Environmental Impact Assessment Report

Volume 3

Chapter 9 Fish, Shellfish, and Turtle Ecology

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Abbreviations

Abbreviation	Term in full
ABP	An Bord Pleanála
AA	Appropriate assessment
AFBI	Agri-Food and Biosciences Institute
ASSI	Area of Special Scientific Interest
BIM	Bord Iascaigh Mhara
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CEMP	Construction Environmental Management Plan
CEA	Cumulative Effect Assessment
CIEEM	Chartered Institute of Ecology and Environmental Management
CPUE	Catch per Unit Effort
CWP	Codling Wind Park
CWPL	Codling Wind Park Limited
DAS	Digital Aerial Surveys
DCCAE	Department of Communications, Climate Action and Environment
DECC	Department of the Environment, Climate and Communications
DHLGH	Department of Housing, Local Government and Heritage
EEC	European Environment Commission
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EIS	Environmental Impact Statement
EMF	Electromagnetic Fields
EPA	Environmental Protection Agency
EU	European Union
EUNIS	European Nature Information System
FMMS	Fisheries Management and Mitigation Strategy
FWPM	Freshwater Pearl Mussel
IBTS	International Bottom Trawl Survey
ICES	International Council for the Exploration of the Sea
IFI	Inland Fisheries Ireland
INNS	Invasive non-native species
IUCN	International Union for the Conservation of Nature

Abbreviation	Term in full
JNCC	Joint Nature Conservation Committee
MAPA	Maritime Area Planning Act
MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive
MSP	Marine Spatial Planning
MI	Marine Institute
NHA	Natural Heritage Area
NIGFS	Northern Irish Groundfish Survey
NIS	Natura Impact Statement
NM	Nautical mile
NMPF	National Marine Planning Framework
NPWS	National Parks and Wildlife Services
OSPAR	Oslo and Paris Convention
PAM	Passive Acoustic Monitoring
PSA	Particle Size Analysis
SAC	Special Area of Conservation
SFPA	Sea Fisheries Protection Authority
SPA	Special Protection Area
SSC	Suspended sediment concentration
SSSI	Site of Special Scientific Interest
TEGE	Technical Expert Group on Eel
TTS	Temporary Threshold Shifts
UWTV	Western Irish Sea Nephrops Grounds Underwater TV
VER	Valued Ecological Receptor
WFD	Water Framework Directive
ZoI	Zone of influence

Definitions

Glossary	Meaning
the Applicant	The developer, Codling Wind Park Limited (CWPL).
array site	The red line boundary area within which the wind turbine generators (WTGs), inter-array cables (IACs) and the Offshore Substation Structures (OSSs) are proposed.
Codling Wind Park (CWP) Project	The proposed development as a whole is referred to as the Codling Wind Park (CWP) Project, comprising of the offshore infrastructure, the onshore infrastructure and any associated temporary works.
Codling Wind Park Limited (CWPL)	A joint venture between Fred. Olsen Seawind (FOS) and Électricité de France (EDF) Renewables, established to develop the CWP Project.
environmental impact assessment (EIA)	A systematic means of assessing the likely significant effects of a proposed project, undertaken in accordance with the EIA Directive and the relevant Irish legislation.
Environmental Impact Assessment Report (EIAR)	The report prepared by the Applicant to describe the findings of the EIA for the CWP Project.
export cables	The cables, both onshore and offshore, that connect the offshore substations with the onshore substation.
generating station	Comprising the wind turbine generators (WTGs), inter-array cables (IACs) and the interconnector cables.
inter-array cables (IACs)	The subsea electricity cables between each WTG between and the OSSs.
interconnector cables	The subsea electricity cables between OSSs
landfall	The point at which the offshore export cables are brought onshore and connected to the onshore export cables via the transition joint bays (TJB). For the CWP Project the landfall works include the installation of the offshore export cables within Dublin Bay out to approximately 4 km offshore, where water depths that are too shallow for conventional cable lay vessels to operate.
limit of deviation (LoD)	Locational flexibility of permanent and temporary infrastructure is described as Limit of Deviation (LoD) from a specific point or alignment.
Maritime Area Planning (MAP) Act 2021	An Act to regulate the maritime area, to achieve such regulation by means of a National Marine Planning Framework, maritime area consents for the occupation of the maritime area for the purposes of maritime usages that will be undertaken for undefined or relatively long periods of time (including any such usages which also require development permission under the Planning and Development Act 2000) and licences for the occupation of the maritime area for maritime usages that are minor or that will be undertaken for relatively short periods of time
offshore development area	The total footprint of the offshore infrastructure and associated temporary works including the array site and the OECC.

Glossary	Meaning
offshore export cables	The cables which transport electricity generated by the WTGs from the offshore substations (OSSs) to the TJBs at the landfall.
offshore export cable corridor (OECC)	The area between the array site and the landfall, within which the offshore export cables cable will be installed along with cable protection and other temporary works for construction.
offshore infrastructure	The permanent offshore infrastructure, comprising of the WTGs, IACs, OSSs, Interconnector cables, offshore export cables and other associated infrastructure such as cable and scour protection.
parameters	Set of parameters by which the CWP Project is defined and which are used to form the basis of assessments.
zone of influence (ZoI)	Spatial extent of potential impacts resulting from the project.

9 FISH, SHELLFISH AND TURTLE ECOLOGY

9.1 Introduction

1. Codling Wind Park Limited (hereafter 'the Applicant') is proposing to develop the Codling Wind Park (CWP) Project, which is located in the Irish Sea approximately 13–22 km off the east coast of Ireland, at County Wicklow.

2. This chapter forms part of the Environmental Impact Assessment Report (EIAR) for the CWP Project. The purpose of the EIAR is to provide the decision-maker, stakeholders and all interested parties with the environmental information required to develop an informed view of any likely significant effects resulting from the CWP Project, as required by the European Union (EU) Directive 2011/92/EU (as amended by Directive 2014/52/EU) (the Environmental Impact Assessment (EIA) Directive).

3. This EIAR chapter describes the potential impacts of the CWP Project's offshore infrastructure on fish, shellfish and turtle ecology during the construction, operation and maintenance and decommissioning phases.

4. In summary, this EIAR chapter:

   - Details the Environmental Impact Assessment (EIA) scoping and consultation process undertaken and sets out the scope of the impact assessment for fish, shellfish and turtle ecology;
   - Identifies the key legislation and guidance relevant to fish, shellfish and turtle ecology, with reference to the latest updates in guidance and approaches;
   - Confirms the study area for the assessment and presents the impact assessment methodology for fish, shellfish and turtle ecology;
   - Describes and characterises the baseline environment for fish, shellfish and turtle ecology, established from desk studies, project survey data and consultation;
   - Defines the project design parameters for the impact assessment and describes any primary mitigation measures relevant to the fish, shellfish and turtle ecology assessment;
   - Presents the assessment of potential impacts on fish, shellfish and turtle ecology and identifies any assumptions and limitations encountered in compiling the impact assessment;
   - Provides the requisite information for a Noise Assessment Statement as required under Underwater Noise Policy 1 of the National Marine Planning Framework; and
   - Details any additional mitigation and / or monitoring necessary to prevent, minimise, reduce or offset potentially significant effects identified in the impact assessment.

5. The assessment should be read in conjunction with **Appendix 9.1 Fish, Shellfish and Turtle Ecology Cumulative Effects Assessment (CEA)**, which considers other plans, projects and activities that may act cumulatively with the CWP Project and provides an assessment of the potential cumulative impacts on fish, shellfish and turtle ecology.

6. A summary of the CEA for fish, shellfish and turtle ecology is presented in **Section 9.11 Cumulative Impacts**.

7. Additional information to support the assessment includes:

   - **Appendix 9.2 Representative Scenario and Limits of Deviation Assessment;**
   - **Appendix 9.3 Noise overlap with spawning and nursery ground calculations;**
   - **Appendix 9.4 Underwater Noise Assessment;** and
   - **Appendix 6.3 Modelling Report**

9.2 Consultation

8. Consultation with statutory and non-statutory organisations is a key part of the EIA process. Consultation with regard to fish, shellfish and turtle ecology has been undertaken to inform the approach to and scope of the assessment and baseline data sources.

9. The key elements to date have included EIA scoping, consultation events and ongoing topic specific meetings with key stakeholders. Data requests have also been submitted to obtain the latest information and reports to feed into **Section 9.6 Existing Environment**. The feedback received throughout this process has been considered in preparing the EIAR. EIA consultation is described further in **Chapter 5 EIA Methodology,** the **Planning Documents** and in the **Public and Stakeholder Consultation Report**, which has been submitted as part of the development consent application.

10. **Table 9-1** Consultation responses relevant to fish, shellfish and turtle ecology provides a summary of the key issues raised during the consultation process relevant to fish, shellfish and turtle ecology and details how these issues have been considered in the production of this EIAR chapter.

Table 9-1 Consultation responses relevant to fish, shellfish and turtle ecology

Consultee	Comment	How issues have been addressed
Scoping responses		
Inland Fisheries Ireland (IFI) 25 January 2021	Inland Fisheries would like to bring the applicant's attention to the potential for migratory species from Northern Ireland to be present, some recent scientific studies tracking seatrout have shown that these fish will migrate from the Northern Irish coast and along the Irish coastline and vice versa. Atlantic salmon have also been shown to migrate through the Irish Sea as part of their route back to or from Northern Irish Rivers. These transboundary species migrations should also be considered in the EIAR.	Transboundary species migrations have been included in **Section 9.6 Existing Environment** and potential impacts to these receptors have been assessed in **Section 9.10 Impact Assessment**.
	The Applicant has indicated in the draft report that they will complete a Construction Environmental Management Plan (CEMP) for any construction activities and likely trans-jurisdictional impacts should be considered in that document also.	A CEMP addressing matters for both offshore and onshore accompanies the application. Measures of relevance to the control of impacts to fish, shellfish and turtle receptors are listed as a condition / mitigation of the construction works and detailed in **Section 9.9 Primary Mitigation Measures**.
	Cumulative impacts should take cognisance of the Dublin Port Maintenance Dredging	Potential cumulative effects are addressed in **Appendix 9.1**

Consultee	Comment	How issues have been addressed
	Programme & Strategic Infrastructure Projects planned.	**Cumulative Effects Assessment (CEA)**.
Marine Institute (MI) 3 February 2021	It is the advice of the MI that the scale of effects of the proposed development be considered beyond the footprint of the turbines and the licenced area.	**Section 9.4** outlines the study area for fish, shellfish and turtle ecology. The receiving environment has been characterised at local, regional and national scale, with potential impacts considered within the identified zone of influence (ZoI) of the project.
	The effects of Electromagnetic Fields (EMF) on electro-sensitive species deserve greater consideration. It would be important that the EIAR examined, in depth, the likely effects of the proposed development on a number of possible receptors. These include, shellfish species (crustaceans), elasmobranchs and demersal species.	The potential impact of EMF has been assessed for shellfish species, elasmobranchs, and demersal species and this is set out in **Section 9.10.1 Impact Assessment.**
	The scoping document references the MI Stock Book. We recommend also reference to the Shellfish Review 2019 for Razor clams among others, (although there are no such fisheries currently in the project area) and earlier versions for Whelk. Also, the Marine Atlas for any information on distribution of fisheries by vessels under 12 m in length.	Ireland's Marine Atlas, the Stock Book 2020 and 2023, Shellfish Stocks and Fisheries Review 2020 and 2022 and earlier versions have been included in **Section 9.6 Existing Environment.**
Topic specific meetings (summary of minutes discussions)		
Marine Institute		
26 February 2020	Agreement to no site investigation Fish, shellfish and turtle surveys as they provide limited additional data and to stick with a well-designed pre- and post-construction survey instead. Recommended to engage with IFI pre-application.	As outlined in **Section 9.14 Potential Monitoring Requirements** - Monitoring programmes are outlined in the In Principle Project Environmental Monitoring Plan (IPPEMP) for agreement with statutory consultees. Should the proposed development be consented the final monitoring and reporting proposal will be submitted to the

Consultee	Comment	How issues have been addressed
		relevant authorities for approval. This is in line with advice regarding collection of data for fish (Department of Communications, Climate Action and Environment (DCCAE 2018)). IFI have been consulted throughout as per **Table 9-1**.
16 November 2021	Discussion on elasmobranch abundance, distribution, and nursery ground data in Irish waters.	International Council for the Exploration of the Sea (ICES) working group reports have been included in **Section 9.6 Existing Environment.** Data on elasmobranch abundance and distribution recorded by observers working on Irish vessels in the Irish Sea was requested in July 2023 but MI were unable to provide it in writing.
2 December 2021	Suggestion to use the Shellfish Stocks and Review report 2011 for data on Whelk.	Shellfish Stocks and Fisheries Review 2022, 2020 and earlier versions have been included in **Section 9.6 Existing Environment**.
Sea Fisheries Protection Authority (SFPA) 11 May 2021	SFPA content with list of data sources used for the study. Conducting an epibenthic survey was suggested for site specific data, but there is no requirement for it to be collected. Pre and post construction monitoring is recommended utilising the JNCC marine monitoring handbook for best practices. The approach to the scope and impacts, CEA and Appropriate Assessment (AA) approved. Suggestion of contacting IFI for tagging data on migratory fish species. Other contacts provided at Bord Iascaigh Mhara (BIM), Marine Institute and SFPA.	As outlined in **Section 9.14 Potential Monitoring Requirements** - Monitoring is provided in the IPPEMP for consultation with statutory consultees. This is line with advice regarding collection of data for fish (DCCAE 2018). Contacts approached and additional data sources have been included in **Section 9.6 Existing Environment.** Full details of the consultation undertaken for fish, turtle and shellfish ecology is presented in the **Public and Stakeholder Engagement Report**.
IFI 14 September 2021	Additional projects to consider in the CIA are the Arklow Flood Relief Scheme and Arklow	These additional projects are addressed in **Appendix 9.1 CEA**.

Consultee	Comment	How issues have been addressed
	Wastewater Treatment Plant projects. Suggestion to look at the Agri-Food and Biosciences Institute (AFBI) COMPASS project for salmon migration data.	COMPASS project outputs have been included in **Section 9.6 Existing Environment**.
Bord Iascaigh Mhara (BIM) 9 December 2021	Provision of mussel seed bed data. Suggestion of using Shellfish Stocks and Fisheries Review.	Mussel seed bed data and Shellfish Stocks and Fisheries Review 2020 and earlier versions have been included in **Section 9.6Existing Environment**.
Other		
Department of Housing, Local Government and Heritage (DHLGH)	Feedback provided on the new Foreshore Investigation Licence. Request to not undertake trawl site investigation surveys unless really necessary, as its harmful to subtidal ecology and little information is gained.	In line with consultation undertaken no trawl surveys were conducted.

9.3 Legislation, policy and guidance

9.3.1 Legislation

11. The legislation that is applicable to the assessment of fish, shellfish and turtle ecology is summarised below. Further detail is provided in **Chapter 2 Policy and Legislative Context**.

- EIA Directive 2011/92/EU, as amended by Directive 2014/52/EU and transposed into Irish law in the Planning and Development Act, 2000-2020 and the Planning and Development Regulations 2001–2020 as amended by S.I. No. 296 of 2018
- Water Framework Directive (WFD) (2000/60/EC);
- Marine Strategy Framework Directive (MSFD) (2008/56/EC);
- Marine Planning Policy Statement (November 2019);
- Maritime Spatial Planning (MSP) Directive (2014/89/EU);
- Fisheries (Consolidation) Act, 1959;
- Habitats Directive (92/43/EEC) which is transposed into law by the European Communities Regulations 2011 (as amended);
- The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention);
- EIA Directive 2011/92/EU, as amended by Directive 2014/52/EU and transposed into Irish law in the Planning and Development Act, 2000–2020 and the Planning and Development Regulations 2001-2020 as amended by S.I. No. 296 of 2018;
- Water Framework Directive (WFD) (2000/60/EC);
- Marine Strategy Framework Directive (MSFD) (2008/56/EC);
- Marine Planning Policy Statement (November 2019); and
- Maritime Spatial Planning (MSP) Directive (2014/89/EU);

- The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention);
- Convention on the Conservation of Migratory Species of Wild Animals (1983);
- Convention on Conservation of European Wildlife and Natural Habitats (1979);
- Convention for the Protection of the Marine Environment of the North-East Atlantic (1992);
- Agreement on the Conservation of Small Cetaceans of the Baltic, North-East Atlantic, Irish and North Seas 1994 (ASCOBANS);
- Council Directive 92/43/EEC on the Conservation of Natural Habitats and Wild Flora and Fauna 1992 (Habitats Directive) - Annexes II, IV and V;
- Wildlife Act (1976) and amendments (2000, 2005, 2010 and 2012) for protected species; and
- Protected wild animal status for basking shark (Section 23 of the Wildlife Act 1976 (Protection of Wild Animals) Regulations 2022);

9.3.2 Policy

12. The overarching planning policy relevant to the CWP Project is described in **EIAR Chapter 2 Policy and Legislative Context**.

13. The assessment of the CWP Project against relevant planning policy is provided in the Planning Report. This includes planning policy relevant to fish, shellfish and turtles.

9.3.3 Guidance

14. The principal guidance and best practice documents used to inform the assessment of potential impacts on fish, turtle and shellfish ecology is summarised below:

- Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, 2022);
- Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine (Chartered Institute of Ecology and Environmental Management (CIEEM), 2022);
- Guidance on Marine Baseline Ecological Assessments & Monitoring Activities for Offshore Renewable Energy Projects Part 1. Department of the Environment, Climate and Communications (Department of the Environment, Climate and Communications (DECC), 2018a);
- Guidance on Marine Baseline Ecological Assessments & Monitoring Activities for Offshore Renewable Energy Projects Part 2. (DECC, 2018b);
- Guidance on Environmental Impact Statement (EIS) and Natura Impact Statement (NIS) preparation for Offshore Renewable Energy Projects. DECC (Barnes, 2017);
- Guidelines for Data Acquisition to Support Marine Environmental Assessments of Offshore Renewable Energy Projects (Judd, 2012); and
- Assessment of the Environmental Impacts of Cables (Oslo and Paris Convention (OSPAR), 2009a) and Underwater Noise (OSPAR, 2009b)
- Guidance on the Strict Protection of Certain Animal and Plant Species under the Habitats Directive in Ireland (NPWS, 2021);
- Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Coastal and Marine (CIEEM, 2019);
- EU Commission's Guidance document on the strict protection of animal species of Community interest under the Habitats Directive (EU, 2021);
- Guidance on survey and Monitoring in Relation to Marine Renewables Deployments in Scotland. Volume 2. Cetaceans and Basking Sharks (SNH and Marine Scotland, 2011);
- Guidance on Marine Baseline Ecological Assessments & Monitoring Activities for Offshore Renewable Energy Projects Part 1 (DCCAE,2018);

- Guidance on Marine Baseline Ecological Assessments & Monitoring Activities for Offshore Renewable Energy Projects Part 2 (DCCAE,2018);and
- Guidance on EIS and NIS Preparation for Offshore Renewable Energy Projects (DCCAE, 2017).

9.4 Impact assessment methodology

15. **Chapter 5 EIA Methodology** provides a summary of the general impact assessment methodology applied to the CWP Project, which includes the approach to the assessment of transboundary and inter-related effects. The approach to the assessment of cumulative impacts is provided in **Chapter 5, Appendix 5.1 CEA Methodology**.

16. The following sections confirm the methodology used to assess the potential impacts on fish, shellfish and turtle ecology.

9.4.1 Study area

17. The study areas for the fish, shellfish and turtle ecology assessment are shown in **Figure 9-1**. It is important to note that the study areas are defined to ensure a comprehensive broadscale understanding of the receiving environment is presented within the description of the existing environment. The regional study area and Irish Sea study area provide context and an understanding of the potential presence of migratory species or species with a broad spatial distribution.

18. The study areas have been informed through reference to the predicted ZoI, and defined spatially on the basis of International Council for the Exploration of the Sea (ICES) statistical rectangles where the offshore development area is located to allow reference to be made to the comprehensive dataset. ICES statistical rectangles are the smallest spatial unit over which relevant fisheries data is aggregated. These are as follows:

- ICES statistical rectangle 35E4 where the entire array site and the southeast section of the offshore export cable corridor is located; and
- ICES statistical rectangle 35E4 and 35E3 where the southeast section of the offshore export cable corridor is contained in 34E3 and the northwest section of the cable corridor contained in 35E3.

19. The local study area includes the onshore and offshore infrastructure including the marine area around the onshore substation location and the extent of the River Liffey. All direct impacts are contained within the local study area.

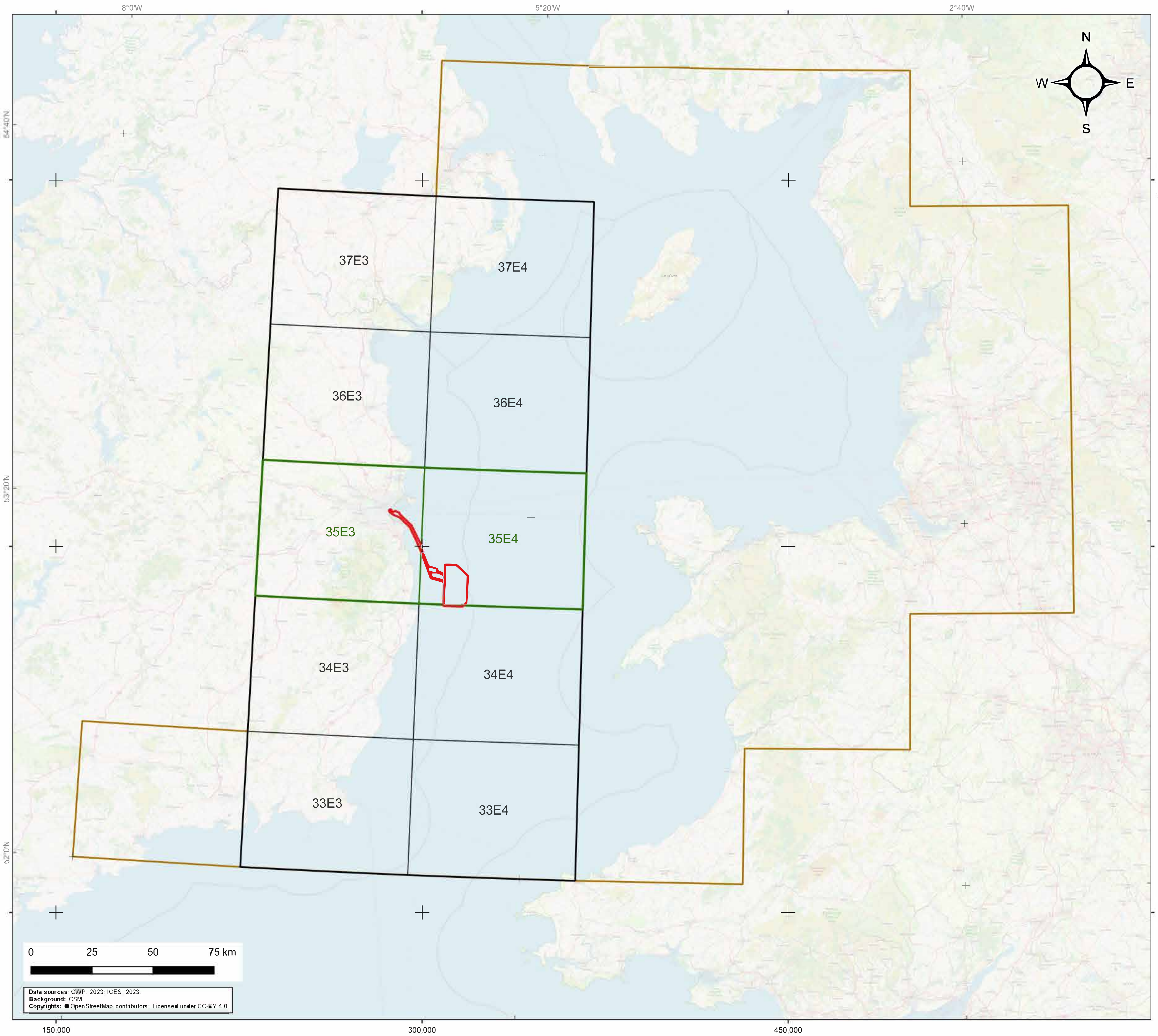
20. The regional study area has been used to provide regional context and ensures data coverage for near field indirect impacts (i.e., impacts arising from sediment dispersion and underwater noise) and comprises of 35E4 and 35E3, as well as adjacent ICES statistical rectangles to the north and south. These are as follows:

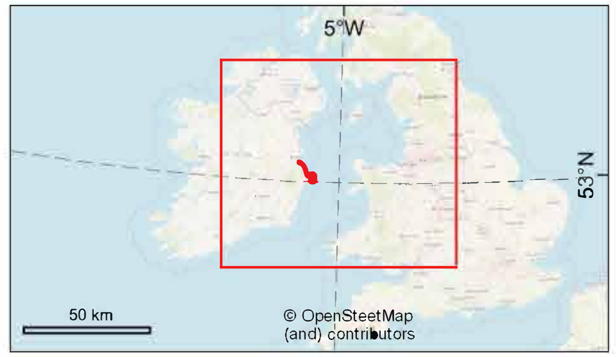
- ICES statistical rectangles 36E3, 36E4, 37E3 and 37E4 to the north; and
- ICES statistical rectangle 34E3, 34E4, 33E3 and 33E4 to the south.

21. The Irish Sea study area has been defined as the Irish Sea using ICES division 27.7.a, to reflect international reporting (e.g., OSPAR) and provides data against which far-field indirect impacts can be considered (e.g., impacts arising from noise propagation).

22. Where appropriate, a broader national study area encompassing the whole of Ireland and Northern Ireland has been used for the purpose of describing diadromous fish migration routes (see **Section 9.2**). This wider study area for diadromous fish is described due to consultee concerns in relation to migrating salmonids.

23. All study areas (and the associated assessment of impacts) extend up to the low water mark where they border an intertidal area.





Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- National study area

Project: Codling Wind Park

Contractor: natural power — www.naturalpower.com

Figure 9.1
CWP project fish, shellfish and turtle ecology study areas (local, regional and national study areas)

CWP doc. number: CWP-NPC-ENG-08-01-MAP-0950

Internal descriptive code:	Size: A3	CRS:
IS - PAB - FSTESAs.LRN - EIAR.FIG.09.01	Scale: 1:1,500,000	EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
00	Final for issue	2024/07/24	AC	ME/EA	SM

9.4.2 Data and information sources

Site-specific surveys

24. As set out in **Section 9.2 Consultation,** it was agreed through consultation with the SFPA and DHLGH that no site-specific fish or shellfish surveys needed to be undertaken during the baseline site investigation survey campaign. Baseline surveys for fish seldom yield additional data that is not already available from fisheries landings data or existing survey data and often use intrusive sampling methods.

25. Through consultation with statutory and non-statutory organisations (**Section 9.2**) the data sources listed below have been deemed sufficient to develop a baseline for fish, shellfish and turtle ecology which will allow a robust impact assessment to be undertaken.

26. A benthic subtidal survey and ecological assessment was conducted between June and July 2021 at 71 stations positioned across the array site and offshore export cable corridor (OECC). Full details are provided in **Chapter 8 Subtidal and Intertidal Ecology**. In addition to faunal and chemical analysis of the samples, sediment Particle Size Analysis (PSA) was conducted. This has informed **Section 9.6 Existing Environment** in reference to habitat suitability for certain fish and shellfish species.

27. A number of site characterisation surveys for the CWP Project were undertaken to inform the baseline for marine mammals and megafauna (i.e. turtles and basking shark). This included two years of monthly, visual boat-based surveys and Digital Aerial Surveys (DAS). Full details are provided in **Chapter 11 Marine Mammals**. This has informed **Section 9.6 Existing Environment** in reference to habitat suitability for basking shark and turtle species.

28. Survey data remain valid and an appropriate characterisation of the receiving environment at the point of application.

Desk study

29. A comprehensive desk-based review was undertaken to inform the baseline for fish, shellfish and turtle ecology. Key data sources used to inform the assessment are set out in **Table 9-2**.

Table 9-2 Data sources for fish, shellfish and turtle ecology

Data	Source	Date	Notes
Commercial landings data by ICES statistical rectangle	Sea Fisheries Protection Authority (SFPA)	2021	Irish landings (weight) into Irish ports
Commercial landings data by port	SFPA	2022	Landings data (weight) by <10 m vessels into Irish ports from sales notes
Commercial landings data by ICES division	International Council for the Exploration of the Sea (ICES)	2022a	Landings data (weight) for all ports that fished in ICES division 27.7.a
International Bottom Trawl Survey (IBTS)	ICES	2022b	Catch per Unit Effort (CPUE) values calculated from the Northern Irish Groundfish Survey (NIGFS)

Data	Source	Date	Notes
	ICES	2020	Spatial distribution of species presented as numbers caught per hour during the 2019 summer / autumn IBTS survey
Shellfish Stocks and Fisheries Review 2011	MI & BIM	2011	Spatial data on the fishing fleet and landings of shellfish species around Ireland with notable work on the status of and recommendations for the whelk fishery
Shellfish Stocks and Fisheries Review 2023	MI & BIM	2023	Spatial data on the fishing fleet and landings of shellfish species around Ireland
The Stock Book 2022	Marine Institute	2022	Annual Review of Fish Stocks in 2022 with Management Advice for 2023
Atlas of Commercial Fisheries Around Ireland	Gerritsen & Kelly	2019	Detailed maps of fishing activity around Ireland, including Irish landings for key commercial species
Folk 16 seabed substrate and European Nature Information System (EUNIS) map	Diesing and Stephens	2018	Spatial dataset with regional coverage of the Irish and Celtic Sea
Tope Tagging in Irish Waters	Clarke	2003	Recapture distribution of tope around the coasts of Ireland and the UK tagged by the Central Fisheries Board
Western Irish Sea *Nephrops* Grounds Underwater TV (UWTV) Survey Report 2019 and catch options for 2020	Lundy et al.	2019	Main results and findings of the 17th annual underwater television survey on the 'Irish sea west *Nephrops* grounds' ICES assessment area, Functional Unit 15
Nephrops grounds	Ireland's Marine Atlas	2016	*Nephrops* habitats or grounds in waters around Ireland.
Ireland Red List - Cartilaginous fish	Clarke et al.	2016	Spatial distribution and habitat usage of red list cartilaginous fish in Irish waters
Irish fishing activity: dredge, static gear, trawl activity and aquaculture sites	Ireland's Marine Atlas	2016	Location of fishing activity (<15 m vessels) in Irish waters
Key fish species spawning and nursery grounds	Ireland's Marine Atlas	2016	Spatial distributions of spawning and nursery grounds for fish species around the UK and Ireland
	Ellis et al.	2012	
	Coull et al.	1998	
Distribution and relative abundance of demersal fishes from beam trawl surveys in the Irish sea	Parker-Humphreys	2004	Spatial distributions of major fish and selected commercial shellfish species from Centre for Environment, Fisheries and Aquaculture Science (CEFAS) beam trawl surveys in ICES Division VIIa

Data	Source	Date	Notes
Irish Sea Roundfish Surveys	Armstrong et al.	2008	Time-series of data on catch-rates, distribution and age composition from Irish Sea roundfish surveys
Larval distribution of commercial fish species in waters around Ireland	Dransfield et al.	2004	Baseline survey on the larval distribution of commercial fish species off the west, north and south coasts of Ireland
Irish Sea seed mussel beds	Bord Iascaigh Mhara	2021	Spatial extent of Irish Sea seed mussel beds
Migrations, fishery interactions and management units of sea bass	Pawson et al.	2007	Tagging study of seabass around the coasts of England, Wales, Southern Ireland, and the Channel Isles
The distribution of the European sea bass in Irish waters	O'Neill	2017	Distribution and putative spawning locations in Irish waters
The Status of Irish Salmon Stocks	Gargan et al.	2021	The Status of Irish Salmon Stocks in 2020 with Catch Advice for 2021
The ocean distribution of Atlantic salmon	Rickardsen et al.	2021	Migration study using satellite tags on post-spawned salmon
Atlantic salmon smolts in the Irish Sea	Barry et al.	2020	Telemetry study investigating migration routes for Atlantic salmon leaving the east coast of Ireland
Salmon and sea trout migration – COMPASS project	Barry et al.	2022	Salmon and sea trout detection data
Eel management and monitoring objectives	Inland Fisheries Ireland (IFI)	2021	Activity report of the Technical Expert Group on Eel (TEGE) 2020
Twaite shad migration	Davies et al.	2020	Marine phase and river fidelity of twaite shad in the UK and Ireland
Fishing, abundance, and life history traits of the anadromous sea lamprey in Europe	Beaulaton et al.	2008	Data on the exploitation, abundance, and life history traits at the European scale
Aspects of Brook lamprey Spawning in Irish Waters	Rooney et al.	2013	Survey of Brook lamprey spawning activity in Irish river catchments
Distribution and abundance of basking sharks in Irish waters	Berrow and Heardman, 1994; Witt et al., 2012	Various years	Sightings scheme
Migration and seasonal abundance of basking sharks	Doherty et al., 2017; Lieber et al., 2020; Sims et al., 2003.	Various years	Tracking studies

Data	Source	Date	Notes
A review of the biology, ecology and conservation status of basking sharks	Sims and Quayle, 1998	Various years	Review
'TURTLE' database	http://data.nbn.org.uk/	Various years	Opportunistically recorded sightings, strandings and bycatch of marine turtles throughout Ireland and the UK

9.4.3 Impact Assessment

30. The significance of potential effects has been evaluated using a systematic approach, based upon identification of the importance / value of receptors and their sensitivity to the project activity, together with the predicted magnitude of the impact.

31. The assessment methodology used for fish, shellfish and turtle ecology has utilised CIEEM guidelines for impact assessment in the UK and Ireland (CIEEM, 2022). The guidelines set out the process for assessment through the following stages:

- Describing the baseline within the study area;
- Identifying the receptors;
- Determining the nature conservation importance of the receptors present within the study area that may be affected by the offshore development area;
- Identifying and characterising the potential impacts, based on the nature of the construction, operation and maintenance including repair and replacement, and decommissioning activities associated with project infrastructure;
- Determining the significance of impacts, using expert judgement;
- Identifying the counter effect of any mitigation measures to be undertaken, that may be implemented in order to address significant adverse effects;
- Determining the residual impact significance after the effects of mitigation have been considered; and
- Assessing cumulative and transboundary effects (with mitigation where applicable).

32. While CIEEM guidelines form the basis of the assessment methodology, other resources such as the Water Framework Directive, the Habitats Directive and the Marine Strategy Framework Directive have been considered during the assessment (see **Section 9.3.1 Legislation**).

Sensitivity of receptor

33. For each effect, the assessment identifies receptors sensitive to that effect and implements a systematic approach to understanding the impact pathways and the level of impacts on given receptors.

34. As set out in the EIA Methodology chapter, the sensitivity of a receptor is a function of its capacity to accommodate change and reflects its ability to recover if it is affected. Sensitivity is quantified via a consideration of its adaptability, tolerance, recoverability, and value.

35. **Table 9-3** sets out the criteria used in defining the sensitivity of the identified fish, shellfish and turtle ecological receptors (CIEEM, 2022; EPA, 2022). All definitions of tolerance and recoverability, including timescales to recover are informed by the Marine Evidence based Sensitivity Assessment

(MarESA) approach (Tyler-Walters et al., 2023). Four defined levels of sensitivity have been determined (high, medium, low or very low). Where a receptor could reasonably be assigned more than one level of sensitivity, professional judgement has been used to determine which level is applicable.

Table 9-3 Receptor sensitivity definitions

Sensitivity	Criteria
High	**Adaptability**: The receptor cannot avoid or adapt to an impact. **Tolerance**: The receptor has no or very low capacity to accommodate the proposed form of change. **Recoverability**: The effect on the receptor is anticipated to be permanent (i.e., over 60 years) and recovery is not anticipated. **Value:** The receptor is of international importance (e.g., Annex II species under the Habitats Directive, or OSPAR list of threatened or declining species).
Medium	**Adaptability**: The receptor has a limited ability to avoid or adapt to an impact. **Tolerance**: The receptor has a moderate to low capacity to accommodate the proposed form of change. **Recoverability**: The receptor is anticipated to recover fully within the medium term (i.e., 7–15 years) to long term (15–60 years). **Value**: The receptor is of national or international importance (e.g., Ireland's red list species, Scottish Priority Marine Features, Northern Ireland Priority Species, or Annex II species under the Habitats Directive, or OSPAR list of threatened or declining species).
Low	**Adaptability**: The receptor has a reasonable capacity to avoid or adapt to an impact. **Tolerance**: The receptor has a high capacity to accommodate the proposed form of change. **Recoverability**: The receptor is anticipated to recover fully within the short term (i.e., 1–7 years). **Value**: The receptor is of national importance (e.g., Ireland's red list species, Scottish Priority Marine Features, Northern Ireland Priority Species).
Very Low	**Adaptability**: The receptor has a high capacity to avoid or adapt to an impact. **Tolerance**: The receptor has a high capacity to accommodate the proposed form of change. **Recoverability**: The receptor is anticipated to recover fully and will be temporary (i.e., lasting <1 year). **Value**: The receptor is not nationally or internationally protected.

Magnitude of impact

36. The scale or magnitude of potential impacts depends on the degree and extent to which the CWP Project activities may change the environment, which usually varies according to project phase (i.e., construction, operation and maintenance (O & M) and decommissioning).

37. Each impact has been characterised in accordance with Guidelines for Ecological Impact Assessment in the UK and Ireland (CIEEM, 2022) and the Guidelines on the information to be contained in Environmental Impact Assessment Reports (Environmental Protection Agency, Ireland, 2022). Magnitude is quantified via a consideration of the impact extent, duration, frequency, and consequences (**Table 9-4**). The duration relates to the time period over which the impact will occur, and the timescales of which have been directly informed by the EPA (2022) guidelines. The impact duration is distinct and separate from the recoverability timescales considered in sensitivity above which relate to the length of time taken for a given habitat type or species to recover from an impact which has ceased.

38. Where an impact could reasonably be assigned more than one level of magnitude, professional judgement has been used to determine which level is most appropriate for the impact. For example, whilst an impact may occur constantly throughout the O & M period it may be indiscernible and immeasurable in practice. Therefore, it would be concluded to be of a negligible magnitude despite the frequency of the impact.

Table 9-4 Impact magnitude definitions

Magnitude	Criteria
High	**Extent**: impact occurs over a large spatial extent, or a large proportion of ecologically important habitat (e.g. spawning or nursery grounds). **Duration**: impact is anticipated to be permanent (i.e., >60 years) or long term (15–60 years). **Frequency**: impact occurs continuously or repeatedly. **Consequences**: impact results in a total change or major alteration to key characteristics.
Medium	**Extent**: impact occurs over a moderate spatial extent or moderate proportion of ecologically important habitat. **Duration**: medium-term (7–15 years) to long-term (15–60 years) impact. **Frequency**: impact occurs continuously or repeatedly. **Consequences**: impact results in a partial loss or change to key characteristics
Low	**Extent**: impact occurs over a small to moderate spatial extent or small proportion of ecologically important habitat. **Duration**: short- (1–7 years) to medium- (7–15 years) term impact. **Frequency**: impact will occur once or repeatedly. **Consequences**: impact results in a minor loss or alteration to key characteristics.

Magnitude	Criteria
Negligible	**Extent**: impact occurs over a small spatial extent or small proportion of ecologically important habitat. **Duration**: temporary (<1 year) to short-term (1–7 years) impact. **Frequency**: impact will occur once or infrequently. **Consequences**: impact results in very slight or imperceptible change to key characteristics.

Significance of effect

39. As set out in **Chapter 5 EIA Methodology**, an Impact Assessment Matrix (IAM) is used to determine the significance of an effect. In basic terms, the potential significance of an effect is a function of the sensitivity of the receptor and the magnitude of the impact, as shown in **Table 9-5**.

40. The matrix provides a framework for the consistent and transparent assessment of predicted effects across all technical chapters; however, it is important to note that the assessments are based on the application of expert judgement.

41. The significance of effect can be determined by comparing the character of the predicted effect to the sensitivity of the receiving environment (EPA (2002), CIEEM (2022)). Significant effects are those considered to be Significant or Very Significant / Profound under the Matrix, whilst effects considered to be Moderate or below are considered to be not significant with regards to the EIA.

42. It should be noted that as per CIEEM (2022) guidance, not all receptors are assessed for all impacts, rather, only those receptors that are potentially vulnerable to a given impact, or where a significant effect may arise have been assessed (**see Section 9.6**).

43. Primary mitigation and, where appropriate, additional mitigation measures have been identified and described where they will avoid, reduce and / or compensate for potentially significant effects. This includes avoidance through the design process.

Table 9-5 Impact assessment matrix for determination of significance of effect

Sensitivity of receptor	Magnitude of impact			
	High	Medium	Low	Negligible
High	Very Significant / Profound	Significant	Moderate / Slight	Slight
Medium	Significant	Moderate	Slight	Slight / Not significant
Low	Moderate / Slight	Slight	Not significant	Not significant
Very Low	Slight	Slight / Not significant	Not significant	Imperceptible

9.5 Assumptions and limitations

44. Data were gathered from a wide variety of data sources using the most up-to-date data at the time of writing, as such baseline data remain valid and provide an appropriate characterisation of the receiving environment at the time of application (**Table 9-6**). Information on the high-level limitations of these data sources is provided in **Table 9-6**.

45. The limitations in the data described below, particularly around the landings data, do not affect the conclusions of this assessment because the data are used together to generate an indication of the likely community composition of fish that are present within the area, and this is combined with other literature / data sources to ensure the most complete picture of the baseline is generated (as possible).

Table 9-6 Data Limitations

Data type	Data limitations
Landings data	There are limitations to this data namely, not all species or vessel sizes are represented; each ICES statistical rectangle covers an area of 30 nautical miles (NM) square and therefore, identifying exact areas within the rectangles where fish were caught is not possible; landings data are recorded for each member state which may be subject to different landings regulations. When used in combination with other data sources, this source still provides relevant data of species present.
ICES catch data	Catch figures do not include estimates for non-reported landings. For 2018–2020 data, Ireland has reported catches in certain areas as confidential following Eurostat guidelines on statistical confidentiality. These have been treated as zero values as actual numbers have not been provided. When used in combination with other data sources, this source still provides relevant data of species present.
Landings data by <10 m vessels into Irish ports from sales notes	Data from <10 m vessels are not available at ICES statistical rectangle level, only by port. Caution should be taken with this data as these species may have been caught from ICES statistical rectangles outside the defined study area. When used in combination with other data sources, this source still provides relevant data of species present.
Fisheries Independent data e.g., ICES survey data	Data are limited to certain species due to the selectivity of the gear used. The Irish Groundfish Survey only has a few stations in the study area. Data from the Northern Irish Groundfish Survey (NIGFS) have therefore been used for CPUE estimates due to better spatial overlap with the study area. When used in combination with other data sources, this source still provides relevant data of species present.
Spawning and nursery ground data	There are limitations with the use of the Coull et al. (1998) and Ellis et al. (2012) papers, which includes: the age of the papers themselves, that only certain species are included and that spawning distributions are under continual revision. These data are still considered relevant based on the long dataset from which they are built. However, these data have been supplemented with more up-to-date information from Ireland's Marine Atlas (further detail in **Section 9.6.3 Spawning and Nursery Grounds**).

9.6 Existing environment

46. The following sections provide a characterisation of the baseline conditions for fish, shellfish and turtle ecology within the study area(s) which incorporate the project ZoI and provide broader regional context.

9.6.1 Commercial Species

47. The following section describes the species targeted by commercial fisheries, consideration of impacts on the fishery itself is provided in **Chapter 12 Commercial Fisheries**. Commercial fisheries data provides an insight into the range of species found within the study area(s). SFPA data includes information on Irish vessels landing into Irish ports for individual ICES statistical rectangles within the study area (SFPA, 2021) (**Figure 9-1**).

48. Five years' worth of fisheries data was examined to provide a list of species recorded in commercial fisheries landings by Irish vessels into Irish ports (SFPA, 2021; average live weight tonnage 2017 - 2021) (**Table 9-7**).

49. For the ICES statistical rectangles that cover the local study area (35E3 and 35E4) there were a total of 15 fish species and five shellfish species recorded over the five-year period. In the inshore rectangle (35E3) where the north west section of the offshore export cable corridor (OECC) is located, there were low catches (by weight), with razor / knife clams (*Solenidae* sp.) Norway lobster (*Nephrops norvegicus*) and sword razor shell (*Ensis* sp.) dominating the landings(**Plate 9-1**). This is expected due to the relatively small sea area in this rectangle and the shallow water depths (maximum ~33 m). In rectangle 35E4 where the array site and the south east section of the OECC is located whelk (*Buccinum undatum*) was the dominant species by weight (**Plate 9-1**), followed by blonde ray (*Raja brachyura*), small-spotted catshark (*Scyliorhinus canicula*), European plaice (*Pleuronectes platessa*), great Atlantic scallop (*Pecten maximus*), and haddock (*Melanogrammus aeglefinus*) (**Plate 9-2**).

50. For the regional study area, the ICES statistical rectangles in the north (36E3, 36E4) recorded 20 fish species and six shellfish species. The catches were dominated by European sprat (*Sprattus sprattus*), haddock, and anglerfish (*Lophiidae sp*.) (**Plate 9-2**). Shellfish landings from 36E3 were dominated by common edible cockle (*Cerastoderma edule*), sword razor shell, and whelk, whereas shellfish landings from 36E4 were dominated by Norway lobster, great Atlantic scallop, and whelk (**Plate 9-1**).

51. There were no landings from Irish vessels into Irish ports recorded in the most recent five years in statistical rectangle 37E3. In 37E4 Atlantic herring (*Clupea harengus*), dominated the landings, with much lower catches of whiting (*Merlangius merlangus*) (**Plate 9-2**).

52. The ICES statistical rectangles in the south of the regional study area (34E3 and 34E4) recorded 10 fish species and two shellfish species. The catches were dominated by whelk, haddock, blonde ray and small-spotted catshark (**Plate 9-1, Plate 9-2**). ICES statistical rectangles 33E3 and 33E4 recorded 18 fish species and eight shellfish species. The catches were dominated by a mixture of European sprat, herring and haddock, along with whelk, edible crab (*Cancer pagurus*) and great Atlantic scallop.

Table 9-7 Commercial fish and shellfish species landed by Irish vessels into Irish ports in the ICES statistical rectangles covering the local and regional study areas (2017–2021)

ICES statistical rectangle	Study area	Species caught
35E3	Local	Anglerfish (*Lophiidae* sp.), Common sole, Norway lobster, Razor / knife clams (*Solenidae* sp.), Sword razor shell (*Ensis* sp.)
35E4	Local	Anglerfish, Atlantic cod (*Gadus morhua*), Blonde ray (*Raja brachyura*), Brill (*Scophthalmus rhombus*), Common sole (*Solea solea*), Cuckoo ray (*Raja naevus*), European plaice (*Pleuronectes platessa*), Great Atlantic Scallop (*Pecten maximus*), Haddock (*Melanogrammus aeglefinus*), Lemon Sole (*Microstomus kitt*), Megrims (*Lepidorhombus* sp.), Norway lobster (*Nephrops norvegicus*), Pollack (*Pollachius pollachius*), Small-spotted catshark (*Scyliorhinus canicula*), Thornback ray (*Raja clavata*), Turbot (*Psetta maxima*), Whelk (*Buccinum undatum*)
33E3	Regional	Anglerfish, Atlantic cod, Atlantic herring (*Clupea harengus*), Common sole, Edible crab (*Cancer pagurus*), European hake (*Merluccius merluccius*), European lobster (*Homarus Gammarus*), European plaice, European sprat (*Sprattus sprattus*), Great Atlantic scallop, Haddock, John dory (*Zeus faber*), Lemon Sole, Ling (*Molva molva*), Megrims, Norway lobster, Pollack, Razor / knife clams, Spinous spider crab (*Maja squinado*), Thornback ray, Turbot, Velvet swimming crab (*Necora puber*), Whelk, Whiting (*Merlangius merlangus*), Witch (*Glyptocephalus cynoglossus*)
33E4	Regional	Atlantic cod, European hake, European plaice, Great Atlantic scallop, Haddock, John dory, Lemon Sole, Ling, Whiting
34E3	Regional	Whelk
34E4	Regional	Anglerfish, Atlantic cod, Blonde ray, Common sole, European hake, European plaice, Haddock, Norway lobster, Small-spotted catshark, Turbot, Whelk
36E3	Regional	Anglerfish, Atlantic cod, Common edible cockle (*Cerastoderma edule*), European sprat, Haddock, Norway lobster, Razor/knife clams, Sword razor shell, Thornback ray, Whelk
36E4	Regional	Anglerfish, Atlantic cod, Blonde ray, Brill, Common edible cockle, Common sole, Common squids (*Loligo* sp.), European hake, European plaice, European sprat, Great Atlantic scallop, Gurnards (*Triglidae* sp.), Haddock, Lemon Sole, Ling, Megrims, Norway lobster, Pollack, Razor / knife clams, Sword razor shell, Thornback ray, Turbot, Whelk, Whiting, Witch
37E3	Regional	N/A
37E4	Regional	Atlantic herring, Whiting

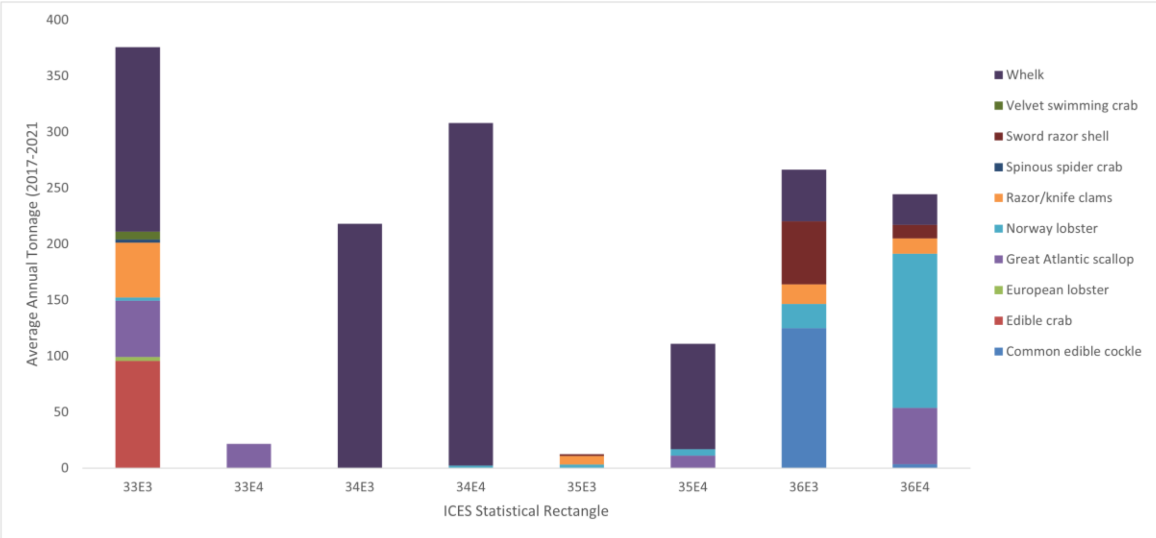


Plate 9-1 Shellfish species landed into by Irish vessels into Irish ports in the ICES statistical rectangles covering the local and regional study areas (Average Live Weight Tonnage, SFPA 2017–2021)

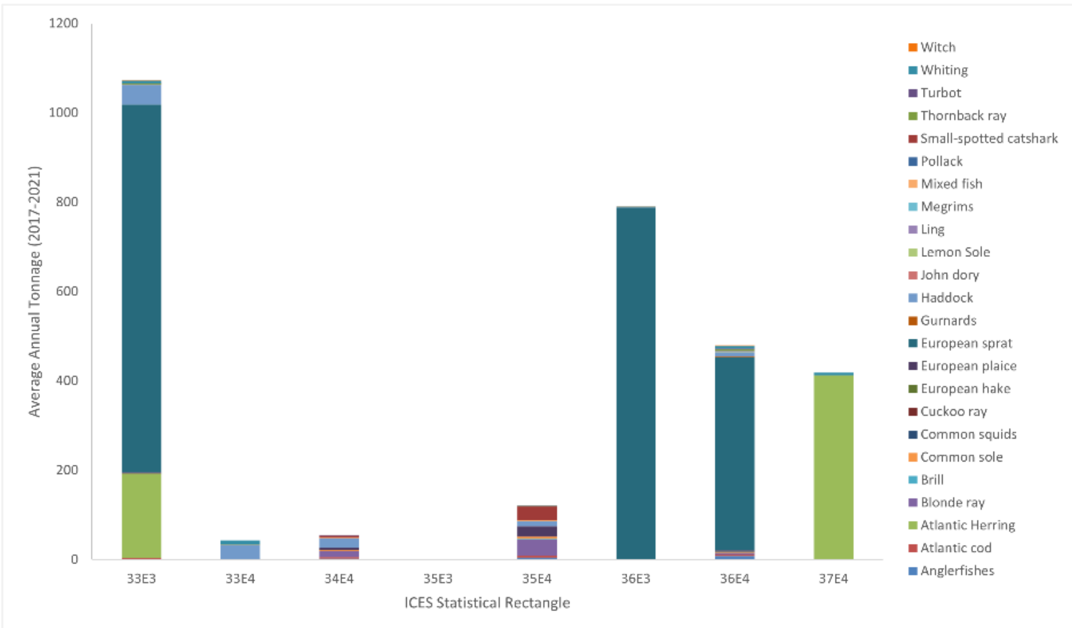


Plate 9-2 Fish / elasmobranch species landed into by Irish vessels into Irish ports in the ICES statistical rectangles covering the local and regional study area (Average Live Weight Tonnage, SFPA 2017–2021)

53. The fish and shellfish assemblage in the national study area (ICES division 27.7.a) was found to be much more diverse with 161 fish species and 64 shellfish species recorded over the past five-year

period (2016–2020) (ICES, 2022a). This is expected as it covers a larger area, and the data includes landings by all member countries.

54. Shellfish landings in ICES division 27.7.a were dominated by whelk, followed by Norway lobster, great Atlantic scallop, queen scallop (*Chlamys opercularis*) and edible crab (**Plate 9-3**). Other shellfish species included blue mussel (*Mytilus edulis*), European lobster, common edible cockle, sword razor shell and velvet swimming crab.

55. Additional information on species that are landed by under 10 m vessels into Irish ports can be obtained from examination of sales note data (SFPA, 2022) (**Table 9-8**). The ports within the local, regional and national study areas are also shown in **Table 9-8**. The species landed into ports within the local study area are whelk, velvet swimming crab, razor / knife clams, edible crab, European lobster and sword razor shell. Landings into ports within the regional study area include a number of additional species including green crab (*Carcinus maenas*), spinous spider crab (*Maja squinado*) and common edible cockle. Landings into the national study area (ICES division 27.7.a) also included Pandalus shrimps and pink glass shrimp (*Pasiphaea multidentate*). Caution should be taken with this data as these species may have been caught from ICES statistical rectangles outside the defined study area.

56. Additional landing's data from inshore pot fishing (<15 m vessels) from Ireland's Marine Atlas (2016) show whelk, lobster and crab effort within the local study area.

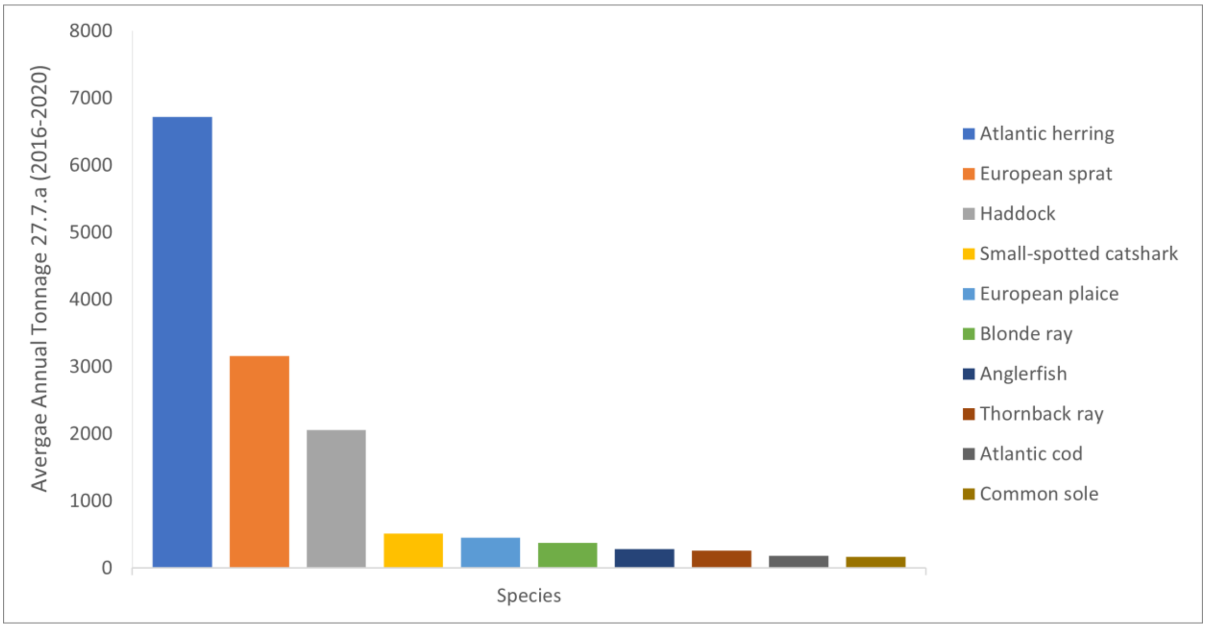


Plate 9-3 Top ten fish / elasmobranch species (by weight) landed by Member States (2016–2020) in ICES Division 27.7.a

Table 9-8 Species landed by <10 m vessels into Irish ports within the local and regional (ICES division 27.7.a) study areas from sales notes (SFPA, 2021)

Study Area	Ports	Landed species
Local	Dun Laoghaire, Howth, Malahide	Whelk, velvet swimming crab, razor / knife clams, edible crab, European lobster and sword razor shell
Regional	Annagassan, Arklow, Balbriggan, Clogherhead, Courtown, Curracloe, Drogheda, Dunmore East, Fethard / Slade, Kilmore Quay, Loughshinny, Mornington, Rosslare, Skerries, Wexford, Wicklow	Whelk, edible crab, green crab, spinous spider crab, velvet swimming crab, common edible cockle, sword razor shell, razor / knife clams, European lobster, common shrimp (*Crangon crangon*), deep-sea red crab (*Chaceon quinquedens*), Palaemonid shrimps, Caribbean Spiny Lobster (*Panulirus argus*), common spiny lobster (*Palinurus elephas*)

9.6.2 Fisheries Independent Surveys

57. The Northern Irish Groundfish Survey (NIGFS) is conducted annually as part of the internationally coordinated International Bottom Trawl Survey (IBTS) (ICES, 2020). The aim is to investigate spatial and temporal changes in the relative abundance and distribution of fish assemblages and obtain the biological parameters of commercial fish species in ICES division 27.7.a for stock assessment purposes.

58. NIGFS data provides information on additional fish species that are not commercially targeted and therefore can be missing from fisheries landings data. The small mesh size also captures small species and juveniles of commercial species whose biomass is underrepresented in fisheries dependent data.

59. Abundances recorded under the NIGFS are presented below as number of individuals captured per 30 minutes of trawling (i.e., Catch per Unit Effort (CPUE)) in 2017–2021 (ICES, 2022b; ICES, 2020) (**Table 9-9**). Therefore, these values are not directly comparable with the commercial landings data presented above.

60. In the local study area plaice, whiting, queen scallop, Atlantic herring, European sprat and small-spotted catshark dominated the catches (**Table 9-10**).

61. In the regional study area to the south, the species above also dominated the catches, along with red gurnard (*Chelidonichthys cuculus*), Atlantic horse mackerel (*Trachurus trachurus*), common dab (*Limanda limanda*) and spotted ray (*Raja montagui*).

62. In the regional study area to the north, the species above also dominated the catches, along with Norway lobster, haddock and grey gurnard (*Eutrigla gurnardus*).

63. There are no NIGFS survey stations in ICES statistical rectangles 33E3 or 37E3, however this does not materially alter the validity of the characterisation of species within the ZoI.

Table 9-9 Top ten species recorded during the NIGFS (presented as number of individuals captured per 30 minutes of trawling) in the ICES statistical rectangles covering the local and regional study areas 2017-2021 (ICES, 2022b)

Study Area	ICES Statistical Rectangle	Species
Local	35E3	Plaice, Whiting, Queen scallop, Atlantic herring, European sprat, Common dab (*Limanda limanda*), Spotted ray (*Raja montagui*), Grey gurnard (*Eutrigla gurnardus*), Common dragonet (*Trisopterus minutus*), Poor cod (*Trisopterus minutus*)
	35E4	Small-spotted catshark, Plaice, Whiting, Queen scallop, Atlantic herring, Spotted ray, Haddock, Poor cod, Grey gurnard, European sprat
Regional	33E3	N/A
	33E4	Small-spotted catshark, Queen scallop, Whiting, Red gurnard (*Chelidonichthys cuculus*), Atlantic herring, Atlantic horse mackerel (*Trachurus trachurus*), Poor cod, Starry smooth hound (*Mustelus asterias*)), Long finned squid (*Loligo forbesii*), Atlantic mackerel (*Scomber scombrus*)
	34E3	Atlantic herring, Whiting, Small-Spotted catshark, Common dab, European Sprat, Atlantic horse mackerel, Common dragonet (*Callionymus lyra*), Grey gurnard, Poor cod, Plaice
	34E4	Small-spotted catshark, Whiting, Spotted ray, Poor cod, Broadnose skate (*Bathyraja brachyurops*), European sprat, Atlantic herring, Atlantic horse mackerel, Plaice, Starry smooth hound
	36E3	Plaice, Atlantic herring, Whiting, Common dab, Norway lobster, European sprat, Long rough dab (*Hippoglossoides platessoides*), Haddock, Grey gurnard, Common dragonet
	36E4	Haddock, Small-spotted catshark, Whiting, Atlantic herring, Norway lobster, Plaice, Grey gurnard, Atlantic mackerel, European sprat, Poor cod
	37E3	N/A
	37E4	Whiting, Atlantic herring, Norway lobster, Haddock, Plaice, Grey gurnard, Small-spotted catshark, Atlantic mackerel, European sprat, Spiny dogfish (*Squalus acanthias*)

9.6.3 Spawning and Nursery Grounds

64. A range of fish and shellfish species are known to spawn and / or have nursery grounds which overlap with the local study area (Ireland's Marine Atlas, 2016; Ellis et al., 2012; Coull et al., 1998). These are listed in **Table 9-10** together with their spawning times and the intensity of spawning (where it has been defined). Visualization of the spawning and nursery habitats in comparison to the offshore development area can be seen below in **Figure 9-2**–**Figure 9-20**. The spawning times are provided in Coull et al. (1998) and the spawning / nursery intensity has been taken from Ellis et al. (2012) (and Coull et al., 1998 where available). Spawning and nursery habitats also occur in the wider regional study area, with similar species as described above. Further detail regarding the wider spawning and nursery habitats can be found under **Section 9.10**.

65. The data sources indicate the presence of spawning and nursery grounds within the local study area for Atlantic cod, haddock, plaice and whiting. Ellis et al. (2012) also indicates low intensity spawning and nursery grounds for Atlantic mackerel, horse mackerel and sandeel (*Ammodytes* sp.) within / in close proximity to the local study area. Coull et al. (1998) indicates the presence of spawning and nursery grounds for Norway lobster and lemon sole within the local study area.

66. Spawning grounds have been recorded in the local study area for common sole, European hake, sprat and ling (*Molva molva*). Nursery grounds have been recorded in the local study area for Atlantic herring, spotted ray, spurdog (*Squalus* sp.), thornback ray and tope (*Galeorhinus galeus*). Blonde rays have also been noted in the area, although whether they spawn or just aggregate in the region is currently unknown (Marine Institute, pers comms, 2021).

67. It is noted that whilst these data sources provide a good basis for identifying the potential presence of spawning areas, for certain species, additional data may also be considered when establishing a baseline of where spawning may take place. This is the case for herring, which is both commercially and ecologically important, and as a substrate spawning fish are particularly vulnerable to impacts that may affect its spawning habitat.

68. Herring spawn on well-oxygenated gravel and sandy gravel with little fine material (Ellis et al., 2012). Coull et al. (1998) cites spawning to occur between January–March in southwest Ireland, and August–September in northwest Ireland. Coull et al. (1998) and Ireland's Marine Atlas (2016) indicate the closest spawning habitats for herring are >50 km from the local study area near the Isle of Man and southern Irish coast respectively, with the closely related sprat having limited grounds in Dundalk Bay which is similarly beyond the ZoI of the proposed development.

69. Sandeel are another substrate spawner and of particular ecological importance as they are considered a keystone species, playing a considerable role in the marine ecosystem as prey for fish, marine mammals and seabirds. Sandeels choose to spawn on clean sand from November–February. Ellis et al. (2012) identified low-intensity spawning within the local study area; however, Coull et al. (1998) indicated no overlap of sandeel habitat with the offshore development area. Data from the Projects benthic survey indicate that substrates in the array site and along the majority of the OECC would not support sandeel spawning as the percentage of sand is low, with the majority of sediments characterised as coarse sediments (**Chapter 8 Subtidal and Intertidal Ecology**).

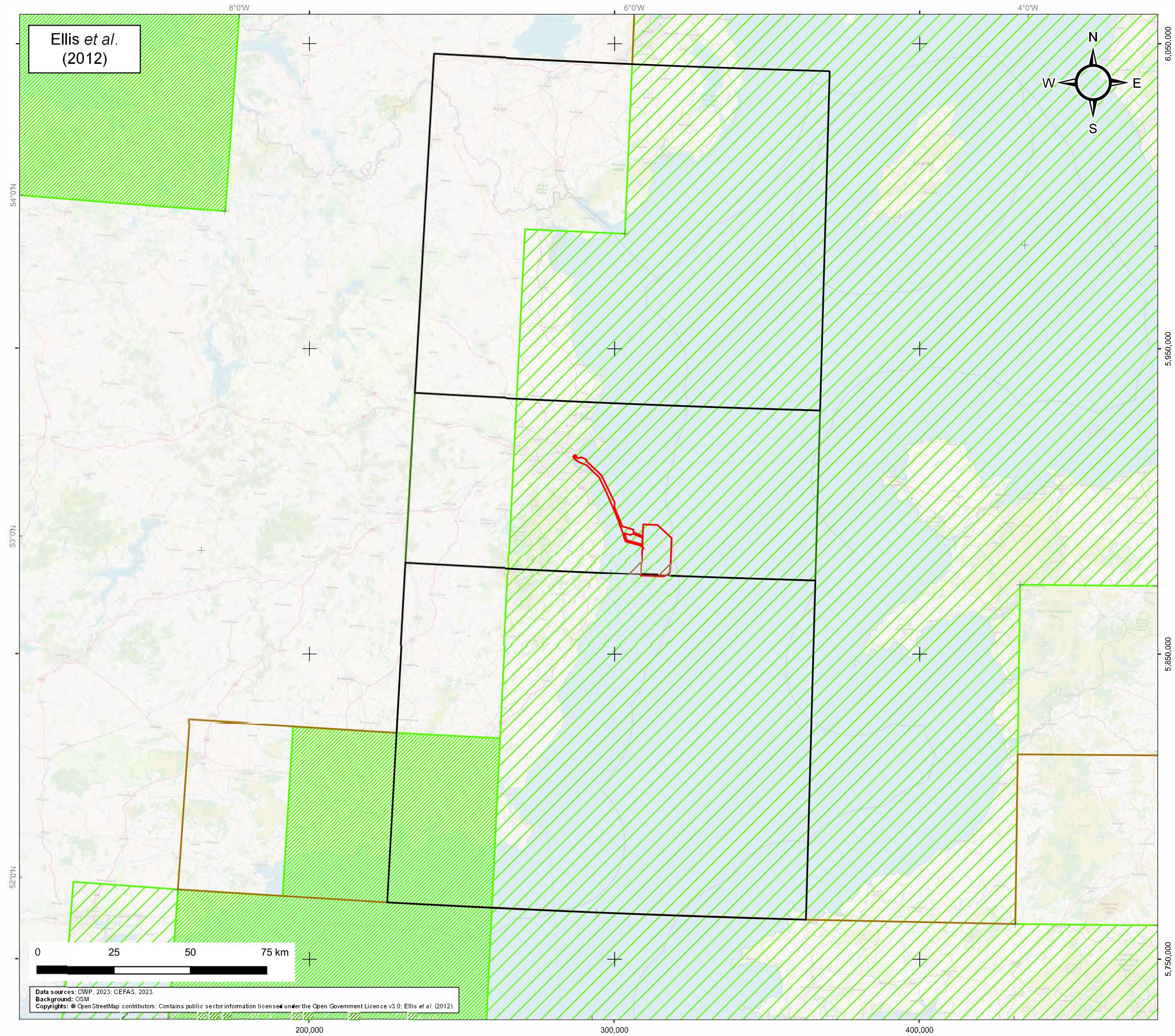
Table 9-10 Spawning and nursery grounds present in the National Study Area (Ireland's Marine Atlas, 2016; Ellis et al., 2012; Coull et al., 1998)

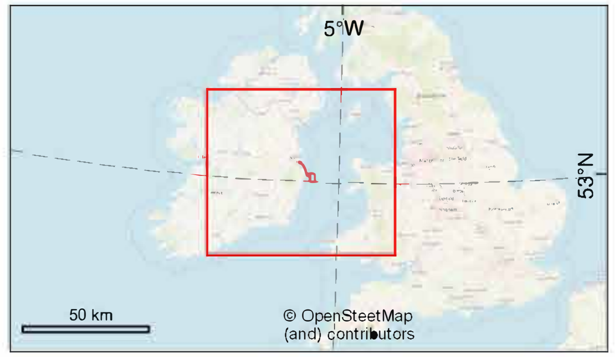
Species	**Spawning areas within the Local Study Area** **Blank = Data not assessed in the reference**			**Nursery areas within the Local Study Area** **Blank = Data not assessed in the reference**			**Spawning times (Coull et al. 1998)**
	Coull et al. (1998)	**Ellis et al. (2012)**	**Ireland's Marine Atlas (2016)**	**Coull et al. (1998)**	**Ellis et al. (2012)**	**Ireland's Marine Atlas (2016)**	
Anglerfish			No		Yes – low intensity	No	
Atlantic cod	Yes – high intensity	Yes – low intensity	Yes	Yes	Yes – high intensity	Yes	January–April
Atlantic herring	62 km from local study area, 124 km from array site		112 km from local study area and array site	Yes	0 km from local study area, 40 km from array site, 24 km from OECC	1.3 km from local study area, 25 km from OECC, 43 km from array site	January–March (SW Ireland) August–September (NW Ireland)
Atlantic mackerel	No	Yes – low intensity	No	No	0 km from local study area, 40 km from the array site, 24 km from OECC	Yes	March–July
Blue whiting (*Merlangus poutassou*)	No		No	No	No	No	April–June
Common skate (*Dipturus batis*)					No		

Species	Spawning areas within the Local Study Area Blank = Data not assessed in the reference			Nursery areas within the Local Study Area Blank = Data not assessed in the reference			Spawning times (Coull et al. 1998)
	Coull et al. (1998)	Ellis et al. (2012)	Ireland's Marine Atlas (2016)	Coull et al. (1998)	Ellis et al. (2012)	Ireland's Marine Atlas (2016)	
Common sole	Yes – low intensity	Yes – low intensity		31 km from local study area, 73 km from the array site, 83 km from OECC	33 km from local study area, 82 km from the array site, 92 km from the OECC		March–May
European hake		0 km from local study area, 44 km from OECC 43 km from array site	No		55 km from local study area	No	
European sprat	Yes			No			May–August
Haddock	No		Yes	Yes		Yes	February–May
Horse mackerel		0 km away from local study area, 24 km from OECC, 40 km from array site	No			Yes	
Lemon sole	Yes			Yes			April–September
Ling (*Molva molva*)		Yes – low intensity			No		

Species	Spawning areas within the Local Study Area Blank = Data not assessed in the reference			Nursery areas within the Local Study Area Blank = Data not assessed in the reference			Spawning times (Coull et al. 1998)
	Coull et al. (1998)	Ellis et al. (2012)	Ireland's Marine Atlas (2016)	Coull et al. (1998)	Ellis et al. (2012)	Ireland's Marine Atlas (2016)	
Megrim			No			No	
Norway lobster	Yes			Yes			April–June
Norway pout (*Trisopterus esmarkii*)	No			No			January–May
Plaice	Yes – low intensity	Yes – low intensity		Yes	Yes – low intensity		January–March
Saithe (*Pollachius virens*)	No			No			January–April
Sandeel (*Ammodytes* sp.)	No	Yes – Low intensity		No	Yes – low intensity		November–February
Spotted ray					Yes – low intensity		
Spurdog (*Squalus* sp.)					0 km from local study area, 40 km from the array site, 24 km from OECC		
Thornback ray					Yes – low intensity		

Species	Spawning areas within the Local Study Area Blank = Data not assessed in the reference			Nursery areas within the Local Study Area Blank = Data not assessed in the reference			Spawning times (Coull et al. 1998)
	Coull et al. (1998)	Ellis et al. (2012)	Ireland's Marine Atlas (2016)	Coull et al. (1998)	Ellis et al. (2012)	Ireland's Marine Atlas (2016)	
Tope (*Galeorhinus galeus*)					Yes – low intensity		
Whiting	Yes – high intensity	Yes – low intensity	Yes	Yes	Yes – low and high intensity	Yes	February–June





Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- National study area

Ellis et al. (2012)

- Nursery ground high intensity
- Nursery ground low intensity

Anglerfish not covered in Ireland's marine atlas and Coull et al. (1998) datasets.

