Morven North Offshore Wind Array Project

Environmental Impact Assessment Report

Volume 1, Chapter 4: Site Selection and Consideration of Alternatives

MVCNS-J1201-RPS-10012
May 2026

B01

Document status

Version	Purpose of document	Authored by	Checker	Approved by	Date
FINAL	Application	TTRPSEL	TTRPSEL	MvOWL	May 2026

Prepared by:	Prepared for:
TTRPSEL	**Morven Offshore Wind Limited**

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4.1 Introduction and overview

4.1.1.1 This chapter of the Morven North Offshore Wind Array Project (hereafter, "Morven North") Environmental Impact Assessment (EIA) Report presents a description of the site selection process and the alternatives considered by Morven Offshore Wind Limited (MvOWL, hereafter referred to as "the Applicant") to develop and refine the design of Morven North , prior to award during the ScotWind Leasing Round in 2021/22 through to design freeze of the Project Design Envelope (PDE) to inform the EIA.

4.1.1.2 This chapter has been prepared in accordance with the Marine Works (Environmental Impact Assessment) Regulations 2007 and Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (hereafter, collectively referred to as the "EIA Regulations"), which make provisions for the Applicant to provide information on their consideration of alternatives. Schedule 3, paragraph 2 of The Marine Works (Environmental Impact Assessment) Regulations 2007 requires the following information to be included in the EIA Report: "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" (HM Government, 2007). Similar provisions are made in Schedule 4, paragraph 2, of the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (HM Government, 2017).

4.1.1.3 In line with the requirements set out above, this chapter presents the alternatives considered by the Applicant and the process used to inform the chosen option for Morven North.

4.2 Assessing the "Do Nothing" scenario

4.2.1.1 The "Do Nothing" scenario outlines the changes which would occur to the baseline environment (if any) if development of Morven North was not progressed. In line with the EIA Regulations, each technical topic (Volume 2, Chapters 7 to 21) has undertaken an assessment of the future baseline under the "Do Nothing" scenario.

4.3 Site selection process

4.3.1.1 The approach taken with regard to site selection and the definition and refinement of Morven North involved the following steps:

- Step 1: Identification of Option Areas within the Sectoral Marine Plan for Offshore Wind Energy;
- Step 2: Sectoral Marine Plan Option Area assessment;
- Step 3: Environmental Impact Assessment Scoping – Identification of the Environmental Impact Assessment Scoping Boundary;
- Step 4: Splitting of the Morven Site into Morven North and Morven South;
- Step 5: Environmental Impact Assessment and application.

4.3.1.2 These stages are discussed in Sections 4.3.2 to 4.3.6. The offshore export cable and onshore transmission infrastructure for Morven North do not form part of this application due to the ongoing work through the Offshore Transmission Network Review (OTNR) and the uncertainty around available grid connection information. Details of these are provided in Section 4.4.

4.3.2 Step 1 – Identification of Option Areas within the Sectoral Marine Plan for Offshore Wind Energy

4.3.2.1 In November 2017, Crown Estate Scotland (CES) announced its intention to launch a leasing round for commercial scale offshore wind energy projects within Scottish waters. In parallel, the Marine Directorate - Licensing Operations Team (MD-LOT) prepared the Sectoral Marine Plan (SMP) for

Offshore Wind Energy (hereafter, the "SMP") in order to identify sustainable Plan Options (POs) for the future development of commercial scale offshore wind energy in Scottish waters (Scottish Government, 2020).

4.3.2.2 The SMP provides a spatial strategy to inform the seabed leasing process for commercial offshore wind energy that minimises adverse effects on the environment, economic sectors and marine users, and maximises opportunities for economic benefits (Scottish Government, 2020). In order to achieve this, the SMP followed an iterative process informed by evidence and stakeholder engagement. Initial Areas of Search (AoS) were identified at first and subsequently refined through three iterations of Opportunity and Constraint (O&C) analysis to identify Draft Plan Options (DPOs) and, subsequently, final PO Areas. The main steps taken to develop Plan Options for future development of commercial scale offshore wind energy in Scotland, and therefore the ScotWind Leasing Round, are outlined below:

1. O&C Analysis – Iteration 1;
2. O&C Analysis – Iteration 2;
3. Scoping Consultation;
4. O&C Analysis – Iteration 3;
5. Identification of DPOs;
6. Assessment of DPOs;
7. Consultation on DPOs;
8. Finalisation and adoption of the SMP.

4.3.2.3 This iterative process reviewed and refined the initial 24 AoS identified to 17 DPOs. The final 15 PO Areas were published as part of the SMP in October 2020 (Scottish Government, 2020) and are shown in Figure 4.1. The first ScotWind Leasing Round was launched by CES in June 2020 which sought applications for the development of commercial scale offshore energy projects within these 15 final PO Areas.

4.3.2.4 In 2019, the Applicant made the decision to prepare and submit bids for PO Areas offered as part of the ScotWind Leasing Round. Bids were submitted in 2021, with Option to Lease Agreements offered in January 2022.

