LLŶR FLOATING OFFSHORE WIND PROJECT

Llŷr 1 Floating Offshore Wind Farm

Environmental Statement

Volume 1: Chapter 03 – Site Selection and Alternatives

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FLOVENTIS ENERGY

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Glossary of project terms

Term	Definition
The Applicant	The developer of the Project, Llŷr Floating Wind Limited.
Array	All wind turbine generators, inter array cables, mooring lines, floating sub-structures and supporting subsea infrastructure within the Array Area, as defined, when considered collectively, excluding the offshore export cable(s).
Array Area	The area within which the wind turbine generators, inter array cables, mooring lines, floating sub-structures and supporting subsea infrastructure will be located.
Floventis Energy	A joint venture company between Cierco Ltd and SBM Offshore Ltd of which Llŷr Floating Wind Limited is a wholly owned subsidiary.
Landfall	The location where the offshore export cable(s) from the Array Area, as defined, are brought onshore and connected to the onshore export cables (as defined) via the transition joint bays (TJB).
Llŷr 1	The proposed Project, for which the Applicant is applying for Section 36 and Marine Licence consents. Including all offshore and onshore infrastructure and activities, and all project phases.
Marine Licence	A licence required under the Marine and Coastal Access Act 2009 for marine works which is administered by Natural Resources Wales (NRW) Marine Licensing Team (MLT) on behalf of the Welsh Ministers.
Offshore Development Area	The footprint of the offshore infrastructure and associated temporary works, comprised of the Array Area and the Offshore Export Cable Corridor, as defined, that forms the offshore boundary for the S36 Consent and Marine Licence application.
Offshore Export Cable	The cable(s) that transmit electricity produced by the WTGs to landfall.
Offshore Export Cable Corridor (OfECC)	The area within which the offshore export cable circuit(s) will be located, from the Array Area to the Landfall.
Onshore Development Area	The footprint of the onshore infrastructure and associated temporary works, comprised of the Onshore Export Cable Corridor and the Onshore Substation, as defined, and including new access routes, that forms the onshore boundary for the planning application.
Onshore Export Cable(s)	The cable(s) that transmit electricity from the landfall to the onshore substation.
Onshore Export Cable Corridor (OnECC)	The area within which the onshore export cable circuit(s) will be located.
The proposed Project	All aspects of the Llŷr development (i.e. the onshore and offshore components).
Onshore Substation	Located within the Onshore Development Area, converts high voltage generated electricity into low voltage electricity that can be used for the grid and domestic consumption.

Term	Definition
Section 36 consent	Consent to construct and operate an offshore generating station, under Section 36 (S.36) of the Electricity Act 1989. This includes deemed planning permission for onshore works.

Acronyms and abbreviations

Acronym or abbreviation	Definition	Acronym or abbreviation	Definition
AfL	Agreement for Lease	AONB	Area of Outstanding Natural Beauty
BGW	BlueGem Wind	BP	British Petroleum
BEIS	Department for Business, Energy and Industrial Strategy	CCC	Climate Change Committee
CBRA	Cable Burial Risk Assessment	Cefas	Centre for Environment, Fisheries and Aquaculture Science
CES	Crown Estate Scotland	CO_2	Carbon Dioxide
CoS	Chamber of Shipping	DESNZ	Department for Energy Security and Net Zero
DDV	Drop Down Video	DIO	Defence Infrastructure Organisation
EIA	Environmental Impact Assessment	ES	Environment Statement
FLOW	Floating Offshore Wind	GHG	Greenhouse Gas
GIS	Geographic Information System	GPS	Global Positioning System
GW	Gigawatt	HDD	Horizontal Directional Drilling
HVAC	High Voltage Alternative Current	HVDC	High Voltage Direct Current
INTOG	Innovation and Targeted Oil and Gas	IPCC	Intergovernmental Panel on Climate Change
JNCC	Joint Nature Conservation Committee	kV	Kilovolts
LEP	Local Enterprise Partnership	MBES	Multi-beam Echosounder
MCA	Maritime and Coastguard Agency	MCZ	Marine Conservation Zone
META	Marine Energy Test Area	MHPA	Milford Haven Port Authority
MLWS	Mean Low Water Springs	MMO	Marine Management Organisation
MoD	Ministry of Defence	MW	Megawatt
NGESO	National Grid Electricity System Operator	NGET	National Grid Electricity Transmission
NNR	National Nature Reserve	NRW	Natural Resources Wales
NRW MLT	Natural Resources Wales Marine Licencing Team	OHL	Electricity Overhead Line
OnECC	Onshore Export Cable Corridor	OfECC	Offshore Export Cable Corridor
ORE Catapult	Offshore Renewable Energy Catapult	PCNP	Pembrokeshire Coast National Park
PCNPA	Pembrokeshire Coast National Park Authority	PCC	Pembrokeshire County Council
PEDW	Planning and Environment Decisions Wales	PDZ	Pembrokeshire Development Zone
PLONOR	Pose Little or No Risk	RAG	Red, Amber, Green
RIGS	Regionally Important Geological Site	RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation	SBP	Sub Bottom Profiler
SPA	Special Protection Area	SNCB	Statutory Nature Conservation Bodies

Acronym or abbreviation	Definition	Acronym or abbreviation	Definition
SSS	Side Scan Sonar	SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage System	T&D	Test and Demonstration
TJB	Transition Joint Bay	UK	United Kingdom
UN	United Nations	UXO	Unexploded Ordinance
WTG	Wind Turbine Generator		

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3. SITE SELECTION AND ALTERNATIVES

3.1 Introduction

1. Llŷr Floating Wind Limited (hereafter the Applicant) is proposing to develop the Llŷr 1 Floating Offshore Wind Farm (hereafter referred to as the proposed Project), located approximately 35 km off the coast of Pembrokeshire in the Celtic Sea.
2. The proposed Project is a test and demonstration wind farm development, comprising up to 10 wind turbine generators (WTGs). The proposed Project will make landfall at Freshwater West before connecting into Pembroke Dock power station and the national grid network.
3. The Applicant is seeking a Section 36 consent and Marine License for the proposed Project, and this chapter forms part of the Environmental Statement (ES) which is submitted in support of the consent applications. This chapter of the ES provides:
    - An overview of the legislative drivers and need for the proposed Project, explaining the role of offshore wind in contributing to climate change and net zero targets;
    - An overview of engagement with the key stakeholders in the development and their inputs into the site selection and project development process;
    - Presents the factors influencing the selection of the proposed Project, including spatial, technological, and operational considerations associated with each component of the proposed Project; and
    - A description of the site selection process and the consideration of reasonable alternatives for the regional selection, location, size, scale, and design of the proposed Project Array Area, the grid connection options, the options considered for the landfall location and the considerations given to the Offshore Export Cable Corridor (ofecc) and Onshore Export Cable Corridor (onecc) to connect the Array Area to the National Grid.
4. The assessment has been undertaken by Llŷr Floating Wind Limited. Further details of the proposed Project Team's competency are provided in **Appendix 1A: Statement of Competence.**

3.2 Legislation

5. This chapter has been prepared in accordance with Schedule 4, paragraph 2 of the Electricity Works EIA Regulations (2017) that requires information to be provided in the ES on;

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

6. In addition, it addresses the requirements of Schedule 3 of the Marine Works (Environmental Impact Assessment) Regulations 2017 (as amended), where;

    "*a description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the applicant, which are relevant to the proposed Project, the regulated activity and their specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects*" needs to be provided.

7. As described above there is a requirement under the EIA Regulations for all relevant projects, as part of the consent application process, to provide information on the options considered and process used to inform selection of the application version of the proposed development.

3.3 Summary of Stakeholder Consultation

8. The concept for a Test and Demonstration floating offshore wind project in the summer of 2018 when work began to identify suitable sites for development. As described later in this chapter, a series of informal meetings and discussions were held with relevant stakeholders including the Welsh Government and the Crown Estate between 2018 and 2021 to assist in the site selection of the proposed Project (**Figure 3-1**). These discussions included aspects such as the scale and nature of the proposed Project and the regional location of the development site.

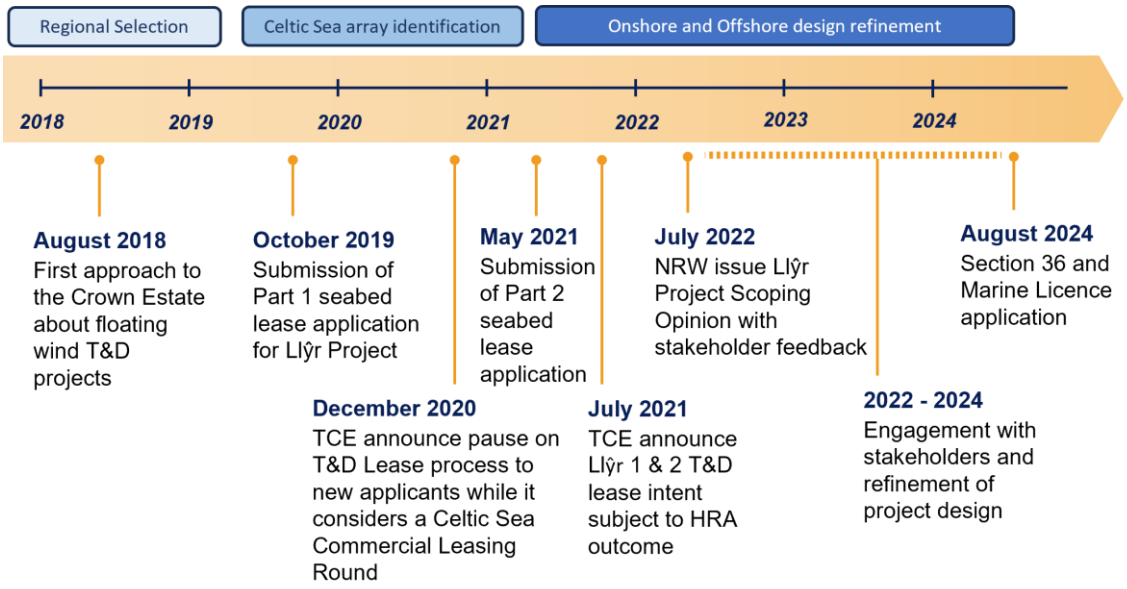

Figure 3-1. Llŷr Project timeline

9. Once the development site was identified, further detailed consultation on the refinement and practical design of the proposed Project was initiated through the submission to Natural Resources Wales Marine Licensing Team (NRW MLT) on 06 April 2022 of a Screening and Scoping Report. The Screening and Scoping report was circulated to relevant statutory bodies and key stakeholders. A Scoping Opinion was received from NRW MLT on 05 July 2022. Comments from the Scoping Opinion that are relevant to the site design and cable refinement are summarised in **Table 3-1** , in addition to a high-level response on how these comments have been addressed.

Table 3-1. NRW responses to the proposed Project scoping report via the scoping opinion

Consultee	Consultation type and date	Comment raised	Response
Scoping			
NRW	Scoping opinion	1.4. We would encourage you to engage early with relevant stakeholders to identify locations of minimal impact to	Consultation on the OfECC and OnECC and grid connection has been undertaken with a number of

Consultee	Consultation type and date	Comment raised	Response
		decide on the export cable route and grid connection.	stakeholders including but not limited to the National Grid (Electricity System Operator and Electricity Transmission), Pembrokeshire County Council (PCC), Pembrokeshire Coast National Park Authority, Milford Haven Port Authority, the Chamber of Shipping, Maritime and Coastguard Agency, Trinity House, commercial fisheries associations, Joint Nature Conservation Commission, RWE, Valero, local landowners, Ministry of Defence, Greenlink and Erebus projects (**Table 3-2**). This chapter sets out the site selection process and alternatives considered by the Applicant. This includes the consideration of the location of the Array Area, the OfECC and OnECC, indicative export cable routes (offshore, landfall location and onshore) and the substation location.
NRW	Scoping Opinion	1.5. The Pembrokeshire County Council (PCC) Local Planning Authority highlights that the number of projects that would all involve the delivery west-east cable routes (within a relatively wide 'development corridor') across the Angle Peninsula and significant infrastructure near Pembroke Power Station (sub or converter stations for each project) would result in an extended impact timeframe during construction. The PCC encourage you to work with these other projects to minimise the combined duration of these works.	The Applicant has held a number of meetings with the Greenlink project and the Erebus project in relation to export cable routing within the OfECC and OnECC, the location of the proposed substation, construction timing and layout of the project infrastructure (**Table 3-2**).

Consultee	Consultation type and date	Comment raised	Response
NRW	Scoping Opinion	1.11 NRW strongly advise that you engage early with SNCBs to review and refine the export cable route corridor and landfall options (4.2 and 4.3), to avoid and mitigate environmental impacts, through a clear site selection process. Of particular concern is the potential for the cable route to interact with sensitive features (Annex 1 habitats) of the Pembrokeshire Marine Special Area of Conservation (SAC). Clarity is required as to whether alternative cable routes have been considered as part of the process.	Since the publication of the proposed Project scoping opinion a number of meetings with the NRW Advisory, the Planning and Environment Decisions Wales (PEDW), the Joint Nature Conservation Committee (JNCC) detailing the approach, the OfECC and OnECC options and outcome of the offshore survey campaign (**Table 3-2**). In addition to the SNCB's, meetings have been held with the RSPB and the Wildlife Trust to discuss the export cable route corridor and export cable corridors.

