use objective; however, light industrial is permitted in principle though it is unclear in the Development Plan whether this would be a compatible use. A new access would also be required. It is considered that, given the requirements of a Strategic Development Zone to strictly adhere to the zoning objectives as set out in the Cherrywood SDZ Development Plan, provision of the substation at this location poses a significant planning risk.

5.10.23 The closest residential dwelling was located approximately 330 m north-east of Option C. However, there is a significant provision of residential and mixed-use development to be provided within close proximity to the location of Option C as set out in the Cherrywood SDZ Development Plan. Any impacts associated with the construction and operation of the substation were considered likely to be moderate.

5.10.24 The straight-line distance to the existing Carrickmines substation was approximately 2.3 km which is longer compared with options A and B. This would increase the electrical losses and the risk of any potential for additional equipment at the site.

5.10.25 Option C comparatively was considered to present significant risks when compared with other site option alternatives. One of the main potential risks with this option is that the Cherrywood SDZ Planning Scheme does not clearly indicate the intention, or suitability, of the location for a large-scale high voltage electricity substation. Recognising that a Planning Scheme provides greater specificity concerning acceptable land-use than a Local Area Plan or a County Development Plan, it was concluded to present considerable risk to successfully securing planning permission at this location.

5.10.26 Option C comparatively was considered to present significant risks when compared with other site alternatives. One of the main potential risks with this option is that the Cherrywood SDZ Planning Scheme does not clearly indicate the intention, or suitability, of the location for a large-scale high voltage substation. Recognising that a Planning Scheme provides greater specificity concerning acceptable land-use than a Local Area Plan or a County Development Plan, it is considered that this is a considerable risk to successfully securing development consent at this location.

5.10.27 From a technical perspective a key differentiating risk was site access. Access to the site was dependent on a number of future road construction projects within the Cherrywood development – the timing and delivery of which is outside of the control of this development.

5.10.28 Overall, it was considered that this option had some potentially significant risks to delivery and as a result was not considered further.

Option D – Kiltiernan Quarry

5.10.29 Option D is located within zoning objective D 'To protect and improve rural amenity and to provide for the development of agriculture' and immediately adjacent to zoning objective G 'To protect and improve high amenity areas' in the Dún Laoghaire-Rathdown County Development Plan 2016 – 2022. The provision of a new substation is open for consideration within the land-use objective. At the time lands comprised a disused quarry (a brownfield site).

5.10.30 Due to the surrounding existing and proposed land uses within the immediate area of the sites and its environs it was considered that the provision of new transmission electrical infrastructure at this location was not clearly compatible land-use with the objectives for the development plan and therefore was at significant risk of not being acceptable.

5.10.31 The closest residential dwelling was located approximately 100 m east of option D with five other residential dwellings within 300 m. Any impacts associated with the construction and operation of the substation was likely to be moderate to moderate high.

5.10.32 The straight-line distance to the existing Carrickmines substation was approximately 3 km which is the longest of any of the options. Also, a feasible cable route between the two sites would be significantly longer. This will increase the electrical losses and the risk of any potential for additional equipment.

5.10.33 Development of the site was determined to potentially require the relocation of three 110 kV overhead line circuits which traverse through the site however this would be dependent on the actual design of the substation and may remain in-situ. These consist of one single circuit overhead line and one double circuit overhead line.

5.10.34 Option D comparatively was considered to present significant risks when compared with other site alternatives. From a technical perspective, the narrow access route through Mine Hill Lane presents safety risks in addition to a potential need for localised enabling works being required to facilitate safe passage. In addition to this based on available geotechnical information there is a risk of encountered high groundwater on the site increasing the potential need for localised dewatering on the site. From a socioeconomic perspective this option is located within lands which are subject to zoning objective D 'To protect and improve rural amenity and to provide for the development of agriculture' and immediately adjacent to zoning objective G 'To protect and improve high amenity areas' in the Dún Laoghaire-Rathdown County Development Plan 2016 – 2022.

5.10.35 To this extent, whilst the quarry site has been the subject of previous 'industrial/employment' type activities it was considered that overall intention in the development plan is not for further industrial/utility type development at this location. Overall, it was considered that this option had some potentially significant risks and as a result was not considered further.

Summary of best performing option

5.10.36 The preferred site for the proposed substation has been identified as being Option A located adjacent to the former Ballyogan landfill within the Dún Laoghaire-Rathdown County Council Recycling Park.

5.10.37 The key differentiators for this site when compared with the alternative sites include in particular the former utility use of the site, suitable land-use zoning, the access options available from the Ballyogan Road, separation distance from residential dwellings and the effective screening available due to neighbouring land-use and landform. The environmental impacts of the preferred option have been documented in the Carrickmines Substation Site Selection Report (004283496-02, RWE, September 2022) included in Volume 6, Appendix 6.5.1-1 of the EIAR.

5.11 Alternative onshore cable corridor options

5.11.1 The onshore cable route describes the double 220 kV high-voltage alternating-current (HVAC) circuits running from the Landfall Site at Shanganagh Cliffs to the onshore substation at the Ballyogan Recycling Park before reaching the national grid. The onshore cables connect the TJBs at the Landfall Site to the GIS switchgear building in the proposed OSS.

5.11.2 Both overhead lines and underground cables would be technically feasible to connect the offshore infrastructure to the national electricity transmission network. However, given the complexities with installing overhead lines in a densely populated urban area and DLRCC Development Plan Objective EI19 Overhead Cables setting land-use planning policy for undergrounding of electricity cables, an early decision was taken during the project development to not progress an overhead grid connection option and therefore only underground cable route options were considered for the proposed development.

5.11.3 A route selection process was undertaken to identify an emerging preferred route from the landfall locations at Shanganagh and the onshore substation at the Ballyogan Recycling Park. This is set out in the Onshore Cable Route Selection Report (004670576-02, RWE, April 2024) included in Volume 6, 6.5.1-2 of the EIAR.

5.11.4 The study area for the potential cable route options was defined by the potential landfall locations at Shanganagh Cliffs and Shanganagh Park and the Carrickmines substation location. Two landfall options were identified for the purposes of onshore cable route selection, one at Shanganagh Cliffs and one at Shanganagh Park, based on proximity to the wind farm, proximity to the grid connection point, prevailing suitable geomorphology (avoidance of high cliffs/elevated terrain) and the existence of sufficient space for construction of transition joint bay infrastructure. Following a site selection process as described in Section 5.7, the emerging preferred landfall location was identified as Shanganagh Cliffs.

5.11.5 The proposed onshore substation site is located approximately 700 m east of the existing Carrickmines 220 kV substation in the Ballyogan Recycling Park.