Data sources: CWP. 2023; CEFAS. 2023.
Background: OSM
Copyrights: ● OpenStreetMap contributors; Contains public sector information licensed under the Open Government Licence v3.0; Ellis *et al.* (2012).

Project: Codling Wind Park

Contractor: www.naturalpower.com natural power

Figure 9.2
Anglerfish spawning and / or nursery habitats compared to the offshore development area

CWP doc. number: CWP-NPC-ENG-08-01-MAP-0634

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IS - PAB - FSTESAs.LRN..SNG.ANGLERFISH - EIAR.FIG.09.02	*Scale:* 1:1,200,000	EPSG 25830

Rev	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
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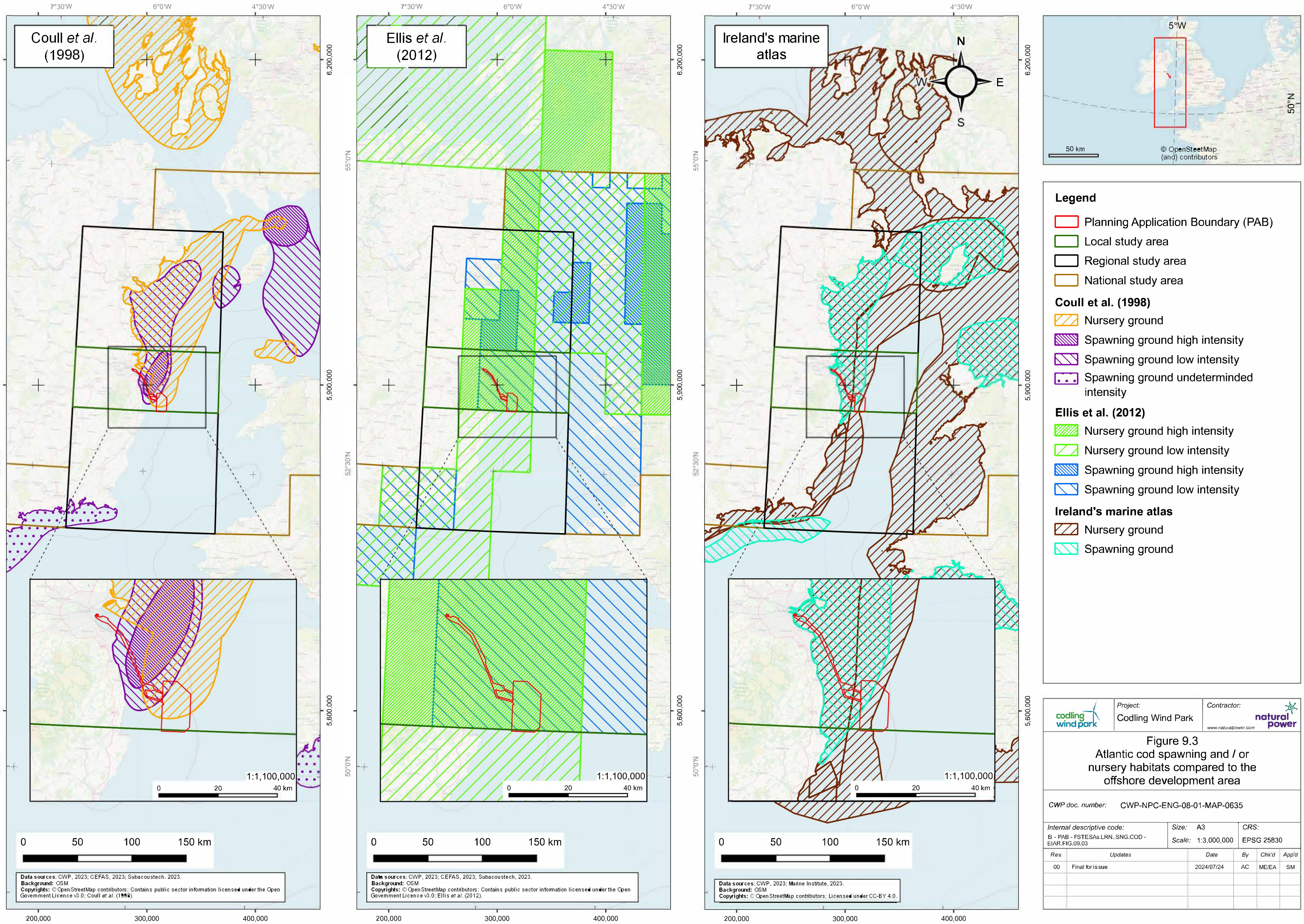

Figure 9.3
Atlantic cod spawning and / or nursery habitats compared to the offshore development area

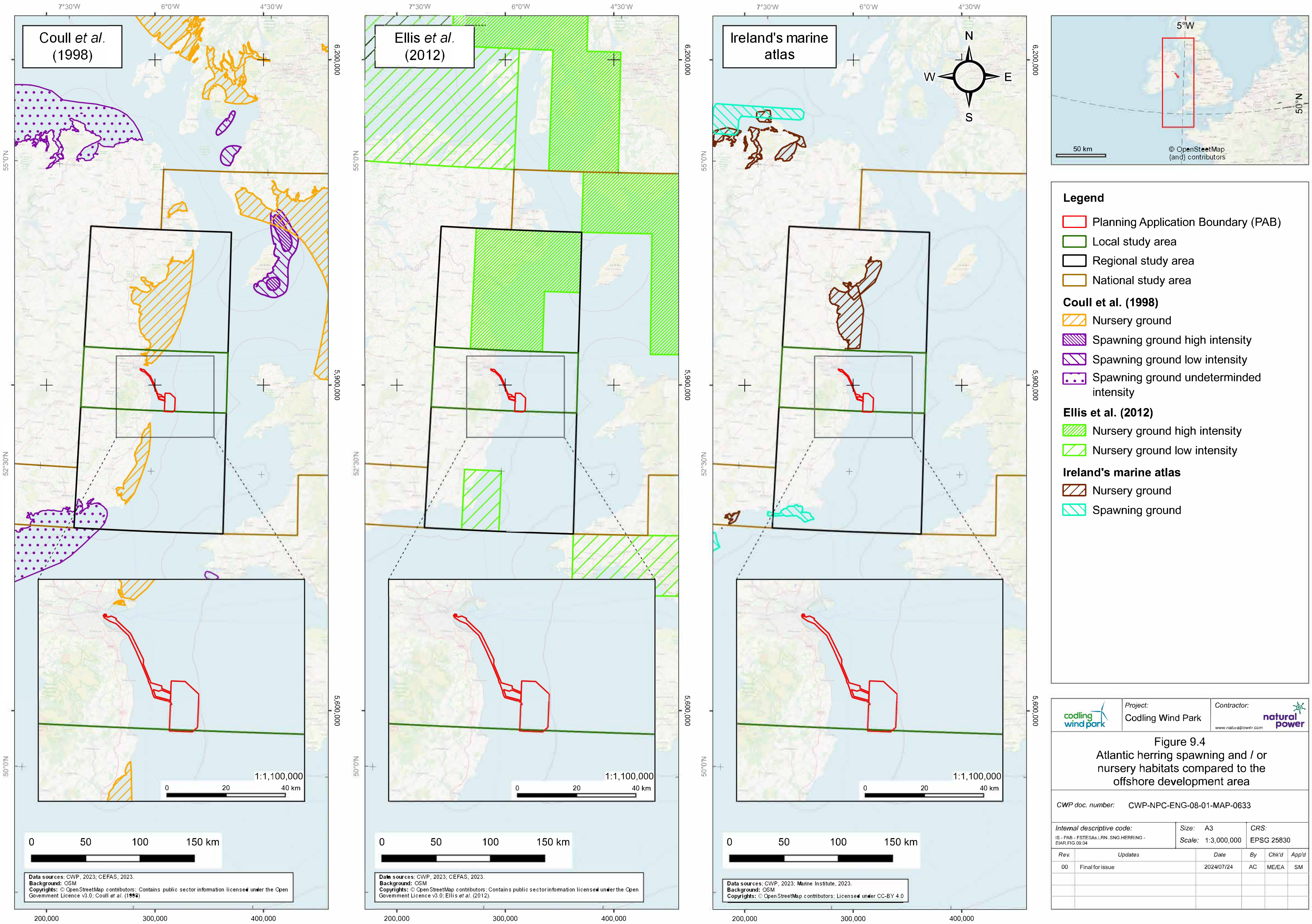

Figure 9.4
Atlantic herring spawning and / or nursery habitats compared to the offshore development area

CWP doc. number: CWP-NPC-ENG-08-01-MAP-0633

Internal descriptive code:	*Size:*	*CRS:*
IS - PAB - FSTESAs.LRN..SNG.HERRING - EIAR.FIG.09.04	A3	EPSG 25830
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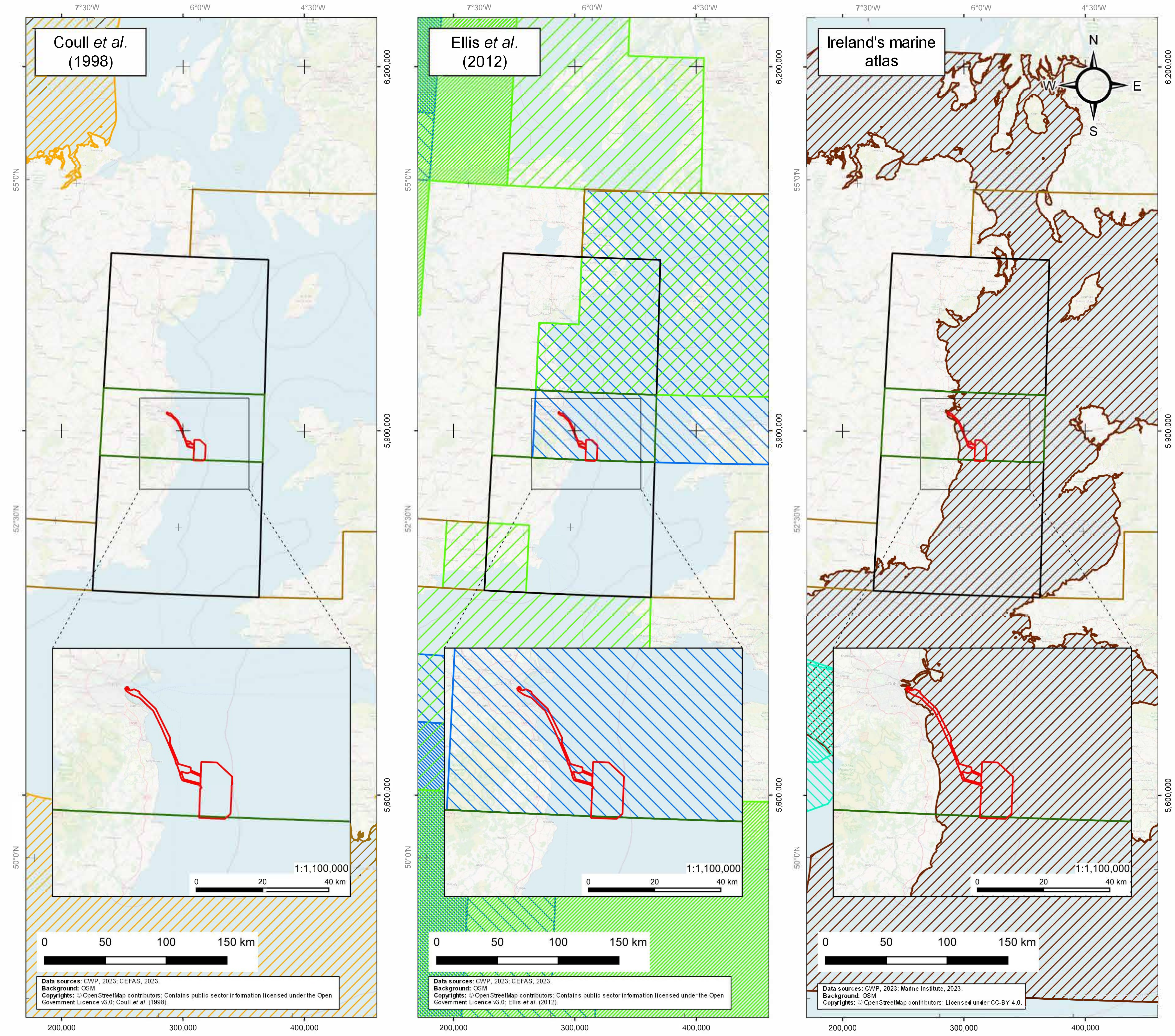
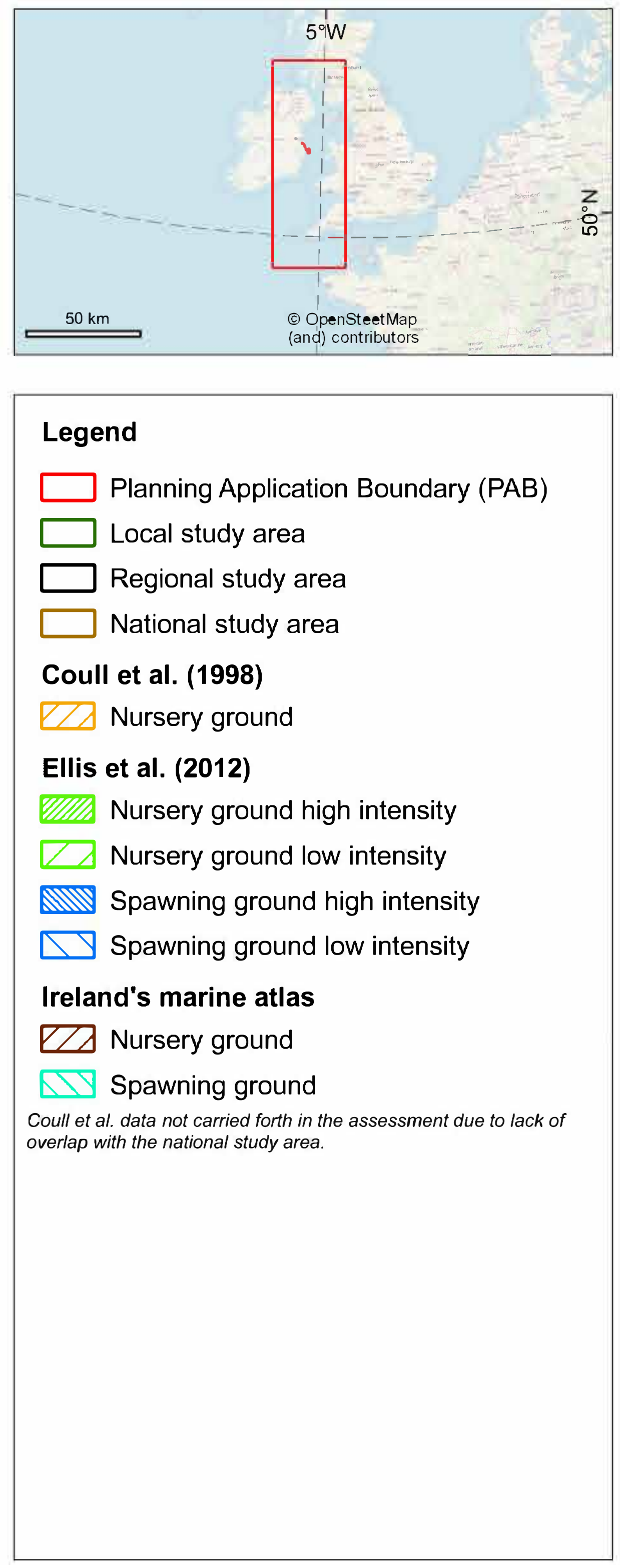
Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
00	Final for issue	2024/07/24	AC	ME/EA	SM





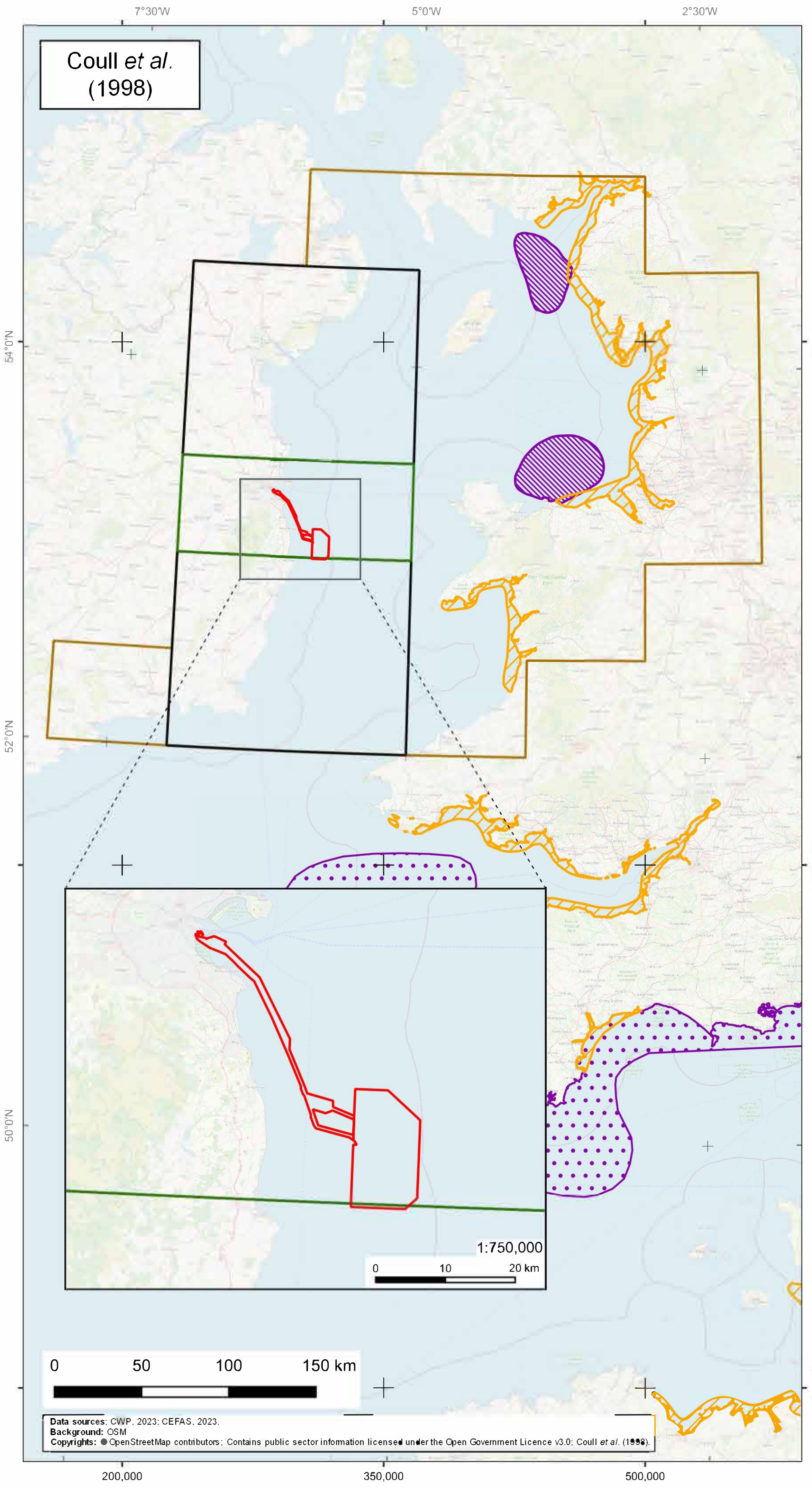
Project:	Contractor:
Codling Wind Park	www.naturalpower.com

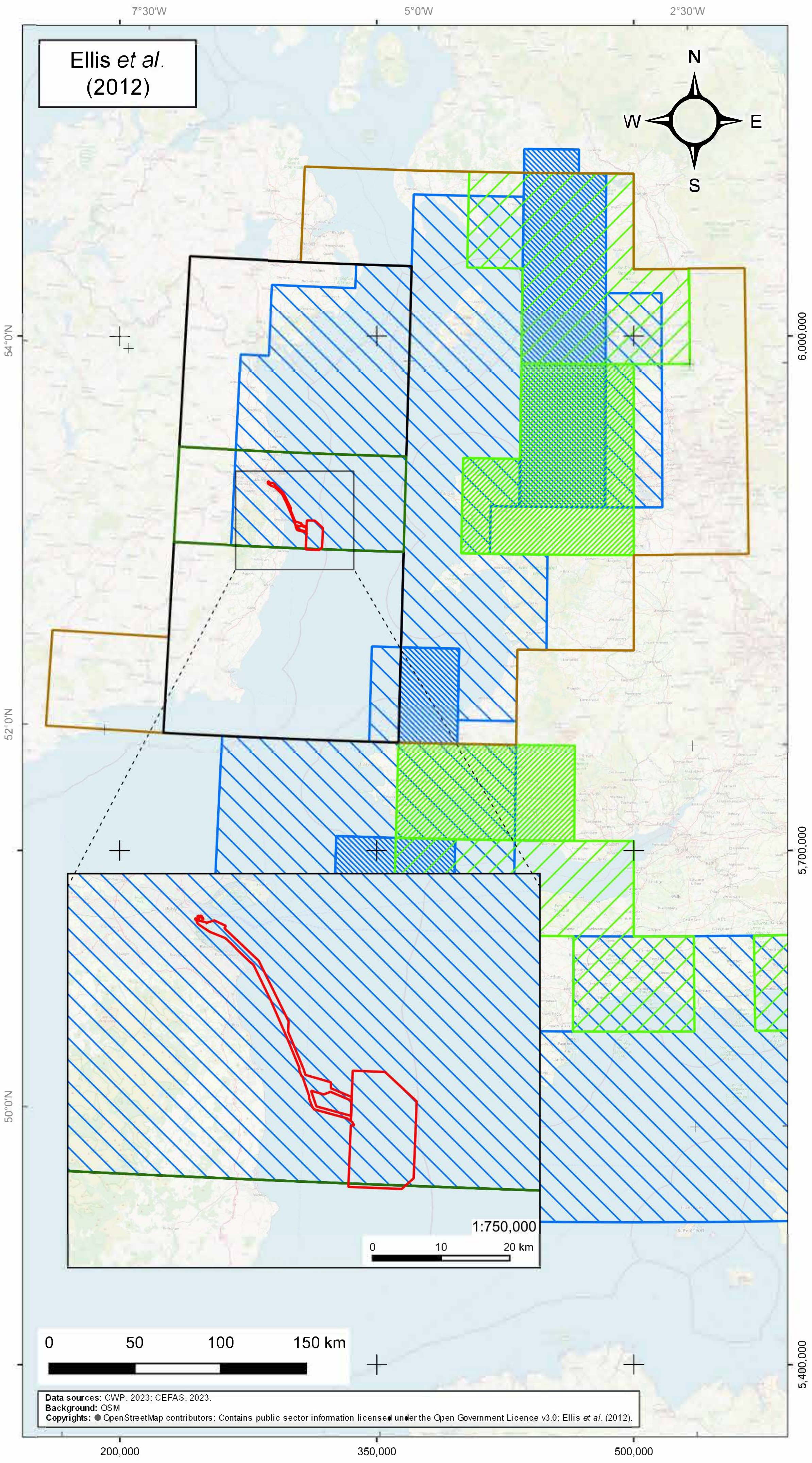
Figure 9.5
Atlantic mackerel spawning and / or nursery habitats compared to the offshore development area

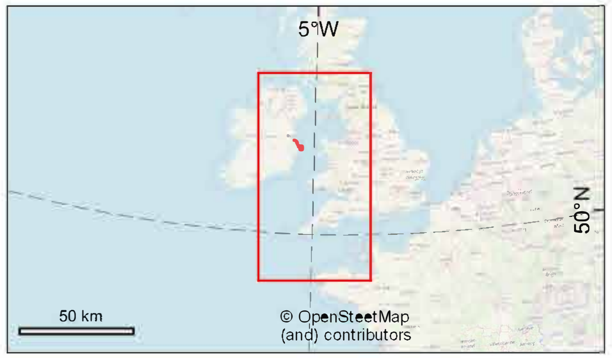
CWP doc. number: CWP-NPC-ENG-08-01-MAP-1136

Internal descriptive code:	*Size:* A3	*CRS:*
IS - PAB - FSTESAs.LRN..SNG.ATLANTIC.MACKEREI - EIAR.FIG.09.05	*Scale:* 1:3,000,000	EPSG 25830

Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
00	Final for issue	2024/07/24	AC	ME/EA	SM







Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- National study area

Coull et al. (1998)

- Nursery ground
- Spawning ground high intensity
- Spawning ground undetermined intensity

Ellis et al. (2012)

- Nursery ground high intensity
- Nursery ground low intensity
- Spawning ground high intensity
- Spawning ground low intensity

Sole not covered in Ireland's marine atlas dataset.

Project:	Contractor:
Codling Wind Park	www.naturalpower.com

Figure 9.6
Common sole spawning and / or nursery habitats compared to the offshore development area

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1137

Internal descriptive code:	*Size:* A3	*CRS:*
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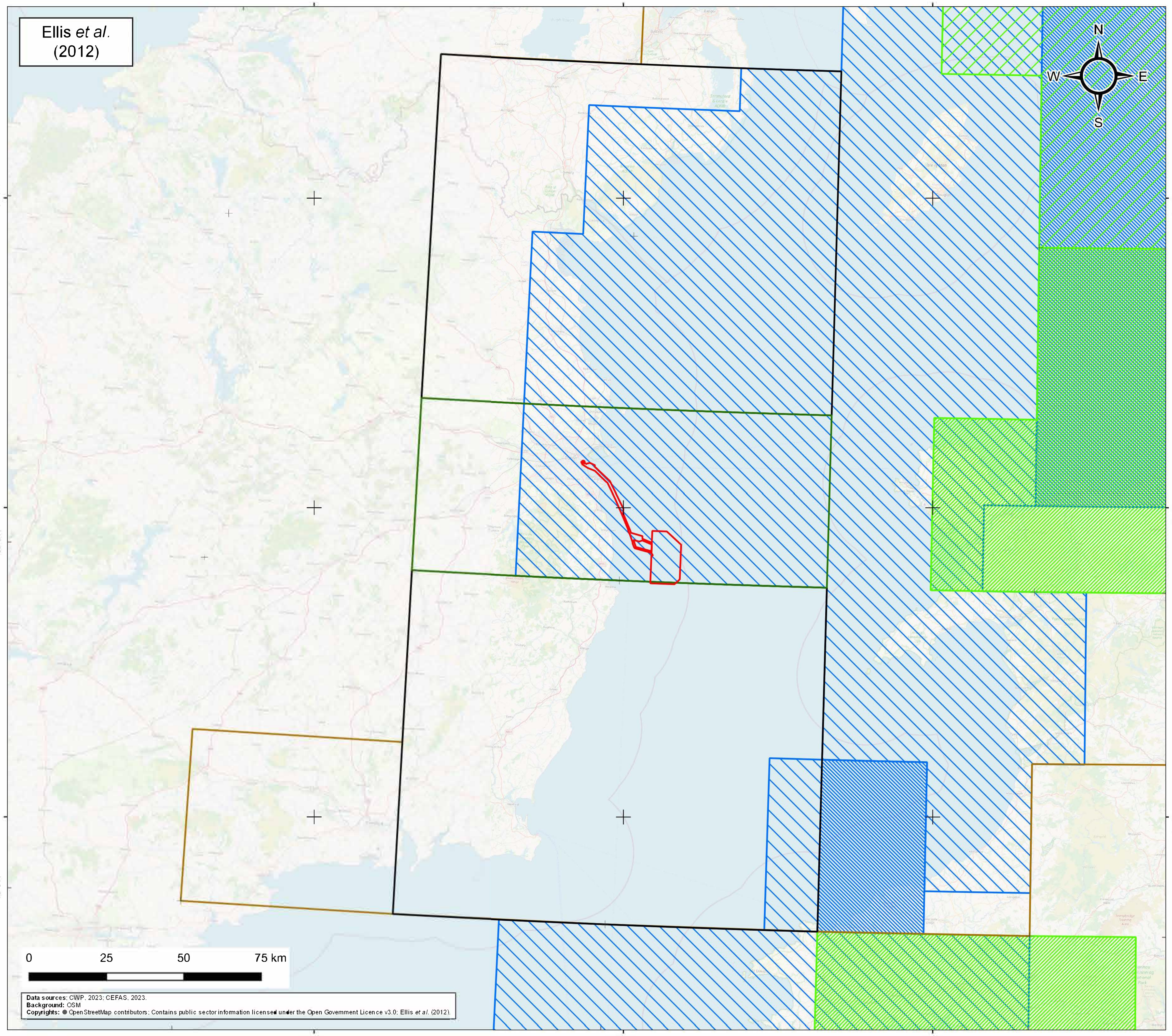
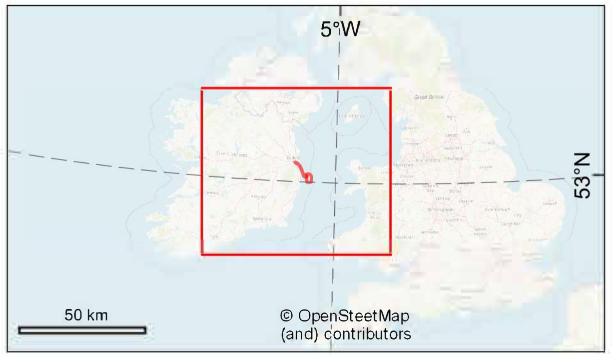
Rev	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
00	Final for issue	2024/07/24	AC	ME/EA	SM





Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- National study area

Ellis et al. (2012)

- Nursery ground high intensity
- Nursery ground low intensity
- Spawning ground high intensity
- Spawning ground low intensity

European hake not covered in Ireland's marine atlas and Coull et al. (1998) datasets.

Project: Codling Wind Park

Contractor: www.naturalpower.com

Figure 9.7
European hake spawning and / or nursery habitats compared to the offshore development area

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1138

Internal descriptive code: IS - PAB - FSTESAs.LRN..SNG.EUROPEAN.HAKE - EIAR.FIG.09.07

Size: A3

Scale: 1:1,200,000

CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
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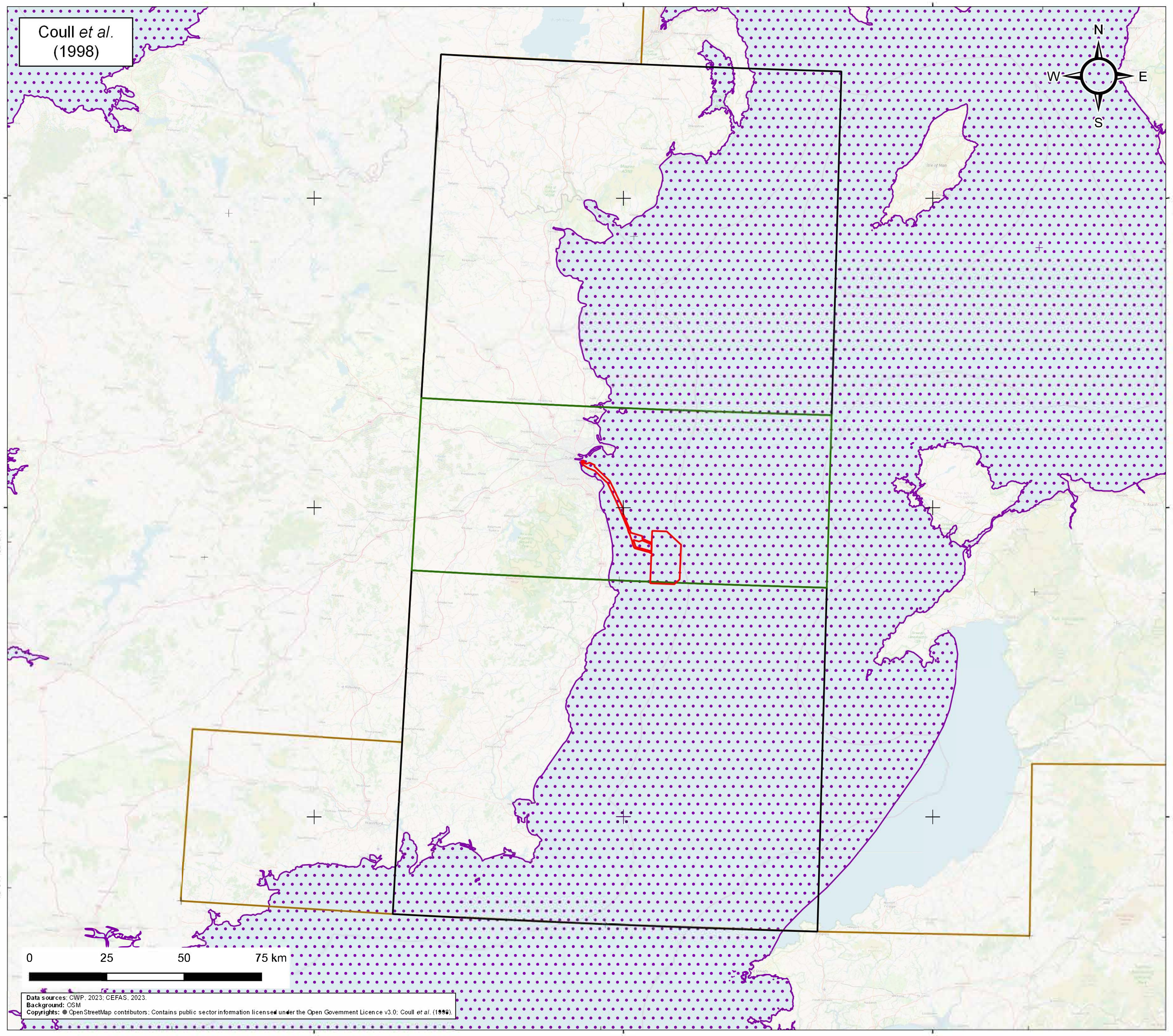

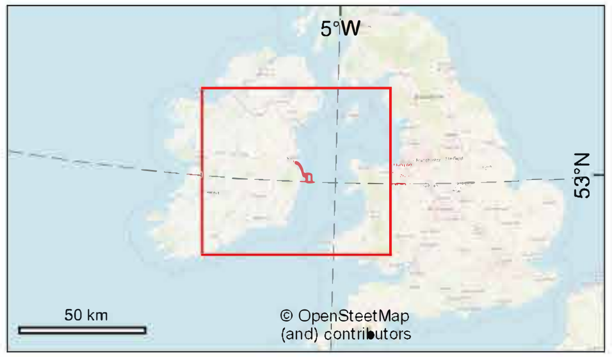

Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- National study area

Coull et al. (1998)

- Spawning ground undetermined intensity

European sprat not covered in Ireland's marine atlas and Ellis et al. (2012) datasets.

Data sources: CWP. 2023; CEFAS. 2023.
Background: OSM

codling wind park	*Project:* Codling Wind Park
Contractor: natural power www.naturalpower.com	

Figure 9.8
European sprat spawning and / or nursery habitats compared to the offshore development area

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1139

Internal descriptive code:	*Size:* A3	*CRS:*
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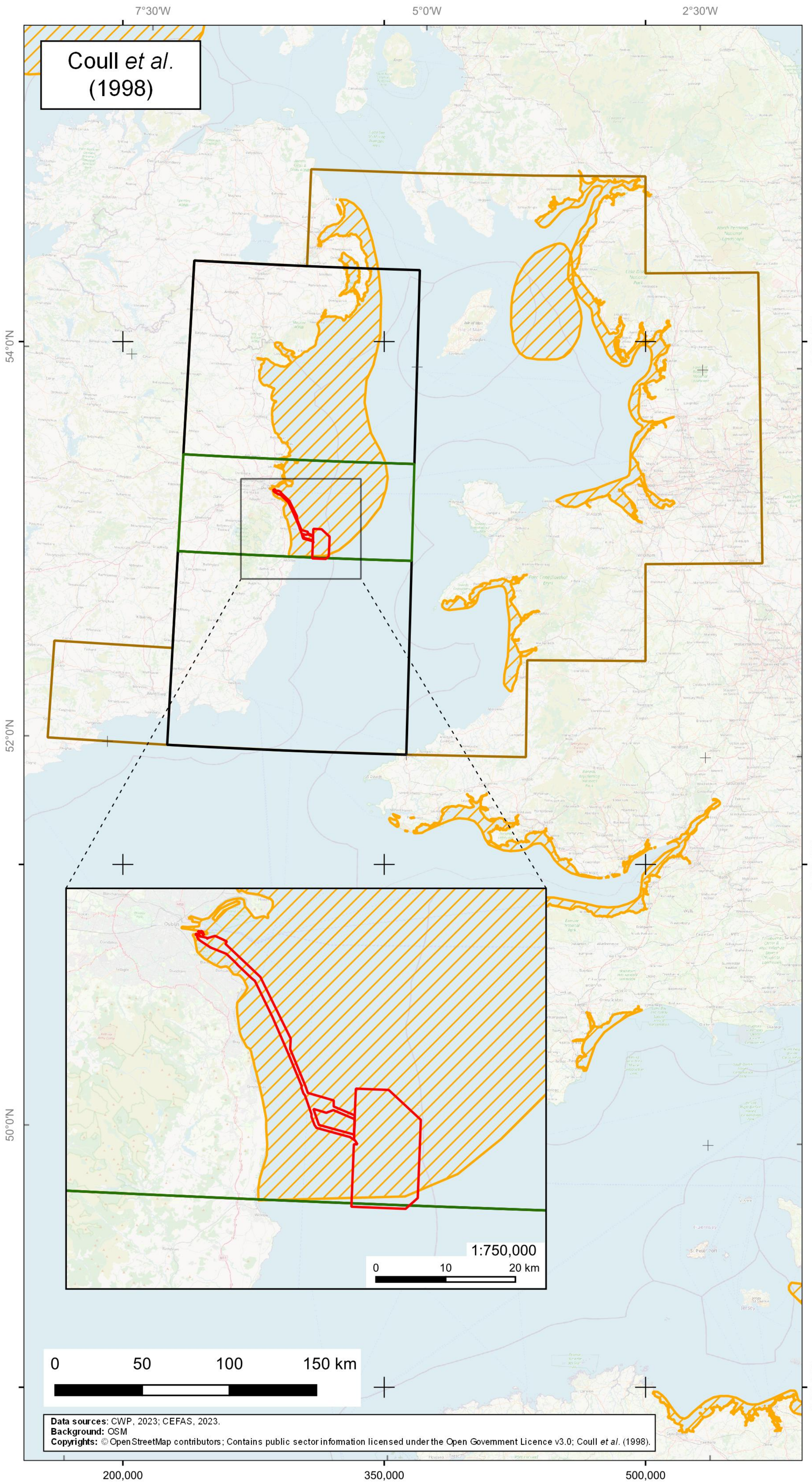
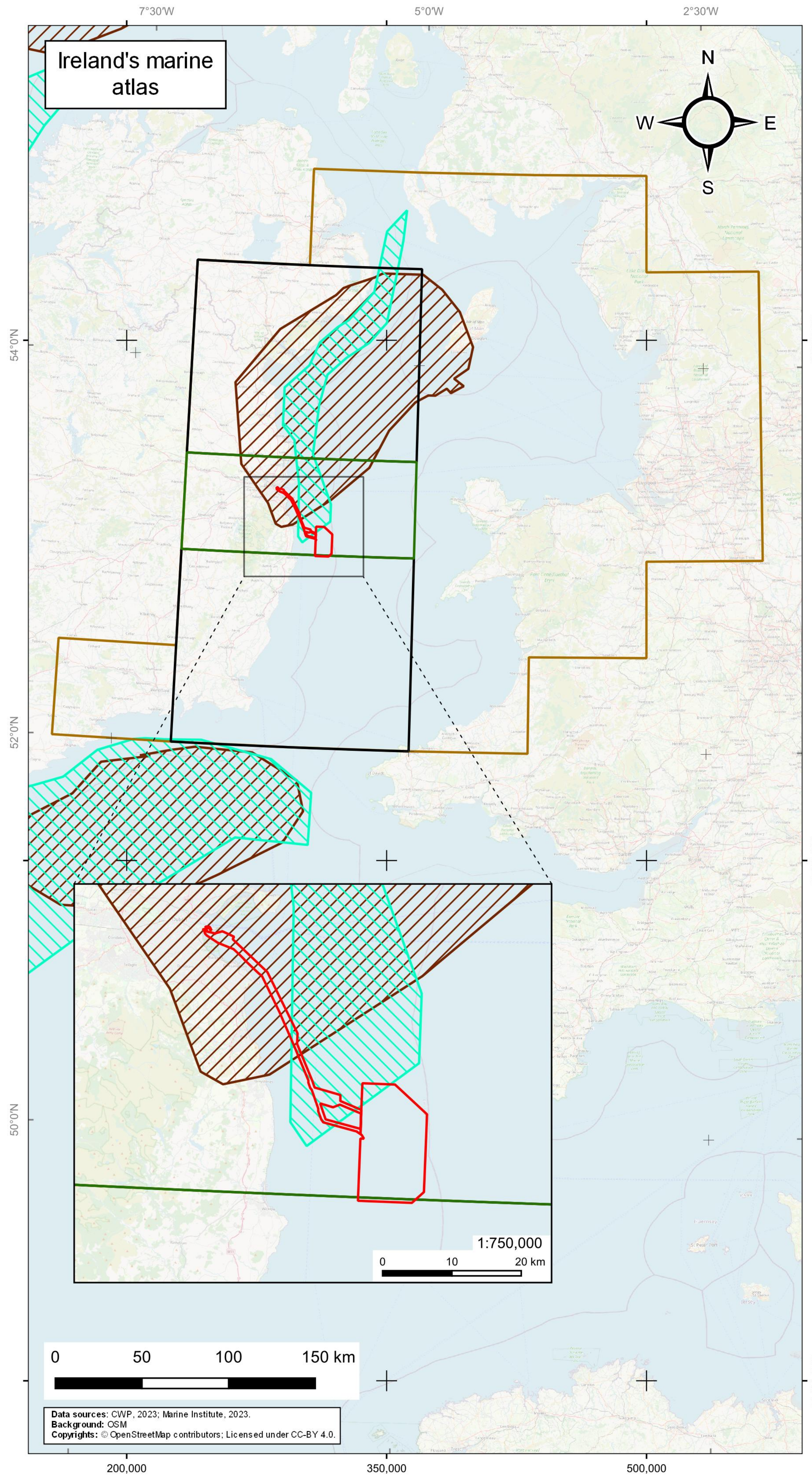
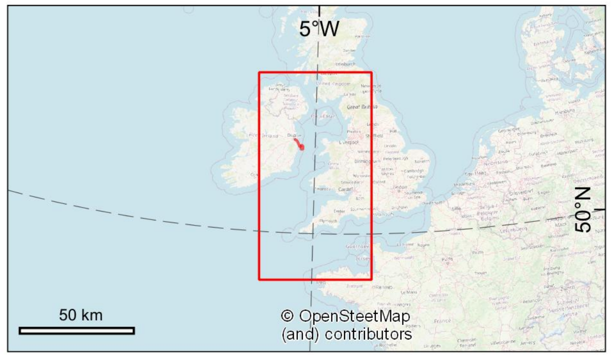
Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
00	Final for issue	2024/07/24	AC	ME/EA	SM







Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- National study area

Coull et al. (1998)

- Nursery ground

Ireland's marine atlas

- Spawning ground
- Nursery ground

Haddock not covered in Ellis et al. (2012) dataset.

codling wind park	*Project:* Codling Wind Park	*Contractor:* natural power www.naturalpower.com

Figure 9.9
Haddock spawning and / or nursery habitats compared to the offshore development area

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1140

Internal descriptive code:	*Size:* A3	*CRS:*
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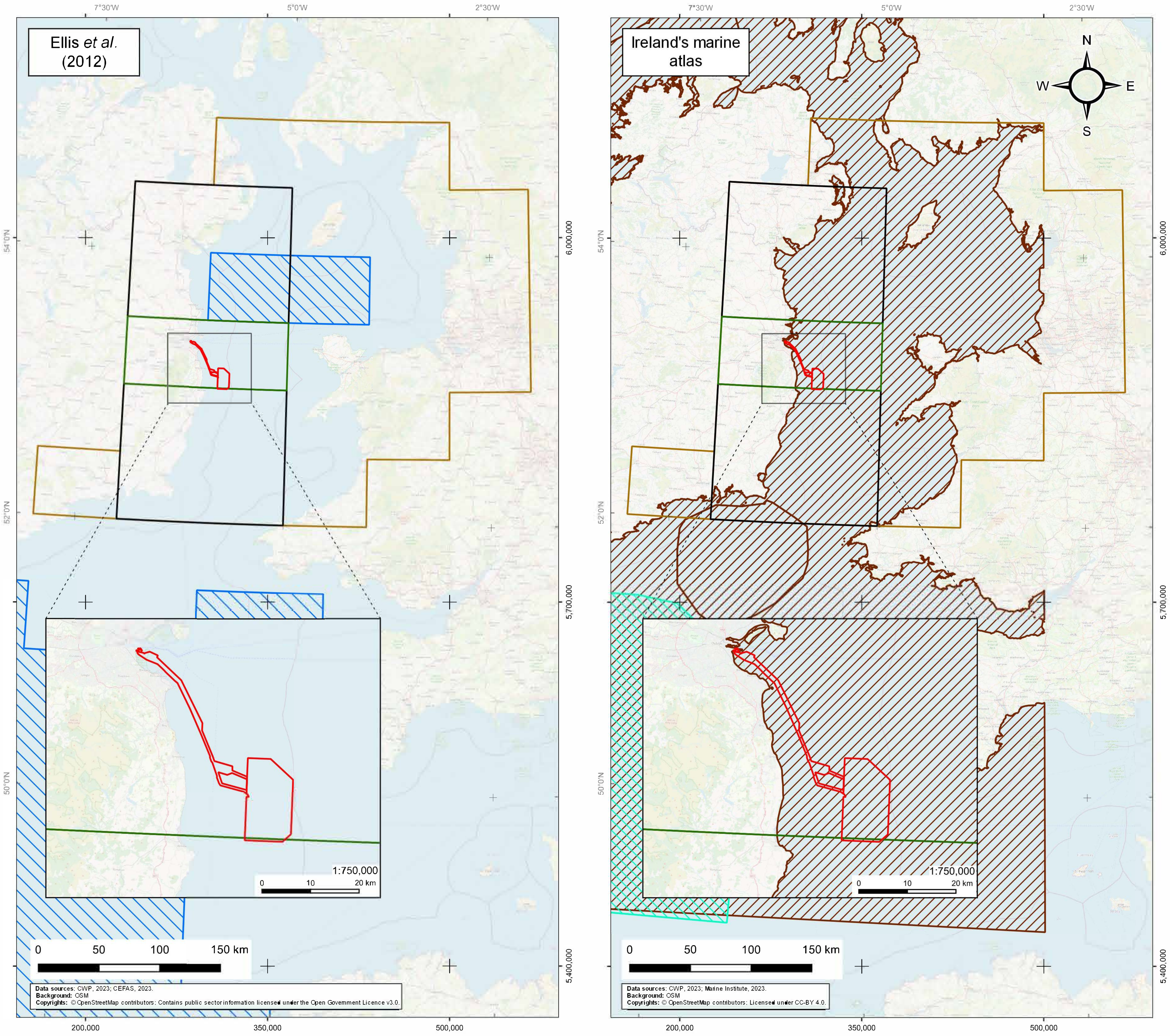
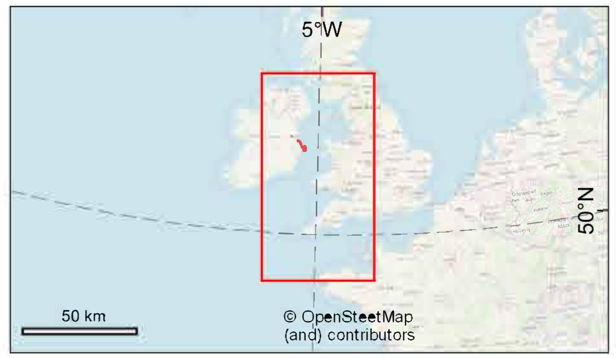
Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
A	Final version	2024/07/24	AC	ME/EA	SM





Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- National study area

Ellis et al. (2012)

- Spawning ground low intensity

Ireland's marine atlas

- Spawning ground
- Nursery ground

Horse mackerel not covered in Coull et al. (1998) dataset.

codling wind park	*Project:* Codling Wind Park	*Contractor:* natural power www.naturalpower.com

Figure 9.10
Atlantic horse mackerel spawning and / or nursery habitats compared to the offshore development area

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1141

Internal descriptive code:	*Size:* A3	*CRS:*
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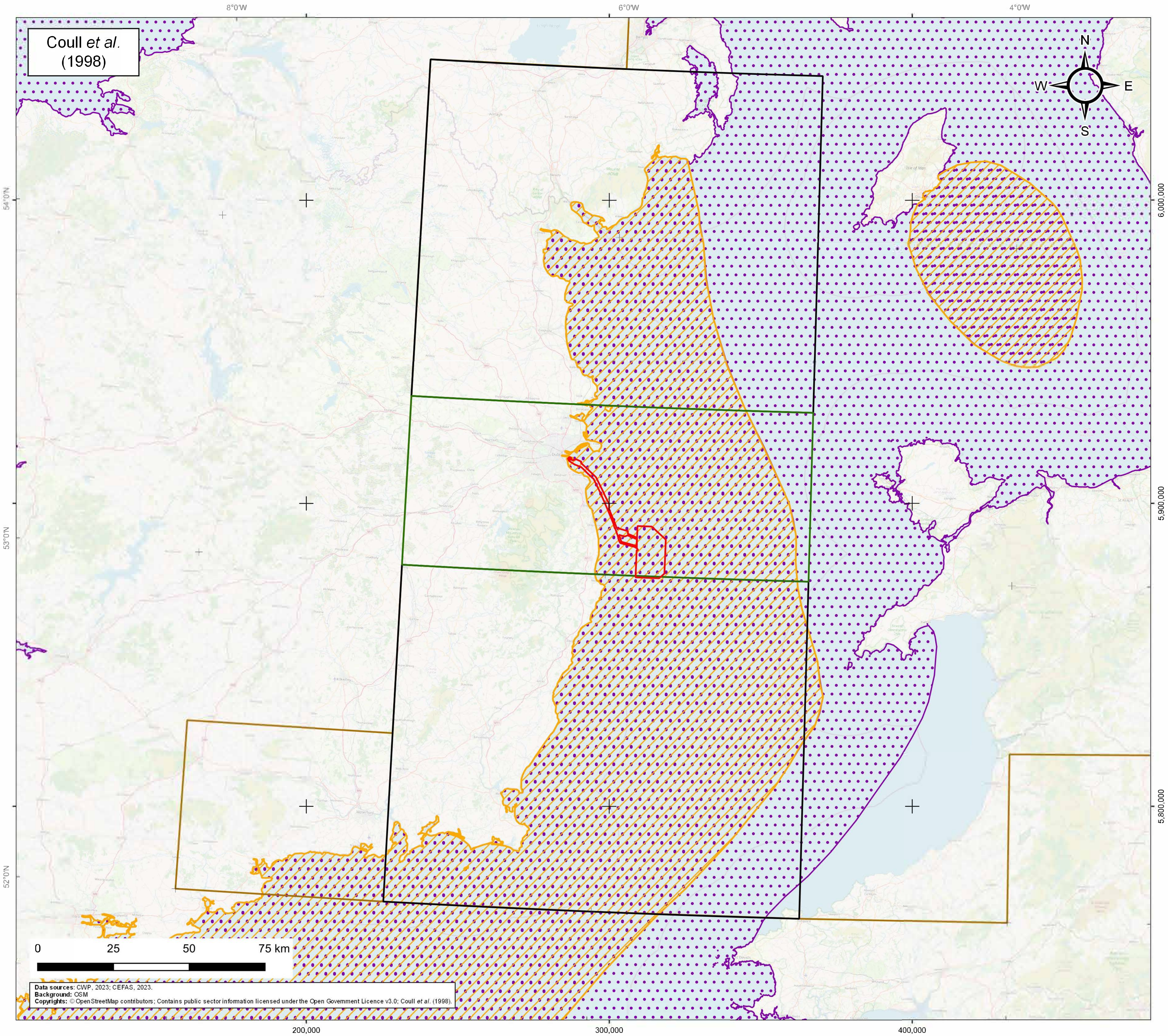
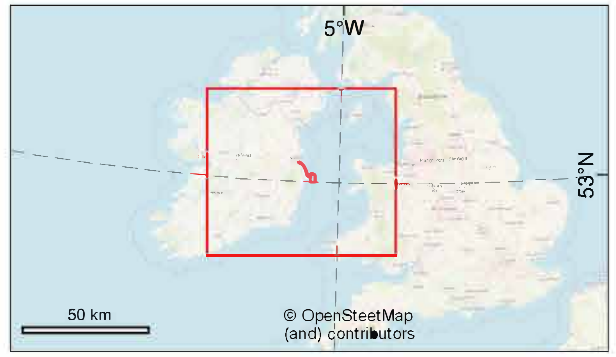
Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
00	Final for issue	2024/07/24	AC	ME/EA	SM





Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- National study area

Coull et al. (1998)

- Nursery ground
- Spawning ground undetermined intensity

Lemon sole not covered in Ireland's marine atlas and Ellis et al. (2012) datasets.

Project: Codling Wind Park

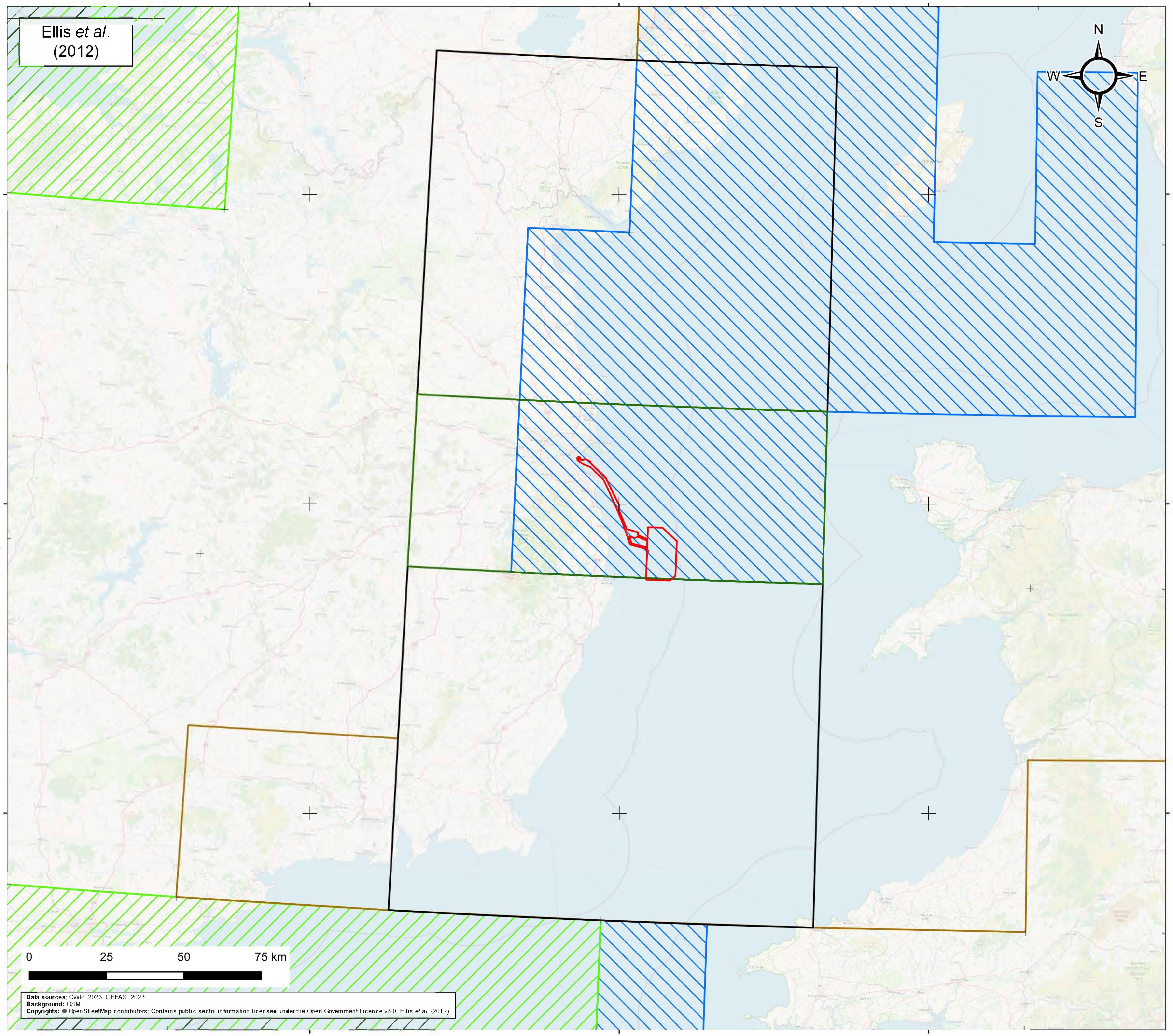
Contractor: natural power — www.naturalpower.com

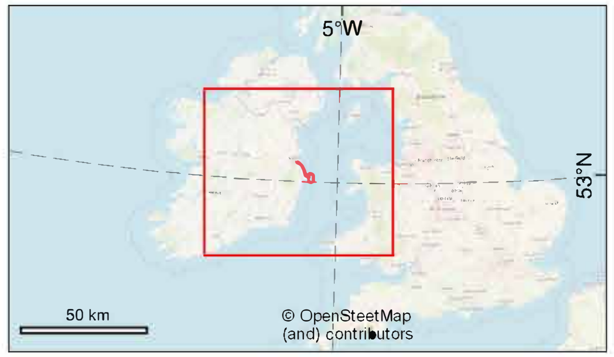
Figure 9.11
Lemon sole spawning and / or nursery habitats compared to the offshore development area

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1142

Internal descriptive code:	*Size:* A3	*CRS:*
IS - PAB - FSTESAs.LRN..SNG.LEMON.SOLE - EIAR.FIG.09.11	*Scale:* 1:1,200,000	EPSG 25830

Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
00	Final for issue	2024/07/24	AC	ME/EA	SM





Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- National study area

Ellis et al. (2012)

- Nursery ground low intensity
- Spawning ground low intensity

Ling not covered in Ireland's marine atlas and Coull et al. (1998) datasets.

codling wind park	*Project:* Codling Wind Park	*Contractor:* natural power www.naturalpower.com

Figure 9.12
Ling spawning and / or nursery habitats compared to the offshore development area

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1143

Internal descriptive code:	*Size:* A3	*CRS:*
IS - PAB - FSTESAs.LRN. SNG.LING - EIAR.FIG.09.12	*Scale:* 1:1,200,000	EPSG 25830

Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
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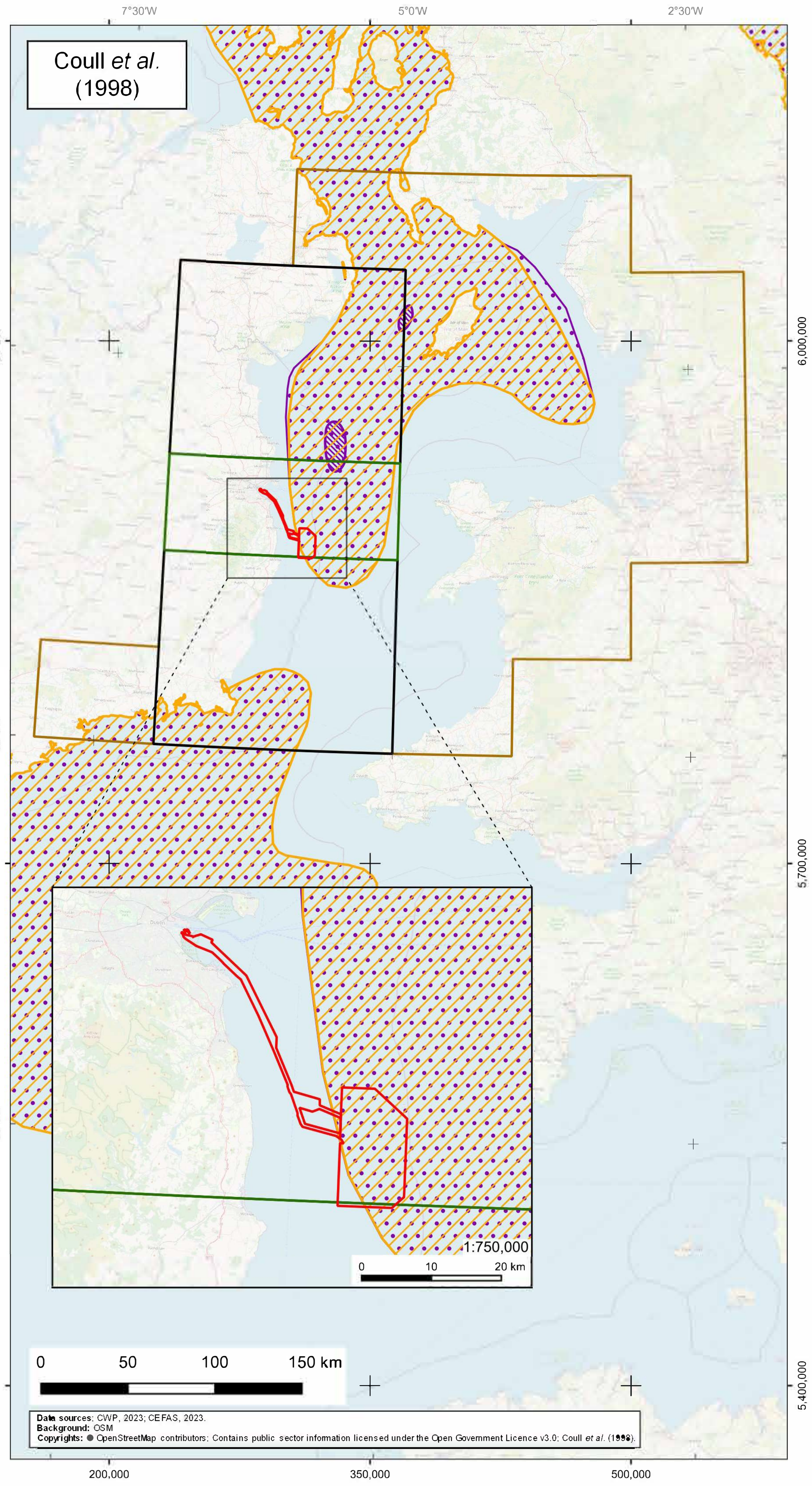
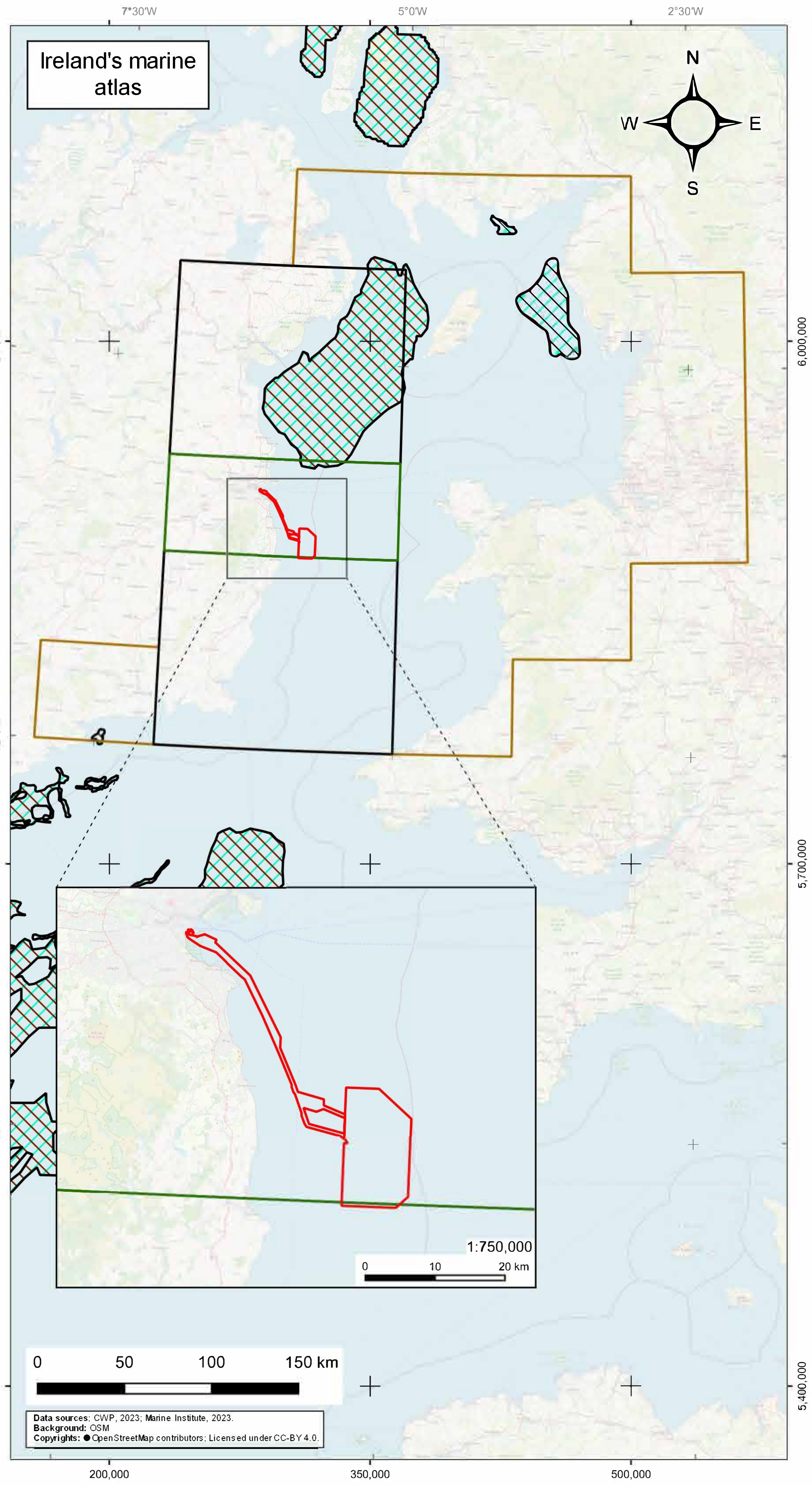
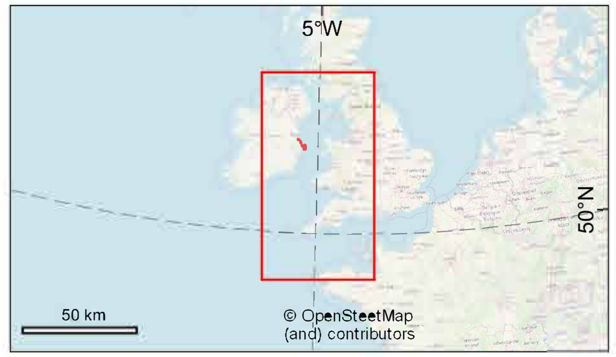






Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- National study area

Coull et al. (1998)

- Nursery ground low intensity
- Spawning ground undetermined intensity

Ireland's marine atlas

- Nursery and spawning ground

Nephrops (Norway lobster) not covered in Ellis et al. (2012) dataset.