10. Further consultation with stakeholders was undertaken throughout the pre-application stage. Consultation activities which are relevant to the site design and cable refinement are summarised in **Table 3-2** , alongside a summary of any key decisions or information from those activities.

Table 3-2. Summary of key information and decisions proposed at pre-application consultation stage

Consultation / consultee	Date	Summary of key information and decisions
NRW	29 / 03 / 2023	Call to discuss the benthic environment and ecology
NRW	14 / 06 / 2023	Meeting to discuss proposed Project Updates
NRW	03 / 07 / 2023	Offshore Cable Route Workshop
NRW	20 / 05 / 2024	Meeting to discuss proposed Project Updates and redefined OfECC following Drop Down Video (DDV) surveys.
NRW	14 / 06 / 2024	Proposed Project Update Call - to discuss the outcome of the DDV surveys and approach to the cable route
PEDW	28 / 07 / 2023	Proposed Project Update Call – PEDW highlighted need to address colocation of infrastructure within application
PEDW	03 / 02 / 2024	Proposed Project Update Call – PEDW reiterated need to address colocation of infrastructure within application
PEDW	14 / 06 / 2024	Proposed Project Update Call to explain submission timelines and redefined OfECC following DDV surveys
National Trust	12 / 01 / 2024	Proposed Project Update Meeting – National Trust highlighted desire for infrastructure co-location and discussed how the project interacted with the Round 5 Crown Estate leasing process.

Consultation / consultee	Date	Summary of key information and decisions
National Trust	25 / 04 / 2024	Proposed Project Update Meeting – discussions on infrastructure co-location, HDD area, site traffic and access arrangements and update on Round 5 Crown Estate leasing process.
MCA / Trinity House / UK Chamber of Shipping	27 / 03 / 2023	Meeting to discuss feedback provided by the Maritime and Coastguard Agency (MCA), Trinity House and Chamber of Shipping on the configuration of the proposed Project in relation to a shipping route to / from the Port of Milford Haven.
MCA / Trinity House / UK Chamber of Shipping / MHPA and RYA	22 / 08 / 2023	Hazard Risk Assessment workshop – feedback given on the location and configuration of the array area and shipping lanes.
Castlemartin Firing Range (DIO)	29 / 01 / 2024	General Introduction to the proposed Project and discussions relating to access arrangements within the Castlemartin firing range 'danger area' offshore.
Castlemartin Firing Range (DIO)	26 / 04 / 2023	Meeting with Major John Poole - confirmation that the Defence Infrastructure Organisation (DIO) and Castlemartin range had no objections to the northern 'danger area' being located within the OfECC provided the proposed Project followed the Castlemartin Firing Range instructions in relation to access to the 'danger area'.
Cllr Steve Alderman	15 / 06 / 2023	General Introduction to the proposed Project, including aims and objectives. Cllr Alderman highlighted the need to work with the other developers (Greenlink and Erebus), and to engage with the local landowners and farming community – particularly in relation to export cable installation activities and timings. Cllr Alderman expressed the preference to minimise development spread and where possible co-locate infrastructure. Cllr Alderman provided assistance in identifying key landowner stakeholders including contacts at Castlemartin.
Cllr Steve Alderman	08 / 01 / 2024	Proposed Project Update – included proposed plans for local community consultation events and the considerations of the cable installation options.
Erebus	04 / 05 / 2022	Call with Erebus Project Director on status of Llŷr project and forward programme.
Erebus	15 / 06 / 2023	Workshop to discuss proposed Project updates, 'pinch point' interactions, co-ordination of activities, lessons learned and data sharing.
Greenlink	01 / 12 / 2022	Introduction to the Greenlink/Llŷr projects – discussions related to onshore and offshore project design, interactions and communication channels.

Consultation / consultee	Date	Summary of key information and decisions
Greenlink	19 / 10 / 2023	Workshop to discuss proposed Project updates, 'pinch point' interactions, co-ordination of activities, lessons learned and data sharing.

11. In addition, the location of the array area, OfECC, OnECC and substation location options were formed a critical aspect to the public consultation activities carried out between 15 January and 11 February 2024. The content, outcome and responses to this consultation activity is detailed in **Chapter 06 – Consultations and Stakeholder Engagement**.

3.4 Background and Need for the Project

12. The objective of the proposed Project, to establish a test and demonstration project in the Celtic Sea for a new floating offshore wind technology, was influenced by the ambitious United Kingdom (UK) Government floating offshore wind policy and commitments (HM Government, 2022) (a target of 5 gigawatts (GW) of floating offshore wind projects by 2050 with a significant UK supply chain component) combined with the need to address the technical, investment and risk barriers currently facing new floating wind technology. The technology challenge can only be addressed through a step wise scaled demonstration of the technology in a real world environment (as opposed to a test tank) where it is intended to be operational at commercial scale.

3.4.1. The UK floating offshore wind opportunity – Policy context

13. The UK Government, through the Climate Change Act 2008, made the UK the first country in the world to set legally binding carbon budgets, aiming to cut emissions (versus 1990 baselines) by 34% by 2020 and at least 80% by 2050. This is to be achieved '*through investment in energy efficiency and clean energy technologies such as renewables, nuclear and carbon capture and storage'*.

14. In October 2018, following the adoption of the Paris Agreement by the United Nations (UN) Framework Convention on Climate Change, the Intergovernmental Panel on Climate Change (IPCC) published a '*Special Report on the impacts of global warming of 1.5°C above pre-industrial levels'* (Intergovernmental Panel on Climate Change, 2018). This report concluded that human-induced warming had already reached approximately 1°C above preindustrial levels, and that without a significant and rapid decline in emissions across all sectors, global warming is not likely to be contained, and therefore more urgent international action is required.

15. In response, in May 2019, the UK Government's independent expert Climate Change Committee (CCC) published 'Net-Zero: The UK's contribution to stopping global warming' (CCC, 2019). This report recommended that the UK Government extend the ambition of the Climate Change Act 2008 and that 'The UK should set and vigorously pursue an ambitious target to reduce greenhouse gas (GHG) emissions to 'Net-Zero' by 2050, ending the UK's contribution to global warming within 30 years.

16. In June 2019, the UK Government announced the laying of a statutory instrument in Parliament, which amends the Climate Change Act 2008, in order to implement the CCC's recommendation into law, and the UK became the first major economy to pass laws to end its contribution to global warming by 2050.

17. In June 2020, the CCC made recommendations for the Department for Business, Energy, and Industrial Strategy (BEIS) to 'deliver plans to decarbonise the power system to reach an emissions intensity of 50 gCO_2 / kWh by 2030, with at least 40 GW of offshore wind and a role for onshore wind and large-scale solar power, with a clear timetable of regular auctions'.

3.4.2. The UK floating wind opportunity – Energy and Supply Chain context

18. Electricity can be generated from low-carbon sources, and the decarbonisation of historically non-electric sectors (transport, heat, industrial process, etc.) will lead to a significant increase in electricity demand. Therefore, the capacity of electricity generation in the UK must grow to meet that demand, and the need for a significant growth in new low carbon generation assets, including well-proven renewable technologies such as wind and solar, is clear.

19. The UK represents one the best locations in the world for offshore wind, with the Celtic Sea offering several advantages for floating offshore wind, including good quality consistent wind resource for energy generation, suitable seabed conditions and proximity to the centre of demand for power. A study by Offshore Renewable Energy Catapult (2021) highlighted the opportunity and benefits of demonstrating floating offshore wind in the Celtic Sea and (through modelling) the advantages of developing larger projects, such as reductions in cost. The study identified that the development of intermediate scale projects (~100-300 megawatts (MW)) offered an opportunity for the UK industry to ramp up in advance of large-scale projects >500 MW) being delivered in the 2030s (such as ScotWind and the Round 5 Celtic Sea Wind leasing opportunity). It was determined that this stepwise approach will allow the technology and the supply chain to gain experience of serial manufacture, assembly, and installation, in advance of the large-scale projects.

3.4.3. The UK floating wind opportunity – risk context

20. Experience has shown over the last 20 years when developing GW scale fixed offshore wind projects that de-risking the technology and project development processes is a key requirement to success. Securing the supply chain, investment, and insurance to develop large scale commercial floating wind projects requires the cost-effective sharing of risk with third parties. To take a new technology such as floating offshore wind to commercial scale (which is required to meet the UK Government renewable energy generation targets), there is a need to address the technical engineering and environmental risk across the whole development process – from design through to fabrication, installation, operation, and decommissioning. Doing this at an appropriate comparatively small scale allows the technology providers to identify and address risk within a commercial environment at each step, whilst at the same time securing valuable learning and experience.

21. Although the learning and experience provided by a Test and Demonstration Project de-risks the delivery of larger projects and helps unlock investment in infrastructure and supply chain growth, the timing of these early demonstration projects is critical. It is vital that for the demonstration projects to have an impact and to augment the development and delivery of large-scale projects later in the 2030s they cannot be inadvertently delayed or hindered in the timing of their delivery. They are a necessary learning point that needs to be understood in a timely manner to allow the learning to be implemented in the next phase of commercial delivery.

3.4.4. Assessing the 'Do-Nothing' Scenario

22. A diverse renewable energy generation fleet (i.e. consisting of many different technologies) in the UK will play an important role in the resilience of the UK's electricity system from an

adequacy and system operation perspective. Diversity improves the resilience of low-carbon supplies against the uncertainty of when energy will be generated.

23. To date, within the floating offshore wind industry worldwide there has been limited deployment of floating offshore wind technologies, typically at a 2 MW turbine scale in established test facilities. Within the UK there are only two operational floating offshore wind projects, the Hywind Scotland project and the Kincardine wind farm. The Hywind Scotland project consists of five turbines at 6 MW each (30 MW total), has been operating since 2017 using a floating spar technology which is unsuitable for deployment within the Celtic Sea. The Kincardine Offshore Wind Farm consists of five 9.5 MW turbines, using semi-submersible technology that started operations in 2021.

24. In the meantime, offshore wind turbine technology has also advanced considerably over the last decade, with 15 MW turbines currently on the market and plans to offer even larger turbines at 18 MW in the near future. To meet the UK Governments ambition of 5GW of floating offshore wind production by 2050, demonstration of a diverse portfolio of floating wind technologies capable of hosting turbines at the 18 to 20 MW scale is required.

25. The proposed Project is intended to act as a pathfinder project to aid the establishment and development of an indigenous UK floating offshore floating wind industrial capability in the Celtic Sea region in preparation for the larger commercial opportunity for floating wind, within Wales, the UK, western Europe and globally. Without projects such as this the following aims and potential benefits of the proposed Project will not be achieved:

    - Demonstrate full-scale floating offshore wind technology solutions with a turbine capacity greater than 12 MW, in UK waters;
    - Optimise the design of floating wind arrays to reduce the costs of large scale floating offshore wind developments within the UK;
    - Contribute to the accelerated development of the UK floating offshore wind industry as a pathfinder project, piloting the development, construction, installation and operation of floating offshore wind at a large scale in UK waters;
    - Contribute to the learning of how floating wind interacts at a large scale with the natural environment and local interests, to better understand the benefits and challenges and to identify opportunities to enhance the local environment; and
    - Identify and maximize the potential opportunities and benefits to the local UK supply chain and employment.

26. Test and Demonstration projects such as the proposed Project are needed to introduce new floating wind technologies into the market. It also provides a host of ancillary benefits such as the development of floating wind specific sub-components, development of the local supply chain and creation of local employment opportunities and training.

27. Fundamentally the ‘do-nothing’ scenario presents the key risks of (a) not providing a key contribution to the challenge of addressing the climate emergency and the need for rapid decarbonisation and (b) missing out on the significant opportunity to develop a highly skilled workforce and indigenous Welsh industry to service not only Floating Offshore Wind (FLOW) in the Celtic Sea but the wider UK and globally.

28. The UK and Welsh governments have each set legally binding commitments to become net-zero by 2050. Offshore wind will play an important part in this, with the UK government identifying a target of 50 GW of wind energy by 2030, enough to power every home in the UK.

In addition, the UK government has set the target of meeting 60% of the offshore wind supply chain from within the UK by 2030. The Celtic Sea has previously been overlooked for fixed offshore wind development due to the seabed depths. However, the potential of FLOW within the region offers an opportunity for highly skilled employment and service provision in the region. There is a significant opportunity for FLOW in the Celtic Sea and nurturing the development of a local supply chain to service this need through Test and Demonstration projects can maximise overall local content and contribute to industry growth within the region (OREC, 2020).

29. An Offshore Renewable Energy (ORE) Catapult report, commissioned by the Cornwall and Isles of Scilly Local Enterprise Partnership (LEP) and the Welsh Government in 2020, suggested that a floating wind industry (related to manufacturing, installation, maintenance and support services) could support 3,200 jobs in the South West and Wales and generate £682 million in spend by 2030 – the proposed Project provides 25% of the contribution of FLOW in the Celtic Sea before 2030.