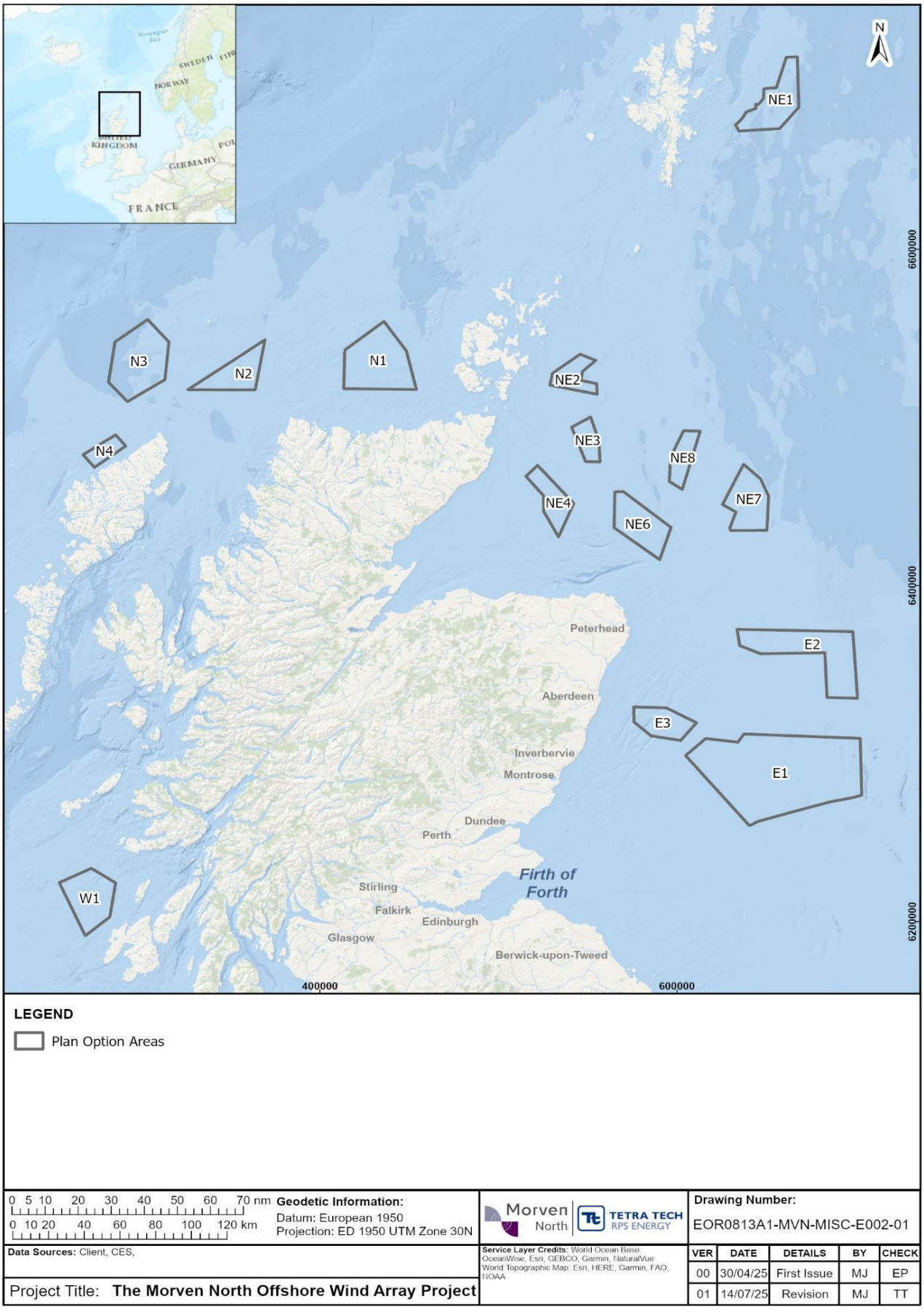

Figure 4.1: Sectoral Marine Plan Option Areas

4.3.3 Step 2 – Sectoral Marine Plan Option Area assessment

4.3.3.1 In order to identify and down-select a preferred site within the SMP, the Applicant completed four phases of site assessment to assess the risks, opportunities and constraints of all 17 DPO Areas, which were refined to 15 final PO Areas in October 2020. This process was supported by Xodus Group to aid the down selection by constraints mapping and Levelised Cost of Electricity (LCoE) assessment for both fixed and floating options, followed by internal financial modelling and development of technical concepts for the selected sites. These analyses were completed throughout the relevant phases below, with the assessments being refined as DPO Areas were dropped from consideration as the process progressed. The four phases of site assessment were as follows:

- Phase 1: Site identification and high-level evaluation.
- Phase 2: Down selection and boundary refinement.
- Phase 3: Detailed LCoE assessment and shortlisting.
- Phase 4: Final selection for bid and project concept.

Phase 1: Site identification and high-level evaluation

4.3.3.2 The Applicant commenced the high-level site evaluation with an initial categorisation into either bottom fixed or floating foundation design sites based on water depths with 80m and above used as the threshold for floating technology. Hybrid sites where fixed and floating foundations might be deployed due to large differences in water depths were considered and evaluated, as well.

4.3.3.3 A set of constraints and "knock out" criteria was evaluated for each of the 17 DPO Areas, including the anticipated consenting timeline, LCoE risk, grid connection risk and anticipated competition for the DPO. Key environmental constraints were considered at a high-level during this phase. These key constraints were used to assign a preliminary consentability ranking across all DPO Areas within the SMP with a range of different concept ideas which included both fixed, floating and hybrid sites. Key environmental constraints were assessed by conducting a desktop study which included a literature review of key statutory guidance notes and publicly available data. In addition, high-level GIS constraint mapping was undertaken to assess designated sites in relation to each of the DPOs. At this early stage in the assessment, the key environmental constraints included offshore ornithology, marine mammals and fish and benthic ecology. DPO Areas were then discarded based on knock out criteria and compared through a high-level LCoE GIS modelling assessment.

Phase 2: Down selection and boundary refinement

4.3.3.4 The high-level evaluation led to six DPO areas being suitable for fixed foundations or a hybrid solution (fixed and floating foundations) and three DPO Areas suitable for floating foundations which were brought forward for further analysis.

4.3.3.5 The constraints mapping was refined for the remaining nine DPO Areas by introducing hard and soft constraints and the most preferable sites within the DPO Areas were identified. More detailed work was done to better understand grid connection feasibility and consenting risks.

4.3.3.6 The consenting risks associated with the nine DPO Areas were mapped and assessed by expanding on the environmental constraints mentioned in paragraph 4.3.3.3, but also adding new constraints, allowing the bid team to analyse the DPO Areas in further detail. Designated site analysis was expanded by looking at the type of site (Special Area for Conservation (SAC), Special Protection Area (SPA), Special Site of Scientific Interest (SSSI) etc.) and the identification of the key features, for example Annex I habitat as listed by the European Union (EU) Habitats Directive, investigating why the site was designated, and how these could influence the consentability of the associated sites within DPO Areas. Further constraint identification incorporated fish spawning, fish nursery sites and seal haul-out sites into the analysis, aiding the refinement process from the nine DPO Areas.

4.3.3.7 In addition, anthropogenic constraints analysis was undertaken during this phase by incorporating human-orientated risks and constraints into the process. Further desktop work was carried out along with GIS mapping to show the DPO Areas in relation to shipping lanes and ferry routes which could

result in impacts to shipping and navigation receptors. Similarly, each of the DPO Areas were analysed in the context of aviation and radar receptors, particularly around Primary Surveillance Radar (PSR) overlap and Helicopter Main Routes for servicing oil and gas platforms. Initial estimates using desktop and publicly available data were used to estimate the value of key commercial fisheries (demersal, pelagic and shellfish) in the North Sea. Furthermore, the DPO Areas were assessed using the overlap of International Council for the Exploration of the Sea (ICES) rectangles to further highlight commercial fisheries constraints at a high-level.