5.11.6 The cable route study area is shown in Figure 18 and is defined to the east by the coastline and the two viable landfall locations and to the west by Carrickmines 220 kV substation. The northern extent is defined by the N11 and dense housing development and to the south by agricultural land & semi-urban ribbon development and the foothills of the Dublin mountains.

5.11.7 The study area was reduced to a 4 km radius centered at Junction 16 of the M50 motorway, which is roughly equidistant between the landfall at Shanganagh (TJB location) to the onshore substation at the Ballyogan Recycling Park. This area is the 'Wider Study Area' (WSA) and illustrated in Figure 9 in black. In general, longer cable routes can result in increased electrical losses and can create the need for additional electrical equipment at the substation, which would require a larger land take for the substation site. Shorter cable routes support more efficient transmission of electricity from the wind farm to the national electricity transmission grid.

5.11.8 The WSA was reduced to a 'Local Study Area' (LSA) as shown in red in Figure 18, having regard to prevailing land-use and development policies included in the Dún-Laoghaire Rathdown County Development Plan (DLRCDP) 2022-28.

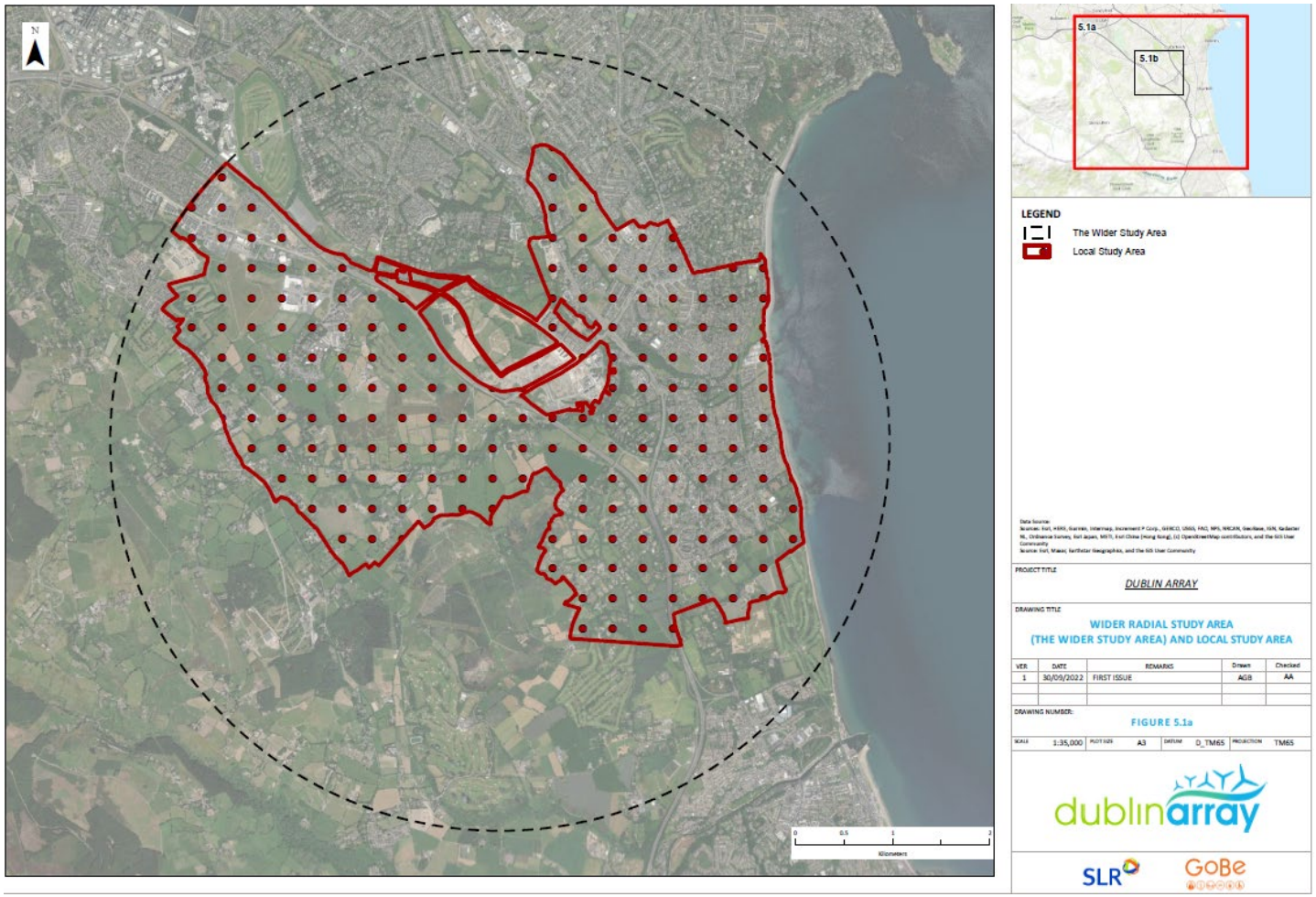


Figure 18 WSA and LSA from the onshore substation and the Landfall

5.11.9 The assessment was informed by a combination of desk-based research, utility information sourced from utility providers or site-specific surveys and field inspections by a combination of technical and environmental specialists. The assessment was based on the development of two parallel 220 kV underground cable circuits and its associated joint bay infrastructure (approximately every 500 to 600 m) to ensure that the full extent of the necessary infrastructure would be taken into consideration.

5.11.10 Considering these assumptions, seven cable route options were identified within the LSA. The seven cable route options have been designed using the Dublin Array Geographical Information System (GIS), which allows known relevant data and constraints to be easily mapped and route options drawn so as to minimise the impacts which would arise from development of the cable route. Information gathered through consultations, sites surveys, and desktop information were used to inform the process. The selection of the proposed seven cable route options were based on the following principles:

- Maximise the use of the national, regional and local roads (avoid motorways where possible)[10];
- Avoid town centres and industrial estates;
- Avoid private and agricultural land where possible;
- Avoid sensitive natural and built heritage locations;
- Minimise impact on communities; and
- Minimise the overall length of the route.

5.11.11 A multi-criteria analysis was employed to rank the overall performance of each route in comparison with each other. The main criteria considered related to;

- Technical;
- Environmental;
- Socio-economic; and
- Economic criteria.

5.11.12 The combined performance of these criteria for each route identified the overall best performing route; the emerging preferred cable route.

[10] This is based on EirGrid's,' 'OFS-CAB-101-R2 220 kV and 400 kV Underground Cable Function Specification' which states a preference for cables to be located in public roads over private lands.