30. The proposed Project not only provides an immediate contribution of powering just over 100,000 homes (based on RenewableUK statistics (RenewableUK, 2024), with clean, green, renewable energy before 2030 but also provides a wider contribution of accelerating the development of the UK floating offshore wind industry as a pathfinder project, piloting the development, construction, installation and operation of floating offshore wind at a large scale in UK waters. The 'do-nothing' scenario poses a risk of undermining the UK and Welsh governments legally binding net-zero objectives and missing out on the potential to developing a critical strategic indigenous supply chain to service a globally developing FLOW market. As the Welsh Affairs Committee inquiry on Floating Offshore Wind in Wales (08 March 2023) concluded (Welsh Affairs Committee, 2023):

31. '*Floating offshore wind in the Celtic Sea will not only be key to meeting the UK's Net Zero targets, it also presents an opportunity to bring significant investment into Wales and provide high quality jobs. If first-mover advantage can be seized for Wales the economic opportunity will be exponentially greater*.'

3.5 Location selection for the array area and consideration of alternatives

32. The Applicant first developed the concept for a Test and Demonstration floating offshore wind project in the summer of 2018 and began work to identify suitable sites for development. At that stage the whole of the United Kingdom was considered, with the initial selection of an appropriate region and development area determined through the following step by step considerations:

- Engaging with key stakeholders at a strategic level to help inform the development strategy;
- Optimising the development opportunity through the identification of the most technically and environmentally suitable development site; and
- Site refinement through consideration of potential interactions with existing and potential seabed users across a selected region.

33. Identification of the proposed Project location was an iterative process, undertaken over two years, as information sources and stakeholder views were assessed and evaluated. During this period the development of the proposed Project was informed by engineering, environmental and socio-economic appraisals, refining the design, and location of the proposed Array Area.

Engagement with statutory and non-statutory stakeholders has also influenced the selection and development of the proposed Project (**Section 3.3**).

3.5.1. Potential Test and Demonstration Sites within the UK

34. During the initial stages of development, the whole of the United Kingdom was considered when seeking a location for the proposed project. To identify a suitable regional administration, a high-level review of the potential regional economic and policy support for floating wind technology projects was undertaken and conversations were held with key policy stakeholders.

35. The following key policy decisions had an impact on the identification of the development region:

- During this period the Crown Estate Scotland (CES) closed their test and demonstration lease process (September 2018) in preparation for their ScotWind commercial lease process, ruling out the ability to apply for a test and demonstration project in Scottish waters during the initial development period; and
- There was no support mechanism for test and demonstration offshore wind projects within the devolved Northern Ireland administration or any ability to create one during the period of site selection, as the administration was suspended between January 2017 and January 2020. The political uncertainty before 2020 was too high a development risk at the time of identifying the appropriate site in 2018 / 2019.

36. As a result of the above factors, the regional area of search was confined to appropriate locations in English and Welsh waters.

3.5.2. Regional Location Assessment

37. From a regional perspective, the Applicant was attracted to Wales due to its favourable offshore wind resources, supportive economic and carbon targets, and evolved marine and energy infrastructure. Two areas were initially identified as appropriate development sites for floating offshore wind with significant technical and environmental information, as they had been subject to previous fixed foundation offshore wind development proposals: a development area in North Wales offshore of Conwy, Denbighshire, and Flintshire coastlines (the former Celtic Array) and a development area in the Celtic Sea (the former Atlantic Array). Projects within both these areas undertook the initial steps in project consenting, such as baseline environmental studies and stakeholder engagement which provided significant information on both the environmental characteristics of the area and initial opinions of stakeholders on offshore wind development proposals.

38. Meetings were also held with the Planning Inspectorate, NRW, the Welsh Government, and industry organisations such as Offshore Renewable Energy Catapult to explore the proposals and understand the economic, regulatory, and political environments in both areas.

39. During this process a series of meetings were also held with the Crown Estate between 2018 and 2019 to identify an appropriately scaled development in a suitable location for the Array Area and therefore the lease application area. Ultimately, it is the Crown Estate, as the owner of the seabed, who determines where an offshore wind demonstration project can be located through the management of their Test and Demonstration (T&D) lease process. Both development areas were discussed and, following the publication of the Crown Estate's Offshore Wind Leasing Round 4 areas for commercial scale lease opportunities, it was decided to concentrate on the Western Approaches and Celtic Sea area to avoid conflict with the Round 4 and associated Habitats Regulations Assessment processes.

3.5.3. *Detailed Alternatives – Identifying the Agreement for Lease (AfL) Area*

40. Following the selection of the Western Approaches and Celtic Sea region as the preferred development location, the Applicant undertook an internal site selection process over the spring of 2019. That process involved the appraisal of the potential constraints and key considerations to identify suitable areas for development, including a range of engineering, environmental, and economic considerations. The environmental and technical information came from a variety of sources including a previous development proposal, available bathymetric and seabed geology datasets, environmental information from the statutory nature conservation groups, and infrastructure information available from the Crown Estate.

41. Technically there are three hard technical constraints that must be satisfactory for a floating offshore wind farm to be viable:

- Water depths (a minimum of 45 m is required);
- Wind resource and potential energy yield; and
- Seabed conditions / characteristics.

42. Once these technical constraints are addressed, secondary criteria are considered, wherever there is an element of flexibility to the siting of the development (**Table 3-3**).

43. The site selection process used a Geographical Information System (GIS) which enabled layering of relevant spatial constraints, drawn from existing sources, to produce a series of constraints maps to help identify areas within the general Western Approaches and Celtic Sea region. The maps which were generated were used to:

- Confirm areas that were not subject to hard constraints as defined above;
- Confirm areas with fewer secondary constraints and of least environmental sensitivity; and
- Inform the proposed area of search for the seabed lease application and therefore the Array Area location.

44. The constraints mapping exercise informed an initial development strategy that evolved as discussions with stakeholders developed to minimise the potential areas of conflict.

Table 3-3. Secondary criteria considered during the site selection process

Site requirements	How it influenced site selection
Grid	Twenty-four potential grid connection locations across Wales and Southwest England were initially identified (from the interactive 'NGET Connect Now' online portal and the National Grid Electricity Transmission (NGET) network map (provided at https://www.nationalgridet.com/network-and-assets/network-route-maps) and considered for the proposed Project. Following discussions with the National Grid Electricity System Operator (NGESO) and NGET, a grid connection application was made on behalf of the proposed Project, and accepted by the NGET, for a point of connection a Pembroke Power Station.
Shipping and Navigation	Using annual vessel shipping density data from the Marine Management Organisation (MMO) available at the time Mapping UK shipping density and routes from AIS (publishing.service.gov.uk) and MMO/ShippingVesselDensityGrid2017 (MapServer) (data.gov.uk), it was determined that the proposed Project lease area avoided the main transit traffic routes in the west and vessel traffic routes from the Bristol Channel. When

Site requirements	How it influenced site selection
	selecting the potential area for lease, it was considered that there was sufficient space to allow traffic from Pembroke Dock to proceed without undue disturbance. However, it must be highlighted that the Celtic Sea Commercial Round 5 leasing opportunity had not been announced in Spring 2019 nor were the Round 5 Project Development Areas identified at the time of the lease application.
Military Practice Areas	Areas of military activity were identified from the Welsh Marine Planning Portal (https://lle.gov.wales/apps/marineportal/) and the selected proposed Project Array Area avoided these areas.
Visual Impact	Information provided within the NRW Designated Marine Character Areas 23 South Pembrokeshire Open Waters (https://naturalresources.wales/media/682028/mca-00-technical-report-summary-method-appendix.pdf) and the NRW '*Seascape and visual sensitivity to offshore wind farms in Wales: Strategic assessment and guidance. Stage 1,2 ,3- Seascape and visual sensitivity assessment for offshore wind farms*' (Natural Resources Wales / Offshore wind developments) was used to assess the potential effect and likely sensitivity of visual impact for potential lease areas.). The information was used to avoid areas of seabed with higher sensitivity. At its closest point, the Llŷr 1 area is located 38 km from the Pembrokeshire coast which should minimise any visual disturbance.
Commercial Fishing Effort	(a) MMO data on fishing activity for UK commercial fishing vessels of 15 m and over in length deemed to have been fishing during 2017. These summaries have been categorised into aggregated gear groups that have relevance to their potential impact on the seabed, environment, or biota. https://environment.data.gov.uk/arcgis/rest/services/MMO/FishingActivityForOver15mUnitedKingdomVessels2017_ms/MapServer/0 (b) International Council for the Exploration of the Sea (ICES) 2018 spatial data layers of fishing intensity / pressure per gear type (Kw / fishing / H), for the years 2009 to 2017 in the OSPAR regions II and III (ver. 2, 22 January, 2019): ICES data product release, http://doi.org/10.17895/ices.data.4686. (c) Centre for Environment, Fisheries, and Aquaculture Science (Cefas) information on fishing activity intensity within 12 nm of the English and Welsh coast. Derived from sightings data from Cornwall, Cumbria, Devon & Severn, Southern, Sussex, Kent & Essex, Eastern, North Eastern, North Western and Northumberland Inshore Fisheries & Conservation Authorities (IFCA), and sightings data provided by the Marine Management Organisation (MMO). http://data.cefas.co.uk/ The information obtained from the above was used to identify and understand potential areas of fishing interest. The information was used in assisting the identification of areas of least interaction or disturbance.
Seabird Sensitivity	Information was taken from the RSPB 2019 Seabird Utilisation Distributions data which provide data from a series of large-scale seabird tracking studies across the UK during the late incubation / early chick rearing period of the breeding season using a cutting-edge Global Positioning System (GPS). Other information available from the RSPB opendata GIS portal (https://opendata-rspb.opendata.arcgis.com/search?collection=Dataset) was used to identify areas of least sensitivity to bird interactions.

Site requirements	How it influenced site selection
Marine ecology	Information detailing Marine Ecology assets (including internationally designated sites and features of marine ecological interest) were obtained from the data portals of the JNCC, NRW and OSPAR Commission to identify areas of interest of marine ecology (Ramsar, Special Areas of Conservation, Special Protection Areas, Sites of Scientific Special Interest, Marine Conservation Zones, and OSPAR sites). The information was utilised to understand the nature and reasons for designation to help inform the site selection for the lease area (see **Figure** 3-2).
Existing seabed infrastructure and Users	Information from publicly available sources identified in the Wales Marine Planning Portal and the Crown Estate Open Data portal (The Crown Estate Open Data Portal (arcgis.com)) was accessed to identify existing lease holders and users of the seabed, such as electricity and telecommunications cabling agreements, disposal sites and aggregate extraction sites. Although the site does extend across a potential disposal site, it is not operational and checks with Welsh Water and Cefas failed to uncover any records or evidence that the disposal site had ever been used.