4.3.3.8 This led to a further down selection to five fixed foundation/hybrid solution sites and two floating foundation sites, and boundary refinement for more detailed financial modelling.

Phase 3: Detailed LCoE assessment and site shortlisting

4.3.3.9 Internal financial modelling including LCoE assessment was undertaken for the seven remaining sites. The results were combined with the ranking of the consenting, grid connection, competition and competitive advantage categories for each site. This resulted in the shortlisting of three sites, comprising two fixed foundation sites (including the E1 DPO Area), and one floating foundation site. The analysis also showed that all potential hybrid sites performed less favourably in the overall ranking than either fixed or floating specific sites so were not considered further.

Phase 4: Final selection for bid and project concept

4.3.3.10 For the three remaining sites, several project concepts were developed, and more detailed financial analyses were undertaken to identify the most favourable concept (and DPO Area) to be taken forward to the ScotWind Leasing Round application.

4.3.3.11 Out of the three DPO Areas taken forward to final selection in the site selection process, five project concepts were developed for final analysis. The final analysis included a detailed Black, Red, Amber, Green (BRAG) assessment for consentability, and a further LCoE on the refined project concepts.

4.3.3.12 The consentability BRAG assessment consisted of another desktop study, this time creating a baseline environment for each of the key disciplines likely to be included in any future EIA and consent application. Key EIA disciplines considered during this phase were:

- water quality (Water Bodies, bathing waters and shellfish waters);
- offshore ecology (benthic, offshore ornithology, fish and shellfish, marine mammals, designated sites);
- aviation and radar (civil radar, air defence radar, Search and Rescue (SAR), Helicopter Main Routes etc.);
- shipping and navigation (vessel activity, navigational features, ferry routes and SAR);
- commercial fisheries (potting/creels, pelagic, demersal, dredging);
- cultural heritage (historic marine protected areas, military remans, submerged landscapes, shipwrecks);
- other sea users (oil and gas developments, renewables, aquaculture, cable projects, recreational activities, etc.);
- unexploded ordnance;
- seascape, landscape and visual (designated sites, coastal sensitivity).

4.3.3.13 Once a high-level baseline had been established for each receptor, project impacts were identified using previous experience and expertise within Xodus Group. Cumulative Impacts were also identified, taking into account several operational and consented wind farms relevant for each of the DPO Areas. Embedded mitigation measures were then attributed to each of the potential impacts, and a BRAG-rating determined with no inclusion of additional mitigation. Finally, potential additional mitigation measures that could be considered for a future EIA by the Applicant were added for each impact, and a post-mitigation BRAG-rating attributed to the impact. By comparing the BRAG assessments for each of the five project concepts, a risk-based decision on site selection and a preferred project concept was identified. Survey requirements were also estimated for each concept, as well as the likely studies/modelling specific to each receptor.

Further details on the analysis of the E1 DPO Area and E1 PO Area, and E1 West

4.3.3.14 In October 2020, the final PO Areas were released, and the Applicant submitted their ScotWind Leasing Round application for one of the available sites within the E1 PO Area known as E1 West. Paragraphs 4.3.3.15 to 4.3.3.21 detail the considerations and constraints analysis undertaken within the E1 PO Area to inform the final down selection to E1 West, in addition to the BRAG assessments detailed in the Phase 4.

4.3.3.15 The BRAG assessment undertaken in Phase 4 above captured the key considerations that were detailed and recommended for the East Region and E1 PO Area within the SMP. The SMP notes that the key environmental and socio-economic constraints associated with the East Region are:

- risks to bird species (including collision risk, displacement and impacts to birds on migratory pathways);
- potential impacts to marine mammal receptors;
- potential impacts to benthic habitat and species;
- potential impacts to migratory fish species;
- potential cost impacts and navigational risk through diversion of key commercial shipping routes;
- potential impacts on commercial fishing (Scottish Government, 2020).

4.3.3.16 This information helped inform the key considerations appropriate for the BRAG assessment. For example, the SMP highlighted that there is already a significant number of consented and operational offshore wind farm projects within the East Region which would require consideration in-combination with any new proposed offshore wind farm development within the area. Specific to the E1 PO Area, the SMP noted that this was potentially an important foraging area for Kittiwake (*Rissa tridactyla*) and Razorbill (*Alca torda*), and areas may also be important spawning grounds for fish species such as herring (*Clupea harengus*), Atlantic cod (*Gadus morhua*), whiting (*Merlangius merlangus*), plaice (*Pleuronectes platessa*) and sandeel (*Ammodytes* spp.). The SMP also recommended further regional survey effort and consultation to be undertaken with respect to the ornithology baseline of the E1 PO Area and noted that any risks to spawning fish from offshore wind farm developments within the E1 PO Area would need to be considered and mitigated at a project-level (Scottish Government, 2020).

4.3.3.17 With respect to socio-economic receptors within the E1 PO Area, potential offshore wind farm developments within this area may result in minor cost impacts to the commercial shipping, fishing and power interconnector sectors, which would need to be considered at a project-level. In addition, consultation with the Ministry of Defence would be required regarding potential radar interference from wind turbines installed within the E1 PO Area (Scottish Government, 2020).

4.3.3.18 Further baseline data utilised in the constraints analysis included wind resource data, geotechnical and geophysical data, and metocean data. The wind resource assessment was carried out using mesoscale modelled wind data from the United Kingdom (UK) Offshore Wind Dataset (2015) produced by the UK Met Office (UKMO). This dataset included 15-year average wind data from 1999 to 2014, which was used as a baseline for wind resource modelling. Preliminary reviews of the geology, including data from the British Geological Survey (BGS), geological maps, and regional reports, provided insights into the seabed and sub-surface soil conditions. Metocean analysis was completed using 25-year datasets from the Danish Hydraulic Institute (DHI) Group, which included wind speed, significant wave height, currents, and water levels.

4.3.3.19 These data identified bathymetry and geotechnical constraints within the E1 PO Area. For the chosen Option Agreement Area (OAA), located in the western part of the E1 PO Area, water depths ranged between 63m and 74m Lowest Astronomical Tide (LAT), and chalk deposits were found to be present. Both of these factors were identified as potential constraints for the foundation design that was presented in the ScotWind Leasing Round concept.