5.11.13 Technical criteria taken into consideration were Construction Disruption (traffic management and public access), Joint Bay Location Suitability, Constructability (major and minor crossings) and Utility Congestion/Interference. The Economic performance criteria included the overall length of cable installed and number of joint bays. The Environmental impact criteria included impact assessment on Biodiversity, Landscape and Visual, Archaeology/Architectural/Cultural Heritage, Water Resources/Flood Risk, Soils/Geology/Hydrogeology and Noise/Air. The Socio-economic performance criteria included Population and Economics, Planning Applications, Land – use Patterns, Existing Utilities and Recreation and Tourism.

5.11.14 The proposed route options are all entirely within the functional area of DLRCC and are outlined as follows and illustrated in Figure 19.

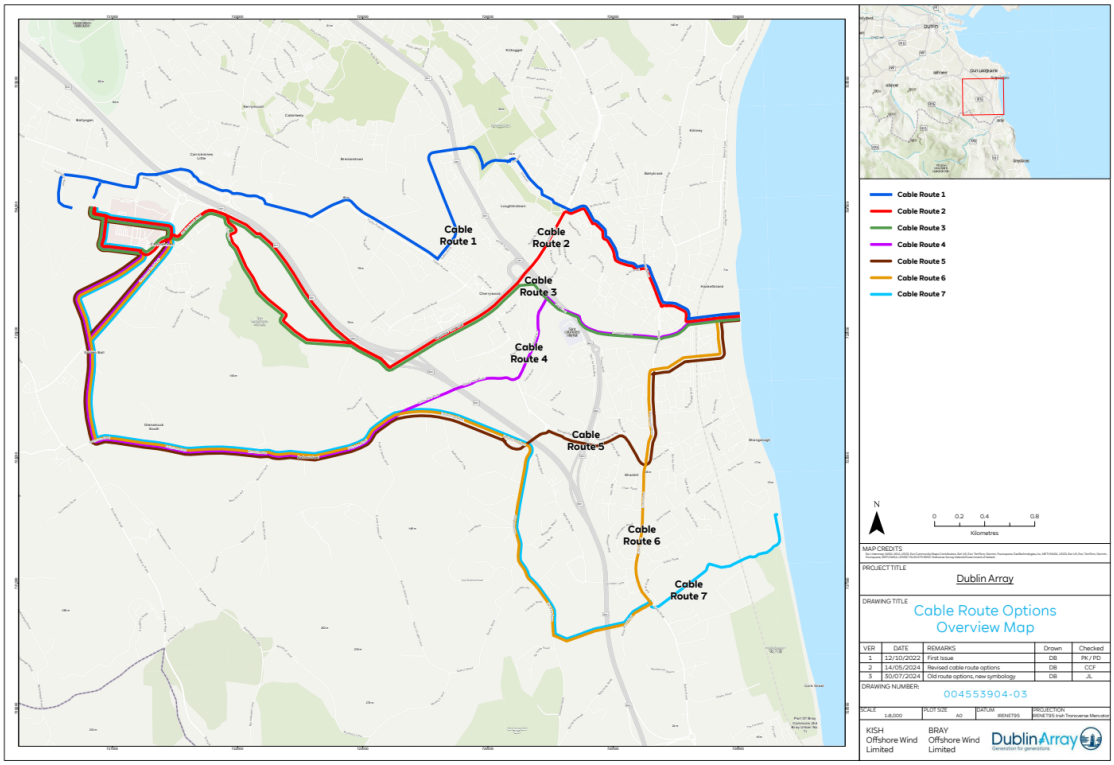


Figure 19 Onshore cable route options considered in the Route Selection Report

Route 1

5.11.15 The proposed onshore route Option 1 originates at the landfall site at Shanganagh Cliffs and progresses in a westerly direction through the adjacent park and under the community gardens. The route then crosses under the DART line and heads north onto Bayview Crescent, through the roundabout and up along Shanganagh Road. From here it will continue for approx. 0.3 km and turning left onto the Achill Road before continuing into the Glenavon Park and Glenavon Park road. The route joins onto the Wyattville Road and crosses the R118 into the Wyattville Park and into the Coolevin Lane before turning off and around the perimeter of the Cabinteely Athletic Running track. From here, the route crosses the N11 into Orchard Square and heads south along the park, routing west onto the Grand Parade and heading north and turning left onto the new section of road and through the next two roundabouts before diagonally crossing the M50. The route passes via the Ballyogan Road routing directly behind the Ballyogan Recycling Park and into the substation.

Route 2

5.11.16 The proposed onshore route Option 2 originates at the landfall site at Shanganagh Cliffs and initially heads directly west inland through the adjacent park and under the community gardens. The route then crosses under the DART line and heads north onto Bayview Close, through the roundabout and up along Shanganagh Road. From here it continues for approximately 0.3 km and turns left onto the Achill Road before continuing into the Glenavon Park and Glenavon Park road. The route joins onto the Wyattville Road and onto the R118 for 1.0 km before crossing the M50 and then along the west side of the M50 as an option A and B. Both option A and B then turn off onto Golf Lane until the roundabout and connects in along the new Glenamuck Distributor Road, around the perimeter of the Carrickmines retail park and into the substation.

Route 3

5.11.17 The proposed onshore route Option 3 originates at the landfall site at Shanganagh Cliffs and initially heads directly inland west through the adjacent park and under the community gardens. The route crosses under the DART line towards Commons Road and crossing the N11 road. The route then runs parallel to the N11 and turns left onto the R118 regional road, crossing the M50 travelling northwards. The route then follows the alignment of Golf Lane until the roundabout and connects in along the new Glenamuck Distributor Road, around the perimeter of the Carrickmines retail park and into the substation.

Route 4

5.11.18 The proposed onshore route Option 4 originates at the landfall site at Shanganagh Cliffs and initially heads directly inland west through the adjacent park and under the community gardens. The route then crosses under the DART line and following inland along Commons Road through to the N11. The route crosses the N11 and follows along Cherrywood Road. At the roundabout the route continues along Brides Glen Road, crossing under the M50 and further onwards along Ballycorus Road. The route turns up north at the new Glenamuck Distributor Road and along the Glenamuck Road into the substation via the Carrickmines retail park.

Route 5

5.11.19 The proposed onshore route Option 5 originates at the landfall site at Shanganagh Cliffs and initially heads directly inland west through the adjacent park and turning off down along the Shanganagh Cliffs roadway to the east of the residential area. The route then turns perpendicular onto the Shanganagh Cliffs residential road and under the DART line. This will route alongside the hedgerows until Shanganagh Road and continue further south along the R119. The route takes a 270-degree bend at the roundabout adjacent St. Anne's Roman Catholic Church and back up along the Dublin Road thereafter joining Stonebridge Road. A trenchless crossing will be required from the carpark at St. Anne's National School under the M11 motorway. The route then crosses the M50 before heading onto Rathmichael Road, then carrying onwards along Ballycorus Road. The route turns up north at the new Glenamuck Distributor Road and along the Glenamuck Road into the substation via the Carrickmines retail park.