Project: Codling Wind Park

Contractor: natural power

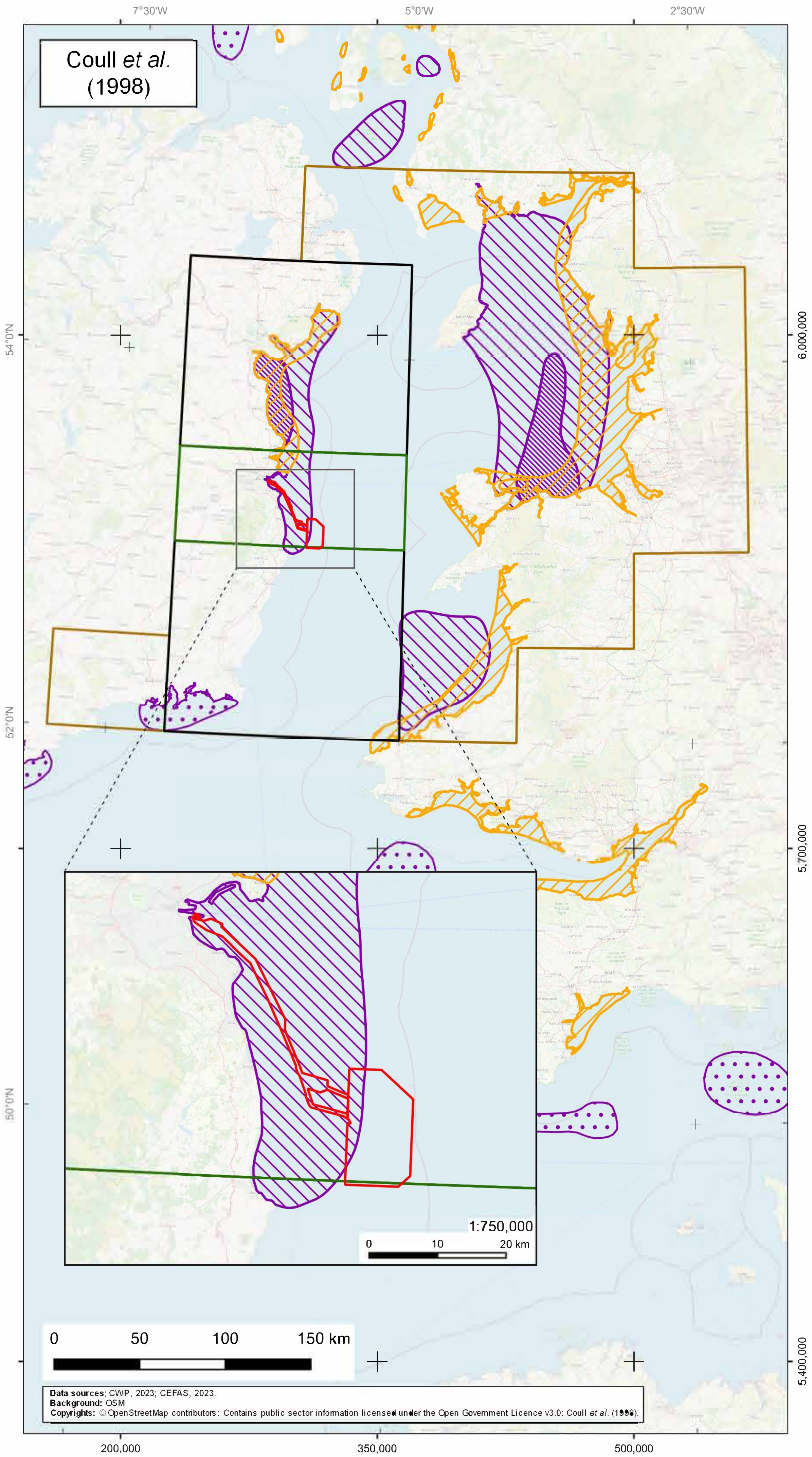
www.naturalpower.com

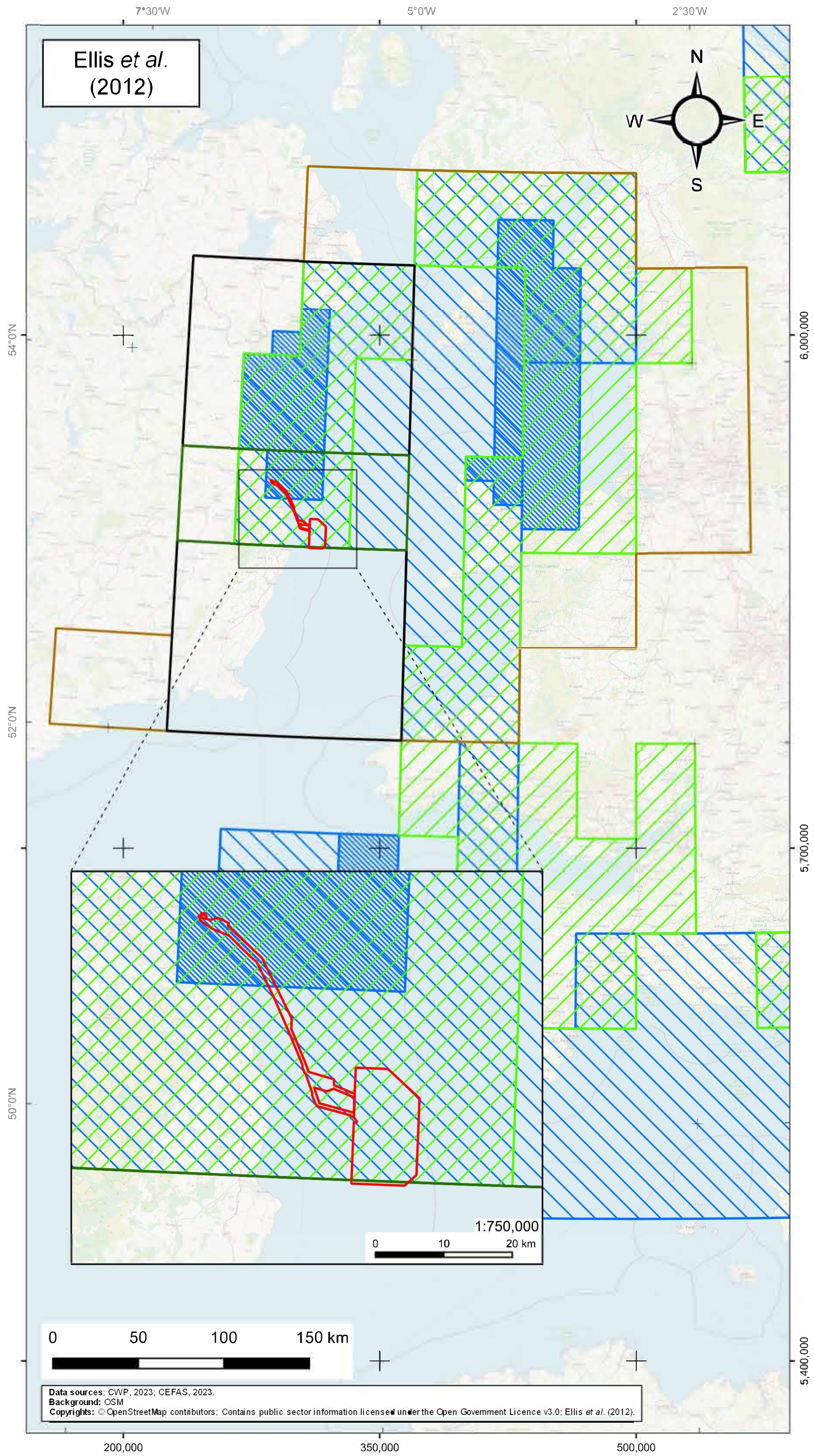
Figure 9.13
Norway lobsters (Nephrops) spawning and / or nursery habitats compared to the offshore development area

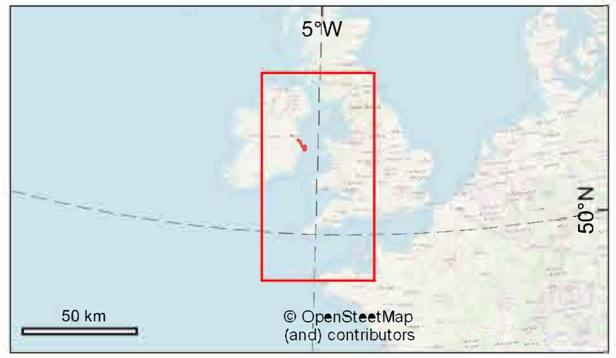
CWP doc. number: CWP-NPC-ENG-08-01-MAP-1144

Internal descriptive code:	Size: A3	CRS:
IS - PAB - FSTESAs.LRN..SNG.NEPHROPS (NORWAY.LOBSTER) - EIAR.FIG.09.13	Scale: 1:3,000,000	EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
00	Final for issue	2024/07/24	AC	ME/EA	SM







Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- National study area

Coull et al. (1998)

- Nursery ground low intensity
- Spawning ground high intensity
- Spawning ground low intensity
- Spawning ground undetermined intensity

Ellis et al. (2012)

- Nursery ground low intensity
- Spawning ground high intensity
- Spawning ground low intensity

European plaice not covered in Ireland's marine atlas dataset.

Project: Codling Wind Park

Contractor: www.naturalpower.com

Figure 9.14
European plaice spawning and / or nursery habitats compared to the offshore development area

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1145

Internal descriptive code: IS - PAB - FSTESAs.LRN..SNG.EUROPEAN.PLAICE - EIAR.FIG.09.14

Size: A3
Scale: 1:3,000,000
CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
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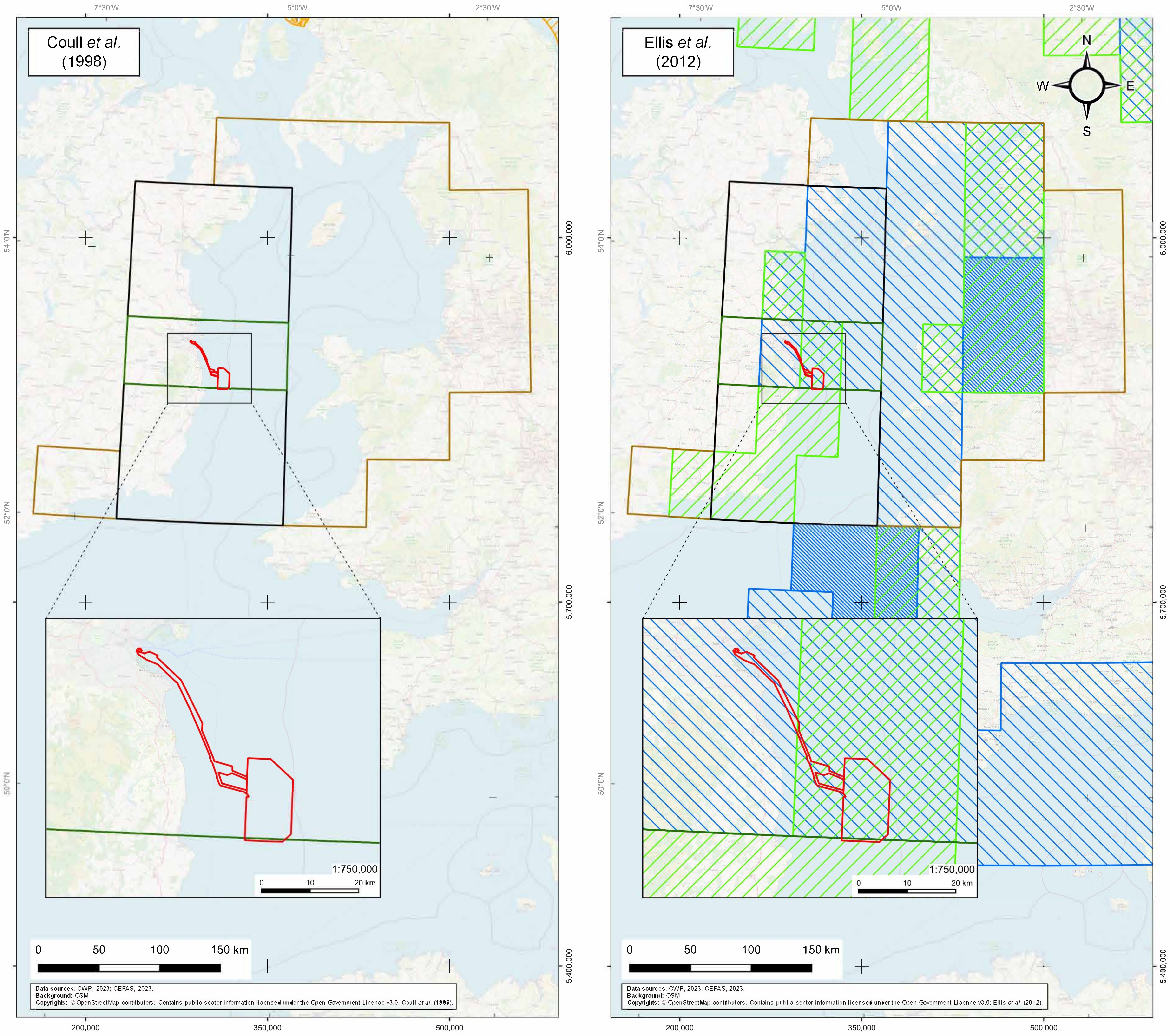
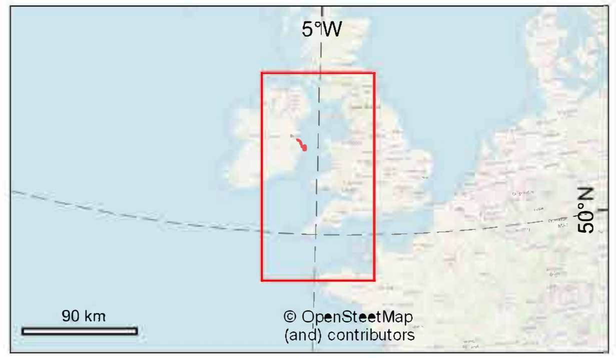




Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- National study area

Coull et al. (1998)

- Nursery ground low intensity

Ellis et al. (2012)

- Nursery ground low intensity
- Spawning ground high intensity
- Spawning ground low intensity

Sandeel not covered in Ireland's marine atlas dataset.

Coull et al. data not carried forth with the assessment due to lack of overlap in the national study area.

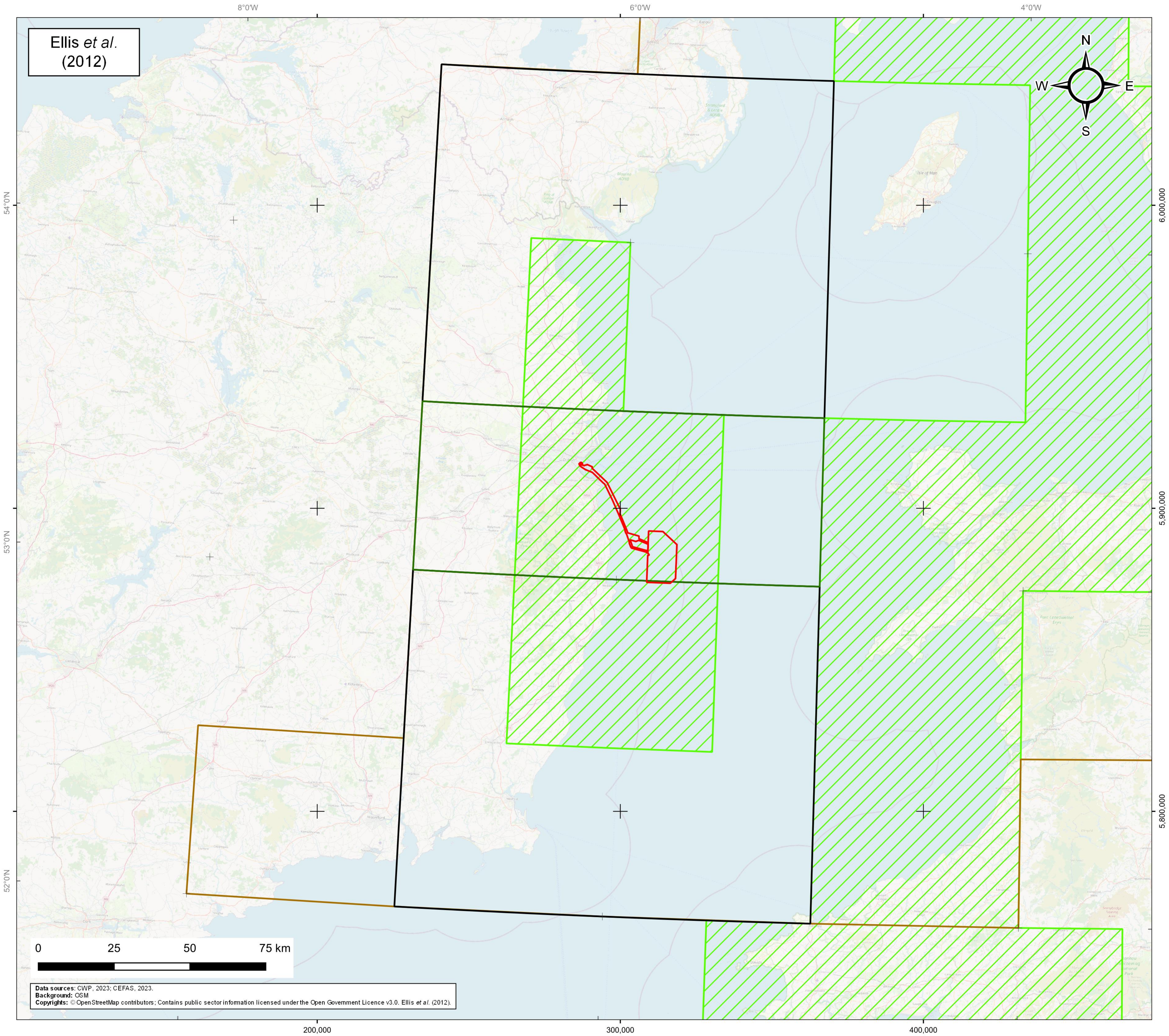
codling wind park	*Project:* Codling Wind Park	*Contractor:* natural power www.naturalpower.com

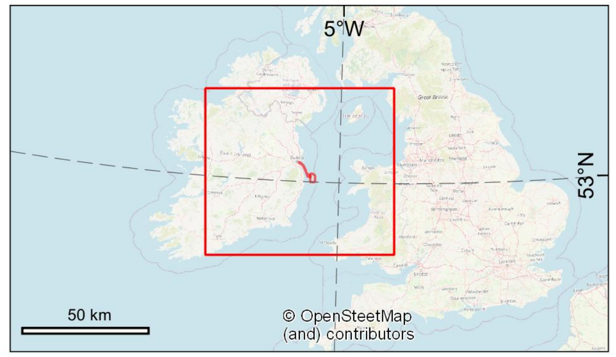
Figure 9.15
Sandeel spawning and / or nursery habitats compared to the offshore development area

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1146

Internal descriptive code:	*Size:* A3	*CRS:*
IS - PAB - FSTESAs.LRN_SNG.SANDEEL - EIAR.FIG.09.15	*Scale:* 1:3,000,000	EPSG 25830

Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
00	Final for issue	2024/07/24	AC	ME/EA	SM





Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- National study area

Ellis et al. (2012)

- Nursery ground low intensity

Spotted ray not covered in Ireland's marine atlas and Coull et al. (1998) datasets.

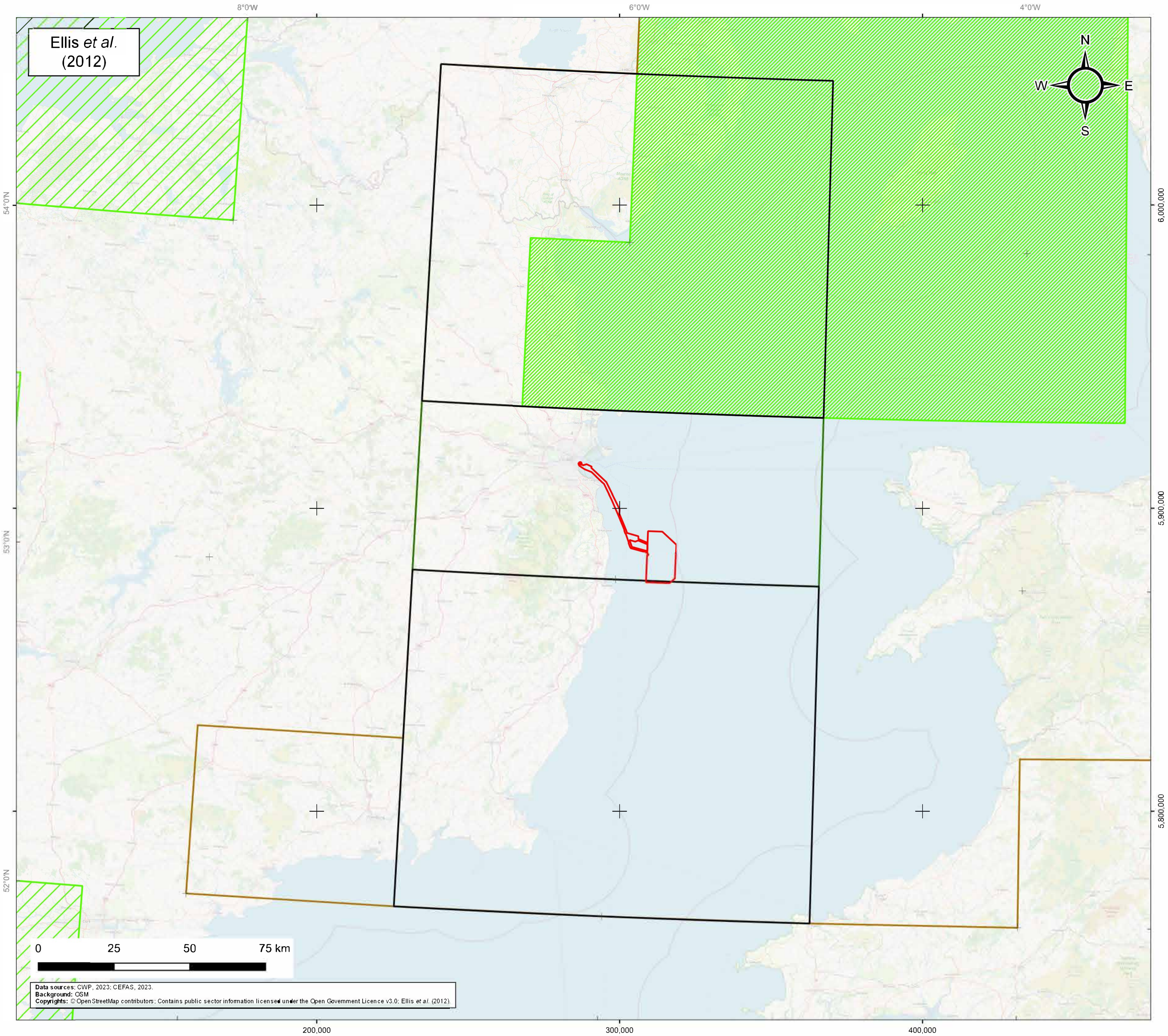
Project: Codling Wind Park	*Contractor:* natural power (www.naturalpower.com)

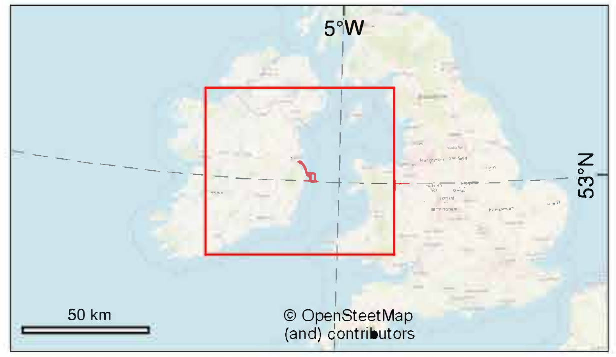
Figure 9.16
Spotted ray spawning and / or nursery habitats compared to the offshore development area

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1147

Internal descriptive code:	*Size:*	A3	*CRS:*
IS - PAB - FSTESAs.LRN..SNG.SPOTTED.RAY - EIAR.FIG.09.16	*Scale:*	1:1,200,000	EPSG 25830

Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
A	Final version	2024/07/24	AC	ME/EA	SM





Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- National study area

Ellis et al. (2012)

- Nursery ground high intensity
- Nursery ground low intensity

Spurdog not covered in Ireland's marine atlas and Coull et al. (1998) datasets.

codling wind park

Project: Codling Wind Park

Contractor: natural power

www.naturalpower.com

Figure 9.17
Spurdog spawning and / or nursery habitats compared to the offshore development area

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1148

Internal descriptive code:	*Size:* A3	*CRS:*
IS - PAB - FSTESAs.LRN..SNG.SPURDOG - EIAR.FIG.09.17	*Scale:* 1:1,200,000	EPSG 25830

Rev.	*Description*	*Date*	*By*	*Chk'd*	*App'd*
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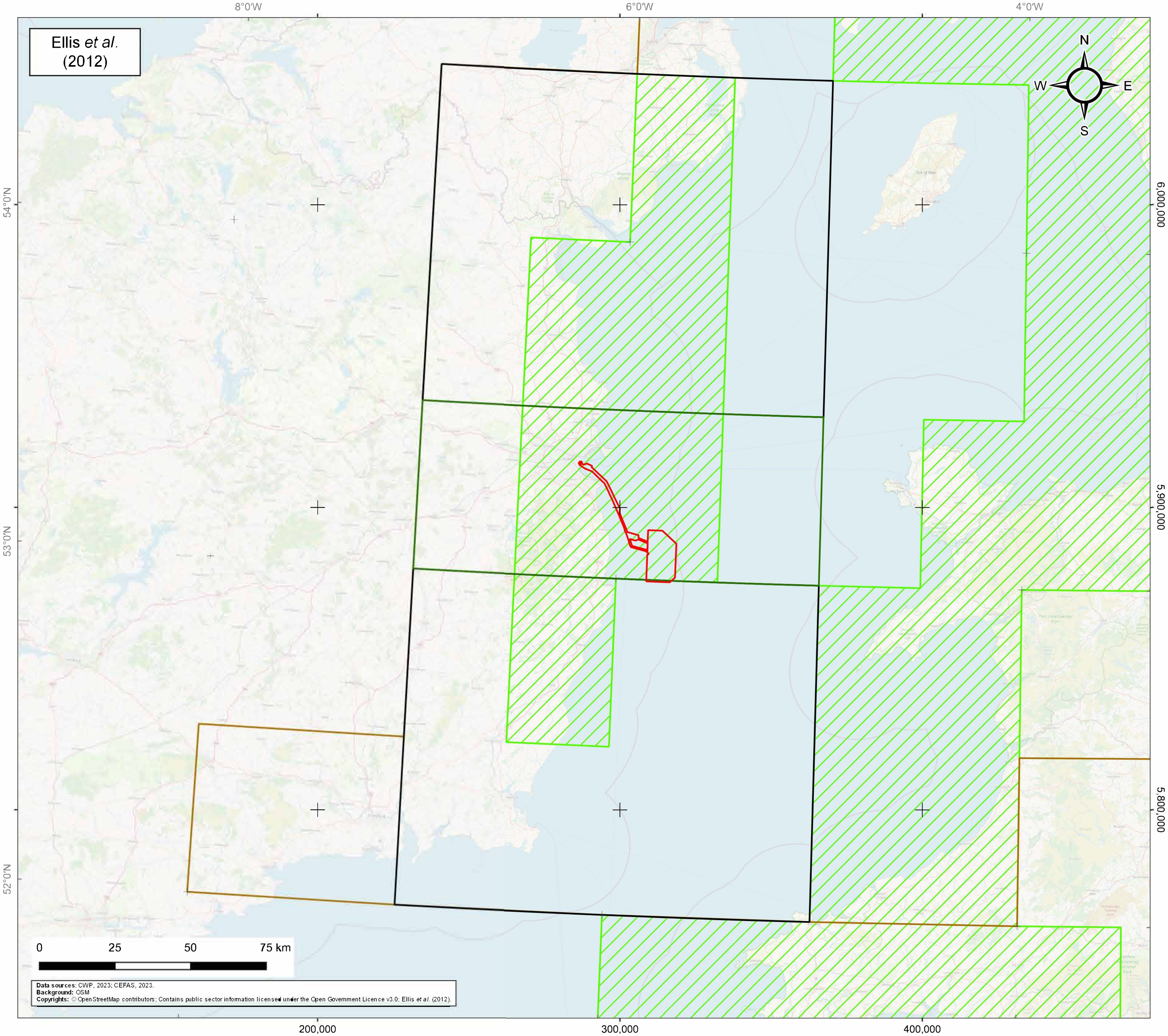
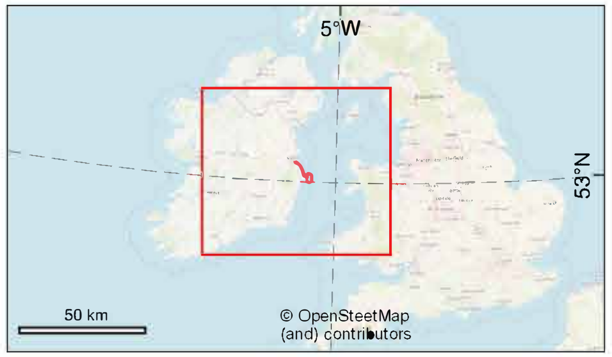




Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- National study area

Ellis et al. (2012)

- Nursery ground low intensity

Thornback ray not covered in Ireland's marine atlas and Coull et al. (1998) datasets.

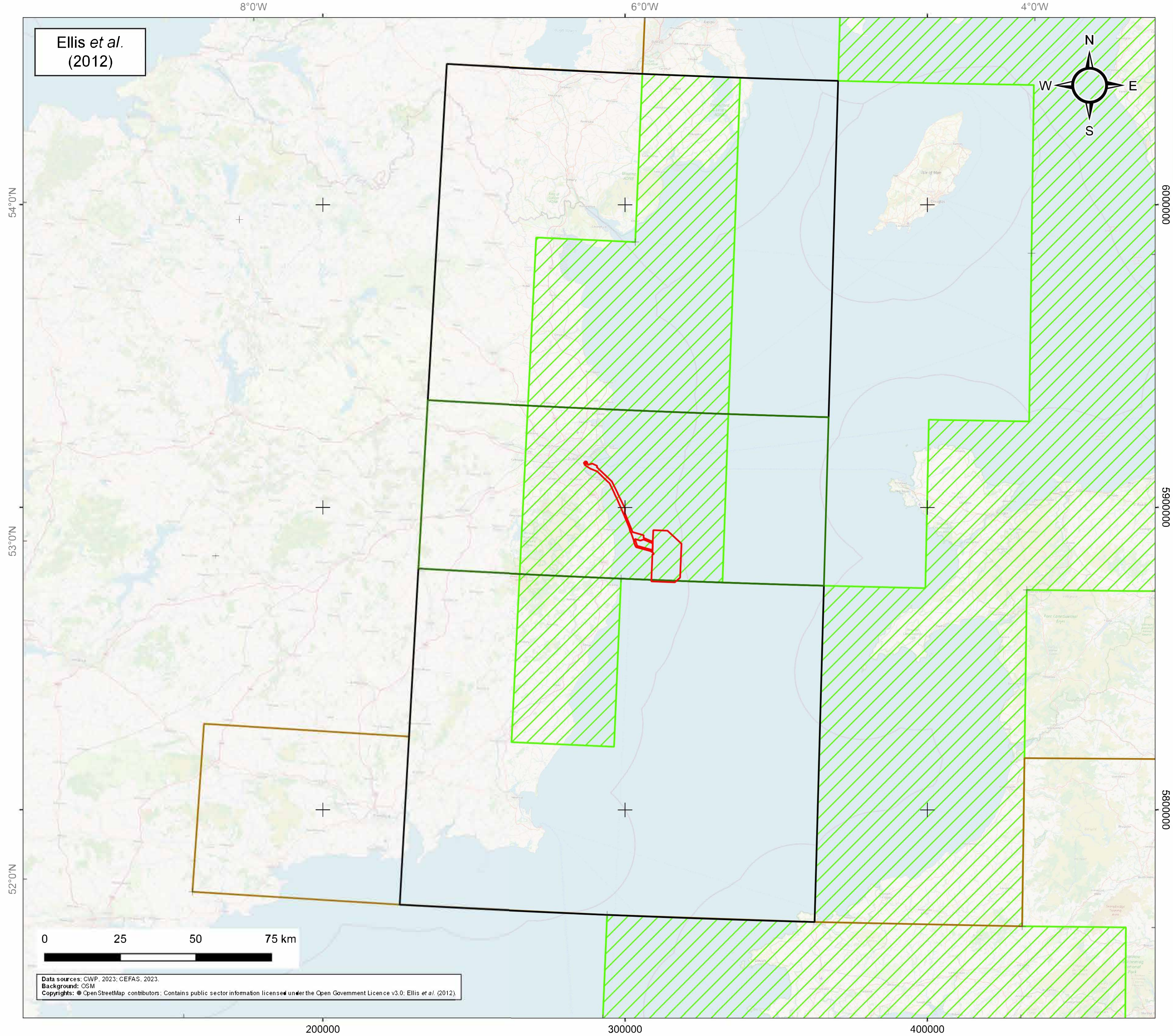
codling wind park	*Project:* Codling Wind Park	*Contractor:* natural power www.naturalpower.com

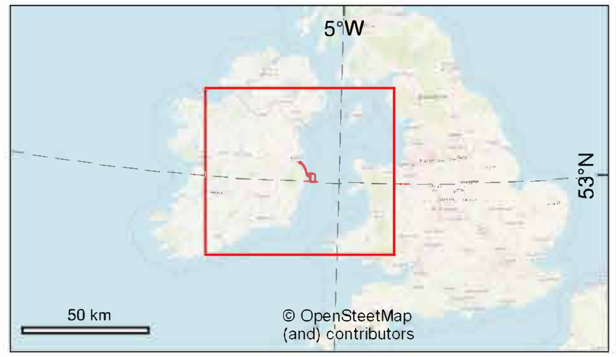
Figure 9.18
Thornback ray spawning and / or nursery habitats compared to the offshore development area

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1149

Internal descriptive code:	*Size:* A3	*CRS:*
IS - PAB - FSTESAs.LRN..SNG.THORNBACK.RAY - EIAR.FIG.09.18	*Scale:* 1:1,200,000	EPSG 25830

Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
00	Final for issue	2024/07/24	AC	ME/EA	SM





Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- National study area

Ellis et al. (2012)

- Nursery ground low intensity

Tope not covered in Ireland's marine atlas and Coull et al. (1998) datasets.

codling wind park

Project: Codling Wind Park

Contractor: natural power www.naturalpower.com

Figure 9.19
Tope spawning and / or nursery habitats compared to the offshore development area

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1150

Internal descriptive code: IS - PAB - FSTESAs:LRN.SNG.TOPE - EIAR.FIG.09.19

Size: A3

Scale: 1:1,200,000

CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
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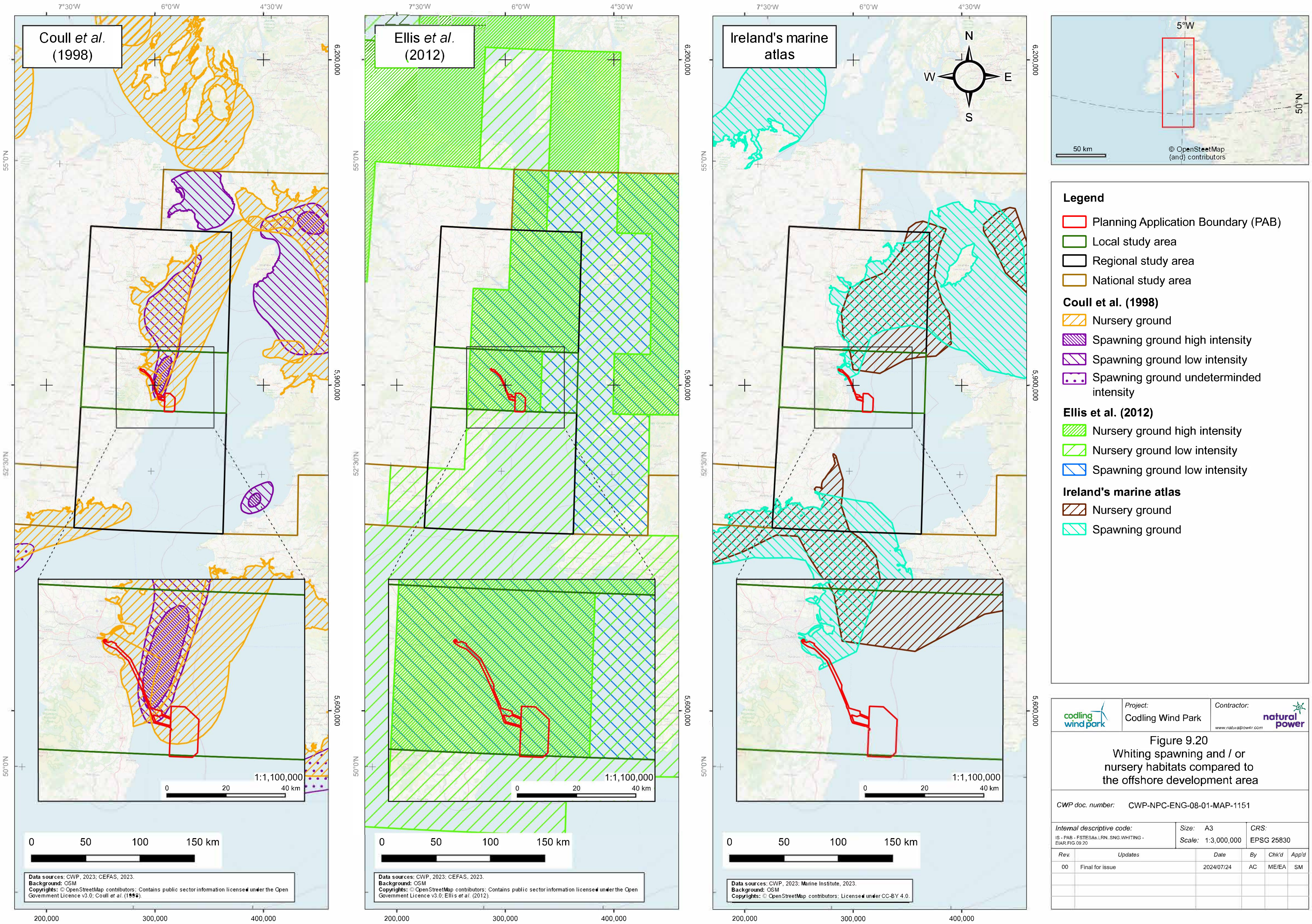


Figure 9.20
Whiting spawning and / or nursery habitats compared to the offshore development area

9.6.4 Basking Shark

70. Basking sharks are obligate filter feeders therefore their distribution is largely determined by their prey species. Sightings of basking sharks are usually during summer months in ‘hotspots’ such as western Ireland, western Scotland, southwest England and the Isle of Man (Sims, 2008; Witt et al., 2012). These areas are termed ‘hotspots’ due to the relatively frequent sightings of basking sharks (Speedie et al., 2009). Although not a “hotspot”, the Irish Sea regularly shows up as an area used by basking sharks (e.g., Berrow and Heardman, 1994; Southall et al., 2005; Witt et al., 2012; Doherty et al., 2017) with inter-annual site fidelity shown by basking sharks to the waters around the Isle of Man (Dolton et al., 2019).

71. Recent genetic studies suggest that the Irish Sea has been identified as an important migratory corridor for basking sharks travelling between aggregation sites (Lieber et al., 2020). Whilst individual sharks may remain in one place for many days, telemetry data have shown that sharks are also capable of long-range movements, moving rapidly between regions over periods of a few weeks (Sims et al., 2003). Movements are driven principally by moving to locate foraging areas with the most abundant zooplankton (Sims et al., 2006).

72. Basking sharks are seasonally abundant in the Irish Sea during summer months. During this time basking sharks feed close to the water surface at slow speeds. Basking sharks are predominantly solitary animals but are known to form aggregations in areas where prey is abundant.

73. During winter months basking sharks are known to carry out deeper dives (>750 m) and travel longer distances (up to 3,400 km) to locate suitable prey foraging areas (Sims et al., 2003).

74. Many life history stages and migratory movements have yet to be described for this species. Mating in basking sharks has not been observed. Courtship-like behaviour has been observed off the west coast of Ireland during August and September months and during similar times in Scotland (Sims et al., 2022). Based on these observations, and previous studies in the northwest and northeast Atlantic regions, it appears that basking sharks participate in courtship and mating from May to November. However, these behaviours are not seen in the same coastal location each year which may suggest some environmental factors impacting site selection. Basking sharks have recently become a protected species under Section 23 of the Wildlife Act 1976 which makes it illegal to hunt, injure, interfere with, or destroy their breeding or resting places.

75. Whilst their distribution patterns are relatively well studied around Ireland and the UK, it should be noted that there are no density estimates for populations of basking sharks anywhere in the world (Sims, 2008). Abundance estimates are limited and based on a large degree of uncertainty. A study based on mitochondrial DNA suggests a worldwide effective population size of 8,200 (Hoelzel et al., 2006). There are no population estimates for basking sharks in Irish waters.

76. During the ObSERVE surveys only one basking shark sighting was recorded off the east coast of Ireland (during a summer survey; Rogan et al., 2018). No basking sharks were recording during the CWP Project’s site-specific surveys. SCANS III surveys only reported on whales, dolphins and porpoises and therefore, it is unknown if basking sharks were observed.

9.6.5 Marine Turtles

77. Six species of marine turtles have been recorded in Irish and UK waters, with the leatherback turtle (*Dermochelys coriacea*) recorded most frequently. Marine turtles mainly feed on gelatinous prey and are found to nest on beaches in warmer climates (Godley, 1998).

78. No marine turtles were recorded during the CWP Project's monthly site-specific surveys. Two sightings of leatherback turtle off the counties of Cork and Clare were recorded within the last 12 months on the IWDG citizen science recording scheme[1]. No recordings on the east coast of Ireland were noted during the ObSERVE surveys (Rogan et al., 2018).

79. Between 1910–2018, a total of 1997 marine turtles were recorded in Irish and UK waters (Botterell et al., 2020; **Plate 9-4**). The majority of these sightings were of the leatherback turtles with recordings along the entirety of the Irish coastline between May and November. Recordings have declined in the last decade (Botterell et al., 2020). It has been estimated that 0.06 leatherbacks are found per 100 km^2 in the Celtic and Irish Seas (Doyle et al., *2008*).

80. While other species do occur, the leatherback is the only regular summer visitor to the UK, whereas the other species are considered strays, likely blown off course from warmer climates (Godley, 1998).

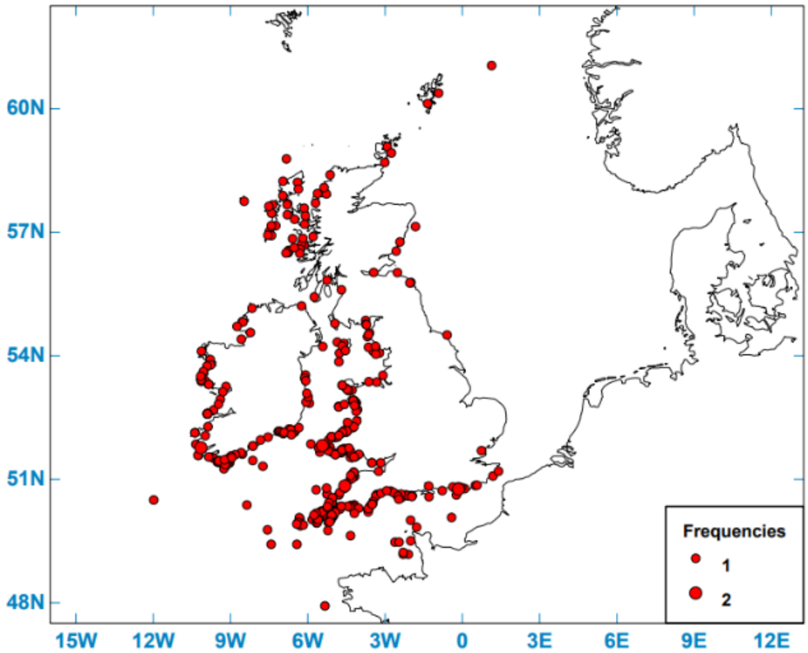


Plate 9-4 All marine turtle sightings and strandings 2011 – 2021 (figure taken from Penrose et al., 2022)

9.6.6 Species of Conservation Importance

81. As in the sections above, the local and regional and Irish Sea study areas have been used to describe species of conservation importance. However, where appropriate, a broader national study area has been used for the purpose of capturing transboundary diadromous fish migrations.

82. The following diadromous fish species are listed under Annex II of the Habitats Directive (Council Directive 92/43/EEC), which means that they are 'animal and plant species of community interest whose conservation requires the designation of Special Areas of Conservation (SACs)':

- Twaite shad (*Alosa fallax*) [1103];
- Allis shad (*Alosa alosa*) [1102];

[1] https://iwdg.ie/browsers/sightings.php

- Atlantic salmon (*Salmo salar*) [1106];
- Sea lamprey (*Petromyzon marinus*) [1095];
- River lamprey (*Lampetra fluviatilis*) [1099]; and
- Freshwater pearl mussel (FWPM) (*Margaritifera margaritifera*) [1029].

83. **Table 9-11** indicates that 27 SACs are designated in Ireland for fish and shellfish qualifying interests (National Parks and Wildlife Services (NPWS), 2022). The majority of these are over 300 km from the offshore development area. The closest is River Boyne and River Blackwater SAC (~74 km from the offshore development area) which is designated for Atlantic salmon and river lamprey. The Slaney River Valley SAC is 81 km from the offshore development area and is designated for Atlantic salmon, twaite shad, sea lamprey, river lamprey and freshwater pearl mussel. There are currently no SACs in Ireland designated for Allis shad. Additionally, there are no relevant designated sites for Natural Heritage Areas.

84. In Northern Ireland there are four SACs and one Area of Special Scientific Interest (ASSI) designated for fish and shellfish qualifying interests (**Table 9-12)** (Joint Nature Conservation Committee (JNCC), 2022a). The closest is Cladagh (Swanlinbar) River SAC (135 km from the offshore development area) which is designated for freshwater pearl mussel.

85. In Wales there are six SACs and seven Sites of Special Scientific Interest (SSSIs) designated for fish and shellfish qualifying interests (**Table 9-13**). The closest is Afon Dyfrdwy (River Dee) SSSI, (87.52 km from the offshore development area) designated for Atlantic salmon, river and sea lamprey, seatrout and European eel.

86. In England there are six SACs and four SSSIs designated for fish and shellfish qualifying interests (**Table 9-14**). The closest is the River Dee SSSI (84.43 km away from the offshore development area) designated for Atlantic salmon.

87. In Scotland there are two SACs and two SSSIs designated for fish and shellfish qualifying interests (**Table 9-15**). The closest is the Cree Estuary SSSI (196.80 km away from the offshore development area) designated for European smelt (*Osmerus eperlanus*).

88. Although some of these SACs, SSSIs and ASSIs are not marine based, the diadromous fish for which they are designated have a marine phase of their lifecycle. These species rely on the sea to migrate to feeding grounds, before returning to rivers to spawn. Therefore, there is potential for one or a number of these species to be present in the offshore development area at certain times of the year. It is expected that the majority of migratory species present in the vicinity of the offshore development area are from rivers within the regional study area. While possible that there are individuals present here from outside of the regional study area, it is highly likely they will be present in negligible numbers due to the great distances they would have to travel.

89. In addition to those species which are listed as qualifying interests of SACs, there are a number of other fish, elasmobranchs and shellfish of conservation importance which may occur in the vicinity of the offshore development area. These are listed in **Table 9-17**. There are no conservation sites for turtle species within Ireland.

Table 9-11 Irish designated sites for fish and shellfish species within the national study area (Ireland) (NPWS, 2022)

Site Code	Name	Qualifying interests	Approximate closest distance to the offshore development area (km)
IE0002299	River Boyne and River Blackwater SAC	Atlantic salmon, River lamprey	74
IE0000781	Slaney River Valley SAC	Atlantic salmon, Twaite shad, Sea lamprey, River lamprey, Fresh water pearl mussel	81
IE0002162	River Barrow and River Nore SAC	Atlantic salmon, Twaite shad, Sea lamprey, River lamprey, Fresh water pearl mussel	151
IE0002137	Lower River Suir SAC	Atlantic salmon, Twaite shad, Sea lamprey, River lamprey, Fresh water pearl mussel	158
IE0002170	Blackwater River (Cork/Waterford) SAC	Atlantic salmon, Twaite shad, Sea lamprey, River lamprey, Fresh water pearl mussel	211
IE0002301	River Finn SAC	Atlantic salmon	345
IE0002176	Leannan River SAC	Atlantic salmon, Fresh water pearl mussel	359
IE0000365	Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC	Atlantic salmon, Sea lamprey, River lamprey, Fresh water pearl mussel	427
IE0002173	Blackwater River (Kerry) SAC	Atlantic salmon, Fresh water pearl mussel	430
IE0000197	West of Ardara / Maas Road SAC	Atlantic salmon, Fresh water pearl mussel	469
IE0000343	Castlemaine Harbour SAC	Atlantic salmon, Sea lamprey, River lamprey	489
IE0000627	Cummeen Strand / Drumcliff Bay (Sligo Bay) SAC	Sea lamprey, River lamprey	519
IE0000428	Lough Melvin SAC	Atlantic salmon	524

Site Code	Name	Qualifying interests	Approximate closest distance to the offshore development area (km)
IE0000458	Killala Bay / Moy Estuary SAC	Sea lamprey	530
IE0001976	Lough Gill SAC	Atlantic salmon, Sea lamprey, River lamprey	530
IE0001898	Unshin River SAC	Atlantic salmon	531
IE0000163	Lough Eske and Ardnamona Wood SAC	Atlantic salmon, Fresh water pearl mussel	533
IE0002298	River Moy SAC	Atlantic salmon, Sea lamprey	540
IE0000500	Glenamoy Bog Complex SAC	Atlantic salmon	547
IE0002165	Lower River Shannon SAC	Atlantic salmon, Sea lamprey, River lamprey, Fresh water pearl mussel	563
IE0002034	Connemara Bog Complex SAC	Atlantic salmon	635
IE0002031	The Twelve Bens / Garraun Complex SAC	Atlantic salmon, Fresh water pearl mussel	645
IE0000534	Owenduff / Nephin Complex SAC	Atlantic salmon	652
IE0001932	Mweelrea / Sheeffry / Erriff Complex SAC	Atlantic salmon, Fresh water pearl mussel	656
IE0002144	Newport River SAC	Atlantic salmon, Fresh water pearl mussel	658
IE0000297	Lough Corrib SAC	Atlantic salmon, Sea lamprey, Fresh water pearl mussel	659
IE0002008	Maumturk Mountains SAC	Atlantic salmon	663

Table 9-12 Northern Irish designated sites for fish and shellfish species within the National Study Area (Ireland) (JNCC, 2022)

Site Code	Name	Qualifying interests	Approximate closest distance to the offshore development area (km)
UK0030233	Owenkillew River SAC	Freshwater pearl mussel, Atlantic salmon	159
UK0030047	Lough Melvin SAC	Atlantic salmon	171

Site Code	Name	Qualifying interests	Approximate closest distance to the offshore development area (km)
UK0030361	River Faughan and Tributaries SAC	Atlantic salmon	176
UK0030360	River Roe and Tributaries SAC	Atlantic salmon	177
ASSI 30	Lough Neagh ASSI	European eel, river lamprey	225

Table 9-13 Welsh designated sites for fish and shellfish species within the National Study Area (Ireland) (JNCC, 2022; Natural Resources Wales, 2023

Site Code	Name	Qualifying interests	Approximate closest distance to the offshore development area (km)
-	Afon Dyfrdwy (River Dee) SSSI	Atlantic salmon. Other migratory fish utilising the system include river lamprey, sea lamprey, sea trout, and eel.	88
-	Dee Estuary / Aber Afon Dyfrdwy SSSI	European smelt	88
-	Afon Gwyrfai a Llyn Cwellyn SSSI	Atlantic salmon	92
UK0030046	Afon Gwyrfai a Llyn Cwellyn SAC	Atlantic salmon	95
-	Aber Mawddach / Mawddach Estuary SSSI	Allis shad, twaite shad, sea lamprey, spawning Atlantic salmon	98
UK0012712	Cardigan Bay / Bae Ceredigion SAC	Sea lamprey*, river lamprey*	100
-	Cadair Idris SSSI	Spawning Atlantic salmon	105
UK0012670	Afon Teifi / River Teifi SAC	River lamprey, Atlantic salmon, sea lamprey*	122
-	Dyfi SSSI	This estuary is important as a spawning ground for marine fish, especially bass.	123
-	Afon Teifi SSSI	River lamprey, sea lamprey, Atlantic salmon, sea trout and European eel. The rare allis shad has also been reported.	129
UK0030075	Afon Eden - Cors Goch Trawsfynydd SAC	Freshwater pearl mussel,	129

Site Code	Name	Qualifying interests	Approximate closest distance to the offshore development area (km)
		Atlantic salmon*	
UK0030131	Dee Estuary / Aber Dyfrdwy (Wales) SAC	Sea lamprey*, river lamprey*	162
UK0030252	River Dee and Bala Lake / Afon Dyfrdwy a Llyn Tegid (Wales) SAC	Atlantic salmon, sea lamprey*, river lamprey*,	191

*Annex II species present as a qualifying feature, but not a primary reason for site selection

Table 9-14 English designated sites for fish and shellfish species within the National Study Area (Ireland) (JNCC, 2022)

Site Code	Name	Qualifying interests	Approximate closest distance to the offshore development area (km)
-	River Dee (England) SSSI	Atlantic salmon	84
UK0030131	Dee Estuary SAC	Sea lamprey*, river lamprey*	171
UK0030252	River Dee and Bala Lake SAC	Atlantic salmon, sea lamprey*, river lamprey*,	201
-	River Eden and Tributaries SSSI	Atlantic salmon, River lamprey, Sea lamprey	202
-	River Derwent and Tributaries SSSI	River lamprey, Sea lamprey	205
-	River Ehen (Ennerdale Water to Keekle Confluence) SSSI	Atlantic salmon; Population of Schedule 5 mollusc: Freshwater pearl mussel	207
UK0030057	River Ehen SAC	Freshwater pearl mussel, Atlantic salmon*	215
UK0030032	River Derwent & Bassenthwaite Lake SAC	Sea lamprey, river lamprey, Atlantic salmon	225
UK0013025	Solway Firth SAC	River lamprey, sea lamprey	239
UK0012643	River Eden SAC	Sea lamprey, river lamprey, Atlantic salmon	277

*Annex II species present as a qualifying feature, but not a primary reason for site selection

Table 9-15 Scottish SACs designated for fish and shellfish species within the National Study Area (Ireland) (JNCC, 2022; NatureScot, 2022)

Site Code	Name	Qualifying interests	Approximate closest distance to the offshore development area (km)
461	Cree Estuary SSSI	European smelt	197
1106	Lower River Cree SSSI	European smelt	197
UK0030249	River Bladnoch SAC	Atlantic Salmon	217
UK0013025	Solway Firth SAC	Sea lamprey, river lamprey	239

90. Although not Annex II species, the European eel (*Anguilla anguilla*) and seatrout (*Salmo trutta*) which are common in Irish rivers and lakes, also have a marine phase of their life cycle. Both species are protected under the Fisheries (Consolidation) Act, 1959 through the implementation of fishing licenses and restrictions to conserve populations.

91. The European eel spawns in the Sargasso Sea before returning as an elver to freshwater to grow. Eels (as well as Atlantic salmon and lamprey species) have been recorded in nearby freshwater habitat, such as the River Liffey. Conversely adult sea trout spawn in fresh water and after several years, the juveniles migrate to the marine environment to feed. Given the marine stage of both of these species, it is possible that they are present within the offshore development area at certain times of the year.

92. Some species also act as key prey resource for a number of fish, marine mammals and sea birds. This includes herring, eel, sandeel, sprat and smelt (*Osmerus eperlanus)* which are known to be present within the Irish Sea (Quigley, 2004).

93. Additionally, rare species such as the IUCN red listed angel shark (*Squatina squatina*), have been recorded within the regional study area (Quigley, 2021).

94. The majority of species found within the River Liffey are freshwater species such as brown trout (*Salmo trutta*), minnow (*Phoxinus phoxinus*), stone loach (*Barbatula barbatula*), pike (*Esox lucius*), perch (*Perca fluviatilis*), roach (*Rutilus rutilus*), three-spined stickleback (*Gasterosteus aculeatus*) and gudgeon (*Gobio gobio*) (Triturus, 2020; Delanty et al., 2022).

95. The Department of Housing, Local Government and Heritage produced an ecological sensitivity analysis of the Western Irish Sea in relation to future Marine Protected Areas (MPAs; Crowe et al., 2023). Within it were highlighted species in which were recommended for spatial protection in the Western Irish Sea, which are listed below in **Table 9-16**.

Table 9-16 MPA Assessment Species (Crowe et al., 2023)

Species	Overlap with the offshore development area?
American plaice or long rough dab (*Hippoglossoides platessoides*)	Yes, there is overlap but density stated is very low.
Angel shark	No overlap.
Basking shark (*Cetorhinus maximus*)	No overlap, but species is in the surrounding area.
Blonde ray	Yes, there is some overlap with bottom trawl data, but density is very low.
Bull huss	No overlap, but species is in the surrounding area.
Cuckoo ray	Yes, there is some overlap with bottom trawl data, but density is very low.
European eel	No overlap.
Short snouted seahorse (*Hippocampus hippocampus*)	N/A (no distribution image presented in Crowe et al., 2023). However, this species is associated with subtidal seagrass beds, which are not present in the relevant ZoI.
Spotted ray	Yes, there is some overlap with bottom trawl data, but density is very low.
Starry smooth-hound	Yes, there is overlap but density is very low.
Thornback ray	Yes, there is some overlap with bottom trawl data, but density is very low.
Tope shark	Yes, there is some overlap, a few species tagged in the surrounding area, but density is very low.
Turbot	Yes, there is some overlap with bottom trawl data, but density is very low.
Witch flounder	Yes, there is some overlap with bottom trawl data, but density is very low.
Barrel jellyfish (*Rhizostoma octopus*)	No overlap.
European flat oyster (*Ostrea edulis*)	N/A (no distribution image presented within Crowe et al., 2023); however, no evidence of flat oyster beds present in the relevant ZoI.

Table 9-17 Vulnerable species, or species of conservation importance which are considered to occur in the vicinity of the CWP offshore development area. *Only species with International Union for the Conservation of Nature (IUCN) designations categorised as threatened (i.e., 'vulnerable', 'endangered', and 'critically endangered' are listed here).

Species	Annex II Species (JNCC, 2022b)	Northern Ireland Priority Species (DAERA, 2022)	OSPAR Threatened/Declining Species (OSPAR, 2022)	Ireland Red List of Cartilaginous Fish (Clarke et al., 2016)	IUCN Red List* (IUCN, 2022)	Captured in Local Study Area by NIGFS	Conservation status (NPWS, 2019)
Twaite shad	X	X					Stable
Allis shad	X	X	X				Not provided
Atlantic salmon	X	X	X				Stable
Sea lamprey	X		X				Stable
River lamprey	X	X					Unknown
Freshwater pearl mussel	X				X		Deteriorating
Lesser sandeel (*Ammodytes marinus*)		X					
European eel		X	X		X		
Atlantic herring		X				X	
Common skate		X	X	X	X		
Atlantic cod		X	X		X		
Tope		X		X	X		
Monkfish		X					

Species	Annex II Species (JNCC, 2022b)	Northern Ireland Priority Species (DAERA, 2022)	OSPAR Threatened/Declining Species (OSPAR, 2022)	Ireland Red List of Cartilaginous Fish (Clarke et al., 2016)	IUCN Red List* (IUCN, 2022)	Captured in Local Study Area by NIGFS	Conservation status (NPWS, 2019)
Whiting		X				X	
Hake		X					
Ling		X					
Plaice		X				X	
Seatrout		X					
Mackerel		X					
Sole		X					
Spiny dogfish		X	X	X	X		
Angel shark (*Squatina squatina*)		X	X	X	X		
Horse mackerel		X					
Spotted ray			X	X		X	
Thornback ray			X	X			
Undulate ray (*Raja undulata*)		X		X	X		
Cuckoo ray (*Leucoraja naevus*)				X			

Species	Annex II Species (JNCC, 2022b)	Northern Ireland Priority Species (DAERA, 2022)	OSPAR Threatened/Declining Species (OSPAR, 2022)	Ireland Red List of Cartilaginous Fish (Clarke et al., 2016)	IUCN Red List* (IUCN, 2022)	Captured in Local Study Area by NIGFS	Conservation status (NPWS, 2019)
Electric ray (*Tetronarce nobiliana*)				X			
Blonde ray				X			
Bull huss (*Scyliorhinus stellaris*)				X	X		
Small-eyed ray (*Raja microocellata*)				X			
Starry smooth hound				X	X		
Small-spotted catshark				X		X	

9.6.7 Identification of Receptors

96. The number of fish, shellfish and turtle species present within the study areas are extensive and, therefore it is impractical to assess each individual species. As such, a Valued Ecological Receptor ('VER') approach has been adopted as outlined in the CIEEM (2022) guidance.

97. The list of species identified in the study areas was reviewed and assessed against a number of criteria (e.g., SAC qualifying feature, spawning within the offshore development area, MPA sensitivity list and commercial importance).

98. It is accepted that different species from the VERs list will be sensitive to different potential impacts arising from the construction, O&M and decommissioning of the offshore development area. Therefore, receptor groups have been identified within the assessment for each potential impact based on their biological traits, and their sensitivity to that impact (e.g., elasmobranchs for Electromagnetic Fields (EMF)), rather than assessing fixed groups of species throughout. Through identification of receptor groups, it is considered that all fish species that might be affected by the CWP Project, even if not detailed in the VERs list, are appropriately assessed, as the groups identified for assessment of each impact are representative of any fish or shellfish species that may be present.

99. Species identified within the MPA sensitivity analysis may or may not be included in the VERS list, for example where there is no overlap with the ZoI, or where there is considered to be minimal overlap with areas of low density of that species. In addition, as per the above description of receptor group assessments, should any species be present, due to the assessment of representative species through the VERS approach, it is concluded that all species that may be affected are suitably assessed.

100. The VERs identified for this chapter are provided in **Table 9-18**.

Table 9-18 Fish, shellfish and turtle Valued Ecological Receptors (VERS)

Receptor (species)	Latin Name	Species of Local Commercial Importance	Spawning and / or nursery grounds in the Local Study Area		Species of Conservation Importance			
			Spawning grounds	Nursery grounds	Annex II Species	Ireland / IUCN Red List Species	OSPAR threatened / declining	Northern Ireland Priority Species
Shellfish								
Razor / knife clams	*Solenidae sp.*	X						
Norway lobster	*Nephrops norvegicus*	X	X	X				
Sword razor shell	*Ensis sp.*	X						
Whelk	*Buccinum undatum*	X						
Great Atlantic scallop	*Pecten maximus*	X						
Edible crab	*Cancer pagurus*	X						

Receptor (species)	Latin Name	Species of Local Commercial Importance	Spawning and / or nursery grounds in the Local Study Area		Species of Conservation Importance			
			Spawning grounds	Nursery grounds	Annex II Species	Ireland / IUCN Red List Species	OSPAR threatened / declining	Northern Ireland Priority Species
European lobster	*Homarus Gammarus*	X						
Elasmobranchs								
Blonde ray	*Raja brachyura*	X				X (Status: Near Threatened; Population trend: Decreasing)		X
Small-spotted catshark	*Scyliorhinus canicula*	X				X (Status: Least Concern, Population trend: Stable)		
Cuckoo ray	*Raja naevus*	X				X (Status: least concern; Population trend: Unknown)		X
Thornback ray	*Raja clavata*	X		X		X (Status: Near Threatened; Population trend: Decreasing)	X (Threatened)	X
Spotted ray	*Raja montagui*			X		X (Status: Least Concern, Population trend: Stable)	X (Threatened)	X
Spurdog*	*Squalus sp.*			X	N/A	N/A	N/A	N/A
Spiny dogfish*	*Squalus acanthias*					X (Status: Vulnerable; Population trend: Decreasing)	X (Threatened)	X

Receptor (species)	Latin Name	Species of Local Commercial Importance	Spawning and / or nursery grounds in the Local Study Area		Species of Conservation Importance			
			Spawning grounds	Nursery grounds	Annex II Species	Ireland / IUCN Red List Species	OSPAR threatened / declining	Northern Ireland Priority Species
Tope	*Galeorhinus galeus*			X		X (Status: Critically Endangered; Population Trend: Decreasing)		X
Common skate	*Dipturus batis*					X (Status: Critically Endangered; Population Trend: Decreasing)	X (Threatened)	X
Angel shark	*Squatina squatina*					X (Status: Critically Endangered; Population Trend: Decreasing)	X (Threatened)	X
Undulate ray	*Raja undulata*					X (Status: Endangered; Population Trend: Decreasing)		X
Basking shark	*Cetorhinus maximus*					X (Status: Endangered; Population Trend: Decreasing)	X	X
Marine Fish								
Haddock	*Melanogrammus aeglefinus*	X	X	X				
Whiting	*Merlangius merlangus*		X	X				X

Receptor (species)	Latin Name	Species of Local Commercial Importance	Spawning and / or nursery grounds in the Local Study Area		Species of Conservation Importance			
			Spawning grounds	Nursery grounds	Annex II Species	Ireland / IUCN Red List Species	OSPAR threatened / declining	Northern Ireland Priority Species
European plaice	*Pleuronectes platessa*	X	X	X				X
Atlantic mackerel	*Scomber scombrus*		X	X				X
Atlantic horse mackerel	*Trachurus trachurus*		X	X				X
Lemon sole	*Microstomus kitt*		X	X				
Common sole	*Solea solea*		X					X
Sandeel	*Ammodytes sp.*		X	X				X
Atlantic herring	*Clupea harengus*			X				X
European sprat	*Sprattus sprattus*		X					

Receptor (species)	Latin Name	Species of Local Commercial Importance	Spawning and / or nursery grounds in the Local Study Area		Species of Conservation Importance			
			Spawning grounds	Nursery grounds	Annex II Species	Ireland / IUCN Red List Species	OSPAR threatened / declining	Northern Ireland Priority Species
Atlantic cod	*Gadus morhua*	X	X	X		X (Status: Vulnerable; Population trend: Unspecified)	X	X
European smelt	*Osmerus eperlanus*					X (Status: Least concern; Population Trend: Unknown)		X
Anglerfish	*Lophius piscatorius*			X		X (Status: Least concern; Population Trend: Unknown)		
European hake	*Merluccius merluccius*		X	X		X (Status: Least concern; Population Trend: Unknown)		X
Ling	*Molva molva*		X					X
Migratory Fish								
Twaite shad	*Alosa fallax*				X			X
Allis shad	*Alosa alosa*				X		X	X
Atlantic salmon**	*Salmo salar*				X		X	X

Receptor (species)	Latin Name	Species of Local Commercial Importance	Spawning and / or nursery grounds in the Local Study Area		Species of Conservation Importance			
			Spawning grounds	Nursery grounds	Annex II Species	Ireland / IUCN Red List Species	OSPAR threatened / declining	Northern Ireland Priority Species
Sea lamprey	*Petromyzon marinus*				X		X	X
River lamprey	*Lampetra fluviatilis*				X			X
European eel	*Anguilla anguilla*					X (Status: Critically Endangered; Population Trend: Decreasing)	X	X
Seatrout**	*Salmo trutta*							X
Leatherback turtle	*Dermochelys coriacea*					X (Status: Endangered; Population Trend: Decreasing)	X	X

*Note: Spawning and / or nursery grounds data are only available to a species level for spurdog (*Squalus sp*.); however, there is more specific information regarding Species of Conservation Importance for the identified sub-species spiney dogfish (*Squalus acanthias*); hence, the species and sub-species are both included in the table.

**It is recognized that these two species support Fresh Water Pearl Mussels (FWPM) as host species. Should significant effects on these receptors be identified, then effects on FWPM will be considered. If no significant effects are identified, then it is considered that there will be no significant effect on FWPM as there are no other direct or indirect impacts on FWPM that may arise from the CWP Offshore Development.

9.6.8 Climate change and natural trends

101. Natural trends in fish, shellfish and turtle species abundance and distribution can be the result of changes in prey availability, net primary production, intra and interspecific competition and predator abundance. Predictions for the Irish sea include impacts such as sea level rise, storm damage, increased precipitation and associated pollution, ocean acidification, or increase of nuisance / harmful species (Callaway et al., 2012). Changes in ocean temperatures may alter the life cycles of related parasites and may cause hosts to expand previous territories (Callaway et al., 2012).