4.3.3.20 A key consideration for the shaping and selection of E1 West by the Applicant included the Firth of Forth Nature Conservation Marine Protected Area (NCMPA), which overlaps the E1 PO Area by approximately 10km² in the westernmost corner. The OAA boundary was designed to avoid this

NCMPA. The analysis highlighted the presence of sensitive benthic features, such as ocean quahog (*Arctica islandica*) and Annex I reef within the E1 PO Area. It was noted at this stage that micro-siting to avoid Annex I reef may be required if this area of E1 West was ultimately developed. The analysis also built on the previous BRAG assessment and further considered the potential effects on marine mammals, seabirds, and fish species, including the risk of disturbance, displacement, and habitat loss. Anthropogenic, or human constraints were also investigated as per paragraph 4.3.3.12. To reduce potential impacts, the Applicant has included various designed-in measures within the Morven North EIA Report, as detailed in Volume 3, Annex 6.3: EIA Commitments Register to reduce environmental impacts and ensure compliance with regulatory requirements.

4.3.3.21 In addition, the Applicant began site specific Digital Aerial Surveys (DAS) in January 2021, prior to ScotWind Leasing Round award. In doing so, the Applicant endeavoured to meet the recommendations set out within the SMP calling for further regional survey effort within the E1 PO Area (see paragraph 4.3.3.16), and ultimately was able to obtain crucial ornithological and marine mammal data, enabling timely and informed decisions with regard to defining and refining the PDE and site boundary at future stages (see Section 4.3.4 to 4.3.6).

Overview of the ScotWind application project concept

4.3.3.22 Following the comprehensive constraints analysis the Applicant identified the western part of the E1 PO Area as the most competitive, technically viable, and consentable site for a fixed bottom offshore wind farm. E1 West was selected based on extensive data review and the suitability of the site for delivering an offshore windfarm, based on previous offshore wind project experience from the Applicant. This, coupled with major projects delivery in the North Sea allowed the Applicant to make an informed decision on the site. For example, the Applicant has previous experience in consenting major projects in the North Sea, as well as the construction of offshore windfarms, based on similar types of data used to inform the PDE and financial viability of the project concept. The main drivers for selecting E1 West included its optimal wind conditions, the level of environmental impacts, and potential for high energy yield.

4.3.3.23 The optimal design identified as part of the ScotWind Leasing Round application submitted by the Applicant for E1 West consisted of 153 wind turbines with a rated power of 19.0MW each, spaced to maximise energy yield while minimising wake losses. Piled jacket foundations were selected as the optimal and most robust foundation type for the wind turbines for E1 West, given their strength-to-weight ratio, fabrication, and environmental conditions. Other foundation options, such as monopiles, gravity base structures, and suction bucket jackets, were considered but not proposed as part of the ScotWind Leasing Round application submitted by the Applicant due to the initial assessment of economic feasibility. The transmission system initially included both High Voltage Alternating Current (HVAC) and High Voltage Direct Current (HVDC) routes to optimise energy transmission and minimise environmental impacts. Due to electrical design informed by the Points of Interconnection (POIs) (and inclusion of both HVAC and HVDC transmission systems) at the time of the project concept, three HVAC OSPs and one HVDC OSP were taken forward. This careful selection of technologies was intended to ensure that E1 West was technically viable, consentable, and optimised for energy yield while minimising environmental impacts.

4.3.3.24 In January 2022, the Applicant was awarded an Option to Lease Agreement for E1 West within the SMP (Figure 4.2), which was subsequently renamed the Morven Lease Option Agreement Site (hereafter, the “Morven Site”). The Scoping Boundary (as presented in the Morven Offshore Wind Array Project Scoping Report (hereafter, the “Morven Site Scoping Report”) is the same as the Morven Site and is discussed in Section 4.3.4.