Route 6

5.11.20 The proposed onshore route Option 6 originates at the landfall site at Shanganagh Cliffs and initially heads directly inland west through the adjacent park and turning off down along the Shanganagh Cliffs roadway to the east of the residential area. The route then turns perpendicular onto the Shanganagh Cliffs residential road and under the DART line. The route then continues towards Shanganagh Road and continues further south along the R119 until it crosses with Allies River Road. From here, the route crosses under the M11 crossing agricultural land to Ferndale Road. The route continues along Ferndale Road joining up with Rathmichael Road and Brides Glen Road, then carrying onwards along Ballycorus Road. The route turns up north at the new Glenamuck District Distributor Road and along the Glenamuck Road into the substation via the Carrickmines retail park.

Route 7

5.11.21 The proposed onshore route Option 7 landfalls at Shanganagh Park routing down along the outskirts of the dog park and Shanganagh playing pitches. The route crosses the R119 and into Allies River Road prior to crossing under the N11 road. The route thereafter crosses agricultural land until Ferndale Road. The route follows Ferndale Road heading north until it converges with Rathmichael Road and Brides Glen Road, then carrying onwards along Ballycorus Road. The route turns up north at the new Glenamuck Distributor Road and along the Glenamuck Road into the substation via The Carrickmines retail park.

Table 23 Overall summary of the route selection report assessment

Route Option	1	2	3	4	5	6	7
Environmental & Socio economic							
Technical							
Economic							
Overall Performance							

5.11.22 The results of the multi-criteria analysis are set out in Table 23 above, which identified route options 1 and 2 as the best performing routes overall. Route options 5, 6 and 7 scored a higher socio-economic impact comparatively with a greater potential impact to local communities. Route options 3 and 4 had significant technical challenges specifically along Commons Road where utility congestion eliminated the opportunity to route a double circuit along this road section.

5.11.23 A number of route sections along route Option 1 were located with the consented Cherrywood Planning Scheme (a permitted strategic development zone in the DLRCDP 2022-28). This area has a number of road infrastructure projects and housing developments at various stages of design maturity. Engagement with DLRCC and other developers indicated that there would be substantial uncertainty that there would be sufficient available space for the onshore cable route in proposed road infrastructure (including Junction Q, Grand Parade and Castle Street).

5.11.24 Considering this feedback, particularly relating to route Option 1 and the uncertainties around Cherrywood development, route Option 2 was identified as the emerging preferred route.

5.11.25 The risks along the emerging preferred route were assessed and through continued consultation with DLRCC, EirGrid and members of the public during the Dublin Array Public Consultation 2023 a number of variations in design and location were made to optimise the route. These included employing trenchless technology to avoid direct works on significant transport networks such as the N11 and the proposed Glenamuck District Distributor Road. In addition, to further reduce potential for traffic disruption and construction impacts, an opportunity was identified to use a section of planned road network (Beckett Road as set out in the Cherrywood Planning Scheme) with spare electrical duct capacity. Using this pre-installed underground electrical duct capacity means that during the construction phase of the project there would be no need to excavate trenches for the purposes of the cable installation – it would only require the pulling of the electricity cables through those ducts. The four variations along the emerging preferred cable route are described in detail in section 11.2 of the Onshore Cable Route Selection Report in Volume 6, 6.5.1-2 of the EIAR.