102. Climate change impacts such as rises in temperature and ocean acidification can lead to the loss of marine habitats and species (e.g., Heath et al., 2012). Changing ocean currents and warming waters are leading to shifts in species ranges and the distribution of fish stocks, altering the structure of ecosystems (Fogarty et al., 2017). Environmentally driven range expansion of squid and prey species such as zooplankton has been documented in the North Sea (Van der Kooij et al., 2016; Beaugrand et al., 2009). Variation in ocean temperature can alter population growth as it leads to impacts on metabolic rates and life history processes (Bently et al., 2020), Bottom-up process modelling has indicated that as environmental changes occur there is a suppression in the overall production of fish stocks and a dampening in recovery in the Irish Sea is likely (Bently et al., 2020). This is noted as key for certain species which have an important predator–prey relationship such as sandeel. Regnier et al. (2019); in particular, note that within a Scottish coastal monitoring site projected warming scenarios indicated a likely decline in sandeel recruitment. The study sheds light on the mechanisms by which future warming could increase the trophic mismatch between predator and prey, and demonstrates the need to identify the temperature-sensitive stages in predator-prey for predicting future responses to climate change across both fish species as prey and the predators that target them. In the absence of increased deployment of renewable energy, species such as sandeel can be expected to decline due to climate change related impacts.

103. In addition, changes in anthropogenic activities such as fishing exploitation rates strongly influence fish, shellfish and turtle populations (Kempf et al., 2022). Commercial and recreational fishing is subject to numerous factors which may cause populations to differ from the baseline provided. This could be a result of, for example, changes in fisheries management policies and legislation, increase in running costs such as fuel prices, alterations in species distribution and abundance, or the introduction of marine conservation areas.

9.6.9 Predicted future baseline

104. In the event of the CWP Project not being developed, and no other developments occurring in the Irish Sea, no change in the baseline conditions would be expected beyond those resulting from climatic factors and natural trends (as detailed above).

9.7 Scope of the assessment

105. An EIA Scoping Report for the Offshore infrastructure was published on the 6 January 2021. The Scoping Report was uploaded to the CWP Project website and shared with regulators, prescribed bodies and other relevant consultees, inviting them to provide relevant information and to comment on the proposed approach being adopted by the Applicant in relation to the offshore elements of the EIA.

106. Based on responses to the Scoping Report, further consultation and refinement of the CWP Project design, potential impacts to fish, shellfish and turtle ecology scoped into the assessment are listed below in **Table 9-19**.

Table 9-19 Potential impacts scoped into the assessment

Impact No.	Description of impact	Notes
Construction		
Impact 1	Temporary seabed habitat disturbance	Impact considers temporary habitat disturbance during construction from the representative scenario for fish, shellfish and turtle receptors.
Impact 2	Noise and vibration	Impact considers noise and vibration disturbance during construction from the representative scenario for fish, shellfish and turtle receptors.
Impact 3	Temporary disturbance of the seabed leading to increases in SSC and associated deposition.	Impact considers temporary disturbance resulting in an increase of SSC and associated deposition during construction from the representative scenario for fish, shellfish and turtle receptors.
Impact 4	Collision with vessels	Impact considers collision with vessels during construction from the representative scenario for fish, shellfish and turtle receptors.
Impact 5	Accidental pollution events	Impact considers accidental pollution events during construction from the representative scenario for fish, shellfish and turtle receptors.
Impact 6	Invasive non-native species (INNS)	Impact considers the introduction of INNS during construction from the representative scenario for fish, shellfish and turtle receptors.
Operation and Maintenance		
Impact 1	Long-term habitat loss	Impact considers long term habitat loss during operation and maintenance from the representative scenario for fish, shellfish and turtle receptors.
Impact 2	Electromagnetic fields (EMF) from cables	Impact considers EMF disturbance during operation and maintenance from the representative scenario for fish, shellfish and turtle receptors.
Impact 3	Operational noise	Impact considers operational noise during operation and maintenance from the representative scenario for fish, shellfish and turtle receptors.
Impact 4	Temporary disturbance of the seabed, including associated increases in SSC and deposition.	Impact considers temporary disturbance resulting in an increase of SSC and associated deposition

Impact No.	Description of impact	Notes
		during operation / maintenance activities from the representative scenario for fish, shellfish and turtle receptors.
Impact 5	Collision with vessels	Impact considers collision with vessels during operation and maintenance from the representative scenario for fish, shellfish and turtle receptors.
Impact 6	Accidental pollution events	Impact considers accidental pollution events during operation and maintenance from the representative scenario for fish, shellfish and turtle receptors.
Impact 7	Invasive non-native species (INNS)	Impact considers the introduction of INNS during operation and maintenance from the representative scenario for fish, shellfish and turtle receptors.
Decommissioning		
Impact 1	Long-term habitat loss	Impact considers the long-term habitat loss during decommissioning from the representative scenario for fish, shellfish and turtle receptors.
Impact 2	Noise and vibration	Impact considers noise and vibration disturbance during decommissioning from the representative scenario for fish, shellfish and turtle receptors.
Impact 3	Temporary disturbance of the seabed, including associated increases in SSC and deposition.	Impact considers temporary disturbance resulting in an increase of SSC and associated deposition during decommissioning from the representative scenario for fish, shellfish and turtle receptors.
Impact 4	Collision with vessels	Impact considers collision with vessels during decommissioning from the representative scenario for fish, shellfish and turtle receptors.
Impact 5	Accidental pollution events	Impact considers accidental pollution events during decommissioning from the representative scenario for fish, shellfish and turtle receptors.
Impact 6	Invasive non-native species (INNS)	Impact considers the introduction of INNS during decommissioning from the representative scenario for fish, shellfish and turtle receptors.

107. Based on responses to the Scoping Report, further consultation and refinement of the CWP Project design, no potential impacts to fish, shellfish and turtle ecology were agreed to be scoped out of the assessment.

9.8 Assessment parameters

9.8.1 Background

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

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

110. **Chapter 4 Project Description** describes the design approach that has been taken for each component of the CWP Project. Wherever possible the location and detailed parameters of the CWP Project components are identified and described in full within the EIAR. However, for the reasons outlined above, certain design decisions and installation methods will be confirmed post-consent, requiring a degree of flexibility in the planning consent.

111. Where necessary, flexibility is sought in terms of:

- Up to two options for certain permanent infrastructure details and layouts such as the WTG layouts.
- Dimensional flexibility; described as a limited parameter range i.e. upper and lower values for a given detail such as cable length.
- Locational flexibility of permanent infrastructure; described as Limit of Deviation (LoD) from a specific point or alignment.

112. The CWP Project had to procure an opinion from An Bord Pleanála to confirm that it was appropriate that this application be made and determined before certain details of the development were confirmed. An Bord Pleanála issued that opinion on 25 March 2024 (as amended in May 2024) and it confirms that the CWP Project could make an application for permission before the details of certain permanent infrastructure described in **Section 4.3 of Chapter 4 Project Description**.

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

114. Notwithstanding the flexibility in design and methods, the EIAR identifies, describes and assesses all of the likely significant impacts of the CWP Project on the environment.

9.8.2 Options and dimensional flexibility

115. Where the application for permission seeks options or dimensional flexibility for infrastructure or installation methods, the impacts on the environment are assessed using a representative scenario approach. A “representative scenario” is a combination of options and dimensional flexibility that has

been selected by the author of this EIAR chapter to represent all of the likely significant effects of the project on the environment. Sometimes, the author will have to consider several representative scenarios to ensure all impacts are identified, described and assessed.

116. For fish, shellfish and turtle, this analysis is presented in **Appendix 9.2** which identifies one or more representative scenario for each impact with supporting text to demonstrate that no other scenarios would give rise to new or materially different effects; taking into consideration the potential impact of other scenarios on the magnitude of the impact or the sensitivity of the receptor(s) that is being considered.

117. **Table 9-20** below, presents a summarised version of **Appendix 9.2** and describes the representative scenarios on which the construction and O&M phase fish, shellfish and turtle assessment has been based. Where options exist, for each receptor and potential impact, the table identifies the representative scenario and provides a justification for this.

9.8.3 Limit of deviation

118. Where the application for permission seeks locational flexibility for infrastructure, the impacts on the environment are assessed using a LoD. The LoD is the furthest distance that a specified element of the CWP Project can be constructed.

119. This chapter assesses the specific preferred location for permanent infrastructure. However, **Appendix 9.2** provides further analysis to determine if the proposed LoD for permanent infrastructure may give rise to any new or materially different effects, taking into consideration the potential impact of the proposed LoD on the magnitude of the impact.

120. For fish, shellfish and turtle ecology this analysis is summarised in **Table 9-21**. Where the potential for LoD to cause a new or materially different effect is identified, then this is noted in **Table 9-21** and is considered in more detail within **Section 9.10** of this chapter.

Table 9-20 Design Parameters relevant to assessment of fish, shellfish and turtle

Impact	Representative scenario details	Value	Notes / assumptions
Construction			
Impact 1: Temporary seabed habitat disturbance	Array site (WTG Layout Option A), and offshore export cable corridor (OECC)		The temporary seabed habitat disturbance relates to seabed preparation for foundations and cables, jack up vessel (JUV) and anchoring operations, the installation of the infrastructure foundations and cable installation, and geotechnical survey. It should be noted that where boulder clearance overlaps with sand wave clearance, the boulder clearance footprint will be within the sand wave clearance footprint. Offshore, WTG Layout Option A forms the representative scenario as this represents the greatest level of temporary seabed habitat disturbance, and therefore Option A forms the presentational basis of the assessment for Impact 1: temporary seabed habitat disturbance in this chapter. WTG Layout Option B would result in a lower level of disturbance and would not introduce new impacts, or an impact of greater magnitude.
	Boulder clearance: Array site seabed clearance area (m^2)	2,556,000–2,934,000	
	Sand wave clearance: Array site seabed clearance area (m^2)	205,250–259,250	
	IAC and interconnector cable installation: Total seabed disturbed (m^2)	1,911,000–2,214,000	
	Boulder clearance: OECC seabed clearance area (m^2)	2,220,000–2,616,000	
	Sand wave clearance: OECC seabed clearance area (m^2)	198,550	
	Offshore export cable installation: Total seabed disturbed (m^2)	1,890,000–2,187,000	
	JUV operations total impact area (m^2)	240,000	
	WTGs and OSS anchoring operations total impact area (m^2)	280,800	
	IAC and interconnector cable anchoring operations total impact area (m^2)	371,520	
	Offshore export cable anchoring operations total impact area (m^2)	630,720	

Impact	Representative scenario details	Value	Notes / assumptions
	Total area of disturbed sediment for offshore construction activities (m^2)	**11,931,840**	There is only one installation method being proposed at landfall, open cut trenching. Therefore, the open cut method to install the cable ducts forms the presentational basis of this assessment. The total area of temporary seabed habitat disturbance for construction activities based on this representative scenario is calculated to be 12,088,840 m^2.
	Landfall		
	Total seabed disturbed by cofferdam (m^2)	6,100	
	Total seabed disturbed by intertidal cable duct installation (m^2)	36,000	
	Total area of seabed in transition zone affected by support structures (m^2)	6,900	
	Total area of seabed in transition zone affected by installation of cables using either open cut trenching or a shallow water trenching tool (m^2)	108,000	
	Total area of disturbed sediment for landfall construction activities (m^2)	157,000	
Impact 2: Noise and vibration	Installation method [WTG Impact piling]		Disturbance from noise and vibration relates to installation of the infrastructure foundations. Offshore, installation of infrastructure via impact piling represents the greatest level of noise and vibration, and therefore impact piling forms the presentational basis of the assessment for Impact 2: Noise and Vibration in this chapter. Drilling and vibropiling would result in a lower level of disturbance and would not introduce new impacts, or an impact of greater magnitude.
	No. of monopile foundations	75	
	Hammer energy (kJ)	440–4400	
	Total hours of piling per monopile	3.5	
	Total no. of monopiles installed in 24 hrs	1–2	
	Total no. of piling days	75	
	Total piling hours	262.5	
	Number of piles being installed simultaneously at any one time	1	
	Installation method [OSS Impact piling]		

Impact	Representative scenario details	Value	Notes / assumptions
	Hammer energy (kJ)	440–4400	
	Hours of piling per monopile	3.5	
	Number of monopiles installed in 24 hrs	1–2	
	Total number of piling days	3	
	Total number of piling hours	10.5	
	Installation method [drilling]		
	No. of monopile foundations	75	
	Number of locations that may require drilling	12	
	Drill diameter (m)	8.5	
	Drill penetration depth (m)	36.0	
	Volume of drill arisings per WTG foundation (m^3)	2,043	
	Total volume of drill arisings (m^3)	**24,516**	
	Installation method [vibropiling]		
	It may also be possible that the piles are installed via vibropiling, where the pile is embedded via vibration rather than hammering or drilling. This method has the benefit of reduced noise emissions compared to hammering but may not be suitable due to the ground conditions within the array site. The use of this method will be investigated further and confirmed post consent once pre-construction geotechnical surveys are complete.		
	Installation method [onshore substation; piling]		
	Maximum length of combi-wall below the HWM (requiring marine piling)	150	Of the onshore substation pile driving scenario, the option where two piles are driven at the same time

Impact	Representative scenario details	Value	Notes / assumptions
	Max time to drive a single tubular pile (hours)	24 hours per group of 4–6 piles but not continuous. 2 hours of pile driving per day for each pile using impact driving	forms the representative scenario as this represents the greatest level of temporary habitat disturbance, and therefore forms the presentational basis of the assessment for Impact 2: Noise and vibration in this chapter. The single piling option would result in a lower level of disturbance and would not introduce new impacts, or an impact of materially different magnitude.
	Max time to drive a single combi-wall sheet pile (hours)	2 hours per sheet pile using impact driving "	
	Max time to drive a single anchor wall sheet pile (hours)	1 hour using impact piling.	
	Combi-wall – Maximum duration of pile driving in a single day (hours)	8 hours	
	Combi-wall tubular piles – hammer energy (kJ)	400 KJ	
	Combi-wall tubular piles - blows per minute	100	
	Combi-wall sheet piles - hammer energy (kJ)	400 KJ	
	Combi-wall tubular piles - blows per minute	100	
	Array site and OECC UXO clearance		UXO clearance requirements will be the same regardless of the WTG option selected. Therefore, there is only one scenario for this potential impact.

Impact	Representative scenario details	Value	Notes / assumptions
	Up to ten UXO have been identified as requiring clearance, with a maximum charge weight of up to 525 kg Net Explosive Quantity (NEQ) for 2,000 lb (907.2 kg) UXO. The UXO items considered most likely to be encountered within the offshore development area are listed below: • Mines Allied • Mines German • Large Bombs (500 lb or larger) • Small Bombs (250 lb or smaller) • Large Projectiles (6–16 inch) • Small Projectiles and Rockets (smaller than 6 inch) • Chemical Munitions • Depth Charges and Torpedoes • Land Service Ammunition • Small Arms Ammunition		
	Array site and OECC Cable Lay Geophysical Survey Noise		Geophysical survey requirements will be the same regardless of the WTG option selected. Therefore, there is only one scenario for this potential impact.
	Increased underwater noise from other construction-related activities e.g., route preparation, cable installation, trenching and cable protection		Offshore, WTG Option A forms the representative scenario as this represents the greatest level of disturbance, and therefore Option A forms the presentational basis of the assessment for Impact 2. Option B would result in a lower level of disturbance and would not introduce new impacts, or an impact of materially different magnitude.
Impact 3: Temporary disturbance of the seabed leading to increases in SSC	Representative scenario parameters are the same as those above for Impact 1 above. Sediment plume modelling suggests that the greatest direction and distance of dispersion of disturbed material was 9–10 km to the east, although one scenario showed dispersion to the southeast	As above for Impact 1	The temporary disturbance to the seabed leading to increases in SSC relates to seabed preparation for foundations and cables, jack up and anchoring operations, the installation of the infrastructure foundations inclusive of drilling, and cable installation. It should be noted that where boulder

Impact	Representative scenario details	Value	Notes / assumptions
and associated deposition	reaching 6–7 km and to the west reaching 3–4 km.		clearance overlaps with sand wave clearance, the boulder clearance footprint will be within the sand wave clearance footprint. Increases in SSC occur as a result of temporary disturbance to the seabed Offshore, WTG Option A forms the representative scenario as this represents the greatest level of temporary habitat disturbance, and therefore Option A forms the presentational basis of the assessment for Impact 3. Option B would result in a lower level of disturbance and would not introduce new impacts, or an impact of materially different magnitude.
Impact 4: Collision with vessels	Peak vessels on site simultaneously	38	Collision with vessels relates to the potential for collision with vessels during construction from the representative scenario for fish, shellfish and turtle receptors. Offshore, WTG Option A forms the representative scenario as this represents the greatest level of potential collision risk as overall more vessels will be required, and therefore Option A forms the presentational basis of the assessment for Impact 4. Option B would result in a lower level of collision risk and would not introduce new impacts, or an impact of greater magnitude.
	Total construction vessels (round trips)	2,409	
Impact 5: Accidental pollution events	Number of WTGs Total construction vessels (round trips)	75 As above for Impact 4	Accidental pollution relates to the oils and fluids which may be used during construction activities include: • Grease • Hydraulic oil • Gear oil • Nitrogen

Impact	Representative scenario details	Value	Notes / assumptions
			• Transformer silicon / ester oil • Diesel fuel • SF6 • Glycol / Coolants • Batteries • Drill fluid The requirement for use of oils and fluids during construction will be the same regardless of the WTG option selected. Therefore, there is only one scenario for this potential impact, and this represents the representative scenario.
Impact 6: Invasive Non-Native Species (INNS)	Total construction vessels (round trips)	As above for Impact 4	There are no known INNS in the offshore development area, therefore this impact relates to the potential transference of INNS from construction vessels or plant into the CWP Project. Offshore, WTG Option A forms the representative scenario as this represents the greatest number of vessels required, and therefore Option A forms the presentational basis of the assessment for Impact 6. Option B would result in a lower level of disturbance and would not introduce new impacts, or an impact of materially different magnitude.
Operation and Maintenance			
Impact 1: Long term habitat loss	Permanent Infrastructure		The long-term habitat loss relates to the footprints of foundations including scour protection and areas of cable protection installations on the
	Total WTG monopile seabed area take (with scour protection) across the array site (m^2)	273,000	
	Total OSS monopile seabed area take (with scour protection) across the array site (m^2)	10,920	

Impact	Representative scenario details	Value		Notes / assumptions
	Interconnector and inter-array cable: total area of seabed covered by cable protection (m²)	208,600		seabed that will remain for the operational lifetime of the CWP Project. Option A forms the representative scenario as this represents the greatest level of long-term habitat loss, and therefore Option A forms the presentational basis of the assessment for Impact 1 long-term habitat loss, in this chapter. Option B would result in a lower level of disturbance and would not introduce new impacts, or an impact of materially different magnitude.
	Offshore export cables: total area of seabed covered by cable protection (m²)	105,000		
	Area of reclaimed land from Liffey (m²)	1,800		
	Total area of long-term habitat loss (m²)	**599,320**		
Impact 2: Electromagnetic Fields (EMF) from cables	Array site (including WTGs, OSSs and offshore export cables within the Array site) and OECC			Electromagnetic fields (EMF) from cables relates to the electromagnetic frequency from the OECC, interconnectors and IACs during the operational phase. Option A forms the representative scenario as this represents the greatest length of cable with the potential to emit EMF and therefore Option A forms the presentational basis of the assessment for Impact 2: Electromagnetic Fields (EMF) from cables in this chapter. Option B would result in a shorter cable length and therefore smaller area with the potential to be impacted by EMF and would not introduce new impacts, or an impact of materially different magnitude.
	Interconnector and IAC Length (km)	127.4–147.6		
	Interconnector and IAC minimum depth of cover (m)	1.0		
	Interconnector and IAC voltage (kV)	66		
	OECC Length (km)	126–146		
	OECC minimum depth of cover (m)	1.4		
	OECC voltage (kV)	220		
	Total length of cables with the potential to emit EMF (km)	**253.4–293.6**		
Impact 3: Operational Noise	Vessel Noise	Peak vessels	Annual Round trips	Disturbance from operational noise and vibration relates to maintenance of the infrastructure. This includes vessels to perform the operations, survey equipment to monitor the infrastructures and sound generated by the turbine itself. The estimated number of vessels required during operation and
	JUVs	2	3	
	Service Operation Vessel (SOV)	1	26	

Impact	Representative scenario details	Value		Notes / assumptions
	CTVs	6	1152	maintenance are the same regardless of the WTG option selected. However, turbine noise is also a consideration for Impact 3: Operational Noise and WTG Option A contains the greatest number of turbines. As such WTG Option A forms the presentational basis of the assessment for Impact 3: Operational Noise in this chapter. Option B would result in a lower level of noise and would not introduce new impacts, or an impact of materially different magnitude.
	Cable maintenance vessel	2	1	
	Auxiliary vessel (Includes survey vessels, ROVs, AUVs, Tug operations, cargo vessels, passenger vessels, and scour replacement vessels)	3	27	
	Total vessels:	14	1,209	
	Array site and OECC Cable Lay Geophysical Survey Noise • MBES • SBI • SBP – pinger • UHRS – sparker • USBL system • Magnetometer			
	Turbine Noise			
	Turbine quantity	75		
Impact 4: Temporary disturbance of the seabed including associated increases in SSC and deposition	Scheduled operation and maintenance activities will not result in any temporary disturbance of the seabed including associated increases in SSC and associated deposition. Unscheduled maintenance activities of WTGs will be required should a component fail or break. If a component requires replacing this may be done from a JUV and would result in some temporary habitat disturbance, however this is likely to be a one location at a time and therefore the potential impact is much less than that of JUV operations during construction. Anticipated JUV requirements during operation and maintenance are for two JUVs making three round trips annually equating to 150 round trips over an anticipated CWP Project lifetime of 25 years. Unscheduled maintenance activities of IAC, interconnector and export cables include cable repair. Should it be required, this may involve a faulty section of cable to be removed from the seabed, repaired, relayed, and reburied. Therefore, resulting in an increase in temporary habitat disturbance including associated increases in SSC and associated deposition. As repair is likely to only ever be required for a section of cable at a time the impacts will be less than the construction phase cable lay and burial.			

Impact	Representative scenario details	Value	Notes / assumptions
	As temporary disturbance of the seabed leading to increases in SSC of the seabed leading to increases in SSC and associated deposition during O&M activities will arise due to unscheduled maintenance activities the values of these activities are unknown. However, reliability and ease of maintenance have been carefully considered in the CWP Project design to minimise maintenance requirements and although maintenance activities will be carried out over a longer period of time than construction activities. The amount of seabed disturbed during repair activities is likely to be less than those of the installation of the infrastructure, as maintenance activities will be conducted in discrete locations whilst construction activities cover the whole CWP Project area. Given this it is anticipated that for the purposes of a representative scenario, the impacts will be no greater than those identified for the construction phase.		
Impact 5: Collision with vessels	Number of vessels on site x annual round trips	1,209	The estimated number of vessels required during operation and maintenance are the same regardless of the WTG option selected. Therefore, there is only one scenario for this potential impact, and this represents the representative scenario.
Impact 6: Accidental pollution events	Number of vessels on site x annual round trips	As above	The requirement for use of oils and fluids during operation and maintenance will be the same regardless of the WTG option selected. Therefore, there is only one scenario for this potential impact, and this represents the representative Scenario.
Impact 7: Invasive Non-Native Species (INNS)	Number of vessels on site x annual round trips	As above	The requirement for use of vessels during operation and maintenance will be the same regardless of the WTG option selected. Therefore, there is only one scenario for this potential impact, and this represents the representative Scenario.
Decommissioning			
Impact 1: Long-term habitat loss			

Impact	Representative scenario details	Value	Notes / assumptions
Impact 2: Noise and vibration **Impact 3:** Temporary disturbance of the seabed including associated increases in SSC and associated deposition	It is recognised that legislation and industry best practice change over time. However, for the purposes of the EIA, at the end of the operational lifetime of the CWP Project, all offshore infrastructure will be rehabilitated. In this regard, for the purposes of a representative scenario for decommissioning impacts, the following assumptions have been made: The WTGs and OSS topsides shall be completely removed. • Following WTG and OSS topside decommissioning and removal, the monopile foundations will be cut below the seabed level, to a depth that will ensure the remaining foundation is unlikely to become exposed. This is likely to be approximately one metre below seabed, although the exact depth will depend upon the seabed conditions and site characteristics at the time of decommissioning. • All cables and associated cable protection in the offshore environment shall be wholly removed. It is likely that equipment similar to that which is used to install the cables may be used to reverse the burial process and expose them. Therefore, the area of seabed impacted during the removal of the cables is anticipated to be the same as the area impacted during the installation of the cables. • Generally, decommissioning is anticipated to be a reverse of the construction and installation process for the CWP Project and the assumptions around the area of long-term habitat loss (of newly formed habitats on the subsea infrastructure), noise and vibration and temporary disturbance of the seabed including associated increases in SSC and associated deposition are therefore the same as described for the construction phase of the offshore components. Given the above, it is anticipated that for the purposes of a representative scenario, the impacts will be no greater than those identified for the construction phase.		
Impact 4: Collision with vessels **Impact 5:** Accidental pollution events **Impact 6:** Invasive Non-	It is recognised that legislation and industry best practice change over time. However, for the purposes of the EIA, at the end of the operational lifetime of the CWP Project, all offshore infrastructure will be rehabilitated. In this regard, for the purposes of a representative scenario for decommissioning impacts, the following assumptions have been made: • Generally, decommissioning is anticipated to be a reverse of the construction and installation process for the CWP Project and the assumptions around the number of vessels on site, and vessel round trips is therefore the same as described for the construction phase of the offshore components. Given the above, it is anticipated that for the purposes of a representative scenario, the impacts will be no greater than those identified for the construction phase.		

Impact	Representative scenario details	Value	Notes / assumptions
Native Species (INNS)			

Table 9-21 LoD Parameters relevant to assessment of fish, shellfish and turtle

Project Component	Limit of deviation	Conclusion from Appendix
WTGs / OSSs	100 m from the centre point of each WTG and OSS location is proposed to allow for small adjustments to be made to structure locations.	No, the implementation of the LoD does not introduce any new impact receptor pathways that have not already been considered as part of the assessment.
IACs and interconnector cables (including cable protection)	100 m either side of the preferred alignment of each IAC and interconnector cable. 200 m from the centre point of each WTG location.	
Offshore export cables (including cable protection)	250 m either side of the preferred alignment within the array site. The offshore export cable corridor (OECC) outside of the array site.	
Onshore substation revetment Location of onshore substation revetment perimeter structure	Defined LoD for sheet piling at toe of the revetement with 0.5–1.0 m horizontal width	

9.9 Primary mitigation measures

121. Throughout the development of the CWP Project, measures have been adopted as part of the evolution of the project design and approach to construction, to avoid or otherwise reduce adverse impacts on the environment. These mitigation measures are referred to as 'primary mitigation'. They are an inherent part of the CWP Project and are effectively 'built in' to the impact assessment.

122. Primary mitigation measures relevant to the assessment of fish, shellfish and turtle are set out in **Table 9-22**. Where additional mitigation measures are proposed, these are detailed in the impact assessment (**Section 9.10**). Additional mitigation includes measures that are not incorporated into the design of the CWP Project and require further activity to secure the required outcome of avoiding or reducing impact significance.

Table 9-22 Primary mitigation measures

Project element	Description
All offshore infrastructure (Construction)	Bedform clearance operations will be undertaken only where necessary, thereby minimising sediment disturbance and alteration to seabed morphology.
Offshore cables (Operation)	Cables will be suitably buried or protected by other means where burial is not practicable. This will reduce the potential for effects relating to the presence of Electromagnetic Fields (EMF).
All offshore infrastructure (Construction and Operation)	A **Construction Environmental Management Plan** (CEMP) has been prepared to provide a management framework, to ensure appropriate controls are in place to manage environmental risks associated with the construction of the CWP Project. It outlines environmental procedures that require consideration throughout the construction process, in accordance with legislative requirements and industry best practice. In summary, the CEMP includes details of: • The Environmental Management Framework for the CWP Project including environmental roles and responsibilities (i.e. ecological clerk of works) and contractor requirements (i.e. method statements for specific construction activities); • Mitigation measures and commitments made within the EIAR, Natura Impact Statement (NIS) and supporting documentation for the CWP Project. • Measures proposed to ensure effective handling of chemicals, oils and fuels including compliance with the MARPOL convention; • A Marine Pollution Prevention and Contingency Plan to address the procedures to be followed in the event of a marine pollution incident originating from the operations of the CWP Project; • An Emergency Response Plan adhered to in the event of discovering unexploded ordnance; • Offshore biosecurity and invasive species management detailing how the risk of introduction and spread of invasive non-native species will be minimised; and • Offshore waste management and disposal arrangements. The CEMP will be implemented by the Applicant and its appointed contractor(s) and will be secured through conditions of the development

Project element	Description
	consent. It will be a live document which will be updated and submitted to the relevant authority, prior to the start of construction.
All offshore infrastructure (Construction, Operation and Decommissioning)	An **Ecological Vessel Management Plan** (EVMP) has been prepared to determine vessel routing to and from construction sites and ports and to include a code of conduct for vessel operators. The EVMP includes details of: • The types and specifications of vessels for the CWP Project; • How vessels will be monitored and coordinated; and • The use of defined transit routes to site from key construction and operation ports, where practicable to do so. The EVMP will be implemented by the Applicant and its appointed contractor(s) and will be secured through conditions of the development consent. It will be a live document which will be updated and submitted to the relevant authority, prior to the start of construction.
All offshore infrastructure (Construction) (relevant measures in the MMMP will also apply to marine megafauna)	A **Marine Mammal Mitigation Protocol** (MMMP) has been prepared to outline the mitigation requirements for minimising the impacts on marine mammals during the construction of the CWP Project. The MMMP will be implemented by the Applicant and its appointed contractor(s) and will be secured through conditions of the development consent. It will be a live document which will be updated and submitted to the relevant authority, prior to the start of construction. Primary mitigation measures in the MMMP include: • Pre geophysical survey visual watch by an MMO • Pre UXO detonation visual watch by an MMO • Pre UXO detonation PAM (if required to supplement to visual observations)
All offshore infrastructure (Decommissioning)	A **Rehabilitation Schedule** is provided as part of the planning application. This has been prepared in accordance with the MAP Act (as amended by the Maritime and Valuation (Amendment) Act 2022) to provide preliminary information on the approaches to decommissioning the offshore and onshore components of the CWP Project. A final Rehabilitation Schedule will require approval from the statutory consultees prior to the undertaking of decommissioning works. This will reflect discussions held with stakeholders and regulators to determine the exact methodology for decommissioning, taking into account available methods, best practice and likely environmental effects.
All offshore infrastructure (Decommissioning)	A **Marine Mammal Mitigation Protocol** (MMMP) has been prepared to outline the mitigation requirements for minimising the impacts on marine mammals during the decommissioning of the CWP Project. The MMMP will be implemented by the Applicant and its appointed contractor(s) and will be secured through conditions of the development consent. It will be a live document which will be updated and submitted to the relevant authority, prior to the start of decommissioning.

9.10 Impact assessment

9.10.1 Construction phase

123. The potential environmental impacts arising from the construction of the CWP Project are listed in **Table 9-20** along with the parameters against which each construction phase impact has been assessed. A description of the potential effect on fish, shellfish and turtle ecology receptors caused by each identified impact is given below.

Impact 1: Temporary seabed habitat disturbance

124. As presented in **Table 9-20**, WTG Layout Option A forms the largest area of habitat disturbance of the two design scenarios and as such is considered to be the representative scenario. Within the offshore development area, approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with 157,000 m^2 potentially disturbed in the landfall area. The overall total area of temporary seabed habitat disturbance is anticipated to be 12,088,840 m^2 as per **Table 9-20**. However, it should be noted that several activities will take place in the same area e.g. where boulder clearance overlaps with sand wave clearance, the boulder clearance footprint will be within the sand wave clearance footprint and such the extent of areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower.

125. Receptors are grouped according to the following criteria for the assessment against temporary seabed habitat disturbance during construction:

- Mobile fish with spawning and nursery areas that overlap the offshore development area;
- Mobile fish and turtle species with no spawning and nursery areas overlapping the offshore development area; and
- Shellfish.

126. Undertaking the assessment using the above groups is considered to provide a suitable level of assessment, which takes account of any potential fish, shellfish, or turtle receptor that may be affected by the CWP Project, whilst focussing on those that are of most relevance to the assessment (see **Section 9.6.7**).

Mobile fish with spawning and nursery areas that overlap the offshore development area

Receptor sensitivity

127. Mobile fish with spawning and nursery areas that overlap the offshore development area are listed below in **Table 9-23**. Sensitivity has been determined based upon the definitions set out in **Table 9-23**, with information from **Table 9-18**. Across the receptor group, all are mobile species and therefore have a high capacity (adaptability) to avoid the impact by fleeing the area of disturbance, with the exception being sandeel, a less mobile species and therefore only a medium capacity (adaptability) to avoid the impact. The tolerance of the majority of species within this group is considered to be high for the impact of temporary seabed habitat disturbance. This is because most species are highly mobile and can move away from the area of impact, and have extensive equivalent habitat in the surrounding area which can be utilised for the same functions. For some species with low mobility or high habitat fidelity, such as sandeels, tolerance is considered to be low as they cannot easily relocate to another area and as such are more susceptible to adverse effects of temporary seabed habitat disturbance. Species which are considered highly mobile but that use the substrate in the immediate area for

spawning (i.e., thornback ray and spotted ray) are considered to have medium tolerance as although adults or juveniles are unlikely to be adversely affected, impacts to eggs may arise. Recoverability is high based on fecundity should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value ranges from low to medium according to conservation status.

128. As per **Table 9-23**, sensitivity for this species group ranges from very low to medium.

Table 9-23 Mobile fish with overlapping spawning / nursery habitat sensitivity

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Anglerfish	High	High	High	Low	Very Low
Haddock	High	High	High	Low	Very Low
Whiting	High	High	High	Low	Very Low
European plaice	High	High	High	Low	Very Low
Atlantic mackerel	High	High	High	Low	Very Low
Atlantic horse mackerel	High	High	High	Low	Very Low
Lemon sole	High	High	High	Low	Very Low
Common sole	High	High	High	Low	Very Low
European sprat	High	High	High	Low	Very Low
Sandeel	Low	Low	High	Low	Medium
Ling	High	High	High	Low	Very Low
Atlantic cod	High	High	High	Medium	Low
Thornback ray	Low	Medium	High	Medium	Medium
Spotted ray	Low	Medium	High	Medium	Medium
Tope	High	High	High	Low	Very low

Magnitude of impact

129. Mobile fish with spawning and nursery areas that overlap the offshore development area are at risk of having the habitats within those spawning and nursery grounds impacted by temporary seabed habitat disturbance from the construction of the offshore infrastructure.

130. The effect on receptors will be a loss of available spawning area or harm or loss of low mobility individuals caused by physical disturbance to the seabed, or through behavioural responses leading to avoidance of the area thereby reducing the overall available area within which spawning or nursery activities may take place.

131. Based upon the Project Design and LOD, the percentage overlap of infrastructure within the array site has been calculated based upon the percentage of overlap of any spawning or nursery ground with the array site. Within the OECC, the area of effect assumes the maximum extent of those activities with the largest footprint, such as boulder clearance, occurring within the overlapping area of any spawning or nursery grounds.

132. The greatest percentage of spawning or nursery area affected (based upon the available spawning and nursery areas within the Irish Sea study area is 0.947 % and 0.079 % for whiting spawning and haddock nursery habitats respectively (**Table 9-24**).

133. Of the species with spawning or nursery areas that overlap the offshore development area, substrate spawners are considered at the greatest risk from temporary seabed habitat disturbance, as this may result in direct disturbance to a key life stage for the species. The duration of this impact is short (no more than 3 years in duration), and disturbance events will not persist for this entire period, instead acting as discrete events throughout the construction phase. It is recognised that some areas may see repeated disturbance within the construction period, though these will be minimal.

134. Substrate spawning species with overlapping spawning areas are:

- Thornback ray (**Figure 9-18**)
- Spotted ray (**Figure 9-16**)
- Sandeel (**Figure 9-15**)

135. Non-substrate spawners with overlapping spawning or nursery grounds are:

- Norway lobster (**Figure 9-13**)
- Tope (**Figure 9-19**)
- Haddock (**Figure 9-9**)
- Whiting (**Figure 9-20**)
- European plaice (**Figure 9-14**)
- Atlantic mackerel (**Figure 9-5**)
- Atlantic horse mackerel (**Figure 9-10**)
- Lemon sole (**Figure 9-11**)
- Common sole (**Figure 9-6**)
- European sprat (**Figure 9-8**)
- Atlantic cod (**Figure 9-3**)
- Anglerfish (**Figure 9-2**)
- Ling (**Figure 9-12**)

136. The following species have known spawning or nursery habitat within the Irish Sea study area, but do not have any overlap with the offshore development area. Therefore, they are considered under mobile species with no overlapping spawning or nursery habitats below.

- Spurdog / spiny dogfish (**Figure 9-17**)
- European hake (**Figure 9-7**)
- Atlantic herring (**Figure 9-4**)

137. The greatest percentage of a substrate spawning species' spawning area affected (based upon the available spawning and nursery areas within the Irish Sea study area) is *c.* 0.02% for all species (**Table 9-24**).

138. Reductions in spawning or nursery habitat at this scale for both substrate and water column spawning species is considered negligible in terms of the species' ability to maintain functional processes. No effect on populations or cohort size is predicted to arise as a result of temporary seabed habitat disturbance during construction on species with spawning or nursery areas overlapping the offshore development area.

139. The magnitude of effect across all species with spawning or nursery habitat affected by temporary seabed habitat disturbance is considered to be negligible.

Table 9-24 Temporary habitat loss based on intended location of offshore infrastructure (% overlap) compared to mapped spawning and nursery grounds in the Irish Sea Study Area when considering PD and representative scenario parameters

	Spawning grounds						Nursery grounds			
Receptor (species)	Ellis et al. (2012) - Low intensity	Ellis et al. (2012) - High intensity	Coull et al. (1998) - Lower Intensity	Coull et al. (1998- Higher Intensity	Coull et al. (1998) - Undetermined Intensity	Ireland's Marine Atlas	Ellis et al. (2012) - Low intensity	Ellis et al. (2012) - High intensity	Coull et al. (1998)	Ireland's Marine Atlas
Norway lobster					0.032 %				0.033 %	
Thornback ray							0.032 %			
Spotted ray							0.031 %			
Spurdog	No overlap with the CWP offshore development area									
Tope							0.026 %			
Haddock						0.249 %			0.076 %	0.048 %
Whiting	0.019 %		0.056 %	0.947 %		0.034 %	0.026 %	0.036 %	0.051 %	
European plaice	0.024 %	0.071%	0.056 %				0.033 %			
Atlantic mackerel	0.022 %									0.015 %
Atlantic horse mackerel										0.015 %
Lemon sole					0.038 %				0.038 %	

	Spawning grounds						Nursery grounds			
Receptor (species)	Ellis et al. (2012) - Low intensity	Ellis et al. (2012) - High intensity	Coull et al. (1998) - Lower Intensity	Coull et al. (1998- Higher Intensity	Coull et al. (1998) - Undetermined Intensity	Ireland's Marine Atlas	Ellis et al. (2012) - Low intensity	Ellis et al. (2012) - High intensity	Coull et al. (1998)	Ireland's Marine Atlas
Common sole	0.026 %		0.062 %							
Sandeel	0.023 %						0.043 %			
Atlantic herring	No overlap with the CWP offshore development area									
European sprat					0.016 %					
Atlantic cod	0.024 %		0.085 %	0.432 %		0.060 %		0.048 %	0.079 %	0.018 %
Angler fish							0.015 %			
European hake	No overlap with the CWP offshore development area									
Ling	0.032 %									

Significance of the effect

140. The significance of effect has been summarised by each receptor in **Table 9-25**. The assessment considers the receptor sensitivity and the likely magnitude of the potential impact to provide a significance conclusion which aligns with the matrix approach presented in **Section 9.4.3**.

Table 9-25 Determination of Significance for mobile fish with spawning and nursery areas that overlap the offshore development area based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Anglerfish	Very Low	Negligible	**Imperceptible** (not significant)
Haddock	Very Low	Negligible	**Imperceptible** (not significant)
Whiting	Very Low	Negligible	**Imperceptible** (not significant)
European plaice	Very Low	Negligible	**Imperceptible** (not significant)
Atlantic mackerel	Very Low	Negligible	**Imperceptible** (not significant)
Atlantic horse mackerel	Very Low	Negligible	**Imperceptible** (not significant)
Lemon sole	Very Low	Negligible	**Imperceptible** (not significant)
Common sole	Very Low	Negligible	**Imperceptible** (not significant)
European sprat	Very Low	Negligible	**Imperceptible** (not significant)
Sandeel	Medium	Negligible	**Slight / Not significant** (not significant)
Ling	Very Low	Negligible	**Imperceptible** (not significant)
Atlantic cod	Low	Negligible	**Not significant**
Thornback ray	Medium	Negligible	**Slight / Not significant** (not significant)
Spotted ray	Medium	Negligible	**Slight / Not significant** (not significant)
Tope	Very low	Negligible	**Imperceptible** (not significant)

141. In summary, mobile fish with spawning and nursery areas that overlap the offshore development area have very low to medium sensitivities. The magnitude of impact is predicted to be negligible. Several species experience the highest significance (slight / not significant), which is not significant. The impact of temporary seabed habitat disturbance from construction is considered to be **not significant** for mobile fish species with overlapping spawning or nursery habitat.

142. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

143. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Mobile fish and turtle species without spawning and nursery areas that overlap the offshore development area

Receptor sensitivity

144. Mobile fish and turtle species without spawning and nursery areas overlapping the offshore development area are listed below in **Table 9-26**. Sensitivity has been determined based upon **Table 9-26**, with information feeding this assessment coming from **Table 9-18**. Across the species group, all are mobile species and therefore have a high capacity (adaptability) to avoid the impact by fleeing the area of temporary seabed habitat disturbance. The tolerance of the species within this group is considered to be high for the impact of temporary seabed habitat disturbance. This is because all species are highly mobile and can move away from the area of impact and have extensive equivalent habitat in the surrounding area which can be utilised for the same functions. Recoverability is high for the majority of receptors in this group based on fecundity should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. For basking shark and marine turtles, recovery is low due to their greater age at maturity and lower fecundity (Wilson et al., 2020). Value ranges from low to high according to conservation status.

145. As per **Table 9-26**, sensitivity for this species group ranges from very low to medium.

Table 9-26 Mobile fish and turtle species with spawning and nursery areas that do not overlap the offshore development area sensitivity

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Small-spotted catshark	High	High	High	Low	Very Low
Cuckoo ray	High	High	High	Low	Very Low
Blonde ray	High	High	High	Low	Very Low
Seatrout	High	High	High	Low	Very Low
Atlantic herring	High	High	High	Low	Very Low
European smelt	High	High	High	Low	Very Low
Undulate ray	High	High	High	Low	Very Low
Twaite shad	High	High	High	High	Low
Allis shad	High	High	High	High	Low
Atlantic salmon	High	High	High	High	Low
Sea lamprey	High	High	High	High	Low
River lamprey	High	High	High	High	Low
European eel	High	High	High	Medium	Low
Common skate	High	High	High	Medium	Low
Angel shark	High	High	High	Medium	Low
Basking shark	High	High	Low	Medium	Medium
Leatherback turtle	High	High	Low	Medium	Medium

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
European hake	High	High	High	Low	Very Low
Spurdog	High	High	High	Medium	Low

Magnitude of impact

146. The effect on receptors will be a temporary loss of available habitat area, caused by physical disturbance to the seabed, or through behavioural responses leading to avoidance of the area thereby reducing the overall available habitat for activities such as foraging.

147. Mobile fish and turtles may use the offshore development area for a wide range of biological functions, from migration to feeding for example. Temporary seabed habitat disturbance may reduce the available area for foraging or other life history requirements; however this represents a short-term impact that affects a negligible proportion of the natural range of all the species that may be present in this area. Extensive areas of comparable habitat are also available outside the affected area. As such, the magnitude of the impact on mobile fish and turtle species without spawning and nursery areas that overlap the offshore development area is considered to be negligible.

Significance of effect

148. The significance of effect has been summarised by each receptor in **Table 9-27**.

Table 9-27 Determination of Significance for mobile fish and turtle species with spawning and nursery areas that do not overlap the offshore development area based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Small-spotted catshark	Very Low	Negligible	**Imperceptible** (not significant)
Cuckoo ray	Very Low	Negligible	**Imperceptible** (not significant)
Blonde ray	Very Low	Negligible	**Not significant**
Seatrout	Very Low	Negligible	**Imperceptible** (not significant)
Atlantic herring	Very Low	Negligible	**Imperceptible** (not significant)
European smelt	Very Low	Negligible	**Imperceptible** (not significant)
Undulate ray	Very Low	Negligible	**Imperceptible** (not significant)
Twaite shad	Low	Negligible	**Not significant**
Allis shad	Low	Negligible	**Not significant**
Atlantic salmon	Low	Negligible	**Not significant**
Sea lamprey	Low	Negligible	**Not significant**
River lamprey	Low	Negligible	**Not significant**
European eel	Low	Negligible	**Not significant**

Species	Sensitivity	Magnitude	Significance
Common skate	Low	Negligible	**Not significant**
Angel shark	Low	Negligible	**Not significant**
Basking shark	Medium	Negligible	**Slight / Not significant** (not significant)
Leatherback turtle	Medium	Negligible	**Slight / Not significant** (not significant)
European hake	Very Low	Negligible	**Imperceptible** (not significant)
Spurdog	Low	Negligible	**Not significant**

149. In summary, this species group is identified as having very low to medium sensitivities. The magnitude of impact is predicted to be negligible. Basking shark and leatherback turtle are assessed to have the greatest level of significance (slight / not significant), which is not significant. The impact of temporary seabed habitat disturbance from construction is considered to be **not significant** for mobile fish and turtle species with spawning and nursery areas that do not overlap the offshore development area.

150. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

151. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Shellfish

Receptor sensitivity

152. Shellfish species are listed below in **Table 9-28**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Across the species group, all are non-mobile or low mobility species and therefore have a low to very low capacity (adaptability) to avoid the impact by fleeing the disturbed area. The tolerance of the species within this group is considered to be low for the impact of temporary seabed habitat disturbance. This is because the species group are not mobile and cannot move away from the area of impact and as such, they are more susceptible to adverse effects of temporary seabed habitat disturbance such as physical harm and damage. Recoverability is high based on fecundity should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value is low according to conservation status.

153. As per **Table 9-28**, sensitivity for shellfish is medium for the group.

Table 9-28 Shellfish sensitivities

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Razor / knife clams	Very low	Low	High	Low	Medium
Norway lobster	Very low	Low	High	Low	Medium
Sword razor shell	Very low	Low	High	Low	Medium
Whelk	Very low	Low	High	Low	Medium
Great Atlantic scallop	Very low	Low	High	Low	Medium
Edible crab	Low	Low	High	Low	Medium
European lobster	Low	Low	High	Low	Medium

Magnitude of impact

154. For temporary seabed habitat disturbance, the effect on receptors will be a loss of suitable habitat, physical injury or mortality, or reduced fitness through increased energetic requirements, such as re-establishment of burrows. Shellfish species are typically less mobile than fish receptors and may burrow or live within the sediment. As such, they can be more susceptible to direct effects arising from temporary seabed habitat disturbance.

155. The duration of this impact is short (no more than three years in duration), and disturbance events will not persist for this entire period, instead acting as discrete events throughout the construction phase. It is recognised that some areas may see repeated disturbance within the construction period, though these will be minimal.

156. Overall, the effects of temporary habitat disturbance may affect up to *c*. 4.4 % of the available habitats that may be utilised by shellfish within the offshore development area, and a negligible proportion of the available habitats within the wider local and regional study areas. *Nephrops Norvegicus* has overlapping spawning and nursery grounds (as per Coull et al. (1998)), and based upon the overlap of potential activities, the area of *Nephrops* habitat affected is 0.02 %. However, most of the habitat in the offshore development area is not suitable for *Nephrops* as it is coarse sediments and sands, and there is no evidence of *Nephrops* fishing in the array site (as per **Chapter 12 Commercial Fisheries**). *Nephrops* prefer muddy sediments which are not present in the array site or along much of the OECC, therefore it is expected that negligible levels of suitable habitat for *Nephrops* will be impacted.

157. As such, the magnitude of impact of temporary seabed habitat disturbance on all shellfish receptors is low.

Significance of effect

158. The significance of effect has been summarised by each receptor in the below **Table 9-29**.

Table 9-29 Determination of Significance for shellfish habitats based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Norway lobster	Medium	Low	**Slight** (not significant)
Whelk	Medium	Low	**Slight** (not significant)
Razor / knife clams	Medium	Low	**Slight** (not significant)
Sword razor shell	Medium	Low	**Slight** (not significant)
Great Atlantic scallop	Medium	Low	**Slight** (not significant)
Edible crab	Medium	Low	**Slight** (not significant)
European lobster	Medium	Low	**Slight** (not significant)

159. In summary, shellfish are identified as having medium sensitivity. The magnitude of impact is predicted to be low. All species experience the highest significance (Slight), which is not significant. The impact of temporary seabed habitat disturbance from construction is considered to be **not significant** for shellfish species.

160. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

161. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Impact 2: Noise and Vibration

162. Fish, shellfish, and turtles may be affected by underwater noise and vibration arising from construction activities. Underwater noise and vibration may arise from piling or other construction activities including cable installation.

163. Modelling of noise sources to develop propagation models from piling events at four representative piling locations within the array site has been undertaken (see **Appendix 9.3** and **Appendix 9.4**). These locations were selected as representative locations of the differing conditions that occur within the site and therefore differing degrees of noise propagation. Thresholds for mortality and recovery from impact piling related impacts are considered as either a single strike peak Sound Pressure Level (SPL_{Peak}) or a Cumulative Sound Exposure Level (SEL_{Cum}), both of which are provided in this assessment. Additionally, the reaction of fish to sound can be considered in two ways; the first is a fleeing model based on a fish fleeing from a sound source, and the second is a stationary model which considers that the fish receiving the increase in noise and vibration levels does not move away. Both of these options are provided within this assessment as a precautionary approach. However, it is considered that in almost all cases, fish will flee the area of elevated underwater noise and vibration, unless there are key drivers (i.e., presence of functional habitat during critical life phases such as a spawning ground) which may cause them to remain relatively static.

164. During monopile installation, piles are generally expected to be driven (impact piling), however, vibropiling or drilling may also be used. As per **Table 9-18**, the representative scenario will focus on impact piling as it presents the greatest noise and vibration generating capacity. Due to the bathymetry of the array site, the south-east corner of the array site has the largest potential area of sound propagation and will be used as the assessment point for species that do not have spawning / nursery grounds. Where spawning / nursery information exists, the overlap will be assessed against all

modelling locations to determine the greatest degree of overlap. Noise modelling was also undertaken in the Liffey where piling will be required. In the Liffey two model scenarios are considered, one where a single pile is installed at a time, and a second model where two piles are installed simultaneously. A summary of the greatest overlap between the noise modelling contours and known spawning and nursery habitats from Coull et al. (1998), Ellis et al. (2012) and Irelands Marine Atlas has been provided. Highlighted maximums of the largest impact arising from the piling of the array site only is presented under each hearing type, as the largest overlap of the Liffey modelling outputs with spawning or nursery habitat was <0.5 % for both fleeing and stationary animals in all cases. For the full outputs of all the overlap areas, refer to **Appendix 9.3**. Barrier effects for migratory species into the River Liffey from piling noise and vibration is also considered.

165. Part of the primary mitigation measures (**Section 9.9;** see the MMMP) includes the use of a soft-start to impact piling. This involves a gradual ramping up of the piling power over an incremental time period in order to reach full power. It is expected that starting the activity at a lower power will allow for nearby marine species, including fish, to flee the area, reducing the likelihood of mortality and injury effects (JNCC, 2010). Additionally, there are three piling scenarios with different levels of impact (listed below). Due to the bathymetry of the site affecting sound propagation, the follow specific scenarios have been used across the site:

- Scenario 1 (slow soft start and ramp up, single pile in 24 hrs) is the only scenario considered in the SE corner outputs;
- Scenario 2 (soft start, single pile in 24 hrs) is the only scenario considered in the NE and SW corner outputs; and
- Scenario 3 (soft start, two piles in 24 hrs) is the only scenario considered in the NW corner.

166. In addition to piling, other noise generating activities are predicted to occur during the construction phase; such as clearance of UXO, geophysical surveys, and construction activities other than piling (e.g. cable installation, seabed preparation, and scour protection installation). This additional noise and vibration has the potential to affect fish, shellfish and turtle, and is assessed below.

167. There are two main categories of sound detection, each related to the different ways in which sound propagates; these are noise detection through sound pressure, and through particle motion. Particle motion is the displacement, velocity and acceleration of particles which stimulate the specially designed sensors, such as otolithic organs within fish ears (Popper et al., 2014). Sound pressure, a deviation from ambient pressure caused by a sound wave (Pulsar Instruments PLC, 2019), can be detected by gas filled organs such as the swim bladder (Popper et al., 2014). Different species have different physiological adaptations which affect how they use or respond to sound and vibration (Popper et al., 2014). These differences, or hearing types, have been used to classify the assessment groups (**Table 9-30**). Within each hearing group, thresholds of sound levels have been established that cause mortality, recoverable injury and temporary threshold shift (TTS; a temporary reduction in hearing sensitivity that may cause a decrease in communication, predator / prey detection as assessment of the environment (Popper et al., 2014)). Where a hearing type includes species with spawning / nursery grounds in the area, the modelling location that produces the greatest spatial overlap of noise and vibration related effects has been chosen as the representative scenario (**Appendix 9.3**).

168. Receptors are grouped according to the following criteria for the assessment against noise and vibration during construction, with the detailed criteria presented in **Table 9-30**:

- Group one hearing type;
- Group two hearing type;
- Group three hearing type;
- Group four hearing type;
- Shellfish; and
- Turtles.

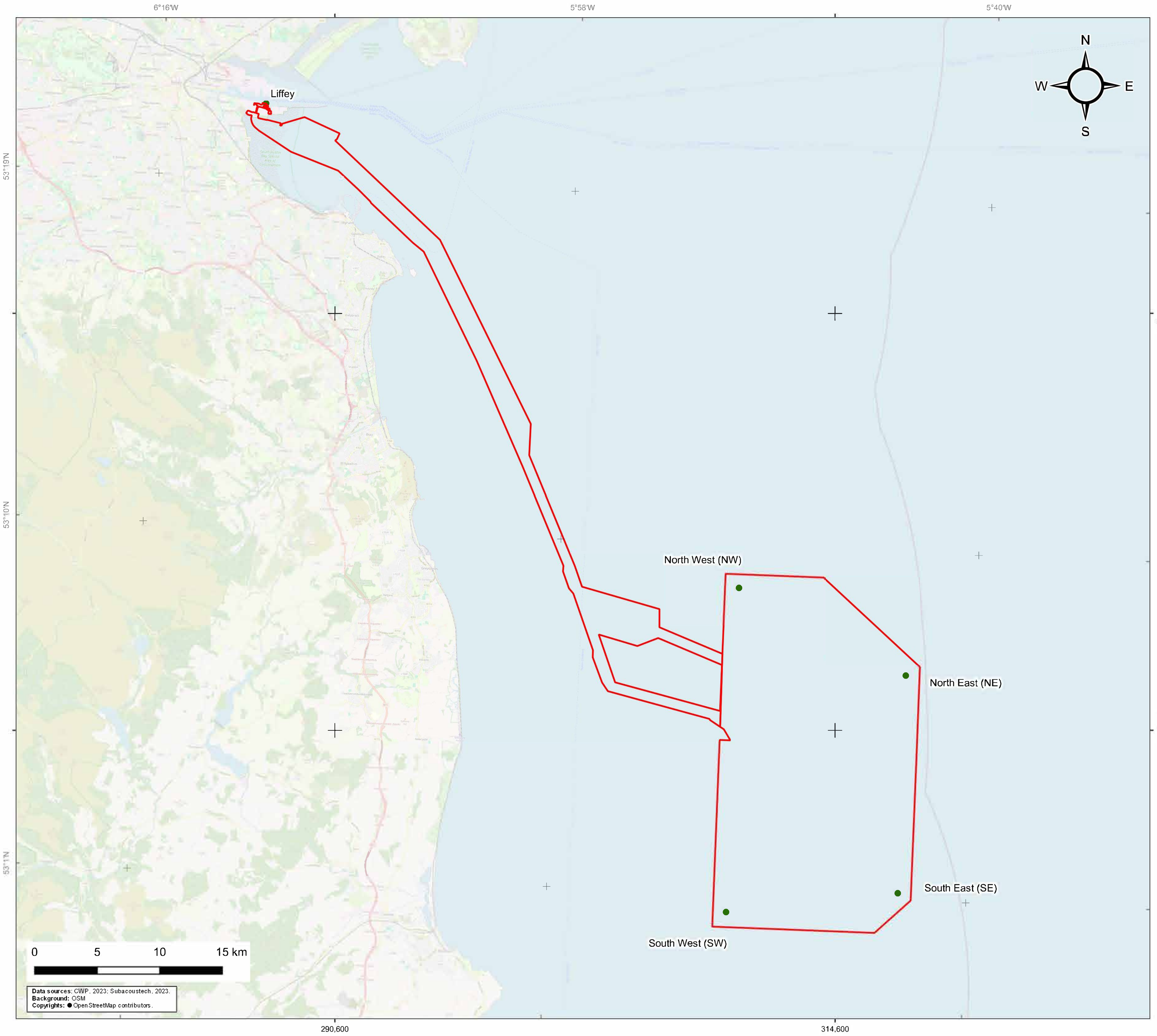
169. Undertaking the assessment using the above groups is considered to provide a suitable level of assessment, which takes account of any potential fish, shellfish, or turtle receptor that may be affected by the construction activities, whilst focussing on those that are of most relevance to the assessment (see **Section 9.6**).

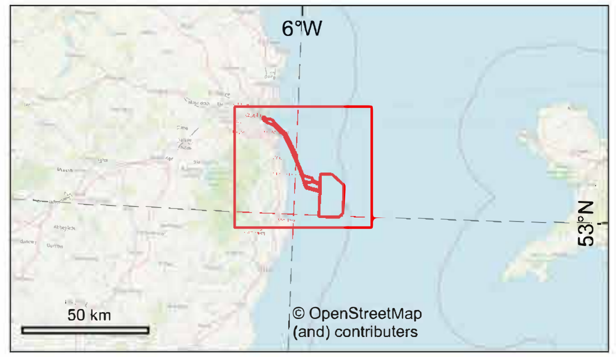
Table 9-30 Classification of species by hearing type as per Popper et al. (2014)

Group	VER Species	Piling			Explosion (UXO)
		Mortality and potential mortal injury	Recoverable injury	Temporary Threshold Shift	Mortality and potential mortal injury
Group one – Fishes without a swim bladder or any other gas-filled body cavities. These species are considered to only be sensitive to particle motion.	Blonde ray, small-spotted catshark, cuckoo ray, thornback ray, spotted ray, tope, common skate, angel shark, spurdog / spiny dogfish, Undulate ray, European plaice, sandeel, sea lamprey, river lamprey, lemon sole, common sole, basking shark	>219 dB SEL_{cum} >213 dB peak	>216 dB SEL_{cum} >213 dB peak	>186 dB SEL_{cum}	229–234 dB peak
Group 2 – Fishes with swim bladders or other gas-filled body cavities which are not involved in hearing. These species are also considered only to be sensitive to particle motion and include salmonids and some pelagic species, such as mackerel.	Atlantic salmon, sea trout, Atlantic mackerel, whiting, Atlantic horse mackerel, ling, European hake, haddock	210 dB SELcum >207 dB peak	203 dB SELcum >207 dB peak	>186 dB SELcum	229–234 dB peak
Group 3 – Fishes with swim bladders or other gas-filled body cavities which are involved in hearing. These species are considered to be sensitive to both particle motion and sound pressure and include gadoids, such as cod, and some pelagic species, such as herring. Due to their ability to detect the pressure component of underwater	Atlantic herring, European sprat, Atlantic cod, European smelt*, twaite shad, allis shad, European eel*, angler fish*.	207 dB SEL_{cum} >207 dB peak	203 dB SEL_{cum} >207 dB peak	186 dB SEL_{cum}	229–234 dB peak

Group	VER Species	Piling			Explosion (UXO)
		Mortality and potential mortal injury	Recoverable injury	Temporary Threshold Shift	Mortality and potential mortal injury
noise, the frequency sensitivity ranges of these species and their acuity levels are greater, hence this group is frequently referred to as the 'hearing specialists'.					
Group 4 – Eggs and larvae	All species	>210 dB SEL_{cum} >207 dB peak	N/A	N/A	>13mm s^{-1}
Shellfish	Razor / knife clams, Norway lobster, sword razor shell, whelk, great Atlantic scallop, edible crab, European lobster	N/A	N/A	N/A	N/A
Turtles	Leatherback turtle	210 dB SEL_{cum} >207 dB peak	N/A	N/A	N/A

*Denotes uncertainty with species hearing mechanism; therefore, placed in the most precautionary grouping





Legend

- Planning Application Boundary (PAB)
- Pile driving noise modelling location

codling wind park	Project: Codling Wind Park	Contractor: natural power www.naturalpower.com

Figure 9.21
Noise modelling locations

CWP doc. number:	CWP-NPC-ENG-08-01-MAP-1152		
Internal descriptive code: WE - PAB..DPNMLs - - EIAR.FIG.09.21	Size: A3	Scale: 1:175,000	CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
00	Final for issue	2024/07/24	AC	ME/EA	SM

Group One

Receptor sensitivity

170. As per **Table 9-30**, group one species have been classed based on their hearing type, and are listed below in **Table 9-31**. Sensitivity has been determined based upon the definitions set out in **Table 9-31**, with information feeding this assessment coming from **Table 9-18**. Across the species group, all are mobile species and therefore have a high capacity (adaptability) to avoid the impact by fleeing during the soft start, with the exception being sandeel, a less mobile species and therefore only a medium capacity (adaptability) to avoid the impact. Recoverability ranges from low to high based on fecundity should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value ranges from low to high according to conservation status. Group one fish have a low ability to perceive sound and lack of gas filled organ and thus a high tolerance to the impact. This high tolerance to underwater noise and vibration is also utilised within the modelling which accounts for the distances over which sound can be perceived by these species.

171. As per **Table 9-31**, sensitivity for group one species ranges from very low to medium.

Table 9-31 Group one species sensitivities

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Small-spotted catshark	High	High	Medium	Low	Low
Cuckoo ray	High	High	Medium	Low	Low
Blonde ray	High	High	Medium	Low	Low
European plaice	High	High	High	Low	Very Low
Sandeel	Medium	High	High	Low	Low
Lemon sole	High	High	High	Low	Very Low
Common sole	High	High	High	Low	Very Low
Undulate ray	High	High	Medium	Low	Low
Thornback ray	High	High	Medium	Medium	Medium
Spotted ray	High	High	Medium	Medium	Medium
Spurdog / spiny dogfish	High	High	Medium	Medium	Medium
Sea lamprey	High	High	High	High	Low
River lamprey	High	High	High	High	Low
Tope	High	High	Medium	Low	Low
Common skate	High	High	Medium	Medium	Medium
Angel shark	High	High	Medium	Medium	Medium
Basking shark	High	High	Low	Medium	Medium

Magnitude of Impact

172. The identification of thresholds (as per Popper et al., 2014), as well as the representative scenario outputs for group one species are listed in **Table 9-32**. The maximum, mean and minimum values represent the radius of impact from the modelling location which is directly influenced by the bathymetry within the receiving environment. A visualisation of the sound level contours for group one species can be seen in **Figure 9-22,** and where relevant species-specific overlaps with established data sources on nursery / spawning habitats can be seen in **Appendix 9.3**.

Table 9-32 Group one Least Restrictive Scenario for piling

					Array				Liffey		
Activity	**Response**	**Level**	**Risk**	**Threshold**	**Area (km^2)**	**Maximum (m)**	**Mean (m)**	**Minimum (m)**	**Area (km^2)**	**Maximum (m)**	**Mean (m)**
Piling	Stationary	SPL_{peak}	Mortality and potential mortal injury	>213 dB	0.04	110	110	110	<0.01	<50	<50
			Recoverable injury	>213 dB	0.04	110	110	110	<0.01	<50	<50
		SEL_{cum}	Mortality and potential mortal injury	>219 dB	0.4	380	360	350	0.03	370	260
			Recoverable injury	>216 dB	1	580	560	550	0.4	550	330
			Temporary Threshold Shift	>186 dB	1,800	34,000	24,000	14,000	25	11000	1300
	Fleeing	SEL_{cum}	Mortality and potential mortal injury	>219 dB	<0.1	<100	<100	<100	<0.01	<100	<100
			Recoverable injury	>216 dB	<0.1	<100	<100	<100	<0.01	<100	<100
			Temporary Threshold Shift	>186 dB	740	24,000	14,000	5,700	3.2	3500	630

Mortality

173. Group one fish at risk of mortality and potential mortal injury in the array piling operations area (**Table 9-32**) under the stationary model may be observed over an area of approximately 0.04 km^2 or a maximum distance of 110 m from the source for peak sound pressure level, and an area of 1.1 km^2 or a maximum distance of 630 m from the source for cumulative level exposure. These values drop significantly to less than 0.1 km^2 or less than 100 m from the source when the fleeing model is used. Fish are expected to flee when not engaged in active spawning or other life critical behaviours, and as such the majority of individuals will be affected over these smaller distances.

174. Group one fish at risk of mortality and potential mortal injury in the proximity to the Liffey piling operations (**Table 9-32**) under the stationary model may be observed over an area of approximately 0.04 km^2 or a maximum distance of 110 m from the source for peak sound pressure level, and an area of 0.4 km^2 or a maximum distance of 380 m from the source for cumulative level exposure. These values drop significantly to less than 0.1 km^2 or less than 100 m from the source when the fleeing model is used.

175. Of the group one hearing species, the following have spawning (S) and / or Nursery (N) grounds in the Irish Sea study area. Thornback ray (N), Spotted ray (N), Tope (N), Spurdog (N) / Spiny dogfish, European plaice (S / N), Sandeel (S / N), Lemon sole (S / N), Common sole (S), and Haddock (S / N). Of note, while present in the area, there is no overlap between Spurdog spawning / nursery habitat.

176. The overlap of the noise modelling contours with the known spawning and nursery habitat within the Irish Sea study area has been calculated in **Appendix 9.3** with maximum values highlighted in **Table 9-34**, based upon the stationary and fleeing model. For visualisation of the noise overlap with spawning and nursery grounds, refer to **Figure 9-23** to **Figure 9-29**.

177. The greatest percentage of area affected by mortality under the stationary model (based upon the overlap with available spawning and nursery areas within the Irish Sea study area) is <0.01 % for all group one nursery and spawning species (**Table 9-34**). It is recognised that fish species not engaged in spawning activities may be present in the area, however, it is considered that any noise impacts will only affect a small number of individuals of such species.

178. The greatest percentage of area affected by mortality under the fleeing model (based upon the overlap with available spawning and nursery areas within the Irish Sea study area) is <0.01 % for all group one spawning and nursery species (**Table 9-34**).

179. Piling is a temporary impact of a maximum 75 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species within the above ranges. For group one species, there is a maximum area of mortality of 1.1 km^2 for any given single piling event, and a negligible overlap with spawning / nursery habitat (<0.01% of habitat within the Irish Sea study area). As such, the magnitude for mortality effects is considered negligible for both the fleeing and stationary models. Primary mitigation measures (**Section 9.9**) including soft start, will provide an opportunity for all individuals to move out of the areas of potential mortality.

Recoverable Injury

180. Group one fish at risk of recoverable injury for the array site piling operations area (**Table 9-32**) under the stationary model are predicted to occur within an area of approximately 0.04 km^2 or a maximum distance of 110 m from the source for peak sound pressure level, and an area of 2.7 km^2 or a maximum distance of 950 m from the source for cumulative level exposure. These values drop significantly to less than 0.1 km^2 or less than 100 m from the source when the fleeing model is used.

181. Group one fish at risk of recoverable injury in proximity to the onshore substation piling operations (**Table 9-32**) under the stationary model are predicted to occur within an area of approximately 0.04

km^2 or a maximum distance of 110 m from the source for peak sound pressure level, and an area of 1 km^2 or a maximum distance of 580 m from the source for cumulative level exposure. These values drop significantly to less than 0.1 km^2 or less than 100 m from the source when the fleeing model is used.

182. The greatest percentage of spawning or nursery area affected by recoverable injury under the stationary model (based upon the overlap with available spawning and nursery areas within the Irish Sea study area) is up to 0.01 % for multiple species (**Table 9-34; Appendix 9.3**). It is recognised that fish species not engaged in spawning activities may be present in the area, however, it is considered that any effect will only affect a small number of individuals of such species.

183. The greatest percentage of spawning or nursery area affected by recoverable injury under the fleeing model (based upon the overlap with available spawning and nursery areas within the Irish Sea study area) is >0.01 % for all group one spawning and nursery species (**Table 9-34; Appendix 9.3**).

184. Piling is a temporary impact of maximum 75 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the recoverable injury of species within the above ranges / overlaps. For group one species, there is a maximum area of recoverable injury of 1.1 km^2, or a negligible overlap of spawning / nursery habitat (0.01 % of habitat within the Irish Sea study area at the most). As such, the magnitude for recoverable injury is considered negligible for both the fleeing and stationary models**.** Primary mitigation measures (**Section 9.9**) including soft start will provide an opportunity for all individuals to move out of the areas of potential recoverable injury.

Temporary Threshold Shift (TTS) / Behavioural responses

185. Group one fish at risk of TTS during the array piling operations under the stationary model are predicted within an area of approximately 1,800 km^2 or a maximum distance of 34 km from the source for cumulative level exposure. These values drop significantly to 740 km^2 or a maximum of 24 km from the source when the fleeing model is used.

186. Group one fish at risk of TTS in proximity to the onshore substation piling operations under the stationary model are predicted within an area of approximately 25 km^2 or a maximum distance of 11 km from the source for cumulative level exposure. These values drop significantly to 3.2 km^2 or a maximum of 3.5 km from the source when the fleeing model is used.