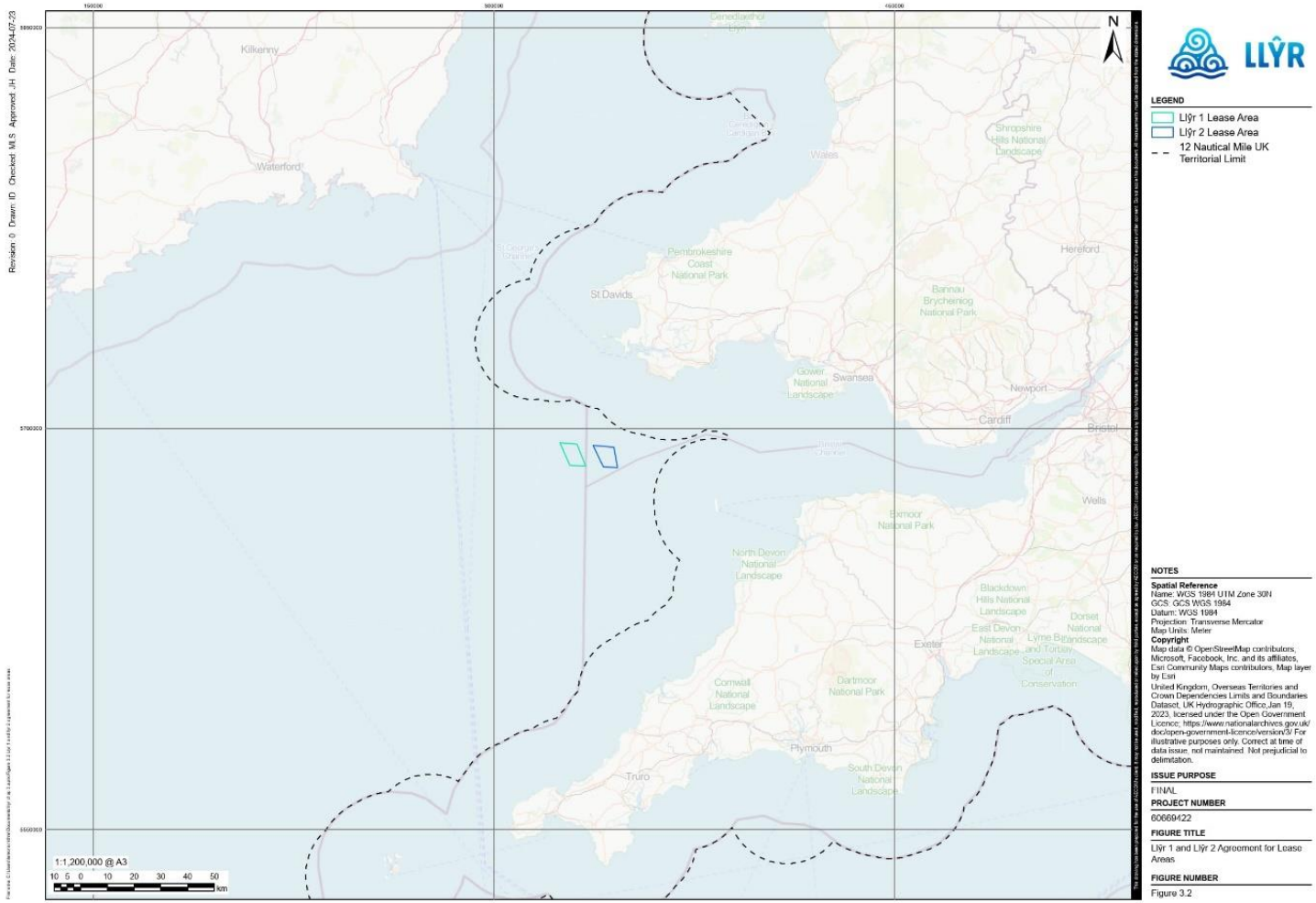

Figure 3-2. Llŷr 1 and Llŷr 2 agreement for lease area

45. Following the consideration of the hard and secondary constraints in **Table 3-3** requirements, Floventis submitted the final Lease application documents to the Crown Estate in May 2021 for two 100 MW demonstration projects using two different floating offshore wind platform technologies. The Crown Estate accepted the application and announced its intention to award the AfL's subject to the outcome of a plan level HRA.

3.5.4. The Llŷr Offshore Array Area Design Evolution

46. The Design Envelope for the proposed Project is set out in **Volume 1: Chapter 04: Description of the Proposed Project**. As detailed earlier, the development and evolution of the offshore array area was influenced through engagement with project stakeholders. The key considerations and evolution are outlined in **Table 3-4** below:

Table 3-4. Summary of design evolution steps

Technical parameter	Design evolution and alternatives considered
Offshore Array Area Location and Development area	During the pre-application process, the Applicant held a series of meetings with the MCA, the Chamber of Shipping, Pembroke Dock, and Trinity House, as detailed in **Volume 3: Chapter 25: Shipping and Navigation**. Feedback was given in relation to the Llŷr 1 AfL area and its overall orientation – specifically the southeastern corner and how it related to the transit direction of tankers from the south to Pembroke Dock and the Crown Estate Round 5 shipping channel identified through their Project Development Areas (PDAs). As a consequence, it was agreed to remove the southeastern corner from the array area to maintain an adequate orientation towards the general shipping routes from Pembroke Dock.
Offshore Array Area boundary configuration	Since the publication of the project scoping request, public consultation and the progression of the Environmental Impact Report, the identified footprint available to locate the WTGs and associated offshore infrastructure by 11% and in turn reduces potential impacts on the marine environment and other sea users. In addition, during the development process, the Crown Estate announced its intention to develop the Round 5 Offshore Wind Leasing to establish a commercial floating wind sector off the coast of South Wales and Sout West England. The opportunity identified three project development areas, each with a potential capacity of 1.5 gigawatts (GW). One of the development areas is adjacent to the proposed Project Array Area and as a consequence and agreement has been reached with TCE to ensure at least a 1 km 'buffer' zone on the western extent of the array area to avoid conflict with any future potential commercial array area.
Progression of the Llŷr 2 development area	Following the submission of the Screening and Scoping request on 06 April 2022 and subsequent Scoping Opinion provided by the NRW MLT on 05 July 2022, a submission was received on 08 March 2023 from the Ministry of Defence's (MODs) DIO. The submission stated that the '*Llŷr 2 array area conflicts with highly surveyed routes*' and that '*wind turbine development within the Llŷr 2 array area would therefore be incompatible with defence requirements*'. It concluded that '*the MOD would object to any development … at the Llŷr 2 location in its current form*'. The response continued where the MOD suggested that '*to mitigate this likely objection, it is recommended that the Llŷr 2 array area is moved at least 3 nautical miles to the west*'.

Technical parameter	Design evolution and alternatives considered
	As a consequence, all development activity on the Llŷr 2 development area was halted until a resolution could be reached with the MOD DIO and a decision was taken to progress only the Llŷr 1 development area (this application) [see **Figure 3-3** below]. In March 2024 a resolution was identified with the MOD DIO that allows the Llŷr 2 development area to progress as a separate application.

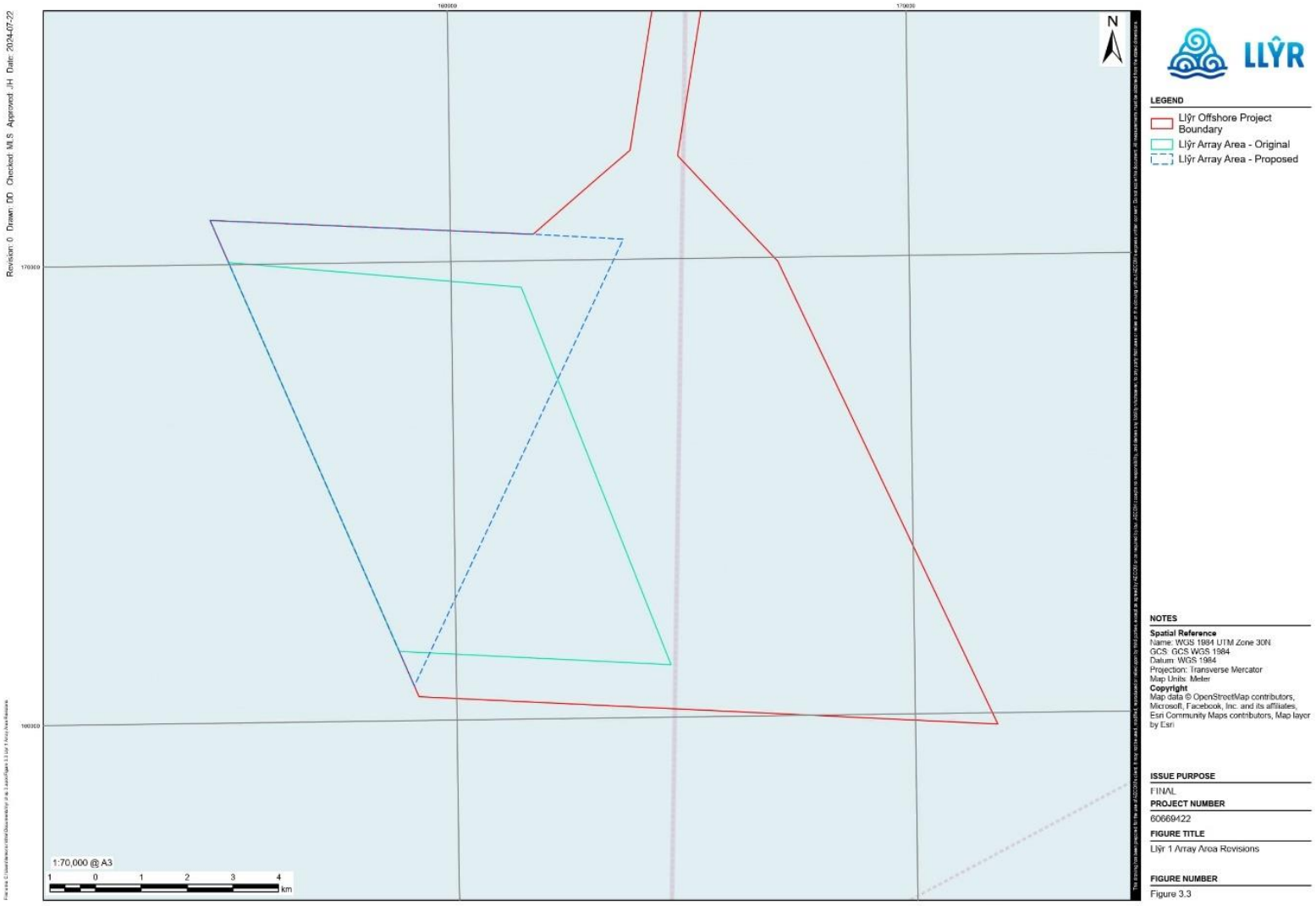

Figure 3-3. Llŷr 1 Array Area revisions

3.6 Offshore cable route identification

3.6.1. Offshore Export Cable Corridor Options Considered

47. A geological desk study was commissioned in 2022 to assess the potential OfECC routes back to shore from the identified Llŷr windfarm AfL areas (**Appendix 3B: Offshore Geological Desk Study**). The aim of this desk-based study was to provide an overview of the geological features, marine habitats and human activity for two OfECC options, one north towards Wales (with a cable landing zone near Milford Haven, Pembrokeshire – near to the National Grid point of connection at Pembroke Power Station) and the second one, with a south-easterly heading towards Northan in Devon (near towards the National Grid point of connection at Alverdiscott in Devon) (see **Figure 3-4**).

48. Based on a review of the available desktop information on the seabed conditions of both OfECC options, the report concluded that the seabed across the cable routes, either north or south show a very similar pattern of relatively thin, coarse sediment cover. The southern route appeared to cross more coarse sediments for the majority of its length than the northern route, which was sandier. Close to the southern cable landing area around Barnstaple Bay, the sediment cover increased to several meters and more fine sediments (sandy, gravelly clay) were anticipated. The bathymetry of the southern route showed a gradual increase of seabed depth from shore to the deeper waters in the centre of the Celtic Sea.

    The northern route showed more bathymetrical changes, especially close to the Welsh coast where several peaks (10 m in height) and troughs were observed. Several known rocky outcrops were identified approximately 6 km offshore.

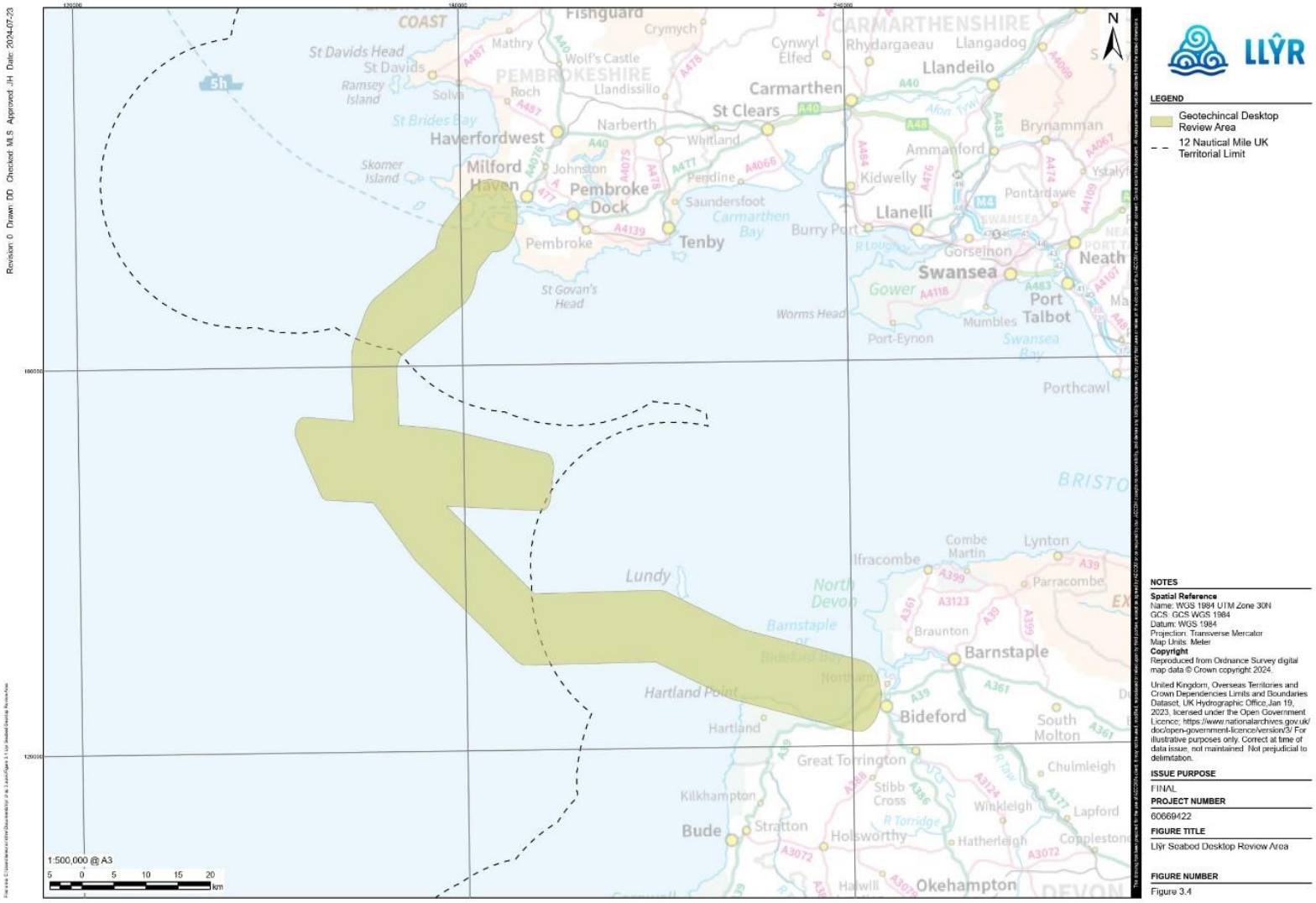

Figure 3-4. Llŷr seabed desktop review area

49. The desk top study concluded that both OfECCs presented environmental and engineering challenges and that the key factor in determining the preferred cable route was based on the relative distances to potential grid connection locations (the northern route is essentially half the distance of the southern route) along with the decision by the NGESO to connect the project at the Pembroke Power Station. This identified the northern route as the most practical option based on consumer cost and environmental impact.