5.11.26 Figure 20 illustrates the preferred route (green) with the sections removed in grey.

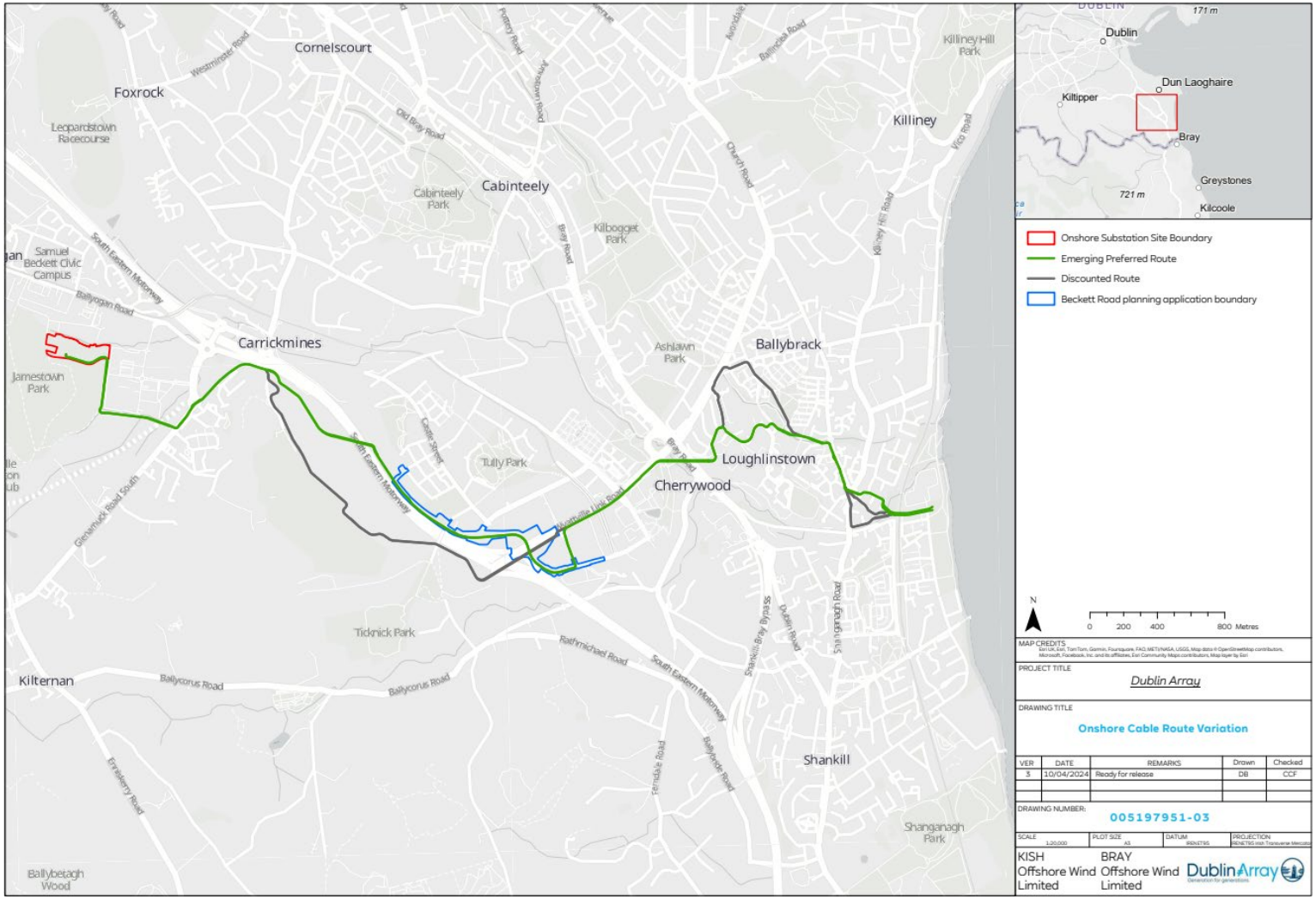


Figure 20 The emerging preferred cable route with variations outlined

5.12 Operations and Maintenance (O&M) Base

5.12.1 During the operational phase, Dublin Array will require ongoing planned and reactive maintenance. A team of approximately 80 personnel, based in an Operations and Maintenance (O&M) Base will co-ordinate, manage and undertake this maintenance during the lifetime of the development. The O&M Base comprises control room (for remote monitoring of the wind farm and associated maintenance and inspection activities) offices, welfare facilities, berthing facilities for crew transfer vessels (CTVs) and a warehouse for the storage of small partes and equipment.

5.12.2 The Applicant completed a two-phase site suitability and feasibility study to identify potential site locations for the proposed O&M Base in October 2019. The stage 1 desk study assessed the suitability of six ports/harbours along the east coast from Howth Harbour in the north to Wicklow Port in the south. These locations were chosen as they were in close proximity to the offshore infrastructure.

5.12.3 The following aspects were taken into consideration;

- The requirement of a maximum transit time of 1 hour to the wind farm (for the reasons outlined below);
- Sheltered vessel moorings to suit up to 4 No. CTVs, with facility to allow for easy loading & unloading of spare parts and equipment;
- Tide independent berth depth of at least 2 m at lowest astronomical tide (LAT) with unrestricted water access and 24-hour work allowance for personnel including 24/7 departure to the offshore wind farm;
- Constructability of the proposed development, including economic viability;
- An internal storage area of 1,000 m² minimum for tools and spare parts;
- Local infrastructure/amenities for personnel including effective access to the public road network and public transport links;
- A quayside lifting capability to lift equipment/parts from shore to the CTV if necessary;
- A local skills base with mechanical and electrical technicians and familiarity with equipment/spares and necessary maintenance requirements; and

- Environmental impact on existing activities including navigation and leisure activities and proximity to designated sites. Environmental impact through minimisation of fuel consumption by CTVs in transiting to the wind farm.

5.12.4 For O&M ports/harbours, a transit distance larger than 25 nm (nautical miles) (approximately 46 km) to the wind farm does not meet the minimum project performance criteria based on travel time and fuel consumption. For transit distances greater than 25 nm to an O&M base, transit durations increase to more than 3 hours which negatively impacts the effectiveness of offshore technicians.

5.12.5 Figure 21 shows the Dublin Array site with transit distances in 5 nm increments.

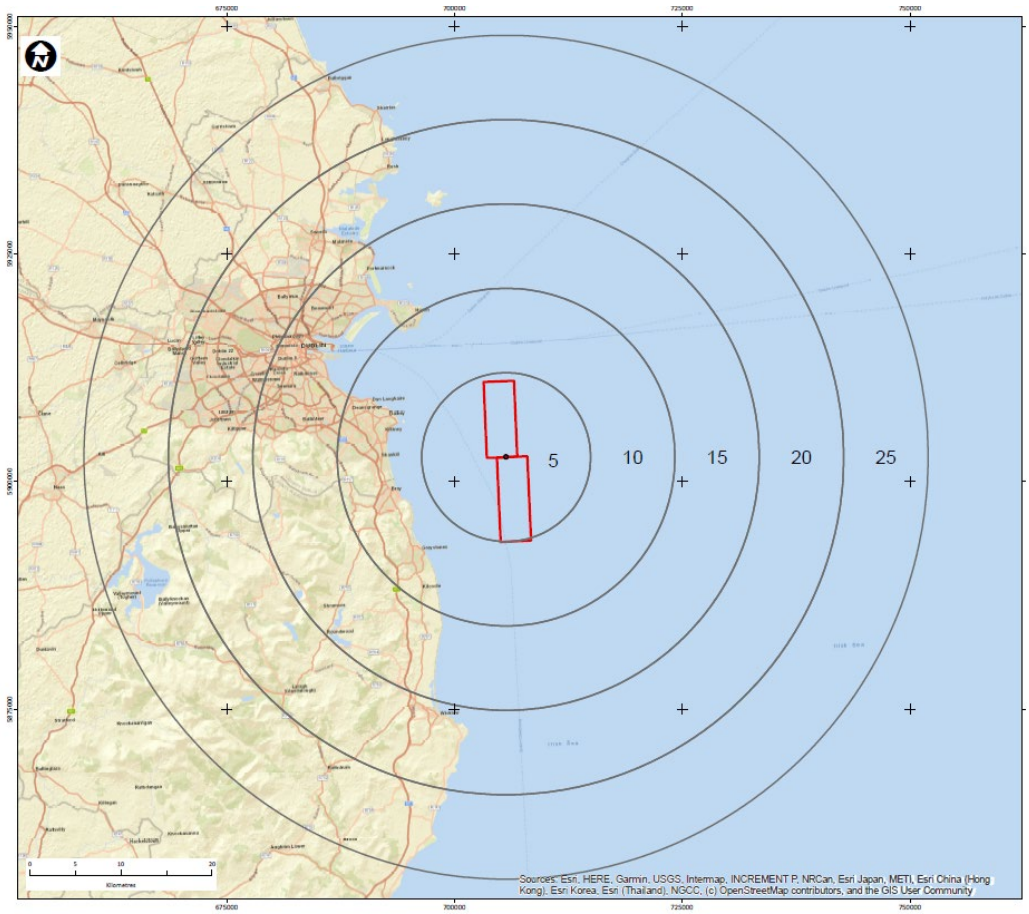


Figure 21 Dublin Array Offshore Wind Farm CTV transit distance

Alternative O&M Base locations

5.12.6 Based on the above minimum screening criteria assessment the following locations were identified for further consideration;

- Howth Harbour;

- Dublin Port;
- Dún Laoghaire Harbour;
- Bray Harbour;
- Greystones Harbour; and
- Wicklow Harbour.