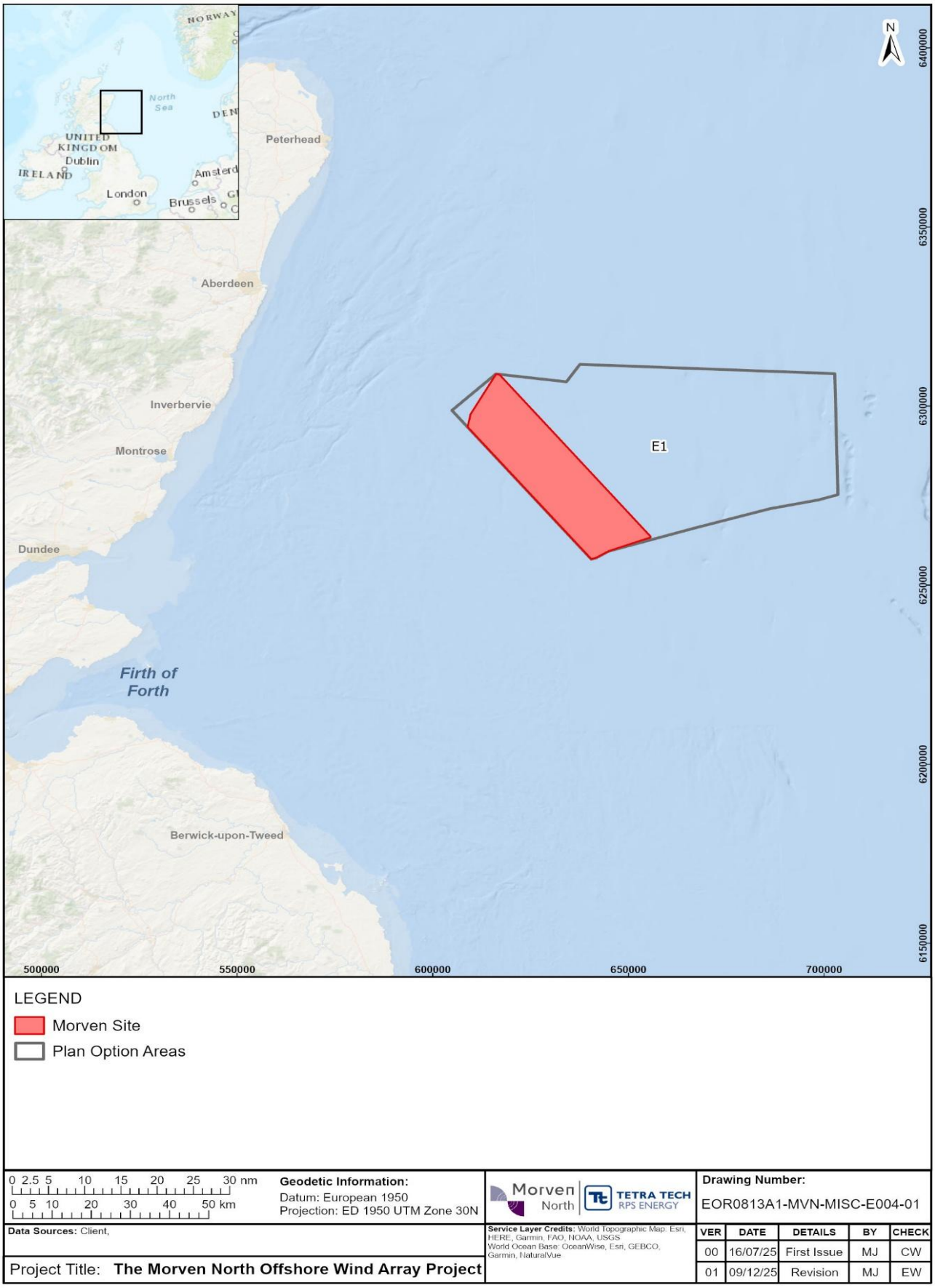

Figure 4.2: The Morven Site located within the E1 Plan Option Area

4.3.4 Step 3 – Environmental Impact Assessment Scoping – identification of Environmental Impact Assessment Scoping Boundary

4.3.4.1 Following on from the success of the ScotWind Leasing Round and subsequent award, the Applicant continued to develop the project and proceeded to EIA Scoping, building on from the studies and analysis completed during the project concept work detailed in Section 4.3.3.

4.3.4.2 The suitability of the Scoping Boundary and Morven Site Scoping Report PDE, was considered with respect to information gathered to inform potential engineering, societal, economic and environmental risks and constraints. These risks and constraints were considered against a range of potential technological parameters, which would ultimately aid the Applicant in defining the Morven Site Scoping Report PDE. The key design parameters considered within the Morven Site Scoping Report PDE were related to the wind turbines and Offshore Substation Platforms (OSPs) and associated fixed foundation options, interconnector and inter-array cables, and scour protection.

4.3.4.3 Results from site specific geophysical surveys during 2022 reaffirmed that the Morven Site would be suitable for fixed foundations, both for wind turbines and OSPs. This remained the case for EIA Scoping, with only fixed foundations being considered in the Morven Site Scoping Report PDE. To build on the studies completed during the project concept stage, as detailed in Section 4.3.3, the Applicant carried out geotechnical and geophysical site investigation and environmental surveys to further determine the constraints and define the PDE for the EIA Scoping phase. To aid in defining the PDE for EIA Scoping, the following project-specific surveys were undertaken within the Morven Site:

- DAS (January 2021 to September 2023) to inform marine mammal and ornithological baseline.
- Geophysical data collection (April to August 2022).
- Benthic subtidal data collection and environmental Deoxyribonucleic Acid (eDNA) sampling (April to August 2022).
- Geotechnical cone penetration test campaign (October to November 2022).
- Geotechnical borehole campaign (August to October 2023).
- Metocean data collection (Light Detection and Ranging (LiDAR), wavebuoys and subsea moorings deployed in 2022)[1]:
  - LiDAR buoy deployment (October 2022 to October 2024);
  - Metocean wave buoy deployment (October 2022 to November 2023);
  - Metocean Acoustic Doppler Current Profiler (ADCP) seabed frame deployment (October 2022 to November 2023).

4.3.4.4 The site investigation surveys confirmed relatively large water depths of the Morven Site. Therefore, as part of the Morven Site Scoping Report PDE, it was important to consider a range of fixed foundation options to maintain flexibility in the design. Engineering studies determined that piled jacket, suction bucket jacket, gravity-based structure, and monopile solutions would be the most suitable fixed foundation options for the Morven Site and were therefore included within the Morven Site Scoping Report PDE. The reasoning for this was that although piled jacket foundations were still considered as the preferred option, the absence of detailed geotechnical data meant it was important to not exclude other options that may prove to be more economically viable once detailed geotechnical data became available.

4.3.4.5 Early in the EIA process, the Applicant was advised by MD-LOT that EIA Scoping workshops for the Morven Site should precede the formal submission of the Morven Site Scoping Report and Habitat Regulations Appraisal (HRA) Screening Report. The purpose of the EIA Scoping workshops for the Morven Site was to provide the Applicant with an opportunity to update statutory and non-statutory consultees on progress and the draft scope for EIA Scoping, allowing stakeholders to request any

[1] This data was not available to inform the baseline for Morven Site Scoping Report but has been utilised in the relevant disciplines of the Morven North EIA Report

additional information to be addressed in the Morven Site Scoping Report. The EIA Scoping workshops for the Morven Site were held on 18 and 19 April 2023 and consisted of a series of topic-specific sessions, targeted to the relevant stakeholders. Stakeholders invited to attend these sessions were as follows:

- MD-LOT;
- NatureScot;
- Marine Directorate Science Evidence Data and Digital (MD-SEDD);
- Royal Society for the Protection of Birds (RSPB);
- Historic Environment Scotland (HES);
- Scottish Fishermen's Federation (SFF);
- Scottish White Fish Producers Association (SWFPA);
- North and East Coast Regional Inshore Fisheries Group;
- Maritime and Coastguard Agency (MCA);
- UK Chamber of Shipping (CoS);
- Forth Ports;
- Montrose Port;
- RYA Scotland;
- Northern Lighthouse Board (NLB).

4.3.4.6 Information on the EIA Scoping workshops for the Morven Site consultation is included within discipline specific chapters. The EIA Scoping workshops helped to inform the methodologies and data sources included in the Morven Site Scoping Report, however, there were no significant design changes ahead of the formal EIA Scoping consultation. Further details of the discipline-specific consultation are presented within Volume 1, Chapter 5: Consultation.

4.3.4.7 Table 4.1 below summarises some of the key design parameters from the project concept that shaped the bid for the ScotWind Leasing Round, compared to the parameters identified as part of the Morven Site Scoping Report PDE. The project concept at the bid stage was developed with limited engineering information and largely desk-based studies. It is natural for the design to evolve as more detailed engineering information becomes available, such as the results of the site specific surveys detailed in paragraph 4.3.4.3. Furthermore, the project concept for the bid was based on optimal design parameters available at the time of drafting.

4.3.4.8 The number of OSPs was increased from four (at the ScotWind bid phase) to 11 (at EIA Scoping) as the indicative POIs specific to the Morven Site, outlined through the OTNR, had changed. This resulted in a rework of the electrical system design, leading to the increased number of OSPs detailed within the Morven Site Scoping Report. Further detail on the OTNR and its relevance for the Morven Site is explained in Section 4.3.5.