3.6.2. Offshore Export Cable Corridor Design Evolution

50. The OfECC was further refined through consideration of the need to take the cable towards Pembroke Peninsula where the NGESO point of connection is and by taking into account the following principles:

- Routing options needed to be able to connect to viable landfall locations identified;
- The number of existing pipeline and cable crossings to be minimised as far as possible;
- Where a crossing is required, cables and pipelines to be crossed at 90 degrees where possible;
- Historic wrecks to be avoided as far as possible;
- Avoidance of other infrastructure, dredging areas, disposal areas etc with suitable buffers; and
- Avoidance of designated sites as far as possible; and
- Avoidance of ecologically important sandbanks and potential reefs.

51. The basic proposed Project parameters were developed prior to undertaking the site specific surveys (which have subsequently evolved as described in **Chapter 4 – Description of the Proposed Project**). These basic proposed Project parameters for the export cable corridor were:

- That the proposed Project will export power through two 66 kV HVAC submarine cables and where the export cables share a common cable corridor, the cables will be laid alongside each other, with a target separation of 50 m (which may decrease between KP38 to HDD exit point (KP48);
- The majority of the cable route it is anticipated that the cables will be buried at a depth of 1.2 metres;
- An allowance is made for a 250 m wide cable corridor (providing a 120 m wide repair bight to one side of each of the two export cables);
- A minimum distance between the proposed Project offshore export cables and the Project Erebus export cable will be 120 m, based on bathymetry;
- At the landfall site, the subsea cables will be connected to the onshore cables in an underground transition joint bay (TJB) located in the terrestrial environment; and
- The HDD compound will be set back approximately 400 m from MHWS which will provide sufficient space for the arced drill profile to pass beneath the intertidal area and exit onto the seabed below MLWS.

52. In line with the recommendations of the geological desk study (**Appendix 3B: Offshore Geological Desk Study**) and complying with stakeholder feedback (**Appendix 5B – Scoping Opinion**), site specific geophysical and environmental marine survey of the nearshore and offshore areas were undertaken between 17 September and 19 December 2022. The aim of

these geophysical and environmental marine surveys was to acquire all the appropriate data for the confirmation of an appropriate OfECC and landfall location. The geophysical survey consisted of topographic measurements, multi-beam echosounder (MBES), seabed mapping (side scan sonar or SSS), sub bottom profiling (SBP)[1] and magnetometry. The environmental survey consisted of benthic grab samples and drop-down video. The objectives of the geophysical and environmental marine surveys were to:

- Identify the seabed and sub-seabed conditions;
- Identify marine habitat areas and the extent and limits of their coverage;
- Identify the distribution and thickness of the superficial sediments and rock head, where possible;
- Measure the topography and seabed bathymetry, surface morphology and identify the nature of the seabed sediments;
- Identify the location, extent and nature of any impediments to the laying or burial of the cable such as wrecks, debris on seafloor, rock outcrop, other cables, pipelines etc;
- Identify potential unexploded ordnance (UXO) within the area; and
- Plan the scope and positioning of the geotechnical sampling programme in the nearshore area to be undertaken prior to the commencement of the Construction phase of the proposed Project.

53. **Appendix 3A - Offshore Cable Route Assessment**, was based on the results of the site specific geophysical and environmental marine survey with the aim to:

- Clearly identify the preferred OfECC;
- Identify all potential 'pinch points' for the cable route within the identified OfECC;
- Minimise interaction with existing projects (Project Erebus and Greenlink) cable corridors; and
- Address stakeholder expectation to minimise the spatial extent of the offshore transmission infrastructure by, where practicable, locating the routes within the same general OfECC and in relative proximity to each other.

54. Following the conclusion of the geophysical and environmental marine surveys (**Appendix 19A – Nearshore Benthic Survey Report** and **Appendix 19B – Offshore Benthic Survey Report**) and the production of the Cable Route Analysis Report (**Appendix 3A - Offshore Cable Route Assessment**), a technical workshop with NRW Advisory to discuss the key environmental considerations for the identified OfECC was held in July 2023. The Cable Route Analysis Report and NRW Advisory meeting both identified the overlap with nearshore Annex 1 reefs and an Annex 1 sandbank (Turbot Bank). NRW Advisory subsequently advised that the nearshore area of the surveyed OfECC may cause adverse impacts to the integrity of the Pembrokeshire Marine SAC via likely significant effect of loss of Annex 1 habitats.

55. Consequently, adjustments were made to the OfECC, guided by SEACAMS bathymetric data (surveyed in 2017 by Bangor University and available from the Imardis website (https://www.imardis.org) and NRW side scan survey data (CCW, 2012) to avoid Annex 1 reef

[1] It should be noted that whilst SBP data were collected it was not collected to full specification / processed because of adverse weather conditions.

and Annex 1 sandbanks. A DDV survey was commissioned between March and April 2024 to identify the viability of the revised OfECC to avoid Annex 1 reef. This would be achieved by routing the OfECC southwards (if heading from landfall to offshore) at the offshore Horizontal Directional Drill (HDD) exit through the Castlemartin Firing Range 'danger area' and following a westerly route towards the already surveyed OfECC.

56. From the 2017 SEACAMs MBES data a potential gap through the Annex 1 reef was identified but it was not clear from the available data whether this extended through the extent of reef (to the edge of Turbot sandbank). The DDV survey to aid benthic characterisation in the area, guided by an onboard ecologist, subsequently confirmed the extent of reef and potential reef within the area and the presence of areas of sediment were identified within and through the potential Annex 1 reef establishing that there was potential for a route to exist, with sufficient space to place two export cables (see **Figure 3-5**).

57. The Applicant consulted with the Castlemartin Firing Range in January 2024 and agreement was reached that the offshore export cable could be installed through the designated offshore 'danger area', provided that the Applicant followed Castlemartin directions on the timing and access to the area during the Construction phase of the proposed Project.

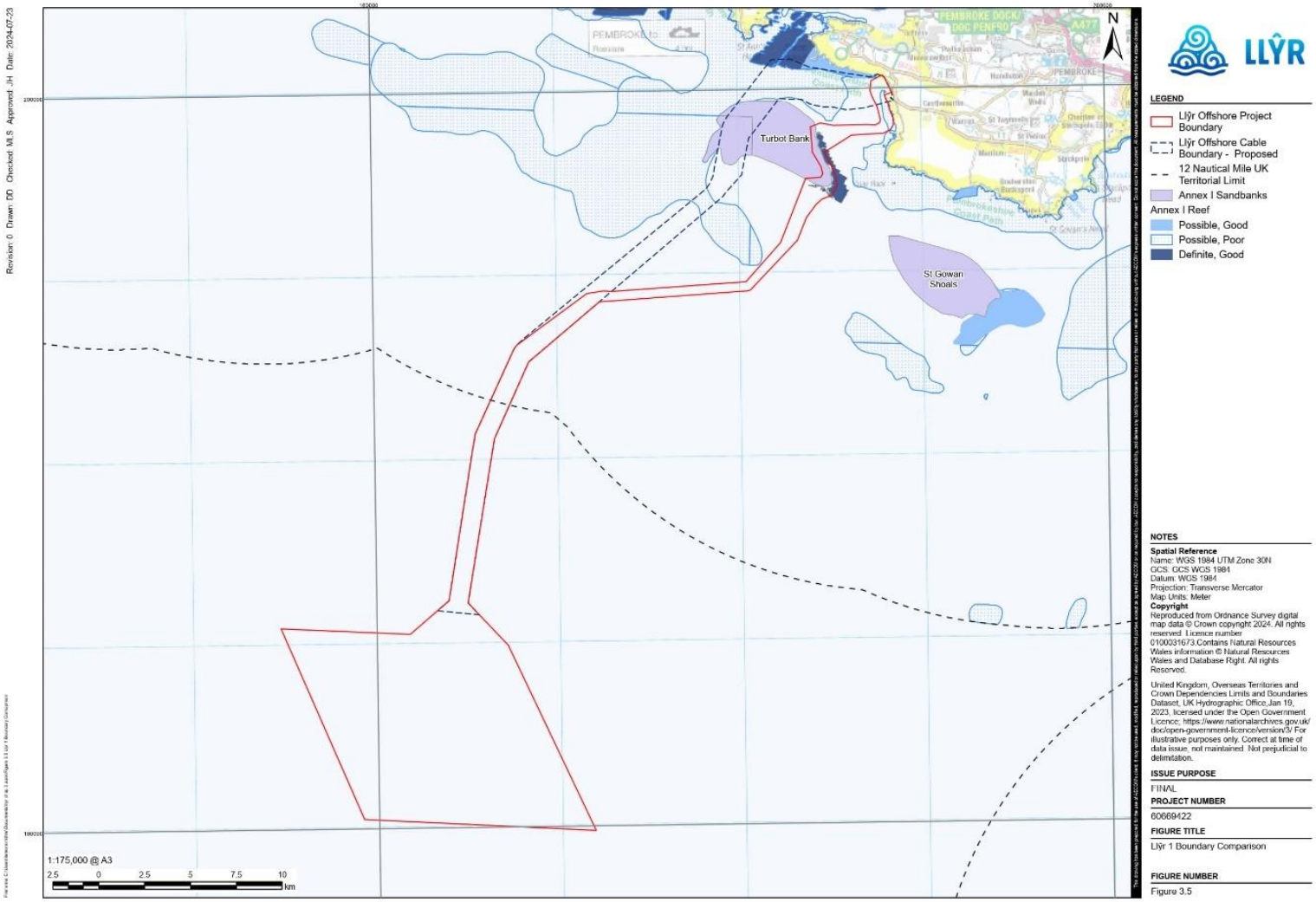

Figure 3-5. Llŷr 1 boundary comparison

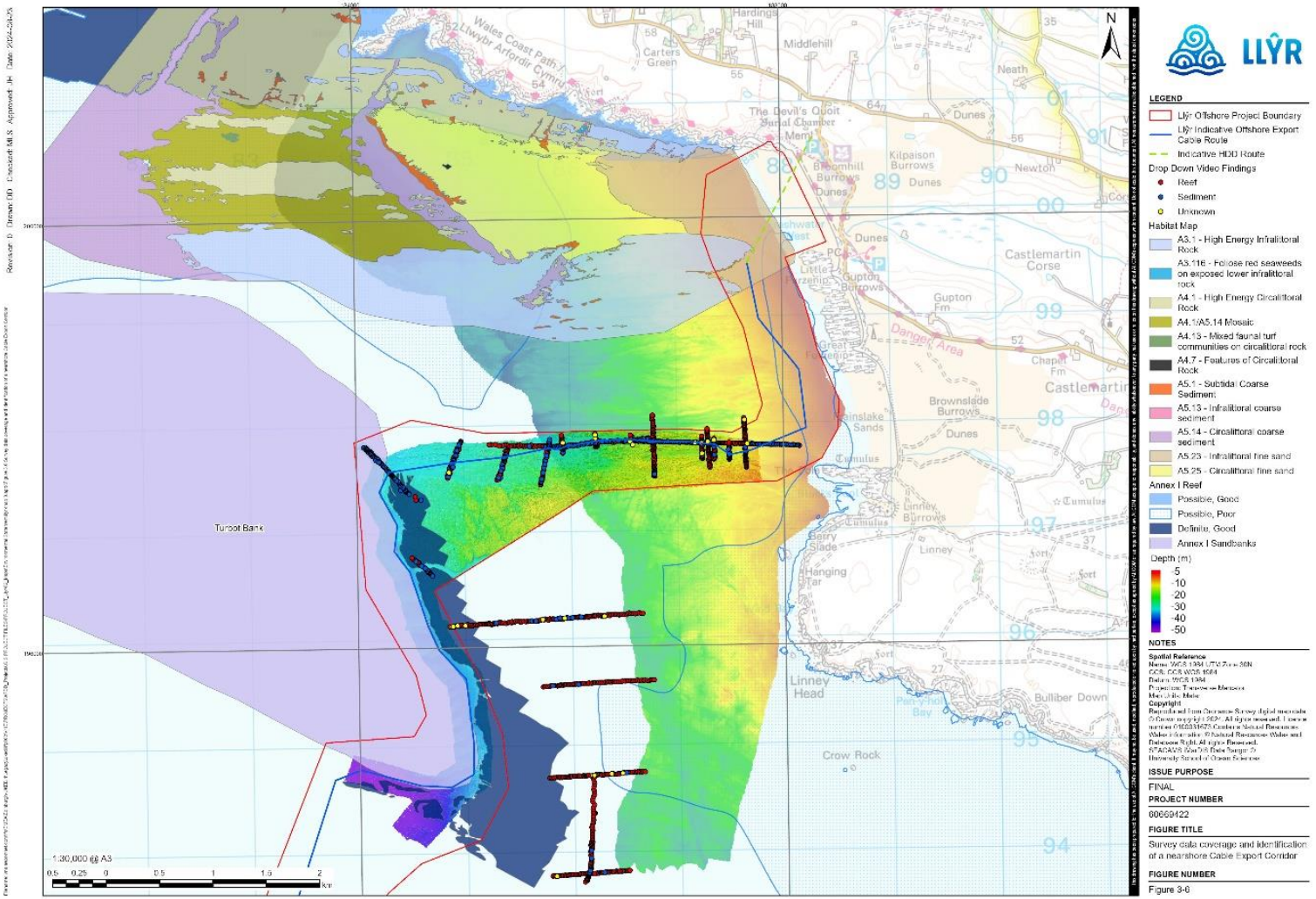

Figure 3-6. Survey data coverage and identification of a nearshore Cable Export Corridor