Howth Harbour

5.12.7 Howth Harbour, located on the north side of Dublin Bay, is a mixed-use commercial and recreational harbour managed by the Department of Agriculture, Food and the Marine (DAFM). The western side of the harbour is primarily used by fishing vessels, while the eastern side consists mainly of swing moorings and pontoons for leisure craft. The west pier, approximately 240 m in length, offers water depths suitable for CTV operations.

5.12.8 The harbour was considered to be easily accessible via road and public transport, benefiting from strong road and rail links to Dublin City and Dublin Airport. At the time of assessment, the harbour included a functional shipyard with electric and fresh water supply available on the quayside. The local supply base offered a robust level of mechanical, electrical, and radio repair services, along with a vessel lift capability of up to 600 tonnes. Additionally, a slipway launch facility was present on site.

5.12.9 In October 2019, a meeting was held with the Howth Harbour Master to explore potential options within the port. The only site identified as a viable option for the proposed O&M Base was the fisheries office and the adjacent (redundant) ice warehouse.

Dublin Port

5.12.10 Dublin Port is Ireland's largest freight and passenger port and is classified as a Tier 1 Port under the National Ports Policy.

5.12.11 The port is easily accessible via road and public transport with a good road and tram link to Dublin City, and a good motorway link directly to Dublin M50/M1 and the Airport. Dublin Port's Masterplan 2012-2040, outlines major development projects, on both the north side of the Port and on the Poolbeg Peninsula (to the south of the main navigational channel). The re-development plans are focussed on large freight and passenger services.

5.12.12 A meeting was held between Dublin Port and the Dublin Array project team in 2019 to assess the feasibility of locating an O&M base on port lands. The meeting concluded that the land to the north of the river was not feasible for an O&M base due to current port usage and predicted demands. Lands to the south of the navigation channel on the Poolbeg peninsula were also heavily restricted due to the Dublin Port Company Masterplan 2040 development.

5.12.13 A potential site was identified on the Poolbeg peninsula which would potentially be suitable for an O&M base. However, the site was undeveloped and was considered to require extensive engineering works to deliver the space, access and berthing infrastructure to meet the project requirements and was not progressed for further consideration.

Dún Laoghaire Harbour

5.12.14 Dún Laoghaire harbour was managed by the Dún Laoghaire Harbour Company until the company was dissolved in 2018 prior to its transfer to Dún Laoghaire-Rathdown County Council (DLRCC).

5.12.15 The ferry terminal and associated services were a significant income stream for the Harbour Company prior to it ceasing to operate in 2015. Permission was granted in 2018 for the change of use for the Ferry Terminal building to a co-working space (planning register reference D18A/0078). The harbour is easily accessible via road and public transport with a good road and train link to Dublin City and Dublin Airport.

5.12.16 The range of general harbour activities within Dún Laoghaire Harbour consists of a mix of harbour operation and maintenance activities, commercial and leisure uses ranging from commercial activities on Carlisle Pier, St. Michaels Pier and Traders wharf, as well as leisure activities on the existing marinas, pontoons and slipways within the harbour. The harbour is enclosed by two piers, East and West Pier which provide shelter within the harbour.

5.12.17 A meeting was held between DLRCC and the Dublin Array project team in October 2019 with the aim of identifying potential locations within the harbour that would be suitable for an O&M base. A key consideration within the harbour was a combination of berth space availability (for CTVs) and land space availability (for O&M Base buildings and quayside space for parts handing and deliveries). Good berthing facilities for CTVs were identified in the western side of the harbour which was well sheltered. The marine space at this location is shared with leisure craft and marinas which introduced potential for significant marine traffic interactions during busier leisure periods. No space was identified landside at this location which could accommodate the development of an O&M base.

5.12.18 The eastern side of the harbour was identified as having large pre-existing marine infrastructure associated with previous ferry options. The general area of St. Michael's Pier was identified as having potential for both water-side infrastructure (berthing) and land-side building space. The proximity of this location to the entrance channel for the harbour was identified as a significant benefit in reducing marine traffic interactions. Dún Laoghaire Harbour was screened in for further assessment.

Bray Harbour

5.12.19 Bray Harbour is a tidal harbour located 10 miles south of Dublin Bay. At the time of assessment, the harbour was used solely for leisure activities. The harbour is accessible via road and public transport with good road and train links to Dublin City and Dublin Airport.

5.12.20 Following a meeting with the Wicklow County Council Port and Harbour Senior Marine Officer in 2019, certain limited land side development opportunities were identified, however, the marine development would require significant capital dredge and harbour improvement works and therefore the harbour was discounted from further consideration.

Greystones Harbour

5.12.21 Greystones Harbour has been significantly developed and upgraded historically into a modern marina. The development consisted of a deep-water marina, berthing for leisure craft and significant quantities of residential development. The harbour is easily accessible via road and public transport with a good road and train link to Dublin City and Dublin Airport.

5.12.22 Whilst suitably located, the harbour did not have marine or land capacity to locate an O&M Base without securing access to significant marine space and land-side space therefore the harbour was discounted from further consideration.

Wicklow Port

5.12.23 Wicklow Port is a small to medium commercial port that, as of 2016, is owned by Wicklow County Council. Whilst not the closest port to Dublin Array, the port has the potential for both land and quayside access that would suit the wind farm. The port is easily accessible via road and public transport with a good road and train link to Dublin City and Dublin Airport.

5.12.24 Following a meeting with the Wicklow County Council/Harbour Senior Marine Officer, limited land-side development opportunities were identified with a requirement to provide shelter for any potential marine infrastructure. The general harbour was also the subject of on-going consideration by other offshore wind farm developers due to its proximity to the prospective Arklow Bank and Codling Wind Park projects. As no specific development or re-use opportunities were identified within the harbour which could accommodate the projects requirements, coupled with its distance from the Dublin Array wind farm, this location was not progressed for further consideration.

Transit distance and fuel consumption

5.12.25 In addition to the above, for each of the individual port/harbours the distance to the wind farm array, the transit times and anticipated fuel consumption associated with CTV journeys was considered.