4.3.4.9 After the bid was awarded, the design parameters were formulated into a project design envelope using the envelope approach, maximising the design and subsequent worst-case for the Morven Site Scoping Report. This is a standard and accepted practice for offshore wind developments requiring EIA. Further details on the envelope approach and EIA Methodology can be found in Volume 1, Chapter 6: EIA Methodology. The Morven Site Scoping Report PDE, as presented in the Morven Site Scoping Report, was submitted to Scottish Ministers in July 2023.

Table 4.1: Evolution of key Project Design Envelope parameters

Parameter	ScotWind bid phase	Morven Site Scoping Report
Indicative capacity (GW)	2.9	2.9
Maximum number of wind turbines	153	191
Maximum blade tip height (m above LAT)	295	390
Maximum hub height (m above LAT)	165	203
Maximum rotor diameter (m)	260	350
Wind turbine foundation type[2]	• Piled jacket (three or four legs) • Suction bucket jacket (three or four legs) • Hybrid gravity-based structure (with short piles underneath) • Monopile	• Piled jacket (three or four legs) • Suction bucket jacket (three or four legs) • Gravity-based structure • Monopile
Maximum number of OSPs	4	11

4.3.5 Step 4 - Splitting of the Morven Site into Morven North and Morven South

4.3.5.1 The Holistic Network Design (HND), developed as part of the Department for Energy Security and Net Zero (DESNZ) OTNR workstream, recommends a network design for the connection of offshore generation assets to the network. The HND was published in 2022, with a HND Follow Up Exercise (HNDFUE) published in April 2024 (National Energy System Operator (NESO), 2022; Ofgem, 2024).

4.3.5.2 As a result of the HND and HNDFUE process, and the uncertainty around grid connections, the Applicant decided to seek consent as part of three distinct packages, which together comprise the Morven Programme:

- Morven Site: comprising the wind turbines and foundations, OSPs and foundations, inter-array and interconnector cables and associated infrastructure.
- Morven Hawthorn Pit Grid Connection Project (hereafter, "MHPGC Project"): comprises an export cable and onshore substation.
- Morven Branxton Area Grid Connection Project (hereafter, "MBAGC Project"): comprises an export cable and onshore substation.

4.3.5.3 Given the uncertainty that persisted around the point of connection for the Morven Site at this time, a decision was taken in 2024 to modify the consenting strategy and split the Morven Site into Morven North Offshore Wind Array Project ("Morven North") and Morven South Offshore Wind Array Project ("Morven South") (See Figure 4.3). This enabled consenting activities for the offshore generating assets to continue in the absence of confirmed grid information and mitigated any further delay. Additionally, this approach provides commercial benefits and flexibility in future financing. The updated consenting strategy would seek separate Section 36 and Marine Licence consents for both Morven North and Morven South as set out in Volume 1, Chapter 2: Policy and Legislation.

[2] Although several wind turbine foundation types were considered during the development of the ScotWind bid phase, the piled jacket option was selected as the preferred foundation type for the concept that was submitted.

4.3.5.4 To define the boundaries of Morven North and Morven South within the Morven Site, the Applicant undertook a detailed constraints analysis, including consideration of consenting and grid connection risk, wind yield and layout and engineering design. A series of project workshops enabled discussion and agreement on the final boundaries of Morven North and Morven South. Ultimately the boundaries of Morven North and Morven South align to the Morven Site, with a split to separate the original boundary into two project areas. Morven North has an area of 511.1km^2 and Moven South an area of 347.7km^2.

4.3.5.5 The consenting constraints analysis drew on sources of information such as the Morven Site Scoping Report and the Morven Site Scoping Opinion and emerging information from the analysis of obtained survey data (e.g. geophysical survey, geotechnical survey, marine traffic survey, DAS). A screening exercise was undertaken to determine which of the key EIA disciplines had potential to spatially influence the location of the Morven North and Morven South boundaries. Following this, a number of EIA disciplines were taken forward for more detailed analysis, including Physical Processes, Offshore Ornithology and Commercial Fisheries. This detailed analysis was undertaken internally by the Applicant. Due to the spatial nature of the identified constraints, the result of the environmental analysis was found to have limited influence on the location of the dividing boundary between Morven North and Morven South.

4.3.5.6 The engineering constraint analysis included the influence of physical objects such as boulders, physical characteristics such as water depth, and an initial view of wind yield effects based on early indicative layouts. The wind yield analysis was undertaken by the Applicant's in-house energy assessment team, working closely with the project engineers. The analysis involved the development of multiple indicative layouts for the intended capacity. The outputs of the geophysical surveys were used to identify areas of significant boulder density, alongside detailed bathymetry data. Indicative layouts were developed at a range of separation distances, seeking to maximise areas with perceived less physical constraint. A wind yield assessment was undertaken from these indicative layouts to optimise output based on these physical variables. The key driving variable was the higher density boulder areas in the north of the Morven Site, leading to the conclusion that there is a need for a larger developable area in the northern portion of the Morven Site. This analysis enabled the Applicant to be confident the intended capacity could be obtained from a project area to the north and to the south and determined the location of the 'split' in the Morven Site.

4.3.5.7 The decision to split the Morven Site enables either Morven North or Morven South to be taken forward independently, should there be an unforeseen delay to either grid connection coming forward. It is not possible at this stage to determine which of the two grid connections Morven North or Morven South would connect to; therefore, the EIA will ensure the flexibility remains to connect either Morven North or Morven South to either grid connection, and is robustly assessed as such.