58. The DDV surveys confirmed the existence of a potentially viable OfECC to enable the proposed Project to commit to installing the export cables within a bounding OfECC area to avoid Annex 1 reef habitat and maintain the integrity of the Pembrokeshire Marine SAC. Following on from the DDV survey undertaken, a further hydrographic survey (using MBES) was undertaken in July 2024 to better inform the habitat assessment reporting and to effectively delineate the presence of a suitable channel for the proposed OfECC. As a consequence, the HDD exit point and OfECC boundary were adjusted to contain the appropriate route (see **Figure 3-6**).

59. The HDD exit point, within the OfECC boundary, emerges below the northern promontory of the Annex 1 reef, exiting approximately 1,500 m from the onshore HDD compound and approximately 600 m offshore in depths of around 8 m. From the HDD exit point on the seabed, the export cable will be laid in a southerly direction, parallel to the coastline and avoiding encroachment to the Annex 1 reef to the west, to a point where the 'gap' has been potentially identified within the Annex 1 reef. At this location the export cable will turn west and laid offshore in this general direction for around 4 km, again avoiding encroachment into any Annex 1 reef. At a point where it approaches the Turbot Bank designated sandbank area, the cable will travel in a southerly direction within the OfECC, maintaining a position outside of the Turbot Bank Sandbank designated area and avoiding encroachment into the Annex 1 reef area. Once the cable has cleared the Annex 1 reef and Turbot Bank sandbank, the cable travels in a south-westerly direction for around 13 km, avoiding environmental protected areas, to a point where it overlaps the original scoped OfECC and continues within this area until it reaches the array area (see **Figure 3-7**).

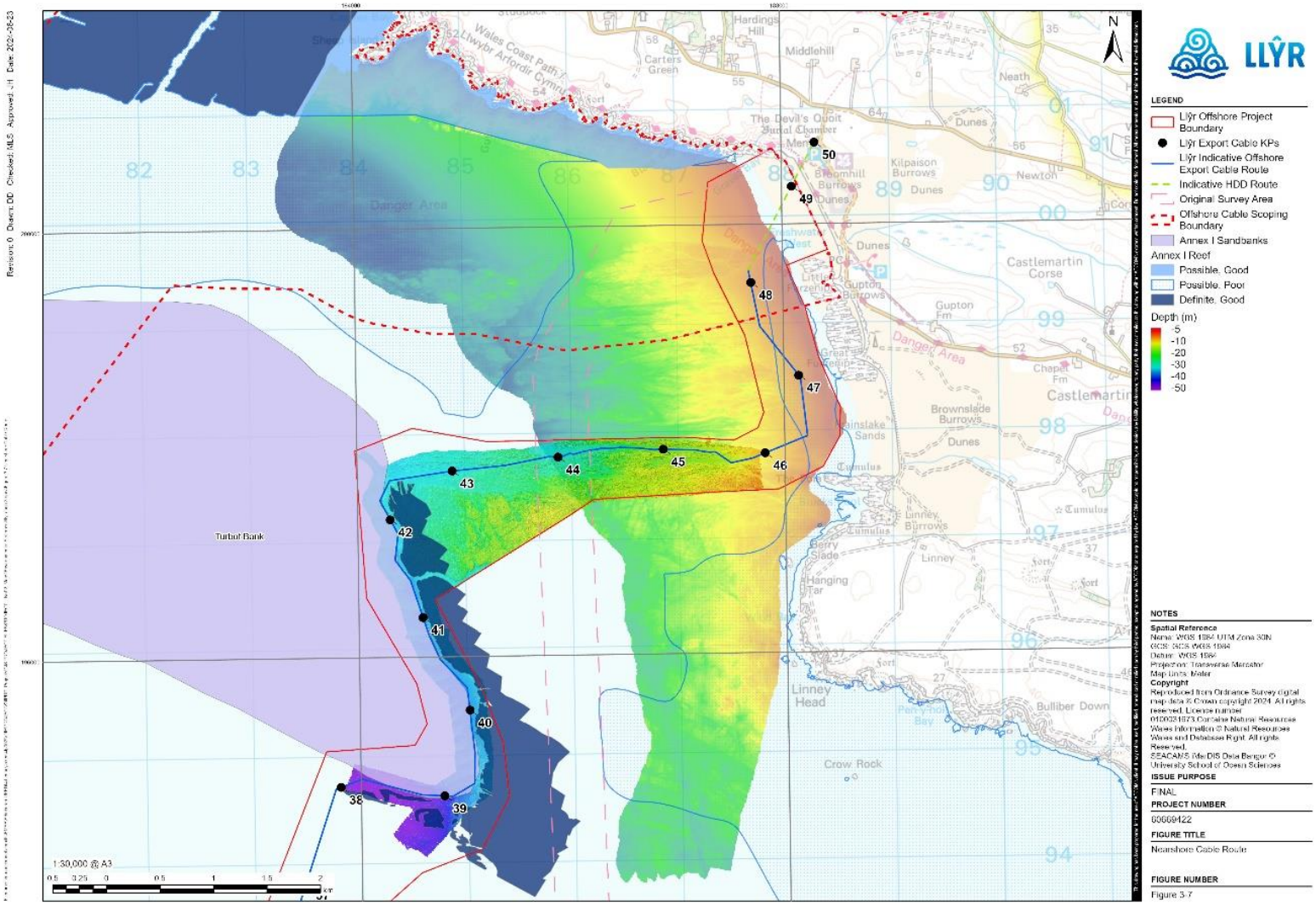

Figure 3-7. Nearshore cable route

60. It is acknowledged that there may be more advantageous routes within the OfECC, therefore the final offshore export cable routes will be refined following further geophysical and geotechnical surveys that will be conducted post consent determination. As part of these pre-construction surveys (the scope of which will be agreed with NRW), data will be analysed to ascertain the locations of the offshore export cable routes along with the potential for micro-siting of the proposed Project infrastructure within the OfECC. The target burial depths and any areas requiring potential cable protection will also be identified and reported as part of the Cable Burial Risk Assessment (CBRA). It is anticipated that the CBRA will be produced to discharge an appropriately worded consent condition and will be provided to NRW for acceptance prior to construction commencing.

61. The final proposed Project layout will be presented within the Design Outline Project (Array) Layout Plan, which is anticipated to form conditions of the Section 36 and / or Marine Licence consent and subject to NRW MLT approval prior to installation operations commencing.

3.6.3. Cable Landfall Design Evolution

62. Pembroke was identified as the preferred grid connection location through discussions with the National Grid and Western Power Distribution. Following an application to the National Grid in November 2021, confirmation was received from the NGESO that it recommended connecting the Llŷr 1 and 2 100 MW T&D projects to the National Grid Pembroke Power Station 400 kV Bay, as it was considered halving the cable route length for Pembroke in comparison to its original holding offer at Alverdiscott; with the resultant effect of reducing costs to consumers and the overall environmental impact.

3.6.4. Selection of the landfall region for consideration

63. The identification and selection of the preferred landfall location forms an integral part of the overall proposed Project definition and refinement of the final boundaries. Prior to identifying the initial region for landfall assessment, OfECC and subsequent survey route, the Applicant reviewed the Welsh and Irish Landfall Final Selection Report (provided as Appendix N of the Greenlink Marine Environmental Statement – Wales) undertaken for the Greenlink Interconnector cable project (Greenlink, 2019). The findings were re-assessed from the applicant's perspective to inform the cable route survey area. As both cables sought a National Grid point of connection at Pembroke Power Station, the proposed project team re-considered the same locations and added another two (**Table 3-5 and Figure 3-8**).

Table 3-5. How each landfall option was considered

Landfall	How it was considered
Freshwater West (preferred)	The Applicant concurred with the Welsh and Irish Landfall Final Selection Report (Greenlink, 2019) that the greatest advantage of using this location as the preferred landfall option is that is it would require the shortest onshore export cable route to the connection point. It is also technically straightforward from an engineering point of view and as it is south of Milford Haven, it avoids the requirement to cross the harbour. The OfECC approaches the Castlemartin firing range; however, as the Greenlink cable utilised this area, it was deemed plausible to eliminate this as a hard constraint. At a meeting with the Castlemartin Firing Range in January 2024, it was confirmed that there was potential to cross the northern danger area during the Construction phase of the proposed Project, subject to further dialogue. The proposed Project would also seek a HDD solution to avoid protected areas

Landfall	How it was considered
	behind the beach (e.g. Broomhill Burrows SSSI, Castlemartin Coarse SSSI, Castlemartin Coast SPA, etc.). It was recognised that subsea Annex 1 habitats were present in the regional area, but it was considered that there is potential to identify an acceptable route that avoided all Annex 1 reef features within the OfECC. The Freshwater West landfall location also offered the greatest opportunity for the colocation of onshore infrastructure (as requested to be considered by the PEDW, Pembrokeshire County Council, Pembrokeshire Coast National Park and the Welsh Government)
West Angle Bay (considered)	Although not considered within the Welsh and Irish Landfall Final Selection Report (Greenlink, 2019) , based on the feedback from PEDW, PCC, PCNP and the Welsh Government, a landfall was also considered at West Angle Bay as it was the selected route identified by the Project Erebus (which has subsequently received consent).
Angle Bay (not selected)	Although not identified within the Welsh and Irish Landfall Final Selection Report (Greenlink, 2019), the Applicant included Angle Bay as part of the landfall option considerations. However, Angle Bay was discounted following consultation with Milford Haven Port Authority (MHPA) who raised concern about the disruption to shipping caused by laying subsea cables around the Angle Peninsula and into the estuary at Milford Haven. Angle Bay is also designated within the Milford Haven Waterway SSSI and Pembrokeshire Marine / Sir Benfro Forol SAC, with the bay largely compromising of Annex I mudflats and sandflats habitat
Broad Haven (not selected)	The landfall location was too far away from the array area (just north of Broad Haven town), the OfECC would cross a number of seabed infrastructure and environmental protected areas if landfall was made at this location. It also would necessitate a technically challenging and expensive offshore export cable route across Milford Haven estuary (involving tunnelling and HDD) which could not be supported by the project finances.
Dale (not selected)	The option to the west of Dale Town, as identified in the Welsh and Irish Landfall Final Selection Report (Greenlink, 2019), is a difficult landfall, due to geology, topography and access issues. It also presents (as with Broad Haven) the challenge of traversing the Milford Haven estuary (involving tunnelling and HDD) which could not be supported by the project finances.
Broad Haven South (not selected)	The Broad Haven South access landfall would involve traversing the active onshore Castlemartin firing range, which would pose additional challenges for construction and operational access. It would also require a 10 km longer onshore export cable route than Freshwater West, therefore was discounted on this basis
Freshwater East (not selected)	Freshwater East is within the Castlemartin Firing Range and would require a 10 km to 20 km longer offshore and onshore export cable route than landfall at Freshwater West, therefore was discounted on this basis.
Tenby South Beach (not selected)	Although landfall at Tenby South Beach could be routed to avoid the Castlemartin Firing range, it would require the longest offshore and onshore export cable route, is a popular tourist area and has a long onshore export cable route. It was therefore discounted on this basis.