187. The greatest percentage of area affected by TTS under the stationary model (based upon the overlap with available spawning and nursery areas within the Irish Sea study area) is 9.71 % for lemon sole spawning and nursery areas respectively (**Table 9-34; Appendix 9.3**). It is recognised that fish species not engaged in spawning activities may be present in the area, however, it is considered that noise impacts will only affect a small number of individuals of such species.

188. The greatest percentage of area affected by TTS under the fleeing model (based upon the overlap with available spawning and nursery areas within the Irish Sea study area) is 3.79 % and 3.80 % for lemon sole spawning and nursery areas respectively (**Table 9-34; Appendix 9.3**).

189. Impact piling operations will last a maximum 75 days over the construction period, and any impacts will be temporary, and a maximum of two piles will be driven per day, for a total of seven hours of piling in a 24-hour period. While the percentage of overlap of a spawning area provides useful context, it does not take into account the short term and temporary nature of the work compared to the duration of available spawning potential. As such the proportion of spawning potential impacted has been calculated in **Table 9-33**, using the TTS area as the greatest modelled area of impact. When availability of spawning duration is factored in, the greatest impact to spawning potential is 0.59 % (common sole). When compared to the available spawning habitat and duration, the impact is considered negligible, and effects will be imperceptible.

Table 9-33 Group one temporal overlap results (presented only for species where there is greater than 1% overlap with spawning or nursery habitat

Species	Spawning potential (km^2h)	Impacted spawning potential (km^2h)	Proportion of spawning potential impacted (%)
European plaice	28,865,991	117,341	0.41 %
Lemon sole	85,367,494	495,420	0.58 %
Common sole	42,707,928	252,315	0.59 %
Sandeel	91,432,768	252,237	0.28 %

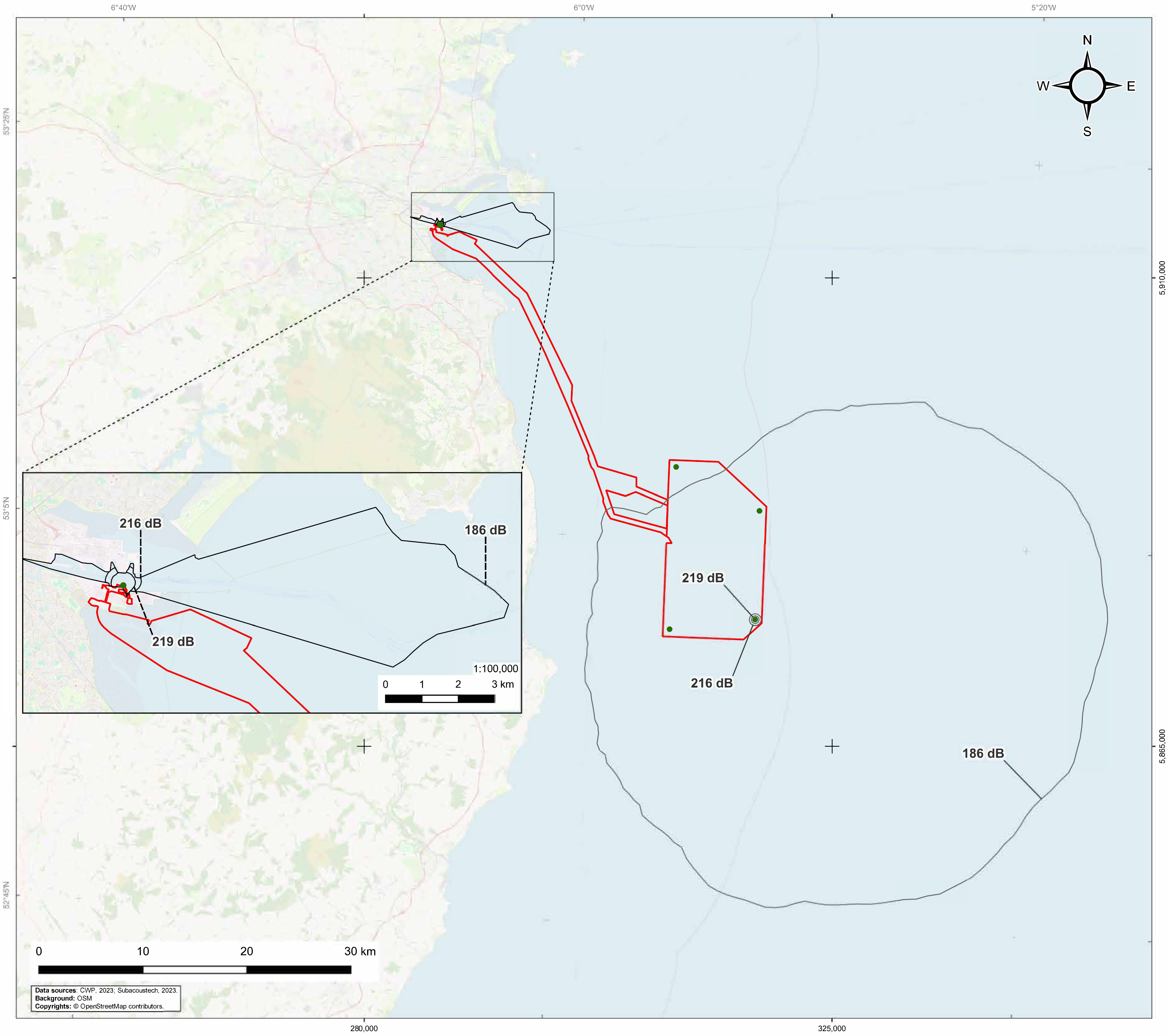
190. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas. These behavioural responses are likely to be akin to predator avoidance responses and will decrease both in severity and in the percentage of the population affected as distance increases from the noise source (Knaap et al., 2021). Such behavioural responses will be short term, and due to the behavioural nature of the effects, recovery will be very fast, with potential for habituation over the term of the construction phase.

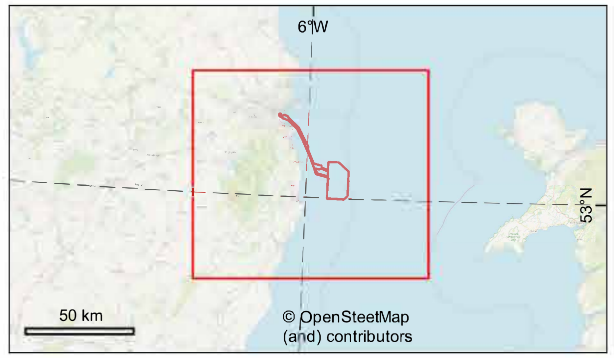
191. For Group one species, there is a maximum area of TTS of 1,800 km^2, or an overlap of TTS noise with spawning / nursery areas of between 1.05 % to 9.71 % of habitat within the Irish Sea study area, and effects on spawning potential of no greater than 0.59 %. As such, the magnitude for TTS is considered to be low to negligible for both the fleeing and stationary models, dependant on the species assessed. Primary mitigation measures (**Section 9.9**) including soft start will provide an opportunity for all individuals to move away, reducing the area of potential TTS.

Table 9-34 Group one maximum noise overlap calculations of the spawning / nursery activity with the greatest overlap

	Spawning			Nursery		
Species	**Mortality**	**Recoverable Injury**	**TTS**	**Mortality**	**Recoverable Injury**	**TTS**
Fleeing						
Sandeel	<0.01 %	<0.01 %	1.05 %	<0.01 %	<0.01 %	3.20 %
European plaice	<0.01 %	<0.01 %	1.06 %	<0.01 %	<0.01 %	1.41 %
Lemon sole	<0.01 %	<0.01 %	3.79 %	<0.01 %	<0.01 %	3.80 %
Common sole	<0.01%	<0.01%	1.17%			
Thornback ray				<0.01 %	<0.01 %	1.38 %
Spotted ray				<0.01 %	<0.01 %	2.32 %
Tope				<0.01 %	<0.01 %	1.96 %
Stationary						
Sandeel	<0.01 %	<0.01 %	3.03 %	<0.01 %	0.01 %	6.93 %
European plaice	<0.01 %	0.01 %	3.34 %	<0.01 %	<0.01 %	3.81 %
Lemon sole	<0.01 %	0.01 %	9.71 %	<0.01 %	0.01 %	9.71 %
Common sole	<0.01 %	<0.01 %	3.35 %			
Thornback ray				<0.01 %	<0.01 %	3.72 %
Spotted ray				<0.01 %	<0.01 %	5.02 %

	Spawning			Nursery		
Species	Mortality	Recoverable Injury	TTS	Mortality	Recoverable Injury	TTS
Tope				<0.01 %	<0.01 %	4.25 %





Legend

- Planning Application Boundary (PAB)
- Pile driving noise modelling location
- South east noise modelling contour
- Liffey noise modelling contour

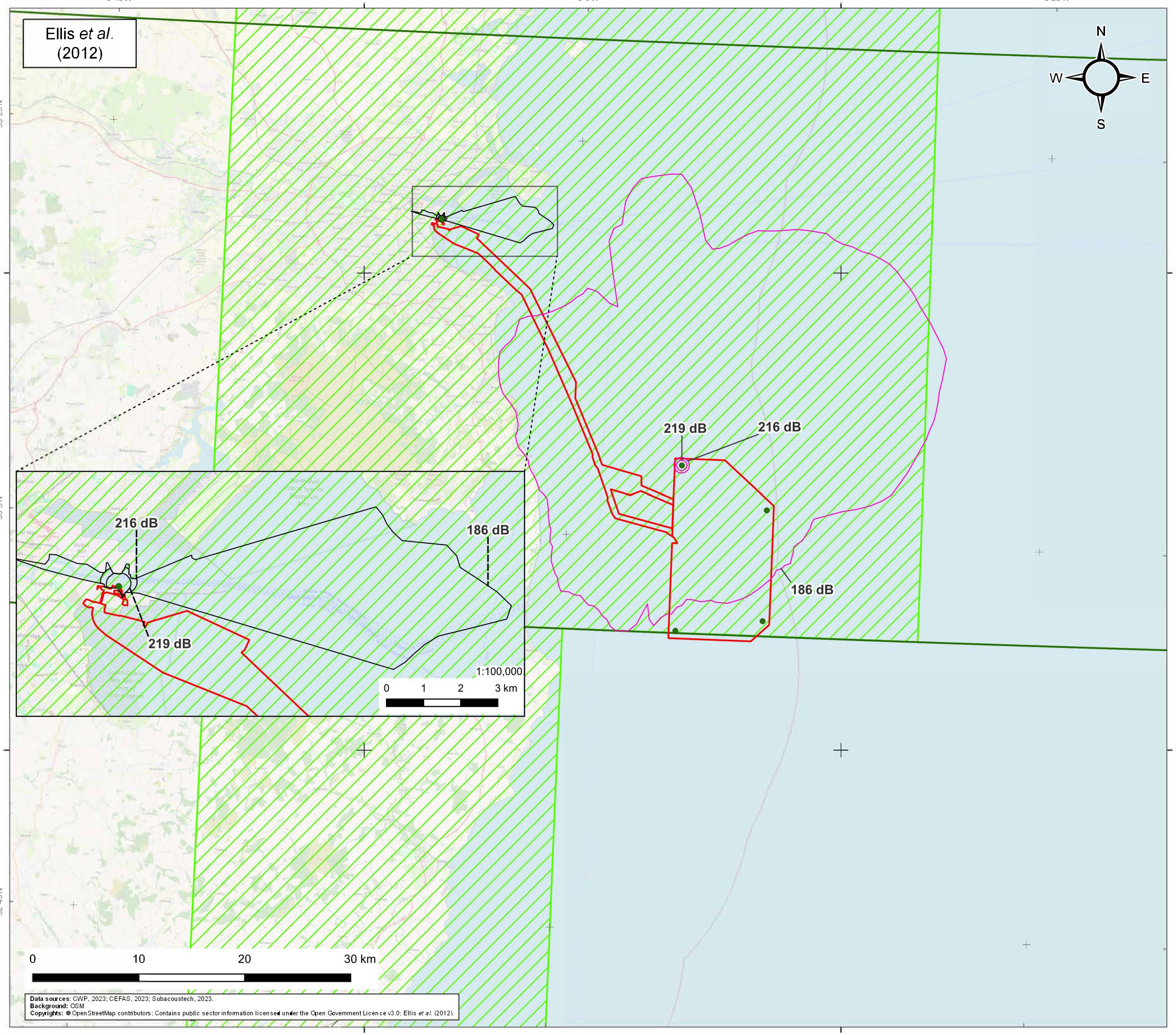
codling wind park	Project: Codling Wind Park	Contractor: natural power www.naturalpower.com

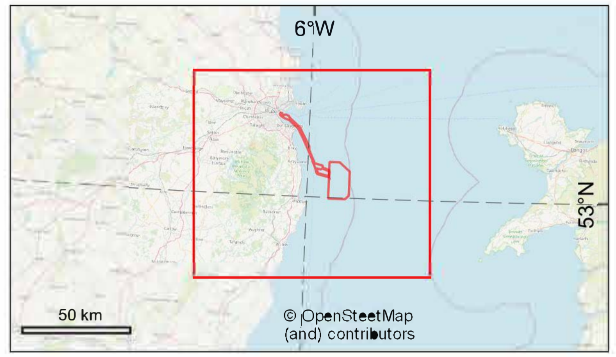
Figure 9.22
Group one noise modelling for species without nursery or spawning habitat

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1153

Internal descriptive code:	Size: A3	CRS:
OFFSH.ALL - PAB. DPNMLs. DPNM.CONT.WTG.SE. DPNM CONT.SS.PP - FSTESAs.LRN .SNG.G1 - (EIAR.FIG.09.22)	Scale: 1:350,000	EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
00	Final for issue	2024/07/24	AC	ME/EA	SM





Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- Pile driving noise modelling location
- North west noise modelling contour
- Liffey Liffey noise modelling contour

Ellis et al. (2012)

- Nursery ground low intensity

Thornback ray not covered in Ireland's marine atlas and Coull et al. (1998) datasets.

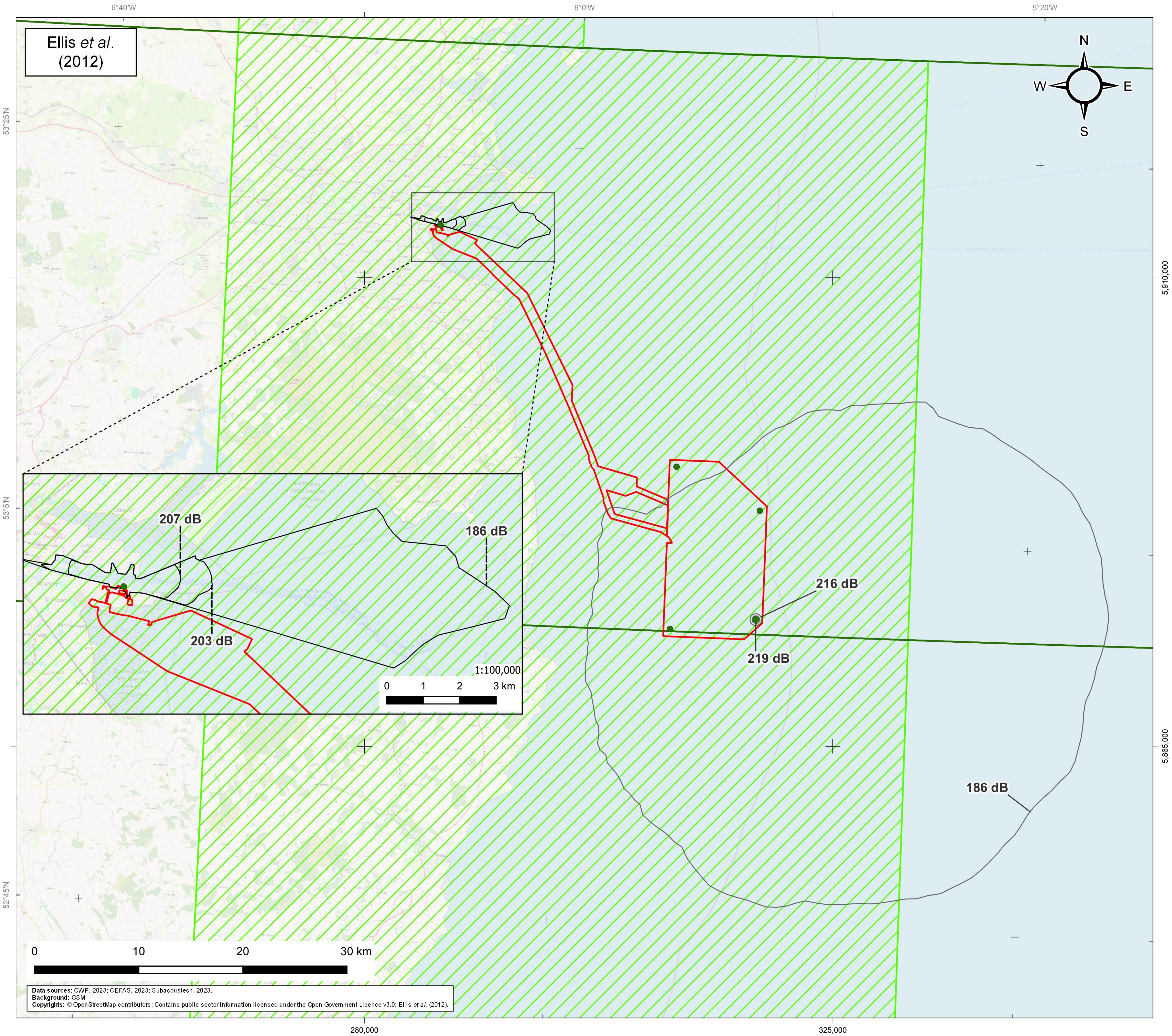
codling wind park	*Project:* Codling Wind Park
Contractor: natural power www.naturalpower.com	

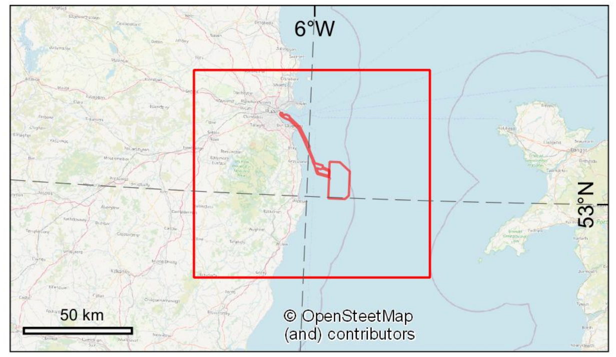
Figure 9.23
Thornback ray spawning and / or nursery overlap with noise modelling

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1154

Internal descriptive code:	*Size:* A3	*CRS:*
OFFSH.ALL - PAB..DPNMLs..DPNM.CONT.WTG.NW..DPNM.CONT.SS.PP - FSTESAs.LRN..SNG.THORNBACK.RAY - EIAR.FIG.09.23	*Scale:* 1:350,000	EPSG 25830

Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
00	Final for issue	2024/07/24	AC	ME/EA	SM





Data sources: CWP, 2023; CEFAS, 2023; Subacoustech, 2023.
Background: OSM
Copyrights: © OpenStreetMap contributors; Contains public sector information licensed under the Open Government Licence v3.0; Ellis *et al.* (2012).

Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- Pile driving noise modelling location
- South east noise modelling contour
- Liffey noise modelling contour

Ellis et al. (2012)

- Nursery ground low intensity

Spotted ray not covered in Ireland's marine atlas and Coull et al. (1998) datasets.

Project: Codling Wind Park

Contractor: natural power
www.naturalpower.com

Figure 9.24
Spotted ray spawning and / or nursery overlap with noise modelling

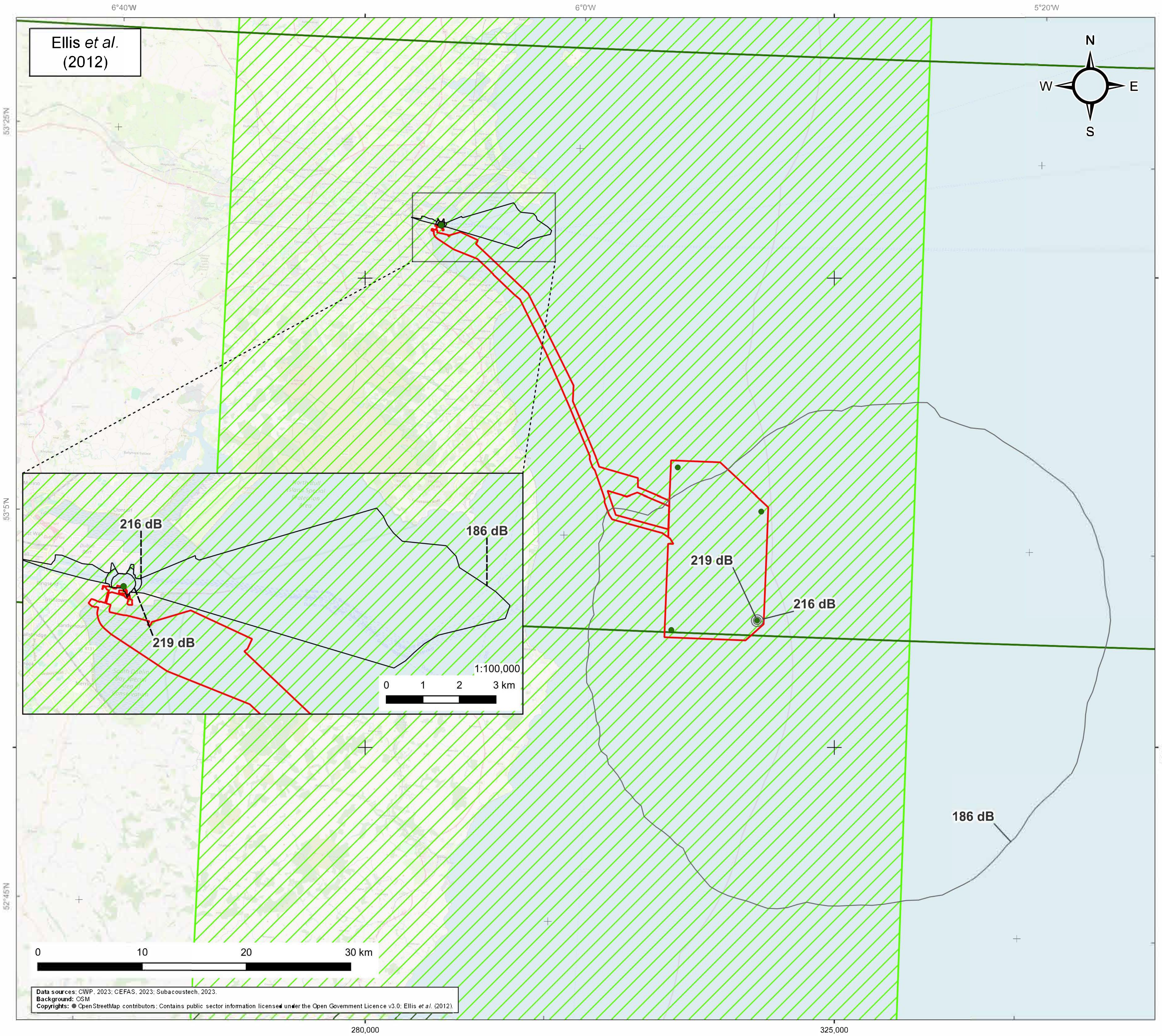
CWP doc. number: CWP-NPC-ENG-08-01-MAP-1155

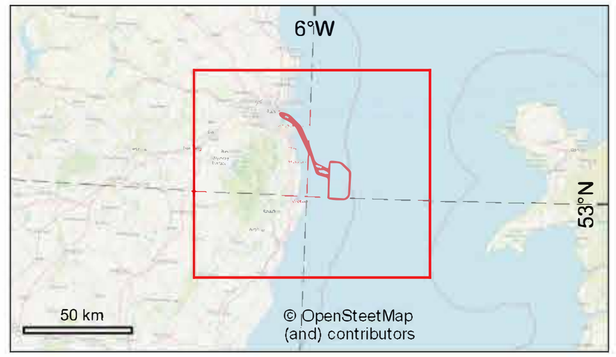
Internal descriptive code: OFFSH.ALL - PAB..DPNMLs..DPNM.CONT.WTG.SE..DPNM.CONT.SS.PP - FSTESAs.LRN..SNG.SPOTTED.RAY - (EIAR.FIG.09.24)

Size: A3
Scale: 1:350,000

CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
A	Final version	2024/07/24	AC	ME/EA	SM





Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- Pile driving noise modelling location
- South east noise modelling contour
- Liffey noise modelling contour

Ellis et al. (2012)

- Nursery ground low intensity

Tope not covered in Ireland's marine atlas and Coull et al. (1998) datasets.

codling wind park

Project: Codling Wind Park

Contractor: natural power www.naturalpower.com

Figure 9.25
Tope spawning and / or nursery overlap with noise modelling contours

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1156

Internal descriptive code: OFFSH.ALL - PAB .DPNMLs..DPNM.CONT.WTG.SE DPNM.CONT.SS.PP - FSTESAs.LRN..SNG.TOPE - (EIAR.FIG.09.25)

Size: A3
Scale: 1:350,000
CRS: EPSG 25830

Rev	Description	Date	By	Chk'd	App'd
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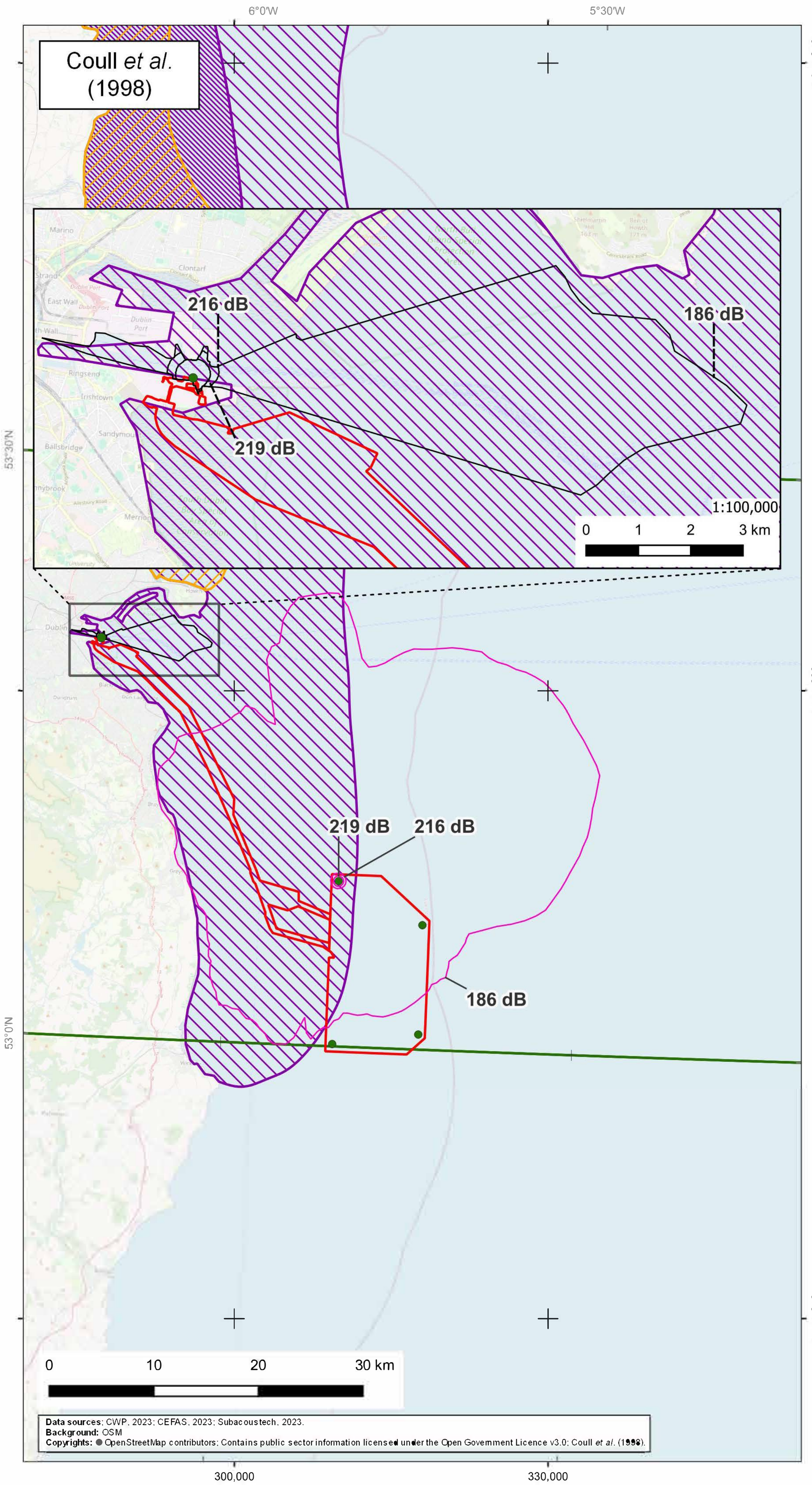
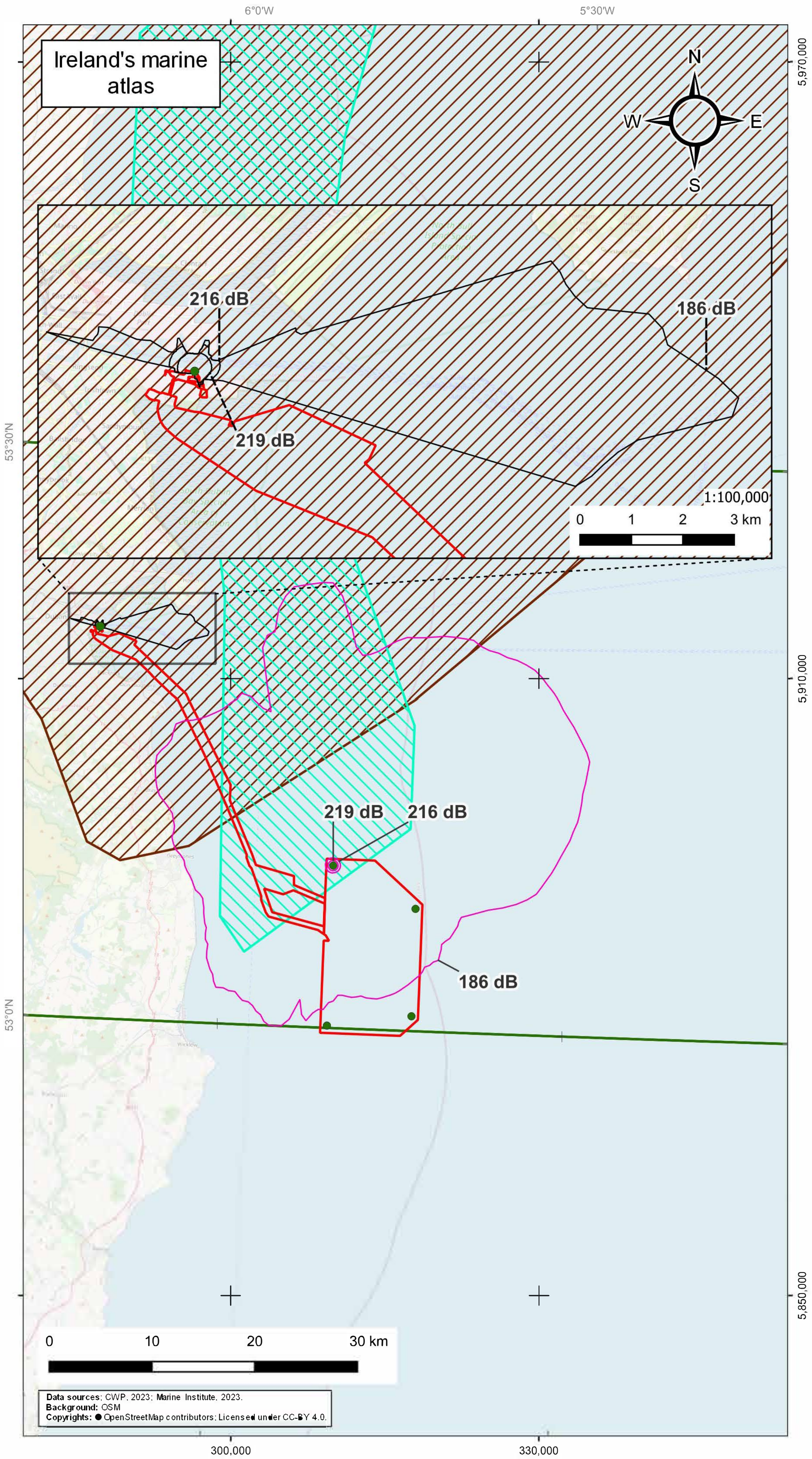
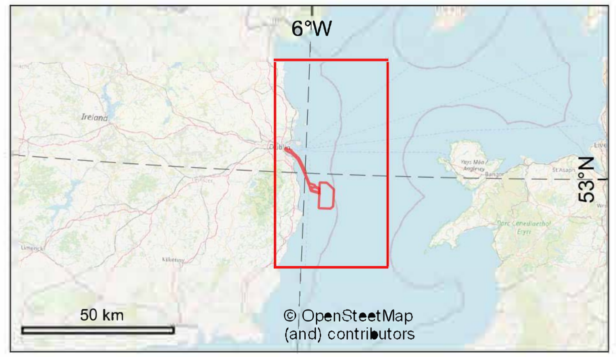






Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- Pile driving noise modelling location
- North west noise modelling contour
- Liffey noise modelling contour

Coull et al. (1998)

- Nursery ground
- Spawning ground high intensity
- Spawning ground low intensity

Ireland's marine atlas

- Spawning ground
- Nursery ground

Haddock not covered in Ellis et al. (2012) dataset.

codling wind park

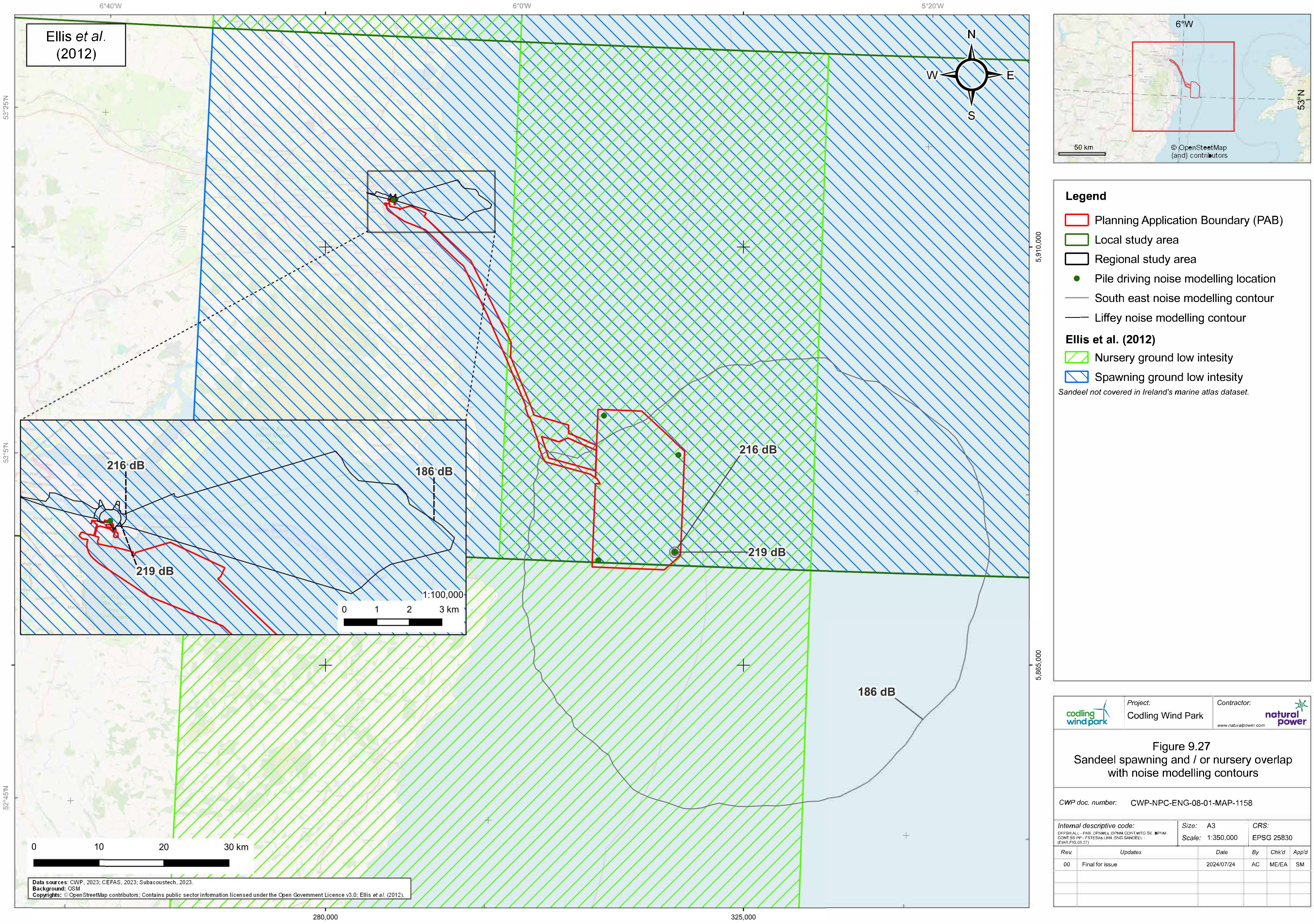
Project: Codling Wind Park

Contractor: natural power www.naturalpower.com

Figure 9.26
European plaice spawning and / or nursery overlap with noise modelling contours

CWP doc. number:	CWP-NPC-ENG-08-01-MAP-1157		
Internal descriptive code: OFFSHALL - PAB, DPNMLs, DPNM CONT WTG NW, DPNM CONT SS PP - FSTESAL LRN SNG EUROPEAN PLAICE - EIAR FIG 09.26	*Size:* A3	*Scale:* 1:500,000	*CRS:* EPSG 25830

Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
00	Final for issuen	2024/07/25	AC	ME/EA	SM



Data sources: CWP, 2023; CEFAS, 2023; Subacoustech, 2023.
Background: OSM
Copyrights: © OpenStreetMap contributors; Contains public sector information licensed under the Open Government Licence v3.0; Ellis *et al.* (2012).

Project: Codling Wind Park

Contractor: natural power — www.naturalpower.com

Figure 9.27
Sandeel spawning and / or nursery overlap with noise modelling contours

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1158

Internal descriptive code: OFFSH ALL - PAB DPNMLs DPNM.CONT WTG.SE. DPNM CONT SS PP - FSTESAs LRN SNG.SANDEEL - (EIAR.FIG.09.27)

Size: A3
Scale: 1:350,000
CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
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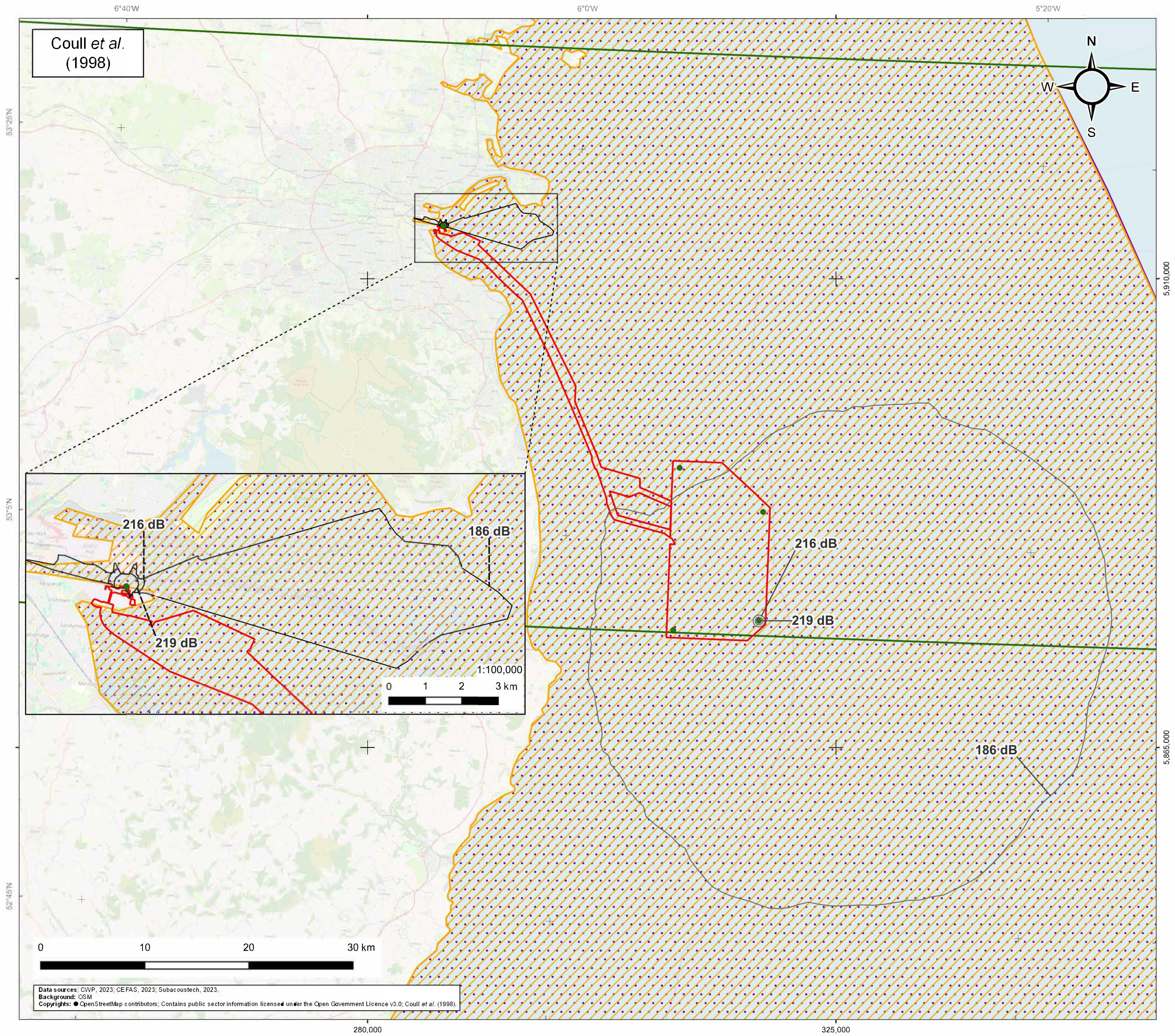
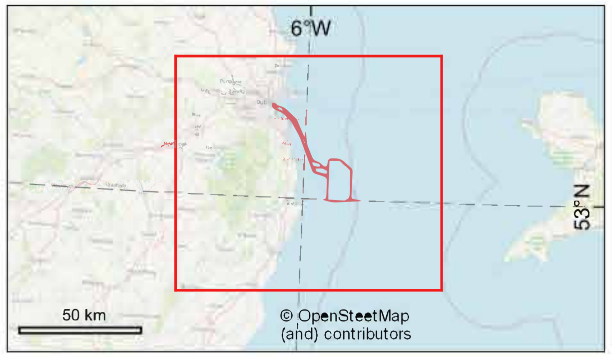




Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- Pile driving noise modelling location
- South east noise modelling contour
- Liffey noise modelling contour

Coull et al. (1998)

- Nursery ground
- Spawning ground undetermined intensity

Lemon sole not covered in Ireland's marine atlas and Ellis et al. (2012) datasets.

Project: Codling Wind Park

Contractor: www.naturalpower.com

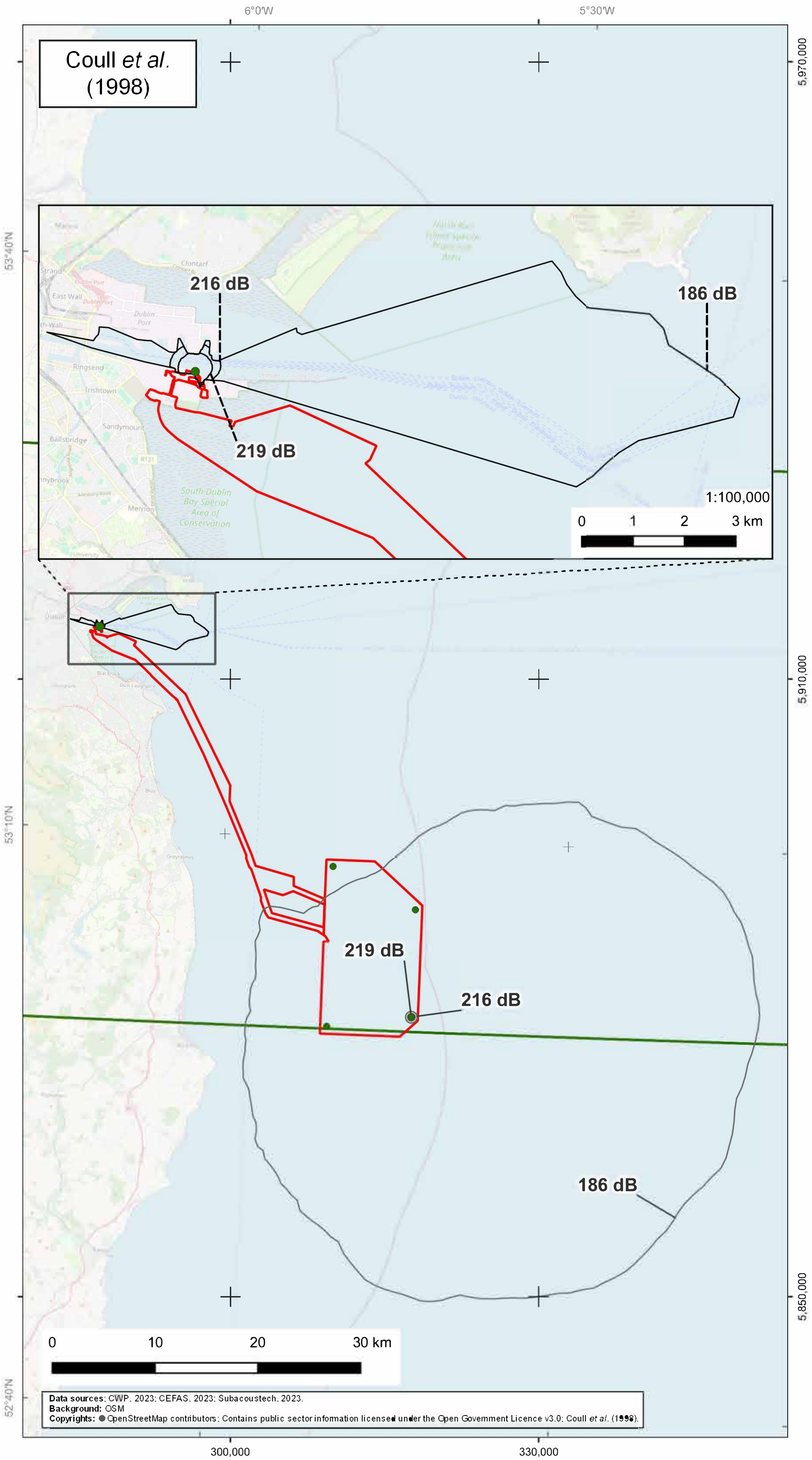
Figure 9.28
Lemon sole spawning and / or nursery overlap with noise modelling contours

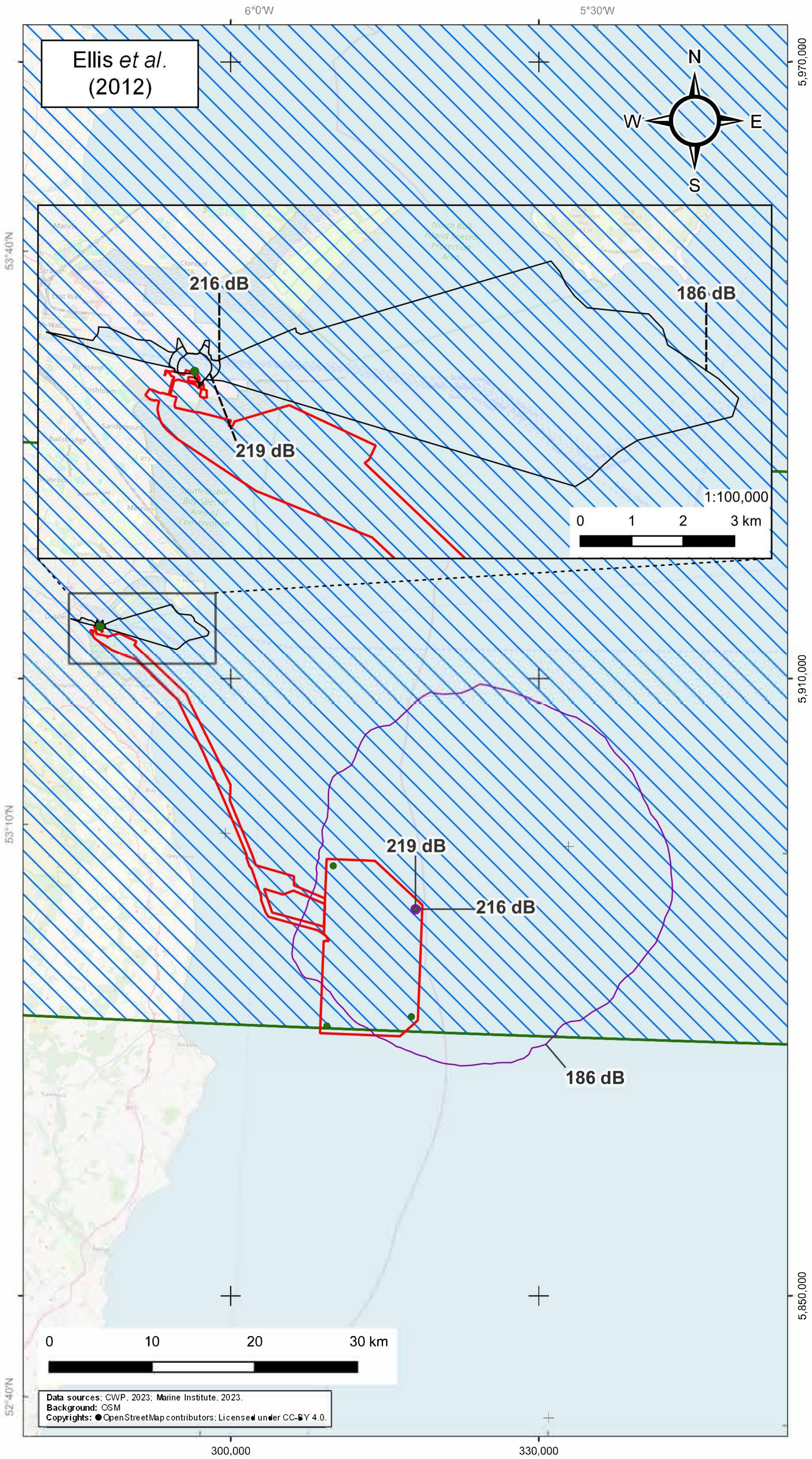
CWP doc. number: CWP-NPC-ENG-08-01-MAP-1159

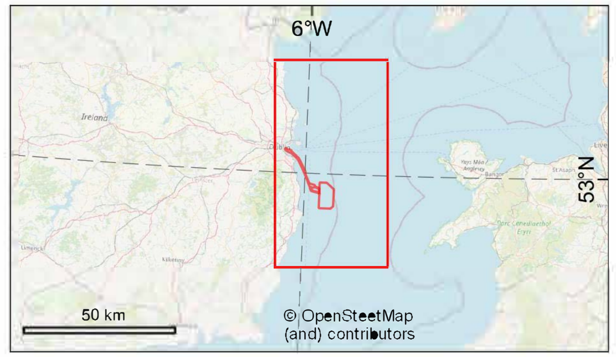
Internal descriptive code: OFFSH.ALL - PAB..DPNMLs..DPNM.CONT.WTG.SE..DPNM CONT.SS.PP - FSTESAs.LRN..SNG.LEMON.SOLE - (EIAR.FIG.09.28)

Size: A3
Scale: 1:350,000
CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
00	Final for issue	2024/07/24	AC	ME/EA	SM







Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- Pile driving noise modelling location
- South east noise modelling contour
- North east noise modelling contour
- Liffey noise modelling contour

Coull et al. (1998)
Nursery ground and spawning ground high intensity exist within national study area but not within the extent of this figure.

Ellis et al. (2012)
- Nursery ground low intensity
- Spawning ground high intensity
- Spawning ground low intensity

Sole not covered in Ireland's marine atlas dataset.

Project: Codling Wind Park

Contractor: natural power

Figure 9.29
Common sole spawning and / or nursery overlap with noise modelling contours

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1160

Internal descriptive code:	*Size:* A3	*CRS:*
OFFSH.ALL - PAB .DPNMLs..DPNM.CONT.WTG.NE.SE..DPNM.CONT.SS.PP - FSTESAs.LRN..SNG.COMMON.SOLE - (EIAR.FIG.09.29)	*Scale:* 1:500,000	EPSG 25830

Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
00	Final for issue	2024/07/24	AC	ME/EA	SM

Significance of effect

192. The significance of effect has been summarised by each receptor in **Table 9-35**.

Table 9-35 Determination of Significance for group one VERs based upon greatest received magnitude of effect

		Mortality / mortal injury		Recoverable injury		TTS	
Species	**Sensitivity**	**Magnitude**	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
Small-spotted catshark	Low	Negligible	**Not significant**	Negligible	**Not significant**	Negligible	**Not significant**
Cuckoo ray	Low	Negligible	**Not significant**	Negligible	**Not significant**	Negligible	**Not significant**
Blonde ray	Low	Negligible	**Not significant**	Negligible	**Not significant**	Negligible	**Not significant**
European plaice	Very Low	Negligible	**Imperceptible** (not significant)	Negligible	**Imperceptible** (not significant)	Low	**Not significant**
Sandeel	Low	Negligible	**Not significant**	Negligible	**Not significant**	Low	**Not significant**
Lemon sole	Very Low	Negligible	**Imperceptible** (not significant)	Negligible	**Imperceptible** (not significant)	Low	**Not significant**
Common sole	Very Low	Negligible	**Imperceptible** (not significant)	Negligible	**Imperceptible** (not significant)	Low	**Not significant**
Undulate ray	Low	Negligible	**Not significant**	Negligible	**Not significant**	Negligible	**Not significant**
Thornback ray	Medium	Negligible	**Slight / Not significant** (not significant)	Negligible	**Slight / Not significant** (not significant)	Low	**Slight** (not significant)
Spotted ray	Medium	Negligible	**Slight / Not significant (**not significant)	Negligible	**Slight / Not significant** (not significant)	Low	**Slight** (not significant)

Species	Sensitivity	Mortality / mortal injury		Recoverable injury		TTS	
		Magnitude	Significance	Magnitude	Significance	Magnitude	Significance
Spurdog / spiny dogfish	Medium	Negligible	**Slight / Not significant** (not significant)	Negligible	**Slight / Not significant** (not significant)	Negligible	**Slight / Not significant** (not significant)
Sea lamprey	Low	Negligible	**Not significant**	Negligible	**Not significant**	Negligible	**Not significant**
River lamprey	Low	Negligible	**Not significant**	Negligible	**Not significant**	Negligible	**Not significant**
Tope	Low	Negligible	**Not significant**	Negligible	**Not significant**	Low	**Not significant**
Common skate	Medium	Negligible	**Slight / Not significant** (not significant)	Negligible	**Slight / Not significant** (not significant)	Negligible	**Slight / Not significant** (not significant)
Angel shark	Medium	Negligible	**Slight / Not significant** (not significant)	Negligible	**Slight / Not significant** (not significant)	Negligible	**Slight / Not significant** (not significant)
Basking shark	Medium	Negligible	**Slight / Not significant** (not significant)	Negligible	**Slight / Not significant** (not significant)	Negligible	**Slight / Not significant** (not significant)

193. In summary, group one fish are identified as having very low to medium sensitivities. The magnitude of impact is predicted to be negligible for both mortality and recoverable injury, and ranges from negligible to low for TTS. Several species experience the highest significance (slight / not significant), which is not significant. The impact of noise and vibration from piling is considered to be **not significant** for all group one species.

194. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

195. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Group Two

Receptor sensitivity

196. As per **Table 9-30**, group two species have been classed based on their hearing type and are listed in **Table 9-36**. Sensitivity has been determined based upon the definitions set out in **Table 9-3,** with information feeding this assessment coming from **Table 9-18**. Across the species group, all are mobile species and therefore have a high capacity (adaptability) to avoid the impact by fleeing during the soft start. Recoverability is high based on fecundity, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value ranges from low to high according to conservation status. Group two fish have a moderate ability to perceive sound and presence of a swim bladder. The thresholds utilised within the modelling already account for the moderate tolerance to sound related impacts, and as most receptors will only be affected at a behavioural level, which will not have any long-term effects on populations, tolerance is assessed as moderate.

197. As per **Table 9-36**, sensitivity for group two species ranges from low to medium.

Table 9-36 Group two species sensitivities

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
European hake	High	Moderate	High	Low	Low
Sea trout	High	Moderate	High	Low	Low
Atlantic mackerel	High	Moderate	High	Low	Low
Whiting	High	Moderate	High	Low	Low
Atlantic horse mackerel	High	Moderate	High	Low	Low
Ling	High	Moderate	High	Low	Low
Haddock	High	Moderate	High	Low	Low
Atlantic salmon	High	Moderate	High	High	Medium

Magnitude of Impact

198. The identification of thresholds (as per Popper et al., 2014), as well as the representative scenario outputs for group two species are listed in **Table 9-37**. The maximum, mean and minimum values represent the largest radius of impact from the modelling location. A visualisation of the sound level contours for group two species can be seen in **Figure 9-30** and where relevant species-specific overlaps with established data sources on nursery / spawning habitats can be seen in **Appendix 9.3**.

Table 9-37 Group two least restrictive scenario for piling

					Array				Liffey		
Activity	**Response**	**Level**	**Risk**	**Threshold**	**Area (km^2)**	**Maximum (m)**	**Mean (m)**	**Minimum (m)**	**Area (km^2)**	**Maximum (m)**	**Mean (m)**
Piling	Stationary	SPLpeak	Mortality and potential mortal injury	>207 dB	0.25	280	280	280	<0.01	<50	<50
			Recoverable injury	>207 dB	0.25	280	280	280	<0.01	<50	<50
		SELcum	Mortality and potential mortal injury	>210 dB	5.8	1,400	1,400	1,300	1	1100	450
			Recoverable injury	>203 dB	40	3,800	3,600	3,400	2.8	2400	630
			Temporary Threshold Shift	>186 dB	1,800	34,000	24,000	14,000	25	11000	1300
	Fleeing	SELcum	Mortality and potential mortal injury	>210 dB	<0.1	<100	<100	<100	<0.1	<100	<100
			Recoverable injury	>203 dB	<0.1	<100	<100	<100	< 0.1	100	<100

					Array				Liffey		
Activity	**Response**	**Level**	**Risk**	**Threshold**	**Area (km^2)**	**Maximum (m)**	**Mean (m)**	**Minimum (m)**	**Area (km^2)**	**Maximum (m)**	**Mean (m)**
			Temporary Threshold Shift	>186 dB	740	24,000	14,000	5,700	3.2	3500	630

Mortality

199. As per **Table 9-37,** group two fish mortality for the array site piling operations under the stationary model is predicted to occur within an area of approximately 0.25 km^2 or a maximum distance of 280 m from the source for peak sound pressure level, and an area of 15 km^2 or a maximum distance of 2300 m from the source for cumulative level exposure. These values drop significantly to less than 0.1 km^2 or less than 100 m from the source when the fleeing model is used.

200. As per **Table 9-37,** group two fish mortality in proximity to the onshore substation piling operations under the stationary model is predicted to occur within an area of approximately 0.25 km^2 or a maximum distance of 280 m from the source for peak sound pressure level, and an area of 5.8 km^2 or a maximum distance of 1,400 m from the source for cumulative level exposure. These values drop significantly to less than 0.1 km^2 or less than 100 m from the source when the fleeing model is used.

201. Of the group two hearing species, the following have spawning (S) and / or Nursery (N) grounds in the area: Atlantic mackerel (S / N), haddock (S / N) whiting (S / N), ling (S) and Atlantic horse mackerel (N). Of note, while present in the area, there is no noise overlap between European hake spawning or nursery habitat.

202. The overlap of the noise modelling contours with the known spawning and nursery habitat within the regional area has been calculated in **Appendix 9.3** and maximum values have been presented in **Table 9-39**, based upon the stationary and fleeing model. For visualisation of the noise overlap with spawning and nursery grounds, refer to **Figure 9-31** to **Figure 9-35**.

203. The greatest percentage of area affected by mortality under the stationary model (based upon the overlap with available spawning and nursery areas within the Irish Sea study area) is 0.17 % and 0.05 % for haddock spawning and nursery, respectively (**Table 9-39; Appendix 9.3**).

204. The greatest percentage of area affected by mortality under the fleeing model (based upon the overlap with available spawning and nursery areas within the Irish Sea study area) is <0.01 % for all group 2 spawning and nursery species (**Table 9-39; Appendix 9.3**). It is recognised that fish species not engaged in spawning activities may be present in the area, however, it is considered that any noise impacts will only affect a small number of individuals of such species and magnitude will be very low.

205. Piling is a temporary impact of a maximum 75 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species within the above ranges. For Group two species, there is a maximum area of mortality of 15 km^2, and a negligible overlap of mortality noise with spawning / nursery habitat (<1% of habitat within the Irish Sea study area). As such, the magnitude for mortality is considered negligible for both the fleeing and stationary models. Primary mitigation measures (**Section 9.9**) including soft start will provide an opportunity for all individuals to move out of the areas of potential mortality.

Recoverable Injury

206. Group two fish at risk of recoverable injury for the array piling operations under the stationary model are predicted to occur within an area of approximately 0.25 km^2 or a maximum distance of 280 m from the source for peak sound pressure level, and an area of 40 km^2 or a maximum distance of 3,800 m from the source for cumulative level exposure. These values drop significantly to less than 0.1 km^2 or a maximum distance of 100 m from the source when the fleeing model is used.

207. Group two fish at risk of recoverable injury in proximity to the onshore substation piling operations under the stationary model are predicted to occur within an area of approximately <0.01 km^2 or a maximum distance of <50 m from the source for peak sound pressure level, and an area of 2.8 km^2 or a maximum distance of 2,400 m from the source for cumulative level exposure. These values drop

significantly to less than 0.1 km^2 or a maximum distance of <100 m from the source when the fleeing model is used.

208. The greatest percentage of area affected by recoverable injury under the stationary model (based upon the overlap with available spawning and nursery areas within the Irish Sea study area) is 0.85 % and 0.29 % for haddock spawning and nursery, respectively (**Table 9-39; Appendix 9.3**).

209. The greatest percentage of area affected by recoverable injury under the fleeing model (based upon the overlap with available spawning and nursery areas within the Irish Sea study area) is <0.01 % for all group two spawning and nursery species (**Table 9-39; Appendix 9.3**). It is recognised that fish species not engaged in spawning activities may be present in the area, however, it is considered that any noise impacts will only affect a small number of individuals of such species and therefore magnitude will be very low.

210. Impact piling operations will last a maximum of 75 days over the construction period and any impacts will be temporary. It is however a reoccurring event which produces sound levels that may result in the recoverable injury of species with the above ranges / overlaps. For Group two species, there is a maximum area of recoverable injury of 0.25 km^2, and a negligible overlap of mortality noise with spawning / nursery habitat (<1% of habitat within the Irish Sea study area at the most). As such, the magnitude for recoverable injury is considered negligible for both the fleeing and stationary models. Primary mitigation measures (**Section 9.9**) including soft start will provide an opportunity for all individuals to move out of the areas of potential recoverable injury.

Temporary Threshold Shift (TTS) / Behavioural responses

211. Group two fish at risk of TTS during the array piling operations under the stationary model are predicted to occur within an area of 1,800 km^2 or a maximum distance of 34 km from the source for cumulative level exposure. These values drop significantly to 740 km^2 or a maximum of 24 km from the source when the fleeing model is used.

212. Group two fish at risk of TTS in proximity to the onshore substation piling operations under the stationary model are predicted to occur within an area of 25 km^2 or a maximum distance of 11 km from the source for cumulative level exposure. These values drop significantly to 3.2 km^2 or a maximum of 3,500 m from the source when the fleeing model is used.

213. The greatest percentage of area affected by TTS under the stationary model (based upon the overlap with available spawning and nursery areas within the Irish Sea study area) is 23.14 % and 8.90 % for whiting spawning and haddock nursery, respectively (**Table 9-39; Appendix 9.3**).

214. The greatest percentage of area affected by TTS under the fleeing model (based upon the overlap with available spawning and nursery areas within the Irish Sea study area) is 3.47 % and 3.24 % for haddock spawning and nursery, respectively (**Table 9-39; Appendix 9.3**). It is recognised that fish species not engaged in spawning activities may be present in the area, however, it is considered that any effect will only affect a small number of individuals of such species and therefore magnitude will be very low.

215. Impact piling operations will last a maximum 75 days over the construction period and any impacts will be temporary, however a maximum of two piles will be driven per day, for a total of seven hours of piling in a 24-hour period. While the percentage of overlap of a spawning area provides useful context, it does not take into account the short term and temporary nature of the work compared to the duration of available spawning potential. As such the proportion of spawning potential impacted has been calculated in **Table 9-38**, using the TTS area as the greatest modelled area of impact. When availability of spawning duration is factored in, the greatest impact to spawning potential is 1.69 % (whiting). When compared to the available spawning habitat and duration, the impact is considered negligible, and effects will be imperceptible.

Table 9-38 Group two temporal overlap results (presented only for species where there is greater than 1% overlap with spawning or nursery habitat)

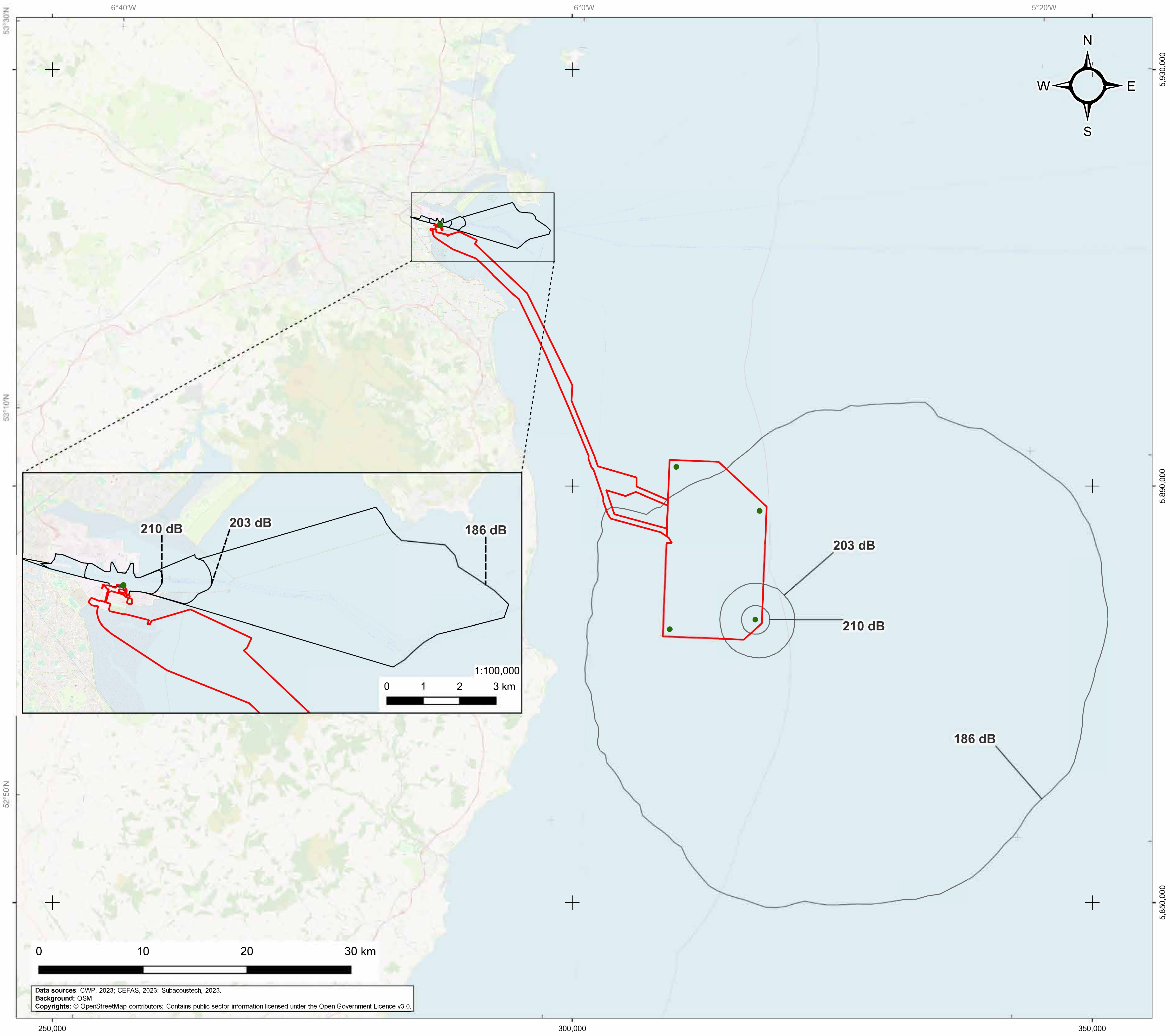
Species	Spawning potential (km^2h)	Impacted spawning potential (km^2h)	Proportion of spawning potential impacted (%)
Haddock	8,641,063	106,126	1.23 %
Whiting	2,835,921	47,864	1.69 %
Atlantic mackerel	122,667,790	252,237	0.21 %
Ling	67,511,784	252,237	0.37 %

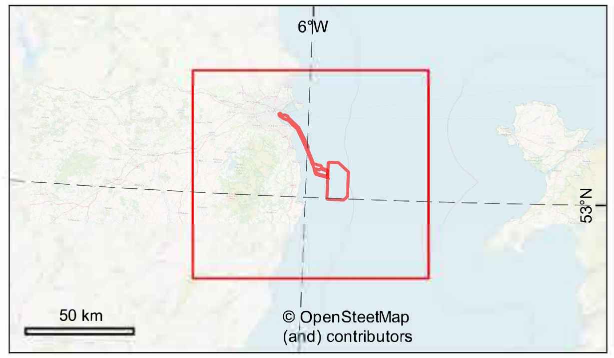
216. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas. These behavioural responses are likely to be akin to predator avoidance responses and will decrease both in severity and in the percentage of the population affected as distance increases from the noise source (Knaap et al., 2021). Such behavioural responses will be short term, and due to the behavioural nature of the effects, recovery will be very fast, with potential for habituation over the term of the construction phase.