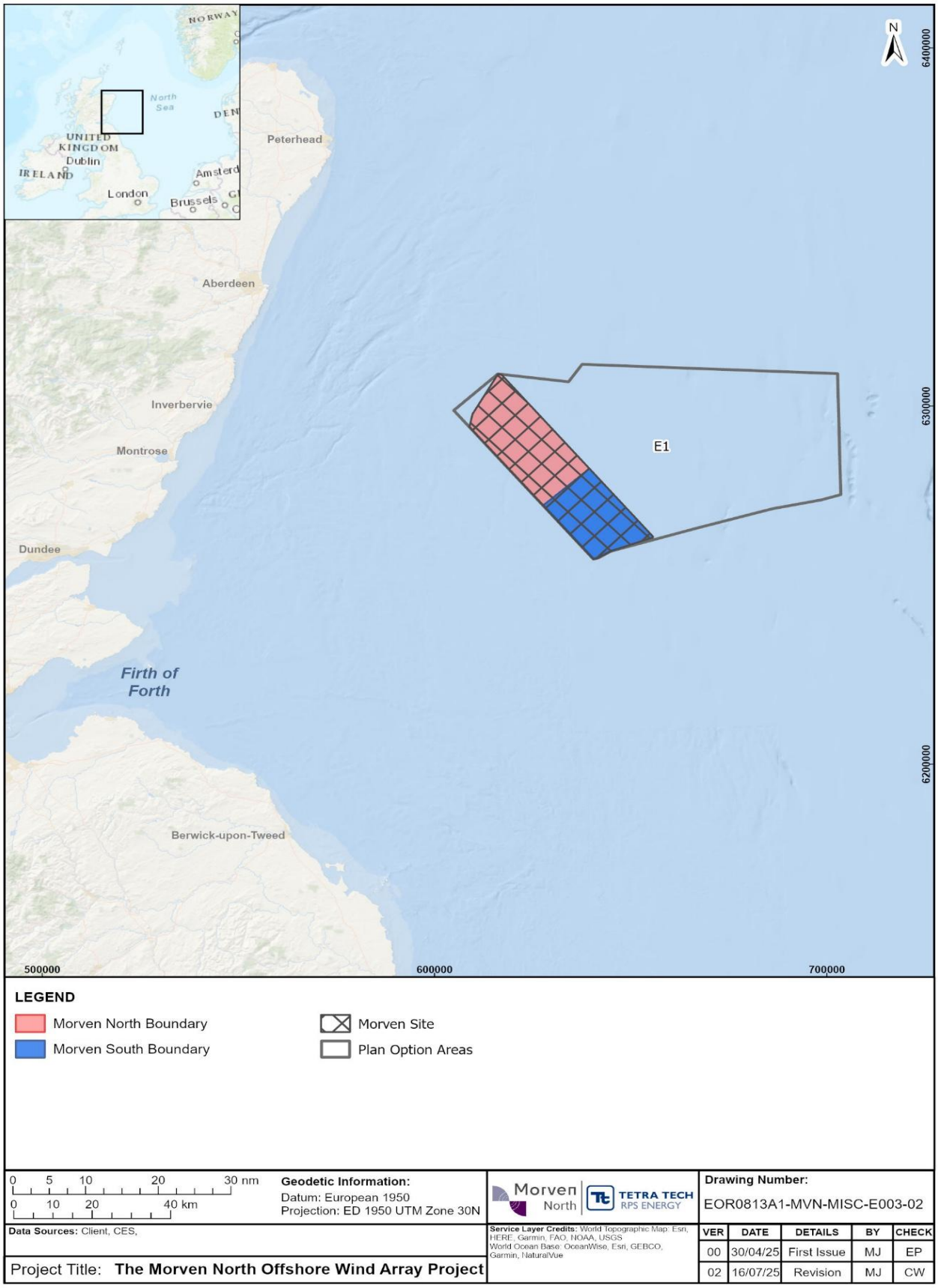

Figure 4.3: The Morven North Offshore Wind Array Project, Morven South Offshore Wind Array Project, and Morven Site located within the E1 Plan Option area

4.3.6 Step 5 – Environmental Impact Assessment and application – refinement of application boundary and identification of application Project Design Envelope

4.3.6.1 Following the receipt of the Morven Site Scoping Opinion in November 2023, the Applicant worked to refine the PDE and undertake a robust EIA. The key refinements made to the PDE from the Morven Site Scoping Report to this Morven North EIA Report are summarised in Table 4.2 and have been informed by early engineering works and consultation with stakeholders. In addition to stakeholder consultation, the Applicant held internal workshops to develop and inform the EIA PDE with representatives from the engineering and consenting teams to ensure proportionate and realistic parameters have been set, while considering environmental, consenting and engineering constraints. Further details on the PDE refinements from the EIA Scoping phase to the EIA Report are summarised below.

4.3.6.2 The Applicant was able to refine the maximum blade tip height of the wind turbines from 390m as provided within the Morven Site Scoping Report, to 363m for this Morven North EIA Report. This refinement was a subsequence of the Applicant removing the largest rated-capacity turbine from the PDE.

4.3.6.3 After receipt of the Morven Site Scoping Opinion, the Applicant endeavoured to assess and refine the minimum blade tip height of the wind turbines in order to decrease the potential impacts on offshore ornithology receptors. As such, interim collision risk modelling studies were carried out to investigate the relative impact on collision risk numbers by increasing the 'air gap' by 1m intervals. This study was based on site specific DAS undertaken across the Morven Site, as outlined in Section 4.3.4. As a result of the interim studies, the minimum blade tip height was increased from 30m as provided within the Morven Site Scoping Report, to 34m outlined in this Morven North EIA Report. This commitment will significantly reduce the collision risk to key seabird species.

4.3.6.4 Further analysis of the electrical systems and transmission design by the Applicant's engineering team also resulted in a refinement of the number of OSPs within the PDE for this Morven North EIA Report. This resulted in the number of OSPs decreasing from 11 (within the Morven Site Scoping Report PDE) to nine[3], with five being taken forward into the EIA for each of Morven North and Morven South.

4.3.6.5 Due to the splitting of the Morven Site into Morven North and Morven South (as detailed in Section 4.3.5) the Applicant included a bridge-linked OSP design option to be included in either Morven North or Morven South. The inclusion of the bridge-linked OSP was a direct result of the splitting of the Morven Site and the subsequent engineering analysis of the electrical and transmission systems. It was concluded that combining the HVDC systems with the use of a bridge-link could be technically and economically advantageous to the Morven Programme.

4.3.6.6 The Applicant has used site specific geotechnical data collected to date to develop indicative worst case layouts for the purposes of the shipping and navigation assessment outlined in Volume 2, Chapter 13: Shipping and Navigation, and Volume 3, Appendix 13.1: Shipping and Navigation Shared Navigational Risk Assessment. The Applicant developed these layouts to align with requirements of shipping and navigation guidance documents including Marine Guidance Note (MGN) 654 (MCA, 2021). These indicative worst case layouts consider maximum number of wind turbines and OSPs that could be installed within Morven North, with minimum spacing of 1,000m, aligning with the PDE developed for the purposes of this EIA Report. The indicative worst case layout also includes at least one line of orientation to comply with SAR requirements (MCA, 2021). The final layout will be developed post-consent through the production of a Development Specification and Layout Plan (DSLP) and agreed with relevant stakeholders, including the MCA.

[3] If a bridge-linked HVDC OSP option is selected as part of the final project design, this would be developed in either Morven North or Morven South, therefore, the total number of OSPs to be developed collectively across Morven North and Morven South will be nine.