Figure 3-8. Landfall option locations considered during the appraisal stage

3.6.5. Selection of the landfall location

64. As a result of the above considerations, a study was commissioned and undertaken by AECOM to identify and evaluate an offshore export cable corridor landfall site located within a search area between West Angle Bay and Freshwater West (**Appendix 3C - Landfall Assessment**). The report assessed the hard and soft environmental as well as engineering constraints, both offshore and at landfall, within a 300 m wide cable corridor located inside the proposed Project offshore survey area. The search area was also defined by the extent of the site specific marine geophysical and environmental survey areas, which covered the land between West Angle Bay and Freshwater West, excluding Angle Bay.

65. Initial evaluation of the landfall search area identified seven potential locations between West Angle Bay and Freshwater West (**Table 3-6 and Figure 3-9**Error! Reference source not found.).

Table 3-6. Potential landfall location coordinates between West Angle Bay and Freshwater West

Location	Coordinates (X, Y)		Length of indicative offshore route (km)	Length of indicative onshore route (km)
West Angle Bay	185260.00	203367.00	43	11
Castle Bay	184589.00	201938.00	42	10
Whitedole Bay	184884.00	201843.00	42	10
Parsonquarry Bay	185164.00	201518.00	42	10
West Pickard Bay	186148.00	201275.00	43	8
East Pickard Bay	186624.00	201120.00	43	8
Freshwater West	188063.00	200532.00	45	7

Figure 3-9. Potential landfall locations considered

66. To evaluate potential landfall options, a desk-based analysis of environmental and engineering constraints was undertaken, using publicly available and purchased data. A site walkover was also undertaken, on the 24 February 2023, to visually assess landfall options between West Angle Bay and Freshwater West.

67. Whilst all seven landfall sites were considered technically feasible, only West Angle Bay and Freshwater West were given further consideration on the basis that the other locations would require cliff face landings on a remote section of coastline with limited access.

3.6.6. Comparison of the Landfall sites at West Angle Bay and Freshwater West

68. At West Angle Bay, the Project Erebus cable corridor allows for two alternatives landfall sites; one situated to the north side of the bay and the other to the south of the bay. The remaining areas at West Angle Bay, considered by Erebus, were discounted due to multiple ecological, cultural heritage, and geological designations.

69. At Freshwater West, two landfall sites are considered. These landfall sites are located to the north and south of the Greenlink joint transition bay and are located outside of the protected areas at Freshwater West.

70. Based on the findings of this study, both West Angle Bay and Freshwater West are considered to offer potential landfall sites for the proposed Project. The method of landfall for both options (West Angle Bay and Freshwater West) will be achieved using HDD. At Freshwater West this is considered the only option in order to mitigate the risk of disturbance to the SSSI and avoid the unintended formation of a scour channel. Although, Project Erebus has identified trenching as a potential, secondary, option at West Angle Bay, the presence of intertidal reefs and important geological features suggests that trenching should also be avoided at this location.

71. Two landfall sites are also identified at Freshwater West, within this study; one to the north and the other to the south of the Greenlink TJB (both located outside of the protected areas at Freshwater West).

3.6.7. Landfall Site Conclusion

72. Based on the outcome of the detailed assessment , the landfall site selected is at Freshwater West.

73. HDD is the appropriate construction method for installation of the subsea cables at landfall to mitigate against the risk of disturbance to intertidal reef and avoid the unintended formation of a scour channel. Although technically complex and challenging due to the length (circa 1300 m) and gradient of the bore, the Greenlink project has demonstrated that cable ducts can be installed here using the HDD technique.

74. It is recognised that the Greenlink project experienced drilling fluid breakout on the beach during HDD operations and it is reasonable to anticipate a potential similar occurrence during HDD installation for the proposed project as the sedimentary bedrock is highlight fractured with weak zones and the presence of faults. Due to the presence of intertidal and subtidal habitat and Annex 1 habitat, the project will use a drill fluid which Pose Little or No Risk to the Environment (PLONOR) comprising of water with a non-oil based drilling fluid such as bentonite or other such drill fluid which is confirmed by its safety data sheet not to be toxic to aquatic organisms and is biodegradable.

75. In addition, a closed loop recycling system will separate the drill cuttings from reusable drilling fluids, meaning that at breakthrough of the seabed offshore or the land onshore there will be a limited quantity of drilling fluid and cuttings lost to the environment. Drill cutting excavated

offshore will be returned to shore and all captured cuttings will be collected for disposal by licensed contractors.

3.7 Onshore Cable Route Design Evolution

76. Feedback from PEDW, PCC, PCNPA and the Welsh Government from the outset was to ensure that disruption to other stakeholders, particularly from cumulative development, was either avoided or minimised and it would be preferable if cable routes could be co-located or shared. At a meeting on 28 / 07 / 2023 that while PEDW acknowledged, while it may not be achievable, it was stated that they expect the consideration of sharing cable routes and infrastructure with other projects in the area to be presented in the application.

3.8 Onshore Cable Route Options Considered

77. As a consequence, three possible onshore cable corridor options were identified to connect the proposed project from the identified landfall site to the NGESO connection point at Pembroke Power station, namely:

- To align with the route utilised by Greenlink cable;
- To align with the route utilised by the Erebus cable; and
- To identify a distinct cable corridor to the north remote from either the Greenlink or Erebus projects.

78. **Figure 3-10** illustrates the onshore Erebus and Greenlink cable routes in relation to the Llŷr onshore Project Boundary. Option a and b were in consideration to specifically address the request from PEDW, and statutory consultees as detailed above. Option (a) to align with the Greenlink cable route – this route was disregarded as it followed the U6306 minor road between Hoplass Farm and Wallaston Cross. This is a single track highway and had a significant technical engineering challenge in that there is insufficient width to place the proposed Project cables and maintain an appropriate safe separation distance with the Greenlink cable. Installing the cables in the agricultural land, adjacent to this highway, was also considered impracticable due to the presence of the Hoplass Solar Park and the nearby residential property at Sunnyridge, which are on opposite sides of the road.

79. Option (b) to align the route utilised by the Erebus Floating Offshore Wind Project has the advantage of maintaining the installation of the cable infrastructure within the same locality, limiting the impact on local communities. The proposed corridor considered:

- Aligns with the consented Erebus cable route in the area around the Kilpason Burrows;
- Sweeps around the head of the valley immediately north of the B4320;
- Crosses the road leading to the Valero Oil Refinery and Pembroke Power Station south of Wallaston Cross;
- Heads east to Lambeeth Farm; and then
- Heads north to arrive at Pembroke Substation.

80. For option (c), the ability to meet the objective and identify a distinct cable corridor to the north, remote from either the Greenlink or Erebus projects, was constrained due to the need to rule out routing through the former BP Tank Farm at Angle Bay (primarily by the risk of disturbing potentially contaminated land) and adjacent to the B4320 (as this would have a significant impact on local communities being in part a single track highway). Taking the

corridor south of the B4320 was ruled out, as this would increase the extent of the development within the PCNP.

81. As a consequence, a distinct corridor alignment was developed to either avoid or minimise impact on potentially sensitive ecological resources, such as hedgerows, woodlands, and watercourses, within the search area. The need to cross roads, public rights of way, underground and overhead utilities, and private infrastructure (Valero high pressure oil pipeline, Greenlink and Project Erebus) was also taken into consideration, with the aim of minimising the number of crossing points.

82. An Engineering feasibility assessment between the two options (option b and the amended option c) was carried out by AECOM and considered the following criteria:

Table 3-7. Engineering feasibility study between option b and option c (amended)

Criterion	Comments
Ground topography	Facilitates understanding of terrain.
Llŷr Onshore Scoping Boundary	Identifies if any part of the cable route extends beyond the scoping boundary.
Ground conditions	Very soft ground or rock affects the suitability for trench excavation / reinstatement. This can impact cost and duration of construction.
Potential to encounter ground contamination	Health, safety, and environmental hazard during construction. Impacts on cost and duration of construction.
Impact on water sources	Potential for cable installation to adversely impact water sources.
Cable routing through areas at risk of flooding	Additional measures may be required for cable installation in areas at risk of flooding.
Cable routing within roads	Extent of cable routing in roads. Disruption to road users.
Crossing of watercourses	Number of crossings required. Construction techniques required at crossings.
Crossing of roads and public rights of way	Number of crossings required. Construction techniques required at crossings.
Sensitive features	Necessary to assess potential of impact and apply relevant mitigation measures Stakeholder engagement requirements.
Natural heritage area	Necessary to assess potential of impact and mitigation measures. Stakeholder engagement requirements.
Other designations e.g., National Parks, Local area plan	Necessary to assess potential of impact and mitigation measures. Stakeholder engagement requirements.
Cultural heritage features: listed buildings / Scheduled Monuments / conservation zones etc.	Necessary to assess potential of impact and mitigation measures. Stakeholder engagement requirements.
Proximity to sensitive receptor, residence and recreational amenity	Potential perception of nuisance or loss of amenity.

83. The details of the engineering and proposed construction methodology are provided within Chapter 4 Project Description.

84. The AECOM engineering study concluded that both cable routes were feasible from an engineering perspective and negotiations were opened up with the prospective landowners to assess the practicable feasibility of securing the necessary land access for construction and operation. However, for the northern alternative route the landowners were either unwilling or reluctant to enter discussions or were considering their own development proposals that were incompatible with the proposed Project proposals.

85. This meant that the focus for the proposed project cable route centred on the cable route identified as option (b), aligned with the Erebus cable route. As a consequence, an engineering refinement of route option b was commissioned by the Applicant to identify a base case onshore export cable route and the consent envelope boundary.

86. The base case onshore export route and consent envelope boundary identified and assessed a total of 55 crossings and 4 ‘pinch point’s’ and this now forms the basis for the onshore cable route for this application.

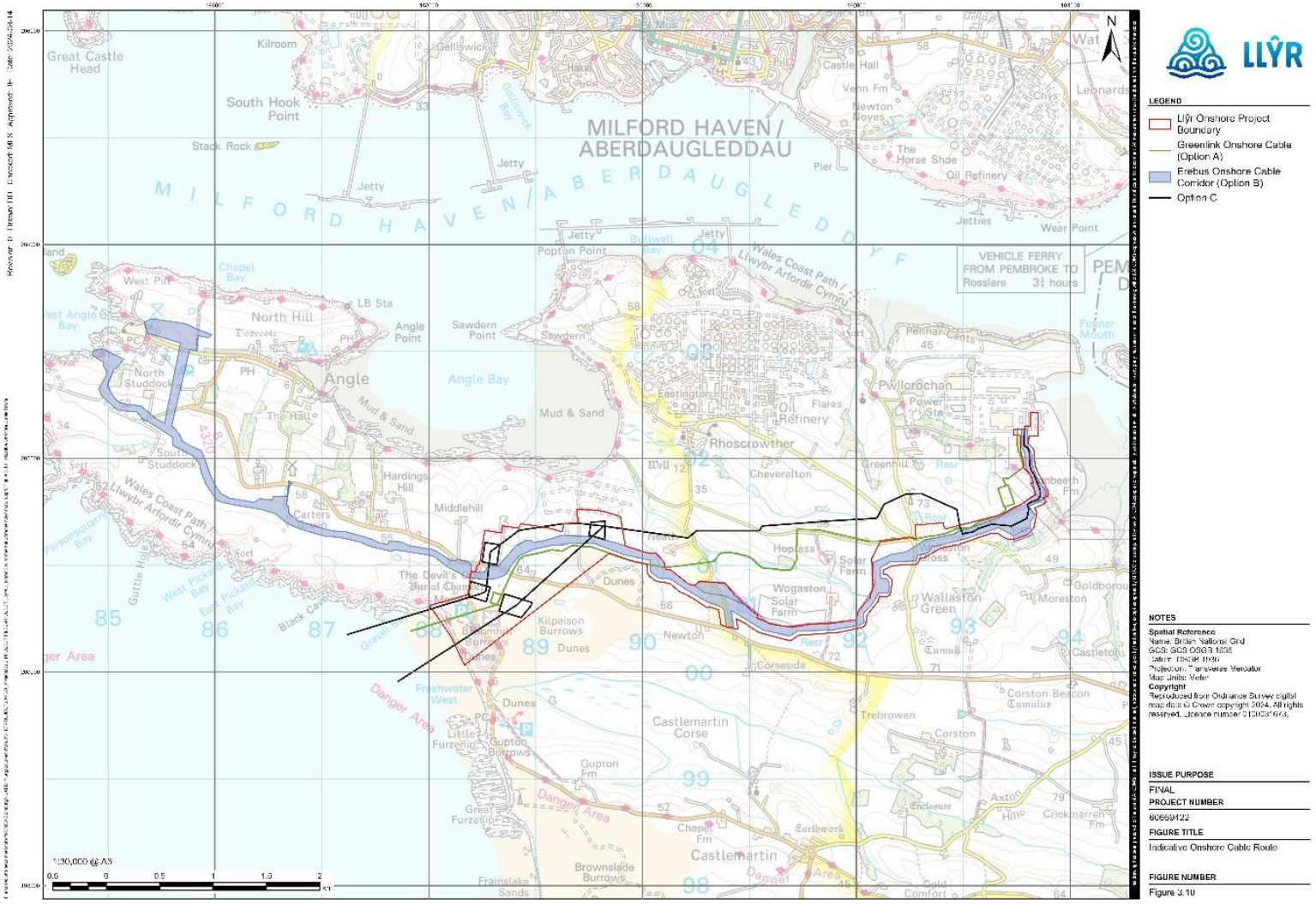

Figure 3-10. Indicative Onshore Cable Route

3.9 Substation – Identification of an Appropriate Location

87. The proposed development will require a substation to transform the voltage from 66-132 kV to the NGET interface voltage of 400 kV. The land required for the substation compound is estimated to be 15,000 m^2 / 1.5 hectares (based on a substation footprint of 6,000 m^2), with an additional 5,000 m^2 / 0.5 hectares required for a temporary construction compound. To aid the initial evaluation of the landscape and visual effects, the overall height of the substation building is considered to be 15 meters. As the area of the substation exceeds 100 m^2, a sustainable drainage system (SuDS) for surface water is also required, with additional land required to accommodate the SuDS. Although an area allocated for SuDS is not shown on the substation site plan, the identification and refinement of the preferred substation sites take into consideration the land required for a SuDS scheme (**Appendix 10A – Flood Consequence Assessment**, **Annex A – Drainage Strategy**).