194. For Group two species, there is a maximum area of TTS of 1,800 km^2, or an overlap of TTS noise with spawning / nursery areas of between 1.00 % to 23.14 % of habitat within the Irish Sea study area, and effects on spawning potential of no greater than 1.69 %. As such, the magnitude for TTS is considered to be low to negligible for both the fleeing and stationary models, dependant on the species assessed. Primary mitigation measures (**Section 9.9**) including soft start will provide an opportunity for all individuals to move away, reducing the area of potential TTS.

Table 9-39 Group two maximum noise overlap calculations of the spawning / nursery activity with the greatest overlap

	Spawning			Nursery		
Species	**Mortality**	**Recoverable Injury**	**TTS**	**Mortality**	**Recoverable Injury**	**TTS**
Fleeing						
Atlantic mackerel	<0.01 %	<0.01 %	1.00 %	<0.01 %	<0.01 %	1.48 %
Atlantic horse mackerel				<0.01 %	<0.01 %	1.48 %
Whiting	<0.01 %	<0.01 %	2.09 %	<0.01 %	<0.01 %	1.71 %
Haddock	<0.01 %	<0.01 %	3.47 %	<0.01 %	<0.01 %	3.24 %
Ling	<0.01 %	<0.01 %	1.43 %			
Stationary						
Atlantic mackerel	0.02 %	0.09 %	2.88 %	0.01 %	0.08 %	3.79 %
Atlantic horse mackerel				0.01 %	0.08 %	3.79 %
Whiting	0.01 %	0.08 %	23.14 %	0.03 %	0.14 %	4.66 %
Haddock	0.17 %	0.85 %	13.47 %	0.05 %	0.29 %	8.90 %
Ling	0.02 %	0.13 %	4.10 %			





Legend

- Planning Application Boundary (PAB)
- Pile driving noise modelling location
- South east noise modelling contour
- Liffey noise modelling contour

codling wind park

Project: Codling Wind Park

Contractor: natural power www.naturalpower.com

Figure 9.30
Group two noise modelling for species without nursery or spawning habitat

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1161

Internal descriptive code:	Size: A3	CRS:
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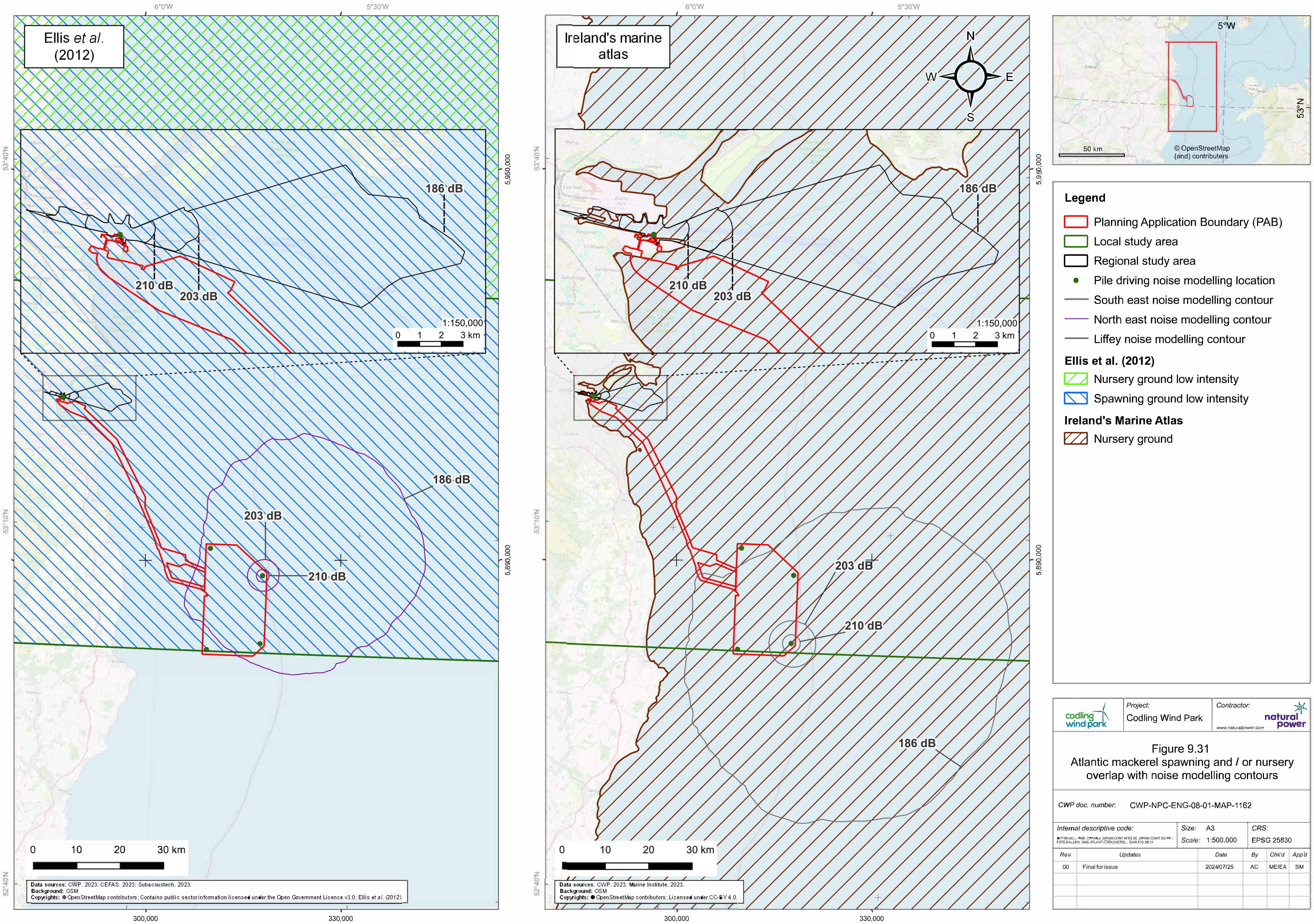
Rev.	Updates	Date	By	Chk'd	App'd
00	Final for issuen	2024/07/25	AC	ME/EA	SM



Project: Codling Wind Park

Contractor: natural power www.naturalpower.com

Figure 9.31
Atlantic mackerel spawning and / or nursery overlap with noise modelling contours

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1162

Internal descriptive code:	Size:	A3	CRS:
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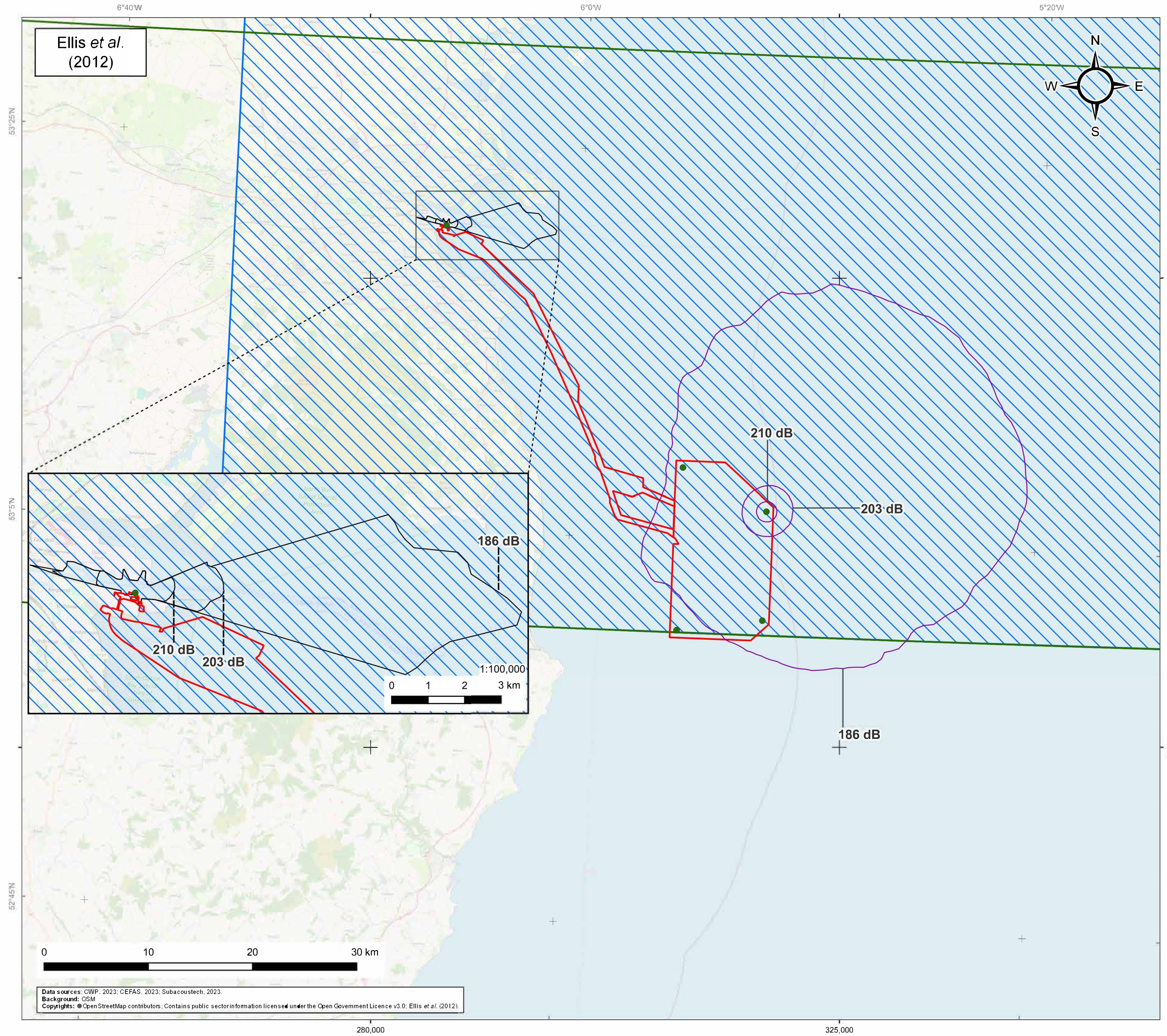
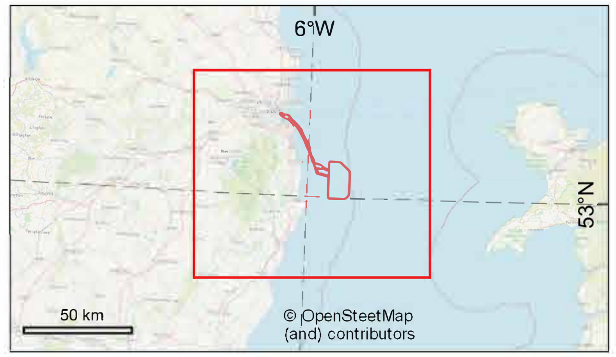
Rev	Updates	Date	By	Chk'd	App'd
00	Final for issue	2024/07/25	AC	ME/EA	SM





Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- Pile driving noise modelling location
- North east noise modelling contour
- Liffey noise modelling contour

Ellis et al. (2012)

- Spawning ground low intensity

Ling not covered in Ireland's marine atlas and Coull et al. (1998) datasets.

codling wind park

Project: Codling Wind Park

Contractor: natural power www.naturalpower.com

Figure 9.32
Ling spawning and / or nursery overlap with noise modelling contours

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1163

Internal descriptive code: OFFSH.ALL - PAB..DPNMLs..DPNM.CONT.WTG.NE..DPNM CONT.SS.PP - FSTESAs.LRN..SNG.LING - (EIAR.FIG.09.32)

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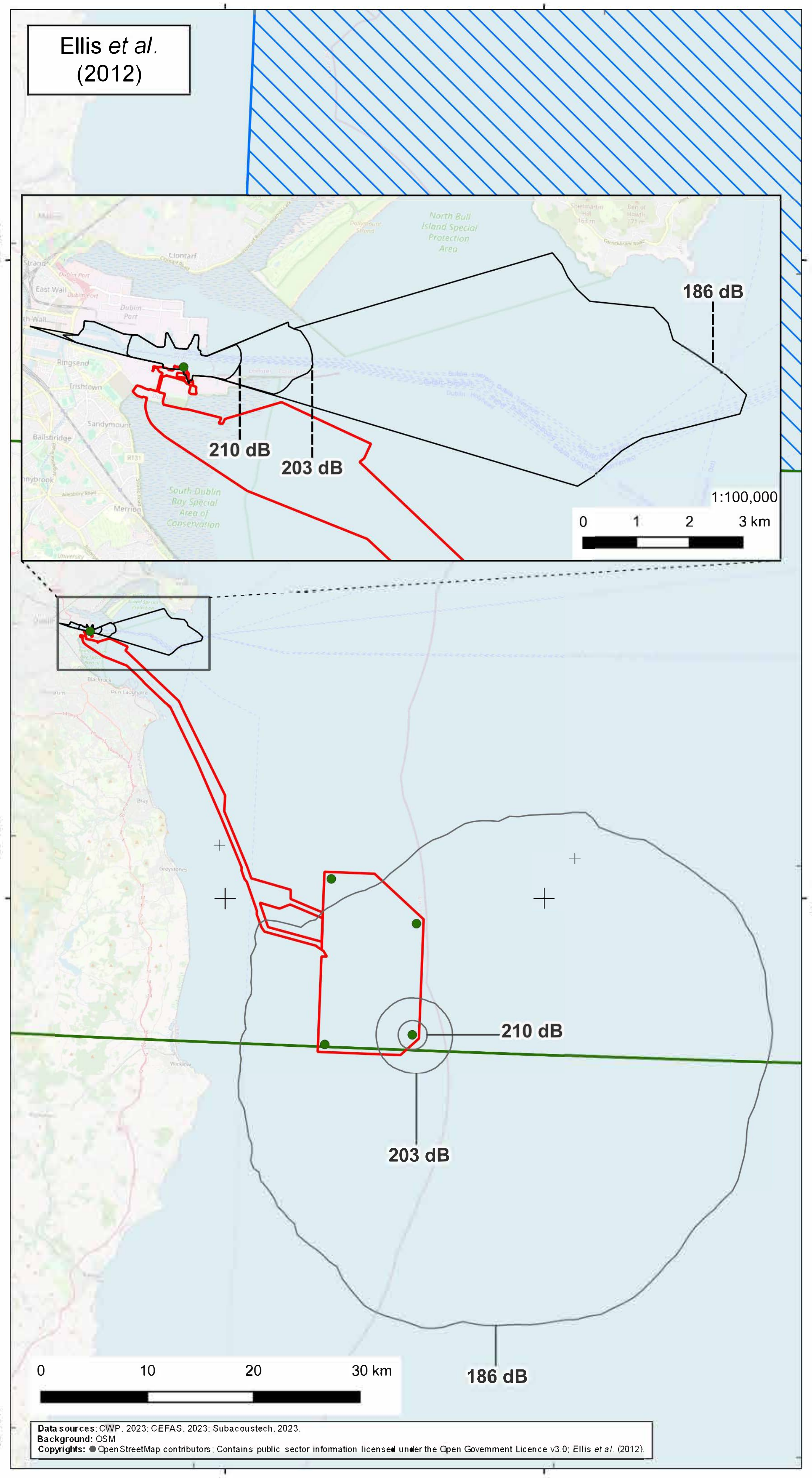
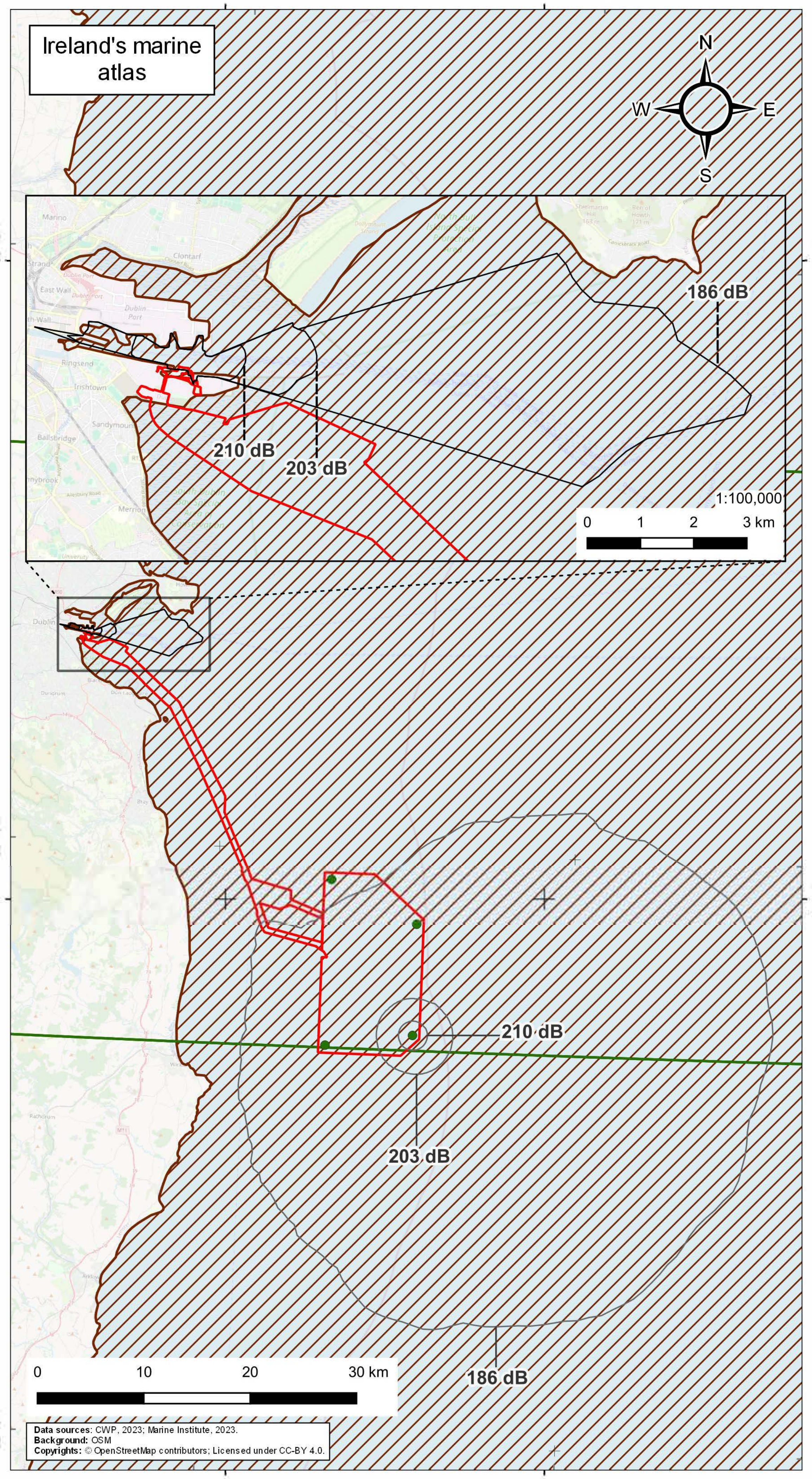
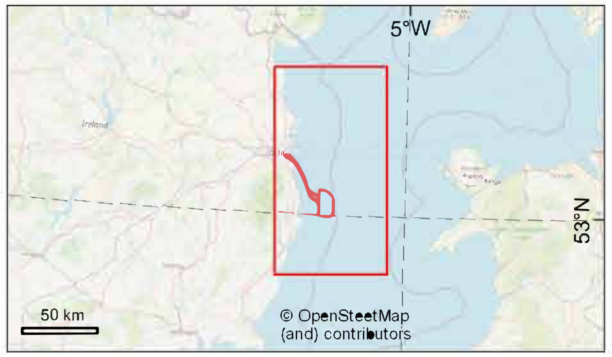
CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
00	Final for issue	2024/07/25	AC	ME/EA	SM







Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- Pile driving noise modelling location
- South east noise modelling contour
- Liffey noise modelling contour

Ellis et al. (2012)

- Spawning ground low intensity

Ireland's Marine Atlas

- Nursery ground

Horse mackerel not covered in Coull et al. (1998) dataset.

codling wind park	*Project:* Codling Wind Park	*Contractor:* natural power www.naturalpower.com

Figure 9.33
Atlantic horse mackerel spawning and / or nursery overlap with noise modelling contours

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1164

Internal descriptive code:	*Size:* A3	*CRS:*
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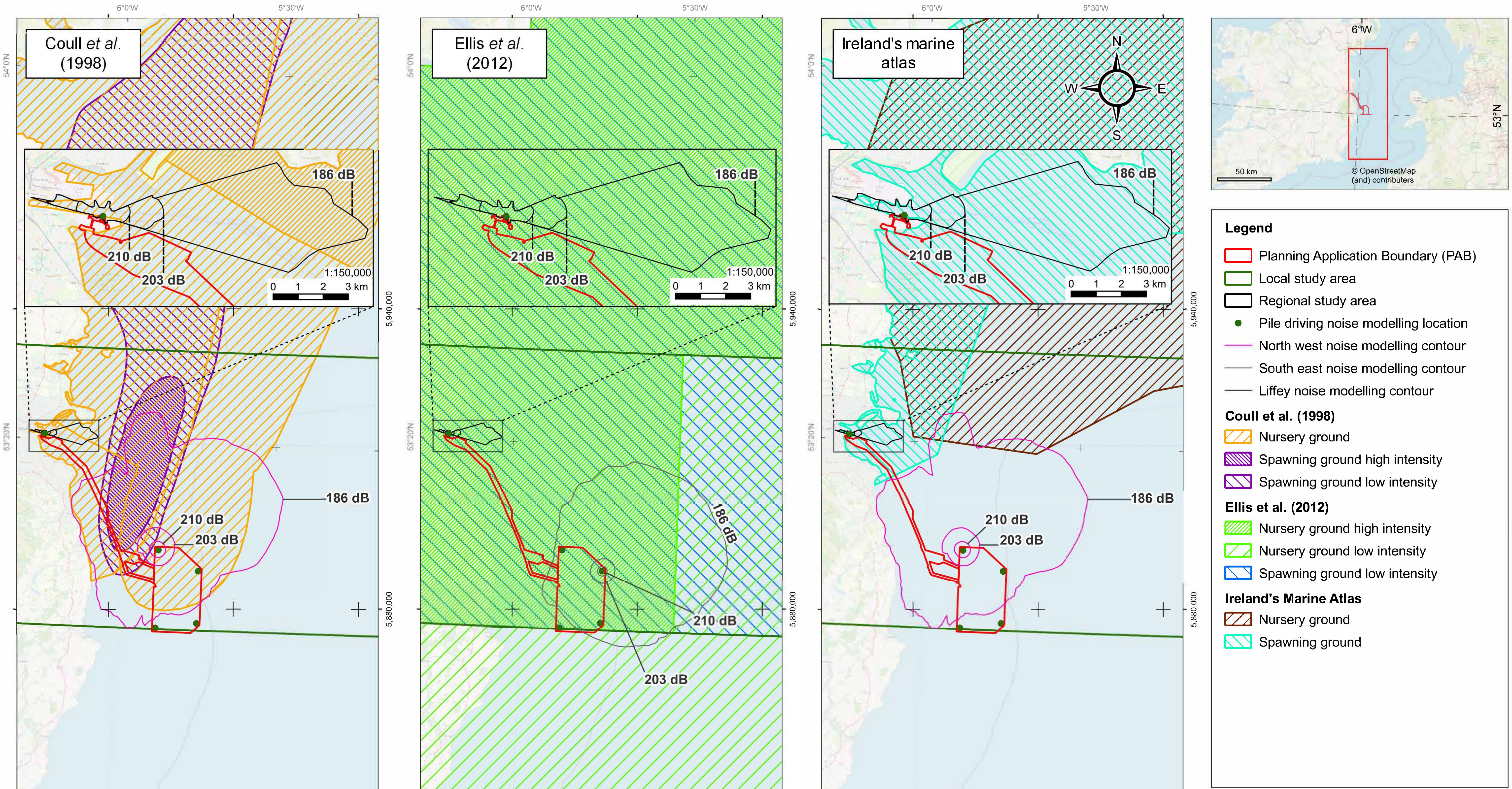
Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
00	Final for issue	2024/07/25	AC	ME/EA	SM



Project:	Contractor:
Codling Wind Park	www.naturalpower.com

Figure 9.34
Whiting spawning and / or nursery overlap with noise modelling contours

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1165

Internal descriptive code:	Size: A3	CRS:
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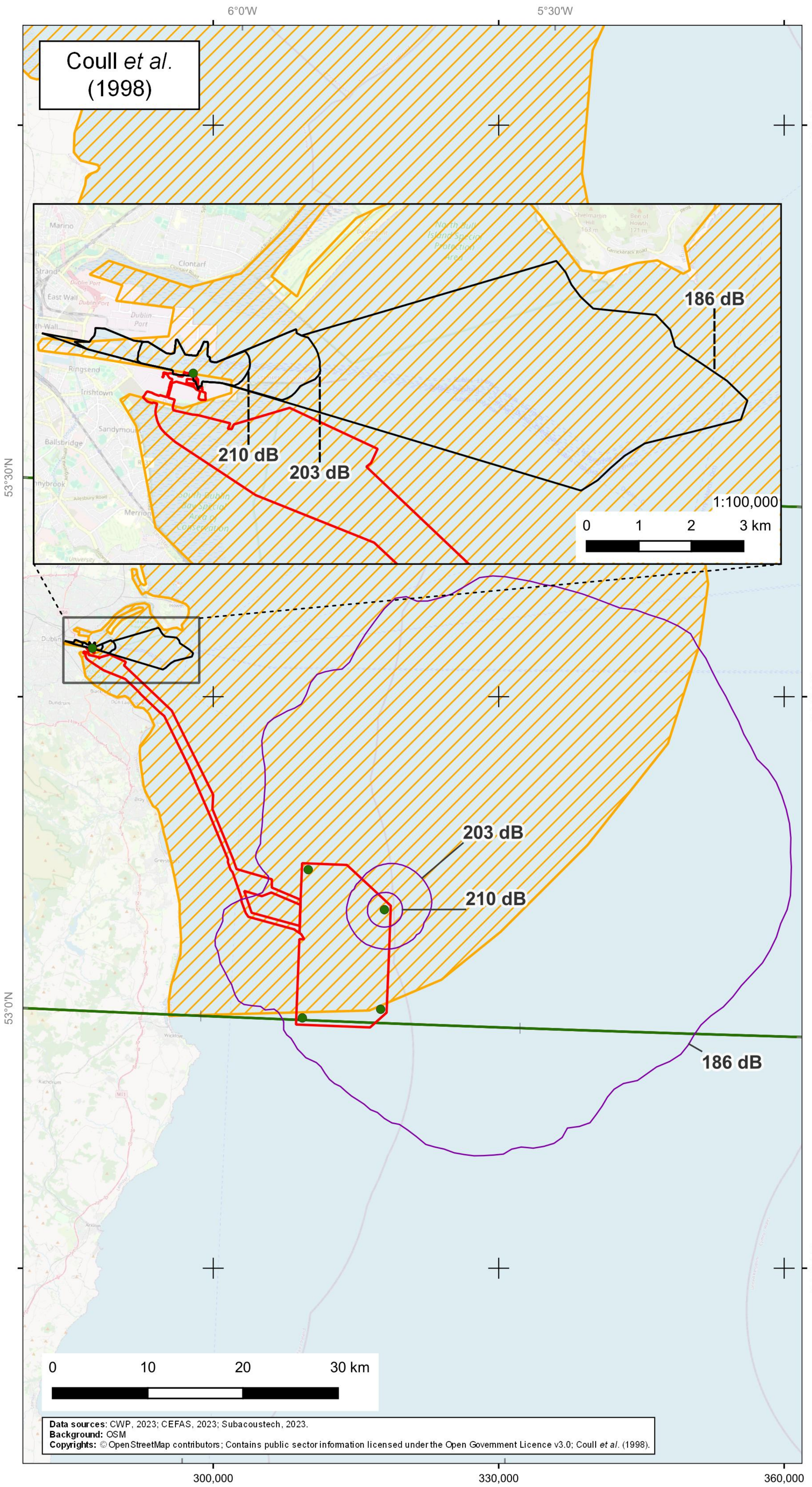
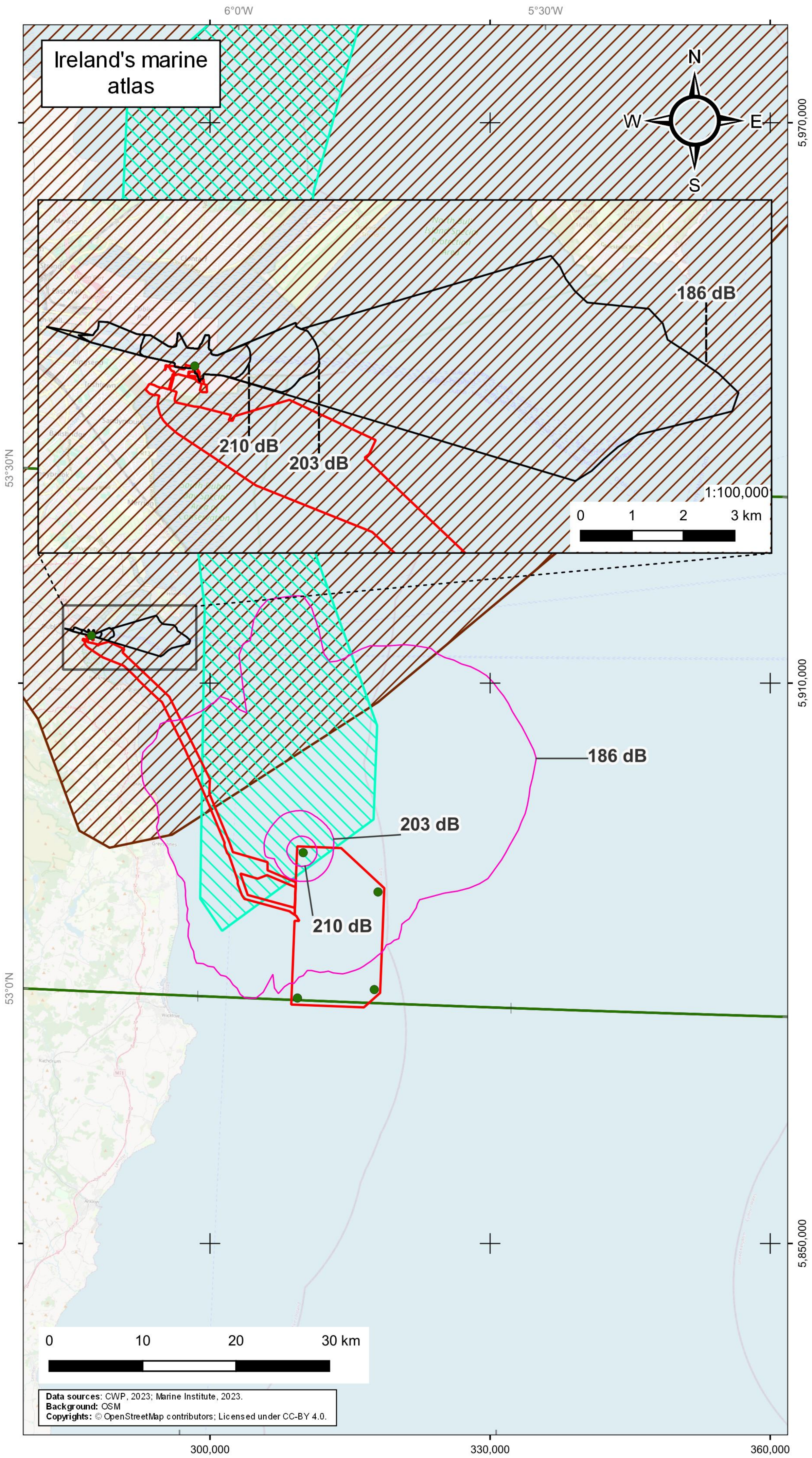
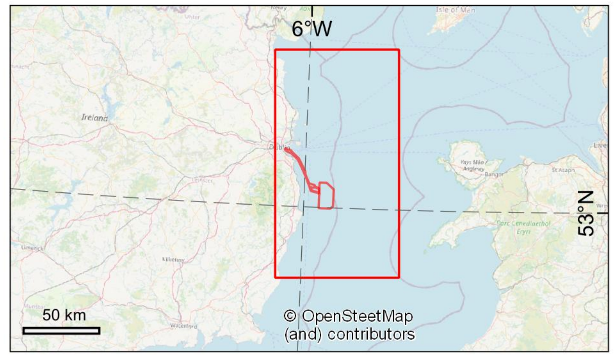
Rev.	Updates	Date	By	Chk'd	App'd
00	Final for issue	2024/07/25	AC	ME/EA	SM







Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- Pile driving noise modelling location
- North west noise modelling contour
- North east noise modelling contour
- Liffey noise modelling contour

Coull et al. (1998)

- Nursery ground

Ireland's marine atlas

- Spawning ground
- Nursery ground

Haddock not covered in Ellis et al. (2012) dataset.

Project: Codling Wind Park

Contractor: natural power — www.naturalpower.com

Figure 9.35
Haddock spawning and / or nursery overlap with noise modelling contours

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1166

Internal descriptive code:	*Size:* A3	*CRS:*
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Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
A	Final version	2024/07/25	AC	ME/EA	SM

Significance of effect

217. The significance of effect has been summarised by each receptor in **Table 9-40**.

Table 9-40 Determination of Significance for group two fish based upon greatest received magnitude of effect

Species	**Sensitivity**	**Mortality / mortal injury**		**Recoverable injury**		**TTS**	
		Magnitude	Significance	Magnitude	Significance	Magnitude	Significance
European hake	Low	Negligible	**Not significant**	Negligible	**Not significant**	Negligible	**Not significant**
Sea trout	Low	Negligible	**Not significant**	Negligible	**Not significant**	Negligible	**Not significant**
Atlantic mackerel	Low	Negligible	**Not significant**	Negligible	**Not significant**	Low	**Not significant**
Whiting	Low	Negligible	**Not significant**	Negligible	**Not significant**	Low	**Not significant**
Atlantic horse mackerel	Low	Negligible	**Not significant**	Negligible	**Not significant**	Low	**Not significant**
Ling	Low	Negligible	**Not significant**	Negligible	**Not significant**	Low	**Not significant**
Haddock	Low	Negligible	**Not significant**	Negligible	**Not significant**	Low	**Not significant**
Atlantic salmon	Medium	Negligible	**Slight / Not significant** (not significant)	Negligible	**Slight / Not significant** (not significant)	Negligible	**Slight / Not significant** (not significant)

218. In summary, group two fish are identified as having low to medium sensitivities. The magnitude of impact is predicted to be negligible for both mortality and recoverable injury, and ranges from negligible to low for TTS. The greatest significance assessed for the group species is slight / not significant, which is not significant. The impact of noise and vibration from construction activities is considered to be **not significant** for all group two species.

219. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

220. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Group Three

Receptor sensitivity

221. As per Table 9-30, group three species have been classed based on their hearing type, and are listed in **Table 9-41**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Across the species group, all are mobile species and therefore have a high capacity (adaptability) to avoid the impact by fleeing during the soft start. Recoverability is high based on fecundity, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value ranges from low to high according to conservation status. Group three fish are considered to be the most sensitive to sound related impacts due to the presence of morphological adaptations for detecting sound, or use of sound during critical life history activities. The thresholds utilised within the modelling already account for the receptors ability to perceive sound, and as most receptors will only be affected at a behavioural level, which will not have any long-term effects on populations, tolerance is assessed as low.

222. As per **Table 9-41**, sensitivity for group three species ranges from low to medium.

Table 9-41 Group three species sensitivities

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Anglerfish	High	Low	High	Low	Low
European smelt	High	Low	High	Low	Low
Atlantic herring	High	Low	High	Low	Low
European sprat	High	Low	High	Low	Low
Atlantic cod	High	Low	High	Medium	Low
Twaite shad	High	Low	High	High	Medium
Allis shad	High	Low	High	High	Medium
European eel	High	Low	High	Medium	Low

Magnitude of Impact

223. The identification of thresholds (as per Popper et al., 2014), as well as the representative scenario outputs for group three species are listed in **Table 9-42**, through reference to the least restrictive scenario and therefore the greatest potential zone of ensonification; the more restrictive scenarios would inherently reduce the zone of ensonification. The maximum, mean and minimum values represent the radius of impact from the modelling location. A visualisation of the sound level contours for group three species can be seen in **Figure 9-36** and where relevant species-specific overlaps with established data sources on nursery / spawning habitats can be seen in **Appendix 9.3**.

Table 9-42 Group three least restrictive scenario for piling

					Array				Onshore substation		
Activity	**Response**	**Level**	**Risk**	**Threshold**	**Area (km^2)**	**Maximum (m)**	**Mean (m)**	**Minimum (m)**	**Area (km^2)**	**Maximum (m)**	**Mean (m)**
Piling	Stationary	SPL_{peak}	Mortality and potential mortal injury	>207 dB	0.25	280	280	280	<0.01	<50	<50
			Recoverable injury	>207 dB	0.25	280	280	280	<0.01	<50	<50
		SEL_{cum}	Mortality and potential mortal injury	>207 dB	14	2,200	2,100	2,000	1.6	1600	520
			Recoverable injury	>203 dB	40	3,800	3,600	3,400	2.8	2400	630
			Temporary Threshold Shift	>186 dB	1,800	34,000	24,000	14,000	25	11000	1300
	Fleeing	SEL_{cum}	Mortality and potential mortal injury	>207 dB	<0.1	<100	<100	<100	<0.1	<100	<100
			Recoverable injury	>203 dB	<0.1	<100	<100	<100	<0.1	100	<100
			Temporary Threshold Shift	>186 dB	740	24,000	14,000	5,700	3.2	3500	630

Mortality

224. The overlap of the noise modelling contours with the known spawning and nursery habitat within the regional study area has been calculated above in **Table 9-42** based upon the stationary and fleeing model.

225. Group three fish mortality for the array piling operations area under the stationary model is predicted to occur within an area of approximately 0.25 km^2 or a maximum distance of 280 m from the source for peak sound pressure level, and an area of 14 km^2 or a maximum distance of 2,200 m from the source for cumulative level exposure. These values drop significantly to less than 0.1 km^2 or less than 100 m from the source when the fleeing model is used.

226. Group three fish mortality in proximity to the Liffey piling operations under the stationary is predicted to occur within an area of approximately <0.01 km^2 or a maximum distance of <50 m from the source for peak sound pressure level, and an area of 1.6 km^2 or a maximum distance of 1,600 m from the source for cumulative level exposure. These values drop significantly to less than 0.1 km^2 or less than 100 m from the source when the fleeing model is used.

227. Of the group three hearing species, the following have spawning (S) and / or nursery (N) grounds in the area: European sprat (S), anglerfish (N), and Atlantic cod (S / N). Of note, while present in the area, there is no noise overlap between Atlantic herring spawning / nursery habitat.

228. The overlap of the noise modelling contours with the known spawning and nursery habitat within the regional study area has been calculated in **Appendix 9.3** and maximum values presented in **Table 9-44**, based upon the stationary and fleeing model. For visualisation of the noise overlap with spawning and nursery grounds, refer to **Figure 9-37** to **Figure 9-39**.

229. The greatest percentage of area affected by mortality under the stationary model (based upon the overlap with available spawning and nursery areas within the Irish Sea study area) is 0.13 % and 0.12 % for Atlantic cod spawning and nursery, respectively (**Table 9-44; Appendix 9.3**).

230. The greatest percentage of area affected by mortality under the fleeing model (based upon the overlap with available spawning and nursery areas within the Irish Sea study area) is <0.01 % for all group 3 spawning and nursery species (**Table 9-44; Appendix 9.3**). It is recognised that fish species not engaged in spawning activities may be present in the area, however, it is considered that any noise impacts will only affect a small number of individuals of such species.

231. Impact piling activities will last a maximum 75 days over the construction period and any impacts will be temporary. It is however a reoccurring event which produces sound levels that may result in the mortality of species with the above ranges / overlaps. For Group three species, there is a maximum area of mortality of 1.6 km^2, and a negligible overlap of mortality noise with spawning / nursery habitat (<0.5 % of habitat within the Irish Sea study area). As such, the magnitude for mortality is considered negligible for both the fleeing and stationary models. Primary mitigation measures (**Section 9.9**) including soft start will provide an opportunity for all individuals to move out of the areas of potential mortality.

Recoverable Injury

232. Group three fish at risk of recoverable injury during the array piling operations under the stationary model are predicted to occur within an area of approximately 0.25 km^2 or a maximum distance of 280 m from the source for peak sound pressure level, and an area of 40 km^2 or a maximum distance of 3,800 m from the source for cumulative level exposure. These values drop significantly to less than 0. 0.1 km^2 or a maximum distance of 100 m from the source when the fleeing model is used.

233. Group three fish at risk of recoverable injury in proximity to the onshore substation piling operations under the stationary model are predicted to occur within an area of approximately <0.01 km^2 or a

maximum distance of <50 m from the source for peak sound pressure level, and an area of 2.8 km^2 or a maximum distance of 2,400 m from the source for cumulative level exposure. These values drop significantly to less than 0.1 km^2 or a maximum distance of 100 m from the source when the fleeing model is used.

234. The greatest percentage of area affected by recoverable injury under the stationary model (based upon the overlap with available spawning and nursery areas within the National Study Area) is 0.32 % and 0.30 % for Atlantic cod spawning and nursery, respectively (**Table 9-44; Appendix 9.3**).

235. The greatest percentage of area affected by recoverable injury under the fleeing model (based upon the overlap with available spawning and nursery areas within the Irish Sea study area) is <0.01 % for all group 3 spawning and nursery species (**Table 9-44; Appendix 9.3**).It is recognised that fish species not engaged in spawning activities may be present in the area, however, it is considered that any effect will only affect a small number of individuals of such species and therefore magnitude will be very low.

236. Piling is a temporary impact of maximum 75 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the recoverable injury of species with the above ranges / overlaps. For Group three species, there is a maximum area of recoverable injury of 94 km^2, and a negligible overlap of mortality noise with spawning / nursery habitat (<1 % of habitat within the Irish Sea study area at the most). As such, the magnitude for recoverable injury is considered negligible for both the fleeing and stationary models. Primary mitigation measures (**Section 9.9**) including soft start will provide an opportunity for all individuals to move out of the areas of potential recoverable injury.

Temporary Threshold Shift (TTS) / Behavioural responses

237. Group three fish at risk of TTS during the array piling operations under the stationary model are predicted to occur within an area of approximately 1,800 km^2 or a maximum distance of 34 km from the source from cumulative level exposure. These values drop significantly to 740 km^2 or a maximum of 24 km from the source when the fleeing model is used.

238. Group three fish at risk of TTS in proximity to the Liffey piling operations under the stationary model are predicted to occur within an area of approximately 25 km^2 or a maximum distance of 11,000 m from the source from cumulative level exposure. These values drop significantly to 3.2 km^2 or a maximum of 3.5 km from the source when the fleeing model is used.

239. The greatest percentage of area affected by TTS under the stationary model (based upon the overlap with available spawning and nursery areas within the Irish Sea study area) is 16.53 % and 7.04 % for Atlantic cod spawning and nursery, respectively (**Table 9-44; Appendix 9.3**).

240. The greatest percentage of area affected by TTS under the fleeing model (based upon the overlap with available spawning and nursery areas within the Irish Sea study area) is 2.78 % and 2.70 % for European sprat spawning and Anglerfish nursery, respectively (**Table 9-44; Appendix 9.3**). It is recognised that fish species not engaged in spawning activities may be present in the area, however, it is considered that any noise impacts will only affect a small number of individuals of such species and magnitude will be very low.

241. Impact piling operations will last a maximum 75 days over the construction period, and any impacts will be temporary, however a maximum of two piles will be driven per day, for a total of seven hours of piling in a 24-hour period. While the percentage of overlap of a spawning are provides useful context, it does not take into account the short term and temporary nature of the work compared to the duration of available spawning potential. As such the proportion of spawning potential impacted has been calculated in **Table 9-43**, using the TTS area as the greatest area of impact with a modelled threshold. When availability of spawning duration is factored in, the greatest impact to spawning potential is 1.51 % (Atlantic cod). When compared to the available spawning habitat and duration, the impact is considered negligible, and effects will be imperceptible.

Table 9-43 Group three temporal overlap results (presented only for species where there is greater than 1 % overlap with spawning or nursery habitat)

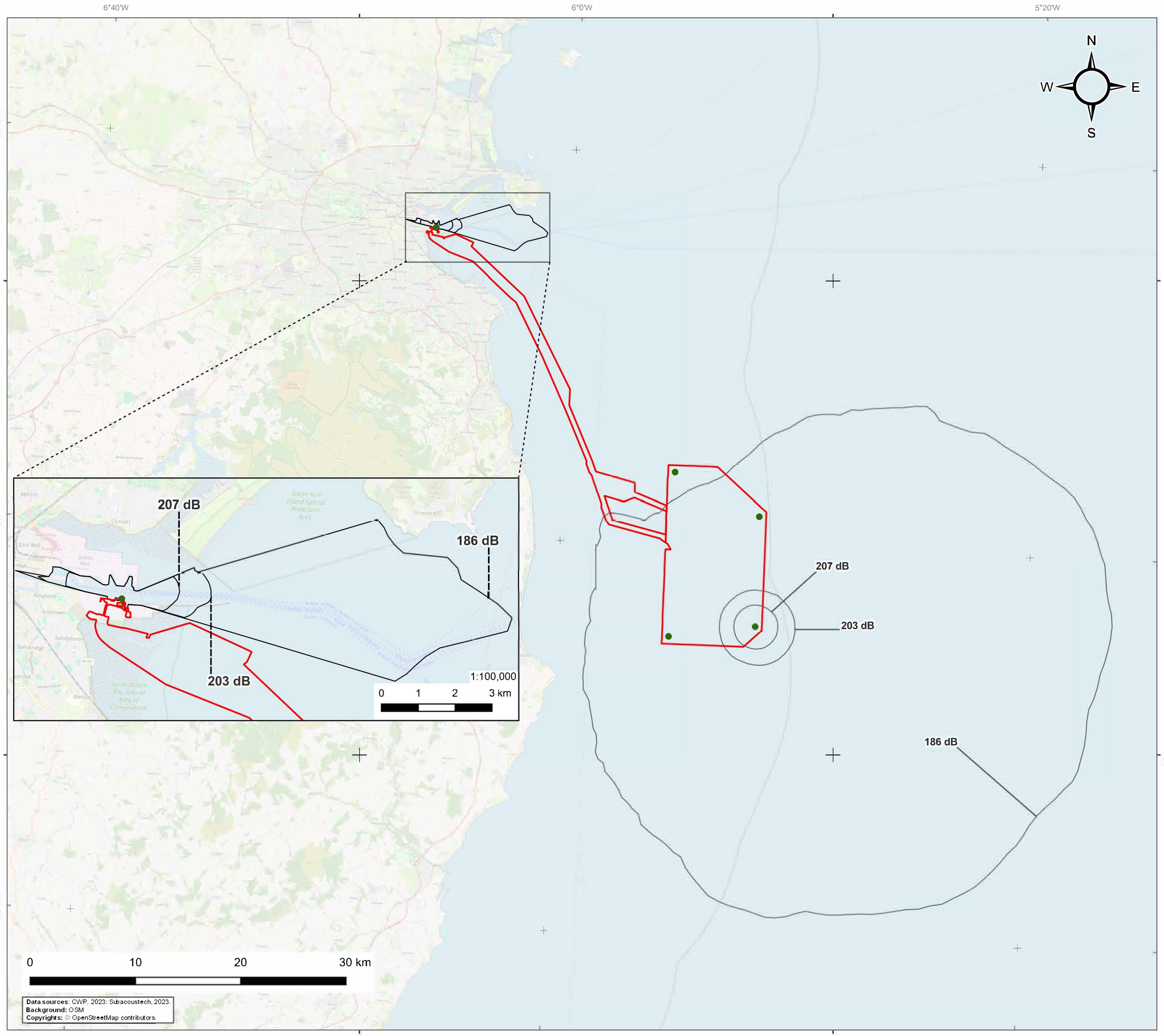
Species	Spawning potential (km^2h)	Impacted spawning potential (km^2h)	Proportion of spawning potential impacted (%)
European sprat	140,069,199	495,420	0.35 %
Atlantic cod	4,966,122	74,830	1.51 %

242. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas. These behavioural responses are likely to be akin to predator avoidance responses and will decrease both in severity and in the percentage of the population affected as distance increases from the noise source (Knaap et al., 2021). Such behavioural responses will be short term, and due to the behavioural nature of the effects, recovery will be very fast, with potential for habituation over the term of the construction phase.

243. For Group three species, there is a maximum area of TTS of 1,800 km2, or an overlap of TTS noise with spawning / nursery areas of between 1.51 % to 16.53 % of habitat within the National Study Area, and effects on spawning potential of no greater than 1.51%. As such, the magnitude for TTS is considered to be low to negligible for both the fleeing and stationary models, dependant on the species assessed. Primary mitigation measures (**Section 9.9**) including soft start will provide an opportunity for all individuals to move away, reducing the area of potential TTS.

Table 9-44 Group three maximum noise overlap calculations of the spawning / nursery activity with the greatest overlap

	Spawning			Nursery		
Species	**Mortality**	**Recoverable Injury**	**TTS**	**Mortality**	**Recoverable Injury**	**TTS**
Fleeing						
Anglerfish				<0.01 %	<0.01 %	1.51 %
European sprat	<0.01 %	<0.01 %	1.55 %			
Atlantic cod	<0.01 %	<0.01 %	1.92 %	<0.01 %	<0.01 %	2.10 %
Stationary						
Anglerfish				0.03 %	0.8 %	3.86 %
European sprat	0.03 %	0.08 %	3.98 %			
Atlantic cod	0.13 %	0.32 %	16.53 %	0.12 %	0.30 %	7.04 %



Legend

- Planning Application Boundary (PAB)
- Pile driving noise modelling location
- South east noise modelling contour
- Liffey noise modelling contour

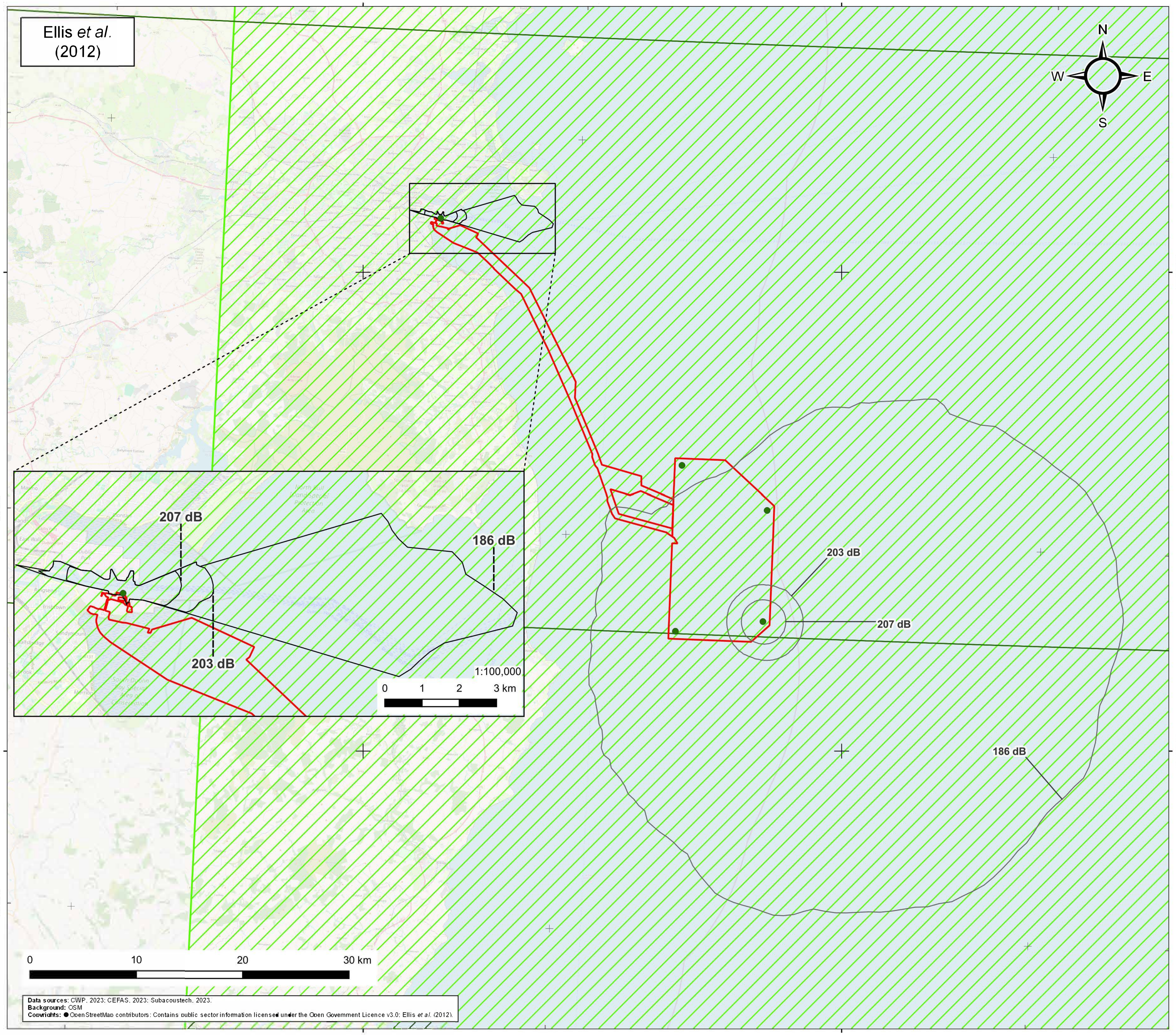
Project:	Contractor:
Codling Wind Park	natural power

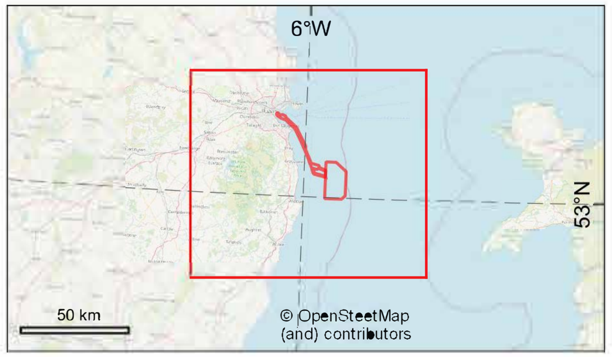
Figure 9.36
Group three noise modelling for species without nursery or spawning habitat

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1167

Internal descriptive code:	Size: A3	CRS:
	Scale: 1:350,000	EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
00	Final for issue	2024/07/25	AC	ME/EA	SM





Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- Pile driving noise modelling location
- South east noise modelling contour
- Liffey noise modelling contour

Ellis et al. (2012)

- Nursery ground low intensity

Anglerfish not covered in Ireland's marine atlas and Coull et al. (1998) datasets.

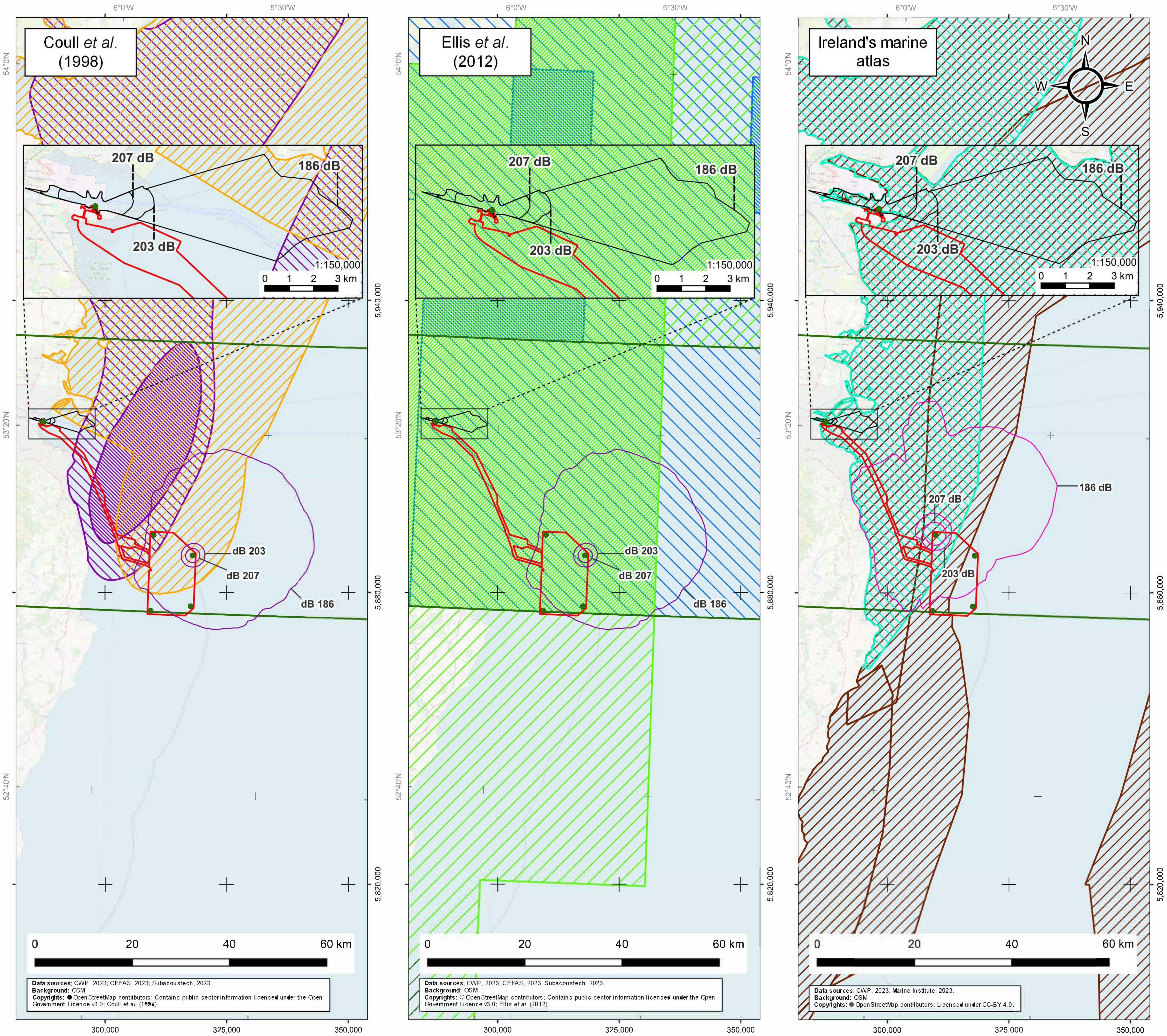
codling wind park	*Project:* Codling Wind Park	*Contractor:* natural power www.naturalpower.com

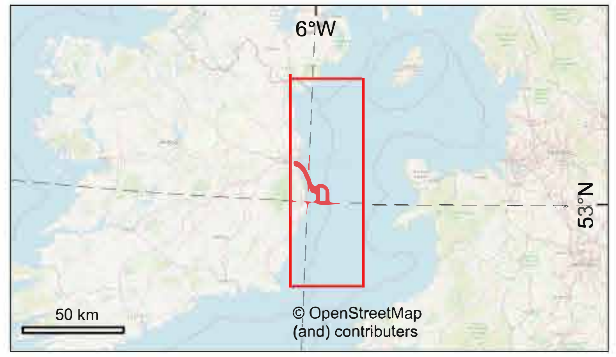
Figure 9.37
Anglerfish spawning and / or nursery overlap with noise modelling contours

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1168

Internal descriptive code:	*Size:* A3 *Scale:* 1:350,000	*CRS:* EPSG 25830

Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
00	Final for issue	2024/07/25	AC	ME/EA	SM





Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- Pile driving noise modelling location
- North east noise modelling contour
- North west noise modelling contour
- Liffey noise modelling contour

Coull et al. (1998)

- Nursery ground
- Spawning ground high intensity
- Spawning ground low intensity

Ellis et al. (2012)

- Nursery ground high intensity
- Nursery ground low intensity
- Spawning ground high intensity
- Spawning ground low intensity

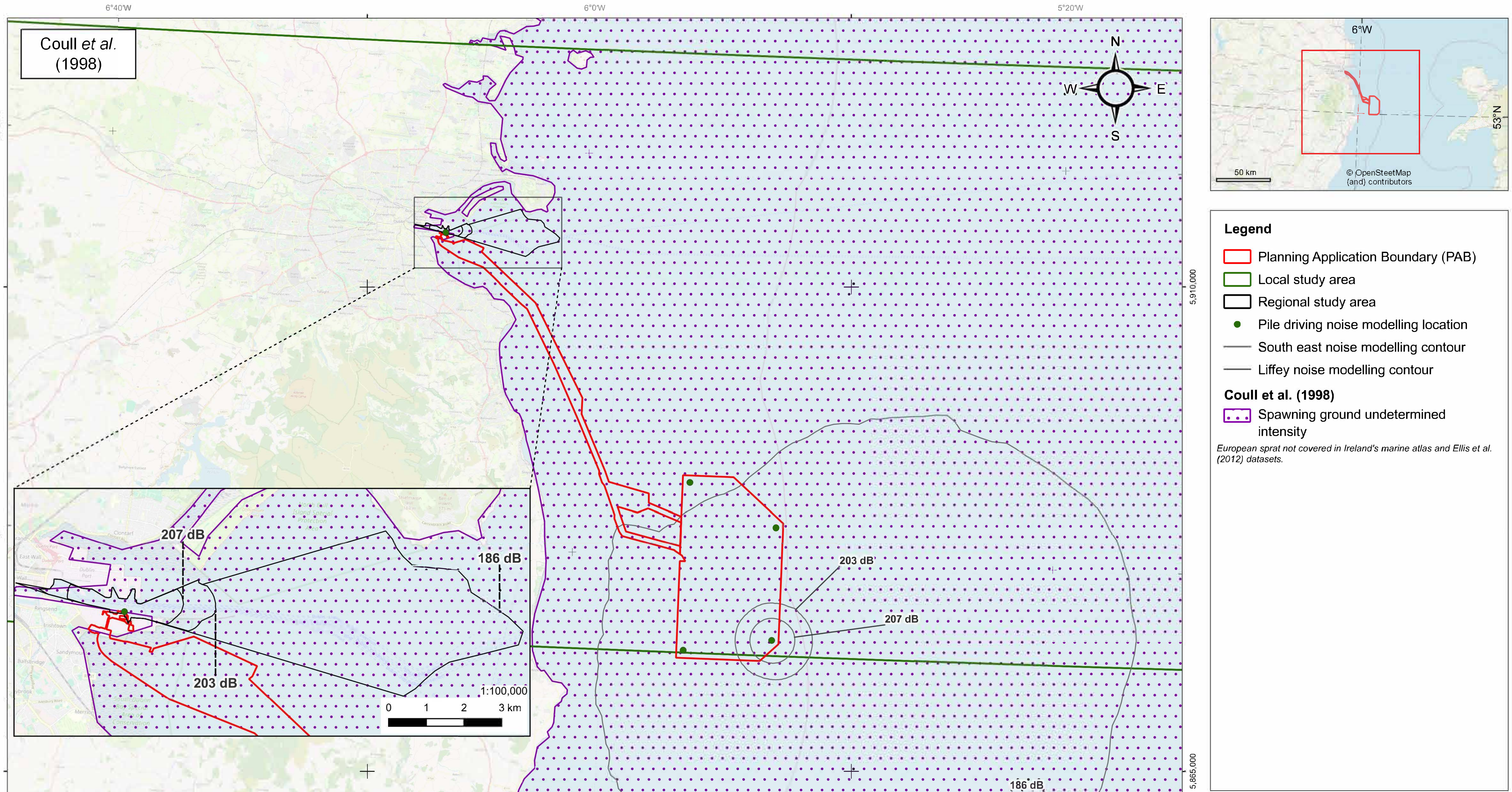
Ireland's Marine Atlas

- Nursery ground
- Spawning ground

codling wind park | Project: Codling Wind Park | Contractor: natural power www.naturalpower.com

Figure 9.38
Atlantic cod spawning and / or nursery overlap with noise modelling contours

CWP doc. number:	CWP-NPC-ENG-08-01-MAP-1169				
Internal descriptive code:	Size: A3	Scale: 1:750,000	CRS: EPSG 25830		
Rev.	Updates	Date	By	Chk'd	App'd
00	Final for issue	2024/07/25	AC	ME/EA	SM



Project: Codling Wind Park	Contractor: natural power www.naturalpower.com

Figure 9.39
European sprat spawning and / or nursery overlap with noise modelling contours

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1170

Internal descriptive code:	*Size:* A3	*CRS:*
OFFSH.ALL - PAB .DPNMLs .DPNM.CONT WTG.SE..DPNM.CONTSS PP - FSTESAs.LRN..SNG.EUROPEAN.SPRAT - EIAR.FIG.09.39	*Scale:* 1:350,000	EPSG 25830

Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
00	Final for issue	2024/07/25	AC	ME/EA	SM

Significance of effect

244. The significance of effect has been summarised by each receptor in **Table 9-45**.

Table 9-45 Determination of Significance for group three VERs based upon greatest received magnitude of effect

Species	Sensitivity	Mortality / mortal injury		Recoverable injury		TTS	
		Magnitude	Significance	Magnitude	Significance	Magnitude	Significance
Anglerfish	Low	Negligible	**Not significant**	Negligible	**Not significant**	Low	**Not significant**
European smelt	Low	Negligible	**Not significant**	Negligible	**Not significant**	Negligible	**Not significant**
Atlantic herring	Low	Negligible	**Not significant**	Negligible	**Not significant**	Negligible	**Not significant**
European sprat	Low	Negligible	**Not significant**	Negligible	**Not significant**	Low	**Not significant**
Atlantic cod	Low	Negligible	**Not significant**	Negligible	**Not significant**	Low	**Not significant**
Twaite shad	Medium	Negligible	**Slight / Not significant** (not significant)	Negligible	**Slight / Not significant** (not significant)	Negligible	**Slight / Not significant** (not significant)
Allis shad	Medium	Negligible	**Slight / Not significant** (not significant)	Negligible	**Slight / Not significant** (not significant)	Negligible	**Slight / Not significant** (not significant)
European eel	Low	Negligible	**Not significant**	Negligible	**Not significant**	Negligible	**Not significant**

245. In summary, group three fish are identified as having low to medium sensitivities. The magnitude of impact is predicted to be negligible for both mortality and recoverable injury, and ranges from negligible to low for TTS. Atlantic cod experience the greatest impacts in terms of spawning area overlap, which is considered to be not significant because of the low likelihood of material impact on spawning potential. The impact of noise and vibration from construction activities is considered to be **not significant** for all group three species.

246. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

247. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Group Four

Receptor sensitivity

248. With spawning and / or nursery grounds present in the area, there is the potential for eggs and larvae to be in the area affected by noise and vibration. Species with spawning or nursery areas in proximity to the CWP Project range from very low to medium in terms of their sensitivities; and these values will be applied to their respective eggs / larvae. The sensitivities are the same as established in **Table 9-31, Table 9-36**, and **Table 9-41**.

249. It is considered that there is no overlap or potential for impact on any species which spawns in freshwater environments, or where spawning and nursery areas are known not to occur within the Irish sea area, for example European eel and Atlantic salmon have been excluded from the below assessment since eel are known to spawn in the Sargasso Sea and salmon spawn upstream and there is therefore no route to impact on the spawning areas of either species. Other species where there is no route to impact to eggs or larvae include allis shad, twaite shad, sea lamprey, river lamprey, sea trout, European smelt and leatherback turtle. Additionally, spurdog / spiney dogfish, tope, common skate, angle shark, and basking shark all produce live young, which are considered under the species-specific hearing type categories above and therefore not considered here.

Magnitude of Impact

250. The identification of thresholds (as per Popper et al., 2014), as well as the representative scenario outputs for group four species are listed in **Table 9-46**. The maximum, mean and minimum values represent the largest radius of impact from the modelling location. A visualisation of the sound level contours for group four species can be seen in **Figure 9-40**.