4.3.6.7 After receipt of the Morven Site Scoping Opinion, the Applicant has, via the PDE for this Morven North EIA Report, reviewed and refined the indicative approach to decommissioning of Morven North, which is detailed further in Volume 1, Chapter 3: Project Description. It should be noted that Morven North has been designed with consideration of Section 105 of the Energy Act 2004 (as amended) and Scottish Government guidance 'Decommissioning of Offshore Renewable Energy Installations in Scottish waters or in the Scottish part of the Renewable Energy Zone under The Energy Act 2004' (Scottish Government, 2022). The default position outlined in this legislation and guidance is for full removal of Offshore Renewable Energy Installations. As detailed in Volume 1, Chapter 3: Project Description, at the time of writing the Applicant anticipates that all structures above the seabed or ground level will be completely removed where this be feasible and practicable, with the exception of monopiles/pin-piles (depending on the foundation option chosen for wind turbines and OSPs; see Volume 1, Chapter 3: Project Description), scour protection and cable protection. The Applicant notes that removal of these components may result in greater environmental impacts in comparison to leaving in situ, therefore, the Applicant currently anticipates that these components will either remain fully or partly in situ. The approach to decommissioning will be dependent on the most up to date legislation and guidance, best practice, and environmental conditions and sensitivities at the time of decommissioning, and will be subject to a Decommissioning Programme which will be submitted for approval by Scottish Ministers, as per Section 105 of the Energy Act 2004.

4.3.6.8 The Applicant also notes in Volume 1, Chapter 3: Project Description that repowering may be an alternative option towards the end of design life for Morven North, whereby structures could be reconstructed and/or replaced with those of different specifications or designs to extend the lifespan of Morven North beyond the 35 years operational lifespan assumed in this application. If repowering is considered a viable option towards the end of design life for Morven North, this may be subject to new/additional consent(s) dependent upon the specifications and/or designs of new structures. Repowering falls outside the scope of this application so is not considered further.

4.3.6.9 Further details on decommissioning and repowering are provided in Volume 1, Chapter 3: Project Description.

Table 4.2: Environmental Impact Assessment Project Design Envelope refinement

Parameter	Morven Site Scoping Report	Morven North EIA Report	Morven North and Morven South (Total)
Wind turbines			
Maximum number of wind turbines	191	96	191
Maximum blade tip height (m) above LAT)	390	363	N/A
Minimum blade tip height (m above LAT)	30	34	N/A
Maximum hub height (m above LAT)	203	203	N/A
Maximum rotor diameter (m)	350	320	N/A
Minimum turbine spacing (m)	1,000	1,000	N/A

Parameter	Morven Site Scoping Report	Morven North EIA Report	Morven North and Morven South (Total)
Wind turbine foundation types considered	• Monopile • Gravity-based; • Piled jacket (three or four legs); • Suction bucket jacket (three or four legs)	• Monopile; • Piled jacket (three or four legs); • Suction bucket jacket (three or four legs)	N/A
Maximum total seabed footprint for wind turbine foundations (m^2) (including scour protection)	7,697,300 (conical gravity-based foundation)	804,914 (suction bucket jacket – three legs)	1,601,443
Maximum hammer energy (kJ) for wind turbine foundations	7,500	6,600 (monopile)	N/A
Maximum diameter of driven piles for wind turbine foundations (m)	19	16	N/A
OSPs			
Maximum number of OSPs	11	5	9
OSP foundation types considered	• Monopile; • Gravity-based; • Piled jacket (three, four or six legs); • Suction bucket jacket (three, four or six legs)	• Monopile; • Gravity-based; • Piled jacket (three, four or six legs); • Suction bucket jacket (three, four or six legs)	N/A
Maximum total seabed footprint for OSP foundations (m^2) (including scour protection)	522,500 (gravity-based foundation)	311,334 (gravity-based foundation)	622,668
Maximum hammer energy (kJ) for OSP foundations	7,500	6,600 (monopile)	N/A
Maximum diameter of driven piles for OSP foundations (m)	19	16	N/A
Inter-array and interconnector cables			
Maximum inter-array cable length (km)	844	424	844
Maximum interconnector cable length (km)	751	484	748

4.4 Export cable corridor and grid connection

4.4.1.1 As mentioned in Section 4.3.5, the UK and Scottish Government's ambitions for offshore wind deployment are supported by the OTNR. The HND, under the OTNR's 'Pathway to 2030' workstream, recommends a network design for the connection of offshore generation assets (for a total capacity of 27.6GW) to the network. Building on this, the HNDFUE refines and expands the original design to incorporate updated project data, stakeholder feedback, and evolving policy objectives, ensuring the network remains fit for purpose as offshore wind deployment accelerates.

4.4.1.2 Within these publications, it was confirmed that the Applicant would be offered two grid connection locations, one at Hawthorn Pit in County Durham, northeast England, and one at Branxton in East Lothian, Scotland. Note this differs from the concept included in the ScotWind bid as this was developed prior to the outputs of the HND being published. As a result of ongoing work through the OTNR and the uncertainty around available grid connection information, to maintain progress on Morven North, the Applicant will seek consent for both the offshore export cable and onshore transmission infrastructure separately and these are therefore not covered in the Morven North EIA Report.

4.5 Conclusion

4.5.1.1 The site selection process described within this chapter has led to the development of the Morven North Boundary and PDE, which is the subject of this application. The site selection process considered a range of engineering considerations as well as environmental, social and economic constraints. Stakeholder engagement undertaken at different stages in the process informed both the site selection and project design.

4.5.1.2 As more detailed information has become available for Morven North the design has continued to evolve. The key factors driving site selection and the refinement of the PDE include:

- Preliminary geophysical and geotechnical information.
- Metocean information from data collected across Morven North.
- Growing understanding of environmental constraints as outputs of offshore survey campaigns and desk-based technical studies become available.
- Ongoing developments on grid connections for Morven North, and the impact on the consenting strategy for the Morven Programme overall.
- Ongoing stakeholder engagement with both statutory and non-statutory consultees, both at a project level and strategically through many industry groups in Scotland and the UK.

4.5.1.3 As described in further detail in Volume 1, Chapter 6: EIA Methodology, the Applicant implemented a PDE approach to the impact assessment, whereby a range of potential project design parameters are considered. Impacts are assessed using the maximum design scenario, and the final design will fall within the maximum PDE parameters, ensuring compliance with the assessment presented in this EIA Report.

4.6 References

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