Table 24 Expected CTV fuel emissions

Port	Distance to middle of Kish Bank (km)	Distance to middle of Bray Bank (km)	Average (km)	Fuel consumption lifetime litres for CTV (litres)	Emissions over lifetime (tCO2e[11])	Transfer time in minutes (assuming 25 knot CTV)
Howth	16.9	25.23	21.1	5,417,661	7,018	27
Dublin Port	22.2	28.8	25.5	6,555,177	8,492	33
Dún Laoghaire	14.9	20.2	17.5	4,515,360	5,849	23
Bray	13.6	12.9	13.3	3,413,833	4,422	17
Greystones	16.2	11.4	13.8	3,544,937	4,592	18
Wicklow	32.8	28.8	25.5	6,555,177	8,492	33

[11]Tonnes of carbon dioxide equivalent

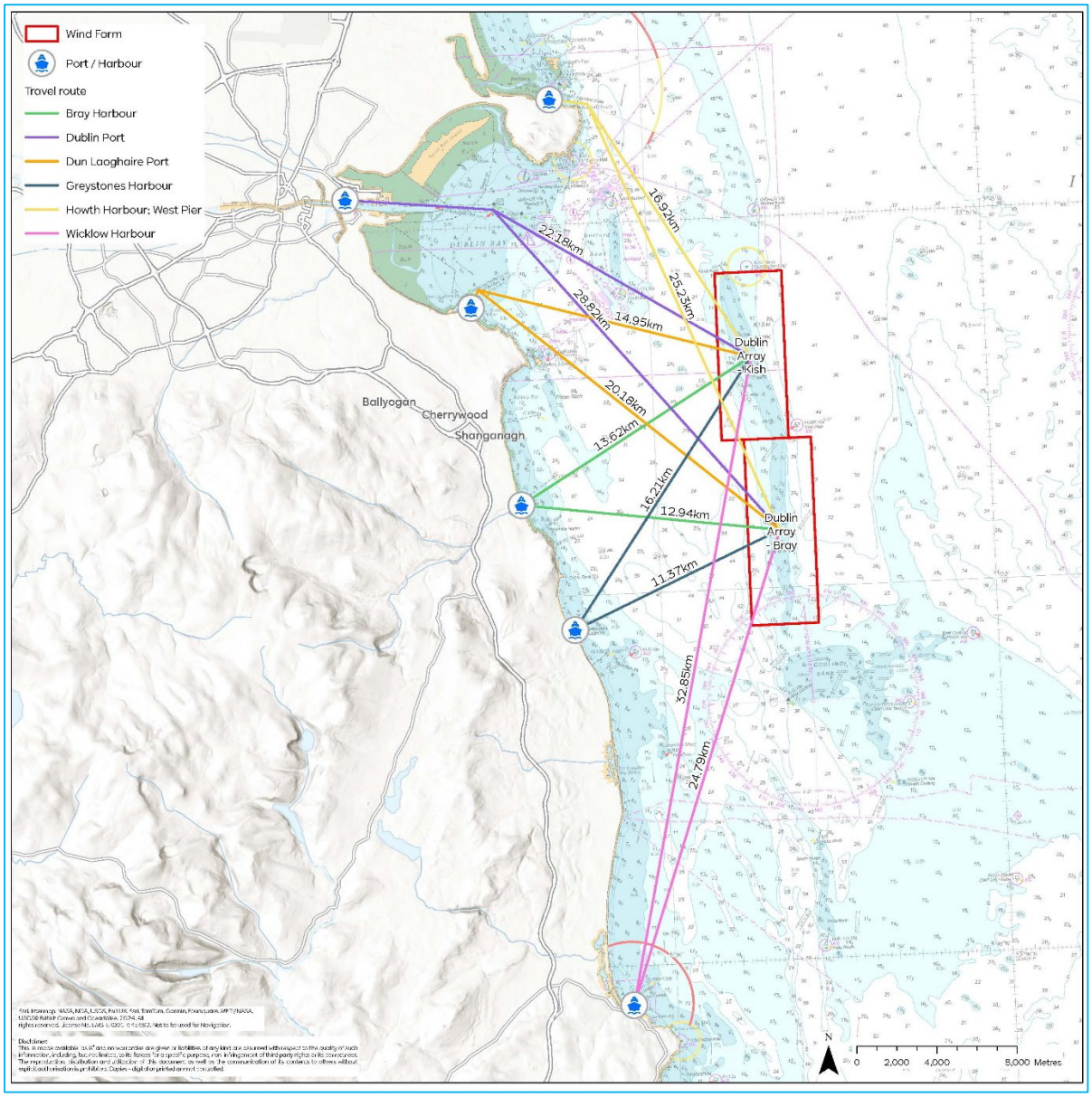


Figure 22 Potential CTV routes to Dublin Array Wind Farm

Summary of screening of sites for O&M Base

5.12.26 Due to the existence of significant land-side or marine-side development/reuse constraints all of the identified ports/harbours (with the exception of Dún Laoghaire Harbour and Wicklow Port) lacked potential as an O&M Base for the Dublin Array wind farm. When comparing the transit times, the effective operating conditions for wind farm technicians, and the environmental criteria of minimising fuel consumption and carbon emissions over the life of the project, Dún Laoghaire Harbour emerged as the preferred location for the O&M Base.

Preferred O&M Base location

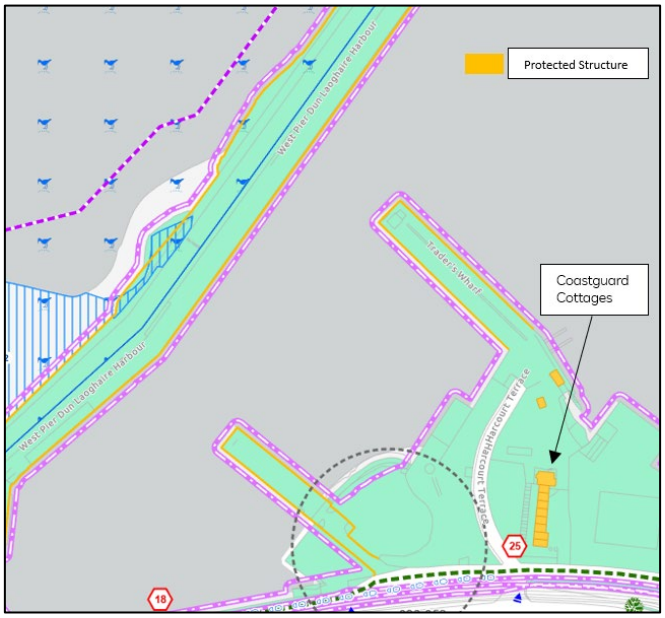
5.12.27 Dún Laoghaire Harbour was identified as having the highest suitability to locate the Dublin Array O&M Base. In consultation with DLRCC Harbours Operations team, two areas within the harbour were identified as potentially having capacity to accommodate the proposed development – Coal Quay and St. Michael's Pier – the locations of which can be seen in Figure 23

Figure 23 Potential locations of O&M Base in Dún Laoghaire Harbour (Source: Google Maps)

Coal Quay

5.12.28 An area in the vicinity of the Coal Quay, the oldest structure within the harbour, was initially identified as a potential O&M Base location. This area is currently being used mainly as a boat yard for members of the public who do not have access to yacht clubs or boat storage facilities. It also consists of a public slipway and public car parking to the west of the potential O&M Base.