Table 9-46 Group four least restrictive scenario for piling

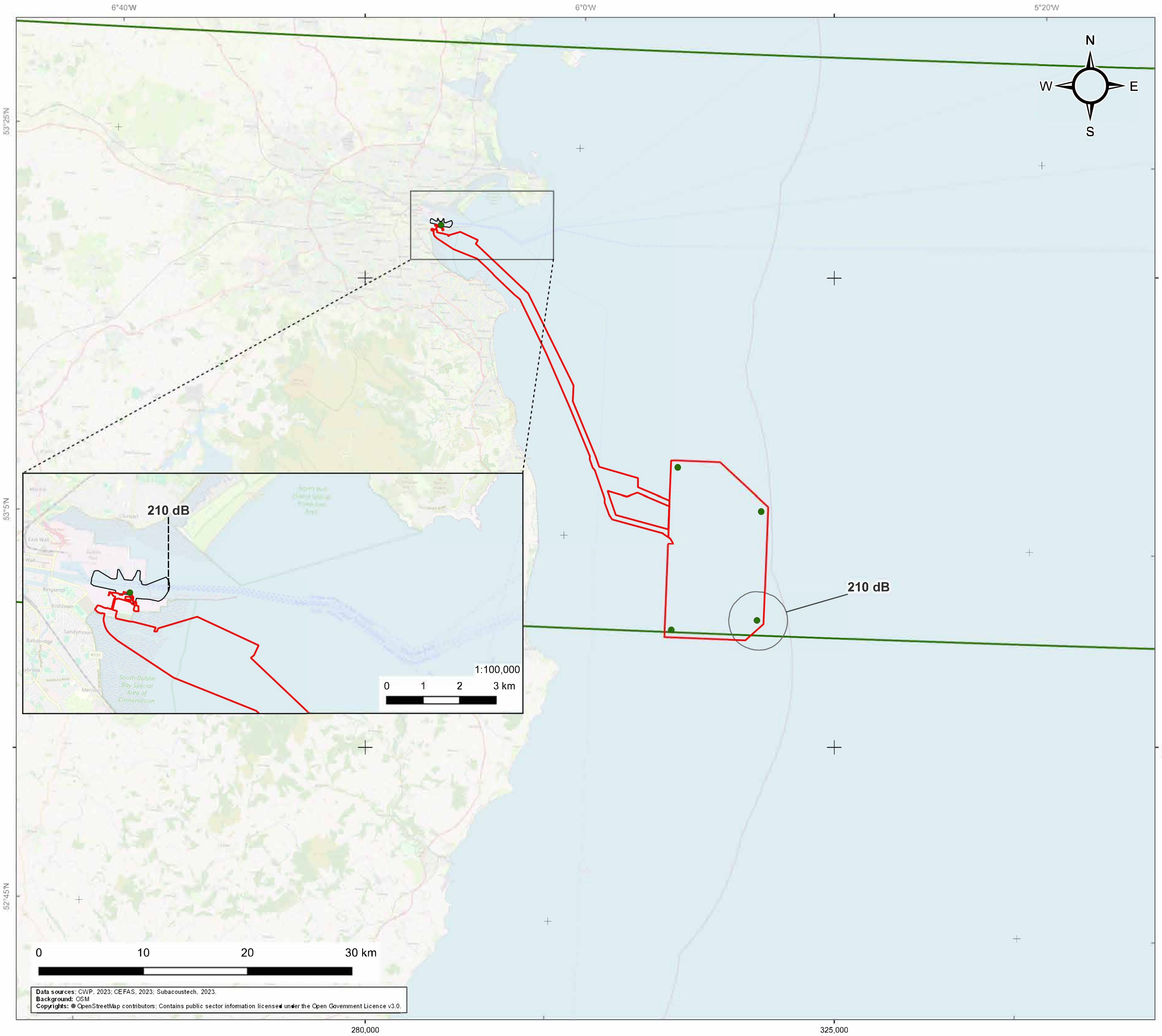
					Array				Liffey		
Activity	**Response**	**Level**	**Risk**	**Threshold**	**Area (km^2)**	**Maximum (m)**	**Mean (m)**	**Minimum (m)**	**Area (km^2)**	**Maximum (m)**	**Mean (m)**
Piling	Stationary	SPL_{peak}	Mortality and potential mortal injury	>207 dB	0.25	280	280	280	<0.01	<50	<50
		SEL_{cum}	Mortality and potential mortal injury	>210 dB	15	2300	2200	2100	1	1100	450

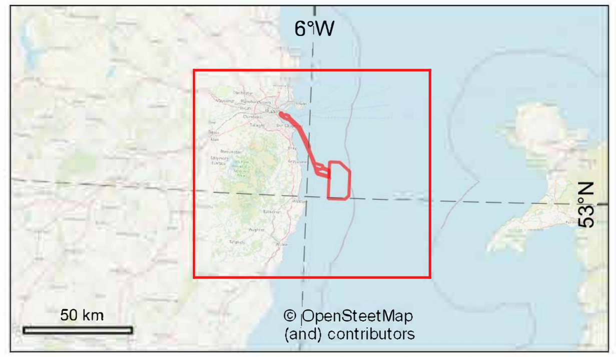
Mortality

251. As per **Table 9-46**, for the array site piling operations under the stationary model, mortality may occur in an area of approximately 0.25 km^2 or a maximum distance of 280 m from the source for peak sound pressure level, and an area of 15 km^2 or a maximum distance of 2,300 m from the source for cumulative level exposure.

252. In proximity to the onshore substation piling operations under the stationary model, mortality may occur in an area of approximately <0.01 km^2 or a maximum distance of <50 m from the source for peak sound pressure level, and an area of 1 km^2 or a maximum distance of 1,100 m from the source for cumulative level exposure.

253. Although these areas are considered to be negligible in size considering the area over which these species may spawn, as the impact is considered to be impacting a critical stage of life the magnitude of effect is considered low.





Legend

- Planning Application Boundary (PAB)
- Local study area
- Regional study area
- Pile driving noise modelling location
- South east noise modelling contour
- Liffey noise modelling contour

codling wind park	Project: Codling Wind Park	Contractor: natural power www.naturalpower.com

Figure 9.40
Group four and turtle noise modelling for species without nursery or spawning habitat

CWP doc. number: CWP-NPC-ENG-08-01-MAP-1171

Internal descriptive code:	Size: A3	CRS:
OFFSH.ALL - PAB..DPNMLs..DPNM.CONT.WTG.SE..DPNM.CONT.SS.PP - FSTESAs.LRN..SNG.G4 - (EIAR.FIG.09.40)	Scale: 1:350,000	EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
00	Final for issue	2024/07/25	AC	ME/EA	SM

Significance of effect

254. The significance of effect has been summarised by each receptor in **Table 9-47**.

Table 9-47 Determination of Significance for group four (eggs and larvae) based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Small-spotted catshark	Low	Low	**Not significant**
Cuckoo ray	Low	Low	**Not significant**
Blonde ray	Low	Low	**Not significant**
European plaice	Very Low	Low	**Not significant**
Sandeel	Low	Low	**Not significant**
Lemon sole	Very Low	Low	**Not significant**
Common sole	Very Low	Low	**Not significant**
Undulate ray	Low	Low	**Not significant**
Thornback ray	Medium	Low	**Slight** (not significant)
Spotted ray	Medium	Low	**Slight** (not significant)
European hake	Low	Low	**Not significant**
Atlantic mackerel	Low	Low	**Not significant**
Whiting	Low	Low	**Not significant**
Atlantic horse mackerel	Low	Low	**Not significant**
Ling	Low	Low	**Not significant**
Haddock	Low	Low	**Not significant**
Anglerfish	Low	Low	**Not significant**
Atlantic herring	Low	Low	**Not significant**
European sprat	Low	Low	**Not significant**
Atlantic cod	Low	Low	**Not significant**

255. In summary, group four receptors are identified as having very low to medium sensitivities, and the magnitude of impact for all species is assessed as low. Several species experience the highest impact significance (slight), which is not significant. The impact of noise and vibration from construction activities is considered to be not significant for all group four species.

256. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

257. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Shellfish

Receptor sensitivity

258. As per **Table 9-30**, shellfish species have been grouped based upon their ability to only detect the particle motion element of sound, and are listed below in **Table 9-48**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Across the species group, all are non-mobile species and therefore have a low to very low capacity (adaptability) to avoid the impact by fleeing during the soft start. Shellfish perceive the particle motion element of sound only, and the majority of any effects will be behavioural in nature (if observable) and as such tolerance is considered high. Recoverability is high based on fecundity, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value is low according to conservation status.

259. As per **Table 9-48**, sensitivity for shellfish species is low for the group.

Table 9-48 Shellfish sensitivities

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Razor / knife clams	Very low	High	High	Low	Low
Norway lobster	Low	High	High	Low	Low
Sword razor shell	Very low	High	High	Low	Low
Whelk	Very low	High	High	Low	Low
Great Atlantic scallop	Very low	High	High	Low	Low
Edible crab	Low	High	High	Low	Low
European lobster	Low	High	High	Low	Low

Magnitude of Impact

260. Whilst a subset of bony fish are able to detect sound pressure, due to the lack of compressible gas-filled organs or cavities which play an important role in such detection, marine invertebrates (including whelk) are not considered to be sensitive to the pressure component of underwater noise (Di Franco et al., 2020; Cook et al., 2017; Roberts and Elliott, 2017; Edmonds et al., 2016; Roberts et al., 2016; Mooney et al., 2012). However, it is now understood that all fishes and many marine invertebrates can detect the particle motion components of sound (Popper et al., 2022; Hawkins et al., 2021; Nedelec et al., 2016). Furthermore, recent thinking is that fishes and invertebrates that live on or close to the substrate are able to detect substrate-borne vibrations from activities where there is direct contact of a sound source with the substrate (e.g., through impact piling) or where sound energy enters the substrate through the water from intense sources (e.g., air guns) (Hawkins et al., 2022; Roberts and Elliott, 2017).

261. Based on the current literature to date, there is no evidence of mortality-associated population effects (such as reduced abundance or catch rates) of invertebrates following exposure to anthropogenic sound sources such as those typical of drilling, impact piling or survey work (Bluewise Marine, 2023). Research on invertebrates provides evidence for low-frequency sound detection abilities which may result in short term, temporary, behavioural responses in marine invertebrate species (Roberts and Breithaupt, 2016; Carroll et al., 2017, Bluewise Marine, 2023). For example, Norway lobster was shown to exhibit repressed burying and reduced locomotion behaviour in response to impact piling sound exposure (Solan et al., 2016). The European hermit crab (*Pagurus bernhardus*) showed an increased delay in antipredator responses due to noise related disturbance, potentially leading to a higher risk of predation (Tidau et al., 2016).

262. The only shellfish species for which there is spawning / nursery information is Norway lobster. While it is established above that shellfish lack sound detecting organs, temporary changes in behaviour are known to occur, therefore the area of this impact for Norway lobster is presented in **Table 9-49**.

263. Piling is a temporary impact of a maximum 75 days over the construction period, however a maximum of two piles will be driven per day, for a total of seven hours of piling in a 24-hour period. While the percentage of overlap of a spawning are provides useful context, it does not take into account the short term and temporary nature of the work compared to the duration of available spawning potential. As such the proportion of spawning potential impacted has been calculated in **Table 9-49**, using the TTS area as the greatest area of impact with a modelled threshold. When availability of spawning duration is factored in, the greatest impact to spawning potential is 0.95 % (Norway lobster). When compared to the available spawning habitat and duration, the impact is considered negligible, and effects will be imperceptible.

Table 9-49 Shellfish temporal overlap results (presented only for species where there is greater than 1% overlap with spawning or nursery habitat)

Species	Spawning potential (km^2h)	Impacted spawning potential (km^2h)	Proportion of spawning potential impacted (%)
Norway lobster (*Nephrops norvegicus*)	34,407,048	328,187	0.95 %

264. Given shellfishes lack of sound detecting organs and limited and temporary changes in behaviour arising from sources of underwater noise arising from construction, including impact piling, the magnitude of impact to shellfish is considered negligible.

Significance of effect

265. The significance of effect has been summarised by each receptor in **Table 9-50**.

Table 9-50 Determination of Significance for shellfish based upon greatest received magnitude of effect

Species	Sensitivity	Mortality / mortal injury	
		Magnitude	Significance
Razor / knife clams	Low	Negligible	**Not significant**
Norway lobster	Low	Negligible	**Not significant**
Sword razor shell	Low	Negligible	**Not significant**
Whelk	Low	Negligible	**Not significant**
Great Atlantic scallop	Low	Negligible	**Not significant**
Edible crab	Low	Negligible	**Not significant**
European lobster	Low	Negligible	**Not significant**

266. In summary, shellfish are identified as having low sensitivity. The magnitude of impact is predicted to be negligible for mortality. All shellfish experience the same significance (not significant), which is not significant. The impact of noise and vibration from impact piling is considered to be **not significant** for all shellfish species.

267. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

268. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Turtles

Receptor sensitivity

269. As per **Table 9-30**, turtles are classed into their own hearing group, and are listed in **Table 9-51**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Turtles are a mobile species and therefore have a high capacity (adaptability) to avoid the impact by fleeing during the soft start. Turtles are unlikely to be present in the area in large numbers, therefore any effects are unlikely to lead to any population level consequences, as such, tolerance is assessed as high. Recoverability is low based on fecundity, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value is medium according to conservation status.

270. As per **Table 9-51**, sensitivity for turtles is medium.

Table 9-51 Turtle sensitivities

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Leatherback turtle	High	High	Low	Medium	Medium

Magnitude of Impact

271. The identification of thresholds (as per Popper et al., 2014), as well as the representative scenario outputs turtle species are listed in **Table 9-52**. The maximum, mean and minimum values represent the radius of impact from the modelling location. A visualisation of the sound level contours for turtles can be seen in **Figure 9-40**.

Table 9-52 Turtles: least restrictive scenario for piling

					Array				Liffey		
Activity	**Response**	**Level**	**Risk**	**Threshold**	**Area (km^2)**	**Maximum (m)**	**Mean (m)**	**Minimum (m)**	**Area (km^2)**	**Maximum (m)**	**Mean (m)**
Impact piling	Stationary	SPL_{peak}	Mortality and potential mortal injury	>207 dB	0.25	280	280	280	<0.01	<50	<50
		SEL_{cum}	Mortality and potential mortal injury	210 dB	15	2300	2200	2100	1	1100	450
	Fleeing	SEL_{cum}	Mortality and potential mortal injury	210 dB	<0.1	<100	<100	<100	<0.1	<100	<100

Mortality

272. As per **Table 9-52**, for the array site impact piling operations area under the stationary model noise modelling contours will result in an area of approximately 0.25 km^2 or a maximum distance of 280 m from the source for peak sound pressure level, and an area of 15 km^2 or a maximum distance of 2,300 m from the source for cumulative level exposure. Under the fleeing model, this reduces to an area of less than 0.1 km^2 or a maximum distance of less than 100 m for the cumulative level exposure. In proximity to the onshore substation piling operations under the stationary model noise modelling contours will result in an area of approximately <0.01 km^2 or a maximum distance of < 50 m from the source for peak sound pressure level, and an area of 1 km^2 or a maximum distance of 1,100 m from the source for cumulative level exposure. Under the fleeing model, this reduces to an area of less than 0.1 km^2 or a maximum distance of less than 100 m for the cumulative level exposure.

273. Part of the primary mitigation measures (**Section 9.9**) includes the use of a soft start to piling activities as part of the MMMP. The mitigation will also ensure that there are no turtles within the area when piling begins. As such, the magnitude is considered negligible for both the fleeing and stationary models for turtles**.**

Significance of effect

274. The sensitivity of turtles in the study area is medium. As impact magnitude is assessed to be negligible, the potential effect of mortality or mortal injury as a result of noise and vibration on turtles from piling operations is slight / not significant and therefore **not significant**.

275. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

276. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Array site and OECC UXO clearance

277. Up to a maximum ten UXO have been estimated as requiring clearance for the purposes of the assessment, with a maximum charge weight of up to 525 kg Net Explosive Quantity (NEQ) for 2,000 lb (907.2 kg) UXO. This is a highly precautionary basis on which to undertake the assessment, as UXO likelihood is very low. Where UXO is identified consideration will also be given to low order detonation where feasible. The UXO items considered most likely to be encountered within the offshore development area are:

- Mines Allied;
- Mines German;
- Large Bombs (500 lb or larger);
- Small Bombs (250 lb or smaller);
- Large Projectiles (6 inch–16 inch);
- Small Projectiles and Rockets (smaller than 6 inch);
- Chemical Munitions;
- Depth Charges and Torpedoes;
- Land Service Ammunition; and
- Small Arms Ammunition.

Receptor Sensitivity

278. As the effects of UXO clearance are irrelevant of hearing type, all species are included in **Table 9-53**. Sensitivity has been determined based upon the definitions set out in **Table 9-3** with information feeding this assessment coming from **Table 9-18**. As this is an instantaneous impact, all species have a low ability to adapt. Tolerance within the group is low as due to the instantaneous nature of the impact, the nature of impact considered is one of mortality and mortal injury. Recoverability is low based on the lowest level of fecundity within the receptor group, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. As all species are considered here, and on a precautionary basis, value is high according to greatest conservation status.

279. As per **Table 9-53**, sensitivity for all species is high.

Table 9-53 Fish, shellfish and turtle sensitivity to UXO clearance

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
All receptors	Low	Low	Low	High	**High**

Magnitude of Impact

280. The detonation of an UXO results in a single pressure wave that emanates from the source, therefore only SPL_{peak} is considered here in terms of thresholds (Popper et al., 2014). All hearing groups have the same threshold, with mortality and mortal injury occurring up to 810 m from the UXO detonation (**Table 9-54**). Though the consequences of the impact are severe, the area of impact is considered to be negligible in the context of the wider availability of habitat and the extents of the known spawning and nursery grounds in the area. Therefore, the magnitude of impact from potential UXO detonations is considered to be negligible.

Table 9-54 Threshold and area of impact for UXO clearance events

Activity	Response	Level	Risk	Threshold	Area (km^2)	Maximum (m)	Mean (m)	Minimum (m)
UXO	N/A	SPL_{peak}	Mortality and potential mortal injury	229–234 dB peak	-	810 (229 dB) –490 (234 dB)	-	-

Significance of effect

281. The significance of effect has been summarised by each receptor in **Table 9-55**.

Table 9-55 Determination of Significance for UXO clearance events based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
All receptors	High	Negligible	Slight (not significant)

282. In summary, all receptors are identified as having a high sensitivity. The magnitude of impact is predicted to be negligible. Therefore, the significance is slight, which is not significant. The impact of noise and vibration from UXO clearance is considered to be **not significant** for all species.

283. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

284. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Surveys and General Construction Noise

285. Prior to the installation of any type of foundation, substructure or cable, a pre-construction survey will be undertaken to identify, in detail, seabed conditions and morphology, and presence / absence of any potential obstructions. These surveys will consist of geophysical and geotechnical surveys and will be conducted across the array site and OECC.

286. General construction noise includes any noise produced by construction activities (i.e. trenching, cable laying, boulder clearance). Noise levels produced by a trenching tool have been shown to be below the injury and TTS levels (Nedwell et al., 2003). In addition to this, construction related activities (excluding piling) will be a continuous noise that will allow for fish to move away from the noise. A recent study by Bluewise Marine (2023) concluded that it is highly unlikely that critical impacts to fish and shellfish receptors will occur from geotechnical surveys, although it is acknowledged that minor impacts (such as avoidance or habituation behaviour) may occur.

Receptor Sensitivity

287. The effects of geophysical surveys are not dependant of hearing type, all species are assessed and included in **Table 9-56**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. As this is impact does not allow time for receptors to flee, all species have a low ability to adapt to this. Tolerance within the group is high, as effects on all receptors are expected to be behavioural at greatest (and which is likely to be habituated to). Recoverability is low based on the lowest level of fecundity within the receptor group, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value is high according to greatest conservation status.

288. As per **Table 9-56**, sensitivity for all species is medium.

Table 9-56 Fish, shellfish and turtle sensitivity to survey and construction noise

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
All receptors	Low	High	Low	High	Medium

Magnitude of Impact

289. Geophysical surveys will be used to survey the offshore development area, which is minimal within the context of the wider habitat availability. Such surveys will typically be of short duration (days / weeks), though only act in any one area for a transient amount of time. Surveys may occur more than once in any given area, though frequency will likely be infrequent.

290. Based on the current literature to date, there is no evidence of mortality or population effects (such as reduced abundances) of fish or invertebrates following exposure to anthropogenic sound sources such as those typical of survey work. Research on invertebrates provides evidence for low-frequency sound detection abilities which may result in short term behavioural responses in a number of marine invertebrate species (Roberts and Breithaupt, 2016; Carroll et al., 2017). There is little to no research on fish responses to geophysical survey work, however as the typical devices used to survey the seabed (e.g., side scan sonar, or multi beam echosounder) are also used to detect fish underwater with no observed behavioural response to the noise emitted from the scanning sonar devices, no effects are predicted from the use of high frequency geophysical survey equipment. Where low frequency equipment is used, it is considered that this may elicit a small scale behavioural (avoidance) response.

291. For turtles, use of survey equipment will adhere to the mitigations described for marine mammals (see **Chapter 11 Marine Mammals**) which will also mitigate the impacts on turtles and remove any risk of injury or harm.

292. In regard to general construction noise and vibration, activities will occur at sporadic intervals (days / weeks) across the estimated three-year construction phase. Activities may occur more than once in any given area, though frequency will likely be infrequent. As none of the general construction activities involve a percussive impact, the magnitude of noise will be significantly less than those from piling. There is the potential that generated nose will result in short term behavioural responses (i.e., avoidance of the area), but this will occur over very small areas in the context of the wider availability of habitat.

293. Therefore, magnitude is determined to be negligible.

Significance of effect

294. The significance of effect has been summarised by each receptor in **Table 9-57**.

Table 9-57 Determination of Significance for geophysical surveys based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
All receptors	Medium	Negligible	Slight / Not significant (not significant)

295. In summary, all receptors are identified as having medium sensitivities to the impact of noise and vibration. The magnitude of impact is predicted to be negligible. All species experience the same significance (slight / not significant), which is not significant. The impact of noise and vibration from geophysical surveys and general construction noise is considered to be **not significant** for all species.

296. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

297. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Barrier effects on migratory species in the River Liffey

298. Piling activities at the onshore substation in the Pigeon Park area of the River Liffey is predicted to occur over a 20-week period. Given the onshore substation piling activities will occur near the mouth of the River Liffey, there is the potential that anadromous fish, which will be in the estuarine area during

a critical life stage, may be prevented from migrating due to noise and vibration, or harmed in the process of migration.

299. Anadromous fish include:

- Allis shad;
- Twaite shad;
- Atlantic Salmon;
- Sea trout;
- Sea lamprey; and
- River lamprey.

Receptor Sensitivity

300. As per **Table 9-30**, anadromous species sensitivity have been based on spawning ecology, and as such may vary from those set out in relation to noise exposure above. Sensitivity is presented in **Table 9-58**, and has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment presented in **Table 9-18**. Across the receptor group, all species require fresh water to complete their life cycle, and therefore have a low capacity (adaptability) to avoid the impact. The tolerance of the majority of species within this group is considered to be high for the impact of noise and vibration as in the main this impact will result in some behavioural response, and in the majority of cases, fish will be able to move through the estuary between piling events where they have a strong preference to do so (e.g., adult salmon migration), or will be able to delay slightly their upstream migration with minimal impact on subsequent phases of their lifecycle (e.g. European eel). The salmon / trout smolt are considered to have a lower tolerance as they are generally considered to be more at risk of predation and other pressures. Recoverability is high based on the fecundity of all species, and as the majority of responses will be behavioural. Value ranges from low to high according to conservation status.

301. As per **Table 9-58**, sensitivity this species group ranges from low to high.

Table 9-58 Migratory species sensitivities

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Allis shad	Low	High	High	High	Medium
Twaite shad	Low	High	High	High	Medium
Atlantic Salmon	Low	High	High	High	Medium
Sea trout	Low	High	High	Low	Low
Salmon/trout smolt	Low	Medium	High	High	High
Sea lamprey	Low	High	High	High	Medium
River lamprey	Low	High	High	High	Medium
European Eel	Low	High	High	Medium	Medium

Magnitude of Impact

302. The river Liffey is not a designated site (SAC) for any migratory fish species. In fisheries assessments of the river, Atlantic salmon, brown / sea trout, sea and river lamprey (*Lampetra* sp.), and European eel were the only migratory species recorded (Delanty, Feeney & Shephard, 2022; Tritus, 2020). Given the river is not designated for either shad species, and none were observed during fisheries assessments, it is concluded that they are not present in a degree that population level impacts could occur and no barrier to migration exists for these species from the CWP Project. The magnitude of impact on shad species is therefore negligible.

303. European eel spawn in the Sargasso Sea and enter freshwater during maturation. Lamprey species spawn in freshwater and the juveniles develop in the riverine environment for up to 8 years in some cases prior to migrating into the marine environment. As lamprey species enter or leave freshwater habitats at a relatively developed stage, and juvenile eels (elvers) migrate upstream at night, they are not considered likely to suffer damage or mortality level effects as they are highly mobile and can avoid such areas of increased underwater noise and vibration. In addition, as the duration of piling is short in relation to the developed nature of these individuals, it is considered that any impact is temporary and will not constitute a barrier to the migration of these species. The magnitude of impact on eels or lamprey species is therefore negligible.

304. Adult salmon and trout utilising the River Liffey are well progressed and developed and are not considered likely to suffer damage or mortality level effects as they are highly mobile and can avoid such areas of increased underwater noise. Salmon are also considered not overly sensitive to noise and vibration and exhibit minimal to no response when exposed to piling noise (Harding et al., 2016). In addition, as the duration of piling at the onshore substation in the River Liffey is short term. As this receptor group will be highly driven to migrate upstream, it is considered they will migrate quickly past any areas of increased underwater noise and vibration. As such, it is considered that any impact is highly temporary, if present at all, and will not constitute a barrier to the migration of these species in their adult phase. As such, magnitude of impact on adult salmon and sea trout is low.

305. Atlantic salmon and sea trout leave freshwater at the smolt stage. Smolts are not as mobile as the adult fish and will likely be present in the estuarine environment for a period of time as they acclimate to salinity changes prior to commencing their at sea migration. Salmon and sea trout are known to synchronise smolt runs where they are both present in a river (Harvey et al., 2020). As smolts have

less opportunity to avoid the impact if it overlaps with the seasonal smolt run, it is considered that barriers to migration have the potential to be present for these species. As such, magnitude of impact on salmon and sea trout smolt is high.

Significance of effect

306. The significance of effect has been summarised by each receptor in **Table 9-59**.

Table 9-59 Determination of Significance for barrier effects based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Allis shad	Medium	Negligible	**Slight / Not significant** (not significant)
Twaite shad	Medium	Negligible	**Slight / Not significant** (not significant)
Atlantic salmon	Medium	Low	**Slight** (not significant)
Sea trout	Low	Low	**Not significant**
Salmon/trout smolt	High	High	**Very Significant / Profound** (significant)
Sea lamprey	Medium	Negligible	**Slight / Not significant** (not significant)
River lamprey	Medium	Negligible	**Slight / Not significant** (not significant)
European eel	Medium	Negligible	**Slight / Not significant** (not significant)

307. In summary, receptors are identified as having low to high sensitivities. The magnitude of impact is predicted to be negligible to high. Atlantic salmon / sea trout smolt experience the highest significance (Very Significant / Profound), which is **significant**. The impact of barrier effects on migratory species in the River Liffey from noise and vibration is considered to be **significant** for Atlantic salmon and sea trout smolt only, and **not significant** for Atlantic salmon, sea trout, Allis shad, twaite shad, sea lamprey, river lamprey and European eel.

308. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

Additional mitigation

309. The following mitigation for Atlantic Salmon and Sea Trout smolt is considered to negate the above-described effects on the smolt run and will allow unimpeded downstream migration of the smolt:

- Piling works along the River Liffey Channel will not be permitted between March and May (inclusive) to avoid noise and vibration impact during the smolt run, which occurs in the river between these months (CEFAS, n. d.; ESB, 2022).

Residual effect

310. With the adoption of the additional mitigation measures, which insures there is no interaction during the smolt run, the magnitude of effect will be negligible. There is therefore no residual effect and the impact of barrier effects on migratory species in the River Liffey and therefore the impact of noise and vibration is considered to be **not significant** for all species.

Impact 3: Temporary disturbance of the seabed leading to increases in SSC and associated deposition.

311. Installation of WTGs, cable installation, and associated works such as dredging, the deposit of dredged material, and trenching, will result in temporary disturbance to the seabed leading to increases in SSC and subsequent deposition which may result in smothering effects.

312. The duration of this impact is short (no more than three years in duration); however, it is recognised that these activities may occur as discrete events on multiple occasions throughout this entire period. It is also recognised that some areas may see repeated disturbance within the construction period, though these will be infrequent.

313. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect fish, turtle and shellfish receptors within and beyond the offshore development area. However, given the mobile nature of most fish species, it is considered that most individuals will be able to avoid the affected area, and that there will be sufficient suitable alternative habitat available to ensure effects are negligible. In addition, most fish, turtle and shellfish species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, or have life history traits that expose them to high levels of SSC (e.g., migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). Those species which are considered at increased risk of increased SSC and sediment deposition are a number of shellfish species, and species with spawning / nursery grounds in the area (particularly those that spawn on the seabed and whose eggs are therefore at greater risk of smothering impacts).

314. There are two key activities that will result in the largest levels of SSC, dredging and trenching, as fully described in **Chapter 6: Marine Geology, Sediments, and Coastal Processes** and **Appendix 6.3** and summarised below.

315. During dredge disposal and trenching activities, SSC's local to the release locations are predicted to be enhanced to up to c. 150 mg/L.

316. Enhanced SSCs are transient, and concentrations are predicted to reduce to baseline levels no more than 15 days after the release activity.

Dredging and dredge disposal

317. Suspended sediment plumes created during dredge disposal operations are predicted to enhance SSC levels in the near field (i.e., to the point of release) and far field (i.e., up to *c*. 10 km) from the point of release).

318. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

319. Modelled representative scenarios of dredge disposal activities within the array site indicated the predominant direction of travel for SSC plumes is eastward (away from shore). In one scenario, a

maximum transient increase in SSC of 150 mg/L was predicted to travel a maximum of up to 4 km over *c*.10 days resulting in a cumulative sediment deposition thickness of *c*. 6 cm, near the disposal location. In another a maximum increase of 100 mg/L was predicted to travel up to 6 km over *c*. 15 days resulting in a cumulative sediment deposition thickness of *c*. 3 cm, near the disposal location. Modelled representative scenarios of dredge disposal activities within the OECC predicted: a maximum transient increase in SSC of 80 mg/L, travelling up to 4 km westward resulting in a cumulative sediment deposition thickness of *c*. 2 cm, near the disposal location. In a final scenario, a maximum increase in SSC of 50 mg/L, travelling a maximum of 5 km south eastward resulting in a cumulative sediment deposition thickness of *c*. 4 cm, near the disposal location.

Trenching

320. A consequence of cable installation will be the liberation of sediment into suspension within the water column, just above the seabed. Jetting results in greater sediment suspension, introducing the potential for distribution of greater volumes of material over a larger spatial area than other cable laying techniques which may be employed during construction and thus is assessed as the representative scenario. This method involves fluidising the material to form a narrow trench into which the cable is laid.

321. Based upon the representative scenario, the predicted transport of sediment plumes generated during cable installation activities across the array site indicates the finest sediments will potentially be transported eastward up to 10 km at an increase of 20 mg/L, resulting in a cumulative sediment deposition thickness of <1 cm, near the release location. Maximum SSC values of up to 40 mg/L were predicted to be transported up to 4 km eastward, resulting in a cumulative sediment deposition thickness of *c*. 1 cm, near the release location. However, these plumes are transient, rapidly decreasing as sand sized sediments deposit to the bed and finer sediments are dispersed.

322. The predicted transport of sediment plumes generated during cable installation activities across the OECC were for a maximum increase in SSC of 50 mg/L being transported for up to 7 km eastward resulting in a cumulative sediment deposition thickness of *c*. 2 cm, near the release location and southward and a maximum increase in SSC of 80 mg/L being transported for <1 km eastward resulting in a cumulative sediment deposition thickness of <1 cm, near the release location.

323. Therefore, the maximum thickness of the deposit on the seabed away from the trenching activities were predicted to be *c*. 2 cm; deposited sediments would be reworked and rapidly integrated into the prevailing sediment transport regime, and thus would have negligible impact on the prevailing environment. Consequently, enhanced SSC and the predicted deposition thickness would not discernible above natural variation observed during storm events, with SSC's predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

324. Background levels of SSC are considered to be between 5–15 mg/L within the offshore development area. Parameters associated with the representative scenario for this impact are provided in **Table 9-20**.

325. In addition to trenching along the OECC, the installation of cables to the landfall location will cause sediment disturbance, through open cut trenching.

326. Receptors are grouped according to the following criteria for the assessment against temporary disturbance of the seabed leading to increases in SSC and associated deposition during construction:

- Mobile fish with spawning and nursery areas that overlap the offshore development area;
- Mobile fish and turtle species with spawning and nursery areas that do not overlap the offshore development area; and
- Shellfish.

327. Undertaking the assessment using the above groups is considered to provide a suitable level of assessment, which takes account of any potential fish, shellfish, or turtle receptor that may be affected

by the CWP Project, whilst focussing on those that are of most relevance to the assessment (see **Section 9.6.6**.

Mobile fish with spawning and nursery areas that overlap the offshore development area

Receptor Sensitivity

328. Mobile fish with spawning and nursery areas that overlap the offshore development area are listed in **Table 9-60**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Across the species group, all are mobile species and therefore have a high capacity (adaptability) to avoid the impact by fleeing the area of disturbance, with the exception being sandeel, a less mobile species and therefore only a medium capacity (adaptability) to avoid the impact, although as noted below the ability to adapt is considered immaterial as a result of the high tolerance of sandeel to SSC and deposition.

329. The tolerance of species within this group is considered to be high for the impact of suspended sediments and deposition. This is because most species are highly mobile and can move away from the area of impact, and have extensive equivalent habitat in the surrounding area which can be utilised for the same functions. This includes European sprat which are highly mobile and pelagic spawners (Munk et al., 2024). Sandeels use the sand as predation cover and also in which to hibernate during the winter. The thickness of sediments outside the immediate vicinity of the disposal location is <1 cm in all cases, and this level of sediment is predicted to be remobilised and dispersed through natural tidal and wave forces rapidly after settlement. This level of sediment deposition is similar to that which sandeels will experience through natural dispersal and movement of sediments, and it has been demonstrated that sandeels can tolerate a degree of sediment deposition by adjusting their depth within the sediment to maintain oxygen availability (Behrens et al., 2007; Latto et al., 2013). Species that spawn on the substrate (such as thornback ray, spotted ray, sand eel) have the potential for their eggs to be impacted by sediment deposition through reduced oxygenation. However, the spatial extent of the impact is negligible in the context of the wider availability of suitable substrate, there are no areas of high intensity spawning of substrate spawning fish in the area potentially affected, and any deposited sediments will be transient, being rapidly dispersed through natural tidal and wave action.

330. All fish species within this group have a relatively high fecundity and therefore a high recoverability. Value ranges from low to medium based upon conservation status.

331. As per **Table 9-60**, sensitivity for mobile fish with spawning and nursery areas that overlap the offshore development area ranges from very low to medium.

Table 9-60 Mobile fish with spawning and nursery areas that overlap the offshore development area sensitivity

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Anglerfish	High	High	High	Low	Very low
Haddock	High	High	High	Low	Very low
Whiting	High	High	High	Low	Very low
European plaice	High	High	High	Low	Very low
Atlantic mackerel	High	High	High	Low	Very low

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Atlantic horse mackerel	High	High	High	Low	Very low
Lemon sole	High	High	High	Low	Very low
Common sole	High	High	High	Low	Very low
European sprat	High	High	High	Low	Very low
Sandeel	Medium	High	High	Low	Low
Ling	High	High	High	Low	Very low
Atlantic cod	High	High	High	Medium	Low
Thornback ray	High	Medium	High	Medium	Medium
Spotted ray	High	Medium	High	Medium	Medium
Tope	High	High	High	Low	Low

Magnitude of Impact

332. For temporary habitat disturbance resulting in SSC and associated deposition, the effect on receptors may include the smothering of substrate spawning species eggs and / or a loss of available spawning area, caused by physical disturbance to the seabed. Additionally, it may cause increase of energetic costs (decreased ability to find prey, increased metabolic cost for removing sediment from gills) or through behavioural responses leading to avoidance of the area thereby reducing the overall available area within which spawning or nursery activities may take place.

333. The maximum extent of elevated SSC is 10 km, as per **Appendix 6.3 Modelling Report**. Of the species with spawning and / or nursery habitat, Atlantic herring, Spurdog / spiny dogfish and European hake are outside the affected area and therefore not assessed within this section (see mobile fish and turtle species with spawning / nursery habitat that does not overlap the offshore development area below). All species to be assessed are included in **Table 9-60**.

334. The potential overlap of spawning or nursery areas is negligible within the context of the regional study area, particularly when it is considered that the area of greatest SSC will be within 1 km of the activities, and outside this area, the SSC levels will rapidly decrease as the plume disperses. Given the mobile nature of these fish species (except sandeel), and the size of the spawning areas relative to the area affected by increased SSC, it is considered that individuals will be able to avoid the affected area, if required, noting it will be well within the tolerance of all species, with no impact on overall spawning efficacy, and that there will be sufficient suitable alternative habitat available to ensure effects are negligible.

335. Based upon the above, it is predicted that the magnitude temporary disturbance to the seabed leading to increases in SSC and subsequent deposition, for spawning adults, and developing juveniles and eggs will be low.

Significance of Effect

336. The significance of effect has been summarised by each receptor in **Table 9-61**.

Table 9-61 Determination of Significance for mobile fish with spawning and nursery areas that overlap the offshore development area based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
European hake	Very low	Low	**Not significant**
Anglerfish	Very low	Low	**Not significant**
Haddock	Very low	Low	**Not significant**
Whiting	Very low	Low	**Not significant**
European plaice	Very low	Low	**Not significant**
Atlantic mackerel	Very low	Low	**Not significant**
Atlantic Horse mackerel	Very low	Low	**Not significant**
Lemon sole	Very low	Low	**Not significant**
Common sole	Very low	Low	**Not significant**
European sprat	Very low	Low	**Not significant**
Sandeel	Low	Low	**Not significant**
Ling	Very low	Low	**Not significant**
Atlantic cod	Low	Low	**Not significant**
Thornback ray	Medium	Low	**Slight** (not significant)
Spotted ray	Medium	Low	**Slight** (not significant)
Tope	Low	Low	**Not significant**

337. In summary, mobile fish with overlapping spawning / nursery grounds have very low to medium sensitivities. The magnitude of impact is predicted to be low for all species. Thornback and spotted ray experience the highest significance (slight), which is not significant. The impact of temporary disturbance of the seabed leading to increases in SSC and associated deposition is considered to be **not significant** for all mobile fish with spawning and nursery areas that overlap the offshore development area.

338. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

339. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Mobile fish and turtle species with no spawning and nursery areas overlapping the offshore development area

Receptor Sensitivity

340. Mobile fish and turtle species with spawning and nursery areas that do not overlap the offshore development area are listed in **Table 9-62**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Across the species group, all are mobile species and therefore have a high capacity (adaptability) to avoid the impact by fleeing the area of disturbance. Atlantic herring, although recognised as a pelagic species, require demersal habitats of coarse substrate such as gravel and stones for spawning purposes (Munk et al., 2024) reducing their adaptability to increased SSC in spawning terms. The survival and development of herring eggs have been reported to be insensitive to even high concentrations of SSC, but studies have concluded that smothering from resulting deposition is likely to be detrimental unless the material is removed rapidly by the current making tolerance to this impact moderate (Birklund and Wijsam, 2005).The tolerance of the other species within this group is considered to be high for the impact of suspended sediment and deposition. This is because the extents and levels of SSC are likely to be similar to those experienced by species naturally, and as most species are highly mobile, and have extensive equivalent habitat in the surrounding area which can be utilised for the same functions should that be required. Recoverability ranges from low to high based on fecundity, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value ranges from low to high according to conservation status.

341. As per **Table 9-62**, sensitivity for group two species ranges from very low to medium.

Table 9-62 Mobile fish species with no overlapping spawning and nursery grounds sensitivity

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Small-spotted catshark	High	High	High	Low	Very Low
Cuckoo ray	High	High	High	Low	Very Low
Blonde ray	High	High	High	Low	Very Low
Seatrout	High	High	High	Low	Very Low
Atlantic herring	Medium	Medium	High	Low	Medium
European smelt	High	High	High	Low	Very Low
Undulate ray	High	High	High	Low	Very Low
Twaite shad	High	High	High	High	Medium
Allis shad	High	High	High	High	Medium
Atlantic salmon	High	High	High	High	Medium
Sea lamprey	High	High	High	High	Medium
River lamprey	High	High	High	High	Medium
European eel	High	High	High	Medium	Low
Common skate	High	High	High	Medium	Low
Angel shark	High	High	High	Medium	Low
Basking shark	High	High	Low	Medium	Medium
Leatherback turtle	High	High	Low	Medium	Medium
European hake	High	High	High	Low	Very Low
Spurdog	High	High	High	Medium	Low

Magnitude of Impact

342. The effect on receptors from temporary habitat disturbance resulting in SSC and associated deposition may include an increase of energetic costs (decreased ability to find prey, increased metabolic cost for removing sediment from gills), temporary loss of available habitat, or behavioural responses leading to avoidance of the area thereby reducing the overall available habitat.

343. Although Atlantic herring eggs have a moderate sensitivity to sediment deposition, no herring spawning areas overlap with the offshore development area or modelled area of sediment deposition, and therefore it is highly unlikely there will any herring eggs will be impacted by temporary increases in sediment deposition.

344. Given the mobile nature of most fish species and the highly localised area of effect, it is considered that any individuals will be able to avoid the affected area, and that there will be sufficient suitable alternative habitat available to ensure effects are negligible. In addition, fish are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment

concentrations, or through having life history traits that expose then to increased levels of SSC (e.g. migration through estuarine environments, feeding on organisms within the sediment, or through their preferred location in the water column being in or on the seabed).

345. As such, given the short-term nature of exposure, transient presence of increased level of SSC and the very small spatial extent of the impact, it is considered that the magnitude of temporary disturbance to the seabed, leading to increased SSC and associated deposition of sediments, will be negligible.

Significance of Effect

346. The significance of effect has been summarised by each receptor in **Table 9-63**.

Table 9-63 Determination of Significance for mobile fish and turtle species with spawning and nursery areas that do not overlap the offshore development area based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Small-spotted catshark	Very Low	Negligible	**Imperceptible (**not significant)
Cuckoo ray	Very Low	Negligible	**Imperceptible** (not significant)
Blonde ray	Very Low	Negligible	**Not significant**
Seatrout	Very Low	Negligible	**Imperceptible** (not significant)
Atlantic herring	Medium	Negligible	**Slight / Not significant**
European smelt	Very Low	Negligible	**Imperceptible** (not significant)
Undulate ray	Very Low	Negligible	**Imperceptible** (not significant)
Twaite shad	Medium	Negligible	**Slight / Not significant** (not significant)
Allis shad	Medium	Negligible	**Slight / Not significant** (not significant)
Atlantic salmon	Medium	Negligible	**Slight / Not significant** (not significant)
Sea lamprey	Medium	Negligible	**Slight / Not significant** (not significant)
River lamprey	Medium	Negligible	**Slight / Not significant** (not significant)
European eel	Low	Negligible	**Not significant**
Common skate	Low	Negligible	**Not significant**
Angel shark	Low	Negligible	**Not significant**
Basking shark	Medium	Negligible	**Slight / Not significant** (not significant)
Leatherback turtle	Medium	Negligible	**Slight / Not significant** (not significant)
European hake	Very Low	Negligible	**Imperceptible** (not significant)

Species	Sensitivity	Magnitude	Significance
Spurdog	Low	Negligible	**Not significant**

347. In summary, species within the group are identified as having very low to medium sensitivities. The magnitude of impact is predicted to be negligible. Multiple species experience the largest significance (Slight / Not significant), which is not significant. The impact of temporary disturbance of the seabed leading to increases in SSC and associated deposition is considered to be **not significant** for mobile fish and turtle species with spawning and nursery areas that do not overlap the offshore development area.

348. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

349. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Shellfish

Receptor Sensitivity

350. Shellfish species are listed in **Table 9-64**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Across the species group, all are non-mobile species and therefore have a low to very low capacity (adaptability) to avoid the impact by fleeing the disturbed area. The tolerance of the species within this group is considered to be high for the impact of temporary disturbance of the seabed leading to increases in SSC and associated deposition. This is because while the species group are not mobile and cannot move away from the area of impact, as substrate dwelling species they are adapted to deal with varying levels of sediment and as such they are less susceptible to adverse effects of sediment deposition, particularly at the levels described. Recoverability is high based on fecundity, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value is low according to conservation status.

351. As per **Table 9-64** sensitivity for shellfish species is low for the group.

Table 9-64 Shellfish sensitivities

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Razor / knife clams	Very low	High	High	Low	Low
Norway lobster	Very low	High	High	Low	Low
Sword razor shell	Very low	High	High	Low	Low
Whelk	Very low	High	High	Low	Low
Great Atlantic scallop	Very low	High	High	Low	Low
Edible crab	Low	High	High	Low	Low

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
European lobster	Low	High	High	Low	Low

Magnitude of Impact

352. For temporary habitat disturbance leading to increases in SSC and associated deposition, the effect on receptors may include the smothering of substrate dwelling species and / or loss of available habitat area, caused by physical disturbance to the seabed. Additionally, it may cause increase of energetic costs (decreased ability to find prey, increased metabolic cost for excavating burrows) or through behavioural responses leading to avoidance of the area (for more mobile species) thereby reducing the overall available habitat.

353. The shellfish species that are present within the local study area are all species that live on or within the substrate. As such, these species are regularly exposed and adapted to increases in SSC and levels of deposition through natural hydrodynamic processes that re-mobilise, transport, and deposit sediments in the area.

354. The increases in SSC are temporary, transient, and will return to background levels within a short period, no longer than 15 days. The levels of deposition away from the immediate location of disposal events are very low (<2 cm) and are predicted to be transient and thus will be remobilised into the natural sediment transport regime within a short period following settlement.

355. The species of shellfish present are considered to be tolerant to the levels of SSC and transient deposition predicted to arise from the predicted activities (assessments based upon Norway lobster, sword razor clams, and edible crab (Hill and Sabatini, 2008; Hill, 2006; Neal and Wilson, 2008; Marshall and Wilson, 2008)). While there are no such assessments available for whelk, razor / knife clam or European lobster, given the similar physiology and bottom dwelling habits to the assessed species, similar conclusions are drawn. As such, it is predicted that the magnitude of SSC on shellfish will be negligible.

Significance of the effect

356. The significance of effect has been summarised by each receptor in **Table 9-65**.

Table 9-65 Determination of Significance for shellfish habitats based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Norway lobster	Low	Negligible	**Not significant**
Whelk	Low	Negligible	**Not significant**
Razor / knife clams	Low	Negligible	**Not significant**
Sword razor shell	Low	Negligible	**Not significant**
Great Atlantic scallop	Low	Negligible	**Not significant**
Edible crab	Low	Negligible	**Not significant**
European lobster	Low	Negligible	**Not significant**

357. In summary, species within this group are identified as having low sensitivity. The magnitude of impact is predicted to be negligible. All receptors experience the highest significance (Not significant), which is **not significant.** The impact of temporary disturbance of the seabed leading to increases in SSC and associated deposition is considered to be **not significant** for shellfish.

358. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

359. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Impact 4: Collision with vessels

360. During construction works there will be an increase in vessel activity in the OECC and array site and surrounding area.

361. Vessel strikes are a known cause of mortality in basking sharks (Wilson et al., 2020). The main threats to leatherback turtles include fishing activity, marine debris and boat collision (Curd, 2009). Long-term injuries from such collisions can be divided into two broad categories – blunt trauma from impact and lacerations from propellers. Such injuries may result in individuals becoming vulnerable to secondary infections or predation and reduced foraging efficiency.

362. Vessels travelling at 10 knots have been shown to reduce the probability of lethal injury to whales to < 50% (Vanderlaan and Taggart, 2007). In addition, vessels travelling at lower speeds have a higher probability of detecting marine megafauna than vessels travelling at faster speeds. In turn, slower vessels following a consistent trajectory allow turtles / sharks the opportunity to avoid collisions.

363. Unlike the majority of fish species, basking sharks are more vulnerable to collision when undertaking behaviours such as feeding and courtship as they spend large amounts of time moving slowly at the water surface. As turtles need to surface regularly to breathe, this can make them vulnerable to collision. Based on this, these two species will form the basis of the assessment as the only two collision vulnerable species. It is considered that there is no risk to other fish or shellfish species, and that effects on all receptors considered in this chapter other than basking shark and turtles are nil.

Receptor Sensitivity

364. Undertaking the assessment using the above groups is considered to provide a suitable level of assessment, which takes account of any potential fish, shellfish, or turtle receptor that may be affected by the CWP Project, whilst focussing on those that are of most relevance to the assessment (see **Section 9.6.6.**

365. Collision vulnerable species are listed in **Table 9-66**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. While these are mobile species, given modern vessel speeds, they have a low capacity (adaptability) to avoid the impact by swimming away from vessels. Tolerance for both species is considered to be low as the ecology of both species necessitates them being at the surface regularly. Species fecundity is relatively unknown and therefore they have a low recoverability. Value is considered to be medium based upon conservation status.

366. As per **Table 9-66,** sensitivity for collision vulnerable species is high.

Table 9-66 Collision vulnerable species sensitivity

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Basking shark	Low	Low	Low	Medium	High
Leatherback turtle	Low	Low	Low	Medium	High

Magnitude of impact

367. The effect of collision with vessels is the potential injury and / or death of basking shark and turtle.

368. This area contains a busy shipping route in and out of Dublin port (**Chapter 16 Shipping and Navigation**), with an average of 37 vessels per day recorded within the shipping and navigation study area in 2021 and 55 vessels per day in 2022.

369. The maximum number of construction vessels being used is 75, with up to 2,409 round trips planned and peak vessels on site simultaneously estimated at 38. This increase in vessel movement could lead to an increase in interactions between construction vessels and basking sharks and turtles. However, the likelihood of occurrence of basking turtles in the area and the likelihood of collision with vessels is considered to be low. Furthermore, vessels will be moving infrequently, at relatively slow speeds and for short durations to and from the offshore development area and consequences of the impact are likely to be low. Magnitude is therefore considered to be negligible.

370. In addition, primary mitigation (**Section 9.9**), includes an environmental vessel management plan (EVMP)**.** This will further reduce the risk of collisions through reduction in number of vessel routes and specification on maximum speeds, thereby minimising the area of potential overlap with receptors, reducing the potential for impact, and further reducing the potential consequences of impact.

Significance of the effect

371. The significance of effect has been summarised by each receptor in **Table 9-67**.

Table 9-67 Determination of Significance for collision vulnerable species based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Basking shark	High	Negligible	**Slight** (not significant)
Leatherback turtle	High	Negligible	**Slight** (not significant)

372. In summary, species within this group are identified as having high sensitivity to the impact of collision with vessels. The magnitude of impact is predicted to be negligible. Both species experience the same significance (slight), which is not significant. The impact of collision with vessels is considered to be **not significant** for basking shark and leatherback turtle.

373. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

374. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Impact 5: Accidental Pollution Events

375. As outlined in the **Table 9-20**, construction vessels and equipment have the potential to result in pollution events from substances such as grease, hydraulic oil, gear oil, nitrogen, transformer silicon / ester oil, diesel fuel, SF6, glycol / coolants, batteries and drill fluid. All such chemicals have the potential to cause harm to the aquatic environment, therefore all species are assessed.

376. Receptors are grouped according to the following criteria for the assessment against accidental pollution events during construction:

- All receptors.

377. Undertaking the assessment using the above group is considered to provide a suitable level of assessment, which takes account of any potential fish, shellfish, or turtle receptor that may be affected by the CWP Project.

Receptor sensitivity

378. All species are included in **Table 9-23.** Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. In order to provide a conservative basis for the assessment, all receptors are considered to have low adaptability to avoid the impact. Tolerance within the group is considered to be low, based on the most sensitive species to such impacts. Recoverability is low based on the lowest level of fecundity within the receptor group, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value is high according to greatest conservation status.

379. As per **Table 9-68**, sensitivity for all species is high.

Table 9-68 Fish, shellfish and turtle sensitivity to pollution events

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
All receptors	Low	Low	Low	High	High

Magnitude of impact

380. Accidental pollution events have the potential to affect receptors by causing impacts such as direct injury or illness, reduction of prey availability, loss of available habitat or through behavioural responses leading to avoidance of the area thereby reducing the overall available habitat.

381. Accidental spills during construction have the potential to have a negative effect on fish, shellfish and turtles. Potential pollutants are outlined in the **Table 9-20** in **Section 9.8**, and are as follows: grease, hydraulic oil, gear oil, nitrogen, transformer silicon / ester oil, diesel fuel, SF6, glycol / coolants, drill fluid and batteries.

382. Primary project mitigation outlined in **Section 9.9** will ensure that vessels follow best practice guidelines for pollution at sea, which will be outlined within the CEMP. The CEMP will follow OSPAR, IMO and MARPOL guidelines, and industry best practices regarding pollution at sea. This includes provision for storage of pollutants and identifies products suitable for use in the marine environment.

383. All materials used in the construction of the CWP Project, will be appropriately controlled as per the CEMP.

384. The probability of such an event occurring is deemed highly unlikely. As the greatest increase in vessel movements will be during the construction phase, the increased risk of accidental pollution events will predominantly be during the construction phase and will therefore be of a temporary nature.

385. Accordingly, and through application of the above-described measures, the potential magnitude of impact is reduced as far as is reasonably practicable to negligible.

Significance of the effect

386. Sensitivity is high and magnitude is assessed to be negligible to the potential effect of accidental pollution events during the construction phase. The significance of the potential impact of accidental pollution events on all fish, shellfish and turtle receptors is considered to be slight, and therefore **not significant**.

387. Where flexibility in the proposed design exists there is no other scenario which would lead to a more significant effect.

388. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Impact 6: Invasive Non-Native Species

389. There are no known INNS in the offshore development area, therefore this impact relates to the potential transference of INNS from construction vessels or plant into the offshore development area.

390. Once introduced to the environment, INNS can quickly outcompete other species for resources, resulting in species decline.

391. Receptors are grouped according to the following criteria for the assessment against INNS Events during Construction:

- All receptors.

392. Undertaking the assessment using the above groups is considered to provide a suitable level of assessment, which takes account of any potential fish, shellfish, or turtle receptor that may be affected by the CWP Project.

Receptor sensitivity

393. All species are included in **Table 9-69**. Sensitivity has been determined based upon the definitions set out in **Table 9-3,** with information feeding this assessment coming from **Table 9-18**. Across all receptors, shellfish are the least mobile and therefore all receptors are considered as having low adaptability to avoid the impact as a conservative basis. Tolerance within the group is considered to be low, based on the most sensitive species to this impact. Recoverability is low based on the lowest level of fecundity within the receptor group, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value is high according to greatest conservation status.

394. As per **Table 9-69**, sensitivity for all species is high.

Table 9-69 Fish, shellfish and turtle sensitivity to INNS

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
All receptors	Low	Low	Low	High	High

Magnitude of impact

395. INNS has the potential effect on receptors of reducing available habitat and foraging opportunities as INNS may outcompete receptors, or through behavioural responses leading to avoidance of the area thereby reducing the overall available habitat.

396. The magnitude of this impact is limited based on the primary mitigation stemming from consideration of the mitigation and control of invasive species measures in line with International Maritime Organization guidance (IMO, 2019) which are secured through the implementation of the CEMP described in **Section 9.9**, specifically that all vessels working on the CWP Project will have a Biosecurity Plan in place. The associated standards and procedures will be incorporated by all vessels and as such the potential magnitude of impact is reduced as far as is reasonably practicable to negligible.

397. Based on the predicted level of effect, it is concluded that no additional mitigation is required beyond the biosecurity plan which will minimise the potential to introduce INNS into the environment.

Significance of the effect

398. As impact magnitude is assessed to be negligible, the potential effect of INNS during the construction phase upon all fish, shellfish and turtle receptors is considered to be slight, and therefore **not significant**.

399. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

400. Based on the predicted level of effect, it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9.**

9.10.2 Operation and maintenance

Impact 1: Long-term habitat loss

401. As presented in **Table 9-20**, WTG Layout Option A forms the largest area of long-term habitat loss out of the two design options. Within the array site approximately 492,520 m^2 of currently available habitat will be lost by operation related activities, with 105,000 m^2 potentially lost over the full length of the OECC, for a total area of disturbance / loss of approximately 597,520 m^2 (or 0.37% of the offshore development area) as per **Table 9-20**. Additionally, maintenance activities my require the use of jack up vessels, as well as physical repairs to the cable / other infrastructure has the potential to cause habitat disturbance.

402. The Applicant will, where practicable, bury all cables to a minimum depth of cover. In cases where depth of cover is inadequate due to unforeseeable seabed conditions, cable protection will be implemented as mitigation to avoid risks to other marine operations. A preliminary cable burial risk

assessment, involving a peer review of environmental considerations, ground conditions, and anticipated installation considerations, has been undertaken to identify locations that may require cable protection. This exercise has determined an anticipated maximum extent and volume of cable protection within those identified locations within the array site and OECC, which has been used as a basis for the EIA.

403. Receptors are grouped according to the following criteria for the assessment against long-term habitat loss during Operation and Maintenance:

- Mobile fish with spawning and nursery areas that overlap the offshore development area;
- Mobile fish and turtle species with spawning and nursery areas that do not overlap the offshore development area; and
- Shellfish.

404. Undertaking the assessment using the above groups is considered to provide a suitable level of assessment, which takes account of any potential fish, shellfish, or turtle receptor that may be affected by the CWP Project, whilst focussing on those that are of most relevance to the assessment (see **Section 9.6.6**.

Receptor sensitivity

405. Mobile fish with spawning and nursery areas that overlap the offshore development area are listed in **Table 9-70**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Across the species group, all are mobile species and therefore have a high capacity (adaptability) to avoid the impact by moving to a new area, with the exception being sandeel, a less mobile species and therefore only a medium capacity (adaptability) to avoid the impact. The tolerance of the majority of species within this group is considered to be high for the impact of long-term habitat loss. This is because most species are highly mobile and can move away from the area of impact, and have extensive equivalent habitat in the surrounding area which can be utilised for the same functions. For some species with low mobility or high habitat fidelity, such as sandeels, tolerance is considered to be medium as they cannot easily relocate to another area and, as such, they are more susceptible to adverse effects of long-term habitat loss. Species which are considered highly mobile but that use the substrate in the immediate area for spawning (i.e., thornback ray and spotted ray) are considered to have medium tolerance and adaptability as although adults or juveniles are unlikely to be adversely affected, impacts to eggs may arise. Recoverability is high based on fecundity, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value ranges from low to medium according to conservation status.

406. As per **Table 9-70**, sensitivity for this species group to long-term habitat loss ranges from very low to medium.

Table 9-70 Mobile fish with spawning and nursery areas that overlap the offshore development area sensitivity

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Anglerfish	High	High	High	Low	Very low
Haddock	High	High	High	Low	Very low
Whiting	High	High	High	Low	Very low

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
European plaice	High	High	High	Low	Very low
Atlantic mackerel	High	High	High	Low	Very low
Atlantic horse mackerel	High	High	High	Low	Very low
Lemon sole	High	High	High	Low	Very low
Common sole	High	High	High	Low	Very low
European sprat	High	High	High	Low	Very low
Sandeel	Medium	Medium	High	Low	Medium
Ling	High	High	High	Low	Very low
Atlantic cod	High	High	High	Medium	Low
Thornback ray	Medium	Medium	High	Medium	Medium
Spotted ray	Medium	Medium	High	Medium	Medium
Tope	High	High	High	Low	Very low

Magnitude of impact

407. Potential for long-term habitat or loss, may arise from periodic maintenance works, and the presence of infrastructure including scour and cable protection. The effect on receptors will be a loss of available spawning area, caused by physical loss of the seabed, or through behavioural responses leading to avoidance of the area thereby reducing the overall available area within which spawning, or nursery activities may take place.

408. Species that have spawning and / or nursery grounds within the offshore development area are at risk of having those spawning and nursery grounds impacted by long-term habitat loss throughout the lifetime of the CWP Project.

409. Based on the PD and the intended locations of the offshore infrastructure, the greatest percentage of spawning habitat affected (based on comparison to the Irish Sea study area) is 0.002 % for haddock. When considering the LoD of the offshore infrastructure, the percentage overlap is 0.004 %. Similarly, the greatest percentage of nursery habitat affected (based on comparison to the Irish Sea study area) is 0.005 % for haddock and considering the LoD of the offshore infrastructure, the percentage overlap is 0.006 % (**Table 9-71**).

410. Of the species with overlapping spawning and nursery habitat, substrate spawners are considered at the greatest risk from long term habitat disturbance / loss, as this may result in direct disturbance to a key life stage for the species.

411. Substrate spawning species with overlapping spawning areas are:

- Thornback ray (**Figure 9-18**)
- Spotted ray (**Figure 9-16**)
- Sandeel (**Figure 9-15**)

412. Non-substrate spawners with overlapping spawning or nursery grounds are:

- Norway lobster (**Figure 9-13**)
- Tope (**Figure 9-19**)
- Haddock (**Figure 9-9**)
- Whiting (**Figure 9-20**)
- European plaice (**Figure 9-14**)
- Atlantic mackerel (**Figure 9-5**)
- Atlantic horse mackerel (**Figure 9-10**)
- Lemon sole (**Figure 9-11**)
- Common sole (**Figure 9-6**)
- European sprat (**Figure 9-8**)
- Atlantic cod (**Figure 9-3**)
- Anglerfish (**Figure 9-2**)
- Ling (**Figure 9-12**)

413. The following species have known spawning or nursery habitat within the Irish Sea study area, but do not have any overlap with the offshore development area. Therefore, they are considered under mobile species with no overlapping spawning or nursery habitats below.

- Spurdog / spiny dogfish (**Figure 9-17**)
- European hake (**Figure 9-7**)
- Atlantic herring (**Figure 9-4**)

414. The greatest percentage of a substrate spawning species' spawning area affected (based upon the available spawning and nursery areas within the Irish Sea study area) is 0.003 % for thornback and spotted ray, which remains the same when considering the LoD (**Table 9-71**).

415. Reductions in spawning or nursery habitat at this scale for both substrate and non-substrate spawning species is considered negligible in terms of the species' ability to maintain functional processes. No effect on populations or cohort size is predicted to arise as a result of long-term habitat loss on species with spawning or nursery areas overlapping the offshore development area. In terms of long-term habitat loss, any loss caused by maintenance activities will be small in extent compared to the wider available habitat.

416. The magnitude of effect across all species with spawning or nursery habitat affected by long-term habitat loss is considered to be negligible.

Table 9-71 Long-term habitat loss based on intended locations of offshore infrastructure (% overlap) compared to mapped spawning and nursery grounds in the Irish Sea Study Area. Consideration of LoD parameters (% overlap) compared to mapped spawning and nursery grounds shown in brackets.

	Spawning Grounds						Nursery Grounds			
Receptor (species)	**Ellis et al. (2012) - Low intensity**	**Ellis et al. (2012) - High intensity**	**Coull et al. (1998) - Lower Intensity**	**Coull et al. (1998- Higher Intensity**	**Coull et al. (1998) - Undetermined Intensity**	**Ireland's Marine Atlas**	**Ellis et al. (2012) - Low intensity**	**Ellis et al. (2012) - High intensity**	**Coull et al. (1998)**	**Ireland's Marine Atlas**
Norway lobster					0.002 % (0.003 %)				0.002 % (0.003 %)	
Thornback ray							0.002 % (0.003 %)			
Spotted ray							0.002 % (0.003 %)			
Spurdog	No overlap with the CWP Project offshore development area									
Tope							0.002 % (0.002 %)			
Haddock						0.002 % (0.004 %)			0.005 % (0.006 %)	<0.001 % (<0.001 %)
Whiting	0.001 % (0.002 %)		<0.001 % (<0.001 %)	0.002 % (0.002 %)		<0.001 % (<0.001 %)	<0.001 % (<0.001 %)	0.003 % (0.003 %)	<0.001 % (<0.001 %)	
European plaice	0.002 % (0.002 %)	<0.001 % (<0.001 %)	0.001 % (0.001 %)				0.003 % (0.003 %)			

Receptor (species)	Spawning Grounds						Nursery Grounds			
	Ellis et al. (2012) - Low intensity	Ellis et al. (2012) - High intensity	Coull et al. (1998) - Lower Intensity	Coull et al. (1998- Higher Intensity	Coull et al. (1998) - Undetermined Intensity	Ireland's Marine Atlas	Ellis et al. (2012) - Low intensity	Ellis et al. (2012) - High intensity	Coull et al. (1998)	Ireland's Marine Atlas
Atlantic mackerel	0.002 % (0.002 %)									0.001 % (0.001 %)
Atlantic horse mackerel										0.001 % (0.001 %)
Lemon sole					0.003 % (0.003 %)				0.003 % (0.003 %)	
Common sole	0.002 % (0.002 %)		<0.001 % (<0.001 %)							
Sandeel	0.002 % (0.002 %)						0.003 % (0.003 %)			
Atlantic herring	No overlap with the CWP Project offshore development area									
European sprat					0.001 % (0.001 %)					
Atlantic cod	0.002 % (0.002 %)		0.001 % (0.001 %)	0.001 % (0.001 %)		0.001 % (0.001 %)		0.004 % (0.004 %)	0.004 % (0.005 %)	0.001 % (0.001 %)
Angler fish							0.001 % (0.001 %)			

	Spawning Grounds						Nursery Grounds			
Receptor (species)	Ellis et al. (2012) - Low intensity	Ellis et al. (2012) - High intensity	Coull et al. (1998) - Lower Intensity	Coull et al. (1998- Higher Intensity	Coull et al. (1998) - Undetermined Intensity	Ireland's Marine Atlas	Ellis et al. (2012) - Low intensity	Ellis et al. (2012) - High intensity	Coull et al. (1998)	Ireland's Marine Atlas
European hake	No overlap with the CWP Project offshore development area									
Ling	0.002 % (0.003 %)									

Significance of effect

417. The significance of effect has been summarised by each receptor in **Table 9-72**.

Table 9-72 Determination of significance for Mobile fish with spawning and nursery areas that overlap the offshore development area based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Anglerfish	Very low	Negligible	**Imperceptible** (not significant)
Haddock	Very low	Negligible	**Imperceptible** (not significant)
Whiting	Very low	Negligible	**Imperceptible** (not significant)
European plaice	Very low	Negligible	**Imperceptible** (not significant)
Atlantic mackerel	Very low	Negligible	**Imperceptible** (not significant)
Atlantic horse mackerel	Very low	Negligible	**Imperceptible** (not significant)
Lemon sole	Very low	Negligible	**Imperceptible** (not significant)
Common sole	Very low	Negligible	**Imperceptible** (not significant)
European sprat	Very low	Negligible	**Imperceptible** (not significant)
Sandeel	Medium	Negligible	**Slight / Not significant** (not significant)
Ling	Very low	Negligible	**Imperceptible** (not significant)
Atlantic cod	Low	Negligible	**Not significant**
Thornback ray	Medium	Negligible	**Slight / Not significant** (not significant)
Spotted ray	Medium	Negligible	**Slight / Not significant** (not significant)
Tope	Very low	Negligible	**Imperceptible** (not significant)

418. In summary, mobile fish with spawning and nursery areas that overlap the offshore development area are identified as having very low to medium sensitivities. The magnitude of impact is predicted to be negligible. Several species experience the highest significance (slight / not significant), which is not significant. Therefore, the impact of long-term habitat loss is considered to be **not significant** for mobile fish with spawning and nursery areas that overlap the offshore development area.

419. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

420. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Mobile fish and turtle species without spawning and nursery areas that overlap the offshore development area

Receptor sensitivity

421. Mobile fish and turtle species without spawning and nursery areas that overlap the offshore development are listed below in **Table 9-26**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Across the species group, all are mobile species and therefore have a high capacity (adaptability) to avoid the impact by fleeing the area of impact. The tolerance of the species within this group is considered to be high for the impact of temporary habitat loss. This is because most species are highly mobile and can move away from the area of impact and have extensive equivalent habitat in the surrounding area which can be utilised for the same functions. Recoverability ranges from low to high based on fecundity, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value ranges from low to high according to conservation status.

422. As per **Table 9-73**, sensitivity for this species group ranges from very low to medium.

Table 9-73 Mobile fish / turtle species with no overlapping spawning and nursery grounds sensitivity

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Small-spotted catshark	High	High	High	Low	Very Low
Cuckoo ray	High	High	High	Low	Very Low
Blonde ray	High	High	High	Low	Very Low
Seatrout	High	High	High	Low	Very Low
Atlantic herring	High	High	High	Low	Very Low
Undulate ray	High	High	High	Low	Very Low
Twaite shad	High	High	High	High	Low
Allis shad	High	High	High	High	Low
Atlantic salmon	High	High	High	High	Low
Sea lamprey	High	High	High	High	Low
River lamprey	High	High	High	High	Low
European eel	High	High	High	Medium	Low
Common skate	High	High	High	Medium	Low
Angel shark	High	High	High	Medium	Low
Basking shark	High	High	Low	Medium	Medium

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Leatherback turtle	High	High	Low	Medium	Medium
European hake	High	High	High	Low	Very low
Spurdog	High	High	High	Medium	Low

Magnitude of impact

423. Potential long-term habitat loss may arise from periodic maintenance works, and the presence of infrastructure including scour and cable protection, or through behavioural responses leading to avoidance of the area thereby reducing the overall available habitat for activities such as foraging.

424. Mobile fish / turtles may use the offshore development area for a wide range of biological functions, from migration to feeding. Long-term habitat loss may reduce the available habitat, however, this represents an impact that affects a negligible proportion of the natural range of all the species that may be present in this area. Extensive areas of comparable habitat are also available outside the affected area.

425. The magnitude of effect on all species affected by temporary disturbance and long-term loss is considered to be negligible.

Significance of effect

426. The significance of effect has been summarised by each receptor in **Table 9-74**.

Table 9-74 Determination of Significance for Mobile fish and turtle species with spawning and nursery areas that do not overlap the offshore development are based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Small-spotted catshark	Very Low	Negligible	**Imperceptible** (not significant)
Cuckoo ray	Very Low	Negligible	**Imperceptible** (not significant)
Blonde ray	Very Low	Negligible	**Imperceptible** (not significant)
Seatrout	Very Low	Negligible	**Imperceptible** (not significant)
Atlantic herring	Very Low	Negligible	**Imperceptible** (not significant)
Undulate ray	Very Low	Negligible	**Imperceptible** (not significant)
Twaite shad	Low	Negligible	**Not significant**
Allis shad	Low	Negligible	**Not significant**
Atlantic salmon	Low	Negligible	**Not significant**
Sea lamprey	Low	Negligible	**Not significant**
River lamprey	Low	Negligible	**Not significant**
European eel	Low	Negligible	**Not significant**

Species	Sensitivity	Magnitude	Significance
Common skate	Low	Negligible	**Not significant**
Angel shark	Low	Negligible	**Not significant**
Basking shark	Medium	Negligible	**Slight / Not significant** (not significant)
Leatherback turtle	Medium	Negligible	**Slight / Not significant** (not significant)
European hake	Very low	Negligible	**Imperceptible** (not significant)
Spurdog	Low	Negligible	**Not significant**

427. In summary, mobile fish and turtle species with spawning and nursery areas that do not overlap the offshore development area are identified as having very low to medium sensitivities. The magnitude of impact is predicted to be negligible. Multiple species experience the highest significance (slight / not significant), which is not significant. The impact of long-term habitat loss is considered to be **not significant** for mobile fish and turtle species with spawning and nursery areas that do not overlap the offshore development area.

428. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

429. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Shellfish

Receptor sensitivity

430. Shellfish species are listed below in **Table 9-75**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Across the species group, there is limited mobility and therefore a low to very low capacity (adaptability) to avoid the impact by fleeing the affected area. The tolerance of the species within this group is considered to be low for the impact of long-term habitat loss. This is because the species group are not mobile and cannot move away from the area of impact and, as such, they are more susceptible to adverse effects of long-term habitat loss such as direct damage. Recoverability is high based on fecundity, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value is low according to conservation status.

431. As per **Table 9-75**, sensitivity for shellfish species is medium for the group.

Table 9-75 Shellfish sensitivities

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Razor / knife clams	Very low	Low	High	Low	Medium

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Norway lobster	Very low	Low	High	Low	Medium
Sword razor shell	Very low	Low	High	Low	Medium
Whelk	Very low	Low	High	Low	Medium
Great Atlantic scallop	Very low	Low	High	Low	Medium
Edible crab	Low	Low	High	Low	Medium
European lobster	Low	Low	High	Low	Medium

Magnitude of impact

432. For long-term habitat loss, the effect on receptors will be a loss of suitable habitat, physical injury or mortality, or reduced fitness through increased energetic requirements, such as re-establishment of burrows. Shellfish species are typically less mobile than fish receptors and may burrow or live within the sediment. As such, they can be more susceptible to direct effects arising from long-term habitat loss.

433. The potential loss of habitat may arise from periodic maintenance works, the presence of infrastructure such as turbine foundations, scour protection, or through use of cable protection where cables cannot be buried. The maximum potential area affected by long-term habitat loss is 492,520 m^2 within the array site and 105,000 m^2 within the OECC. *Nephrops Norvegicus* has overlapping spawning and nursery grounds (as per Coull et al. (1998)), and based upon the overlap of potential activities, the area of *Nephrops* habitat affected is >0.01 %. However, most of the habitat is not suitable for *Nephrops* as it is coarse sediments and sands, and there is no evidence of *Nephrops* fishing in the offshore development area (as per **Chapter 12 Commercial Fisheries)**. *Nephrops* prefer muddy habitats in which they can burrow, therefore it is expected that no nephrops habitat will be impacted.

434. However, the presence of the infrastructure, scour protection, and cable protection in the marine environment also increases habitat heterogeneity which can increase biodiversity, as well as providing refugia for a number of species, particularly mobile shellfish such as whelks and crustaceans. The additional biodiversity can increase food resource for species, and the habitat heterogeneity and refugia can provide protection against predators. As such, though the availability of existing habitat will be decreased very slightly, the increased level of biodiversity and habitat heterogeneity can provide positive effects for shellfish species.

435. Though the duration of this impact is long, the area affected is negligible in the context of wider availability of equivalent habitat, and there may be considerable positive effects arising through increased heterogeneity of the seabed, as a result of the introduced infrastructure and materials. As such, the magnitude of impact for all species is low.

436. In terms of long-term habitat loss, reduction in habitat is considered negligible in terms of the species' ability to maintain functional processes. No effect on populations or cohort size is predicted to arise as a result of long-term habitat loss on shellfish species within the offshore development area.

437. The magnitude of effect across all shellfish species affected by long-term habitat loss is considered to be negligible.

Significance of effect

438. The significance of effect has been summarised by each receptor in **Table 9-76**.

Table 9-76 Determination of Significance for shellfish habitats based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Norway lobster	Medium	Negligible	**Slight / not significant** (not significant)
Whelk	Medium	Negligible	**Slight / not significant** (not significant)
Razor / knife clams	Medium	Negligible	**Slight / not significant** (not significant)
Sword razor shell	Medium	Negligible	**Slight / not significant** (not significant)
Great Atlantic scallop	Medium	Negligible	**Slight / not significant** (not significant)
Edible crab	Medium	Negligible	**Slight / not significant** (not significant)
European lobster	Medium	Negligible	**Slight / not significant** (not significant)

439. In summary, shellfish are identified as having medium sensitivity. The magnitude of impact is predicted to be negligible. All species experience the same significance (slight / not significant), which is not significant. Therefore, the impact of long-term habitat loss is considered to be **not significant** for shellfish.

440. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

441. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Impact 2: EMF from Cables

442. As electricity passes through cables, electromagnetic fields are produced. These consist of electrical fields, magnetic fields, and induced electrical fields which are produced when a conductor (such as seawater) passes through the magnetic field. Standard cables include shielding to prevent the passage of electrical fields, therefore there will not be an impact resulting from direct electrical fields. However, magnetic fields will be emitted by the cable, and as such, induced magnetic fields may also be present.

443. There is a maximum of approximately 146 km of OECC cable, 8.6 km of inter-connector cable and 139 km of inter-array cabling proposed to be installed for the CWP Project. Cables will mostly be protected by burial, although where required, cable protection will be used (for further details, refer to **Chapter 4 Project Description**). Burial or protection of a marine cable, as proposed by the CWP Project acts as a buffer between the potential source of EMF and the receptor.

444. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a minimum depth of cover of 1 m) will be 1.5 µT for a 1400 Cu mild steel cable (**Plate 9-5**), 2.05 µT for a 1800 Cu mild steel cable (**Plate 9-6**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 9-7**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable.

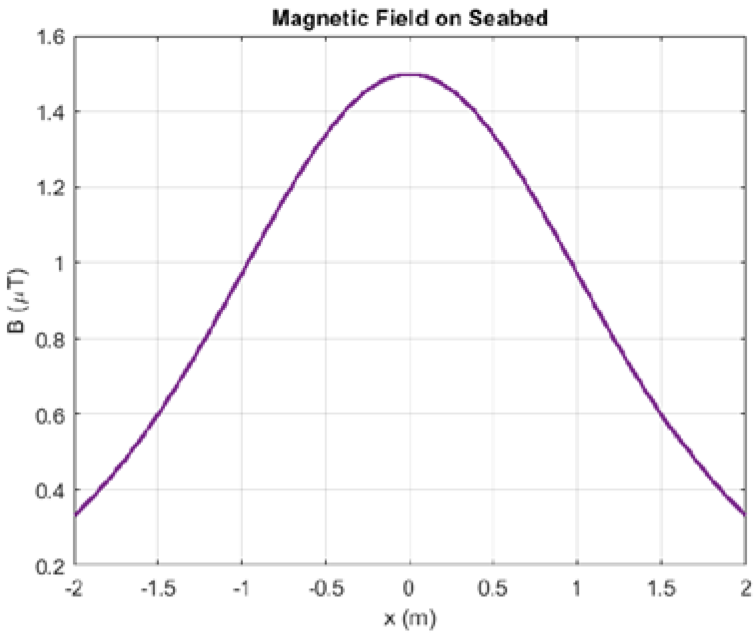


Plate 9-5 OECC Magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

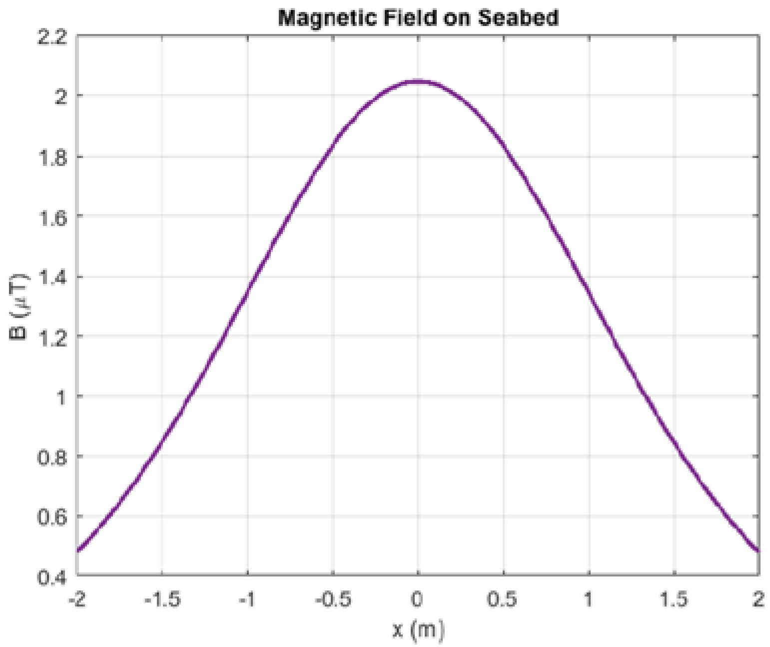


Plate 9-6 OECC Magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

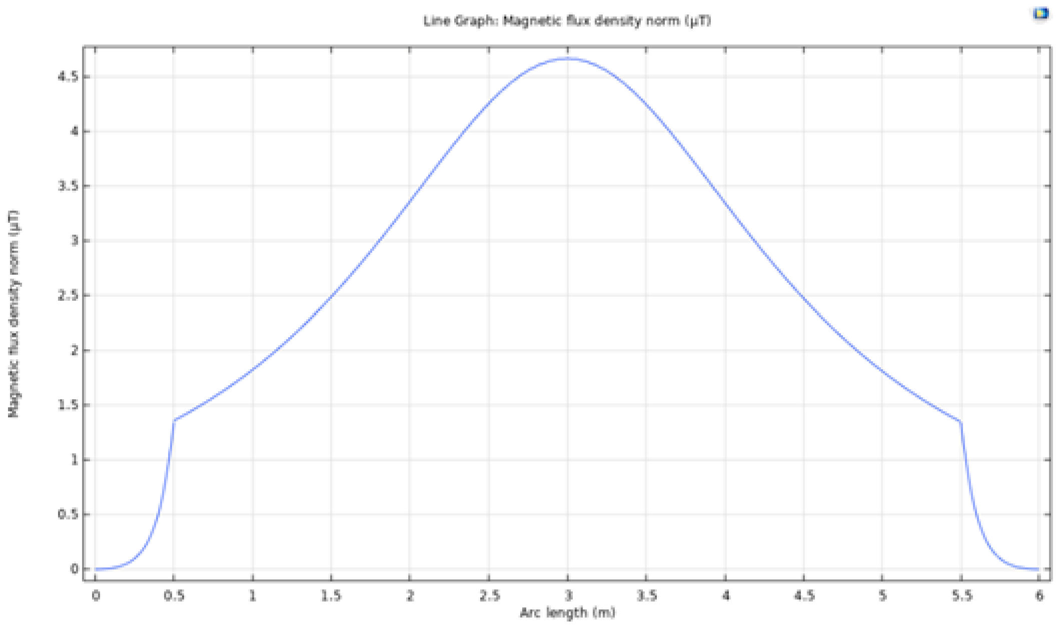


Plate 9-7 IAC magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

445. Receptors are grouped according to the following criteria for the assessment against EMF from cables during operation and maintenance:

- Elasmobranchs and turtles;

- Other fish; and
- Shellfish.

446. Undertaking the assessment using the above groups is considered to provide a suitable level of assessment, which takes account of any potential fish, shellfish, or turtle receptor that may be affected by the CWP Project, whilst focussing on those that are of most relevance to the assessment (see **Section 9.6.6**.

447. Elasmobranchs are considered to be potentially sensitive to EMF with a number of different species present along the OECC, inter-connector and IAC cabling. The ability of elasmobranch species to detect electric fields is well known. Most species within this large group of fish possess anatomical structures called ampullae of Lorenzini which are used for the detection of prey, predators, conspecific detection, and in some species, navigation (Tricas & Gill, 2011).

448. Sea turtles that cross subsea power cables could be deviated from their migration pattern as it studies have shown anthropogenic magnetic fields can affect migration behaviours (Snoek et al., 2016).

Receptor sensitivity

449. Elasmobranch and turtle species are listed in **Table 9-77**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Adaptability is considered high as all are mobile species and there is considerable equivalent habitat within the immediate area. The presence of EMF may result in behavioural changes such as attraction or avoidance of a discrete area or changes in normal behaviours such as foraging (Gill et al., 2009), as such tolerance is considered high. Recoverability ranges from low to high based on fecundity, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value ranges from low to medium according to conservation status.

450. As per **Table 9-77**, sensitivity for elasmobranch and turtle species to the impact of EMF from cables is very low to medium for the group.

Table 9-77 Elasmobranch and turtle sensitivities to EMF

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Blonde ray	High	High	High	Low	Very low
Small-spotted catshark	High	High	High	Low	Very low
Cuckoo ray	High	High	High	Low	Very low
Thornback ray	High	High	High	Medium	Low
Spotted ray	High	High	High	Medium	Low
Spurdog	High	High	High	Medium	Low
Tope	High	High	High	Low	Very low
Common skate	High	High	High	Medium	Low
Angel shark	High	High	High	Medium	Low
Undulate ray	High	High	High	Low	Very low
Basking shark	High	High	Low	Medium	Medium

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Leatherback turtle	High	High	Low	Medium	Medium

Magnitude of impact

451. A study commissioned by the MMO (2014) evaluated the results of environmental data associated with post-consent monitoring of licence conditions of UK Round 1 and Round 2 OWFs, and some European sites. The report concluded that from the results of post-consent monitoring conducted to date, there is no evidence to suggest that EMF pose a significant risk to elasmobranchs at a site or population level, and little uncertainty remains (MMO, 2014). In a study on elasmobranchs response to EMF, it was determined that while elasmobranch species did respond to the presence of EMF from a subsea cable, species remained present in the vicinity of the cable regardless of EMF presence (Gill et al., 2009).

452. In addition, the NPS EN-3 Renewable Energy Infrastructure (2011) and MMO (2014) both conclude that effects from EMF are not predicted to be significant for fish and more specifically, elasmobranchs. Additionally, the earth's magnetic field is typically between 22 µT and 67 µT (British Geological Survey, n. d.). The maximum level predicted to arise from OECC, IAC and interconnector cables (**Plate 9-7**) from the cables is 4.9 µT and is well below the background levels all the receptors experience. Any effects on elasmobranch and turtle are anticipated to only occur within the immediate vicinity of the cable. Given the low predicted levels, it is considered that effects from EMF from cables on elasmobranchs and turtle are considered negligible.

Significance of the effect

453. The significance of effect has been summarised by each receptor in **Table 9-78**.

Table 9-78 Determination of Significance for elasmobranchs based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Blonde ray	Very low	Negligible	**Imperceptible** (not significant)
Small-spotted catshark	Very low	Negligible	**Imperceptible** (not significant)
Cuckoo ray	Very low	Negligible	**Imperceptible** (not significant)
Thornback ray	Low	Negligible	**Not significant**
Spotted ray	Low	Negligible	**Not significant**
Spurdog	Low	Negligible	**Not significant**
Tope	Very low	Negligible	**Imperceptible** (not significant)
Common skate	Low	Negligible	**Not significant**
Angel shark	Low	Negligible	**Not significant**
Undulate ray	Very low	Negligible	**Imperceptible** (not significant)
Basking shark	Medium	Negligible	**Slight / Not significant** (not significant)
Leatherback turtle	Medium	Negligible	**Slight / Not significant** (not significant)

454. In summary, elasmobranchs and turtles are identified as having very low to medium sensitivities. The magnitude of impact is predicted to be negligible. Several species experience the highest significance (slight / not significant), which is **not significant**. Therefore, the impact of EMF from cables is considered to be **not significant** for elasmobranch and turtle species.

455. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

456. Based on the predicted level of effect, it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Other fish

457. The majority of the fish species present within the OECC and array site lack the specific adaptations to detect EMF fields present in elasmobranchs, although they may still be able to detect EMF field changes in the environment (Gill et al., 2005).

Receptor Sensitivity

458. Species are listed in **Table 9-79.** Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Adaptability is considered high as all are mobile species (except sandeel which has limited ability to avoid any impact and as such has a medium adaptability) and there is considerable equivalent habitat within the immediate area. The presence of EMF from cables may result in behavioural changes such as attraction or avoidance of a discrete area or changes in normal behaviours such as foraging (Gill et al., 2009), as such tolerance is considered high. Recoverability is high based on fecundity, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value ranges from low to high according to conservation status.

459. As per **Table 9-79**, sensitivity for this species is very low to medium for the group.

Table 9-79 Sensitivity for other fish species to EMF

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Haddock	High	High	High	Low	Very low
Whiting	High	High	High	Low	Very low
European plaice	High	High	High	Low	Very low
Atlantic mackerel	High	High	High	Low	Very low
Atlantic horse mackerel	High	High	High	Low	Very low
Lemon sole	High	High	High	Low	Very low
Common sole	High	High	High	Low	Very low
Sandeel	Medium	High	High	Low	Low
Atlantic herring	High	High	High	Low	Very low
European sprat	High	High	High	Low	Very low

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Atlantic cod	High	High	High	Medium	Low
European smelt	High	High	High	Low	Very low
Anglerfish	High	High	High	Low	Very low
European hake	High	High	High	Low	Very low
Ling	High	High	High	Low	Very low
Twaite shad	High	High	High	High	Medium
Allis shad	High	High	High	High	Medium
Atlantic salmon	High	High	High	High	Medium
Sea lamprey	High	High	High	High	Medium
River lamprey	High	Low	High	High	Medium
European eel	High	Very low	High	Medium	Medium
Seatrout	High	High	High	Low	Very low

Magnitude of Impact

460. The presence of EMF from cables may result in behavioural changes such as attraction or avoidance of a discrete area or changes in normal behaviours such as foraging (Gill et al., 2009).

461. As stated above, the NPS EN-3 Renewable Energy Infrastructure (2001) and MMO (2014) both conclude that effects from EMF are not predicted to be significant for fish, in particular where cables are buried or subject to secondary protection as is the case for the CWP Project. A review of the potential effects of EMF was also conducted on Atlantic salmon by Marine Scotland. It determined that salmonoids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015).

462. Additionally, the earth's magnetic field is typically between 22 µT and 67 µT (British Geological Survey, n. d.). The maximum level, as derived from **Plate 9-7**, from the cables is 4.9 µT, well below the background levels all the receptors experience. Any effects on fish are anticipated to only occur within the immediate vicinity of the cable. While it is likely that fish can detect EMF levels, the levels, compared to background, and the minimal area of effect is such that it is considered that the magnitude of effects from EMF on fish are considered negligible.

Significance of the Effect

463. The significance of effect has been summarised by each receptor in **Table 9-80**.

Table 9-80 Determination of Significance for other fish species based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Haddock	Very low	Negligible	**Imperceptible** (not significant)
Whiting	Very low	Negligible	**Imperceptible** (not significant)

Species	Sensitivity	Magnitude	Significance
European plaice	Very low	Negligible	**Imperceptible** (not significant)
Atlantic mackerel	Very low	Negligible	**Imperceptible** (not significant)
Atlantic horse mackerel	Very low	Negligible	**Imperceptible** (not significant)
Lemon sole	Very low	Negligible	**Imperceptible** (not significant)
Common sole	Very low	Negligible	**Imperceptible** (not significant)
Sandeel	Low	Negligible	**Not significant** (not significant)
Atlantic herring	Very low	Negligible	**Imperceptible** (not significant)
European sprat	Very low	Negligible	**Imperceptible** (not significant)
Atlantic cod	Low	Negligible	**Not significant** (not significant)
European smelt	Very low	Negligible	**Imperceptible** (not significant)
Anglerfish	Very low	Negligible	**Imperceptible** (not significant)
European hake	Very low	Negligible	**Imperceptible** (not significant)
Ling	Very low	Negligible	**Imperceptible** (not significant)
Twaite shad	Medium	Negligible	**Slight / Not significant** (not significant)
Allis shad	Medium	Negligible	**Slight / Not significant** (not significant)
Atlantic salmon	Medium	Negligible	**Slight / Not significant** (not significant)
Sea lamprey	Medium	Negligible	**Slight / Not significant** (not significant)
River lamprey	Medium	Negligible	**Slight / Not significant** (not significant)
European eel	Medium	Negligible	**Slight / Not significant** (not significant)
Seatrout	Very low	Negligible	**Imperceptible** (not significant)

464. In summary, species within the other fish group are identified as having very low to medium sensitivities. The magnitude of impact is predicted to be negligible. Multiple species experience the highest significance (Slight / Not significant), which is not significant. Therefore, the impact of EMF from cables is considered to be **not significant** for all other fish species.

465. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

466. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Shellfish

467. It is suggested that shellfish (particularly those that undergo migration) have the ability to detect EMF fields (Scott et al., 2020).

Receptor Sensitivity

468. Shellfish species are listed below in **Table 9-81**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Across the species group, all are non-mobile species and therefore have a low to very low capacity (adaptability) to avoid the impact by fleeing the affected area. The presence of EMF may result in behavioural changes such as attraction or avoidance of a discrete area or changes in normal behaviours such as foraging (Gill et al., 2009), as such tolerance is considered high. All shellfish species have a relatively high fecundity and therefore a high recoverability. Value is low according to conservation status.

469. As per **Table 9-81**, sensitivity for shellfish species is low for the group.

Table 9-81 Shellfish sensitivities

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Razor / knife clams	Very low	High	High	Low	Low
Norway lobster	Very low	High	High	Low	Low
Sword razor shell	Very low	High	High	Low	Low
Whelk	Very low	High	High	Low	Low
Great Atlantic scallop	Very low	High	High	Low	Low
Edible crab	Low	High	High	Low	Low
European lobster	Low	High	High	Low	Low

Magnitude of Impact

470. No behavioural or physiological changes have been observed in shellfish below exposure levels of 200 µT (Scott et al., 2020), a value far higher than the predicted maximum of 4.9 µT (**Plate 9-7).** Additionally, the earth's magnetic field is typically between 22 µT and 67 µT (British Geological Survey, n. d.). The maximum level, as derived from **Plate 9-7**, from the cables is 4.9 µT, well below the background levels all the receptors experience. Any effects on shellfish are anticipated to only occur within the immediate vicinity of the cable. Therefore, it is considered that effects from EMF from cables on shellfish are considered negligible.

Significance of the Effect

471. The significance of effect has been summarised by each receptor in **Table 9-82**.

Table 9-82 Determination of Significance for shellfish habitats based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Norway lobster	Low	Negligible	**Not significant**
Whelk	Low	Negligible	**Not significant**
Razor / knife clams	Low	Negligible	**Not significant**
Sword razor shell	Low	Negligible	**Not significant**
Great Atlantic scallop	Low	Negligible	**Not significant**
Edible crab	Low	Negligible	**Not significant**
European lobster	Low	Negligible	**Not significant**

472. In summary, shellfish are identified as having low sensitivity. The magnitude of impact is predicted to be negligible. All species experience the same significance (not significant), which is not significant. Therefore, the impact of EMF from cables is considered to be **not significant** for shellfish.

473. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

474. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Impact 3: Operational Noise

475. During the operation and maintenance phase, various sources of noise will exist. This includes noise from vessels, noise from the operation of the turbines, geophysical survey noise and noise from any maintenance tasks on offshore infrastructure.

476. Receptors are grouped according to the following criteria for the assessment against operational noise during operation and maintenance:

- All receptors.

477. Undertaking the assessment using the above groups is considered to provide a suitable level of assessment, which takes account of any potential fish, shellfish, or turtle receptor that may be affected by the CWP Project (**Section 9.6.6**).

Receptor sensitivity

478. All species are included in **Table 9-83**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Across all receptors, shellfish are the least mobile and therefore all receptors will be grouped conservatively as low adaptability to avoid the impact. Tolerance within the group is considered to be high, as operational phase noise levels are considered to be relatively low and are only likely to lead to behavioural effects at most. Some species fecundity is low, and therefore a low recoverability is the conservative ranking used. Most species are not of international importance, however there are also species which are, causing value to be high as the conservative rank.

479. As per **Table 9-83**, sensitivity for all receptors is medium.

Table 9-83 Fish, shellfish and turtle sensitivity to operational noise

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
All receptors	Low	High	Low	High	Medium

Magnitude of impact

480. For operational noise, the effect on receptors is considered to be a loss / avoidance of available habitat through physical or behavioural responses to low level continuous noise leading to avoidance of the area thereby reducing the overall available area for species to use.

481. In regard to vessel noise, it is already established that this area contains a busy shipping route in and out of Dublin port, therefore unlikely that operation / maintenance related vessels (peak daily amount of 14 vessels; **Table 9-20**) will introduce a new impact.

482. The operation of the wind turbine itself will produce noise. It is however established that turbines can act as fish aggregating devices, offering new structures that can be used as habitats (Wilhelmsson, Malm and Öhman, 2006; Haberlin, Cohuo and Doyle, 2022). This indicates that the noise produced is such that fish are not affected and do not avoid the project infrastructure due to noise emissions.

483. Geophysical surveys will be used to survey offshore infrastructure. As such the area of effect will be restricted to the offshore development area. Such surveys will typically be of short duration (days / weeks), though only act in any one area for a transient amount of time. Surveys may occur more than once in any given area, though frequency will likely be infrequent during the operational life of the project, assuming once every three years.

484. Based on the current literature to date, there is no evidence of mortality or population effects (such as reduced abundances) of fish or invertebrates following exposure to anthropogenic sound sources such as those typical of survey work. Research on invertebrates provides evidence for low-frequency sound detection abilities which may result in short term behavioural responses in a number of marine invertebrate species (Roberts and Breithaupt, 2016; Carroll et al., 2017).

485. Activities such as seismic surveys (not required for the CWP Project) that produce larger levels of generated noise have been shown that fish and shellfish will display physical responses, behavioural responses, and physiological responses. Physical responses include the potential of damage to hearing capabilities for fish, behavioural responses include startle behaviours (but no avoidance behaviour) and physiological responses such as endocrinological stress (Carrol et al., 2017). While the predicted impacts from geophysical surveys are likely to be similar, the sound levels associated with geophysical surveys will be to a lesser extent than that of seismic, and as such responses displayed by receptors will be to a lesser extent. There is little research on fish responses to geophysical survey work, however as the typical devices used to survey the seabed (e.g. side scan sonar, or multi beam echosounder) are also used to detect fish underwater with no observed behavioural response to the noise emitted from the scanning sonar devices, no effects are predicted from the use of high frequency geophysical survey equipment. Where low frequency equipment is used, it is considered that this may elicit a small scale behavioural (avoidance) response.

486. For turtles, use of survey equipment will adhere to the mitigations described for marine mammals (see **Chapter 11 Marine Mammals** and the **Marine Mammal Mitigation Protocol**) which will also mitigate the impacts on turtles and remove any risk of injury or harm.

487. In regard to general maintenance noise, activities will occur at undetermined but likely sporadic intervals (days / weeks) across the 25-year operation period. Activities may occur more than once in any given area, though frequency will likely be infrequent. As none of the general maintenance activities involve a percussive impact, the magnitude of noise will be significantly less than those from

construction. While there is the potential that operational noise will result in in short term behavioural responses (i.e. fleeing the area), but this will occur over very small areas within the offshore development area and be for a temporary period.

488. Therefore, magnitude of operational noise for all receptors is determined to be negligible**.**

Significance of effect

Table 9-84 Determination of Significance for operational noise based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
All receptors	Medium	Negligible	**Slight / Not significant** (not significant)

489. In summary, the sensitivity of receptors in the local study area, to operational noise is medium and the magnitude the of impact for all species is assessed as negligible. All species experience the same significance (Slight / Not significant), which is not significant. Therefore, the impact of operational noise is considered to be **not significant** for all receptors.

490. Where flexibility in the proposed design exists, no other scenario would lead to a materially different effect significance.

491. Based on the predicted level of effect, it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Impact 4: Temporary disturbance of the seabed including associated increases in SSC and deposition

492. Operation and maintenance activities and their associated vessels, have the potential to cause a temporary disturbance of the seabed including associated increases in SSC and deposition which may result in smothering effects.

493. Receptors are grouped according to the following criteria for the assessment against temporary disturbance of the seabed including associated increases in SSC and deposition during Operation and Maintenance:

- Mobile fish with spawning and nursery areas that overlap the offshore development area;
- Mobile fish and turtle species with spawning and nursery areas that do not overlap the offshore development area; and
- Shellfish.

494. Undertaking the assessment using the above groups is considered to provide a suitable level of assessment, which takes account of any potential fish, shellfish, or turtle receptors that may be affected by the operation and maintenance activities, whilst focussing on those that are of most relevance to the assessment (**Section 9.6.6**).

Mobile fish with spawning and nursery areas that overlap the offshore development area

Receptor Sensitivity

495. Mobile fish with spawning and nursery areas that overlap the offshore development area are listed below in **Table 9-85.** Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Across the species group, all are mobile species and therefore have a high capacity (adaptability) to avoid the impact by fleeing the area of temporary disturbance, with the exception being sandeel, a less mobile species and therefore only a medium capacity (adaptability) to avoid the impact.

496. The tolerance of the majority of species within this group is considered to be high for the impact of suspended sediments and deposition. This is because most species are highly mobile and can move away from the area of impact and have extensive equivalent habitat in the surrounding area which can be utilised for the same functions. Sandeels use the sand as spawning substrate, predation cover and also in which to hibernate during the winter. The thickness of sediments outside the immediate vicinity of the disposal location is <1 cm in all cases, and this level of sediment is predicted to be remobilised and dispersed through natural tidal and wave forces rapidly after settlement. This level of sediment deposition is similar to that which sandeels will experience through natural dispersal and movement of sediments, and it has been demonstrated that sandeels can tolerate a degree of sediment deposition by adjusting their depth within the sediment to maintain oxygen availability (Behrens et al., 2007; Latto et al., 2013). Species that spawn on the substrate (such as thornback ray, spotted ray, sandeel) have the potential for their eggs to be impacted by sediment deposition through reduced oxygenation. However, the spatial extent of the impact is negligible in the context of the wider availability of suitable substrate, there are no areas of high intensity spawning of substrate spawning fish in the area potentially affected, and any deposited sediments will be transient, being rapidly dispersed through natural tidal and wave action.

497. All fish species within this group have a relatively high fecundity and therefore a high recoverability. Value ranges from low to medium based upon conservation status.

498. As per **Table 9-85**, sensitivity for this species group to temporary disturbance of the seabed including associated increases in SSC and deposition, ranges from very low to medium.

Table 9-85 Mobile fish with overlapping spawning / nursery habitat sensitivity

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Anglerfish	High	High	High	Low	Very low
Haddock	High	High	High	Low	Very low
Whiting	High	High	High	Low	Very low
European plaice	High	High	High	Low	Very low
Atlantic mackerel	High	High	High	Low	Very low
Atlantic Horse mackerel	High	High	High	Low	Very low
Lemon sole	High	High	High	Low	Very low
Common sole	High	High	High	Low	Very low
European sprat	High	High	High	Low	Very low
Sandeel	Medium	High	High	Low	Low
Ling	High	High	High	Low	Very low
Atlantic cod	High	High	High	Medium	Low
Thornback ray	High	Medium	High	Medium	Medium
Spotted ray	High	Medium	High	Medium	Medium
Tope	High	High	High	Low	Low

Magnitude of Impact

499. For temporary disturbance of the seabed leading to increases in SSC and associated deposition, the effect on receptors may include the smothering of substrate spawning species eggs and / or a loss of available spawning area, caused by deposition on the seabed. Additionally, it may cause increase of energetic costs (decreased ability to find prey, increased metabolic cost for removing sediment from gills) or through behavioural responses leading to avoidance of the area thereby reducing the overall available area within which spawning or nursery activities may take place.

500. The potential overlap of spawning or nursery areas is negligible within the context of the Irish Sea study area, particularly when it is considered that the area of disturbance will be much smaller than construction activities, producing smaller plumes of sediment. Given the mobile nature of these fish species (except sandeel), and the size of the spawning areas, relative to the area affected by increased SSC, it is considered that individuals will be able to avoid the affected area, if required, with no impact on overall spawning efficacy, and that there will be sufficient suitable alternative habitat available to ensure effects are negligible.

501. Based upon the above, it is predicted that the magnitude of temporary disturbance of the seabed leading to increases in SSC and associated deposition, for spawning adults, and developing juveniles and eggs will be low.

Significance of Effect

502. The significance of effect has been summarised by each receptor in **Table 9-86**.

Table 9-86 Determination of Significance for mobile fish with overlapping spawning habitats based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Anglerfish	Very low	Low	**Not significant**
Haddock	Very low	Low	**Not significant**
Whiting	Very low	Low	**Not significant**
European plaice	Very low	Low	**Not significant**
Atlantic mackerel	Very low	Low	**Not significant**
Atlantic Horse mackerel	Very low	Low	**Not significant**
Lemon sole	Very low	Low	**Not significant**
Common sole	Very low	Low	**Not significant**
European sprat	Very low	Low	**Not significant**
Sandeel	Low	Low	**Not significant**
Ling	Very low	Low	**Not significant**
Atlantic cod	Low	Low	**Not significant**
Thornback ray	Medium	Low	**Slight** (not significant)
Spotted ray	Medium	Low	**Slight** (not significant)
Tope	Low	Low	**Not significant**

503. In summary, mobile fish with spawning and nursery areas that overlap the offshore development area have very low to medium sensitivities, and the magnitude of impact is predicted to be low. Thornback and spotted ray experience the highest significance (slight), which is not significant. Therefore, the impact of temporary disturbance of the seabed and associated increases in SSC and deposition is considered to be **not significant** for all species with the group.

504. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

505. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Mobile fish and turtle species with spawning and nursery areas that do not overlap the offshore development area

Receptor Sensitivity

506. Mobile fish and turtle species with spawning and nursery areas that do not overlap the offshore development area are listed below in **Table 9-87**. Sensitivity has been determined based upon the

definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Across the species group, all are mobile species and therefore have a high capacity (adaptability) to avoid the impact by fleeing the area of disturbance. Atlantic herring, although recognised as a pelagic species, require demersal habitats of coarse substrate such as gravel and stones for spawning purposes (Munk et al., 2024) reducing their adaptability to increased SSC in spawning terms. The survival and development of herring eggs have been reported to be insensitive to even high concentrations of SSC, but studies have concluded that smothering from resulting deposition is likely to be detrimental unless the material is removed rapidly by the current making tolerance to this impact moderate (Birklund and Wijsam, 2005). The tolerance of the other species within this group is considered to be high for the impact of suspended sediment and deposition. This is because most species are highly mobile and can move away from the area of impact and have extensive equivalent habitat in the surrounding area which can be utilised for the same functions. Recoverability ranges from low to high based on fecundity, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value ranges from low to high according to conservation status.

507. As per **Table 9-87**, sensitivity for this species group ranges from very low to medium.

Table 9-87 Mobile fish and turtle species with spawning and nursery areas that do not overlap the offshore development area sensitivity

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Small-spotted catshark	High	High	High	Low	Very Low
Cuckoo ray	High	High	High	Low	Very Low
Blonde ray	High	High	High	Low	Very Low
Seatrout	High	High	High	Low	Very Low
Atlantic herring	Medium	Medium	High	Low	Medium
Undulate ray	High	High	High	Low	Very Low
Twaite shad	High	High	High	High	Low
Allis shad	High	High	High	High	Low
Atlantic salmon	High	High	High	High	Low
Sea lamprey	High	High	High	High	Low
River lamprey	High	High	High	High	Low
European eel	High	High	High	Medium	Low
Common skate	High	High	High	Medium	Low
Angel shark	High	High	High	Medium	Low
Basking shark	High	High	Low	Medium	Medium
Leatherback turtle	High	High	Low	Medium	Medium
European hake	High	High	High	Low	Very Low
Spurdog	High	High	High	Medium	Low

Magnitude of Impact

508. For temporary habitat disturbance resulting in SSC and associated deposition, the effect on receptors may include an increase of energetic costs (decreased ability to find prey, increased metabolic cost for removing sediment from gills), temporary loss of available habitat or through behavioural responses leading to avoidance of the area thereby reducing the overall available habitat.

509. Although Atlantic herring eggs have a moderate sensitivity to sediment deposition, no herring spawning areas overlap with the offshore development area or modelled area of sediment deposition, and therefore it is highly unlikely there will any herring eggs will be impacted by temporary increases in sediment deposition.

510. While increased SSCs may result in an increase of energetic costs (decreased ability to find prey, increased metabolic cost for removing sediment from gills), given the mobile nature of most fish species and the highly localised area of effect (much smaller than that during construction), it is considered that any individuals will be able to avoid the affected area, and that there will be sufficient suitable alternative habitat available to ensure effects are negligible. In addition, fish are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, or through having life history traits that expose then to increased levels of SSC (e.g. migration through estuarine environments, feeding on organisms within the sediment, or through their preferred location in the water column being in or on the seabed).

511. As such, given the short-term nature of exposure, transient presence of increased levels of SSC, and the very small spatial extent of the impact, it is considered that the magnitude of temporary disturbance to the seabed including associated increases in SSC and deposition of sediments will be negligible.

Significance of Effect

512. The significance of effect has been summarised by each receptor in **Table 9-88**.

Table 9-88 Determination of Significance for mobile fish and turtle species with spawning and nursery areas that do not overlap the offshore development area based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Small-spotted catshark	Very Low	Negligible	**Imperceptible** (not significant)
Cuckoo ray	Very Low	Negligible	**Imperceptible** (not significant)
Blonde ray	Very Low	Negligible	**Not significant**
Seatrout	Very Low	Negligible	**Imperceptible** (not significant)
Atlantic herring	Medium	Negligible	**Slight / Not significant** (not significant)
European smelt	Very Low	Negligible	**Imperceptible** (not significant)
Undulate ray	Very Low	Negligible	**Imperceptible** (not significant)
Twaite shad	Low	Negligible	**Not significant**
Allis shad	Low	Negligible	**Not significant**
Atlantic salmon	Low	Negligible	**Not significant**
Sea lamprey	Low	Negligible	**Not significant**

Species	Sensitivity	Magnitude	Significance
River lamprey	Low	Negligible	**Not significant**
European eel	Low	Negligible	**Not significant**
Common skate	Low	Negligible	**Not significant**
Angel shark	Low	Negligible	**Not significant**
Basking shark	Medium	Negligible	**Slight / Not significant** (not significant)
Leatherback turtle	Medium	Negligible	**Slight / Not significant** (not significant)
European hake	Very Low	Negligible	**Imperceptible** (not significant)
Spurdog	Low	Negligible	**Not significant**

513. In summary, species within this group have very low to medium sensitivities. The magnitude of impact is predicted to be negligible. Multiple species experience the largest significance (slight / not significant), which is not significant. Therefore, the impact of temporary disturbance of the seabed leading to increases in SSC and associated deposition is considered to be **not significant** for all mobile fish and turtle species with spawning and nursery areas that do not overlap the offshore development area.

514. Where flexibility in the proposed design exists, no other scenario would lead to a more significant effect.

515. Based on the predicted level of effect, it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Shellfish

Receptor Sensitivity

516. Shellfish species are listed in **Table 9-89**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Across the species group, all are non-mobile or limited mobility species and therefore have a low to very low capacity (adaptability) to avoid the impact by fleeing the disturbed area. The tolerance of the species within this group is considered to be high for the impact of temporary disturbance of the seabed leading to increases in SSC and associated deposition. This is because while the species group are not mobile and cannot move away from the area of impact, as substrate dwelling species they are adapted to deal with varying levels of sediment and as such they are less susceptible to adverse effects of sediment deposition. Recoverability is high based on fecundity, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. The value of all species is considered to be low according to conservation status.

517. As per **Table 9-89** sensitivity for shellfish species is low for the group.

Table 9-89 Shellfish sensitivities

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Razor / knife clams	Very low	High	High	Low	Low
Norway lobster	Very low	High	High	Low	Low
Sword razor shell	Very low	High	High	Low	Low
Whelk	Very low	High	High	Low	Low
Great Atlantic scallop	Very low	High	High	Low	Low
Edible crab	Low	High	High	Low	Low
European lobster	Low	High	High	Low	Low

Magnitude of Impact

518. The impact upon shellfish receptors may include the smothering of substrate dwelling species and / or loss of available habitat area, caused by physical disturbance to the seabed. Additionally, it may cause increase of energetic costs (decreased ability to find prey, increased metabolic cost for excavating burrows) or through behavioural responses leading to avoidance of the area (for more mobile species) thereby reducing the overall available habitat.

519. The shellfish species that are present within the local study area are all species that live on or within the substrate. As such, these species are regularly exposed to increases in SSC and levels of deposition through natural hydrodynamic processes that re-mobilise, transport, and deposit sediments in the area.

520. The increases in SSC are temporary, transient, and will return to background levels within a short period. The levels of deposition away from the immediate location of disturbance will be much lower than construction levels and thus will be remobilised into the natural sediment transport regime within a short period following settlement.

521. The species of shellfish present are considered to be tolerant to the levels of SSC and transient deposition predicted to arise from the predicted activities. As such, it is predicted that the magnitude of temporary seabed disturbance including associated increases in SSC and deposition on shellfish will be negligible.

Significance of the effect

522. The significance of effect has been summarised by each receptor in **Table 9-90**.

Table 9-90 Determination of Significance for shellfish habitats based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Norway lobster	Low	Negligible	**Not significant**
Whelk	Low	Negligible	**Not significant**
Razor/knife clams	Low	Negligible	**Not significant**
Sword razor shell	Low	Negligible	**Not significant**
Great Atlantic scallop	Low	Negligible	**Not significant**
Edible crab	Low	Negligible	**Not significant**
European lobster	Low	Negligible	**Not significant**

523. In summary, species within the group are identified as having low sensitivity. The magnitude of impact is predicted to be negligible. All species experience the same significance (Not significant), which is not significant. The impact of temporary disturbance of the seabed leading to increases in SSC and associated deposition is therefore considered to be **not significant** for all shellfish species.

524. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

525. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Impact 5: Collision with vessels

526. During the operation and maintenance phase, there will be vessel activity in the OECC and array site and surrounding area. Basking sharks are more vulnerable to collision when undertaking behaviours such as feeding and courtship at the water surface. As turtles need to surface regularly to breathe, this can make them vulnerable to collision. Based on this, these two species will form the basis of the assessment as the only two collision vulnerable species. Other fish and shellfish species are not considered vulnerable to collision as they are small, highly mobile, and do not spend long periods at the water's surface.

527. Undertaking the assessment using the above groups is considered to provide a suitable level of assessment, which takes account of any potential fish, shellfish, or turtle receptor that may be affected by the CWP Project, whilst focussing on those that are of most relevance to the assessment (**Section 9.6.6**).

Receptor sensitivity

528. Collision vulnerable species are listed in **Table 9-91**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. While these are mobile species, given modern vessel speeds, they have a low capacity (adaptability) to avoid the impact by swimming away from vessels. Tolerance for both species is considered to be low as the ecology of both species necessitates them being at the surface regularly. All species have a lower fecundity and therefore a low recoverability. Neither species is of international importance, causing value to be medium.

529. As per **Table 9-91,** sensitivity for basking shark and leatherback turtle is high.

Table 9-91 Collision vulnerable species sensitivity

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
Basking shark	Low	Low	Low	Medium	High
Leatherback turtle	Low	Low	Low	Medium	High

Magnitude of impact

530. The effect of collision with vessels is the injury and / death of both basking shark and turtle.

531. The assessment of collision with vessels during the construction phase noted that the area in which the CWP Project is proposed to be constructed contains a number of busy shipping routes in and out of Dublin Port and through the Irish Sea more broadly. The maximum number of operation vessels being used at any one point is 14, with up to 1,209 round trips planned. This slight increase in vessel movement could lead to an increase in interactions between construction vessels and basking sharks and turtles. However, the likelihood of occurrence of basking turtles in the area and the likelihood of collision with vessels is considered to be low. Furthermore, vessels will be moving infrequently, at relatively slow speeds and for short durations to and from the offshore development area and consequences of the impact are likely to be low. Magnitude of collision with vessels is therefore considered to be negligible.

532. In addition, primary mitigation (**Section 9.9**), includes an environmental vessel management plan EVMP, as described in **Section 9.9**. This will further reduce the risk of collisions through reduction in number of vessel routes, thereby further minimising the area of potential overlap with receptors.

Significance of the effect

533. The significance of effect has been summarised by each receptor in **Table 9-92**.

Table 9-92 Determination of Significance for collision vulnerable species based upon greatest received magnitude of effect

Species	Sensitivity	Magnitude	Significance
Basking shark	High	Negligible	**Slight** (not significant)
Leatherback turtle	High	Negligible	**Slight** (not significant)

534. In summary, basking shark and turtles have high sensitivities. The magnitude of impact is predicted to be negligible. This results in a slight adverse effect for low sensitivity receptors, which is not significant. Therefore, the impact of collision with vessels during operation and maintenance is considered to be **not significant** for basking shark and turtle.

535. Where flexibility in the proposed design exists there is no other scenario which would lead to a more significant effect.

536. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Impact 6: Accidental Pollution Events

537. As outlined in **Table 9-20**, operational vessels and equipment have the potential to result in pollution events from substances such as grease, hydraulic oil, gear oil, nitrogen, transformer silicon / ester oil, diesel fuel, SF6, glycol / coolants, batteries and drill fluid. All such chemicals have the potential to cause harm to the aquatic environment.

538. For the purposes of the assessment of potential Accidental Pollution Events during operation and maintenance all receptors are grouped.

539. Undertaking the assessment using the above groups is considered to provide a suitable level of assessment, which takes account of any potential fish, shellfish, or turtle receptor that may be affected by the CWP Project (see **Section 9.6.6**).

540. All species are included in **Table 9-93.** Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Across all receptors, shellfish are the least mobile and therefore all receptors will be grouped conservatively as low adaptability to avoid the impact. Tolerance within the group is considered to be low, based on the species with least mobility and thus unable to avoid the impact as well as mobile species. Recoverability is low based on the lowest level of fecundity within the receptor group, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value is high according to greatest conservation status.

541. As per **Table 9-93**, receptor sensitivity is established as high.

Table 9-93 Fish, shellfish and turtle sensitivity to pollution events

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
All receptors	Low	Low	Low	High	High

Magnitude of impact

542. Accidental pollution events have the potential to effect receptors by causing impacts such as direct injury or illness, reduction of prey availability, loss of available habitat or through behavioural responses leading to avoidance of the area thereby reducing the overall available habitat.

543. Accidental spills during operation and maintenance have the potential to have a negative effect on fish, turtles and shellfish. Potential pollutants are outlined in the **Table 9-20** in **Section 9.8**, and are as follows: grease, hydraulic oil, gear oil, nitrogen, transformer silicon / ester oil, diesel fuel, SF6, glycol / coolants, drill fluid and batteries.

544. Primary project mitigation outlined in **Section 9.9** will ensure that vessels follow best practice guidelines for pollution at sea, which will be outlined within the CEMP. The offshore CEMP will follow OSPAR, IMO and MARPOL guidelines, and industry best practices regarding pollution at sea. This includes provision for storage of pollutants and identifies products suitable for use in the marine environment.

545. All materials used in the operation and maintenance of the CWP Project, will be appropriately controlled as per the CEMP.

546. The probability of such an event occurring is deemed highly unlikely. As the greatest increase in vessel movements will be during the construction phase, the increased risk of accidental pollution events will predominantly be during the construction phase.

547. Accordingly, and through application of the above-described measures, the potential magnitude of impact is reduced as far as reasonably practical to negligible.

Significance of the effect

548. Sensitivity is assessed as high, and magnitude is assessed to be negligible to the potential effect of accidental pollution events during the operation and maintenance phase. The significance of the potential impact of accidental pollution events on all fish, shellfish and turtle receptors is considered to be slight, and therefore **not significant**.

549. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

550. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Impact 7: Invasive Non-Native Species

551. There is the potential that INNS could be introduced by operation and maintenance related activities, through methods such as the release of contaminated ship's ballast. Once introduced to the environment, INNS can quickly outcompete other species for resources, resulting in species decline.

552. Receptors are grouped according to the following criteria for the assessment against INNS Events during operation and maintenance:

- All receptors.

553. Undertaking the assessment using the above groups is considered to provide a suitable level of assessment, which takes account of any potential fish, shellfish, or turtle receptor that may be affected by the CWP Project (**Section 9.6.6**).

554. All species are included in **Table 9-94**. Sensitivity has been determined based upon the definitions set out in **Table 9-3**, with information feeding this assessment coming from **Table 9-18**. Across all receptors, shellfish are the least mobile and therefore all receptors will be conservatively grouped as low adaptability to avoid the impact. Tolerance within the group is considered to be low, based on the species with least mobility and thus unable to avoid the impact as well as mobile species. Recoverability is low based on the lowest level of fecundity within the receptor group, should individuals be lost from the population or based on the ability for receptors to revert to pre-impact behaviours. Value is high according to greatest conservation status.

555. As per **Table 9-94**, receptor sensitivity is established as high.

Table 9-94 Fish, shellfish and turtle sensitivity to INNS events

Species	Adaptability	Tolerance	Recoverability	Value	Sensitivity
All receptors	Low	Low	Low	High	High

Magnitude of impact

556. INNS has the potential effect on receptors of reducing available habitat and foraging opportunities as INNS may outcompete receptors, or through behavioural responses leading to avoidance of the area thereby reducing the overall available habitat.

557. The magnitude of this impact is limited based on the primary mitigation stemming from consideration of the mitigation and control of invasive species measures in line with International Maritime Organization guidance (IMO, 2019) which are secured through the implementation of the CEMP described in **Section 9.9**, specifically that all vessels working on the CWP Project will have a biosecurity plan in place. The associated standards and procedures will be incorporated by all vessels and as such the potential magnitude of impact is reduced as far as is reasonably practicable to negligible.

Significance of the effect

558. Sensitivity is high and impact is assessed to be negligible to the potential effect of accidental pollution events during the operation and maintenance phase. The significance of the potential impact of accidental pollution events on all fish, shellfish and turtle receptors is considered to be slight, and therefore **not significant**.

559. Where flexibility in the proposed design exists there is no other scenario which would lead to a materially different effect significance.

560. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

9.10.3 Decommissioning phase

561. The potential environmental impacts arising from the decommissioning of the CWP Project are listed in **Table 9-20**.

562. It is recognised that legislation and industry best practice change over time. However, for the purposes of the EIA, at the end of the operational lifetime of the CWP Project, all offshore infrastructure will be rehabilitated. Primary mitigation measures set out in **Section 9.9** include a Rehabilitation Schedule is provided as part of the planning application. This has been prepared in accordance with the MAP Act (as amended by the Maritime and Valuation (Amendment) Act 2022) to provide preliminary information on the approaches to decommissioning the offshore and onshore components of the CWP Project.

563. A final Rehabilitation Schedule will require approval from the statutory consultees prior to the undertaking of decommissioning works. This will reflect discussions held with stakeholders and regulators to determine the exact methodology for decommissioning, taking into account available methods, best practice and likely environmental effects.

564. A description of the potential effect on fish, shellfish and turtle receptors caused by each identified impact is given below.

Impact 1: Long-term habitat loss

565. Activities associated with the removal of CWP infrastructure during decommissioning activities have the potential to remove the hard substrate habitats formed during the CWP Project lifetime.

566. It is likely that long-term habitat loss during decommissioning with be no greater than that of long-term habitat loss caused during the operation and maintenance phase. Where newly created habitat is lost the areas in which it is lost from will return over time to the habitats of the surrounding areas. Given this the potential effects of this impact on the fish, shellfish and turtle will be less than, or equal to, those of long-term habitat loss during operation and maintenance which have been assessed as not significant.

567. Therefore, an effect of **not significant** adverse impact on the fish, shellfish and turtle receptors is predicted.

568. Based on the predicted level of effect it is concluded that no additional mitigation is required beyond the primary mitigation described in **Section 9.9**.

Impact 2: Noise and vibration

569. Activities associated with removal of the CWP generating station and OfTI have the potential to produce levels of noise and vibration.

570. For the purposes of the EIA, at the end of the operational lifetime of the CWP Project, all offshore infrastructure will be rehabilitated. Levels of noise and vibration will be significantly less than that of the installation process as no piling will be required and no other sources of percussive sound are anticipated in the decommissioning. Given this, the potential effects of this impact on the fish, shellfish and turtles will be less than, or equal to, those of noise and vibration during construction, which have been assessed as not significant.

571. Therefore, an effect of **not significant** adverse impact on the fish, shellfish and turtle receptors is predicted.

Impact 3: Temporary disturbance of the seabed including associated increases in SSC and deposition

572. Activities associated with the removal of CWP infrastructure during decommissioning activities have the potential to lead to local temporary disturbance of the seabed including associated increases in SSC and deposition.

573. It is likely that temporary disturbance of the seabed including associated increases in SSC and deposition during decommissioning with be no greater than those associated with the dredge and disposal and trenching activities during construction. Given this the potential effects of this impact on the fish, shellfish and turtles will be less than, or equal to, those of temporary disturbance of the seabed including associated increases in SSC and deposition during construction which have been assessed as not significant.

574. Therefore, an effect of **not significant** adverse impact on the fish, shellfish and turtle receptors is predicted.

Impact 4: Collision with vessels

575. Generally, decommissioning is anticipated to be a reverse of the construction and installation process for the CWP Project and the assumptions around the number of vessels on site, and vessel round trips is therefore the same as described for the construction phase of the offshore components, which was assessed as not significant.

576. Therefore, an effect of **not significant** adverse impact on the fish, shellfish and turtle receptors is predicted.

Impact 5: Accidental Pollution Events

577. Generally, decommissioning is anticipated to be a reverse of the construction and installation process for the CWP Project and the assumptions around the number of vessels on site, and vessel round trips is therefore the same as described for the construction phase of the offshore components.

578. Therefore, an effect of **not significant** adverse impact on the fish, shellfish and turtle receptors is predicted.

Impact 6: Invasive Non-Native Species

579. Generally, decommissioning is anticipated to be a reverse of the construction and installation process for the CWP Project and the assumptions around the number of vessels on site, and vessel round trips is therefore the same as described for the construction phase of the offshore components, which was assessed as not significant.

580. Therefore, an effect of **not significant** adverse impact on the fish, shellfish and turtle receptors is predicted.

9.11 Cumulative Impacts

581. A fundamental component of the EIA is to consider and assess the potential for cumulative effects of the CWP Project with other projects, plans and activities (hereafter referred to as 'other development').

582. **Appendix 9.1** presents the findings of the Cumulative Effects Assessment (CEA) for fish, shellfish and turtle ecology, which considers the residual effects presented in **Section 9.10,** alongside the potential effects of other proposed and reasonably foreseeable other development.

583. As the magnitude of impacts of Introduction of INNS and Accidental pollution events are assessed as negligible from CWP Project activities alone, it is considered that there is no potential for cumulative impacts with the other projects identified in **Appendix 9.1.**

584. A summary of the CEA for fish, shellfish and turtle ecology is presented below. The potential impacts considered for cumulative assessment are in line with those described above for assessment of the project alone and include the following:

For construction

- Cumulative Impact 1: Temporary habitat disturbance / loss, **Not significant**
- Cumulative Impact 2: Noise and vibration, **Not significant**
- Cumulative Impact 3: Temporary disturbance of the seabed leading to increases in SSC and associated deposition, **Not significant**
- Cumulative Impact 4: Collision with vessels, **Not significant**
- Cumulative Impact 5: Accidental pollution, **Not significant**
- Cumulative Impact 6: INNS, **Not significant**

Operation and maintenance

- Cumulative Impact 1: Habitat disturbance and long-term loss, **Not significant**
- Cumulative Impact 2: Electromagnetic fields (EMF), **Not significant**
- Cumulative Impact 3: Operational noise, **Not significant**

- Cumulative Impact 4: Temporary disturbance of the seabed including associated increases in SSC and deposition, **Not significant**
- Cumulative Impact 5: Collision with vessels, **Not significant**
- Cumulative Impact 6: Accidental pollution, **Not significant**
- Cumulative Impact 7: INNS, **Not significant**

585. It is anticipated that the impacts will be no greater than those identified for the construction phase, and therefore no separate assessment of cumulative impacts during the decommissioning phase is presented.

9.11.1 CEA Conclusion

586. The CEA, as per **Appendix 9.1**, has assessed the potential cumulative effects on fish, shellfish and turtles from the construction and operation and maintenance phases of the CWP Project alongside other development.

587. In summary, the CEA for fish, shellfish and turtle ecology demonstrates that no meaningful contribution will be made by the CWP Project to any cumulative effects and other developments will be subject to the same legislation. Therefore, the CEA for fish, shellfish and turtle ecology does not identify any significant cumulative effects resulting from the CWP Project alongside other development.

9.12 Transboundary Impacts

588. Due to the mobile nature of the receptors considered in this chapter, and the use of study areas that capture all ZoI, it is considered that any potential transboundary effects are assessed (e.g., impacts of underwater noise on distant spawning or nursery grounds). All such impacts have been found to be not significant, with mitigation where required, and as such no significant transboundary impacts are predicted.

9.13 Inter-relationships

589. The inter-related effects assessment considers the potential for all relevant effects across multiple topics to interact, spatially and temporally, to create inter-related effects on a receptor group. This includes incorporating the findings of the individual assessment chapters to describe potential additional effects that may be of greater significance when compared to individual effects acting on a receptor group.

590. The term ‘receptor group’ is used to highlight the fact that the proposed approach to the inter-relationships assessment has not assessed every individual receptor considered in this chapter, but instead focuses on groups of receptors that may be sensitive to inter-related effects.

591. **Chapter 5 EIA Methodology** provides a matrix to show at a broad level where across the EIAR interactions between effects on different receptor groups have been identified.

592. The potential inter-related effects that could arise in relation to fish, shellfish and turtles are presented in **Table 9-95**.

Table 9-95 Inter-related effects (phase) assessment for fish, shellfish and turtle ecology

Impact / Receptor	Related chapter	Phase Assessment
The greatest scope for potential inter-related impacts is predicted to arise through the interaction of direct damage and disturbance, increased SSC and deposition and underwater noise effects.	Chapter 6 Marine Geology, Sediments and Coastal Processes. Chapter 7 Marine Water Quality Chapter 8 Subtidal and Intertidal Ecology Chapter 10 Ornithology Chapter 11 Marine Mammals	With respect to this interaction, these individual impacts were assigned a significance of imperceptible to slight/not significant as standalone impacts and although potential inter-related impacts may arise, it is important to recognise that some of the activities are potentially mutually exclusive. Underwater noise from piling is predicted to result in displacement of mobile fish species to a greater extent than the ZoI for SSC and deposition effects. This means that assuming there is temporal overlap of piling and SSC generating activities, these species will not be exposed to the greatest predicted increases in SSC from seabed preparation and drilling in the array site, because they will have already been displaced to beyond the ZoI because of noise disturbance. Similarly, any potential behavioural effects would likely occur over the same areas as habitat loss / disturbance, and therefore these effects would not be additive. Therefore, effects of greater significance than the individual impacts in isolation are not predicted. However, where these activities do not take place concurrently, there is potential for receptor-led effects to occur. With respect to this interaction, although potential combined impacts may arise, it is predicted that they will not be any more significant that the individual impacts in isolation. This is because the affected habitats are widespread, with ample unaffected habitat available for displaced receptors. The impacts are also predicted to be temporary, with full recovery anticipated after the cessation of activities. As such, this interaction is predicted to be no greater in significance than for the individual effects assessed in isolation.
Long-term habitat loss	Chapter 6 Marine Geology, Sediments and Coastal Processes. Chapter 8 Subtidal and Intertidal Ecology Chapter 10 Ornithology	A small proportion of the available habitat that may be utilised by fish, shellfish and turtles in the offshore development area and / or wider study area have the potential to be impacted by permanent infrastructure. This potential impact is addressed within this chapter as **not significant**.
Presence of EMF	Chapter 8 Subtidal and Intertidal Ecology Chapter 11 Marine Mammals	Operation and maintenance activities within the offshore development could introduce the presence of EMF. This potential impact is addressed within this chapter as **not significant**.

9.14 Potential monitoring requirements

593. Monitoring requirements for the CWP Project are described in the In Principle Project Environmental Monitoring Plan (IPPEMP) submitted alongside the EIAR and further developed and agreed with stakeholders prior to construction.

594. The assessment of impacts on fish, shellfish and turtle ecology as a result of the construction, operation and maintenance and decommissioning phases of the CWP Project are predicted to be not significant. As such, it is not deemed necessary for the purposes of validation or removal of uncertainty in terms of the EIA conclusions to undertake any survey work for fish, shellfish, or turtle ecology.

9.15 Impact assessment summary

595. This chapter of the EIAR has assessed the potential environmental impacts on fish, shellfish and turtle ecology from the construction, operation and maintenance and decommissioning phases of the CWP Project. Where significant impacts have been identified, additional mitigation has been considered and incorporated into the assessment.

596. This section, including **Table 9-96**, summarises the impact assessment undertaken and confirms the significance of any residual effects.

597. Fish, shellfish and turtle have been assessed as there is the potential they can experience significant effects from the various aspects of the CWP Project. For construction and decommissioning, this includes temporary seabed habitat disturbance, noise and vibration, temporary disturbance of the seabed leading to increases in SSC and associated deposition, collision with vessels, accidental pollution events and Invasive Non-Native Species. For operation and maintenance this includes long-term habitat loss, EMF from cables, operational noise, temporary disturbance of the seabed leading to increases in SSC, collision with vessels, accidental pollution events and Invasive Non-Native Species.

598. Key consultations have taken place with stakeholders such as Inland Fisheries Ireland, the Marine Institute, Sea Fisheries Protection Authority (SFPA), Bord Iascaigh Mhara, and the Department of Housing, Local Government and Heritage. Key sources, such as SPFA landings data, Northern Irish Groundfish Survey (NIGFS) data, historical spawning and nursery grounds, fish species designated for protected sites or with protected designations and species of Ecological Importance have been used to determine Valued Ecological Receptors (VERs) within the National Study Area.

599. VERs species have been categorised. The first category is shellfish, which includes Razor / knife clams, Norway lobster, Sword razor shell, Whelk, Great Atlantic scallop, Edible crab and European lobster. Next is elasmobranchs, consisting of Blonde ray, Small-spotted catshark, Cuckoo ray, Thornback ray, Spotted ray, Spurdog / Spiny dogfish, Tope, Common skate, Angel shark and Undulate ray. Marine fish include Haddock, Whiting, European plaice, Atlantic mackerel, Atlantic horse mackerel, Lemon sole, Common sole, Sandeel, Atlantic herring, European sprat, Atlantic cod, European smelt, Angler fish, European hake, Ling. Finally, there are migratory species such as Twaite shad, Allis shad, Atlantic salmon, Sea lamprey, River lamprey, European eel, and Seatrout.

600. These species have then been assessed in terms of assigning species sensitivity, based on the definitions provided in **Section 9.4**. The sensitivity, in combination with the magnitude determined for each impact, were used to determine the significance of the predicted effects for the various activities that will occur over the CWP lifetime.

601. A summary of the sensitivities, magnitudes of impact and significances are provided in **Table 9-96**.

602. As no significant impacts were identified, it is not deemed necessary for the purposes of validation or removal of uncertainty in terms of the EIA conclusions to undertake any survey work for fish, shellfish, or turtle ecology.

Table 9-96 Summary of potential impacts and residual effects

Impact	Receptor	Receptor Sensitivity	Magnitude of Impact	Significance of effect	Additional Mitigation	Residual effect
Construction						
Impact 1: Temporary seabed habitat disturbance	Mobile fish with overlapping spawning and nursery habitat	Very low to medium	Negligible	**Imperceptible to Slight / Not significant** (not significant)	**N / A**	**Imperceptible to Slight / Not significant** (not significant)
	Mobile fish without overlapping spawning and nursery habitat	Very low to medium	Negligible	**Imperceptible to Slight / Not significant** (not significant)	**N / A**	**Imperceptible to Slight / Not significant** (not significant)
	Shellfish	Medium	Low	**Slight** (not significant)	**N / A**	**Slight** (not significant)
Impact 2: Noise and vibration	Group 1	Very low to medium	Negligible to Low	**Not significant to Slight / Not significant** (not significant)	**N / A**	**Not significant to Slight / Not significant** (not significant)
	Group 2	Low to medium	Negligible to Low	**Not significant to Slight / Not significant** (not significant)	**N / A**	**Not significant to Slight / Not significant** (not significant)
	Group 3	Low to medium	Negligible to Low	**Not significant to Slight / Not significant** (not significant)	**N / A**	**Not significant to Slight / Not significant** (not significant)

Impact	Receptor	Receptor Sensitivity	Magnitude of Impact	Significance of effect	Additional Mitigation	Residual effect
	Group 4	Very low to medium	Low	**Not significant to slight** (not significant)	**N / A**	**Not significant to slight** (not significant)
	Shellfish	Low	Negligible	**Not significant** (not significant)	**N / A**	**Not significant** (not significant)
	Turtles	Medium	Negligible	**Slight / Not significant** (not significant)	**N / A**	**Slight / Not significant** (not significant)
	All species (UXO)	High	Negligible	**Slight** (not significant)	**N / A**	**Slight** (not significant)
	All species (Geophysical Surveys / General Construction Noise)	Medium	Negligible	**Slight / Not significant** (not significant)	**N / A**	**Slight / Not significant** (not significant)
	Migratory species (Barrier effects in the River Liffey)	Low to high	Negligible to high	**Slight / Not significant to Very Significant / Profound**	**Yes**	**Slight** (not significant)

Impact	Receptor	Receptor Sensitivity	Magnitude of Impact	Significance of effect	Additional Mitigation	Residual effect
Impact 3: Temporary disturbance of the seabed leading to increases in SSC and associated deposition.	Mobile fish with overlapping spawning and nursery habitat	Very low to medium	Low	**Not significant to Slight** (not significant)	**N / A**	**Not significant to Slight** (not significant)
	Mobile fish without overlapping spawning and nursery habitat	Very low to medium	Negligible	**Imperceptible to Slight / Not significant** (not significant)	**N / A**	**Imperceptible to Slight / Not significant** (not significant)
	Shellfish	Low	Negligible	**Not significant**	**N / A**	**Not significant**
Impact 4: Collision with vessels	Turtle / basking shark	High	Negligible	**Slight** (not significant)	**N / A**	**Slight** (not significant)
Impact 5: Accidental pollution events	All VERS species	High	Negligible	**Slight** (not significant)	**N / A**	**Slight** (not significant)
Impact 6: Invasive Non-native species (INNS)	All VERS species	High	Negligible	**Slight** (not significant)	**N / A**	**Slight** (not significant)
Operation and Maintenance						
Impact 1: Long term habitat loss	Mobile fish with overlapping spawning and nursery habitat	Very low to medium	Negligible	**Imperceptible to Slight / Not significant** (not significant)	**N / A**	**Imperceptible to Slight / Not significant** (not significant)

Impact	Receptor	Receptor Sensitivity	Magnitude of Impact	Significance of effect	Additional Mitigation	Residual effect
	Mobile fish without overlapping spawning and nursery habitat	Very low to medium	Negligible	**Imperceptible to Slight / Not significant** (not significant)	**N / A**	**Imperceptible to Slight / Not significant** (not significant)
	Shellfish	Medium	Negligible	**Slight / Not significant** (not significant)	**N / A**	**Slight / Not significant** (not significant)
Impact 2: Electromagnetic Fields (EMF) from cables	Elasmobranchs and turtles	Very low to medium	Negligible	**Imperceptible to Slight / Not significant** (not significant)	**N / A**	**Imperceptible to Slight / Not significant** (not significant)
	Other fish	Very low to medium	Negligible	**Imperceptible to Slight / Not significant** (not significant)	**N / A**	**Imperceptible to Slight / Not significant** (not significant)
	Shellfish	Low	Negligible	**Not significant**	**N / A**	**Not significant**
Impact 3: Operational noise	All receptors	Medium	Negligible	**Slight / Not significant** (not significant)	**N / A**	**Slight / Not significant** (not significant)
Impact 4: Temporary disturbance of the seabed including associated increases in SSC and deposition	Mobile fish with overlapping spawning and nursery habitat	Very low to medium	Low	**Not significant to slight** (not significant)	**N / A**	**Not significant to slight** (not significant)
	Mobile fish without overlapping spawning and nursery habitat	Very low to medium	Negligible	**Imperceptible to Slight / Not significant** (not significant)	**N / A**	**Imperceptible to Slight / Not significant** (not significant)

Impact	Receptor	Receptor Sensitivity	Magnitude of Impact	Significance of effect	Additional Mitigation	Residual effect
	Shellfish	Low	Negligible	**Not significant**	**N / A**	**Not significant**
Impact 5: Collision with vessels	Turtle / basking shark	High	Negligible	**Slight** (not significant)	**N / A**	**Slight** (not significant)
Impact 6: Accidental pollution events	All VERS species	High	Negligible	**Slight** (not significant)	**N / A**	**Slight** (not significant)
Impact 7: Invasive Non-Native Species (INNS)	All VERS species	High	Negligible	**Slight** (not significant)	**N / A**	**Slight** (not significant)
Decommissioning						
Impact 1: Long-term habitat loss	All VERS species	Very low to medium	-	**Not significant** (not significant)	**N / A**	**Not significant** (not significant)
Impact 2: Noise and vibration	All VERS species	Very low to high	-	**Not significant** (not significant)	**N / A**	**Not significant** (not significant)
Impact 3: Temporary disturbance of the seabed including associated increases in SSC and deposition.	All VERS species	Very low to medium	-	**Not significant** (not significant)	**N / A**	**Not significant** (not significant)
Impact 4: Collision with vessels	Turtle / basking shark	High	-	**Not significant** (not significant)	**N / A**	**Not significant** (not significant)

Impact	Receptor	Receptor Sensitivity	Magnitude of Impact	Significance of effect	Additional Mitigation	Residual effect
Impact 5: Accidental pollution events	All VERS species	High	-	**Not significant** (not significant)	**N / A**	**Not significant** (not significant)
Impact 6: Invasive Non-Native Species (INNS)	All VERS species	High	-	**Not significant** (not significant)	**N / A**	**Not significant** (not significant)
	*Highest magnitude between mortality, potential injury and TTS present					

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