88. An initial eight potential locations were identified and assessed for suitability to host the substation sites (**Table 3-8**). These areas were defined by taking into consideration:

- Topography of the land and location of existing properties;
- Location of infrastructure for Greenlink;
- Visual and environmental considerations; and
- The substation location and cable infrastructure of the Project Erebus.

89. A brief description of the options identified in **Table 3-8** below and are shown in **Figure 3-11**.

Table 3-8. Summary of substation options considered

Option number	Summary of location
Option 1	Option 1 is located within the project scoping boundary and is approximately 11ha in size. Option 1 is 1.2 km southwest of the Pembroke Substation, approximately 100 m south of Goldborough Road.
Option 2	Option 2 is located within the project scoping boundary and is approximately 7.9ha in size. The Pembroke Substation is located 1.3 km to the northeast.
Option 3	Option 3 is located within the project scoping boundary and is approximately 3.4ha in size. The Pembroke Substation is 2.3 km to the northeast.
Option 4	Option 4 is located within the project scoping boundary and is approximately 3.7ha in size. The Pembroke Substation is 2.8 km to the northeast. Option 4 is located approximately 450 m north of the B4320.
Option 5	Option 5 is not located within the project boundary. It is just north of the boundary near Green Hill and is approximately 1 ha in size. The Pembroke Substation is approximately 1.3 km to the northeast.
Option 6	Option 6 is not within the project boundary. It is approximately 10 m east of Option 5. The Pembroke substation is approximately 1.1 km to the northeast.
Option 7	Option 7 is not within the project boundary and is approximately 2.8 ha in size. This option is to the east of the project boundary immediately adjacent to Goldborough Pill. The site is 670 m southeast of Pembroke Substation.
Option 8	Option 8 is within the project scoping boundary and is approximately 4.1 ha in size. The Pembroke Substation is 900 m to the north.

90. These locations were then assessed through consideration of a number of technical, construction, environmental and safety factors, including:

- Avoiding, where possible, dense areas of population or close proximity to other building or residential dwellings;
- Avoiding areas and sites of international and national designations (e.g. Ramsar, SAC, SPA, National Nature Reserve (NNR), SSSI's);
- Avoiding, where possible, areas subject to international and national landscape designations, such as the National Park and Areas of Outstanding Natural Beauty (AONB's);
- Avoiding, where possible, sites and features subject to cultural heritage designation, such as listed building, scheduled monuments, etc.;
- Minimising the impact of agricultural interests as far as possible;
- Avoiding, where possible, difficult construction areas, such as side slopes, solid rock strata and complex river crossings;
- Safe access for construction traffic, ease of access, and avoidance of undue disturbance to the local road network; and
- Adherence to cable separation distances and project specific design constraints.

3.10 Substation Optioneering Assessment

3.10.1. Summary of Substation Options Appraisal

91. The eight potential Project substation locations identified were subject to a Red, Amber, Green (RAG) rating exercise to assess the strengths and weaknesses of the various options. The rating criteria used in the report is as follows:

Green – No or limited issues that could be managed via design and mitigation;

Amber – Several issues to overcome that would require mitigation; and

Red – Significant issues in multiple locations that would require significant mitigation.

92. The RAG assessment considered the topics of: Agricultural Land Classification, Air, Quality, Contaminated Land, Cultural Heritage – Archaeology, Ecology, Flood Risk, Landscape and Visual, Noise and Vibration, Traffic and Transport, the Water Environment and Planning. Key findings are:

93. Options 1, 3, 4, 5 and 7 were least favoured from an engineering and constructability point of Options 2, 6 and 8 were preferred Options and were rated at an Amber level. There were no Green rated Options following RAG assessment.

94. Based on the assessment the locations for options 2, 6 and 8 were brought forwards for public consultation and further consideration. Feedback from stakeholders and ongoing landowner negotiations were included to update the RAG assessment, with option 2 being identified as the preferred substation location. A summary of the RAG assessment is provided in Table 3-9.

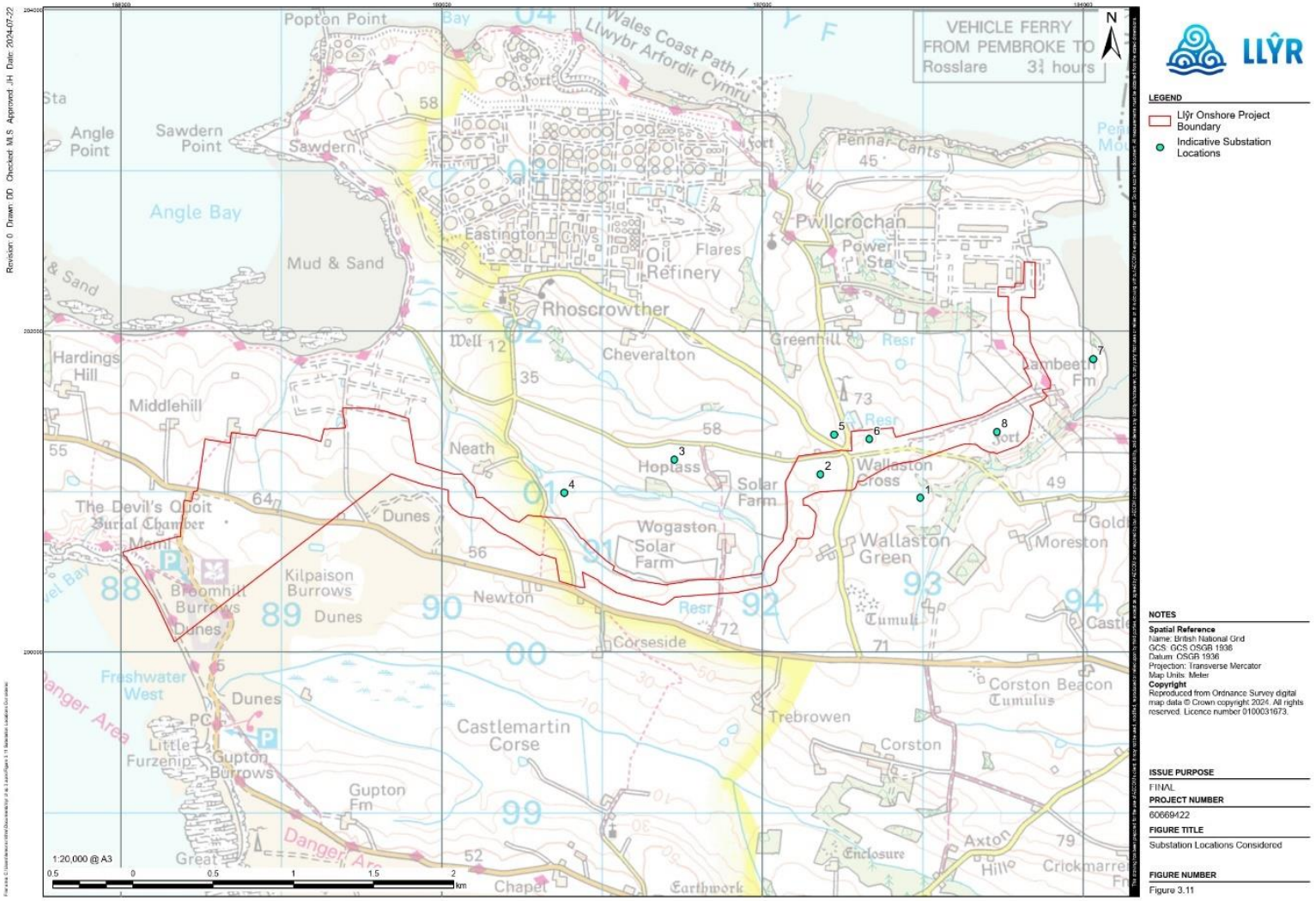

Figure 3-11. Substation locations considered

Table 3-9. Summary of RAG assessment

Option	Environmental Constraints	Land Acquisition	Stakeholder View	Engineering	Cable Routing & Consolidation Opportunity	Score
1	• Located within the Milford Haven Waterway Historic Landscape Area. • Close proximity to statutory designated sites and habitats. • Heavily screened and barely discernible within the landscape.	• Landowner willing to engage.	• No preference indicated at stakeholder events or formal feedback routes.	Approximately 11 ha in size • Steeply sloping and will require levelling- key issue of how to address SUDS as the site slopes down to a watercourse (circa 3 m differential), creating issues for embankments, etc. • Congested site with other operational / planned developments either beside or encroaching the area.	• Near to the Greenlink and Erebus substations, but not directly adjacent. Greenlink cable is approximate 160 m to the north. • Pembroke Power Station 1.2 km to the northeast.	4
2	• One of the least ecological sensitive sites. • Visible within the surrounding area, although mostly screened from the roads and residential receptors. • No flood risk.	• Landowner willing to engage.	• No preference indicated at stakeholder events or formal feedback routes	• Approximately 7.9 ha in size • Sufficient space and level ground for compound and SUDS. • costliest due to distance from NGET substation.	• Areas restricted due to presence of Erebus cable in northern end of the site (may require construction traffic to cross cable).	7
3	• Visible within the surrounding area. • No flood risk.	• Landowner does not want to engage.	• No preference indicated at stakeholder events or formal feedback routes	• Approximately 3.4 ha in size (insufficient) and has poor access.	• Too small • Significant distance to other infrastructure.	1
4	• Heavily screened and barely discernible within the landscape. • Watercourse runs nearby with local water abstraction point.	• Landowner does not want to engage.	• No preference indicated at stakeholder events or formal feedback routes	• Approximately 3.7 ha in size (insufficient) • Very poor access.	• Significant comparative distance for 400 kV cable • Furthest away location which has little opportunity for co-location • Too small	1
5	• Visible within the surrounding area. • No flood risk.	• Spatially constrained for what we need, would require additional land acquisition.	• No preference indicated at stakeholder events or formal feedback routes	• Approximately 1.0 ha in size (insufficient) • Bounded by a high pressure oil pipeline.	• Too small	1
6	• Visible within the surrounding area. • No flood risk. • Several residential receptors within 250 m of the site.	• Spatially constrained for what we need (consideration of hedges, SUDS requirements, construction	• No preference indicated at stakeholder events or formal feedback routes	• Approximately 2.8ha in size, although it possibly could accommodate substation if temporary construction compound is secured in the adjacent field. • Greenlink cable adjacent to southern boundary	• Near to the Greenlink and Erebus substations, but not directly adjacent.	3

Option	Environmental Constraints	Land Acquisition	Stakeholder View	Engineering	Cable Routing & Consolidation Opportunity	Score
		requirements and site levelling requirements • Landowner prefers other opportunities offered.		• Erebus cable 215 m to the south		
7	• Prone to flooding and needs to cross coastal path. • Subject to substantive environmental constraints - proximity to a number of statutory designated sites and habitats. • Heavily screened and barely discernible within the landscape.	• Part of a residential property • Issues to get cable access (needs to go through farmyard)	• No preference indicated at stakeholder events or formal feedback routes	• Poor access through Lambeth Farm. • Approximately 2.8 ha in size • Located 670 m southeast of Pembroke Power Station. • Greenlink cable located 575 m to the west. • Erebus cable route runs along the western boundary.	• Relatively close to the Erebus and Greenlink substations.	2
8	• Close proximity to statutory designated sites and habitats. • Heavily screened and barely discernible within the landscape.	• Land already under option.	• No preference indicated at stakeholder events or formal feedback routes	• Approximately 4.1 ha in size • Poor access along narrow roads. • Pembroke Power station located 900 m to the north, • Greenlink substation and cable along the north of the site. • Erebus substation adjacent to the site on the east and cable route within southern half of the site.	• The best location to collocate infrastructure. • Other challenges / risks - assumes all Erebus works being complete before start as the site is their identified construction compound.	5

3.11 References

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