5.12.29 The area consisted of a number of vacant 19th century coastguard cottages and boat houses which were reviewed to determine their potential for re-use/redevelopment as a building/series of buildings to support the O&M operations. Following an assessment of the area it was deemed that the space available was not sufficient to serve as an O&M Base without significant clearance/redevelopment of existing structures and existing commercial activities within the general area. Existing structures include both a boathouse and coastguard station which are legally protected structures due to their



cultural/architectural heritage significance constraining their potential for demolition or repurposing.

Figure 24 Extract from the Dun Laoghaire Rathdown Development Plan 2022 – 2028

St Michaels Pier

5.12.30 The second area assessed within the harbour included an area adjacent to the existing St. Michael's Pier, which is the site of the former ferry terminal. The ferry terminal was previously used for the Stena Line high-speed ferry service between Dún Laoghaire and Holyhead, Wales. Ferry operations using the terminal and berthing (Berth No. 5) at this location ceased in 2015.

5.12.31 The immediate surroundings of the site are used on a daily basis for harbour-related uses. This includes a maintenance depot and service yard for maintenance activities associated with harbour operations by DLRCC. The current infrastructure within the site includes a parking area, office buildings, storage buildings and storage containers. The pier also supports the existing single-storey harbour maintenance building. A redundant roll on/roll-off (Ro-Ro) ramp structure is located at Berth 5 which was previously used for the drive-on /drive-off car ferry terminal (see Figure 25). This structure is currently used as a storage area for the harbour maintenance team.

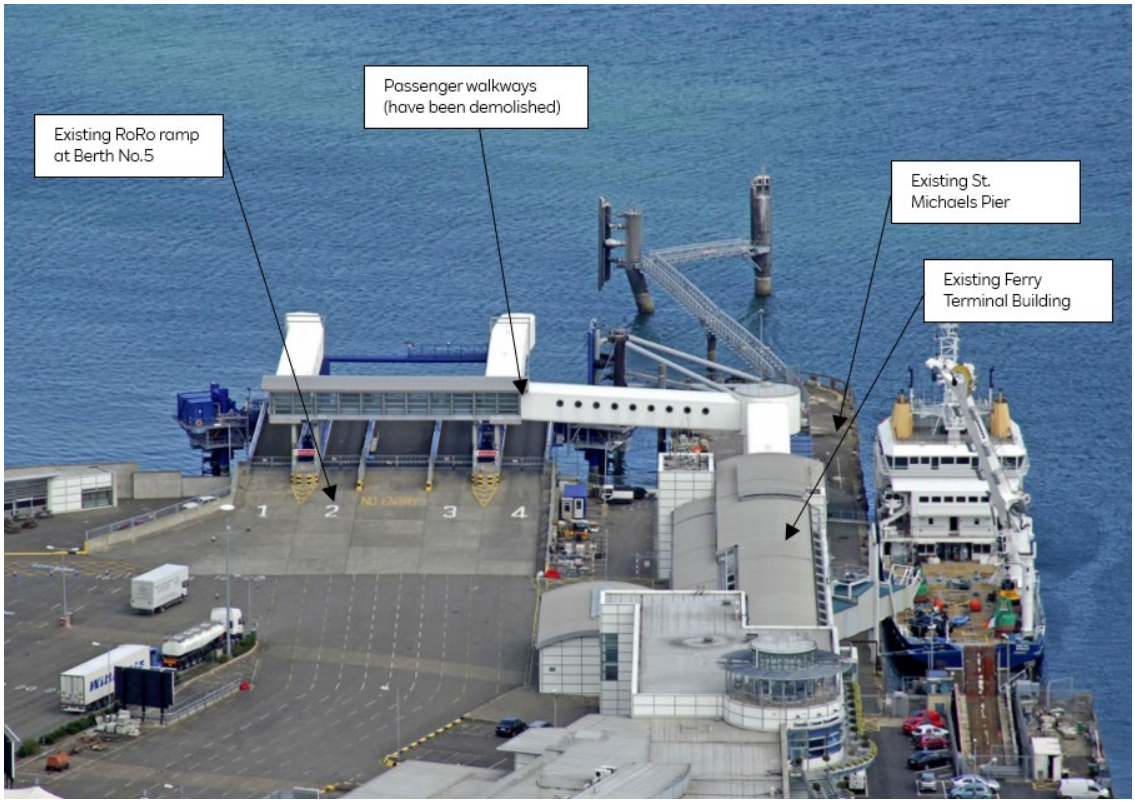


Figure 25 Image of previous ferry operations in Dún Laoghaire Harbour (source: www.marinas.com)

5.12.32 The development of an O&M Base (land-side and water-side infrastructure) requires the demolition of an existing maintenance workshop, redundant ferry infrastructure (fender panel and RoRo ramp). Unlike any potential development in Coal Quay, none of these structures are protected from a cultural heritage/architectural heritage perspective.

5.12.33 It was considered that developing a building on St. Michael's Pier (consistent in scale and form with the existing former ferry terminal building) and the provision of a mooring pontoon at Berth No. 5 would be consistent with the type of infrastructure and use of this location historically. In addition, the provision of a new pontoon at Berth No. 5 would mean that any CTV traffic associated with the O&M Base will be located immediately adjacent to the base itself eliminating any inefficiencies with travel distances for staff and consumables between the base and the pontoon.

5.12.35 The close proximity of this location to the offshore wind farm means that sailing times of the CTVs to the OWF will be in the region of 20 minutes which will have significant beneficial effects such as;

- Lowering fuel consumption (quantities, costs and emissions) from CTVs compared to other locations assessed (as presented above, in Table 24, section 5.12.25);
- CTVs will be transferring hundreds of people to the OWF over the operational lifetime of the development. Long transfers to the OWF from the O&M base prolongs exposure to general risks of working at sea, increases the length of the working day, and increases the possibility of sea sickness on employees. Therefore, reducing the sailing time of a CTV will reduce the likelihood of negative health impacts on employees; and
- The O&M base is likely to generate significant local economic benefit locally and in the wider Dublin area, which is further considered in Volume 3, Chapter 17 of the EIAR.

5.12.36 The Operations and Maintenance Base in in Dún Laoghaire Harbour is discussed further in Volume 2, Chapter 6: Project Description of the EIAR.

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